DRAFT REPORT OF EIS OF GLOBAL OIL STORAGE TERMINAL IN LAUHATA, WITH THE CAPACITY OF 10,000 M^3 TANK

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1. EXECUTIVE SUMMARY

The environmental impact statement (EIS) of the proposed project development has been prepared based on Timor – Leste environmental licensing law (DL 5/2011) and other relevant regulation that required every major development to conduct the environmental impact assessment (EIA) prior to construction and operation of the project. The environmental license is also required information by ANPM to approve the project location and eventually the design document of the project.

The proposed project development of fuel terminal in the Suco Lauhata, Liquica, with the total capacity of storage tank of 10,000 KL, is considered major development, which will contribute the adverse impacts to the environment (land, marine water, groundwater, soil, and air), socio-economic and occupational health safety. All these mentioned impacts should be properly assessed, during the preparation of project (project planning and design) in order to mitigate the impacts during the implementation of the project (construction and operation stages). The impact assessment would also need to consider the baseline information (existing condition = no project yet) prior to the commencement of the project, which is important, as the reference point/information. This baseline information should be important for the future monitoring program of the environmental quality in respect to the project development.

Based on the impacts and scenarios, developed, the mitigation measures are designed in order to eliminate, minimized or offsetting the impact that potentially arise during the project implementation. The environmental management and monitoring plan (EMMPs), as presented provide the detail information of the impact, mitigation, measured, and cost required to implement them. The monitoring program with the clear KPI (Key Performance Indicator) would also be necessary in order to ensure the effective implementation of EMMPs.

1.1 Project Overview

The project development of fuel storage terminal with total storage tank of 10,000 KL which planned to be constructed in Suco Lauhata is an investment an investment proposal from Global Oil Storage Terminal LDA, an international company originated from Singapore that has been in petroleum product trading and distribution in Timor – Leste since 2004. The development will take a total land of 1.3 HA, which has been secured by the project through the long-term lease with Timor Cement LDA. This total area of land will be used to construct the for storage tanks, supporting office, loading and unloading bay, and other supporting utilities such as fire water, fire management system, piping system, bridges, and other miscellaneous items to make safety and sustainable operation of the fuel storage facility.

The existing jetty and other basic infrastructure such as national road of Dili – Liquica and National Power gridline, make the selected project location is most suitable, compare to other place. The project owner will not have to invest its own capital to construct the jetty, power grid, and road access to the project area and to the costumers.

Two downstream petroleum products (Gasoline and Diesel fuels) will be imported from foreign countries and stored in this storage terminal and distributed to various market outlets such as fuel filling stations in Timor – Leste or any other company such as constructor that required bulk amount of fuel in their construction area. As the scale and potential impacts would significant (similar industry in other places), the environmental and social impacts assessment would necessary to plan a proper mitigation measures in order minimize the impacts and ensure the safety and sustainable operation.

1.2 Relevant Regulatory Framework

The review of existing regulations is very important to provide a legal information that need to be complied by both Government as the regulatory body and project proponent as the implementing agency that execute the project. The following table provides the summary of the important relevant legal framework in Timor – Leste to the current proposed development project.

Table 1.1. Summary of the Relevant Legal Framework to the Business Development

Subject	Regulation	Relevant Article
Environmental Protection	1. Constitution of Republic of Timor – Leste 2. Environmental Licensing law (Decree law 5/2011)and base law of environmental (decree law 26/2012)	• Article 6- f: Protection of environment and natural preservation to ensure the sustainability Decree laws on environmental protection: these two DL are relevant to the project development. • Require for every major development to have proper environmental license prior to the commencement of the development
Downstream Petroleum product related business	1. Decree law 1/2012: on the Downstream sectors 1. ANPM Regulation no.2/2014, of 24, October 2014, first amendment of the decree law No. 1/2012 2. ANPM Regulation No. 1 /2013 3. ANPM Regulation no.3/2014, of 24, October 2014, 4. ANPM regulation No. 1/2016, March 2, 2016, on Installation and Operation of Fuel Storage Facilities	Basic regulation for the business related to the downstream petroleum products, including the procedures and police for safety the installation and operation of fuel storage facilities
Crime against the Environment	Penal Code II Crime Against the Environment, such as water, air, marine, and soil pollution: Article 215 – 218	Proper punishment for the crime against the environment

Land owner and territorial	• Law 3/2017 – land title in Timor - Leste • Law 13/2017 - Special Regime on non-moveable properties • Lei 6/2017 – 19 of Abril 2017 - Spatial Planning Law • Law 1/2003	• Entire regulation should be complied by the project owner in solving the land issue and title • Project owner to arrange the land lease with the government for the parcel of the land that belong to the government
Biodiversity and protected zones	• Decree Law 5/2016 on Protected Area • Decree Law 6/2020 – 6 February 2020 - Legal Regime of Protection and conservation of biodiversity • Decree law 26/2012 – Environment base law • Government resolution in 2012 that approved the action plan for biodiversity	Assessment on the protected zone and any relevant sensitive biodiversity around project area that will be affected by the project development
Fishery	• Decree Law 5/2004 - General Regulation on Fishing • Law No.6/2004 on Legal • Decree Law 14/2004 – Offences of Fisheries	General guidance on the fishery zone and regulation to be complied when fishing, including the size of the net, etc.
Air Quality Guideline	• World Health Organization (WHO) – 2006 – Air quality Guideline for PM 10 • IFC Performance Standard on Ambient air quality	Adopted in absence of regulation in Timor – Leste. This guideline provide the threshold of ambient water quality standard measure in PM and flue gases (SO_2, NO_2, Ozone)
Labor Code, Visa and Social Security	• Law 4/2012 – labor code • Decree law 5/2010 – Visa Granting • Law 12/2016 – social security • Decree law 17/2017 – Mechanicm to implement the social security law	• Labor and employer right and responsibility to be complied • Company to comply the regulation in ensuring the reponsability in social security contribution
Solid Waste management	Decree Law 2/2017 – Urban Solid waste Management System	Regulate the current mechanism of urban solid waste collection and disposal system
Noise and Vibration	UNTAET Guideline on Ambient Noise - 2002	Adopted the ambient noise issue from UNTAED in absence of Timor – Leste own regulation
Climate change related issue	• UN Framework to combat global climate change in 1992 and Kyoto Protocol • Vienna Convention in 1993 for the protection of ozone layer and Montreal protocol	Overall guidance on the climate change issue and how to build climate adaptation program
Soil pollution	No regulation yet. But the groundwater will be issue if soil shall be polluted	
Water resources and drinking water	• Decree law 4/2004 - Water Supply for Public Consumption • Draft – Law on Water Resource Protection	Drinking water quality standard for human consumption. Some other laws such as water resource protection need to be developed and approved

	• Ministerio da Saude – Timor Leste - Decre Law 31/2020 – 26 of August 2020 • WHO – Drinking water quality Standard	
Occupational health and safety	IFC and other relevant best practice internationally (ISO, Singapore National Standard)	Various options provided in order to minimize the accident rate related to the occupational, health, and safety system. The project owner could take this reference and tailor into the project need
Port	• Decree Law 3/2003 – Port Authority • Decree Law 19/2003 Port Fee and Charge • Decree Law 4/2003 Minimu safety requirement for gargo	Project owner to consutl the port authority regarding any fee apply to permit the vessel coming to jetty in Lauhata
Road and Transport	• Decree Law 6/2003 – Highway Code • Decree Law 2/2003 – Base Law on the Transport Sector	Proper consultation on the transport facility utilization and weight of the vehicle

Beside the legal frame work, the baseline data collection is also an important part of the study to provide the necessary data and information to properly asses the impacts and provide the mitigation measures.

1.3 Baseline Environmental Information

The baseline data of environmental and socio-economic are important to be established prior to the development, which will be used as reference information by the project owner and regulatory agencies during the implementation of the project.

This baseline information is used to perform various analyses to support the environmental impacts assessment and proposed the mitigation measures. The baseline data should also be useful information as reference to conduct the monitoring program/activities during the project implementation. For this study, the following baseline data of environment and socio-economic were stablished or collected as part of the Environmental Impact Assessment (EIA) study.

- Groundwater availability and Quality within the project boundary (groundwater pumping test and quality measurement)
- Surface water availability and quality from the river, including the flood flow analysis
- Baseline information of air quality measured in term of particulate matter (PM10, PM2.5) , CO_2, NO_2, and
- Noise and Vibration
- Soil quality
- Marine water quality and benthos
- Bottom sediment in coastal area
- Topographic of the project area
- Direct observation on the coral and fisheries (for the selected spots)

- Geo-technical site investigation and other soil transport parameters
- Tidal data collection
- Social economic data collection (direct survey and interview)

These above baseline information/data was used to help assess the environmental and social impacts of the project development.

1.4 Summary of Impacts and Mitigation Measures

Using the baseline information combine with the environmental modeling (hydrologic, hydraulic, and hydrodynamic) and review of various literatures and information from past experience of similar industry, the environmental and social impact of each stage of project development (construction, operation, and decommissioning) were established. The following table provides summary of each impact and mitigation measured in relation of the project implementation of proposed fuel storage terminal system in the Suco of Lauhata.

Table 1.2. Summary of Impact and Mitigation Measures during the Construction of Phase 1 A

Impact Assessed and Mitigation Measure during Construction of Phase 1 A			
Impacts	Area of Coverage	Particular concern	Mitigation Measure
Air quality Degradation	1.3 HA of land surrounding area	PM	• water spraying • Measure the PM level in case any complaint
		Flue gases (CO2, NO2, Sox)	• Application of latest version of equipment that produce less flue gases • Measure the flue gas level during the construction to know if any major issue related to the gases
Marine water quality	1.3 HA of land surrounding contributing area to the marine waterbody	High turbidity of storm water runoff can impact the marine water body (high turbidity and sediment load to the coral)	Temporary detention basins to reduce and filter the suspended sediment
Occupational Health and Safety	People who work inside the facility	• Work related electricity • Exposure to heat • Exposure to the dust and particular matter • Risk injury related to accident (vehicle, heavy duty equipment, etc.) • Risk of death	• Proper training prior to executing the certain work. Certain special work such as electrical work should be done by person who has certified training related to electrical work • Using the proper PPE (eye, nose, ear, protection system) • Supervisor to control the worker to follow proper working procedures • Temporary medical help in the project site to provide help in case accident • Dedicate team to response the emergency in the field • Evacuate as soon as possible to the nearest help center or hospital • Proper compensation to the death
Traffic disturbance	Vehicular get in and out of construction area	• Traffic accident • Temporary congestion • Loss of life	• Assign dedicated person to watch and direct the traffic related to construction activity • Response team to help resolve the traffic accident •
Noise	Within the project area up to 50	• Disturb the convenience of the	• Use the PPE (ear protection equipment) within the

	meter radius	community • To big noise could potentially cause the health hazard	project area • Schedule the construction activity only during the day time
Vibration	Within the radius of 100 m	• Potential collapse of old Aipelo prison • Structural crack of the building within the radius of 50 m	• Monitor the vibration level from the source of vibration and further distance away from the source to know the vibration level • Apply some safer technique of foundation work that produce minimum vibration • Apply PPE for the worker within the project area during the execution of work

Table 1.3. Summary of Impact and Mitigation Measures during the Operation of Phase 1 A and Phase 1 B

Impact Assessed and Mitigation Measure during Operation of Phase 1 A and Phase 1 B			
Impacts	Area of Coverage	Particular concern	Mitigation Measure
Flooding	Project area	storm water washed the oil polluted surface and contribute pollution to marine water body	• Application of oil-water separator • Frequent washing the ground where the oil spill prior to the heavy rain • Isolated a major spill and cleaned up quickly prior to the heavy rain
	Riverine flooding	Flood magnitude at higher frequency of 50 –year could overflow from river and cause damaged in the project site - emergency situation	• Retaining wall • Construction of main drainage canal to reroute the overflow of flood water • Construction elevated floor level • Emergency flooding insurance for higher frequency of 50 -years • Flooding warning system and emergency preparedness • Flood emergency response • Monitoring the rainfall

	Coastal Flooding	During the high tide, could potentially wipe out the facility - emergency condition	• Coastal wall protection • Elevated floor level of project rea • Emergency response planning and recovery system • Monitoring the tidal level
Major oil spill	In the project area	Polluted the marine water body and economic loses	• Oil boomer • Oil slimmer • Applied absorbent to catch the oil • In-situ burning of the oil layer in the marine water body • Prepare emergency oil response planning and team • Coordinate with the national and international team to help in case of major large oil spill
	Marine waterbody	polluted the marine water body and transported to large extend of coastal area	• Coastal cleaning • Monitoring of marine water quality • Implement emergency response plan
		Impact to mangrove	• Mangrove re-planting • Compensation to the loss • Cleaning and removal of oil spill debris in the mangrove forest
		Impact to coral and fisheries	• Coral cleaning • Compensation to the economic loss • Coral rehabilitation (if possible)
		Impact to beach	• Provide public information to close the beach access due to pollution form the oil • Cleaning of the beach and other impacted area • Compensation of the economic loss, especially coastal community who rely on the income from the coastal resources

		Impact social at the coastal community	• Proper compensation • Proper community engagement plan
Fire Hazard	Storage tank	Prevention	• Major fire could be prevented by design and construction of the storage tank/yard according the best international specification and ANPM • Proper spacing the storage tanks • Using the water coolant to control the temperature • Proper detection of fuel leaking (automatic sensor) • Proper operation procedure of loading and unloading of fuel from the tank • Fire drill periodically to build fire awareness in the entire facility
		Response to fire emergency (already happens)	• Fire alarm system and evacuate people from the place fire to the assembly point to further moving away from the storage yard • Isolate the area that under the fire • Evaluate the scale of emergency and mobilize the resource to response the emergency (ties1, tier1, tier 3) • Mobilize the internal team of fire fighter to kill the fire (tier 1) • Communicate with external agency to mobilize any help require in responding the emergency • Evaluate the incident to know the cause of the fire for future improvement • Apply fire damaged compensation (insurance) • Restore the emergency condition
	Fuel filling area	Prevention	• Proper design and construction according to the best international standard (fire proof) • Proper procedure to be in place to regulate the operation so that the spill of fuel can be minimized • Installation of fire equipment system to kill

			immediately before the fire getting bigger • Proper control the operation system so that any failure could be detected (such as fuel spill)
		Response to fire emergency (already happens)	• Fire alarm system and evacuate people from the place fire to the assembly point to further moving away from the storage yard • Isolate the area that under the fire • Evaluate the scale of emergency and mobilize the resource to response the emergency (ties1, tier1, tier 3) • Mobilize the internal team of fire fighter to kill the fire (tier 1) • Communicate with external agency to mobilize any help require in responding the emergency • Evaluate the incident to know the cause of the fire for future improvement • Apply fire damaged compensation (insurance) • Restore the emergency condition
	Jetty	Prevention	• Ensure that the pipe (fuel pipes) is properly connected to the tanker and proper inspection by the certify person prior to pumping of the fuel from tanker in the jetty to the fuel storage system • Regular inspection to the piping system (prior to the loading and unloading in the jetty • Follow all the procedure of operation as recommended in best practice of industry • Installation of proper fire equipment system in the jetty • Special team need to be ready during the loading and unloading of the fuel tanker • No smoking must be allow during the unloading of fuel tanker in the jetty • Unloading during the good weather (to avoid unnecessary accident) to avoid fire incident

		Response to fire emergency (already happens)	• Fire alarm system and evacuate people from the place fire to the assembly point to further moving away from the storage yard • Isolate the area that under the fire • Evaluate the scale of emergency and mobilize the resource to response the emergency (ties1, tier1, tier 3) • Mobilize the internal team of fire fighter to kill the fire (tier 1) • Communicate with external agency to mobilize any help require in responding the emergency • Evaluate the incident to know the cause of the fire for future improvement • Apply fire damaged compensation (insurance) • Restore the emergency condition
	other project area (office building, buffer zone, outside the project area)	Prevention	• Cutting grass regularly within the buffer zone and within the certain distance from the project area • Fire drill regularly to all employees • Proper installation of fire equipment system • Management waste management system, especially the rubbish that easily be burn • Perimeter fencing should be fire proof so that no fire bushes from outside the project facility should affect the project
		Response to fire emergency (already happens)	• Evacuate people inside the facility • Utilize all the available resource to kill the fire • Seek for the external help if internal team cannot handle the fire • Seek for regional help if the national scale cannot handle the fire

Soil pollution	within the project area	oil polluted to soil and transport downward to groundwater	• Monitoring periodically to detect as early as possible the pollutant transport from the soil to the soil column • Taking the soil sample within the project area once a year to measure the soil quality • Management the oil spill in the facility to prevent the transport of contaminant to the soil column • Waste periodically the ground surface that that contaminated by the minor oil spill • Follow the proper SOP in transferring the fuel to minimize the risk of spills
Groundwater	Quantity	Over pumping	• Monitoring the water utilization rate within the facility to optimize the water utilization • Monitor the groundwater pumping (drawdown level in the aquifer) • Enhance tree-planting in the upland catchments to achieve more recharge rate of rainfall to groundwater • Help population by providing water supply if their shall well get dry
	Quality - pollution	Pollution due to over pumping (salt water intrusion and groundwater contamination)	• Sampling measurement of the groundwater to detect the trend of water quality change • Minimize the spill in the ground surface • Response quickly to the spill so that the risk of contaminant transport downward will be reduced • Inform the government that groundwater is contaminated and stop utilization of groundwater • Pumping out the contaminate water and treated it polluted water • Measure also the well in surrounding project area if the polluted well is localized or entire aquifer
Waste production	General solid waste	Production of general solid waste during the operation	• Collect properly the solid waste and apply 3R (recycle, reused. Reduced, and disposal) • Dispose the waste into Tibar control landfilled

			area • Mange the solid waste to achieve the minimum target to landfill
	Hazardous waste	From the bottom product of tank (0.05% of the total volume will deposit at bottom of the tank to be cleaned and treated)	• Have proper treatment system of hazardous material (see the method of treatment at the part of waste management) • Produce the concrete material from hazmat (liquid hazmat is mixed within the concrete cement and produce concrete block
	Liquid hazardous waste	• Oil residue • Oil from the oil- water separator	• Apply special treatment method onsite or out scorching the external company to treat the B_3 waste • Treated the oil residue and recycle into the reusable fuel (third party should be contracted to do it • Deliver the oil residue to the third party that already has proper oil residue treatment in place • Deliver the oil residue to Tibar (government provided the holding tank) • Proper collection of the waste to be handled by the third party
Traffic management		Vehicle coming in and out of the proposed development facility	• Proper traffic management system • Proper traffic sign • Designated person to watch the traffic and manage it • Proper parking arrangement
Climate change	Sea level rise	Coastal inundation	• Proper design and construction of the sea wall protection • Elevated floor level at the storage yard (based on tidal measurement and HAT data) • Adjust the groundwater treatment, as the water will be getting salty

	Flooding	More frequent rain with high frequency	• River improvement • Retaining wall • Proper drainage system
	Drought	Prolong dry season	• Water storage • Minimize the water utilization • Sea water treatment (optional) • Provide water to the community
Occupational Health and Safety	Proper Design and Operation	• Integrity of workplace structure • Severe weather and facility shutdown • Woks space and Exit • Fire Precaution • Lavatory and Shower • Portable water supply • Clean eating area • Lighting • Safe access • First Aid • Air supply • Work Environment Temperature	Detail refer to - Annex 13 • IFC Performance indicator • ISO 45001 • Singapore National Standard • Global Oil Terminal Internal Procedure on th safety • Reference from good industry practice
	Communication and Training	• OHS training • Visitor orientation • New employee and contractor training • Area Signage • Communicate Hazard code • Labeling Equipment	Detail refer to - Annex 13 • IFC Performance indicator • ISO 45001 • Singapore National Standard • Global Oil Terminal Internal Procedure on th safety
	Physical Hazard	• Rotating and Moving Equipment • Noise • Vibration • Electrical • Eye hazard • Welding/Hot work • Industrial Vehicle Driving	Detail refer to - Annex 13 • IFC Performance indicator • ISO 45001 • Singapore National Standard • Global Oil Terminal Internal Procedure on th safety

		• Working Environment Temperature • Working at height • Illumination	
	Chemical Hazard	• Air quality • Fire and explosion • Corrosive, oxidation, and reactive chemical • Volatile Organic compound	Detail refer to - Annex 13 • IFC Performance indicator • ISO 45001 • Singapore National Standard • Global Oil Terminal Internal Procedure on th safety
	Other Special Hazard		Detail refer to - Annex 13 • IFC Performance indicator • ISO 45001 • Singapore National Standard • Global Oil Terminal Internal Procedure on th safety
	Peroneal Protective Equipment (PPE)	Protection equipment to protect various part of the body to prevent the hazard (eyes, nose, ear, skin, hat, body, foot, etc.)	Detail refer to - Annex 13 • IFC Performance indicator • ISO 45001 • Singapore National Standard • Global Oil Terminal Internal Procedure on th safety
Community health and safety	• Groundwater accessibility • Traffic accident • Large fire hazard	• Water conservation and monitoring system • Traffic management system • Fire hazard management and socialization to the community members in Lauhata, as well as evacuation route	Detail refer to - Annex 13 • IFC Performance indicator • ISO 45001 • Singapore National Standard • Global Oil Terminal Internal Procedure on th safety

Table 1.4. Impacts and Mitigation Measures during the Construction of Faze 1 B

Impact Assessed and Mitigation Measure during Construction of Phase 1 B			
Impacts	Area of Coverage	Particular concern	Mitigation Measure
Occupational Health and Safety	People who work inside the facility	• Work related electricity • Exposure to heat • Exposure to the dust and particular matter • Risk injury related to accident (vehicle, heavy duty equipment, etc.) • Risk of death	• Proper training prior to executing the certain work. Certain special work such as electrical work should be done by person who has certified training related to electrical work • Using the proper PPE (eye, nose, ear, protection system) • Supervisor to control the worker to follow proper working procedures • Temporary medical help in the project site to provide help in case accident • Dedicate team to response the emergency in the field • Evacuate as soon as possible to the nearest help center or hospital • Proper compensation to the death
Traffic disturbance	Vehicular get in and out of construction area	• Traffic accident • Temporary congestion • Loss of life	• Assign dedicated person to watch and direct the traffic related to construction activity • Response team to help resolve the traffic accident • Proper traffic signal and speed limit • Only license/authorize personnel would allow to operate the machinery/vehicles
Noise	Within the project area up to 50 meter radius	• Disturb the convenience of the community • To big noise could potentially cause the health hazard	• Use the PPE (ear protection equipment) within the project area • Schedule the construction activity only during the day time • Apply noise barrier in the perimeter fence
Vibration	Within the radius of 100 m	• Potential collapse of old Aipelo prison • Structural crack of the building within the radius of 100 m	• Monitor the vibration level from the source of vibration and further distance away from the source to know the vibration level • Apply some safer technique of foundation work that produce minimum vibration • Apply PPE for the worker within the project area during the execution of work

Table 1.5. Expected Impacts and Mitigation Measures during the Decommission phase of Fuel Storage Terminal

Impact Assessed and Mitigation Measure during Decommissioning phase			
Impacts	Area of Coverage	Particular concern	Mitigation Measure
Occupational Health and Safety	People who work inside the facility	• Work related electricity • Exposure to heat • Exposure to the dust and particular matter • Risk injury related to accident (vehicle, heavy duty equipment, etc.) • Risk of death	• Proper training prior to executing the certain work. Certain special work such as electrical work should be done by person who has certified training related to electrical work • Using the proper PPE (eye, nose, ear, protection system) • Supervisor to control the worker to follow proper working procedures • Temporary medical help in the project site to provide help in case accident • Dedicate team to response the emergency in the field • Evacuate as soon as possible to the nearest help center or hospital • Proper compensation to the death
Traffic disturbance	• Vehicular get in and out of construction area • Vehicle taking the demolished or dismantled material	• Traffic accident • Temporary congestion • Loss of life	• Assign dedicated person to watch and direct the traffic related to construction activity • Response team to help resolve the traffic accident • Proper traffic signal and speed limit • Only license/authorize personnel would allow to operate the machinery/vehicles
Demolition of storage tank	Chemical hazard such as gas that trapped inside the storage tank	• Cause health hazard • Potentially cause death	• Authorize and trained people to dismantled the storage system • Using proper PPE
Noise	Within the project area up to 50 meter radius	• Disturb the convenience of the community • To big noise could potentially cause the health hazard	• Use the PPE (ear protection equipment) within the project area • Schedule the construction activity only during the day time • Apply noise barrier in the perimeter fence
Vibration	Within the radius	• Potential collapse of old	• Monitor the vibration level from the source of vibration and

	of 100 m	Aipelo prison • Structural crack of the building within the radius of 50 m	further distance away from the source to know the vibration level • Apply some safer technique of foundation work that produce minimum vibration • Apply PPE for the worker within the project area during the execution of work
Social Impacts	loss of opportunity and job	• 30 people will loss the job and income • Project owner will loss the economic opportunity • Fuel supply will be impacted and potentially the price will increase	• Proper compensation and transition program • Transfer the workers to other similar facility • Find other alternative busies modality
Economic Impacts	Loss of source of income	• No tax payment to the government • Loss of revenue from the project owner • No social corporate responsibility to the local people	• Required a new business modality • Government to diversify the economic into other sector

1.5 Summary of Cost of Mitigation Measures

The environmental management plan only is implemented effectively if budget is allocated properly by the project owner. The following table provide summary of rough cost estimation of the mitigation measures various impact identified during the project implementation.

Table 1.6. Summary of Cost Estimation of EMP (CAPEX and OPEX)

Stage of Project Implementation	Estimated cost (CAPEX)	OPEX - Without major Incident	OPEX with Major Incident
Construction of Phase 1 A	$ 155,000	0	
Operation of Phase 1 A	$ 1,332,000	$300,000.00	$ 17,600,000.00
Construction of Phase 1 B	$ 33,000	0	
Operation of Phase 1 A and 1 B	-		
Decommissioning	$ 285,000	0	0
Total Cost	$ 1,795,000	$350,000.00	$17,600,000.00

Note: Major Capital expenditure has been construction of flood protection (Storm runoff and coastal water), equipment to retain oil spill (Boomer, skimmer, etc.) and fire equipment system. Further detail breakdown of the cost per item of mitigation measures can be found in the cost estimation of the EMP.

1.6 Monitoring of Implementation of EMPs

Monitoring the implementation of EMPs is very important to ensure effective implementation of the plan in order to achieve the objective of the environmental protection and social safeguard system. The following table provided the summary of impacts, cost, monitoring agency and frequency of monitoring activity for the proposed project development.

Table 1.7 Summaries of Environmental Impact, Mitigation, and Monitoring Plans

IMPACT MITIGATION				MONITORING		
Environmental Impact	**Mitigation Measures**	**Mitigation Responsibility**	**Mitigation Cost (US$)**	**Monitoring Measures**	**Frequency and means of verification**	**Monitoring Responsibility**
Construction Phase 1 A and 1 B						
Air Quality	• Operation of well-maintained construction vehicle and equipment to avoid polluted exhausts. • Proper piling of spoil from earth work • Spraying of water in the working area • Construct fence on the project area	Project owner	US$ 45,000 (mainly to build the fence and operation cost for water spraying)	• Periodic qualitative monitoring within mining areas; • Assessment of record of dust complaints from workers and communities living near project area.	Day to day monitoring especially during dry period.	Project owner and regulatory agency (if necessary)
Marine water quality from soil erosion	• Construction of temporary detention basins to catch and filter the sediment • Compact the soil during the dry period with the gravel or non-eroded material to prevent the erosion	Project owner	$15,000	• Measurement of marine water quality after the rain (grab sample) to measure the sediment • Monitoring the TSS of the effluent at the detention pond	Day to day monitoring, especially after the onset of rain.	Project owner and regulatory agency (if necessary)
Traffic	• Installation of signage near the facility to inform general traffic those construction vehicles might make an access in and out of the facility. • Appointing designated personnel to help smoothing traffic out during an especially heavy vehicle movement • Regulate speed limit in and out of project area • Only authorize personnel must drive the vehicles	Project owner	US$ 30,000	• Installation of permanent signage near the facility to inform general traffic that costumer vehicles are making an access in and out of the facility • If a long queuing actually happened and could heavily disrupt traffic, several designated personnel should help smoothing the traffic in and out of the facility.	Day to day monitoring, especially after the onset of rain.	Project owner and regulatory agency (if necessary)
Noise and Vibration	• All noise-generating equipment should be insulated and well maintained to ensure that they	Project owner	US$ 10,000	• Record of complaint about noise/vibration from workers and	Day to day monitoring especially during dry period.	Project owner and regulatory agency (if necessary)

	operate within the noise limits they were designed to operate. • Operation of noise generating equipment should only be during the day • Provision of personal protection measures from noise to workers (see section on Occupational Health and Safety)			communities living near the project. • Follow with the noise level measurement		
Occupational health and safety	Hazard minimizing measures: • Minimize exposure to hazard through workers rotation and limitation to working hours (max. 8 hrs.) • Provision of training for proper equipment handling and safety precautions for equipment handling • Adequate supervision for handling of heavy machinery • Adjustment of work and rest period for workers when days are especially hot (e.g. there have been several hotter than usual days in Timor Leste in 2014). • Provision of adequate and easy access to drinking water. Provision of PPE: • Facemasks, eye protection • Ear protection • Helmet, boots, safety shoes • Rubber gloves • Body protection	Project Owner	$30,000	Keep daily record on any event related to the OSH inside the project area, including the major accident related to work execution	Day to day monitoring system	Project owner with the surveillance from local authority and relevant agency
Operation Period						
Flooding	• Construction of retaining flood protection in the river • Elevated the floor level	Project owner	$1,000,000	• Monitoring the rainfall in the upland catchment system • Tide gauge for tidal measurement	daily to day and long-term operation	Project owner, supervision consultant and relevant government agency (if needed)

	• Construction of main drainage canal • Construction of oil-water separator • Isolated a major spill and cleaned up quickly prior to the heavy rain • Coastal wall protection • Frequent washing the ground where the oil spill prior to the heavy rain • Emergency flooding insurance for higher frequency of 50 -years • Flooding warning system and emergency preparedness • Flood emergency response • Monitoring the rainfall • Emergency response planning and recovery system • Monitoring the tidal level • Measurement of rainfall at upstream area			• Inspection of the flood protection work		
Major Oil spill	• Purchase Oil Boomer • Oil Skimmer • Chemical Absorbent • In-situ burning system • Coastal Cleaning • Mangrove re-planting • Coral rehabilitation	Project owner	CAPEX = $100,0000 (if no accident) OPEX = $50,000 If accident, the cost could be range from $10M – $15 M	Project owner to monitoring the current and wind to ensure operation safety	• Record daily event inside the fuel storage facility • Record the loading and unloading event in jetty	Project owner and relevant agencies (if needed)

	• Cleaning of the impacted beach • Design and construct the fuel terminal and other supporting facility with the highest standard in the industry to minimize the equipment error and equipment failure • Developed the proper operating procedure in every part of operating system • Proper communication protocol during the operation • Prepare emergency oil response planning and team • Monitoring of marine water quality • Implement emergency response plan • Compensation to the loss • Compensation to the economic loss • Coordinate with the national and international team to help in case of major large oil spill • Provide public information to close the beach access due to					

	pollution form the oil • Compensation of the economic loss, especially coastal community who are rely on the income from the coastal resources • Proper community engagement plan • Proper insurance system					
Fire hazard	• Proper fire prevention system (design construction with the highest standard, proper operating procedure, minimize leaking from the system, control processing) • Modern Fire prevention equipment system in place • Well structure and trained fire management system • Fire drill and evacuation system • Fire insurance system	Project owner	CAPEX = $200,000 OPEX = $50,000/year	• Control the operating system (automatic control), i.e. mass balance and volume rate • Inspect the all the operating equipment system before and after loading and unloading the fuel	Day to day monitoring	Project owner and report to be reviewed by the relevant entity
Soil pollution from oil spill	• Soil remediation system • Minimize the spill by proper design and operation • Taking the soil sample within the project area once a year to measure	Project owner	US$ 15,000	Monitoring periodically to detect as early as possible the pollutant transport from the soil to the soil column	Day to day monitoring especially during fuel loading and unloading	Project owner

	the soil quality • Management the oil spill in the facility to prevent the transport of contaminant to the soil column • Wash periodically the ground surface that that contaminated by the minor oil spill • Follow the proper SOP in transferring the fuel to minimize the risk of spills					
Groundwater	• Enhance tree-planting in the upland catchments to achieve more recharge rate of rainfall to groundwater • Help population by providing water supply if their shall well get dry • Response quickly to the spill so that the risk of contaminant transport downward will be reduced • Inform the government that groundwater is contaminated and stop utilization of groundwater • Pumping out the contaminate water and	Project owner	$15,000/year	• Sampling measurement of the groundwater to detect the trend of water quality change • Monitor the groundwater pumping (drawdown level in the aquifer) Minimize the spill in the ground surface • Monitoring the water utilization rate within the facility to optimize the water utilization	• Day to day monitoring • Real time measurement in the groundwater pumping	Project owner and could be inspected by the relevant government agencies

	treated it polluted water • Measure also the well in surrounding project area if the polluted well is localized or entire aquifer					
Solid waste impacts	• Collect properly the solid waste and apply 3R (recycle, reused. Reduced, and disposal) • Dispose the waste into Tibar control landfilled area • Mange the solid waste to achieve the minimum target to landfill • Have proper treatment system of hazardous material (see the method of treatment at the part of waste management) • Produce the concrete material from hazmat (liquid hazmat is mixed within the concrete cement and produce concrete block • Apply special treatment method onsite or out scorching the external company to treat the B_3 waste Treated the oil residue and recycle into	Project owner	S$30,000	• Record keeping and assessment to adapt the practice. • Promote public education on the proper solid waste collection system	Day to day monitoring and provide the monthly report	Project owner (designated officer).

	the reusable fuel (third party should be contracted to do it • Deliver the oil residue to the third party that already has proper oil residue treatment in place • Deliver the oil residue to Tibar (government provided the holding tank) • Proper collection of the waste to be handled by the third party					
Traffic impacts	• Proper traffic management system • Proper traffic signal • Proper parking arrangement • Designated person to watch the traffic and manage it • Limit the speed limit in the project area • Only authorize person could drive the vehicle	Project Owner	$5,000/year	• Keep the record of vehicle in and out of the project area and any related event • Record if any traffic accident	Day to day monitoring	Project owner and local authority
Climate change	• Proper design and construction of the sea wall protection • Elevated floor level at the storage yard (based on tidal measurement and HAT data)	Project owner	$20,000/yr.	Monitoring it tide (already proposed)	Sharing the data of the climate change information (rainfall and tidal measurement)	Project owner

	• Adjust the groundwater treatment, as the water will be getting salty • River improvement • Retaining wall • Proper drainage system • Construction of Water storage • Minimize the water utilization • Sea water treatment (optional) • Provide water to the community					
Occupational health and safety	Hazard minimizing measures: • Minimize exposure to VOC usually associated with gasoline through rotation of workers handling diesel fuel and gasoline. • And limitation to working hours (max. 8 hrs.) Provision of PPE: • Use of proper PPE for workers exposed to high emission of VOC (especially during handling of transfer of fuel into storage). • Provision of PPE for workers exposed to high risk from fire and explosion.	Project owner	US$ 35,000/Year	It is recommended that monitoring measures involve routine (every year) risk assessment involving the following objectives: • Identify where fire and explosion hazards may exist; • Consider procedural practices, what have been done wrongly, what and who have been affected; • Evaluate the findings and see if precautionary measures implemented are enough to significantly reduce risk from fire and explosion. • Keep a good record of the findings • Plan for intervention as found necessary		Project owner (designated officer) can be coordinated with local forestry officer
Community Health	• Water conservation and	Project owner	$50,000/year			

and Safety	monitoring system • Traffic management system • Fire hazard management and socialization to the community members in Lauhata, as well as evacuation route					
Decommissioning Phase						
Traffic	• Installation of signage near the facility to inform general traffic that vehicular movement access in and out of the facility. • Personnel to direct the traffic when necessary	Project owner	US$ 2000 /decommissioning	• Installation of permanent signage near the facility to inform general traffic that costumer vehicles are making an access in and out of the facility • If a long queuing actually happened and could heavily disrupt traffic, several designated personnel should help smoothing the traffic in and out of the facility.	Day to day monitoring, especially after the onset of rain.	Project owner
Noise	• All noise-generating equipment should be insulated and well maintained to ensure that they operate within the noise limits they were designed to operate. • Operation of noise generating equipment should only be during the day • Provision of personal protection measures from noise to workers (see section on Occupational Health and Safety)	Project owner	US$ 1,000	• Record of complaint about noise/vibration from workers and communities living near the project.	Day to day monitoring especially during dry period.	Project owner (designated officer).
Occupational health and safety	Hazard minimizing measures: • Minimize exposure to hazard through workers rotation and limitation to working hours (max. 8 hrs.) • Provision of training for proper equipment handling and safety		$30,000			

	precautions for equipment handling • Adequate supervision for handling of heavy machinery • Adjustment of work and rest period for workers when days are especially hot (e.g. there have been several hotter than usual days in Timor Leste in 2014). • Provision of adequate and easy access to drinking water. • Minimize exposure to VOC usually associated with gasoline through rotation of workers handling diesel fuel and gasoline. Provision of PPE: • Facemasks, eye protection • Ear protection • Helmet, boots, safety shoes • Rubber gloves					
Social and economic impacts	• Compensation to the employee • Transfer the employee to other facility and business modality	Project owner and worker inside the facility	$100,000			Project owner and relevant government agency

1.7 Performance Indicators

Effective implementation of any plan is only possible with the rigorous monitoring system by both internal and external parties. To be objective, the some performance indicators and baseline information must be used by the relevant parties. Performance indicator must result in the compliance to standard performance of clear environmental parameters. In following performance indicators shall be used as part of the environmental management plan (EMP) document, this study, to judge the compliance of project owner to the overall implementation of the EMP during the project execution.

- OSH (IFC Standard, 2007)
- Noise Indicator (relevant to human health)
- Ambient air quality (IFC standard)
- Ambient water quality standard (swimmable, fishable, drinkable, etc.)
- Drinking water quality standard (WHO)
- Effluent waste water quality standard (WHO and IFC)

The following table provides the summary of indicator to be complied in order to achieve the objective of the environmental protection and social safeguard principles.

Table 1.8. Summary of Environmental Performance Indicator

Type of Indicator	Measureable Parameters	Standard Threshold
Occupational Health and Safety (OHS)	Number of Incident per month	Zero
Noise Level	Noise indicator at the receiving site	<80 dB without PPE
Ambient Air Quality	CO_2	Refer to the table 1.9
	NO_2	Refer to the table 1.9
	$PM_{.2.5}$	Refer to the table 1.9
	PM_{10}	Refer to the table 1.9
	SO_2	Refer to the table 1.9
Receiving water Quality	Drinkable	Refer to the standard quality of drinking water: Physical, Chemical, and Biological indicator

	Swimmable	The discharge of any effluent to a water body shall not cause the water body to lost its function as swimmable
	Fishable	waste load into water body but the fish is still eatable by health standard
Effluent waste water discharge	BOD_5, mg/L	25
	COD, mg/L	125
	PH	6-9
	Total Nitrogen, mg/L	10
	Total Phosphorus, mg/L	2
	Oil and Grease, mg/L	10
	TSS, mg/L	50
	Temperature increase, C	<3
	Total Coliform , MPN/100 mL	400

Table 1.9 Ambient Air Quality Indicators

Parameter	**Average Period**	**Guideline Value (µg/m^3)**
Sulfur dioxide (SO_2)	24-hour	20
	10 minute	500
Nitrogen dioxide (NO_2)	1-year	40
	1-hour	200
PM_{10}	1-year	20
	24-hour	50
$PM_{2.5}$	1-year	10
	24-hour	25
Ozone	8-hour daily maximum	100

Table 1.10. Drinking Water Quality Standard in Timor – Leste (WHO)

No	Paramter	Unit	WHO/Timor - Leste Guideline	Testing Method
			Physical	
1	PH		6.5-8.5	PH meter
2	E. Conductivity	mc/cm	NS	Conductivity meter
3	TSS	mg/L	50	Gravimentry
4	TDS	mg/L	1000	Gravimentry
5	Salinity	ppt	0.25	Conductivity meter
6	Temperature	C	Natural	Conductivity meter
7	Turbidity	NTU	5 NTU	Turbidity meter
			Chemical	
1	NH3 -N	mg/L	1.5	Spectrophotometer
2	NO3-N	mg/L	10	Spectrophotometer
3	NO2-N	mg/L	1	Spectrophotometer
4	Fe	mg/L	0.3	Spectrophotometer
5	Mn	mg/L	0.5	Spectrophotometer
6	Flouride	mg/L	1.5	Spectrophotometer
7	Cl2	mg/L	0.5	compactor
8	Ca.Hardness	mg/L	NS	Titration
9	Arsenic	mg/L	0.01	compactor
	Total hardness	mg/L	200	Titration
10	Total alkalinity	mg/L	NS	Titration
11	Sulphate	mg/L	250	Spectrophotometer
			Biological	
1	Total Coliform	CFU/100 mL	0	Membrane Filtration
2	E. Coli	CFU/100 mL	0	Membrane Filtration

Timor – Leste has also defined and formulated its owne standard by taking reference from best practice internationally (WHO) and practice in the Ministry of Health many years. The following table shows the standard drinking water quality paramters, which limites on up 15 parameters.

Table 1.11 Drinking Water Quality Parameters Set by Ministry of Health of Timor – Leste

No	Parameter	Unit	Standard value	Criteria for standard value
Physical				
1	Colour	TCU	<5	Acceptablity should have no visible colour
2	PH		6.5 – 8.5	Acceptable within this range
3	Taste and odour		Unobjectable	No objectable taste and odour felt from the user
4	TDS	Mg/L	1000	Not acceptable >1000 and <600 is good
5	Turbidity	NTU	<5	Need for clean water. Below 1 NTU is good for clorination
Chemical				
6	Arsenic	Mg/L	0.01	Health based: It is toxic for the body and not demonstrated to be essential
7	Flouride (as F-1)	mg/L	1.5	Health based: cause fluorosis (<0.5 ppm) Artificial fluoridation 05 – 1 Mg/L
8	Hardness as CaCO3	mg/L	200	Acceptability :Scale deposition above 200 ppm
9	Iron (as Fe2+)	mg/L	0.3	Acceptability : Iron stains in laundry and plumbing fixtures (>0.3 ppm). Health based: 2 Mg/L No significant health impact known up to 2 Mg/L
10	Manganese (as Mn2+)	mg/L	0.4	Acceptability : Taste (0.1 mg/L). Health based (0.4) Mn stains in laundry and fixtures at 0.2 Mg/L
11	Nitrate (as NO-)	mg/L	50	Health based: 50 mg/L as nitrate (11 mg/L as nitrate nitrogen. Based on methaemoglobinaemia in infant
12	Sulfat (SO4 -2)	Mg/L	250	Acceptability : cause Taste (250 soduim sulfate). There is a gastrointestinal effect in axcess concentration
13	Residual clorine	mg/L	01.- 0.3	Acceptability : Measure at tap point and only applicable to the water system that applies clorination
Biological				
14	Total Coliform	MPN/100 mL	0	Health based: must not be present in 95% of sample taken throughout the year. Indicartor for contamination or incomplete treatment 12 months period
15	E. Coli or Thermo tolerant bacteria	Count/100 ML	0	Health based: indicator for faecal contamination

1.8 Positive and Negative Social and Economic Impacts

There are always impacts, as consequences of any project development. Zero impacts would be certainly impossible to be achieved, unless the project is not continued or no development. No development scenario. The following table provide the positive and negatives impacts of the project development, including no development, which could be used to quickly evaluate in order to make a high level decision to proceed or to stop the project development.

Table. 1.12 Summary of Positive and Negative Impacts of the Project Development

Alternative option	Negative Impacts	Positive Impacts
Project Development	1. Temporary Environmental impacts during the construction that can be managed on-site 2. Oil spill impacts that can be managed but risk of major spill and cause the coastal pollution 3. Potential large fire hazard but can be minimize with high standard of design and construction and other fire protection system 4. Pollution of VoCs – can be minimized with proper design of the system and on site mitigation measure 5. Contribute to the marine water quality degradation 6. Contribute to the air quality degradation (if there is any major fire that create the smoke)	• High return of investment on the project development • Provide stable fuel supply with the competitive price • Contribute to the economics of Timor – Leste (national and local in Lauhata) • Create the jobs and other economic opportunities • Contribution directly to the taxation to the government of Timor – Leste • Provide various corporate responsibility to the local population • Enhance more foreign direct investment to the country
No project Development	• No job creation and no other opportunities will be created • No income to the country from the tax payment • Perhaps high fuel price in Timor – Leste due to lack of competition	• No marine water pollution and no other disturbance in the coral and other coastal resources • No environmental and social impacts

1.8.1 Positive to the project owner

The proposed project development shall contribute maximum profit gain the project owner and this main positive point that drive the development of this project. According to market feasibility study and business plan developed internally by the Global Oil Storage Terminal, the project will generate high return on the investment in the future due to competitive advantages that the company has given the

modality of the project (higher capacity of storage, closed distance to soon to be complete Tibar Port, and high capacity of professional employee hire by the company)

- High return of investment (profit oriented project)
- Has a competitive advantages
- Shorter payback period
- Higher revenue that will be generated as a result of the large fuel storage

1.8.2 Positive Impacts to the Public and Government

Government has high priority to diversify the economic, by means of increase the domestic revenue that currently not sufficient to development and sustain the government. This project will contribute directly to the domestic revenue through the tax payment and enhancing the more foreign direct investment (FDI) that will eventually contributing to the economy. The total direct tax benefit that the project can contribute to the government is around $500,000 per year and still more other intangible benefit that will be realized by the project development.

1.8.2.1 Contribute the Economy of Timor – Leste

250 MW of power plants have been constructed by the government of Timor – Leste with an intention to support the social and economic development of the country. At the moment, the utilization capacity of the power plant is reasonably small (less than 50%), which means that the operation cost (fuel, etc.) will be much higher than the total revenue that generated by the user. This means that more users are expected by the government on utilization of the electricity in Timor – Leste to maximize or leverage the existence of these two power plants. Maximizing the utilization of the energy, shall contribute to the domestic revenue in Timor – Leste.

The projected utilization by the proposed project development would be around 1 MW to operate various equipment uses in the project, lighting, and other operating system within the fuel storage area. The average power consumption would around 50% of the total supply and if this consumption shall be converted into financial term by using the energy tariff established by EDTL at $0.24/KWH, then the total monthly bill of energy cost from the project owner to the government can be estimated as followed:

Table 1.13 Calculation of Energy Use an d Billing

Uitlization , KWH	Hour of operation	Unit Cost	Daily cost	Monthly , bill
100	8	$ 0.24	$ 192.00	$ 5,760.00

This means that annual contribution of the project to revenue from energy sector is around $70,000 per year, which is a significant contribution to the national revenue.

Beside the revenue contribution from the energy utilization, the presence of the project will contribute to the tax, to the petroleum authority and the Ministry of Finance. The monthly and annual income tax at the ministry of finance has established at the rate of 0.5% and 10% respectively. Depending on the income from the petroleum product sale, the tax can be easily calculated. However, the following table shows the

revenue projection and estimate income as well as the storage fee that the project owner shall contribute to the project. The following table shows the annual fuel volume that will be stored in the proposed fuel storage facility.

Table1.14 Annual Storage Fee to be paid to the Government

Year	Diesel	Gasoline	Total Quantity (liters)	Storage Fee
2021	3,200,000.00	1,200,000.00	4,400,000.00	$ 154,000.00
2022	3,680,000.00	1,380,000.00	5,060,000.00	$ 177,100.00
2023	4,232,000.00	1,656,000.00	5,888,000.00	$ 206,080.00
2024	4,866,800.00	1,987,200.00	6,854,000.00	$ 239,890.00
2025	5,596,820.00	2,384,640.00	7,981,460.00	$ 279,351.10
2026	5,764,724.60	2,456,179.20	8,220,903.80	$ 287,731.63
2027	5,937,666.34	2,529,864.58	8,467,530.91	$ 296,363.58
2028	6,115,796.33	2,605,760.51	8,721,556.84	$ 305,254.49
2029	6,299,270.22	2,683,933.33	8,983,203.55	$ 314,412.12
2030	6,488,248.32	2,764,451.33	9,252,699.65	$ 323,844.49

As no refinery in Timor – Leste, the above downstream petroleum product will be imported, which subject to import duty. The average import duty per litter of fuel is around $0.09. That's means the revenue to the government from the import duty to the fuel that will be stored in the proposed fuel storage development facility can be determined in the following table.

Table 1.15 Future Projection of Import Duty Paid to the Government by Fuel storage

Year	Fuel, Litter	Import duty, $/L	Total Paid to Government, $
2022	4400000	$ 0.09	$ 396,000.00
2023	5060000	$ 0.09	$ 455,400.00
2024	5888000	$ 0.09	$ 529,920.00
2025	6854000	$ 0.09	$ 616,860.00
2026	7981460	$ 0.09	$ 718,331.40
2027	8220903	$ 0.09	$ 739,881.27
2028	8467530	$ 0.09	$ 762,077.70
2029	8721556	$ 0.09	$ 784,940.04
2030	8983203	$ 0.09	$ 808,488.27
2031	9252699	$ 0.09	$ 832,742.91

Annual import duty paid by the project to the government at the startup of the project development around $400,000, which a reasonable amount of revenue that will contribute to the national economy of Timor – Leste. Beside the import duty, the project owner will also be subject to monthly sale tax of the fuel, which, which is usually 0.5% per month.

- Tax payment, tax payment, can calculate
- Positive signal to more foreign direct investment
- Multiplying effect to the economic grow (local economy for instance service and loja)

Beside the direct financial benefit that government will be entitled, there are still other intangible economic benefits that will be realized including sending the positive signal to other foreign direct investment to come and invest in Timor – Leste. Once the project is realized (constructed and operated), positive feeling and message will be sent to other business sectors that would like to come and invest in Timor – Leste. The presence of the project in Timor – Leste and the local community in Lauhata, the multiply positive impacts will be also realized such as service, transportation, restaurant, etc.

1.8.2.2 Job Creation and Technical Transfer

The VIII government has an objective to create the job of 60,000 per year in next 3 years and this proposed development shall contribute to this government initiative. During the construction = 200 works/year and construction period of 2 years. During the operation = 150 workers will be required.

Beside the job creation, the presence of project development shall contribute to the skill and technical knowledge transfer from foreign country to Timor – Leste. At the beginning of the operation, many foreigners shall participate in the operation, especially skill people with the high technical know-how capacity to operate smoothly and sustainably the fuel storage. Overtime, the skills and technical knowledge will be transferred to Timorese and hopefully in the future Timorese will take fully the operation and maintenance of the facility.

1.8.2.3 Sustainable supply of Fuel in Timor – Leste

The proposed project development will become the fourth fuel storage in Timor – Leste with the largest capacity of the storage. With the competition, it is expected that fuel price will become more competitive, as it will not be monopolized by a single supplier. Especially, with the large capacity of fuel storage, the company has a capacity to store large volume at any given time and

1.8.2.4 Social corporate responsibility to the local community

The project owner is doing business in Timor – Leste and has contributed various volunteers work to the public and societies. During the emergency due heavy rain in Dili, the company contributes to the water tank to clean the city and help the community members who are in need. These are only an example of social program that the company has contributed as part of in kind contribution to the public and society. In the future, the kind of SCR could be designed more systematic so that it will allow the public to audit and report the achievement.

1.8.2.5 Create the competitiveness leads to better price in fuel (not monopoly)

This proposed fuel storage is the fourth facility in Timor – Leste. The presence of the storage will help stabilize the price and competiveness in the sector. With more competation, it will ensure the price and quality of fuel delivery to the end-users.

Considering the more positive impacts that project development can contribute, it is recommended to continue and government to endorse the project development, if and only the negative impacts would be able to be managed and minimized by the project owner. The proposed fuel storage project is a private business project and will generate the positive impacts for both project owner (private) and public as well. The positive impacts of the project are the main driving force for both the company (Global Oil) and the government to endorse this propose business development.

2. PROJECT PROPONENT

Global Oil Storage Terminal, Lda is a Timor Leste registered company. It is a part of the Global Group with operations in Singapore, Greater China, Indonesia, and Myanmar. They are involved in the oil and gas industry as well as in infrastructure development. In Timor Leste, the group (Petroleum Division) is involved in downstream petroleum business that imports and provides wholesale fuel supplies to construction companies and petrol stations. The company owns downstream supply chain from cargo procurement, quality control and logistic deployment.

Since 2014 until today, Global Group has hired and trained local labors into qualified officers in the business of petroleum trading. Since then, several have risen through the ranks to become trusted partners of its operation in Timor Leste.

2.1 Contact Information

The project is proposed by Global Oil Storage Terminal, Lda. The office is located in the Avenida Presidente Nicolau Lobato, next to Comoro River, Dili – Timor Leste. The following map shows the location of the existing office of Global Oil Storage Terminal

Figure. 2.1 Existing Location of Global Oil Storage Terminal in Dili

The company's contact detail is provided as follows:

Mr. Kelvin Lim Project Manager
Tel: +670 7706 0008
Email: Kelvin.lim@globalsgp.com

Project Manager (FEED Design)
Mr. Bani
Email: annadurai.banikannan@rotaryeng.com.sg

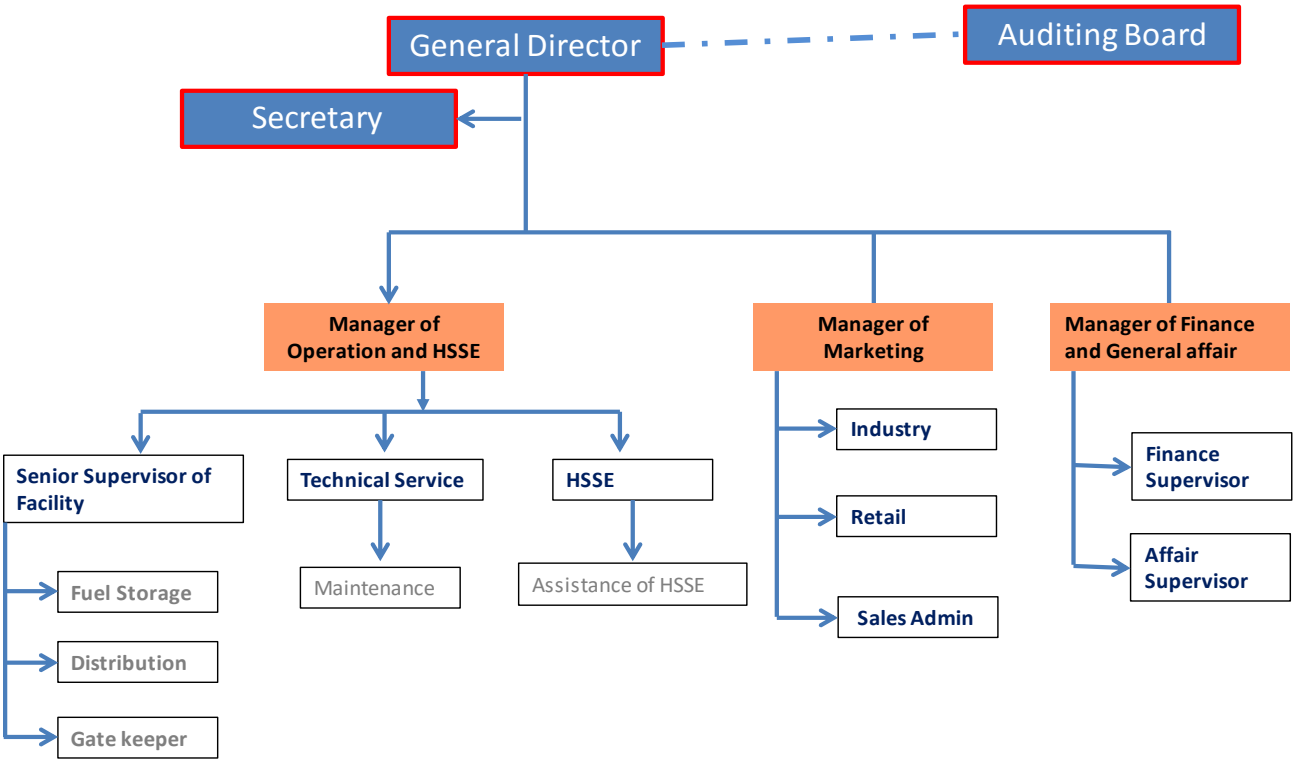
Jonio Sarmento (Assistant Project Manager)
Rua Estrada, Avenida Nicolau Lobato Dili, Timor Leste
Tel: +670 7728 6603 2)

Ms. Maria Elizabeth (Project Secretary)
+670 77663574

2.2 Management Structure

The following is the general management structure of the company.

Figure 2.2 Management Structure of Global Oil Storage Terminal Company



The project owner should be flexible to modify this organogram based on the need in the organization in responding to the vision and objective of the project development.

2.3 Company Vision and Values

To be customer's first choice in the area of petroleum supplies and risk management. Providing industry-exceeding class wholesale and retail level oil supplies and services through continuous improvement driven by integrity, trustworthiness, responsibility, teamwork and operational excellence.

The strategy to achieve our vision is to implement the roadmap our mission, which is enduring. It declares our purpose as a company and serves as the standard against which we weigh our actions and decisions.

- Energy that comes alive through focus on societal well-being
- To create value and make a difference
- Protecting the health of our employees, the environment, and putting safety first at all times
- Aim to achieve customer satisfaction and operational excellence through striving for quality and quantity (QQ) assurance

3. PROJECT DESCRIPTION

3.1 Project Overview

The proposed development project consists of construction of fuel storage tanks and supporting facilities in a total area of 1.3 Ha lands, which has been secured by project owner. Project owner has also planned for the use existing jetty structure located approximately 300m to the east of project site as unloading point of oil from tanker ship that belong to the Timor Cement SA. The following figure provides information on the general layout of the project. Current lay out is at a conceptual level, with more detailed layout/project engineering design to be provided once they are made available by the engineering department.

Construction of the facility is planned to be completed within 2 years. It is projected, that by 2022, the facility will be operated fully by the project proponent or any other designated operator.

Figure 3.1 Project Concept and Site Plan (See Annex 13 for more detailed drawing)

There two petroleum products that will be stored and distributed within this proposed facility. They are gasoline and diesel fuels, which are mainly used in Timor Leste as the source of automobile fuel and also other such power generation fuel. The specifications of gasoline and diesel fuels are presented in the following table.

Table 3.1 Summary of Physical and Chemical Properties of Gasoline

No	Parameter	Units	Limits		Grade	Test Method
			Min	Max		
1	Sulphur	mg/kg		150	All grades	ASTM 0543
2	Research Octane Number (RON)	--	92		All grades	ASTM D2699
3	Motor Octane number (MON)	--	78		All grades	ASTM D2700
4	Distilation, Final Boiling Point	^{0}C		210	All grades	ASTM D86
5	Olefins	% v/v		18	All grades	ASTM D1319
6	Aromatic	% v/v		42	All grades	ASTM D1319
7	Benzene	% v/v		3.0	All grades	ASTM D5580
8	Lead	mg/L		5.0	All grades	ASTM D3237
9	Oxsigen	% m/m		2.7	All grades (no ethanol)	ASTM D4815
				3.5	All grades (with ethanol)	ASTM D4815
10	Ethanol	% v/v		10	All grades	ASTM D4815
11	Oxygenates Except Ethanol, Each	% v/v		1.0	All grades	ASTM D4815
12	Phosphorus	mg/L		1.3	All grades	ASTM D3231
13	Copper corrossion (3hrs at 50^{0}C)	rating		Class 1	All grades	ASTM D130
14	Existent Gum (washed)	mg/100 ml		5.0	All grades	ASTM D381
15	Induction Period	minutes	360		All grades	ASTM D525
16	Rapid Vapour Pressure	kPa	45	65	All grades	ASTM D323
17	Flexible Volatility Index	index		100	All grades	ASTM D86 & ASTM D323

Table 3.2 Diesel Fuel Specifications

No	Parameter	Units	Limits		Test Method
			Min	Max	
1	Sulphur Content	mg/kg		500	ASTM D5453
2	Cetane Index	--	45.0		ASTM D4737
3	Density at 15^{0}C	kg/mg^3	820	850	ASTM D4052 ASTM D1298
4	Distilation T95	^{0}C		360	ASTM D86
5	Polyaromatic Hydrocarbon (PAHs)	% m/m		11	IP 391
6	Ash Content	% m/m		0.01	ASTM D482
7	Viscosity	mm2/s	2.0	4.5	ASTM D445
8	Carbon residue (10% distilation residue)	% m/m		0.2	ASTM D4530
9	Water Content	mg/kg		200	ASTM D6304
10	Total Contamination	mg/kg		24	EN 12662
11	Conductivity at Ambient Temperature	pS/m	50.0		ASTM D2624
12	Oxidation Stability	mg/L		25	ASTM D2274
13	Colour	Rating		2.0	ASTM D1500
14	Copper Strip Corrosion (3 Hours at 50^{0}C)	Rating		Class 1	ASTM D130
15	Flash Point	^{0}C	61.5		ASTM D93
16	Filter Blocking Tendency	Rating		2.0	ASTM D93
17	Fatty Acid Methyl Ester (FAME)	% v/v		5.0	EN 14078
18	Lubricity	mm		0.46	IP 450

Understanding these physical and chemical properties are very important and they indicate the type of pollutant that will be transferred to the receiving environment such as soil and water body.

3.2 Project Identification

The proposed fuel terminal facility was identified by the project owner as the final effort to involve in the current business of fuel supply and distribution in Timor – Leste. By constructing the fuel terminal, the project owner shall have greater flexibility in the distribution and control the price fluctuation in the

market. The location of the project was also identified as viable one by taking advantage of already constructed jetty, where the size of the land is reasonably large to construct the decent volume of the fuel terminal area.

3.3 Project Category

The project document submitted to the National Petroleum and Mineral Authority (ANPM) and approved has resulted the proposed development project fall under the category A, which required full scale environmental Impact Assessment (EIA) to identify various adverse impacts to the environment, people, and ecosystem. Based on the impact assessment, the proper mitigation measures can be proposed to minimize or prevent the impacts.

3.4 Project Location and Boundary

The project is located along the national road of Dili – Liquica, approximately within 30 minutes of overland travel from Dili to the west. Study area would be composed of project footprint, surrounding areas including residential, marine water body, upland catchment system that will affect the project by contributing runoff rate to the river nearby the project location.

Figure 3.2. Project Location in Reference to Capital Dili

The study area however, will cover up to the radius of 10 KM and beyond. Especially, the investigation on the coastal resources and pollution contribution from the project that will be transported along the coastline will be investigated within the radius of 15 KM. The following map shows the coverage of study from the project location toward east and west and north south.

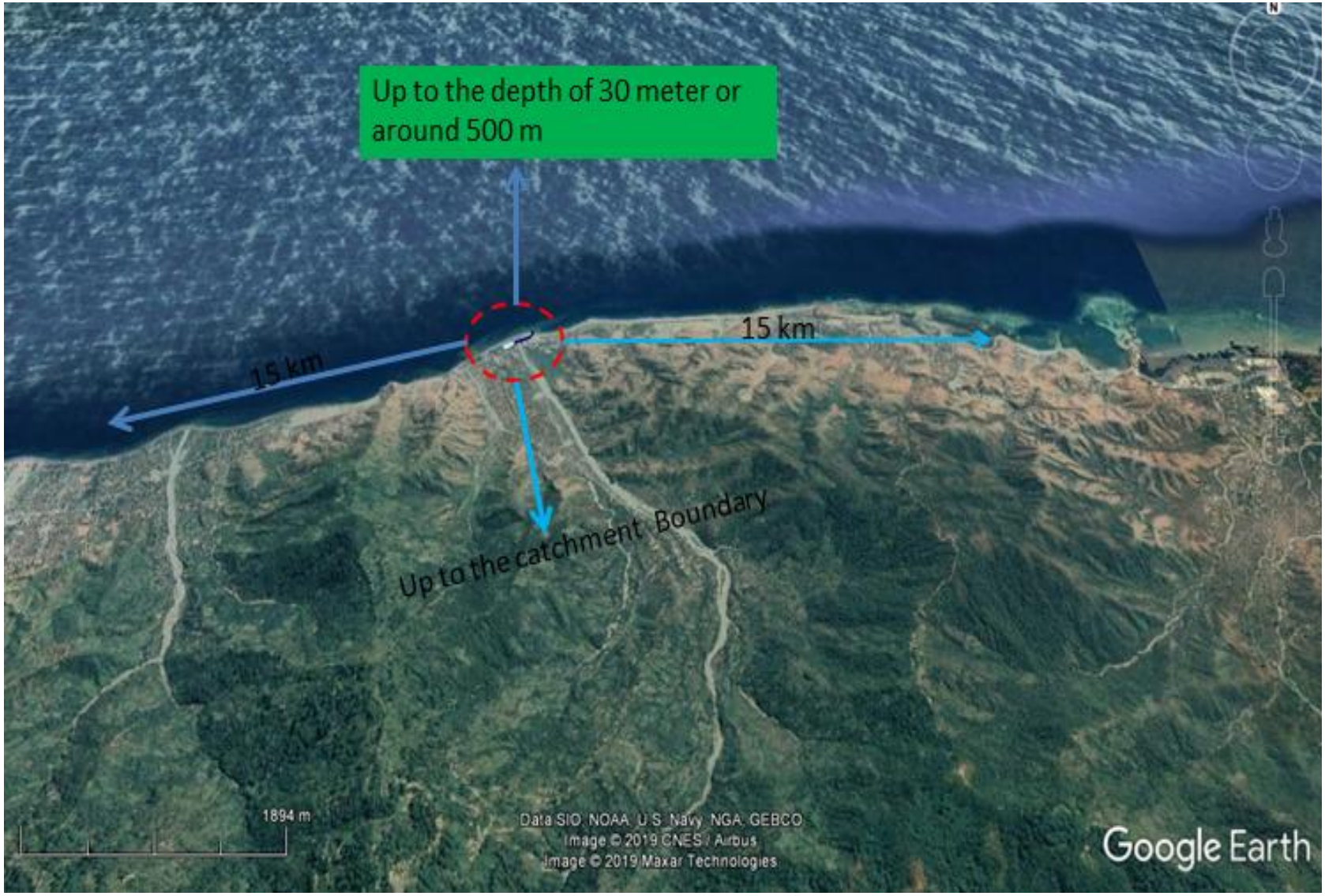


Figure. 3.3 Extend of the study.

The northern part is marine water, which will be impacted by the project in term of the operation of jetty and also the marine water can become the ultimate receiver of the pollutant generated by the project due to oil spill and wastewater discharged by the project. The Preliminary study and information suggested that the depth up to 20 m, is where most of the marine resources such as coral, mangrove, benthos, and fisheries, are located. The following figure shows the NOAA coastal research that has shown the coastal marine habitat.

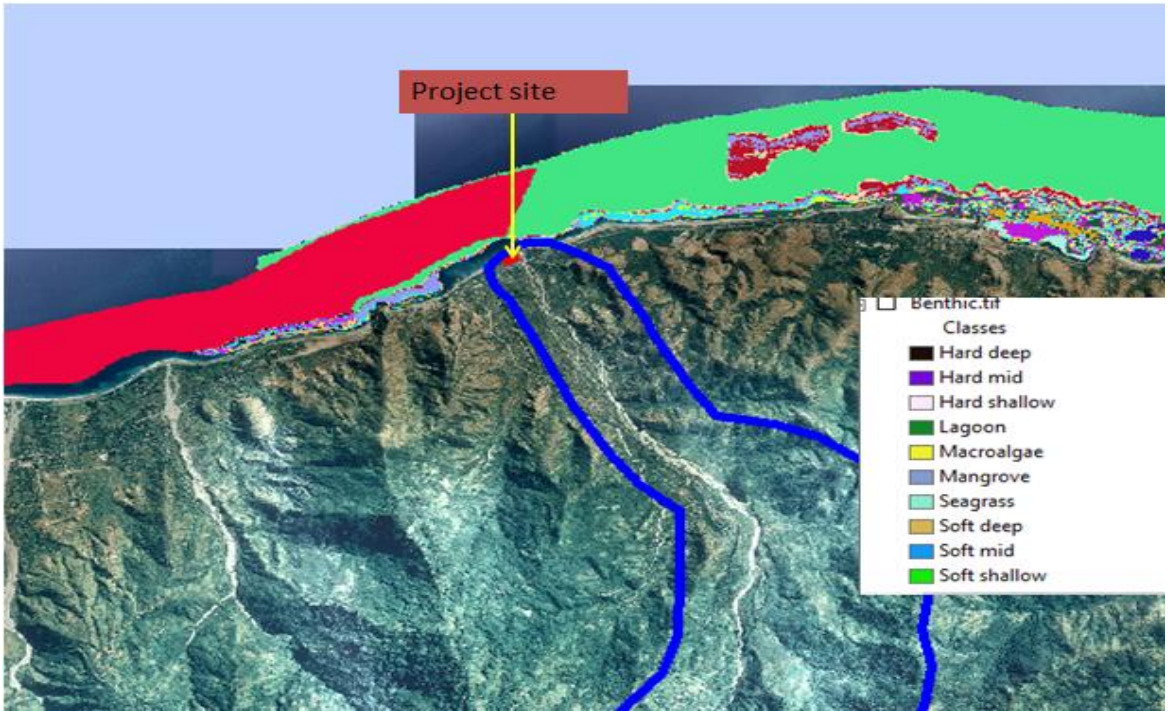


Figure 3.4. Benthic Marine Habitat (Source: NOAA Coastal Research Program)

Therefore, the environmental investigation toward the northern side will be limited by the water depth up to 30 meter, as many of the marine resources are within the 30 meters of water depth. Toward the east and west boundary, the extend of the study will be enlarged to the distance of 15 KM, as the movement of fate or pollutant could cover up to 15 KM from the point of origin, depending on the season and magnitude of current. Toward the southern boundary, the study shall cover up to the boundary of watershed, with the total contributing area of 18 KM^2. Several rivers locate along the northern part of Liquica contribute the runoff during the rainy season to the marine water, which will affect the turbidity of the marine water, which will be only temporary.

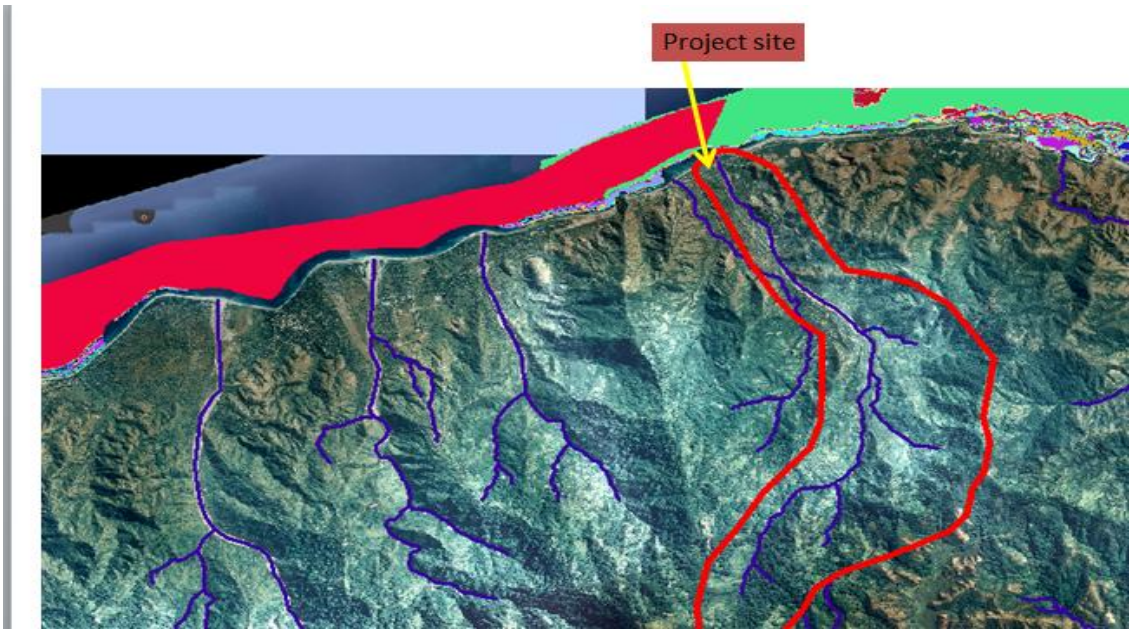


Figure 3.5 Major River Contributing Runoff

The rainfall-runoff analysis will be conducted to estimate the flooding risk carried by the small river that will affect the directly to the project.

Figure 3.6Project Location along the National Road of Dili – Liquica

The proposed development is located along the northern shoreline of Timor Leste. It is bounded by the sea in the northern part, residential houses to the south, a river to the east and local community houses to the west. Aipelo prison, a historical site, is located approximately 250 m to the west of the site. Along

the North coast of Liquica, various beautiful touristic places could be found and have identified as site to be improve in order to attract the tourism industry in the country.

The old Prison Aipelo and other touristic places, along the north shore of Liquica areas, could be affected by the project during the operation, especially in the event of emergency such as major oil spill in the sea, fire accident, and other natural hazard that may cause by the project.

- Salt Lake Maubara
- Maubara Fort
- Lauhata Resort
- Black Rock
- Loes River

Toward the eastern side of the project boundary, there are recreational resort and government major project that could potentially affected by the project.

- Tibar Port Development
- Industry area
- Tibar Resort area
- Kaitehu, protection area due to special coral reef

Toward south, the project location is bounded by the following features:

- River contribute runoff to the marine aquatic environment
- Mountain hike
- Coffee plantation in Bazartete area

However, in term of cross border impacts, the transport of impact from the project to east, west, and northern part of the project. Therefore, more focus of the study should be on the east, west, and northern boundary of the project site

3.5 Project Rationale and Feasibility

The project proponent proposed the development facility based on market analysis of demand growth of fuel supply in Timor – Leste and the opportunity to construct a new facility that will strengthen their existing business in the country. The new storage facility will also help in rapidly increasing in-country storage capacity that will contribute to easing of price fluctuation of fuel in domestic market. At the same time, having such a large capacity of storage will ensure competitiveness of the business, the price of which will eventually be passed on to the customer in the form of better retail price at consumer's level. Market feasibility study done by the project owner suggested that current increasing trend in fuel consumption will continue and therefore, it is profitable for the project owner.

3.3 Project Financing

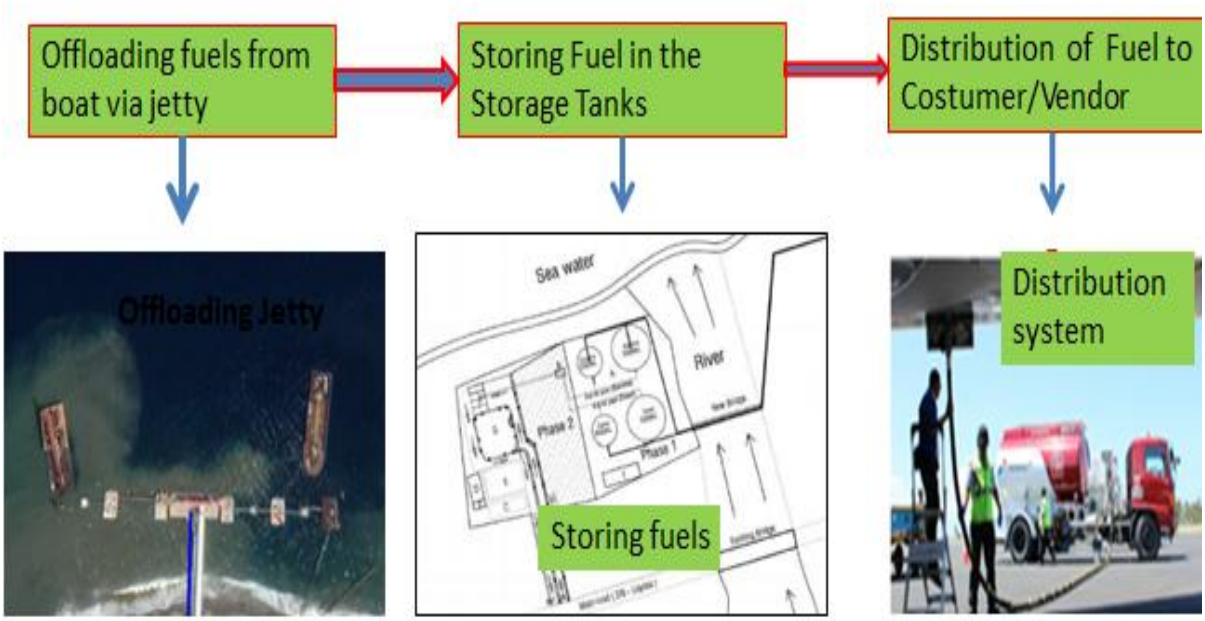
The proposed development project will be financed through one hundred percent equity from the parent company in Singapore. The construction of the facility will be completed within 2 years with operation planned to commence by 2022. The facility will be operated fully by the project proponent. It is estimated that revenue over 10 years of operation in Timor Leste will cover the investment.

3.4 Project Components

The proposed development consists of the construction of fuel storage tanks and supporting facility on a 1.3 Ha land area. Land for the development has already been secured by project proponent. General lay out for the fuel storage complex is provided in the following figure.

Project components consist of - (i) unloading of fuel in Jetty, (ii) storing the fuel in the storage tanks, (iii) transporting and distributing the fuel from the fuel storage to users and small vendors of the fuel in Timor Leste. All the required facilities such as storage tanks, piping system, utilities, office, parking, etc., shall be constructed as part this development project. Information related to project component, including processes involved will be described as followed.

Figure 3.7 Overview of Main Project Operation Components



Offloading Jetty

The jetty has already been constructed (existing jetty structure). Project proponent will use this jetty as unloading point and in return the project proponent is subject to user charge that will be applied by the owner of the jetty. The existing jetty was desgined and constructed in 2012 -2013 to serve the purpose of

offloding of breakbulk cement to be stored in the facility owned by the jetty owner. The total designed capacity of jetty is around 10,000 DWT. Project proponent planned to carry out unloading of its petroleum products twice a month. It is planned that fuel tanker with the capacity of 4,500 – 5,000 KL will transport the product, which will typically carried by the ship with a maximum capacity of 12,000 DWT (Dead Weight Tonnage).

Figure 3.8 Existing Off Loading Jetty (around 100 from the shoreline)

Figure 3.9 Jetty Platform

Figure 3.10 Jetty Structure

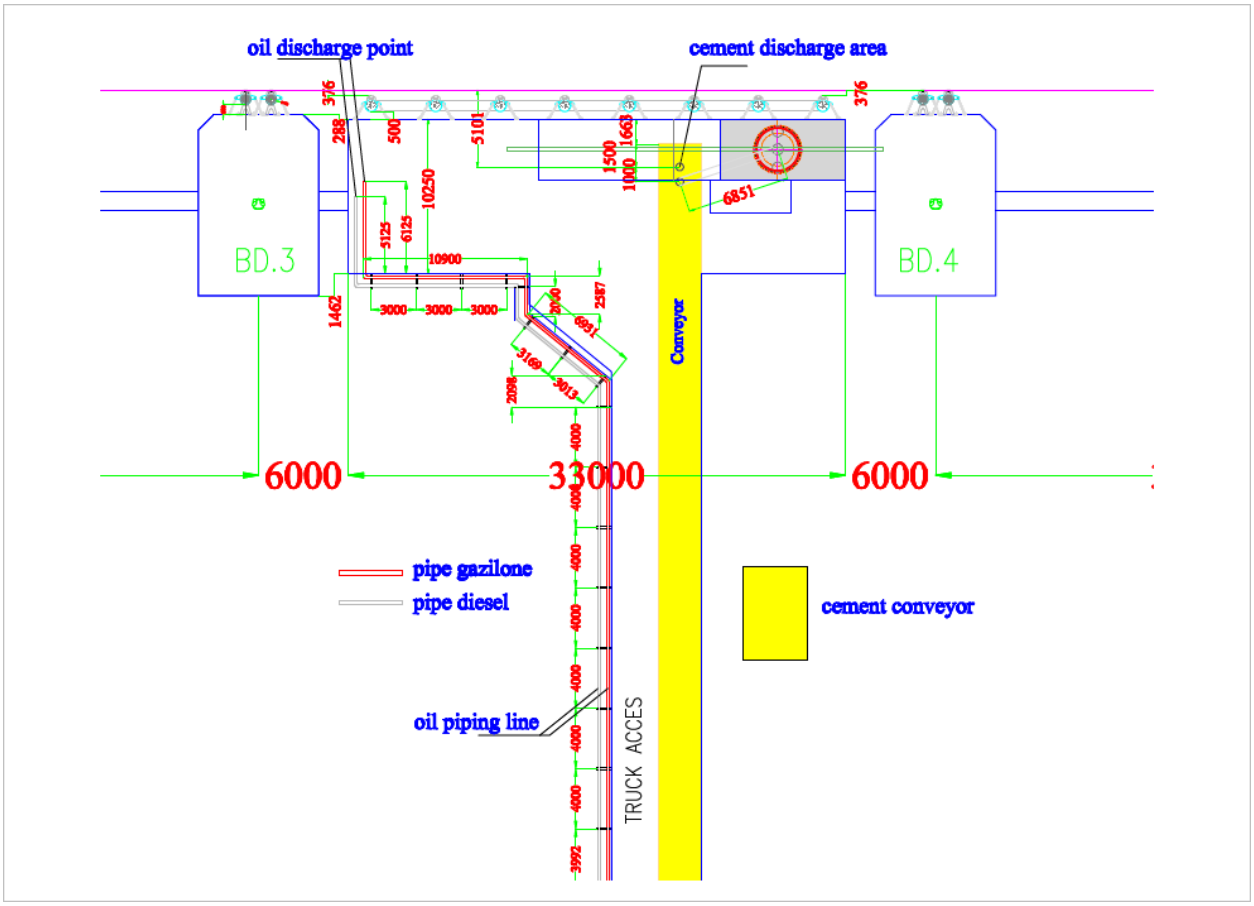


Figure. 3.11 Layout Design of the Jetty in Ulmera

The above original layout of jetty, as can be seen from the above figure indicate that the total area of ancored area is around 50 m.

Piping System

A piping network will be constructed in order to allow for fuel transfer from unloading point to the storage tanks and from storage tanks to the fuel truck. The design and specifications of the piping system will be carried by the professional independent engineers by taking the standard best practice in relevant industry (American Petroleum Institute/API standard).

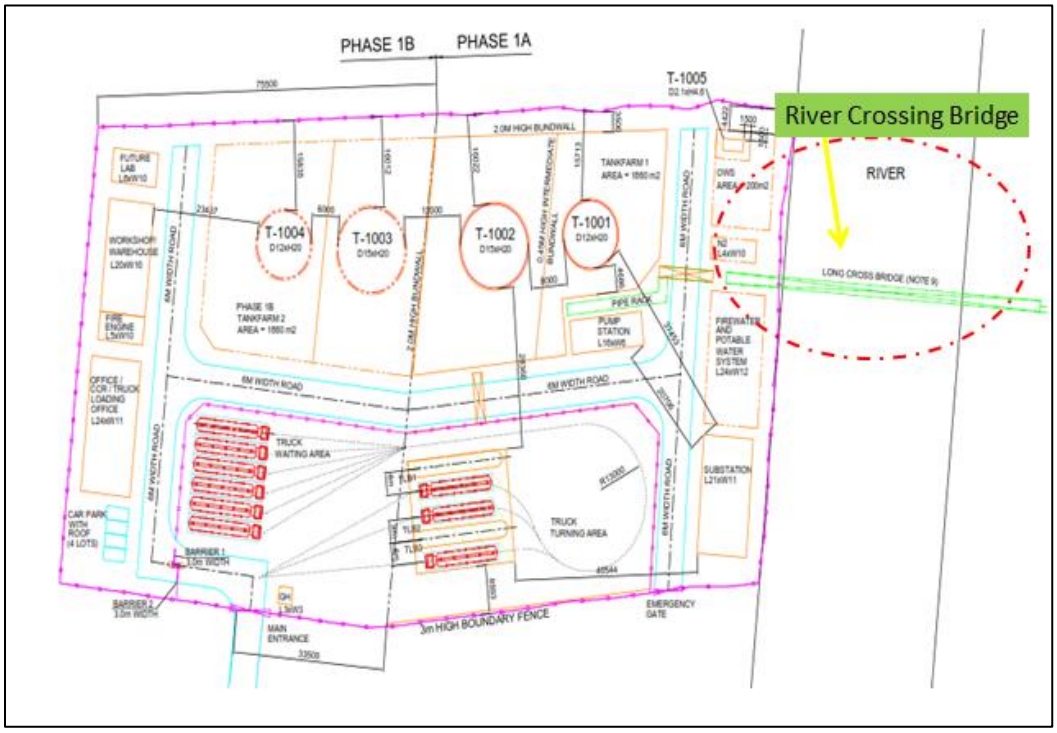
Figure 3.12 Concept Layout of Main Fuel Pipes

Two fuel pipes, one for gasoline and the other one for diesel fuel with the size of 6 inches, will be installed from the off loading jetty platform all the way to the storage tank. The pipe shall be above the ground and laid on the top of river crossing bridge. Detail layout of pipeline in respect to jetty, storage tanks, and other facilities will be provided in the draft EIS and EMP.

River Crossing Bridge

As the off loading jetty and storage area is divided by an existing river, a bridge crossing structure will be developed as part of the project. The bridge will be constructed such that it will be able to withstand high river flow. A hydrology analysis will be conducted as part of the EIS, however, preliminarily, it is recommended that the bridge structure has to be designed to withstand a minimum of 50 years flooding frequency. A more detailed study will be conducted to provide flooding magnitude information that will be used in detailed design work.

Figure 3.13 Concept Design of Facility and Crossing Bridge



Storage Tanks

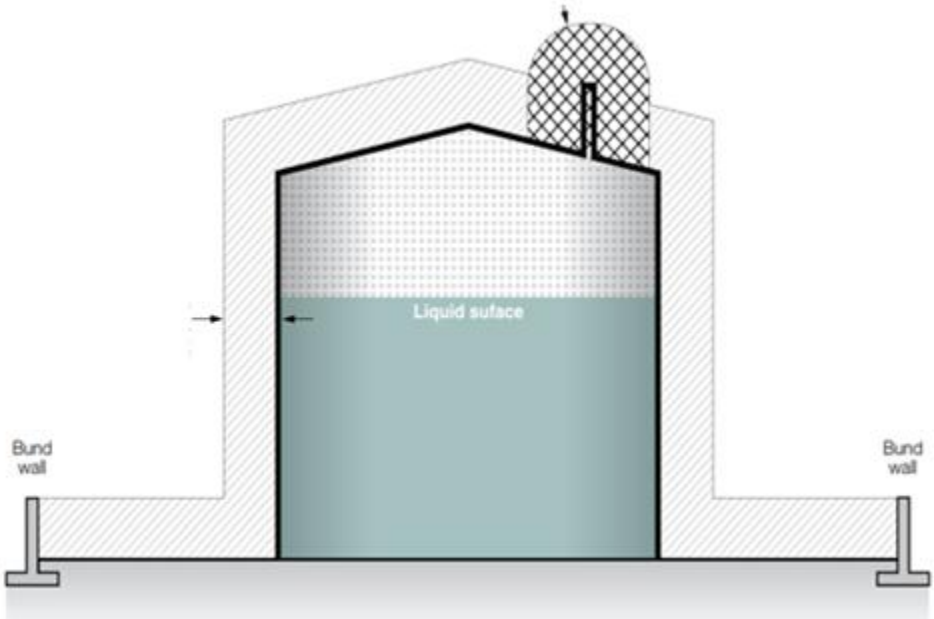
A total of 4 storage tanks, with the capacity of 2,000 m^3 and 3,000 m^3 will be constructed on the 1.3 Ha of land that has already been secured by project owner via long-term lease arrangement with the land owner. Project development phasing and volumes of tanks to be built are presented in the following table.

Table 3.3 Number of Storage and Respective Volume

Phase	Number of Tank	Volume of each Tank, m3	Total Volume (m3)	Height (m)	Diameter (m)	Type of Fuel
Phase 1 - A	1	2000	2000	20	12	Gasoline
	1	3000	3000	20	15	Diesel
Phase 1 - B	1	2000	2000	20	12	Gasoline
	1	3000	3000	20	15	Diesel
Total	**4**		**10000**			

A total volume of 5,000 KL storage tank will be constructed in the first phase (phase A) of the project and it is expected to be completed by the end of 2021. After the completion of the phase 1 A, the management will start to plan for the phase 1 B with an additional volume of 5,000 KL storage tank, aimed to be complete by the end of 2025 if found feasible. The design and construction of the fuel storage system shall include all necessary components to operate sustainably by considering health, safety and environment (HSE) aspects. This includes but not limited to bund walls as the secondary containment that will contain the fuel if there shall be any overflow or accident in the fuel tank.

Figure 3.14 Typical Tank Design with Secondary Containment



The decision of whether or not to expand to phase 1-B will depend on the country's economy and rental demand for storage tank. Therefore, design for phase 1-B is subject to change. The design of the fuel storage tank, including the material selection, type of tanks, tanks spacing, and ratio of height to diameter shall follows standards recommended by the API.

Secondary Containment

The secondary containment should be constructing as part of the storage facility with the total capacity of 110% of the total volume of the largest tank or a group of tank or 10% of the total volume of tank (Europium Union Standard, 2010). The main purpose of the containment is to retain the fuel spill (in case on emergency) from the storage tank and already consider the fire water.

There are two methods to estimate the dimension of secondary containment; (1). Based on 110% of the largest volume of the tank; (2). Base on the 10% of the total volume of tank group.

- First method: Volume of Secondary containment = 3,300 KL
- Second Method: Volume of Containment = 1000 KL

This means that the total volume of the secondary containment of 3,300 m^3 will be constructed.

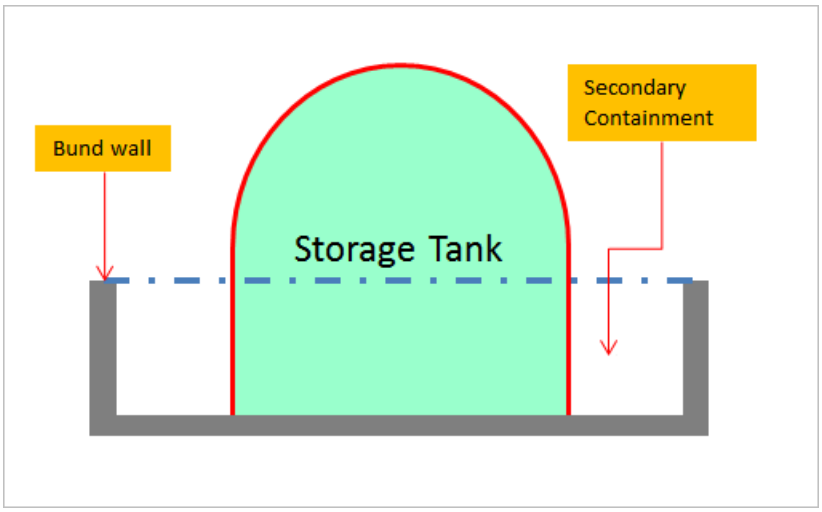


Figure 3.15 Secondary Containment and Bund wall

With this containment, the major spill of oil, in case an emergency major oil spill will be retained inside this confined space. The secondary containment consists of the following:

- Dike or retaining wall that is impervious to retain or keep fuel inside this perimeter
- Curbing or drip pan
- Sumps and collection system
- Drainage system
- Weirs, boom or other barrier
- Spill diversion pond
- Retention pond
- Sorbent material

Detail Engineering Design (DED) should present the detail layout of the each tank and the respective secondary containment.

Fuel Distribution System

Fuel in the storage shall be pumped into the distribution unit, where it will then be loaded on to the fuel truck for further delivery to the fuel filling station. Detail information on the distribution system, will be presented later DED document.

Utilities System

Utilities required consist of water, electricity and back-up power system as well as life and fire safety system (described separately below). The utilities are necessary components to ensure smooth operation of the facility.

Water Supply System

Water will be sourced from a groundwater pumping well, which will be constructed as part of this project. In normal condition, the capacity of water demand will be reasonably small around 2000 L/day or 0.14L/s assuming the pump is continuously active for four hours per day. A much larger amount, however, will be needed during a fire event.

A pool that store water for every-day use and fire event will be constructed near the storage area with a total capacity of 3000 m^3. The pool will be filled with water from the well in the facility which will require a gradual pumping until it reaches the capacity. After the capacity is reached, the pumping rate will be reduced to cover the daily need of 2000L/day and evaporation loss. Detail information on the production well for water supply and capacity of the pool will be provided in the EIS and EMP report.

Power Supply

Power supply for the project will be source from the national power grid available in the project site. The power will be utilized for pumping water and fuel, general office need, and other electricity needs. The total power requirement is around 1 MW per year during operation stage, which is a reasonable size of power consumption for this type of facility.

Wastewater and solid waste treatment

Two types of waste will be produced from the facility, the wastewater and solid waste. Wastewater will be mainly coming from domestic sanitation activities which include black water (resulting from toilet flush) and grey water (resulting from kitchen sink, other washing facility) and runoff during rainy events. Black and grey water will be flushed into a septic tank which will be designed to allow for in-situ treatment of the water with effluent discharged into the drainage which will eventually enter the marine waterbody. Storm runoff, on the other hand, will be washed off the ground surface in the project area and likely to be contaminated by fuel products (due to minor spill). Storm runoff will pass the oil-water separator to catch the oil prior to the release of the treated wastewater into the drainage system. Detailed engineering design (DED) of each wastewater treatment system (septic tank and oil-water separator) will be provided as part of design approval. A description of the utilities will be provided in greater detail in the full EIS and EMP.

Fire Protection System

Fire management system is an important part of project development, as fuel is susceptible to fire. Project proponent shall construct a system that meet the international life and fire safety standards to ensure integrity of its own facility, safety of workers and surrounding community.

Fire protection system shall consist of the following element:

- Pump, with a high capacity pumping head to the reach a storage tank of 20 m high
- Fire hose
- Fire hydrant system
- Moveable fire extinguisher
- Fire water system (pool)

Site layout on the arrangement of fire management system, including the equipment, fire fighter team, and mechanism of responding should fire actually happens will be developed by the project owner as separate document.

Support Office

Support office mainly consists of the office space for staff, security post, parking zones, and unloading zone of the fuel from storage tanks to the buyer trucks. Detail engineering design on the support office will be presented at later stage of project implementation.

3.5 Project Implementation Timeline

The project will be implemented according the general stages, which include, Design and construction, operation and maintenance, and decommissioning. The project preparation such as study and design is only small portion of the project and this stage is mainly related to the survey and analysis of the data, which shall not produce any major impacts. So in term of environmental impact assessment, this can be taking as an integral part of design and construction. The duration of the design and construction will roughly take 3 –years since the commencement of the study. The following implementation timeline shall be used an indicative for the project implementation.

Table 3.4. Project Implementation Schedule

Stage	Year								
	2019	2020	2021	2022	2023	2024	2025	----	2055
Planning and Preparation									
Procurement and Construction									
Operation and Maintenance									
Decommission									???

3.51 Planning and Preparation

During the planning and preparation stages, various works related to the legal issue such as land title, market feasibility study, environmental impacts assessment study, data collection and water resource investigation were carried out. Based on this information, the design engineer will prepare the detail engineering design, which provides a detail information and layout how to construct the facility, including the cost of the construction, as well as material engineering requirement.

It is expected that by the end of 2020, all the work related to the planning and preparation have already completed and the project owner will seek the approval of the design, which will become a basis to further procure the contractor to build the proposed development fuel terminal.

3.5.2 Procurement and Construction

The procurement and follow with the contract award is planned to be commenced by the end of 2020 or initial 2021. The construction of phase 1 A, is expected to take two years' time. By the end of 2022, the fuel terminal facility is expected to be completed already.

3.5.3 Operation and Maintenance

Starting from 2022, the inspection and testing of all the component of the facility will be done. It is hope that by the end of 2022, the operation approval for the phase 1 A will already been granted. Then the facility will be ready to be operated by the beginning of 2023. Depending on the market condition in Timor – Leste, the project owner will inform the ANPM, regarding the construction of the phase 1 B.

3.5.4 Decommission of the Facility

The normal age of the facility is designed for 30 –years of operation and after this service years, the project owner will make a decision to continue or decommission the facility. The extension to continue the operation of the facility is also up to the government, considering the performance of Global Oil Terminal LDA, in relation to the compliance of environmental, safety, and social regulation, as stipulated in the EMP document

3.6 Justification of Project

The proposed project development is a private business that would like to take the opportunity to build larger fuel terminal system in the Liquica. As any other business development, this proposed development is being considered as the business case is justifiable (economically, financially, and commercially). According to the market study done by the project owner, the development is justified as a Better Business Case (BBC) and therefore the project owner decide to go further into this project development toward the realization. With this new business development, the Global Oil Terminal Storage hopes to contribute to a better and efficient fuel supply with the competitive price in Timor – Leste. The Environmental Impacts Assessment (EIA) study on the other hand, shows that the project location is not within any sensitive or protected area defined by the regulation in Timor – Leste. Moreover, the major impacts related to process can be mitigated with technical, as well as non-technical approach to mitigate them.

With this successful project development, the project owner shall contribute to the Timor – Leste economy in a larger scale through the following project benefit:

- Contribute to the job creation to the youth that currently employed
- Technological transfer to Timor – Leste in managing the large project that contain high risk
- Contribute to the tax payment to the government (in line with the government plan on the economic diversification)
- Enhance other economic activity in local (multiply effect) and provide the good image of the business development in Timor – Leste so that may foreign direct investment will entering into Timor - Leste

Given the better business case (BBC), which is profitable, that ensures the financial sustainability with the expected minimization of the environmental and social impact, the project owner decided to pursue this development project.

3.7 Proponent's Endorsement

The project proponent has already reviewed and approved this document as part of the application for the approval of the location of the project. Therefore, we endorsed this report.

Mr. Kelvin Lim Project Manager
Tel: +670 7706 0008 Email:
Kelvin.lim@globalsgp.com

3.8 Structure of EIS Report

The structure of the EIS document, as presented in the table of content, follows standard guidelines released by DNCPIA, as provided in the Expert 101 package according to decree Law 5/2011:

- Detail of project Proponent
- Detail of EIA Consultant
- Description of project which cover the location, justification and rationale of the project, and detail component of the proposed project
- Legal framework and institutional arrangement of environmental protection in Timor Leste
- Description of existing environment
- Alternative options considered in the project development
- Environmental, social, and economic analysis related to the project development
- Environmental Management Plan (EMP)
- Public consultation and stakeholder engagement during the project development and implementation
- Difficulties and problems that may occur during the project development
- Conclusion and recommendation

4 EIA CONSULTANT

This Environmental Statement (EIS) and respective EMP documents have been prepared by PEC Consulting, Lda., a Timorese-own planning and engineering consulting company headquartered in Dili. PEC Consulting is headed by Sr. Krispin Fernandes, PhD., who has qualifications in Chemical Engineering, Hydrology and Environmental Planning and Engineering. PEC Consulting has experience in Timor Leste in the area of environmental and planning for developmental projects, including - irrigation infrastructure, water infrastructure, drainage infrastructure, and environmental impact assessment for environmental licensing according to Timor Leste regulatory framework.

Staffs involved in the environmental assessment and preparation of the EIS are listed in the following Table, which combine the local and other overseas staff.

Table 4.1 Summary of Consultant Staff who prepared the Preparation of this EIS and EMP

No	Staff	Expertise
	CONSULTANT STAFF	
1	Sr.Krispin Fernandes, PhD	He has more than 15-years of experience in environmental engineering, process engineering, and wastewater treatment and disposal into the deep ocean through a marine outfall. Sr. Krispin has undergraduate degree in Chemical Engineering, hence is qualified to understand the manufacturing processes involved in beer production, petrochemical, food, and other type of processing engineering, fuel storage system
2	Sr. Mario Marques Cabral, S.Si, M.Sc	Mr. Mario has more than 15-years of professional experience in marine biology and fishery assessment including assessment of socio-economic characteristics of coastal community. He is a marine ecological specialist for PEC Consulting and has involved in most of the projects under PEC management.
3	Sr. Juvencio dos Santos	Trained Economist and social impacts assessment specialist. He has two year of experience in data collection and analysis of social and economic profile
4	Sra.Rosalyn Fernandes, S.T. MURP	Rosalyn has substantial professional experience in delivering small to large scale environmental impacts assessment documents, including for fuel storage development, University Campus development, Sanitation Improvement Schemes, etc. She has recently finalized a task as senior environmental specialist who writes the environmental assessment reports for ADB loan funded road project.
5	Lourenco Pedro, S.T. MS	Mr. Lourenco has experience in regional geological interpretation and he has a master degree of Geology. He provide his input in the section of geology of Timor – Leste, including the soil boring test result and analyzing the soil structure into the foundation sustainability
6	Adelino Ro Sarario, S. Forestry	Mr. Adelino, specialist in the forestry and protected zone in Timor – Leste. His role in this EIA study is to identify the existing forest in the project area and other nearest protected areas that should affected by the project development
7	Sr. Venancio Rego Fernandes, S.T.	Trained in Industrial Engineering, Venancio has experience working as plant engineer in major manufacturing establishment in Indonesia, environmental officer and recently as a project engineer for stream flow and meteorology study in Timor Leste
8	Mr. Muslim Muim, Ph.D.	Ph.D. from Rode Island University, USA and currently a professor at coastal Engineering Department, Bandung Institute of Technology (ITB). He has numerous experiences in area of coastal hydrodynamic modeling, particularly he developed oil spill modeling in the ocean, which was applied by this study under his direct supervision
9	Mr. Aminuddin	Master of Science from Marine Biology, University of Diponegoro, Indonesia. He is a professional marine biologist and diving in the marine resources identification.

10	Dr. Mont Kania Dewi, S.T., M.T.	Head of Air Quality Laboratory, Faculty of Civil and Environmental Engineering, Institute Technology Bandung (ITB). Mrs. Kania, is responsible in providing observation data on air quality baseline.

The detailed descriptions of PEC profile, including various projects that have completed in the past can are presented as followed.

4.1 PEC - Consulting Summary

Since its establishment eight years ago, PEC has involved in various development projects and has successfully delivered 15 projects (small – medium size of the projects). The company has a vision to support sustainable infrastructure development in Timor Leste through proper planning and engineering design that also adhere to the social and environmental safeguarding principals.

The areas of specialties of PEC consulting include:

(1). Hydrologic and Hydraulic Analysis for various infrastructure development

(2). Environmental Impacts Assessment (EIA) and Licensing for various infrastructure projects

(3). Survey - Topographic and Bathymetric data collection

(4). River flow estimation and Catchment Analysis

(5). Hydro-Meteorological Data Collection

Our client of the consultancy works includes private sectors and international agencies such as JICA, World Bank, and Asian Development Bank (ADB), and various private sectors in Timor – Leste, such as Indonesia PERTAMINA, Global Oil Company, ETO –moving Energy, Heineken Timor SA and other many small companies.

4.2 Resume of Specialist Involved in this Project

4.2.1 Krispin Fernandes, PhD

He has more than 15-years of experience in environmental engineering, hydrology and hydraulic modeling, process engineering, and wastewater treatment and disposal into the deep ocean through a marine outfall. Sr. Krispin has undergraduate degree in Chemical Engineering, hence is qualified person to understand the manufacturing processes involved in beer production. Recently he involved directly in managing large scale project implementation.

A. Experiences:

1. *2012- Present,* ***Principle Environmental Engineer, at PEC – Consulting, that has completed all the environmental impacts Assessment (EIA) from Beverage processing plant, fuel storage development, quarry, and cement industry, and irrigation infrastructure development.***
2. *April 2013 – July 2013,* **Consultant for Aurecon, Pty., Ltd. On Water and Wastewater Treatment Design in F-FDTL Training Center, Metinaro, Timor Leste**
3. *November 2012 – July 2013,* **Consultant for Japan International Cooperation Agency (JICA) on Irrigation Rehabilitation and Improvement Project, Laleia, Manatuto, with primary duty on the hydrological survey and environmental baseline data collection**

4. *October 2011 –July 2012, Consultant for* **SKM Consulting, Australia, working on the Dili urban drainage and sanitation master plan, including training of GIS and Hydrological Modeling for GoTL staff**
5. *February 2011 – October 2011, consultant for* **Melbourne Water Corporation** , working on the Dili Hydrological Modeling and data collection for master plan development of Sanitation and Drainage system of Dili
6. *June- December 2010,* **Water Resource Research University of Hawaii at Manoa, Post-Doctoral Research Scholar working on the project of:** Survey and modeling analysis of Municipal Separate Storm Sewer System (MS4) at highway storm runoff network on Oahu, Hawaii, USA.
7. *July 2006 – August 2010, University of Hawaii at Manoa,* **Research Assistant at Water Resource Research Center, University of Hawaii at Manoa,**
8. *Summer 2002 and Summer 2003,* **Climate and Information System Project Intern, National Oceanographic and Atmospheric Administration (NOAA), Office of Global Program (OGP), Silver Spring, Maryland, USA**
9. *November 1999 – January 2000* **, Staff at Oxfam International Australia in Timor Leste, working on the** Water supply and sanitation improvement project in Dili, Liquica, and Bobonaro

B. University Education

No	*University*	*Main Course of Study*	*Place*
1.	University of Hawaii at Manoa, USA	Civil and Environmental Engineering (Completed Doctor of Philosophy)	Honolulu, Hawaii, USA
2.	University of Hawaii at Manoa, USA	Civil and Environmental Engineering (Completed Master Degree)	Honolulu, Hawaii, USA
3.	Gadjah Mada University Yogyakarta, Indonesia	Chemical Engineering (Completed Bachelor Degree)	Jogjakarta, Indonesia

C. *Computer Skill*

1. ArcGIS 9.3.1 : Mapping, data conversion, spatial analyst, 3D analyst, and other general GIS operation
2. ArcView 3.x: Mapping, spatial analyst
3. EPA-BASINS/MapWindow: GIS-based modeling, database management
4. HEC-HMS: Catchment hydrological modeling
5. HEC-RAS: River Hydraulic modeling
6. GEO-HEC-RAS: Flood plain modeling
7. EPA-SWMM: Hydraulic modeling for urban drainage system
8. EPANET: Drinking water distribution modeling
9. MS. Office: Excel, words, power point, front page

D. Publications

1. **Fernandes K**, Liu C.C.K.,Moravcik, P. 2010. GIS-Based Linear Systems Modeling of Watershed Sediment Transport Process. (*presented at 2010 AWRA Annual Conference in Philadelphia, USA*)
2. Liu C.C.K, **Fernandes K**. 2009. Linear Systems Modeling of Watershed Hydrology and Sediment Transport. *The 3rd IWA-ASPIRE Conference, International Water Association (IWA), October 188211;22, 2009, Taipei, Taiwan*
3. **Fernandes K**, Liu C.C.K. 2005. Flood Hydrograph Analysis for Manoa Watershed, Oahu, Hawaii. *Proceedings of AWRA 2005 Summer Specialty Conference.* Honolulu, Hawaii, American Water Resources Association, Published in CD-ROM
4. Liu C.C.K., **Fernandes K**. 2006. Natural-Energy-Driven Brackish Water desalination: Field testing and mathematical modeling. *Technical Report, water resources research center, University of Hawaii at Manoa*, Honolulu, HI, USA

4.2.2 Muslim Muim, Marine Ocean Hydrodynmaic

Mr. Muslim Muim has a Ph.D., of Coastal Engineering from Rode Island University USA. Mr. Muim Involvement is mainly in the ocean hydrodynamic modeling, which mainly investigate the dispersion of oil spill in the marine environment.

4.2.3 Kania Dewi, Air Quality Expert

Ms. Kania Dewi is an expert in the air quality issue and mainly responsible for the air quality measurement and analysis. Detail of her expertise can be found in her resume in the annex file.

4.2.4 Aminuddin, Marine and Terrestrial Biology

Graduated from Marine Biology, University of Diponegoro, Indonesia, with rich experiences in Diving, coral assessment, and marine aquatic system.

4.2.5 Rosalyn Fernandes, S.T., MURP

Rosalyn has substantial professional experience in delivering small to large scale environmental impacts assessment documents, including for fuel storage development, University Campus development, Sanitation Improvement Schemes, etc. She has recently finalized a task as senior environmental specialist who writes the environmental assessment reports for ADB loan funded road project.

A. Experience

1. *January 2014 – Present, PEC – Consulting,* **Environmental Specialist,**

Working on Simplified Environmental Impact Statement (SEIS) and full scale EIS under contract from PEC Consulting. Responsibility including desk review of relevant document, field investigation, document write ups, presentation and coordination of other specialist.

2. *October 2012– October 2013***Consultant for Timor Leste Greenhouse Gas (GHG) Inventory,** Contracted service at UNDP Timor Leste for the national GHG Inventory and Mitigation Options Analysis. Duties include conducting research, analysis, workshop and training for stakeholders from different agencies. Stakeholders include ALGIS, SOL, DNMA, DNAAI, Forestry, Fisheries, DNSSB, EDTL, and others.
3. *June – July 2012,* **Environmental Specialist, Part** of the team that put together the Environmental Impact Assessment document for development of UNTL Hera facility on 365 ha land. Responsible for baseline write up on socio-economic condition and waste management. Responsibilities include report writing, analysis, map making, community consultation, and client liaison. Contracted service by Oasis, Sustainable Projects.
4. *January – May 2012, Community* **Engagement Specialist**, Contracted by SKM International, coordinated and implemented Sanitation Willingness to Pay Survey (600 samples), coordinated and implemented Flooding Damage Survey (50 samples), and coordinated and implemented community consultation (qualitative survey) covering topics: environmental cleanliness, sanitation, hygiene, solid waste, flooding, and kangkung management.

5. *February – June 2012,* **Consultant for State Secretary for the Environment,**
Consultant for Timor Leste State Secretary for the Environment (SEMA) working on compilation and analysis of SEMA's activities between 2007 – 2012 to articulate achievements and recommend ways to improve weaknesses. Purpose of project was preparation of three documents – SEMA activities 2011, SEMA activities 2007-2012 for the government, SEMA activities 2007 – 2012 for the general public. The documents concluded on SEMA achievements as well as opportunities for future improvements towards environmental sustainability in Timor Leste. Works included interviewing with SEMA employees, desk review of documents, and report writing.

6. *July - December 201,* **National Environmental and Safeguard Specialist**,
Contracted by ADB Timor Leste, working as the national environmental and safeguard specialist for the district capital water supply specialist. The project includes three components – rehabilitation of the Debo Lehumo Lake weirs, rehabilitation of the water supply system in Pante Makassar, Oecusse and rehabilitation of the water supply system in Manatuto. Engaged by Aurecon, Inc., the main contractor for the PPTA. Responsible for:

7. *2008 -2010,* **Environmental Specialist/Planner,** Staff planner at Townscape, Inc. in Hawaii, USA, **for Preparation of Koolau Poko Watershed Management Plan,**
8. *2008-2010, GIS* **Specialist for Ala Wai Drainage Project,** The Ala Wai Drainage Project was an urban drainage upgrade with two main thrusts: flood control and improvements to the natural conditions of Honolulu urban streams.
9. **Graduate Assistant for Community Consultation for the Transit Oriented Development Project,** *2006-2008*

B. University Education

No	University	Main Course of Study	Place
1.	University of Hawaii	Urban and Regional Planning (Completed Master Degree)	Honolulu, Hawaii
2.	University of Gadjah Mada	Chemical Engineering (Completed undergraduate level)	Jogjakarta, Indonesia

C. International Seminar

- Participant at the East West Center International Graduate Student Conference, 2007.
- Participant at the UH Manoa International Graduate Student Conference, 2008
- Participant at the Xian Urban Planning Practicum at Xian, China, 2006. The Practicum involved collaboration between students from Northwestern University in Xian, China; students from the National Taiwan University in Taiwan and students from the Urban Planning Department, University of Hawaii. All students travel to Hawaii, Taipei and Xian for research, discussion and presentation.

D. Certificate of Competencies:

- Basic and advance security in the field of the United Nations system

E. Organization:

- American Planning Association (APA), Hawaii Chapter

4.2.6 Mario Marques Cabral, S.Si, M.Sc

Mr. Mario has more than 15-years of professional experience in marine biology and fishery assessment including assessment of socio-economic characteristics of coastal community. He is a marine ecological specialist for PEC Consulting and has involved in most of the projects under PEC management.

A. Experiences

1. **Agriculture Specialist/Consultant,** *November – December 2012:*
   Contract service with JICA Study Team for the Project for Rehabilitation and Improvement of Buluto Irrigation Scheme (Laleia and Vemase) in Baucau and Manatuto Districts. Agriculture survey, interview to government and farmers, interpretation, reporting.

2. **Marine Biology Specialist/Consultant,** *July – August 2012:*
   Contracted service at Ministry of Marine Affairs and Fisheries, Directorate General of Marine, Coastal and Small Islands (Indonesia). Review and Profiling the Potential of Ecological and Social Economical for Marine Protected Area in Gunungkidul and Bantul Districts of Yogyakarta Province.

3. **Natural Resources Management Specialist/Consultant,** *October – December 2011:*

Contracted service at Forestry Ministry, Directorate General of Watershed Management Building and Social Forestry, Watershed Management Center of Benain Noelmina, Strengthening Community-Based Forest and Watershed Management (SCBFWM) Project Region of East Nusa Tenggara. Cooperation among Ministry of Forestry (Indonesia), UNDP and GEF.

4. **Extra ordinary lecturer,** *September 2011 – August 2012:* Employed as extra ordinary lecturer at Faculty of Fisheries and Marine Science of Artha Wacana Christian University Kupang (East Nusa Tenggara Province-Indonesia).
5. **Coastal and marine resources management specialist**, *August - December 2011:*
   Act as volunteer service at fish hatchery unit of Marine Affairs and Fisheries Services of East Nusa Tenggara Province (Indonesia).

6. **Manager Program,** *August 2011– until now:*
   Founder and member of Talitawan (a local NGO with core development mission in agriculture, forestry, marine affairs and fisheries), coverage areas of East Nusa Tenggara Province (Indonesia).

7. **Natural resources management specialist, volunteer**, *July - December 2011:*
8. **Natural resources management specialist, volunteer,** *February –July 2011:*
9. **National Project Manager,** *January – December 2010*, Personnel service agreement at Regional Fisheries Livelihoods Programme (RFLP) for South and South East Asia (GCP/RAS/237SPA), FAO Indonesia. Project location: Kupang Municipality, Kupang District, Alor District and Rote Ndao District of East Nusa Tenggara Province. Cooperation between FAO and AECID.
10. **Coastal and marine resources management specialist,** *April - October 2009:* Contracted service at PT.Nusa Karimun Divers, Semarang-Central Java Province (Indonesia).
11. **Coastal and marine resources management specialist,** *March-April 2008* :Acted as Freelance Consultant service at CV. Rekayasa Jati Mandiri, Semarang-Central Java Province to provide technical assistance for coastal habitat degradation study in Pulau Panjang (Jepara District) as conservation and ecotourism basis development.
12. **Natural resources management specialist,** *May- July 2007:* Contracted service at PT. Puri Aji Buana, Semarang-Central Java Province to provide a technical assistance for Detail Engineering Design (DED) of picnic park Kalianyar river basin-Solo project.
13. **Fisheries Consultant, volunteer,** *January- March 2007:* Volunteer service at National Directorate for Fisheries and Aquaculture Timor Leste to provide a technical assistance for National Consultant under the project of Strengthening the Capacity in Fisheries Information Gathering for Management. The main assignment was to design a pilot project cycle for Community Based-Marine Sanctuary (CB-MS) in the coastal areas of Batugede and AtauroAnd as Resource Person to advise the Director of the Fisheries Directorate and staff and provide assistance to develop an enhance the capability and achieve respective objectives.
14. **Resource Person/Fisheries Consultant/Fisheries Information Management Specialist,** *April 2005 – December 2006, Contracted* service at Ministry of Agriculture, Forestry and Fisheries, National Directorate of Fisheries and Aquaculture Timor Leste cooperate with FAO (GCP/RAS/199/SWE) "Strengthening the Capacity in Fisheries Information Gathering for Management Project." Project location: 11 coastal districts of Timor Leste.

15. **Part time lecturer,** *March 2005 – November 2006:* Contracted service at University of National Timor Lorosa'e, Faculty of Civil Engineering, Dili-Timor Leste.
16. **Fisheries expert staff,** *September – December 2004:* Contracted service at *(PT. Swakon, Semarang-Central Java Province)* cooperate with Coastal Community Development and Fisheries Resource Management Project. Posted at Tegal Municipality, Central Java Province (Indonesia).
17. **Research and development staff,** *July up to August 2003:* Contracted service at *(LPPSP, Semarang-Central Java Province)* a Local NGO of Research, Improvement and Development Resources Institute cooperate with Central Java Development Planning Agency including Strategic Planning of Central Java Province.

B. University:

No	*University*	*Attended from/to*	*Main Course of Study*	*Place*
1.	University of Gadjah Mada	2000 – 2003	Environmental Science (Post graduated – S2)	Yogyakarta (Indonesia)
2.	University of Diponegoro	1992 – 1999	Marine Science (Bachelor graduated – S1)	Semarang (Indonesia)

C. International Seminar Experiences:

- Participant on APFIC the third Regional Consultative Forum Meeting on balancing the needs of people and ecosystems in fisheries and aquaculture in the Asia Pacific, in Jeju – Republic of Korea, 1 – 4 September 2010;
- Speaker on international workshop at field study of fisheries which sponsored by Regional Asia and the Pacific of FAO with title *Second Regional Transfer Workshop on Gathering Information for Fisheries Management* in Halong Bay – Viet Nam, 24 – 27 October 2006;
- Participant on the Third Biannual International Conference and Exhibition on Energy 2002 "Energy for Sustainable Development." Yogyakarta – Indonesia, 29 – 31 July 2002;
- Participant on Indonesian in Transition. Yogyakarta, 22 – 23 November 2001;
- Participant on International Seminar and Exhibition on Information Technology for Sustainable Management of Natural Resources. Bogor – Indonesia, 2 October 2001; and
- Participant on Linggarjati Environmental Meeting "Towards Decentralized Environmental Management" Kuningan, West Java – Indonesia, 9 – 13 November 2000.

D. Trainer Experiences:

- Coastal community-based and fisheries resources management;
- Performance, Improvement and Planning (PIP);
- Logical Framework Approach (LFA);
- Participatory Approach-Ranking, Scoring and Map/Diagram Design;
- Social Impact Assessment (SIA);
- Socio-economic monitoring;
- Learning to lead: An approach of managerial and leadership test score;
- Fishery extension planning: Bottom-up development planning;
- Basic fishery statistics of data collection and analysis;
- Participatory problems ranking and SWOT analysis; and
- Problem solving and decision making.

E. Certificate of Competencies:

- Basic of procurement of FAO;
- Basic and advance security in the field of UNDSS; and
- Environmental management specialist.

F. Publication:

- The study of unconfined groundwater quality distribution based on the types of non-irrigated rice field and fish pond land uses in Karimunjawa Island. Journal of People and Environment. Vol. 12, No. 2, July 2005. Center for Environmental Studies of Gadjah Mada University.

G. Organization:

- Founder of local NGO "Talitawan" (Community Care for Agriculture, Forestry, Marine Affairs and Fisheries) located at Kupang-East Nusa Tenggara Province;
- Association of sustainable forestry for people of Indonesia, East Nusa Tenggara Province;
- Indonesian Fishers Union of Kupang District, East Nusa Tenggara Province;
- Founder of Sumawis Enterprise, an event organizer for environmental education, located at Semarang-Central Java Province;
- Member of student regiment, Diponegoro University, Semarang-Central Java Province.

4.2.7 Venancio Fernandes, S.T.

Trained in Industrial Engineering, Venancio has experience working as plant engineer in major manufacturing establishment in Indonesia, environmental officer and recently as a project engineer for stream flow and meteorology study in Timor Leste

A. Experience

1. **Project Engineer, Timor Leste,** *February 2014 – Present,* Contracted by PEC Consulting to provide services as follows:
   - Planning, design and installation of automatic meteorological data collection equipment
   - Through PEC Consulting, contracted by Seeds of Life (SOL) to repair and maintain SOL's automatic meteorological data collection equipment already in the field
   - Manage a team of 4 personnel for field installation, equipment checking and data collection monitoring
   - Coordinate for recruitment of field assistants at each thirteen locations of weather station installation. Recruitment was conducted through consultation and close collaboration with *chief de Suco* and/or *chief de Aldeia*.
   - Responsible for payment of services to district field assistants.

2. **Agricultural Census Coordinator, Indonesia,** *March 2011 –December 2011*

   Contracted service at P.T. Tanjung Buyu Perkasa Timur in East Kalimantan, Indonesia to coordinate for palm tree census at Tanjung Buyu's plantation. Responsible for:
   - Coordination of field assistance
   - Random sampling of palm fruit trees about to be harvested. Sampling was conducted for each block of the palm fruit trees.
3. **Foreman, Indonesia,** *January 2010 – December 2012*
   Contracted service at P.T. Tanjung Buyu Perkasa Timur. Responsible for checking employees' presence and work quality.

4. **Administrative Staff at Ticketing Agency in Timor Leste,** 2009

   Staff at a local ticketing agency (LGX Tour and Travel) in Timor Leste. Responsible for keeping of reservation document and delivering deposit money to the bank.

5. **Distribution Staff at P.T. Diamond Ice Cream, Jogjakarta,** 2006 – 2007
   Staff at P.T. Diamond Ice Cream in Jogjakarta, Indonesia. P.T. Diamond Ice Cream is a supplier of ice cream to McDonalds Indonesia as well as a large processed food producer in the country with products ranging from frozen meat to frozen vegetables. Previously recruited as intern in the company branch in Jogjakarta and later on recruited as permanent staff. Responsible for delivering frozen food to hotels and restaurants including to McDonald's in Jogjakarta.

6. **Assistant Trainer at Computer Laboratory at Akprind College in Jogajakarta,** 2006
   Professionally paid as lab assistant at the Computer Laboratory at Akprind College in Jogjakarta, Indonesia. Responsible for preparation of computers, student organization and filling in for the lecturer when he is absent.

B. Education

No	University	Main Course of Study	Place
1.	Institute of Science and Technology Akprind	Industrial Engineering (Completed Bachelor Degree)	Jogjakarta, Indonesia
2.	Escola Vocational de Dom Bosco Fatumaka, Baucau	Majoring in Mechanical Engineering	Baucau, Timor Leste
3.	SMP Negri 1, Lospalos		Lospalos, Timor Leste
4.	SD Negri 19, Cacavei		Lospalos, Timor Leste

E. Trainings

No	*Training Course of Subject*	*Organized by*	*Year/Month*	*Place*
1.	Water Treatment for Industrial Application Training	Institute of Science and Technology Akprind and P.T. Ipal	2004	Jogjakarta, Indonesia
2.	Environmental Impact Assessment Training	Institute of Science and Technology Akprind	2005	Jogjakarta, Indonesia
3.	Verification and Data Analysis for Statistical Purposes	Institute of Science and Technology Akprind	2005	Jogjakarta, Indonesia
4.	Sugar Production Processing and Fabrication	Institute of Science and Technology Akprind in collaboration with P.T. Madu Baru	2005	Jogjakarta, Indonesia

F. Computer and Other Skills

- Corel Draw for Engineering Application
- SPSS
- QSB
- Microsoft Office 2003 and 2007

4.2.8 Juvencio dos Santos

Trained Economist and social impacts assessment specialist. He has two year of experience in data collection and analysis of social and economic profile

A. Experience

2013 – Present, PEC – Consulting, LDA, as project assistant and economist of the EIA

A. Education

B.A degree from the National University of Timor Leste (UNTL), 2013

B. Training

Attend the business development training with the Government of Timor Leste

5 LEGAL REQUIREMENTS AND POLICIES FRAMEWORKS

The development project of fuel storage terminal and associate supporting facilities will be constructed in the Suco Lauhata and owned by the foreign company, which has already registered locally under the Timor – Leste jurisdiction. Therefore, the construction and operation this proposed development project is subject to various local jurisdictions in Timor – Leste and other best practice regulation or standard such as ISO (international Standard Operation), International standard regulation and best practice in the related industry. Especially, the legal framework on the business related project and environmental safeguards principles that must be complied by the project owner. While, legal framework of international standard and other best practice are only an optional, when the local regulation is not available, the relevant regulations in Timor – Leste are mandatory to be complied. Therefore, review of the following legal framework, existing policies and standard, as well as best practice in the proposed development industry will be provided.

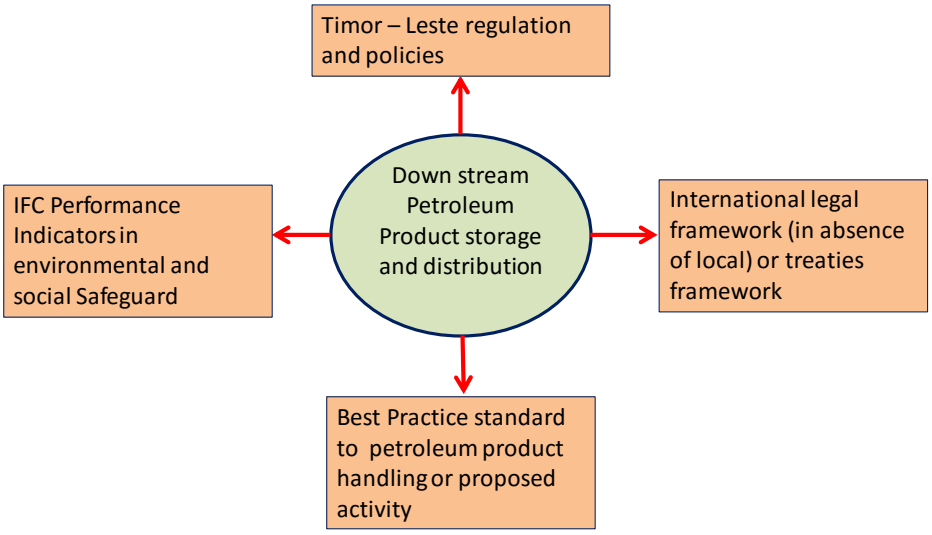


Figure. 5.1 Scope of Review of Policies and Legal Framework

Moreover, the institutional arrangement to ensure the effective the implementation of policies and regulation would be also proposed, particularly related to the environmental management and monitoring system.

5.1 Relevant Policy and Legislation in Timor - Leste

5.1.1 Constitution of RDTL

The Constitution of Timor Leste has mandated the protection of environmental and preservation of natural resources (article 6 – f) to ensure that the development of the economics of Timor Leste, should not jeopardizing the natural environment, in achieving the national goal. It is the highest hierarchy of

law, which must be complied by every citizen who perform any kind of business activity in Timor – Leste, including the petroleum and gas sectors.

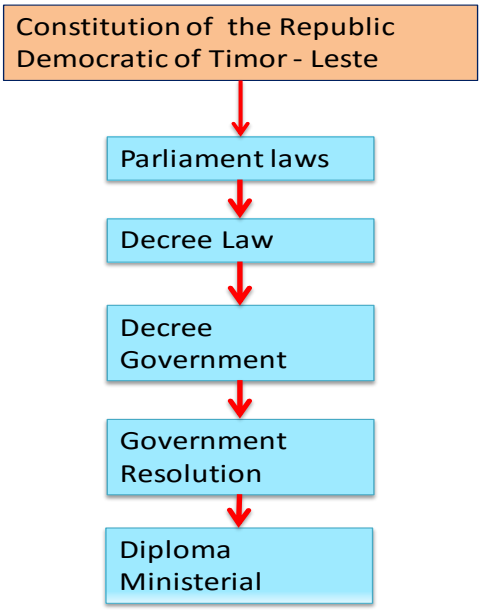


Figure 5.2. The Hierarchy of Law in Timor – Leste

5.1.2 Downstream Petroleum Product Legal Framework

Other laws are more technical regulation to regulate the technical operation of specific activity but should be in-line with the Timor – Leste Constitutional. For example the following laws present the specific regulation on the downstream petroleum activity, which must be complied by the business related to the downstream petroleum activity.

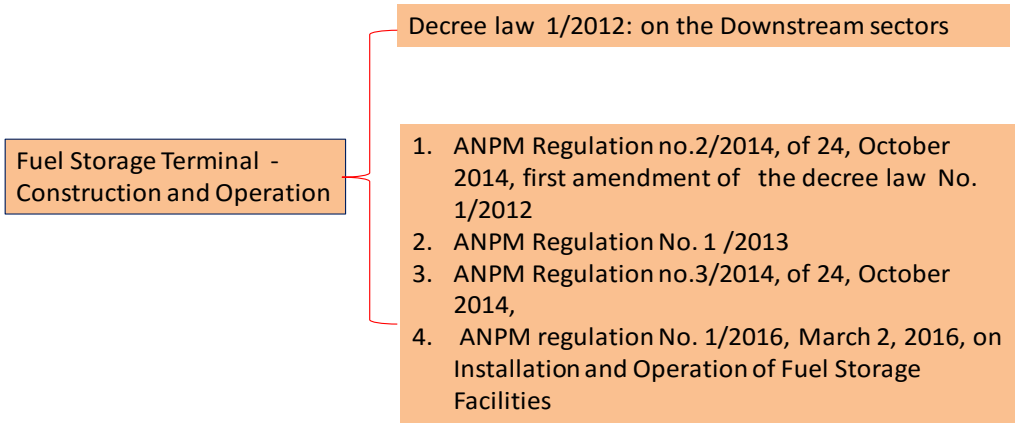


Figure 5.3. Timor – Leste Regulation of the Downstream Petroleum Activity

More detail procedure on the installation of the fuel storage, including the technical requirement is presented in the section 5.5

5.1.3 Environmental Protection and Safeguard Policy

To ensure the implementation of the laws related to the downstream petroleum activities, especially, to protect the natural environment, other technical laws related for the environmental protection should be created. Since 2011, the Government of Timor – Leste, has made it mandatory for every major business or major projects to have proper environmental study as the pre-requirement prior to the granting of the environmental permit to commence the construction. Decree law 5/2011- Environmental Licensing provides a technical guideline on how to exercise the constitution mandate in securing environmental permit to start development activities. According to this decree law, every major development should go through proper environmental impacts assessment (EIA) in order to get the environmental licensing prior to the commencement of the development to ensure that the impacts of the proposed development is identified and mitigation measures are proposed in order to minimize the environmental and social impacts. Knowing the negative impacts and proposed mitigation measures to the impacts of the project in the early project development is very important and is considered as a good initial investment to the project, as it would be more expensive to mitigate the impacts that were not identified prior to the project implementation. The guidelines for the formulation of required documents to prepare for environmental license have been developed through the Expert101 system that contains checklist and other necessary documents for the preparation of Project Document, Environmental Impact Statement (EIS) for category A projects and Simplified EIS for category B projects.

The following figure shows the regulation related to the environmental licensing in Timor – Leste

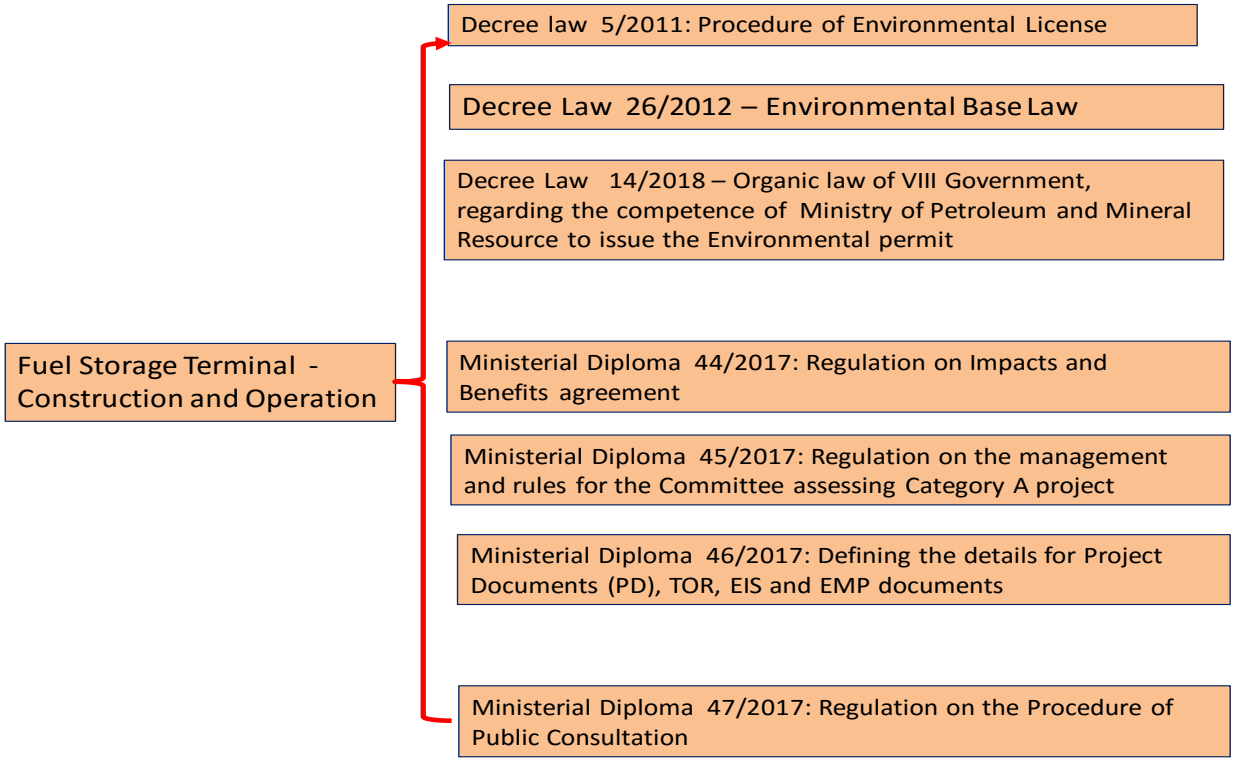


Figure. 5.4 Regulation Related to the Environmental License and Preparation of Related Document

More detail on the actualization of the environmental licensing law is presented in the section 5.6.

5.1.4 Crime against Environment

The penal code of Timor – Leste defined clearly, the crime against the certain article related to the environmental violation, including the type punishment applied to the project owner. The following table provides the detail information on the law

Table 5.1 Summary of Penal Code on the Crime against the Environment

Regulation	Summary	Relevancy
Penal Code-Section II	Crime Against the Environment, such as water, air, marine, and soil pollution: Article 215 – 218	Article 215: (1). Defined emission from private property to any receiving environment should not be greater than the natural assimilation capacity. If it is above the natural ability, then according this article, the institution can be sentenced 3 – years in prison or fined Article 216 Related to the pollution discharge and punishment that the company may get if violate any rule and regulation. The project owner must provide all the record to anytime, they can proof on the compliance to the environment. Article 217 The pollution that cause the damaged of flora and fauna can be punished with 3 years jail or fined. Article 218 Pollution from the project, that cause the loss or damaged of the endangered species will be punished or fine. Relevance of the project activities to these above mentioned articles would be related to the pollution emission to the marine waterbody, soil/groundwater and air emission that will cause the irreversible damaged of environment and affect people. The project owner is subject to fined or jailed if the pollution threshold will be greater than the maximum allowable that can be received by the specific environment (waterbody, marine water, soil, or air)

5.1.5 Land Owner and Territorial law

The land title is still a major issue in Timor – Leste and that contribute to the limited grow of private investment in the country. Although the National Parliament has already passed the land title for Timor – Leste in 2017, various adjustments will need to be made in order to fully implement the law smoothly in the territory of Timor – Leste. The following table summarizes the land ownership and any related spatial planning laws that should be taking into consideration in the planning and designing of any proposed development project.

Table 5.2 Land Title and Spatial Planning

Regulation	Summary	Relevancy
Law No. 1/2003 -	Law of land and property: Entire regime defines the land and property in rural and urban area and defines the public and private land. The land and property to represent the government in the land title identification	• The Foregin people can own the law but can rent the law for the purpose of bunsiess • Land that is not own by the private belong to the public • Land that has mineral owned by the public • Arrangement of land lease with the public land shall be done with the government directly
Law 3/2017 – land title in Timor - Leste	Proper compensation to the land owner and public interest	The project development in Lauhata will take 1.3 HA that was secured by the project owner through the long-term lease arrangement. The land title was arrange base on the existing law
Law 13/2017 - Special Regime on non-moveable properties	This law establishes the special regime for defining the ownership of real estate through the recognition and assignment of the first property rights over real estate	- Foreign citizen can not own the land - The current dispute of the existing parcel of the land to be used as future facility of the fuel storage of Global shall be solved with this law - Article 8 of law defined that 50 meter from the coast inland land parcel and the river bed belongs to the state. This means that Global Oil Storage to make a land lease arrangement to the government for the land parcel that belong to the government
Lei 6/2017 – 19 of Abril 2017 - Spatial Planning Law	The law defines the policy of spatial planning and utilization of space for public interest. There are two important matter related to the public space: - National level - Municipal level	The project is located in the Municipality of Liquica and required to follow proper legal framework according to the proper arrangement of national spatial plan and municipal level

5.1.6 Biodiversity and Protected Area

The objective of the laws of biodiversity and protected area is to protect the natural resources, especially the biodiversity and endangered species , as well as to reserve the area that consider as valuable resources to be protected in the specific zone due to uniqueness and specialties. During the planning stages, the identification proper regulation and protection of the biodiversity and protected area would be necessary to be done in order to properly design and map out the impacts of any project development to the biodiversity and protected land and nature. The following table summarized the relevant legal frameworks for the biodiversity and area of protection zone in Timor – Leste.

The following table provides the summary of the evolution of framework since the UNTAET administration.

Table 5.3: Summary of legal framework on Biodiversity and Protected Zones

Regulation	Summary	Relevancy
Decree Law 5/2016 on Protected Area	This decree law provides general guideline on the protected area in Timor –Leste. The most relevant article from the decree law, specifically to the project would be annex 1, the list of protected area in Timor – Leste, where the project owner should identify and conclude that the project location is not within any protected area, as stipulated in the decree law 5/2016	By law the any project development should identify the location and its relation of the projected zones. The protected zones and national parks are reviewed as presented in the section 6.2.5
Decree Law 6/2020 – 6 February 2020 - Legal Regime of Protection and conservation of biodiversity	Thus recently approved decree law provide the legal regime to proected and conserve the sustainability of biodiversity in Timor – Leste	The EIA has already incorporated the biodiversity into the study and assessment of the certain important biodiversity according the regulation should be considered. Article 26 -30 required the identification of protected zones that may become an ecosystem of various biodiversity specieis in Timor – Leste. Article 45 -46 stated that EIA of any project development should considered and assess the protected area and any biodiversity that may affect by the project development. In this document those concerns have already being elaborated
Decree law 26/2012 – Environment base law	Article 27 This article under this decree law provide the principle of biodiversity protection and state must take a led, including protection of endangered species, insitu protection, and national protected system to ensure the sustainability	Project owner to identify the any biodiversity species that consider endangred and required protection

Biodiversity strategic action plan – approved by Council of Ministry on 15 of February 2012	The document presents a framework for guiding approaches to biodiversity conservation and ecosystem management, and is addressed to district authorities and sub-district, civil society and the private sector. The National Biodiversity Strategy and Action Plan for Timor-Leste meets one of the objectives of the Convention on Biological Diversity, of which Timor-Leste is a signatory, and creates the foundation for the future ratification of the Protocol of Nagoya Access and Benefit Sharing of Genetic Resources	

5.1.7 Fisheries

Fishery is one of the important sectors that can contribute to the economic development of the country. The legal regime related to fishery can be summarized in the following table:

Table 5.4. Summary of Legal Framework of Fisheries in Timor – Leste

Regulation	Summary	Relevancy
Decree Law 5/2004 - General Regulation on Fishing	Provide the general guidance on the importance of fisheries and sustainable exploration and encourage to create the employment through the fishery industry	Fisheries industry could be enhancing by the proposed project development.
Law No.6/2004 on Legal	Basis for Management and Regulation of Fisheries and Aquaculture	Article 95 – The zones of Fisheries that will be regulated by the diploma ministerial. The northern coast is also indicated at the area of fisheries, and then pollution emission becomes an issue.
Decree Law 14/2004 – Offences of Fisheries	Provide the legal framework on the type and method of fishing activity that prohibited as they will damaged in fisheries industry and to protect aquatic environment and achieve sustainability in fishery	Pollutant contribute by the proposed project development will implicate the coral and marine fisheries habitat. Assessment on the fishery type in the project location and boundary is important to provide the baseline information for future monitoring program

5.1.8 Forestry

Forest is an important component of natural ecosystem that should be managed sustainably in supporting Timor – Leste economy. The legal regime on the Timor –Leste forestry including the management, proction and other function of the forest are presented in the following table.

Tabel. 5.5 Sumamry of Legal Regime of Forestry in Timor – Leste

Regulation	Summary	Relevancy
Law 14/2017 – Legal Regime of Forestry	This law provide a higher decree of forest protection and management in Timor – Leste	Mangrove forest along the coastline that will likely affected by the project in case the oil spill occur from the fuel storage system
Government Resolution 9/2007 - National Policy of Forestry sector	The National Development Plan emphasizes the importance of a sustainable approach to the development and management of national forest resources. It recognizes the importance of forests for their biological diversity and that the conservation of forests is a priority task in planning forest development.	Identification of existing forest in the project area, especially type of forest that is affected directly by the project development

5.1.9 Air Quality Guidelines

The regulation on the air quality protection from the pollution generated from various point and non-point source have not being established. The ambient air quality standard has being use widely to evaluate the air quality issue. In the absence of national standard and regulation, the international best practice shall be adopted. The following table presents the framework

Table 5.6 Summary of Policy Framework on Air Quality Protection

Regulation	Summary	Relevancy
World Health Organization (WHO) – 2006 – Air quality Guideline for PM 10	The standard ambient quality for Timor – Leste has not being established. Currently the WHO standard of water quality of ambient measured in term of the following parameters have been adopted: SO_2, NO2, PM, CO2, and Ozone	The project involve the storing and distribution of fossil fuel, which is the primary source of CO2 and other flue gases such as SO2, NO2, H2O, which will be emitted by the project (directly and indirectly)
IFC Performance Standard on Ambient air quality	Similar of WHO standard	The project involve the storing and distribution of fossil fuel, which is the primary source of CO2 and other flue gases such as SO2, NO2, H2O, which will be emitted by the project (directly and indirectly)

5.1.10 Labor Code and Immirgation (visa)

The labor code is very important and relevant to any project to be complied. Timor – Leste labor law and related regulation to be considered in the phase of planning in the project development is provided in the following table. Morover, the project owner would also tend to deployed more skills people from outside the country in order to transfer the knowledge and technical skill to Timorese. In this regards, there is also an immigration law related to visa policey that must be complied by the project owner or workers under the project development

Table 5.7 Summary of the Labor Code Relevancy and Visa Issue

Regulation	Summary	Relevancy
Law 4/2012 – labor code	It is the responsibility of the company, as the employer to provide good working environment to the workers, include any risk mitigation measures related to occupational health and safety, including the utilization of Personal Protective Equipment (PPE) to ensure the safety and minimize the risk. This law also regulate the responsibility of each parties (employee and employer) to be complied	The impact of OHS related to the fuel terminal operation is highlighted, especially to provide the PPE in each section of the operation
Decree law 5/2010 – Visa Granting	This Decree-Law shall impose restrictions on the issuance of visit visas and transit visas on arrival in Timor-Leste, taking into consideration the port of arrival and/or the nationality of the traveler.	When proposed project development involve any workers from foregin country should complay this regulation
Law 12/2016 – social security	This legal framework provide the social protection from the government and company to the worker and	The company must comply this regulation by contributing into the social security fund, 6% from the monthly salary
Decree law 17/2017 – Mechanicm to implement the social security law	This decree law provide the guidance on how to implement the law 12/2016 regarding the social security, especially the percentage of contribution from the company, workers, and in the long run, pension provided by the government	The company must comply this regulation by contributing into the social security fund, 6% from the monthly salary

5.1.11 Solid Waste Management

Solid waste management laws have not been established at national level that covers the Timor – Leste territory. However, it is important to regulate the solid waste management system in order to achieve the sustainable management of waste collection and disposal, which are important to ensure the good quality of environment to human health and other component of ecosystem.

Currently, the regulation has been established locally based on the need to respond to the existing problem. In Dili area, the solid waste has become an issue and therefore the government central established the resolution to help the relevant entity to manage well urban solid waste in Dili. Similar arrangement should also be applied to Liquica and other municipalities. Moreover, no provision has made regarding the hazardous solid waste that produced by the industry, which should be managed and regulated by best practice in the industry related. The following table provides a summary of this relevant solid waste management legal framework

Table 5.8 Summary of Legal Framework on Solid Waste Management

Regulation	Summary	Relevancy
Decree Law 2/2017 – Urban Solid waste Management System	The law on Urban Solid Waste Management System introduces the management of municipal solid waste for the purpose of promoting and ensuring cleanliness of municipal towns that will positively impact the well-being of its citizens while enabling an integrated, sustainable and socially inclusive management system. Decree Law No.2/2017 sets out nine principles for the management of urban solid waste, as follows: 1. Protection of public health and the environment; 2. Promotion of universality and equality of access; 3. Quality and continuity of service and protection of the interests of users; 4. Economic and financial sustainability of services; 5. User-payer principle; 6. Citizen responsibility, adopting preventive behavior in relation to production of waste, as well as practices facilitating the reuse, recycling or other forms of valuation; 7. Transparency in the provision of services; 8. Efficiency assurance and continuous improvement in utilization of affected resources, responding to the technical requirements and best environmental techniques available; Promoting economic and social solidarity, the correct planning of the territory and regional development	The proposed development project will produce solid waste that should be management through the proper collection, treatment, and disposal according to the existing legal framework. Section 5.1.9, presents further detail information on the solid waste produced by the proposed development projects and method to manage them during the operation of the project

5.1.12 Noise and Vibration

Noise and vibration regulation have not been established. Currently, the UNTAET regulation will be still enacted in the absence of national regulation.

Table 5.9 Summary of Legal Framework on Noise Issue

Regulation	Summary	Relevancy
UNTAET Guideline on Ambient Noise - 2002	During the UN administration in Timor Leste, UNATET adopted the guideline, which derived from best practice international to protect public from noise and vibration from various machineries in outdoor environment.	The background Noise and Vibration are measured by this study and mitigation measures were proposed as part of this document

5.1.13 Climate Change related

Climate change regulation issue was initiated globally as the nature of impact that is cross boundary from one country to the other. Timor – Leste, as part of the global community, particularly, a small island that should be prone to impact from global climate change, should be part of campaign in promoting the mitigation measures to minimize the climate change impacts. The following international framework, where Timor – Leste is also a member should be considered in the national policy such as in the infrastructure development, carbon credit, etc.

Table. 5.10 Summary of Relevant Framework and Legal Regime Related to Climate Change

Framework	Summary	Relevancy
UN Framework to combat global climate change in 1992 and Kyoto Protocol	Under this framework, the threshold of greenhouse gas emission to the atmospheric was established to limit the emission rate from industrialized country. Timor – Leste, is exempted from this and can get the carbon credit, as the greenhouse has contribution is very much below the threshold	The project locates in the coastal area and shall be impacted by the climate change such as sea level rise, rainfall pattern change (frequent flooding, etc.). this study consider the climate and impacts that should be considered and mitigated
Vienna Convention in 1993 for the protection of ozone layer and Montreal protocol	Under this framework, the ozone layer should be protected by controlling certain chemical, as part of a product/substance that cause the ozone depletion	As part of the study, the assessment shall be provide on utilization of chemical that affect the ozone depletion such as Freon and other chemical elements that induce the ozone layer

5.1.14 Soil Pollution

Soil pollution law does not exist at a moment in Timor – Leste. However, as many emerging businesses that could potentially contaminated the soil and eventually groundwater, the regulation should be established to control the contaminant transport to the soil. In the absence of national legal regime, an international best practice and legal regime should be adopted in order to ensure that the certain activity shall be mitigated properly its contaminant transport into the soil. The soil pollution shall be related to directly to the drinking water standard, as the pollutant will eventually pollute the groundwater body, where the groundwater shall be extracted for the water supply purposes. The penal code, as presented in the section 5.1.4, could be applied to the project owner the cause the soil pollution.

5.1.15 Water Resources and Drinking Water Quality

Water resource is the most valuable vital resource for human consumption that must be regulated in order to ensure enough quantity and good quality for consumption. The resource protection and delivering as part of public utility should be strengthening in Timor – Leste. However, at this stage, there are still gaps in regulation that need to be improved in the future. The following table shows the available legal framework related to the water consumption and some draft for the water resource protection.

Table 5.11 Summary of Legal Framework for Water Resource

Regulation	Summary	Relevancy
Decree law 4/2004 - Water Supply for Public Consumption	This decree law define the government intuitional (DNSAS) that responsible for water production and distribution for domestic consumption in urban and non-urban area	In line with this regulation, the project should comply this regulation by ensure that the community well in supplying water in each house is sustainable and no disturbance
Draft – Law on Water Resource Protection	DNCQA – is the proponent of this proposed law , to protect the groundwater resource and utilization	The Project will utilize the groundwater and will comply the law, especially the permit will be asked to the government once the law is enacted. The groundwater study shall be conducted in order to ensure the sustainability of groundwater resource in the aquifer
WHO – Drinking water quality Standard	Define various physical, chemical, and biological parameters related to health and human consumption	The study conduct water quality testing for water source that will be utilized by the project (boring well) and wells from the community
Ministerio da Saude – Timor Leste - Decre Law 31/2020 – 26 of August 2020	Formulation of standard drinking water quality paramters in Timor – Leste and defined the role and responsibility of government agencies to the enforcement of the law.	Project owner shall use the standard and guideline as baseline information to the treatment and purification required to the water well in the project location. The annex 1 of this regulation provide the threshold of water quality parameters for human consumption that should be used as an indicator to treat the raw water

5.1.16 Port and Fee

The port of entry of the proposed project development will use the existing jetty belong to Cement Timor. However, port or jetty should subject to any juridication apply in Timor – Leste, especially related to the safety and any applicable fee. The following table provides the summary of regal regime of Port authority and any associate fee, as well as minimum safety requirement that must be complied by vessel operator or project owner.

Table. 5.12 Summary of legal framework of Port and Associate fee and safety Requirement

Regulation	Summary	Relevancy
Decree Law 3/2003 – Port Authority	Provide general legal framework on the port authority in the territory of Timor – Leste and agency that responsible in the planning and exeution of the plan	Regualtory body that regulate navigation in Timor – Leste
Decree Law 19/2003 Port Fee and Charge	Legal basis to apply the fee and charge that need to be applied for any good and service to the government port facility in Timor – Leste	The propose development project will use the existing jetty belongs to Timor Leste Cement. The fee will be paid to Timor Cement SA and any tax due to the government will be paid by Timor Cement SA to the Government
Decree Law 4/2003 Minimu safety requirement for gargo	Decree-Law envisages establishing minimum safety and regulation requirements for cargo ships with a gross tonnage of less than 500 tons carrying out national and international maritime traffics from or to a port of Timor-Leste. The safety requirmement shall be verified by the Harbour Master	Minimum safety requirement that should aslo be complied by the cargo that come for loading and unloading of fuel in Lauhata - Proper navigation equipmemt - Approved and certified fire fighting equipment - Life saving equipment - Radio communication - Crew qualification and life safety - Identification of the ship/vessel

5.1.17 Road and Highway Code

Road and high code are also an important regulation to be considered in the project development, especially related to the transport load and maximum design load of the road infrastructure. The following table shows the summary of important regulation need to be taken into consideration in the project development.

Table. 5.13 Summary of legal framework of Road and Associate safety Requirement

Regulation	Summary	Relevancy
Decree Law 6/2003 – Highway Code	Legal framework on the road, traffic, and vehicles, including the traffic violation and punishment to ensure public and road safety order	To comply the regulation all the time, including the driveway in and out of the project area
Decree Law 2/2003 – Base Law on the Transport Sector	This decree law provide the legal framework for the road transport syste, including the reponsability of the government to plan, construct, operate and maintain road infrastructure in Timor – Leste territory	Private sector, shall comply in paying the tax, according the type of vehicle, use in the territory of Timor – Leste Section 5 -7 of this decree law provide the legal ground on the tax harmonization and transports rules that must be complied by the road user in Timor – Leste Section 18 of this decree law specifically regulated the heavy duty equipment that will pass by the national road that need the special lisence from the transport authority

5.1.18 Occupation Health and Safety (OHS)

Occupation health and safety are one of the important tools and framework to be adopted by the large operation of the facility to ensure that the sustainable operation of the proposed development project. In term of regulation and policy framework, it should be developed locally by each country and respective industry. However, some best practice in the industry, as guided by the IFC (International Finance Corporation), ILO (International Labor Organization), ISO (International Standard Organization), and US-OHSA (United States Occupational Health and Safety Administration) would be the most appropriate one to be adopted, as these agencies and guidelines have already developed many years ago and already validated in the best related industry.

Table 5.14 Policy and Guideline on OSH

Regulation	Summary	Relevancy
IFC	IFC guideline one the OHS, consist of general project activity and specific of OSH related work to the proposed development industry Moreover, the IFC also established 8 criteria of assessment standard that should be considered by the private and public sector in doing the business in the member county of the international	Major section of the EIS and EMP discuss about the OHS issue related to the project and how this proposed project shall adopted a specific part of the guideline in the project implementation

	community that ratified the convention	
ISO	ISO also has its own standard best practice concern related to environment, health, and safety	The project owner should develop its own standard operating system in relation to environment, health, and safety system by taking the reference from all the best international practice and the experience during the operation
Petroleum Related Industry Standard	Various petroleum related industry such as American Petroleum Society, etc has developed various safety standard that is most applicable to the proposed project development	The project owner shall develop its own safety standard based on various recommended references in the best industry practice. Annex 17 – Provide internal safery standard document that Global Oil Storage Terminal has prepared
Law 2/2010 - Timor – Leste National Security	High level legal framework on the national security protection in the land border, sea border, air and how to protect the national security from any event that put country in the risk and other disaster.	Artcile 10 of this law, spesifically define the civil protection aspect, including the fire fighter system in place to kill and manage the fire disaster

The above, list of guidelines are a general one, and specific to fuel terminal construction and operation have also been developed overtime. However, to be really fit in this specific project in given location and reality in Timor – Leste, the project owner must adopt the part and tailored into the local needs.

5.2 International Finance Corporation Performance Indicator

Timor – Leste, as a member of International community, should also complies with various legal and standard performance indicator that already ratified by members of the community. Beside the national legal framework, other international best practice of legal should also be adopted in substituting the absence of the national legal framework.

- Air emission quality Standard
- Noise and Vibration
- Marine water quality Standard (marine receiving water)
- Hazardous Material Standard and management

The legal framework for these above mentioned subject for Timor – Leste have not established. In absence of national legal regime, the international law shall be adopted. In addition to the above legal framework (national and international), the project development should also consider and compliance the other international standard best practice in order to the meet the objective of the environmental, health, safety, and social safeguard principles. Particularly, the IFC standard indicator could be considered, as

guideline in the development of the environmental and social impact assessment study and in the monitoring of the project implementation. The following

1. Environmental health and safety General Guidelines
2. EHS Guidelines for Ports, Harbor, and Fuel Terminal
3. Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Market
4. IFC Performance Standards.

The summary of these 8 IFC performance standards and relevant international guidelines that must be complied by the project is summarized in the following table.

Table 5.15: IFC standard Performance and Relevancy to the proposed project

No	IFC Performance	Relevancy to the existing proposed development project and this performance will be met by this project
1	Assessment and Management of Environmental and Social Risks and Impacts	The environmental and social impacts assessment will be conducted as part of the study in this project. All the relevant standard (environmental and social indicators) will be considered and follow in order to ensure the sustainability of the project within the environmental and social safeguard policy
2	Labor and working condition	The Plan and design of the system will considered a good working condition to ensure the safety of , construction and operation within the proper occupational health and safety (OHS) standard
3	Resource efficiency and pollution prevention	Resource efficiency should be considered
4	Community, Health, Safety and Security	Community health and safety related to the spill, fire, and major emergency situation should be considered and anticipated
5	Land acquisition and involuntary resettlement	Several houses should be relocated and compensate as, they are very close the project area and could be affected by the project, especially in case of emergency condition
6	Biodiversity conservation and Sustainable management of living natural resource	Marine ecosystem as a primary recipient of the pollutant if released by the project. Therefore, study and identification of biodiversity in marine aquatic environment will be major part of the study to provide comprehensive information of the status of marine environment as baseline information for future reference. The mitigation measure on managing the pollutant and prevention will be the key to help reduce the risk in order to achieve the sustainable operation and keep natural ability of ecosystem to recover from the pollutant
7	Indigenous people	Local people in Lauhata should be incorporate in the project development
8	Cultural Heritage	Aipelu prison preservation and impact to the proposed development project

5.3 Best Practice of International Standard

Furthermore, the proposed development is also has very high risk to fire and oil spill, therefore the best industry practice standard regulation would be considered in designing the system. The following standard of the designing the fuel storage and its' fire management plan shall be considered.

Table 5.16: Standard Practice of Industry to be considered

Design Component	Common Practice	Relevancy with the current Proposed development Project
Storage Tank Design and specification	API 650 and 620	Standard design and material selection for fuel storage system
Pump	API 610 and API 674, API 675, 676	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries; Positive Displacement Pumps – Reciprocating, Positive Displacement Pumps – Controlled Volume for Petroleum, Chemical and Gas Industry, Positive Displacement Pumps – Rotary
Venting	API 2000	Venting Atmospheric and Low-Pressure Storage Tanks
Recommended Practice for Classification of Location for Electrical Installation at Petroleum Facilities according the classification zones	API 505	Project owner the sheck the Classified as Class I, Zone 0, Zone 1, and Zone 2 into the existing project design and construction
Fire Management System	NFPA330	Standard Guideline to the fire safety concept of the flammable liquid storage
Electrical Installation code and standard	NFPA 70	This standard and document provide an overview of electrical code for the industrial business owner that approved by American National Standard. By follow this code it is hope that practical safeguard that protect people and property from electrical hazard can be minimize or eliminated
	NFPA 10	
Standard for low, medium, and high expansion foam	NFPA 11	This standard document cover the aspect of design, installation, operation, testing, and maintenance of low, medium, and high expansion foam system for fire protection to help minimize the fire hazard
	NFPA 12, 12 A	
Standard for the installation of Sprinkler system	NFPA 13	This document specified how to properly design and install a sprinkler system using the proper component and material whenever the project owner decide to use the sprinkler system
Fire standpipe and hose	NFPA 14	Standard for the Installation of Standpipe and Hose Systems
Fire water system	NFPA 15	Standard for Water Spray Fixed Systems for Fire Protection
Standard for installation of foam – water installation and foam –water	NFPA 16	This document provide standard for the installation of foam-water sprinkler and foam-water spry system, which outline the requirements for the design, installation, and

spry system		maintenance of the system for reliable fire protection system
Fire protection for chemical	NFPA 17	Standard for dry Chemical extinguishing system : This code and document provide the standard for dry chemical extinguishing system for the fire suppression system
Fire pump system design	NFPA 20	Standard for the Installation of Stationary Pumps for Fire Protection
Fire Liquid system design	NFPA 30	Flammable and Combustible Liquids Code
Fire protection in matine piers	NFPA 307	Standard for the Construction and Fire protection of the Marine Piers and Wharves.
Piping Standard Design and installation	API 570 or ASME B31.3	Over all guideline on the design and inspection of the piping system in the chemical plant and other industrial application
Construction Standards		
Flood Frequency Standard Design	River flow of minimum 50 –year of flood frequency should be considered	Storage facility locates adjacent to the river and prone to the riverine flooding. Therefore, design of retaining wall, floor level area must consider the higher frequency of rainfall design • Retaining wall • Crossing Bridge • Floor level

5.4 Relevant Institutional Aspects

There are several institutional aspects related to the implementation of Decree Law 5/2011 on Environmental Licensing that are relevant to the proposed development. The first one is institutions responsible for general environmental protection (marine, coastal and terrestrial). The second one is institution responsible to regulate and monitor downstream petroleum industry including large scale fuel storage. The third one is institutions responsible for the protection of public health and safety. These institutions are identified in the following table.

Table 5.17 Government Responsibility and Relevant Institutions

No	Responsibility	Relevant Institutes
1	Environment and Nature Protection (Terrestrial)	Ministry of Commerce and Environment (MCIA)
		Ministry of Agriculture and Fisheries (MAF)
2	Marine and Coastal Environment	Ministry of Agriculture and Fisheries (MAF)
3	Water and Sanitation System , Power and energy consumption	Ministry of Public Works - Water and Sanitation
4	Public Health and Safety	Ministry of Health
		National Directorate for Civil Protection
5	Worker Health and Safety	State Secretary for Professional Training (SEPFOPE – Portuguese Acronym)
6	Oil and Gas industry	Ministry of Petroleum and Mineral Resources – ANPM

5.5 Procedure of the License of Installation and Operation of Fuel Storage System

Decree – Law 1/2012 on February 1, 2012, has mandated the National Petroleum and Mineral Authority (ANPM) to approve the technical requirement, including the principles and conditions to be complied in the installation and operation of the Fuel Storage Facility in Timor – Leste.

To exercise the above mention mandate, the ANPM approve the ANPM regulation, no. 1/2016, which defined the technical criteria and requirement that must be followed by the project proponent who wish to install and operate the fuel storage system in Timor – Leste, including the existing facility. According this regulation, there are two stages of approvals required prior to granting the license for the installation and operation of fuel storage system.

- Approval of Project Location
- Approval of Project

There are minimum requirement that must fulfilled by the project proponent in order to get the approval of the project location, include securing the environmental license, soil boring testing report and proof of flooding free zone of the propose project location. All these pre-required information should ensure that the proposed location of the project is technically feasible and environmentally sustainable. Prior to granting the license, the project proponent will submit the detail engineering design of the whole facility (fuel storage and other supporting) to the ANPM for the review and comment prior to the approval. Based on the approval of the technical detail in the DED, the ANPM shall issue the license to the project proponent to commence the project.

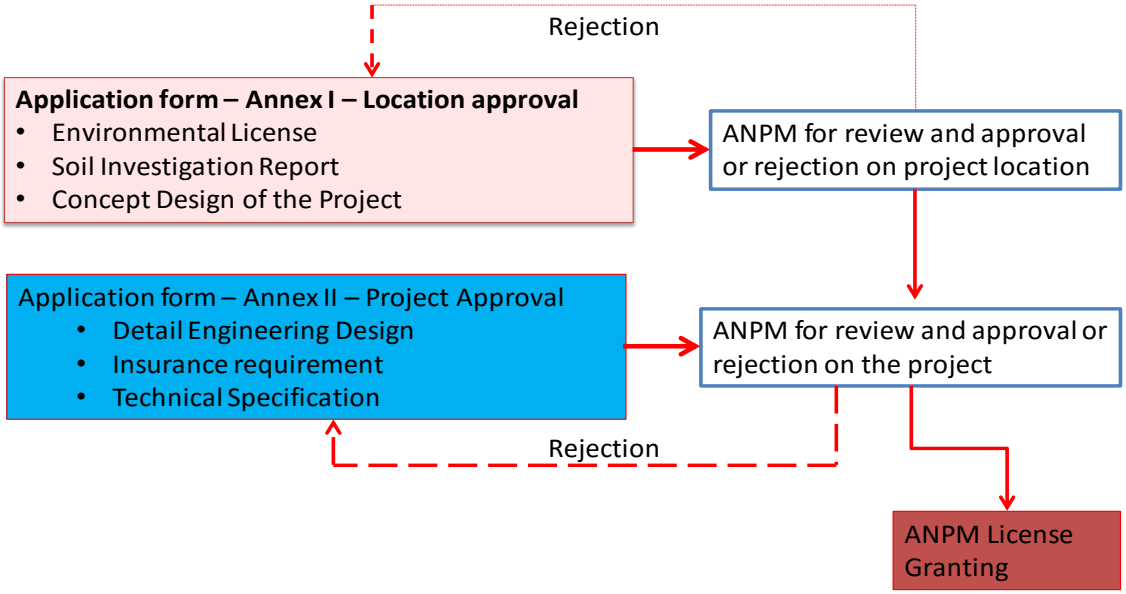


Figure 5.5. Procedure of License Granting for the Installation and Operation of Fuel Storage System in Timor – Leste

The role of government as the regulatory agency is to ensure that all these existing policies and regulations have been rigorously follow or complied in the design and construction of the proposed facility to ensure the sustainable operation without jeopardizing the quality of the environment.

5.6 Procedure of Environmental License

The decree law 5/2011 provide a specific guideline on how to issue environmental license and urge to follow several steps in order to ensure a duly implemented classification, review and monitoring of the environmental impacts. These steps include screening, scoping, preparation of an EIS/Simplified EIS and monitoring of the implementation of Environmental Management Plans (EMPs) contained in the EIS/SEIS. The process for issuance of environmental permit according to Decree-Law No 5/2011 is shown in the figure below.

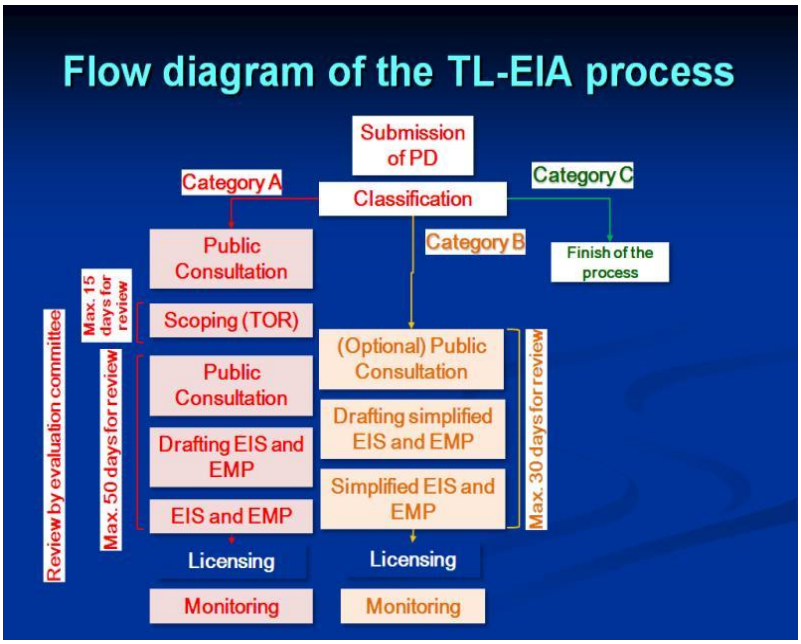


Figure 5.6. Processes for Issuance of Environmental Permit

Complementary regulation of the environmental licensing law is the Organic Government of the VIII Constitutional, which provide competent to the Ministry of Petroleum and Mineral to overseeing the environmental license for the area related to the petroleum and mineral.

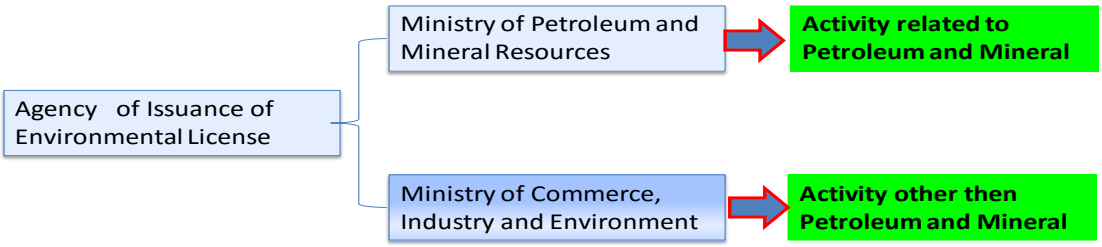


Figure. 5.7 Complementary Regulation of Environmental Licensing Agency in Timor - Leste

The environmental licensing process starts with screening of the project based on project document (PD) and application form submitted by the project proponent. The result from screening is a classification of projects into either Category A, B or C (No EIA required). For Category A projects, screening is followed by scoping, where project coverage is defined. Opinion on the environmental scope of the project is issued by ANPM within 15 days of the receipt of the project documentation such as application form, project document, and any feasibility assessment document. For Category B projects, no scoping is required and project proponents can proceed to preparing the SEIS.

EIS for category A or SEIS for category B as well as the application document is then prepared by project proponent and submitted to ANPM for reviewing. Upon duly submission of all required documentation, technical review process commenced. As shown in Figure 2.1, Category A projects are required to go

through lengthier review process through the formation of an evaluation committee and conduct of public consultation. The evaluation committee usually consists of representatives from several relevant entities.

The evaluation committee has a duty to carry out technical evaluation of the document, review public input and recommend the approval or denial of application for environmental permit. Public consultation has to be conducted starting 10 days after the formation of the evaluation committee. The public is given 24 days to submit comments, recommendations or proposals on the EIS and EMP.

To complete technical evaluation and decide on the recommendation for approval or denial of the project, the Evaluation Committee has 50 days, counted from 5 days after the formation of the Evaluation Committee. During the review period, the Evaluation Committee may request additional information from project proponent, local communities where the project is going to take place or government agencies that have interest on the project. The 50 days allowance to come to decision is suspended until all required information is received. The Environmental License Law also allows 10 days for review of additional information submitted by proponent.

After the technical review, the Evaluation Committee will write a report that contains recommendation for approval or denial of the application. The report is then submitted to the Superior Environmental Authority that will issue final approval. Environmental permit should be released within 15 days from the time the Evaluation Committee report is received. When an application is not approved, the proponent will be notified of the decision. Decree Law No. 5/2011 makes provision for an Impact Benefit Agreement between project proponent and local communities affected by the development. Negotiation for Impact Benefit Agreement can start at the time the approval for environmental permit is published.

For Category B projects, after an SEIS which contains and EMP and the application are submitted, the Environmental Authority has 30 days to complete technical evaluation of the application. Similar to the EIS process, the Environmental Authority may ask for additional information from project proponent, affected communities or government agencies with interest on the project. The 30 days period will be suspended until all required information is submitted. The Environmental Authority has 10 days to review additional information and may require a public consultation be conducted on the project.

Once the evaluation is completed, the Environmental Authority then submits to the Superior Environmental Authority the approval or denial recommendation. The Superior Environmental Authority, within 10 days of receipt of the evaluation, shall then issue an order for issuance of environmental permit.

For projects that do not require preparation of an EIS/SEIS (Category C projects), the Environmental Authority would recommend that the projects implement certain measures to protect the environment and maintain an environmental management plan.

The Decree Law No.5/2011 categorizes projects according to the potential impacts to the environment. There are three categories of projects:

1. Category A – to include projects that potentially cause significant environmental impacts. These projects are subject to Environmental Impact Statement (EIS) developed based on Impact Analysis and Environmental Management Plan (EMP) in accordance with the Decree Law No. 5/2011.

2. Category B – to include projects that potentially cause environmental impacts and are subject to the procedure of Simplified Environmental Impact Statement (SEIS) developed based on the EMP in accordance with the Decree Law No. 5/2011.
3. Category C – to include projects where environmental impacts are negligible or nonexistent and not subject to any procedure for Environmental Assessment in accordance with Decree Law No.5/2011.

Annexes I & II of Decree Law No.5/2011 spelled out in more detail the type and scale of projects within mining, oil, energy, general industry, transport, civil, water, sanitation, agriculture, tourism and defense sectors that belong to Category A and B projects. It also makes stipulations that those developments that happen within environmentally, socially and geographically sensitive areas should fall under Category A projects.

Further detail of the above regulations have been strengthening by the government diploma to regulate the technical procedure on how to carry out the study, forming the evaluation committee, benefit-offset agreement, and mechanism how to the conduct the public and community consultation. The following table presents the summary of diploma ministerial that the government has already approved in 2017.

Table 5.18 Diploma Ministerial on the Guidelines for the Implementation of Decree Law No. 5/2011

Type Diploma and Responsible Ministry	Content of the Diploma Ministerial
Diploma Ministerial no. 44/2017 under the Ministry of Commerce, Tourism, Industry, and Environment	Regulation on Impacts and Benefits; covering the process for agreement between the project Proponent and the local community regarding the advantages and disadvantages of the project
Diploma Ministerial no. 45/2017 under the Ministry of Commerce, Tourism, Industry, and Environment	Regulation on the management of and the rules for the Committee assessing Category A projects
Diploma Ministerial no. 46/2017 under the Ministry of Commerce, Tourism, Industry, and Environment	Defining the details for Project Documents (PD), TOR, EIS and EMP documents, as stated in Annexes 1, 3, 4 and 5 respectively.
Diploma Ministerial no. 47/2017 under the Ministry of Commerce, Tourism, Industry, and Environment	Regulation on public consultation Procedures and requirements during an environmental assessment process.

This EMP report has been prepared by using the latest guideline and policy as presented, especially the diploma ministerial no 46/2017, regarding the table of content of the report of EIS and EMP that have strictly followed by this report.

6 DESCRIPTION OF THE ENVIRONMENT

The description of existing environment, which include the most relevant bio-physical, socio-economic, ecological, and cultural components are very important to provide sufficient baseline information, which may be useful for the proposed project development and implementation, especially designing and implementation of the system to operate efficiently. Moreover, the baseline existing environmental characteristics could be useful information for regulatory agency for better monitor of the effective implementation of the project. The following figure, describe the relevance of the reviewing and analysis of the description of existing environment and relation to the type of impacts and mitigation measured in the project development.

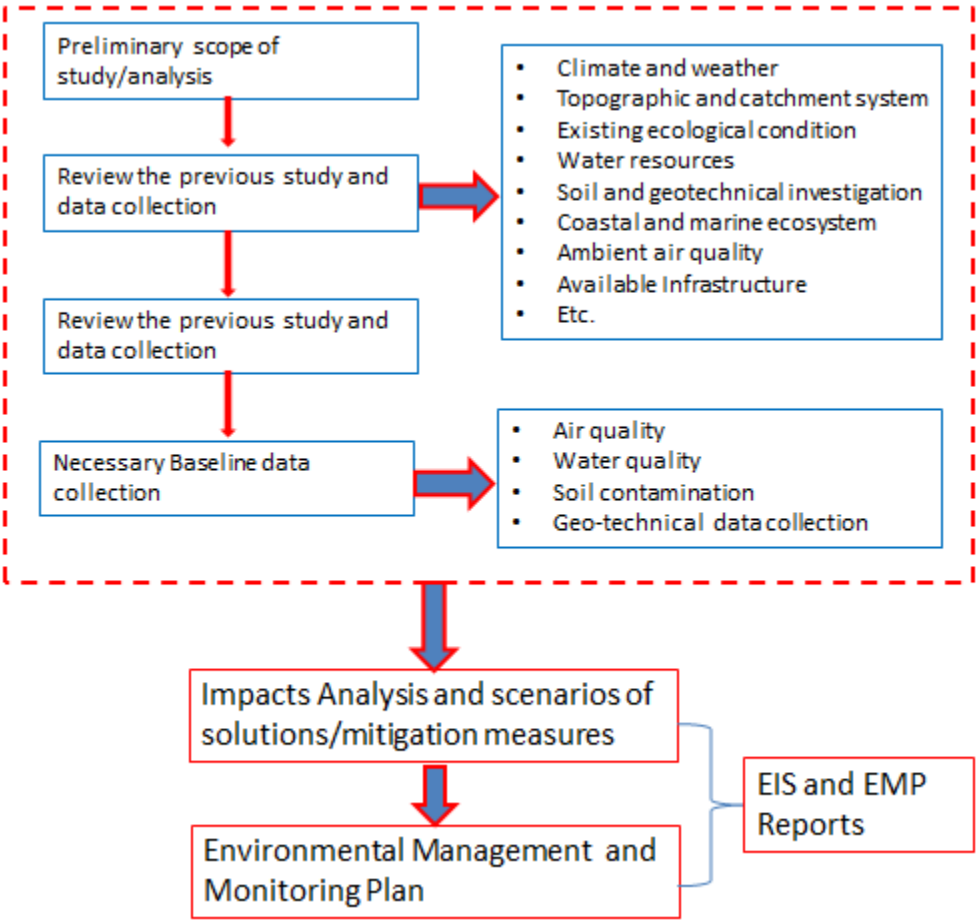


Figure 6.1. Methodology of the Preparation of EIS/EMP and Existing Environment Factor

The following information provide the review of existing environment based on the available information, which relevant to the nature of the project, type of impact, and location of the project.

6.1 Baseline Information on Physical Components

Understanding of the physical component of the existing baseline information would be necessary, particularly, the quantity of the physical parameters that could be useful in design and construction of the proposed development facility in order to minimize certain impacts of the environment during the operation of the project. For example, quantity measured of the climate parameters such as rainfall, temperature, humidity, could be useful in the designing the storage facilities or supporting facility to have minimum impact in the future. Other important physical component of the environment consists of topographic, water resources, air quality, geology and soil, which are important information in the project development (design construction, and operation). Although, the data collection of this mentioned information is limited in Timor – Leste, the regional study such as nearby location will be described and presented in this study. The following review was based on the available data was collected from the relevant governmental agencies.

6.1.1 Climate

Clear understanding of the climate condition is very important for any kinds of project development. Not only, because, certain design part of the facility may need climate data/information, but also by having the clear understanding of local climate, certain risk related to climate could be minimized by mitigating them. The climate information, particularly, in Timor – Leste, is still limited in space and time frame of data collection. Consequently, often time, the regional climate information could be adopted as an important reference to help better design of the system. The following information is the common climate parameters that usually collected in the established climate station.

- Rainfall
- Wind Speed
- Evaporation/evapo-transpiration
- Solar radiation
- Temperature

The historical data availability and how the data could be relevant or useful to the development of the project will be presented in the following sub-sections. The following table provides the summary of extreme climate parameters value within the project area (Liquica area)

Table. 6.1 Summary of Extreme Climate parameter value (Analysis Done by SoL, 2012)

Extremes

Highest Daily Rain (mm)	Highest Temp (C)	Lowest Temp (C)	RH Max(%) Min	RH Min(%)	Solar Radiation (MJ/m2/d)	Wind Speed(m/s)	Highest Gust Max(m/s)	Highest Eto (mm)
138.4	35.1	13.1	100.0	27.3	24.7	1.9	13.6	5.2

This extreme historical record should provide general perspective on the extreme should be used as consideration in the design of any system that related to the climate parameters. For instance the design of the maximum daily rainfall would be roughly around 140 mm, when no other historical record is available to be used as benchmark value.

6.1.1.1 Historical data of Climate

Climate data collection in Timor – Leste only started during the Portuguese administration, where, the observation point in each Postu Administration was established. The data collection however, only covered the rainfall data. The following map shows the points of rainfall data collection, which covered the entire territory of Timor –Leste. The data collection started since 1900 to 1970s or with the record at least 20- years of data.

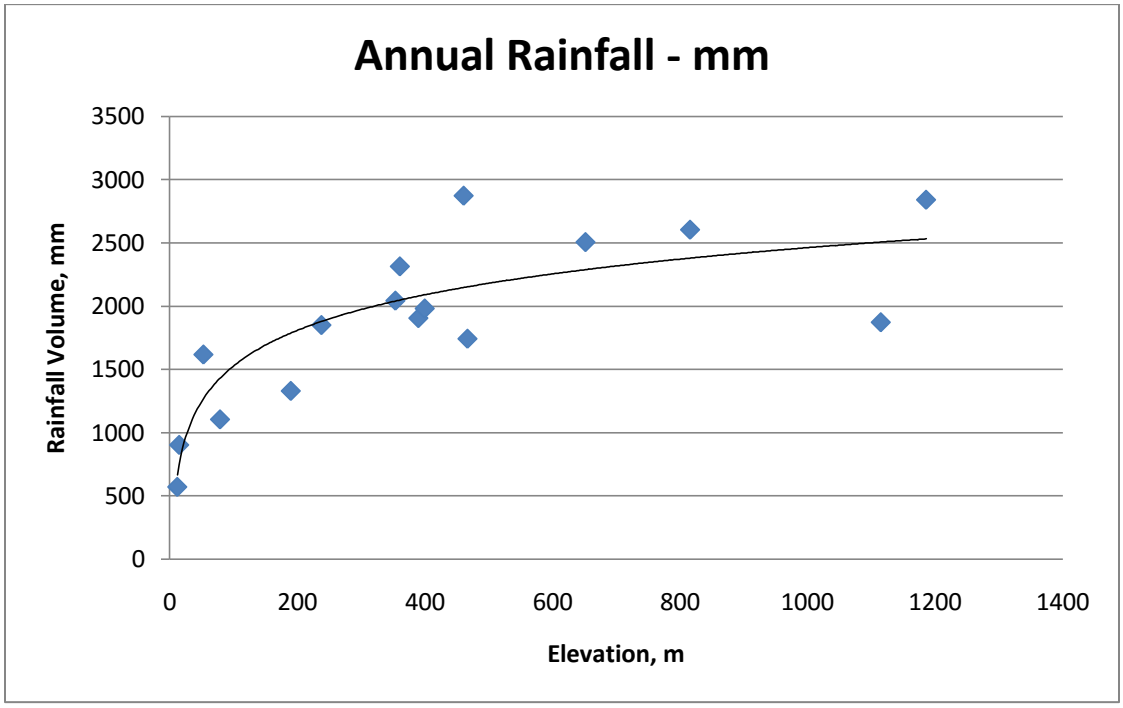


Figure 6.2. Annual Average of Rainfall data (Portuguese Administration)

Table 6.2 Summary of Annual Rainfall Record, mm

Elevation	y	x	Location	P, mm
12	-8.517	126.017	Manatuto	570
15	-8.583	125.583	Dili	902
53	-8.867	126.367	Viqueque	1617
79	-9.2	124.383	Okussi	1104

190	-9.15	125.45	Zumalai	1329.045
238	-8.78	126.567	Uto Lari	1850
354	-8.71	126.828	Ilomar	2043
361	-8.627	126.66	Baaguia	2314
390	-8.52	127	Lospalos	1905
400	-9	125.767	Alas	1981
461	-9.005	125.65	Same	2873
467	-8.595	125.567	Dare	1742
652	-8.86	125.941	Soibada	2506
816	9	125.5	Ainaro	2604
1115	-8.73	126.367	Ossu	1872
1186	-8.755	125.328	Fatu Bessi	2841

As the data collection was done manually, they only recorded monthly rainfall volume, which could be useful for certain application, such as regional one. The annual average of rainfall volume from each station was used to derive the annual average rainfall map for the entire country, which should be useful tool to estimate the rainfall design for certain places. The average monthly rainfall volume for the station near project location, Liquica, as presented in the following figure, suggested that wet season, started from November to May or Seven months, while dry season, would only last for five months.

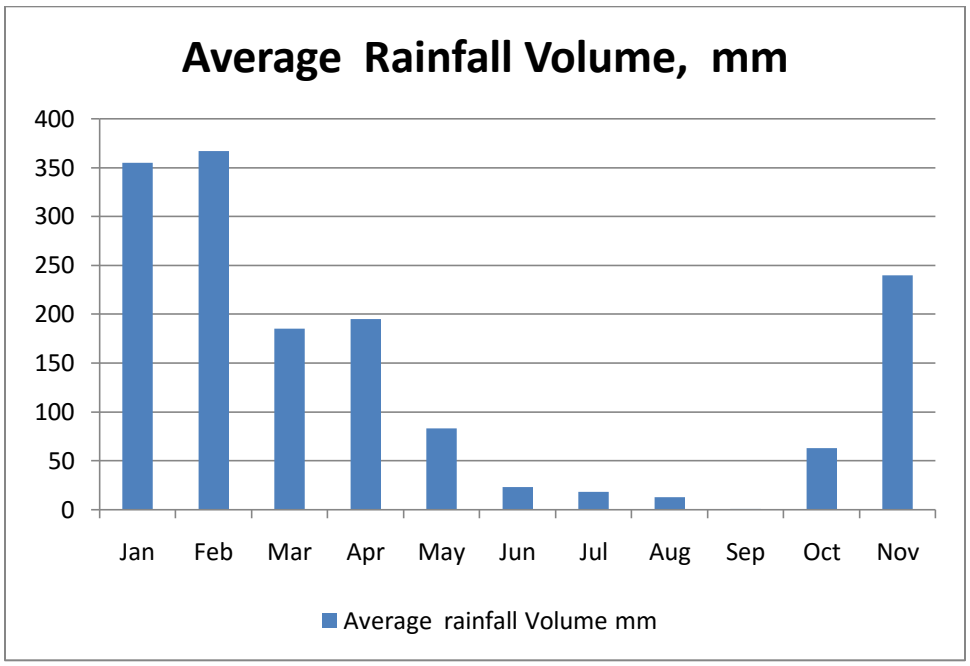


Figure. 6.3 Monthly Average Rainfall in Liquica Area

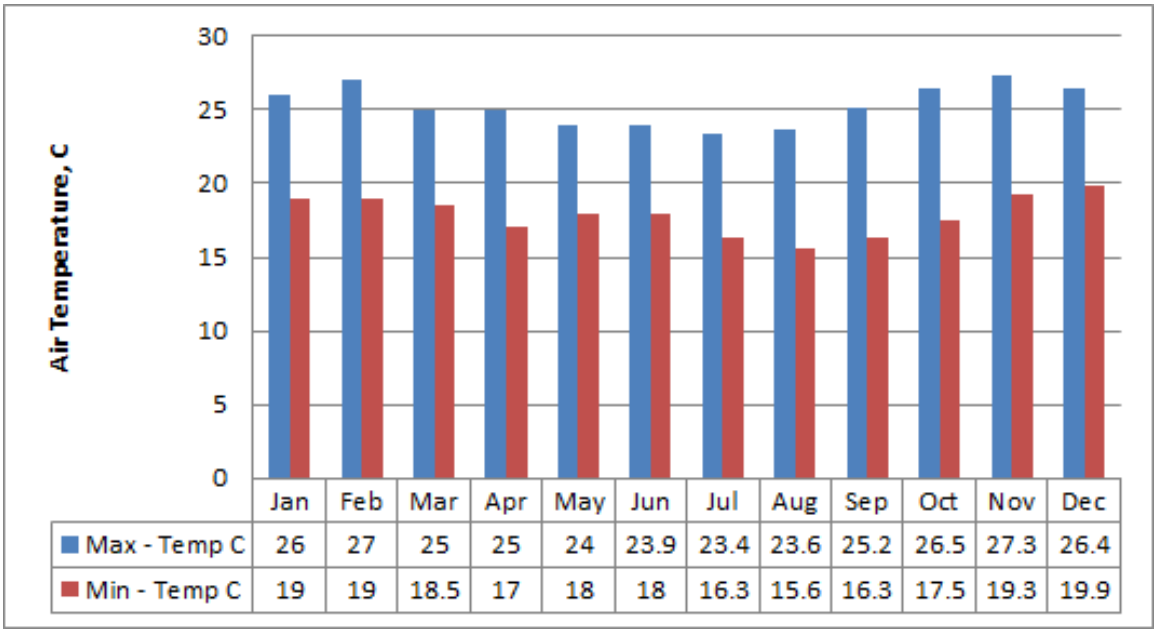
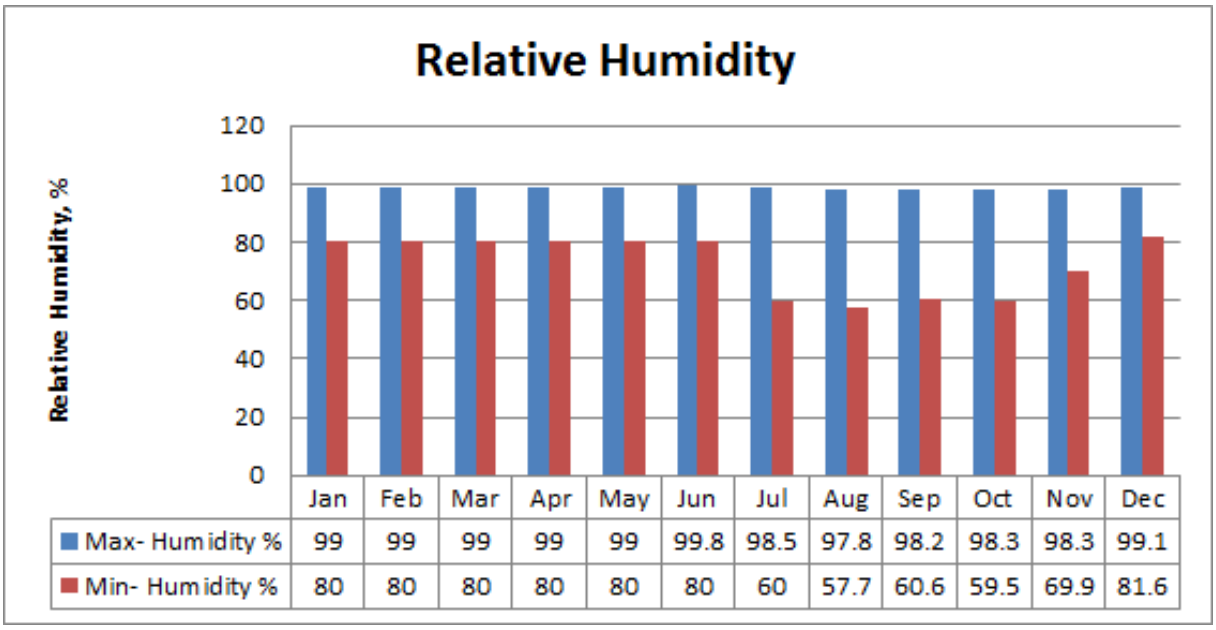


Figure 6.4. Maximum and Minimum Temperature Data



The development is going to be located on the coastal area, which is relatively flat and could be prone to both flooding from coastal surge and storm runoff. Particularly, the location of the project is next to the river bed. Though, the river is dry most of the time throughout the year, it is possible, that few rainfall event could produce high runoff rate/flood that could become an issue. Rainfall pattern in Timor-Leste is a seasonal dry tropical climate characterized by warm temperature and several months of dry period each

year. During the Indonesian administration, the data collection was improved to be more digital recording and in smaller time distribution, such as daily, time interval, in some location.

Figure 6.5. Map of Auto-weather system

Summary of the monthly historical climate data is presented in the following table

Table 6.3: Monthly Average Historical Climate Parameters in Liquica

Month	Average rainfall Volume mm	Max - Temp C	Min - Temp C	Max- Humidity %	Min- Humidity %	Radiation MJ/m2/d	Wind Speed m/s	Max - wind m/s	ETO mm
January	355	26	19	99	80	13	0.2	4.5	2.9
February	367	27	19	99	80	12	0.3	4	2.9
March	185	25	18.5	99	80	12	0.4	3.3	2.8
April	195	25	17	99	80	12	0.4	4	2.7
May	83	24	18	99	80	11	0.4	5	3
June	23	23.9	18	99.8	80	10.5	0.4	5.8	3.8
July	18	23.4	16.3	98.5	60	13.2	0.4	6.3	4.7
August	13	23.6	15.6	97.8	57.7	17.2	0.4	5.9	3.2
September	1	25.2	16.3	98.2	60.6	17.3	0.4	6.4	3.6
October	63	26.5	17.5	98.3	59.5	16.4	0.4	5.6	3.4
November	240	27.3	19.3	98.3	69.9	17.1	0.4	5.7	3.6
December	292	26.4	19.9	99.1	81.6	13.7	0.4	4.4	2.9

Recently, Government of Timor – Leste through various international collaborations, has established various automatic climate and weather data collection system, collecting the complete data sets of climate information as described earlier. The data shall be useful for various design and development of the system. The following figures presented the daily interval of climate data collected in the Bazartete, which is the upland catchment of project location.

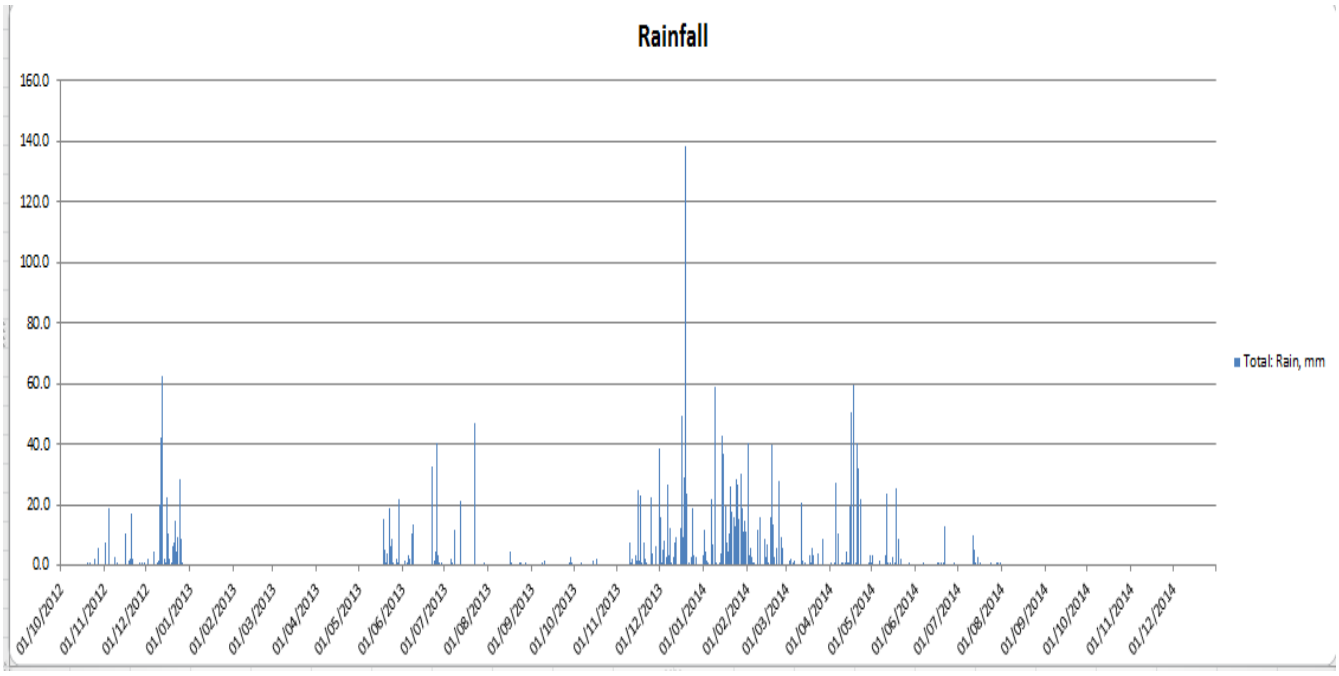
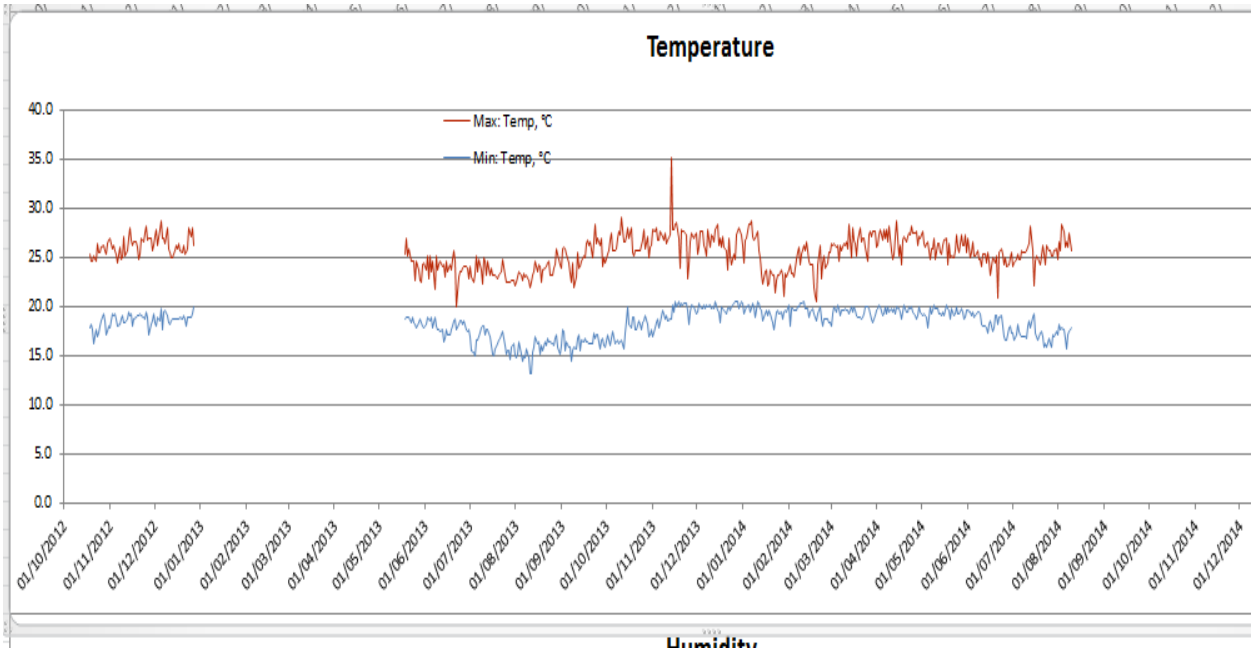


Figure 6.6. Total Record of Daily Rainfall Volume in Bazartete

The recorded daily rainfall volume suggested that the volume of daily rainfall can be large or equivalent to monthly rainfall volume, which can cause a dangerous flooding. This data indicates that total monthly volume of the rainfall composed by the only a few days of rain in the given month. This rainfall information should be useful for the design the hydraulic structure or any water infrastructure, such as drainage, waterways, river protection, and landscape design.

Other important climate data that need to be considered in the investigation and design of the system is temperature, which also has been collected.

Figure 6.7. Daily Temperature Record in Bazartete



Timor Leste's temperatures vary considerably according to altitude with northern coastal areas typically registering the highest temperature. The northern areas of the county from the coast to 600 m elevation have an approximate annual average temperature of 24°C. The project is located in areas between Dili and Liquica is noted as having average daily temperatures above 27°C (see Figure 9).

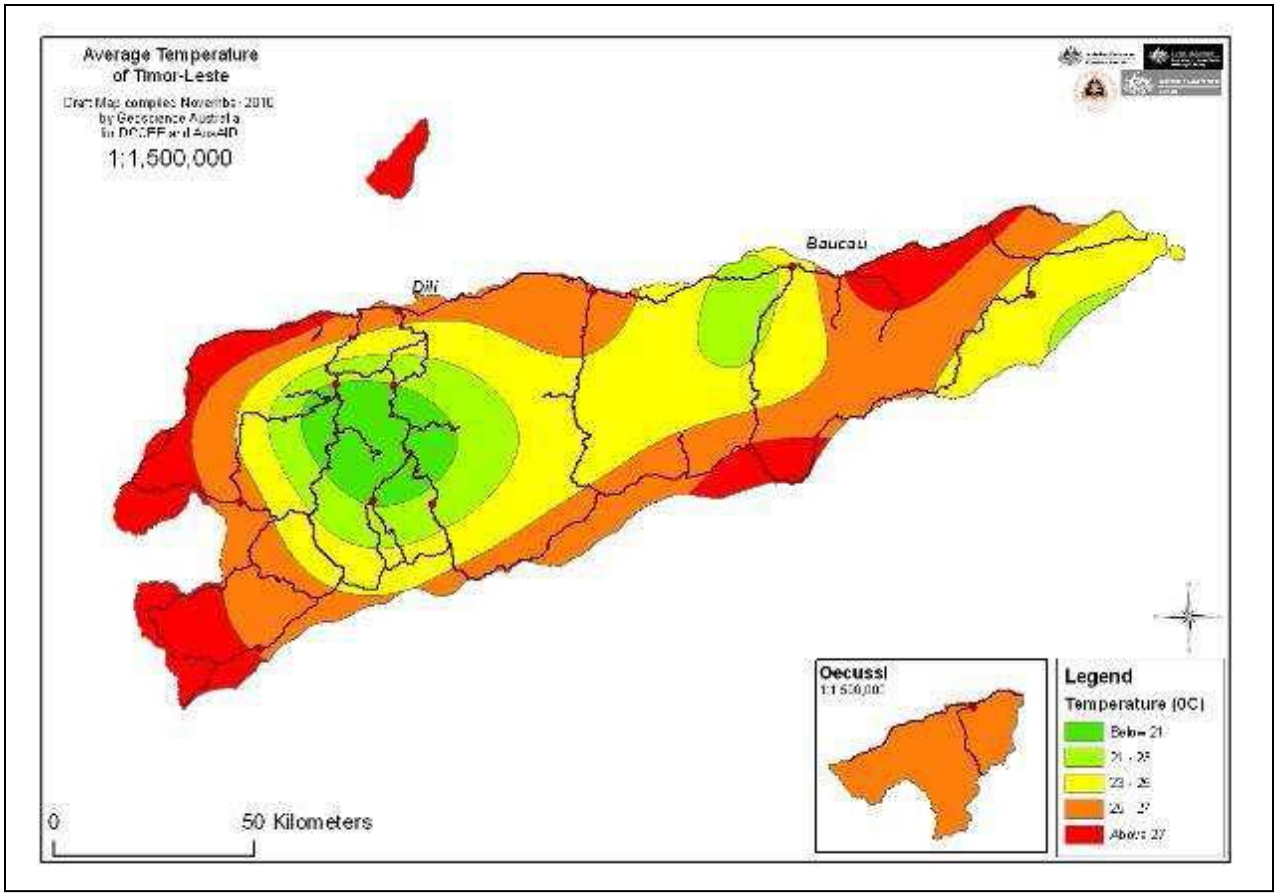


Figure 6.8 Average Daily Temperature Timor Leste: Source: Agriculture and Land-Use Geographic Information System Project, 2007.

Wind speed in the country is typically mild between 8 and 12 km/hr. Elevated wind speed happened between June and July each year.

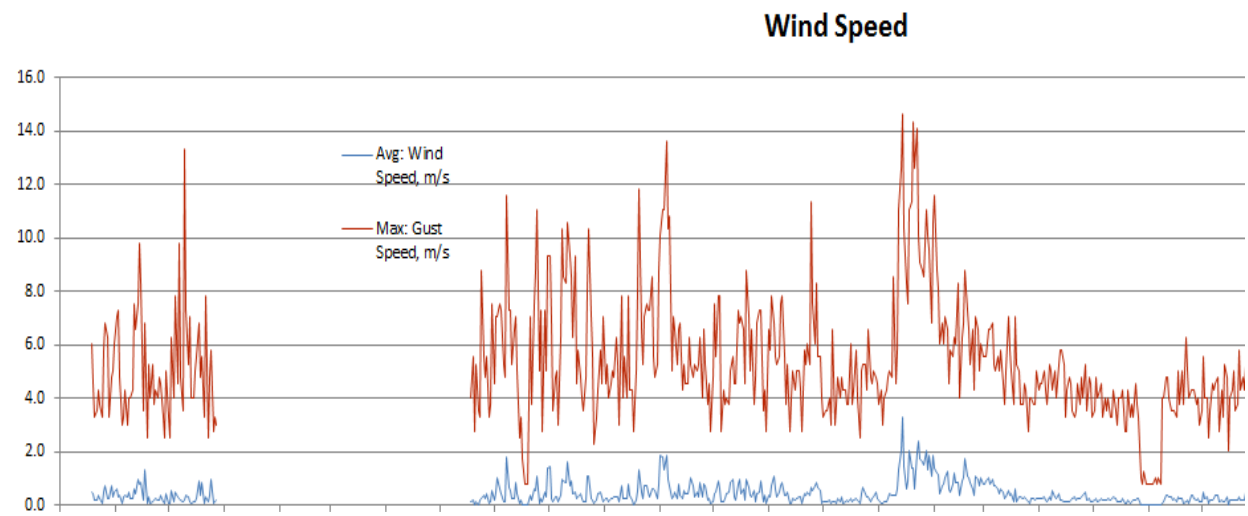
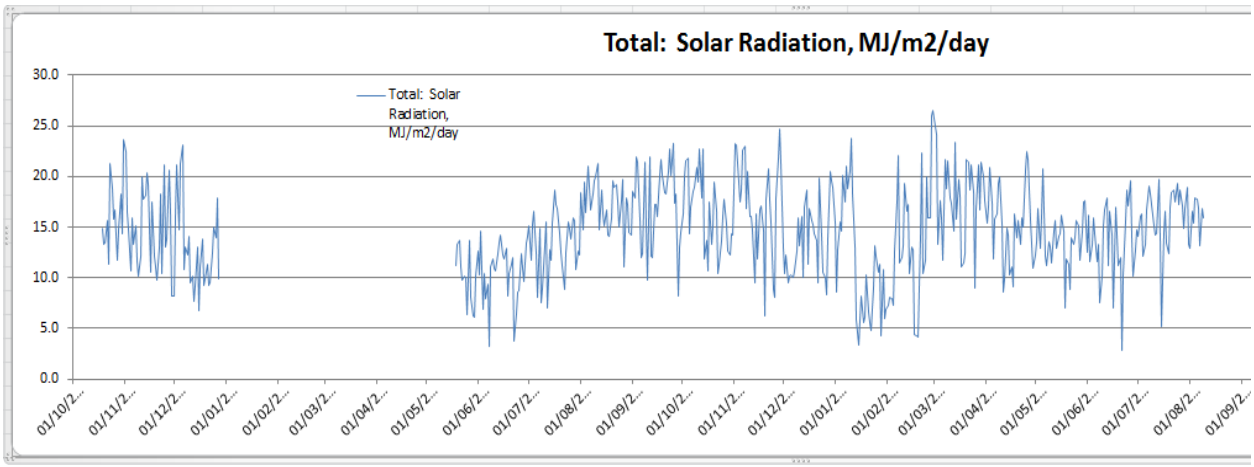


Figure 6.9. Average Monthly Wind Speed

Other climate factor such as solar radiation and evaporation rates could also an issue to be considered in design the system to be resilience during the operation of the facility. However, these parameters are mainly constant throughout the year and the impact to propose development facility could be considered minor.

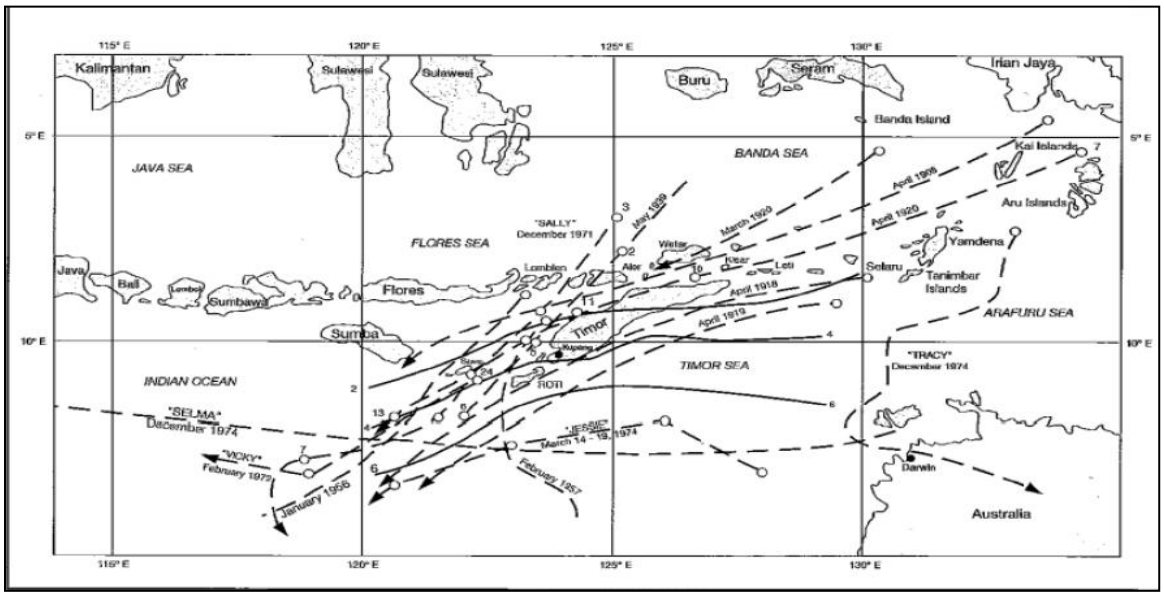
Figure. 6.10 Solar Radiation Data Collected in Bazartete



The data and information of climate related will be used by this study in estimating some of the engineering parameters to design the system. Another important climatic parameter especially for development in the coastal area is the occurrence of tropical storms or tropical cyclones. Tropical storms bring heavy rain and strong winds and may be harmful to infrastructure and other development along the coast and near coast areas. Timor Leste belongs to the Banda – Sawu Region where tropical cyclones may occur during April to May and move southwest (Figure 5.3). Previous study by Kirono (2010) noted that the mean occurrence of tropical cyclone over Timor Leste region is around 0.2 per year essentially means that there is two out of ten chances that heavy rain and strong winds occur in the country in any given

year. Timor Leste, however, according to record, has experienced few or no tropical cyclones at all since 1970[1]. Findings from records taken by Timor Leste Agriculture and Land Use Geographic Information System (ALGIS) also noted that at least from the period since 2004 to the present time, no major strong winds has occurred in the country.

Figure 6. 11 Occurrences of Tropical Cyclones in the Past over Timor-Leste



Source: Crippen International, cited in Kirono 2010

6.1.1.2 Climate/Rainfall Design

As described earlier that the climate and weather information can be useful, particularly to proper design of a system/facility that resilience to the climate. The climate information that is useful in the design of the proposed development facility, are rainfall, wind speed, temperature, and solar radiation. As the historical record, in time and space variation is not existing in the project location, the regional approach shall be used, which means that the record from other places, such as in Dili, which has better time history of data can be valuable. The rainfall design is the single most important, climate parameters that will to be taken in order to design properly the supporting facility of the project. Other climate parameters such as temperature, solar radiation, and evaporation, could be assumed to have similar value elsewhere, as the parameters, may not be sensitive to the propose development project. However, the rainfall occurs in the mountain area could also affect the project, as the project is located next to the river bed, where the runoff from the mountain shall be discharged into the marine water as the receiving water body. The daily rainfall volume however, sometime could really high, which shows potential flashflood could occur in the project location. The table shows some of the daily

[1] State of the Coral Reefs of Timor Leste Coral Triangle Marine Resources: Their Status, Economies and Management, 2012.

rainfall record that collected in the upper reach of the catchment area, near the Fazenda at Bazartete.

Table 6.4: Daily Rainfall Volume recorded at Upland Catchment System

Data	12/12/2012	25/06/2013	22/07/2013	19/12/2013	09/01/2014	17/04/2014	31/12/2014	23/01/2015	28/01/2015	14/02/2015	17/04/2015
Volume, mm	62.4	40.4	47.2	138.4	58.8	59.2	52.8	79.6	100.4	86.6	61.0

The daily rainfall volume over the monthly rainfall data suggested that the monthly rainfall amount would contribute by a few rainfall events only. This means that the daily rainfall event could produce very large amount of rain water that could potentially produce riverine flooding. The existing river that mainly dries a yearlong is also an indication of the rainfall characteristics.

Compare to similar region such as Dili, which is also coastal town with similar elevation range, the rainfall volume in Liquica is higher by 50%, which can used as an indication for designing the rainfall for flood analysis by this study. The following table shows the comparison of annual average rainfall volume in adjacent areas of Liquica.

Table 2.1 Annual Average Rainfalls of Various Station adjacent to Dili (Ministry of Infrastructure, 2010)

Table 6.5: Summary of Annual Average Rainfall Comparison

Station	Annual Average Rainfall (P), mm
Dili	940
Dare	1530
Ermera	1765
Liquica	1383

This data indicated that roughly the rainfall design in Liquica area would around 1.5 times higher than in Dili. For Dili, the IDF curve was developed as part of the drainage master plan, of drainage design, which could be adopted in the flood flow estimation by this study. Note that, the better way should involve in the field measurement of the rainfall data but it normally takes many years to have the data and eventually develop the IDF curve. For this purpose, the rainfall design for Dili is used by this study with the factor of 1.5 and it is probably very conservative estimation.

Maximum daily rainfall data recorded at Dili airport station were used to update IDF curves developed by earlier efforts in 1994 and 2003 (The Government of Indonesia, 1994; GHD, 2003). Although available rainfall record is in fairly short period (23 years), the data were used in the development of IDF curves because it is deemed a better starting point rather than adopting available IDF curves from other places. IDF curves adopted from other places may be more reliable because they were developed from long historical data with high temporal resolution. However, the curve may not reflect the actual condition of Dili drainage system. Another factor that was taken into consideration when using available local data was that showing how the data were utilized and how they should be improved will send a positive reinforcement to local authorities collecting the data and encourage them to improve data collection in the future.

Historical rainfall data collected in Dili airport between 1977 and 2010 were used to develop IDF curve for Dili drainage master plan work. Maximum daily value for a given year is selected as one data point. Using almost 23 years of data point, the average maximum and the standard deviation of daily rainfall volume can be calculated.

Table 6.6 Historical Data of Maximum Daily Rainfall Volume Collected at Dili Airport Station

Year	Maximum Daily Volume (P), mm
1977	80
1978	113
1979	58
1980	85
1981	102
1982	58
1983	61
1984	78
1985	72
1986	52
1987	45
1988	60
1989	40
1990	51
1991	46
2003	54.2
2004	127
2005	113
2006	69.4
2007	69.4
2008	81.6
2009	34.6
2010	140
2011	84.6
2012	55.5
2013	91

The following figure presents the location of Dili Airport meteorological station in respect to the whole Dili drainage system. Note that there is another meteorological station located at Dare, still within Dili drainage system. Dare station have been recording data from 2003 in daily (24-hrs) time increment but the data were not included because they do not represent long enough period. Nevertheless, it is important to keep Dare station functioning to provide better spatial representation of Dili rainfall distribution.

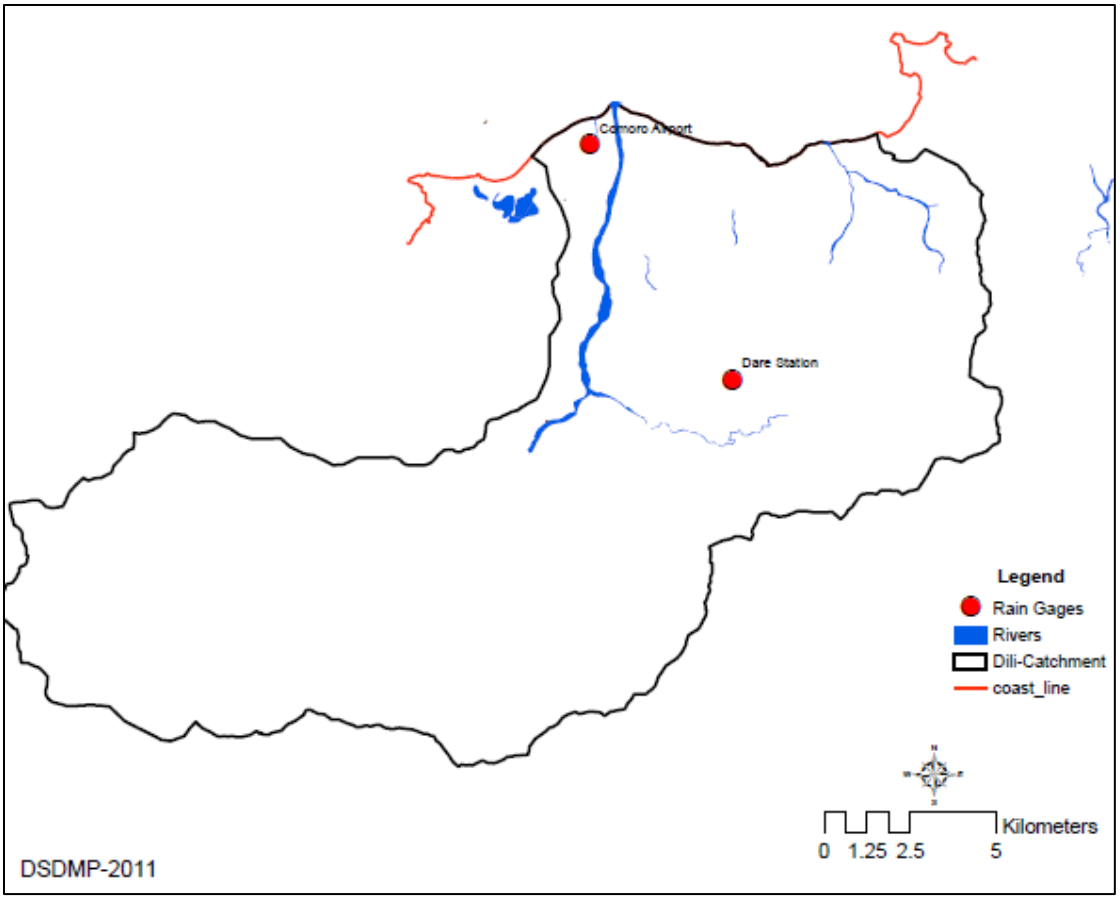


Figure 6.12 Existing Meteorological Station within Dili Drainage System

The above maximum daily record would very useful in developing the rainfall design curve, which would be used various water infrastructure such as drainage system, water canal, bridges, and floor level of the ground to be free from flooding. The most common design curve that is commonly used is known as Intensity Duration Frequency (IDF). In this study, the IDF of Dili will be used to design the rainfall for the purpose of flooding analysis related to the project development.

Assuming the rainfall distribution follows a certain probability density function, IDF curve for one day duration can be developed. The average IDF curve should be taken from several selected probability distribution functions. In this case, normal distribution, Log Person type III distribution, and Gamble distribution functions were used. The average IDF curves from the above selected distribution function plus an additional marginal safety of 10 % is taken as the final IDF curve for 24 hour duration of various return periods. The following figure shows the IDF curve of Dili for various return periods of rainfall.

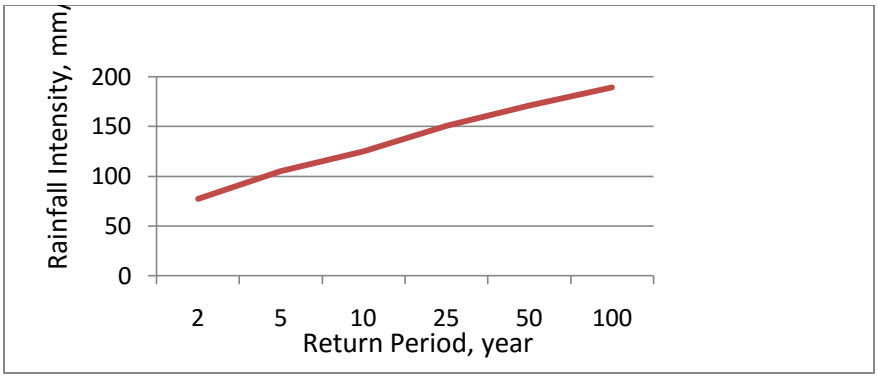


Figure 6. 13 24-hours Duration of IDF

The following table presents the exact values of rainfall intensity for each return period.

Table 6.7 Average Rainfall Intensity of Various Return Periods

Return Period, T, years	**Average Rainfall, P, mm/day**
2	78.1
5	105.6
10	126.5
25	154
50	173.8
100	194.7

Daily duration of rainfall for the above return periods should be converted into smaller duration to represent the actual rainfall duration which is usually less than 24 hours. To convert the duration, the Mononobe method was used. Mononobe formula is as follows:

$$I = \left(\frac{R_{24}}{24}\right)\left(\frac{24}{t}\right)^{2/3}$$

Where:

I = rainfall intensity (mm/h)

R_{24} = design rainfall, maximum daily (mm)

t = duration of design rainfall (hrs).

Most of the rainfall duration used in the design was about 3 hour's duration. This means that the daily rainfall amount occurred within average 4 hours duration Therefore, the rainfall design used for the Liquica area was proposed as followed:

Table 6.8 Rainfall Design for Flood Frequency

ARI, years	**P, mm/day (Dili)**	**P, mm/day (Liquica)**	Average rainfall, mm/4.5 hrs.
2	78.1	117	66
5	105.6	158	90
10	126.5	190	107
25	154	231	131
50	173.8	261	148
100	194.7	292	165

The following table shows the rainfall design and the temporal rainfall distribution used by this study in estimating the time distribution of rainfall for flood flow estimation.

Table 6.9 Rainfall Volume for 4.5 duration for various Design Rainfall Frequencies

time	Temporal Distribution	P2, mm	P5, mm	P10, mm	P25, mm	P50, mm	P100, mm
0		0	0	0	0	0	0
15	0.021	1.386	1.89	2.247	2.751	3.108	3.465
30	0.101	6.666	9.09	10.807	13.231	14.948	16.665
45	0.138	9.108	12.42	14.766	18.078	20.424	22.77
60	0.187	12.342	16.83	20.009	24.497	27.676	30.855
75	0.071	4.686	6.39	7.597	9.301	10.508	11.715
90	0.068	4.488	6.12	7.276	8.908	10.064	11.22
105	0.058	3.828	5.22	6.206	7.598	8.584	9.57
120	0.035	2.31	3.15	3.745	4.585	5.18	5.775
135	0.031	2.046	2.79	3.317	4.061	4.588	5.115
150	0.044	2.904	3.96	4.708	5.764	6.512	7.26
165	0.05	3.3	4.5	5.35	6.55	7.4	8.25
180	0.057	3.762	5.13	6.099	7.467	8.436	9.405
195	0.039	2.574	3.51	4.173	5.109	5.772	6.435
210	0.028	1.848	2.52	2.996	3.668	4.144	4.62
225	0.024	1.584	2.16	2.568	3.144	3.552	3.96

240	0.019	1.254	1.71	2.033	2.489	2.812	3.135
255	0.016	1.056	1.44	1.712	2.096	2.368	2.64
270	0.013	0.858	1.17	1.391	1.703	1.924	2.145

This systematize data will be used as input function to the hydrological modelling for the estimation of the flood hydrograph, which should be used to design the river training work, drainage improvement and the floor level design as part of the project development.

6.1.1.3 Climate Change and Trend for Timor - Leste

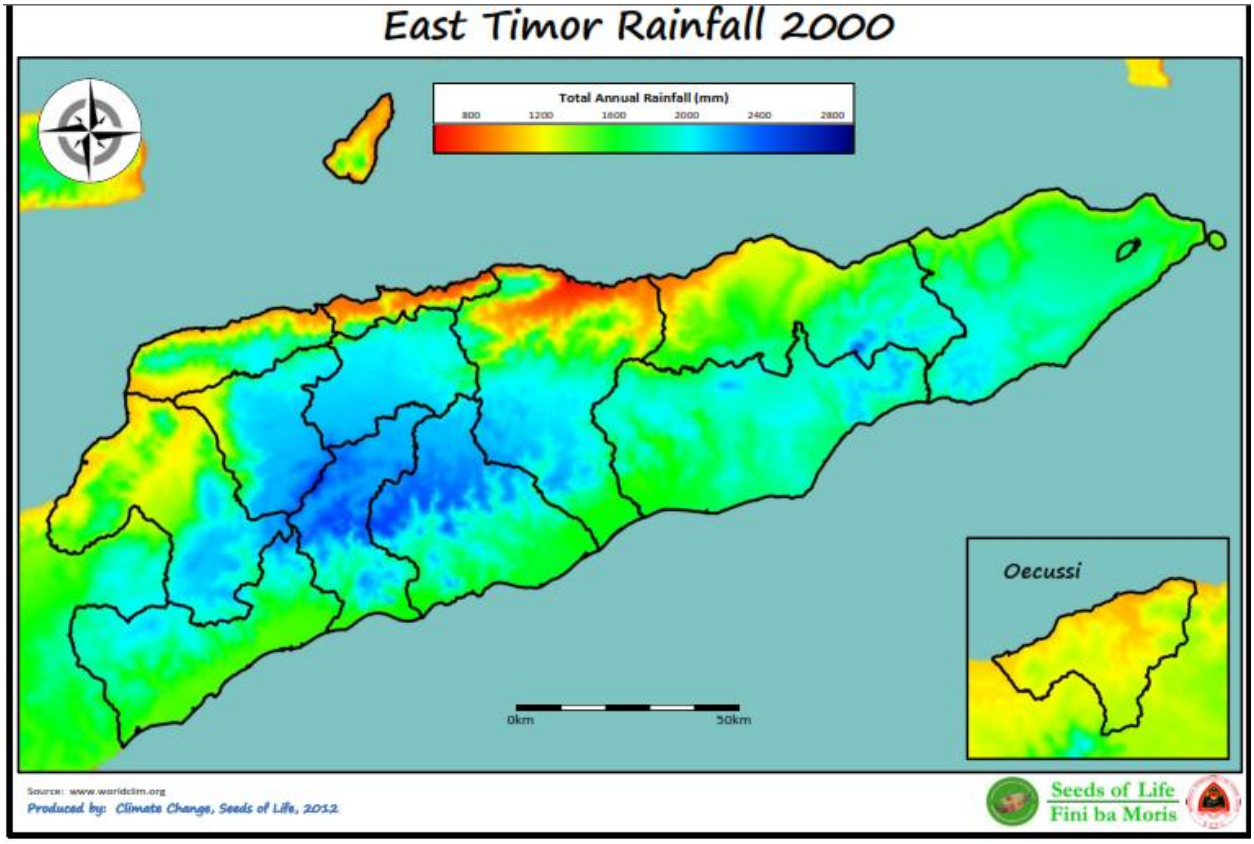
Understanding the climate change and the trends are very important information to be considered in the design and development of the project, particularly, for the project that located along the coastal area, where the change of the climate could affect the sustainability of the operation. Due to the data limitation as described earlier, the regional analysis of climate change and trend has already made to support various development programs.

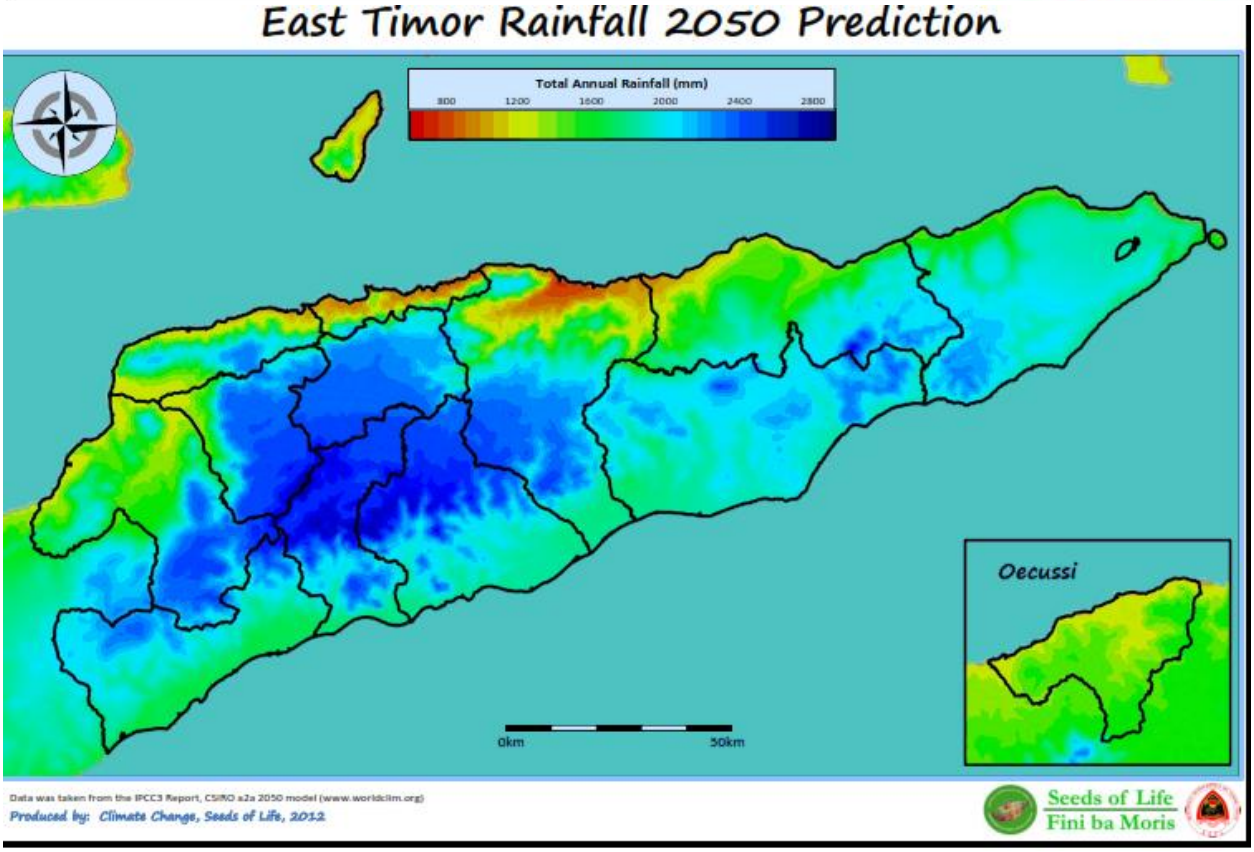
The climate parameters that have already believed to be variable over the long period of time are the temperature and rainfall, which will affect many other factor such as ice melting, coastal flooding, drought, which need to be considered in the designing of the project development. The historical analysis on the trend of these two climate parameters, including the margin of change overtime are presented as followed:

Rainfall trend in the future

According to the historical data analysis of the rainfall in Timor – Leste, the rainfall variability could happen in the future, in term of the intensity, duration, and total volume. CSRO, estimated that for the long-term variation, the total volume of the rainfall, such as annual basis, remain constant. While the duration and intensity is believed to change in the future.

The following figure shows the future annual variation compared to the annual variation in 2000, which was predicted based on the historical data by SoL in 2012.


East Timor Rainfall 2000
Total Annual Rainfall (mm)
800
1200
1600
2000
2400
2800
Oecussi
0km
50km
Source: www.worldclim.org
Produced by: Climate Change, Seeds of Life, 2012
Seeds of Life
Fini ba Moris


East Timor Rainfall 2050 Prediction
Total Annual Rainfall (mm)
800
1200
1600
2000
2400
2800
Oecussi
0km
50km
Data was taken from the IPCC3 Report, CSIRO a2a 2050 model (www.worldclim.org)
Produced by: Climate Change, Seeds of Life, 2012
Seeds of Life
Fini ba Moris

This analysis suggested that no major annual variation in term of the rainfall volume. However, the variation occurred in respect to the intensity and duration of the rainfall. This means that in the future there will be shorter duration with high intensity that could potentially produce flooding in the low laying area. There is also issue related to the number of wet months and dry month, which is related to the duration of the rainfall. As the duration of the rain shorter with the larger volume, the flooding could be issue on one hand but also the drought could be an issue due to short duration. Therefore, the rainfall variability in term of intensity and duration would impact the flooding and drought.

Summary of climate change impacts to the rainfall, temperature, and sea level rise, according the previous climate study is presented in the following table.

Table 6.10 Summary of Expected Climate Change Parameters in the Future

Variable	Season	2030	2055	2090	Confidence
Surface air temperature (°C)	Annual	+0.7 ± 0.4 +0.8 ± 0.4 +0.7 ± 0.3	+1.1 ± 0.6 +1.5 ± 0.6 +1.4 ± 0.4	+1.5 ± 0.7 +2.3 ± 0.9 +2.8 ± 0.7	High
Maximum temperature (°C)	1-in-20-year event	N/A	+1.0 ± 0.6 +1.4 ± 0.6 +1.5 ± 0.5	+1.4 ± 0.8 +2.2 ± 1.1 +2.8 ± 1.5	Low
Minimum temperature (°C)	1-in-20-year event	N/A	+1.3 ± 1.6 +1.6 ± 1.8 +1.6 ± 1.7	+1.7 ± 1.6 +2.2 ± 1.8 +2.5 ± 1.8	Low
Total rainfall (%)*	Annual	+1 ± 9 +1 ± 8 0 ± 11	0 ± 15 -1 ± 18 0 ± 16	0 ± 13 0 ± 19 +1 ± 23	Low
Wet season rainfall (%)*	November-April	+1 ± 7 +1 ± 7 0 ± 8	+1 ± 10 +1± 14 +3 ± 10	+2 ± 9 +2 ± 15 +5 ± 16	Moderate
Dry season rainfall (%)*	May-October	+1 ± 20 +3 ± 18 0 ± 23	-2 ± 31 -4 ± 35 -3 ± 31	-4 ± 28 -3 ± 40 -4 ± 51	Moderate
Sea-surface temperature (°C)	Annual	+0.6 ± 0.4 +0.7 ± 0.4 +0.6 ± 0.4	+1.0 ± 0.5 +1.3 ± 0.6 +1.2 ± 0.4	+1.4 ± 0.7 +2.1 ± 0.8 +2.5 ± 0.7	High
Aragonite saturation state (Ωar)	Annual maximum	+3.3 ± 0.2 +3.2 ± 0.1 +3.2 ± 0.2	+3.0 ± 0.2 +2.9 ± 0.2 +2.8 ± 0.2	+2.8 ± 0.2 +2.5 ± 0.2 +2.3 ± 0.2	Moderate
Mean sea level (cm)	Annual	+10 (6–15) +11 (6–15) +10 (6–15)	+18 (10–27) +21 (12–30) +20 (12–29)	+32 (17–47) +40 (21–59) +42 (22–62)	Moderate

The coastal infrastructure development, such as jetty and fuel storage, as part of the proposed modality of the project development should take the reference from this summary of climate change impact in the future so that project would be sustainable.

6.1.2 Topography

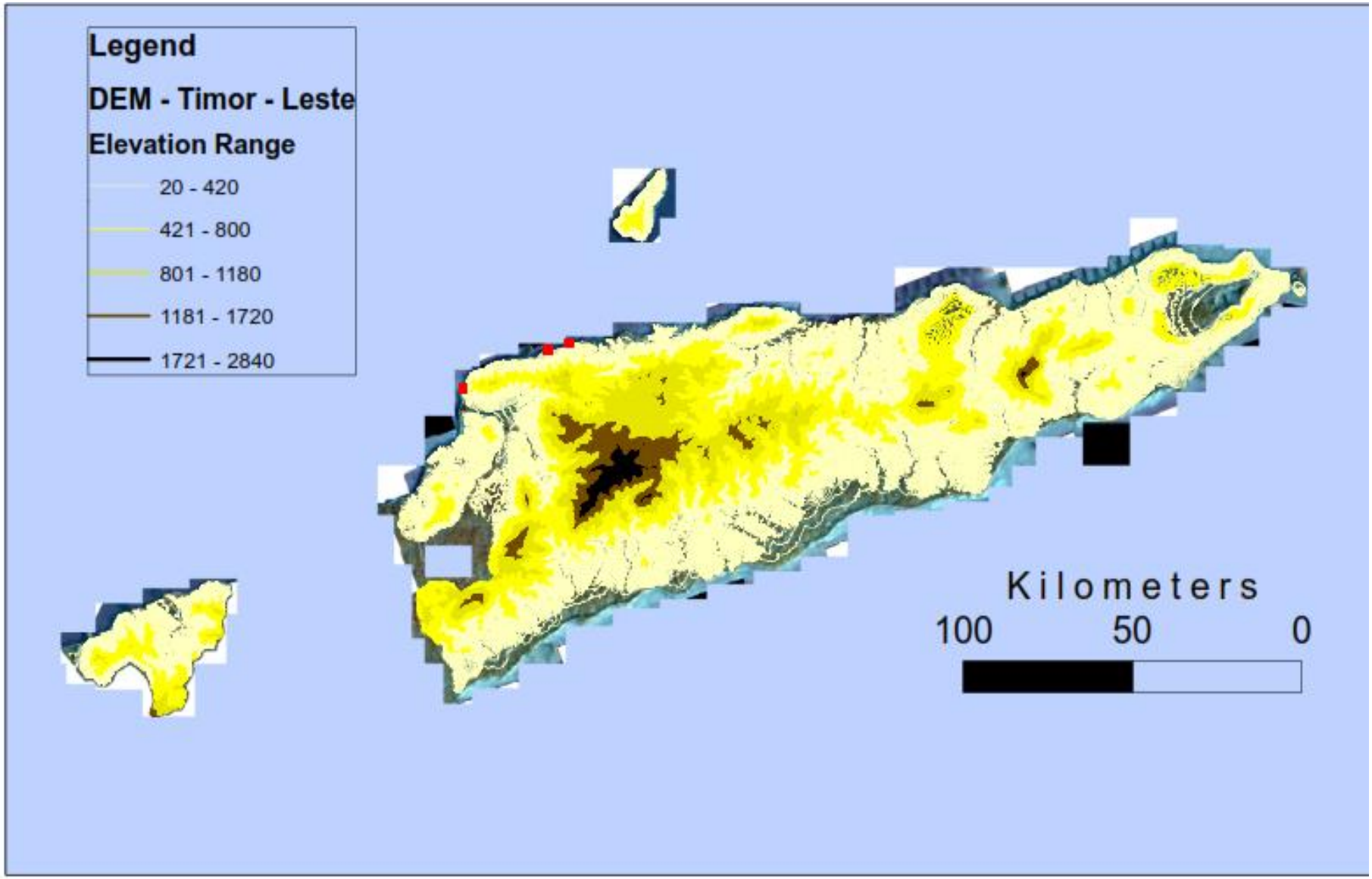
A topographic condition in a simple term is the representation of elevation point above certain reference point (or benchmark), that describe the natural landscape of the terrain system. Because it shows the elevation difference between one points to the others, it does very useful data in the design and construction of various infrastructures. Therefore, any project development, which involves a certain large area, the topographic data should be collected. In the proposed development project, the topographic data shall be useful in the design of the landscape system that consider free or minimum flood impact from the upland catchment system, design of various utilities (pump, water system, energy, etc.).

The project location is in the coastal area of low laying, which is prone to flooding from high frequency of storm runoff as well as coastal inundation. The use topographic in this case will be important and useful for the following estimation:

- Catchment definition to define the contributing area of runoff into the mouth of the river, as well as other hydrological parameters such as landscape slope, channel slope, and other dimension, which are useful in the hydrological modeling. For this application, the topographic data with the spatial resolution of 90 meter, that widely available could be sufficient.
- Detail design related to the project, such as landscape, pumping design of the bridge, level of the tank to be constructed respect to other structures, and other purposes that need high resolution of the topographic data (in 10 mm spatial resolution). For this purpose, the project owner will collect the data by mobilizing the ground survey team.

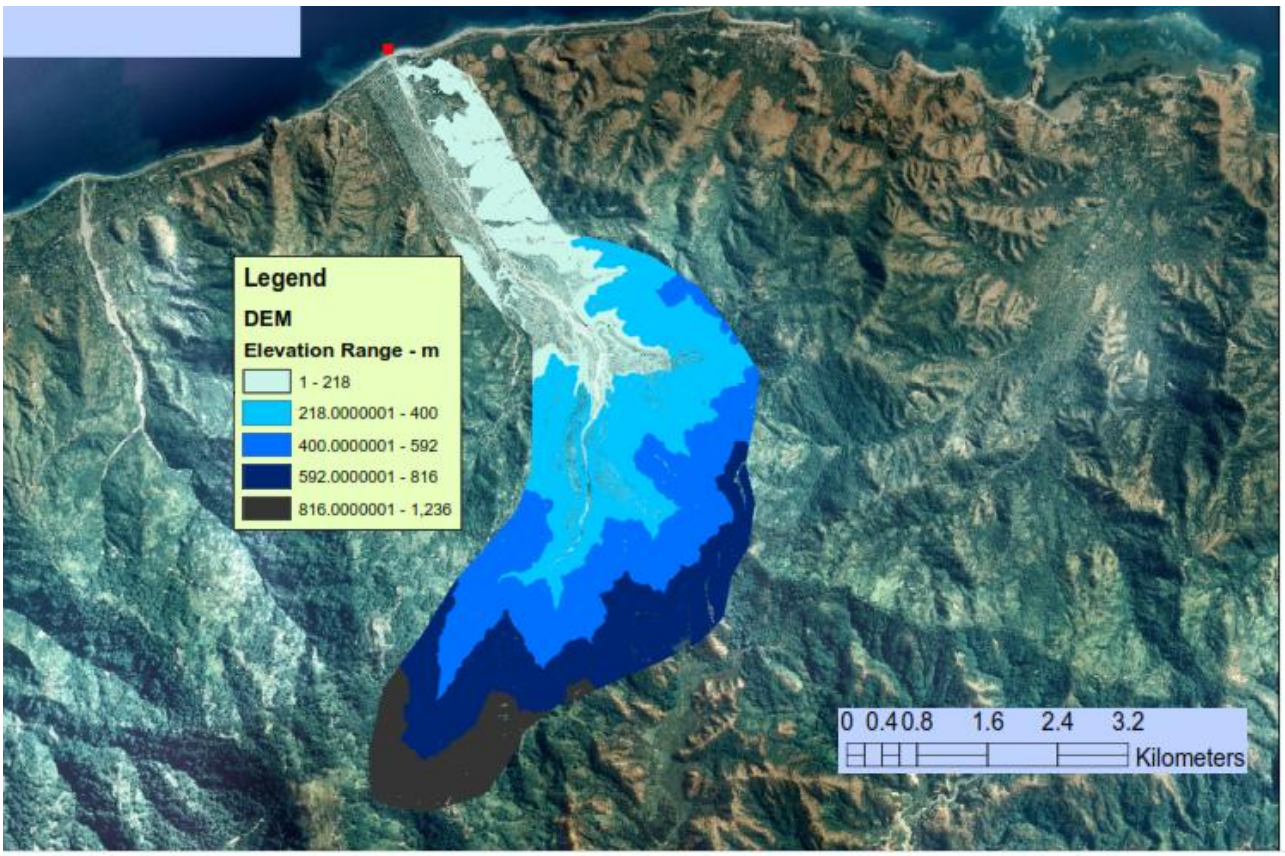
The following map shows the topographic information derived from the ASTER Digital Elevation Model (DEM) by https://earthdata.nasa.gov/learn/articles/new-aster-gdem .

Figure 6.14. Topography Information of Timor Leste (90 meter resolution)



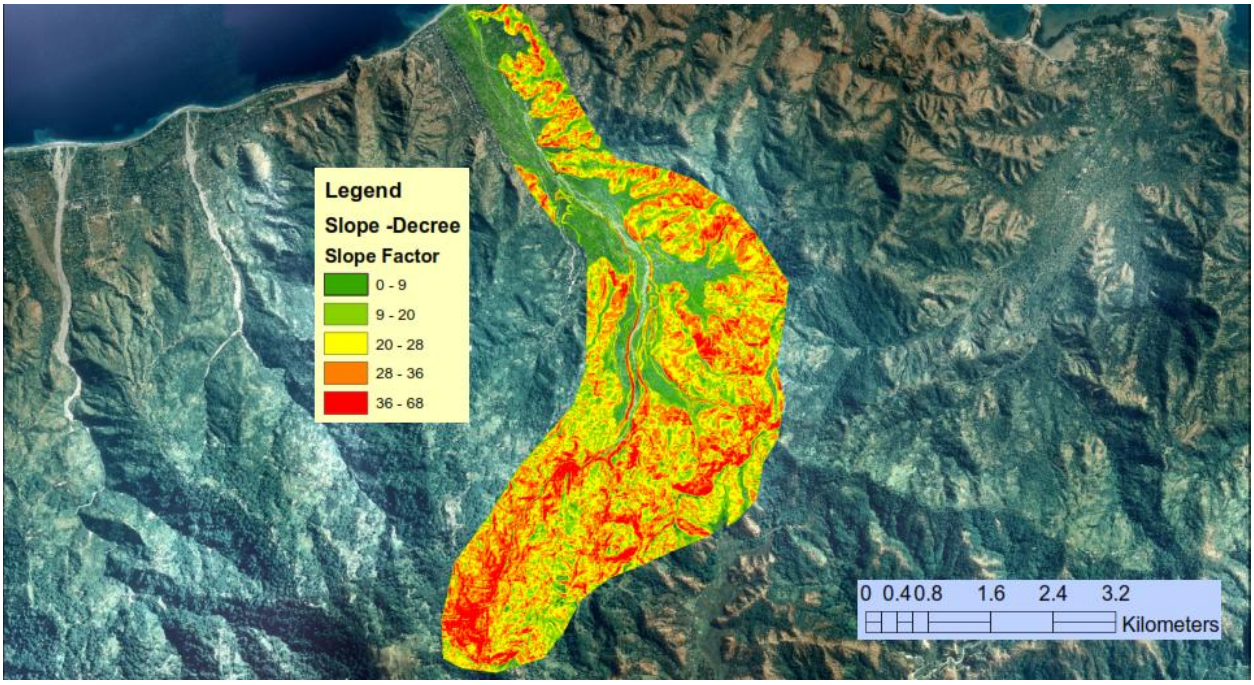
For further application to the project location, the DEM for the Lauhata catchment system was derived by using the standard ArcGIS software. The result of the DEM that cover the location, where the proposed development will be constructed can be seen in the following figure.

Figure 6.15. Elevation Range and Terrain System



From the above elevation in the form of DEM, the various land characteristic such as watershed, landscape slope, river channel and river network, can be derived. This information is provided in the section 7.2.3 (Hydrology and flooding). The following figure, slow the slope of the landscape of Lauhata watershed.

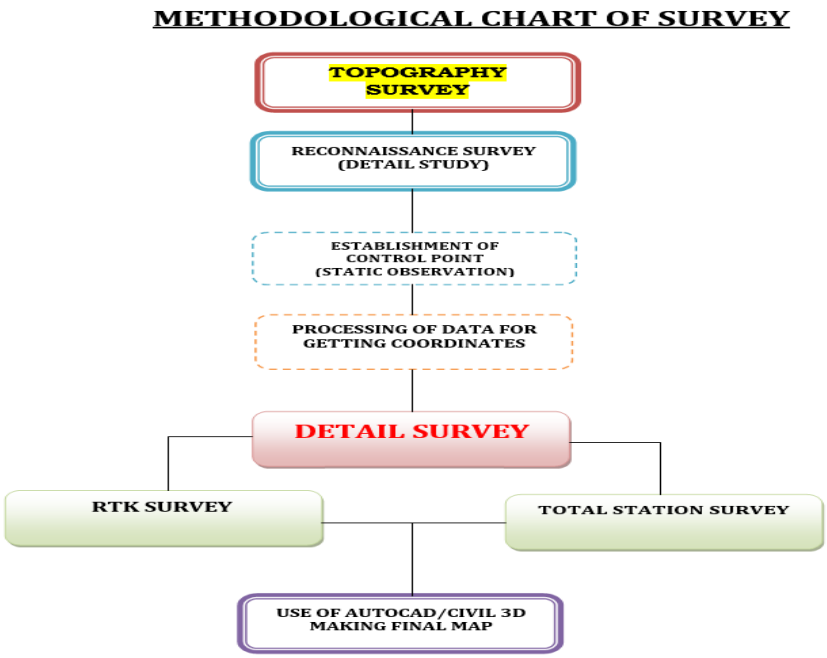
Figure 6.16 Landscape Slope Factor Estimated by DEM



It is shown by the slope landscape estimation that the upland catchment system is fairly steep in terrain (30 – 70- decree), which should transport the runoff at the faster rate or time duration of the hydrological process is short. However, the project is located at the slope factor between 0 and 9 decrees, which is the low laying area.

The more detail topographic data will be required in the design and construction of various systems such as floor level design, grading, excavation, cut and fill design, and other design and construction purposed of the project. The detail of ground topography must be surveyed directly by the surveyors. As part of project preparation and design, a topographic site survey will be conducted to provide more accurate information for design and construction. The methodology of ground survey of data collection is basically, using the differential GPS that has precise measurement of elevation point. The following figure, provide the general overview of methodology of ground topographic survey that will be used by this project.

Figure 6.17. General Overview of Topographic Survey Methodology



The following figure shows the most common use of differential GPS that uses in the ground survey of topographic data collection.

Figure 6.18. Equipment of Topo Survey and BM establishment

The step of data topographic data collection:

- Establishment of Benchmark (or reference point of survey).
- Data collection (a person, use the GPS and collection data point)
- Process the data and convert into the topographic map of drawing
- AutoCAD program programing is commonly used

The application of topographic data for the proposed development project can be summarized as followed:

- Catchment definition and Hydrologic Modeling
- Landscape design (site grading and excavation)
- Design layout of overall facility
- Design of the pump and

The result of topographic data collection to support the design of the system can be seen from the following map.

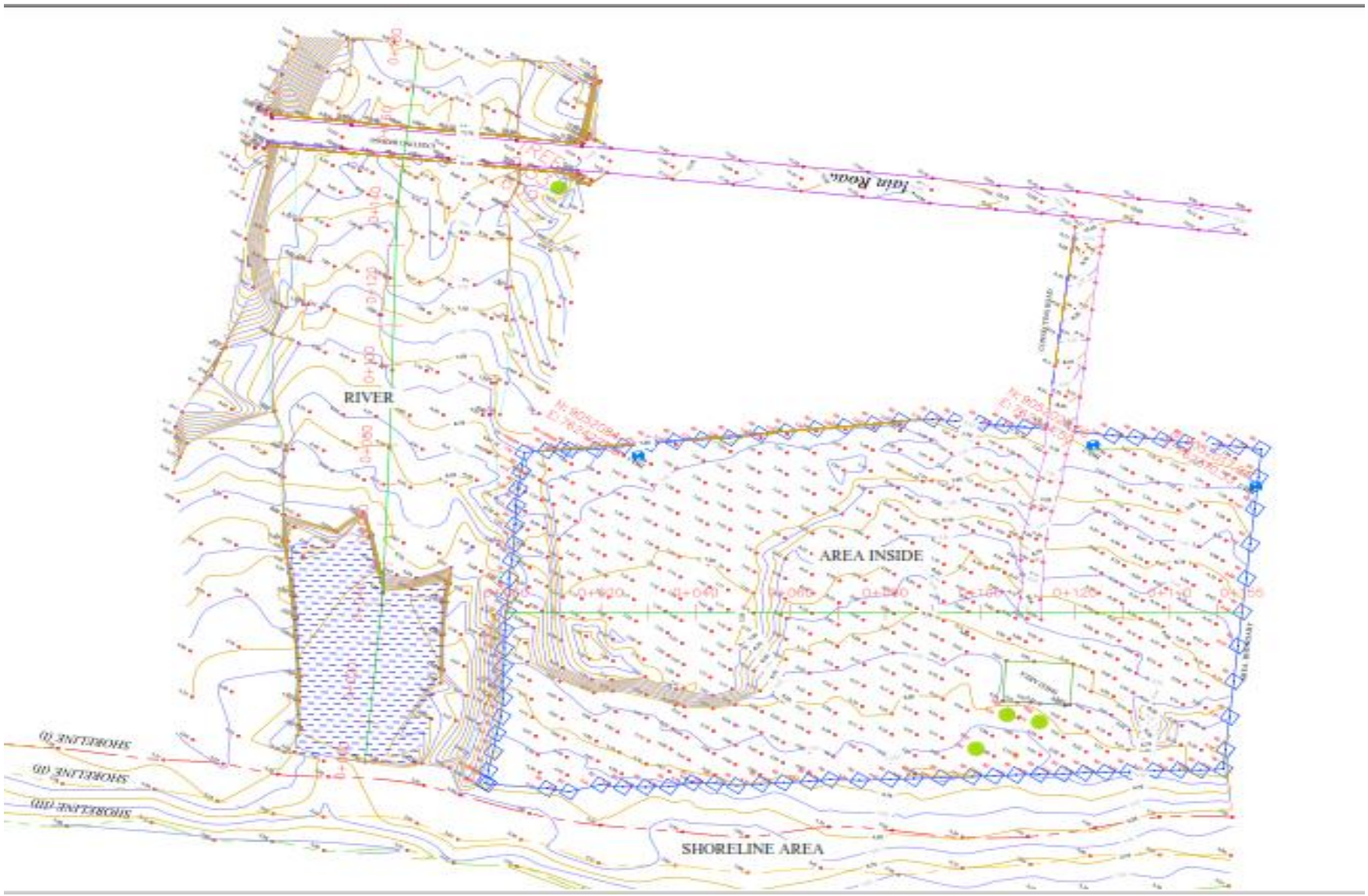


Figure 6.19. Topographic Information collected in the project location.

6.1.3 Geology

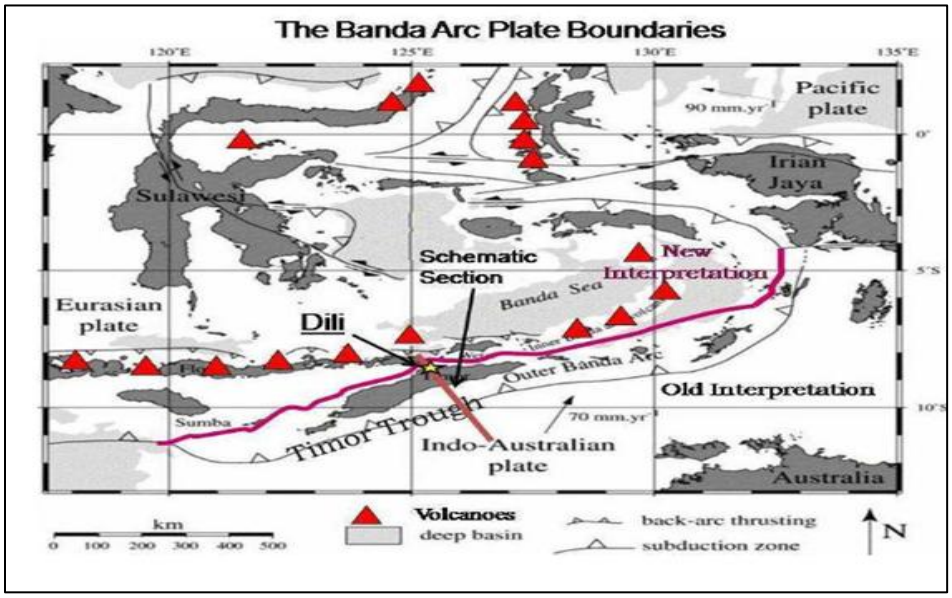
Geotechnical or engineering geology study for any project activities is very important due to the geo-hazard impact, which can cause geological hazard (Natural hazard) to the project site area. The geological hazard, possible to occur in the project site including; landslide, flooding and coastal hazards. More detail geological site investigation would normally conducted, as part of the project preparation study to know more detail soil and rock characteristic in the vertical direction, which are useful for foundation design, liquefaction, soil bearing capacity, and other purposes.

As part of the EIA study, the review of regional study on the geological formation of Timor –Leste will be provided by previous study, including the site visit to the project location to collect the geological footprint/evidence in the local context. The geo-technical site investigation will be conducted as part of the study to collect for detail information of rock type, soil texture, and other physical as well as chemical properties of soil in the vertical direction. In general the methodology of geological and hydro-geological analysis by this is to review the exiting expert opinion of the regional geology and hydro-geology, related to the project area, and further data collection related to rock type and groundwater data collection.

6.1.3.1 Review of Regional Geology and Hydro-Geological Information

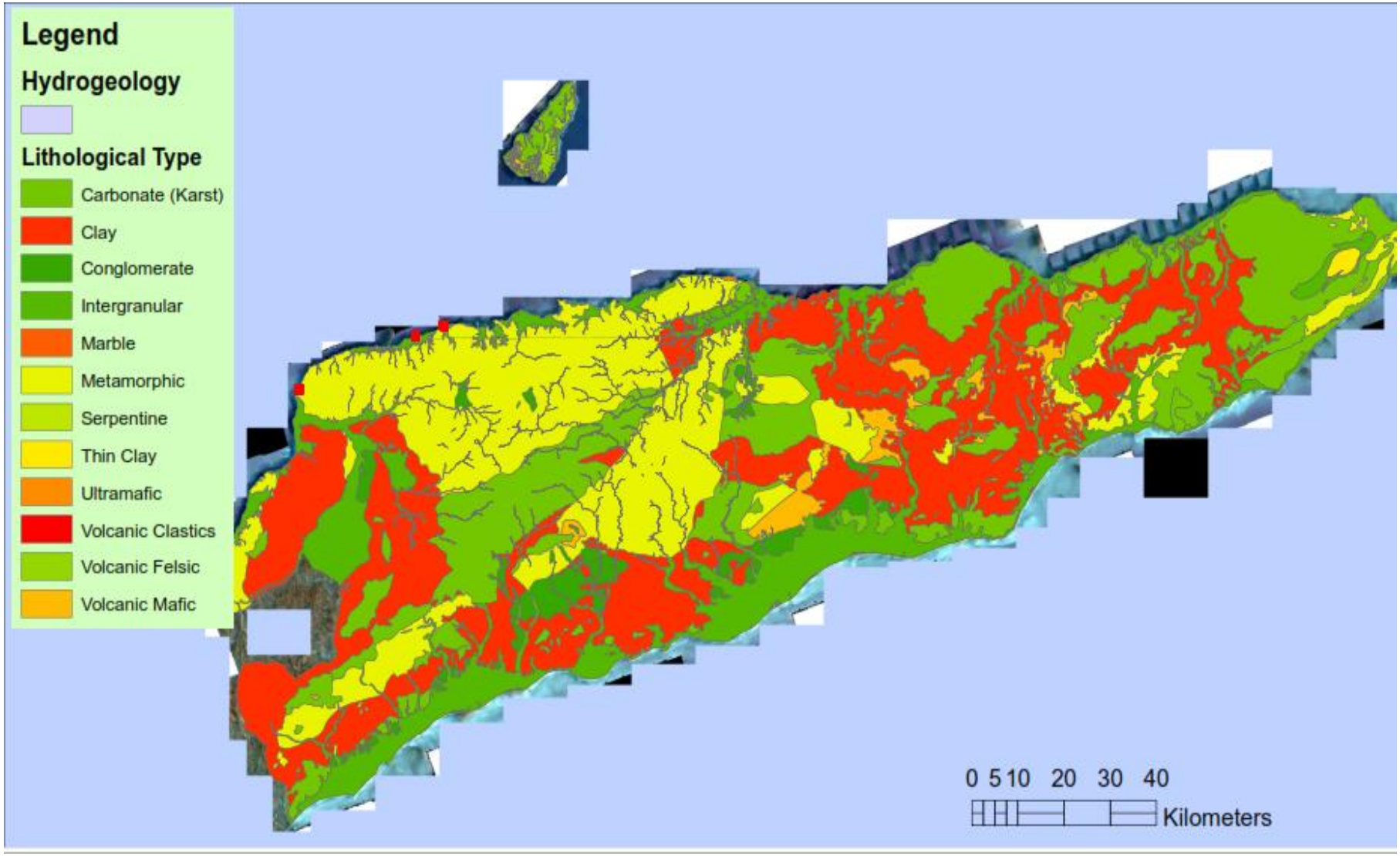
The geology of Timor Leste is complex in both composition and tectonic influence. Timor Island is part of Banda Arc, marked by a string of islands and underwater formations that are thought to be the results of collision of the Indo-Australian Plate, the Pacific and the Eurasian Plate. Timor Island, according to Hamilton (1978) and other experts is formed from fragments from the Australian plate, deep marine sediment thrusted upward by the collision, oceanic crust and Quaternary sediments brought by the collision.

Figure 6.20 Timor Island Geological Formations



The geological condition (rock type and properties) will control groundwater storage and flow. Therefore, hydro-geological investigation in terms of lithology and aquifer type is important. According to the Australian Geoscience (2012), the lithological type of Timor Island is dominated by carbonate, intergranular, and "***Metamorphic***" rock types, where each type of rock has different characteristics in storing and transporting water.

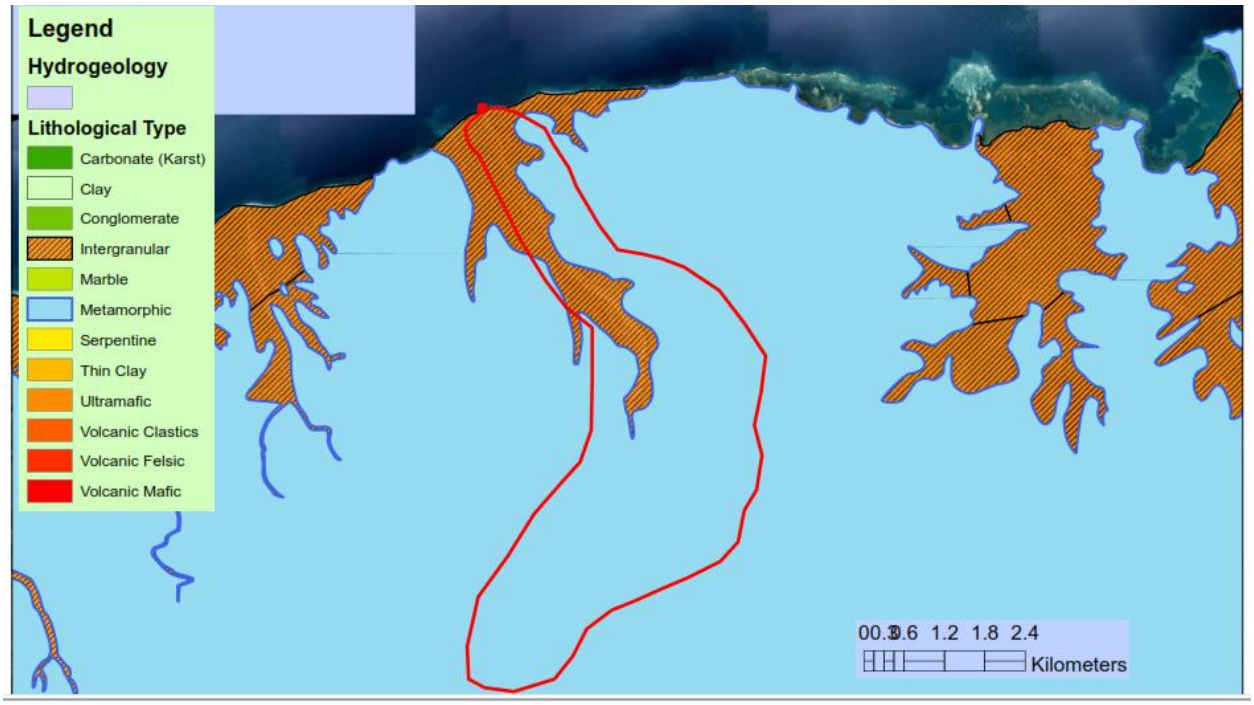
Figure 6.21 Timor Leste Lithology/Rock Type



Source: Australian Geoscience, 2012

The rock type in the project location, as indicated in the following map, is dominated by the metamorphic and intergranular type.

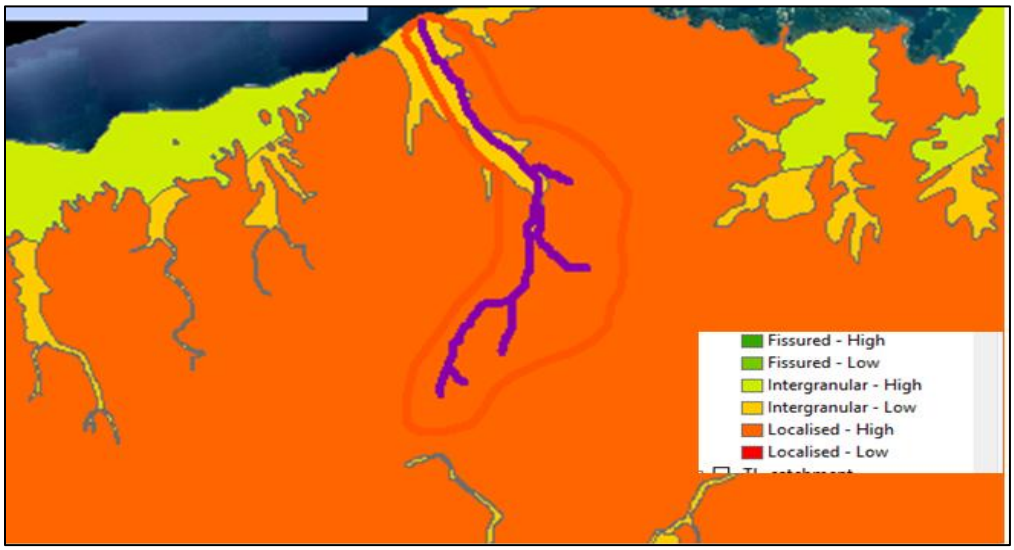
Figure 6.22 Lithology/Rock Type in the Project Area



Source: Australian Geoscience, 2012

The most relevant application of the geological rock type is the assessment of the groundwater, as rock is essentially the storage of the groundwater. The following map shows the type of aquifer in terms of groundwater storage and transmitivity in the project area.

Figure 6.23 Aquifer Type in Project Area



The type of aquifer is classified as intergranular low, where the type of aquifer is confined and normally has very low groundwater yield that is susceptible to rainfall change and seawater intrusion. As aquifer and recharge area is reasonably small, fresh water availability in the groundwater system is limited. The same study of Australian Geoscience also suggested that around the project area, only brackish water would exist. A preliminary testing of the shallow and deep groundwater wells around the project area suggested that the groundwater availability near the shoreline is dominated by brackish water. Further testing will be conducted in the upstream to know the salinity profile as the distance of well is further away from the shoreline. Further assessment on the local rock type within the proximity of project location will be done by this study as part of deep bore testing.

6.1.3.2 Rock Type Data Collection in the Project Site

The field was conducted in the project in order to know the soil condition in the top soil as well as condition downward until the hard rock. Two deep boring and two surface boring were conducted in order to collect the sample of the soil for laboratory analysis. The N value of each soil deep was determined based on force applied. Rock type data will be collected by the project owner, to understand the structural type of rock under the ground, which should provide information for the foundation design and other major structure by this project. The methodology of geotechnical site investigation will be conducted as part of the EIA study by with the following approaches.

- Drilling 4 boreholes to explore subsurface stratigraphy and groundwater conditions and to obtain samples of the subsurface materials for laboratory testing
- Surface penetration test to know the soil property at the soil surface for four locations within the project location.
- Conducting laboratory tests on selected soil samples recovered from the borehole to evaluate pertinent physical and engineering properties; and
- Analyzing the field and laboratory data for the Engineering and to develop engineering recommendations.

The following map shows the location of deep boring soil data collection and cone penetration test (CPT) to collect the soil information.

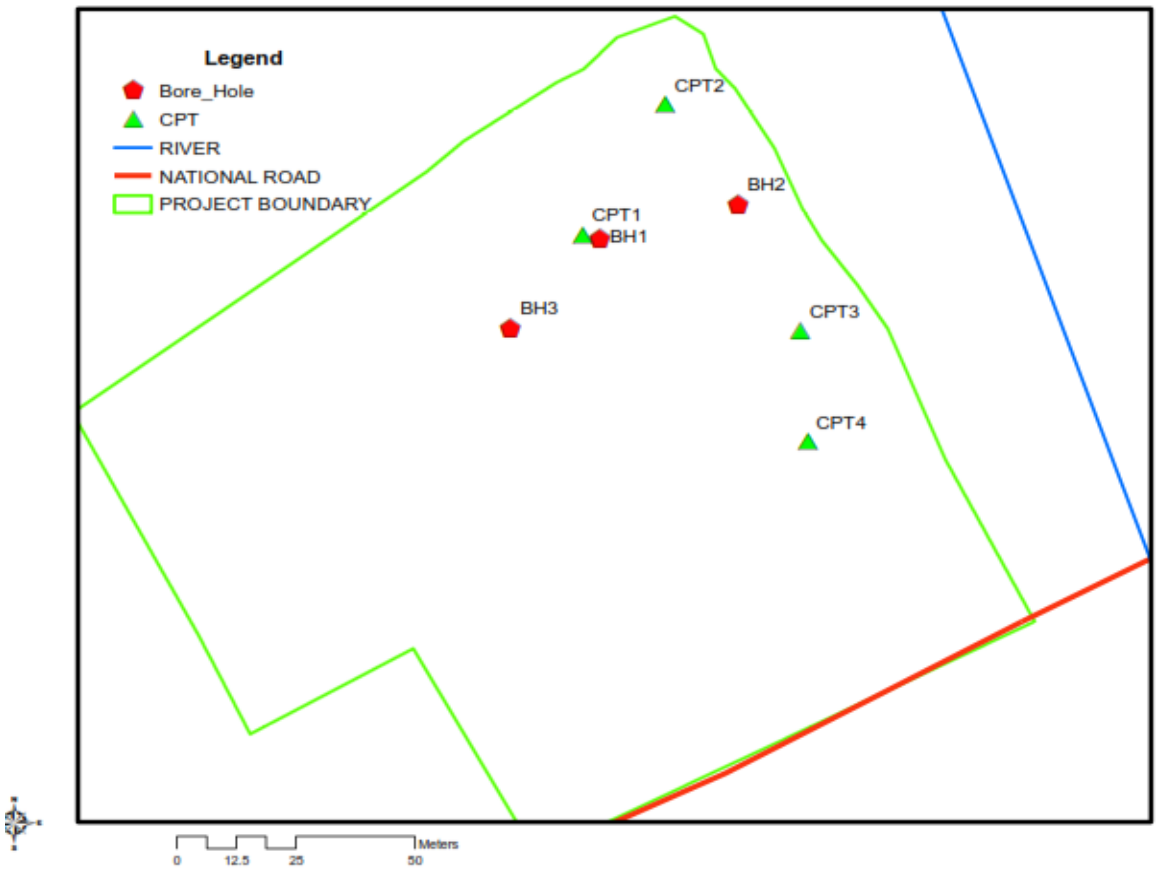
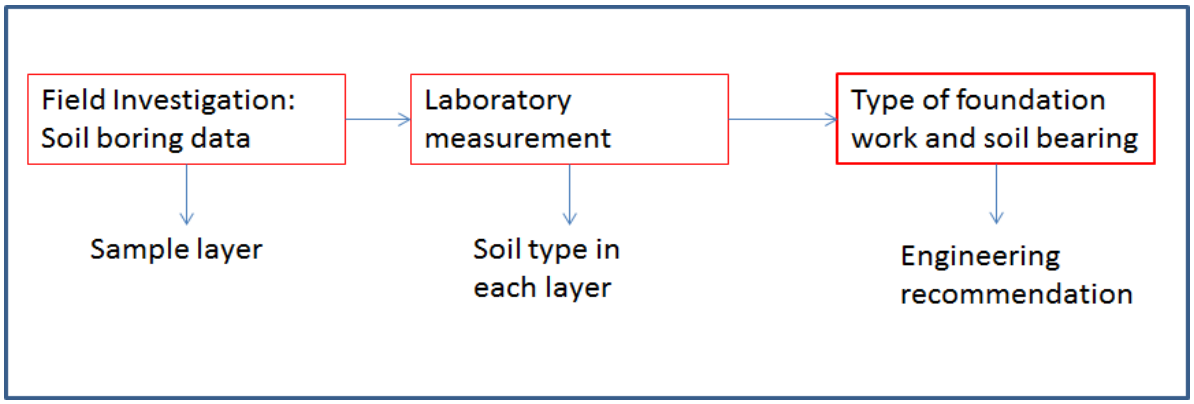


Figure 6.24. Location Deep Boring Data Collection and CPT

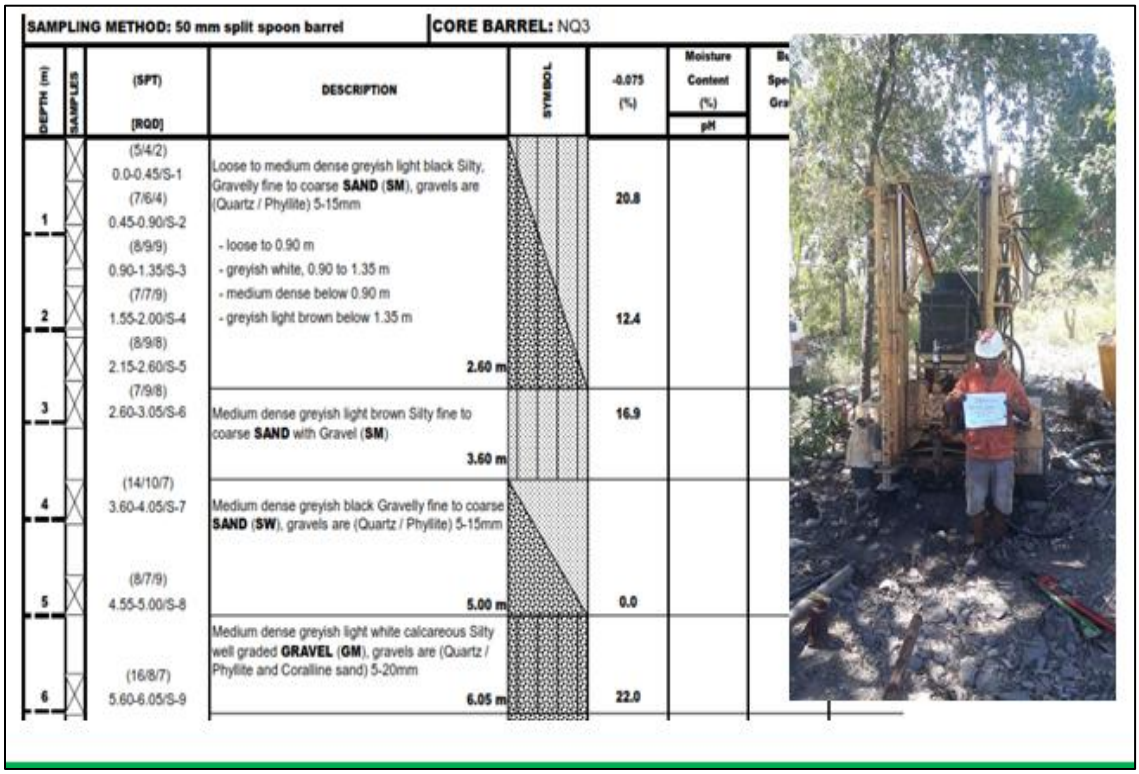
The geotechnical investigation team shall be mobilized in the project site to perform the geotechnical soil boring data collection. The following figure shows the methodology and workflow of soil data collection and engineering recommendation for the foundation works.

Figure 6.25 Proposed Field Study and Application of Result



The expected results of the soil test would be information on the type of soil in each depth, water content, and permeability of the soil.

Figure 6.26 Examples of Soil Test Results



SAMPLING METHOD: 50 mm split spoon barrel | CORE BARREL: NQ3

DEPTH (m)	SAMPLES	(SPT) [RQD]	DESCRIPTION	SYMBOLS	-0.075 (%)	Moisture Content (%) / pH
1		(5/4/2) 0.0-0.45/S-1 (7/6/4) 0.45-0.90/S-2	Loose to medium dense greyish light black Silty, Gravelly fine to coarse **SAND** (**SM**), gravels are (Quartz / Phyllite) 5-15mm		20.8	
2		(8/9/9) 0.90-1.35/S-3 (7/7/9) 1.55-2.00/S-4 (8/9/8) 2.15-2.60/S-5	- loose to 0.90 m - greyish white, 0.90 to 1.35 m - medium dense below 0.90 m - greyish light brown below 1.35 m 2.60 m		12.4	
3		(7/9/8) 2.60-3.05/S-6	Medium dense greyish light brown Silty fine to coarse **SAND** with Gravel (**SM**) 3.60 m		16.9	
4		(14/10/7) 3.60-4.05/S-7	Medium dense greyish black Gravelly fine to coarse **SAND** (**SW**), gravels are (Quartz / Phyllite) 5-15mm			
5		(8/7/9) 4.55-5.00/S-8	5.00 m		0.0	
6		(16/8/7) 5.60-6.05/S-9	Medium dense greyish light white calcareous Silty well graded **GRAVEL** (**GM**), gravels are (Quartz / Phyllite and Coralline sand) 5-20mm 6.05 m		22.0	

The N value for each sample taken for each deep boring data is presented in the following table:

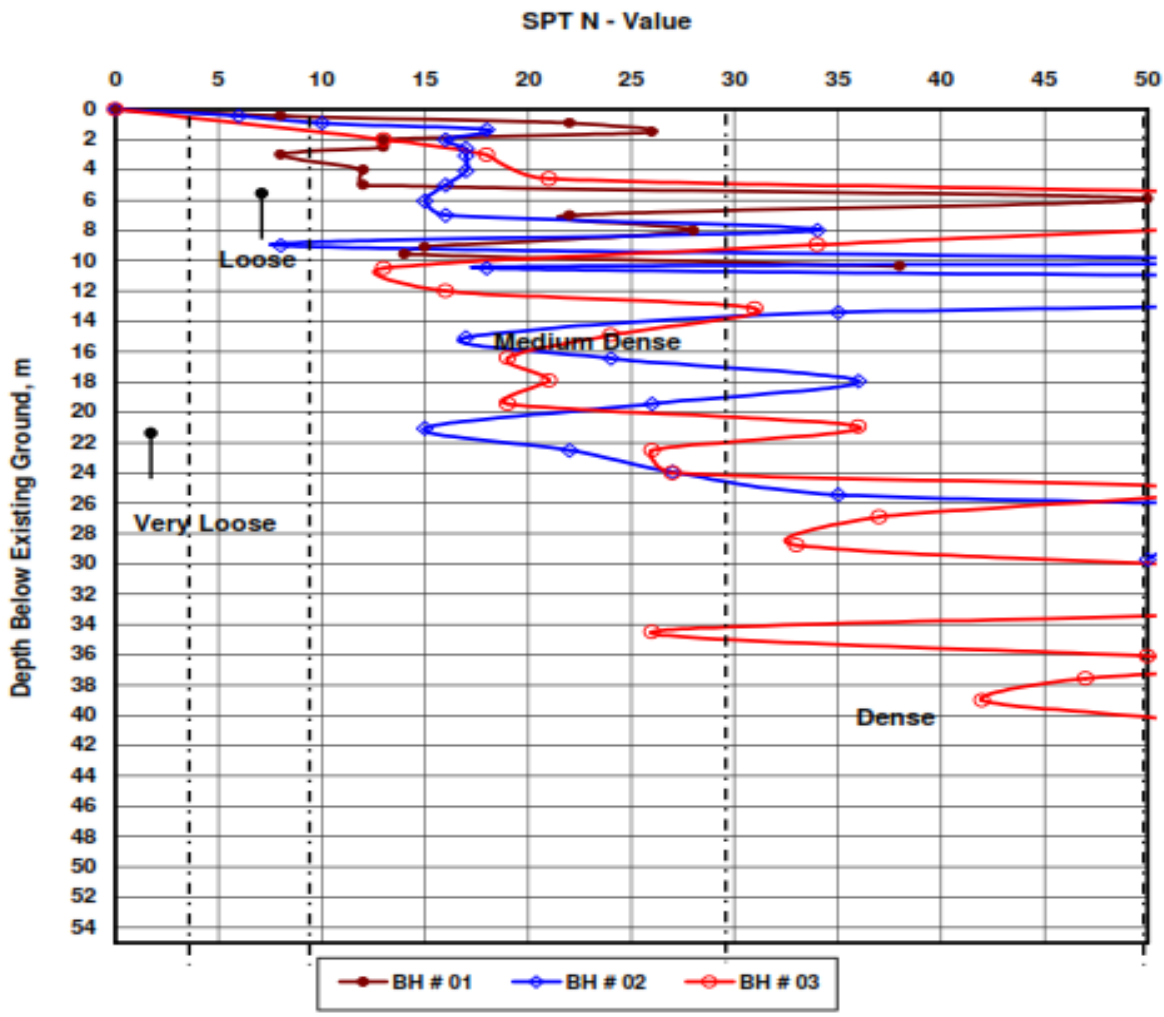
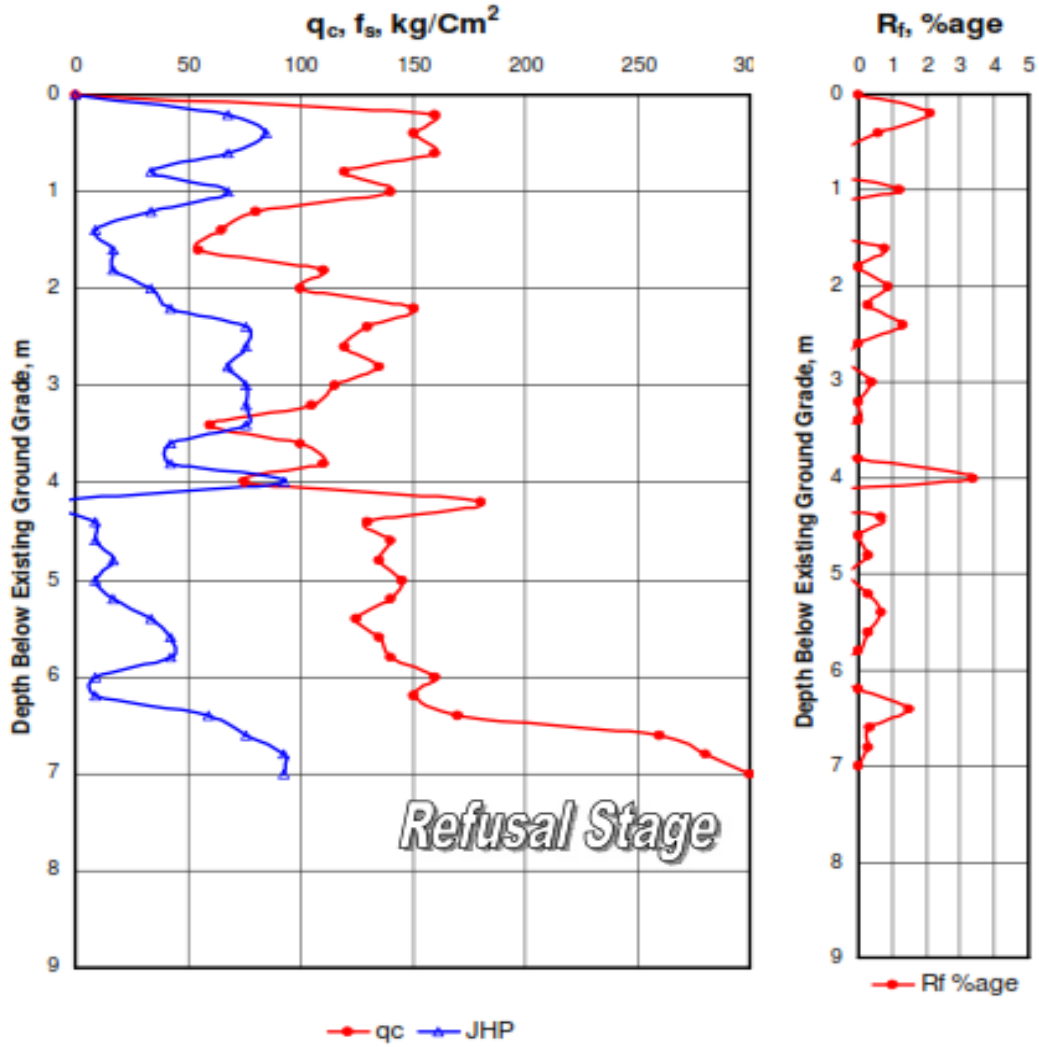


Figure 6.27. N value of each Soil Depth at Vertical Direction of Soil Column

The soil of each soil layer was taken to the laboratory to test the physical and chemical properties of the soil, which may need to be taken into consideration in the design and construction of the fuel terminal to ensure the sustainable operation of the facility. Detail information regarding the soil layer properties, chemical and physical properties is presented in the annex 14_ Soil Investigation Report. As the complementary testing, the CPT (Cone Penetration Test), was also conducted for detect the physical soil properties in the surface layer. The location of testing, has already presented earlier. The result of CPT can be summarized as followed:

Details	CPT # 1	CPT # 2	CPT # 3	CPT # 4
Refusal (qc = 300 kg/cm^2), Depth m	7.00	5.20	3.40	4.00

Figure. 6.28 CPT Test and Result at the Refusal Depth



In addition to the type of rock, the geotechnical investigation also, produced the soil type in each layer. The following table shows the soil type

Table.6.11 Soil Type Vertical Downward

Depth, m	Type soil	Remark
0-1	Loose to medium dense greyish light black Silty, Gravelly fine to coarse SAND (SM), gravels are (Quartz / Phyllite) 5-15mm	
1-2	Medium dense greyish black Silty, Sandy fine to coarse GRAVEL (GM), gravels are (Quartz / Phyllite) 5-15mm	
2-3	Medium dense greyish light brown Silty fine to coarse SAND with Gravel (SM), gravels are (Quartz / Phyllite) 5-15mm	

3-4	Medium dense greyish light brown Silty fine to coarse SAND with Gravel (SM)	Water Surface
4-5	Medium dense greyish black Gravelly fine to coarse SAND (SW), gravels are (Quartz / Phyllite) 5-15mm	
5-6	Medium dense greyish light white calcareous Silty well graded GRAVEL (GM), gravels are (Quartz / Phyllite and Coralline sand) 5-20mm	
6-7	Medium dense greyish brown Well graded GRAVEL with Sand (GW), gravels are (Quartz / Phyllite) 5-20mm	
7-8	Loose to dense greyish black calcareous Sandy fine to coarse GRAVEL with Silt (GW-GM), gravels are (Quartz / Phyllite and Coral fragments) 5-25mm	
8-9	Loose to dense greyish black calcareous Sandy fine to coarse GRAVEL with Silt (GW-GM), gravels are (Quartz / Phyllite and Coral fragments) 5-25mm	
9-10	Very dense greyish yellow calcareous Silty, Gravelly fine to coarse SAND (SM), gravels are (Quartz / Phyllite and Coral fragments) 5-15mm	
10-11	Medium dense to dense greyish black Silty, Gravelly fine to coarse SAND (SM), gravels are (Quartz / Phyllite) 5-25mm	
11-12	dense yellowish grey,	

More detail on the CPT methodology and result, as well as interpretation on the result into the design and development of the propose fuel storage development facility can be seen in the annex-4 of this report.

6.1.4 Air Quality

Air quality is a growing concern in urban Timor Leste. The World Bank assessment on outdoor air pollution in Timor Leste (2009) noted that air pollution is currently not a major concern and usually it is only localized and temporary problem relevant to an activity that may be completed at the certain period of time. Sources of air pollution in Timor Leste are typically:

1. Particulate Matter (PM) from construction activity, lack of road maintenance and clean-up program, forest fire.
2. Gas emission from vehicular movement and operation of power plant

As the nature of the propose project will contribute gas emission to the atmosphere, such as SO_x, NO_x, CO_2 and CH_4 (Methane), baseline data collection on these mentioned gases would be important. Baseline data would provide important information as reference prior to the commencement of project. Air

pollution from vehicle combustion starting to be a concern in the Capital Dili and other main roads due to the increasing number of cars, trucks and other vehicles. Air quality is commonly measured in terms of concentrations of NO_2, SO_2, Particulate Matter (PM_{10}, $PM_{2.5}$) and ozone. The following table contains WHO ambient air quality guidelines, which could be adopted in Timor – Leste in substitute the national guideline that currently not available.

Table 6.12 WHO Ambient Air Quality Guidelines

Parameter	**Average Period**	**Guideline Value (µg/m^3)**
Sulfur dioxide (SO_2)	24-hour	20
	10 minute	500
Nitrogen dioxide (NO_2)	1-year	40
	1-hour	200
PM_{10}	1-year	20
	24-hour	50
$PM_{2.5}$	1-year	10
	24-hour	25
Ozone	8-hour daily maximum	100

Source: IFC, http://www.ifc.org/

As part of the study, the baseline air quality measurement will be conducted to measure and monitor the existing baseline air quality condition. The following map shows the identification project location and potential sensitive receptors that could be affected by the source of emission from the project during the project construction and operation.

Figure 6.29 Project Location and Potential Receptor Location

1) Prisao Do Ai Pelo	260 meters
2) Residential Area	350 meters
3) Pathways	70 meters
4) Vida Diak Petrol Station	230 meters
5) Cement Timor	222 meters
6) Communities	91 meters

The methodology of the baseline data collection would be consist of the 24-hour monitoring of the air quality parameters and sampling. The samples were taken to the certified labaoratory for the estimation of the air quality paramenters. The following map procides the proposed air qaulity sampling points, where the data will be taken.

Figure 6.30 Proposed Monitoring and Measurement of Air Quality Sampling

The result will be used as background information to do the monitoring of the air quality condition that where the project has already in operating (contribute of gases emission from the project to the ambient environment).

Figure. 6.31 Field Measurement setup of Particulate matter Observation

The methodology of data collection of the above mentioned parameters and laboratory measurement are described as followed:

6.1.4.1 PM (Particulate Matter)

Particulate matter measured by this study consist of $PM_{.2.5}$ and PM_{10}, as suggested by IFC and WHO, to be the main air quality indicators due to dispersion of fine particulate matter. The samples were taken from the field and measure the amount of PM10 and PM2.5 in the laboratory, via gravimetric method.

The method measurement of particulate matter (PM) is based on gravimetric method, which basically using the gravimetric method, where filter with the size of 2.5 mm and 10 mm were used to filter the airflow and the filters will catch the particulate matter that has larger size than the size of the filter. The filter that already retains some particulate matter will be measured via using the digital high accuracy of scaling. The difference of weight between the filter after airflow through and prior will be the amount of the particulate matter. The measurement will be taken in 24-hours monitoring in the site, according to recommended IFC and WHO (2007).

In principle, the instrument consists of pump and filter, which setup such that the pump delivers the airflow through the filter so that the particulate matter will be retain in the filter.

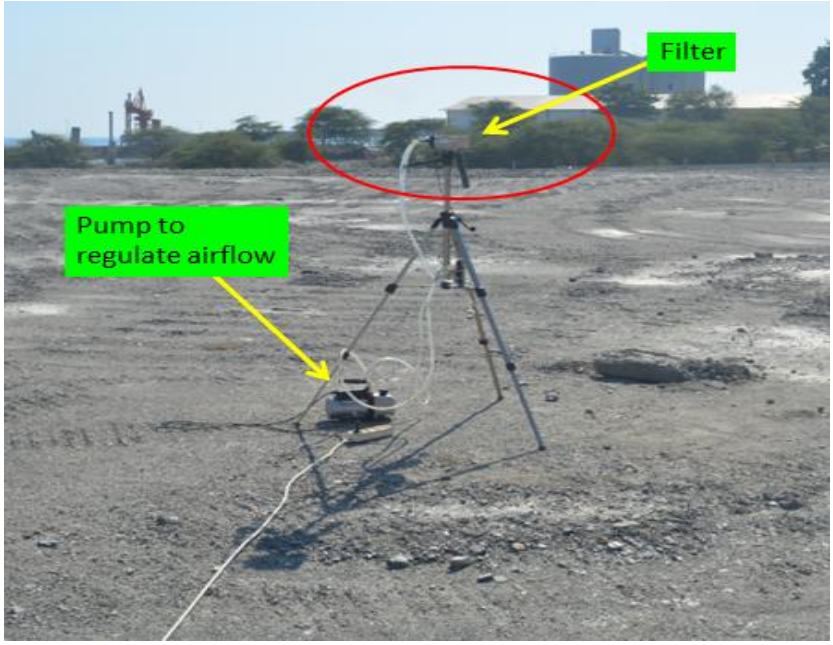


Figure. 6.32 General Setting of Airflow – Filter in the Field

The observation will be conducted for 24 hours and the filter will be placed inside the tight glass and bring the laboratory for the measurement. Measurement of the moisture shall also be taken in order to know the dry basis matter.

$$C = \frac{W2 - W1}{V}$$

Where, C = concentration of PM

W2 = weight of filter +PM

W1 = weight of Filter

V = volume of air

The volume air shall be calculated based on the universal gas equation, by comparing the standard condition (at temperature of 25 C and 1 atm) and actual condition of the field. The temperature and pressure during the field measurement were conducted. The measurement result of particulate matter (PM) in Lauhata that was conducted on 12 -13 of September 2019 can be seen from the following table.

Table 6.13. Summary result of PM measurement

Location	Parameters Measurement	
	PM 10, (**µg/m^3**)	PM 2.5, (**µg/m^3**)
Within Proposed Terminal	148	64
Community - sensitive receptor	115	48
Standard by WHO	50	25

The above table indicated the baseline air quality condition, prior to the commencement of the project implementation. It shows that the background particular matter (PM) is much higher than the maximum allowable threshold of the quality standard. The PM issue is only temporary, due to the construction activity and the level will drop after the completion of the construction activity. The following table shows the comparison of PM level in Kaitehu (taken during the construction of Tibar –Liquica road), Ulmera (within the forest area)

Table 6.14 Comparison of PM level for different places

Location	Particulate matter		Notes: Condition of the Measurement
	PM2.5, (**µg/m^3)**	PM 10,(**µg/m^3)**	
Ulmera	22	53	Near the Forest or natural and measured in 2017
Kaitehu	21	27	Near coastline and measured in 2015 – where no major construction started yet
Lauhata	48	115	During the construction of Fuel Terminal
Standard Value by WHO	25	50	

The above table suggested that prior to the commencement of construction activity (2016); the particulate matter was lower than the standard threshold of level of PM set by WHO. Similarly, the PM level, taken in Ulmera, near forest area, the measured PM was within the standard allowable value of PM. As currently, the traffic is busier than the previous 5 –years and also major construction such as China Harbor Quarry, local sand mining, and minor construction activities near the project area, the potential particulate matter dispersion and transport should be expected to have an impact to elevated value of PM observation.

6.1.4.2 SO_2

Sulfur dioxide is also measured as the water quality indicator, as this chemical compound is also very common one that could be found in combustion of fuel related to the petro-chemical fuel based. The sampling and measurement of these parameters of ambient air quality standard was based on the SNI (Standard National Indonesia), 7119-7, which was updated in 2017. The principle is known as pararosaniline method, where the ambient, was absorbed by chemical solution of tetra cloro merculate (TMC), which will resulted in the complex chemical known as dicloro sulfone merculate. By adding the pararosaniline solution and formaldehyde to this sample mixture, resulted in the pararosaniline sulfonate that has certain color if there is a presence of SO_2 in the ambient air. The spectrometer was used to measure the wave length of the sample and compare with the standard solution to read the concentration value. The measurement of the ambient air quality in Lauhata suggested that no background issue related to the SO_2, as reading is less than 0.01 ppm. Further detail information on the SNI -7119-7 regarding each step of measurement , including the establishment of equipment, can be found in the document annex. The following table (table 6.13) summarized the result of the ambient air quality indicator measured in SO2

6.1.4.3 NO_X

The measurement of ambient quality of NO_2 has similar principle as SO2, where the air sample was observed with the chemical solution known as Griess- Saltzman. So the method is also known as "***Griess – Saltzman***". The principle is similar to the SO2, where the Griess- Saltzman solution shall absorbed NO_2 in the air sample and resulted the chemical compound known as Ozo dye, that has light red color. The concentration of NO2 shall be measured with the spectrometer with the wave length of 550 nm. The result as can be seen in the following table indicated no presence of NO_2 in the air sample taken.

6.1.4.4 CO_2

Portable gas analyzer of CO_2 was mobilizing in the project area to measure directly the CO_2 in the ambient air.

Figure. 6.33 Portable CO_2 gas analyzer

Carbon dioxide level in the project area is reasonable value, the concentration approaching 400 ppm. The source of CO_2 coming from the automobile combustion, burning the trach, or cooking with firewood that coming from the human activity. According to NOAA, the global average CO2 level was measured at

400 ppm. However, there has no standard yet established by regulator regarding the level of ambient CO_2. The EU, established based on the impact to the human health, with the following level:

- 250 – 350 ppm is a normal background concentration in the outdoor ambient
- 350 – 1000 ppm concentration of CO2, with good air exchange in door (normal condition with no health issue)
- 1000 – 2000 ppm of CO_2 concentration, create complaints of drowsiness and poor air quality
- 2000 – 5000 ppm of CO_2, consider as poor air quality and can create major health issue such as headache and sleepiness
- Above 5000 ppm, suggested for human being to only exposure maximum 8 hour a day
- >40,000 ppm, exposure may lead to serious oxygen deprivation, resulted in the permanent brain damage, comma, or even death

Given above facts, the result of ambient air quality in term of CO2 in Timor – Leste, is relatively good as the result approaching to the natural background where no major activity.

The summary of the baseline air quality parameters, as measured during the field observation can be seen in the following table.

Table 6.15: Summary of Air Quality Measurement

Location	Parameters Measurement				
	PM_{10}, (**µg/m³**)	$PM_{2.5}$, (**µg/m³**)	CO_2, ppm	NO_2, (**µg/m³**)	SO_2, (**µg/m³**)
Within Proposed Terminal	148	64	380	<2.5	<3
Community - sensitive receptor	115	48	371	<2.5	<3
Standard by WHO	50	25	-	200	25

The result shows that the measured particulate matter in the project area is higher than in the sensitive receptor, as the area is under pre-construction site, where a lot of broken soil was observed. The wind could easily blow the broken soil and cause the particulate matter transport from one place to the other. The results in these two areas of measurement show the elevated value of particulate matter. Compare the standard, the measured value of PM observed in the project area was higher than the standard. However, the measured value is only temporary and turn to normal threshold value once the construction has already completed. Other parameters such as CO_2, SO_2, and NO_2, do not know any issue for the baseline information. More detail information on the measurement result of the baseline air quality assessment can be seen in the annex 5.

6.1.5 Surface Water

The main water course in the project location is the marine water, surface water and groundwater system. The following map shows the catchment system where project facility is located. The river network within the catchment system is mainly dry throughout the year, except during the rainy day, where flashflood could potentially become an issue in the project location. The following figures show many rivers that carries the surface water runoff from upland catchment area to the sea.

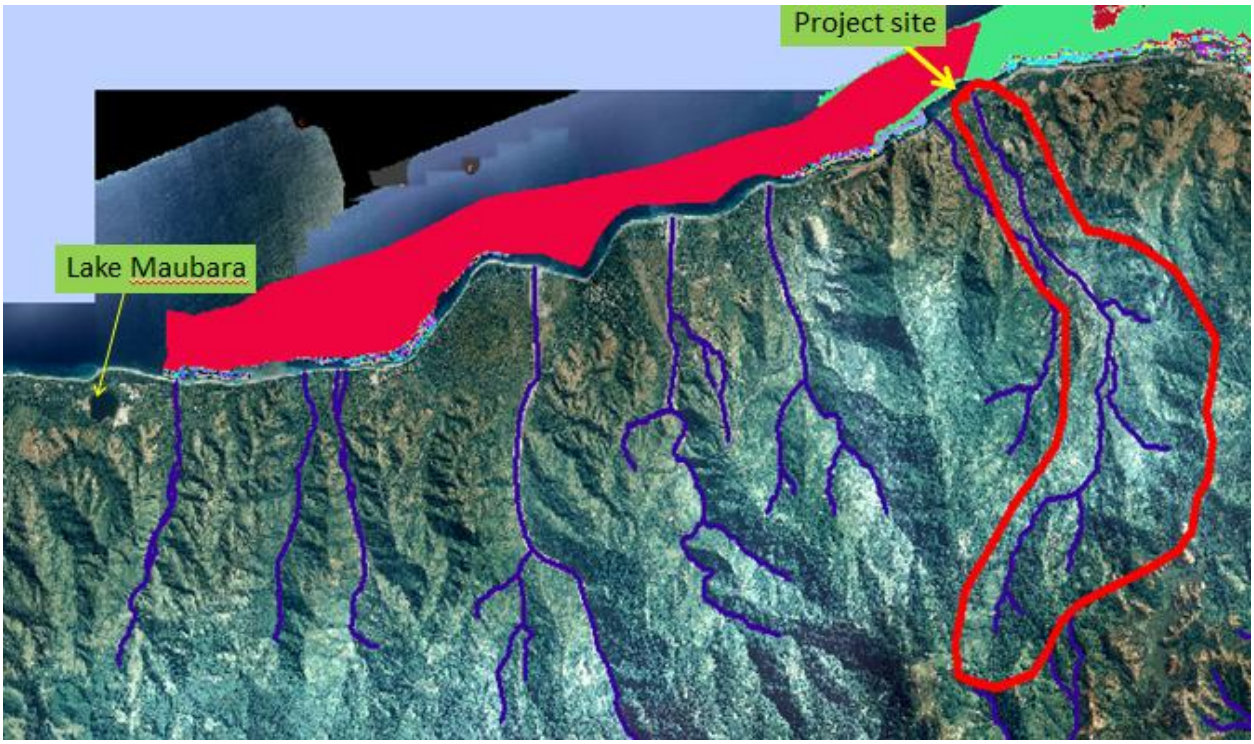


Figure. 6.34River Network in Liquica Area

Some part of the river, particularly at the upstream location, in Liquica town is used as water supply source for the town of Liquica, which normally gets dry during the prolong dry season. Stable water resoruces that utilizes in the low laying area is the groundwater. The proposed project development will take place nearby the river bank, where the surface water study, related to the flooding will be important.

Figure 6.35Liquica River

Potential impact from the project to the river, especially, in transporting the contaminant that build-up on the land surfaces next the river during the rainy season to the marine water body as the ultimate receiving water body. The analysis of the storm water quality, in relation to the oil related business will be conducted, during the rainy season to know the background quality of surface water for the future reference. Grab sample of storm water runoff will be collected to be measured the quality in the laboratory.

Beside the river, there is also Saline Lake in Maubara, which has already identified as the protected zone. The study done by the government on how to make Lake Maubara area as an attractive place to attract the tourism to support the country in the future.

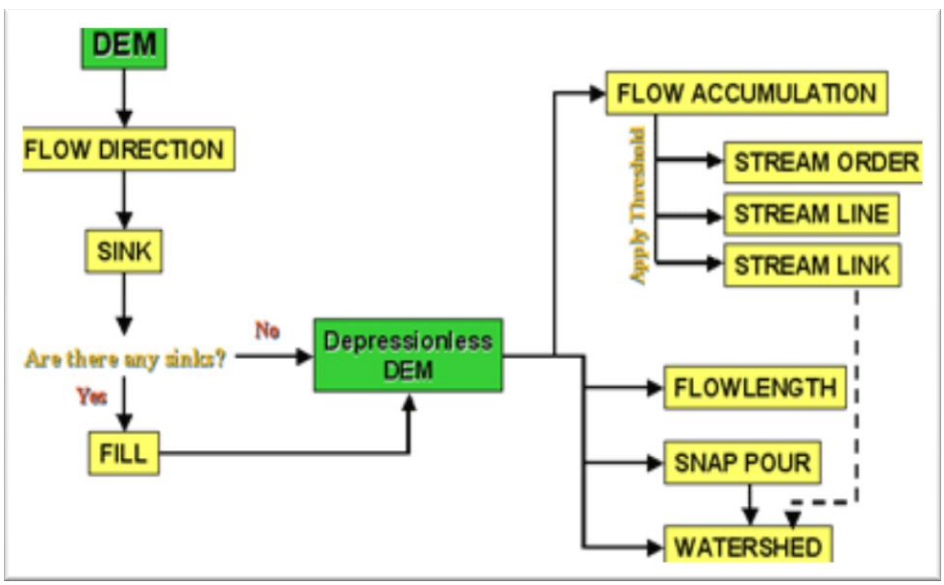
Figure. 6. 36 Proposed Marine Water Quality Sampling Location

The lake is mostly saline or brackish, which is not suitable for human and most of the animal consumption. The surface water flow in the term of catchment flow, river hydraulic, and quality of storm water runoff in the river are the most important subjects of investigation by this study to provide information of the hydrological process, especially flooding and storm runoff quality impact to the marine aquatic system. Therefore, as part of the current EIA study, the catchment definition, flood flow estimation, river flow capacity estimation, and water quality measurement shall be conducted.

6.1.5.1 Catchment Definition

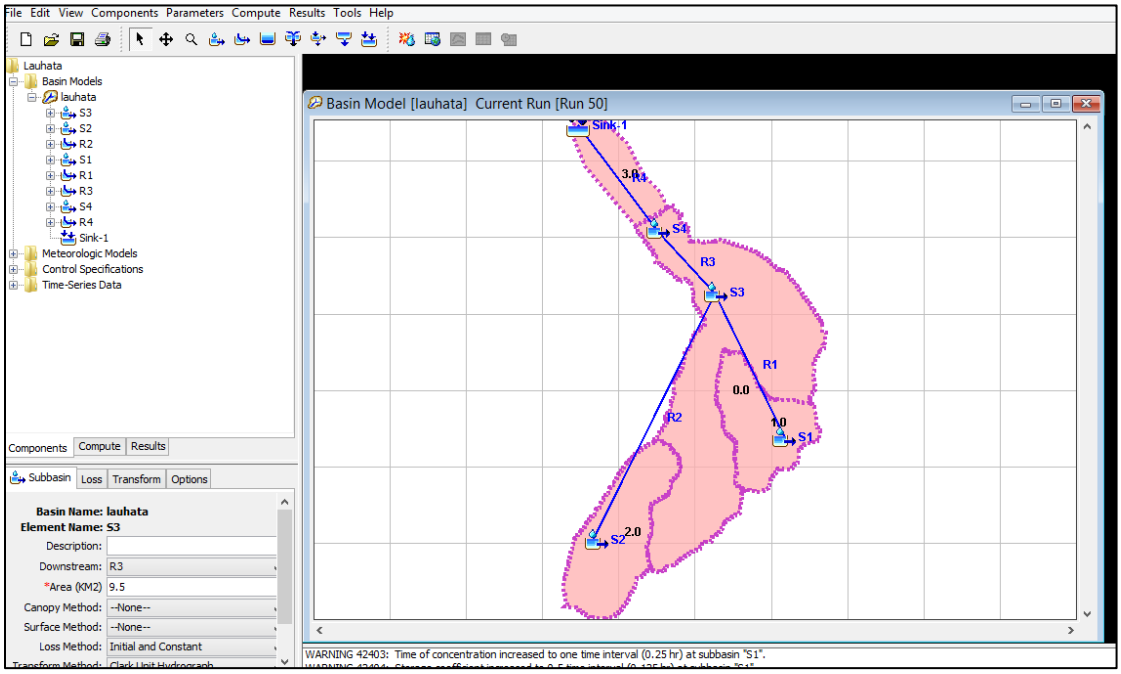
In order to estimate the flooding rate in any catchment system, the catchment as system would need to be determined. As described from the previous section (6.1.2) that the DEM is the most common use of data to determine accurately the catchment system. Using the GIS method and DEM the catchment of Lauhata can be determined. The methodology of catchment estimation based GIS method can be summarized as followed:

Figure 6.37 Summary of Catchment Definition in GIS



The result of the above methodology is the catchment with the parameters required for the hydrological modeling system. The hydrological modeling software using by this study is the one derived by US. Army Corp of Engineers or HEC-HMS modelling package to perform the flood flow estimation.

Figure 6.38 Example of HEC-HMS



Important model parameters to be considered in the modeling are:

- Area of each sub-catchment
- Average slope
- % of impervious area
- Time of concentration
- Lag time

Using the GIS tools and topographic data defined earlier, important hydrological model parameters can be determined. The output of the hydrological model will be used in the hydraulic modeling to assess flooding risk that the catchment contributes to the project area during the operation of the proposed development facility. Particularly, the high rainfall frequency such as 50 –years of rainfall would likely to produce a high flow/flooding in the river and potentially produces overflow in the bridge, as the bridge is assessed as bottle neck of the river flow. Preliminary assessment of river condition indicated that the natural river has larger capacity to retain high flow of flood water, except at the bridge, that act as bottleneck to the flow. Overflow will likely occur in this bridge. The following pictures provide the geomorphology of the river.

Figure 6.39 Width of River at Upstream Location

The assessment indicated that the width of the river was estimated to be around 70 m the average depth of 1.8 m, which shows the river has a very large capacity.

Figure 6.40 Flow Bottleneck at Existing Bridge

The downstream of river section on the other hand, shows that the river capacity getting smaller. Information from the local population suggested that at one time, overflow occurs in the road, as the carrying capacity of cross section under the bridge is much smaller than the upstream or downstream cross section.

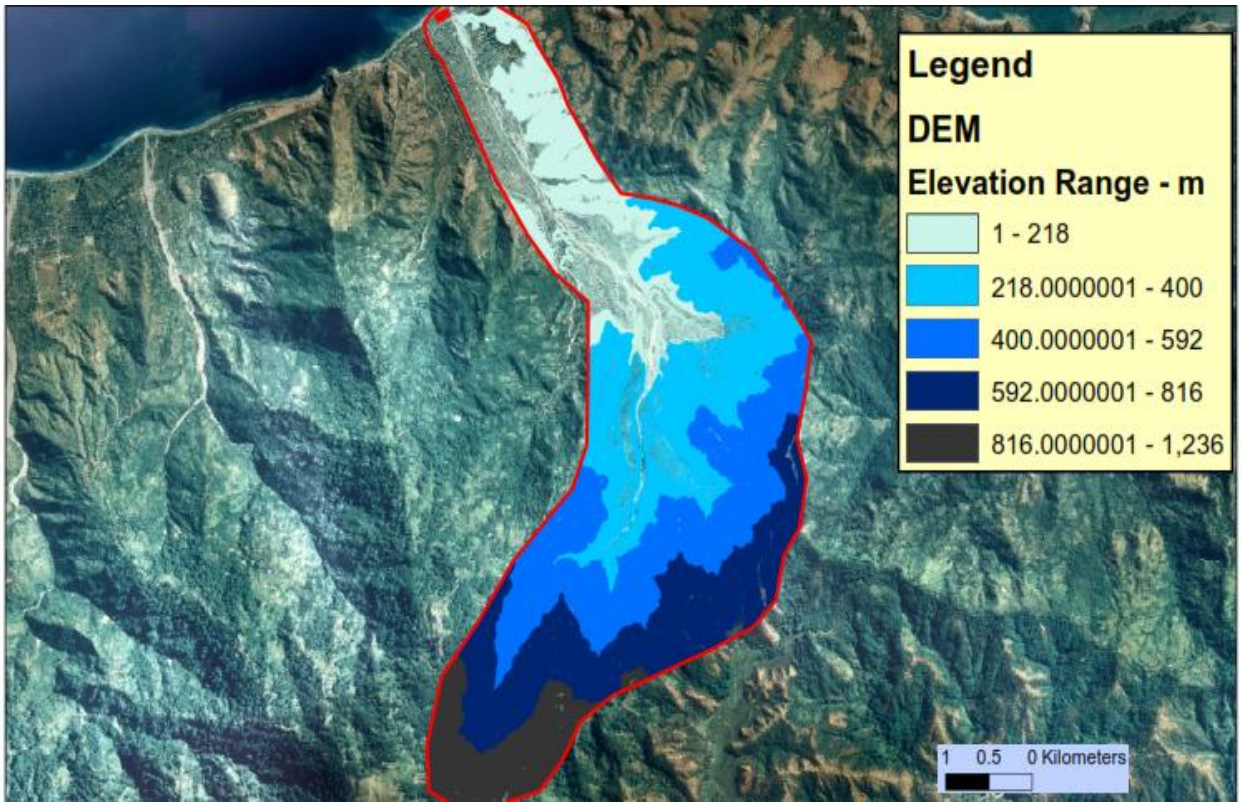
Figure 6.41 Rivers Downstream Location

6.1.5.2 Hydrologic and Flooding Analysis

The project is located within highly modified urban environment where lands have been compacted and graded and the natural drainage pattern has been altered with man-made drainage lines. The topography of the project location is generally flat in the low land area with hills in the southerly direction. The site will further be elevated to approximately 2-3 m above the current ground level, to be at the same level as road. Topographic interpretation of contour lines in the area shows original project location to be at approximately 1-6 m from msl.

Figure 6.42 Topographic Profile of Surrounding Area (Source, ASTER DEM)

However, at the upland catchment area, the elevation value from 600 to 1300 meters and the terrain is reasonable steep.



The topographic condition will affect the construction, particularly related to the floor level to prevent flooding that potentially coming from the river, as well as coming from sea (coastal flooding due to surging during the highest tide). Topographic data will also be useful information to design the grading of the facility and foundation work, as well as any structure within the proposed facility. As part of project preparation and design, the topographic site survey will be conducted to provide more accurate information for design and construction. The topographic data can used for various analyses such as catchment analysis, slope analysis, land cover analysis, which are important information in hydrological and flooding study. Using the digital elevation model (DEM), the catchment of the Raukasa River was derived for the further hydrological modeling study. Using the DEM of Timor – Leste, which derived from ASTER, the Lauhata catchment was determined and the result is presented in the following figure.

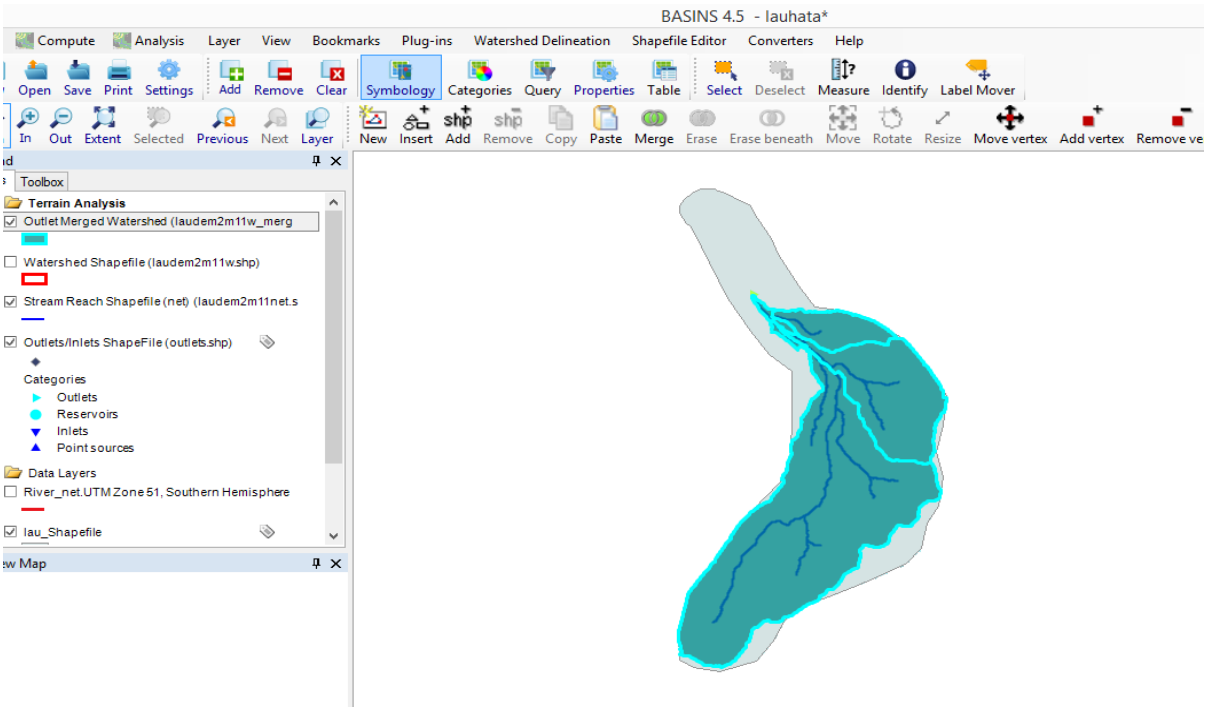


Figure 6.43. Lauhata Catchment System

The total area of the catchment is equal to 17.1 KM^2, which contribute the runoff from mountain area to the sea. Other catchment characteristics such as slope of channel, channel width, and other that will be useful in the modeling of flood flow.

Table: 6.16 Catchment Properties

MWShapeID	Area_SqKM	AveSlope	AveElev	CH_W2	CH_D	CH_L	CH_S
0	9.5	54.5	540.3	0.2	0.0	425.7	4.0
1	0.9	44.7	218.4	1.2	0.1	1024.2	4.6
2	2.9	48.3	331.3	1.0	0.1	2062.4	4.3
3	4	20	290	1	0.4	500	2

The clear catchment definition is important in the flood flow estimation. The above catchment characteristics were used to determine the hydrologic model parameters, in HEC – HMS modeling, such as time of concentration, lag time, and storage parameter of each sub-catchment system. Other important catchment parameters such as infiltration, decree of imperviousness, were determines at the very conservative level, such as at the saturation, were the infiltration rate reach the steady state and the storm runoff reach the maximum contribution of runoff from the entire catchment area

The relevancy of the hydrological study in this proposed project development is related to the flooding analysis, due to the location of the project, which is at lower level of the catchment, especially next to the river bank. The high flow due to high frequency of rainfall could affect the existence of the project, during the operation. Therefore, the hydrological and hydraulic analyses were conducted in order to

provide the hydrological and hydraulic information to better design the facility for minimization of flooding impacts.

The HEC-HMS modeling package was used to calculate the flood flow generated by various rainfall frequencies designs. The following figure shows the modeling setting of the rainfall-runoff modeling.

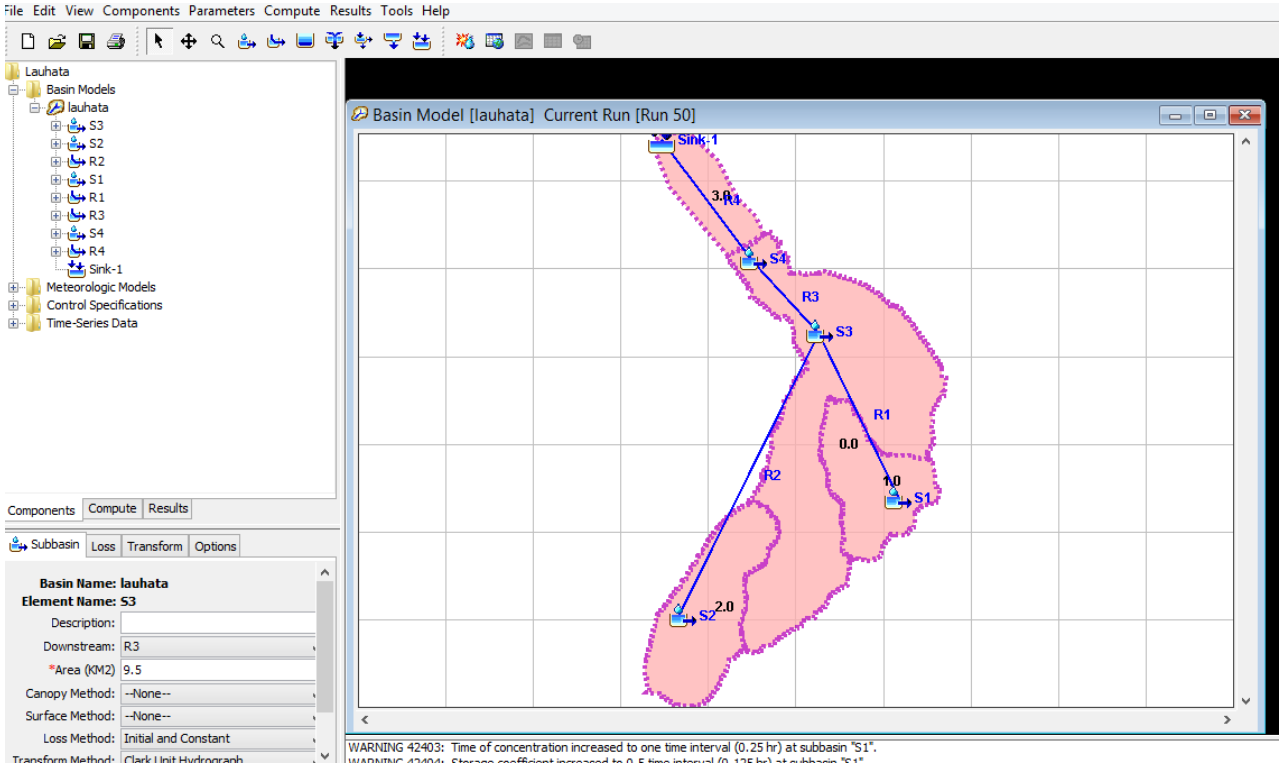


Figure. 6.44 HEC-HMS Hydrological Modeling Setting

Further detail on the modeling and parameters estimation can found in the appendix 1 – Hydrological Analysis. The result of the modeling the time series of flood flow (Flood hydrograph) due to various rainfall frequency.

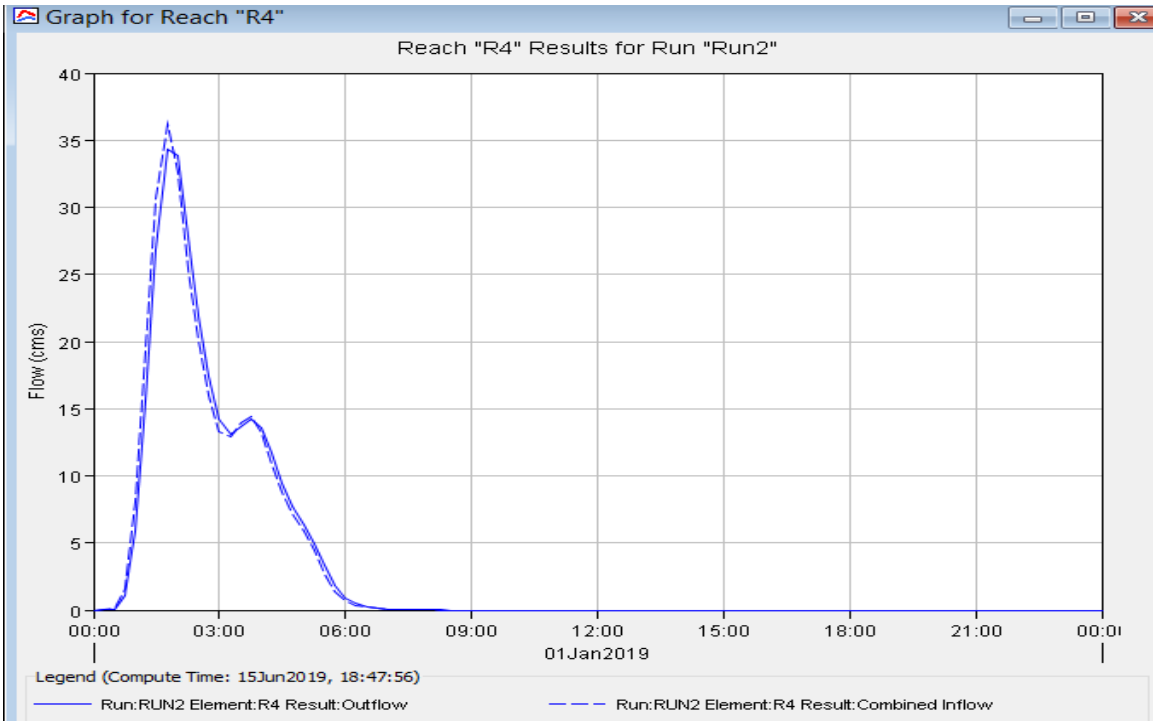


Figure. 6.45 Flood Hydrograph due to 2 –year Rainfall Frequency

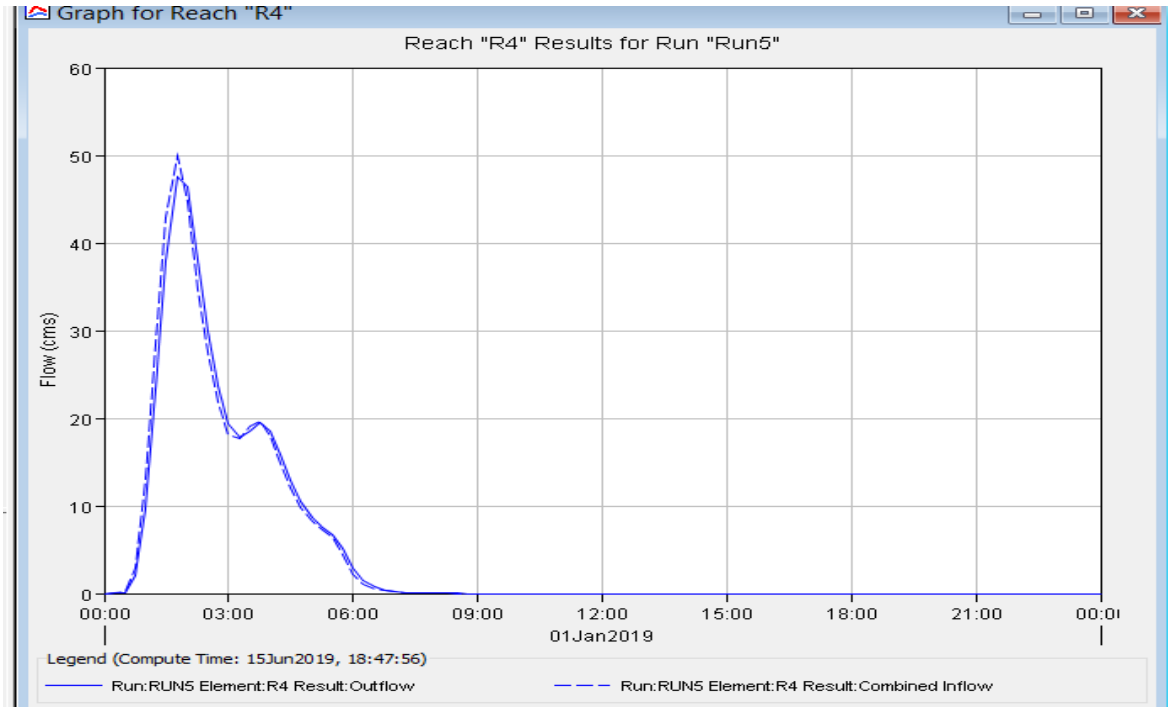


Figure. 6.46 Flood Hydrograph due to 5 –year Rainfall Frequency

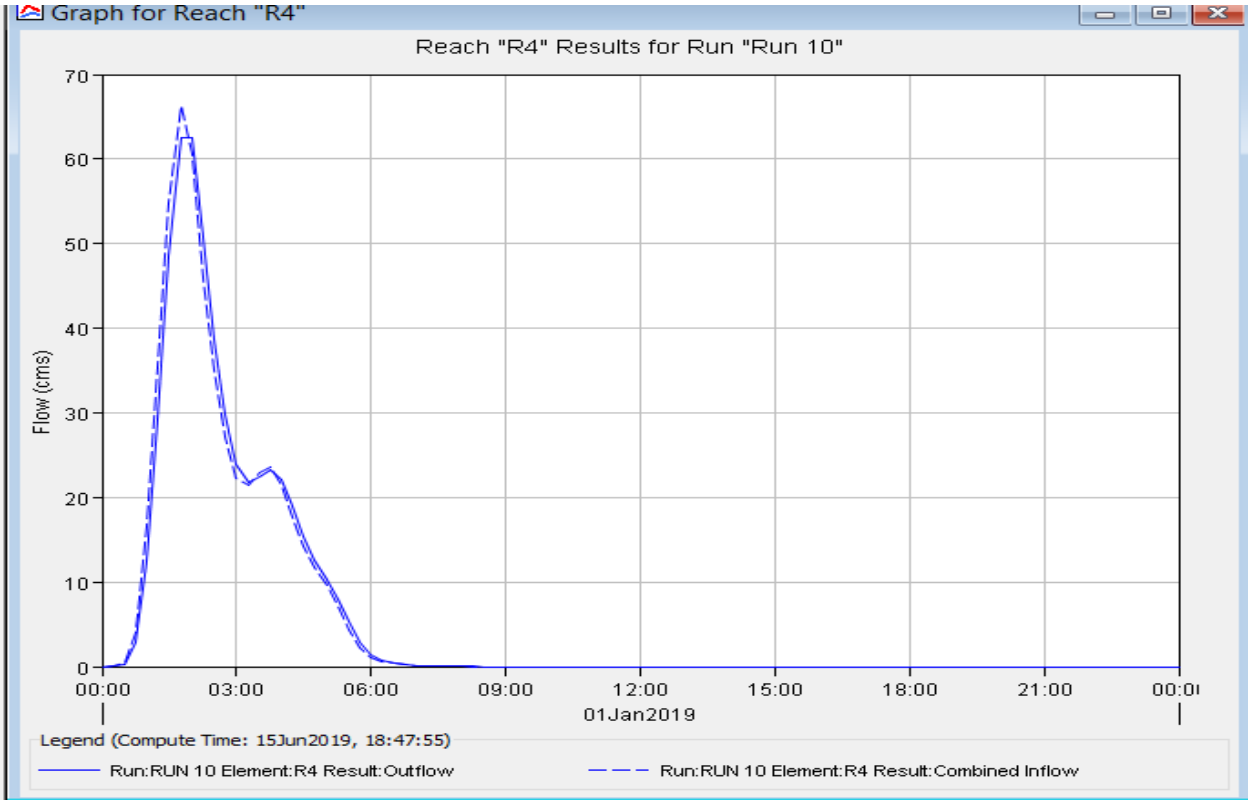


Figure. 6.47 Flood Hydrograph due to 10 –year Rainfall Frequency

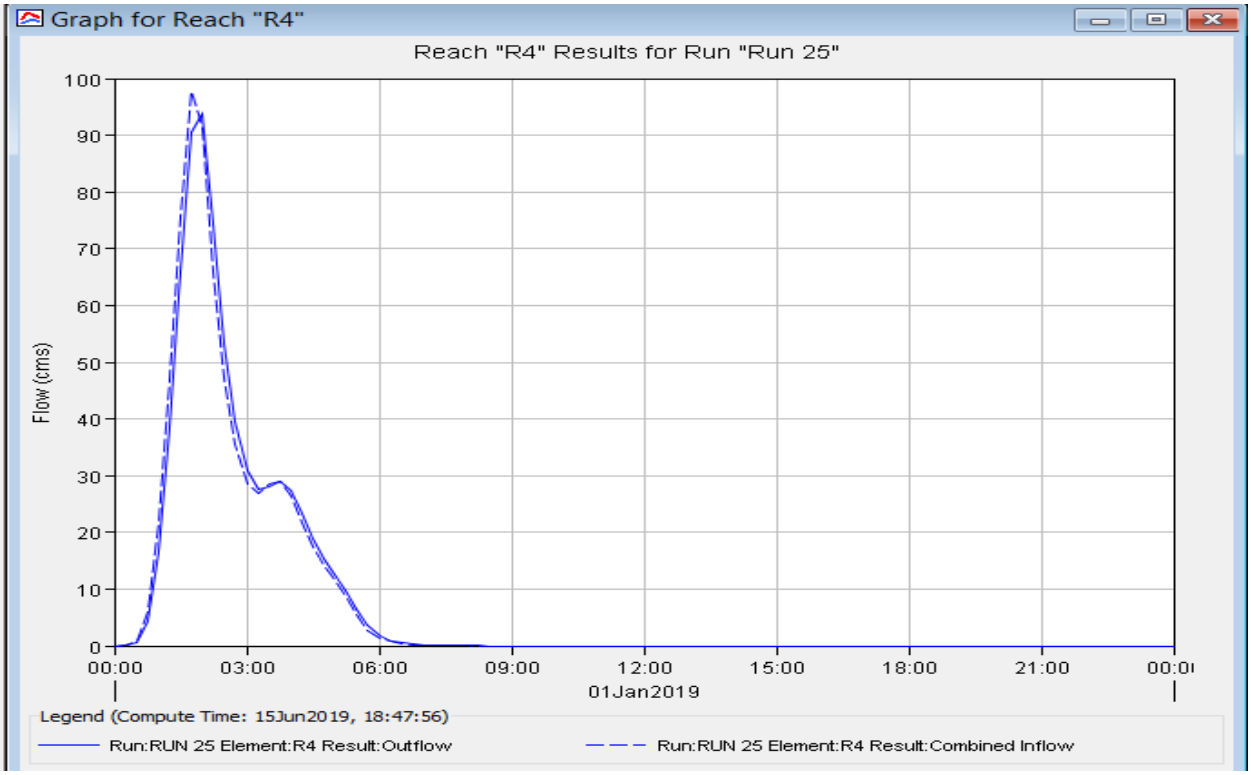


Figure. 6.48 Flood Hydrograph due to 25 –year Rainfall Frequency

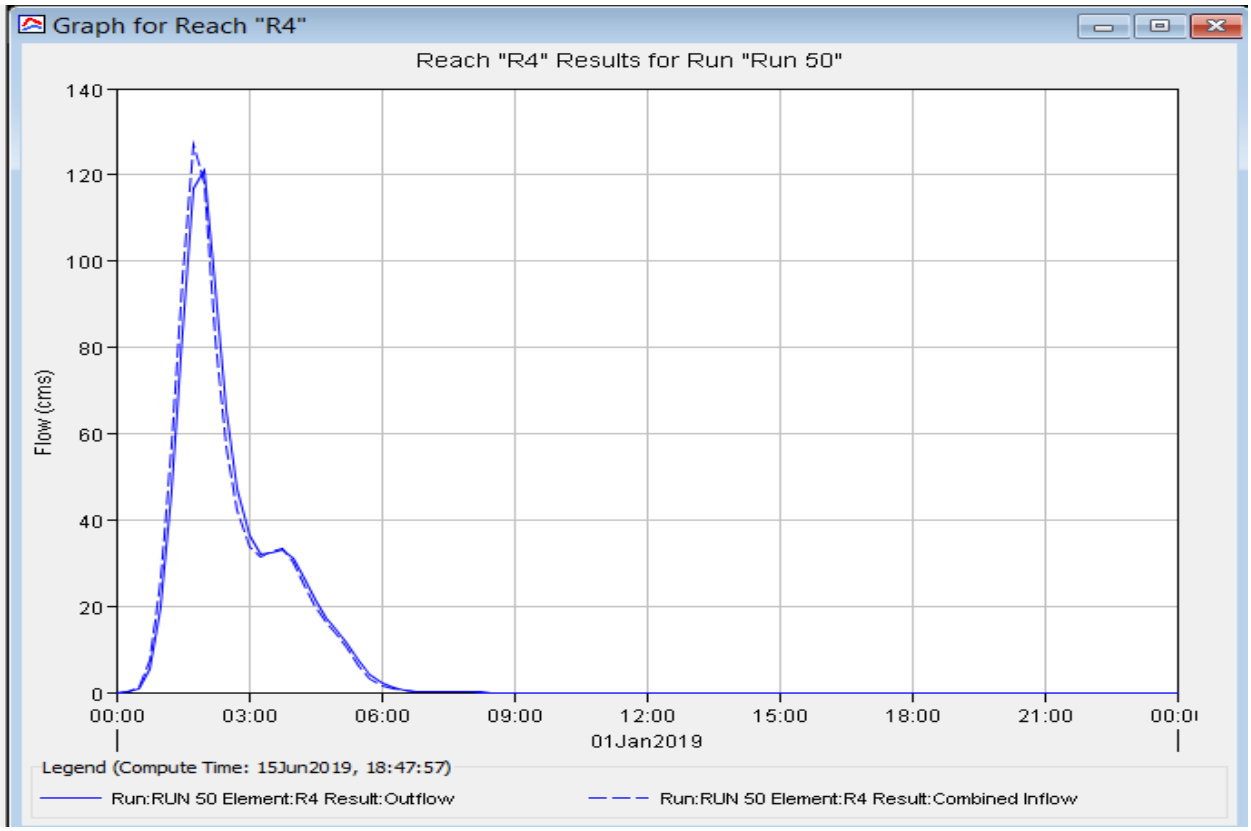


Figure. 6.49 Flood Hydrograph due to 50 –year Rainfall Frequency

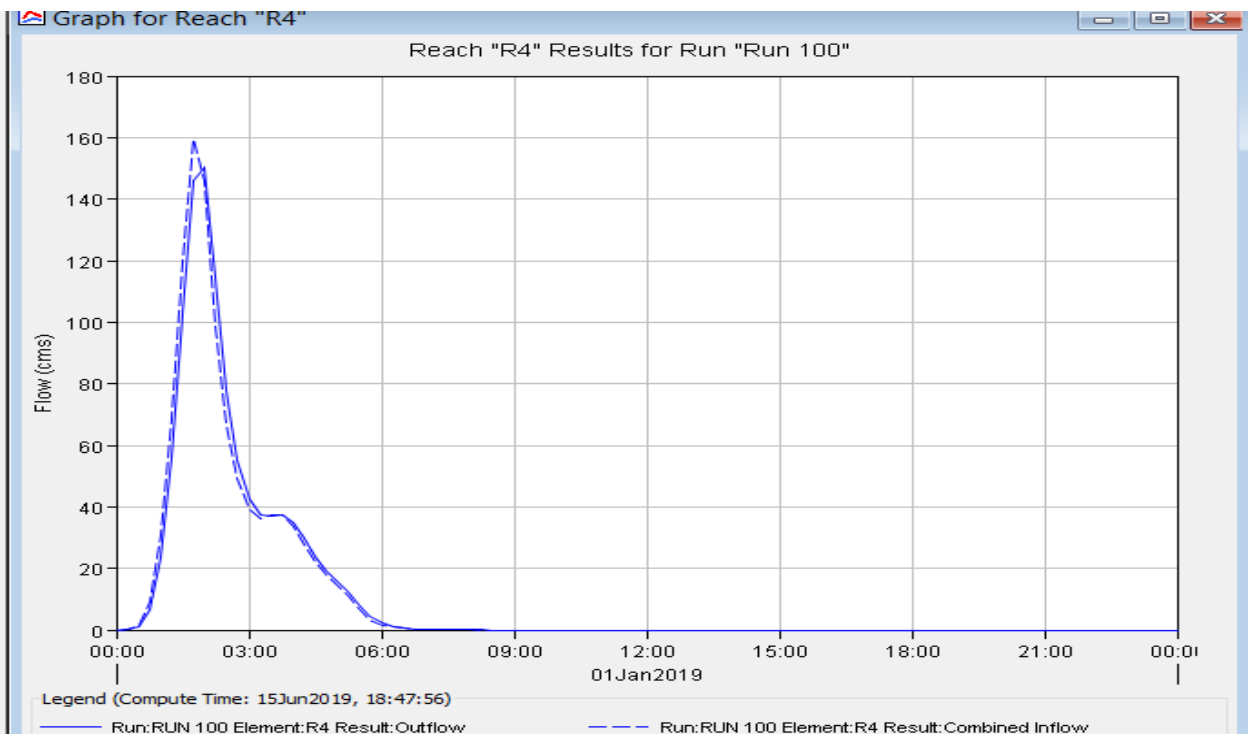


Figure. 6.50 Flood Hydrograph due to 100 –year Rainfall Frequency

The peak flows of each design storm frequency are presented in the following table.

Table 6.17: Summary of Peak Flood Flow

Peak flow of various Design Storm	
Design Storm, year	Peak flow, cms
2	34.3
5	49.9
10	66.4
25	97.9
50	127.2
100	159.3

The information of flood flow can be useful to map the flood pattern in the project location, particularly determining the flood depth, which will be useful for the designer to adjust the flood level and type of retaining wall to be constructed in the river for the flood protection purposes The flood hydrograph however, did not show any issue related to the flooding in the project area. In order to understand the flood hydrograph in term of flooding situation, the hydraulic modeling was conducted.

6.1.5.3 Hydraulic Analysis

Hydraulic modeling was conducted to analyze the channel or river capacity in respect to the flood flow and determining the level of over flow, which will flooded the adjacent area, such as project location. EPASWM modeling was used to calculate the flood behavior within the river system. The river cross section was measured by surveyor.

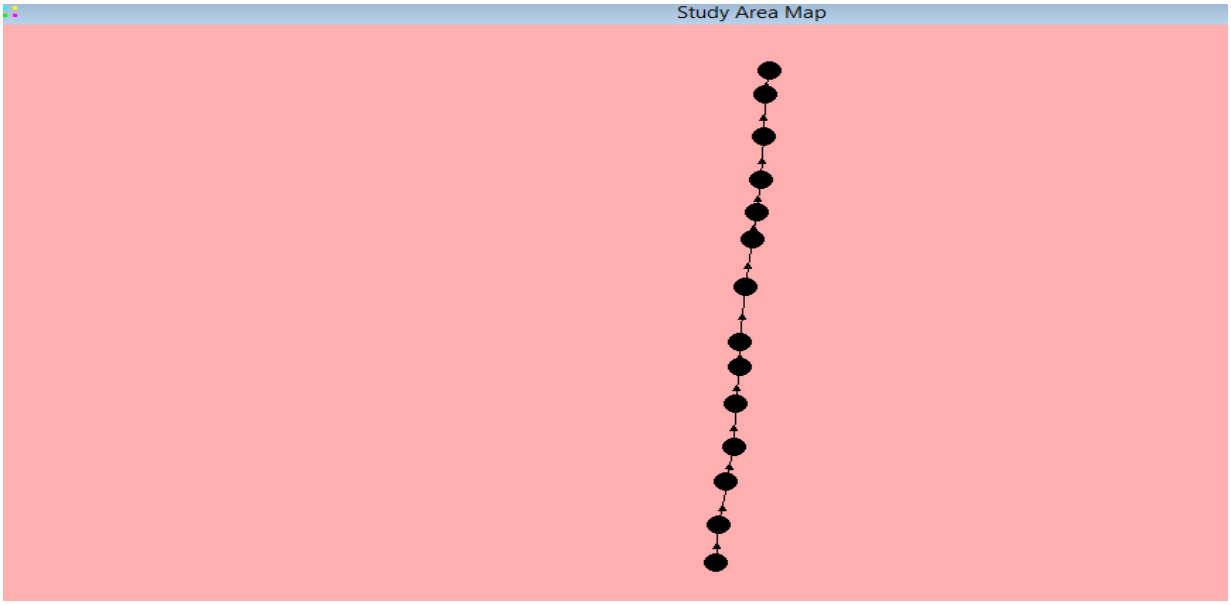
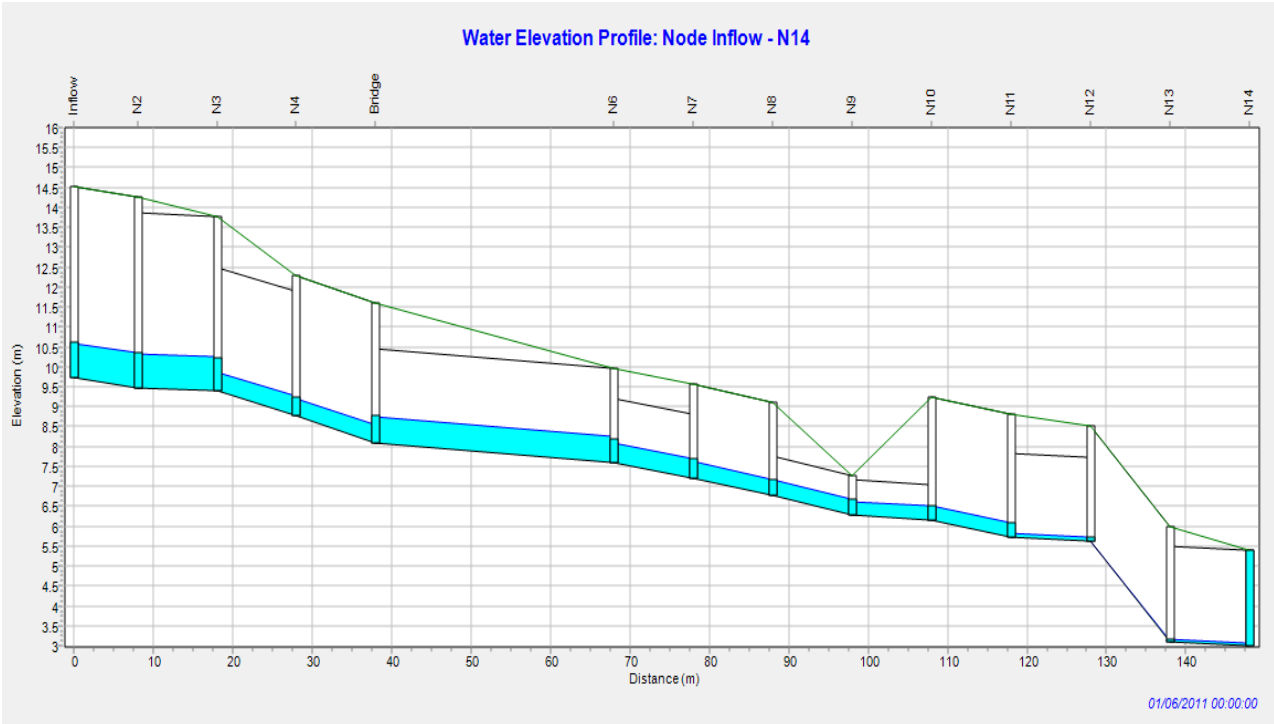


Figure. 6.51 Hydraulic Modeling Setting



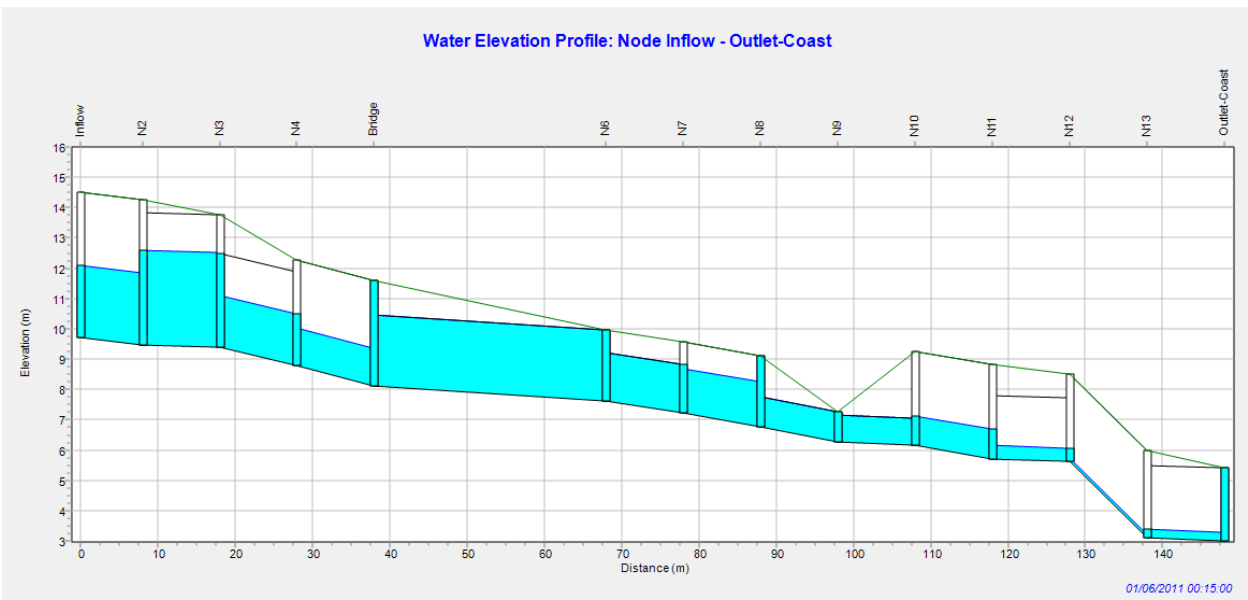
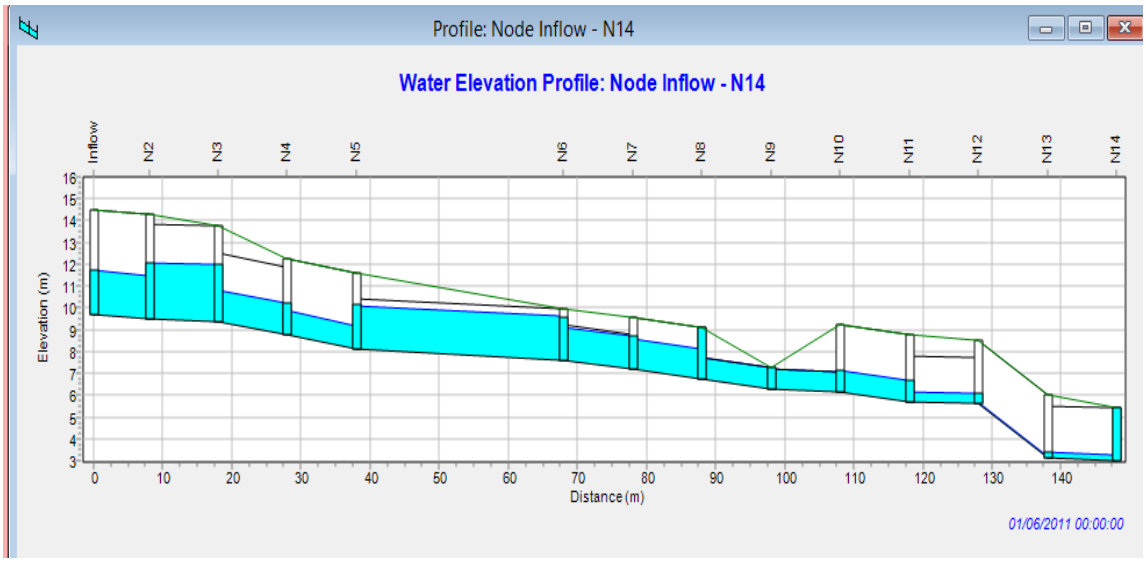


Figure. 6.52. Water Profile in the River (Hydraulic Modeling Result)



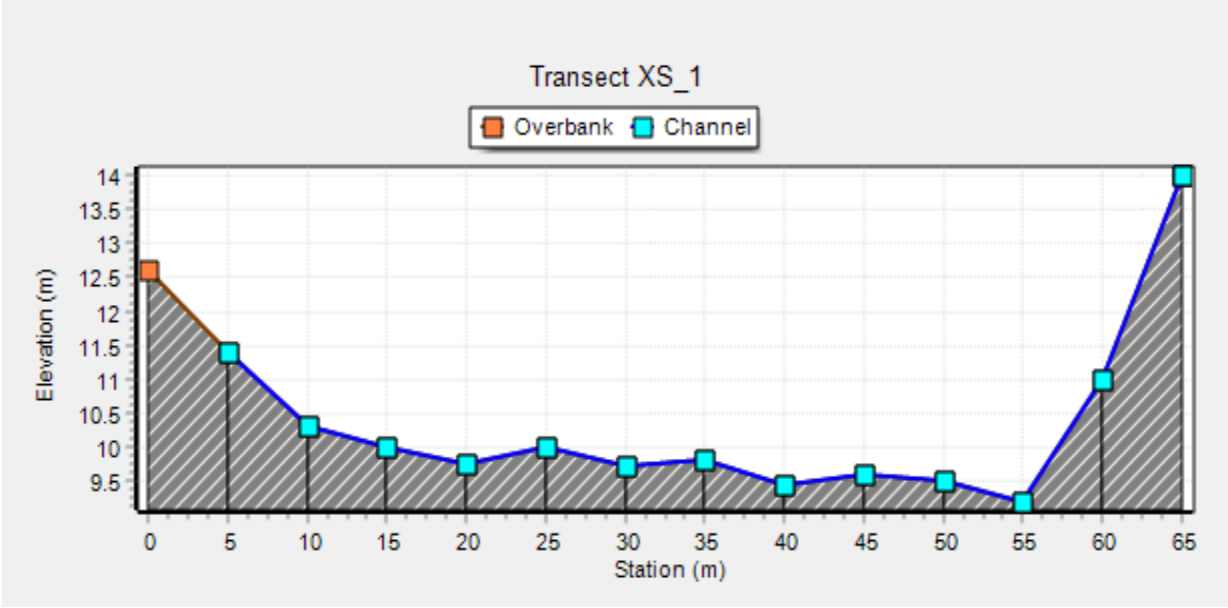


Figure. 6.53 Cross Section of the upstream of River

The result of the hydraulic analysis suggests that the river has a capacity to hold the flood flow up to 50 – years of rainfall frequency. However, overflow occurs that the bridge at the rainfall frequency of 25 – years. This overflow of the flood flow water will affect the project and action would be required to reduce the flooding risk in the project area and river section.

6.1.5.4 Surface Water Quality

Surface water from the river near the project site is only available during the rainy day. Few hours after the rain, the river goes back to dry. Some further upstream along the catchment, there is spring water utilized by local population as water source. As a prolonged dry season progress, the spring water will also dry out. Samples will be taken from both the spring water and the river during rainy days to measure

water quality. Test will be conducted locally at DNSA laboratory. The method of sample taken basically putting/catching the storm water flow in the river during the rainy day and bring to the laboratory for further measurement. The physical, chemical, heavy metal parameters will be measured within the storm runoff, which will provide the baseline information for the future reference. Particularly, the Total Petroleum Hydrocarbon (TPH) will be measured, in order to understand if there shall be any existing activity that polluted the ground surface and washed off by the storm runoff.

In general two methods shall be applied to estimate the TPH and Pb in the sample:

- Gravimetric Method, which is to measure the weight of sample and moisture
- Volumetric method, which to measure the volume of the sample to measure in the instrument for reading the TPH and Pb, and other parameters.

The methodology of the measurement of surface water quality parameters would further be described in the following table.

Table. 6.18 Summary of Surface Water Quality Measurement Result

No	Parameter	Unit	Raukasa – River	WHO/Timor - Leste Guideline	Testing Method
1	TPH	Mg/L	<1		
2	Pb	Micro g/L	<0.001		

6.1.6 Groundwater

Groundwater assessment is very important to be conducted as part of the preparatory study for the project development, concerning the fact that the project operation will need water source that originated from the groundwater. Prior to the final decision on the construction of water well, the assessment on the groundwater availability should be conducted to ensure the potential of groundwater resource for the utilization.

The pumping test of the groundwater wells in the project location was done in order to estimate the sustainable yield of the local groundwater aquifer. The sustainable yield was estimated based on the annual rainfall amount that contribute to recharge of aquifer. The pumping test data was conducted in order to know the aquifer drawdown in responding to the rate of pumping, as well as the aquifer properties. The geotechnical site investigation data was also used to determine the soil and aquifer properties in transmitting the water flow through the porous medium of aquifer.

The following map shows the constructed groundwater wells by the proposed development project, as well as the existing wells that have already in operation and shall be affected by the future pumping by the project.

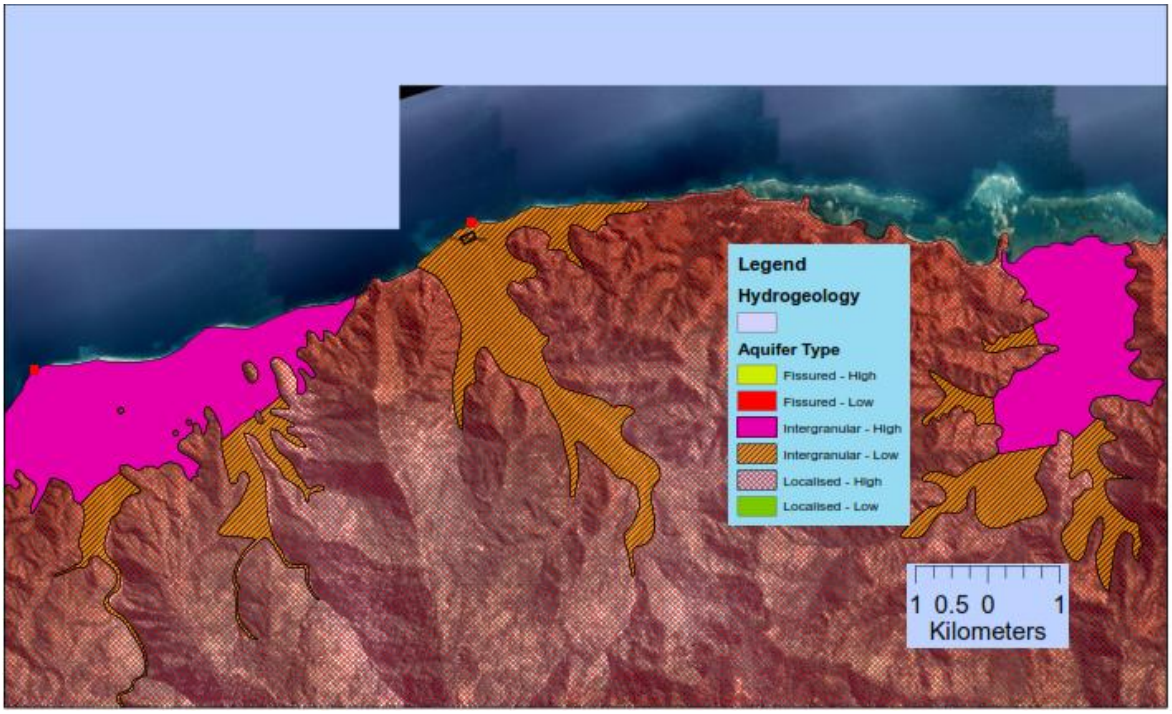
Figure 6.54. Proposed well and Existing Wells in Project Area

The preliminary information from the regional hydro-geological study suggested the groundwater potential in the project site, which followed by field work on observing the existing wells that shows the groundwater availability in the relatively shallow depth. The geotechnical boring work also shows the availability of groundwater in the depth between 8 -12 meters. All the above information, provide a prudent data to go to the next step, which is the groundwater bore drilling. The two site of drilling was proposed and each of the sites shows the large aquifer volume. However, pumping test will be conducted in order to know the aquifer storage versus the volume rate of withdrawal (pumping rate).

6.1.6.1 Groundwater Demand and Supply

Knowing the potential resource availability is very important information so that the groundwater resource utilization shall be sustainable. The hydro-geological information in the project area, as presented in the section 6.1.3, suggested that the type of lithology in the project area has potential groundwater availability. The following map shows the type of aquifer, which shows potential groundwater resources in the project location.

Figure 6.55 Aquifer Type of Groundwater in the Project Location



Type of aquifer is localizing high and intergranular low (Australian Geo-science), this type of aquifer with large area of recharge area, it is possible to have very high volume of groundwater resources in the project area and surrounding. However, the groundwater resources would also be depending on the demand (utilization rate). Therefore, analysis of the demand (utilization rate) and the availability of the source would be important to understand the rate of consumption versus the resource availability. Groundwater will be the main water supply source for the proposed development. The demand of groundwater shall be estimated as followed;

- Demand by the proposed development project = 2000 L/d
- Demand by the Cement Timor = 1000 L/d
- Demand by the population (200) = 10,000 L/d

Total water demand in the project area is projected to be 13,000 L/day, where the current consumption from the project is around 15% of the total current consumption rate. Although the capacity requirement of the water demand is fairly small, at the 2000 L/day, testing of the groundwater sources (quantity) and quality will be conducted. A pumping test will be conducted as part of the study to determine the sustainable yield of groundwater aquifer in the project location. As part of the project development, two groundwater bore will be constructed. One for groundwater production well and another one, is the groundwater monitoring well.

6.1.6.2 Construction of Well

The project owner decided to construct two groundwater wells, to service the following two objectives in supporting the proposed project development.

- Production well to fulfill the water need by the project
- Monitoring well to monitor the groundwater aquifer drawdown as a result of pumping by the project and other groundwater extraction in the project location

The location of the well can be chosen anywhere and the project owner decided to construct the wells according to the following map. The following proposed wells, where constructed.

Figure 6.56 Location of Groundwater Well in the Project area

Table 6.19. Coordinate location of each Well

No	Name	X	Y
1	BH1	125.399	-8.594
2	BH2	125.383	-8.568

These two wells have data related to the geo-technical investigation, where each soil type was taken. The following table shows the soil layer each meter downward.

Table.6.20 Soil Layer Type at BH#1

PROJECT: For Fuel Terminal Facility with the Capacity of Storage between 2000 and 3000 KL Steel Tank Liquica, Timor Leste		BORING NO: BH # 1 (GEOTEK-1)
DRILLING METHOD: Mud Rotary	DIAM: 96 mm	SHEET: 1 OF 1
SAMPLING METHOD: 50 mm split spoon barrel	CORE BARREL: NQ3	

DEPTH (m)	SAMPLES	(SPT) {REC} [RQD]	DESCRIPTION	SYMBOL	-0.075 (%)	Moisture Content (%) pH	Bulk Specific Gravity	LL [PL] (%)
		(2/3/5) 0.0-0.45/S-1	Loose greyish brown Silty fine to coarse **SAND** with Gravel (**SM**), gravels are (5-10mm)		36.9	5.4	2.60	
1		(15/11/11) 0.45-0.90/S-2 (12/11/15) 1.05-1.50/S-3	Medium dense greyish black Silty, Sandy fine to coarse **GRAVEL** (**GM**), gravels are (Quartz / Phyllite) 5-15mm **1.50 m**		25.7	8.0	2.50	
2		(16/9/4) 1.55-2.00/S-4 (5/7/6) 2.05-2.50/S-5	Medium dense greyish light brown Silty fine to coarse **SAND** with Gravel (**SM**), gravels are (Quartz / Phyllite) 5-15mm		35.2	8.5	2.64	
3		(7/8/8) 2.55-3.00/S-6	- greyish brown to 2.00 m					
4		(9/8/4) 3.55-4.00/S-7	**4.55 m**		22.1	11.1	2.63	
5		(8/6/6) 4.55-5.00/S-8	Medium dense greyish black Sandy fine to coarse **GRAVEL** with Silt (**GW-GM**), gravels are (Quartz / Phyllite) 5-20 mm - very dense greyish white below 5.60 m					
6		(33/50/-) 5.60-5.90/S-9	**5.90 m**		11.9	7.8	2.18	
7		(9/10/12) 6.55-7.00/S-10	Medium dense greyish yellow Silty, Gravelly fine to coarse **SAND** (**SM**), gravels are (Quartz / Phyllite and Coral fragments) 5-15mm **7.00 m**		12.9	14.2	2.48	
8		(18/18/10) 7.55-8.00/S-11	Medium dense greyish white calcareous Silty fine to coarse **SAND** with Gravel (**SM**), gravels are (Quartz / Phyllite and Coral fragments) 5-15mm		22.0	7.4	2.58	
9		(9/8/7) 8.65-9.10/S-12 (4/8/6) 9.10-9.55/S-13	- greyish Black below 8.65 m **9.10 m**		14.1	9.4	2.50	
10		(21/27/11) 9.90-10.35/S-14	Dense greyish black Silty, Gravelly fine to coarse **SAND** (**SM**), gravels are (Quartz/Phyllite) 5-15mm **10.35 m**		20.7	2.2	2.67	

DATE	TIME	BORING DEPTH (m)	CASING DEPTH (m)	WATER DEPTH (m)	REMARKS
14-May-19	8:00AM	10.35	9.90	3.50	Logger: N. A. RIZVI
16-May-19	5:00PM				

Table 6.21 Soil Layer Data at BH #2 (At the west side next to river bed)

CLIENT: PEC CONSULTANT UNIP.LDA.

PROJECT: For Fuel Terminal Facility with the Capacity of Storage between 2000 and 3000 KL Steel Tank Liquica, Timor Leste

BORING NO: BH # 2 (GEOTEK-2)

DRILLING METHOD: Mud Rotary | **DIAM: 96 mm** | **SHEET: 1 OF 1**

SAMPLING METHOD: 50 mm split spoon barrel | **CORE BARREL:** NQ3

DEPTH (m)	SAMPLES	(SPT) {REC} [RQD]	DESCRIPTION	SYMBOL	-0.075 (%)	Moisture Content (%) pH	Bulk Specific Gravity	LL [PL] (%)
		(5/4/2) 0.0-0.45/S-1	Loose to medium dense greyish light black Silty, Gravelly fine to coarse **SAND** (**SM**), gravels are (Quartz / Phyllite) 5-15mm		20.8	3.8	2.66	
1		(7/6/4) 0.45-0.90/S-2						
		(8/9/9) 0.90-1.35/S-3	- loose to 0.90 m - greyish white, 0.90 to 1.35 m					
2		(7/7/9) 1.55-2.00/S-4	- medium dense below 0.90 m - greyish light brown below 1.35 m		12.4	1.9	2.68	
		(8/9/8) 2.15-2.60/S-5	**2.60 m**					
3		(7/9/8) 2.60-3.05/S-6	Medium dense greyish light brown Silty fine to coarse **SAND** with Gravel (**SM**)		16.9	4.7	2.66	
			3.60 m					
4		(14/10/7) 3.60-4.05/S-7	Medium dense greyish black Gravelly fine to coarse **SAND** (**SW**), gravels are (Quartz / Phyllite) 5-15mm					
5		(8/7/9) 4.55-5.00/S-8	**5.00 m**		0.0	7.7	2.61	
6		(16/8/7) 5.60-6.05/S-9	Medium dense greyish light white calcareous Silty well graded **GRAVEL** (**GM**), gravels are (Quartz / Phyllite and Coralline sand) 5-20mm **6.05 m**		22.0	6.5	2.59	
7		(11/7/9) 6.55-7.00/S-10	Medium dense greyish brown Well graded **GRAVEL** with Sand (**GW**), gravels are (Quartz / Phyllite) 5-20mm **7.00 m**		1.4	3.8		
8		(18/11/23) 7.55-8.00/S-11	Loose to dense greyish black calcareous Sandy fine to coarse **GRAVEL** with Silt (**GW-GM**), gravels are (Quartz / Phyllite and Coral fragments) 5-25mm - dense to 8.00 m		9.6	9.0	2.61	
9		(6/6/2) 8.55-9.00/S-12	- loose greyish brown below 8.00 m **9.00 m**		6.2	9.4	2.65	
10		(15/16/45) 9.60-10.05/S-13	Very dense greyish yellow calcareous Silty, Gravelly fine to coarse **SAND** (**SM**), gravels are (Quartz / Phyllite and Coral fragments) 5-15mm **10.05 m**		18.1	11.6	2.58	

DATE	TIME	BORING DEPTH (m)	CASING DEPTH (m)	WATER DEPTH (m)	REMARKS
16-May-19 17-May-19	8:00AM 5:00PM	10.05	29.50	3.20	Logger: N. A. RIZVI

PLATE - 4a

Similar to the bore hole 1, the water table was detected at the depth of 3.2 m However, after the completion of the well, the actual water table was measured to be at the depth of 5 meter from the groundsurface.

6.1.6.3 Groundwater Pumping Test

The following map shows the constructed groundwater wells by the proposed development project, as well as the existing wells that have already in operation and shall be affected by the future pumping by the project.

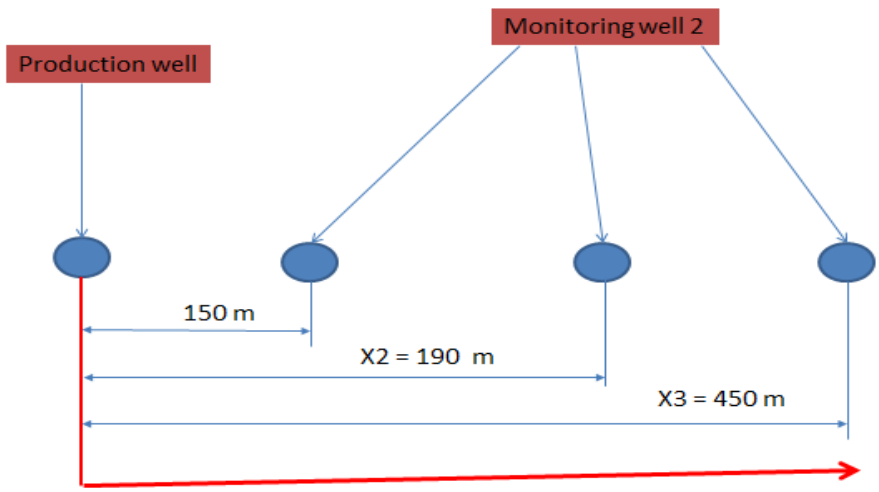
Figure 6.57 Proposed well and Existing Wells in Project Area

Moreover, the quality of the groundwater will be measured at DNSA laboratory to determine if any treatment of the groundwater is needed to fulfill the needs of the project. Currently, a shallow well exists in the site, however, a deep groundwater production well and one groundwater monitoring wells will also be constructed. The pumping test will be conducted during the construction of the two wells to determine sustainable pumping yield.

Proposed pumping test will be conducted for several scenarios:

- Pumping Rate variations with constant time against constant distance of monitoring well
- Constant pumping rate with variations over the distance

Figure 6.58 Proposed Pumping Test Works



The pumping test will provides the data of the local aquifer conditions and the impact of pumping to the water level drop in the aquifer (determine through observation of the monitoring wells). This analysis will be used as basis to propose mitigation measures in order to minimize impacts during operation of the storage facility.

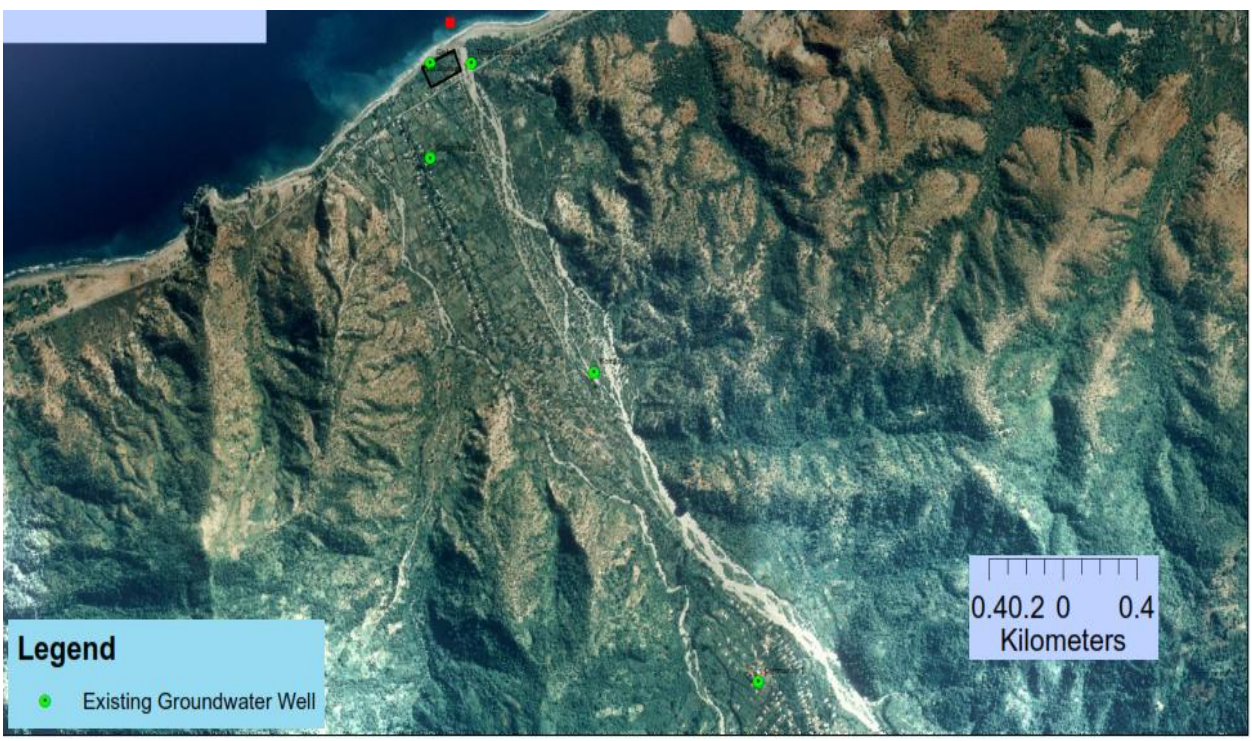


Figure 6.59 Locations of Community Wells

Detail information on the method of pumping test and data can be found in the appendix_2

Table 6.22 Location of Existing Groundwater Wells

No	Name	X	Y
1	Community 1	125.399	-8.594
2	Global	125.383	-8.568
3	Community 2	125.383	-8.572
4	Company	125.391	-8.581
5	Timor Cement	125.385	-8.568

Nevertheless, the result of pumping test can be summarized as followed:

- Pumping rate variation versus the maximum drawdown
- Maximum drawdown versus the distance of the monitoring
- Maximum drawdown versus the distance of monitoring

The following figure presents the summary result of the pumping test conducted by this study.

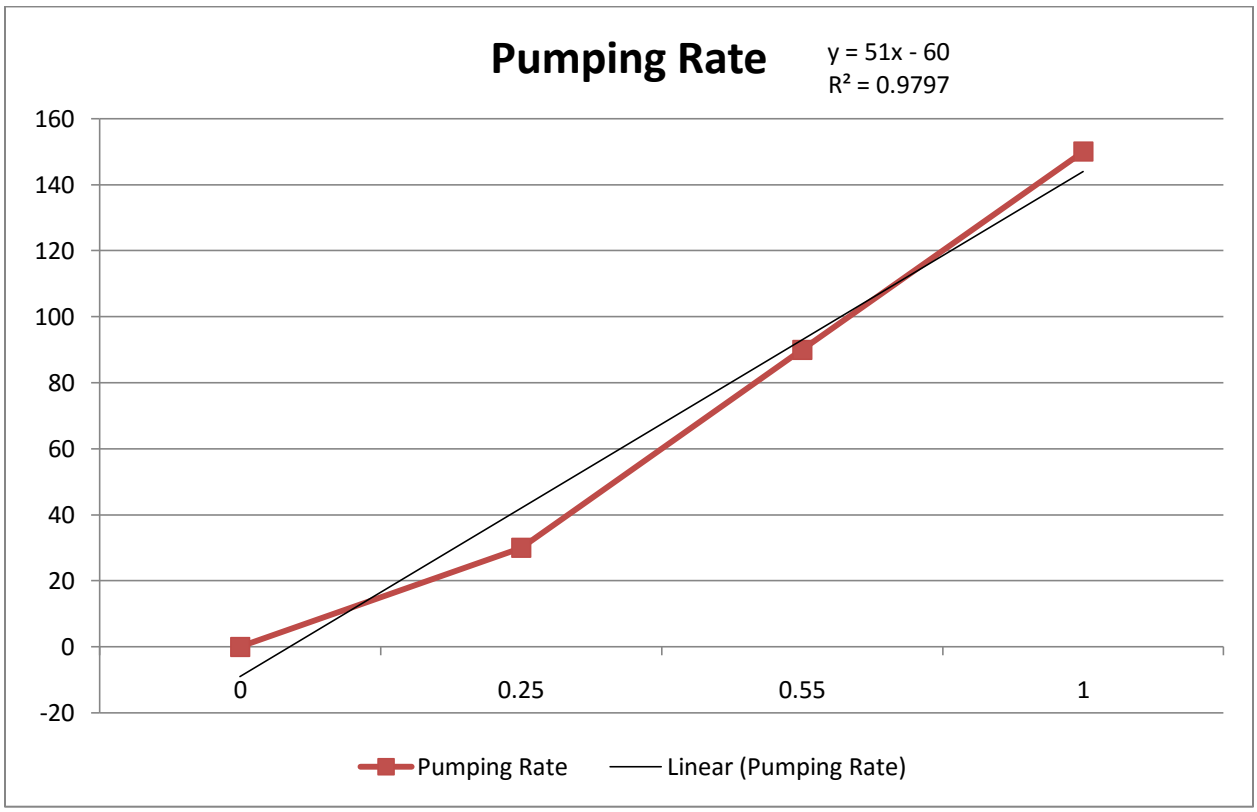
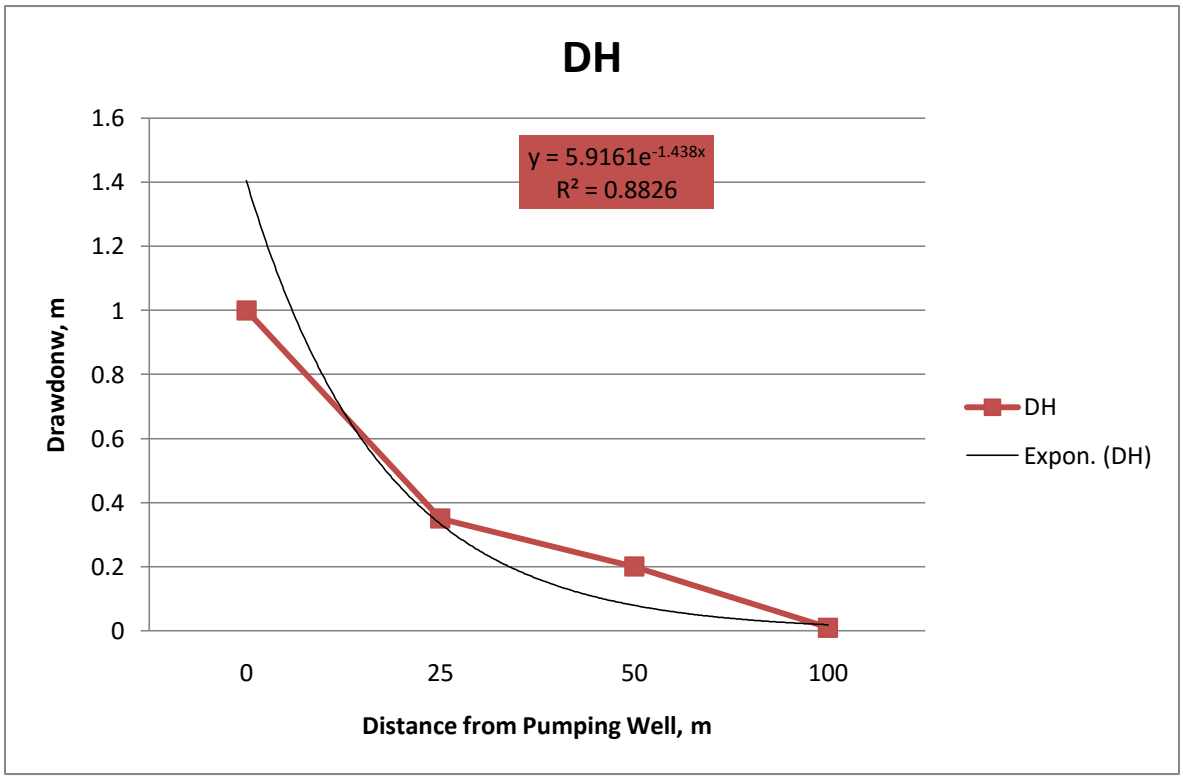


Figure. 6.60 Trend of pumping rate Against the Maximum Drawdown

The pumping testes were also conducted to know the impact of drawdown from the distance away from the pumping well. The result indicated that at the distance of 25 m from the pumping well the maximum drawdown achieved would only be very minor, around 35 cm.



The recovery test indicated that the well instantaneously filled up after the pump which should the high yield of groundwater resources.

6.1.6.4 Estimation of Groundwater Recharge Rate

The recharge area is very difficult to be estimated due to lack of regional study on the groundwater. However, the area of catchment would be considered as the smallest area of groundwater recharge area. The total area of catchment that contributes the hydrological flow into the area of interest of the project was estimated to be 18 KM^2. This means that the potential groundwater recharge area can be larger than the area of catchment or 18 KM^2. For the conservative estimation, the sustainable yield estimation, the area of catchment will be used as baseline information.

Information requirement:

- Recharge area = 18 Km2
- Annual average rainfall volume = 1500 mm
- Runoff coefficient = 0.7

Recharge rate = 0.3*1500 = 450 mm

Total annual recharge rate = 8.1 10 ^9 (m^3) Or 300 m^3/s or 300,000 L/s

This calculation indicated that the total maximum water that can be withdrawn from the groundwater would be around 300 m^3/s.

6.1.6.5 Groundwater Sustainability

Sustainability estimation of groundwater is very important to ensure that the resource is not over-extracted, that will jeopardize the aquifer being damaged permanently (irreversible) and also create various environmental risks, such as land subsidence and groundwater contamination. The demand of groundwater consumption is estimated to grow over time with the population grow.

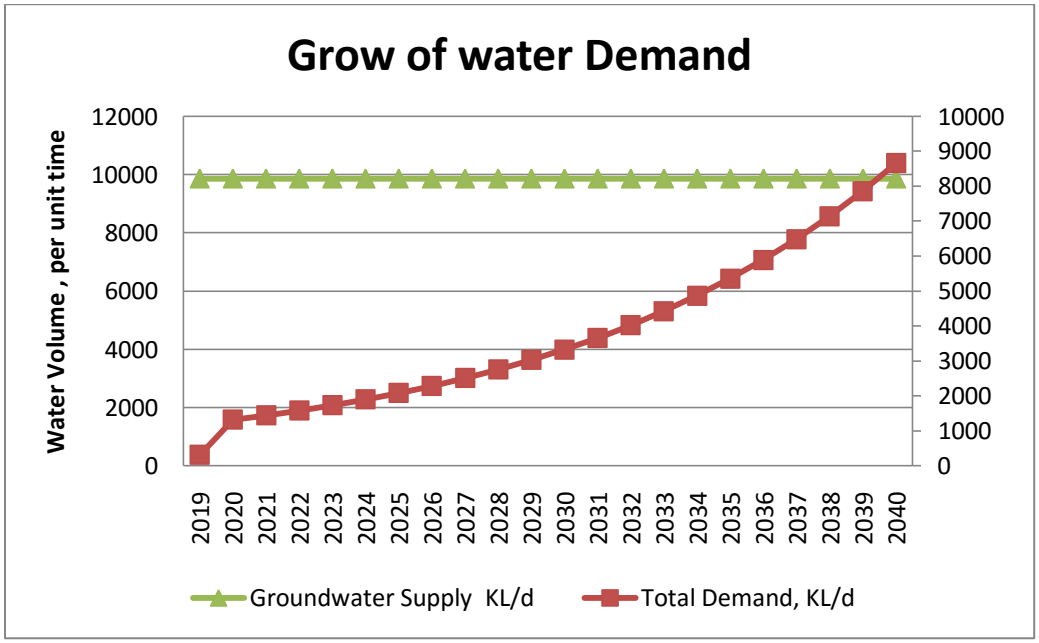


Figure. 6.61 Protection of Demand Grow with Constant Supply

It was concluded that the aquifer is able to provide the water supply in to response to demand and margin of safety is large, as resources is available from recharge of rainwater. Therefore no major should be arising in relation to groundwater quantity and sustainability.

6.1.6.6 Groundwater Quality Testing and Monitoring

In addition to the pumping test study, the sample of groundwater from each well will be taken for the measurement of physical, chemical, heavy metal, and biological parameters. The following map shows the groundwater quality measurement, which include the two well-constructed by this project and groundwater wells belong to the community and other companies operated in the area:

Figure. 6.62 Location of Groundwater Quality Measurement

The parameters measurement result in term of TPH (Total Petroleum Hydrocarbon) and lead are presented in the following table.

Table 6.23 Summary Result of Groundwater Quality Measurement (related to Petroleum pollution)

ID	X	Y	TPH	Pb	Name
1	125.3842778	-8.5677972	<1	<0.01	Production well
2	125.3831111	-8.5687222	<1	<0.01	Monitoring well
3	125.3830556	-8.5689167	<1	<0.01	Community well
4	125.3841111	-8.5695	<1	<0.01	Community well
5	125.3843611	-8.5701389	<1	<0.01	Company well

This data suggested that no sign of groundwater pollution related to the petroleum product and its derivative. More general physical, chemical, and biological quality parameters were measured in the Government laboratory at the Ministry of Public Work. The result is presented in the following table.

Table 6.24 Result of Groundwater Quality Measurement by DNSAS Laboratory (Ministry of Public Work, 2020)

No	Parameter	Unit	BH1	BH2	BH3	BH4	BH5	BH6	BH7	WHO/Timor - Leste Guideline	Testing Method
Physical											
1	PH		7.1	7.4	7.8	7.4	7.3	8.4		6.5-8.5	PH meter
2	E. Conductivity	mc/cm	16.29	10.45	10.23	9.68	2.65	10.61		NS	Conductivity meter
3	TSS	mg/L	0.1	0.05	0.02	0.05	0.06	0.04		NS	Gravimetric
4	TDS	mg/L	8.14	522	512	484	632	531		1000	Gravimetric
5	Salinity	Mg/L	9500	500	500	500	600	500		250	Conductivity meter
6	Temperature	C	28.1	28	19.2	27.7	27.8	28			Conductivity meter
7	Turbidity	NTU	33.9	0.7		10.9	1.6	0.2		5 NTU	Turbidity meter
Chemical											
1	NH3 -N	mg/L	0.8	0.8	0	0.9	1	0.8		1.5	Spectrophotometer
2	NO3-N	mg/L	0.6	0.6	0.4	0.8	1.5	0.9		10	Spectrophotometer
3	NO2-N	mg/L	0.011	0.004	0.003	0.011	0.012	0.006		1	Spectrophotometer
4	Fe	mg/L	0.6	0.02	0.04	0.2	0.04	0.03		0.3	Spectrophotometer
5	Mn	mg/L	0.3	0	0.1	0.3	0	0		0.5	Spectrophotometer
6	Fluoride	mg/L	0.17	0.03	0.04	0	0.16	0.32		1.5	Spectrophotometer
7	Cl2	mg/L	0	0	0	0	0	0		0.5	compactor
8	Ca.Hardness	mg/L	495	120	240	100	105	250		x	Titration
9	Arsenic	mg/L	0	0	0	0	0	0		0.01	compactor
	Total hardness	mg/L	515	140	x	150	125	340		200	Titration
10	Total alkalinity	mg/L	550	150	250	175	135	350			Titration
11	Sulfate	mg/L	250	92	80	80	103	109		250	Spectrophotometer
12	TPH	Mg/L	<1	<1	<1	<1	<1	<1	<1	<1	
13	Pb	Mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Biological											
1	Total Coliform	CFU/100 mL	3	1	TNC	3	TNC	2		0	Membrane Filtration
2	E. Coli	CFU/100 mL	0	0	22	0	TNC	0		0	Membrane Filtration

The result of groundwater quality measurement data indicated no major pollutant related to the petroleum product and other major pollutant that cause health and safety risk. However, there are issues related to the following parameters:

- Hardness and alkalinity
- Salinity
- Biological Indicator (E.Coli and coliform)

The harness and alkalinity of drinking water in various places is Timor – Leste has a problem naturally. Perhaps it is caused by the fact that calcite and dolomite is widely available in the soil, where the part of chemical would naturally dissolve in the water. While salinity profile indicated the relative distance to the coastal area. The following figure shows the analysis of salinity profile of the groundwater measurement in relation to the distance from the coastal area.

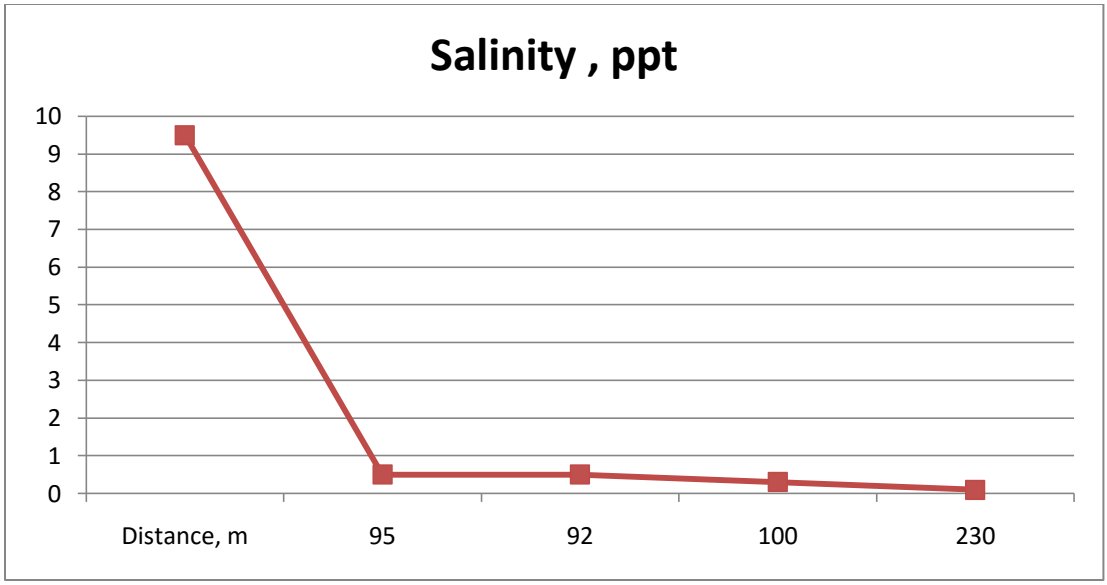


Figure 6.63. Salinity Profile Measured in the Groundwater

The result of groundwater quality measurement also provide an information to the project owner to further treat the raw water pumps out from the groundwater, as the quality of the water of brackish or salty with the salt concentration between 1000 – 10000 mg/L. The fresh or consumable water should have salt contain only 250 mg/L or less.

Beside the salinity issue, the quality of groundwater issue that nee d to be take into consideration, in order to ensure the quality of operation and sustainability as shown by the data are the total harness and carbonate contain. These two element of the chemical contain the water is very common issue in Timor – Leste, which will affect the health of the people who consume this type of water for a long time and the water will also cause corrosion and crack in the certain processing equipment.

The Reverse Osmosis (RO) technology can be used to treat easily this raw water prior to utilization in the project area. The treatment process will also prolong the lifetime of the equipment and facility of fuel storage system.

6.1.6.7 Freshwater and Seawater Interface

Annex 3 provides the report on the groundwater assessment, including the interface between the groundwater in the aquifer and seawater. The pumping test and monitoring of the groundwater level indicated that groundwater aquifer in the project area is affected by the seawater.

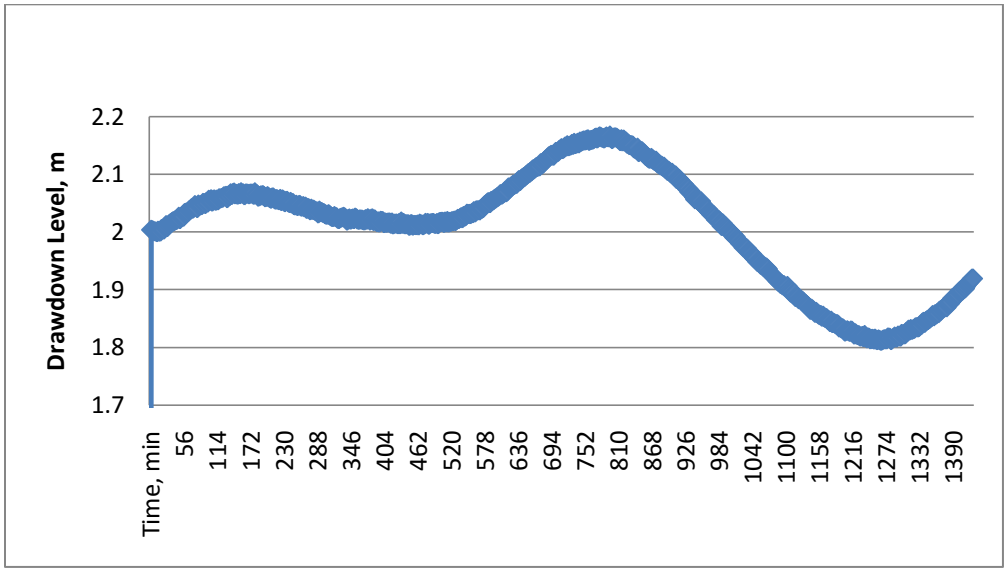


Figure. Groundwater level Monitored at X = 50 m with Q = 180 L/min

The water quality testing indicates the salinity range from 500 – 10,000 mg/L. The salinity level of the groundwater is much higher at the deeper well. Two well (one production and an other monitoring well), at the two different depth.

Table.6.25 Salinity Profile at the Different depth of Well

ID	Name	Depth	X	Y	Salinity, mg/L
1	Production well	20	125.3842778	-8.5677972	500
2	Monitoring well	30	125.3831111	-8.5687222	10,000

This measured data suggested that the freshwater layer is probably small for this localized aquifer. However, further research is required to fully understand the interface between the freshwater and groundwater, especially closer to the coastal area.

The figure at the salinity profile versus distance from the shoreline (figure 6.63), aslo suggested that the the further the distance away from the shoreline, the less impact of salt water to the groundwater, which is

normal. So probably, the the point where groundwater and salt water interface is at around 95 – 200 from the coastaline.

6.1.7 Coastal Water

Coastal hydrology or coastal water deals with the water movement in the coastal area. As the project will be located in the coastal area, the understanding of hydrological process in the coastal region could be important and significant. The project can be affected by the water movement in the coastal area, such as coastal inundation, which in the very large event, can be considered as tsunami and vice versa, the project may contribute negatively to the coastal hydrological process itself, such as contaminant transport to the coastal water that eventually spread-out into the wider coverage area. Therefore, study and investigation of hydrological coastal process can be significant to the project development.

The hydrological process (rainfall-runoff), as described from the previous section, shall contribute the runoff to the coastal water body. However, for the project, coastal, area is mainly the beach, where the main hydrological process, is affected by the low and high tides. During the low tide, the coastal shall not be inundated, so storm runoff coming from the upland catchment, shall not contribute any major impact, unless at the very large storm such as 50 –years of ARI. On the other, during the high tide, thee coastal hydrological event can affect the project, as coastal tends to be inundated. The situation could be major one, with high storm surge occur, during the high tide. In this case, the project location could be indicated. Furthermore, coastal hydrological process can also deal with the contaminant transport from the land based area to the coastal and eventually polluted the marine water.

Therefore, it is important to study the flooding flow from the upland catchment system and high tide the sea water movement inland is significant, to understand the wave/tidal impact to the sustainability of the project during the operation. The contaminant transport related to the project (oil spill, etc.), can also contribute a significant impacts to the marine water body. The result of the study will be used to properly design the floor level of the project area, to minimize the coastal flooding.

The important data and information required to carry out the coastal hydrological assessment related to the project development can be summarized as followed:

- Bathymetric
- Ocean current direction
- Tide measurement
- Coastal water quality

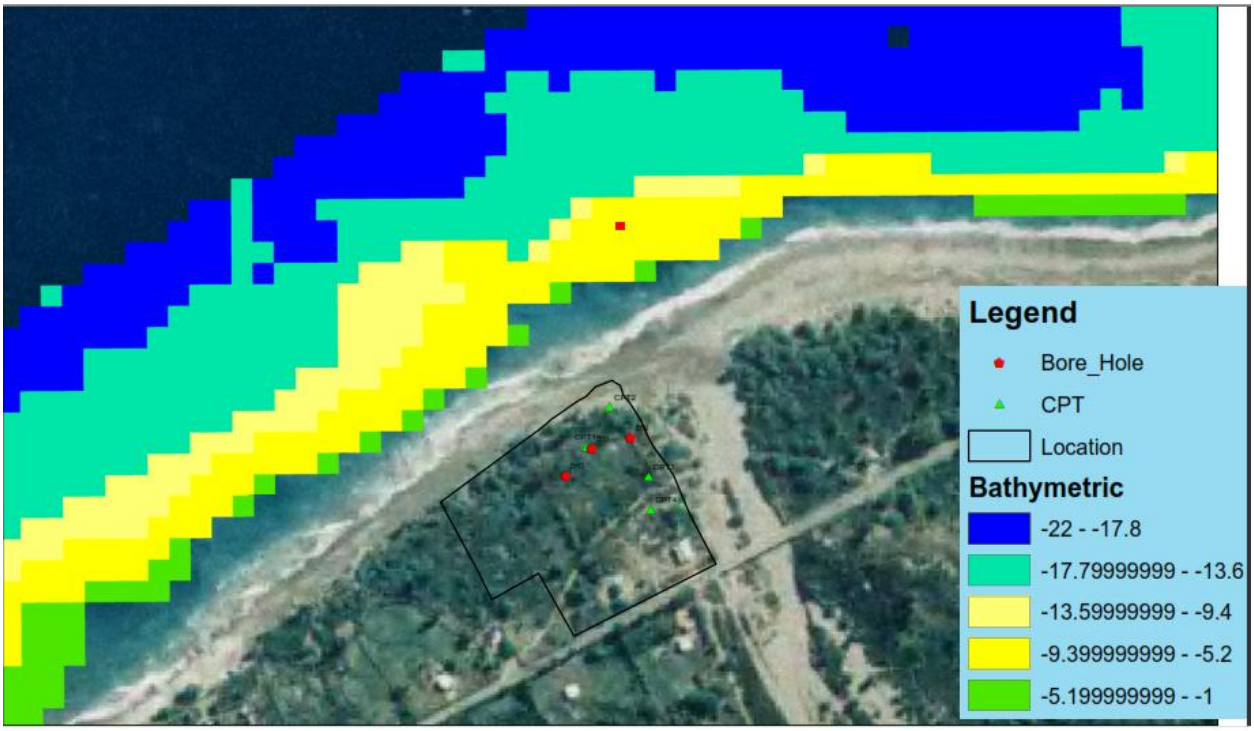
As the above data is expensive to be collected, in this study, secondary data will be sufficient to approximate the process and draw the conclusion, so that marginal safety in the design can be taken in order to minimize the impacts that may occur during the operation of the proposed development project. The limited measurement of the tide will be conducted by this study to measure directly the low and high tide, which can be used as information to design the floor level and other coastal protection structure needed to help reduce the risk during the operation.

6.1.7.1 Bathymetric

Bathymetric is similar principle as topographic in the land area that describes the terrain under the water. It becomes the basic principle of ocean science and engineering that characterize the marine habitats and have a various important management applications that include information about the depths and shapes of underwater terrain system. Bathymetry is a key element of biological oceanography. The depth and characteristics of the seabed define the habitat for benthic (bottom-dwelling) organisms and are fundamental aspects of marine ecosystems. Nearshore bathymetric data are increasingly important as scientists learn more about the effects of tsunamis, cyclones, and climate change-driven sea level rise on coastal communities and economies.

Bathymetric data for shallow-water areas are critical for assessing the status of coral reef ecosystems located there, as the exchange of nutrients, sediments, and pollutants between the land and ocean must pass through these habitats. It is also an area susceptible to anthropogenic impacts, such as sedimentation, nutrient enrichment, and ship groundings. Perhaps most importantly for the people and coastal communities of Timor-Leste, these nearshore areas provide food and livelihoods. Therefore, these data can be useful in helping protect and manage these fragile resources that support high levels of biodiversity. Understanding the bathymetric profile is very important for various purposes in engineering design for the purpose of navigation. The proposed project will incorporate the use of existing jetty with clear navigational route where ships have docked. Therefore the bathymetric and marine hydrodynamic investigation will be conducted for the purpose of analysis of pollutant transport. The following bathymetric data was derived from satellite images, done by NOAA in 2014.

Figure 6.64 Bathymetric Data derived by NOAA in 2016 for nearshore



The information will be used for proper design of the coastal protection system to ensure that safety operation of the propose development facility. As the data only cover the shallow water up to the depth of 20 meter, other secondary data of bathymetric would be need, especially, for the purpose of marine

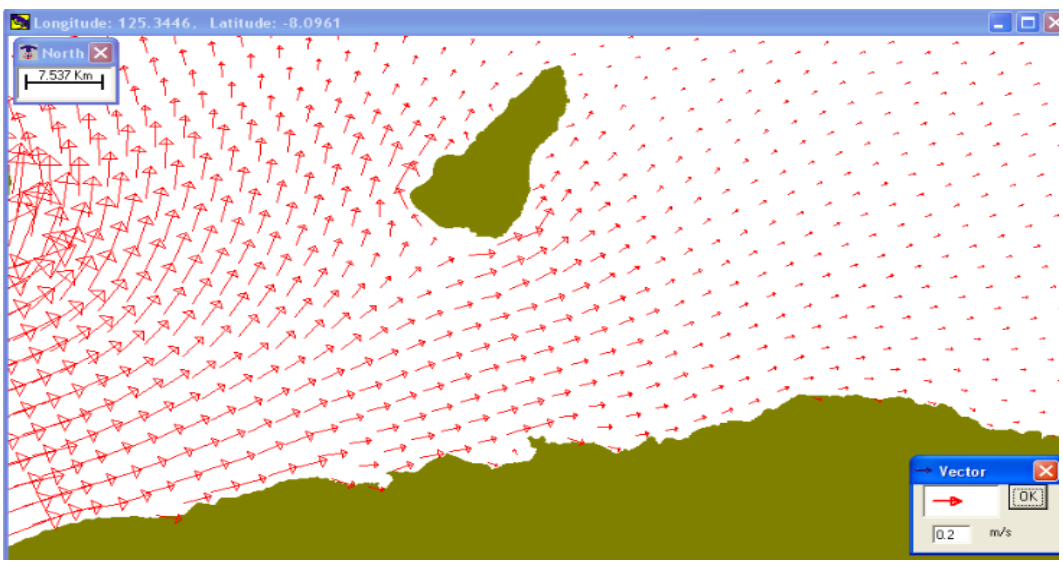
hydrodynamic modeling to estimate the widespread of oil spill in the jetty. For this case, the bathymetry from the US NOAA GEODAS can be used. The interpolation of water depth will be made. Further detail information related to marine hydrodynamic modeling related to the oil spill will be presented as part of annex2 of this report.

6.1.7.2 Marine Hydrodynamic

Important marine hydrodynamic data to be collected area low and high tides, ocean current, temperature, and other physical and chemical properties of the ocean. The temporary tide gauge will be established the collect the data of high and low tides and current of the ocean flow. The location of measurement will be selected to installed sensor safety for data collection. Potential spot would be at the existing jetty support or pillars. Further detail on the measurement of tidal, is presented in the section 7.3.10.

Other marine hydrodynamic data such as wind and ocean current shall be extracted through the computational domain by NOAA with global surface data. The Ocean current for instance, can be derived from the global observation in the Ombai Strait

Figure 6.65. Ocean Current for West Season in the Vicinity

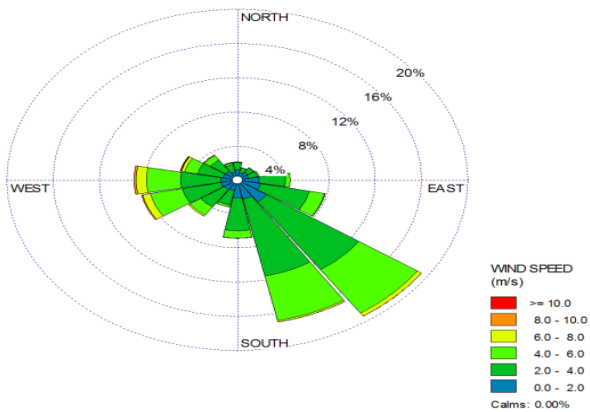


The above hydrodynamic data should be useful in performing the marine hydrodynamic modeling to calculate the movement of the oil in the sea due to spill. The current and direction however change from one season to the next.

The wind speed and direction are also very important factor to considered, not only for the modeling purpose, but also useful during the operation of the proposed development facility. The observed data is very limited however; some computational data was derived from the global data at the US. National Oceanic and Atmospheric Administration (NOAA). The version used in this study is NCEP Reanalysis 2, NOAA/NCDC blended daily in surface wind. Similar to ocean current, the wind speed and direction

would also variable from season to the other. The following figure presented the approximation of the speed and direction of the wind.\

Figure 6.66 Wind Rose at Area Study (derived from NOAA surface data)



Marine hydrodynamic modeling for conducted by this study to understand the movement of the fate and pollutant, especially oil spill from the proposed. Marine hydrodynamic parameters and important data for the modeling of oil spill

- Wind speed
- Ocean current

The secondary data is used by this study, especially in modeling exercise to calculate the dispersion of the potential oil spill in jetty that will eventually spread-out in the coastline area. The following mathematical equation was used to describe the probability of oil spill in the jetty and pipe, where the spill oil shall enter the marine ecosystem and disperse into the wide coverage in the sea.

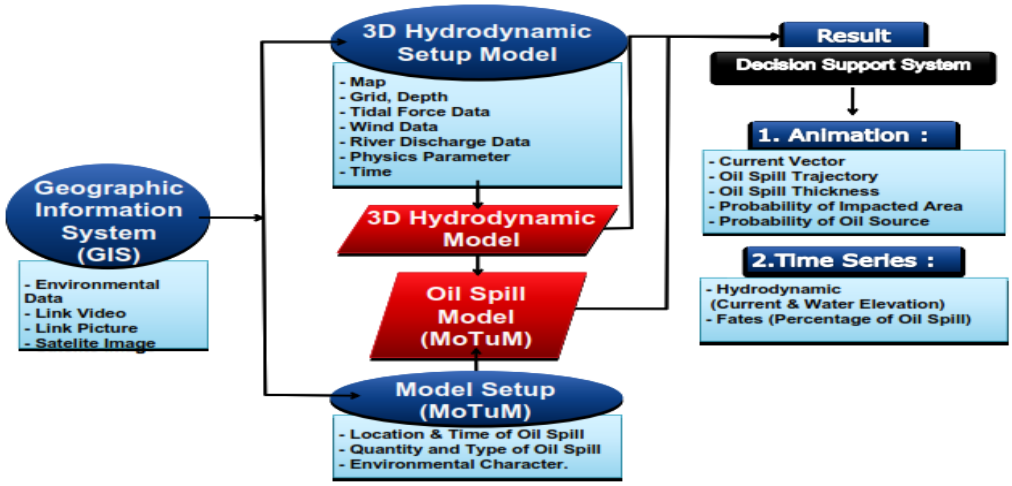


Figure 6.67. Hydrodynamic Mathematical Equation

Further detail describe of the mathematical equation can be found in the annex 2. The scenario of spill was made to simulate the area impacted of oil spill for the intervention.

Table 6.26: Proposed Oil Spill Scenario for Oil Spill Modeling

No	Scenario	Quantity (bbls)	Oil Type	Simulation Period (days)
1	Leakage from pipeline along 2 hours (Flowrate 100 Liter/s))	4.528	Gasoline	2
2	Worst Case Scenario – 5000 tons from Tanker at Jetty Reference: Tanker Capacity is 4500 – 5000 tons	42.000*	Gasoline	2
2	Leakage from pipeline along 2 hours (Flowrate 100 Liter/s))	4.528	Diesel	2
4	Worst Case Scenario – 5000 tons from Tanker at Jetty Reference: Tanker Capacity is 4500 – 5000 tons	42.000*	Diesel	2

*. 1 ton of gasoline is 8.4 barrels.

6.1.7.3 Tidal Level Measurement

The observation of tidal height is one of the important parameters to be considered in the designing the infrastructure within the coastal area. The measurement of tidal condition should be conducted for the long-term in order to collect the data that represent this natural phenomenon.

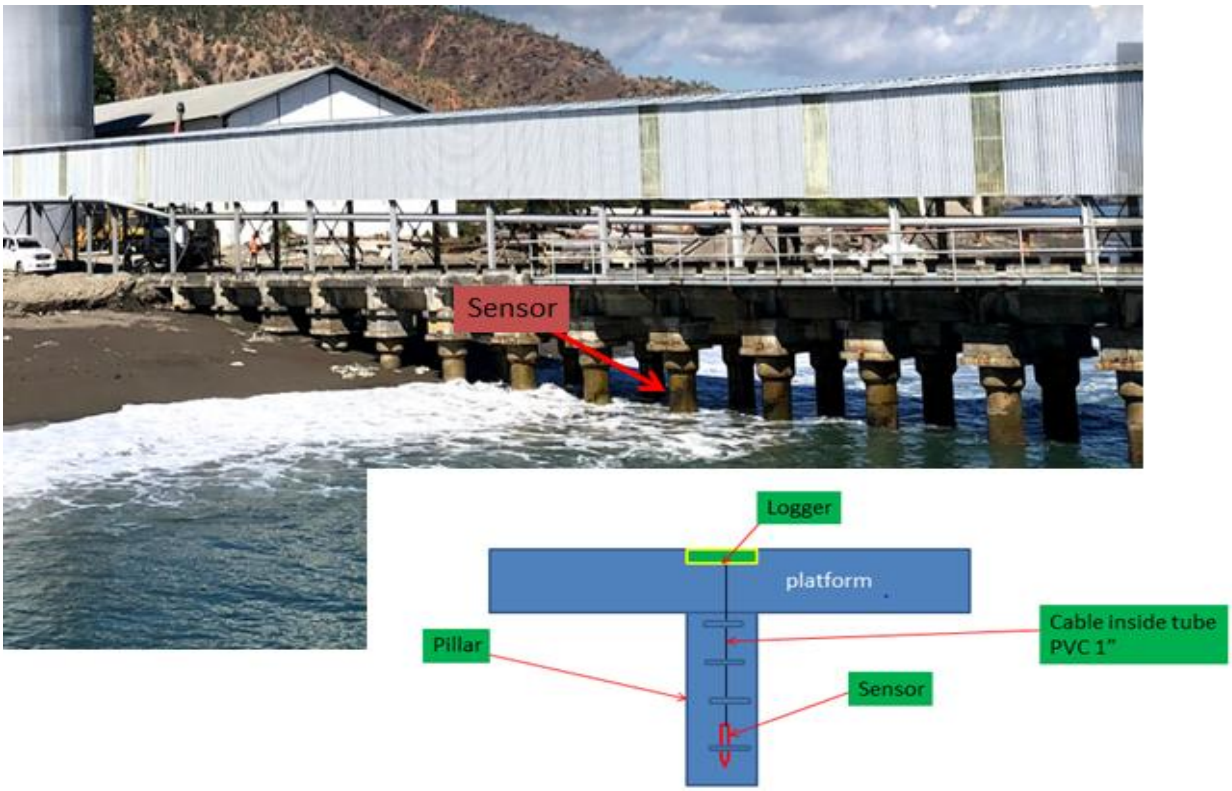


Figure 6.68. Tidal measurement system establishment

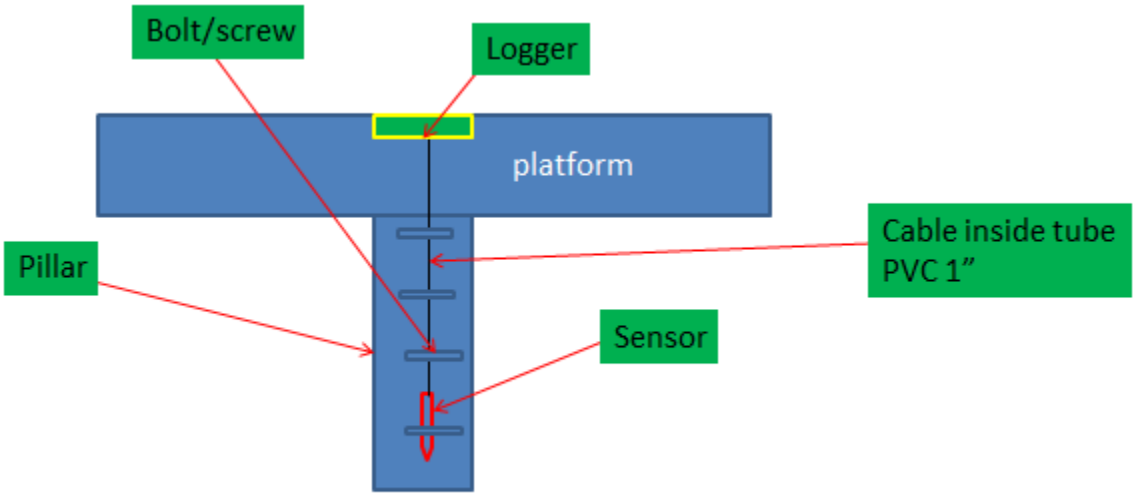


Figure 6.69 Schematic measurement

The reference of elevation was set at 1.5 m based on the existing benchmark established from the surveyor. The tidal observation has conducted using the automatic water level sensor since August 25, 2019.

The measurement method is based on the hydraulic pressure that measured by the automatic sensor, installed under existing bridge of the jetty. The water depth shall be calculated by the following equation, which should be done automatically by the instrument and store the data inside the data logger.

$$P = \rho g H$$

Where P = hydraulic pressure

r = density of sea water

G = gravity acceleration rate (= 10)

H = water level, m

The following figure shows the result of the tidal observation during one month field work. The following data of tidal condition during the observation.

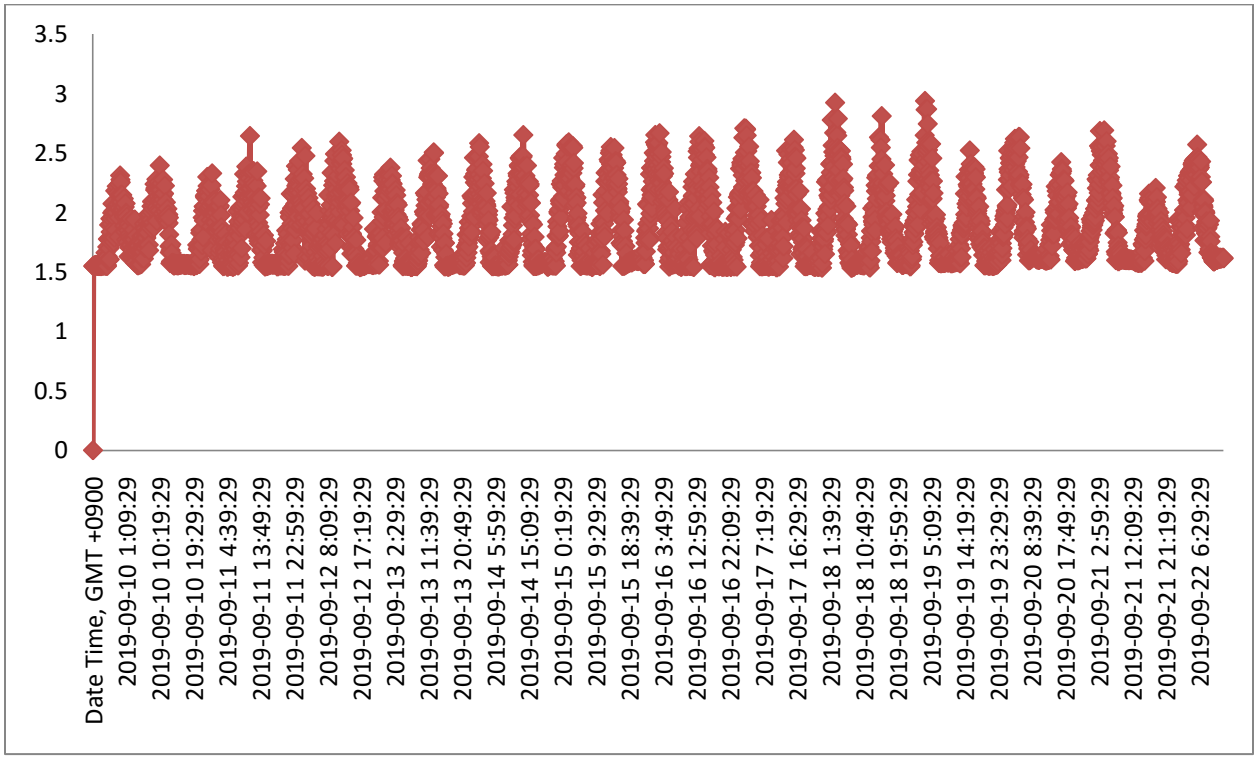


Figure. 6. 70 Tidal Observation Result in Jetty

This data is in combining with the topographic data for better recommendation to protect the proposed development project from the coastal inundation. The data from the above figure suggested that the maximum tidal level occur during the observation was about 4 m above the mean sea level. Compare the

measured tidal level; the elevation value around the coastline is around 3.3, which means that the coastal inundation occurs somewhat frequently

The measurement however, only available for 1 month, which is not enough to conclude the highest of the high tide (HAT). However, the study in the Hera Naval Port, suggested that adding the safety factor of the 1 meter above the measured of high tide would be factor that should be considered to make the structural free from coastal flooding.

Therefore, the minimum floor level to be considered free from coastal flooding = Highest level of measured tide + 1 = 4 +1 = 5.0 m. The lowest elevation within the project location is 5.2 meter, which is around 1 meter above the maximum tide level. For the safety factor, it is better to elevate the floor level of the proposed project area into 6 meter, which means that the level of floor shall be higher of 2 meter above this marginal safety factor

6.1.7.4 Coastal Water Quality

Marine water quality measurement is very important to provide background information on the status of marine water body prior to the commencement of the project, where potentially marine water quality will be affected. By having the measurement of the water quality, it is possible to monitoring and control waste load coming from the project facility so that the quality of ambient will be ensuring to its functionalities (swimmable and fishable, and other utilization of marine water body). Marine water quality in term of various water quality parameters, have conducted by many studies, including USAID – Supported NOAA research project in collaboration with the Ministry of Agriculture and Fisheries (MAF) since 2012 – 2016.

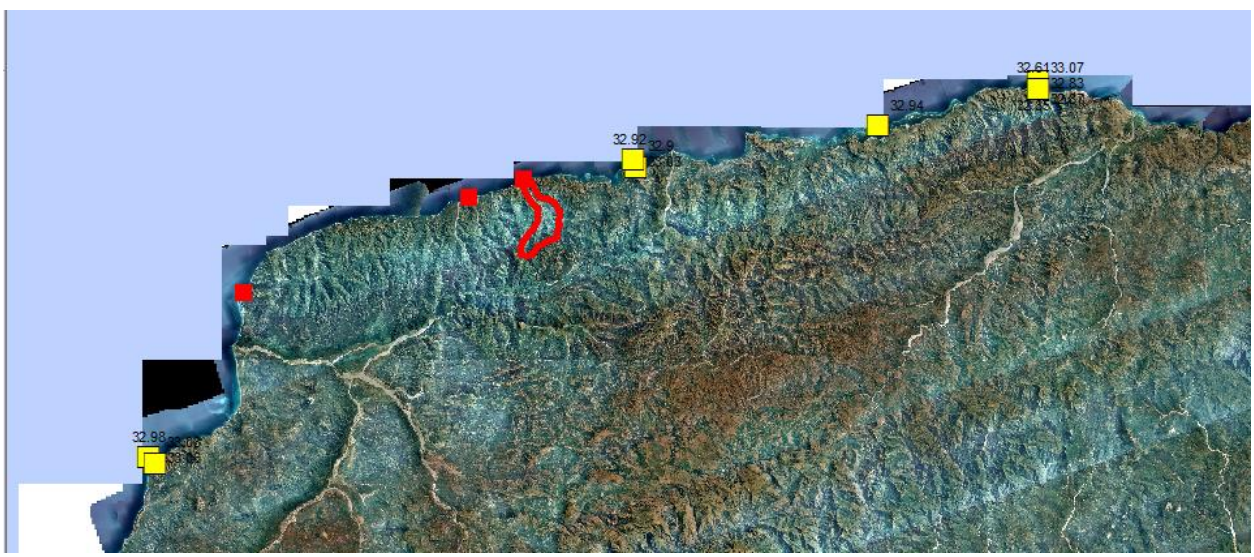


Figure 6.71. Salinity Profile of Near Seashore

The salinity profile from the above measurement are range from 32 – 33 % with relatively healthy in the dissolved oxygen (DO) demand. However, the above measurement is only limited parameters, which may only be useful to monitor certain biodiversity in the marine water, especially related to the ocean

acidification and coral reef monitoring program. As part of the study, the water quality parameters measurement was conducted to provide information on the baseline marine water quality prior to the commencement of the project. The following map shows the location of the data collection.

Table 6.27 Location of Marine Water Quality Sampling

FID	Shape *	No	Name	X	Y
0	Point	6	Lauhata	125.386	-8.566
1	Point	0	TMP	125.370	-8.574
2	Point	0	Black Rock	125.352	-8.578
3	Point	0	Kaitehu	125.414	-8.562
4	Point	0	Ulmera	125.454	-8.567

The water quality parameters that were measures in the laboratory after taking water samples can be seen in the following table, which cover 21 parameters.

Table 6.28: Proposed water quality parameters Measurement

No	Parameter	Unit	Ambient Standard
Physical			
1	Turbidity	NTU	
2	Smell	-	No smell
3	TSS	mg/L	80
4	Solid waste	-	-
5	Temperature	C	natural
6	Oil layer	-	-

7	pH	-	6.5 - 8.5
8	Salinity	Ppt (part per thousand)	Natural
Chemical			
9	Total Ammonia	mg/L	0.3
10	Sulfide	mg/L	0.03
11	Total Petroleum Hydrocarbon	mg/L	1
12	Total Phenol	mg/L	0.002
13	Surfactant	mg/L	1
14	Oil and Grease	mg/L	5
15	Hg	mg/L	3
16	Cu	mg/L	0.05
17	Zn	mg/L	0.1
18	Cd	mg/L	0.01
19	Pb	mg/L	0.05
20	Total coliform	MPN/100 mL	1000
Biological			
21	Benthic composition		
	ID. Simpson		
	ID. Shannon and Weiner		

The methodology of the measurement of the above 21 water quality parameters are provided in the following table.

Table 6.29. Summary of Marine Water Quality Parameters and Measurement Method

No	Parameter	Metode	Instrument
1	Turbidity	Nephelometric	Turbidimeter
2	Smell	Odor	-
3	TSS	Total Suspended Solid Dried at 103-105°C	Oven & Neraca
4	Solid Waste	-	-
5	Temperature	Temperatur	Termometer
6	Oil Layer	-	-
7	pH	Electrometric	pH Meter
8	Salinity	Electrical Conductivity	Conductivity Meter
9	Total Amonia	Macro Kjeldahl	Kjeldahl flask, Heater, & Destilator
10	Sulfida	Methylene Blue	Spectrometer
11	Total Hydrocarbon	Soxhlet Extraction	Vacuum Pump, Filter Paper, Oven & Neraca
12	Total Fenol	Chloroform Extraction	Spectrometer
13	Nitrat	Cadmium Reduction	Spectrometer
14	Surfactan	Anionic Surfactants	Spectrometer
15	Oil & Grease	Soxhlet Extraction	Vacuum Pump, Filter Paper, Oven & Neraca
16	Hg	Direct Air-Acetylen Flame	Atomic Absorption Spectrometer
17	Cu	Direct Air-Acetylen Flame	Atomic Absorption Spectrometer
18	Zn	Direct Air-Acetylen Flame	Atomic Absorption Spectrometer
19	Cd	Direct Air-Acetylen Flame	Atomic Absorption Spectrometer
20	Pb	Direct Air-Acetylen Flame	Atomic Absorption Spectrometer
21	Benthic Composition	Benthic Macroinvertebrates	-

The result of the water quality measurement is summarized in the following table:

Table 6.30: Result of Marine Water Quality Parameters Measurement in North Coast of Liquica

No	Parameter	Location of Sampling					Measured by NOAA	Standard
		Ulmera	Kaitehu	Lauhata	TMP	Black Rock	North Coast	
1	Turbidity	1.84	1.7	1.29	0.18	0.65		-
2	Smell	No smell	No Smell	No smell	No smell	no smell		No smell
3	TSS	10	2.2	2.66	2.5	2.5		80
4	Solid waste	Negative	Negative	no solid waste	No waste	no waste		Negative
5	Temperature	30.4	Natural	27.7	30.2	28.1		Natural
6	Oil layer	Negative	Negative	no Oil Layer	No oil layer	No oil Layer		Negative
7	pH	7.4	7.2	7.9	7.91	7.93	8	6.5-8.5
8	Salinity	34.4	33.4	26.6	26.6	26.2	33	Natural
9	Total Ammonia	0.008	0.326	0.263	0.383	0.342		0.3
10	Sulfide	<0.01	0.013	<0.001	<0.001	<0.001		0.03
11	Total Petroleum Hydrocarbon	<1	<1	<1	<1	<1		1
12	Total Phenol	0.034	<0.001	0.104	<0.001	<0.001		0.002
13	Surfactant	0.406	<0.001	<0.01	<0.01	<0.01		1
14	Oil and Grease	1.2	1.2	2.34	1.4	1.82		5

15	Hg	0.09	0.18	<0.5	<0.5	<0.5		3
16	Cu	0.102	0.024	<0.001	<0.001	<0.001		0.05
17	Zn	0.086	0.116	0.018	0.015	0.021		0.1
18	Cd	<0.001	0.045	<0.001	<0.001	<0.001		0.01
19	Pb	<0.01	0.016	<0.001	<0.001	<0.001		0.05
20	Total Coliform	240	24	0	0	4		1000
21	I.D Shimpson	0.8	0.72	0.693	0.781	0.777		
	I.D Shannon &Weiner	1.304	1.332	1.414	1.559	1.56		

The measurement of marine water quality of the 21 parameters from the selected sites suggested that marine water quality has no issue at the moment, as the measured parameters are smaller than the threshold or standard ambient water quality. The conclusions that can be made based on the field measurement of the marine water quality:

- Marine water quality is relatively pure and no major influence of pollutant that causes the impairment. This is also indicated that no human intervention on the pollutant contribution at the moment to the marine water quality, which is expected as the Timor – Leste or north coast of Timor – Leste has no industry that could potentially contribute the pollutant to the elevate d value of certain pollutant level
- The baseline marine water quality data shall be used as reference to conduct the monitoring program of the ambient marine water quality assessment
- The total Petroleum Hydrocarbon (TPH) on the other hand also shows very small, that indicates no pollutant related to the petroleum derivative product entering into the marine water body
- The biological indicator that describe the general understanding of the biodiversity in the marine water body also shows the healthiness of the marine ecological condition

This baseline data should be used also a source of information during the implementation of the project, especially, to evaluate if there shall be any pollutant contribution due to oil spill in the marine water.

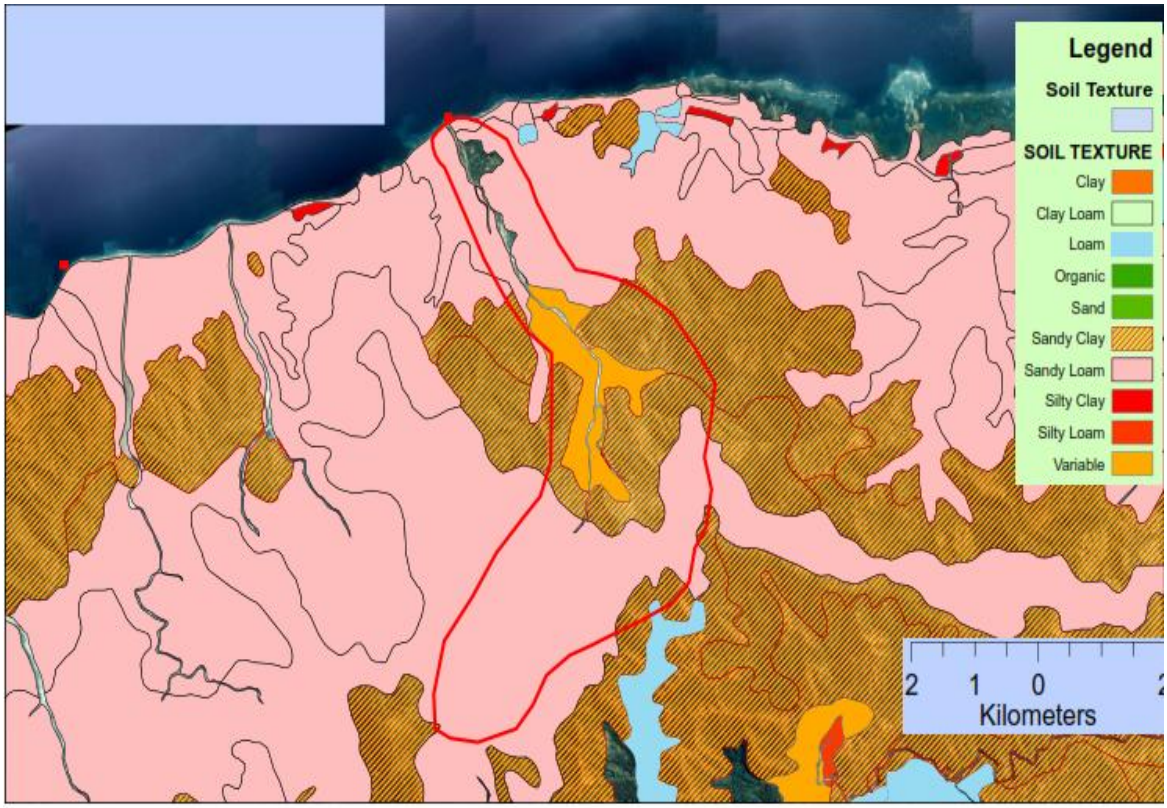
6.1.8 Soil

Understanding of the soil characteristics/properties can be very important for various purposes and applications, including the agriculture, water resources, contaminant transports, and others such as design and construction of the infrastructures. Soil type/texture around the project location was identified as sandy –loam and sandy soil, which is not suitable for agriculture crop production. The following map shows the soil texture map prepared for the purpose of agriculture development by the Ministry of Agriculture, Forestry and Fishery (MAFF, 2012).

6.1.8.1 Soil Data and Texture

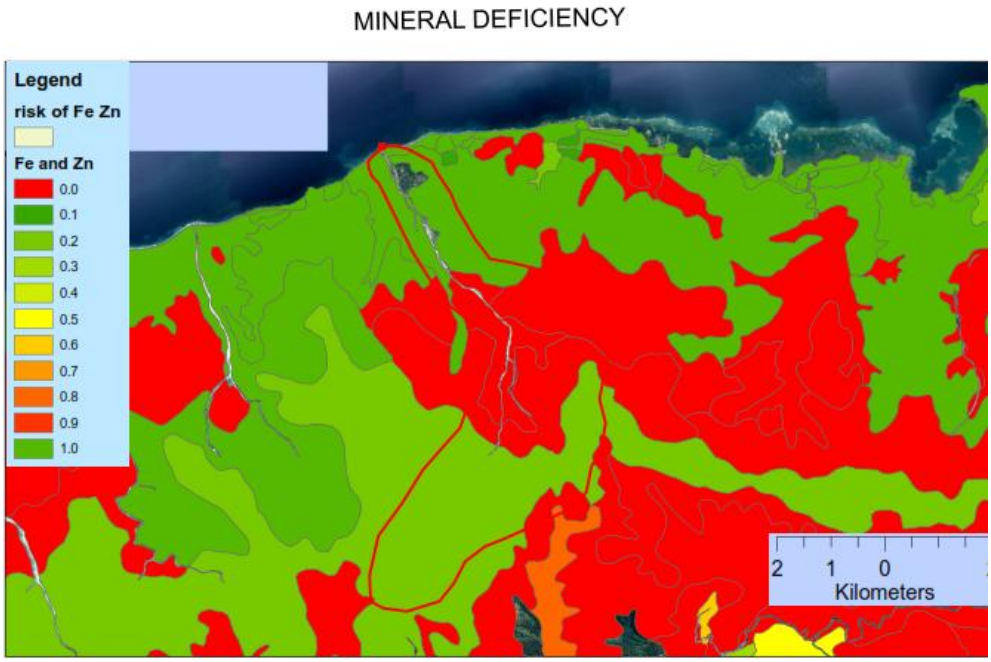
The data as presented in the following map was derived from the data points that were collected during the Portuguese administration. The data points (point collection) were plot in the GIS and the spatial interpolation was made and the following maps can be produced. This information is used to provide the general overview on the soil texture in the spatial context, which are useful for various applications such as agriculture, water resources, and contaminant transport process.

Figure 6.72 Soil Texture Map



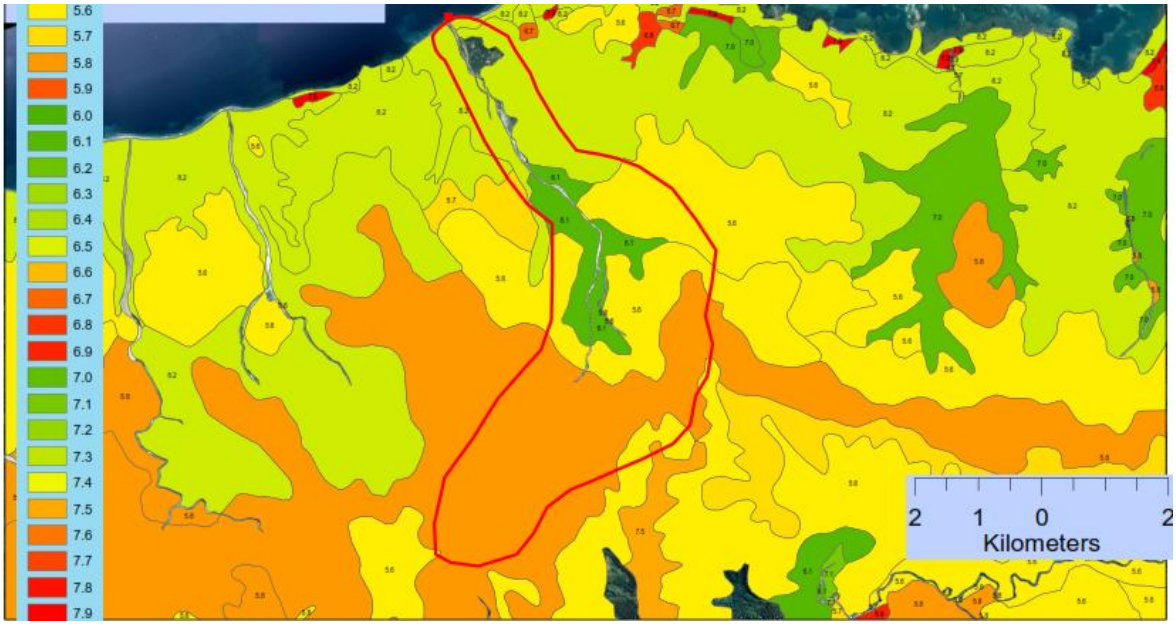
The direct observation of top soil in the project area indicated the result of soil type, which dominated by the sandy soil (sandy clay and sandy loam). This kind of soil type would have a lower holding water retention capacity or higher infiltration rate into the downward. More detail information for the specific application should be collected on the site. The MAFF through the Seed of Life (or SoL) Program has also collected some of the data related to mineral deficiency in the soil which can be used as indicators for soil suitability for the agriculture purposes.

Figure 6.73 Soil Mineral Deficiency Map



In term of pH, secondary information for the project site indicated that the pH of the soil is around 6, which is acidic.

Figure. 6.73 PH Value of Top Soil



This type data is mainly useful for the agriculture application in determining the site suitability for certain crop to be adopted. Soil investigation will be conducted as part of this study to determine the soil properties such as permeability, water retention, and the type of rock layer, total hydrocarbon, which may

be useful in monitoring or estimating the transport coefficient of contaminant and other transport phenomena in the future. Furthermore, for the baseline soil quality data in relation to the petroleum hydrocarbon or chemical that related to the downstream petroleum product will be conducted by this study. The Total Petroleum Hydrocarbon (TPH) and Pb are the main chemical parameters of the soil that will be measured through the sample collection and measurement in the laboratory

The authority, in this case, the ANPM, has asked the project proponent to provide the measurement also with the mineral contain in the soil, such as Mg, Zn, N_2, and Fe. However, given the nature of the proposed project is not related to this mentioned chemical element. These chemical elements are most relevant to the agriculture application. The most relevant chemical compound in the soil however, to the proposed development project is the total hydrocarbon, soil permeability, soil texture, type, water retention, and which will be measured as well by this project. Within the radius of 1 KM, 5 samples point of the top soil will be collected and the measurement of the total petroleum hydrocarbon (TPH), PH, and heavy metal compound (Pb). Furthermore, five soil samples within the project area will also be taken for the measurement of TPH, and Pb. The follow table shows the GPS coordinate of the location of sampling points.

Table6.31. GPS Coordinate of Sampling Points

FID	Shape	No	Name	X	Y	TPH	Pb
0	Point	12	Soil1	125.384253	-8.568047	0	0
1	Point	13	Soil2	125.383882	-8.567395	0	0
2	Point	14	Soil3	125.383494	-8.568073	0	0
3	Point	15	Soil4	125.382827	-8.568158	0	0
4	Point	16	Soil5	125.383073	-8.568775	0	0
5	Point	17	Soil6	125.376366	-8.573055	0	0
6	Point	18	Soil7	125.380545	-8.570273	0	0
7	Point	19	Soil8	125.384679	-8.57249	0	0
8	Point	20	Soil9	125.387435	-8.566938	0	0
9	Point	21	Soil10	125.393169	-8.565103	0	0

Figure 6.73 Soil Sampling Locations within the Project Area

The method of sample taken is simple dig the soil up to the 50 cm depth and taken soil sample. Put the sample in the container to maintain the moisture level. Sample will be taken to the laboratory to measurement the desire parameters, which are the TPH and Pb.

6.1.8.2 Soil Quality Analysis

In addition to the soil boring test for soil layer analysis, this study also taking the sample of soil within the project location and up to the radius of 1 km of project location to understand the baseline soil information of the total petroleum hydrocarbon content from the top soil.

Figure 6.75. Map of Top Soil Quality Assessment

Figure. Soil Sampling for Quality Measurement

The following table shows the GPS location of the soil sample data collection.

No	Name	X	Y
1	Soil1	125.3843	-8.5680
2	Soil2	125.3839	-8.5674
3	Soil3	125.3835	-8.5681
4	Soil4	125.3828	-8.5682
5	Soil5	125.3831	-8.5688
6	Soil6	125.3764	-8.5731
7	Soil7	125.3805	-8.5703
8	Soil8	125.3847	-8.5725
9	Soil9	125.3874	-8.5669
10	Soil10	125.3932	-8.5651

The following parameters will be measured by using the gravimetric and volumetric method. The following steps were used to measure the type of chemical contaminant in each soil sample.

- Measurement of moisture contain the soil by using the gravimetric method
  - Weight 5 mg of soil sample
  - Put in the oven at the 100 C for 1 hour
  - Weight the dry sample for the mass

Calculate the moisture contain = wet mass – dry mass

- Certain gram of soil sample was diluted in the certain volume of pure water and measurement of the TPH and Pb can be done by reading the wavelength.

As the above chemical elements are related to the petroleum product, this baseline information will be useful in the monitoring of the soil quality in the future related to the potentially oil spill in the soil. The following table shows the result of the laboratory analysis of the soil quality in relation to the petroleum hydrocarbon and lead (Pb), as the chemical elements that commonly found in the petroleum derivative product.

Table 6.31: Result of Soil Quality Measurement within the Project Area

No	**Parameter**	Location of Soil Sample within Project Location				
		Soil1	Soil2	Soil3	Soil4	Soil5
1	Soil sample at depth of 50 cm	V	V	V	V	V
2	Total Petroleum Hydrocarbon, mg/Kg	29	28	29	22.9	21.9
3	Pb, mg/kg	18.4	16.2	15.3	14.1	14.6

Table 6.32 Result of Soil Quality Measurement within 1 KM Radius

No	Parameter	Location of Soil Sample within Project Location				
		Soil6	Soil7	Soil8	Soil9	Soil10
1	Soil sample at the depth 50 cm	V	V	V	V	V
2	Total Petroleum Hydrocarbon, mg/Kg	19.9	22.9	19.9	23	21
3	Pb, mg/kg	14.4	19.5	12	7.9	8.98

The result from the above table suggested that the background soil quality measured in terms of TPH in the project location is in the range of 20 – 29 mg/KG. That means that each Kg of soil contain roughly 20 – 29 gram of TPH. On the other, the total Pb value in soil is in the range of 8 – 20 mg in each KG of soil sample. This information provides the data for future reference of monitoring of the project implementation. The measurement of soil sample in term of TPH and Pb should be conducted periodically to know if the project activity shall pollute the soil. The following table provides the soil quality in deep boring, as part of geo-technical site investigation.

6.1.8.3 Soil Quality of Deep Boring and Permeability

As indicated in the section 6.1.3, that deep boring of two points within the project area was conducted in order collection physical and chemical data related to soil, which is useful for design of the foundation, as well as other purposes, such as groundwater and contaminant transport process. Chlorine, sulfate, and carbonate contain are very important chemical properties of soil that need to be measured in order to be considered in the design of the type of foundation and protection requirement so that the foundation will be sustainable for many years. The following table shows the data of these chemical properties, measured by taking the soil sample to the laboratory.

Table 6.33: Summary of Chemical Parameters of Soil in Lauhata

Soil Depth	Chloride, %	Sulfate Content, %	$CaCO_3$	PH
3	0.15	0.14	16.2	6.1
9	0.16	0.16	28.3	6.4
12	0.15	0.15	24.7	6.3
16	0.15	0.14	26.6	6.4
25	0.14	0.15	25.8	6.4

In addition to the above chemical properties, the important physical properties, related to the water flow in porous media, is the soil permeability, which is an important transport properties that useful in the estimating the transport phenomena such as water flow and contaminant transport in the soil and water.

The following table shows, the measurement of soil permeability in different depth

Table 6.34 Summary Result of Permeability Soil

Borehole No.	Sample No., Depth m	Soil Permeability, Darcy
BH # 2	S - 16 / 13.40 m	4.99
BH # 3	S - 9 / 14.90 m	0.75
BH # 3	S - 28 / 41.82 m	0.40

The permeability measurement shows that top soil is more permeable, which is dominated by the sandy soil, while the deep soil, while dominate by dense material the hard rock which has lower permeability rate. However, in general the measurement shows the soil permeability in different soil depth is same order or magnitude.

6.1.9 Noise and Vibration

Noise and vibration could be also important environmental factor to be investigate and measure the baseline, particularly the noise and vibration could be an issue during the construction of the storage tanks such as foundation work, noise from vehicular coming in and out of the project site, as well as the construction of the above ground storage tank. The noise and vibration measure will be conducted within the project site to understand the noise and vibration variation between day and night.

Table 6.35 Noise Level Produced by Heavy Duty Equipment (Source: IFC, 2007)

Type of System	Noise Level, dB
Belt Conveyor	small
Elevator	small
Fan	70-90
Compressor	91-100
Rotary blower	80-95
Ring Blower	80-95
Hopper	60-85

Elevator	small
Belt Conveyor	small
Fan	70-90
Rotary Blower	80-95
Truck	83-94
Concrete mixer	76
Power Generator	70-91
Pump	82-99

As source of noise is reasonable far from concentration of population, except from the road, the impact should be minimum and can be managed during construction and operation. Unfortunately, the no regulation has established by the Government of Timor – Leste regarding the noise level issue. Nevertheless, there was a draft that proposed by the VI constitutional government in relation to noise regulation. The background noise and vibration measurement will be conducted as part of the current study to provide the baseline data for future reference and the impact assessment and mitigation measured. The measurement of the noise and vibration level from the various distances will be conducted, in order to know the level of noise and vibration impacts. It is generally understood that the farer the distance, less impact would be. Based on the data that would be collected, the impacts of noise and vibration that generates could be assessed and mitigated. Typically, the measurement will be taken from various points with different distances from the source of the noise and vibration. Moreover, the measurement also taken to know the difference of noise and vibration background between day and night.

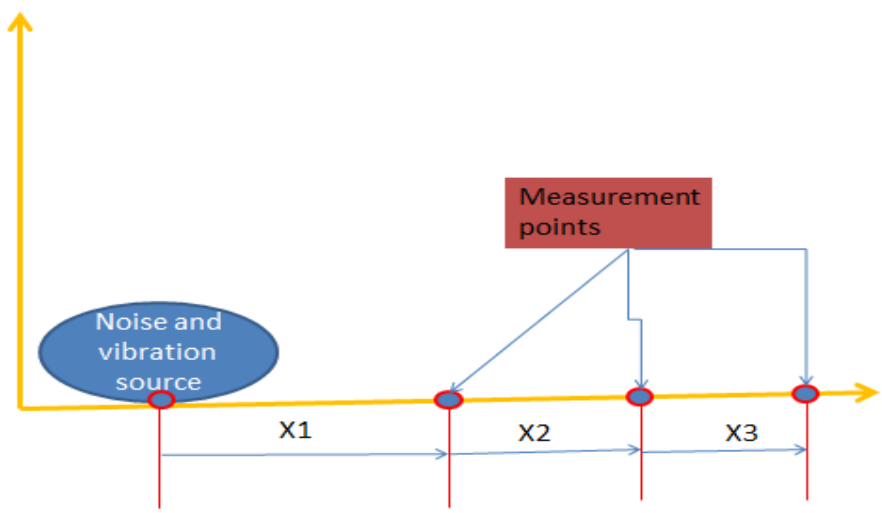


Figure 6.76. Illustration of the Proposed Field Measurement of Noise and Vibration Impacts

The heavy duty equipment will be operated in the project site with normal noise and vibration. The measurement will be taken from the point where the equipment operates and move the equipment further

way from the equipment and observe the noise and vibration level. The observation of the noise background in the project location was conducted in order to know the following information:

- Difference background noise level between day and night
- The Noise level generated by a specific heavy duty equipment in various difference distance away from the source

The field measurement was conducted at two locations that are important to the project development; within the project area and within the center of community at the potential receiver of the noise impact. Within project location, as it is expected, the natural background of noise level was measured to be at the level of 47 dB and no variation between the day and night.

The other location of measurement point, which was in the center of the community, the level of noise is variable by very small margin. During the day time, the noise level was at 41 dB during the night time and 47 dB during the day time, when there shall be a sound of people, vehicular and other machineries that were operated within certain distance from the measurement point. The result of measured noise level can be seen in the following table.

Table 6.36 Noise Level Measurement Day and Night

Location	Night, DB	Day, dB	Average, dB
Inside Project Area	47	47	47
In the Center of Community	41	47	44

The noise measurement was also conducted to know/understand how the noise impact would be declining over the distance away from the source of the noise. The experiment was conducted to measure the noise produced by the compressor.

Table 6.37: Vibration Level from Heavy duty Equipment (Comopressor)

Noise Level Observation for Compressor (90 – 100 dB)	
Noise Level, DB	Distance from Compressor , m
92.6	0
72.2	10
64.9	20
61	30
58.44	40

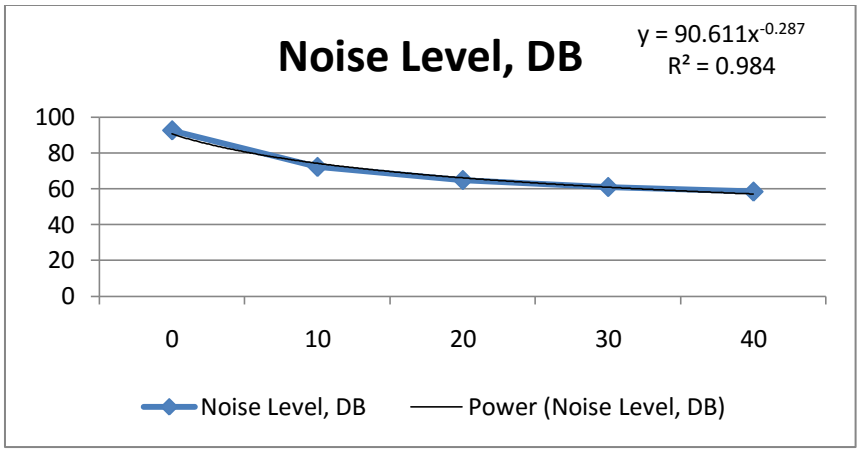


Figure. Trend of Noise Level for various Distance

With the dictance of zero meter away from the compressor, the noise level reach the highest and the noise decline over the distance away from the source. It would be expected that the natural noise level in the project area is around 42 dB and the community living within the proximity of project area should not be affected by the noise prodcued during the contrucion the facility and the operation of the storage.

Figure. 6.77 Photos of Measuremen of Noise level

Beside the noise level, the vibration level was also measured by using the handheld instrument. However, the backround level of vibration was not detectable by the instrument, which relatively insignifcant level of backround vibration level. The vibration level generated by the specific heavy duty equipment such as ecavator and bludozer, were conducted and the resutl is prensted in the following table:

6.1.10 Waste Collection and Management

Waste management consists of managing the liquid and solid wastes that produced by the household, industry, public and private offices, or any individual. The waste management, especially in the urban area is still a problem for Timor – Leste. The capital Dili has collection and disposal system, however, the service is still not very reliable and much improvement is needed for collection, treatment, and disposal. The consequences of the unreliable service of waste collection would result in the trash that is piled for days without being collected creating unsanitary condition.

On the other hand, the condition at Tibar landfill where ultimate disposal is conducted is also unmanaged creating hazardous condition to the surrounding area.

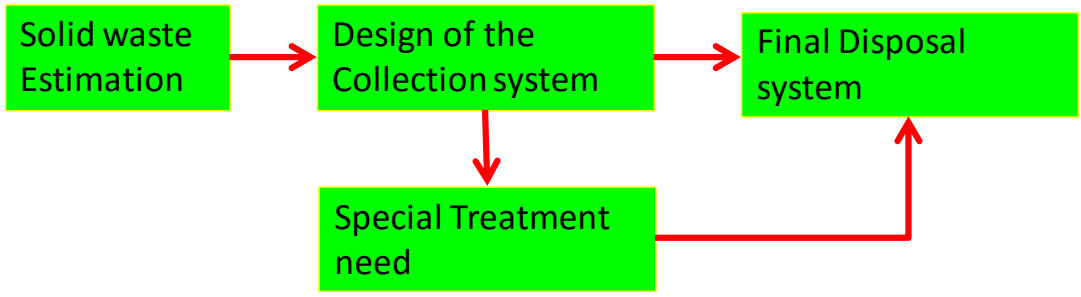
Figure 6.78 Burning of Solid Waste at Tibar Landfill

For the proposed development, project proponent planned to be responsible for the collection of its own solid waste and dumping in Tibar. Currently, the Government of Timor Leste has a plan to improve both collection system in Dili and the landfill/disposal system in Tibar. Because the improved collection system will only cover Dili area, project proponent's plan for the collection of its own solid waste will be appropriate. It is expected that Tibar landfill will introduce new regulations as well as possible charge once the system is improved. Project proponent will adjust accordingly.

The methodology of solid waste estimation will be conducted in order to know the quantity of solid waste produce during the operation. Based on the estimated information of the solid waste, the type of handling

will be proposed in order to minimize the impacts of the solid waste to the project, community, and health hazard. The following figure describes the approach of solid waste management system during the implementation of the proposed development project.

Figure 6.79. Solid Waste Management Approach



Under the above approach, there should be general waste that involve and collection and disposal system and as well as type solid waste that considered hazardous, which required special treatment prior to final disposal system.

6.1.10.1 Solid Waste Collection and Disposal in Liquica

The solid waste collection is the urban area such as Dili, currently conducted by the Dili municipality, where the private company collect and dispose the solid waste into Tibar landfill on behalf of Dili municipality or the government. The Tibar landfilled is currently full and undergone very low maintenance. Therefore, future improvement of this landfill would be necessary done by the government of Timor – Leste. Tibar landfill area is also receiving the waste various places in Liquica area, including the Liquica urban area that produce significant amount of daily solid waste. The point of collection is provided by the local municipality and regularly the dump truck will collect the waste from the point of collection and dump into Tibar landfill area.

Figure 6.80 Solid Waste Point of Collection and Disposal in Liquica

Total production of solid waste in Liquica urban area is estimated based on the population project and the empirical result on the waste production per capita. According to ADB study in 2015, the average waste production per person is range from 0.7 Kg – 0.85 KG per day for the urban population. The current population of Liquica town according to the Census 2015, is 20,000 with the grow rate of 3%. So that means the urban waste production in the next 20 –years is estimated to be projected to grow overtime. The following figure provides general information of the trend of solid waste production from the Liquica urban area.

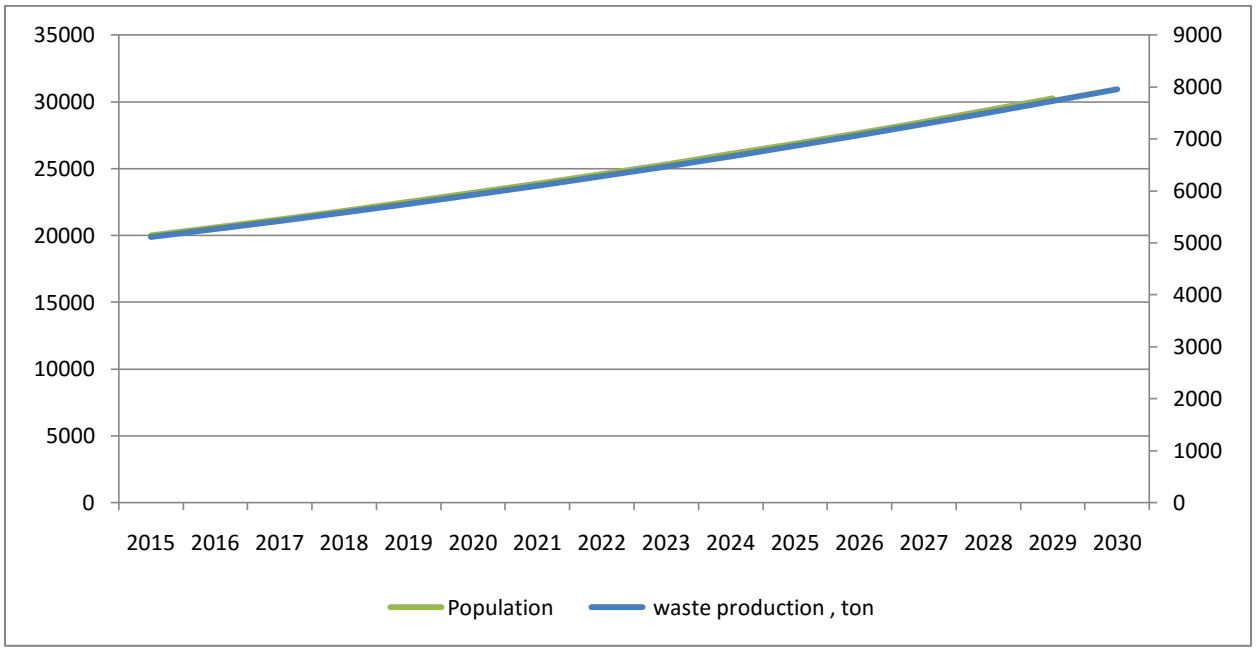


Figure 6.81. Liquica Urban Population Projection and Waste Production

The above figure provide the trend of waste produced by the urban area of Liquica, which should provide and information for the government to design and improve the Tibar landfill area as the final disposal area. The daily production of the solid waste in the urban area of Liquica is between 15 and 20 ton, which should be deployed by trucks that rented by the local government and dump into the Tibar landfill area.

However, the service of waste collection and disposal is only covering the public area or do not cover the private company. There has been an issue, related to the private company with large waste to be disposed in the point of collection system. Unofficially, the government agency has recommended the private company to have own collection system and dispose directly into the landfill area in Tibar.

6.1.10.2 Waste Production and Treatment

Both liquid and solid waste result for the project development will be collected, treated and disposed according to the existing regulation and best industry practice that shall resulted in the better management of the environment. The general solid waste is estimated for the project based on the empirical approach from the similar industry.

Daily production of the general solid waste during the construction could be high, equal to 1 or 2 tons

- Site clearance waste
- Construction related waste

During the operation the solid production should be reasonably small, with the estimated:

Rate = 10 kg/day, which is significantly small compare to the waste produced by the whole town in Liquica. With the total monthly rate = 300 kg/month, the project owner should arrange its own system of collection in the project area and dispose the waste into Tibar landfill area. There are however, solid waste that considered as hazardous material, which is be collected properly and dispose in the designated place in order to avoid the further impact to the environment.

The solid waste that considered hazardous is coming from the sludge related to bottom tank of the fuel storage and oil spill that washed by the storm runoff catching by the oil-water separator. According, estimation from various established storage facility, roughly 0.01 – 0.05% of the total volume of the tank will eventually become waste at the bottom of the storage tank. Conservatively, in this calculation, the rate of solid waste production takes 0.05% of tank volume every 5 years. The total volume of the tank = 10,000,000 L. This means that the hazardous solid waste produced every 5 –years is about 5000 L or equal 5 tons of hazardous solid waste. This type of waste can be easily collected and treated or transformed into the useable material. However, prior to converting into the useable material, the liquid and solidwaste need to be separated.

The liquid waste treatment need to be conducted in order separate the liquid from solid waste. The liquid is normally water and volatile hydrocarbon. By treating the lagoon system, the water shall evaporate and only solid waste remained.

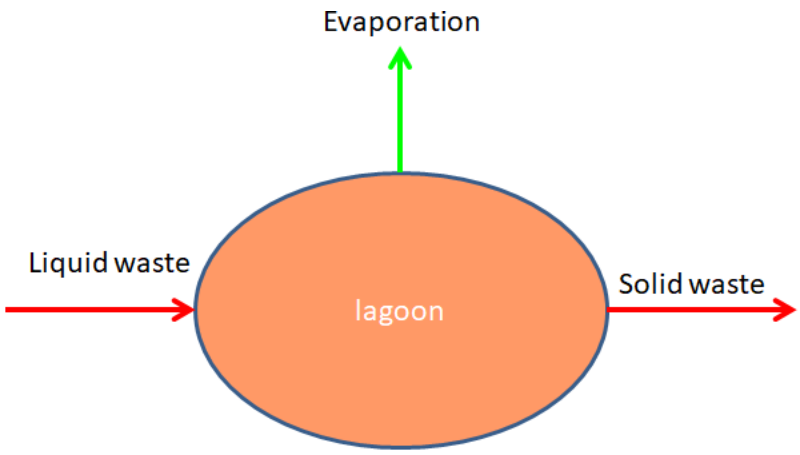


Figure. 6.80a Schematic of Liquid Waste Treatment of Hazardous material

There are still other hazardous solid waste resulted from the overland spill that collected by the oil-water separator. This amount was estimated to be variable from one operator to the next, as the spill of fuel in each facility will not be the same. This hazardous waste should be treated in the special area with special treatment to minimize the impact of the waste to the people and environment (water, soil, and animal). The treatment of the hazardous solid waste should be treated prior to the disposal or reuse the material so that the impact to the environment would be small. Example of the treatment system, would creating the retention pond that receive the hazardous liquid water and let the liquid dry up and leave the hazardous solid waste, which has smaller quantity. This waste can be further mixed with concrete cement to produce the concrete block. The projection of total solid waste that potentially produced by the project can be summarized in the following table.

Table 6.37. Estimated Solid Waste Produced by the Project

Type of Waste	Estimated Amount, kg
General Waste, Monthly Rate	300
Hazardous Waste, Monthly Rate	90
General waste produced by Liquica, Monthly rate	500,000

This amount of total solid waste contribution from this development project to the total amount of the solid waste from Liquica to Tibar landfilled area is less than 0.1% from the total waste produced by the Liquica town.

6.1.11 Seismicity and Earthquake

Earthquake and tsunami are natural phenomena that need to be assessed and considered in the planning and development of a project, so that any future event that may affect the existence of the project may be anticipated earlier. According to USGS study, Timor Island is prone to earthquake as it is being located in a tectonically active region, along the collision zone of the Australian plate and the Eurasian Plate. Compilation of major shallow earthquakes in Indonesia from 1897 to 1984 by the Southeast Asia Association of Seismology and Earthquake Engineering (SEASEE, 1985) showed a number of earthquakes (magnitude 6 to 6.9) with epicenters located offshore north of Timor Island. A magnitude 8 or greater has been recorded in 1963 with epicenter located offshore southwest of Timor Island. Recently, a very shallow (depth of 1.1 km) earthquake with magnitude of 5.6 and epicenter located on-shore south of Dili occurred last 26 April 2011.

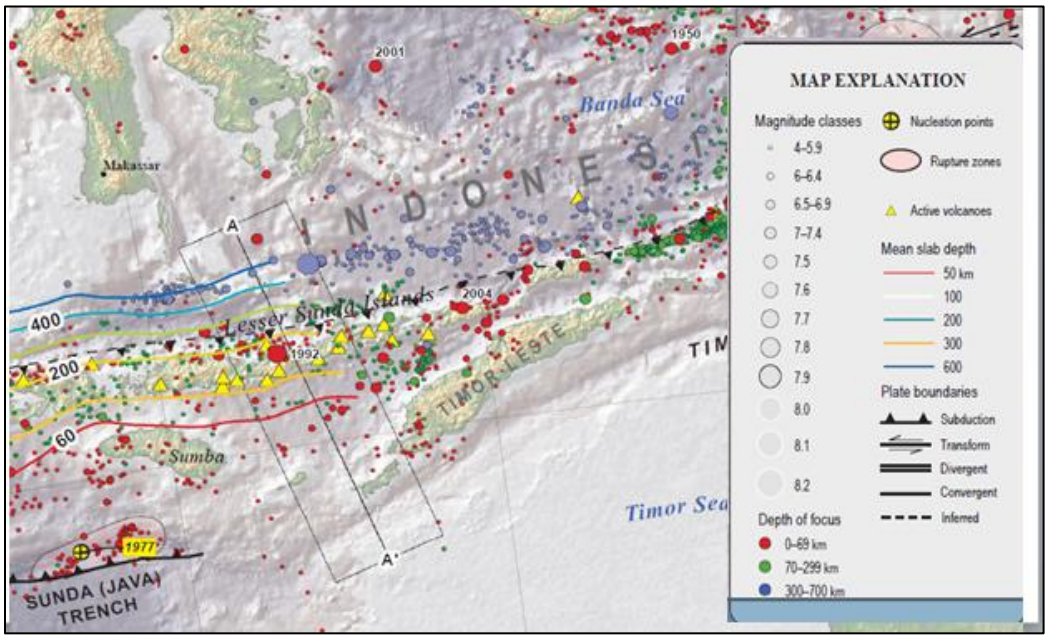


Figure 6.82 Historic Earthquakes in the region of Timor Island from 1990 to present (Source: USGS).

Even though no major structural damaged to large infrastructure happened due to earthquake in past several decades, it may be important to apply structural codes that prevent or minimize any major damaged should major earthquake occur in the future. According g to the design of the propose development project, all the major structure, such as jetty, fuel storage tanks (foundation), will be constructed with the minimum of 8 scale Richter, which has very small probability of occurrence around north coast of Timor Island. So it should be relatively safe and sound with the seismicity impact to the project development and sustainability.

6.2 Baseline Information on Ecological Components

The most important ecology that will be affected by the proposed development project is the marine environment, as the marine ecology will become the recipient of the impacts that could be potentially

contributed by the proposed development project. For instance, oil spill, fire, or flooding impacts, will eventually affect the marine environment, as the lowest point in the ecosystem. Therefore, review the baseline information related to marine ecology within the project location will be discussed in some great detail, such as wetland, coastal resources, mangrove, coral, protected zones that mainly located in the coastal regimes, as well as wildlife and endangered species that could potentially affected by the project development.

The methodology of ecological baseline data collection and investigation employed by this study consist of the following:

- Literature review on the previous studies related to the ecology and important species identified
- Utilization of Secondary data that already collected to support the hypothesis of the study
- Primary data collection in the project site (witin the proximity of the project area)

The following figure providethe overall methodology of the ecological study based on the distance from the project location.

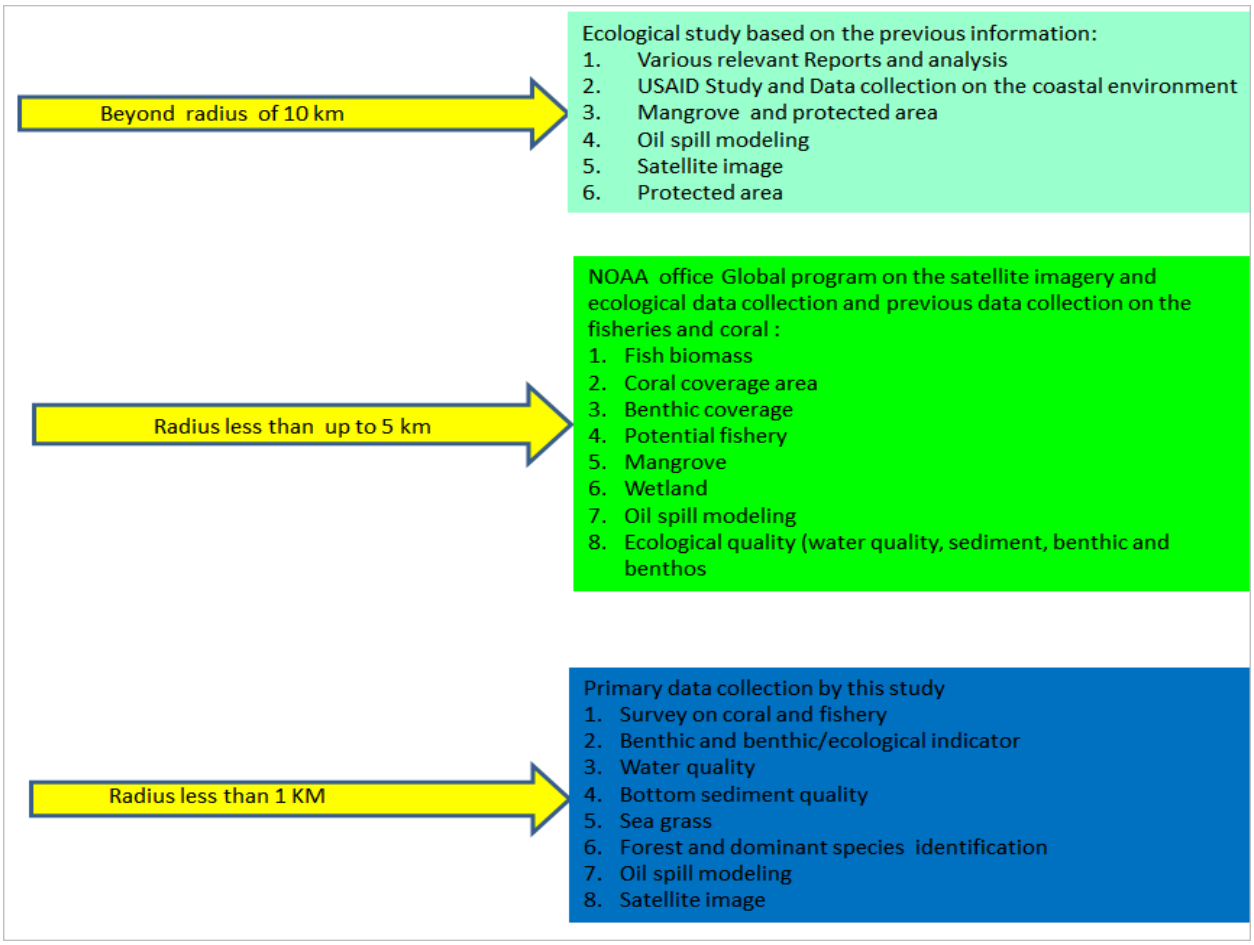


Figure. 6.82 a Schematic Methodology of Ecological Assesment of the Study

The previous study and secondary data that have been collected from the previous study an investigation were used to help in the ecological assessment. Especially, the oil spill modeling, which potentially

becomes an input function (if the spill occurs), is provided to understand the nature of the impact to the oveall ecological quality (coral, benthos, benthic, fisheries, etc.).

Furthermore, the most relevant secondary data from NOAA – USAID support study, on the coastal resources assessment, include the Timor – Leste Northshore, covering also the project area was very helpful in ecological quality assessment. The primary data collection, related to coral, benthos quality, water quality, fishery were conducted to complement the existing data and to validate the data, especially with the high probability of affected area (closer distance to the project location). More detail information and data extracted based on the above mentioned methodologies are presented in the following each section. The following maps, shows the area coverage study (data collection and investigation of the ecologic).

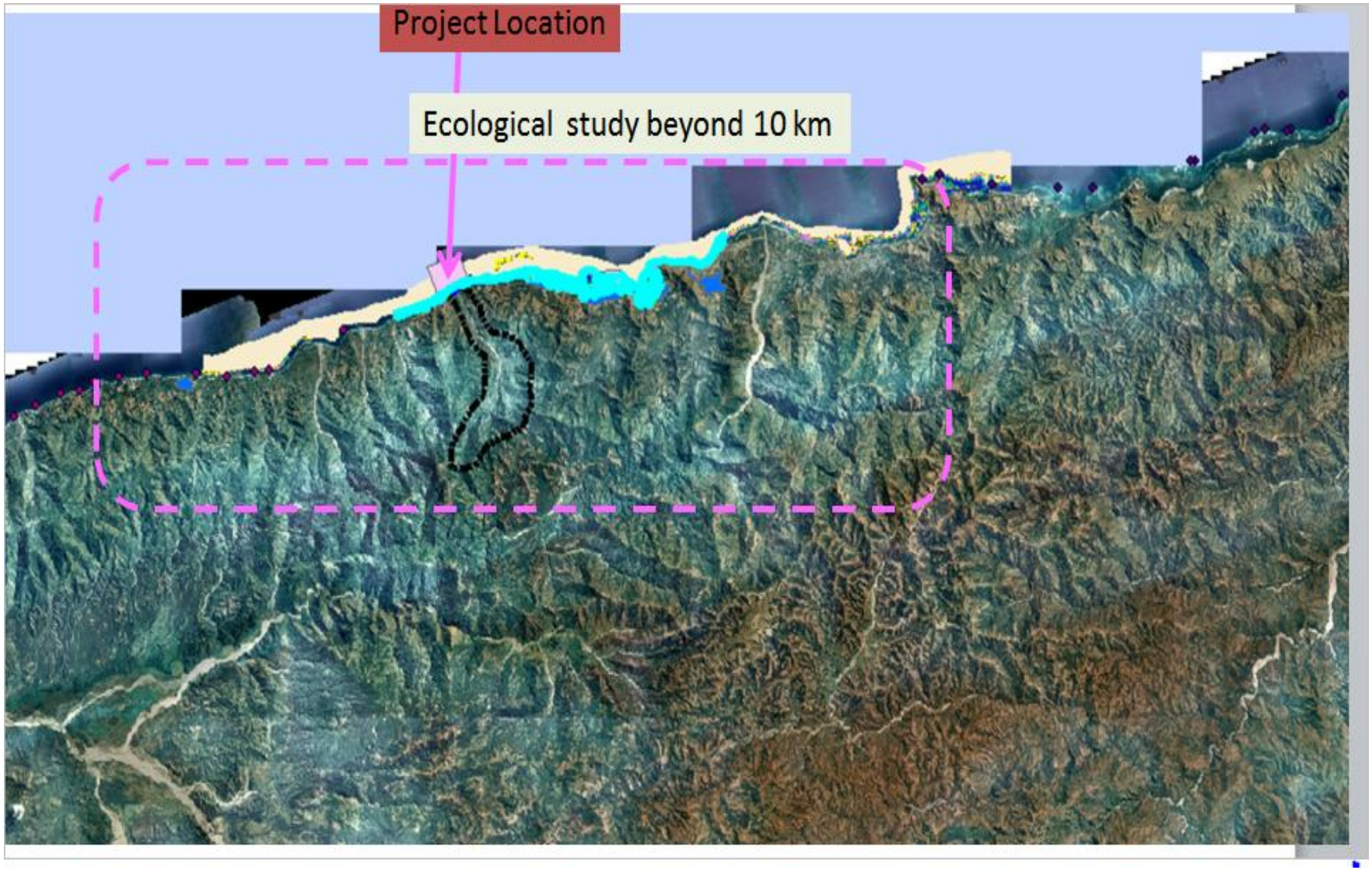


Figure 6.82b . Coverage of Ecological Investigation at the Distance Beyond 10 KM radius

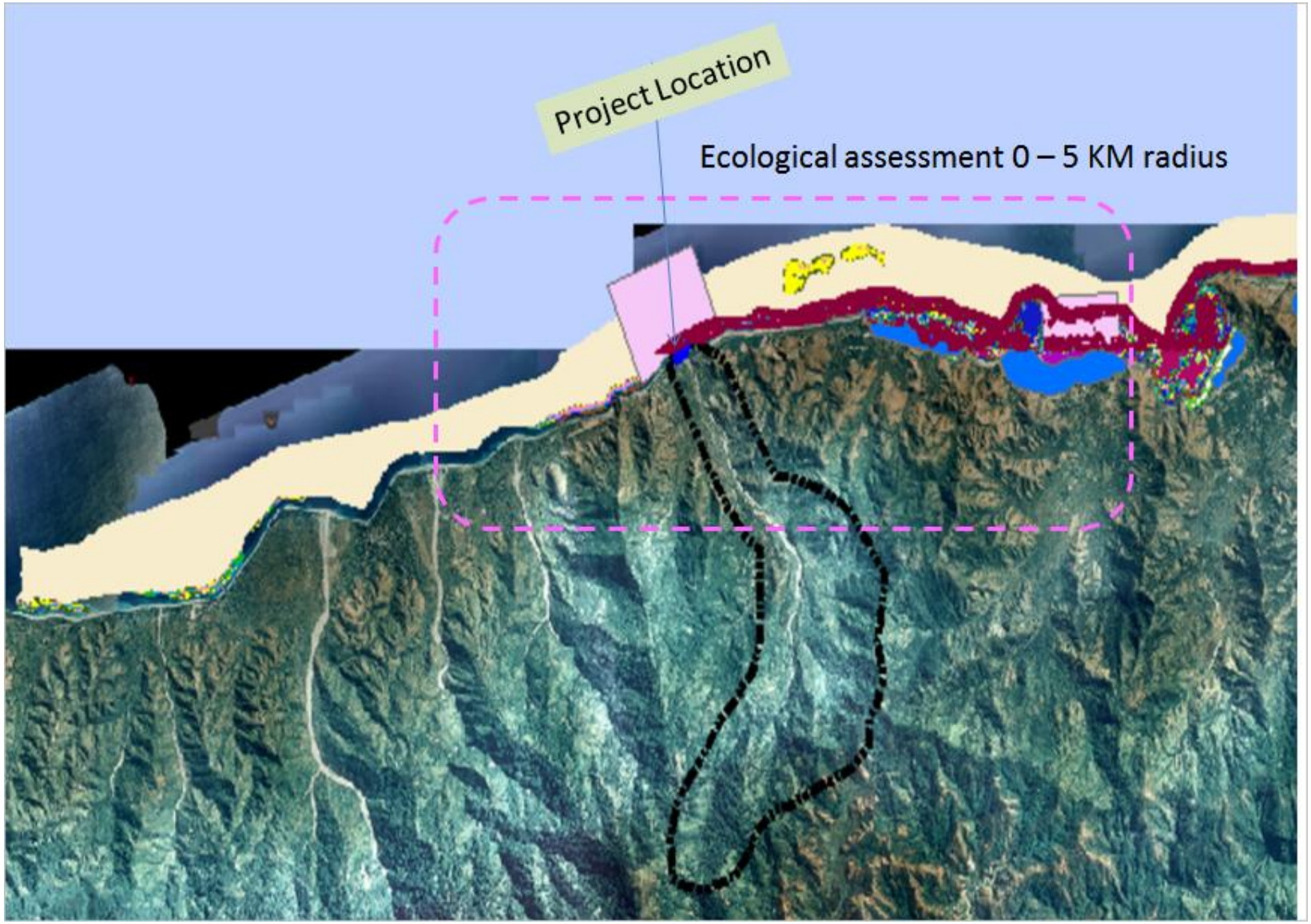


Figure. 6.82c Coverage of Ecological Investigation at the Distance Beyond 1-5 KM radius

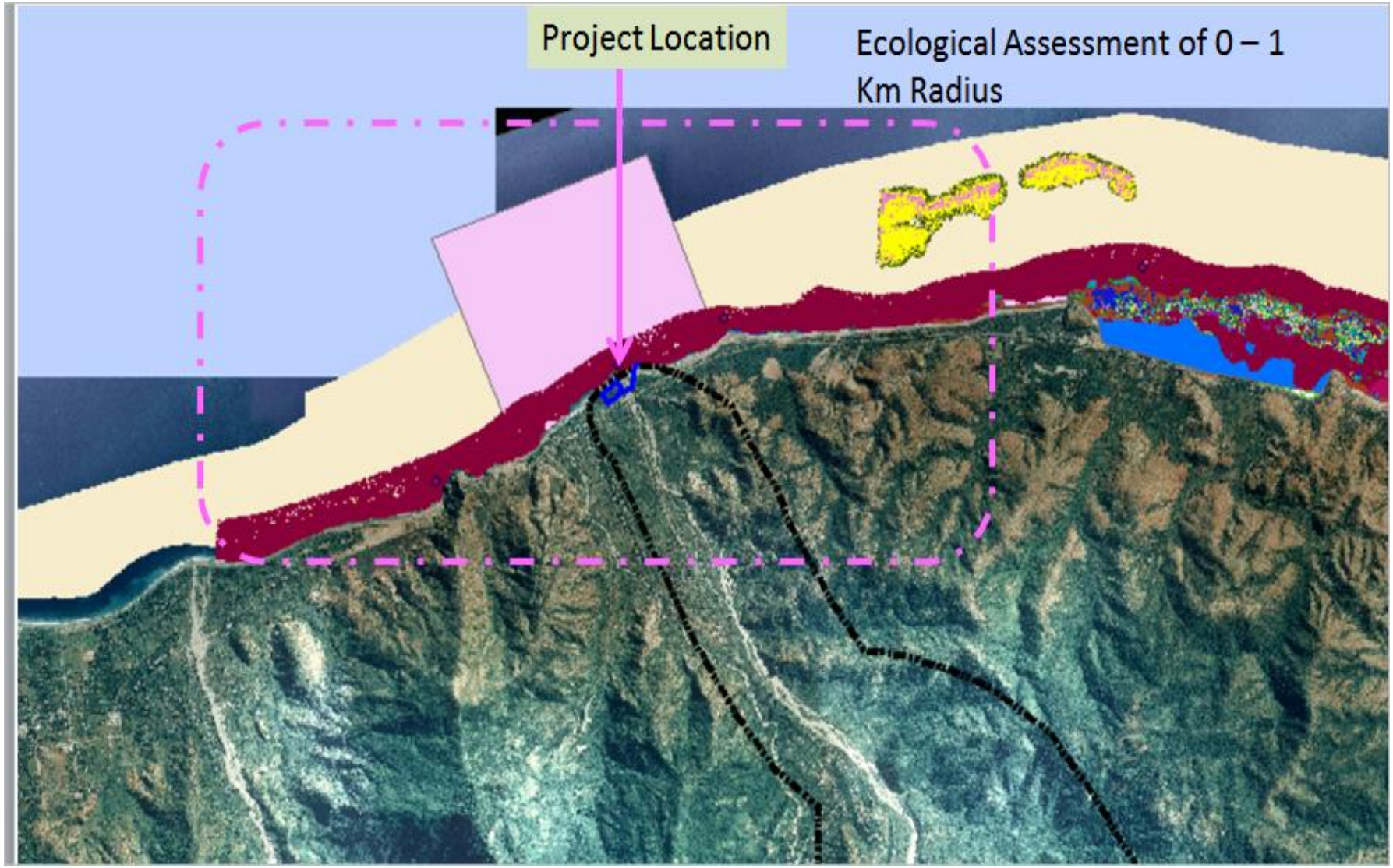


Figure. 6.82d . Coverage of Ecological Investigation at the Distance Beyond 0-1 KM radius

6.2.1 Wetlands

Wetland consist of lakes, river, estuary, and beaches that, may provide natural buffer to the surrouidng ecosystem. The following 15 wetlands have alresdy identified as an important wetland for birds habitat and the habitat for other natural biodiversities.

Table 6.38 : List of Protected wetland in Timor -Leste

Site	No. field-days	No. waterbird species (& no. wader species)	Habitat	Importance for waterbirds	Priority for further surveys
Tasitolu	110	53(30)	Saline lakes, mudflat, beach	***	**
Lake Iralalara	28	50(20)	Freshwater lake, swamps, stream	***	***
Secal	5	43(24)	Estuary, mangroves and mudflats	**	***
Loes river estuary	5	38(21)	Braided stream, estuary and mudflats	**	***
Lake Laga	21	35(24)	Saline lake, beach	**	**
Lake Be Malae	5	31(14)	Shallow saline lake and estuary	**	*
Manatuto mudflats	10	31(19)	Mudflats, mangrove and fishponds	**	**
Tibar aquaculture	21	31(21)	Mudflats, mangrove and fishponds	*	**
O'Swamp	14	23(9)	Spring-fed marsh, reedbeds, short grass	***	***
Raumoko estuary	7	21(14)	Beach and exposed reef	*	*
Dili foreshore	42	20(12)	Beach and estuary	*	*
Lake Eraulo	5	19(7)	Freshwater marsh	**	**
Lake Maubara	10	18(9)	Shallow saline lake	*	*
Lake Seloi	5	17(8)	Freshwater marsh	**	**
Lake Modo Mahut	1	15(2)	Freshwater lake	***	***

Within the project location however, there several wetlands, that are several important habitat, as well as become the tourism spots. There are still other wetlands such as mouth of the river but the area mainly dry, except during the rainy season. Considering the importance of natural buffer of wetland to the ecosystem and other biodiversity, the following important wetlands nearby project location are presented.

- Tasitolu Saline Lake
- Tibar Aquaculture
- Ulmera Aquaculture
- Maubara Saline Lake

The following map shows the most relevant wetland area that could potentially impacted indirectly by the project development.

Figure. 6.83 Wetland Area nearby Project Location

In an extreme case, such as major oil spill, these natural wetlands could be affected, due to ocean hydrodynamic system. Therefore, review these wetlands, particularly knowing location and proximity to the propose project location, as well as any importance biodiversity or other economic activities that shall be affected by the pollution from the oil shall be carried out. The hydrodynamic modeling on the oil spill dispersion in jetty indicated that those wetlands could be affected by the oil spill if the spill does occur.

6.2.1.1 Tasitolu Saline Lake

Tasitolu is classified as a protected area due to the presence of saline lakes with unique ecological characteristics, historical background during the Indonesian occupation and after, also a strategic location that connect various landmarks such the historical park of Joao Paolo II, Nicolau Lobato International Airport, National celebration places, and soon to be completed Green Field Tibar Bay Port.

The shallow saline lakes are surrounded by hills and vegetation covers that include tropical dry forest, grassland, mangrove and eucalyptus trees making the area has unique littoral ecosystem that is important for various native birds and also becomes a destination place for water birds that migrate from Russia every winter time.

Figure 6.84. Overview of Tasitolu with possible connectivity to other areas

Moreover, Tasitolu is a historical and cultural heritage to Timorese people. Many Timorese people were possibly killed and buried in this area between 1975 and 1999. Because of this, Pope Joao Paul the II visited this area in 1989 based upon request from Timor Leste Bishop at that time. In this place, the independent declaration was made in 2002 and ever since then Tasitolu had become a regular venue for independent celebration every year.

Despite all the above uniqueness, little has been done to protect and improve this area from potential disturbances caused by natural and manmade events. Some parts that are low-lying in the area have become a dumping site and location of sand extraction. Timber and firewood collection are occurring in the upland areas. With relatively little cover of plants; the hills with steep slope in Tasitolu are susceptible to high rate of soil erosion and landside during rainy season. Runoff and associated suspended solid materials from uphill and surrounding areas will eventually load in the lakes. Settlements are emerging surrounding the lakes and start to encroach very close to the lakes

The total area of this natural wetland is around, 100 HA, which has already being surrounded by the community housing. Government is working on the resettlement process to control the growth of the settlement in the location. The connection between the sea and the lakes is subject to further investigation to understand the various physical and chemical processes in the sea and the implication to the Tasitolu wetland area. Nevertheless, the hydrodynamic modeling on the oil spill suggested that the origin of oil spill in the proposed project location under the emergency condition could spread-out as far away as possible to the coast of Dili. This means that this natural wetland could be potentially affected by the project. The following figure present the extend of the oil spill impact and potentially reach the coast of Dili

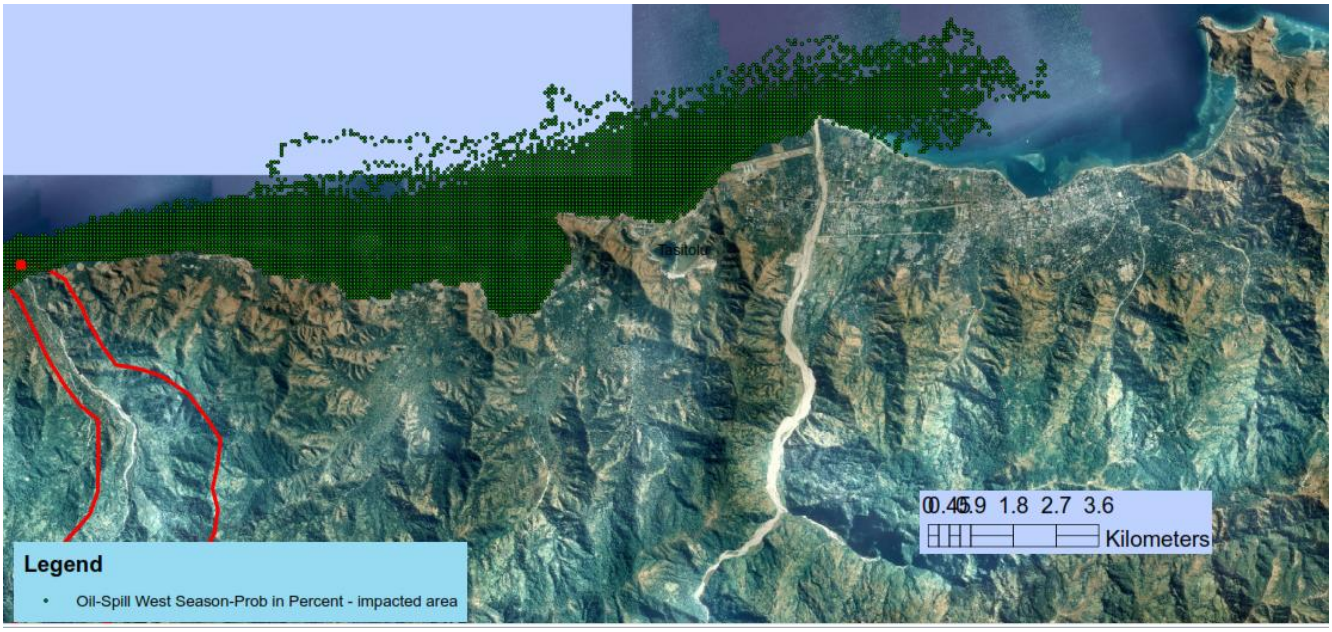


Figure. 6.85 Oil Spill Impact under the Emergency Situation

If this natural saline wetland shall be affected by the pollution from the oil spill, the following biodiversity will be affected:

- Migratory birds
- Mammal
- Fish
- Trace of mangrove
- Other natural wildlife creatures that occupies this wetland area

6.2.1.2 Tibar Aquaculture

Tibar wetland locates in the lower side of Tibar area and traditionally this wetland has used for aquaculture for fish and shrimp production. However, recently, the aquaculture development is not very well developed due to unreliable water source from the sea, especially during the dry seasons. The present of the mangrove forest in this wetland provide a natural buffer and protection of wetland from the wave and erosion from the upland catchment. Large percentage of mangrove forest in the wetland in Tibar area has already damaged or loss due to natural event such as sedimentation and manmade evenlike cutting for firewood. The infrastructure development, such as mega project of Tibar container port would really affect the nature and presence of this wetland in the future, as around 27 HA of wetland shall be reclaimed for the container yard of the port.

Figure. 6.86 Tibar Wetland for Aquaculture

This natural wetland of Tibar Bay is traditional a habitat for crocodile, migratory bird, shrimp aquaculture, and significant size of mangrove forest that provide natural and socio-economic benefit.

Due to hydrodynamic process of in the marine aquatic process, the impact of the project, particularly in case of emergency oil spill can reach this wetland. The oil modeling performed by this study suggested that spill occurs in jetty during a particular season, could generate the spill impact that covers up to Tibar wetland area. Therefore, knowing the importance of this ecological wetland, especially in term of economic recourse could be important to be assessed such that any offsetting to the unavoidable impact would be calculated.

6.2.1.3 Ulmera Aquaculture

The wetland in this area is simply the intertidal wetland that gets wet due to high tide and gets back to dry during the low tide. The total area of wetland in Ulmera is reasonably large with the estimated area of 300 HA. This large wetland could provide various opportunities such as local industry of salt making by creating the salt pan, near the coastline to catch the seawater during the high tide to produce the salt during the low tide. Moreover, the aquaculture is also an importance activity within this area as a source of income to the local community.

Figure. 6. 87 Ulmera Wetland Utilization

This industry (salt pan) and fisheries activities could be affected by the project, if there shall be any contaminant transport into this area. According to information from the interview in the project area (salt making), the annual production is range from 50 -80 tons. This product will enter into the market where the net sale is estimated to be $0.1/kg of raw salt. The economic value of this salt production in the wetland around this area is estimated to $12,000 to 125,000 annually.

Potentially wetland could be affected by the project operation only during the extreme event such as major disaster like oil spill in the jetty that will be dispersed away by the ocean current and wind from the jetty to the other adjacent area such as this natural wetland. The following figure shows the result of the marine hydrodynamic modeling of the movement of oil fat that could potentially reach the project area from the origin of spill in the jetty. Although, all the organic compound in the fuel shall evaporated during the process of salt making, it would not be impossible the salt production shall be contaminated by the oil spill. Therefore, it is recommended the salt production to be suspended in case of an emergency oil spill in the jetty that will potentially transport oil and other associate chemical to this area.

Figure 6.70. Wetland and Pollutant from the Oil Spill

6.2.1.4 Maubara Saline Lake

Maubara saline lake, is similar to Tasitolu lakes, has brackish water quality characteristics, and function as the ecological buffer zone to the surrounding area. The connection between the lake and the sea is subject further scientific investigation to know how the physical and chemical process interaction between the sea and lake, which would provide an information on the impact occur in the sea and how that affect t the lake and also the other way around. The impact of fuel terminal project development to the natural lake would primarily relate to the ocean hydrodynamic transport of pollutant (oil or fuel) during the emergency situation. However, it is not clear how the polluted sea would affect the pollutant transport in the lake.

Nevertheless, the hydrodynamic modeling of the oil-spill in the jetty (emergency scenario), suggested that the pollutant would never arrive the nearby beach or shoreline. The following map shows the probability of impacted area of oil spill during, in case of emergency, situation in the jetty.

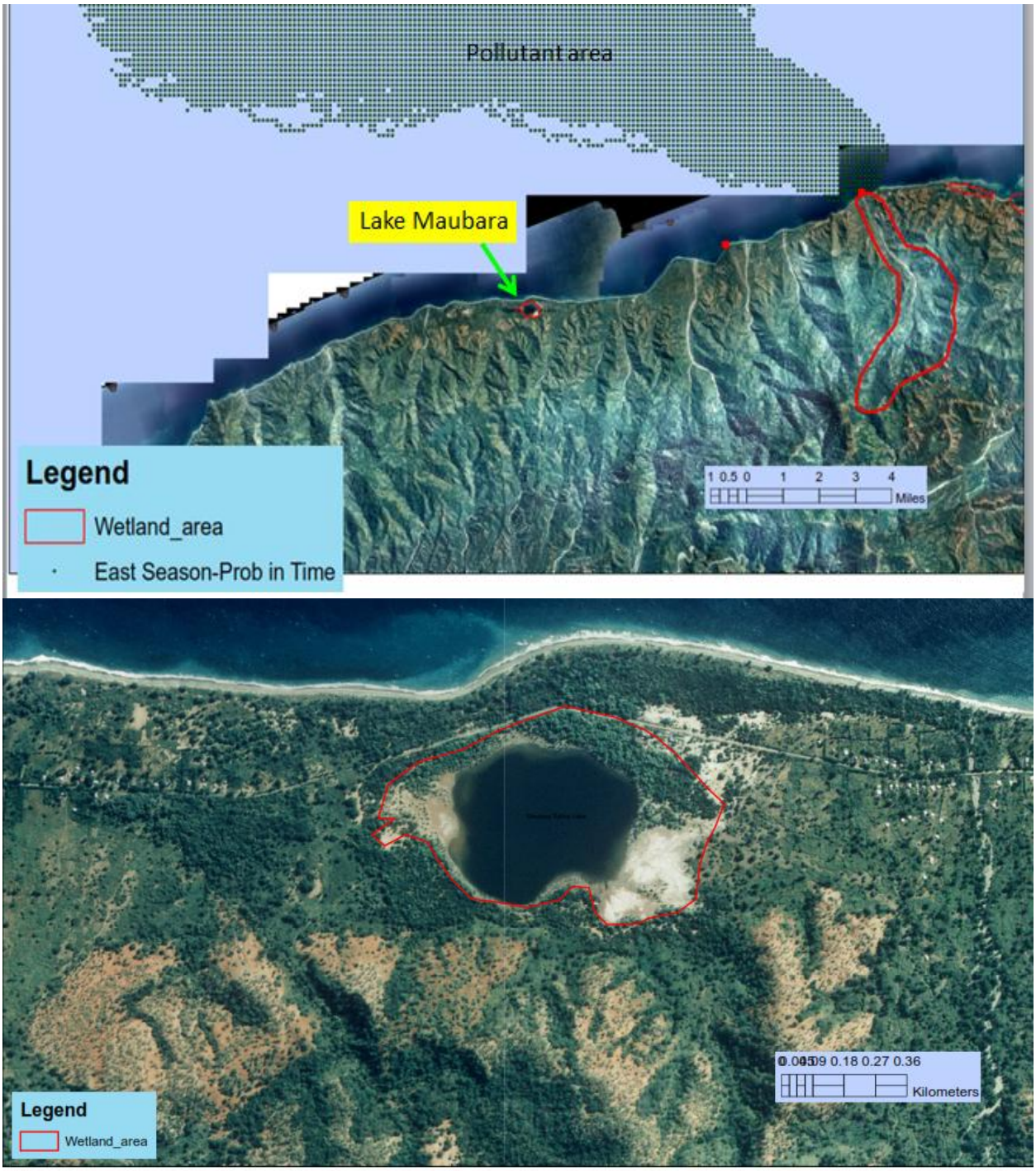


Figure. 6.71 Maubara Wetland Area and Pollutant Area Impacted

The above figure suggested that the oil spill pollutant would never arrive in the shoreline area of Maubara, which will affect the existence of the wetland area.

6.2.2 Mangroves

Mangrove forest is an important plant in the ecosystem that providing various ecosystems function and services that supports the both livelihoods and environment. It can be found in both North Coast and South Coast of Timor Island, occupying small patches along narrow coastal flats in the north coast; and in the river mouths, lagoons, and behind sandbars in the SouthCoast. Mangrove areas covering around 1,300 ha, mostly located in the North Coast (Alongi, 2014, Richards and Friess, 2015).

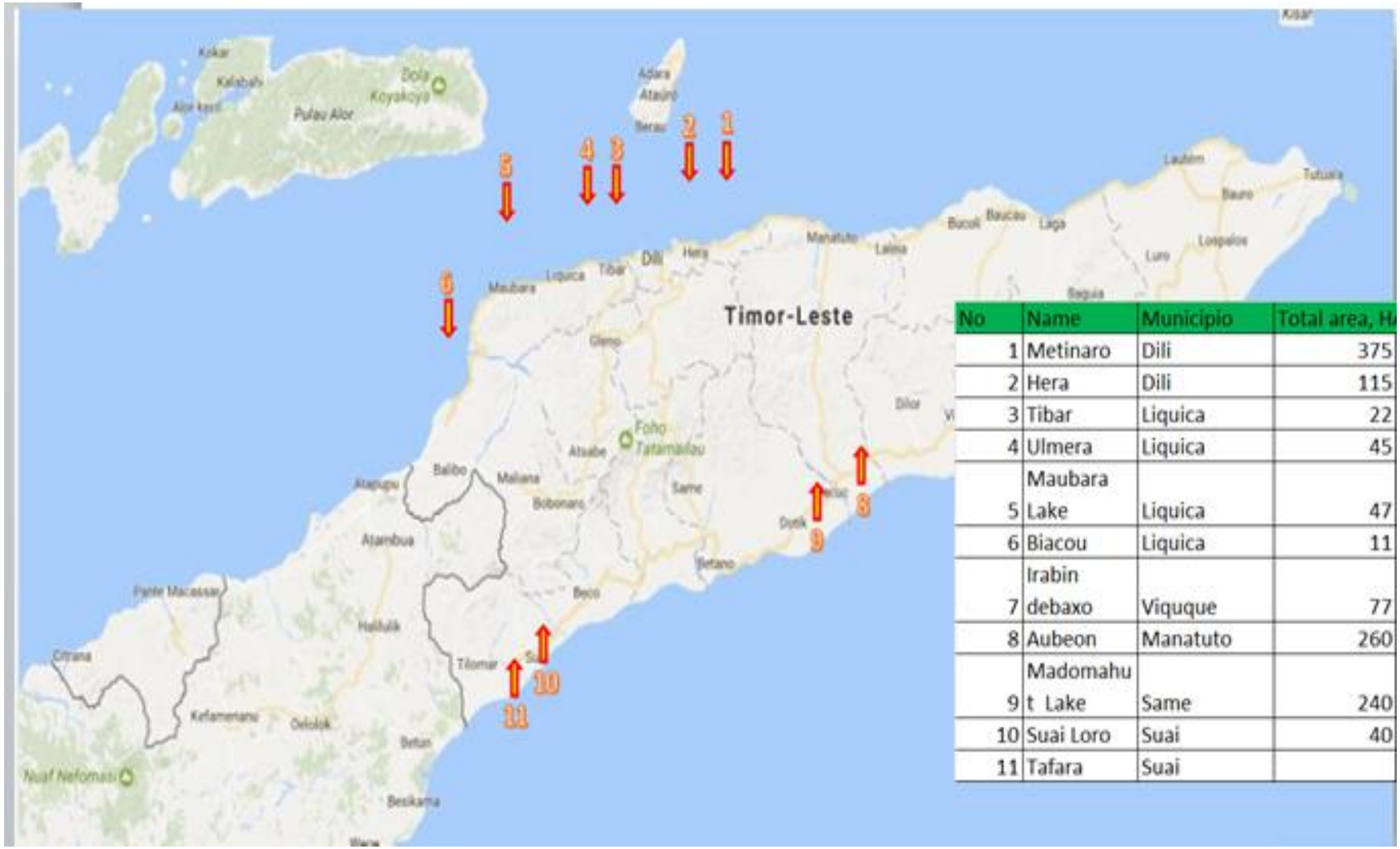
Mangrove forests provide a valuable ecologic and economic resource as nursery grounds for many commercially important fish, shellfish, and crustaceans, as well as preventing coastal erosion (Alongi et al. 2009). The importance mangrove existence is related to the following areas;

- Timber wood exploitation
- Fish pond and salt pan
- Wave breaker and help reducing the coastal inundation risk
- Filter of sediment
- High contain of Carbon biomass, which in turn mangrove forest absorbs more CO_2, that transmit by various activities, which in turn contribute to the global climate change
- Healthy mangrove forest would also provide nursing and habitat for fish
- Ecosystem function to support fishery (fish nursery)

Moreover, the mangrove is also protecting the coastal area such as beach, road infrastructures along the beach, and house of the population from the high wave of the sea, with high density of the mangrove will break the wave. The presence of mangrove will also provide habitat to marine life, which is also an important food cycle in the marine ecosystem. As mentioned earlier that the mangrove in Timor – Leste can be found in north and south coasts area. Various reports have indicated that around 90% of the original mangrove forest since 1940 has already lost. The degradation of mangrove loss, have caused by the various reasons, as follow:

- Settlement creation by cutting the mangrove forest for agriculture production
- Over-exploitation of mangrove forest for firewood and timber wood usage to construct the house within the coastal area
- High sedimentation rate due to soil erosion from upland catchment system. Note that the sediment deposit will cover up the small mangrove tree and eventually die
- Animal grazing in the mangrove forest that also reported as one of the cause of the mangrove degradation

According to the assessment made by UNDP in 2017, there are about 11 main spots of mangroves area in Timor – Leste, which should be conserved and replant furthermore.



No	Name	Municipio	Total area, H
1	Metinaro	Dili	375
2	Hera	Dili	115
3	Tibar	Liquica	22
4	Ulmera	Liquica	45
5	Maubara Lake	Liquica	47
6	Biacou	Liquica	11
7	Irabin debaxo	Viquque	77
8	Aubeon	Manatuto	260
9	Madomahu t Lake	Same	240
10	Suai Loro	Suai	40
11	Tafara	Suai	

Figure 6.72. Major Mangrove Community in North and South Coast of Timor - Leste (UNDP, 2017)

The following map shows the presence of mangrove in the West North coast, with the proximity to the proposed project development in Lauhata.

Figure. 6.73 Area Coverage of Mangrove nearby Project Area

Mangrove has degraded overtime and according to the research, the causes of the mangrove loss can be summarized as follow:

- Infrastructure development such as road and settlement
- Fish and shrimp pond
- Uncontrolled animal grazing
- Mangrove cutting
- Pollution and sedimentation
- Sea level rise

Within good understanding of the above list of the causes of the factors that have contributed to the damaged of mangrove forest, it is hope that a rehabilitation and restoration program can be formulated.

Figure 6.74 Sedimentation covered up the Baby Mangrove to grow

Taking into consideration of the importance of mangrove to ecosystem in the coastal area, the effort to protect and manage the mangrove is very important. Government of Timor Leste with support from various development agencies has done various efforts to support the following program in order to conserve and maintain the integrity of mangrove in the coastal ecosystem.

- Mangrove rehabilitation and restoration
- Mangrove awareness program
- Pollution reduction (sedimentation from upland catchment system and point source pollution)

The proposed project development, especially, during the extreme condition such as oil spill contributed as consequences of the operation of the fuel storage will contribute the pollution to the marine water body where eventually the pollutant will be transported to coastal area. The mangrove as coastal protection zone will be impacted by the transport of pollutant.

The analysis of satellite image indicated that the total area of mangrove, the east side of the project location was estimated to be around 54 HA and government of Timor- Leste through various development partners has made a significant effort in replanting the mangrove along the coastal area. Considering the importance of mangrove to the local community, ecological protection, and other biodiversity, it is important to understand the coverage of project impacts to the existing mangrove so that the proper management can be taken in order to minimize the negative impact. The following map shows that in the emergency situation such as major oil spill, the mangrove, as identified from the previous map will be impacted by the oil spill.

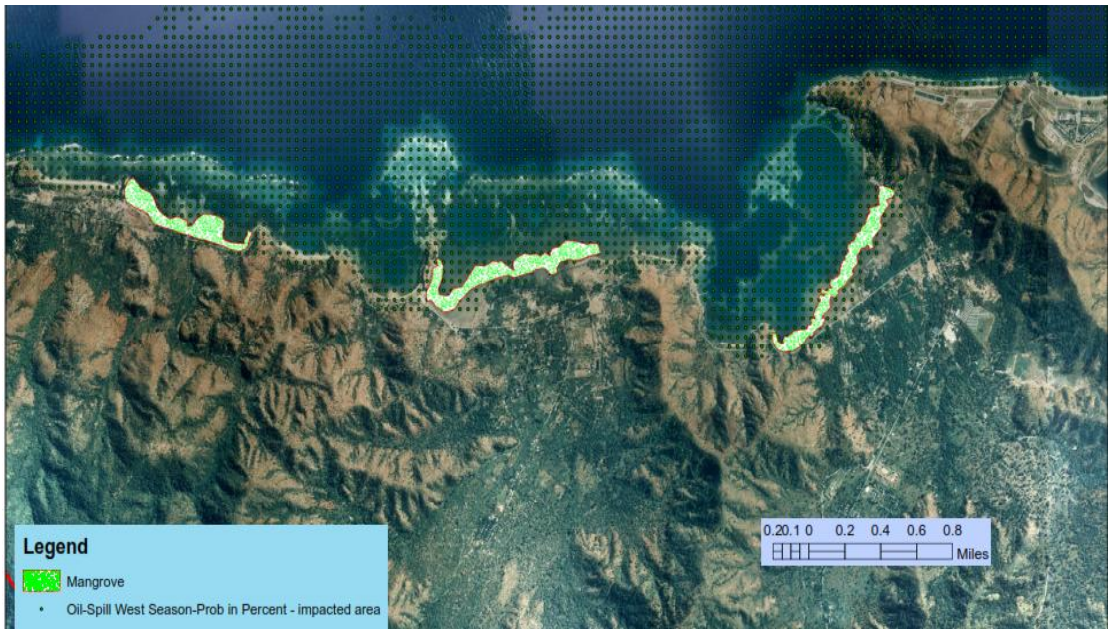


Figure. 6.75 Oil Spill Impacted Area with Mangrove Coverage

Further information related to the mangrove areas/communities that will be affected by the project development is presented in the following sections.

6.2.2.1 Mangrove in Tibar

Mangrove in Tibar area around 18 HA by this study but there is other study that shows the different size of mangrove coverage area in various locations. The UNDP mangrove assessment found that the total area was around 22 HA in Tibar, which include all the part of the dead mangrove.

Figure. 6.76 Mangrove Community in Tibar Bay

Some part of this mangrove community has already damaged (tree already died). The observation of the mangrove in this area indicated that roughly, 30 – 40% of mangrove area already damaged due to natural event like sedimentation from the upland catchment that covered up the baby mangrove from growing further.

Figure. 6. 77 Photos of traces (mangrove tree that damaged)

Infrastructure development in Tibar bay, such as construction and operation of Tibar Port and connection road will destroy roughly 4- 10 Ha of mangrove forest. However, according the government plan, the mangrove that destroys will be offset by replanting with 16 HA in Ulmera beach.

Figure. 6. 78 Photos of Tibar Port project development

6.2.2.2 Mangrove in Ulmera

Mangrove Habitat in Ulmera is considered as one of the largest one in the west side of North Coast of Timor- Leste with the total area of 40 HA.

Figure. 6.79 Mangrove Coverage in Ulmera

Figure. 6.80 Mangrove Community near Ulmera

The existence of mangrove community in Ulmera beach is event more tangible in term of the function of buffer zone between open sea and salt pan and marine aquaculture that constructed by the Ulmera Community members. The present of the mangrove shall protect the salt pan and marine aquatic system from the ocean wave.

6.2.2.3 Mangrove in Maubara Lake

Mangrove area surrounding the wetland of Lake Maubara is estimated to be around 10 HA, near the road side of the lake. As the following map indicated that the presented of the mangrove in the lake would provide protection of the road from abrasion, as well as other ecological function in the lake such habitat for various fishes and other marine aquatic life.

Figure. 6.81 Area Coverage of Mangrove Identification in Maubara

Mangrove diversity in term of species in around Lake Maubara was observed to be very low and only three species was found in the area. Lacking the species diversity caused by the lack of water exchange (tidal). The three mangroves species that grow in Lake Maubara are *Avicenna marina* which dominated the area, 355 species/ha, occupied shallow part of the lakes up to the dry land that only inundated by the water one or twice a year (buffer zone). Another species that common in the buffer zone is, particularly in the northern side, is young trees of *Exoecaria Agollacha* (<2m high), 1950 trees/ha. While the densely populated adult tree of the *Exoecaria Agallocha* (177 trees/ha) can be found in the South side of the lake. The third mangrove species is *Lumnitzera Racemosa*. Their population is very small, scattered in the east side of the Lake.

Currently there is no specific community activity to utilize the mangrove resources in the lakes. There were tourism facilities, boardwalk, abandoned in poor conditions. It seems, some community members were also catch fish in the lakes but the scale was very smalls.

The mangroves in the Lake are heavily degraded due to logging, particularly in the east side of The lake. However, there are many signs showing that natural seedlings could survive if the areas are protected from animal trampling and grazing. In addition, creating canals to the degraded areas would enable the distribution of seedlings and restore back the wetlands forest Surrounding the lakes.

6.2.3 Coral

Timor Leste is located in the triangle of in Coral reef regions as one of the six countries, which has detected as the area that has highest marine biological diversity in the world. This diversity of resource becomes a potential resource for larger economic development of each country and as well as becomes the resources that people and community in the coastal region relied on.

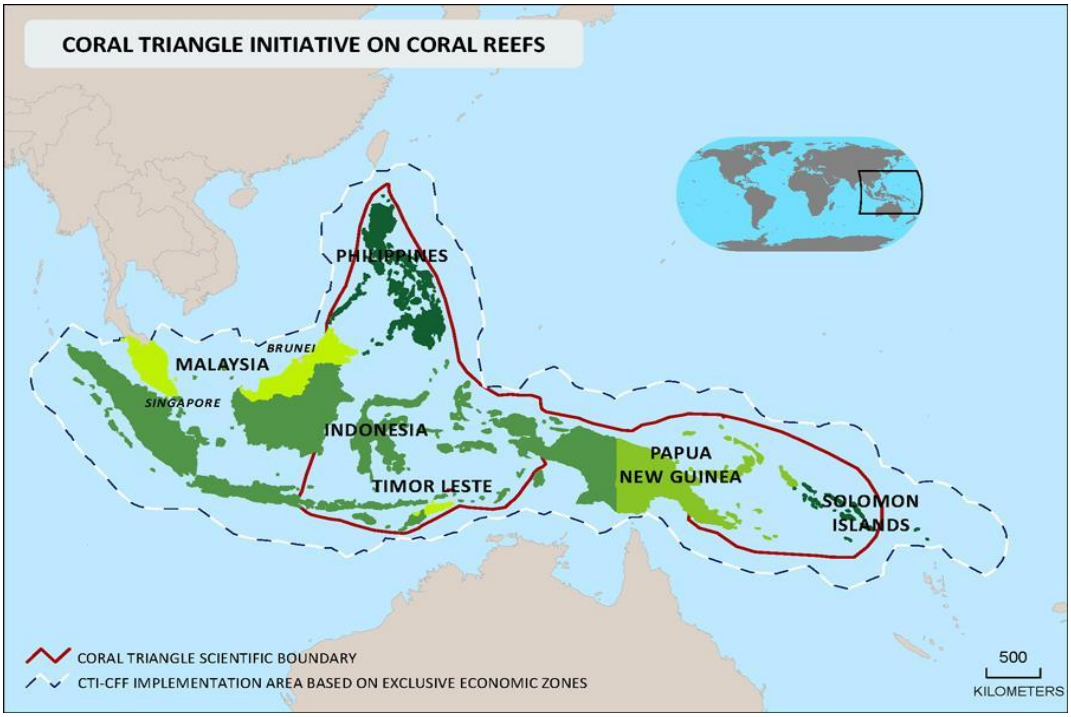


Figure. 6.82 Timor – Leste Position in the Coral Region

Because of the importance economic opportunity in term of fishery, tourism, and other marine resources, managing and protecting the coral reef and their associate resources across the coral tringle becomes an essential. Especially the island nation, like Timor – Leste, managing the and conserving the coral reef ecosystem for future generation connects directly to the provision of food, resilience to the climate change and adaptation, and other coastal protection and risk reduction.

In order to manage the coral reef resources by means of protection and utilization sustainably, the identification of the resource area, physical and chemical element that affects resource availability and existence would be important. Timor – Leste in partnership with various donors and other international agencies within this coral triangle framework has established the collaboration to the conduct the proper identification of the resources availability within the region, including the current status and future trend.

The following map shows the NOAA and USAID co-funded project in Timor – Leste to identify the coral related resources, as part of the global partnership effort to support the coral reef resource identification process, which will provide information to the decision-making in order to manage the resource sustainably. Coral is a habitat of fish and healthy coral is important factor in maintaining the natural production of fish in sea. Northshore of Timor is rich with various kinds of coral with relatively health, where the percentage of soft coral is high. This condition need to be maintained for the ecosystem balance such as fish production and other marine life. The identification of the percentage of coral as baseline information is also important information for future monitoring program, when the project is already in the operation stage. Further study and data collection to validate the percentage of benthic coverage in various spots in within the certain radius of project location will be conducted. The baseline data on coral was conducted by NOAA in working together with the MAF, suggested that percentage of coral cover in the north coast of Liquica is reasonable high, which shows the

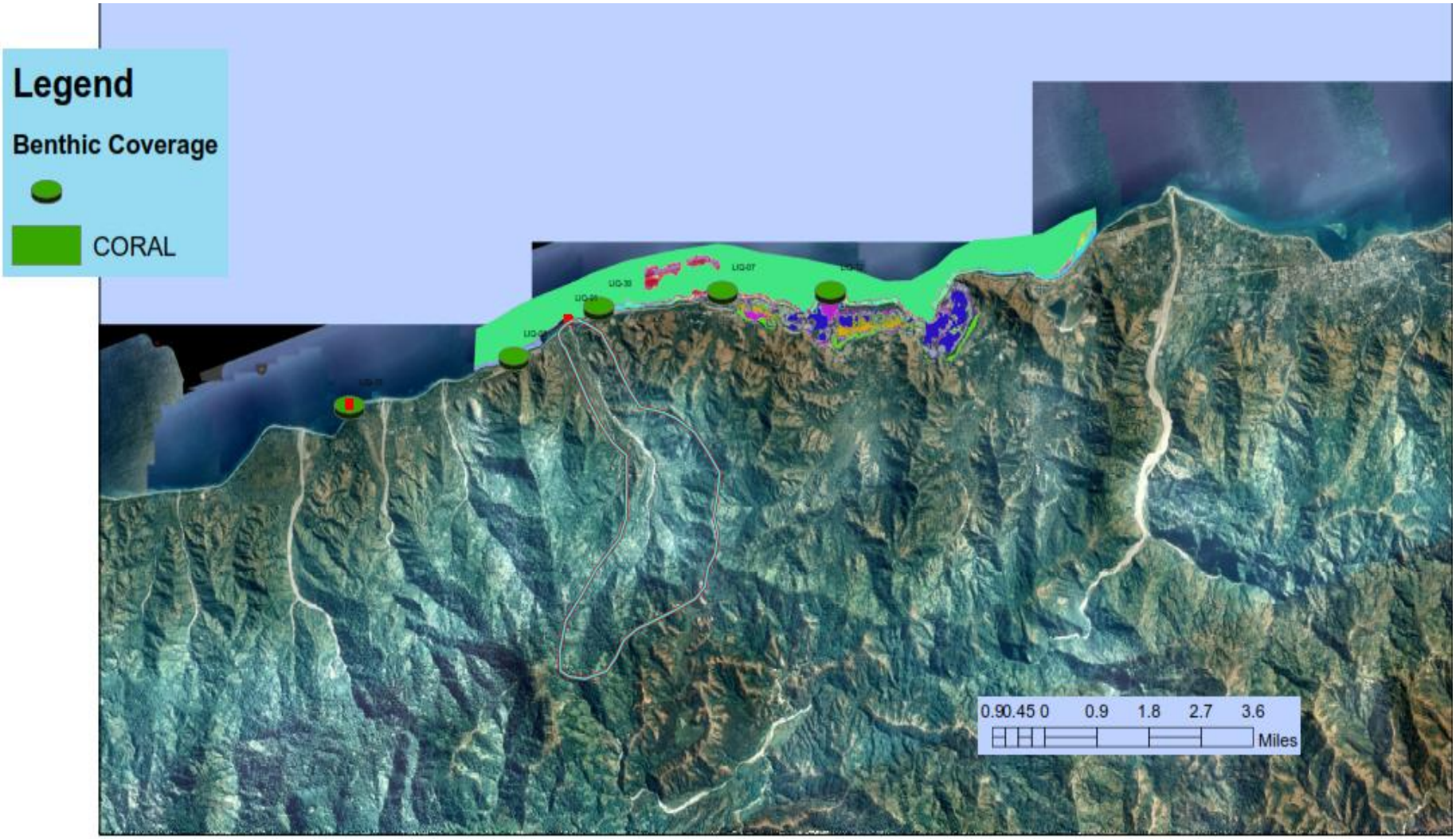


Figure. 6.83 Coral Coverage in the North Coast of Liquica

Table of the data on the percentage coral coverage in the spot survey.

Table 6.39. Percentage of Coral Coverage

DISTRICT	SITE	Total Coral, %	I, %	MA, %	SED, %	TURF, %	UC, %	BSR, %	Total
Liquica	LIQ-01	0.0	0.4	9.6	7.0	81.7	1.4	0.0	100.1
Liquica	LIQ-07	40.3	0.0	0.6	13.0	40.4	5.7	1.0	101.0
Liquica	LIQ-08	50.6	3.3	1.0	0.0	43.5	1.6	1.1	101.1
Liquica	LIQ-12	38.4	0.0	4.1	5.7	48.0	3.8	0.7	100.7
Liquica	LIQ-15	3.2	1.4	3.6	23.1	68.4	0.3	0.0	100.0
Liquica	LIQ-30	27.1	4.3	2.7	7.0	54.1	4.7	0.5	100.4

The survey data in 6 spots survey suggested that the north coast area has a potential coral that coverage up 30%. The highest percentage of surface coverage is mainly turf, which is the habitat of various fishes and other natural biodiversity.

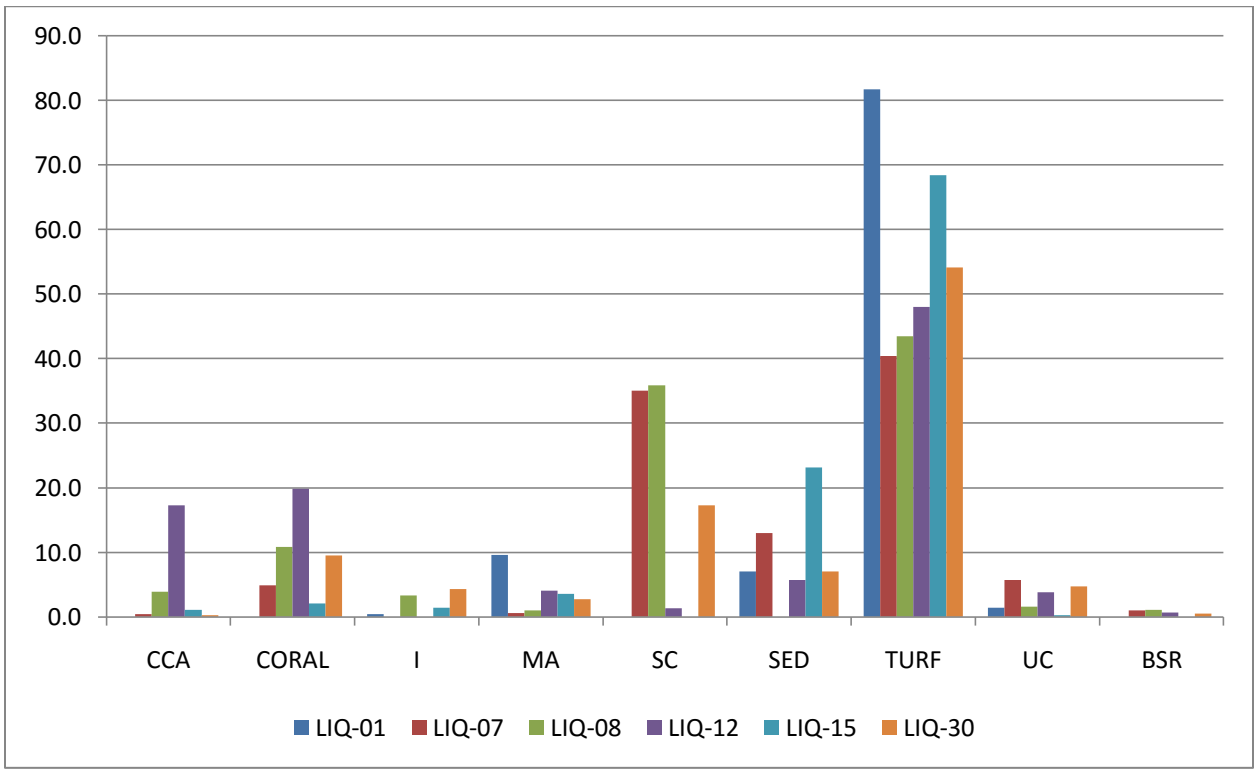


Figure. 6.84 Benthic Composition in the Coast of Liquica

As part of the study of EIA, for the proposed project development, the diver's team was mobilized to conduct spot survey to validate the above data and finding. Three spots were selected as the area if representation of the survey:

- Ulmera (LIQ – 12)

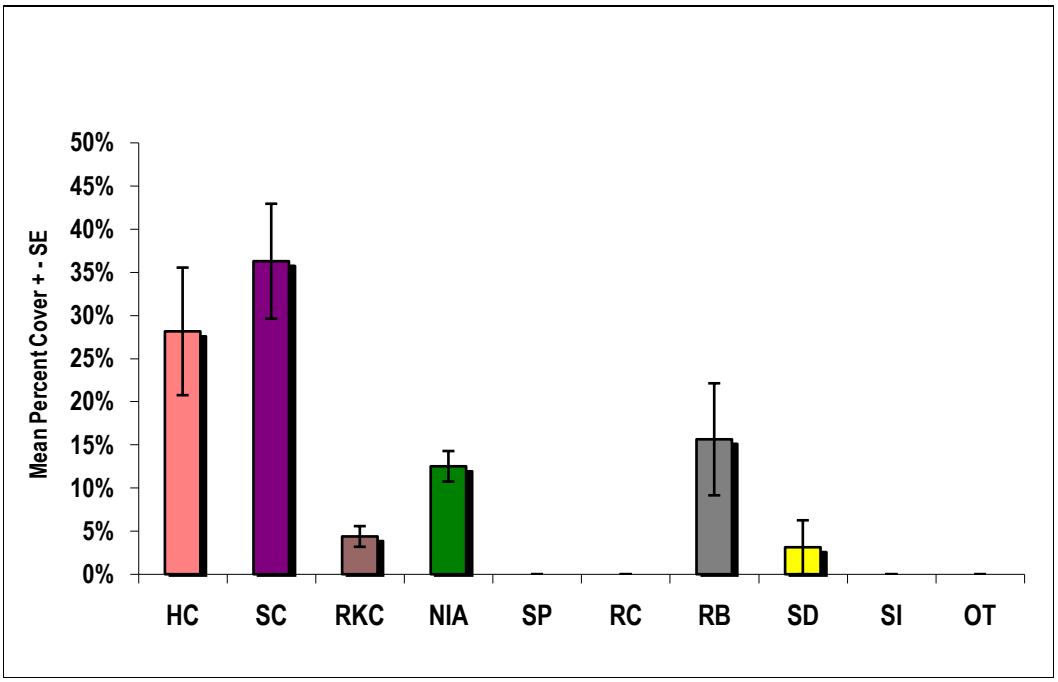
- Kaitehu (LIQ-07)
- Lauhata (LIQ-30)

Figure. 6.85 Coral Survey by Divers

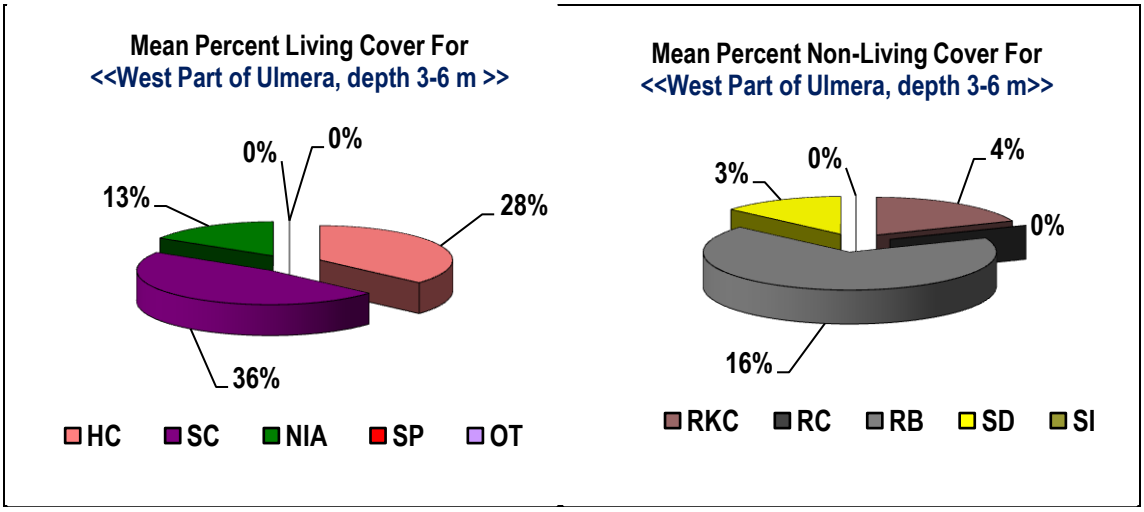
Further detail finding on the coral status in these three locations of survey is presented in the following sections.

6.2.3.1 Coral Coverage in Ulmera

As part of the EIA study, the diver team was mobilized to conduct the instantaneous observation in the selected spot in Ulmera at the depth of 2 meters to 10 meters. The total survey area is around 100 HA with 4 members of diver team that conducted the visual survey during 3 days' time. The summary result of the observation of coral survey from east and west Ulmera can be seen in the following figure, the existing coral is relatively healthy at the higher percentage of the soft coral.



Obs: HC= Hard Coral; SC=Soft Cora; RKC=Recently Killed Coral; NIA, Nutrient Indicator Algae; SP= Sponge; RC= Rock; RB= Rublle; SD= Sand; SI= Silt/Clay & OT= Other



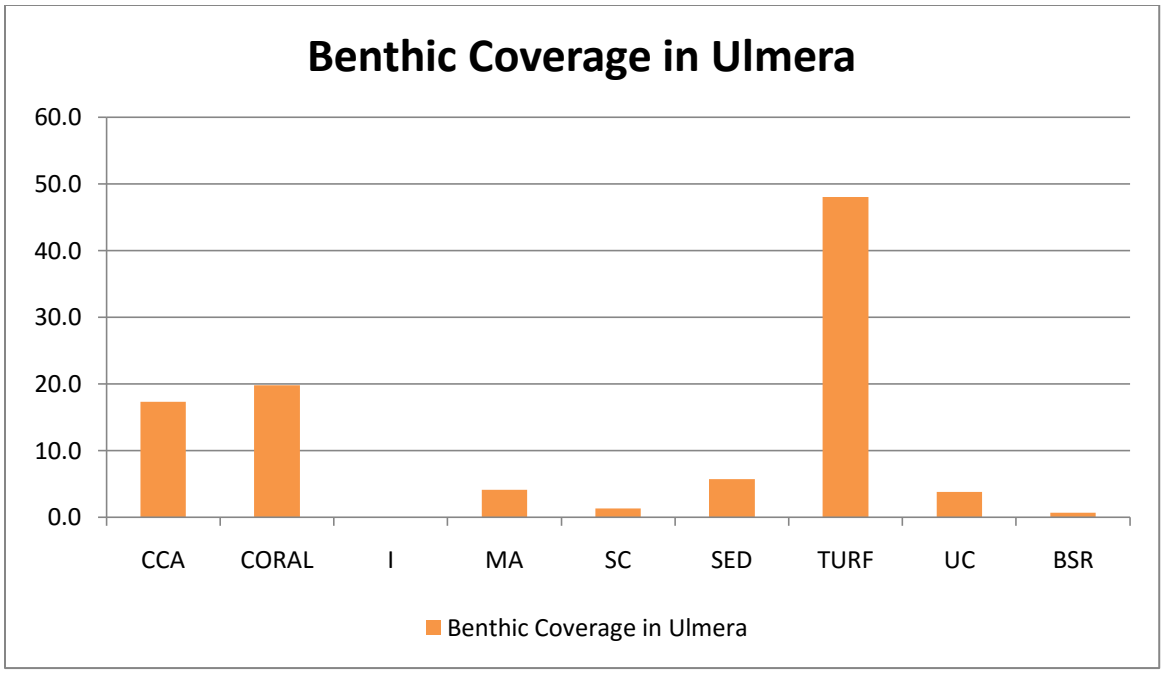


Figure. 6 .86 Benthic Coverage Distribution in Ulmera

The result of this EIA study and investigation conducted by the NOAA shows, the similarity in the term of coral coverage in the survey spot, which is range from 10 – 30% and majority of the benthic habitat is dominated by turf around 40%.

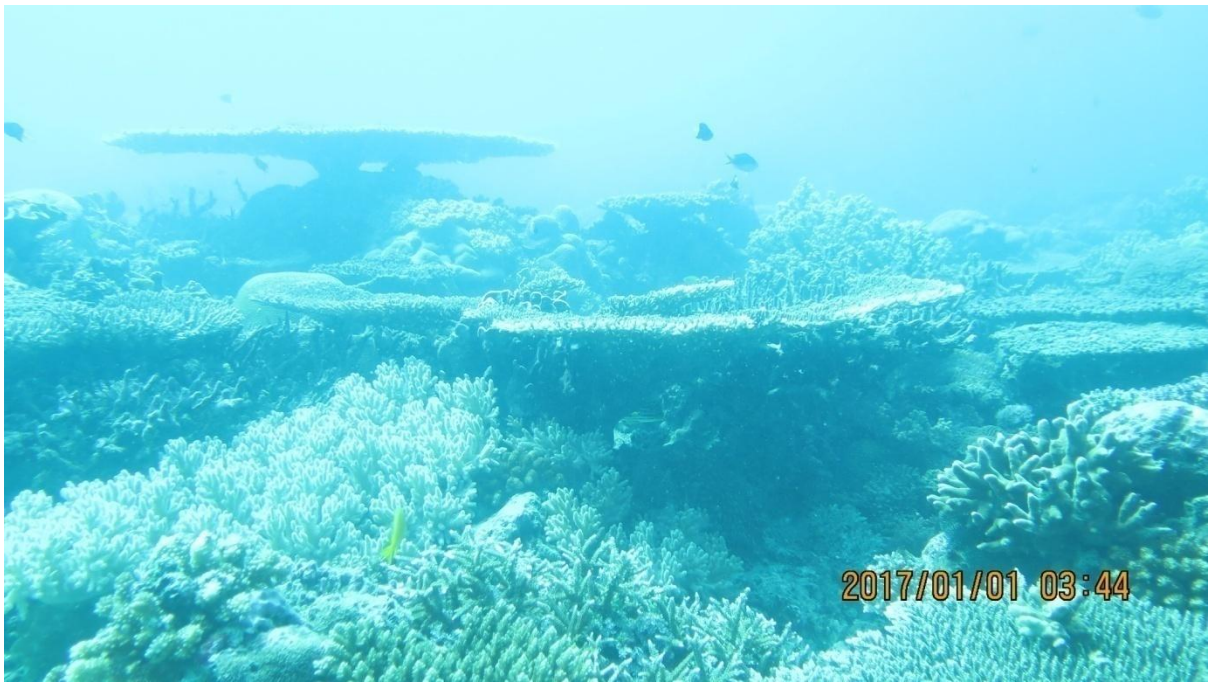
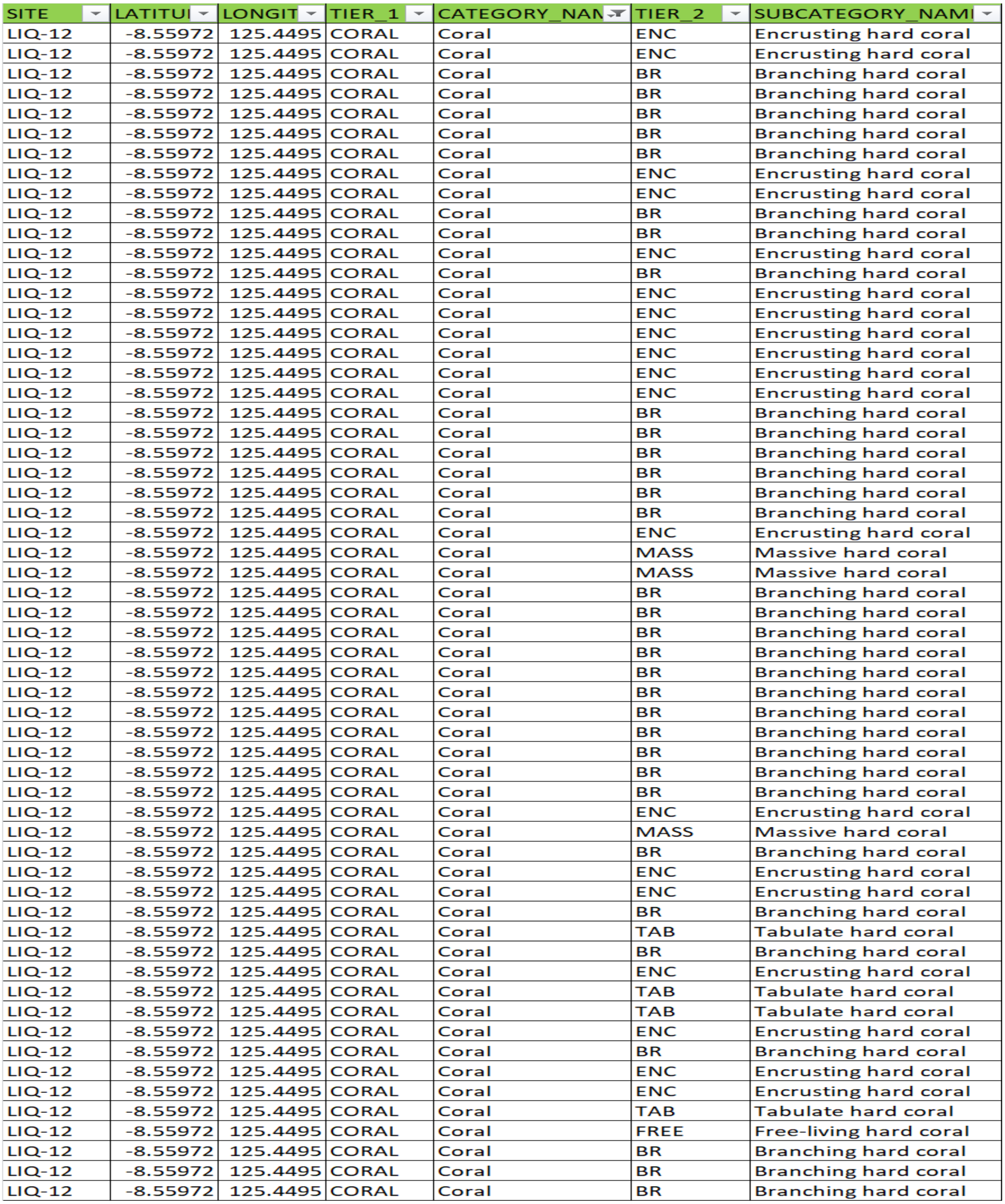


Figure 6.87 Observation and measurement of Coral presence in the seafloor

The following table shows the list of common type of coral identified in the project area

Table 6.40. List oc Coral type Identified in Ulmera



SITE	LATITU	LONGIT	TIER_1	CATEGORY_NA	TIER_2	SUBCATEGORY_NAM
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	MASS	Massive hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	MASS	Massive hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	MASS	Massive hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	TAB	Tabulate hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	TAB	Tabulate hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	TAB	Tabulate hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	ENC	Encrusting hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	TAB	Tabulate hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	FREE	Free-living hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral
LIQ-12	-8.55972	125.4495	CORAL	Coral	BR	Branching hard coral

The most dominant coral in the area of Ulmera can be seen from the following table of summary.

Table 6.41. Sumamry of Coral Classification in Ulmera

Station of LIQ-12		
Type Coral	**Total Count**	**%**
Branching hard coral	32	54%
Encrusting hard coral	19	32%
Free-living hard coral	1	2%
Massive hard coral	3	5%
Tabulate hard coral	4	7%
total	59	

The most dominant coral is ***branchin hard coral*** and ***encrusting hard coral***, which take the total of 86% of the total benthic coverage.

Figure. 6.88 Dominant Coral Type in Ulmera

6.2.3.2 Coral Coverage in Kaitehu

Similar survey was conducted in the survey sport at the shallow water depth in Kaitehu to know the existing condition of the coral, including the composition of dead and life coral. The total coverage area was around 20 HA, as showing in the following map.

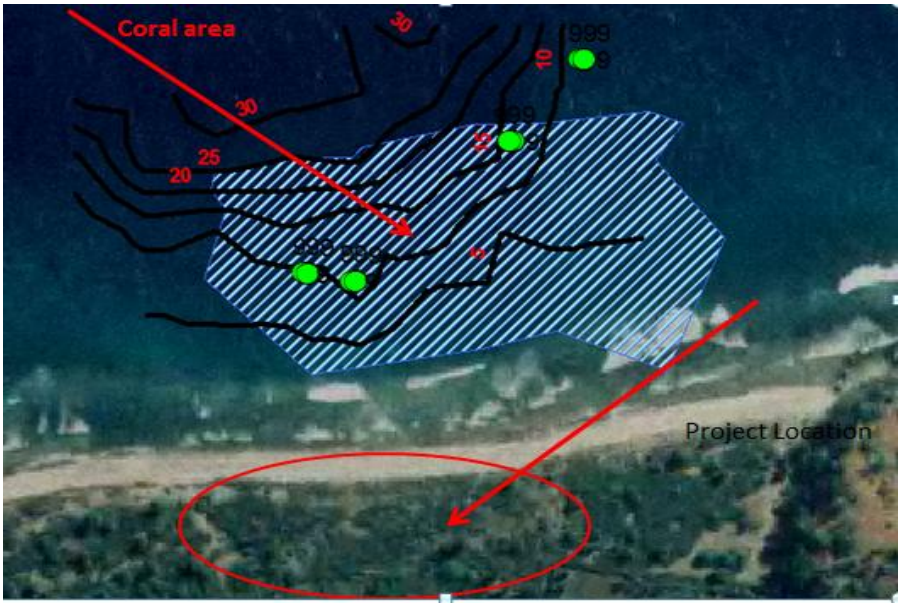


Figure. 6.89 Mapping of Coral Area Observed During the Diving

According to the observation done by the diver team from PEC-Consulting, the coral can be found from coastline up to the depth of 20 meters. The density and status of coral were assessed to understand the distribution in the certain depth so that the information will be used as guideline in determining the suitable location of landing jetty that will give a minimum impact to the overall coral and determining the type of method to be used in constructing the jetty. Overall distribution of coral and status are presented in with the following figure.

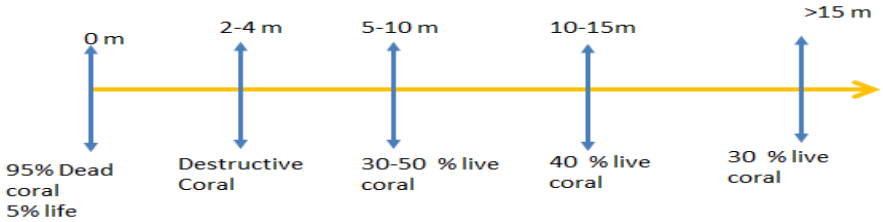


Figure Graphical Representation of Coral Distribution versus the water depth

At the intertidal zone at the depth of zero meters, some recovery coral is found but 95% are dead coral. The coral status at the depth of 2-4 meter has destroyed by the fishing activity. The health of coral is found in the depth of 5-25 meter, which percentage of coral and sand coverage to the seabed is almost equal.

Figure. 6.90 Composition of Life and dead Coral

Table.6.42 List of Corl identified in Kaitehu (LIQ-07)

SITE	LATITU	LONGITUDE	TIER_1	CATEGORY_NAME	TIER_2	SUBCATEGORY_NAME
LIQ-07	-8.55974	125.4225294	SED	Sediment	SAND	Sand
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	CORAL	Coral	FOL	Foliose hard coral
LIQ-07	-8.55974	125.4225294	TURF	Turf Alga	TURFH	Turf growing on hard substrate
LIQ-07	-8.55974	125.4225294	CORAL	Coral	ENC	Encrusting hard coral
LIQ-07	-8.55974	125.4225294	CORAL	Coral	MASS	Massive hard coral
LIQ-07	-8.55974	125.4225294	CORAL	Coral	MASS	Massive hard coral
LIQ-07	-8.55974	125.4225294	CORAL	Coral	MASS	Massive hard coral
LIQ-07	-8.55974	125.4225294	TURF	Turf Alga	TURFH	Turf growing on hard substrate
LIQ-07	-8.55974	125.4225294	TURF	Turf Alga	TURFR	Turf growing on rubble
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	UC	Unclassified	UNK	Unclassified/Unknown
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	TURF	Turf Alga	TURFH	Turf growing on hard substrate
LIQ-07	-8.55974	125.4225294	TURF	Turf Alga	TURFH	Turf growing on hard substrate
LIQ-07	-8.55974	125.4225294	TW	Tape and wand	WAND	Wand
LIQ-07	-8.55974	125.4225294	UC	Unclassified	SHAD	Shadow
LIQ-07	-8.55974	125.4225294	TURF	Turf Alga	TURFH	Turf growing on hard substrate
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	TURF	Turf Alga	TURFH	Turf growing on hard substrate
LIQ-07	-8.55974	125.4225294	TURF	Turf Alga	TURFH	Turf growing on hard substrate
LIQ-07	-8.55974	125.4225294	SC	Soft Coral	OCTO	Octocoral
LIQ-07	-8.55974	125.4225294	SED	Sediment	SAND	Sand

The species in the above table is further tabulated into the following table to undertand the most dominant type of coral in the area of Kaiterhu.

Table.6.43 Dominant Class of Coral Type in Kaitehu

Station of LIQ-7		
Type Coral	**Total Count**	**%**
Turf growing on hard substrate	113	37%
Anemone		0%
Branching hard coral	1	0%
Bryozoan		0%
CCA growing on hard substrate	1	0%
Encrusting hard coral	5	2%
Encrusting macroalga	2	1%
Foliose hard coral	1	0%
Free-living hard coral	1	0%
Want	3	1%
Massive hard coral	7	2%
Mobile fauna		0%
Octocoral	107	35%
Sand	39	13%
Shadow	6	2%
Sponge		0%
Tabulate hard coral	0	0%
Unclassified soft coral	0	0%
Unclassified/Unknown	11	4%
Turf growing on rubble	10	

The most dominant coral around Kaitehu is ***Turf growing on hard substrate*** and **Octocoral**, which takes total of 72% of benthic coverage.

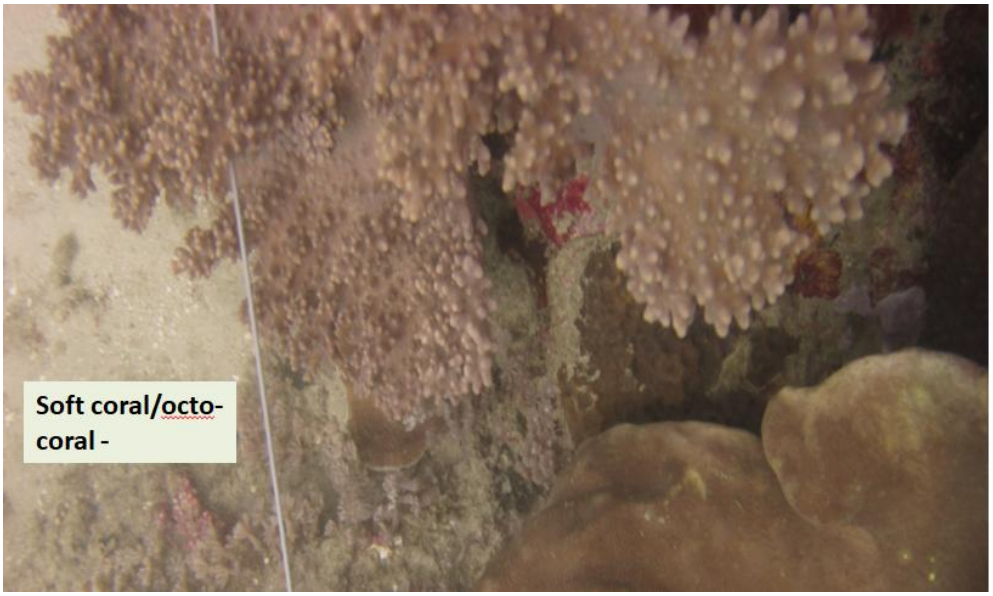
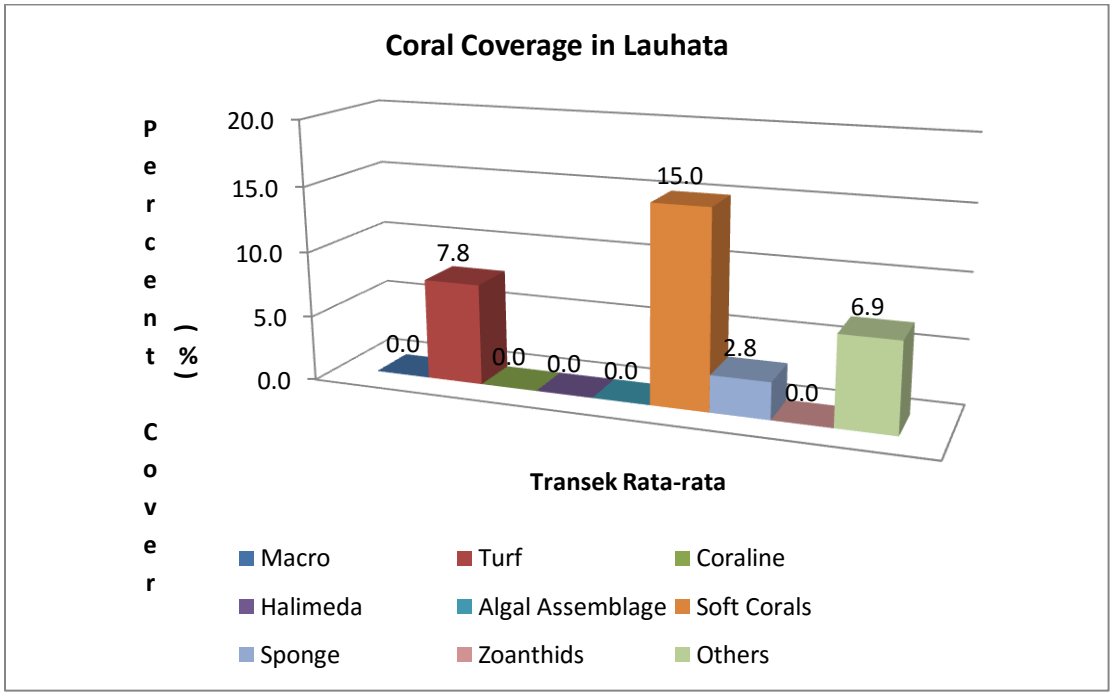


Figure. 6.91 Dominant coral in Kaitehu – Octocoral – softcoral

The physical structure of a coral reef is built by a tiny sea creature called polyps. As they secrete calcium carbonate skeletons, they create a complex three dimensional framework upon which an abundance of coral species and other marine plants and animals may live. Coral reefs are home to approximately 25% of all marine life on the planet includes around 2 million species of fish, crustaceans, molluscs, sponges, sea cucumbers and seaweeds

6.2.3.3 Coral Coverage in Lauhata

The divers team was also mobilize to observe the status of coral and fisheries in the Lauhata beach, near the existing Jetty. Since the focus of the study is in the Lauhata beach, the total survey area is larger than the other, which was around 250 HA. The result can be seen in the following figure.



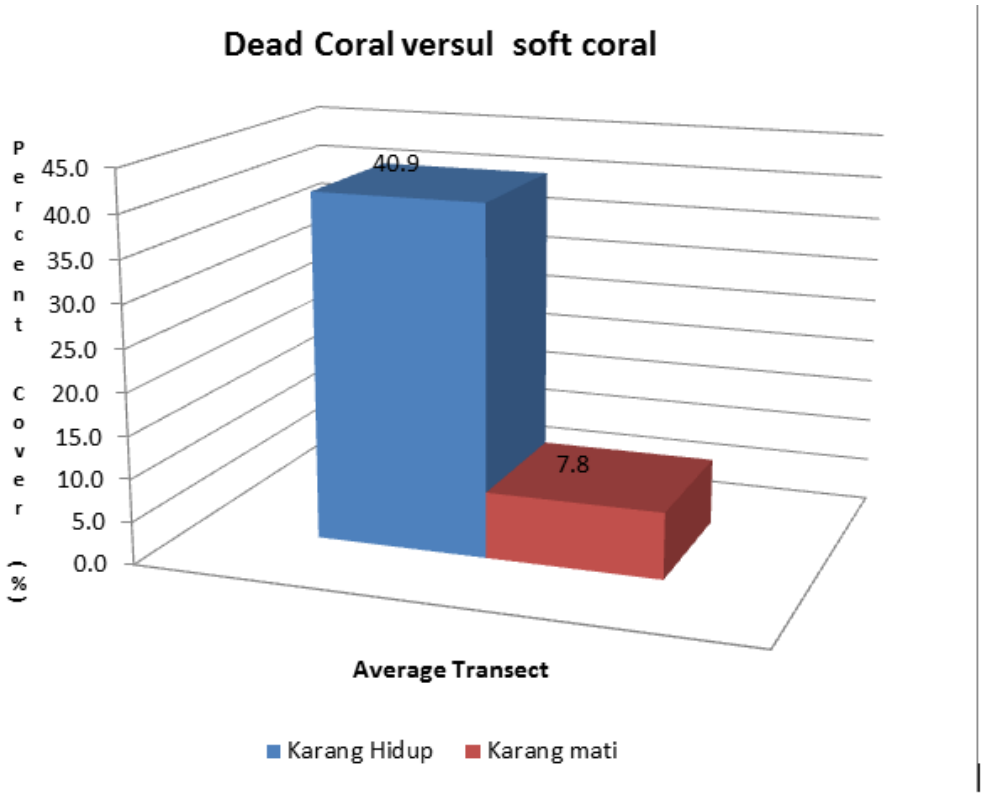


Figure. 6.91 Composition of Dead Coral and Young

It shown the similar trend as the previous study or survey conducted by the NOAA researcher. The reason why limited coral coverage is due to ocean current that is very strong that limits the coral to grow in the bottom of the sea. The survey in the selected spot in coastal area, indicated the present of the healthy coral reef in the North coast of Liquica, with relatively low percentage of dead coral, which shows no intervention from the human being or pollutant, except ocean current that constantly remove or preventing the grow of the coral.

Figure 6.92. Diver conducting the observation and measuring the Coral size

The data from the NOAA-USAID research indicated that the type of dominant coral in near the project area (LIQ-30), can be seen from the following table.

Table 6.44 List of Coral Type with Nomenclature in the Project Area (Lauhata)

SITE	LATITUDE	LONGITUD	TIER_1	CATEGORY_NAME	TIER_2	SUBCATEGORY_NAME
LIQ-30	-8.56315	125.3917	CORAL	Coral	FREE	Free-living hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	FOL	Foliose hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	BR	Branching hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	BR	Branching hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	BR	Branching hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	MASS	Massive hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	FOL	Foliose hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	TAB	Tabulate hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	TAB	Tabulate hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	TAB	Tabulate hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	TAB	Tabulate hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	TAB	Tabulate hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	TAB	Tabulate hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	FOL	Foliose hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	FREE	Free-living hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	ENC	Encrusting hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	BR	Branching hard coral
LIQ-30	-8.56315	125.3917	CORAL	Coral	BR	Branching hard coral

The detail list of coral type can be found in the annex 17. However, the following table summarized the percentage of each coral type and the dominant species:

Table 6.45Summary of Coral Diversity Around Lauhata (Project Area) – LIQ-30

Type Coral	Total Count	%
Turf growing on hard substrate	162	54%
Anemone	2	1%
Branching hard coral	5	2%
Bryozoan	1	0%
CCA growing on hard substrate	1	0%
Encrusting hard coral	11	4%
Encrusting macroalga	6	2%
Foliose hard coral	3	1%
Free-living hard coral	2	1%
Halimeda sp	2	1%
Massive hard coral	1	0%

Mobile fauna	1	0%
Octocoral	50	17%
Sand	21	7%
Shadow	1	0%
Sponge	9	3%
Tabulate hard coral	6	2%
Unclassified soft coral	2	1%
Unclassified/Unknown	14	5%
total	300	

The table indicate the the most dominant coral around Lauhata area is Turf growing on hard substrate and Octocoral, which take total 71% of all the specieis.

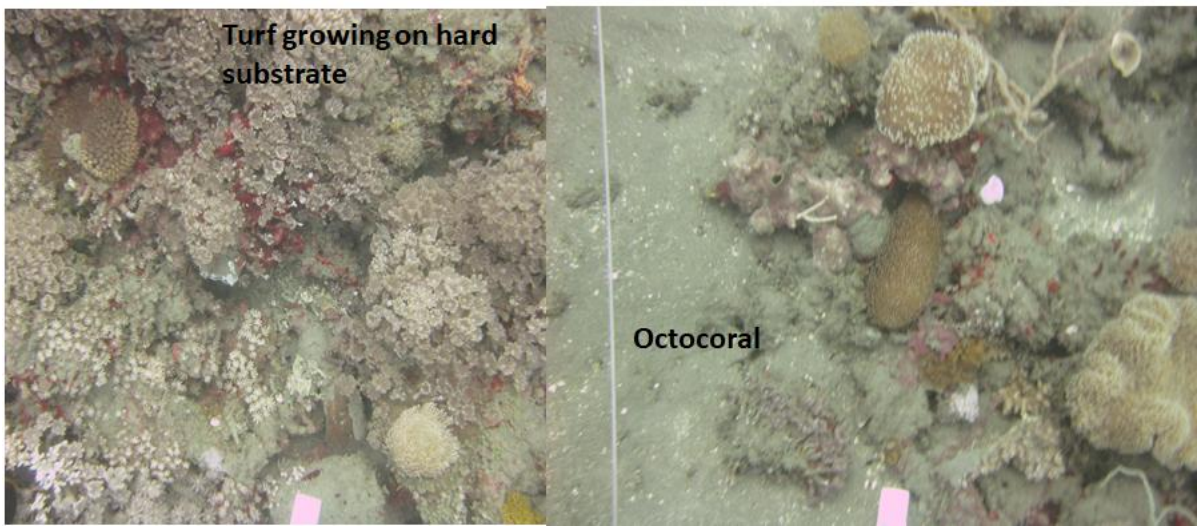


Figure. 6.93 Dominant Coral in Lauhata

Given the importance of the existence of coral to the fish production as well as beautiful nature to attract divers to come and explore more to investigate further the coastal resources, the protection of coral is very important. However, the location, of the coral existence in the shallow water depth, in the coastal area, it shall be impacted highly, if the any oil spill shall occur in the jetty that will be transported from the point of origin to the other coastal region. The following maps shows the modeling result of scenario oil spill in the jetty and the oil will be transported by the ocean current and wind that resulted in the pollutant of all the coral coverage area

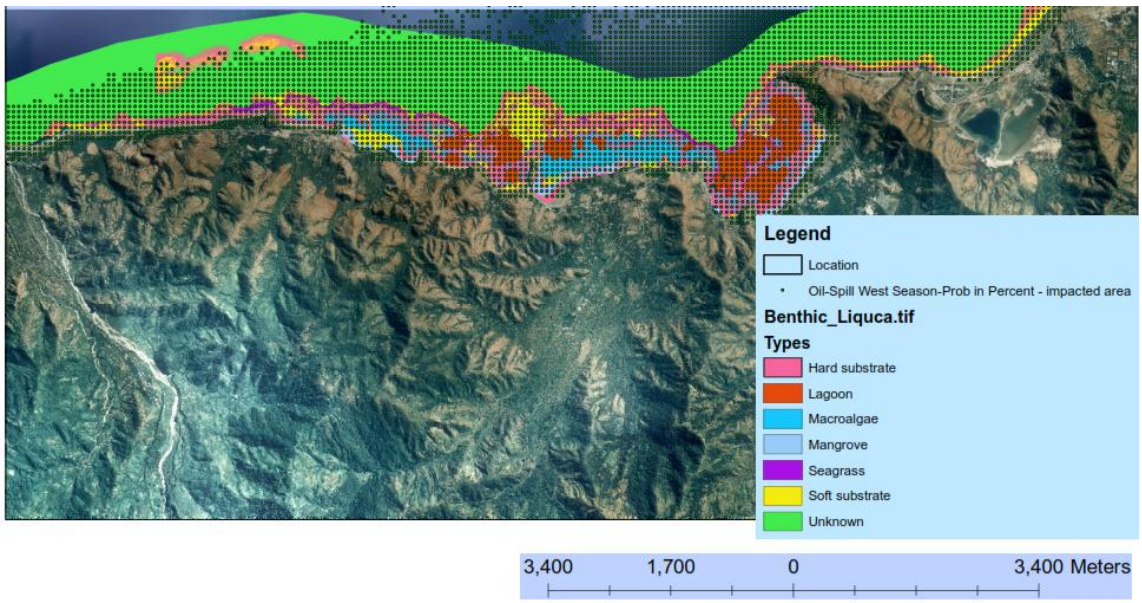


Figure 6.94. Coral Coverage area and Oil Spill Dispersion

6.2.4 Fisheries

Total area of Timor-Leste is 16,000 km^2 with a coast line around 706 km length and marine economical jurisdictions area of approximately 75,000 km^2. The Government has established control of a fishing zone five times larger than the national land area of the country. It consists of the eastern half of the Timor Island, 265 km in length and 92 km of maximum width. It also includes the enclave of Oecusse on the north coast, 70 km to the west and is surrounded by Indonesian West Timor. Also part of East Timor is Atauro Island which is 144 km2, located just 23 km north of the capital Dili and the tiny islet of Jaco with 8 km2, located on the eastern most tip of East Timor (Thematic Report-ATSEA, 2011).

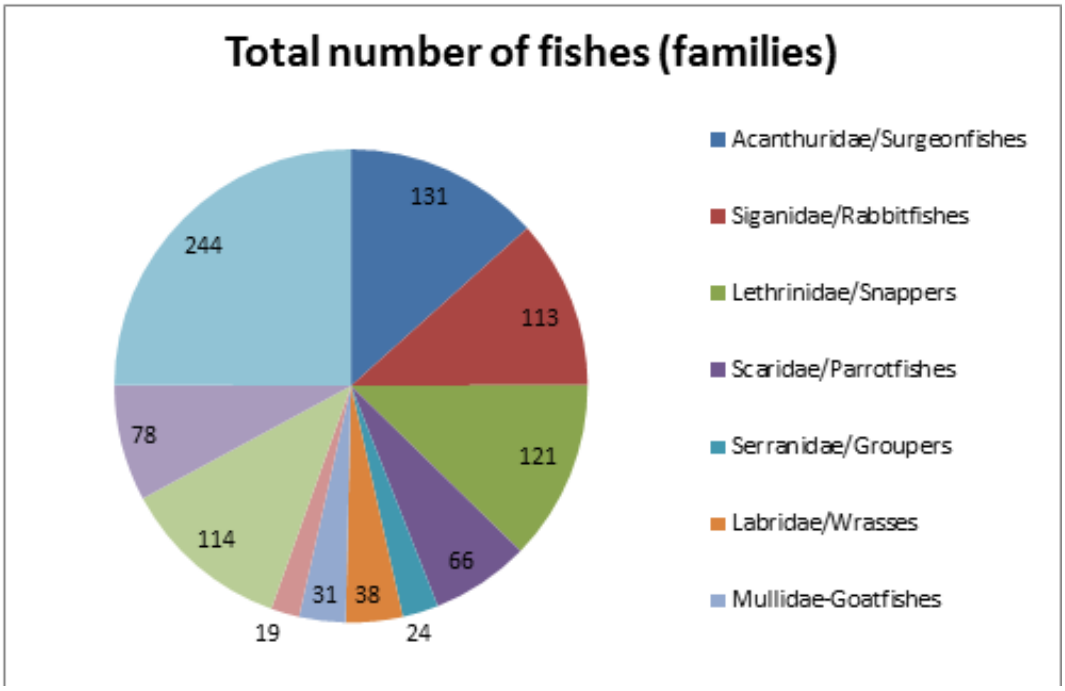
The waters of Timor Leste are defined as all surrounding waters of the north and south coast of the country. These waters extend out to the edge of the off shore Fishing Zone (200 nautical miles). Allocation of use rights were divided into 5 zones i.e. A= 200 m for artesian; B = 3 nm for semi-industrial, C = 12 nm for National Industrial at southern coast of Viqueque; D = 6 nm for foreign semi-industrial at southern coast of Viqueque; E = 18 nm for foreign industrial at southern part facing sahul bank (SHC, February 2009). The artisanal reef fishery on the north coast of East Timor is largely exploited by subsistence fishermen (Thematic Report-ATSEA, 2011).

Gill nets and hand lines are the most popular type of fishing gear in the coastal fisheries because they are easy to use and the equipment is relatively cheap to buy and maintain. Timor Leste's National Directorate of Fisheries & Aquaculture (NDFA) provides nets and hand nets to local fishers as part of a Fishermen Assistance Program. Trammel nets are commonly used by small-scale fishers in southern coastal areas to catch shrimp and traditional spear guns are popular among Atauro fishers. Bottom longline and Fish Aggregation Devices continue to be popular in the coastal fisheries.

Lack of marketing infrastructure, particularly ice-making and transport facilities continues to restrict sale of fresh fish in supplying limited local demand. Such observations reinforce the anecdotal evidence of a limited and small-scale Timorese cultural and economic engagement with their coastal waters and marine resources. They also highlight the likelihood that the extent and elaboration of customary marine tenures will be culturally variable and probably weakly articulated in terms of defined property rights and obligations, given the dispersed geography of coastal settlements and the low pressure on fishing resources in the contemporary environment.

Timorese fishers use various types of fishing gear, and the fish species caught varies depending on the gear used. Handlines and gill nets are commonly used to catch demersal species such as snapper, croaker and bream, and pelagic species like tuna, mackerel, scad and sardines. Other species frequently caught include prawns, crabs, lobsters, bivalves and cephalopods. Women's fisheries activities tend to focus on the collection of molluscs, crabs, small fish, varieties of seaweed and other edible plants within the inter-tidal zone. The international data base of fish species reported that there are 196 marine fish species in 50 families for Timor-Leste waters, with four species listed as Threatened, the Bigeye Tuna (*Thunnus obesus*), Whale shark (*Rhincodon typus*), honeycomb stingray (*Himantura uarnak*) and the Celebes medaka (*Oryzias celebensis*). Nine of fish species are listed as deep water species. Many of the species listed for Timor-Leste are found throughout the tropics and are important commercial species such as the tuna, mackerels and snappers.

It is estimated that over 80% by weight of local marine fish consumed in Timor-Leste belong to 15 main Families and 128 species. The most abundance fish families in Timor Leste waters are as follows: Labridae (Wrases), Pomacentridae (Damselfishes), Gobiidae (Gobies), Serranidae (Groupers), Apogonidae (Cardinalfishes), Chaetodontidae (Butterflyfishes), Acanthuridae (Surgeonfishes), Lutjanidae (Snappers), Scaridae (Parrotfishes) and Blenniidae (Blennies). This fish fauna of Timor Leste consists mainly of species associated with coral reefs (CTI, 2013). Based on the result of survey (visual census) there was only dominated by Damselfishes of 351 individu (Fig. 6.92)



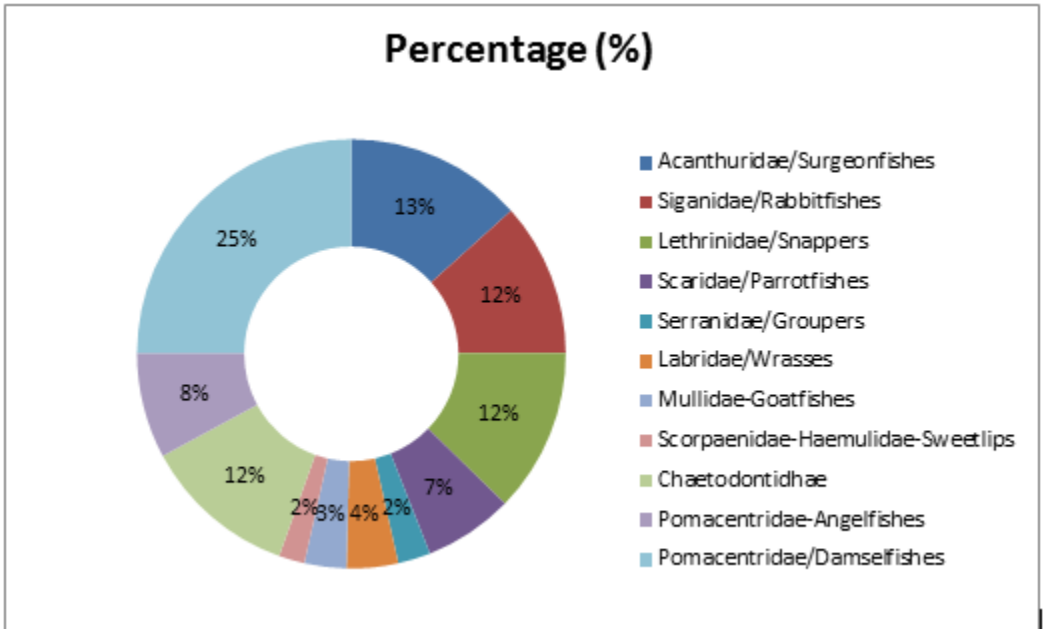


Figure. 6.95 Statistical; Number of Fish Population

As pat of the EIA study for the proposed fuel storage development the Global Oul Storage Terminal ina Lauhata, the fishery identification , especially with the proximity of project location that potentially

affected by the operation of the facility is important to be conducetd. In this study, there are two approaches.

1. Using the secondary data derived by the NOAA –USAID program
2. Direct fish survey by the diver that was done in three sites toward eastern part of the project location

The following map shows the location of the survey on the fishery potential by previous study and by Diver.

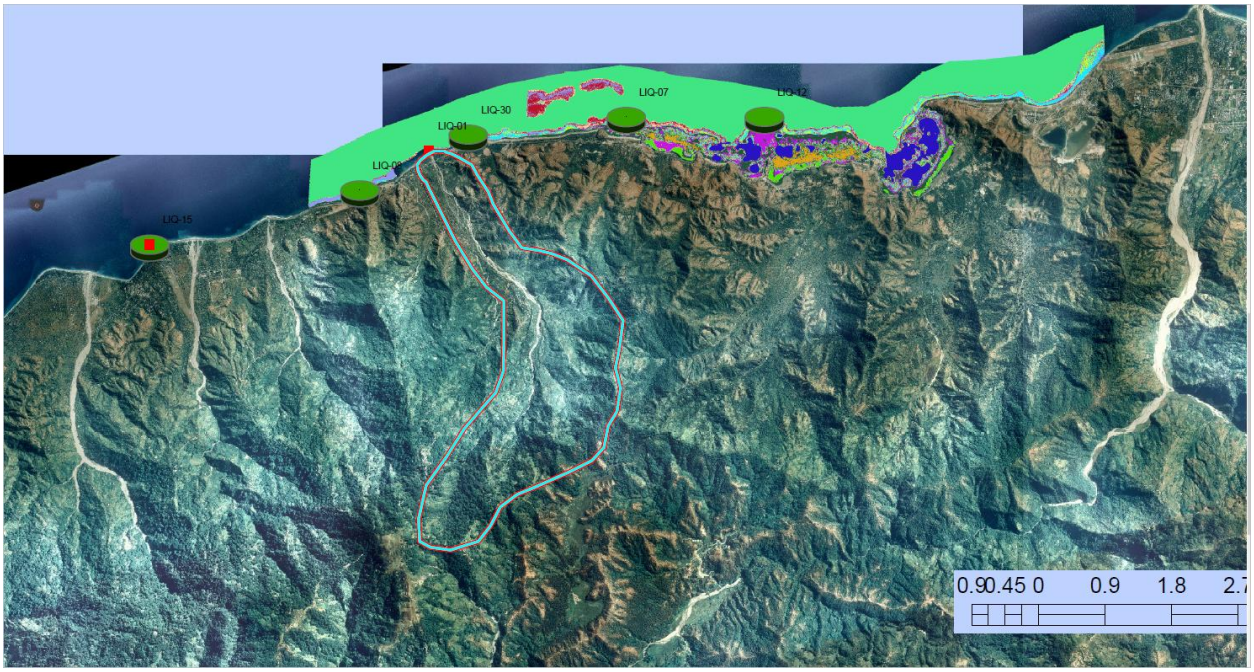


Figure 6.96 Fishes Population Survey (Map Recreated from NOAA-USAID Database)

Table 6. 46 Summary of th Location of Survey on the Potentia Fishery in the Northcoast of Liquica

SITE	LATITUDE	LONGITUDE	REEF_ZONE	DEPTH_BIN	DATE_	OBS_YEAR	METHOD	DEPTH, m
LIQ-01	-8.566286	125.383981	Forereef	Shallow	6/10/2013	2013	nSPC	5
LIQ-01	-8.566286	125.383981	Forereef	Shallow	6/10/2013	2013	nSPC	6
LIQ-07	-8.559743	125.422529	Forereef	Mid	6/9/2013	2013	nSPC	14
LIQ-08	-8.574045	125.370505	Forereef	Shallow	6/10/2013	2013	nSPC	2
LIQ-15	-8.584635	125.329447	Forereef	Mid	6/10/2013	2013	nSPC	13
LIQ-30	-8.563152	125.391697	Forereef	Mid	6/9/2013	2013	nSPC	16
LIQ-12	-8.559717	125.449542	Forereef	Shallow	6/10/2013	7/5/1905	nSPC	10

Among the above the locations, LIQ-01, LIQ-30, LIQ-12, LIQ-15, LIQ8, were the closer to the project area respectively. The result of the survey was to observe the most dominant fish species within the

survey spot, which should be used as information to plan and protect the fishery development in the country. The example of the survey result, for the site LIQ-30 in Lauhata is presented in the following table.

Table. 6.47 Summary of Fishery Survey in Lauhata

SITE	LATITUDE	LONGITUDE	SPECIES	TAXONNAME	COMMONNAME	FAMILY	RANK	Kg/HA
LIQ-30	-8.56	125.39	CHKL	Chaetodon kleinii	Sunburst butterflyfish	Chaetodontidae	Species	9.81
LIQ-30	-8.56	125.39	AERO	Aethaloperca rogaa	Redmouth grouper	Serranidae	Species	33.25
LIQ-30	-8.56	125.39	GUCU	Gunnellichthys curiosus	Curious wormfish	Microdesmidae	Species	0.109
LIQ-30	-8.56	125.39	FOFL	Forcipiger flavissimus	Longnose butterfly fish	Chaetodontidae	Species	2.445
LIQ-30	-8.56	125.39	PAMU	Parupeneus multifasciatus	Manybar goatfish	Mullidae	Species	0.722
LIQ-30	-8.56	125.39	CHMA	Chromis margaritifer	Bicolor chromis	Pomacentridae	Species	0.467
LIQ-30	-8.56	125.39	POPH	Pomacentrus philippinus	Philippine damsel	Pomacentridae	Species	0.844
LIQ-30	-8.56	125.39	CHTE	Chromis ternatensis	Ternate chromis	Pomacentridae	Species	0.79
LIQ-30	-8.56	125.39	PSEV	Pseudocheilinus evanidus	Striated wrasse	Labridae	Species	0.072
LIQ-30	-8.56	125.39	BODI	Bodianus diana	Diana's hogfish	Labridae	Species	1.511
LIQ-30	-8.56	125.39	BAUN	Balistapus undulatus	Orange-lined triggerfish	Balistidae	Species	3.886
LIQ-30	-8.56	125.39	CHWE	Chromis weberi	Weber's chromis	Pomacentridae	Species	0.769
LIQ-30	-8.56	125.39	ANTW	Anampses twistii	Yellowbreasted wrasse	Labridae	Species	0.832
LIQ-30	-8.56	125.39	HAPR	Halichoeres prosopeion	Twotone wrasse	Labridae	Species	0.558
LIQ-30	-8.56	125.39	CEUR	Cephalopholis urodeta	Darkfin hind	Serranidae	Species	1.05
LIQ-30	-8.56	125.39	POIM	Pomacanthus imperator	Emperor angelfish	Pomacanthidae	Species	12.49
LIQ-30	-8.56	125.39	CTBI	Ctenochaetus binotatus	Twospot surgeonfish	Acanthuridae	Species	3.33
LIQ-30	-8.56	125.39	ACPY	Acanthurus pyroferus	Chocolate surgeonfish	Acanthuridae	Species	2.238
LIQ-30	-8.56	125.39	DARE	Dascyllus reticulatus	Reticulate dascyllus	Pomacentridae	Species	0.234
LIQ-30	-8.56	125.39	MEAT	Meiacanthus atrodorsalis	Forktail blenny	Blenniidae	Species	0.027
LIQ-30	-8.56	125.39	CHAT	Chromis atripes	Dark-fin chromis	Pomacentridae	Species	0.515
LIQ-30	-8.56	125.39	POAM	Pomacentrus amboinensis	Ambon damsel	Pomacentridae	Species	0.324
LIQ-30	-8.56	125.39	POBR	Pomacentrus brachialis	Charcoal damsel	Pomacentridae	Species	0.771
LIQ-30	-8.56	125.39	HAPR	Halichoeres prosopeion	Twotone wrasse	Labridae	Species	5.825
LIQ-30	-8.56	125.39	ACPY	Acanthurus pyroferus	Chocolate surgeonfish	Acanthuridae	Species	4.172
LIQ-30	-8.56	125.39	LADI	Labroides dimidiatus	Bluestreak cleaner	Labridae	Species	0.029

There are more than 30 species that identified in this survey and the most dominant species is AERO , with common name of "***Redmouth grouper***", with the fish biomass density of 33.25 kg/HA, while other species are relatively small part. In addition to the secondary data from the previous investigators, the study also made an effort to mobilize the diver, who conducted the instantaneous survey on the potential fishery in two location spots to validate the secondary data. The following map shows the location of direct survey on the fish population by Divers in two locations near the project sites.

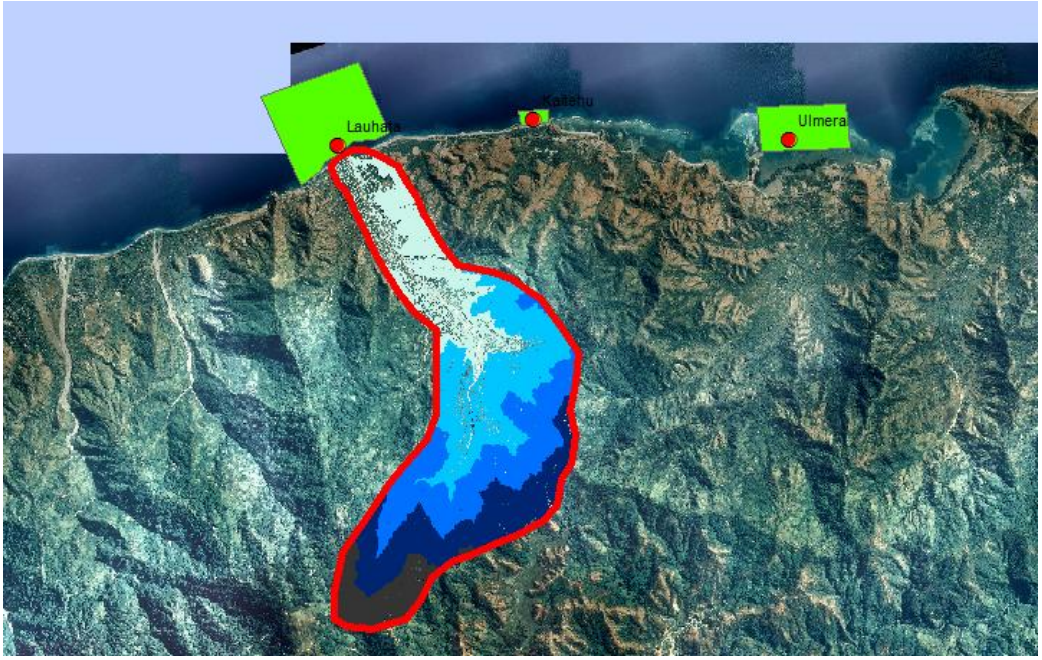


Figure 6.97 Location of Direct Survey by Diver in Ulemera, Kaitehu, and Lauhata

The following table shows the coordina

Location	Lattitude	Longitude
Lauhata	-8.559772°	125.384981°
Kaitehu	-8.560550°	125.415041°
Umera	-8.566459°	125.456571°

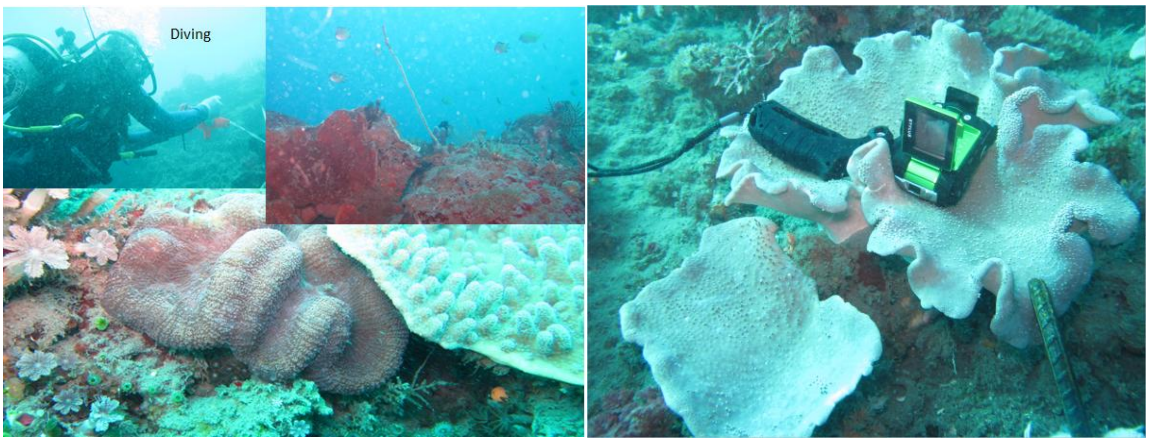


Figure. 6.98 Photos of Diving under water to perform fish survey

Within Lauhata, survey spot was conducted in the following coordinate points.

Table 6.48 Survey Point in Lauhata

No	Name of Station	Coordinate of Location
1	Stasiun 01	**S 08° 33'56.98", E 125° 23'09.43"**
2	Stasiun 02	**S 08° 34'02.57", E 125° 22'48.23"**
3	Stasiun 03	**S 08° 34'00.96", E 125° 22,55.63"**
4	Stasiun 04	S **08° 33'50.32", E 125° 23'22.90"**
5	Stasiun 05	S **08° 33'45.57", E 125° 23'45.62"**

The result of survey, suggested the following summary table of the fish family and species.

Taksonomy	Quantity Observed	Note
Famili	9	Can be more
Genus	12	Can be more
Spesies	23	Can be more

Tabulation of reef fish data from 5 data collection stations in Mota Ulun coastal waters, Lauhata Village, Bazartete District, Liquica District. Timor Leste (Table ....) shows that most species come from the Acanthuridae family which consists of 6 species, namely Acanthurus Bariene, Acanthurus Leucheilus, Acanthurus Geographicus, Acanthurus Nigrofuscus and Acanthurus Neoguinaicus, followed by the Lutjanidae family with 2 dominant species namely Lutjanus Kasmira and Lutjanus. Bohar. The Acathuridae family is included in the major group, where usually this family fish is the largest group of fish that inhabit coral reefs, generally living in large groups (schooling fish). Likewise, the Lutjanidae family is one of the families included in the economic indicator fish group in coral areas, such as the type of fish from the Labridae family which is popularly known as the grouper (Grouper). Another indicator fish that is considered the most strongly associated fish group with coral reef conditions is from the Chaetodontidae family. Only a few species were found, namely: Chaetodon Citrinellus, Chaetodon Kleinii, and Chaetodon Ignobillis.

The major group, which is usually the fish of this family, is the largest group of fish that inhabit coral reefs, generally living in large groups (schooling fish). Likewise, the Lutjanidae family is one of the families included in the economic indicator fish group in coral areas, such as the type of fish from the Labridae family which is popularly known as the grouper (Grouper). Another indicator fish that is considered the most strongly associated fish group with coral reef conditions is from the Chaetodontidae family. Only a few species were found, namely: Chaetodon Citrinellus, Chaetodon Kleinii, and Chaetodon Ignobillis.

Data collection for reef fish at this location was carried out during the day so that most of the reef fish obtained were diurnal fish which were active during the day, while nocturnal fish which were active at night were rarely found. Some examples of the nocturnal fish family Apogonidae (beseng), Haemulidae

family, Priachanthidae (bigeyes), Muraenidae (moray), Serranidae (jawfish) and some from the Mullidae family (goatfishes).

The condition of coral fish observed at five locations included the species and number of individuals encountered during the observation, besides that it was also supplemented with data from information from local residents. In addition to the catch of fishermen, coral fish data were also collected using direct observation methods, namely by using a visual census.

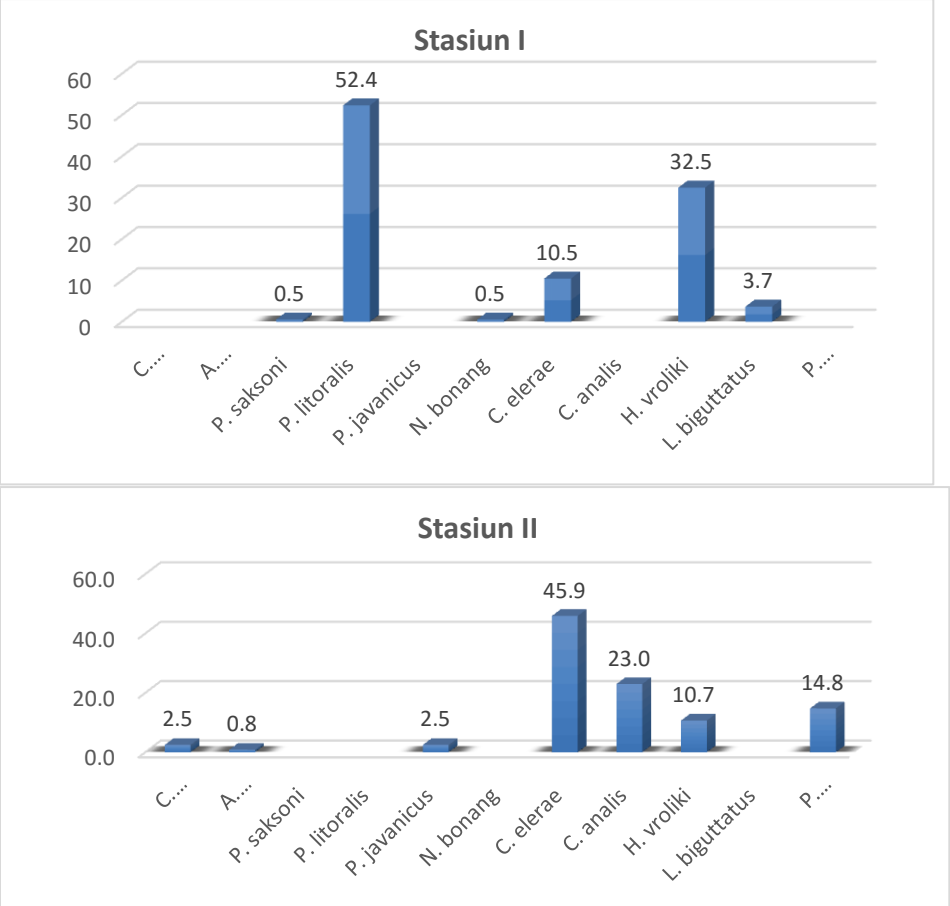


Figure. 6.99 The Percentage of Coral Fish Surveied in the Area

Further detail information the fishery survey near the project location can be found in annex-17.

Beach is the most important marine resources that become a public good, where everyone must have a right to access the beach. It is mainly use for recreation such as swimming, diving, snorkeling, and any other water sports. In Liquica area, there are many good spot beaches, which can be considered as tourist spot for various water sport activities.

Figure. 6. 100 Photos of Beach and the Activity along the Coastal Community

Beside the recreational facility, beach also becomes an entry of point of fishery industry and other economic activity by the local population. Therefore, maintain the balance of ecosystem including the beach is very important for sustainable life cycle in the area. Along the beach line, several fisheries spots can be found. As part of the study, the fish population will investigate and identified the diversity; in of fish density, biomass, and size will be provided. The preliminary assessment of fish spot as identified by the NOAA Coastal Research in collaboration with the Ministry of Agriculture and Fishery (MAF), and USAID will be considered and become a good reference for fisheries assessment in this study. The following maps shows the preliminary study done by NOAA and MAF, in the process of identification of fish diversity and it can be found in the following maps, that the fish population is very diverse in term of family, species, and genes.

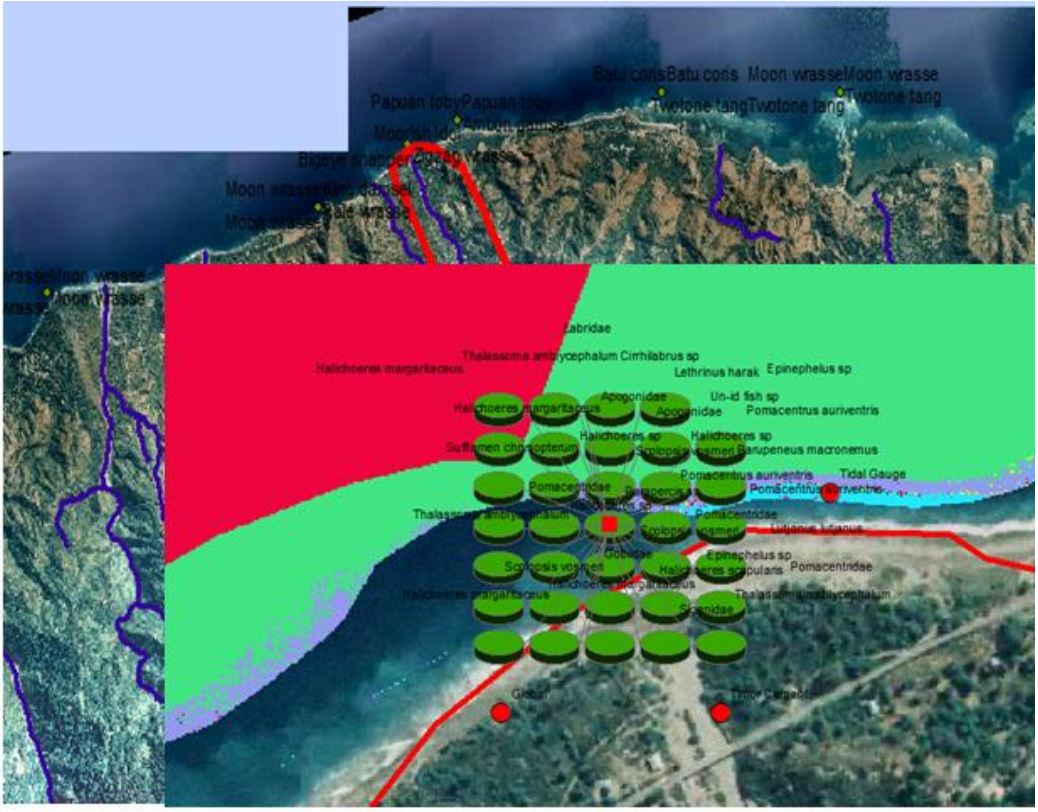


Figure 6.101 Fish Spot Identification by NOAA Coastal Research

6.2.5 Protected areas and National Parks

There are around 46 national protected areas of both marine and terrestrial in Timor – Leste and the largest on is known as Nino Koni Santana National Park in Municipio of Lautem, including two marine protected areas in Dili and Maliana. The main reason of protected zone is mainly considering the historical background, cultural, and environmental sensitive areas, which should be defined and protected for various national interests including supporting the future ecotourism, adaptation program for climate change, and other natural buffer zone for the ecological protection system. Proper identification and effective management of protected areas that cover a wide range of natural habitats for birds and other fauna are keys to the protection of wildlife in Timor Leste.

The recently enacted Protected Area Law (D.L. No 5/2016) contains a list of protected areas in the country, with the total of 46 protected areas; include two marine aquatic protections in Atauro and Bobonaro (Batugede). The following table provides the list of area protection according to the decree law 5/2016.

Table 6.48 Protected Areas in Timor Leste

ID	Name	Municipio	Coverage area, KM2
1	National Park of Nino Koni Santana	Lautem	1236
2	Mount Legumau	Lautem/Baucau	360
3	Lake Maurei	Lautem/Viqueque	5
4	Spring Water Irabere	Viqueque	
5	Mount Matebian	Viqueque/Baucau	240
6	Mount Mundo Perdidio	Viqueque	250
7	Mount Laretame	Viqueque/Baucau	164
8	Mount Builo	Viqueque	80
9	Mount Buraboo	Viqueque	185
10	Mount Aitana	Viqueque	170
11	Mount Bibileo	Manatuto/Viqueque	190
12	Mount Diatuto	Manatuto	150
13	Mount Kuri	Manatuto	
14	National Park of Xanana Gusmao	Manufahi/Ainaro	180
15	Clerek River Basins	Manufahi	300
16	Lake Modomahut	Manufahi	0.2
17	Lake Welenas	Manufahi	0.2
18	Mount of Manukoko	Dili	40
19	Cristo Rei	Dili	16
20	Lake Tasitolu	Dili	
21	Mount Fatumasin	Liquica	40
22	Mount Guguleur	Liquica	132
23	Lake Maubara	Liquica	
24	Mount Tatamailao	Ainaro/Ermera	200
25	Mount Laumeta	Ainaro	150
26	Mount Loelako	Bobonaro/Ermera	47
27	Mount Tapo/Saburai	Bobonaro	50
28	Lake Bemalai	Bobonaro	
29	Korluli	Bobonaro	
30	Mount Lakus	Bobonaro	
31	Mount Taroman	Covalima	192
32	Reseve Tilomar	Covalima	70
33	Cutete	Oecusse	133
34	Mount of Manuleo	Oecusse	200
35	Mangal Citrana area	Oecusse	10
36	Oebatan	Oecusse	4
37	Ek Oni	Oecusse	7
38	Usmetan	Oecusse	2
39	Makfahik	Manatuto	
40	Area Mangrove Metinaro	Dili	
41	Area Mangrove Hera	Dili	
42	Lake Hasan Foun	Covalima	0.12
43	Lake Bikan Tidi	Ainaro	1.1
44	Samik Saron	Manatuto	
45	Natural Aquatic Reserve	Bobonaro	11.3
46	Natural Aquatic Reserve	Dili/Atauro	51

The facility is not located within any of the above Protected Areas (PA). The closest PA is the mount of Fatumasin, Lake Maubara, and Tasitolu saline lake, and Mount Guguleur in Maubara, which range from 5 to 20 km from the from the project site.

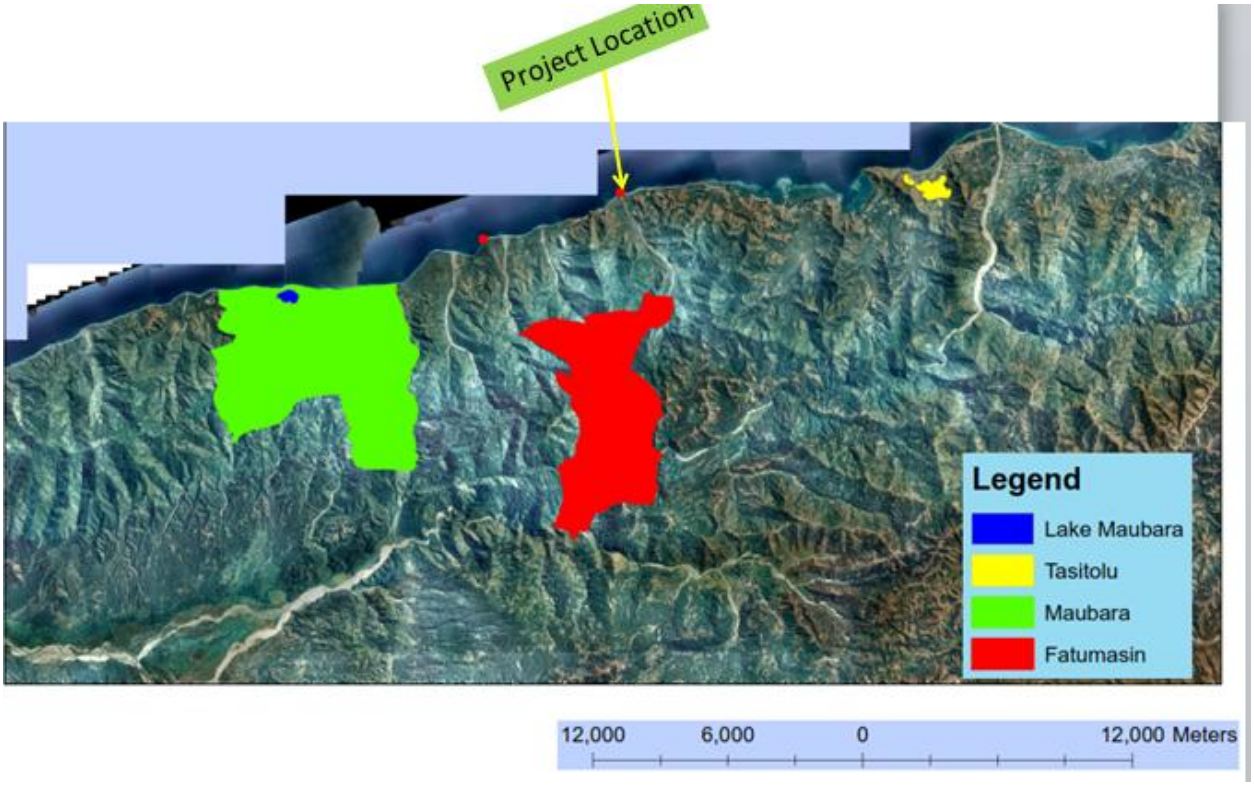


Figure 6.102 Protected Area Respect to Project Location

Further description on each uniqueness of this relevant protected areas that potentially impacted by the project development will be presented as followed.

6.2.5.1 Tasitolu Saline Lake

Tasitolu saline lake is considered as one of the protected zone, due to the uniqueness of the saline lakes, which separated by the land and yet the lake water has brackish physical and chemical properties. In addition, these saline lakes also provided a historical background, for Timor – Leste, struggle for independent, where many people have assumed killed. After the independent, the Tasitolu area has already become the symbol of the independent square for the celebration and every year from 2002, this place has always become a center for the celebration. In term of environment and biodiversity, this saline lake has always becomes a place for bird migratory from various places, which become a very interesting place, as many people may visit this lake to watch various beautiful birds. Considering these natural uniqueness of this lakes, valuable historical moment occurred in this place, as well as potential eco-tourism spot in the mountain surrounding, the government has a very strong reason to decide this area as one of the protected zone. This means that any development should be planned and measured properly the

impacts so that the development shall not jeopardize the existence of these natural saline lakes for many years to come. In relation to the propose development in Lauhata, the greatest risk that may affect this existence saline lake would be transport of pollutant from the oil spill in the project location to reach the coastal area nearby the saline lake. As the mass transport of pollutant from marine water to the saline lakes may occur, it is possible that the oil or petroleum derivative chemical element may pollute this natural environment.

6.2.5.2 Maubara Saline Lake

Similar to Tasitolu Saline Lakes, the Maubara lake, also provide natural buffer zone the surrounding area and it is considered as protected zone due to environmental unique environmental characteristics, such as brackish lake , shallow, and small size, which become an attractive place for many migratory birds. As lakes is surrounded by many small size of hills, it is possible to develop ecotourism schemes around this lake area, while at the same time, the lake should be protected by planting more forest in the upland catchment system. The lake also becomes a special places for some important migratory birds that the habitat.

Table 6.49: Birds Species that take the Habitat in Lake of Maubara

NO	English Name	Nama Indonesia	Scientific Name/ Ilmiah	Status
1	Salty Cuckoo-dove	Merpati-hitam timor	*Turacoena modesta*	NT RR
2	Pink-headed Imperial- pigeon	Pergam katanjar	*Ducula rosacea*	NT RR
3	Olive-shouldered Parrot	Nuri-raja kembang	*Aprosmictus jonquillaceus*	NT RR
4	Streaky-breasted Honeyeater	Meliphaga dada lurik	*Meliphaga reticulata*	RR
5	Plain Friarbird	Cikukua timor	*Philemon inornatus*	RR
6	Plain Gerygone	Remetuk timor	*Gerygone inornata*	RR
7	Fawn-breasted Whistler	Kancilan timor	*Pachycephala orpheus*	RR
8	Timor Figbird	Burung-ara timor	*Sphecotheres viridis*	RR
9	Olive-brown Oriole	Kepudang timor	*Oriolus melanotis*	RR
10	White-bellied Bushchat	Decu timor	*Saxicola gutturalis*	NT RR
11	Red-chested Flowerpecker	Cabai lombok	*Dicaeum maugei*	RR
12	Flame-breasted Sunbird	Burung-madu matari	*Nectarinia solaris*	RR
13	Timor Sparrow	Gelatik timor	*Pada fuscata*	NT RR

Note:
Status: CR = Critically endangered/ kritis,EN= Endangered /genting ; NT= Near threatened/ mendekati terancam punah; RR= Restricted range/ sebaran terbatas
Dadus: Colin Trainor dkk. 2014, livru Important Bird Areas (IBA) iha Timor-Leste pagina

Considering the status of various important birds and other biodiversity, as well as the buffer zone to various vegetation in that area, it is important to conserve and protect this lake. Moreover, the protection

of the lake for future healthiness will also help enhance the eco-tourism in the area, which will be important to support the economy of Timor – Leste.

6.2.5.3 Mount of Fatumasin

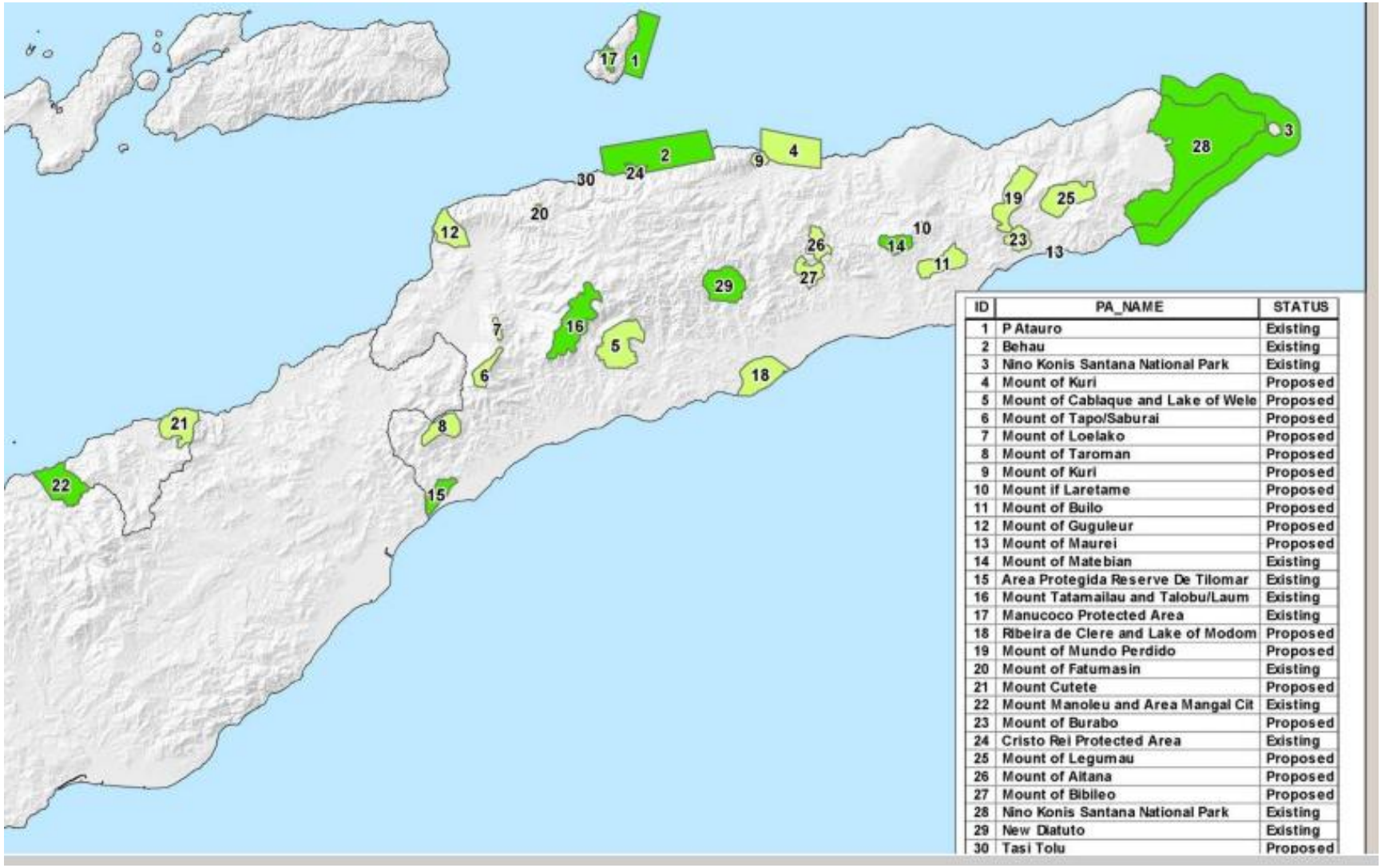
Mount Fatumasin, is located at the south side of the project location and the protection of this mountain, should be needed in order to reduce various environmental risks in the surrounding low laying area, including in the project location. The mount of Fatumasin is located around 10 km, in the Sub-administration of Bazartete. According to previous study, 15 species of bird living in this area of protection has already identified. In addition to the important bird area, the mount Fatumasin is also upstream stream of several watershed or catchments system, which contribute the runoff to Mota Loes and other rivers in the north coast of Liquica. Therefore, protection of the forest in this protected area would be important to reduce the flooding risk in the downstream area of the catchments. Furthermore, the protection would also reduce the sediment load in the storm runoff that eventually contributes to the marine water quality.

The following table presents the list of important birds that already identified in the Fatumasin protected zone.

Tabela 6.50. List of Birds Species in Mount Fatumasin

No	English name	Nama Indonesia	**Scientific name / nama ilmiah**	**Status**
1	Dusky Cuckoo-dove	Uncal kelam	*Macropygia manga*	*RR*
2	Pink-headed Imperial-pigeon	Pergam katanjar	*Ducula rosacea*	*NT RR*
3	Yellow-crested Cockatoo	Kakatua-kecil jambul-kuning	*Cacatua sulphurea*	*CR*
4	Olive-shouldered Parrot	Nuri-raja kembang	*Aprosmictus jonquillaceus*	*NT RR*
5	Streaky-breasted Honeyeater	Meliphaga dada-lurik	*Meliphaga reticulata*	*RR*
6	Plain Friarbird	Cikukua timor	*Philemon inornatus*	*RR*
7	Red-rumped Myzomela	Myzomela timor	*Myzomela vulnerata*	*RR*
8	Plain Gerygone	Remetuk timor	*Gerygone inornata*	*RR*
9	Fawn-breasted Whistler	Kancilan timor	*Pachycephala orpheus*	*RR*
10	Olive-brown Oriole	Kepudang timor	*Oriolus melanotis*	*RR*
11	Timor Stubtail	Buntut-tumpul timor	*Urosphena subulata*	*RR*
12	Timor leai-warbler	Cikrak timor	*Phylloscopus presbytes*	*RR*
13	Orange-banded Thrush	Anis timor	*Zoothera peronii*	*NT RR*
14	Timor Blue-flycatcher	Sikatan bakung	*Cyornis hyacinthinus*	*RR*
15	Red-chested Flowerpecker	Cabai lombok	*Dicaeum maugei*	*RR*
16	Flame-breasted Sunbird	Burung-madu matari	*Nectarinia solaris*	*RR*

Note: CR = Critically endangered, EN= Endangered; NT= Near threatened or nearly extinct , RR = Restricted range (Data *Colin Trainor dkk. 2014, livru Important Bird Areas (IBA) iha Timor-Leste pagina 64)*



ID	PA_NAME	STATUS
1	P Atauro	Existing
2	Behau	Existing
3	Nino Konis Santana National Park	Existing
4	Mount of Kuri	Proposed
5	Mount of Cablaque and Lake of Wele	Proposed
6	Mount of Tapo/Saburai	Proposed
7	Mount of Loelako	Proposed
8	Mount of Taroman	Proposed
9	Mount of Kuri	Proposed
10	Mount if Laretame	Proposed
11	Mount of Builo	Proposed
12	Mount of Guguleur	Proposed
13	Mount of Maurei	Proposed
14	Mount of Matebian	Existing
15	Area Protegida Reserve De Tilomar	Existing
16	Mount Tatamailau and Talobu/Laum	Existing
17	Manucoco Protected Area	Existing
18	Ribeira de Clere and Lake of Modom	Proposed
19	Mount of Mundo Perdido	Proposed
20	Mount of Fatumasin	Existing
21	Mount Cutete	Proposed
22	Mount Manoleu and Area Mangal Cit	Existing
23	Mount of Burabo	Proposed
24	Cristo Rei Protected Area	Existing
25	Mount of Legumau	Proposed
26	Mount of Aitana	Proposed
27	Mount of Bibileo	Proposed
28	Nino Konis Santana National Park	Existing
29	New Diatuto	Existing
30	Tasi Tolu	Proposed

Figure. 6.103 Protected area Identification.

6.2.6 Wildlife and Endangered species

Generally speaking, the natural environment of the country has been subjected to a lot of anthropogenic influence. Therefore, much of the forest resource of the country is in altered condition with pristine forests only found in the eastern part or highly perched on top of the mountains where access is difficult.

Firewood collection, shifting cultivation and land clearing for residential purposes are several types of resource consumption that put tremendous pressure on the forest and wildlife. Within the changed landscape, however, natural habitats still flourished although land fauna in Timor Leste have been poorly studied until recently[2]. Bird fauna, on the other hand, have been better studied and identification of main habitats as well as areas of importance has recently been made.

The project site, however, is located in dense urban area where even the close by stream has been straighten and lined to accommodate human habitation, mainly for fast drainage and flood prevention. A lowland area which is located nearby where the area appears to be wet at all times. This small urban wetland, however, appears to be insignificant in terms of bird habitat. The following table lists relevant main habitats and bird species to the project.

Table 6.51. Main Habitats and Bird Species on Areas near Project Location

Main Habitat	**Bird Species**
Streams and wetlands	*Anhinga melanogaster* (Oriental Darter), *Limosa limosa* (Black-tailed Godwit) and *Limnodromus semipalmatus* (Asian Dowitcher).
Coastal/beach	*Artamus cinereus* (Black-faced woodswallow), *Lanius schach* (Long-tailed Shrike), *Geopelia maugei* (Barred Dove), *Taeniopygia guttata* (Zebra Finch) and *Lonchura punctulata* (Scaly-breasted Munia).

In addition to the above general description of main habitats, Important Bird Areas (IBAs) have been identified for Timor Leste. IBA are sites of international biodiversity significance which support globally threatened birds, restricted-range birds, biome-restricted birds or globally important populations of congregatory birds (e.g. waterbirds). There are 16 IBAs in Timor Leste, and the closest of them to the project site is the Tasi Tolu wetland, at approximately 25 aerial km to the east of the project site. Maubara Lake, as well as Fatumasin, is also the important bird area and protected area that have been identified by the Government of Timor – Leste, where many wildlife animals take as the habitat.

The following map shows the important bird habitat that need to be protected in the territory of Timor – Leste, where some of the bird may have considered as endangered species.

[2] Recent studies have discovered new species of bats, frogs, geckos and skinks (source: As Aves de Timor Leste, others?).

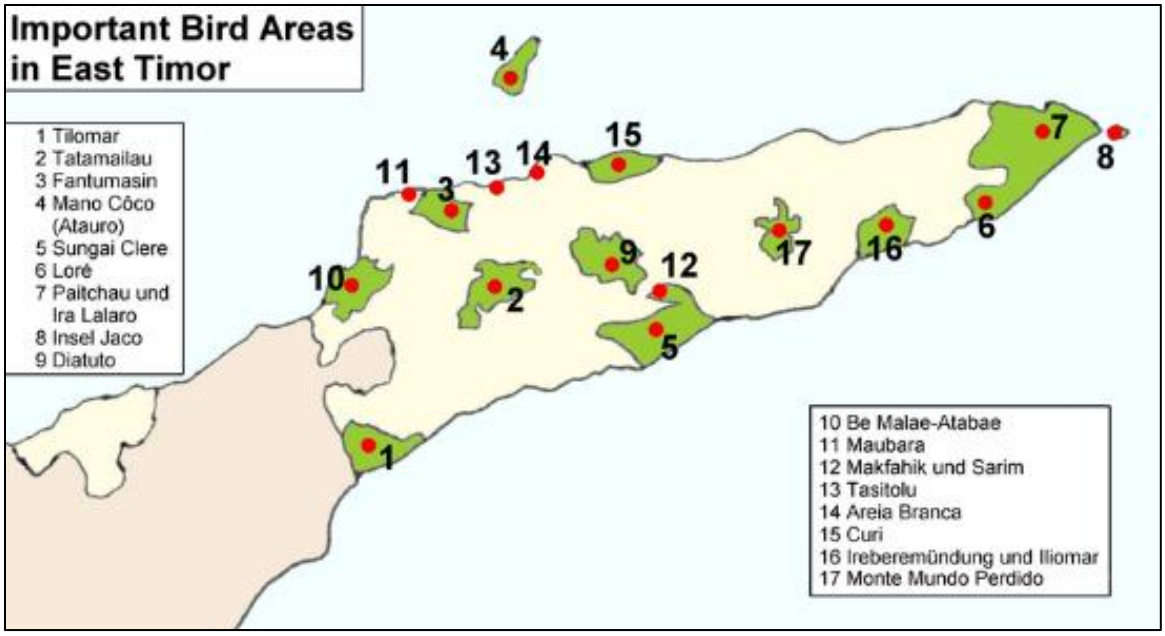


Figure. 6.104 Important Bird Areas (Source: Birdlife International)

As the map indicated that the Tasitolu Lake, Maubara Lake, and Fatumasin are the important bird area beside the protected area as described earlier. Beside the bird, there are also wild animal that identified in the project area such as insecticide and mammalian. The following tables provide the list of these wildlife animals.

Table 6.52: List of Insect Observed in the Project area

No	Naran espesies insekta			Quantity			Role in Ecosystem
	Indonesia	Tetum /daerah	Scientific	small	Suffices	many	
1	Belalang	Gavenoto	Locusta migratoria		✓		Help the plant to
2	Honey Bee	bani	Apis mellifera		✓		• Honey • Medicine • etc.

The presence of insect in any ecosystem, should keep the balance ecological balance, as insect may be a source of food for other animal that eventually provide an important contribution to the human being such as source food and other function. In addition to the insect, there are also mammal that was observed in the project location and surrounding area. The following table provides the list of mammal that may contribute to the balance of ecosystem.

Table: 6.53 List of Mammal

No	Naran			Quantity			Role in Ecosystem
	Indonesia	Tetum /daerah	Scientific	small	Average	large	
	Kadal (lizards)			✓			Provide the balance in ecosystem
	Tikus (Rat)	Laho	*Rattus norvegicus*	✓			Balance in ecosystem and food chain
	Kelelawar	Kiki	*Chiroptera sp.*	✓			Source of protein

In general the both mammal and insect are the fauna that are not considered endangered as they are wild and difficult to be reached by the human and other predators.

6.2.7 Forests

Timor –Leste as sub-tropical zone of Wallace located between Indonesia and Australia, which is rich in biodiversity, include in the forest ecosystem such as terrestrial forest, aquatic, and coastal zone forestry that contribute to the health of overall ecosystem and human being. In term of forestry, there are three type of plants or forest that was observed and identified in the proximity of the project area

- Natural forest Coverage
- Forest or trees that government or community plants as part of national re-forestation program
- Plant or trees that community grow as part of their subsistence effort to support the daily life or business

The observation of forest type in the project areas was conducted, with the following area of intervention

- Upstream reach toward the southern side of the project location
- Westside of the project cover the mainly the coastal region
- Eastern side of the project cover the coastal forest

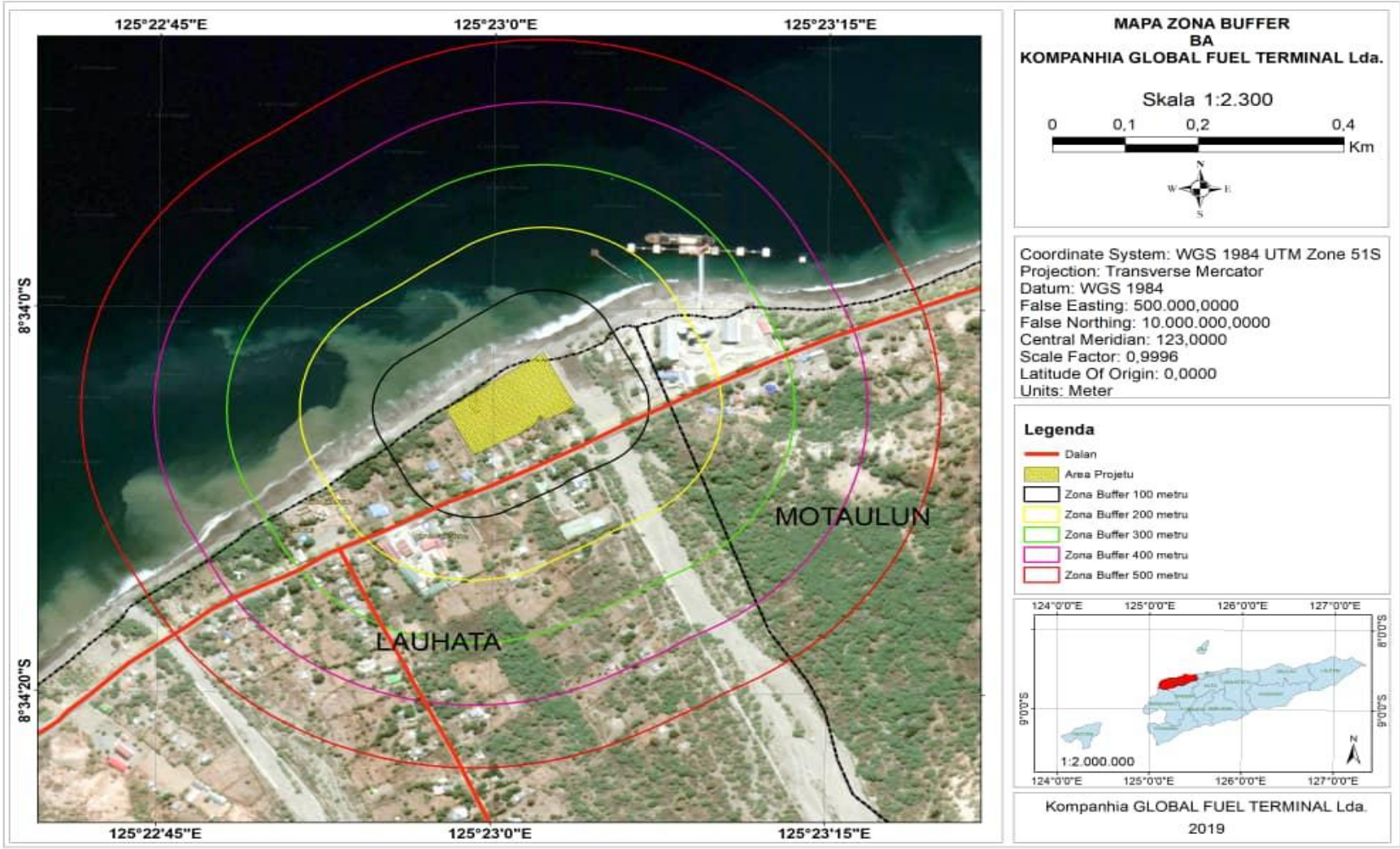


Figure. 6.105v Forest Coverage Observation in Lauhata

Selecting the above area of intervention is the very important due to the presence of the project, where the presence of the forest may affect the project, as well as the impact of the project to the existing forest, such as the emergency oil spill in the marine waterbody.

6.2.7.1 Plant that planted by the Community

There are various forest types that a community member planted inside their property. However, the observation indicated that the ***mahoni*** ((*Swietenia macrophylla*) and ai ***kafe*** (*Leucaena leucocephala*) are the most dominant plants. This type of forest is suitable growing in the type of soil observes in the project area and this type of forest provides some economic value to the community. These two forests can be used to construct the house and when the tree gets large the economic value would increase proportionally.

Another commercial species that community plant inside their property are known as "***aiteka*** (*Tectona grandis*), ai ***kameli*** (*Gmelina arborea*), and ***ai kakeu*** (*Casuarina cunninghamina*). The community planted these commercial plants to build the house, selling commodity, and also for the purpose of environmental protection such as buffer, carbon absorption, water storage, and other function such as habitat for wild animal.

The sheet for these plants that community planted in their property, were from the government, which has a center of sheet in Maubara, Liquica municipality for free. Every year, the National Director of Forestry management and Hydrologist, produce around 250,000 baby plants to be distributed to the community, NGOs, government official, and other individual as part of the national reforestation program.

Figure. 6.98 Commercial plant

Seedlings iha Maubara

Ai Mahoni (Sweetenia macrophylla),

Aikameli (sandalwood)

The following table provides the summary of commercial plants that planted by the community with the function or economic value of the plant.

Table 6.54 List of commercial plant and the function of the forest

No	Name of species plant			Qualitative amount			Function
	Indonesia	Tetum /daerah	Scientific	Average	Sufficient	More than sufficient	
1	Jati	Teka	Tectona grandis	✓			Use for construction, furniture, and conservation
2	Gmelina	Teka mutin	Gmelina arborea	✓			Construction, furniture and conservation
3	Mahoni	Ai mahoni	Sweetenia macrophilla		✓		Construction, furniture and conservation
4	Nimbah	Ai Nimba	Azadirachta indica	✓			Construction, furniture and conservation , shade for animal, conservation for the soil protection
5	Lamtoro	Ai kafe	Leucaena leucocephala		✓		Food for animal and for nutrient cycle in the soil (fertilizer) as well as forest conservation
6	Trembesi	Ai matan dukur	Samania saman	✓			Food for animal and for nutrient cycle in the soil (fertilizer) as well as forest conservation
7	Cemara	Kakeu	Casuarina cunninghamina	✓			Construction and conservation
8	Cendana Sandalwood	Ai kameli	Santalum album	✓			Industry and essential oil
9	Kapuh	Ailele	Sterculia foetida	✓			Food for animal and for nutrient cycle in the soil (fertilizer) as well as forest conservation

Source: Direct Observation in the project area

6.2.7.2 Plant for food or Fruits

Some community in Suco Lauhata planted their land/property with some shorter plant, which can be harvest to fulfill their need or as a commercial commodity that enter the market system. The fruit that community planted such as banana *(musa sp); mango (Mangifera sp*), coconut (Cocos nusifera), Papaya *(Careca papaya)*, **marungi** *(Moringa olifera*), play an economic role in the family or livelihood income.

Figure. 6.106 Example of the Commercial Fruit Planted by the Community

Detail of the commercial fruits observed in the project location is presented in the following table.

Table 6.55: List of Fruit that Community Planted in their Properties

No	Naran espesies ai horis			Quantitative			Main Function
	Indonesia	Tetum/daerah	Scientific	Naton	Barak	Barak liu	
1	Sirsak (soursop fruit)	Ai ata	Anona muricata	✓			• Juice • Medicine
2	Sirkaya Custard apple	Ai ata kiik	Anona squamosa		✓		Source of fruit and
3	Jambu air (water apple)	jambua	Syzygium aqueun	✓			• Guava juice • Soil protection • Habitat for certain animal species
4	Sukun (bread fruit)	Kulu tunu	Artocarpus altilis dari famili Moraceae	✓			• Source of carbohydrate • Soil protection • Habitat for various wild animal
5	Nangka (jack fruit)	Kulu jaka	Artocarpus heterophylla	✓			Source of vegetable
6	Kelapa	Nu'u	Cocos nusifera		✓		• Food for animal • Coconut virgin oil

							• Coconut oil • Cosmetic • Soil protection
7	pinang (betel nut tree)	Bua	Areca catechu	✓			• Soil protection • For industrial use • Traditional use for mama malus
8	Manga	Has	Mangifera indika	✓			
9	Pisang	Hudi	Musa paradisiaca		✓		• Consume as fruit • Can be industrialize into other secondary product
10	Jambu biji (guava)	Guava	Psidium guajava L.	✓			• Can be consumed directly as a source of tromphosit to prevent the dengue • Medicine • Soil protection
11	Nanas	Ai nanas	Ananas comosus (L) Merr.	✓			• Fruit • Can be used to produce secondary product to eat with bread • Make cookies
12	Kelor	Marungi	Moringa oleifera		✓		Good source of vitamin and can lower the blood pressure level and cholesterol
13	Delima (granade)	Rumaun	Punica granatum	✓			Fruit
14	Pepaya / papaya	Aidila	Carica papaya	✓			Source of vitamin and can be industrialized

The fruit that community planted is kind of mixing practice, where people tend to diversify their farm or property to plant many fruit, instead of only one fruit. Consequently, the quantity of each fruit is not very much. The community could commercialize into more productive option, which produce less crop/fruit but more quantity on the selected fruit.

6.2.7.3 Ecosystem Forest

Total natural forest in Timor – Leste was roughly estimated by around 0.8 Million HA (estimated by Ministry of Agriculture and Fishery, 2010-2011). It was estimated that every year, the rate of degradation of the natural forest was around 1,7% due to illegal logging, forest burning, opening of new settlement and farmland, and animal intervention to the forest. The forest coverage to the soil is very important to provide ecosystem balance, such as soil prevention erosion from rain, store the water, and important habitat for various wildlife animals. More importantly the forest provides direct economic value for community and country from the production of timber and other forest products. In this perspective the forest conservation and protection are very important to achieve the ecological sustainability and economic contribution.

The diversity of flora in Timor – Leste, exists in various part of the region such as National Park of Nino Konis Santana, where large tree that has highest economic value around 212 species can be found. Other small species, classify as scrubs, herb, species of palm tree type have also been identified. According to direct survey to the project area, the plants exist in the project area is dominated by the trees called ***jarak*** (*Jatropha,gossypiifolia*), Mazquite /aitarak (*Proporsis cineraria*), which is maximum height of the tree around 5 m. These two species are dominant in the project area and take the function as natural protection from erosion, as well as protection abrasion from sea.

Further upstream of 1 KM, toward the mountain, the trees are dominated by the tree, which has local name of ***ai bubur or white gum*** (*Eucalyptus alba*), which is a native tree with the function of firewood for local community, provide natural protection to the soil erosion, and become a habitat for various wild animal.

Figura 6.99 . Native tree Identify in the project area

Coastal area

Mezquite (Proporsis cineraria)

Th of t pr

Iponea sp Tamarindus sp Jatropah sp

Tabela 6.56. List of Natural Forest Species

No	Name of Species tree			Quantity			Role
	Indonesia	Tetum/daerah	Scientific	Average	Sufficient	Dense	
1	Jarak Kosta		Jatropha curcas		✓		• Fence • Energy source/firewood • For herbal
2	Jarak		Jatropha gossypiifolia			✓	• Grow naturally • Energy source for bio-diesel • Medicine
3	Mezquite	Ai tarak	Proporsis cineraria			✓	• Food for livestock • Construction material • Shading
4	Kepuh	Ai lele	Sterculia foetida	✓			• Shading • Construction house • Protection of soil and water
5	Tarum	Lalakasa (makasae)	Indigofera tinctoria	✓			• Used to color the textile
6	Katang-katang		Ipomea sp	✓			Natural protection of soil and water
7		Ai hanek					
8	Asam	Sukaer	Tamarindus sp				• Consumption • Protection of water and soil
9	White gum trees	Ai bubur	Eucalyptus alba				Firewood
10	Kusambi	Ai dak	Schleichera oleosa Merr				• Firewood • Fruit for consumption • Habitat for wildlife animal
11	Bidara (Indian Jujube)	Ai lok	Ziziphus mauritiana				Ai firewood and medicine

Note: Direct Observation

The following table provide the list of flora and fauna observed in the project areaa, including the status according to IUCN

Table: 6.57 List of Plant Observed in the Project area with the Status

No	Naran			Status IUCN
	Indonesia	Tetum	Latino	-
1	Jati	Teka	*Tectona grandis*	-
2	Gmelina	Teka mutin	*Gmelina arborea*	-
3	Mahoni	Ai mahoni	*Sweetenia macrophilla*	-
4	Nimbah	Ai Nimba	*Azadiractha indica*	-
5	Lamtoro	Ai kafe	*Leucaena leucocephala*	-
6	Trembesi	Ai matan dukur	*Samania saman*	-
7	Cemara	Kakeu	*Casuarina cunninghamina*	-
8	Cendana Sandalwood	Ai kameli	*Santalum album*	CR
9	Kapuh	Ailele	*Sterculia foetida*	-
	Aihoris ai fuan sira			
10	Sirsak (soursop fruit)	Ai ata	*Anona muricata*	-
11	Sirkaya Custard apple	Ai ata kiik	*Anona squamosa*	-
12	Jambu air (water apple)	jambua	*Syzygium aqueun*	-
13	Sukun (bread fruit)	Kulu tunu	*Artocarpus altilis*	-
14	Nangka(jack fruit)	Kulu jaka	*Artocarpus heterophylla*	-
15	Kelapa	Nu'u	*Cocos nusifera*	-
16	pinang (betel nut tree)	Bua	*Areca catechu*	-
17	Manga	Has	*Mangifera indika*	-
18	Pisang	Hudi	*Musa paradisiaca*	-
19	Jambu biji (guava)	Guava	*Psidium guajava L.*	-
20	Nanas	Ai nanas	*Ananas comosus (L) Merr.*	-
21	Kelor	Marungi	*Moringa oleifera*	-
22	Delima (granade)	Rumaun	*Punica granatum*	-
23	Pepaya / papaya	Aidila	*Carica papaya*	-
24	Jarak Kosta	Ai oan mutin	*Jatropha curcas*	-
25	Jarak	Ai oan mutin	*Jatropha gossypiifolia*	-
26	Mezquite	Ai tarak	*Proporsis cineraria*	-
27	Kepuh	Ai lele	*Sterculia foetida*	-
28	Tarum	Lalakasa(makasae)	*Indigofera tinctoria*	-
29	Katang-katang		*Ipomea sp*	-
30	Pulai	Ai hanek	*Alstonia scholaris*	-
31	Asam	Sukaer	*Tamarindus sp*	-
32	White gum trees	Ai bubur	*Eucalyptus alba*	
	Insecta, no animal			-
1	Belalang	Gavenoto	*Locusta migratoria*	-
2	Kadal			-
3	Tikus (Rat)	Laho	*Rattus norvegicus*	-
4	Burung bibit	Manu lin	*Estrididae sp*	-
5	Bebek	Manu rade	*Anas platyrhynchos*	-
6	Ayam	Manu	*Gallus domesticus*	-
7	Merpati	Bombo	*Turacoena mondesta*	NT, RR
8	Pagan katanjar		*Ducula rosacea*	-
9	Kambing	Bibi Timor	*Capra aegagrus hircus*	-
10	Sapi	Karau vaka	*Bos sp*	-

Status : CR=Critically Endangered/kritis; EN= endangered/genting; NT= Near Threatened ; RR=Restricted-range

Table 6.58 List of Specieis of Bird in Maubara Lake

ENGLISH NAME	NAMA INDONESIA	Scientific Name/Nama Ilmiah	Status IUCN
Slaty Cuckoo-dove	Merpati-Hitam Timor	*Turacoena modesta*	NT RR
Pink-headed Imperial-pigeon	Pergam Katanjar	*Ducula rosacea*	NT RR
Olive-shouldered Parrot	Nuri-raja Kembang	*Aprosmictus Jonquillaceus*	NT RR
Streaky-breasted Honeyeater	Meliphaga dada-lurik	*Meliphaga reticulata*	RR
Palin Friarbird	Cikukua Timor	*Philemon inornatus*	RR
Plain Gerygone	Remetuk Timor	*Gerygone inornata*	RR
Fawn-breasted Whistler	Kancilan Timor	*Pachycephala orpheus*	RR
Timor Figbird	Burung-ara Timor	*Sphecotheres viridis*	RR
Olive-brown oriole	Kepudang Timor	*Oriolus melatonis*	RR
White-bellied Bushchat	Decu Timor	*Saxicola gutturalis*	NT RR
Red-chested Flowerpecker	Cabai Lombok	*Dicaeum maugel*	RR
Flame-breasted Sunbird	Burung-madu Matahari	*Nectarinia solaris*	RR
Timor Sparrow	Gelatik Timor	*Padda fuscata*	NT RR

Status : CR=Critically Endangered/kritis; EN= endangered/genting; NT= Near Threatened/mendekati terancam punah; RR=Restricted-range/sebaran terbatas

Table 6.59 List of Specieis of Bird in Area Protegidas Fatumasin

ENGLISH NAME	NAMA INDONESIA	Scientific Name/Nama Ilmiah	Status IUCN
Dusky Cuckoo-dove	Uncal kelam	*Macropygia magna*	RR
Pink-headed imperial-pigeon	Pergam Katanjar	*Ducula rosacea*	NT RR
Yellow-crested Cockatoo	Kakatua-kecil jambul-kuning	*Cacatua sulphurea*	CR
Olive-shouldered Parrot	Nuri raja kembang	*Aprosmictus jonquillaceus*	NT RR
Streaky-breasted Honeyeater	Melipha dada-lurik	*Meliphaga reticulate*	RR
Plain Friarbird	Cikukua timor	*Philemon inomatus*	RR
Red-rumped Myzomela	Myzomela timor	*Myzomela vulnerata*	RR
Palin Gerygone	Remetuk timor	*Gerygone inomata*	RR
Fawn-breasted Whistler	Kancilan timor	*Pachycepala Orpheus*	RR
Olive-brown Oriole	Kepudang timor	*Oriolus melanotis*	RR
Timor Stubtail	Buntut-tumpul timor	*Urosphena subulata*	RR
Timor Leaf-warbler	Cikrak timor	*Phylloscopus presbytes*	RR
Orange-banded Thrush	Anis timor	*Zoothera peronji*	NT RR
Timor Blue-llycather	Sikatan bakung	*Cyomis hyacinthinus*	RR
Red-chested Flowerpecker	Cabai Lombok	*Dicaeum maugei*	RR
Flame-breasted Sunbird	Burung-madu matari	*Nectarinia solatis*	RR

Status: CR=Critically Endangered; EN= endangered; NT= Near Threatened; RR=Restricted-range

6.2.8 Marine Environment

The north coast of Timor Leste is topographically dramatic with rocky and steep hills extending directly into the sea. Dominant vegetation type along most of the north coast of Timor Leste is arid coastal vegetation consisting of plants such as spinifex grass and beach morning glory. Liquica area, however, is dominated by natural ecological remnants observed in the area and close by vegetation cover consists of planted trees and bushes such as flowers, other ornamental and fruit trees. Marine ecological or coastal resources are very important component of the study, as this ecosystem will become an ultimate recipient of the impacts that will be potentially generated by the project. The sources available in the coastal ecosystem are very important to be managed in order to achieve the ecological balance. The survey will be conducted to map out the spatial location of the various coastal resources in the project boundary that will be potentially be affected by the operational of the project.

Some of the important coastal resources such as coral and mangrove have already discussed from the previous sections. Therefore, in this particular section, other coastal resources such as seagrass, marine megafauna, and benthic habitat will be discussed.

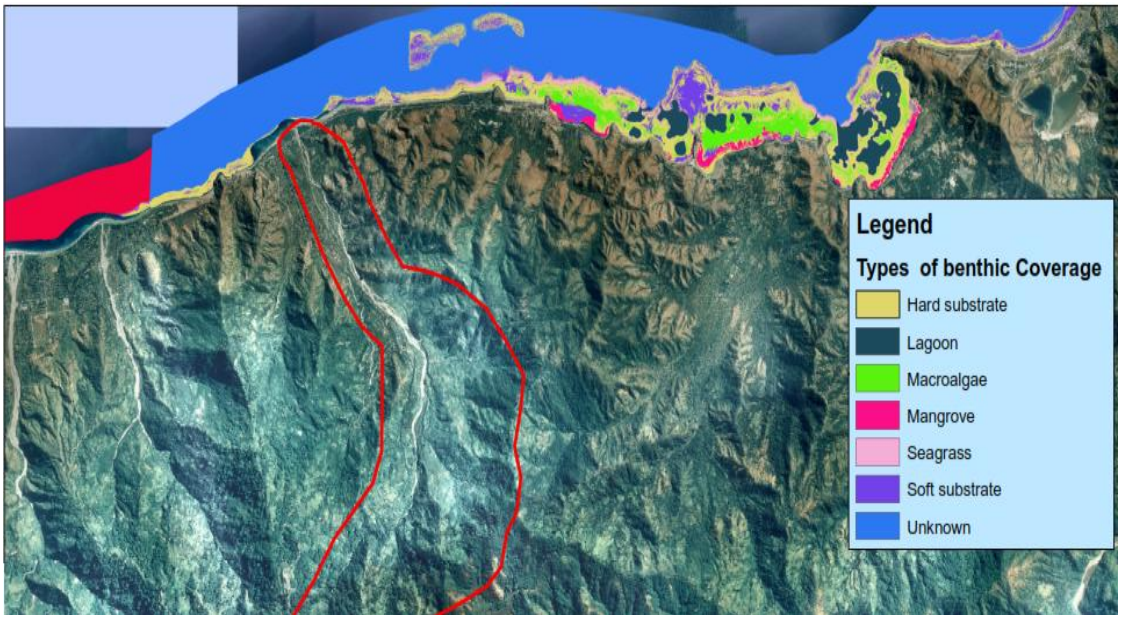


Figure. 6.107 Type of Benthic Coverage in the North Coast Liquica Area

Table 6.60: Summary of Benthic Coverage in Liquica North Coast

Benthic Type	Total Area, HA
Hard substrate	378
Soft substrate	163
Seagrass	34
Mangrove	34
Lagoon	116
Macroalgae	108
Unknown	1499
Total	2332

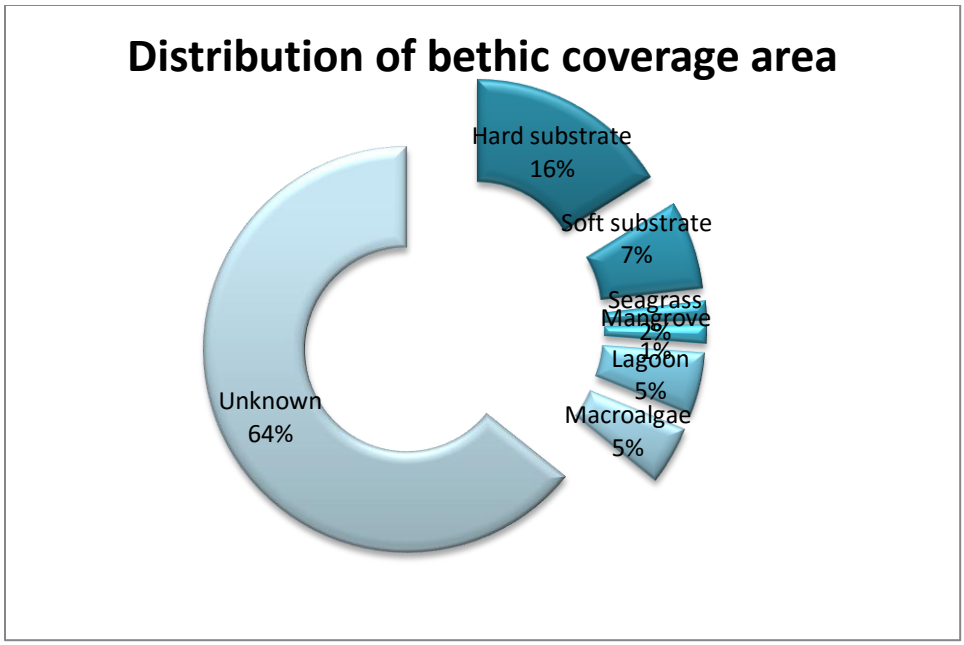


Figure. 6.108 Statistical Distribution of Benthic Coverage Area in Liquica

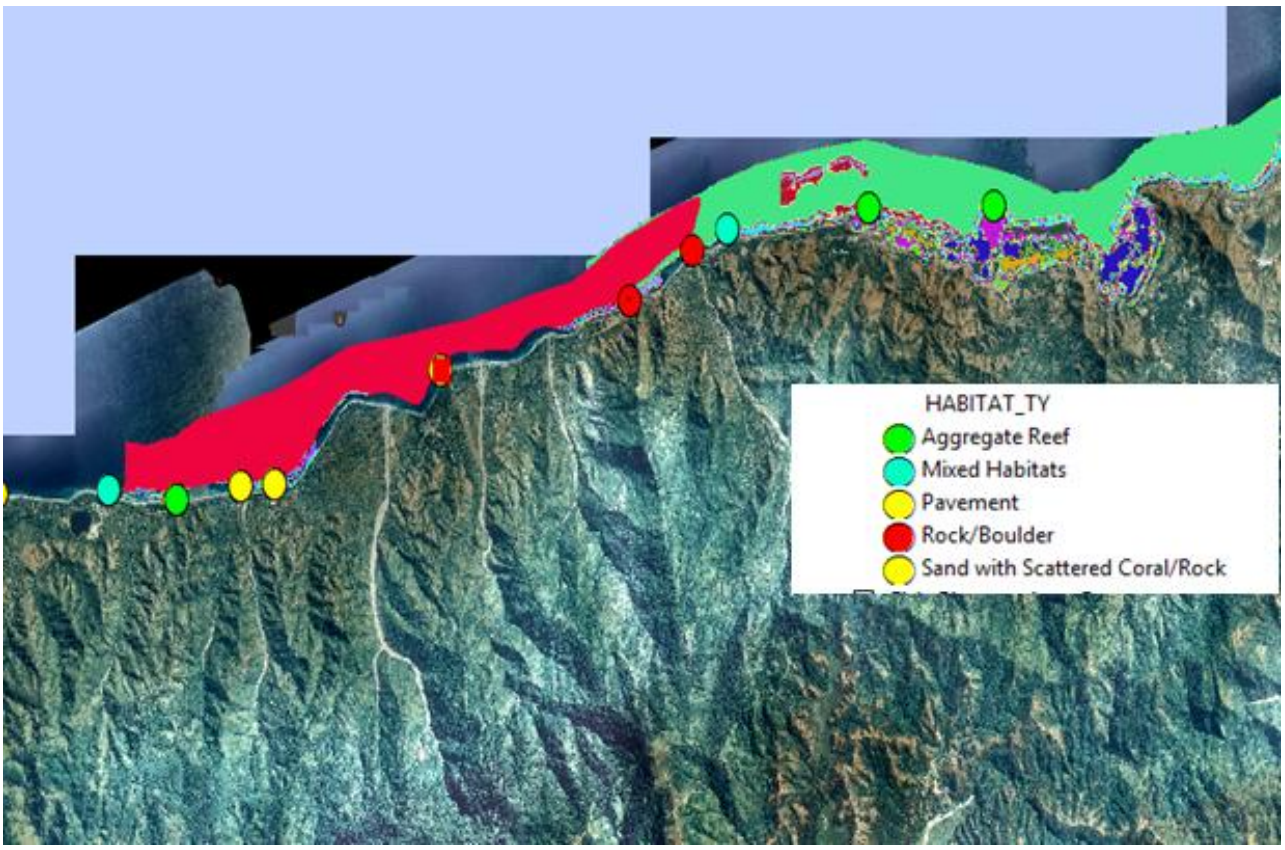
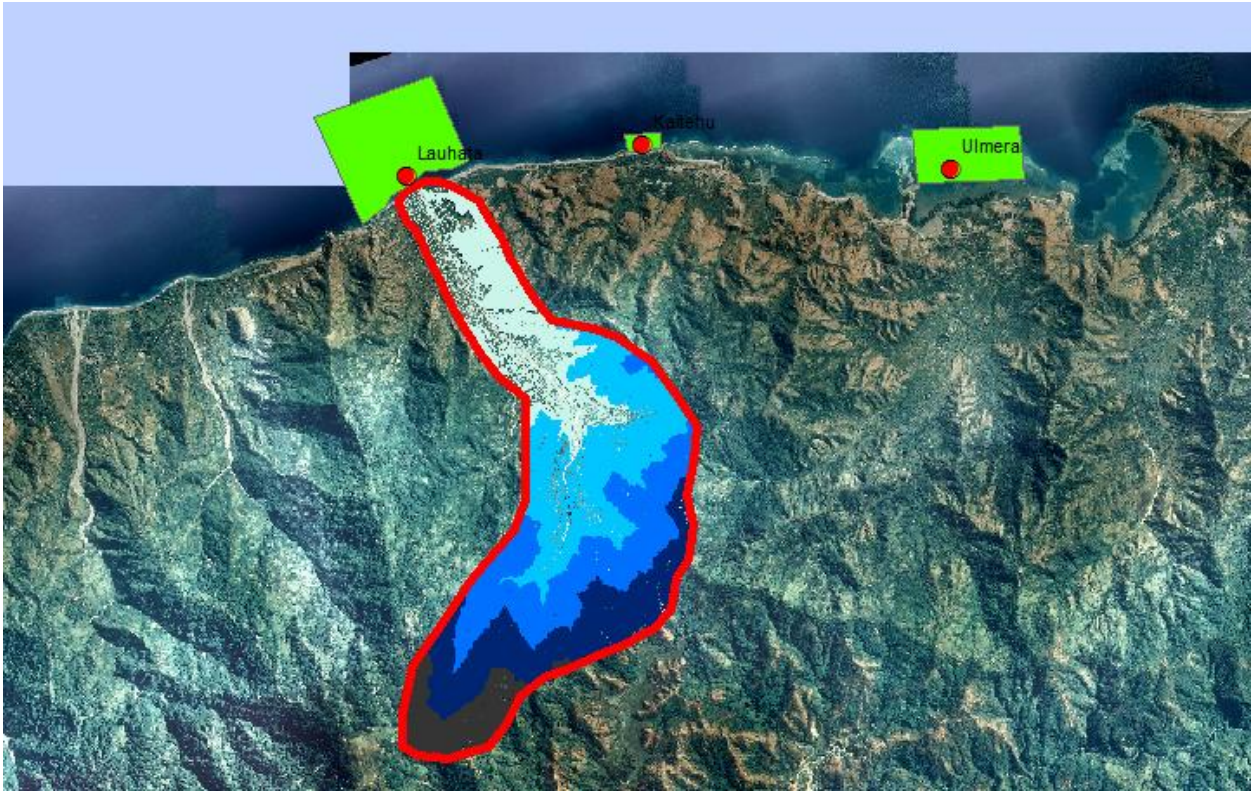


Figure. 6.109 Habitat Type of Fish

In Average there are about 52 special of fishes were identified in the North Coast of Liquica, which shows the rich diversity of fish in the island of Timor – Leste, compare to other pacific island countries in the region. Further detail studies of marine ecology that covers the benthic coverage, fisheries, coral, mangrove, seagrass, and bottom sediment have conducted as part of this study in the following map shows the location.



The field work include the mobilizing the diving team, who has an expertise in marine ecosystem to collect the information and provide the technical view on the result to know the ecological status of the spot. The following table provides the summary of the information collected in each survey spot.

Table 6.61: Summary of Marine Ecology data Collection

Spot name	Total Coverage area, HA	Type of data					
		Water Quality	Fisheries	Mangrove	Coral	Benthos	Bottom Sediment Quality
Ulmera	50	V	V	V	V	V	V
Kaitehu	25	V	V	V	V	V	V
Lauhata	100	V	V	V	V	V	V

The GPS coordinate of the coastal marine survey can be summarized in the following map

Table: 6.62 Survey Location (X, Y) coordinate – Taken as Rectangular shape

Location	Lattitude	Longitude
Lauhata	-8.564488°	125.383159°
Kaitehu	-8.560686°	125.414536°
Umera	-8.566887°	125.457451°

The result of the direct survey for the above mentioned three project sites includes the composition of existing coral could be presented as follow:

6.2.8.1 Benthic Habitat

The benthic coverage of the surface of the sea up to the depth of 20 meters was observed by NOAA coastal research program to provide information for better management of the coastal resources in Timor – Leste. Sport survey, as can be seen in the following figure shows the following benthic classification in the north shore of Liquica:

Table 6.63: Benthic Classification

CATEGORY_CODE	CATEGORY_NAME
CCA	Coralline Alga
CORAL	Coral
I	Sessile Invertebrate
MA	Macro alga
MF	Mobile Fauna
SC	Soft Coral
SED	Sediment
TURF	Turf Alga
TW	Tape and wand
UC	Unclassified

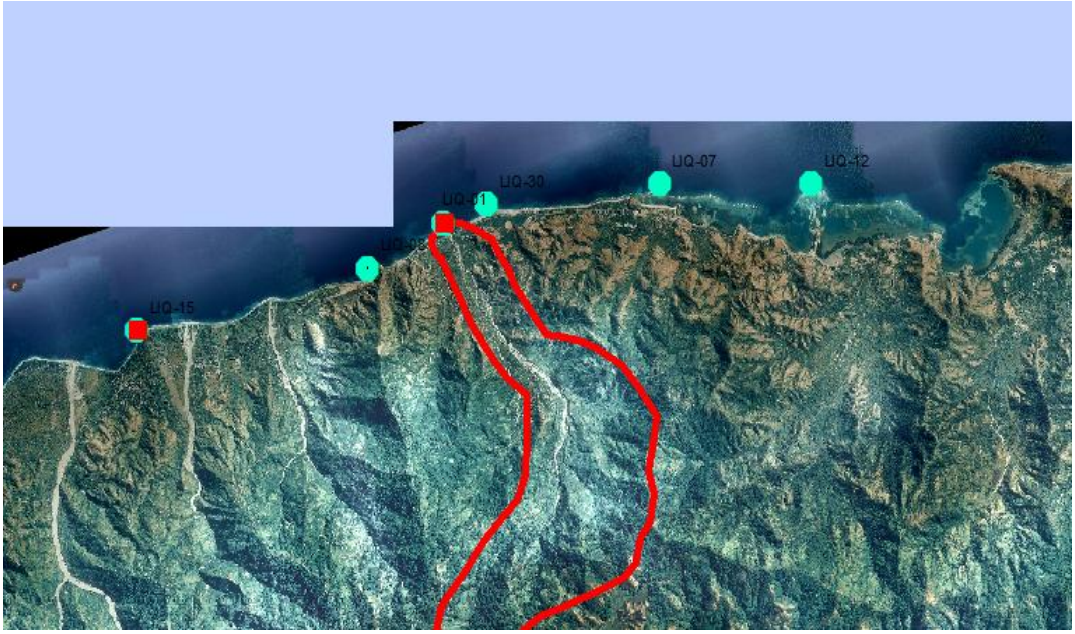


Figure. 6.109 Spot Survey of Benthic Coverage in Liquica North Shore

The importance of this benthic coverage is proportional to marine habitat.

The data indicate that the benthic coverage in the north

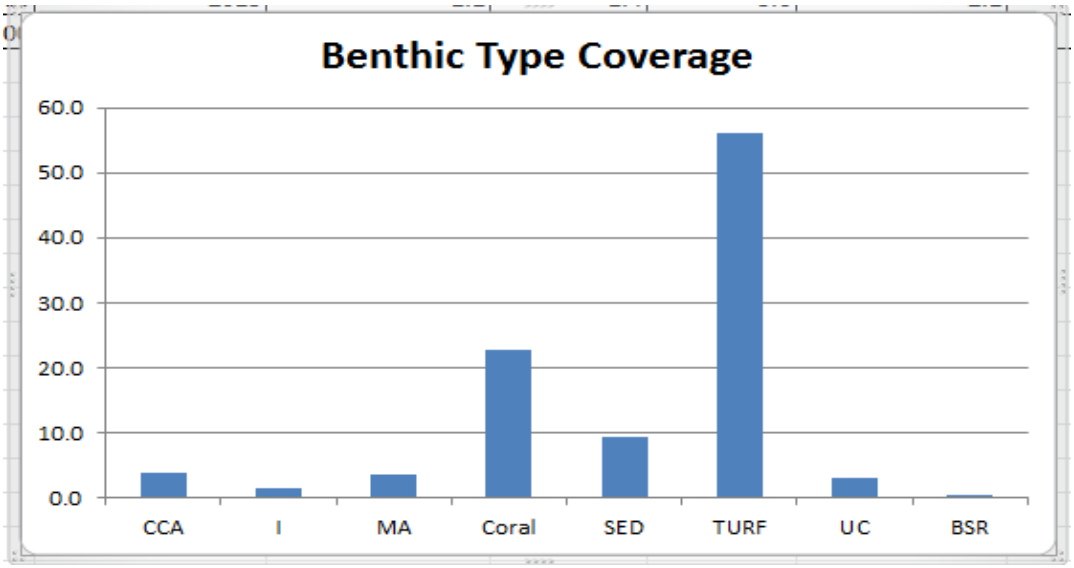


Figure 6. 110. Benthic Coverage of Liquica Shallow water depth

The figure suggested that the benthic coverage in the project area is dominated by the turf and follows with the coral, which is suitable for fisheries.

6.2.8.2 Seagrass

Similar to mangroves, seagrass beds have high rate of primary production, ability to filter sediment and organic nutrients and harbor a rich food chain. Tropical seagrasses are important foraging area for dugong and turtle as well as critical nursery and feeding area for certain types of shrimps, commercial fish and crabs. In the Arafura and Timor Sea region, extensive seagrass beds are typically found in shallow, sheltered waters. In Timor Leste, in a recent survey of the northern coast, a total of 5 species has been identified in an estimated area of 2,200 ha.

The average percentage cover of seagrass is 12 -14 %, which means that the relative density is relatively small (less than 25%) in this particular location. The species observed were *Thalasia hemprichii (Th), Enhalus acoroides (Ea), Syringodium isotefolium (Si), Halophila ovalis (Ho), Cymododcea serrulata (Cs), and Halimeda sp (Hm)*. For individual species was dominated by *Syringodium isotefolium with 13.35%* (Fig 6.38).

Figure 6.40 Percentage of Sea grass Cover by Transect (at East Coast)

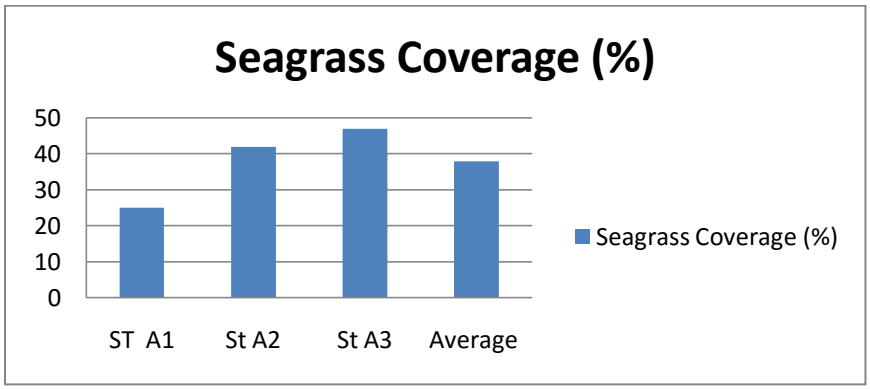
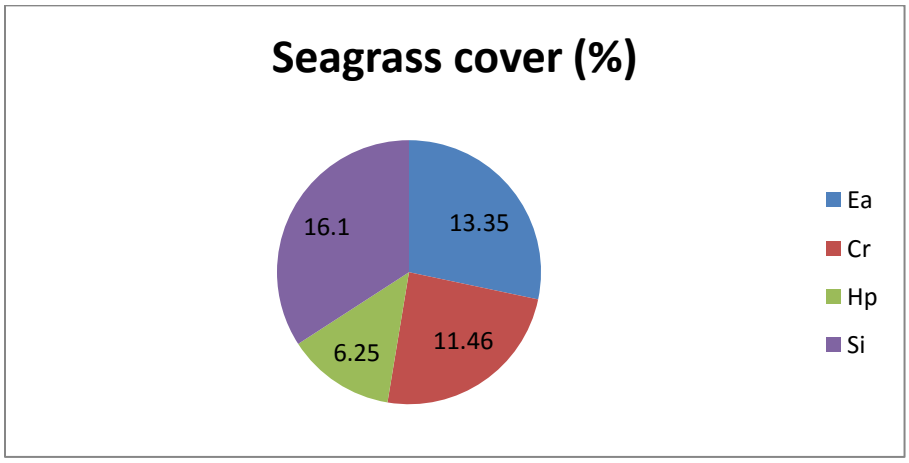


Figure 6.111 Species of Seagrass Cover



The following figure shows some pictures of seagrass beds observed near project location.

Figure 6.112 Sea grass Observed near Project Site

6.2.8.3 Seaweed

Seaweed or macroalage is also a common marine resources that could be found along the northen coastline. This marine resource is utilized as source of food and vegetable and several coastal communities depend on harvesting the seaweed. The following map shows the potential seaweed resources in the Northen coast of Liquica and in the nearest to the project area that will likely to be impacted by the project development.

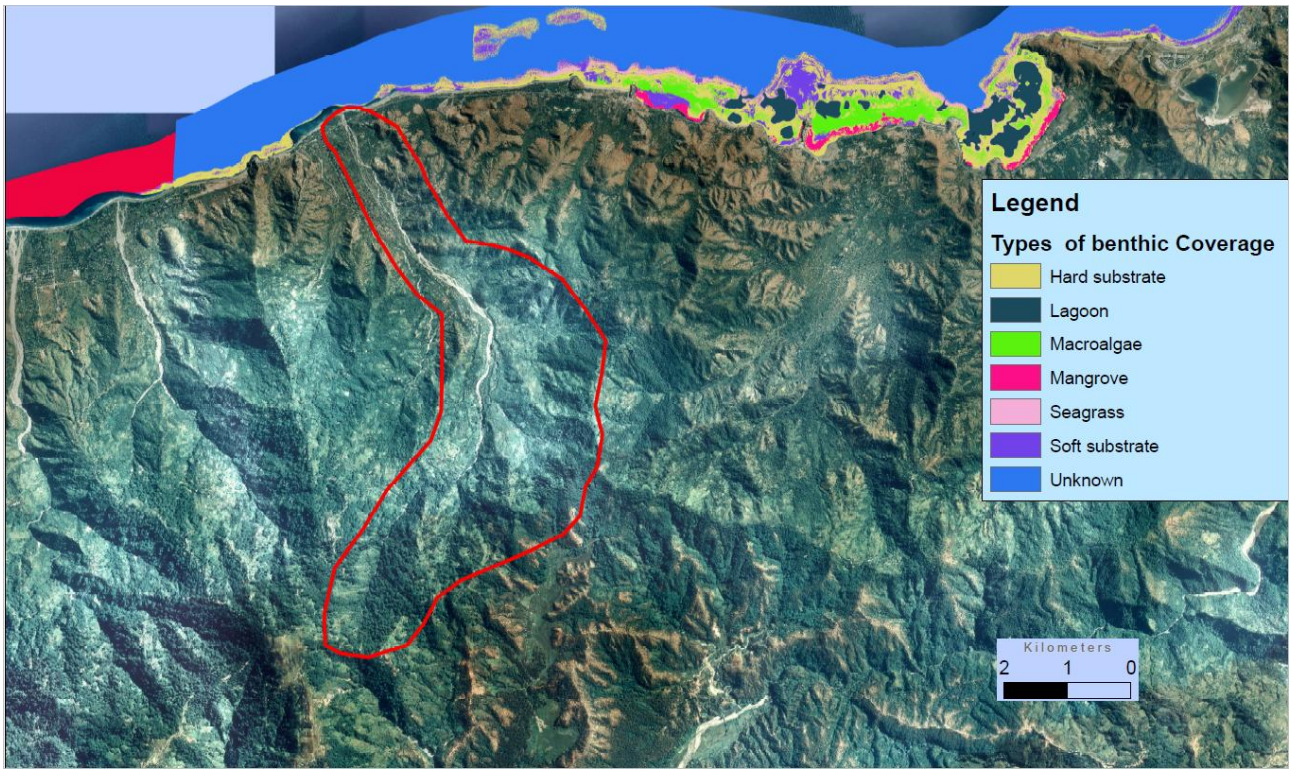


Figure. 6.113 Availablity of Macroalgae – seaweed in the project Area

As indicated by the survey conducted by the USAID and NOAA that the eastside of the project area, potential resourcs of seaweed can be found. Area like Ulmera, Kaitehu, and some part of Tibar has protential seaweed that local population utilizes as a source of livelihood. The survey that has already visualized in the map, suggested that the coverage area of potential seaweed in Northcoast of Liquica is around 100 HA, which is located at 5 KM toward east side of the project location. The habitat of seaweed in around Tibar and Ulmera, classified into two method/ways:

1. Natural seaweed production
2. Cultivate by the people

Total 100 HA of potential magroalgae was categorized as natural and local population collected and harvest the seaweed for their economic activity. While, the cultivate one, normally they do it for the commercial reasons.The estimated area of culativted seaweed at around 3 HA.

Figure. 6.114 Magro-Algae Collected by the people

Figure. 6.115 Macroalgae Collected from the Cultivated Area

Figure. 6.116 Interviewed with the Local Seaweed Collection

The economic value of the cultivated seaweed in the mentioned potential area was estimated based on the survey conducted as part the study. The total seaweed farmers were equal to 70 family with unit production and sale price as followed:

Table 6.64 Data Collected based on Interview regarding the income of seaweed harvesting

Condition of Seaweed	Harvesting time	Total Sack	Unit price/sack or kg	Total income
Sale as raw	1 weekly	70-140	$3/sak	$420/week/ 70 family
Dry	6 month	4-5 ton	$0.85/kg	$4,250/6 months/ 70 family

6.2.8.4 Marine Megafauna and Mamal

Identification of marine megfauna or the large mamal in the marine area is important study and assessment to be conducted in order to provide the information about the avalablity, location and time to that some protection plan and other economic acitivties can be developed. In many places, people want to see the large marine mamal because it is rare and unique, so in this case potential eco-torism industry can be developed. On the other hand, knowing the geographic location and timing of the arrival of marine megafauna in a spefiic place would be useful to plan the nenessary protection and formulate the mitigation measured in case any issue in the fufure as an impacts of the development. The widely used method to monitor and assess the availability of marine megafauna is through the aerial survey and followed with the spot survey in the ground. However, it is relatively expensive to conduct such survey.

As part of this EIA study, the various references were used to provide the efidence and information on the potential availability of marine megafauna in the northcoast of Timor – Leste, especially near the project area in Liquica. The following references and previous studies were used:

- Marine Megafauna Surveys in Timor Leste: Identifying Opportunities for Potential Ecotourism – Final Report, 2009, by Charless Darwin University, Australia
- Marine & Coastal Habitat Mapping in Timor Leste (North Coast) – Final Report, 2012, Charless Darwin University, Australia

The ocean current systems that surround Timor Leste are well known as a migration pathway for many species of marine megafauna including cetaceans, sharks and other fishes. The north coast of Timor Leste provided the most accessible area to view marine megafauna. Sea conditions on the south coast were often rough and road access to the coast and port facilities are very limited. In contrast, the generally calmer waters on the north coast and proximity of megafauna to the coastline offer better opportunities for development of an ecotourism industry. However, such an industry would require the predictable appearance of megafauna on a year-to-year basis, including protection of the marine environment from pollutant influence by the industry such as oil and gas.

According to survey conducted by the Charles Darwin University and Ministry of Agriculture and Fishery (MAF) Timor – Leste, found that megafauna's assemblages are very diverse, with over a third of all known whale and dolphin species found in the region. Additionally, other types of megafauna such as whale sharks (*Rhincodon typus*) and manta rays (*Manta birostris*) are also known to inhabit the region. Whale sharks, orcas (*Orcinus orca*) and mantas have been sighted at Whale Shark Point (also known as Lone Tree) during the months of August November, and groups of migrating whales and dolphins are regularly seen in the deep waters between Dili coastline and Atauro Island. The approach of megafauna close to the coast of Timor is facilitated by the very deep (3km) waters just offshore and the narrow fringing reef lining the coast. The following map shows the previous study regarding the presence of marine mega fauna, in the coastal region, including in North Coast of Liquica, where the project will be located.

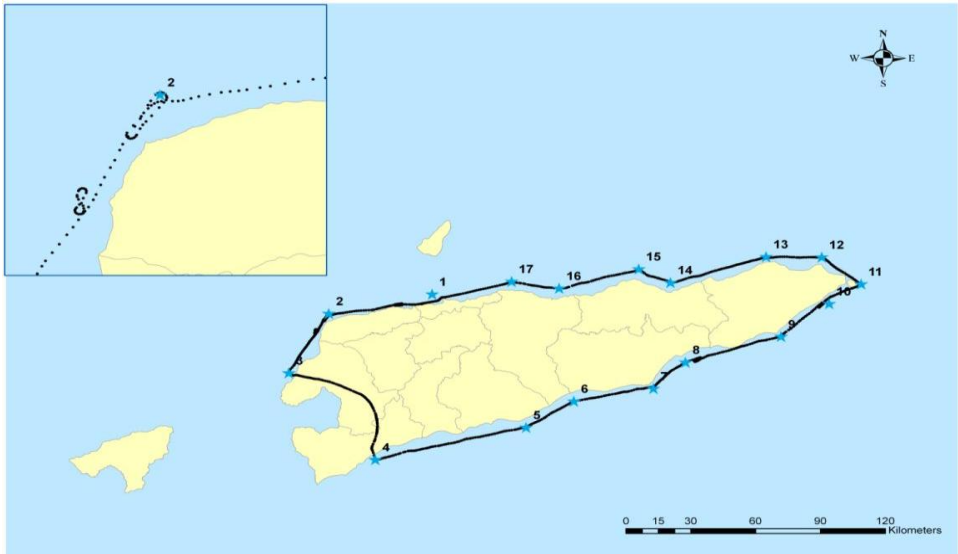


Figure. 6. 117 Previous Survey on Marine Megafauna

Two spot surveys near the project development were conducted to as part of the survey and data collection of the marine mega fauna or marine mammal. Species of marine megafauna identified in the north shore of Timor – Leste.

Table. 6.65 Survey Result of Marine Mega Fauna in Timor – Leste, 2008

Date	April 21	May 27	June 17	July 16	August 13	September 24	November 5
Dolphin	200	5	120	165	230	350	1300
Small marine mammal	1	20	35	25	20	3	190
Dugong			1				5
Manta ray (*Manta birostris*)							5
Ray				1	1	1	9
Shark			3	1			
Hammerhead shark (*Sphyrna spp.*)			1				1
Whale shark (*Rhincodon typus*)		1	1				1
Sperm whale (*Physeter macrocephalus*)			1				
Blue whale (*Balaenoptera musculus*)						2	3
Sei whale (*Balaenoptera borealis*)							2
Large whale		1		1			1
Turtle	7	9	22	7	9	2	44

Common name	Scientific name	Indonesian name	IUCN status
blue whale	*Balaenoptera musculus*	Paus biru	EN
sperm whale	*Physeter macrocephalus*	Paus sperma	VU
sei whale	*Balaenoptera borealis*	Paus sei	EN
or Bryde's whale	*Balaenoptera brydei*	Paus Bryde	DD
short-finned pilot whale	*Globicephala macrorhynchus*	Paus sirip pendek	DD
false killer whale	*Pseudorca crassidens*	Paus pembunuh palsu	DD
pygmy killer whale	*Feresa attenuate*	Paus pembunuh kerdil	DD
melon-headed whale	*Peponocephala electra*	Paus kepala semangka	LC
Cuvier's beaked whale	*Ziphius cavirostris*	Paus paruh Cuvier	LC
rough-toothed dolphin	*Steno bredanensis*	Lumba-lumba gigi kasar	LC
Rissos's dolphin	*Grampus griseus*	Lumba-lumba abu-abu	LC
Spotted dolphin	*Stenella attenuate*	Lumba-lumba totol	LC
spinner dolphin	*Stenella longirostris*	Lumba-lumba paruh panjang	DD
Fraser's dolphin	*Lagenodelphis hosei*	Lumba-lumba Fraser	LC

EN = Endangered, VU = Vulnerable, DD = Data deficient, LC = least Concern

Figure 6.118. Marine Megafauna in North Coast of Timor – Leste

With high potential ecotourism sector that can be developed based on the migration of all the above marine megafauna, the protection of marine coastal water from pollution would be very important. The proposed development of fuel terminal storage in the coastal area of Liquica, would need to take into consideration of the presence of the marine megafauna, particularly the impacts of pollutant that contribute by the propose facility to marine water body. According, the marine hydrodynamic modeling of oil spill (emergency spill), most of the north coast would be impacted by the dispersion of pollutant transport from the jetty (origin of spill location). If n, emergency oil would happen, then the marine mammal or megafauna would be affected, especially during the migration time from April – November every year.

6.3 Baseline Information on Economic Components

Baseline component of the existing economic characteristics of Timor – Leste, especially related to the local population according latest census, include the employment sector, available infrastructure facilities, existing land use and future plan, as well as other economic resources available and utilization area important component of the economic part of the EIS. After all, the proposed development will provide/contribute to the economic development in both national and local level.

According to the recent Census (2015), Suco Lauhata has a total population of 3,632 people, consisting of 1,853 male (51%) and 1,779 female (49%). Number of private household (HH) in the Suco is reported at

533, making the average persons per HH at approximately 6.8. As shown in the following population pyramid, the broad based of pyramid indicates that Suco Lauhata has a young population characterized by high fertility. This profile is consistent to the national profile where a significant portion of the population is less than 25 years of age.

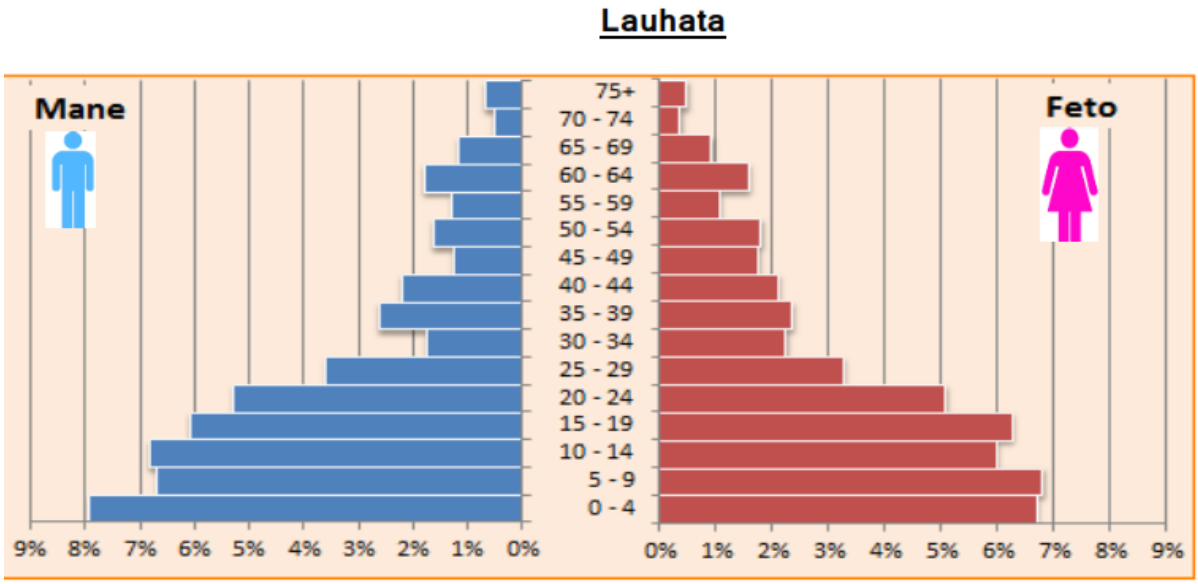


Figure 6.119 Population Pyramid of Suco Lauhata (Source: Census 2015)

6.3.1 Employment Sector

The 2015 Census defines Timor Leste's economically active population (labor force) as those aged 10 years old or above that was either working during the 7 days prior to the Census enumeration or those that were available for work but were unemployed at the time of Census. Economically inactive population, on the other hand, is defined as those who at the week prior to the Census are not working and not available for work[3].

As shown in the following table, unemployed population is about 7% in Suco Lauhata, a figure that is higher than Liquica Municipality or the national figure.

Table 6.66 Percentage of Employed and Unemployed Population in Lauhata Suco and Municipality of Liquica (Source: Census 2015)

	Lauhata	Percent	Municipality of Liquica	Percent	Timor Leste	Percent
Total						
Labor Pool	**2,642**	100%	**52,657**	100%	**873,562**	100%
Employed	**324**	12%	**24,227**	46%	**388,952**	45%
Unemployed	**174**	7%	**1,447**	3%	**20,403**	2%
Inactive	**2,144**	81%	**26,983**	51%	**464,207**	53%

[3]Census 2015.

Because there are no data available on Suco level for type of employment, data for rural Liquica are being used as proxy to shed light on the type of employment of local population. As shown on Table __, self-employed farming remains the largest type of income generating activity for the population of rural Liquica. At about 79%, the figure is slightly higher than the national figure for rural areas at 77%. The second income generating activities are government job and self-employed non-farming similar in general to the other rural areas of the country.

Table 6.67 Types of Employment in Rural Liquica (Source: Census 2015)

	Rural Timor Leste		Liquica Municipality		Rural Liquica	
Occupation	**Number**	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**
Government	24,081	8%	2,229	9%	1,865	8%
State-Own Enterprise	5,887	2%	394	2%	354	2%
Private-Own Business or Farm	7,183	2%	709	3%	556	2%
Self Employed Farmer	227,219	77%	18,420	76%	17,793	79%
Self Employed Non-Farmer	26,107	9%	2,149	9%	1,802	8%
Non-Governmental/Non-Profit Organizations	1,752	1%	173	1%	134	1%
Embassies and Bilateral Institutions	213	0%	20	0%	12	0%
United Nations and Specialized International Organizations	184	0%	11	0%	10	0%
Other	2,255	1%	122	1%	104	0%
	294,881	**100%**	**24,227**	**100%**	**22,630**	**100%**

6.3.2 Infrastructure Facility

Infrastructure in Lauhata Suco is quite basic. The Suco is traversed by the national road connecting Dili to Liquica which is extending all the way to the border with Indonesia. Electricity has also reached the Suco with distribution lines observed along the national road. Municipal water supply, however, is not available and Suco population has find their own source of water, most of the time through constructing shallow wells within the premise of their houses.

6.3.2.1 Power gridline

Between 2011 – 2015, Government of Timor – Leste has invested heavily in the infrastructure development, notable the power sector, which has resulted in the stable power supply delivery to almost 80% of Timor – Leste population. The two modern power plants in Hera and Betano have already supplied the constant power to the entire municipal center, which has a power sub-station, including the one in Liquica town.

The available power supply, including to the project area is very important and the proposed project development can benefited from the constant power supply. The reliability and stability of power supply would be very important to support the sustainable and safety operation of the proposed fuel terminal

facility. The project owner will check the power supply quantity from the power sub-station from Liquica, as according the preliminary information, the voltage of the existing power may not be sufficient for the power.

6.3.2.2 Road Connectivity and Traffic

Road and bridges are also other important basic infrastructures that Government has to make them available, especially; the investor would appraise their proposal of business based on the road condition and availability. Currently, the national road of Dili – Liquica has already updated with the very quality of hot mix.

Figure. 6.120 Photos of Road Condition in Tibar - Liquica

The Dili – Liquica road upgrading would provide a lot of advantage to the project development in the future. The average traffic condition has increased from 2000 VOR in 2015 (prior to the upgrading of road) to 3000 VOR in 2019 (after the upgrading of the road). The traffic would expect to increase significant in the very near after the commencement of the operation of Tibar Port in 2021.

6.3.2.3 Other Supporting Basic Infrastructure

Other supporting basic infrastructure that the Government of Timor – Leste should provide in supporting the public and private sector development are water supply and sanitation, include the waste management

service. Government is working on the development this mentioned infrastructure. Including make a significant capital investment in order to provide the reliable service in the future. Up to this moment, this infrastructure to provide the utilities (water and sanitation) will be provided by the project owner. The Tibar landfilled area, is currently under the consideration of the future upgrading system, where the proposed project development will take a benefit from this infrastructure.

Figure. 6. 121 Photo of Tibar Dumpsite Area (soon to be improved)

6.3.2.4 Port and Jetty

The government of Timor – Leste is engaging the private consortium to design, build, and operate the Tibar port, under the Public Private Partnership arrangement. Currently, the port is under the construction and expected to be in full operation toward the end of 2021. The operation of port under the concessionary arrangement would be expected to be efficient in supporting the economic development of Timor – Leste. Other important infrastructure facility, especially, direct relation to the current proposed project development is jetty, which is used mainly to transfer the good such as cement or liquid that can be easily pumped out from the tanker and store in the facility constructed near the coastal area. However, this kind of jetty would normally own privately by the company that run the business related to the oil and gas as well as cement.

Therefore, three private jetties that have been constructed and operate to serve those purposes:

- Jetty in Hera
- Lai Ara Jetty in Kaitehu
- Timor Cement Jetty in Lauhata

The first two jetties were constructed to load and unload of the fuel in Timor – Leste, while the last is more like multi purposes, with the original intention to unload the bulk cement be stored in the cement

packing plant and distributed in Timor – Leste. The project owner has an intention to take the benefit of the presence of this jetty to support the operation of fuel terminal in Lauhata, with the modality of long-term rental.

6.3.3 Land Use and Future Urban Plans

Land use planning and zoning in Timor – Leste is not well defined and that's why it is difficult to predict the future land use and control the urban growth. Area surrounding the facility is believed to be originally coastal stretch with its natural coastal vegetation consisting of government owned land (50 me from the coastline and 25 m from the river bank. The original land uses have been replaced by more urbanized typed of uses as the area accommodates urban expansion both from Dili and the Liquica sides. In the last few years, more houses have been built in the area on both the sea and mountain side of the national road while small and medium size businesses as well as natural resource based industry (sand and rock mining) and the related concrete casting manufacturing proliferated.

6.3.4 Forest Resources

In terms of forest resources, Timor Leste is well known as host for valuable forest resources including sandalwood/*ai kameli* (*Santalum album*), Timor white gum/*ai ru* (*Eucalyptus urophylla*), red wood/*ai na* (*Pterocarpus indicus*) and _____ (*Casuarina junghuhniana*)[4]. Non-timber forest resources include tamarind (*Tamarindus indica*), kiar (*Canarium reidentalia*), *ai kamii* (*Aleurites mullocana*), honey, medicinal herbs and others. Sandalwood in the country is noted to be in the brink of extinction with recent cultivation conducted only in Maliana, Suai and Oecusse while red wood is_____.

Along the northern coast in Liquica where project is located, the forest is dominated by woodland and savannas consisting of *ai bubur (Eucalyptus alba)*, palm and acacia. *Eucalyptus urophylla*, an excellent source of timber, is typically found in higher altitudes[5]. Non-timber forest resource collection is a common source of household revenue although they typically provides only very small amount of income.

6.3.5 Fishing

The northern coastal area of Timor Leste supports robust fishing and coastal resource gathering economy providing some income for its residents[6]. Small scale fisheries are common albeit restricted to relatively narrow areas along the coastline. This small scale nature of fishing operation indicates fishing as only one of several income generating activities that a household engaging in. Majority (62.4%) of the fishing vessels are small non-motorized wooden canoes powered by sail and paddles with motorized boats comprised the remainder (37.6%), most of which are outboard engines attached to dugout canoes. Fishing equipment for non-motorized canoes consists of hand-lines and small gillnets to catch small pelagic fish within a few hundred meters of the shoreline while motorized canoes are better equipped with drifting gillnets, hand and bottom long lines. Small canoes are also used by divers who catch fish and shellfish in the reef areas. Reef and near coast gatherers (mostly women) glean for clams, crabs and juvenile prawns

[4] Old et all, 2003
[5] Grantham et all, 2010
[6] FAO, 2009

close to the shore. Another form of fishing commonly observed in the northern coast of Liquica is people who use fish nets from shore.

A recent publication by the United States Agency for International Development (USAID)[7] on ecosystem assessment surveys to near coast water in much of Timor Leste shed lights on near shore/reef fishery resources of the country. It was found that average reef fish species richness was extremely high in Timor Leste compared to any other pacific region within the Coral Triangle area (averaging 57 species per site surveyed). Fish biomass was greatest in West Atauro with surgeonfish family having the highest biomass accounting for 20% of the total fish biomass. Reef fish observed in Liquica monitoring station with their respective biomass are presented in the following table.

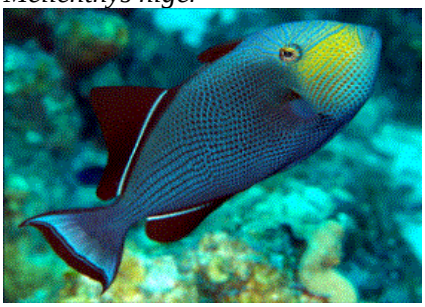
Table 6.68 Reef Fish Observed in Liquica

LIQUICA		
RANK	SPECIES	MEAN BIOMASS $g\ m^{-2}$ (SE)
1	*Melichthys niger*	2.9 (1.8)
2	*Pterocaesio tile*	2.6 (1.2)
3	*Acanthurus mata*	1.8 (0.8)
4	*Caesio teres*	1.0 (0.9)
5	*Naso hexacanthus*	0.9 (0.6)
6	*Scarus rubroviolaceus*	0.8 (0.4)
7	*Melichthys vidua*	0.8 (0.2)
8	*Ctenochaetus binotatus*	0.6 (0.3)
9	*Ctenochaetus striatus*	0.5 (0.2)
10	*Acanthurus lineatus*	0.5 (0.2)
11	*Chaetodon kleinii*	0.4 (0.0)
12	*Cephalopholis argus*	0.4 (0.2)
13	*Lutjanus lutjanus*	0.4 (0.2)
14	*Naso brachycentron*	0.3 (0.3)
15	*Dascyllus reticulatus*	0.3 (0.1)
16	*Acanthurus nigrofuscus*	0.3 (0.1)
17	*Balistoides viridescens*	0.3 (0.3)
18	*Pseudanthias huchtii*	0.3 (0.1)
19	*Pomacanthus sexstriatus*	0.3 (0.3)
20	*Lutjanus rivulatus*	0.2 (0.2)

The pictures of four highest reef biomass fishes on Liquica coasts are provided in the following.

7

Melichthys niger



Pterocaesio tile

Acanthurus mata

Caesio teres

6.3.6 Agriculture

Until recently, agriculture remains the most important economic sector in Timor Leste. Census 2015 found that 64% of employed population aged 10 years old and over identified themselves as self-employed farmers. Of this, 91% resides in rural areas.

Important staple food production in Timor Leste are rice and maize which have been found to be generally in decline nationally in terms of the area planted and gross production, meaning production before allowances for post-harvest losses and retainer for seeds. While national rice production is showing approximately 25% of downward trend for the period between 2013 and 2015, maize production is showing an even more dramatic reduction of 30% for the same period. For maize, it is thought that this dramatic reduction is mostly due to change in preference of maize consumption among the population as well as the particular effect of El Nino event of 2015/2016. The following table shows national level production and production of the main staple food for the national level and Liquica Municipality.

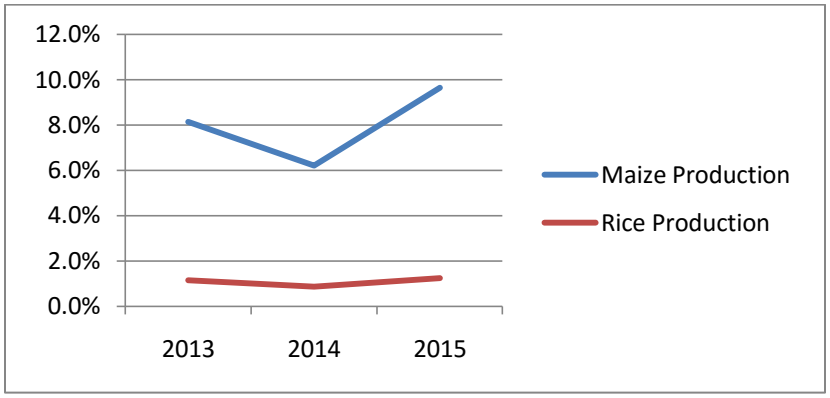
Table 6.69 Rice and Maize Production between 2013 and 2015 in Timor Leste and Liquica Municipality (Source: Tomak, 2016 based on secondary information available including from Census 2015)

	Total HH	HH Growing Staple Food	% of HH Grow. Staple Food	Area Planted (Ha)			Gross Production (Mt)		
				2013	2014	2015	2013	2014	2015
Rice									
National	204,597	71,541	35%	28,717	28,514	20,793	88,260	88,947	66,514
Liquica	11,885	1,734	14%	275	250	254	1,001	760	823
% of Liq.	5.8%	2.4%		1.0%	0.9%	1.2%	**1.1%**	**0.9%**	**1.2%**

Maize									
National	204,597	142,361	70%	42,820	31,460	33,815	103,163	78,651	71,997
Liquica	11,885	9,652	81%	2,747	1,876	1,985	8,405	4,878	6,948
% of Liq.	5.8%	6.8%		6.4%	6.0%	5.9%	**8.1%**	**6.2%**	**9.7%**

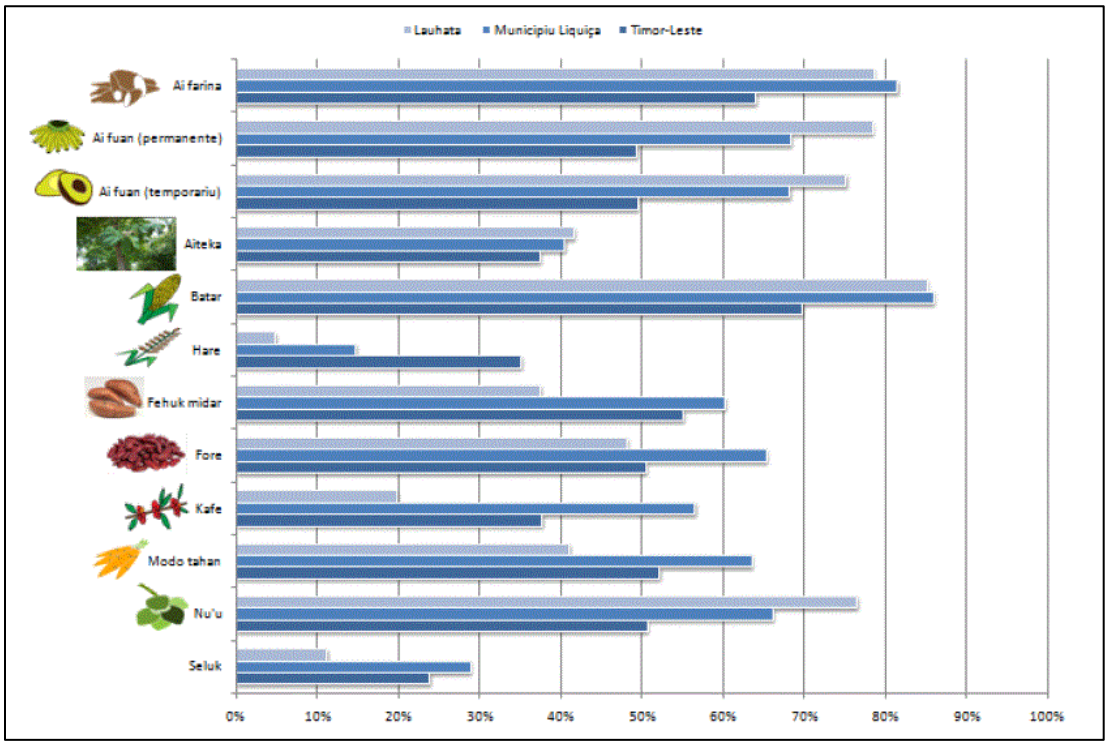
It is important to note that while production for rice and maize from Liquica Municipality is keeping with the decreasing national trend, as a percentage of national production, it is actually increasing with maize showing an even more significant contribution at about 9.7% of the national gross production in 2015 (see Figure 6.112).

Figure 6.123 Rice and Maize Gross Production in Liquica Municipality as a Percentage of National Production



Census fo Fila Fali (2015) for Suco Lauhata reported on household agriculture diversification including on the staple food production (rice, maize, tubers/cassava, root food/sweet potato), fruits (perennial and intermittent), agroforestry/timber, legumes, coffee, horticulture/vegetables, coconut and others. As shown in the following figure, consistent with the municipal level data, more than 80% of Suco household reported that they harvest corn. In terms of percentage, there were fewer households harvesting rice within Lauhata compared to Municipality of Liquica proportion in 2015 (about 5% compared to the 14% municipal wise data). Other important agricultural production from the Suco includes cassava, coconut, perennial and intermittent fruits.

Figure 6.124. Percentage of Household Involves in Diversified Agricultural Product Collection (Census Fila Fali, 2015)



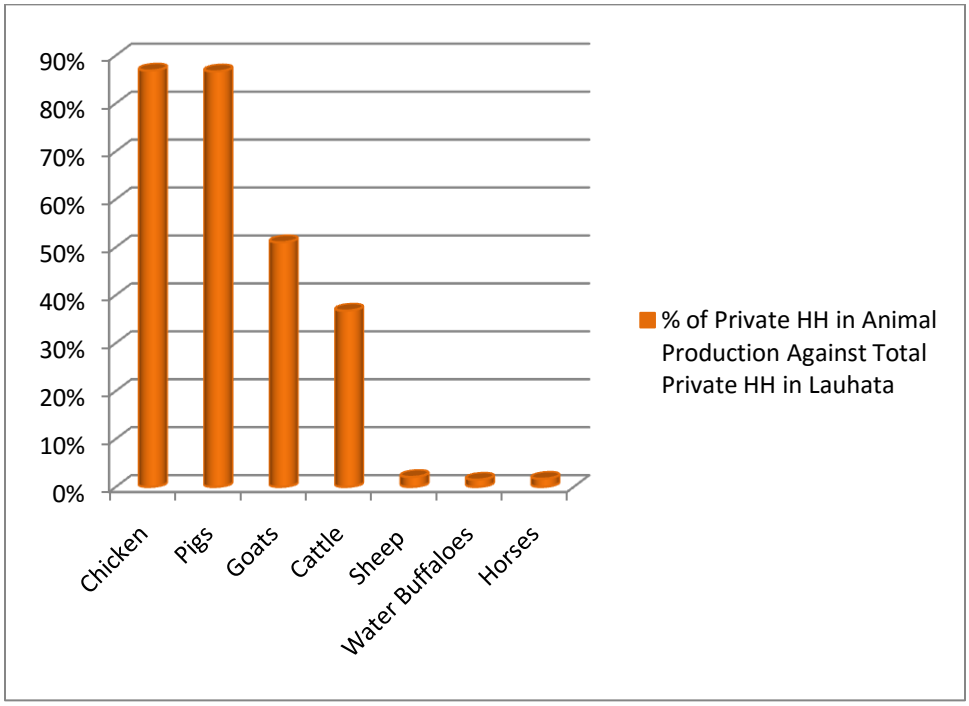
In terms of animal husbandry, Census 2015 showed that livestock rearing remains an important part of livelihood strategy along with fishery and agricultural production for the population in Lauhata. Almost 100% of the households reported that they rear animals, a number that is consistent with the overall number of the municipality of Liquica (see Table xx).

Table 6.70 Households Involved in Livestock Rearing at the National, Municipality and Suco Level

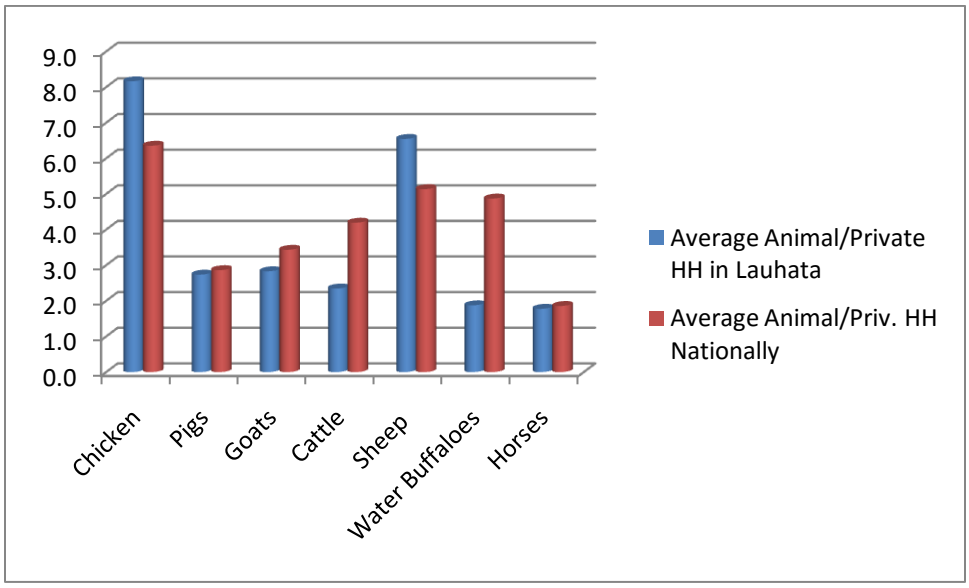
	Private HH	Private HH involved in Livestock Rearing	% of HH involved in Livestock Rearing
Timor Leste	204,597	178,363	87%
Liquica Municipality	11,885	11,390	96%
Lauhata Suco	533	522	98%

Households in Lauhata were especially engaged in the production of chicken, hogs, goats and cattle with only a few reared other livestock's such as sheep's, water buffaloes and horses. As shown in the following figure, most households reared chicken and pigs while about half of them kept goats. Cattle/cows were raised by more than 30% of the households.

Figure 6.125. Private HH in Animal Production in Suco Lauhata



Average number of animals in each household is shown in Figure xx, where it shows that on average, households in Lauhata kept the number of livestock at about the same or less than the national level, except for chicken and sheep. There were higher number of chicken and sheep per household in Lauhata then the national average.



6.3.7 Tourism and Other Activities

The northern coast of Timor Leste is dotted with beautiful wide beaches ranging from the white sandy beaches of Araba to the black sandy beaches of Lauhata and Liquica. A well frequented small resort (is located within the Suco boundaries aptly called Lauhata Beach Escape. The resort is located 5 km west from project location and can be accessed from the main road through a small rough asphalted road for 500m toward the seaside. Facilities include a restaurant with extensive yard and gardens. It was a popular weekend spot visited by families and individuals alike.

Another excellent visitor attraction point is the Aipelo Prison, located about 300m west of project location. Aipelo Prison is the first major touristic attraction when visitors make their ways out of Dili toward the west. It can be reached in about 30m drive from Dili. Aipelo Prison is a historic building built in the late nineteen century (year 1889) and was in operation until its deactivation in 1939. More on Aipelo Prison is presented under Section 6.5.3 Historic Sites.

6.3.8 Other Industries

Other industries in Lauhata including concrete block (bataco) and concrete cast manufacturing, sand mining/quarry and cement packing, and salt industry have contributed to the economic development, including the local. Small and medium size businesses include fuel station and supermarket, café, retail kiosks and small eateries. Medium size to large industries vary from petrol industry to salt, as well as pre-cast concrete block are presented as follow

6.3.8.1 Sand Mining and Quarry

Sand mining industry is a most common industry within the project boundary, from traditional with the simple equipment to more modern equipment such as stone crushing.

- Traditional mining in the river
- Modern mining with modern equipment (nearby, china Harbor to serve the Tibar Port development)

6.3.8.2 Fuel Filling Station

Many fuel filling stations have been constructed along the national road and in the inter-city such as Liquica serve the customers who buy the fuel.

Figure. 6.128 Fuel Filling Station Industry

6.3.8.3 Salt Industry

The low laying area of Kaitehu, Ulmera, and Tibar area, have utilized the wetland as salt pan, which will be sent to the salt purification in Ulmera.

Figure. 6.129 Salt Pan in Near Ulmera

Figure. 6.130 Salt Production in Ulmera

There are two industries of salt making:

- Traditional salt making
- Modern satl making

The traditional salt making has very low capacity and usually sale their salt product to the bulk buyer that will further purify the salt for packing prior to entering the market system. The following table provides the total family identified in Kaitehu, Ulmera, and Tibar.

Table 6.71 Produksi masak garam tradisional

Location	Number of Family
Kaitehu	1
Ulmera	22
Tibar	2

Average production per family, is around 4 sacks a week, where each sack can be sold with total $10. Therefore, the total economic value of the traditional salt industry is around $1000. The modern salt production in Ulmera and Kaitehu, on the other is more organize but required larger space to make creare natural pan and dry the water based on the sun. The following table provide the total salt production in Ulmera and Kaitehu

Table. 6.72 Salt Production and Financial Estimation

Location	Monthly Production, kg	Unit price, $/kg	Monthly sale, $
Kaitehu	1000	0.09	90
Ulmera	20,000	0.1	2000

6.3.8.4 Cement Packing Plant

Cement packing plant was constructed in 2013 with an objective to pack the bulk amount of cement coming from foreign country. The bulk cement delivered by the boat/taker is stored in the existing SILO to further pack into regular cement with 40 KG sack prior to entering the market in Dili. This packing plant also delivers the large amount of cement to various contractors in Timor – Leste that are working in the area of construction.

As part of the cement packing plant facility, the jetty was also contracted to support the operation of the cement packing plant. In fact, the current proposed development of oil terminal will use the jetty to unload the fuel and feed into the oil terminal system.

Figure. 6.131 Cement Packing Plant and Jetty

6.3.8.5 Concrete block and Precast

The concrete block and pre-cast fabrication are also located in the road along Dili – Liquica, due to the availability of raw material such as rock and sand. There is still a high demand on the concrete pre-cast material as Timor – Leste is in the process of developing the infrastructure in the entire territory.

Figure. 6.132 Photos of Pre-cast Industry

6.3.8.6 Lai Ara Fuel Terminal

Oil Terminal belongs to Lai - Ara was constructed in about 3 KM in the east side of the proposed project area. This company is one the competitor of the proposed development.

Figure. 6.133 Lai-Ara Oil Terminal and Global Oil Terminal

6.4 Baseline Information on Social Components

6.4.1 Population and Communities

As previously noted according to Census 2015, Suco Lauhata has a total population of 3,632, composed of 51% male and 49% female. The population has remained relatively the same compared to the previous count during Census 2010. The Suco contributed about 5% of population to the total Liquica Municipality population which has seen an increase in the total population from 63,403 in 2010 to 71,927 in 2015. With a total private household of 533, Suco Lauhata has on average 6.8 members per household.

Educational attainment is an important indicator of community's social achievement. For Timor Leste, according to the latest census (2015), as much as 73% of population five years old and over have had some schooling, signifying that they are at school or have left school at the time of the census. This rate is also reflected in Lauhata although it should note that for the Suco, a significant discrepancy remains along the gender line, there are more man with some schooling (77%) than women with some schooling (68%).

As for educational attainment level, data from Suco Lauhata shows that of the population that have received education, about 50% are attending or have attended up to primary level education, with 41% are attending or have attended up to secondary level of education. Only about 7% of the population either attending or have attended university level of education. This profile of Lauhata education attainment level is consistent with the profile of educational attainment at rural Timor Leste in general. The following figure shows more detailed information on educational attainment level for Suco Lauhata.

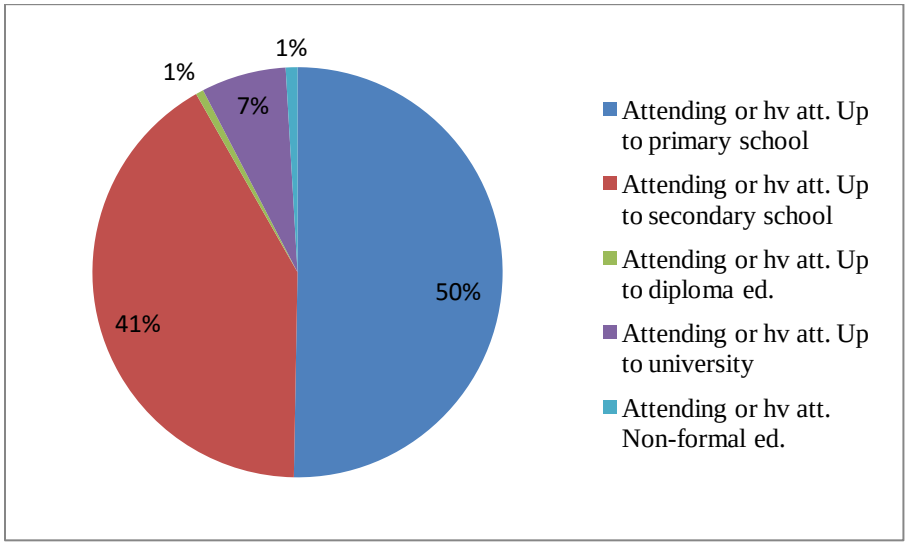


Figure 6.134 Educational Level Attainments for Lauhata Suco (Source: Census 2015)

6.4.2 Health Profile

Due to the inexistence of detailed data on Suco level health profile, much of the description on Lauhata communities health profile relies on data reported on the national and to some degree district level paying close attention to the rural side of the population. This approach is thought to be appropriate since general demographic information as well as educational attainment level of Lauhata has been found to be very consistent with the national rural profile.

6.4.2.1 Maternal Death

Census 2015 reported on maternal mortality in accordance with WHO's definition of total deaths during pregnancy, while giving birth and within 6 weeks of delivery. In general, it is believed that there is a significantly higher maternal death in rural areas compared to urban areas of Timor Leste.

Table 6.73 Deaths during Pregnancy, Whilst Giving Birth and Within 6 Weeks of Delivery during the 12 Months before Census (Source: Census 2015)

Administrative Boundary	**Total deaths during pregnancy, whilst giving birth and within six weeks of delivery**	**During pregnancy**	**Giving birth**	**Within six weeks of delivery**
Timor Leste	**219**	**139**	**56**	**24**
Urban	49	36	8	5
Rural	170	103	48	19
Municipality Of Liquica	9	5	2	2

6.4.2.2 Child Health

Generally, child health has been thought to be rapidly improved in Timor Leste since the country gained independence. Results from Demographic and Health Surveys (2003 and 2009) noted a significant decline in infant and child mortality. The Government of Timor Leste has continuously trying to improve children's health through implementation of immunization programs for infant and children as reported in the following table.

Infant mortality rate is defined as the number of deaths of children less than one year of age, expressed per 1,000 live births while Under-5 mortality is defined as the number of deaths of children less than 5 years of age, expressed per 1,000 live births. Another indication of Timor Leste's positive achievement in terms of child health is reported in Timor Leste Demographic and Health Survey (2016) where it was noted that infant and under-5 mortality rates have shown a 50% declined compared to profile from the turn of the century (see following figure).

Child mortality in general has been thought to correlate to multiple socio-economic risk factors of the mother and family. For Timor Leste, researchers have identified:

1. Infant mortality is highest among women in their forties.
2. Infant and child mortality all decline with increasing education of the mother and increasing wealth of the household.
3. Under-5 mortality varies greatly across region from the lowest of 19 deaths per 1,000 live births in Lautem to the highest of 76 per 1,000 live births in Oecusse. Municipality of Liquica registered 33 deaths per 1,000 live births.
4. Mortality rates are notably higher among births after short intervals (less than 2 year).

6.4.2.3 Most Prevalent Disease in Suco Lauhata

The Lauhata Suco health post registered the following cases of traffic accident, acute diarrhea, skin disease and upper respiratory tract infection in 2019 (table xx). Except for diarrhea and skin disease, the other two cases are cases that could increase due to new construction activities nearby. As shown in the table, cases of upper respiratory tract infection is the most of the four cases. While there are many causes to upper respiratory tract problems including virus and bacterial infections, exposure to dust have been found to cause coughing, sneezing and eye irritation and could lead to onset of asthma and throat infection. This should be something that project should take into consideration as not to contribute to making situation worse for the population in the suco.

Table 6.74. Cases of Disease and Accident at Suco Lauhata Health Post - 2019

Month	**Traffic Accident**	**Acute Diarrhea**	**Skin Disease**	**Upper Respiratory Tract Infection**
January	1	70	64	195
February	4	58	92	298
March	1	47	57	460
April	3	32	39	370
May	5	26	81	371
June	6	16	45	360
July	1	26	37	259
August	6	6	36	217
September	0	29	26	291
October	2	21	40	179
November	0	15	38	173
December	1	45	35	204
Total	**30**	**391**	**590**	**3377**

Figure 6.135. Suco Lauhata Health Post

6.4.3 Institutions, Schools and Health Facilities

A primary school (*Ensino Basico)*, a church and a health post can be found in the Suco. The primary school hosts children in grade 1-12 while the health post is providing basic health services to the population. No other institutions can be found within the Suco.

6.4.4 Community and Family Structures

The recent Timor Leste Demographic and Health Survey (TLDHS) in 2016 noted that more than 75% of children under the age of 18 live with both biological parents while about ten percent of the same age group does not live with any biological parent. This does not mean there is a high rate of orphan hood in the country as most of the children not living with a biological parent have both biological parents alive. Additionally, the survey found that 9% of children live only with their mother. Moreover, for 6% of those under the age of 18, at least one biological parent has died. Fostering, meaning taking in children that are not directly biologically related, is most common in Baucau Municipality while orphan hood is most prevalent in Ainaro.

6.4.5 Landownership

Now almost two decades after independence, Timor Leste still lacks the complete legal basis to determine land ownership. The recently passed land law (Lei 13/2017)[8] is noted as lacking regulation packages to be implemented in full. Landownership in general is a problem in rural area due to lack of legal

[8] The land law is formally titled "Special Regime for the Ownership of Immovable Property", passed by the Parliament on February 6th, 2017 and promulgated by the President on June 1, 2017.

documentation of ownership while in urban area there are conflicting claims from different colonial eras[9]. For example, one parcel of land might have several claims with claimants presenting land ownership certificate from the Portuguese time, Indonesian time and claims that are rooted in customary ownership.

Land and property ownership in the country either falls into privately owned land/property or State owned land/property. State owned land/real estate falls into two general categories – (1) public domain and (2) private domain. Public domain state lands and real estate are those that are clearly noted to be so by applicable law or those that are not allowed to be subject to economic/commercial transactions meaning that they are not tradable due to their nature and/or social values. State-owned land and real estate that is not in the public domain makes up the State private domain. Land and other assets in the private domain are those that can be owned and disposed of by the State and public institutions.

6.4.6 Common and Individual Rights to Natural Resources

All over the world, natural resources providing common benefits are frequently held in common. Spring and coastal areas are such examples. As previously noted, coastal lands 50m from the ____ are deemed State Land.

6.5 Baseline Information on Archaeological and Cultural Components

6.5.1 Archaeology

The island of Timor was primarily inhabited by population from Papua, about 7000 BC, then by Austronesia communities at about 2000 BC which were subsequently followed by other migrating populations from Asia and Australia and the Pacific islands. Different geographical formations within the island as well as internal wars between communities and the consequent integration of subgroups into other ethnic linguistic groups lead to a cultural and linguistic diversity within Timor Leste.

Taking into account linguistic characteristics of the people, about 20 major ethnic groups emerge with a smaller number of dialects. Most of the languages of Timor Leste are part of the Austronesia or Malay-Polynesia language family, most likely as a result of the occupation of the Proto Malay ____. Other languages, including Bunak, Fataluku and Makasae, are likely ___ Papuan languages.

The Liquica Municipality is inhabited mostly by the Tocodede ethnic group. Tocodede is _____. The pattern prevails within Lauhata Suco, where 2015 Census reported close to 80% of the population identified Tocodede as their mother tounge (see following figure). The second and third most common mother tounge are Tetum Praca (less than 20%) and Mambai (less than 10%).

[9] Almeida and Wassel, 2016

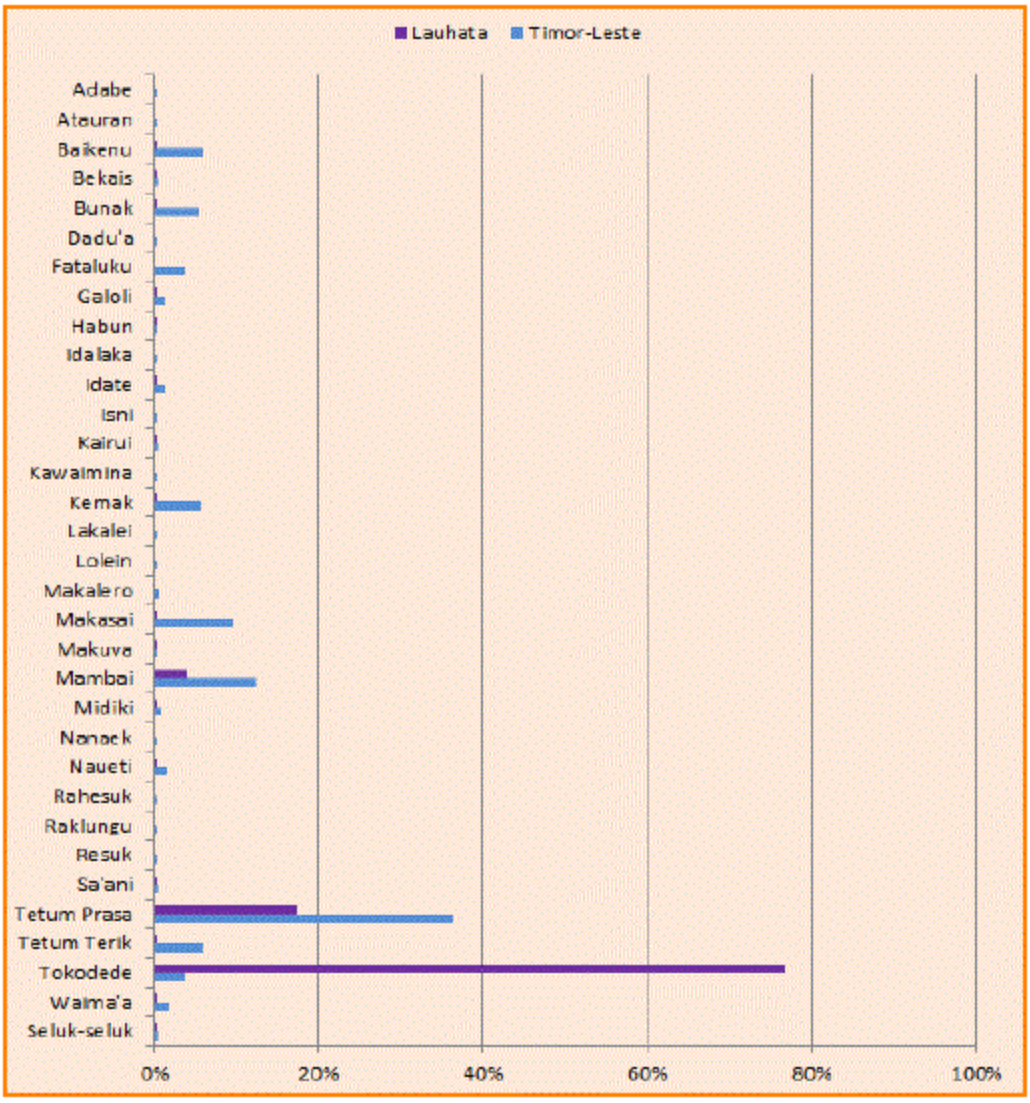


Figure 6.136 Mother Tongue Spoken in Lauhata Suco (Source: Census 2015)

6.5.2 Cultural

Most of the population in Dili identified Tetum Praca as their mother tongue suggesting the metropolitan nature of urban Dili residents where most of the population speak the national language at home. Terum Praca is spoken by approximately 90% of the population with Mambai and Makasai as the second and third most spoken mother tongue at four and three percents respectively.

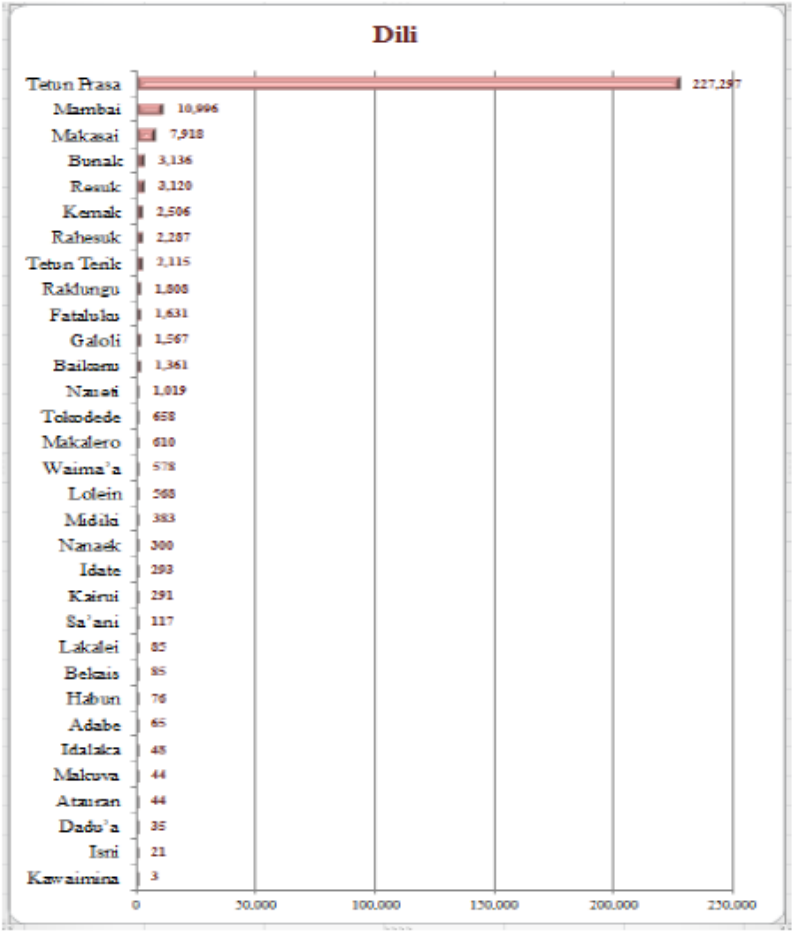


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Figure 6.137. Mother Tongue in Dili (Source: Census

7 ALTERNATIVES

Several alternative scenarios have been assessed before coming into conclusion to propose for the current development. These alternatives include location alternative, business model alternative, scale of the project alternative and a no-development alternative. The following description provides discussion on alternatives considered for the development.

7.1 Location alternative

The project is essentially about importing of fuel products from foreign country to be stored and then distributed within Timor Leste. The most economical ways of delivering large scale fuel from a foreign country would be via tanker ships. Therefore, the most economical location of the project would be in the coastal area nearby Dili where most customers are located. The other requirement is the existence of jetty/harbor where ships will be docked before fuel is unloaded. If a jetty is non-existence, project owner has to construct its own at a significant cost. Taking into account these pre-requisites, a location right to the west or the east of the Cement Packing factory was considered (these are locations that will not need investment is bridge crossing). The Cement Packing factory already has a functioning jetty which was assessed as able to support the fuel piping system into the proposed project location

The sites immediate to the east and west of the Cement Packing factory, however, have not been available or suitable. The site to immediate to the west will be used by the Cement Packing plant for expansion while the site east factory is a narrow coastal strip that will not be able to support the proposed facility. Therefore, the current location is chosen and the most suitable. However, other factor such as current and tidal would also affect the successful operation of the facility, which need to be considered during the operation of the proposed development facility. In this case, the project must adjust the operational schedule, especially during the high and low tides, which may put the operation of fuel loading and unloading into the risk.

7.2 Alternative Scale of the Project

In the beginning, project proponent planned to propose building larger capacity storage at 20,000 KL. Larger storage capacity means better business as higher capacity means higher profit. The plans for higher scale than what is currently proposed, however, has been scaled down due mostly to safety and environmental concern as higher capacity means higher risk for fire. Additionally, the development has been proposed in phases to better manage demand risk as higher capacity without demand means significantly less return on investment.

Given the size of the land availability and perhaps the market demand in the next 10-years, the proposed capacity is the most reasonable one under the current technical setting, as well as current condition of Timor – Leste, where many of emergency support system is not properly in place.

7.3 No Development Alternative

No development alternative is a situation where the project proponent is not proposing any development and operates as today where the project owner has supply the fuel with lower capacity of operation by moveable truck tanker. However, this means that positive impacts from the development such as higher tax, job generation and higher financial return would be not realized.

8 IMPACTS ASSESSMENT AND MITIGATION MEASURES

The Impacts Assessment (IA) and proposed mitigation measures for the proposed fuel terminal storage in Lauhata was carried out for each stages of project implementation. The methodology to asses each impact, including the data collection from the project sites, as well as secondary information use to help assess the impacts, scope and area coverage of impact assessment, as well as the residual impacts, as suggested in the Government diploma ministerial, regarding the propose EIS document.

- Methodology and approach
- Scope of the assessment
- Identification of impacts
- Determination of significance of those impacts
- Mitigation measures
- Incorporation of mitigation measures into project design
- Determination of any residual impacts

The potential impacts, related to the various project activities, are determined by taking the reference with the similar industry or activity that already established. Each impact was identified an d assed the magnitude with the best available method, which provide the basis for determining the most proper mitigation measures to help reduce, minimize, and or eliminate the impacts.

8.1 Impacts Assessment and Mitigation Measures during the Pre-Construction Phase

The pre-construction mainly cover the preparatory activity that does not generate the significant impacts that should be a major concern. The following project activities are carried out during the pre-construction:

- Environmental Impact Assessment (EIA) study
- Groundwater assessment and well construction
- Geotechnical Site investigation
- Project site clearance and fencing
- Land title issue (administration)

- Grading of the project area

The impacts of these above activities are generally minor, which related to the occupational health and safety issue, which should be managed properly onsite during the execution of each of the above activity. The following table presents the impacts and proposed mitigation measures.

Table 8.1 Impacts and Mitigation Measures during the Pre-Construction – Preparatory works

No	Impact Assessment and Mitigation Measure during Pre-construction		
	Impact	Magnitude	Mitigation type
1	Air Quality due to particulate matter	cover the project area	**Personnel health and safety** (use PPE) Water spraying the project area Fence the project area and closed for the public access to Community health and safety
2	Solid waste - due to site clearance	1.3 Ha of land	Collection and disposal at Tibar landfilled area **Personnel health and safety** - using the PPE **Community Health and safety-** limited accessibility of community to the project site
3	Storm runoff and marine water quality	1.3 Ha of land	Temporary detention basins to detention storm water and filter the sediment

8.2 Impacts Assessment and Mitigation Measures during the Construction Phase 1 A

Impacts during the construction of phase 1 A would be considered temporary and will be reduced or eliminated after the completion of the construction works. The design layout of the facility will be used to guide the phases of the construction of the proposed fuel storage facility.

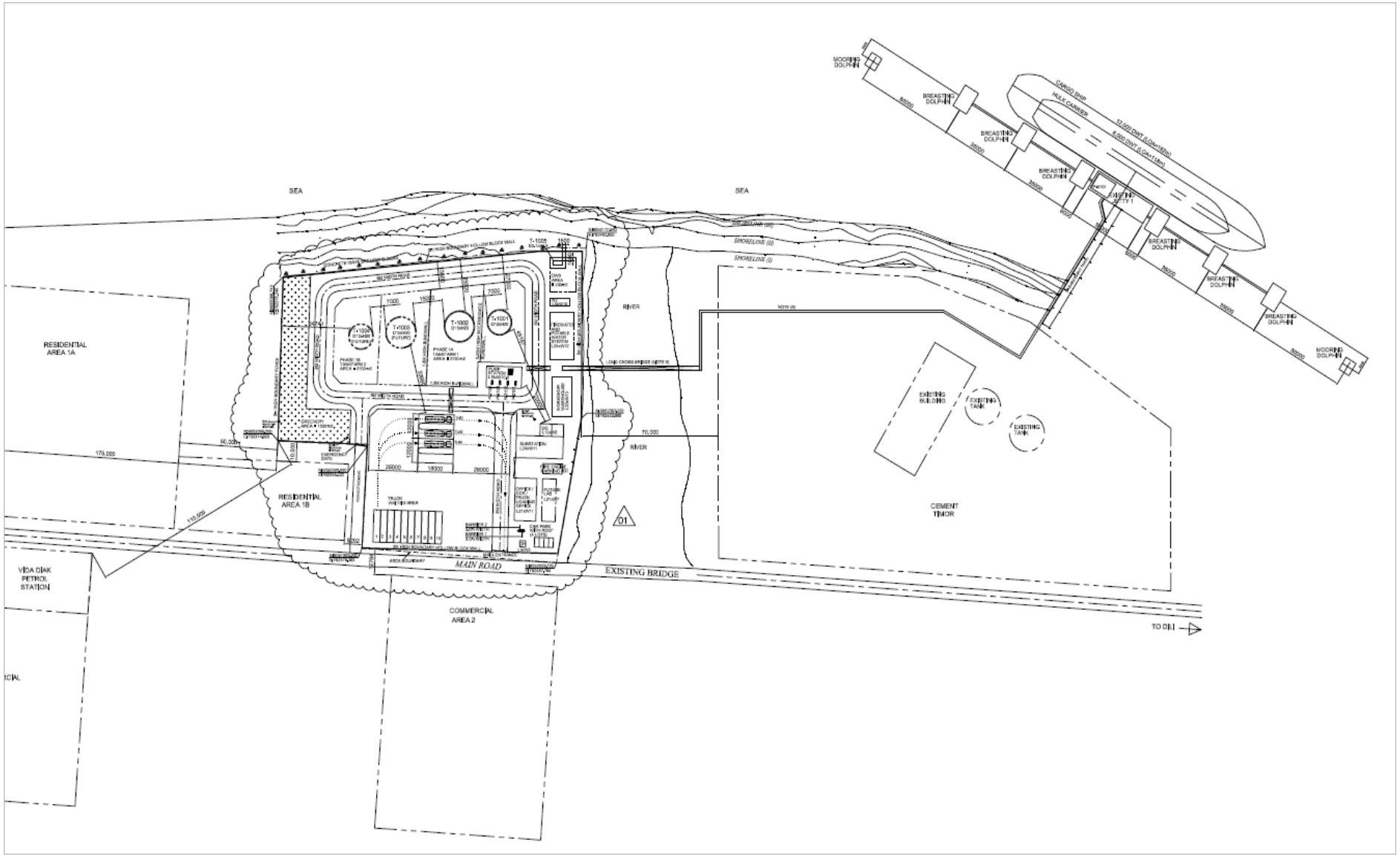

Figure. 8.1 Design Layout

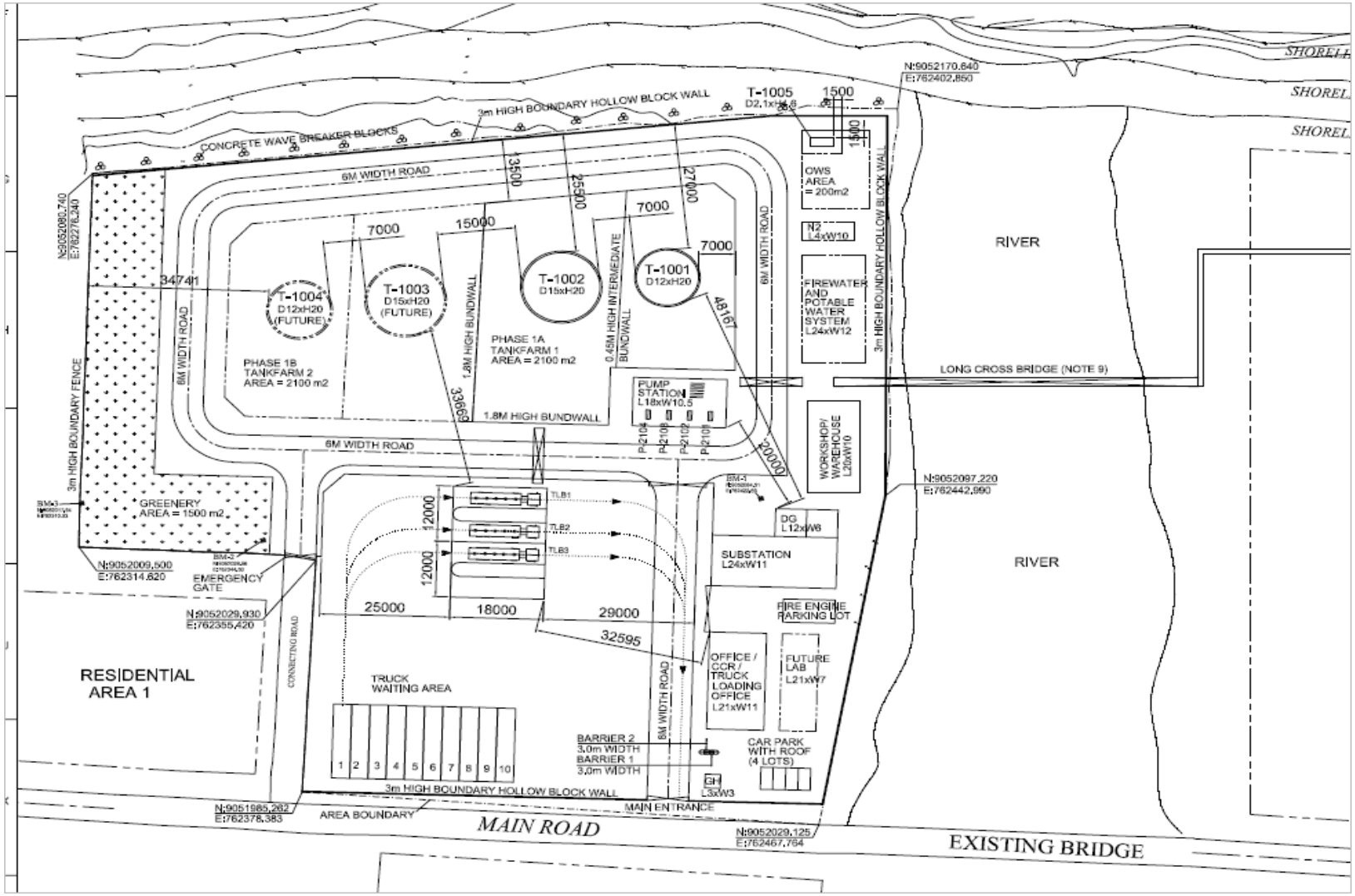

Figure. 8.2 Layout of Proposed Development Plant

During the construction, the following major activities will be executed and the related impact will occur:

- Installation of fuel storage (foundation work, primary containment, fence, etc.) – Tank A1
- Construction of office space
- Construction Cooling water tank
- Construction bridge and piping system
- Construction of River Protection

The impacts generated by these construction activity will mainly related to air quality degradation, marine water pollution, noise and vibration, and occupation health and safety to the workers, as well as community and health and safety issue. Many of the impacts are impacted locally and few of them could impact surrounding area due to dispersion and transport phenomena. Detail layout of DED can be found in the annex document. The following table summarized the impacts identified and proposed mitigation measures to minimize the impact and risk

Table 8.2 Impacts Identified and Mitigation Measures

Impact Assessed and Mitigation Measure during Construction of Phase 1 A			
Impacts	Area of Coverage	Particular concern	Mitigation Measure
Air quality Degradation	1.3 HA of land surrounding area	PM	• water spraying • Measure the PM level in case any complaint
		Flue gases (CO2, NO2, Sox)	• Application of latest version of equipment that produce less flue gases • Measure the flue gas level during the construction to know if any major issue related to the gases
Marine water quality	1.3 HA of land surrounding contributing area to the marine waterbody	High turbidity of storm water runoff can impact the marine water body (high turbidity and sediment load to the coral)	Temporary detention basins to reduce and filter the suspended sediment
Occupational Health and Safety	People who work inside the facility	• Work related electricity • Exposure to heat • Exposure to the dust and particular matter • Risk injury related to accident	• Proper training prior to executing the certain work. Certain special work such as electrical work should be done by person who has certified training related to electrical work • Using the proper PPE (eye,

		(vehicle, heavy duty equipment, etc.) • Risk of death	nose, ear, protection system) • Supervisor to control the worker to follow proper working procedures • Temporary medical help in the project site to provide help in case accident • Dedicate team to response the emergency in the field • Evacuate as soon as possible to the nearest help center or hospital • Proper compensation to the death
Traffic disturbance	Vehicular get in and out of construction area	• Traffic accident • Temporary congestion • Loss of life	• Assign dedicated person to watch and direct the traffic related to construction activity • Response team to help resolve the traffic accident •
Noise	Within the project area up to 50 meter radius	• Disturb the convenience of the community • To big noise could potentially cause the health hazard	• Use the PPE (ear protection equipment) within the project area • Schedule the construction activity only during the day time
Vibration	Within the radius of 100 m	• Potential collapse of old Aipelo prison • Structural crack of the building within the radius of 50 m	• Monitor the vibration level from the source of vibration and further distance away from the source to know the vibration level • Apply some safer technique of foundation work that produce minimum vibration • Apply PPE for the worker within the project area during the execution of work

Further detail information of the specific impacts during the construction of the project is presented in the following sections.

8.2.1 Air Quality Degradation

The ambient air quality degradation from the project is mainly caused by the particulate matters and Carbon Dioxide due to combustion from the automobile or heavy duty equipment that operated within the

project location. The background of air quality measured by parameters of PM, NOx, Sox, and CO2, as presented earlier, indicated that the baseline ambient air quality condition are in the good and healthy as the measured parameters values are below the minimum threshold to be acceptable by the receiving environment. The ambient environment covers the project location and boundary up to the radius of 1 KM, distance was observed during the monitoring of the ambient air qualities parameters.

The detail description on the ambient air quality parameter measurement, were presented in the section 6.1.4 (Description of Existing Environment), including the methodology of fields data collection as well as the laboratory measurement to determine the parameter values. As the construction starts, it may be possible that the parameters value could be elevated. The cause of elevated value of the air quality parameters is due to construction activity that disturbs the soil, where the wind can transport the particulate matter from one location to the other. Moreover, the machineries, particularly the heavy duty equipment that use to make site clearance, excavation, and grading, etc., could produce the gas as a result of combustion in the machine that will be discharged into the ambient air. Although the impacts would be temporary, the proper and effective mitigation measures would be taken in order to minimize the impact to people, environment, and workers within the facility.

8.2.1.1 Particulate matter (PM)

The particulate matter (PM) mainly coming from the fine particle in the ground that blown by the wind. Especially, the broken soil in the ground from the project site from the site clearance, where the vegetation cover already removed, is susceptible to the particulate matter. When the wind blows, the fine material shall be carried by the wind and transport according to the wind direction.

Figure. 8.3 Source of Particulate Matter (PM)

The method to minimize the impact dust or particulate matter would be described as followed:

- Soil compaction by using the water or cover the site with gravel material to cover the fine soil particle
- Re-suspension of the fine particulate matter by regularly spraying the water to site that has no coverage and has already detected often produce dust
- Apply nose coverage (PPE) when inside the project area
- Construct the barrier or fence of the construction site

8.2.1.2 Gases from Combustion

Gases such as CO2, NO2, SO2, are coming from the internal combustion using the fossil fuel by automobile or heavy duty equipment that use to help construction activity. This gases is normally very small, however, require monitoring the gas emission to ensure that the level is below the minimum requires

In order to minimize impact of the project activity to the degradation of ambient air quality during the construction of the project, the following mitigation measures could be taken.

- Application of PPE (Nose protection) to minimize the exposure of worker inside the project area to the emission of the gases
- Utilization of fuel efficient heavy duty equipment that produce less flue gases

8.2.2 Marine water quality due to Storm runoff

The total area of 1.3 HA land that will be converted from original land use, which is the open space and vegetative land. The clearances of the vegetation inside this facility, the storm runoff produce during the rainy day would be reasonable, particularly, the sedimentation rate would be high.

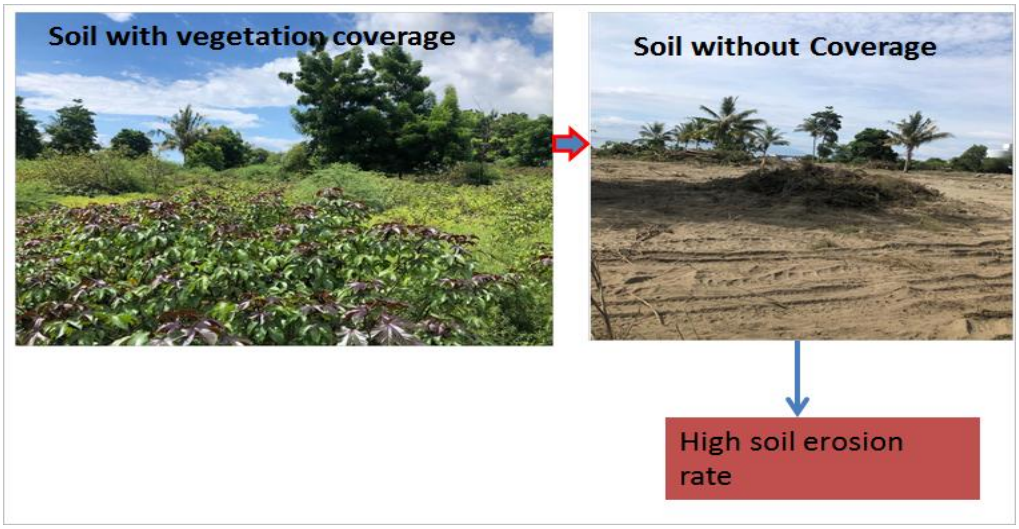

Figure. 8.4 Removal of Vegetation Coverage will Cause Soil Erosion

The eroded material will be carried by the rain storm and eventually contribute the sediment to the marine water body. The estimation of the flood hydrograph using the HEC-HMS suggested that the maximum flow of runoff generated by the proposed development facility could around 4 cms, which will be entering the marine water body.

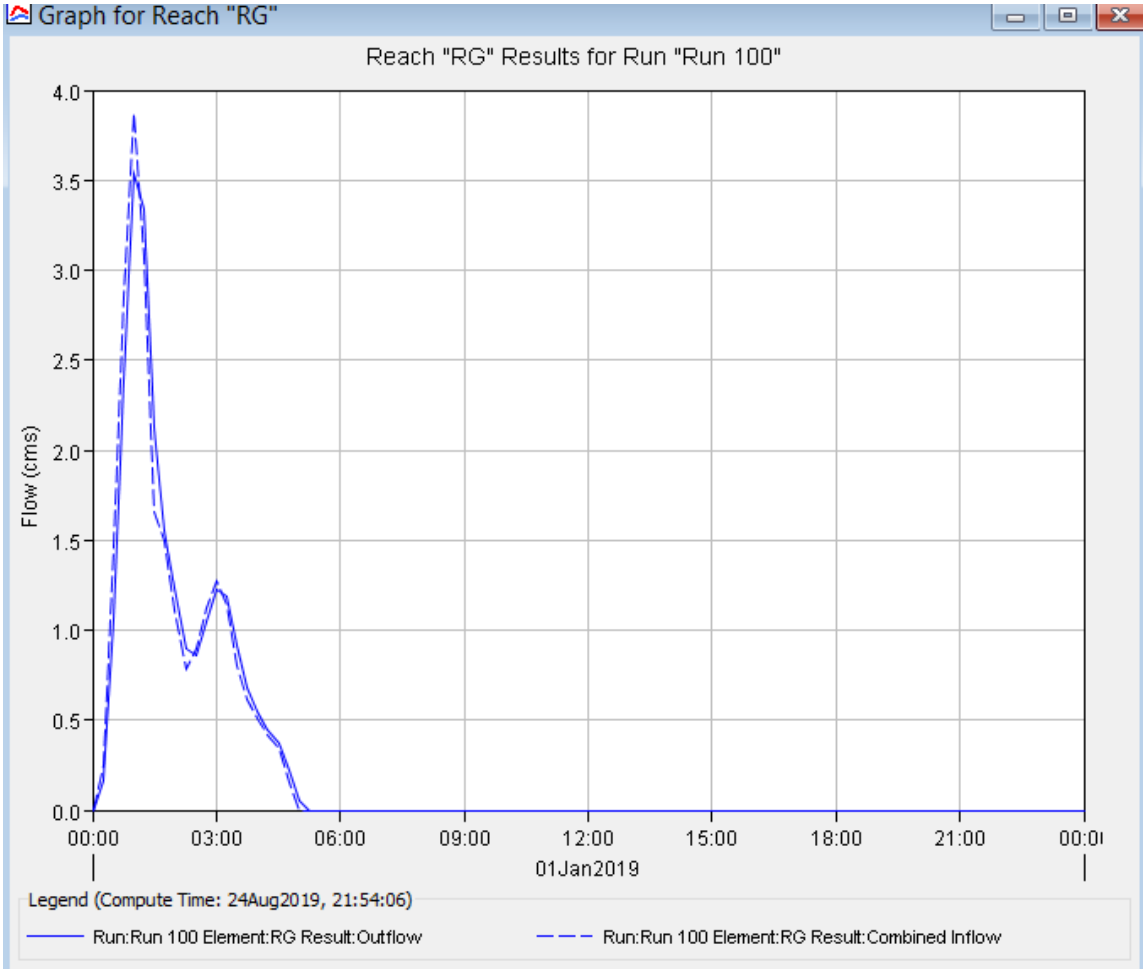

Figure. 8.5 Flood Hydrograph Generated by the unit Land area of proposed development Facility

With the high sedimentation due to soil erosion from the project site that already has no coverage as the vegetation has already removed. The rough estimation of total mass of sediment that could be generated for storm runoff of due 100 –years of rainfall could be estimated.

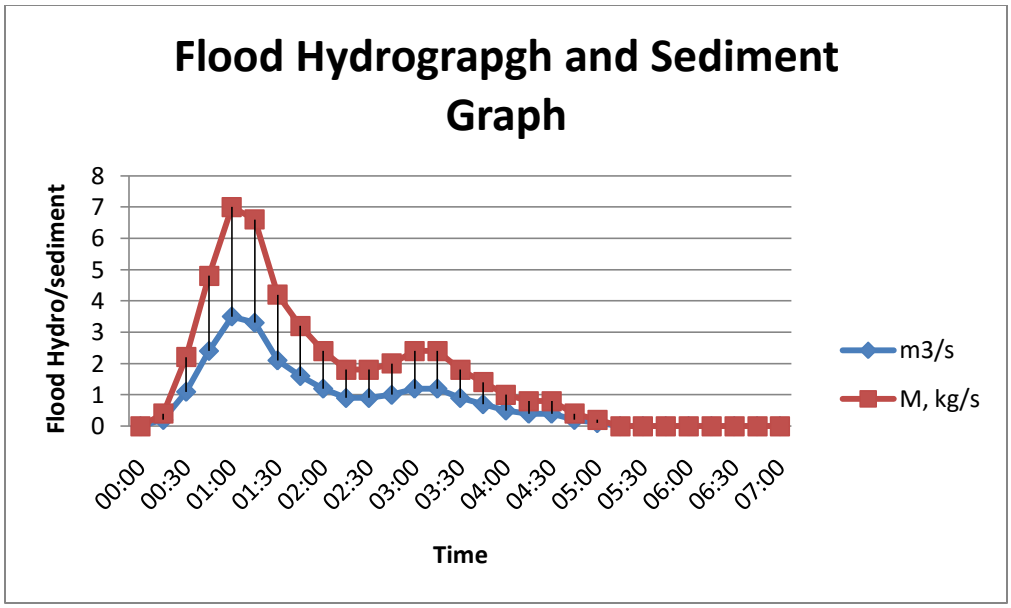

Figure. 8.6 Flood Hydrograph and Sediment Graph

The total mass produced by the 100 –years of rainfall designed could be around, 40 ton, which will be entering the marine water body and cause the marine water quality degradation. The turbidity of marine water will be affected and this further blocks the sun light penetration in the marine water body.

- Impact to the turbidity of marine water which will affect the photosynthesis in the marine aquatic
- Impact to the coral, as the sedimentation will settle on the young coral and eventually, the coral would go die
- Impact to the mangrove, as the sedimentation will cover up the mangrove, though it is small probability as mangrove community is around 6 KM toward eastside of the project

To reduce the impacts of this storm runoff, mitigation measured should be proposed in order to reduce the amount of sediment entering the marine water body. The following best practice should be implemented in order to reduce the sediment load during the rainy season:

- Creation of temporary detention basins to catch the runoff from the project site and let the sediment settle in the detention basins
- Application of sand filter to filter the storm runoff during the rainy day

The following proposed detention pond could be constructed and shall help reducing the sediment load to the marine waterbody during the rainy season.

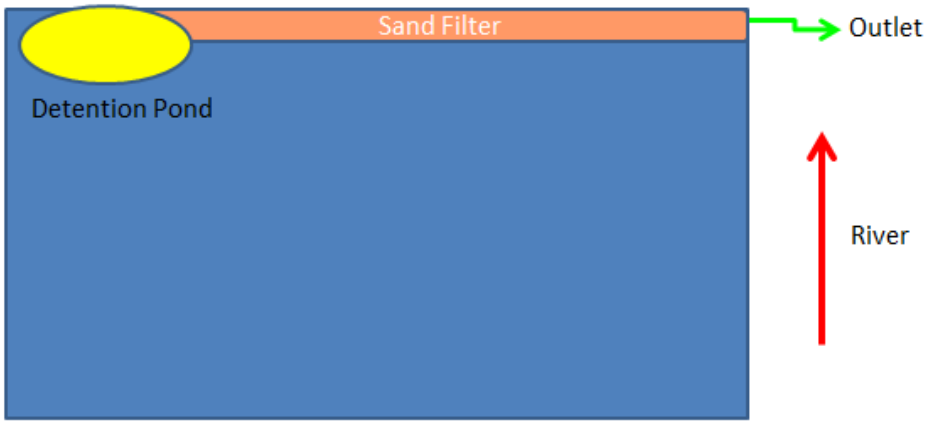

Figure. 8.7 Site Layout of Detention Pond

The size of detention pond should be reasonable to catch most of the storm water generated by the maximum 5 – year flow of ARI.

8.2.3 Irreversible loss of Vegetation

The loss of vegetation inside the project is irreversible or permanent, as the area will be fully converted into the fuel storage facility that will operate for many years. While the vegetation is mainly bushes and few coconut trees, which cleared from the project sites, the impacts of vegetation loss are the storm runoff that will contribute the sediment to the marine water body.

Figure. 8.8 Irreversible Vegetation loss before and after the Project Site Clearance

The impact of the vegetation loss is temporary sedimentation due to soil erosion that affects the marine water quality. The mitigation measures for these impacts would be the temporary detention basins and site grading before the rainy season so that the compaction would take place, which should minimize the soil erosion from the project site. On the other hand, the existing land has permanently converted into the impervious surface land, which has no vegetation. The mitigation of issue will to be constructing the buffer zone in the perimeter of the project and plant trees to keep balance of ecosystem during the operation of fuel storage with addition function of absorption of gas by the tree.

8.2.4 Occupational Health and Safety

The occupational health and safety concern related to the construction or civil works must become a top priority and first concern in to execute the construction work successfully by protecting the worker from the unnecessary risk. The supervisor and workers must be obligated to implement the reasonable precautions to protect the health and safety of workers. Global Oil Storage Terminal LDA, is highly committed to hire a professional contractor that has a technical capability in executing the contraction activity, which include managing the occupational health and safety issue of their employees, extending the application of the hazard management activities through formal procurement agreements

The impacts of occupational health and safety for following items of work during the construction of the fuel terminal facility in Lauhata would need to assed and mitigated.

1. Site preparation and grading, involve in material mobilization and operator
2. Construction of bridge
3. Construction of fence
4. Foundation work
5. Construction of fuel storage
6. Piping installation
7. Construction of fuel filling area
8. Construction of office building
9. Electrical installation
10. Water system and fire water tank installation

The execution of each of the above work associate with the health and safety risks that need to be identified and mitigated. Preventive and protected measures are the general principles that should be introduced into the workflow of the project execution in order to better manage the risk associate with the hazard and safety. The major impact of OHS during the construction stage are assumed below and mitigated:

8.2.4.1 Risk of Physical Work

Injuries or illness that caused by over-working the human physical that more than the maximum capacity to handle. The mitigation by means of prevention and controlling OSH risk can be achieved by the following actions:

- Training of workers in lifting and materials handling techniques throughout the construction activities of the projects, including the placement of weight limits above which mechanical assists or two-person lifts are necessary
- Planning work site layout to minimize the need for manual transfer of heavy loads
- Selecting tools and designing work stations that reduce force requirements and holding times, and which promote improved postures, including, where applicable, user adjustable work stations
- Implementing administrative controls into work processes, such as job rotations and rest or stretch breaks

8.2.4.2 Risk of Slips and fall

Slips and fall in the construction area could possible happen, especially disorganizing ground surface with material construction, debris, liquid spill, and no good housekeeping. To minimize the probability of slips and fall, it is recommended the implement the following actions:

- Implement the good housekeeping practice such as sorting and placing loose contractor material or debris in the designated area that is way from the pathway
- Cleaning the waste debris and liquid spill that could cause the slips and fall
- Locating the electrical cord and ropes on the ground and mark properly
- Use slip retardant footwear

8.2.4.3 Risk of Work in Height

The construction and installation of the fuel storage tanks, especially with the total height up 20 m (according to preliminary design information), could potentially involve working condition as higher ground. To minimize the risk of fall from the height during the construction and installation of fuel storage tank, fall protection plan should be in placed to minimize the risk, which includes:

- Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 95 kg, then working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface
- Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards able to support 230 kg (also described in this section in Working at Heights above), as well as fall rescue procedures to deal with workers whose fall has been successfully arrested. The tie in point of the fall arresting system should also be able to support 230 kg
- Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces

8.2.4.4 Stuck by Object

Construction activity may cause significant hazard related to potential falls of material, tools, as well as other solid material from abrasive or other type of powders tools which can result in injury to the head, eyes or other part of the body. The following measures should be taken in minimizing the hazards risk to of being stuck by object to the employees:

- Using a designated and restricted waste drop or discharge zones, and/or a chute for safe movement of wastes from upper to lower levels
- Conducting sawing, cutting, grinding, sanding, chipping or chiseling with proper guards and anchoring as applicable
- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap
- Use of temporary fall protection measures in scaffolds and out edges of elevated work surfaces, such as hand rails and toe boards to prevent materials from being dislodged
- Evacuating work areas during blasting operations, and using blast mats or other means of deflection to minimize fly rock or ejection of demolition debris if work is conducted in proximity to people or structures
- Wearing appropriate PPE, such as safety glasses with side shields, face shields, hard hats, and safety shoes

8.2.4.5 Moving Machinery

The construction activities has described earlier involve moving machineries such as vehicles, heavy duty equipment, could produce temporary hazard that cause physical contact, spill, dust, emission and noise, which impact to the workers who are inside the construction camp. Techniques to control or minimize the hazard would include:

- Planning and segregating the location of vehicle traffic, machine operation, and walking areas, and controlling vehicle traffic through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic
- Ensuring the visibility of personnel through their use of high visibility vests when working in or walking through heavy equipment operating areas, and training of workers to verify eye contact with equipment operators before approaching the operating vehicle
- Ensuring moving equipment is outfitted with audible back-up alarms
- Using inspected and well-maintained lifting devices that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

8.2.4.6 Dust

Dust impact, as described in the air quality impact assessment, would occur and the level of dust would normally be elevated as the construction activity. The workers and supervisors inside the construction area should take precaution measures to minimize the impact of dust through the suppression of dust and utilization of PPE work workers to minimize the exposure of dust.

8.2.4.7 Noise and Vibration

Construction activity of fuel storage system would use various heavy study equipment that will produce noise and vibration that could affect the people or workers inside the project area. Utilization of PPE would help reduce the impact. Other option that considers effective is not operate all the heavy duty

equipment at the same time or schedule the construction activates such that the cumulative level of noise and vibration would be still in the tolerable level.

8.2.4.8 Confine Space and excavation

Construction of the fuel storage, such as deep foundation working area or storage tank installation, which should has limited access as workers who entering this area could be subject to risk and hazard. The risk of confined space can be minimized by the action as followed:

- Controlling site specific factor which may contribute to excavation slope instability, including deep foundation work, sidewall support, slope gradient adjustment that should eliminate or minimize the risk of collapse, entrapment, or drowning
- Providing safe means of access and degrees from excavation
- Block the area of storage installation and access permit to the authorize workers only

8.2.4.9 Electrical Charge Risk

Power installation is part of the construction activity, which could be potentially because the incident or risk associates with the electrical power or charge. The risk should be minimized and worker who involve in this type of job should already has proper training and execution plan of the project.

8.2.5 Community Health and Safety

Community health and safety issue related the construction of the project is related to the following impacts:

- Air quality issue
- Noise and Vibration
- Traffic safety
- Social issue such as land title, which need to be resolved by the project owner

The solution of the above risk and impact to the community would be discussed as followed:

In respect to the air quality, PM would likely to be elevated but the project owner or contractor on behalf of project owner should minimize the PM level from the construction area by spraying regularly with water (resuspension of fine particulate matter). The project owner to monitor also the PM level, especially in community center, as one of the sensitive receptor that will be impacted by the elevated value pf PM level.

The noise and vibration level produce within the construction site can be significant, especially more than 4 heavy duty equipment are operated at the same time. It was observed that the simultaneous

operation of only one or two equipment would not produce noise and vibration that affect the community. Therefore, the noise and vibration should be controlled by proper work schedule of equipment and timing of the construction activity.

Social issue such as land title still an issue related to the community health and safety, as several communities members have involved in disputing the land title. The project owner is currently working together with the government and other relevant third party to solve the land title issue to the project.

8.2.6 Traffic disturbance

The construction activity involves the mobilization of material and people from other location to the project area, which affect the traffic. However, the given the existing traffic volume, which is around 2000 vehicles per day, proper arrangement and direct the traffic could be done to minimize the impacts.

Impacts that may arise:

- Traffic delay and potential traffic accident

These impacts should be managed onsite by the following mitigation measures:

- The project owner to assign person to direct the traffic or vehicle come in and out of the project area
- All the driver should already have experience and proper license
- Provide information to the public regarding the construction activity

8.2.7 Noise and Vibration

Noise and vibration related to the project activity could provide an impact to the surrounding area and people. During the construction of the proposed project, heavy duty equipment shall be operated as part of the project activities that will produce the noise and vibration. The measurement of the background noise and vibration suggested that prior to the commencement of the project, the noise and vibration background are summarized as followed:

Table. 8.3Summary of Noise Measurement

Noise Level Observation for Compressor	
Noise Level, DB	Distance from Compressor , m
92.6	0
72.2	10
64.9	20
61	30
58.440	40

The impact of noise to the existing environment and people is related to the hearing or health safety issue. According to the WHO, exposure to the noise below 80 dB for the long-term should not affect any hearing or health issue, with the bench mark provided as followed:

- Repeated long-term exposure to sound above 80 dB can lead to permanent damage. Consider using the hearing protection or move to quieter area
- 80 dB: around 5 hours and 30 minutes a day at this level can cause temporary hearing loss. The weekly limits is 40 hours
- 85 dB: Exposure around 1 hour and 45 minutes a day at this this level can cause temporary hearing loss. Weekly limit at this level is 12 hours and 30 minutes
- 90 dB: Around 30 minutes a day at this level can cause temporary hearing loss. The weekly limits is 4 hours
- 95 dB: just 10 minutes a day at this level can cause temporary hearing loss. The limit of weekly exposure at this level is 1 hour and 15 minutes
- 100 dB: Even a few minutes a day at this level can cause temporary hearing loss. Weekly limits is 20 minutes

The noise would decline from farer distance away from the origin source, where the noise generates. As part of the environmental investigation, the noise levels versus the distance were observed for the compressor. The result is presented in the following table.

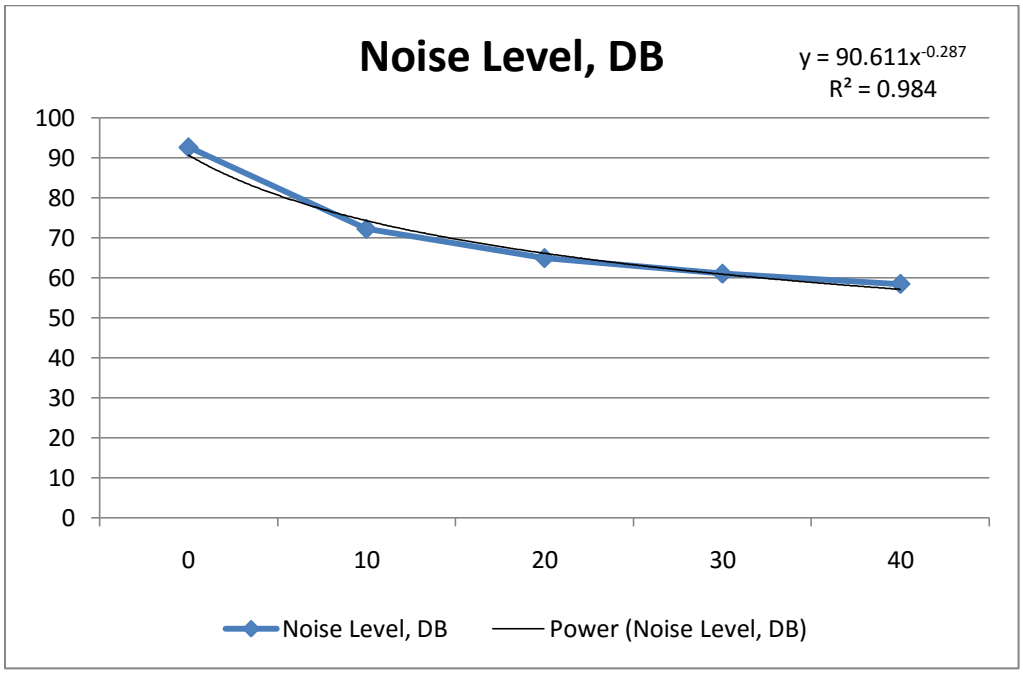

Figure. 8.9 Noise Level Measurement with Distance Variation

The vibration was measure but no major activity that significantly produce the vibration that become a concern. However, during the construction, especially foundation work, it will be possible to produce some vibration level that could impact to the existing structure surrounding.

The mitigation measured during the construction, would be:

- Construct the noise barrier to delay the propagation of noise so when teach the target people, outside the project area, the noise level become small
- Arranged the schedule of working only during the day time
- Application of heavy duty equipment that produce less noise (latest version of equipment)
- Ear protection for the worker (PPE) with the project area that exposure to the noise level greater than 80 dB

8.3 Impacts and Mitigation Measures during Operation of Phase 1 A

While potential impacts during the Pre-Construction and Construction Phases are all considered minor impacts, those that are generated during the Operation and Management phase consists of major and minor impacts. Major impacts should be identified during project planning, therefore avoidance or mitigation of the impacts have already been integrated into the design and construction of the facility. As previously noted, major impacts are impacts related to activities from fuel transporting from tanker into the storage tanks, storing within the tanks and dispensing to tanker trucks. There are also potential for major impacts associated with maintenance of the storage tanks which are usually done every few years.

The following table shows the summary of potential impacts and proposed mitigation measures during the operation of the phase 1 A of the project.

Table 8.4 Summary of Impacts and Mitigation measured during the Operation of Phase 1 A

Impact Assessed and Mitigation Measure during Operation of Phase 1 A			
Impacts	Area of Coverage	Particular concern	Mitigation Measure
Flooding	Project area	storm water washed the oil polluted surface and contribute pollution to marine water body	• Application of oil-water separator • Frequent washing the ground where the oil spill prior to the heavy rain • Isolated a major spill and cleaned up quickly prior to the heavy rain
	Riverine flooding	Flood magnitude at higher frequency of 50 –year could overflow from river and cause damaged in the project site - emergency situation	• Retaining wall • Construction of main drainage canal to reroute the overflow of flood water • Construction elevated floor level • Emergency flooding insurance for higher frequency of 50 -years • Flooding warning system and emergency preparedness • Flood emergency response • Monitoring the rainfall
	Coastal Flooding	During the high tide, could potentially wipe out the facility - emergency condition	• Coastal wall protection • Elevated floor level of project rea • Emergency response planning and recovery system • Monitoring the tidal level
Major oil spill	In the project area	Polluted the marine water body and economic loses	• Oil boomer • Oil slimmer • Applied absorbent to catch the oil • In-situ burning of the oil layer in the marine water body • Prepare emergency oil response planning and team

			• Coordinate with the national and international team to help in case of major large oil spill
	Marine waterbody	polluted the marine water body and transported to large extend of coastal area	• Coastal cleaning • Monitoring of marine water quality • Implement emergency response plan
		Impact to mangrove	• Mangrove re-planting • Compensation to the loss • Cleaning and removal of oil spill debris in the mangrove forest
		Impact to coral and fisheries	• Coral cleaning • Compensation to the economic loss • Coral rehabilitation (if possible)
		Impact to beach	• Provide public information to close the beach access due to pollution form the oil • Cleaning of the beach and other impacted area • Compensation of the economic loss, especially coastal community who rely on the income from the coastal resources
		Impact social at the coastal community	• Proper compensation • Proper community engagement plan
Fire Hazard	Storage tank	Prevention	• Major fire could be prevented by design and construction of the storage tank/yard according the best international specification and ANPM • Proper spacing the storage tanks • Using the water coolant to control the temperature • Proper detection of fuel leaking (automatic sensor) • Proper operation procedure of loading and

			unloading of fuel from the tank • Fire drill periodically to build fire awareness in the entire facility
		Response to fire emergency (already happens)	• Fire alarm system and evacuate people from the place fire to the assembly point to further moving away from the storage yard • Isolate the area that under the fire • Evaluate the scale of emergency and mobilize the resource to response the emergency (ties1, tier1, tier 3) • Mobilize the internal team of fire fighter to kill the fire (tier 1) • Communicate with external agency to mobilize any help require in responding the emergency • Evaluate the incident to know the cause of the fire for future improvement • Apply fire damaged compensation (insurance) • Restore the emergency condition
	Fuel filling area	Prevention	• Proper design and construction according to the best international standard (fire proof) • Proper procedure to be in place to regulate the operation so that the spill of fuel can be minimized • Installation of fire equipment system to kill immediately before the fire getting bigger • Proper control the operation system so that any failure could be detected (such as fuel spill)
		Response to fire emergency (already happens)	• Fire alarm system and evacuate people from the place fire to the assembly point to further moving away from the storage yard • Isolate the area that under the fire • Evaluate the scale of emergency and mobilize the resource to response the emergency (ties1, tier1, tier 3)

			• Mobilize the internal team of fire fighter to kill the fire (tier 1) • Communicate with external agency to mobilize any help require in responding the emergency • Evaluate the incident to know the cause of the fire for future improvement • Apply fire damaged compensation (insurance) • Restore the emergency condition
	Jetty	Prevention	• Ensure that the pipe (fuel pipes) is properly connected to the tanker and proper inspection by the certify person prior to pumping of the fuel from tanker in the jetty to the fuel storage system • Regular inspection to the piping system (prior to the loading and unloading in the jetty • Follow all the procedure of operation as recommended in best practice of industry • Installation of proper fire equipment system in the jetty • Special team need to be ready during the loading and unloading of the fuel tanker • No smoking must be allow during the unloading of fuel tanker in the jetty • Unloading during the good weather (to avoid unnecessary accident) to avoid fire incident
		Response to fire emergency (already happens)	• Fire alarm system and evacuate people from the place fire to the assembly point to further moving away from the storage yard • Isolate the area that under the fire • Evaluate the scale of emergency and mobilize the resource to response the emergency (ties1, tier1, tier 3) • Mobilize the internal team of fire fighter to kill the fire (tier 1) • Communicate with external agency to mobilize

			any help require in responding the emergency • Evaluate the incident to know the cause of the fire for future improvement • Apply fire damaged compensation (insurance) • Restore the emergency condition
	other project area (office building, buffer zone, outside the project area)	Prevention	• Cutting grass regularly within the buffer zone and within the certain distance from the project area • Fire drill regularly to all employees • Proper installation of fire equipment system • Management waste management system, especially the rubbish that easily be burn • Perimeter fencing should be fire proof so that no fire bushes from outside the project facility should affect the project
		Response to fire emergency (already happens)	
Soil pollution	within the project area	oil polluted to soil and transport downward to groundwater	• Monitoring periodically to detect as early as possible the pollutant transport from the soil to the soil column • Taking the soil sample within the project area once a year to measure the soil quality • Management the oil spill in the facility to prevent the transport of contaminant to the soil column • Waste periodically the ground surface that that contaminated by the minor oil spill • Follow the proper SOP in transferring the fuel to minimize the risk of spills
Groundwater	Quantity	Over pumping	• Monitoring the water utilization rate within the facility to optimize the water utilization • Monitor the groundwater pumping (drawdown level in the aquifer) • Enhance tree-planting in the upland catchments to achieve more recharge rate of rainfall to

			groundwater • Help population by providing water supply if their shall well get dry
	Quality - pollution	Pollution due to over pumping (salt water intrusion and groundwater contamination)	• Sampling measurement of the groundwater to detect the trend of water quality change • Minimize the spill in the ground surface • Response quickly to the spill so that the risk of contaminant transport downward will be reduced • Inform the government that groundwater is contaminated and stop utilization of groundwater • Pumping out the contaminate water and treated it polluted water • Measure also the well in surrounding project area if the polluted well is localized or entire aquifer
Waste production	General solid waste	Production of general solid waste during the operation	• Collect properly the solid waste and apply 3R (recycle, reused. Reduced, and disposal) • Dispose the waste into Tibar control landfilled area • Mange the solid waste to achieve the minimum target to landfill
	Hazardous waste	From the bottom product of tank (0.05% of the total volume will deposit at bottom of the tank to be cleaned and treated)	• Have proper treatment system of hazardous material (see the method of treatment at the part of waste management) • Produce the concrete material from hazmat (liquid hazmat is mixed within the concrete cement and produce concrete block
	Liquid hazardous waste	• Oil residue • Oil from the oil- water separator	• Apply special treatment method onsite or out scorching the external company to treat the B_3 waste • Treated the oil residue and recycle into the reusable fuel (third party should be contracted to do it • Deliver the oil residue to the third party that already has proper oil residue treatment in place

			• Deliver the oil residue to Tibar (government provided the holding tank) • Proper collection of the waste to be handled by the third party
Traffic management		Vehicle coming in and out of the proposed development facility	• Proper traffic management system • Proper traffic sign • Designated person to watch the traffic and manage it • Proper parking arrangement
Climate change	Sea level rise	Coastal inundation	• Proper design and construction of the sea wall protection • Elevated floor level at the storage yard (based on tidal measurement and HAT data) • Adjust the groundwater treatment, as the water will be getting salty
	Flooding	More frequent rain with high frequency	• River improvement • Retaining wall • Proper drainage system
	Drought	Prolong dry season	• Water storage • Minimize the water utilization • Sea water treatment (optional) • Provide water to the community
Occupational Health and Safety	Proper Design and Operation	• Integrity of workplace structure • Severe weather and facility shutdown • Woks space and Exit • Fire Precaution • Lavatory and Shower • Portable water supply • Clean eating area • Lighting • Safe access • First Aid	Detail to be provided in the annex 13

		• Air supply • Work Environment Temperature	
	Communication and Training	• OHS training • Visitor orientation • New employee and contractor training • Area Signage • Communicate Hazard code • Labeling Equipment	Detail provided in the annex 13
	Physical Hazard	• Rotating and Moving Equipment • Noise • Vibration • Electrical • Eye hazard • Welding/Hot work • Industrial Vehicle Driving • Working Environment Temperature • Working at height • Illumination	Detail provided in the annex 13
	Chemical Hazard	• Air quality • Fire and explosion • Corrosive, oxidation, and reactive chemical • Volatile Organic compound	Detail provided in the annex 13
	Other Special Hazard		Detail provided in the annex 13
	Peroneal Protective Equipment (PPE)	Protection equipment to protect various part of the body to prevent the hazard (eyes, nose, ear, skin, hat, body, foot, etc.)	Detail provided in the annex 13

Community health and safety	• Groundwater accessibility • Traffic accident • Large fire hazard	• Water conservation and monitoring system • Traffic management system • Fire hazard management and socialization to the community members in Lauhata, as well as evacuation route	Actions to be taken to minimize this impact of the project to the community health and safety is provided in annex 13

Further detail on each impact and mitigation measures are presented as followed:

8.3.1 Flooding Impacts

The project is located near the river bank, which is subject to the flood risk due to high frequency of rainfall. The flood water could potentially cause the damaged of the fuel storage and further generate an environmental disaster, such as major marine water pollution from the oil spill that originated from the fuel storage. The flooding impact could still be an issue, even without the presence of the project in the proposed development area. However, with the project, further derivative impacts, such as damaged to fuel storage facility from the flooding could be an issue related to the marine pollution. Therefore, it is important to assess the flooding risk and method to minimize the flooding risk to the proposed development project.

8.3.1.1 Method of Flooding Impact Assessment

The flooding is the result of high frequency of rainfall occurs from the entire catchment system. Hydrological modeling approach was used to understand the flood magnitude and associate impacts related to the presence of the project, which occupied the land at the river bank by the mouth of the river. Appendix 1, provide the detail description on how the hydrologic and hydraulic modeling were carried to assess the magnitude of the flood flow due to various rainfall design (i.e. 100 – years) and the asses the capacity of the existing river to carry the flood water. In this section the summary of approach is summarized as followed:

- Catchment estimation by using the Digital Elevation Model (DEM) to determine the catchment properties and using the GIS software
- Information of the design frequency of rainfall (5 – 100 years ARI) and develop the time series of data
- Setup the HEC-HMS modeling for the flood hydrograph estimation from the rainfall design and catchment properties

Figure 8.10 Storage Facilities and River Bed

The report provides the flood hydrograph generated by the upland catchment in responding to various rainfall frequencies from 2 –year to 100 –year recurrence intervals. The following table shows the summary of peak flow generated by various rainfall frequencies.

Table 8.5 Summary of Peak flow of Flood Water

Peak flow of various Design Storm	
Design Storm, year	Peak flow, cms
2	34.3
5	49.9
10	66.4
25	97.9
50	127.2
100	159.3

The example of the flood hydrograph estimated by HEC-HMS modeling, software for the 100 –year's rainfall design, is presented in the following figure.

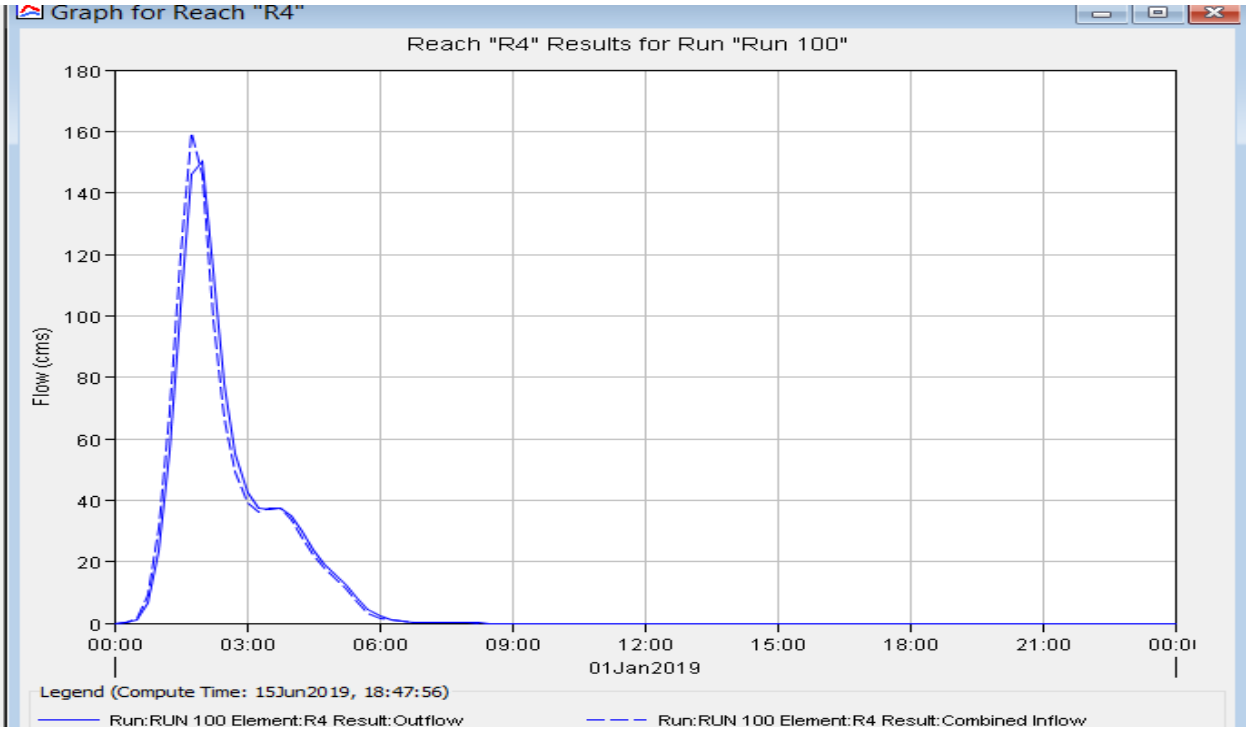

Figure. 8. 11 Peak flow Hydrograph of 50 –year flood

The flooding could potentially occur, as the fuel storage locates at the much lower elevation than the upstream of the river. Moreover, the bridge that connect the national road of Dili – Liquica, could be an obstruction of the river flow (bottle neck) so the overflow of the river could potentially occur in this point. In order to understand the impact of the flood, then the assessment of the existing river capacity, need to be done. By comparing the magnitude of the flood and capacity, it is possible to know the overflow of flood water from the river. The overflow of flood water will enter the project area and cause properties damaged in the fuel storage facility. The hydraulic modeling using the EPA-SWWM modeling software was conducted to evaluate the capacity of the river and the flood flow generated by each rainstorm design.

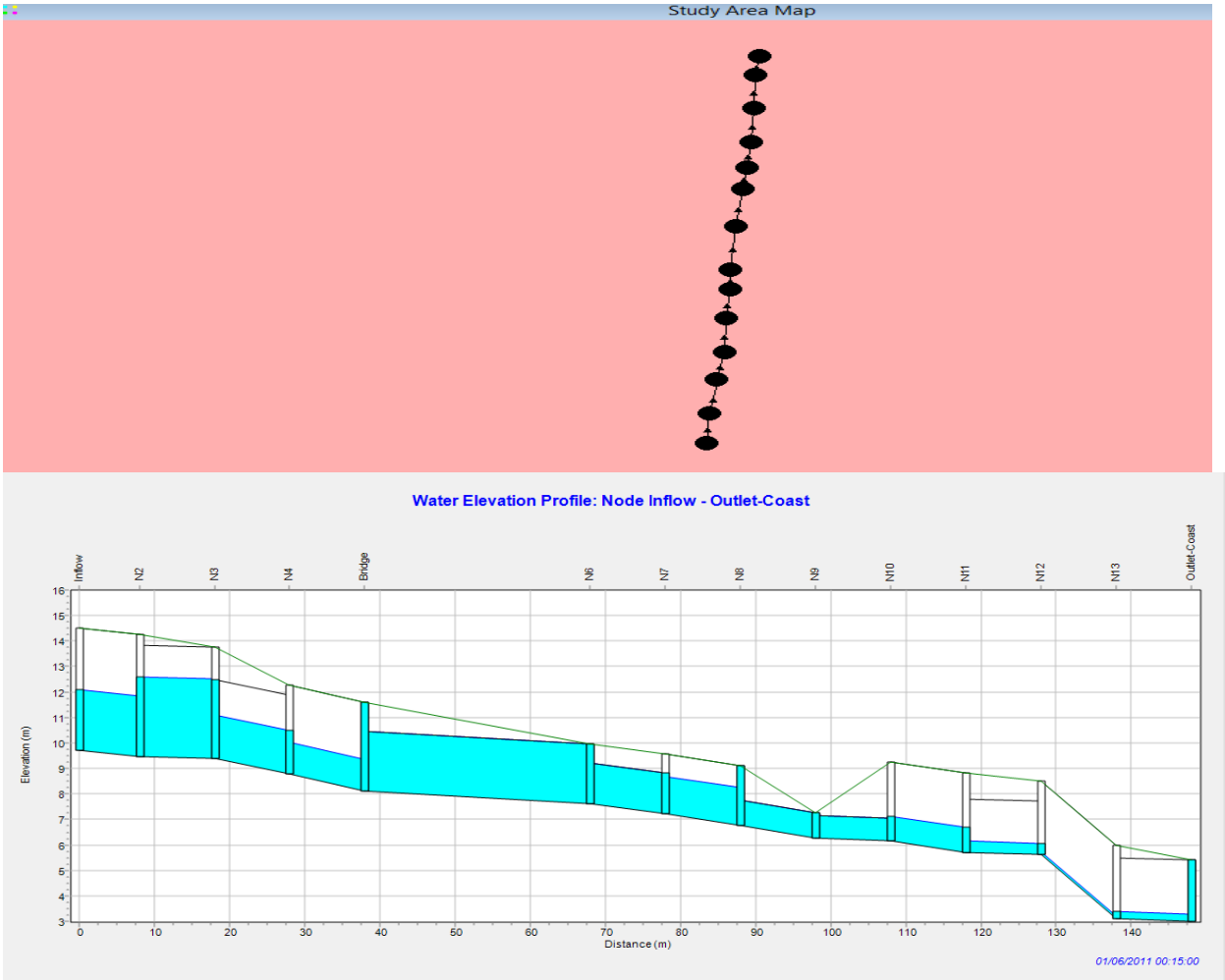

Figure. 8.12 Hydraulic Modeling Setting to Evaluate the Existing River Capacity

The hydrologic and hydraulic modeling result suggested that the existing river has sufficient capacity to carry the flood water up to 25 –year of rainfall frequency. Above this rainfall frequency, there will be overflow, especially at the bridge, that becomes the bottle neck of higher frequency of river flow. The flooding impacts only become an issue, the ARI 25-year, the overflow shall occur at the existing bridge.

- Overflow of flood water at the existing bridge that connects the national road of Dili – Liquica.
- Crossing bridge as part of the proposed development project will impacted by the high frequency of rainfall
- Storm runoff quality (built-up and wash off pollutant)
- Higher frequency (50 –year and above) of rain could damage the property in the storage tanks and cause spill of oil
- Pollutant to the marine waterbody

The mitigated measures shall be taken in order to reduce or eliminate the flood risk to the proposed storage operation and maintenance.

8.3.1.2 Mitigation Measures of Flooding Impacts

The mitigation measures of flooding impacts, especially for the larger storm consist of two methods:

- Technical approach, which is basically the accommodate high flow of flood water by proper floor elevation, reroute the flood water (overflow) to the downstream river, higher frequency design of the crossing bridge (minimum 50 – yr.)
- Improvement of the river downstream section to make larger capacity than 50 year of ARI
- Re-direct the flood flow to the downstream of the river after overspill in the bridge
- Non-technical approach, would consist of, emergency and flood evacuation, cleaning the river (especially under the existing bridge), flood insurance to cover the emergency

8.3.1.3 Residual Impacts of High Frequency of Flooding

The residual flooding impacts would always be existed, as it is not possible to eliminate the risk, considering the business and commercial aspect of the propose development project. This means that the design and development will be up to the design frequency of the flood, which will be around 50 –years. This means that even greater than 50 – yr. shall produce residual impacts that should be managed by the non-technical solution.

Any event, greater than 50 –year frequency should be considered as force major (or emergency) and the emergency response by the emergency team should take the duty. In this emergency situation, the insurance should cover all the damaged caused by the major flooding.

- Flood hazard emergency response system
- Implement flood insurance program to compensate the flood risk cause by the very low probability but would be devastating

8.3.2 Major Oil spill Impacts Assessment in Marine Water

As presented earlier that the process workflow of fuel storage operation consist of fuel loading and unloading in the jetty, storing the fuels in the fuel storage tanks, and distribution of the fuel by loading to the truck tanks from the storage areas to various users end in Timor – Leste. The operation of this mentioned process could potentially case oil spill at several points, that allow the oil/fuel entering the receiving environment and cause the pollution. As presented earlier that the major receiving environment of this proposed development project would the marine coastal water. When the oil spill into marine water, the oil will spread horizontally in top of water and cover the larger area due to marine hydrodynamic (current, wind, and marine water properties), physical properties of oil, and mass transport phenomena. Although the probability of major oil spill during the loading and unloading of fuel to the storage system is significant low (less than 0.5%), if the spill occurs the impact of the spill could very large, to the environment, social, and economic loss would be huge. Therefore, it is important to carry out

the impact assessment, particularly understanding the general high level, where the pollutant would flow and affect the surrounding environment.

The hypothetical assumption was made to assess the location and scale of the major spill that may occur during the operation of proposed fuel terminal development. Other minor spill could also happen within the fuel storage yard but it is assumed that the internal system such as oil-water separator can capture the oil and treated properly prior to the acceptable effluent discharge into the drainage system.

- At the jetty (during unloading) with the extreme capacity spill at 5000 KL instantaneous spill
- Piping System (from jetty to fuel storage system) with spill due to failure in operation at the capacity spill of 702 KL
- Spill in the tank (from primary containment)

The spill in the tank will not be considered, as the tank farm will be consisting of storage tank as primary containment, secondary, and tertiary containments. Therefore, the it is assumed that all oil spills (in case tank failure) shall be containing inside the storage tank farm.

The modeling tool is utilized by this study to predict the movement of the spill from the origin of spill, in case no intervention or no technical mitigation measures such as oil boom or skimmers to stop the movement of the oil spill. So the oil spill will naturally move away from the point of spill origin to other places surrounding areas. The objective of the Oil spill modeling study is to assess the impacted area of an oil spill, that assumed hypothetically occur in jetty or some failure in the piping system that cause the major oil spill entering the marine water body. The outcome will be used to help assess the impacted area, particularly, environmental and socio-economic resources that potentially could be affected by the fate transport in case the spill shall occur. The modeling result will also use to map out the response plan to mitigate the impacts of the spill to the resources that have already identified. Modeling of Tumpahan Minyak (MoTum) was used by this study to analyze the movement of the fate as a result of marine hydrodynamic within the marine water body. Further information regarding the mathematical model, coverage area, modeling, setting and result of simulation in the North Coast of Liquica can be seen in the annex 2 of this report.

Figure. 8.13 Potential Oil Spill in two points of Project Site

In general the oil spill impact assessemnt should link directly to the oil spill response planning or the mitigation measures to minimize the risk or risk reduction.

8.3.2.1 Area Coverage Modeling

The simulation covers the most of the area of north coast Liquica that could potentially receive the impact of fate transport is there shall be any spill.

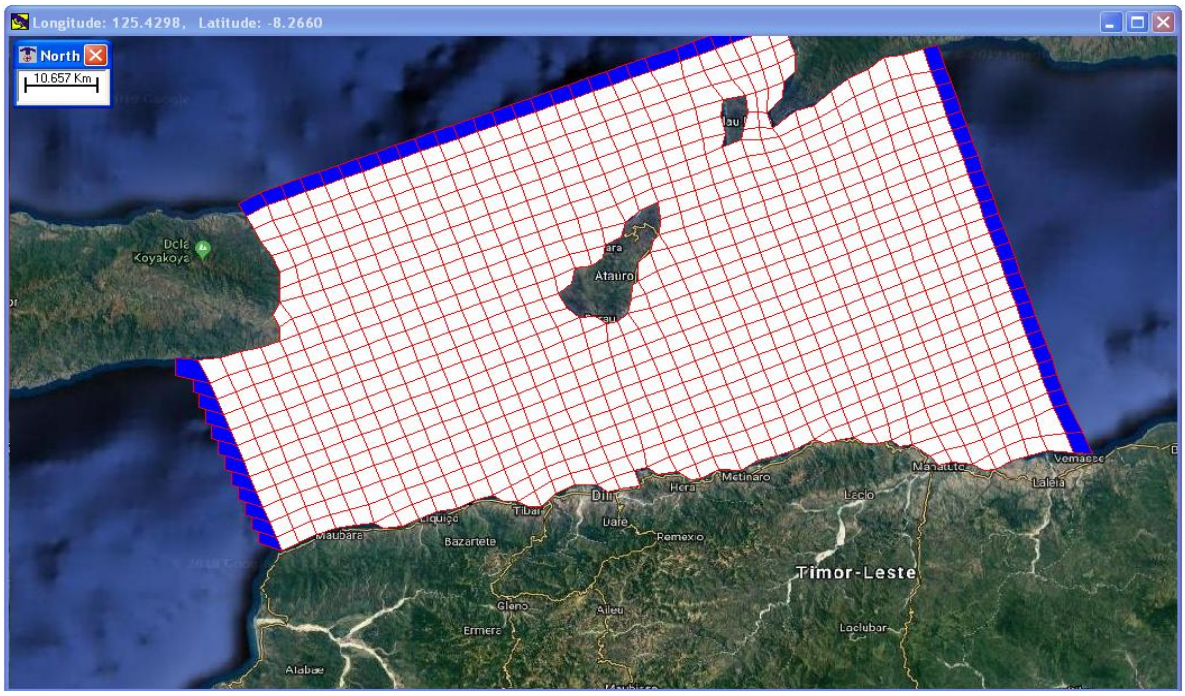

Figure. 8.14 Marine Hydrodynamic Modeling Setting

The model will calculate the worst case scenarios of oil spill in the jetty and in the pipe, during the unloading.

8.3.2.2 Modeling Setting /Approach

The mathematical model use lagrangian approach to simulate the advection and turbulent diffusion oil movement. The ocean current as main driven force are obtained from the 3D hydrodynamics model as described in the following. The multiple location time series of wind data in the computational domain are obtained from observation or from the results of simulation. The Oil Spill Model consists of four modules:

- Trajectory
- Fates/Weathering
- Stochastic
- Backtracking

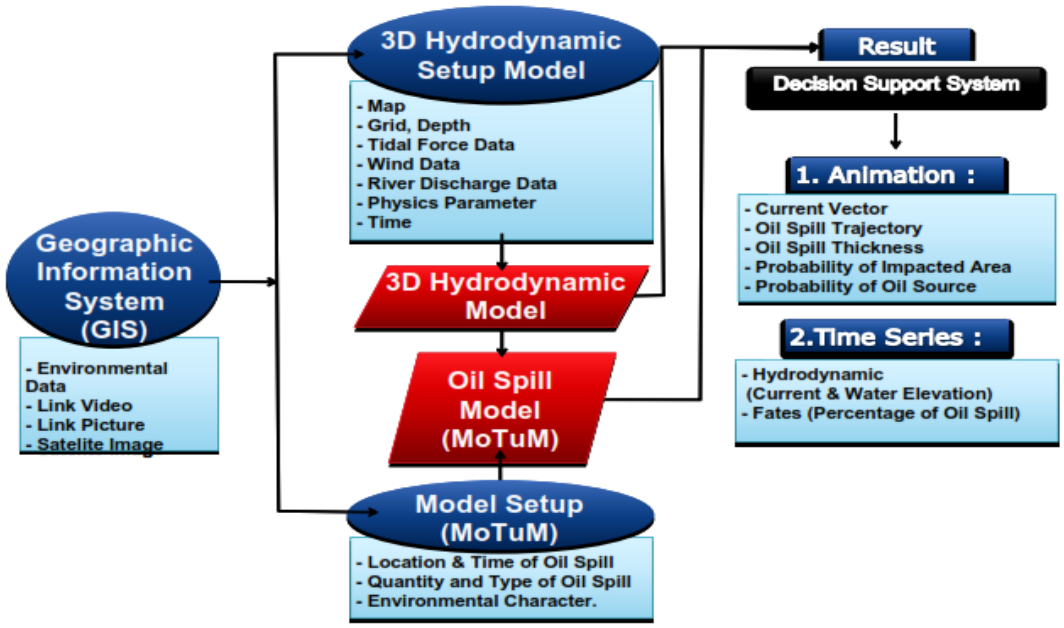

Figure. 8.15 Mathematical Modeling Setting

The detail of 3D hydrodynamic al modeling can be found in the appendix 2.

8.3.2.3 Scenario of Modeling

The modeling excise in this study was done based on various scenarios or assumptions that could happen in during the operation. These following scenarios are only hypothetical one, which may not occur. But if they do, then what is the size of the impacts, which should be intervening by the project owner to minimize the damaged.

Table 8.6 Scenario of Oil Spilling for Modeling

No	Scenario	Quantity (bbls)	Oil Type	Simulation Period (days)
1	Leakage from pipeline along 2 hours (Flowrate 100 Liter/s))	4.528	Gasoline	2
2	Worst Case Scenario – 5000 tons from Tanker at Jetty Reference: Tanker Capacity is 4500 – 5000 tons	42.000*	Gasoline	2
2	Leakage from pipeline along 2 hours (Flowrate 100 Liter/s))	4.528	Diesel	2
4	Worst Case Scenario – 5000 tons from Tanker at Jetty Reference: Tanker Capacity is 4500 – 5000 tons	42.000*	Diesel	2

*. 1 ton of gasoline is 8.4 barrels.

8.3.2.4 Result of Simulation

The result of the modeling shows the area of intervention of fate transport from the point of origin in spatial distribution. The modeling result for each scenario mentioned above is summarized in the following table.

a. The thickness of oil enter the Coastal Water and trapped along coastline exceed the minimum thickness threshold 0.1 mm. Therefore, the oil spill will impact the marine environment.
b. The spillage of Gasoline will be evaporated about 35 % and for Diesel is about 7 % will be evaporated after two days simulation.
c. The coverage of impacted area is 14 - 36 km length after two days simulation.
d. The travel time to hit the shoreline region for each season of simulation is presented in the following table:

Table 8.7: Summary of Shoreline exposure for Leakage of Gasoline from pipeline Case (Scenario 1)

Season	Shoreline with highest probability of impact (%)	Minimum time before shoreline exposure (hours)	Maximum volume on shore (bbl)	Width of Shore Area impacted by oil (km)
West Season	95	0.1	3000	20.1
West to East Season	75	0.1	800	1.4
East Season	95	0.1	250	0.7
East to West Season	95	0.1	1150	1.2

Table 8.8 Summary of Shoreline exposure for Worst Case of Gasoline (Scenario 2)

Season	Shoreline with highest probability of impact (%)	Minimum time before shoreline exposure (hours)	Maximum volume on shore (bbl)	Width of Shore Area impacted by oil (km)
West Season	95	0.1	28000	20.1
West to East Season	75	0.1	9000	1.4
East Season	95	0.1	2500	0.7
East to West Season	95	0.1	11500	1.2

Table 8.9. Summary of Shoreline exposure for Leakage of Diesel from pipeline Case (Scenario 3)

Season	Shoreline with highest probability of impact (%)	Minimum time before shoreline exposure (hours)	Maximum volume on shore (bbl)	Width of Shore Area impacted by oil (km)
West Season	95	0.1	4300	20.1
West to East Season	75	0.1	1150	1.4
East Season	95	0.1	400	0.7
East to West Season	95	0.1	1700	1.2

Table 8.10 Summary of Shoreline exposure for Worst Case of Diesel (Scenario 4)

Season	Shoreline with highest probability of impact (%)	Minimum time before shoreline exposure (hours)	Maximum volume on shore (bbl)	Width of Shore Area impacted by oil (km)
West Season	95	0.1	40000	20.1
West to East Season	75	0.1	12500	1.4
East Season	95	0.1	3400	0.7
East to West Season	95	0.1	16000	1.2

8.3.2.5 Impacted Area Assessment

The modeling result, under the two hypothetical conditions, as performed by the study suggested that most of north coast of Liquica up Dili could be impacted by the oil spill and fate transport. The most impacted, as can be seen in the following maps, are the north shoreline, from point of origin toward east side.

1. North Coast of Timor – Leste with the impact length of 10 – 40 KM
2. Deep ocean (just matter of time) will evaporate completely or move to the shoreline, as the density of oil is lower than the water
3. Coast of Island of Alor (Indonesian Island)

The density of the oil (gasoline and diesel) is less than the density of salt water; the oil will be either in the surface and evaporate or carried by the wave and end-up in the shoreline. The impacted area of shoreline, coverage 14 – 40 km length and 1 – 20 km width. With spatial impacted area, the quantification of the area of intervention could be done in order to maximize the utilization of resources to better response the impacts

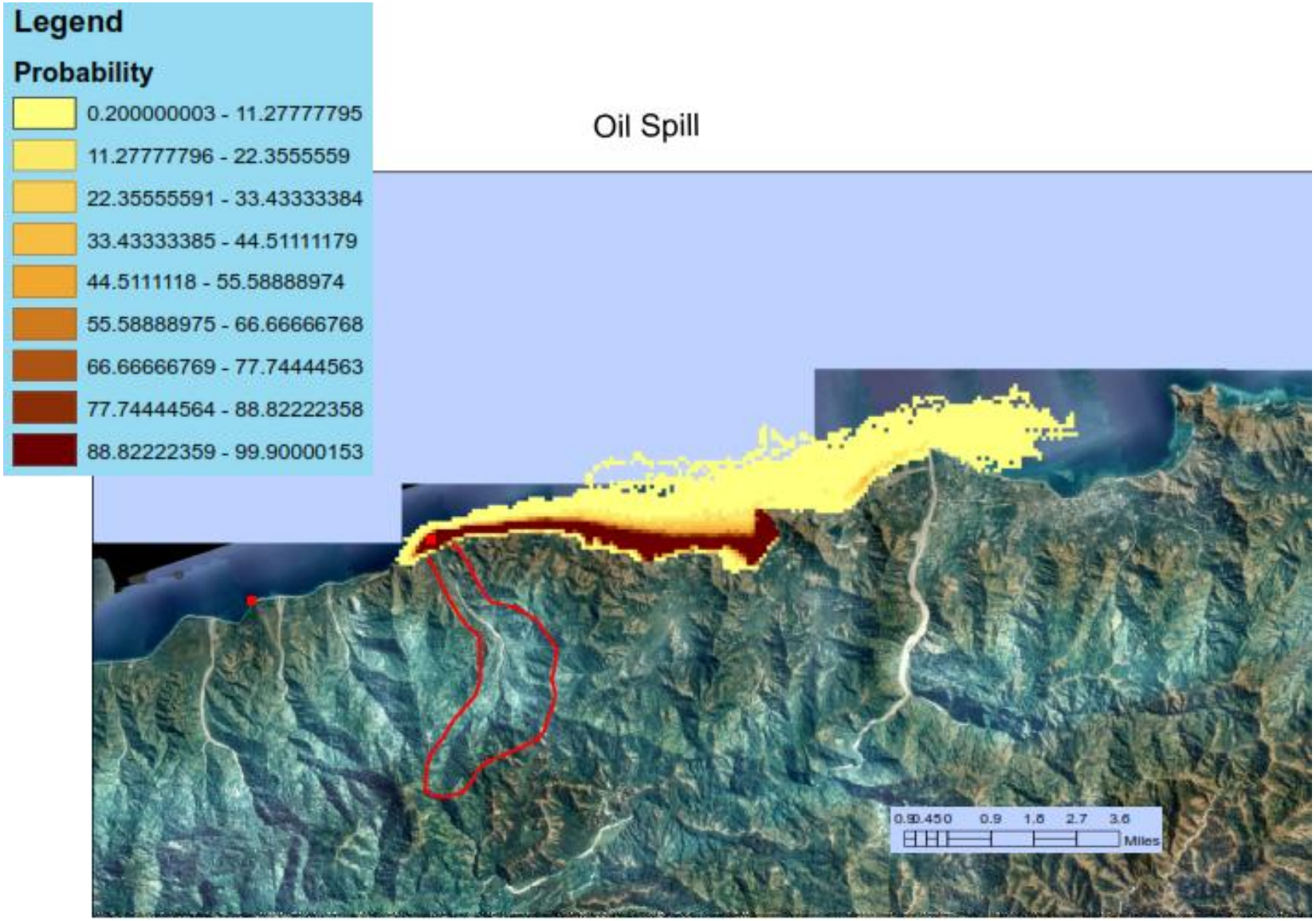

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Figure 8.16. Modeling Result of Oil Spill under worst case Scenario

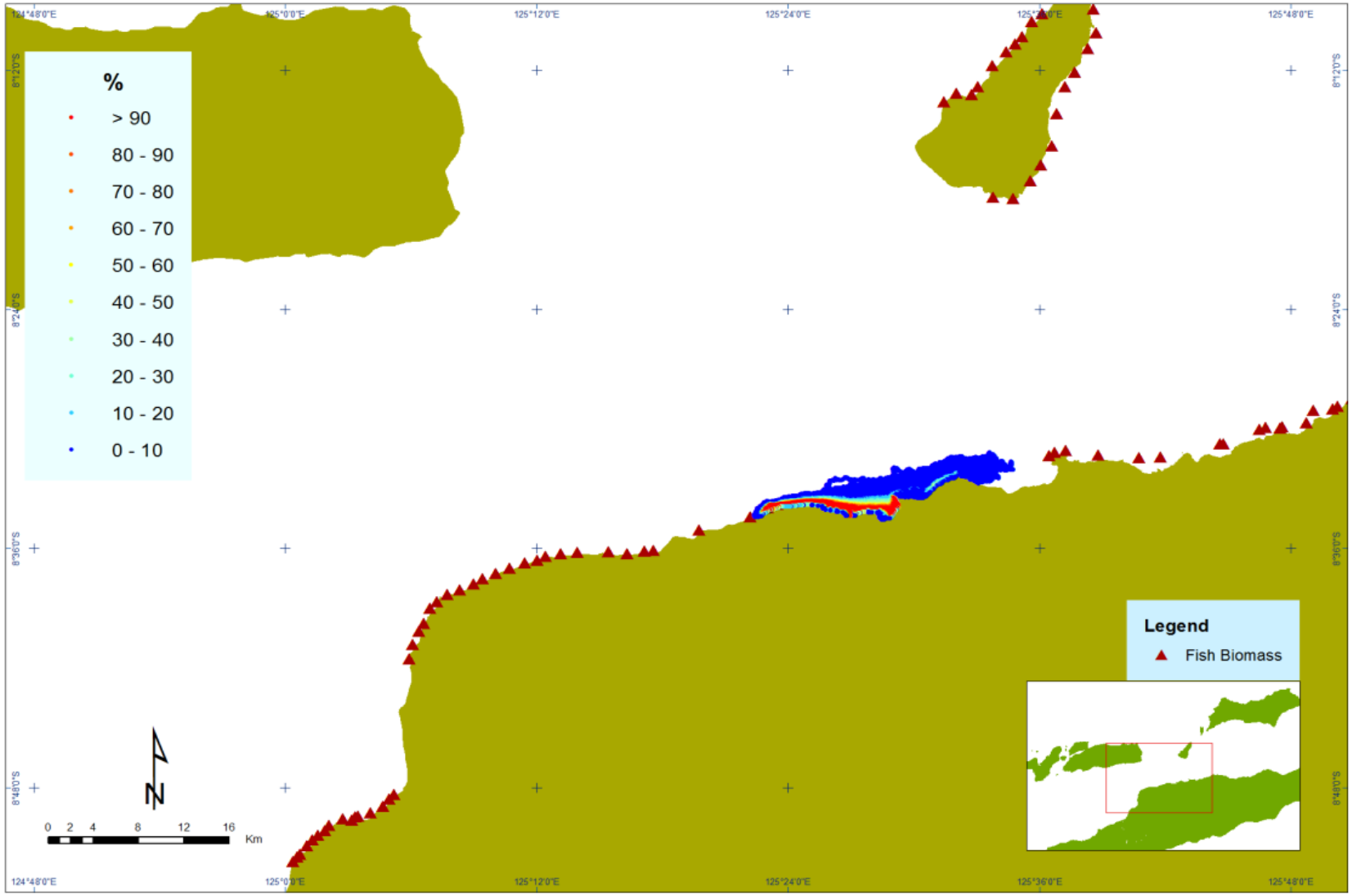


Figure 8.17. Oil Spill Impacted Area with Biomass Fish

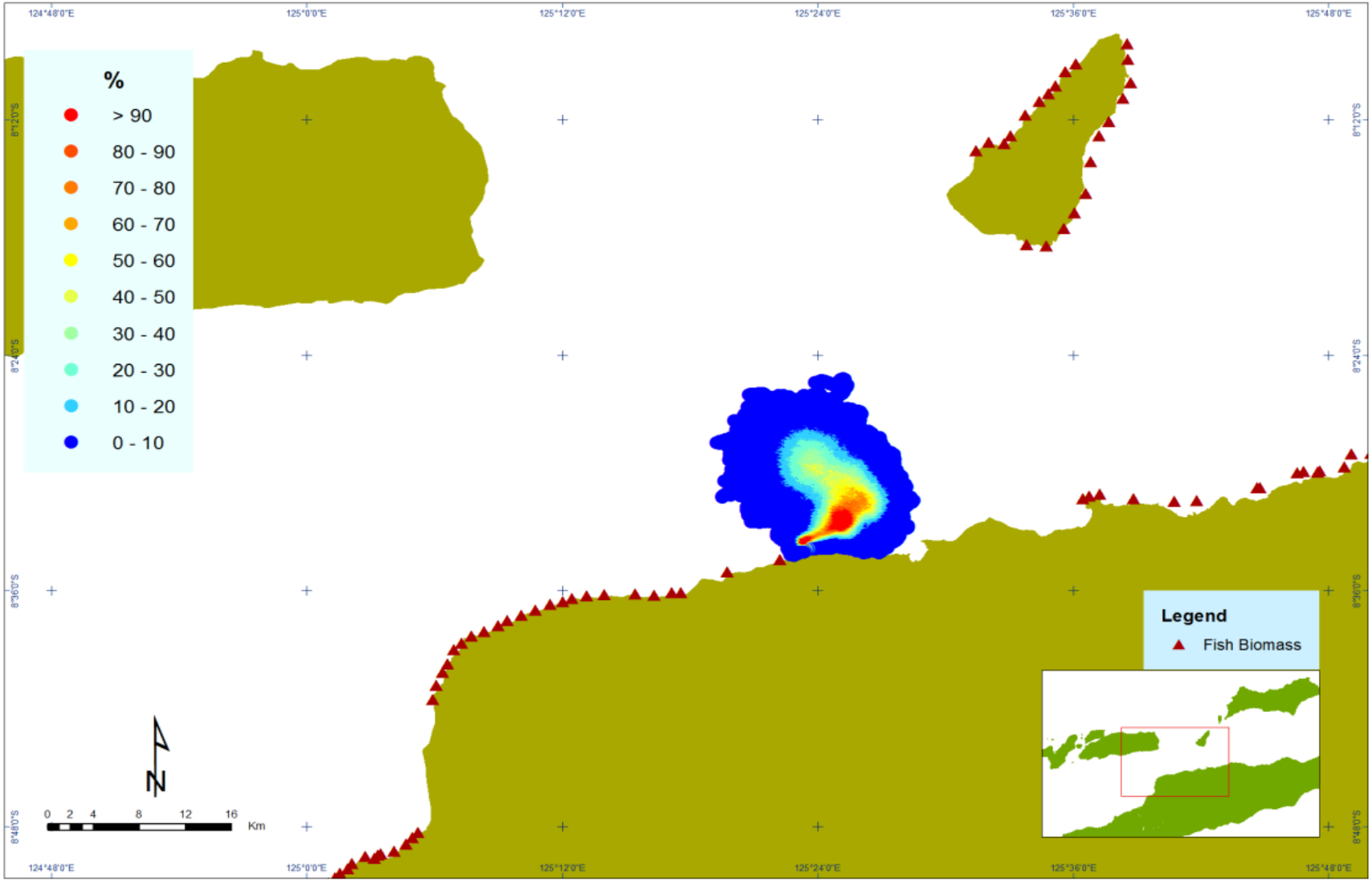


Figure 8.18. Impacted Area of Oil Spill

Further detail description of the oil spill modeling, including the hypothetical scenarios, as well as the modeling setting can be found in the appendix 2.

8.3.2.6 Identification of Impacted Marine Resources

Various marine resoruces, as presnted, in the baseline existing information, presented in the section 6.2.1 (marine ecology). The resources that identified and map, will be superimposed to the map of impacted area, to understand the impacts of the oil spill to the existing resources.

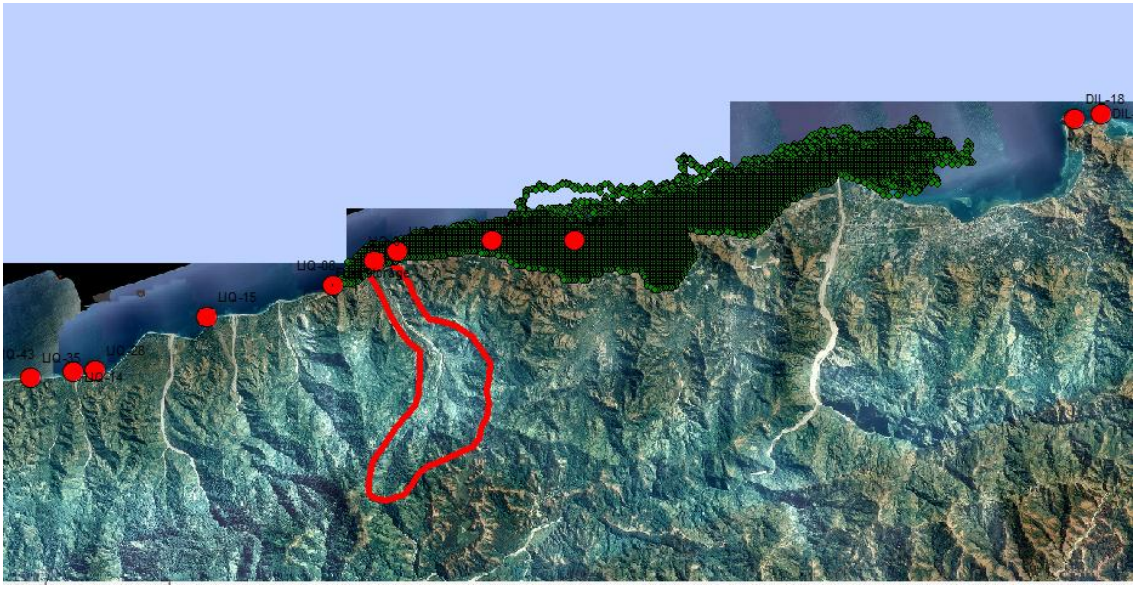


Figure. 8.19 Benthic Coverages and Impacted Area of Oil spill

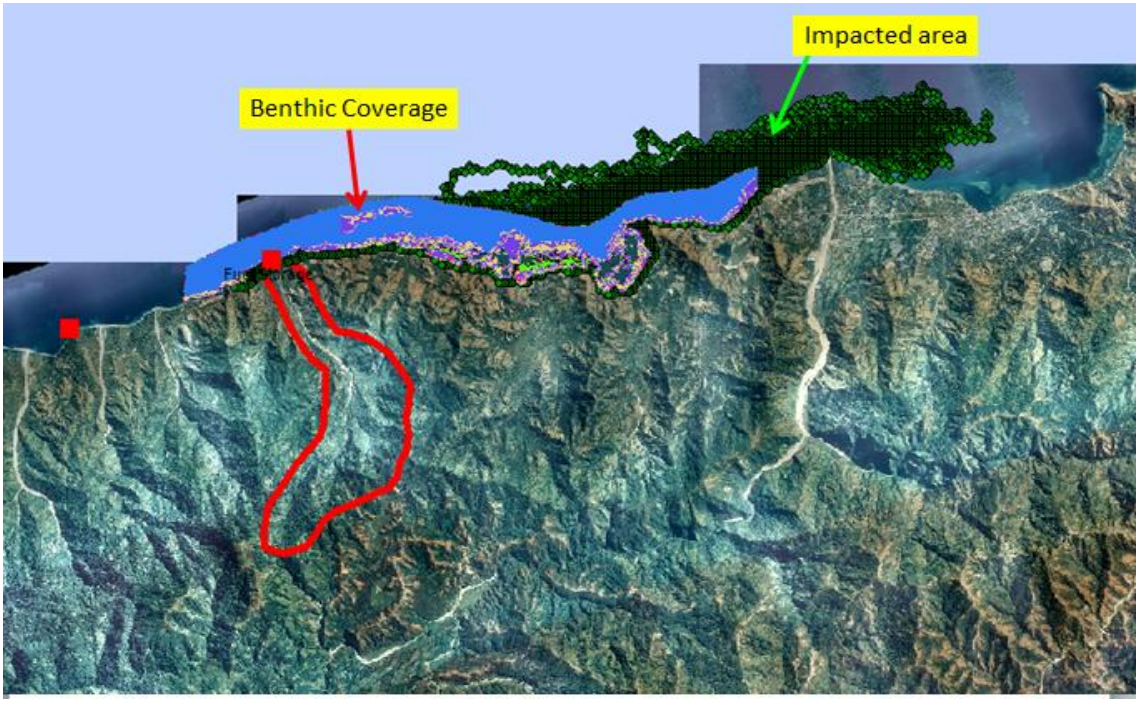


Figure. 9.20 Benthic Coverage and Oil Spill Trajectory

It is clearly shown that when the oil spill occur, most part of the benthic coverage will be impacted or covered by the spill. The following table shows the marine resources that will be potentially affected by the oil spill.

- Marine Habitat (coral reef, macro algeae, important nursheries for fish, shrimp, and other marine animal, beach, tidal flat which is rich with bird,
- Mangrove with the total area rouhgly 54 HA
- Fishing spots and Local Marine aqucutlure in Ulmera and Tibar
- Salt industry in Ulmera and Tibar
- Sensitive bird and mamal (phyiscal contacts, toxic contaminantion, dstruction of food chain resource and habitat, reproductive problem)

The demaged of the above resources will further impacted the fisheries and the sustainbality of the marine ecosystem.

Local Salt Industry

Wetland area near Tibar and Ulmera is currently used as salt pond that produces the salt under the natural drying process by sun. With the contamination of marine water by oil spill, the production must stop or costly purification of the salt making must apply to continue produce the salt under the condition of oil spill recovery. It is probably a good option to stop the production, which means the economic loss from the salt industry. Under the worst case scenario, the cleaning and complete recovery could take several years. So the compensation could be the solution for several years when the production of the salt must interrupted in case oil spill, which follow with the cleaning and recovery. The estimated production (based on interview in the project location), the total annual production is around, 100 tons, where this product shall be purchased by the ***Salt de Mor***, for further salt purification prior to sale the product in the market. The total annual loss due to the oil spill pollution would be estimate to be around, $100,000 per year.

Loss of Mangrove Forest

Total mangrove forest in the North coast of Liquica was estimated to be around 54 HA and the oil spill will impacted this total area of mangrove. It has presented by various agency in respect to the importance of mangrove forest to the marine coastal ecosystem and socio-economic benefit, as well as the role played for the climate change factor for absorbing the greenhouse gases. Consequently, the pollutant from the major oil spill could affect the mangrove existence in the long-run and potentially eliminate the benefit of mangrove in the ecosystem and socio-economic. The pollutant could cause the loss of mangrove forest. The loss of mangrove forest would cause the following domino impacts:

- Affect the fish production in coastal area and also marine aquaculture
- Affect the coastal hydrodynamic, where the coastal area could be easily eroded or abrasive by the high wave from open sea
- No filter of sediment from the upland catchment system and cause marine water pollution that will further affect the marine aquatic ecosystem
- Loss of mangrove function as greenhouse gas absorption
- Coastal community loss the livelihood that rely on the harvesting of mangrove forest

Marine Habitat and Marine Animal

Coral reef, seagrass, turf, and other will be affected by the oil spill occurs in the jetty, under the worst case scenario.

- Megafauna (dugong, whales, dolphin, crocodile)
- Migratory bird
- Sea turtle

Fisheries and Marine Aquaculture

The local fishery industry shall be impacted by the oil spill in the jetty, which will be dispersed throughout the shoreline of the north coast. On the other hand, local people in Ulmera and Tibar area use the wetland area to produce the marine aquaculture will be affected by the oil spill impacts.

- Fish will be contaminated by the oil spill and marine fish will die
- The fish nesting in the marine nearshore area will be impacted and potentially loss
- Production of fish will decline significantly
- Shrimp farm and fishery in marine aquaculture will shut down the operation due to pollution
- Loss of income and livelihood from fishery and marine product

Beach accessibility and Tourism Sector

There many good beaches along the north coast of Liquica, where many tourists from Dili and other place would spend their valuable time in swimming and relaxing. This privilege will be interrupted and economic loss of tourism will be the case

- Whale watching would stop as the spill will polluted the marine spot, where the whale and dolphin usually appear
- Impact the integrity of dolphins and other marine megafauna that become attraction for eco-tourism sector
- Impacts other marine ecosystem

8.3.2.7 Trans Boundary Impact to Indonesia

The oil spill modeling result for certain season also indicated that potential oil spill impact could reach the territory beyond Timor – Leste jurisdiction. The following map shows, the result of scenario (hypothetical) modeling of oil spill in jetty that could reach Indonesian shoreline.

Figure. 8.21 Oil Spill Modeling Result of East - Season

The modeling result provide an information on the potential impact of oil spill to Indonesia, where special arrangement need to be made between the Government of Indonesia and Timor – Leste, as regulatory body that provide the license for the design, construction and operation of the fuel terminal in Liquica.

8.3.2.8 Mitigation Measures of Oil Spill Impacts /Oil Spill Response Planning

The modeling result already shows the area of impacted and potential resource s that can be impacted by the oil, if no mitigation measured was applied. The major oil spill in marine water body can very significant in term of environmental as identified above and in many cases the impacts are translated into cost, which can be high. Various major oil spill in marine water body, has reported to cause economic loss of multi million to billion US dollar, which should be the responsibility of project owner and associate shipping agencies.

Because of this significant economic loss and environmental implication, the proper mitigation planning should be in place to minimize or prevent the oil spill. Therefore, the first most important thing to be done is to minimize the probability of occurrence of the spill. The oil spill response planning should consist of tactical and logistical detail on how to response the spills that already occurred:

1. Prevention of oil spill and minimize the spill at impacted area
2. Mitigate the Impact of Spill in the area Impacted
3. Shoreline cleanup
4. Compensation to the economic and social loss

Secondary and Tertiary Containments

As stated that the spot, where major spill could also cause the oil spill is the major leak in the storage tank. In the case the major spill inside that storage tank, it is expected that the spill of oil/fuel will be retained in the secondary containment, until the oil is recovery or cleaning. So in this case, the spill of oil or fuel shall not produce any significant environmental impacts.

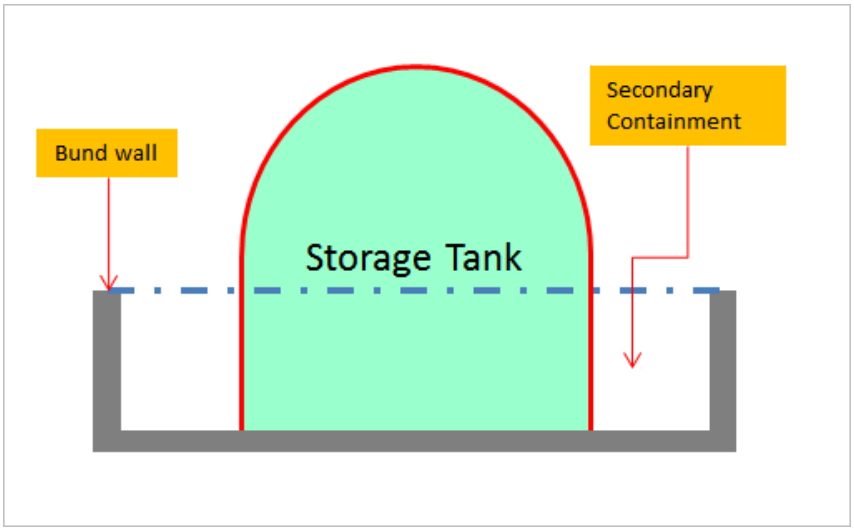


Figure. 8.22 Secondary Containments to retain the spill from Primary Container (Storage Tanks)

According to various Good Industry Practice (GIP), the total design volume of the secondary containment usually takes 110% of the largest volume of tank or 10% of the total volume of group of tank to ensure that the total failure of fuel spill, plus volume of water fire and water from the storm will remain inside the secondary containment. With this mitigation, the oil spill from the storage tank impacts to the marine water body is eliminated. Given the total volume of 10,000 KL storage tank to be constructed in Lauhata, the total volume of secondary containment, equal to:

The mitigation measure of the fuel spill inside the secondary containment is to recover the fuel by process of separation method or cleaning up the containment.

- Evaluate the quality of spilt fuel
- Pumped out the fuel from the containment
- Apply the proper treatment technology to separate the water from the fuel and recover the fuel for further utilization
- Evaluate the quality of wastewater (hazardous liquid waste)
- Treat the liquid hazardous waste prior to discharging into the landfilled or final disposal

Oil Spill Prevention

The prevention of oil spill would be the best approach that can save a lot of resources, financial, and environment, as well as socio-economic. The oil spill, especially the major can only be prevent is the factors contribute to the risk is controlled.

- Weather condition (high wave and high ocean current)
- Failure from tanker operation
- Lack of communication
- Proper operation procedure in operating the fuel unloading in the jetty
- Competent team or professional team
- High standard design and construction of fuel storage facility, including the piping system

In order prevent the oil spill associate with the fuel terminal operation, the above factor to should be considered and rigorous control must be in place to ensure the above factors have been considered in the operation of the jetty and fuel storage system. However, the spill could potentially occur due to natural event such as Typhon, seismic event, and any unexpected that cause the accident of major oil spill in the jetty and storage facility. In that case, only minimize the impacts would be necessary.

Minimize the Spill Impacts

The minimization spill impact means to limit the spill dispersion and movement from the point of spill, which is in jetty and around the piping connection from jetty to the storage tank. By doing so, the oil shall stay in one place to be clean up or pump by the emergency response team. The control and minimize the impacts of spill consist of mechanical containment, recovery system, clean up equipment. The following flow diagram process of the oil spill containment and recovery of spill oil in the marine water body.

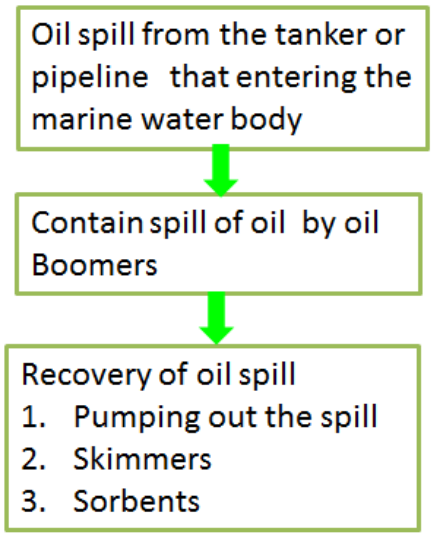
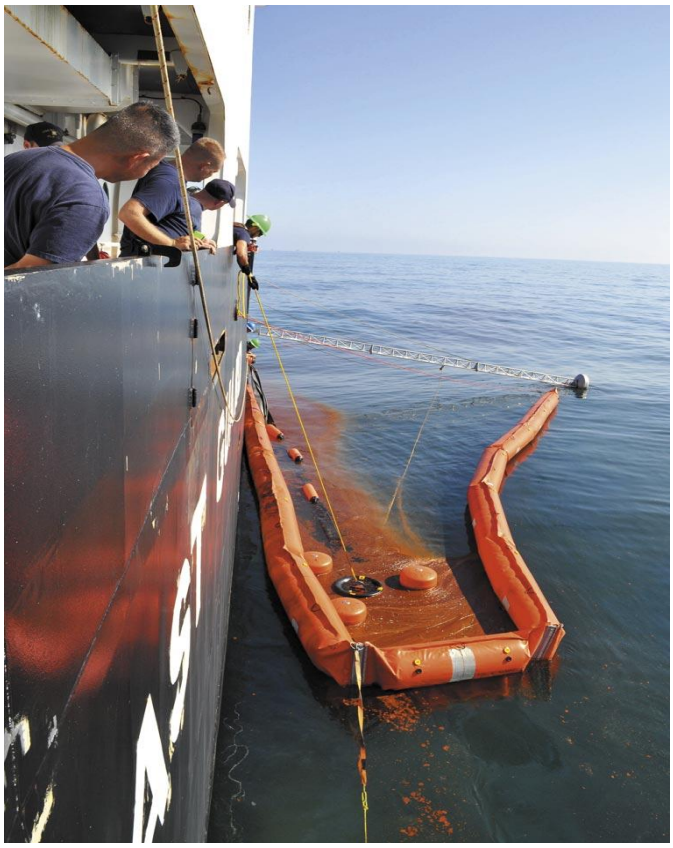


Figure. 8.23 General Flow Diagram of Oil spill Minimization

The purpose of containment is the block the spill of oil so that the oil will be concentrated in one area and the spill of oil can be removed by pumped it out and suck up to separate the oil from marine water. By taking out the majority of oil in the marine water, the impact of the spill is expected to be minimum. The research and other experience indicated that the above process can recovery 80% of the oil that spill in the marine aquatic environment.



However, other counter measures should be taken in case this method does not work out well due to various such as strong wind, ocean current is very high, in order to minimize the impacts of oil spill. These counter include following methods (EPA, 2007).

- Dispersing agents
- Biological agents
- In-situ burning

The purpose of using the chemical agent is to neutralize the oil product into other small chemical element so that the oil in the impacted area would be cleaned by more natural process and the spill of will not reach the shoreline or coastal area. The chemical method however, involve the toxicity risk of chemical its self that may affect the environment. The other counter measured that naturally effective in cleaning up the area impacted by the oil spill would be to add the biological agent in the impacted area. Essentially the biological agents are the nutrient and microorganism add to spill area in order to help decompose the chemical element of the oil and breakdown into the smaller chemical compound that is not harm to the marine ecosystem. However, the biological process takes a long time, while the transport of spill oil would reach the coastal area and impacted the sensitive area such as mangrove, coral, and

fisheries, as identified above. In this case, cleaning up the coastal area that impacted by the oil pollutant would be needed.

However, all these methods are subject to weather condition such as wind and tidal level. Therefore, it may be possible that the spill could move away from the point spill and polluted the coastal area. In case the shoreline cleaning could be necessary to mitigate the impacts of oil spill in the coastal area.

Shoreline Cleanup

The modeling result, as presented earlier, have suggested that because of density of petroleum product is much lower than the sea water, the spill of petroleum product would remain in top of marine water surface. The petroleum product would either evaporate into the atmosphere or carried by the ocean current into the marine coastal area or shoreline. The modeling result, indicated that within few hours, the spill oil already reach the coastal area if no containment was applied. This suggested that the clean-up of shoreline should be conducted in order to clean the coastal area in minimizing the environmental impact of the spill. Depending on the season, the clean-up coverage of shoreline could be range from 5 to 40 KM in total length.

- Biological process – bio-remediation
- Physical process of cleaning up
- Disposal of oil and debris

The following map shows the total area of intervention of shoreline cleaning up as a consequence of oil spill under the worst case scenario of fuel terminal operation in Lauhata.

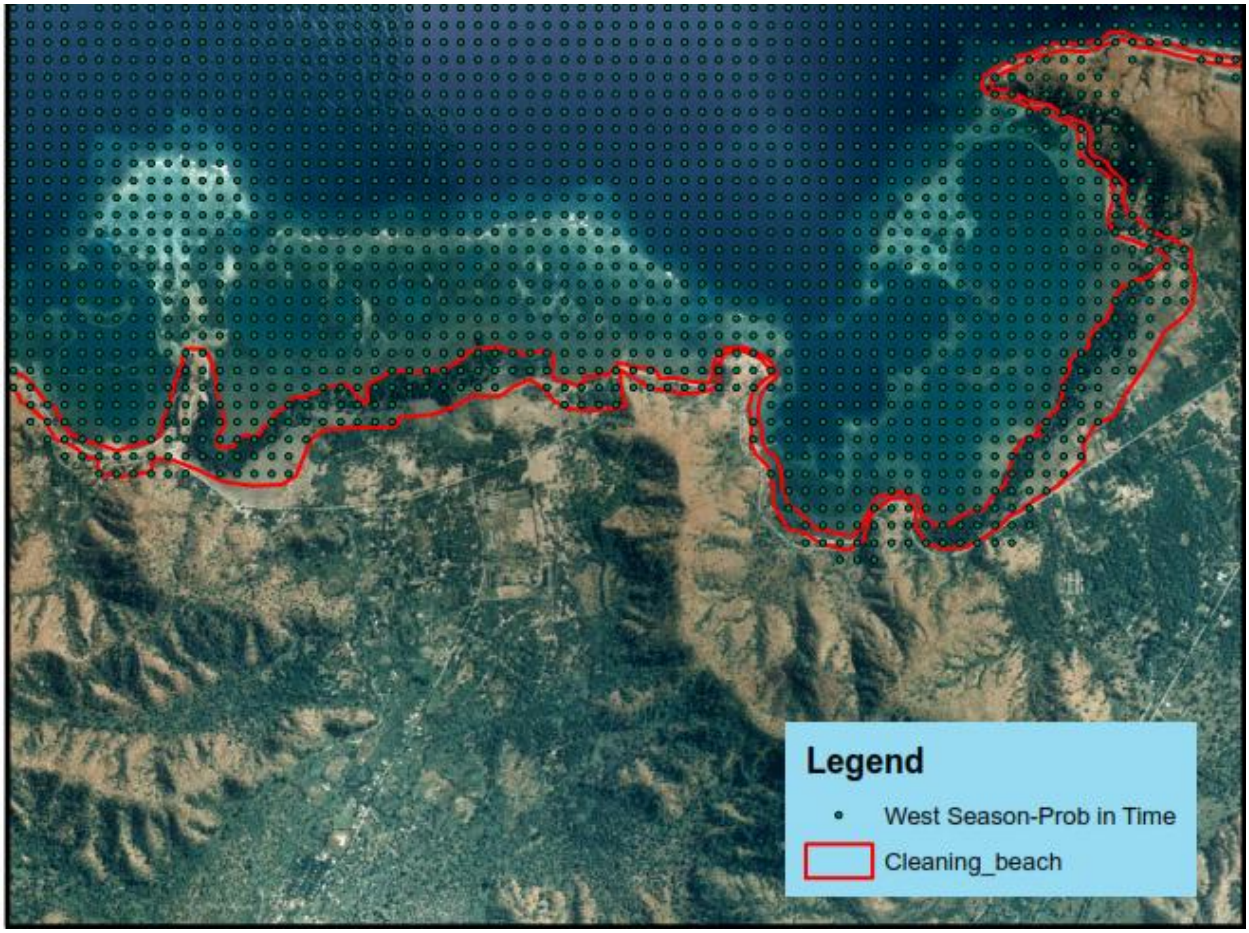


Figure. 8.24 Clean-up Area Identification of Oil Spill Response Plan

Biological process of cleaning up of shoreline is simply the natural process, which take many years to remove all the contaminant from the area of impacted. The biological process should be accelerate by the natural process such as evaporation and oxidation which help to remove some the volatile organic compound that normally more harmful to the environment.

The physical process of cleaning up the shoreline is a more tangible and personnel involve in the process. With the map of area of cleaning as presented in the above map, the personnel (clean up tam) and logistic should be prepared to help the clean up the impacted area. Methods used to physically clean oil from shorelines include the following:

- Wiping with absorbent materials
- Pressure washing
- Raking or bulldozing

Figure. 8.25 Example of Oil Spill Cleaning of Shoreline

Before physical cleaning methods are used, booms made of absorbent material are often set up in the water along the edge of the bank. Booms prevent oil released during bank cleanup activities from returning to the water and contain the oil so that it can be skimmed from the water for proper disposal. The debris and other liquid waste from oil spill that already collected should be disposed in the proper area. The most efficient way to handle this waste to disposed in the landfill area.

Compensation of the economic and social loss

The oil spill impact as identify earlier can affect the economic and financial loss, which need to be paid, as consequence.

- Compensation payment for the salt industry
- Fisheries
- Coral reef damage
- Mangrove replantation and rehabilitation

Further detail assessment on how to actualize, the compensation, need to be made after the spill event to know exactly the real impacted area, which require compensation or offsetting mechanism.

8.3.3 Fire Hazard Impacts and Mitigation Measures

The petroleum product, particularly the gasoline, has very low flash point, in which when the vapor is in contact with the oxygen, the ignition of fire could start immediacy. Therefore, fire management plan is very essential in storing and distribution of fuel system.

Table 8.11: Petroleum Product with Flashpoint

Type of Product	Flash point, c
Gasoline	-43
Diesel Fuel	>52

Most of the fire accidents occurred in the past have involved in the gasoline storing and distribution system. Therefore, focus on better management of fire related to gasoline would be considered the key to achieve the objective of the fire management system. Major fire hazard shall be also considered as an emergency situation, where the emergency response plans should be considered. The impact related to the fuel transportation, storage, and distribution is related to the fire. Fire only occurs, with the following 3 conditions, except when the temperature of the fuel already reach beyond the flash point, where auto-ignition may occur to the fuel with presence of the oxygen.

- Fuel
- Oxygen
- Ignition

So in general managing the above three factors should help minimize the fire hazard impacts. In case large fuel spill, the two things (fuel and oxygen) will meet. If there shall be an ignition, the large fire will occur. In this study, the fire accident will assume related to the fuel spill in the storage tank. The fire impacted to the people (worker inside the facility) and public space within the vicinity of the project area.

Figure 8.26 . Fire Hazard and impacted location

The scopes of fire impact assessment for the proposed fuel storage development consist of the following important parts:

- Identifying the potential location where the fire may occur
- Assessing the potential cause of fire from past experience in the related industry
- Proposed mitigation measures, necessary to prevent the fire hazard from occurring, minimize the impact when the fire occur, as well as fire management equipment use to fight the fire in order to kill the fire.

Only when the potential location is identified, then the impact of fire to the surrounding can be identified. In this case, the potential location where the fire may occur are (based on an experience or documented fire that already occurred in the past)

- Loading and unloading area, where the fuel is transferred from one place to the other
- Storage tank (including the primary and secondary containment)
- Jetty during the unloading the fuel from the tanker
- Pipes and valves (leaking)

The fire that may occur in the storage tank could potentially generate the largest fire impact due to the large volume of the fuel storing in the tanks (around 5,000 KL). It is also possible localize fire event may propagate or further generate larger fire impacts, which involve larger area of coverage.

In case the large fire accident, the following potential properties will be affected directly, from the fire and oil spill. The impact of large fire should be analyzed with the scenario with the large fire, which could happen in the storage tank and in the jetty, where the entire fuel storage, with the volume of 5000 KL would be on fire.

According to past empirical study done by Fire Management Alliance in 2014, that correlate between the effect of heat flux radiation to the target of distance away from the center of the heat, where the heat radiation reach maximum level.

Distance (m) / Diameter (m)	10	20	30	49	50	57	67	75	86	100	115	125	135	145	150	165	200	250	300
10	15.4	5.115	2.68	1.23	1.19	0.97	0.75	0.63	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.07
15	29.34	9.747	5.12	2.34	2.27	1.84	1.43	1.19	0.96	0.8	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.2	0.13
20	46.36	15.4	8.08	3.7	3.59	2.91	2.25	1.88	1.51	1.2	1	0.8	0.7	0.7	0.6	0.5	0.4	0.3	0.21
30	88.34	29.34	15.4	7.06	6.84	5.55	4.29	3.59	2.89	2.3	1.8	1.6	1.4	1.3	1.2	1	0.8	0.5	0.4
34.1	108.3	35.97	18.9	8.65	8.38	6.8	5.26	4.4	3.54	2.8	2.2	2	1.7	1.5	1.5	1.3	0.9	0.6	0.49
37.5	126	41.84	22	10.1	9.75	7.91	6.12	5.12	4.12	3.2	2.6	2.3	2	1.8	1.7	1.5	1.1	0.8	0.56
40	139.6	46.36	24.3	11.2	10.8	8.77	6.78	5.67	4.56	3.6	2.9	2.5	2.2	2	1.9	1.6	1.2	0.8	0.63
48.2	187.7	62.36	32.7	15	14.5	11.8	9.12	7.62	6.13	4.8	3.9	3.4	3	2.7	2.5	2.2	1.6	1.1	0.84
50	199	66.11	34.7	15.9	15.4	12.5	9.67	8.08	6.5	5.1	4.1	3.6	3.2	2.8	2.7	2.3	1.7	1.2	0.89
59.4	261.7	86.94	45.6	20.9	20.3	16.4	12.7	10.6	8.55	6.7	5.4	4.7	4.2	3.7	3.5	3	2.2	1.6	1.17
60	265.9	88.34	46.4	21.3	20.6	16.7	12.9	10.8	8.69	6.8	5.5	4.8	4.2	3.8	3.6	3.1	2.3	1.6	1.19
65.8	308	102.3	53.7	24.6	23.8	19.3	15	12.5	10.1	7.9	6.3	5.6	4.9	4.4	4.2	3.6	2.6	1.8	1.38
75	379.2	126	66.1	30.3	29.3	23.8	18.4	15.4	12.4	9.7	7.8	6.8	6	5.4	5.1	4.4	3.2	2.3	1.7
100	599.1	199	104	47.9	46.4	37.6	29.1	24.3	19.6	15	12	11	9.6	8.5	8.1	6.9	5.1	3.6	2.68
125	854.3	283.8	149	68.3	66.1	53.7	41.5	34.7	27.9	22	18	15	14	12	12	9.9	7.3	5.1	3.83

Figure. 8.27 Diameter and Distance away from the heat Radiation

Incident Heat Flux	Effect	Estimated Surface T (C)
1.4	Harmless for person without any special protection for short exposure	150
2.1	Minimum required to casue pain after 60s	185
4.7	Causes pain in 15-20s and burns after 30s	275
6.3	Tolerance limit for firefighters completely protected by turnout gear	330
10.0	Certain polymers (EFR clothing) may ignite	380
11.7	Partly or non-insulated steel may lose integrity	405
12.6	Wood will ignite after prolonged exposure, 100% lethality	420
25.0	Fully insulated steel may lose integrity	545
37.5	Damage to process equipment and collapse of structures	630

The during the operation of fuel storage in Lauhata in the phase 1 A, the total fuel that will be storage is maximum equal to 5,000 KL. With the height of 14 m, the diameter of the tank was calculated to be 21.5 m. By this empirical information, the maximum impact that will be generated by the fuel terminal in case fire hazard can be approximate as followed.

If the large fire occur in the storage tank and completely burn the fuel storage, where the total volume of 5,000 KL fuel shall be burn. The impact of the fire hazard to the surrounding environment or properties can be described in the following diagram.

Figure. 8. 28 Heat Radiation Versus distance

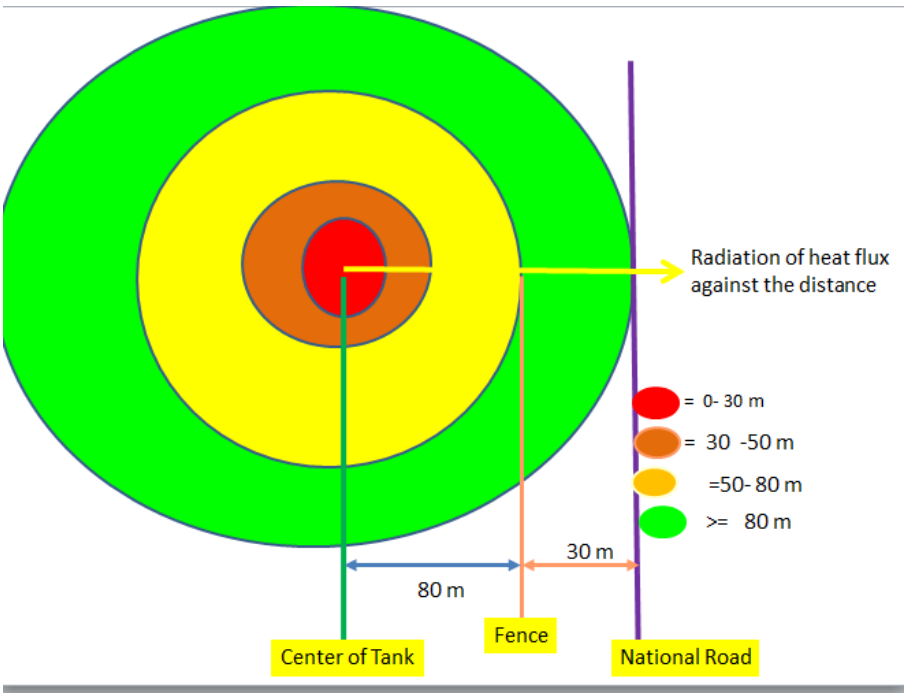


Table. Heat Radiation Impact with Given a Distance for Proposed Fuel Storage System (for the diameter of 22m)

Table 8. 12 Heat Radiation Impact in Respect to Distance

Distance, m	Heat Flux , W/m^2	Temperature, C	Effect
20	15	450	Fully insulated steel may lose the integrity
30	8	450	Tolerance limit of firefighter completely protected by turnout gear
50	3.5	350	Cause pain to human if exposure more than 60 second
80	1.8	200	Harmless to person without any special protection in the short duration
110	1.1	170	Provider an impact of burning for the heat exposure for a long time
200	0.4	150	Does not cause any major impact
300	0.21	110	Does cause any impact

According this analysis, the large fire hazard would only impact internally to the integrity of the project. At the radius of 110 m, the impact of the heat radiation has already reached the level that is harmless to the human body. Similar to oil spill impact assessment, the fire impact assessment would also be possible to be made with the scenario of fire that occurs within the several locations.

- Large fire in the storage tank and in the jetty
- Small fire in loading bay and other places from oil spill

The small fire should be able to be handled by the local firefighters that be established by the project, while the large fire will affect the following properties:

- The integrity of the fuel storage facility
- Public transportation, potentially the national road Dili – Liquica will be interupted and no alternative road is currently available. The distance of national road to the center of the storage of tank is around 110 m and the concrete fence of the project boundary is around 80 m.
- Fuel station (Aipelu fuel station)
- Timor Cement SA
- Several houses thaat located within 50 meter radious from the storage tanks
- Marine water body and beach accessability

Further detail of this impact is presnted and assesed as followed:

8.3.3.1 Impact of Large Fire

When the large fire occur, which could potentially the case in the fuel storage and jetty, where large volume of fuel is store (temporary), the radiation of heat flux will affect the objective (facilities, house, industry, and domino effect to the marine water body). If the large fire occurs within the fuel terminal facility, the impact could be summarized as followed:

- Integrity of national power grid line
- Property loss of the fuel storage system
- Major air pollution from the smoke
- Potential economic and social loss
- Marine water pollution
- Disruption of economic and business activity
- Traffic disruption

Further detail of each this impact is presented as followed:

Integrity of Fuel Terminal System

The large fire, such as in the fuel tank will impacted the integrity of the operation of the fuel terminal. Therefore, a strong fire management system should be in place to manage and minimize the fire risk in order to protect the business and integrity of the properties surrounding from the fire impact. Potential impact from the large fire hazard:

- Damaged the entire properties (fuel storage, office, and other component of the system operation)
- Rebuild the fuel storage terminal which require new capital investment
- Impact to the maintenance cost
- Public opinion on the safety and integrity of the project

Public Utilities

The public utilities or properties observed nearby project location are national power gridline, national road of Dili – Liquica, old Aipelu Prison, and beach at shoreline, will be affected in case the large fire accident. The following table provides the summary of important public utilities with relative distance to the center of storage tank or to the perimeter fence.

Table. 8.13 Public Utilities and Distance from the Proposed Fuel Storage

Public Utilities	Distance to Center of Tank, m	Project Boundary - Fence, m
Power Gridline	95	20
National Road	110	25
Aipelo Old Prison	270	200
Beach	40	10

If the large fire should occur in the fuel storage tank, the impact of the fire to the above public facility can be significant. However, according to the past study, the heat flux radiation with the total diameter of 22 m of the proposed fuel storage tank in the phase 1 A, would reach the distance of 86 m, without any major impact to the national road. When the perimeter fence is in place, the heat radiation to from the fire generate in the storage tank can be reduced significantly. Potentially, long-term impact to the public facility would be to the power gridline, as the cable of powerline would be overheated by the heat radiation, potentially, the integrity of power cable will be affected.

Residential and Local Industries

Few residential houses, which located around the radius of 50 m from the project area, could also be affected if the large fire should occur in the storage tank. The local industry such as fuel station, supermarket, restaurant, and other small shops are also currently, in operation nearby project location. The following table summarized the relative distance of these mentioned facilities in relation to the project development.

Table. 8.14 List of Facilities Nearby project Location

Local Industry and Residential	Distance to Center of Tank, m	Project Boundary - Fence, m
Houses/residential	80	10
Aipelu Fuel Station	250	150
Concreate Industry	270	200
Cement Plant	260	120
Traditional Mining - river	250	50
Existing Quarry	2000	1500

With relative safe distance from the proposed project location, the impact of heat radiation flux should be negligible, except the 5 houses which locate within perimeter fence, need to be resettled to another location.

Air Quality Impact

If the fuel in the storage tank shall be completely burned due to large fire, the air quality becomes issue. In addition to the heat flux, the flue gases will also be emitted by the facility as a result of the completely burning of the fuel. The flue gases, such as CO_2, H_2O, CO, and other, which are basically, the greenhouse gases type that contribute to the global climate change. These flue gases would also cause the health issue, especially with the high concentration during the large burning in the fuel storage tank.

- Pollution that contribute to the health hazard to the local community and potentially impact of trans boundary
- Contribute to the climate change
- Acid rain, if rain after the large fire in the storage tank and acid runoff shall enter the marine water body and could potentially causes marine water quality issue

8.3.3.2 Cause of Fire Hazad in Storage Terminal

According to the data from the past experiences, in the fuel storage industry, the main cause of the fire hazard related to the fuel terminal is related to the lighting, which caused by the Lighting (poor grounding, rim seal leak from seal rim, direct heat), (Noah, 2014). The remaining factors around 67% the fire caused by operational error, maintenance error, equipment failure, leakd and rupture, as well as static electricity. Understanding of these factros from the past exeperiences that contribute to the fire hazarad is very important, which should be become an important reference to help improve the design and construction of the fuel terminal facility and design proper operational which leads to safety operation in the minimum acceptable risk level.

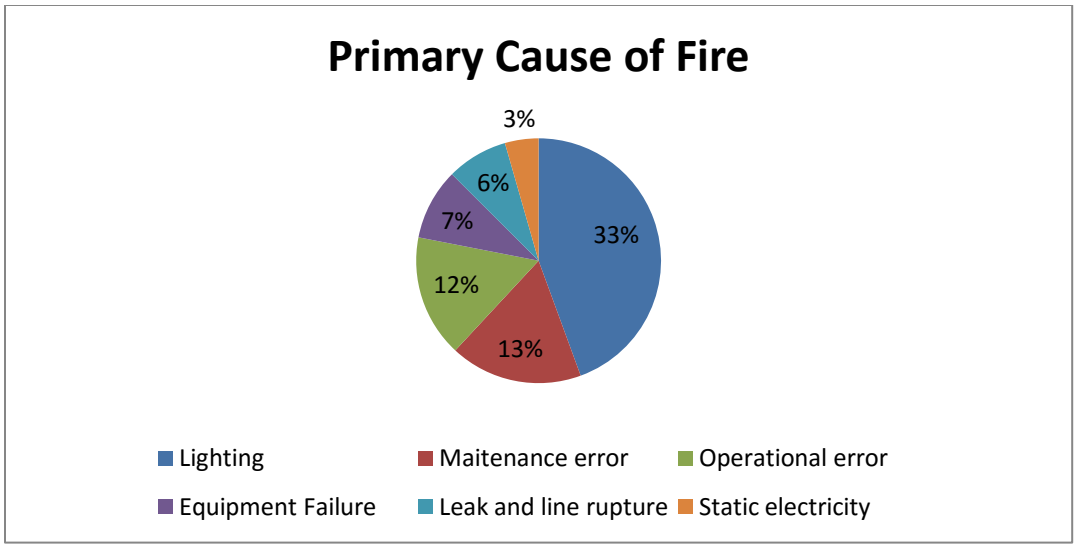


Figure 8.29. Summary of primary Cuase of the Fire in Fuel Storage System

Further detail on the particualr concern from the above factors that contribute to the fire hazard is presnted in the following table.

Table 8.15 Major Cause of Fire Hazard in the Fuel Storage System

Factor	Particular Concern
Operational error	Tank overfilling
	Drain valve left open accidentally
	Vent Closed during loading and unloading
	Oil leaks due to operators error
	High inlet temperature
	Drainage ducts to retention basins blocks
Equipment or instrument failure	Floating roof sunk
	Level indicator
	Discharge valve rupture
	Rusted vent valve does open
Lighting	Poor grounding
	Rim seal leaks
	Flammable liquid leak from seal rim
	Direct hit
Static Electricity	Rubber seal cutting
	poor grounding
	Fluid Transfer
	Improper sampling procedure
Maintenance Error	Welding/cutting
	Circuit shortcut

	transformer spark
	poor grounding and soldering equipment
	Poor maintenance of equipment
Tank crack or rupture	Poor soldering
	Corrosion
	Shell distortion/Buckling
	Pipe leak/rupture
Safety support system	electric power loss
	insufficient tank cooling
	firefighting water loss
Miscellaneous	Earth quake
	Extreme weather
	vehicle impact on piping
	open flame/smoking
	domino effect from other
Piping leak/rupture	valve leaking
	flammable liquid leak from the gasket
	piping failure
	pump leak and cut accidentally

Understanding the above factors that have caused some majore fire in other places, will be a very important and valubale leasson learn for the operator and company to design and construct the system up to the highest standard, as well as proffesional training to the operator to follow the best practice of operation in the industry to avoid the same mistake may occur again to their storage tank. Considering the fire hazard could potentially, cause large or cadastrophic impact to people, environment, and business itself, the above factors must be taken into consideration in the design and construction of the propose fuel storage facility. Morover, the operation and maitenance of the facility should always consider or check and re-heck of all the factors to minmize the failure or risk. The design of the facility should be in consideration of the reciever of impacts such that the impacts would be minimum, withn the distance of public, community and workers. Particularly, the design and construction to consider the minimum distance between the fuel storage tank (source of major fire) and theh nearest public utility or the residential. The fire hazard impact could create more derivative impacts such as lossing the storage facility, if it is permanetly damaged, and could create other socio-economic issue. The mitigation measures of fire impact management system consist of three important steps to minimze the risk:

- Preventive actions (pre-fire acicdent)
- Manging the fire (fire already occurred)

The scale of the management will be depending on the fire scale to be managed. Accoridng to NFPA, the concept of fire management system, cover the above three important steps, which has an objective to prevent and minimize the impact of fire hazarad:

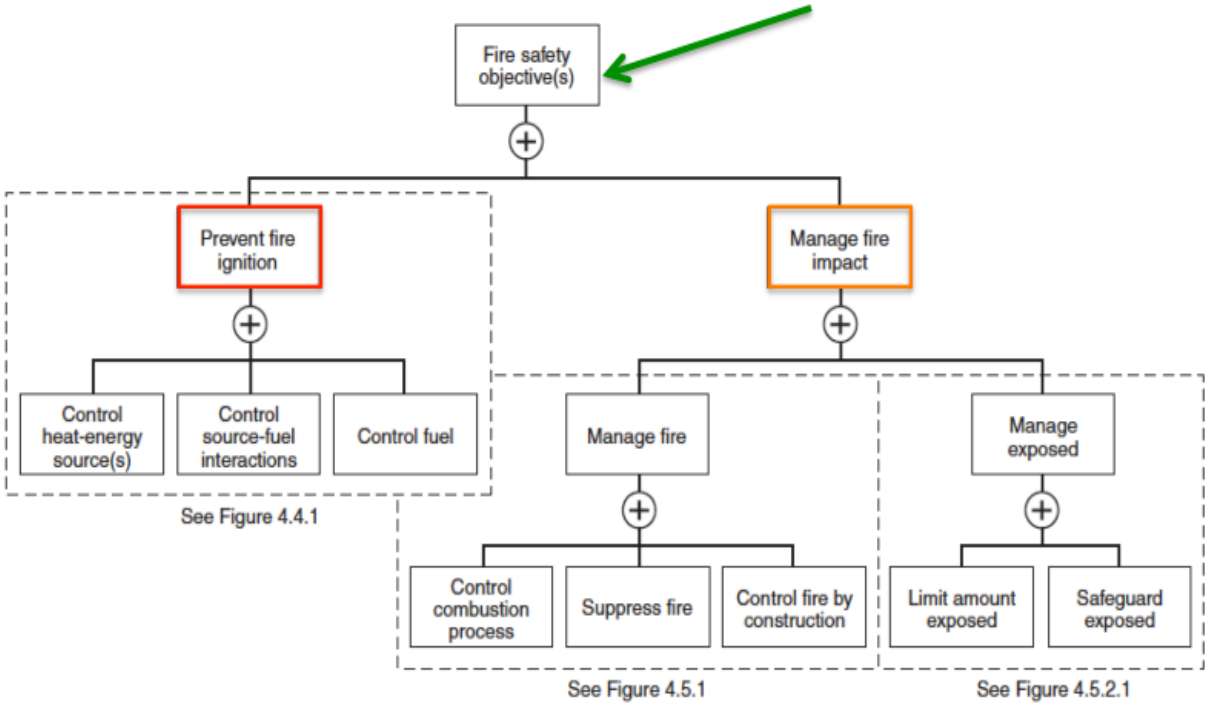


Figure. 8.30 Concept of Fire Risk Safety (NFPA, 2007).

8.3.3.3 Fire Mitigation Measures

As presented, arlier that, three important elements should presence at the same time to produce the fire, which are oxygen, fuel, and ignition. The present oxygen can not be controlled, as the most of the important component of the faiclity will be constructed to be at the open air. Then, what need to be done to prevent the fire hazard from hazard are:

1. Eliminate or minimzie the fuel leak throuhgout the proceee work flow from loading/unloading the jetty , piping system, valves, pumps, storage, loading and unloaidn bay, fuel dispencer, and fuel delivery tankers
2. Control or minimize the ignition of the fire

With the controling and minmizing the above two factors that cause the fire, the risk of fire, could be eliminated.

Minimize of Eliminate the Fuel Leak

The preventive action to minimize ro eliminate the fire hazard means things that must be done in order to prevent fire hazard from happening. Fuel leak can elimiated or minimized if it is properly understood the where the common area or part of the system that usually leaks:

Very common part of the fuel storage that often, leak te fuel out of the system and cause the fire are including the following:

- Pipe (rusted and leak)
- Valve that already corroded or rusted
- Tank (rupture)
- Pumps
- Dispencer, operation error
- Pipe connection

The leaks of fuel from the mentioned parts can be minimized or eliminated if the following measures shall be taken:

- Proper design and contrcution of the component of system with hihg standard with proper material selection according to the best industry (API,ASME,ASCE, AFPA)
- Regular inspection and maitenance of all the component of the fuel terminal system, particularly, the asses the corrosion, as the project is the coastal area that prone to corrossion
- Developed standard opeating system and required all the employees to have proper training and understanding of the process prior to involve in the operating of the system
- Training and communication of the staff/operator to eliminate the error of operating system
- Proper grounding of all the electrical equipment

Control or Eliminate the Ignition of Fire

The source of ignition could be coming from natural process such as lighting, high tempeaure, or man made, source such as irresponsible smoking near the leak fuel area, and other that potentially start the fire in the area where the petroleum product, especially gasoline leaks out.

- High tempetature
- Lighting
- Smoking
- Bushes fire
- Vandalism (people put fire on purpose)

This cause of ignition of fire can be minimized or eliminated by the following mitigation measures:

- Proper grouding of all the electrical system

- Compaign of non-smoking area within the proposed project area (or smoking area is highy regulated)
- Developed buffer zone near the perimeter fence to eliminate the potential bushes fire from the surrounding area, especially during prolong dry season. This buffer zone should always be green and wetted
- Automatic control of the tempetaure of fuel and apply the proper cooling system
- Take the precaution measure, to control the vandalis people (put the CCTV to control for instance)

8.3.3.4 Managing Fire Impact

Managing fire means how to kill the fire and minimize the impact to the people, to the system of operating, and to the surrouding enviroment. In order to manage the fire impacts, the facility will need the fire management system which include, equipment, procedure, well trained team, communication internal and external, and other which are disscused below:

Fire Equipment System

Fire equipment is the last thing that should be made available inside the facility, such as fuel storage system that is proven to be prone to the fire hazard risk.

- Fire alarm system to be installed in every key point that suspect would generate fire, so that anytime when there is fire hazard, the alarm shall go on
- Water sprinkler system design and layout. The water
- Foam system design
- Fire truck
- Fire water
- Fire hydrant
- High speed of pump to pump the water
- Foam tank

All this emergencies equipment should be installed according to the standard, as required by best industries standard with high standard quality (NFPA: 11, 13, 15, 20, and 72). The design engineer of this development facility should design the in detail all these fire equipment system, including the location and technical specification, as well as the proper design capacity.

Emergency Fire Response System

Beside the adequate fire equipment as mentioned above, the procedure of handling the fire hazard system during the condition of emergency is also equally important. The procedure is like the software to run the system or execute the program to achieve the objective of fire management system, which is killing the fire.

The procedure of emergency response system for every operating system should be developed to response the event and therefore, the response system/procedure will be depending on the type of event or emergency situation. According to NFPA, there are three steps/tiers, response plan to be in placed to response the condition:

- Tier1 – emergency with the small scale
- Tiers 2 – emergency event that is large such as that internal team is not able to response, required external (national level)
- Tires 3 – emergency event that is very large that even the national level cannot response the condition/event. In this case, regional or international help may be required. For instance, large fuel spill, that required intervention from various international agencies

The operational procedure for each emergency scale should be developed by the project owner and training the necessary team to be familiar with the event.

Well trained fire fighter team

The project owner should have fire bridge team, who is highly trained in fire management system to prevent and minimize the fire hazard impacts. The team should develop the necessary skill required to handle the emergency fire system. The type of fire emergency that can be handled by the fire brigade team, including what are the personnel, should be presented in the detail fire emergency plan.

Emergency Exit Route Map

The emergency exit route map, is needed in case of emergency route or evaculation. The project onwer will provde the Detailed Engineering Design (DED),which include also on the layout of fire hazaard management plant and evaculation route map.

8.3.4 Soil and Marine Pollution

Soil and marine pollutions could only occur if there shall be a major oil spill in the land area. Mainly the project area shall be fully paved and therefore any minor spill shall be washed off during the rainy days or using the fresh water and the contaminant shall be collected and treated in the oil-water separator to clean wastewater prior to discharging into the drainage system. However, the soil pollution could happen in the area that is unpaved, such as in the garden or Small Park that will be constructed as buffer zone in the project area. If the oil spill shall mix with the storm water and infiltrate into the downward, the soil could be polluted and eventually the pollutant can reach the groundwater.

The pollutant, mostly total petroleum hydrocarbon (TPH) will transport downward and eventually reach the groundwater level. The soil investigation indicated that the soil type is mainly sandy soil, which has very low holding capacity of the water. Consequently, the transport process of contaminant (TPH) downward shall be quicker than other type of soil such as clay. The estimation of contaminant that could transport through the soil and eventually reach the groundwater can be estimated as followed:

8.3.4.1 Method Oil spill Impacts Assessment from the Ground Surface

According the landscape design, around 20% of 1.3 HA (or around 2600 m^2) would be pervious land surface, which could potentially cause the soil pollution, if any oil-spill shall enter to this pervious land surface.

- Pervious land surface could cause soil pollution and eventually cause groundwater contamination
- Impervious land surface could cause pollution to marine water body

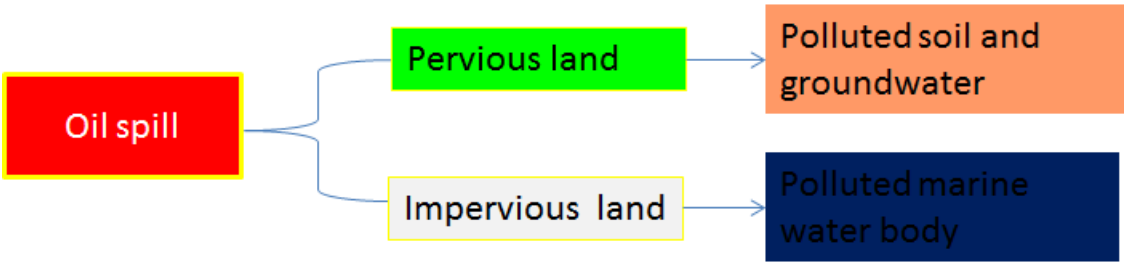


Figure. 8.31 Soil and Marine Water Quality Impacts Assessment

Whenever the major oil spill occurs, the soil impact assessment should be conducted immediately in order to know the level and area extend of impact. Knowing the level of pollutant transport (petroleum related chemical) in soil depth is necessary to take treatment of soil that polluted. The soil pollution due to contaminant from the downstream petroleum product related would impact to the groundwater and marine water body:

- Groundwater pollution petroleum derivative product
- Soil pollutant will be transported overland and discharge to the marine waterbody

The minor spill within the fuel storage yard, will be washed by the storm runoff or by cleaning water and will be captured oil –water separator to remove oil layer at the top of the separator and further treatment would be performed.

8.3.4.2 Soil and Marine Water Quality Impacts Mitigation Measures

The mitigation measures of soil and marine pollution would be to prevent or minimize the oil spill in the groundwater from entering the soil system and or marine waterbody.

- Prevention of oil spill to the ground surface within the project facility (proper design and construction of the facility, including piping system, valve, etc., and safety operating procedure to prevention of spill)
- Treatment of the oil spill in the ground surface as quickly as possible with the oil-water separator

The oil water separator has proven to remove the 80-90% of oil layer from the wastewater. The capture oil layer will be treated further prior to the disposal.

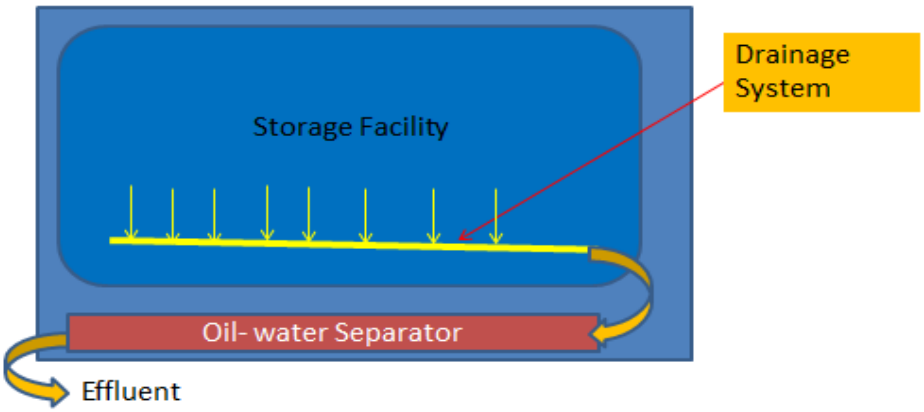


Figure. 8.32 Schematic of Oil-water Separator

The effluent that believes to have low BOD, low Petroleum Hydrocarbon (TPH) could enter the marine waterbody without creating any marine pollution issue.

8.3.5 Groundwater Quantity and Quality Impacts Assessment

The proposed development project will extract groundwater from the groundwater aquifer to fulfill the demand of water supply in the proposed facility. While at the same time, the contaminant such as oil spill within the project location can leak into the groundwater and pollute the groundwater and becomes an issue. Therefore groundwater impacts consist of two important factors to be managed and assessed

- Groundwater Quantity
- Groundwater Quality

8.3.5.1 Quantity of groundwater impacts (from Pumping)

The water demand in the facility is estimated to be 1500 L/day, which is reasonable small. However the pumping test will be conducted from the well that will be constructed by the project owner to see the marginal capacity of the groundwater and compare with the pumping rate of 1500 L/d (or 1 L/minute). Refer to the section 6.1.92, regarding the pumping test, the pumping test results shows that impact of pumping of groundwater at the rate of 1500 L/day is reasonably small and does not generate any impact.

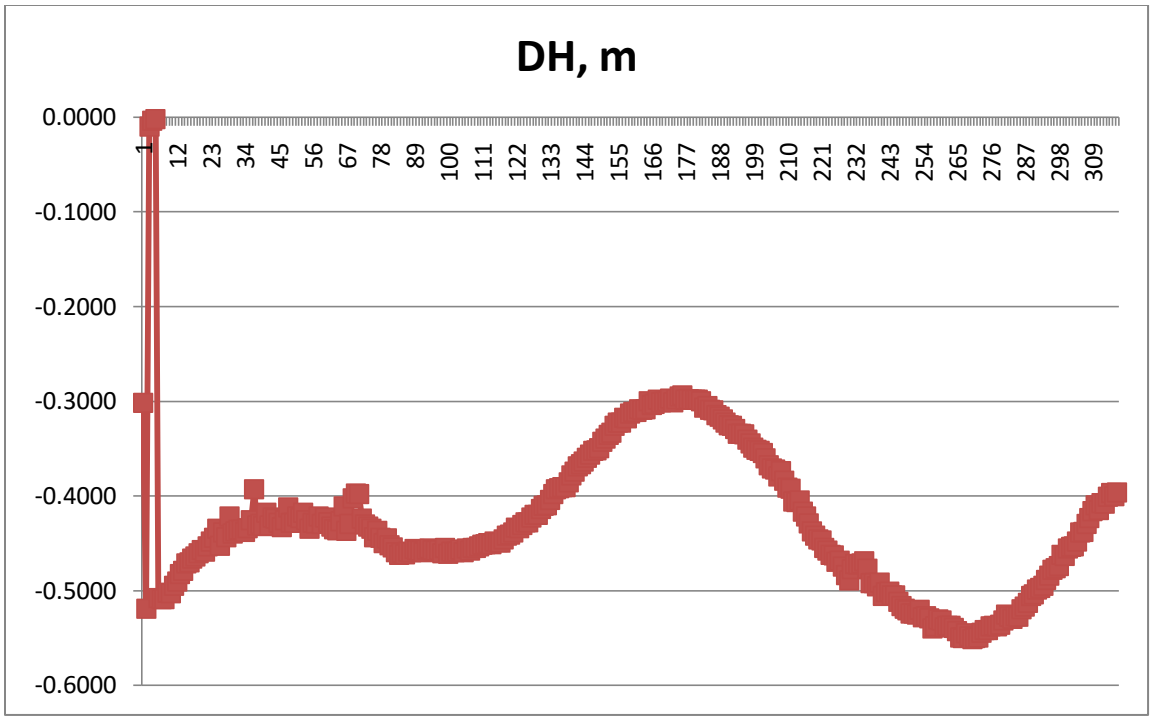


Figure. 8.33 Graphical Representation of maximum drawdown versus the pumping rate

It is shown from the above figure that even at the pumping rate of 240 L/min, the maximum drawdown occurs only 0.5 m. The recovery time is very quick only within 10 minutes, the drawdown level already reach the original level. This shows that the groundwater flow inside the aquifer is much larger than the pumping rate at 240 L/min. This provides the credible information that no major impact shall be caused by the groundwater extraction at the rate of 240 L/min or 245,000 L/day. Compare to the water demand, which is only 2000 L/day, the impact would be negligible. Further information could be found in the groundwater assessment report which covers the pumping testing the groundwater resource estimation (see annex 3).

Even though, the pumping test result suggested that the groundwater aquifer volume is sufficient to response the need and beyond, the monitoring of groundwater pumping would be established to detect the groundwater level in the aquifer as a result of pumping. The automatic sensor level has been installed in the groundwater monitoring well to detect the groundwater drawdown from now and in the future.

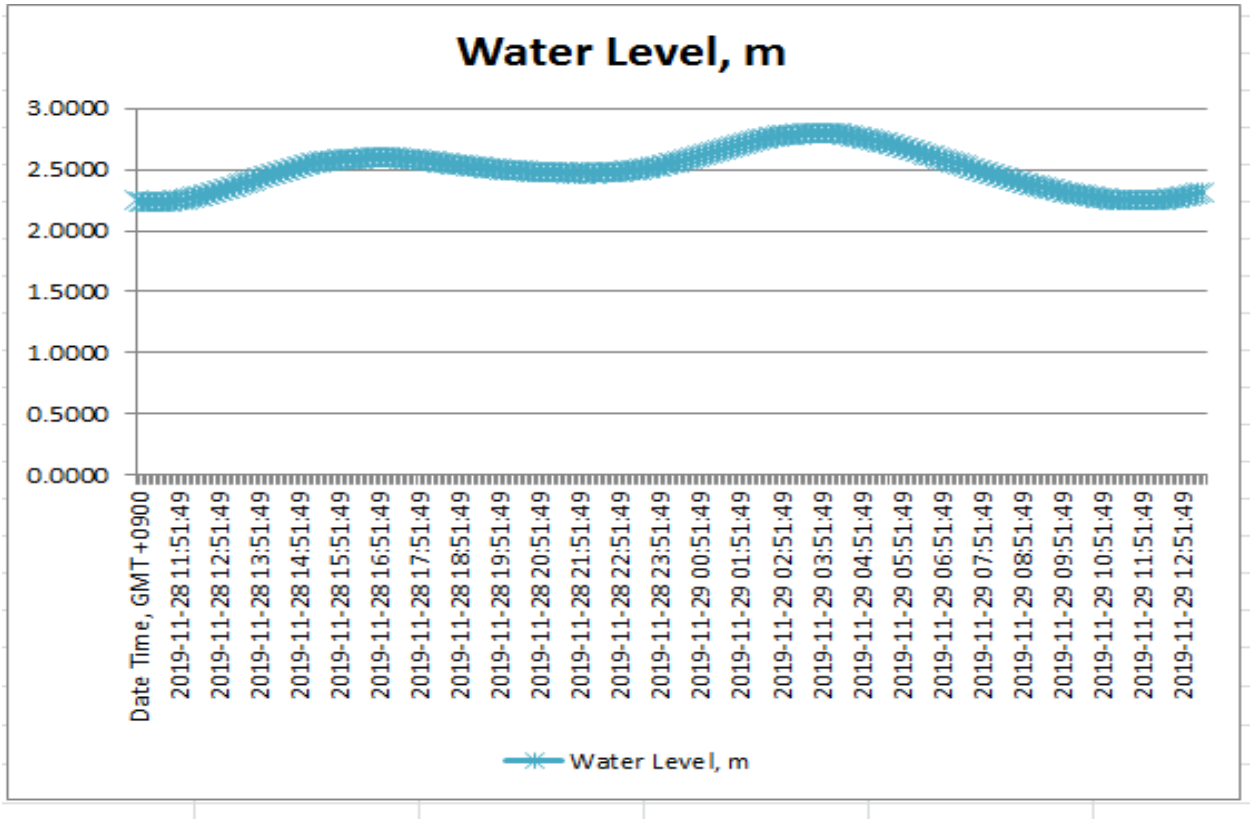


Figure. 8.34 Groundwater Monitoring of drawdown Level

The result of groundwater monitoring suggested that the groundwater in the project area is highly influenced by the tidal, which is a typical coastal groundwater condition. It is concluded that no major groundwater issue should be faced in the future related to the pumping of groundwater by the project owner to fulfill the water supply need.

8.3.5.2 Quality of groundwater (from oil spill)

The contaminant transport of oil spill from the ground surface to the groundwater aquifer is important subject to be investigated as part of this impact analysis, due to the presence of shallow groundwater level in the project area. Although, the probability spill into the previous layer of soil is very mall, as all the process of fuel storing the distribution in the proposed development facility in impervious layer of soil, it is possible that certain event can cause the spill. In this case, the impact and mitigation measures should be in place.

The impacts to the groundwater could have a permanent impact and irreversible. Therefore, the impact measurement and mitigation measured should be reliably conducted so that the probability of success in mitigating the risk is high. The ground water table, as assed by the current investigation indicated at the depth of 4 meters from the ground surface. The measured permeability of soil, as conducted by this study

suggested that the soil permeability of top soil from the ground surface to depth of 5 meters is around 5 cm/hr.

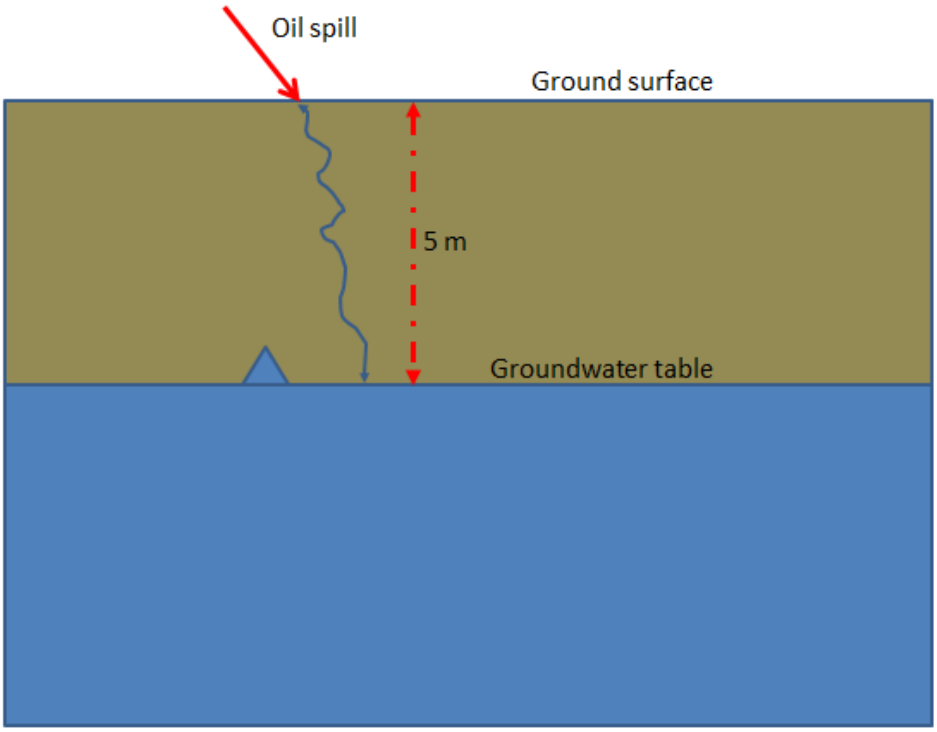


Figure. 8. 35 Process of Pollutant Transfer overland

The transport phenomena through the porous medium will take minimum around 5 days to reach and polluted the groundwater. However, the porous medium flow shall not be a linear one and therefore, the actual travel time will be much larger than this simple calculation. Therefore, potentially, if the advance detection of the spill is available, then would be possible to remedy the oil spill from the top soil before reaching the groundwater table.

8.3.5.3 Mitigation Measures of Groundwater Quantity and Quality

The mitigation measure of groundwater quantity, would be minimize the pumping of groundwater via monitoring of groundwater level

- Limit or regulate the groundwater utilization
- Limit or eliminate the oil spill in the ground surface that could entering the groundwater body
- Monitoring of groundwater quantity and quality
- Observe and monitor the oil spill in the ground surface and act accordingly if there is any spill
- Top soil remediation in case oil spill in the ground surface, where the spill entering the soil layer
- Groundwater remediation if there is any groundwater contamination

Further discussion on the soil remediation and groundwater remediation from the oil spill pollution area presented as followed:

Soil Remediation Techniques

When the soil is already polluted by the oil spill, then part of the soil that is polluted must be taken and store in the special storage to stop the transport process from reaching the groundwater level. Type of soil remediation could be very simple as thermal remediation to the complicated bio-remediation.

Table 8.16: Proposed Bio-remediation of Soil pollution

Method of Remediation	How
Thermal	Contaminant soil is heating up the higher temperature to let the organic hydrocarbon evaporate. Burning the contaminate soil could also be part of soil remediation. After the contaminant already removed, soil can be stored back to the original place.
Encapsulation	The principle of encapsulation is like an adding certain chemical into the soil that is already contaminated to stop the flow further down.
Bio-Remediation	This technique is to apply the bio-logical process in the removal of the oil in the soil surface. The biological process normally takes longer time and it may not work for current soil condition that has very permeability rate

Groundwater Remediation from Pollutant

If the groundwater is contaminant by the spill in the soil surface, then the only remediation way is to pump out the groundwater and treat them. The groundwater remediation is very expensive and most of the time the result is not effective as the volume of the water to be treated is so huge. Therefore, in situ treatment would be applied.

8.3.6 Air Quality from VoCs (Volatile Organic Carbon)

Air quality is potentially impacted from Volatile Organic Compound (VOC) associated with low hydrocarbon chain compound easily evaporated into the air. Gasoline contains benzene, which easily evaporated into the atmosphere during handling of product. Large amount of VOC transferred into the atmosphere will cause pollution and can be harmful to those expose to it. Given the capacity and the closed handling system, the nature of this impact is localized and can be significantly mitigated. Another potential for air pollution from the use of products (vehicle emission) can come in the form of the release of NOx, Sox, Cox and Particulate Matter (PM) from combustion system. Retail petrol stations direct traffic to and concentrate vehicles in its compound, making the potential for release of these gases and

particulate matter especially high in the compound and surrounding areas. The nature of this impact is localized with potential to be mitigated to some degree.

Within the fuel storage terminal, several points have already identified as points, where the release f of VoCs often takes a place.

8.3.6.1 Source and Cause of VoCs Release

The source of VoCs, particularly from the gasoline, coming from the following activity of the project during the operational of the fuel storage:

- Loading and unloading system (in loading bay and jetty)
- Fuel Storage tank (type of tank would cause different vapor loss and required different method of minimization)
- Leaking in the pump, valve, leak and piping system

Among these three, loading bay is the highest percentage of that contributes the VoCs emission to the atmosphere, follow with the storage tanks. There are many factor cause emission:

- Storage respiration/air respiration
- Storage evaporation
- Instantaneous emission after opening the valve during the loading and unloading due to poor sealing of storage tank

The release of VoCs from fuel terminal system contributes the impact to financial and environment. The financial loss is imperative, as loss the fuel/VoCs means.

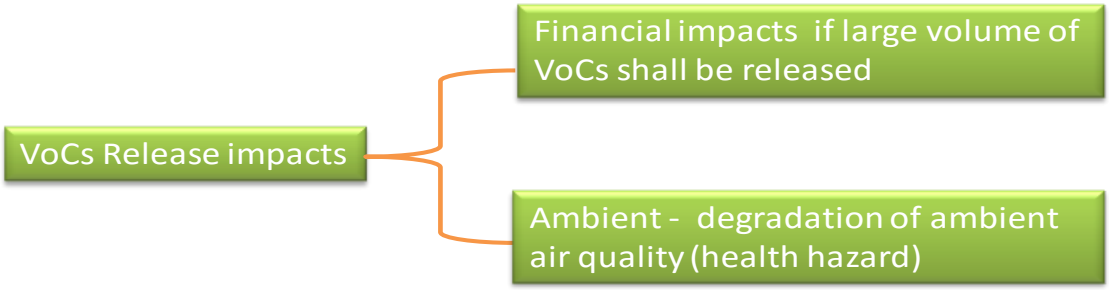


Figure. 8.36 Impact of Released VoCs from the Fuel Storage

Therefore, the release of the VoC should be minimized in order to two goals, which the financial benefit and ensure the ambient air quality. The technical and non-technical methods should be in placed as part of the normal operation process to minimize the VoCs.

8.3.6.2 Mitigation and Minimization of VoCs

The best management practice in mitigating the impacts of VoCs as described earlier should be composed by technical and non-technical method. These two methods should complement to each other in order to achieve the best outcome.

Table. 8.17 Option of Mitigation Measures to minimize the VoCs

Method of Mitigation	Mitigation Options	How to Implement/
Technical	Maintaining stable tank pressure and vapor space	• Coordinating filling and withdrawal schedules, and implementing vapor balancing between tanks (a process whereby vapor displaced during filling activities is transferred to the vapor space of the tank being emptied or to other containment in preparation for vapor recovery); • Reducing breathing losses by using white or other reflective color paints with low heat absorption properties on exteriors of storage tanks for lighter distillates (e.g. gasoline, ethanol, and methanol) or by insulating tanks. The potential for visual impacts from tank colors should be considered;
	Secondary emission control - if the VoC loss is high	• Vapor condensing • Install vapor recovery unit • Catalytic oxidizer • Vapor combustion unit • Gas absorption unit
	Minimize vapor loss during the process of fuel/gasoline transfer	• Apply Gasoline supply and return system • Apply vapor recovery hoses and vapor tight truck or other in the loading and unloading gasoline
	Use of bottom loading truck / rail car filling system	Bottom tank loading resulted minimum vapor loss
Non-Technical	Tree planting	Near perimeter of the fence and green zone in the project area
	Proper SOP	• Tank operation • Loading and loading in Jetty • Loading and unloading procedure in Loading bay • Pump and valve operation and control system
	Periodic maintenance system	• Follow properly the maintenance schedule as recommended by the designer • Implement Periodic inspection (annual) to all the system and equipment to ensure that they all working property according the design and operation manual
	OHS	PPE

8.3.7 Solid Waste Impact and Mitigation Measures

Solid wastes will that produce consist of domestic solid waste that is proportional to the personnel or worker within the facility. The estimation and projection of the potential solid waste quantity from the Liquica area and in relation to the project development have already being presented. If the waste is not managed well, then the waste will contribute the health hazard and marine water quality.

The source of the solid generated by the similar fuel storage facility around the world with the projected quantity is presented in the following table.

- Domestic/general solid waste
- Bottom tank product
- Washed off from the surface of the facility

8.3.7.1 Estimation of General Solid Waste

The total employee working in this development facility would around 30 persons. Using the information and the daily unit rate of solid waste production, which is around 0.8 kg/person/day. The total monthly solid waste produced by this development project would around 720 kg per month. This amount is relatively small comparing the total solid waste produced by Liquica town. The project owner should provide the collection system inside by separating the type of solid waste (recyclable and non-recyclable material).

8.3.7.2 Bottom Tank Product

The solid waste produced in the bottom tank of the fuel storage would normally estimate based on experience from the operator. According to the experience of PITSA (PERTAMINA International, SA), who operate the fuel storage in Pantai Kelapa, Dili, Timor – Leste, the rate of bottom tank product of solid waste is around 0.05% of total volume of the tank per 5 years of operation.

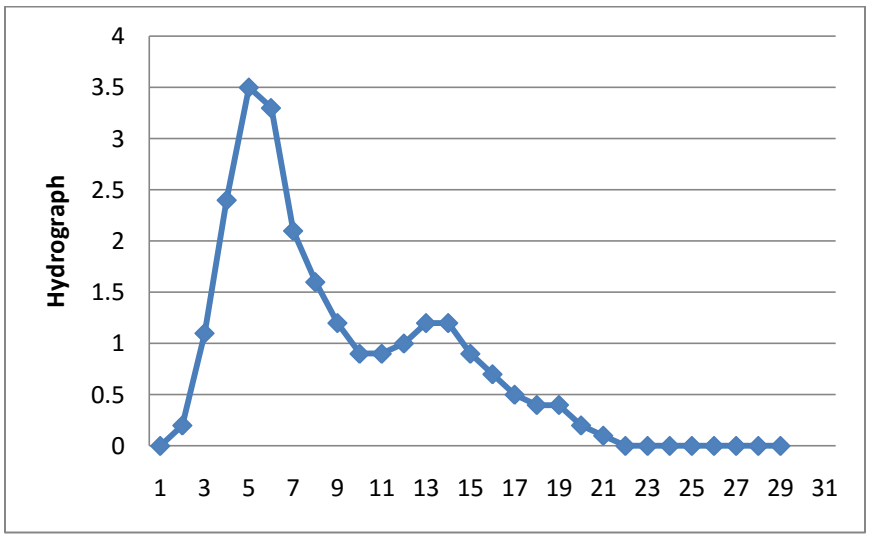
If the volume of storage is equal to 5000 KL at the phase 1 A, the total solid waste produced by the bottom tank is around 400 Kg/5 year. That means that monthly waste is very small less than 10 Kg. However, this waste is considered hazardous and required special treatment prior to the disposal. Therefore, 400 Kg of this solid waste will be treated by evaporating the water and burn the waste to reduce the impact to the environment.

8.3.7.3 Wash off from Oil spill

The oil spill in the surface will be washed off by the storm water runoff or water and effluent will be captured by the oil-water separator to capture the oil and release the runoff. The estimation of the total oil spill within the fuel storage area during the loading and unloading of fuel is difficult to be estimated.

However, roughly the concentration of organic carbon measured during various sampling was around 20 – 80 mg/L. Using this type of information, the solid waste produced by the storm runoff can be estimated.

The storm runoff hydrograph of a rainfall event at the frequency of 5 –year, ARI was estimated by hydrologic modeling, as follow:



Using the concentration of organic carbon of 50 mg/L, the pollutograph can be estimated.

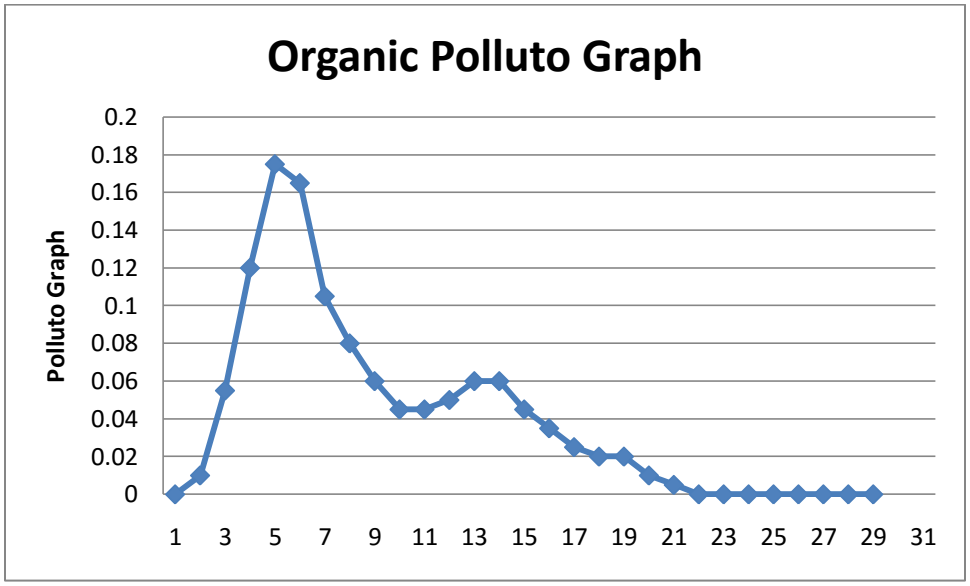


Figure. 8.37 Polluto Graph of Oil spill

Taking the integration of this pollute graph, the total mass of oil can be determine for one particular storm event. For the rainfall size of 5 –years ARI, the total mass produced would be equal to 1000 kg. If

there are around 10 storms per year, then total annual solid waste that considered hazardous could be around 10,000 kg. The following table provides an estimated of the solid waste contributed by the project development.

Table 8.18 Summary of Solid Waste Estimation by the Project

Type of Waste	Estimated Amount, kg
General Waste, Monthly Rate	720
Hazardous Waste from Bottom tank/5 years	400
Hazardous Material from Surface-washed oil spill, Monthly	1500

The impact of solid resulted by the proposed development project will affect the following if the waste production and disposal is not managed properly:

- Human health hazard
- Polluted the soil and damaged the soil as plastic waste is non-biodegradable or taking a long time to decompose the chemical element and transform into the saver substances.
- Contribute the pollution to the marine water body, where various biodiversity take the habitat

However, managing the solid waste by this project should be simple and does not require a serious technology and investment. It required the regulation and simple approach to manage the waste production and disposal.

The mitigation measures of general solid waste can be achieved by the implementation of the concept of 3 RD (Reduced, Recycle, Re-use and Disposal). During the operation the company should provide the two type of waste collection:

- Recycle material/waste
- Non-Recyclable

To accommodate this solution the project owner will construct the waste bin to collect the solid waste within the facility.

The recyclable material should be sent to agency to recyclable the waste and while the non-recycle material should be collected and dispose into Tibar Dumpsite area. The hazardous waste need to be treated prior to the disposal. As currently, designated treatment site/area for the hazmat waste, the project owner will have its own hazardous waste treatment. The simple treatment that commonly adopted is to let the liquid evaporate and burn the solid material.

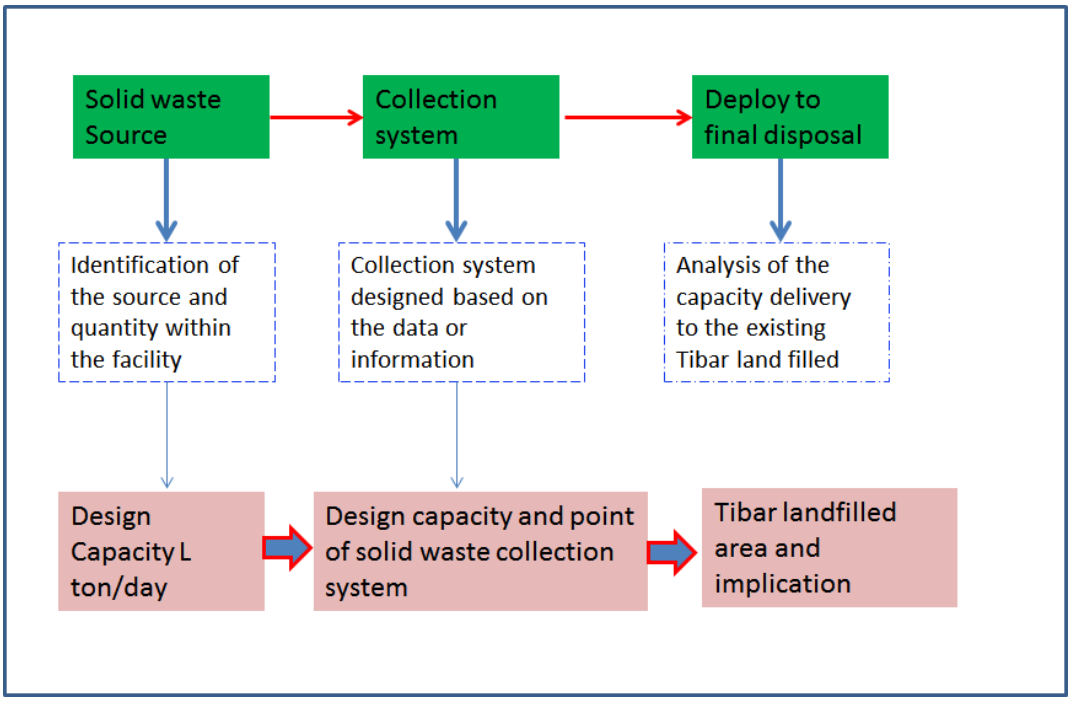


Figure. 8.38 Process and Method of Solid Waste Management

The solid waste can be disposed in landfilled area or private landfill should be developed by the project owner. Hazardous solid waste need to be treated prior to disposal in the designated location that the government already identified. The hazardous solid waste that produced from the fuel storage system, particularly from the bottom tank, after 5 –years of operation need to be taking out and required the proper treatment and prior to disposal in the designated area.

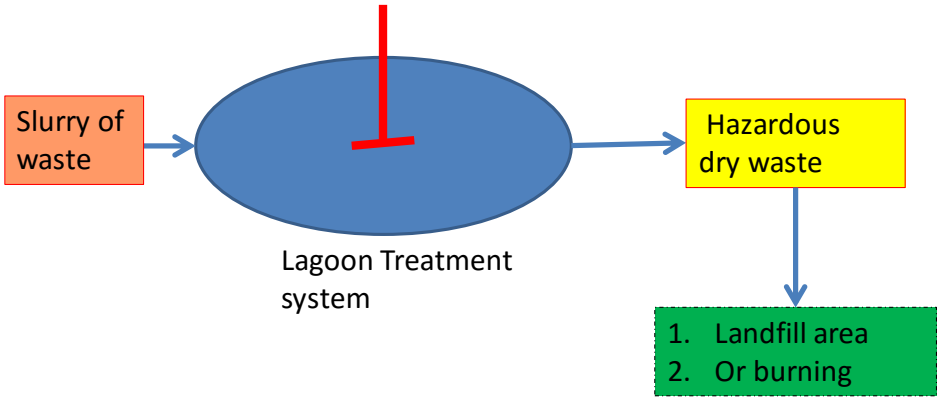


Figure. 8.38 Process Treatment of Hazardous Material

The process treatment of hazardous solid waste is described as followed:

- The waste collected from the fuel storage tank and oil-water separator it stored in the lagoon treatment system
- Liquid and solid will be separated by the natural evaporation process.

Once the water already completely evaporate, then solid waste can be collected for reuse material or disposal by burning the solid part, which assumed to be the petroleum product

8.3.8 Traffic Accident

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The current traffic survey indicated that the total occupancy of the existing road is measured around 3000, which is still reasonably small. With the operation of the fuel storage facility, traffic volume would increase much. However, the of the grow of traffic volume has dramatically increased by 50% annually after the improvement of the Dili – Liquica road starting from 2017.

Table 8.19 Traffic Survey of Dili - Liquica Road

Year	Traffic Volume, N
2015	1000
2017	2000
2019	3000

Assuming that the grow rate of traffic would follow equal trend in the future; the development project will contribute to the higher traffic risk. According to the US National Highway Manual, the normal traffic volume of the national highway would be at the range of 20,000 – 30,000 vehicular per day. This information from to country suggested that with the trend of traffic grow, as mentioned, the national road Dili – Liquica, shall need to be upgrade by 2030 or ten years from now. The traffic risk from the project development would be summarized:

- Potential traffic accident that cause loss of property and life
- Traffic delay in the national road due
- Tragic accident fatality

The mitigation measure of traffic impact during the operation of fuel terminal facility includes:

- Dedicated person to direct the traffic in and out, as well as watch the oncoming traffic
- Potentially required to install traffic light to regulate the traffic
- Installation of traffic signage and limit the vehicular speed in and out the facility
- Required only authorize personnel can drive the vehicular
- Government of Timor – Leste to upgrade the national road of Dili – Liquica
-

8.3.9 Occupation Health and Safety

Global Oil Terminal, LDA is a dedicated company that has a responsibility in ensuring the health and safety of the workers for sustainable operation in storing and distribution of the petroleum product in Timor – Leste. The safety and health are the first concern that should become the responsibility of the company and workers by taking necessary measure to prevent the risk, minimizing or eliminating the risk associate to the work or project execution. Similar to the construction phase, the impact of the project to the occupational health and safety should be managed according the following hierarchy:

- Eliminating the risk/hazard
- Controlling the hazard
- Minimizing the hazard
- Providing the proper personnel protective equipment (PPE) for the last resort to protect the workers from unnecessary injuries or accidents.

Further detail information on how the propose fuel terminal facility should be design and operated to comply with the best industry standard in order to minimize the hard or risk associate with the OHS are presented as followed:

- Proper design and operation system will lead to the minimization of various unnecessary accident related to the executing of the work.
- The incident related to the occupational would also be reduced by having a proper communication procedure (protocol) within the project area and training of the staff involve in every part of the work would need to ensure that everyone understand the role and responsibility in doing their part to contribute to the better outcome
- Many important physical, chemical, biological hazards can be minimized by better understanding of the hazard itself and design the workspace to eliminate or minimize the incident related to the physical, chemical and biological hazards.
- Last but not least is using the proper personnel protective equipment (PPE) in executing the specific work to minimize the personal risk during the execution of the work.

Detail information on each hazard and action to be taken are presented in annex 13, which was summarized from IFC Guideline on the occupational health and safety.

8.3.10 Community Health and Safety

Community health and safety issue during the operation of the proposed fuel storage terminal, would be proportional the major impacts that could affect the occupational health and safety within the proposed development facility.

- Groundwater availability
- Traffic safety
- Fire and explosion within the fuel storage that cause the domino effect
- Major oil spill that polluted the coastal and damaged various marine resources

These above could be prevent, minimize and or compensate (if it occurs)

Table 8:20 Summary of Impacts and Mitigation Measures of Community Health and Safety

Community Health and Safety Mitigation Measures - Operation Phase		
Area of Concern	Action to taken	Objective
Groundwater availability	• Apply water conservation • Measure the water utilization • Provide help to the community, especially during the prolong dry season • Monitor the groundwater depletion	To ensure the groundwater sustainability and ensure the availability for people and the project
Traffic Safety	• Provide proper traffic signage and dedicated person in the project to redirect the traffic • Apply proper speed limit within the project area (suggested 10 KM/h) • only proper license could operate the certain vehicular	To minimize the impact of accident related to the transportation
Large fire and explosion within the fuel storage and cause larger domino effect	• Evacuate the people or community within the radius of 50 meter from the project boundary • Provide public announcement regarding the accident • Provide the same evacuation route of the emergency	To minimize the hazard impact to the community and public
Major Oil spill that polluted the coastal and damaged various marine resource	• Informed the community about the potential hazards of oil spill • Informed the fishermen regarding the impact area so to limit the fish catching that already contaminated by the pollutant • Provide the proper signage to the area/beach that already polluted to limit the public access to the water that already polluted	To avoid the impact of oil spill to the public and community members

8.3.11 Climate Change and Coastal Inundation

Climate change and its impacts could affect the existence of the project, as given the fact that the project is located in the shoreline and river bed, which shall be prone to the riverine flooding and coastal inundation. Furthermore, utilization of groundwater as the main water supply source, may also be affected by the seawater intrusion to the local groundwater, in case the prolong dry season, where the fresh water volume in the groundwater storage shall decrease.

- Frequent flooding and potentially coastal inundation
- Seawater intrusion

- Temperature increase would cause more vapors loss organic petroleum hydrocarbon, which will contribute to the air quality
- More carbon footprint (indirect impacts due to fossil fuel combustion)

Considering the potential impact of climate change and coastal inundation, the design of the facility should consider these above factors.

- Adaptation measures such as elevated floor design and coastal wall protection (already described in the flooding section)
- Monitoring of the tide and adjust the operation of the fuel loading and unloading
- Frequently cooling the storage tank to minimize the vapor loss by controlling temperature inside the tank

8.4 Impacts during Construction of Phase 1 B

It is assumed that most of the preparation work for the storage tank installation has already been prepared during the phase 1 A – construction. Therefore, the scope of construction work of the phase 1 B may only include the following work items:

- Preparation and installation of two storage tanks
- Piping connection
- Instrumentation
- Bund wall
- Miscellaneous work

The impacts of the above activity would mainly be related to the occupational health and safety However, some of the work related to the tank installation could create the ignition for the large fire to the operational of the stage 1 A. This impacts assessment has been prepared by assuming the following scenarios:

- During construction of the phase 1 B, the operational of phase 1 A will be suspended.
- Operation of phase 1 A and construction of the phase 1 B

For the environmental impacts assessment study, it is assumed that during the construction of the phase 1 B project, the operation of the phase 1 A would be suspended. With this arrangement, the impacts during the project implementation could be minimized. The following table provide the summary of impacts and mitigation measure during the project the phase 1 B of the project implementation.

Table 8.21: Summary of Impacts and Mitigation Measures during the Construction of Phase 1 B

Impact Assessed and Mitigation Measure during Construction of Phase 1 B			
Impacts	Area of Coverage	Particular concern	Mitigation Measure
Occupational Health and Safety	People who work inside the facility	• Work related electricity • Exposure to heat • Exposure to the	• Proper training prior to executing the certain work. Certain special work such as electrical work should be done

		dust and particular matter • Risk injury related to accident (vehicle, heavy duty equipment, etc.) • Risk of death	by person who has certified training related to electrical work • Using the proper PPE (eye, nose, ear, protection system) • Supervisor to control the worker to follow proper working procedures • Temporary medical help in the project site to provide help in case accident • Dedicate team to response the emergency in the field • Evacuate as soon as possible to the nearest help center or hospital • Proper compensation to the death
Traffic disturbance	Vehicular get in and out of construction area	• Traffic accident • Temporary congestion • Loss of life	• Assign dedicated person to watch and direct the traffic related to construction activity • Response team to help resolve the traffic accident • Proper traffic signal and speed limit • Only license/authorize personnel would allow to operate the machinery/vehicles
Noise	Within the project area up to 50 meter radius	• Disturb the convenience of the community • To big noise could potentially cause the health hazard	• Use the PPE (ear protection equipment) within the project area • Schedule the construction activity only during the day time • Apply noise barrier in the perimeter fence
Vibration	Within the radius of 100 m	• Potential collapse of old Aipelo prison • Structural crack of the building within the radius of 50 m	• Monitor the vibration level from the source of vibration and further distance away from the source to know the vibration level • Apply some safer technique of foundation work that produce minimum vibration • Apply PPE for the worker within the project area during the execution of work

The main impact during the installation of these two additional tanks would increase the fire risk hazard, as potentially, the increase the probability of ignition to the existing fuel operation. The following discussion provides the additional impacts during the construction of phase 1 B of the project.

8.5 Impacts and Mitigation Measures during the Operation of Phase 1 A and Phase 1 B

The impacts during the operation of phase 1 A and B would be same as operation of the phase 1 A, except the derivative of the impact could be double. For instance, flooding impact to the project would be remain the same, except if the flood water, damaged the property, the amount of spill oil that entering the marine water would increase substantially. The following table provide summary on major impacts that expected to increase in term of magnitude.

- Fire hazard
- Oil spill Impact
- Occupational Health and Safety
- Community Health and Safety

Other impacts would be remaining same as the operational of Phase 1 A and therefore, the mitigation measures and management of environment would be same.

8.5.1. Flooding

The flood water coming from the rainstorm would produce the same impact, like the phase 1 A and the mitigation measures would be same as the phase 1 A.

8.5.2. Oil Spill Impact

With increasing the capacity of fuel storage tank, the frequency of fuel tanker load the system would be increased double. Therefore, the probability of the spill to occur would be higher than the phase 1 A project. However, the magnitude would be remaining the same, as the volume of tanker bring the fuel to load the oil terminal system would same, which is 5000 ton.

For instance, the loading frequency in the phase 1 A is around once week and the frequency become double in the phase 1B, which is 2 times. Therefore, in term of impact assessment and mitigation measures, they should be same as the phase 1 A, except that the probability of occurring the spill in phase 1 B is much higher than the phase 1 A. The impacts to the existing environment, socio-economic, and sensitive area would still same. Therefore, the similar approach of mitigation measures in the phase 1 A can be adopted. Refer to the section 8.3.2, related to the modeling of the oil spill impacts and mitigation measures. The impacted are would be larger, in the stage 1 A and B, if no mitigation measures shall be applied.

8.5.3. Fire Hazard

The magnitude of fire would be increased double in a very extreme condition, where the whole facility will be completely on fire. In this case, the impact would be double and potentially cover the national road and other existing business. As assessed from the section 8.3.3, that the following protection components/sections:

- Jetty during the unloading to the storage facility
- Loading bay area during the unloading to the truck tanker
- Storage area (storage, primary, and secondary containment)
- Pump, pipe, and valve

The fire impacts at other than fuel storage, would remain be the same as in the section 8.3.3 (during the operation of phase 1 A). Thus, method described earlier is applicable in this section. This section only describes the major fire impact if the total 10,000 KL of fire shall be completely burn out. In This case, the major impact is the heat radiation impacts, from the center of the tank area to the distance away from the fire point.

As described earlier also that the relationship between the heat radiations versus distance produced by the amount of fuel burn (measured in term of total diameter of tank). The total dimeter of tank for this phase of project implementation become 30 m, which will generate the larger heat radiation impacts if the whole storage tank will be burn out. The following graphic show the range amount of heat radiation impact from center of the tank, which has highest radiation impact.

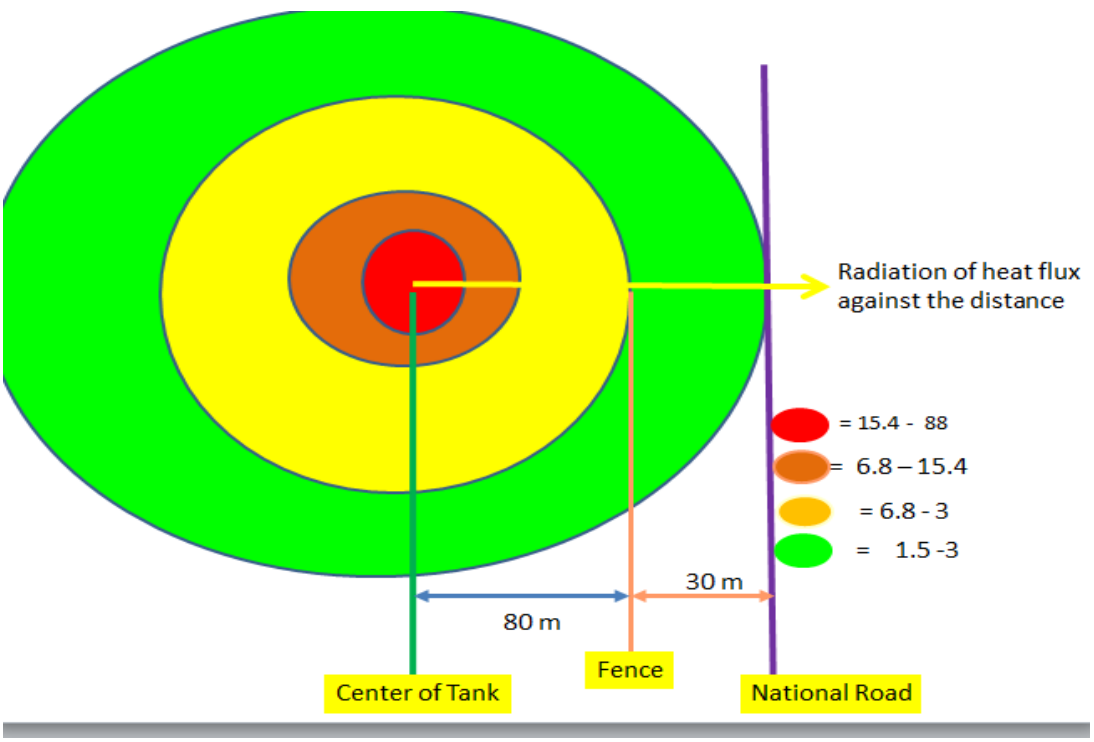


Figure. 8. 40 Impact of Fire in the Worst Case Scenarios (Storage tank completely on Fire)

The following table presented in the distance away from the storage tank with the heat radiation severity, which is used to assess the fire hazard impacts if the fire occurs.

Table 8.22. Heat Radiation Severity and Distance

Distance , m	Symbol /Color	Heat Radiation	Severity
0 -30		15.5 - 88	Damage to any structural material and all the storage and facility within this radius will be completely burn
30- 50		6.8 - 15.4	Wood and any office building construct in this radius will get burn after prolong exposure. Any metal will loss the integrity of the structure
50 -80		3.0 – 6.8	Cause pain in human after 30 second exposure and more than 30 sec, will cause burn in skin. Fire fighter will fully protection equipment may work freely inside this radius
80 - 110		1.5 – 3.0	After 60 second, the radiation still causes pain, if the body is not protected.
>110		<1.5	No longer any major affect

So according this above table, when the major fire occur, which cause the whole storage tank, that full with the 10,000 KL get burn, the heat radiation would take major effect from the distance of 0 – 80 m, which is the project boundary (fence). The following table provides the information on the facility that impacted by this major fire effect.

Table 8.23 Impact of Large Fire with the Facility Nearby

Facility	Distance to Center of Tank, m	Impacts
Storage tank and containment	0 -50	The storage tank will be completely damage and lost their integrity
Office Building and other fuel storage supporting facility	50 - 70	The office will also get burn but will the firewater could reduce the severity. All people and valuable good should be evacuated
Project boundary and buffer zone	70 -80	Fence probably not damage and block the radiation to the public
Power Gridline	90 -95	The integrity of power cable may be affected heavily in case major fire

National Road	110	National road access be affected temporarily and required re-route the traffic
Aipelo Old Prison, Aipelo fuel station	270	No impact should be anticipated but precaution to the potential ignition to the fuel station
Beach	40	Beach near the project area should be closed from public access

As presented, the severity of impacts of fire hazard under this stage of project implementation is larger and if the hazard would occur the operation of phase 1 A and B, the net impact would be significant.

Therefore, the similar approach of mitigation measures should be applied in order to response to this emergency risk due to fire. There are two ways to manage the fire hazard, as described already from the previous section; (1) Fire prevention; and fire management system.

Prevention of the fire hazard as described earlier can be achieved eliminating one component that cause fire:

- Eliminate the ignition of fire
- Eliminate and minimize the

1. Design of the system (Storage tank, piping system, office building, etc.) with the highest technical standard in line with the better fire hazard management system. API 650 regarding the design of the tank that will be fire proof and emit the minimum vapor loss (VoCs), which will enhance the fire hazard and air quality degradation.
2. Proper operating procedure in place to minimize the error during the operation of the facility
3. Regularly inspect the equipment and control system to detect any issue earlier prior to creating the operating problem such as leaking of the fuel. This will also eliminate the equipment error that cause the fire hazard
4. Implement proper grounding system with all the electrical equipment to avoid the lighting that ignite the fire inside the facility

When the fire already occurs, the fire management is the solution to minimize the impact from fire from the fire management team. As described already that the option for fire management system or fire response system depends on the size and severity of fire. If fire hazard is considered as an emergency event, the type of emergency should be defined and management would adjust to type of emergency.

- Type 1 of fire event (event that can be handled internally by the fire management team)
- Type 2 of fire (fire scale is large so internal team cannot handled by them self so need external assistant
- Type 3 of fire (very large fire so required other country's help)

Each type shows the level of severity or scale and therefore, required different management response system. Global Oil Terminal LDA will develop the emergency response plan document which includes the fire management system to help minimize the fire hazard impacts.

8.5.4. Soil and Marine Pollution

Similar to the operation of the phase 1 A, except that the volume of the product to be handled become double. In this case, risk or probability for the soil to be polluted would be increased. Nevertheless, the impact to the soil and further to the groundwater is the same and similar approach would be adopted to mitigate the impacts.

8.5.5. Groundwater Quantity and Quality

With increasing the volume of fuel to stored and manages the water demand to be fulfilled from the pumping of groundwater become double or reach the maximum capacity, which is 2000 L/day. However, according the study, as presented in the section 8.3.5, that the pumping rate of 2000 L/day does not create any issue related to the groundwater volume in the groundwater aquifer. However, potentially the impacts as mentioned in the section 8.3.5 could happen, which should be mitigated by the approach presented in the section 8.3.5.

8.5.6. Solid Waste

The quantity of solid waste produce will be double especially the bottom tank product, and the volume of fuel storage would increase double during this phase. The following table provide the calculated/estimated solid waste resulted by this stage of project implementation.

Table 8.24. Summary of Solid Waste Estimation by the Project during the operation of Phase 1 A and B

Type of Waste	Estimated Amount, kg
General Waste, Monthly Rate	720
Hazardous Waste from Bottom tank /5 year	800
Hazardous Material from Surface-washed oil spill, Monthly	1500

The mitigation measures of this impact would be exactly same as the Phase 1 A operation phase.

8.5.7. Air Quality from VoCs

Increasing the volume of fuel product to be stored, the rate of vapor loss and other potential spill that cause the emission of the VoCs would be double compares to the phase 1 A. The mitigation measured of the VoCs would be same as the method in the phase 1 A of project operation.

8.5.8. Occupation Health and Safety (OHS)

Exactly same impacts and mitigation measures approach must be applied in order reduce the risk of accident related to the occupational health and safety (Refer to operation of phase 1 A)

8.5.9. Community Health and Safety

Similar concern of community health and safety to be taking into consideration during the operation of phase 1 A and 1 B. However, large fire impact would be considered the major risk that community in Lauhata will be faced.

The mitigation measures of large fire impacts and explosion:

- Dissemination of information to the community member regarding the fire hazard
- Proper fire evacuation route and evacuate the community members who live nearby project area into the safe point

. Impact during the Decommissioning phase

Though the lifetime of the system according to design, is 25, years, the project owner, plans to continue the business in the selected area as long as the viability of the project justifies. In case, the project is no longer viable due to various reasons such as economic, social, or and other, the project owner has responsibility to decommissioning the constructed system. The project activities during the commissioning stage include removing all the facility from the current location to the new one or shutdown the facility from the existing project. The impacts assessed during the decommissioning stage include:

- Occupational Health and Safety (OHS) related physical activities
- OHS related to biological and chemical exposures
- Dust and air quality issue
- Noise and vibration from the activity of removing the project
- Social and economic impacts such ad loosing opportunity and employment

The above mentioned impacts are only temporary that can be mitigated during the duration of decommissioning activities. Furthermore, the economic and social lost my be need be compensated properly until a new opportunity arrives.

Any commissioning works need to submit new or updated document of environmental impact statement (EIS) to accommodate any change in nature requirement or any regulation change. At this stage, the impacts of social, economic and financial can be project.

In general the impacts and mitigation measures are similar to the construction phase, except that may be major socio-economic impacts that need to be mitigated by the project owner and the government of Timor – Leste.

Table 8.25. Impacts and Mitigation Measure during the Decommission phase

Impact Assessed and Mitigation Measure during Decommissioning phase			
Impacts	Area of Coverage	Particular concern	Mitigation Measure
Occupational Health and Safety	People who work inside the facility	• Work related electricity • Exposure to heat • Exposure to the dust and particular matter • Risk injury related to accident (vehicle, heavy duty equipment, etc.) • Risk of death	• Proper training prior to executing the certain work. Certain special work such as electrical work should be done by person who has certified training related to electrical work • Using the proper PPE (eye, nose, ear, protection system) • Supervisor to control the worker to follow proper working procedures • Temporary medical help in the project site to provide help in case accident • Dedicate team to response the emergency in the field • Evacuate as soon as possible to the nearest help center or hospital • Proper compensation to the death
Traffic disturbance	• Vehicular get in and out of construction area • Vehicle taking the demolished or dismantled material	• Traffic accident • Temporary congestion • Loss of life	• Assign dedicated person to watch and direct the traffic related to construction activity • Response team to help resolve the traffic accident • Proper traffic signal and speed limit • Only license/authorize personnel would allow to operate the machinery/vehicles
Demolition of storage tank	Chemical hazard such as gas that trapped inside the storage tank	• Cause health hazard • Potentially cause death	• Authorize and trained people to dismantled the storage system • Using proper PPE
Noise	Within the project area up to 50 meter radius	• Disturb the convenience of the community • To big noise could potentially cause	• Use the PPE (ear protection equipment) within the project area • Schedule the construction activity only during the day

		the health hazard	time • Apply noise barrier in the perimeter fence
Vibration	Within the radius of 100 m	• Potential collapse of old Aipelo prison • Structural crack of the building within the radius of 50 m	• Monitor the vibration level from the source of vibration and further distance away from the source to know the vibration level • Apply some safer technique of foundation work that produce minimum vibration • Apply PPE for the worker within the project area during the execution of work
Social Impacts	loss of opportunity and job	• 30 people will loss the job and income • Project owner will loss the economic opportunity • Fuel supply will be impacted and potentially the price will increase	• Proper compensation and transition program • Transfer the workers to other similar facility • Find other alternative busies modality
Economic Impacts	Loss of source of income	• No tax payment to the government • Loss of revenue from the project owner • No social corporate responsibility to the local people	• Required a new business modality • Government to diversify the economic into other sector

9. SOCIAL IMPACT ASSESSMENT

Social impact assessment is an integral component of the Environmental Impact Statement as developments can negatively impact socio-cultural advancement and cohesion of a community. For this purpose, assessment of the social impacts is carried out for this EIS paying close attention to the impacts of development to Suco Lauhata.

9.1 Purpose and Objectives

Social impact assessment is carried out with the objectives of analyzing, synthesizing and then coming up with measures to manage the social consequences of a development. This is in particular conducted for the population of Suco Lauhata, the smallest administrative unit where the development is happening.

Impact assessment has been based on results from the baseline study conducted on secondary literature as well as primary study/social field study that are part of the environmental impact assessment. The desk study mainly composed of review of studies on the social characteristics of Suco Lauhata. Much of the secondary literature is sourced from official reports such as Census 2015, Demographic and Health Studies and others. The field study, on the other hand, is conducted using questionnaire and interview of members of local community. For this assessment, no specific set of community groups have been focused on (for example women, youth or fishermen group) due to the belief that the development will not be particularly harmful to these sub-groups of the community.

It should be noted that questionnaire and interview questions being developed for the field study were designed to understand community's perception of the development itself, whether they are aware of the potential impacts of the development and whether they have certain expectations from the development. These types of questions will shed lights on the difference between what is going to materialize through the development and what local community expects out of the development and find ways to help close the gap between expectation and what is possible to happen.

9.2 Social Impact Assessment Context

Socio-culturally, Liquica Municipality is inhabited mostly by the Tocodede ethnic group. This pattern is reflected in Suco Lauhata where it was reported in Census 2015 that close to 80% of the population identified Tocodede as their native language. The second most spoken native language, albeit lower than 20% was identified as Tetum Praca, the national language which is widely spoken in Timor Leste.

As previously discussed in the description of social component, according to Census 2015, Suco Lauhata has a total population of 3,632 with roughly equal distribution of male and female. The number of population has interestingly remained relatively the same to the population counted during Census 2010. This lack of change in the number of local population can be attributed to several factors such as number of birth that is roughly the same as the number of mortality (birth rate at natural replacing rate) or out-migration factor where local youth are migrating to Dili or Liquica in search of jobs. Within the overall

trend of population increase in Liquica Municipality and the country in general, it should be noted that most likely outmigration is the reason behind the lack of population increase for the Suco. Note that Suco Lauhata has a high average number of persons per household consistent with rural Timor Leste in general at 6.8.

Suco Lauhata is located along the national road connecting Dili to Liquica. Given several years of high economic growth and stability experienced by the country, there is high demand for construction material such as sand and rocks. The Dili-Liquica region is a natural location to source these materials given the availability of high quality as well as high quantity sand and rocks for construction. Following this, related industries such as manufacturing of pre-cast concretes proliferate along the main road including within Suco Lauhata and the nearby Suco Mota Ulun.

Over the years, Dili – Liquica road section continues to urbanize with lands on the left and right sides of the road being subdivided and sold by original owners and developed into permanent, concrete housing as well as supporting businesses such as stores, fuel stations, restaurants and others. This urbanization trend, however seems to stop along the national road as areas of the sucos about 100 meters away from the national road typically maintains its rural characteristics with houses constructed from *bebak* or semi-concrete. Socially, this observation is also backed with Census data showing the sucos generally retain its rural characteristics. It is therefore concluded that this region is currently undergoing urbanization especially along the national road with some areas continue to host expansion of industrial land uses (e.g. Suco Lauhata). However, it has also retained much of its rural characteristics where much of the population is farmers with a variety of other livelihood means including fishing.

Another important social context where the development is proposed is the existence of historical site within the Suco. The Aipelo Prison represents important colonial as well as architectural history of the country that should be preserved as it provides a sense of continuation to the current generation, reminding current population of what happened in the past while providing a lesson for the future. From architectural point of view it is also an integral part of the clusters of historical buildings in Liquica town consisting of the former administrative headquarters, former administrator's residence and the former municipal market all built between 1930s and 1940s. These colonial buildings are currently national tourism assets that should be preserved accordingly.

The proposed development is happening within this socio-cultural context emphasizing the need of a development that should pay continuous attention to safety, social cohesion, and opportunities for local community, historical preservation and conservation of the environment.

9.3 Legislative and Regulatory Considerations

In the context of social impact assessment, a review of legislation and regulations is conducted to better understand the legal context for social safeguarding. The review starts with Decree Law No. 5/2011, where two provisions are found to be very relevant – (i) provision on public participation and (ii) provision on impacts and benefits agreement. These two provisions are presented in the following table.

Table 9.1 Social Safeguarding Provisions in Decree Law No.5/2011

Chapter	Article	Article Title	Main Point
IV	11	Public Consultation	Establishing the main objectives of the consultation which includes providing access to public document, providing information on potential environmental impacts and mitigation measures; establishing timing and requirement/procedures for public consultation
V	15	Impacts and Benefits Agreement (IBA)	Establishment of the IBA as the legal instrument for communities around or near the proposed Category A projects to enter into an agreement that defines rights and obligations between the community and project proponent in relation to traditional land use, customs and community rights to the scale of potential impacts identified in the EIS.
	16	Negotiation of the IBA	Timing of the IBA negotiation, process, facilitation, conflict resolution and status of the IBA as a "statute."

In addition to the Decree Law No.5/2011, the Environmental Base Law – Decree Law No. 26/2012 also contains provisions on social safeguarding. It should be noted that these provisions on social safeguarding should be understood within the primary purpose of the Environmental Base Law which is to define the framework of environmental policy as well as the guiding principles for conservation and environmental protection as well as sustainable use of natural resources. All for the ultimate goal of increasing the quality of life of the citizens of Timor Leste. The following table discusses provisions relevant to social safeguarding in the Environmental Base Law.

Table 9.2 Social Safeguarding Provisions in Decree Law No.26/2012

Chapter	Article	Article Title	Main Point
I	6	Rights of Citizen	Establishing the right to participate in environmental protection, the right to access environmental information and education
	7	Duties of Citizen	Establishing citizens' duty for the conservation, protection and improvement of the environment
	8	Tara Bandu	Recognizing the role of Tara Bandu as a mechanism to regulate relationship between humans and the environment,
IV	24	Surface and Groundwater	Guaranteeing access to and sharing of water resources among users; Guaranteeing participation of local community especially vulnerable groups in water management
VII	49	Access to Environmental Information	Establishing open access to environmental information system and the need to develop a specific mechanism for public consultation for programs, plans and projects

The operationalization of these social safeguarding provisions are made clearer through the passing of relevant regulations including – (i) Ministerial Diploma No. 44/2017 on Regulations on Impacts and Benefits Agreement and (ii) Ministerial Diploma No. 47/2017 Regulations on the Procedures of Public Consultations.

9.4 Analysis of Key Social Issues

Social diversity and gender issues are very relevant in the context of Timor Leste. They are in fact, thought as key social issues that influence the overall well-being of local communities. While previous reports such as the UNDP Millennium Development Goals report for Timor Leste 2009 noted that gender equality is improving based on indicators such as higher enrollment of girls compared to boys in Primary and Secondary education, recent reports highlight pressing emerging issues indicating that there are more to be done related to gender equality in the country. A recent report has been released in 2017 by UNFPA, Plan International and the Secretary of State for Youth and Sport on Teen Pregnancy and Early Marriage in Timor Leste further shed lights on the plight of young women in the country. Data showed that about one in four young women in Timor Leste already have a child by the time they turn 20 years old. This fact is a concern given the high maternal mortality rate persisting in the country. In fact, the report expressly noted that Timor Leste teenagers have been found to be twice as likely to die in child birth compared to older women. The root cause of the situation has been found to be lack of access to adequate information on reproductive health, entranced gender inequality issue leading to lack of power on young women in exercising decision making on whether or not to enter into sexual relationships as well as in some cases, abuse.

Another useful gender related indicator is the participation of women in the labor force. Recent UNDP report found that there is still less women engaged in wage employment in the non-agricultural sector compared to men. This situation is a reminder of more works that needs to be done to achieve more social equality especially in the rural side of the country. One of the implications of this gender relation for the project is the opportunity to contribute to improving the situation through contribution to social programs and by consciously giving preference for women workers for appropriate jobs that will be available during the construction (e.g. janitorial and administrative jobs) and during the operational phases of the development.

Social institutions in Timor Leste constitute of local administrative authority, representative of national agencies such as educational and health institutions, the Catholic Church and church-related institutions that are presents in many parts of the country including convents, dormitory, parochial housing and others. Civil society groups can be found in the form of national and international Non-Governmental Organizations (NGOs), local cultural groups, or martial art groups. The latter group – martial art groups, however, has been banned from public gathering and any other activities for the negative influence it has on the youth and the social problems it generates. Specifically in Lauhata, a local church is present as well as local authorities and primary educational institutions.

Important local stakeholders to the proposed development include local authority, close by community, local church and others. Local authority and other local stakeholders has been consulted and generally welcoming the proposed development although he noted on the need to ensure jobs for local population and to have adequate safety protection from fire accidents.

As part of the preparation of the EIS, public participation is actively sought out and stakeholders are contacted to participate in several public community meetings held. Detailed accounts of participating

stakeholders, their input, comments and questions are provided under the Transparency and Consultation Section.

It is believed that opportunities for participation have been provided sufficiently enough through stakeholder meetings and interview with community members. Later on, during project construction and O&M phases, opportunities for citizen's grievance about the proposed development should be channeled through several mechanisms as follows:

1. Direct mechanism where citizens or affected community members come and logged their input or complaint directly to the office during office hours
2. Indirect mechanism where affected community contacted local authority, be it *chief de Aldeia* or *chief de Suco*
3. There is also outreach mechanism that should be implemented by project owner where the management routinely conducts an outreach meeting with local community, for example, once a year. This kind of outreach can be organized with the help of local authority. A routine community gathering is also a good way to ensure good relationship between facility management and local community although community expectation should be properly managed during the interaction.

Social risk analysis point out to one key social risk from the proposed development – historical preservation as other potential key risks usually found in rural community facing scalable development such as land ownership and loss of access to natural resources are not found to be threatening social fabrics of the local community. Land ownership is the government and local community in the Suco Lauhata while local fishermen access the coast from coastal stretch to the east of the Cement Packing plant; therefore, none of their access points are affected. Historic preservation is under risk from environmental impacts, which is the noise and vibration impacts potentially affecting the integrity of its structure.

9.5 Strategy to Achieve Social Development Outcomes

Given the socio-cultural context of local community, likely social development outcomes that can be expected from the project consisting of both negative and positive outcomes during the Construction and Operation phases of the development. Negative outcomes during the Construction phase could materialize due to concentration of workers in the facility or the construction yard nearby. This concentration of workers, while temporary, has the potential to create tension in the community for unruly behavior. Also during the Construction phase, negative impacts could also come in the form of impacts to the integrity of historic building complex in the Suco. During the Operational phase, positive impacts can be realized mostly through the socio-economic impacts of the development to local population in the form of provision of jobs including inclusion of women workers for appropriate jobs as well as in the form of routine social contribution from facility owner to the local community. Ultimately, the presence of a feasible private development that is socially conscious lead to the realization of a long term social

development outcome which include higher skill level for local labor force, provision of stable jobs with its subsequent benefits such as upgrading of houses, opening of small businesses, educated children and others.

9.6 Implications for Analysis of Alternatives

Implication of social impact only occurs for the non-development option, where many of the social benefit will not be realized. On the other hand, development option only contribute to the small social impact, except in the case of catastrophic event, such as major oil spill and fire that are uncontrollable by the emergency response team, which may cause large social problem

9.7 Recommendations for Project Design and Implementation arrangements

The Timor Leste checklist for preparation of Environmental Impact Statement requires the document to incorporate guidance or recommendations on how to integrate social development issues into project design and implementation arrangements including the preparation of Impact Benefits Agreement when needed. This requirement is considered very positive and help ensuring negative social impacts resulting from rapid development pace the country is undertaken can be avoided, mitigated or offsetted.

As for the proposed development, given the socio-cultural and socio-economic characteristics described above, also within the potential negative impacts identified based on the assessment, no resettlement plan or impact benefit agreement has been recommended as no direct or widespread social impacts will be imposed on the community. Nevertheless, an integration of social development issues into implementation arrangements are strongly recommended through the following measures:

1. Absorption of local labor into the facility: this should start right from the Construction Phase of the development and during the Operation and Management Phase.
2. Opportunities for women labor: during the Construction as well as the Operation phases, the facility should actively identify job opportunities at the complex that are appropriate for women labor and then clearly indicate in job advertisement or in outsourcing of the job that women are preferred candidates for the job. It should be emphasized that this opportunity for women labor is especially important during the Operational phase, since jobs provided during the Operation Phase tend to be permanent and stable positions which will positively impact the community as well.
3. Training for facility employees: trainings for facilities employees should be pursued in a continuous basis with tangible and measurable results. For example, upper level management that will be filled with foreign employees at the beginning of the operation should be filled with Timor Leste citizens within several years.
4. Social contribution: routine social contribution should be made to local community and should contribute to meeting long term needs of the community. For example, contribution to support implementation of local sport events leading up to independent day celebration, small grant that

goes to support facility or equipment of local primary school, or other appropriate social contribution that help to enhance local cohesion and well-being.

Positive social outcomes will be able to be achieved through routine outreach and close relationship between the project owner and local authority. This outreach and relationship building can be facilitated by Marketing or HSE or other appropriate division whose job description and performance indicator clearly reflects the need to engage meaningfully with local community. It should be noted that while engaging with local community is a positive thing it also run the risk of building up too much expectation on the part of local community that can not necessarily be met by facility owner. This situation requires a thoughtful, measured and consistent approach that should be well communicated between high level management and those implementing the work.

9.8 Monitoring Plan

Monitoring for social impacts should be pursued through the implementation of a monitoring and evaluation framework that clearly identifies expected social development indicators as well as organizational responsibilities in terms of monitoring, supervision and evaluation procedures. The following table contains the monitoring framework for social impacts from the proposed facility.

Table 9.3. Monitoring Framework for Social Impacts

No	Social Impacts	Indicator	Responsibility
Construction Phase			
1	Historic preservation	Damage to the Aipelo Prison structure	Project proponent and contractor
2	Job opportunities expanded to Suco Lauhata population	Grievance or complaints from local population	Project proponent and contractor
Operation Phase			
1	Job opportunities expanded to Suco Lauhata population	Grievance or complaints from local population	Facility management
2	Opportunities for women workers	Grievance or complaints from local population	Facility management
3	Training for local employees	Progressive responsibility for local workers	Facility management
4	Social contribution to Suco (not social impact per se)	Grievance or complaints from local authority	Facility management

10.ECONOMIC IMPACT ASSESSMENT

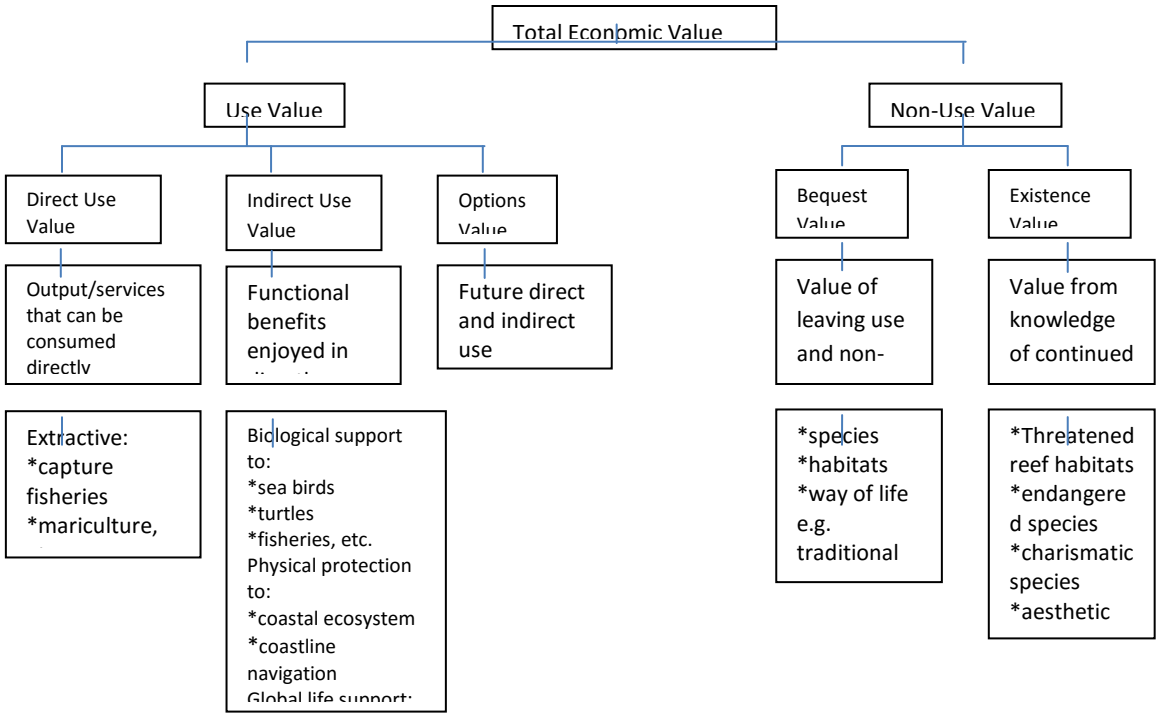
Economic impact assessment is very important to be considered, as the impacts that potentially arise during the project implementation could affect the economic loss. This economic loss should be estimated in order to provide an estimated of the net economic loss due to the presence of the project without any application of mitigation measure.

- Potential economic loss due to the presence of the project (without any mitigation measures)
- Potential economic -net loss after the mitigation measure to the impacts
- Residual economic loss, if any

10.1 Economic Loss Estimation

Economic loss due to environmental impacts from the proposed development can be estimated using several tools developed by environmental economists. The most widely used tool for economic loss prediction is the Total Economic Value (TEV) tool that sum up the Use Value (UV) and Non-Use Value (NUV) of resources (Figure 10.1). The UV consists of values derived from actual use of resources, actual services derived from the ecosystem function and values that represent people's willingness to pay to ensure that environmental goods can be available to them at a later date. While the NUV, on the other hand, consists of values attributed to environmental goods just by existing as well as value attached to the ability to leave behind the environmental goods for the next generation (bequest value).

Figure 10.1 Total Economic Value



Oil spill has the potential to impact coastal environment especially mangrove ecosystem along the coastal locations. Mangrove forests are sensitive ecosystems that provide significant economic goods and services to local, regional as well as global community. Economic quantification of these goods and services have become a focus of studies lately as it becomes evident that these resources are facing threat from various economic activities taking place in the coastal areas or otherwise.

In Timor Leste, a study on economic valuation of mangrove ecosystem published in 2017[10] shed lights on the economic values of mangrove ecosystem. The study employs the TEV method and looks at mangrove forests in holistic ways in that it provides critical ecosystem services which is not only provisioning for wood and fuelwood but also other services as noted in the following table. This is in conformance with the Millennium Ecosystem Approach which is based on recognition of mangrove forests and other ecosystems as not only generating physical products but also provides primary life support services that are important for anthropogenic wellbeing and livelihoods in areas that are studied.

Table 10.1 Critical Ecosystem Service of Mangrove

No	Ecosystem Service	Examples
1	Supporting	Nutrient cycling, soil formation
2	Provisioning	Food, fresh water, wood, fuelwood
3	Habitat provisioning	As nursery for fish
3	Regulating	Climate and flood regulation, biodiversity support
4	Cultural	Aesthetic, educational, recreational

The study was conducted using three-tiered approach – (i) **first**: calculation of direct value of mangrove products. This assessment is conducted using current market prices based on household survey on use and prices of products from mangrove ecosystem; (ii) **second**: calculation of value of habitat provisioning services provided by mangroves paying particular attention to the support it provides to offshore fisheries. The study did not include estimation of mangrove-based tourism as it was found that no mangrove-based tourism exists in Timor Leste; (iii) **third**: valuation of regulating services including shoreline protection and coastal flood regulation and biodiversity support using Willingness to Pay (WtP) method.

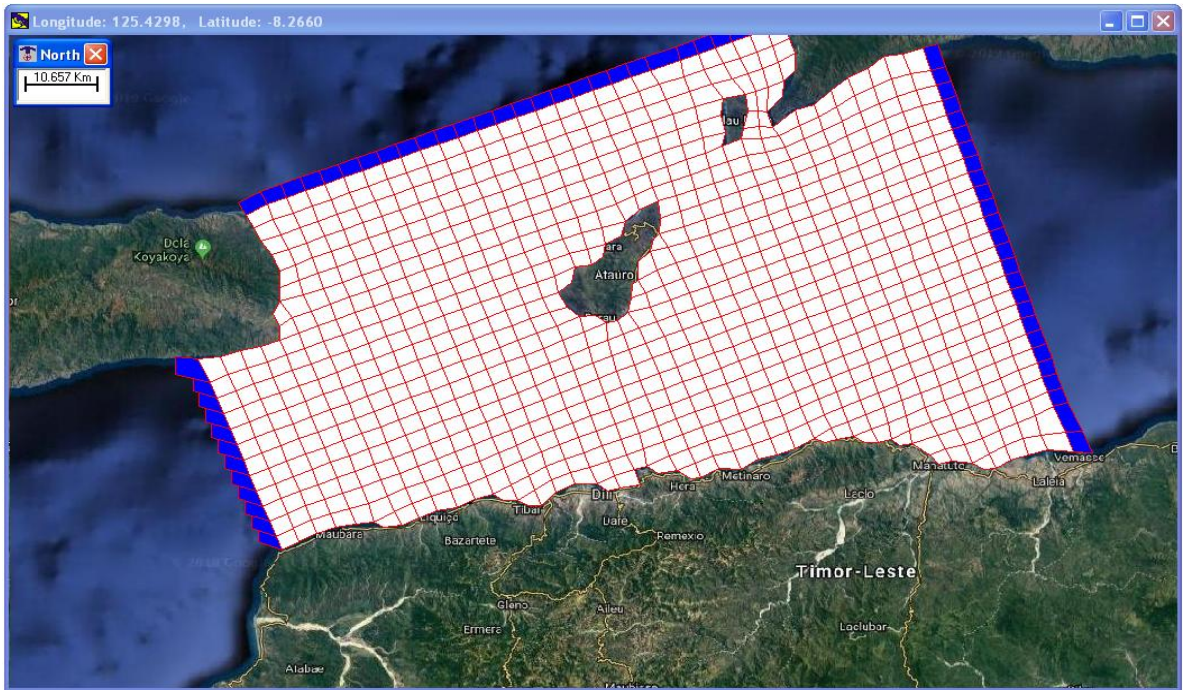
Results from the study show a Total Economic Valuation of USD 55,538.00 per hectare per annum for mangrove ecosystem in Timor Leste. When applied to mangrove areas along the northern coast of Timor Leste within the area of influence boundary which covers up to Tibar Bay area to the East and up to Maubara (Figure 10.2) to the West, it was found that the maximum potential economic loss could amount to figures shown in the following table.

[10] United Nations Development Program (UNDP), 2017, Economic Analysis and Implementation Strategy of Selected Mangrove Supportive Livelihood Options for the Targeted Coastal Community of Timor Leste.

Table 10.2 Potential Economic Loss from Impacts to Mangrove Areas from Oil Spill

Direction from Project Site	**Mangrove Ecosystem Areas (Ha)**	**TEV per Ha per Annum**	**Maximum Potential Economic Loss**
Eastern	54	USD 55,538.00	USD 2,999,052.00/year
Western	10	USD 55,538.00	USD 555,380.00/year

Figure 10.2 Areas Potentially Impacted from Oil Spill



10.2 Cost, Benefit and Cost Effectiveness of Mitigation Measures

Actual impacts from oil spill will depend on the scale of spill and other factors such as seasonal variations influencing actual amount of oil making onshore landing and area covered by oil layer. Mitigation measures in place have the potential to mitigate impacts from spill, however, there are also outside factors such as weather which will determine effectiveness of the mitigation put in place. For example, in the case of spill during unloading of oil at the jetty and failure from pipe that convey fuel from jetty to the storage, oil will end up in marine environment. Mitigation measures such as oil boom followed by pumping out or application of dispersant will be in place, however effectiveness of preventing oil from running loose into the larger marine environment will also depend on weather and other factors. Cost of mitigation measures are provided in the following table.

Cost effectiveness of mitigation measures depends on many factors and in some circumstances, even though mitigations measures are all in place, spill cannot be contained effectively resulting in needs to carry out cleans up on the coastal area. In regard to oil spill in marine environment, a recent study[11] has noted the following:

1. Weather condition determines effectiveness of mitigation measures. For instance, in the event of bad weather, containment and collection system could fail against high speed winds, waves and currents while the use of dispersants might not effective enough on water-in oil emulsions (mousse being formed). This could result in the need to do clean up.
2. Cleaning up is generally more costly on the coastal area than in the sea, especially when sensitive ecosystem is involved – therefore as much as possible, when spill happen and containment around the spill fails, when deemed necessary – for example in the event there is large enough spill, defensive booming protecting sensitive ecosystem should be employed increasing overall effectiveness of the mitigation measures.

On the other hand, cleaning up could be straightforward after oil has made it to the shoreline, especially when no sensitive ecosystem is involved. Cleaning up of shoreline is also a largely manual undertaking generating temporary jobs for local community. All of this should be taken into consideration in the event of out of control spill.

10.3 Other Impacts Not Expressed in Monetary Value

In addition to discussion on the above potential economic impacts, it is also important to quantitatively discuss impacts that have not been expressed in monetary value either because it is hard to put a financial value on it or because it is deemed unnecessary to do so.

These types of impacts included impacts related to the protection of workers from injury and loss of life from fire accidents. For a high-risk facility such as terminal oil storage, should an accident happen, there is a real possibility that workers can be debilitating injured and lives lost. A few recent industrial accidents including one that happened at an oil storage facility have proven that protection of workers within the facility is something that should be taken seriously.

Monetary consequences for workers' injuries or lives lost can be transferred from facility owner to insurance, however, stigma attached to a facility that has had significant fatal accident will demoralize the workforce and community living close to the facility. In addition, government authorities, civil society organizations and other communities whether they live close by or not will also question the viability of a large depot operated by private sectors. All of these are impacts that are hard to put monetary value on, therefore, safety standards and procedures should always be implemented unfailingly.

[11] I.C. White and F.C. Molloy, "Factors that Determine the Cost of Oil Spills", International Tanker Owners Pollution Federation Limited, London, United Kingdom.

11. SUMMARY OF ENVIRONMENTAL MANAGEMENT AND MONITORING PLANS (EMMPS)

Environmental management plans (EMP) in this section summarized the general overview of project development proposal, identification of environmental impact including the necessary environmental parameters identification, mitigation measures to be taken on each identified impacts, monitoring plans for effective implementation, as well as summary of necessary emergency plan to response the emergency condition.

Based on various impacts that was assessed and quantified by this study, an environmental management plan will be proposed to mitigate or offset each impact. The scope of the management plan shall include mainly the following:

- Measures related to the management of impacts to the integrity of the project from flooding by adjusting project design and construction of the floor level. Including in the management measure is flood prone design and construction of the facility incorporating proper rain frequency parameter. A river training work could also be proposed.
- Measures related to mitigating risks due to accidental spill of oil/fuel in the marine waterbody
- Measures related to mitigating risks from fire accidents
- Emergency response system for accidental spill and fire.
- Managing impacts due to occupation health and safety system

Environmental Management Plans (EMP) that will be proposed by this study shall cover the phase 1 –A of project implementation, which include pre-construction, construction, operation and maintenance, and de-commissioning stages. If the decision to proceeded the construction of the phase 1 B shall be made, then the project owner will submit the updated EMP that covers the construction of the phase 1 B, operation of phase 1 A, and operation of phase 1 B, as well as decommission of phase 1 A and phase 1 B

The following section present the summary of EMP and necessary monitoring program to ensure that the EMP is implemented so that the project objective achieve on one hand and the environmental and social impacts are also management sustainably.

11.1 Project Overview

The project owner, Global Oil Storage Terminal, LDA, is an international company from Singapore that has established downstream petroleum product business in Timor – Leste, would like to construct and operate the fuel terminal Suco Lauhata, posto Administrasaun Bazartete, Municipio Liquica, Timor – Leste. The total capacity of storage tank is 10,000 KL, where 5000 KL is designed for gasoline and 5000 KL for diesel fuel storage.

The scale and impacts of the project would be considered significant, according environmental licensing law of Timor – Leste. The environmental authority has already classified the proposed development project as category A, which contribute the adverse impact to the environmental, social, and economic. These impacts should be assessed according to the regulation in order to minimize the impact during the project implementation. The project owner, nominated the environmental consultant company to prepare the environmental impacts statement (EIS) document and environmental management (EMP) plan for the regulatory agency prior to the approval of the project design and eventually construction of the fuel terminal facility.

11.2 Environmental Parameters Identification

The environmental impact assessment study consist of baseline data collection, impact assessment, which include quantification of the major impacts, proposed mitigation measures, community and stakeholder consultation.

The environmental parameter measurement and identification consist of

- Marine water quality sampling and measurement
- Bottom sediment data collection
- Soil quality measurement
- Groundwater pumping test and quality assessment
- Surface water quantity modeling (flood estimation)
- Surface water quality assessment
- Air quality measurement and assessment in term of PM and flue gases
- Geotechnical site investigation
- Oil spill modeling and hydrodynamic
- Reviewing other relevant studies

All of these environmental parameters measurement would provide background information prior to the commencement of the fuel storage terminal facility. The result of all the above measurement and impact assessment have already present in throughout this document.

11.3 Summary of Environmental Management Plan

Environmental management plan (EMP), is plan that describe various technical and non-technical methodologies to mitigate the impacts as assessed earlier. Combination of both technical and non-technical approaches would normally produce a better outcome in solving a particular environmental issue to achieve the objective of the management system.

11.3.1 Managing Impacts during Construction Phase 1 A

The following table provides the summary of both technical and non-technical approaches of the management techniques that will be applied to reduce or mitigate the impacts.

Table 11.1. Technical and Non-technical Management Plan during the Construction of Phase 1 A

Impact	Environmental Management Plan Approach - during Construction		
Impacts	Technical Approach	Non –Technical Approach	Cost of Implementation
Air quality Degradation (SO_2, CO_2, PM, NO_2)	• Resuspension of particulate matter using water • Construct the fence to isolated the area of construction	• Measure the PM level in case any complaint • Application of latest version of equipment that produce less flue gases • Measure the flue gas level during the construction to know if any major issue related to the gases	$45,000
Marine water quality Degradation from sediment	Application of temporary detention basins to filter the sediment	Measurement of the turbidity of marine water	$15,000
Occupational Health and Safety	• Application of proper PPE (eyes, nose, ear, body, foot, etc.) • Evacuate as soon as possible to the nearest help center or hospital • Temporary medical help in the project site to provide help in case accident	• Proper training prior to executing the certain work. Certain special work such as electrical work should be done by person who has certified training related to electrical work • Using the proper PPE (eye, nose, ear, protection system) • Supervisor to control the worker to follow proper working procedures • Dedicate team to response the	$70,000

		emergency in the field • Proper compensation to the death	
Traffic disturbance	• Installation of signage near the facility to inform general traffic those construction vehicles might make an access in and out of the facility • Traffic signal and traffic management system	• Appointing designated personnel to help smoothing traffic out during an especially heavy vehicle movement • Regulate speed limit in and out of project area Only authorize personnel must drive the vehicles	$20,000
Noise	• Provision of personal protection measures from noise to workers (see section on Occupational Health and Safety) • Construct the noise barrier to isolate the noise source or increase the travel path of noise	• All noise-generating equipment should be insulated and well maintained to ensure that they operate within the noise limits they were designed to operate. • Operation of noise generating equipment should only be during the day •	$5,000
Vibration		• Monitor the vibration level from the source of vibration and further distance away from the source to know the vibration level • Apply some safer technique of foundation work that produce minimum vibration • Apply PPE for the worker within the project area during the execution of work	$5,000
Total Cost			$155,000

11.3.2 Managing Impacts during Operation of Phase 1 A

The following table provide the management plan and approach to minimize the impacts arise during the phase 1 A operation.

Table 11.2. Summary of Environmental Management Plan (EMP – Technical and Non-technical Approaches

Impact	Environmental Management Plan (EMP) during Operation of Phase 1 A		
Impacts	Technical Approach	Non –technical approach	Cost Estimate of EMP
Flooding	• Construction of retaining flood protection in the river • Elevated the floor level • Construction of main drainage canal • Construction of oil-water separator • Isolated a major spill and cleaned up quickly prior to the heavy rain • Coastal wall protection	• Frequent washing the ground where the oil spill prior to the heavy rain • Emergency flooding insurance for higher frequency of 50 -years • Flooding warning system and emergency preparedness • Flood emergency response • Monitoring the rainfall • Emergency response planning and recovery system • Monitoring the tidal level • Measurement of rainfall at upstream area	$1,000,000 The cost mainly for the flood protection infrastructure
Major oil spill in Storage and in Jetty	• Purchase Oil Boomer • Oil Skimmer • Chemical Absorbent • In-situ burning system • Coastal Cleaning • Mangrove re-planting • Coral rehabilitation • Cleaning of the impacted beach • Design and construct the fuel terminal and other	• Developed the proper operating procedure in every part of operating system • Proper communication protocol during the operation • Prepare emergency oil response planning and team • Monitoring of marine water quality • Implement emergency response plan • Compensation to the loss	Technical cost = $100,000 With this technical cost, it is expected that the cost of compensation and environmental restoration would be small

	supporting facility with the highest standard in the industry to minimize the equipment error and equipment failure	• Compensation to the economic loss • Coordinate with the national and international team to help in case of major large oil spill • Provide public information to close the beach access due to pollution form the oil • Compensation of the economic loss, especially coastal community who are rely on the income from the coastal resources • Proper community engagement plan • Proper insurance system	If the major spill occurs and technical approaches are not effectively mitigated, the cost of compensation and cleaning would be expensive: • Cleaning cost = $500,000 • Restoration = $2,000,000 • Compensation = $10,000,000 **Total cost of non-technical mitigation = $12.5M**
Fire Hazard	Fire prevention plan: • Proper spacing the storage tanks • Using the water coolant to control the temperature • Proper detection of fuel leaking (automatic sensor) • Provide the robust fire equipment system • Proper design and construction according to the best international standard (fire proof) • Proper grounding system to avoid the lighting	Fire prevention plan: • Major fire could be prevented by design and construction of the storage tank/yard according the best international specification and ANPM • Fire drill periodically to build fire awareness in the entire facility • Proper operation procedure of loading and unloading of fuel from the tank • No smoking in the fuel storage area • Fire proof commissioning to ensure that the system already design with high standard of fire protection system	**$200,000**

	Fire Management Plan • Installation of fire equipment system to kill immediately before the fire getting bigger • Proper procedure to be in place to regulate the operation so that the spill of fuel can be minimized • Proper control the operation system so that any failure could be detected (such as fuel spill) • Fire water and sprinkler system • Fire foams system • Perimeter fencing should be fire proof so that no fire bushes from outside the project facility should affect the project • Ensure that the pipe (fuel pipes) is properly connected to the tanker and proper inspection by the certify person prior to pumping of the fuel from tanker in the jetty to the fuel storage system	Fire Management Plan • Fire alarm system and evacuate people from the place fire to the assembly point to further moving away from the storage yard • Isolate the area that under the fire • Evaluate the scale of emergency and mobilize the resource to response the emergency (ties1, tier1, tier 3) • Mobilize the internal team of fire fighter to kill the fire (tier 1) • Communicate with external agency to mobilize any help require in responding the emergency • Evaluate the incident to know the cause of the fire for future improvement • Apply fire damaged compensation (insurance) • Restore the emergency condition • Special team need to be ready during the loading and unloading of the fuel tanker • No smoking must be allow during the unloading of fuel tanker in the jetty • Unloading during the good weather (to avoid unnecessary accident) to avoid fire incident	1. Total Investment of fire equipment system = $200,000 2. Small Fire- Tier 1 – Emergency fire, the cost = $45,000 3. Fire scale – tier 2, cost = $200,000 4. Fire scale – tiers 3 , the cost = $ 3- 5 M

Soil pollution from oil spill	• Soil remediation system • Monitoring periodically to detect as early as possible the pollutant transport from the soil to the soil column	• Minimize the spill by proper design and operation • Taking the soil sample within the project area once a year to measure the soil quality • Management the oil spill in the facility to prevent the transport of contaminant to the soil column • Wash periodically the ground surface that that contaminated by the minor oil spill • Follow the proper SOP in transferring the fuel to minimize the risk of spills	1. No spill major soil pollution , then cost = $15,000 2. If soil pollution occur, then remediation could be costly; estimated be ranged from $50,000 – 500,000 (depending on the spill scale)
Groundwater	• Enhance tree-planting in the upland catchments to achieve more recharge rate of rainfall to groundwater • Help population by providing water supply if their shall well get dry • Sampling measurement of the groundwater to detect the trend of water quality change	• Monitoring the water utilization rate within the facility to optimize the water utilization • Monitor the groundwater pumping (drawdown level in the aquifer) Minimize the spill in the ground surface • Response quickly to the spill so that the risk of contaminant transport downward will be reduced • Inform the government that groundwater is contaminated and stop utilization of groundwater • Pumping out the contaminate water and treated it polluted water • Measure also the well in surrounding project area if the polluted well is localized or entire aquifer	1. Cost of monitoring = $15,000 2. Mitigation measures if problem occur with groundwater quality,; cost can be expensive: $100,000 - $500,000

Solid waste impacts	• Collect properly the solid waste and apply 3R (recycle, reused. Reduced, and disposal) • Dispose the waste into Tibar control landfilled area • Mange the solid waste to achieve the minimum target to landfill • Have proper treatment system of hazardous material (see the method of treatment at the part of waste management) • Produce the concrete material from hazmat (liquid hazmat is mixed within the concrete cement and produce concrete block • Apply special treatment method onsite or out scorching the external company to treat the B_3 waste Treated the oil residue and recycle into the reusable fuel (third party should be contracted to do it • Deliver the oil residue to the third party that already has proper oil residue treatment in place	• Promote the education on the proper collection system • Proper design of the waste collection system in the facility with the indicative signage -	Total cost = $30,000

	• Deliver the oil residue to Tibar (government provided the holding tank) • Proper collection of the waste to be handled by the third party		
Traffic management	• Proper traffic management system • Proper traffic signal • Proper parking arrangement	• Designated person to watch the traffic and manage it • Limit the speed limit in the project area • Only authorize person could drive the vehicle	$5,000
Climate change	• Proper design and construction of the sea wall protection • Elevated floor level at the storage yard (based on tidal measurement and HAT data) • Adjust the groundwater treatment, as the water will be getting salty • River improvement • Retaining wall • Proper drainage system	• Construction of Water storage • Minimize the water utilization • Sea water treatment (optional) • Provide water to the community	Major cost already provided in the flooding protection system
Occupational Health and Safety	Proper Design and Operation	• Integrity of workplace structure • Severe weather and facility shutdown • Woks space and Exit	Part of the design and construction cost

		• Fire Precaution • Lavatory and Shower • Portable water supply • Clean eating area • Lighting • Safe access • First Aid • Air supply • Work Environment Temperature	
	Communication and Training	• OHS training • Visitor orientation • New employee and contractor training • Area Signage • Communicate Hazard code • Labeling Equipment	Part of the design and construction cost
	Physical Hazard	• Rotating and Moving Equipment • Noise • Vibration • Electrical • Eye hazard • Welding/Hot work • Industrial Vehicle Driving • Working Environment Temperature • Working at height • Illumination	Part of the design and construction cost
	Chemical Hazard	• Air quality • Fire and explosion • Corrosive, oxidation, and reactive chemical • Volatile Organic compound	Part of the design and construction cost

	Other Special Hazard		
	Peroneal Protective Equipment (PPE)	Protection equipment to protect various part of the body to prevent the hazard (eyes, nose, ear, skin, hat, body, foot, etc.)	$50,000/year
Community health and safety	• Groundwater accessibility • Traffic accident • Large fire hazard	• Water conservation and monitoring system • Traffic management system • Fire hazard management and socialization to the community members in Lauhata, as well as evacuation route	Cost ~ $50,000/year
Total Cost of EMP			1. CAPEX = $1,332,000 2. OPEX Without major accident = $300,000 3. Cost with Major accident (oil spill or fire) = $17,600,000

11.3.3 Managing Impacts during Construction Phase 1 B

Table 11.3. Summary of Management Plan and Costing of EMP

Impact Assessed and Mitigation Measure during Construction of Phase 1 B			
Impacts	Technical Approach	Non – technical Approach	Cost of EMP
Occupational Health and Safety	• Using the proper PPE (eye, nose, ear, protection system) • Evacuate as soon as possible to the nearest help center or hospital • Proper compensation to the death	• Proper training prior to executing the certain work. Certain special work such as electrical work should be done by person who has certified training related to electrical work • Supervisor to control the worker to follow proper working procedures • Temporary medical help in the project site to provide help in case accident • Dedicate team to response the emergency in the field	Total cost = $10,000
Traffic disturbance	• Proper traffic signal and speed limit	• Assign dedicated person to watch and direct the traffic related to construction activity • Response team to help resolve the traffic accident • Only license/authorize personnel would allow to operate the machinery/vehicles	$4,000
Noise	• Use the PPE (ear protection equipment) within the project area • Apply noise barrier in the perimeter fence	Schedule the construction activity only during the day time	$5,000
Vibration	Apply PPE for the worker within the project area during the execution of work	• Monitor the vibration level from the source of vibration and further distance away from the source to know the vibration level • Apply some safer technique of foundation work that produce minimum vibration	Cost = $10,000
Total Cost EMP Phase 1 B – Construction			$33,000

11.3.4 Managing Impacts during Operation of Phase 1 A and Phase 1 B

This section is same as the Phase 1 A operation, the scale of emergency would be similar, except the frequency, of occurrence, which could be higher. Nevertheless, the mitigation and management plan to handle the impact are the same, except during the emergency of major fire, could involve the large fuel volume. In this case, the contingency cost would be increased.

11.3.5 Managing Impacts during Decommission Phase

Decommission phase is not anticipated and only the case in an emergency condition, such as large fire that cause major damaged or perhaps, if the project owner violate or damaged environmental that cause the government to stop the fuel storage operation, or else in any case, where the project owner found out that the business case of the project is no longer justified commercially, which force the project owner to stop the operation. In these circumstances, the managing the impacts would be necessary. The following table provide a rough cost estimated on the mitigation measures during the decommission phase.

Table 11.4. EMP and Costing during Decommission Phase

Environmental Management Plan (EMP) and Costing during the Decommission Phase			
Impacts	Technical Approach	Non-Technical approach	Cost of EMP
Occupational Health and Safety		• Proper training prior to executing the certain work. Certain special work such as electrical work should be done by person who has certified training related to electrical work • Using the proper PPE (eye, nose, ear, protection system) • Supervisor to control the worker to follow proper working procedures • Temporary medical help in the project site to provide help in case accident • Dedicate team to response the emergency in the field • Evacuate as soon as possible to the nearest help center or hospital Proper compensation to the death	$20,000
Traffic disturbance	• Proper traffic signal and speed limit	• Assign dedicated person to watch and direct the traffic related to construction activity • Response team to help resolve the traffic accident • Only license/authorize personnel would allow to operate the machinery/vehicles	$5,000
Demolition of storage tank	• Using proper PPE to minimize exposure to the hazard	Authorize and trained people to dismantled the storage system	5,000
Noise	• Use the PPE (ear protection equipment) within the project area • Apply noise barrier in the perimeter fence	• Schedule the construction activity only during the day time	2,500
Vibration	• Apply PPE for the worker within the project area during the execution of work	• Monitor the vibration level from the source of vibration and further distance away from the source to know the vibration level • Apply some safer technique of foundation work that produce minimum vibration	2,000

Social Impacts		• Proper compensation and transition program • Transfer the workers to other similar facility • Find other alternative busies modality	200,000
Economic Impacts		• Required a new business modality • Government to diversify the economic into other sector	
Total cost of EMP – Decommission Phase			$285,000

11.4 Overall Mitigation and Monitoring Roles and Responsibilities

11.4.1 Implementation of the EMMP

Project proponent, Global Oil Terminal LDA will be the sole responsible party for the implementation of the Environmental Management Plans (EMP). All measures identified in this document shall be implemented according to the specifications identified below.

11.4.2 Monitoring Responsibility

The project proponent will also be solely responsible for implementing the Environmental Monitoring Plans. All monitoring measures identified in this document shall be implemented according to the specifications included in this report.

11.4.3 Inspection Responsibility

Based the Decree law 5/2011, the National Directorate of Pollution Control and Environmental Impacts (NDPCEI) have the right to inspect the implementation of both the Environmental Management and Monitoring Plans for any major project development facility. However according the organic law of VIII Constitutional Government, Ministry of Petroleum and Mineral Resources, is the competence agency to issue the environmental license. Therefore, ANPM should also be responsible for the inspection of the implementation of EMPs. Regular or spot inspections of the implementation of the EMMP will be conducted. Additionally, air, water and soil quality may be checked visually in the beginning and using methodological laboratory tests as needs arise.

Other agencies, related to any particular concern of the impacts could also be involved in the inspection on the ad hoc basis. The following agencies may involve on the ad hoc basis, depending on the severity of issue related their particular field.

- Ministry of Agriculture and Fisheries
- Ministry of Finance
- SEFOPE
- Ministry of Commerce and Industry
- Ministry of Transport and Communication
- NGOs
- Ministry Public Woks
- Secretariat state of Civil Defense
- Firefighting department

Table 11.5 the following table provides information of the Inspection Responsibility

Relevant Agency	Inspection Responsibility
MPRMN/ANPM	• Design of fuel storage approval and inspection of the construction according to the required standards • Environmental Licensing approval, inspect and monitoring the implementation of EMP
DNCPEA/MTCIA	• Approval of environmental license for projects other than petroleum and natural resources related. They can inspect the implementation of EMP according to environmental performance standard • Inspect the Commercial license and
MAF	• Only is there is any marine pollution that impacted the marine ecosystem and fishery • Coral damaged and mangrove implication
MOP	Groundwater resource utilization need to be monitored by the project owner and inspected by the Ministry of Public Works
MTC	Related Jetty and navigation system
SEFOPE	Inspect and monitoring the employment and ensure that the project owner follow labor code and enforce the implementation of OHS standard
Civil Defense - Bombeiros	• Fire design and equipment inspection • Involve in the firefighting system for tier 2 of the fire hazard (The fire scale that can be handled by the project owner) • Provide feedback on the fire management system to the project owner
Ministry of Finance	Related to the business activity and taxation

11.5 Summary of Mitigation and Monitoring Plans

Impacts assessment and various methods to mitigated that impacts arise from the fuel storage development (construction, operation, and decommission phases) in Lauhata have already presented from the chapter 8, 9, 10 of this document. These impacts consists of impacts to air quality, soil and groundwater, surface water, marine water, traffic, noise, occupational health and safety, impacts to cultural and archaeological resources, and socio-economic impacts. Mitigation measures proposed for the impacts consist of physical measures that require the construction of certain structures or installation of certain equipment and programmatic measures that call for the establishment of certain programs to mitigate the impacts. The following table contains the summary of the EMMP, including the cost of mitigation and responsible agency during the project implementation. Detailed descriptions of the EMMP are provided with the accompanying Environmental Management Plans document.

Table 11.6. Summary of EMP Cost and Monitoring Plans

IMPACT MITIGATION				MONITORING		
Environmental Impact	**Mitigation Measures**	**Mitigation Responsibility**	**Mitigation Cost (US$)**	**Monitoring Measures**	**Frequency and means of verification**	**Monitoring Responsibility**
Construction Phase 1 A and 1 B						
Air Quality	• Operation of well-maintained construction vehicle and equipment to avoid polluted exhausts. • Proper piling of spoil from earth work • Spraying of water in the working area • Construct fence on the project area	Project owner	US$ 45,000 (mainly to build the fence and operation cost for water spraying)	• Periodic qualitative monitoring within mining areas; • Assessment of record of dust complaints from workers and communities living near project area.	Day to day monitoring especially during dry period.	Project owner and regulatory agency (if necessary)
Marine water quality from soil erosion	• Construction of temporary detention basins to catch and filter the sediment • Compact the soil during the dry period with the gravel or non-eroded material to prevent the erosion	Project owner	$15,000	• Measurement of marine water quality after the rain (grab sample) to measure the sediment • Monitoring the TSS of the effluent at the detention pond	Day to day monitoring, especially after the onset of rain.	Project owner and regulatory agency (if necessary)
Traffic	• Installation of signage near the facility to inform general traffic those construction vehicles might make an access in and out of the facility. • Appointing designated personnel to help smoothing traffic out during an especially heavy vehicle movement • Regulate speed limit in and out of project area • Only authorize personnel must drive the vehicles	Project owner	US$ 30,000	• Installation of permanent signage near the facility to inform general traffic that costumer vehicles are making an access in and out of the facility • If a long queuing actually happened and could heavily disrupt traffic, several designated personnel should help smoothing the traffic in and out of the facility.	Day to day monitoring, especially after the onset of rain.	Project owner and regulatory agency (if necessary)
Noise and Vibration	• All noise-generating equipment should be insulated and well maintained to ensure that they	Project owner	US$ 10,000	• Record of complaint about noise/vibration from workers and	Day to day monitoring especially during dry period.	Project owner and regulatory agency (if necessary)

	operate within the noise limits they were designed to operate. • Operation of noise generating equipment should only be during the day • Provision of personal protection measures from noise to workers (see section on Occupational Health and Safety)			communities living near the project. • Follow with the noise level measurement		
Occupational health and safety	Hazard minimizing measures: • Minimize exposure to hazard through workers rotation and limitation to working hours (max. 8 hrs.) • Provision of training for proper equipment handling and safety precautions for equipment handling • Adequate supervision for handling of heavy machinery • Adjustment of work and rest period for workers when days are especially hot (e.g. there have been several hotter than usual days in Timor Leste in 2014). • Provision of adequate and easy access to drinking water. Provision of PPE: • Facemasks, eye protection • Ear protection • Helmet, boots, safety shoes • Rubber gloves • Body protection	Project Owner	$30,000	Keep daily record on any event related to the OSH inside the project area, including the major accident related to work execution	Day to day monitoring system	Project owner with the surveillance from local authority and relevant agency
Operation Period						
Flooding	• Construction of retaining flood protection in the river • Elevated the floor level	Project owner	$1,000,000	• Monitoring the rainfall in the upland catchment system • Tide gauge for tidal measurement	daily to day and long-term operation	Project owner, supervision consultant and relevant government agency (if needed)

	• Construction of main drainage canal • Construction of oil-water separator • Isolated a major spill and cleaned up quickly prior to the heavy rain • Coastal wall protection • Frequent washing the ground where the oil spill prior to the heavy rain • Emergency flooding insurance for higher frequency of 50 -years • Flooding warning system and emergency preparedness • Flood emergency response • Monitoring the rainfall • Emergency response planning and recovery system • Monitoring the tidal level • Measurement of rainfall at upstream area			• Inspection of the flood protection work		
Major Oil spill	• Purchase Oil Boomer • Oil Skimmer • Chemical Absorbent • In-situ burning system • Coastal Cleaning • Mangrove re-planting • Coral rehabilitation	Project owner	CAPEX = $100,0000 (if no accident) OPEX = $50,000 If accident, the cost could be range from $10M – $15 M	Project owner to monitoring the current and wind to ensure operation safety	• Record daily event inside the fuel storage facility • Record the loading and unloading event in jetty	Project owner and relevant agencies (if needed)

	• Cleaning of the impacted beach • Design and construct the fuel terminal and other supporting facility with the highest standard in the industry to minimize the equipment error and equipment failure • Developed the proper operating procedure in every part of operating system • Proper communication protocol during the operation • Prepare emergency oil response planning and team • Monitoring of marine water quality • Implement emergency response plan • Compensation to the loss • Compensation to the economic loss • Coordinate with the national and international team to help in case of major large oil spill • Provide public information to close the beach access due to					

	pollution form the oil • Compensation of the economic loss, especially coastal community who are rely on the income from the coastal resources • Proper community engagement plan • Proper insurance system					
Fire hazard	• Proper fire prevention system (design construction with the highest standard, proper operating procedure, minimize leaking from the system, control processing) • Modern Fire prevention equipment system in place • Well structure and trained fire management system • Fire drill and evacuation system • Fire insurance system	Project owner	CAPEX = $200,000 OPEX = $100,000/year	• Control the operating system (automatic control), i.e. mass balance and volume rate • Inspect the all the operating equipment system before and after loading and unloading the fuel	Day to day monitoring	Project owner and report to be reviewed by the relevant entity
Soil pollution from oil spill	• Soil remediation system • Minimize the spill by proper design and operation • Taking the soil sample within the project area once a year to measure	Project owner	US$ 15,000	Monitoring periodically to detect as early as possible the pollutant transport from the soil to the soil column	Day to day monitoring especially during fuel loading and unloading	Project owner

	the soil quality • Management the oil spill in the facility to prevent the transport of contaminant to the soil column • Wash periodically the ground surface that that contaminated by the minor oil spill • Follow the proper SOP in transferring the fuel to minimize the risk of spills					
Groundwater	• Enhance tree-planting in the upland catchments to achieve more recharge rate of rainfall to groundwater • Help population by providing water supply if their shall well get dry • Response quickly to the spill so that the risk of contaminant transport downward will be reduced • Inform the government that groundwater is contaminated and stop utilization of groundwater • Pumping out the contaminate water and	Project owner	$15,000/year	• Sampling measurement of the groundwater to detect the trend of water quality change • Monitor the groundwater pumping (drawdown level in the aquifer) Minimize the spill in the ground surface • Monitoring the water utilization rate within the facility to optimize the water utilization	• Day to day monitoring • Real time measurement in the groundwater pumping	Project owner and could be inspected by the relevant government agencies

	treated it polluted water • Measure also the well in surrounding project area if the polluted well is localized or entire aquifer					
Solid waste impacts	• Collect properly the solid waste and apply 3R (recycle, reused. Reduced, and disposal) • Dispose the waste into Tibar control landfilled area • Mange the solid waste to achieve the minimum target to landfill • Have proper treatment system of hazardous material (see the method of treatment at the part of waste management) • Produce the concrete material from hazmat (liquid hazmat is mixed within the concrete cement and produce concrete block • Apply special treatment method onsite or out scorching the external company to treat the B_3 waste Treated the oil residue and recycle into	Project owner	S$30,000	• Record keeping and assessment to adapt the practice. • Promote public education on the proper solid waste collection system	Day to day monitoring and provide the monthly report	Project owner (designated officer).

	the reusable fuel (third party should be contracted to do it • Deliver the oil residue to the third party that already has proper oil residue treatment in place • Deliver the oil residue to Tibar (government provided the holding tank) • Proper collection of the waste to be handled by the third party					
Traffic impacts	• Proper traffic management system • Proper traffic signal • Proper parking arrangement • Designated person to watch the traffic and manage it • Limit the speed limit in the project area • Only authorize person could drive the vehicle	Project Owner	$5,000/year	• Keep the record of vehicle in and out of the project area and any related event • Record if any traffic accident	Day to day monitoring	Project owner and local authority
Climate change	• Proper design and construction of the sea wall protection • Elevated floor level at the storage yard (based on tidal measurement and HAT data)	Project owner	$20,000/yr.	Monitoring it tide (already proposed)	Sharing the data of the climate change information (rainfall and tidal measurement)	Project owner

	• Adjust the groundwater treatment, as the water will be getting salty • River improvement • Retaining wall • Proper drainage system • Construction of Water storage • Minimize the water utilization • Sea water treatment (optional) • Provide water to the community					
Occupational health and safety	Hazard minimizing measures: • Minimize exposure to VOC usually associated with gasoline through rotation of workers handling diesel fuel and gasoline. • And limitation to working hours (max. 8 hrs.) Provision of PPE: • Use of proper PPE for workers exposed to high emission of VOC (especially during handling of transfer of fuel into storage). • Provision of PPE for workers exposed to high risk from fire and explosion.	Project owner	US$ 35,000/Year	It is recommended that monitoring measures involve routine (every year) risk assessment involving the following objectives: • Identify where fire and explosion hazards may exist; • Consider procedural practices, what have been done wrongly, what and who have been affected; • Evaluate the findings and see if precautionary measures implemented are enough to significantly reduce risk from fire and explosion. • Keep a good record of the findings • Plan for intervention as found necessary		Project owner (designated officer) can be coordinated with local forestry officer
Community Health	• Water conservation and	Project owner	$50,000/year			

and Safety	monitoring system • Traffic management system • Fire hazard management and socialization to the community members in Lauhata, as well as evacuation route					
Decommissioning Phase						
Traffic	• Installation of signage near the facility to inform general traffic that vehicular movement access in and out of the facility. • Personnel to direct the traffic when necessary	Project owner	US$ 2000 /decommissioning	• Installation of permanent signage near the facility to inform general traffic that costumer vehicles are making an access in and out of the facility • If a long queuing actually happened and could heavily disrupt traffic, several designated personnel should help smoothing the traffic in and out of the facility.	Day to day monitoring, especially after the onset of rain.	Project owner
Noise	• All noise-generating equipment should be insulated and well maintained to ensure that they operate within the noise limits they were designed to operate. • Operation of noise generating equipment should only be during the day • Provision of personal protection measures from noise to workers (see section on Occupational Health and Safety)	Project owner	US$ 1,000	• Record of complaint about noise/vibration from workers and communities living near the project.	Day to day monitoring especially during dry period.	Project owner (designated officer).
Occupational health and safety	Hazard minimizing measures: • Minimize exposure to hazard through workers rotation and limitation to working hours (max. 8 hrs.) • Provision of training for proper equipment handling and safety		$30,000			

	precautions for equipment handling • Adequate supervision for handling of heavy machinery • Adjustment of work and rest period for workers when days are especially hot (e.g. there have been several hotter than usual days in Timor Leste in 2014). • Provision of adequate and easy access to drinking water. • Minimize exposure to VOC usually associated with gasoline through rotation of workers handling diesel fuel and gasoline. Provision of PPE: • Facemasks, eye protection • Ear protection • Helmet, boots, safety shoes • Rubber gloves					
Social and economic impacts	• Compensation to the employee • Transfer the employee to other facility and business modality	Project owner and worker inside the facility	$200,000			Project owner and relevant government agency

12 STAKEHOLDER ENGAGEMENT AND PUBLIC CONSULTATION

As part of the environmental impacts assessment, the consultant team on behalf of project proponent organized public and community consultations in order to collect input from relevant stakeholders and local communities on the proposed development. Community consultations will be conducted in accordance to DL 5/2011 in the following sequence:

The public consultation and stakeholder engagement is very important component of the preparation of environmental management plan (EMP). The purpose of public consultation is to engage the public and relevant agencies include the government and NOGs in the preparation of EMP document, so that they will be well informed the project development, especially knowing the expected impacts and mitigation measures. The consultation has also an objective to inform the government official, especially, who involve in making a decision regarding the project development. By having public consultation in the preparation of the EMP, as regulated by the law (decree law 5/2011 and Diploma Ministerial, 47/2017), it is expected the implementation of the EPM will be ensured.

12.1 Methodology and Approach

The methodology of public consultation, as stipulated the law, indicated that minimum two times consultation should be conducted.

- Consultation of the Scope of Environmental Impact Assessment Study
- Consultation on the result of the study (EIS and EMP)

In addition this above formal consultation, it is also important to conduct the community consultation, especially people who are affected by the project development.

12.1.1 Method of Consultation on the TOR

The objective of the consultation at this stage is to introduce the component of the environmental and social impacts assessment to the relevant line ministries and get their opinion on the scope of the study. The consultation should be conducted to cover the public and community in the big meeting to hear the presentation and provide the comment on the content of the study.

- Issue the invitation to relevant stakeholders one week prior to the meeting
- Follow up the invitation by phone call regarding the meeting in day prior to the meeting to get the maximum participation of the stakeholder in the meeting
- Realize the public consultation meeting to introduce the project from the project owner, present the scope of environmental impact assessment study, and listening the feedback from the stakeholder

- Elaborate the comments and suggestion from various stakeholders in the TOR or scope of the study report

12.1.2 Method of Public Consultation of EIS and EMP Report

The method of stakeholder and public consultation engagement of the draft report of EIS and EMP follows several steps that already being established by the ANPM. The following process should be followed prior to the meeting of the engagement.

- ✓ EIS and EMP reports shall be published in the ANPM website and the website of project owner
- ✓ The printed books of EMP and EIS should be made available at various points for public reaching and reviewing. In this project, the printed draft report of EIS and EMP were made available at the following location
    - The office of ANPM
    - Office of Global Oil Storage Terminal, LDA
    - Center of Municipio Liquica
- ✓ Public notice in the national media such as Radio/TV and newspaper. For this project GMN TV/Radio published this public notice in the TV, Radio, and daily news
- ✓ The publications was done for two weeks' time to engage the public and community on their opinion
- ✓ Collect all the comments, the result of publication and produce the report
- ✓ Conduct the town hall type of meeting to present the report of the EIS and EMP
- ✓ Collect all the feedback and comment during the meeting to be elaborated in the draft of the EIS and EMP prior to submission to the ANPM for the review

12.2 Result of Public Consultation

The consultation activity carried out as part of the EIA study consists of two with different target of audience. The community consultation was conducted in the project location, where the affected people and local authority were invited to discuss about the project and scope of environmental impacts assessment study. Similarly, the public consultation was also conducted in order to inform the public and government agencies regarding the project and scope of environmental study. Further detail of the consultations activates are presented in the following section.

12.2.1 Community Consultation on the Scoping Study

The consultation consist of community consultation, as part of socialization program at the community level and the also consultation with the government level, where the relevant government agencies were invited to ask their opinion on the scope of the study, from each relevant agencies.

This first community consultation for the ToR was held in Lauhata nearby project site on June 22, 2019. Around 30 people, who represented community leader, youth, and communities members who are

affected by the project due their houses that very close to the project site. In general, the community members, including the youth support the project development and would like the project owner to engage local work force into the project development. Impacts of the environmental and safety are the main concern that project owner should study and mitigate. The following tables shows the community concern related to the project, based on the consultation of the first time in Lauhata.

Table 12.1 List of Concern of Community Members in the Aldeia Raukasa

No	Name	Concern/Questions	Respond/Future Follow up
1	Sr. Daniel do Santos: Chief of the Suco of Lauhata	The represent the local leader and the community provide the support for this investment as it will create opportunity for local and bring the revenue for the country as well	The project owner is so happy to hear the support from the local leader and it will give the moral support to the company to continue mobilize the project in the site
2	Sr. Jose do Santos Bareto: Ex Chief the Suco and also the land owner	He raised the concern regarding changing the land use change from the previous arrangement, which was not for fuel storage and distribution. He is asking about the status of his right, as the land owner	The project owner respond that the his right with the Timor Cement, who is the primary holder of the use of this parcel of land would remain the same and any change would be subject to the negotiation between him and Cement Timor, SA. For this part, there will be a follow up meeting between the land owner and the land use right holder (renter)
3	Sr. Gilberto das Silva: Land owner and youth representative	He is happy and supports the project but the status of the land use need to be cleared.	The process is under reviewed
4	Sr. Faustino Xavier-Chief of Aldeia	We support the investment and support the construction. The problem with the land (if any) will be solved with dialogue that involve the local leader	The recommendation will be considered
5	Sr. Filomeno Bareto: Chief of Aldeia Raukasa	He raised the concern related to the impact during the construction and operation, specially related to the public health issue	The study of environmental Impacts assessment will provide the recommendation of the method to minimize the risk to the impacts that will arise from the project during the construction and operation. The result of the study will be presented again in the next meeting
6	Dominggoes Gonsalves Soares: Community members	He raised the concern related to the public health issue, like from VOCs and how to mitigate this impact	The mitigation as part of the EMP will be developed and implemented so that the impact would be minimal
7	Chief Suco:	Local leader will help solving some of remaining issue	The support is welcome to create good condition for all

8	Sr. Filomeno Bareto: Chief of Aldeia Raukasa	He raised the concern about the evacuation plan in case of emergency	The study will recommend the emergency response plan and include the evacuation plan and map
9	Sr. Gilberto das Silva: Land owner and youth representative	Asking about the study of river flow and recommend the company to elevate the floor level and river protection to minimize the impact	This is exactly part of the study of EIA to identify the flooding problem and what need to be done in reducing the flood risk from the river

Figure 12.1. First Consultation to the Community Members in Aldeia Raukasa, Suco Lauhata

12.2.2 Public Consultation on the Scope of Study

In addition to consultation with community members, a separate consultation was conducted with public agencies, especially those that are involved directly in the project, as the regulatory agencies shall involve

in the project monitoring to ensure compliance of the project implementation to already established regulations.

The consultation on the scoping study (TOR) was conducted on 25 of June 2019, in Hotel Ramelau, where about 10 government agencies from 30 agencies invited attended the consultation meeting. During the meeting, project owner, which was represented by PEC – Consulting, LDA, presented the scope of the environmental impact assessment (EIA) that will be carried out prior to the preparation of the EIS and EMP to be submitted to the ANPM for the license approval. Various government agencies that are relevant to the project such as ANPM, Ministry of Agriculture and Forestry (MAF), Ministry of Public Works (MOP), and other agencies, including the representatives of local authority in Liquica, participated in the workshop of the scoping of the environmental impact assessment study.

The detail of the scope of work presentation can be found in the annex 3- Presentation of the TOR. During the meeting, the following question and concerns were raised:

- Water utilization from the groundwater aquifer and the impact to the local people
- Method of risk mitigation and risk management
- Social corporate responsibility from the company to local community
- Impact of oil spill to the sea and protected zones near project location
- Scope of extended oil spill coverage
- How to manage and mitigate fire risk/hazard
- Waste management during the operation (liquid and solid wastes)
- Design and specifications according the standard best practice

Further detail information related to the question and comment can be found in the following table.

Table 12.2 Summary of the Question and Concern Raised during the presentation of TOR in Hotel Ramelau

No	Name	Concern/Questions	Respond/Future Follow up
1	**Sr. Jose Calderas**. Husi Bombeiros, Secretary of State of Civil Protection	• How to manage the waste oil? • How to minimize the risk from the disaster related to the fuel business operation	The risk assessment and mitigation measured will be studies as part of EIA and waste will be managed according the industrial best practice
2	Sr. Jose Representaive from Administrador Liquica	• Any solution for the cultural sensitivity area? • Method of Piping system from jetty to the storage tank • Groundwater utilization and impact to the community well production • How to protect the fish from the impacts such as oil spill • Recommended to the company to support social program for the local community	All the suggestions are very good and will be elaborated in the EIA study and shall be included in the EIS and EMP report
3	Sr. Nelson de Jesus, Director of Downstream, ANPM	• Ask to clarify the 200 m of study from the slide presentation • Why soil investigation only two points? • Design of all the facility should follow the high standard quality according to API so it will ensure the level of safety in the operation of the facility • ANPM will review the document based on the environmental study prior to granting the license • All the operators of fuel related business must have proper insurance to cover the risk • EIS and EMP should be presented according the phases of project implementation (construction, operation, and decommission) • How to manage the larger fire risk, involves several tanks together	• 200 m radius of oil spill modeling was only tentative but the modeling will have result to show the impact of the oil spill up to which extend • Soil investigation only two points as the site is small and also according to the secondary data of hydro-geologic, the single layer of • All other suggestion will be considered in the preparation of EIS and EMP
4	Sr. Abrao - Climate Change Section, Secretariat of State of Environment	• How to manage the waste • Application of best practice in the other place to this business in managing the risk. Example of using foam method for fire risk management	Waste consist of liquid and solid wastes and they all will be managed internally with the method of oil-water separator (liquid waste) and solid waste will be collected and dispose

Figure 12.2. Stakeholder Consultation at Hotel Ramelau

All the questions and suggestion that already being incorporating in the final TOR as basis to conduct the study of EIA, which has already presented in the EIS and EMP report. Similar stakeholder engagement will be conducted again as part of the current study of the environmental impacts assessment (EIA) to discuss the result and finding of the environmental impact assessment (EIA) study

12.2.3 Public Consultation on the Result of Study (EIS and EMP)

The purpose of this second consultation is the share the result of the EIA study that already reported in the form of EIS and EMP report. The important stakeholder from the government agencies (both local and central) and the affected communities members must be invited to the review the result of EIA study and provide the comment is they have for the improvement of the report prior to the final submission. As presented earlier to achieve the objective of the public consultation of the result of EIA study, the following steps were followed:

- Make available of the report of EIS and EMP for public and community to review
- Conduct the town hall meeting to the public and community to present the EIS and EMP report and response to any question during the meeting.
- Elaborate the comment and concern in the final report of EIS and EMP and submitted to the ANPM

Further detail of each step and result are presented in the following sub-sections.

12.2.3.1 Information Dissemination

Public and community should be well informed on the result of the environmental impact assessment, which already reported in the EIS and EMP document. Based on the Diploma Ministerial, 47/2017, regarding the mechanism of public consultation:

- Printed the EIS and EMP report and make them available in the ANPM, Global office in Dili, Center Municipio of Liquica
- Established the mechanism to deliver the public comment and information by creating the email and established/designated the place, where public can get access to the hardcopy of the EIS and EMP reports
- Advertise to the public via local news or Radio to inform the project and the EIS and EMP reports, which are available in hardcopy and online via ANPM website and Global website
- Record and monitoring the number of visitor to the sites and record the comment that provided by the community
- Report the result of the collecting the public opinion regarding the project in general and the report of EIS and EMP
- Elaborate the comment in the report of public consultation

Presentation with the relevant public agencies (Governments, NGOs, private company) and presentation to the community affected at the project site

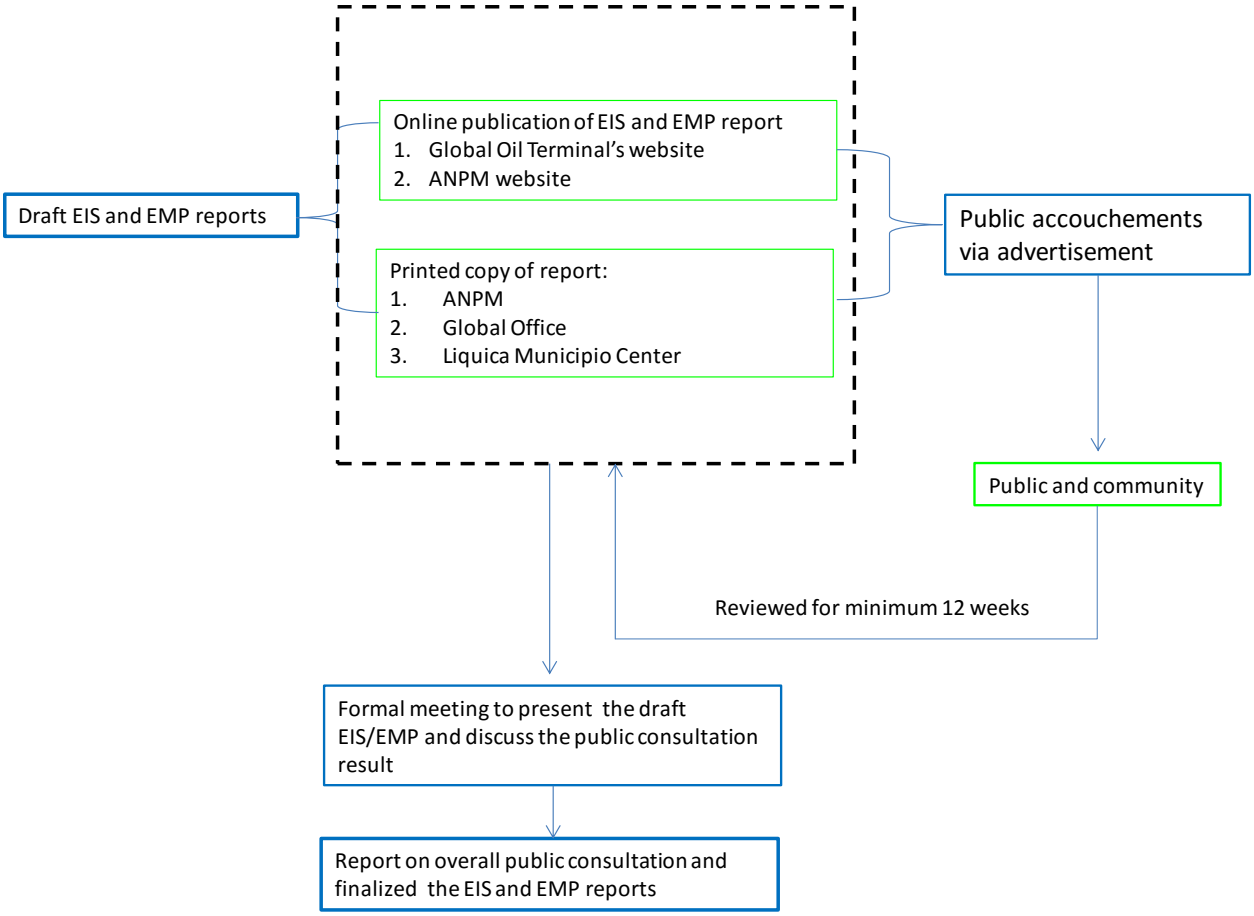


Figure 12.3. Procedure of Public Consultation on the Draft EIS and EMP

Publication of the EIS and EMP

- Printed copy of EIS and EMP reports in ANPM office, Global Oil Storage office, and in the Center of Municipio Liquica
- Online publication (ANPM website and Global website)
  The ANPM published the draft report of EIS, EMP, and approved TOR in the website on the 24 of February 2020. : http://www.anpm.tl/category/public-consultation/
  - EIS
  - EMP
  - TOR

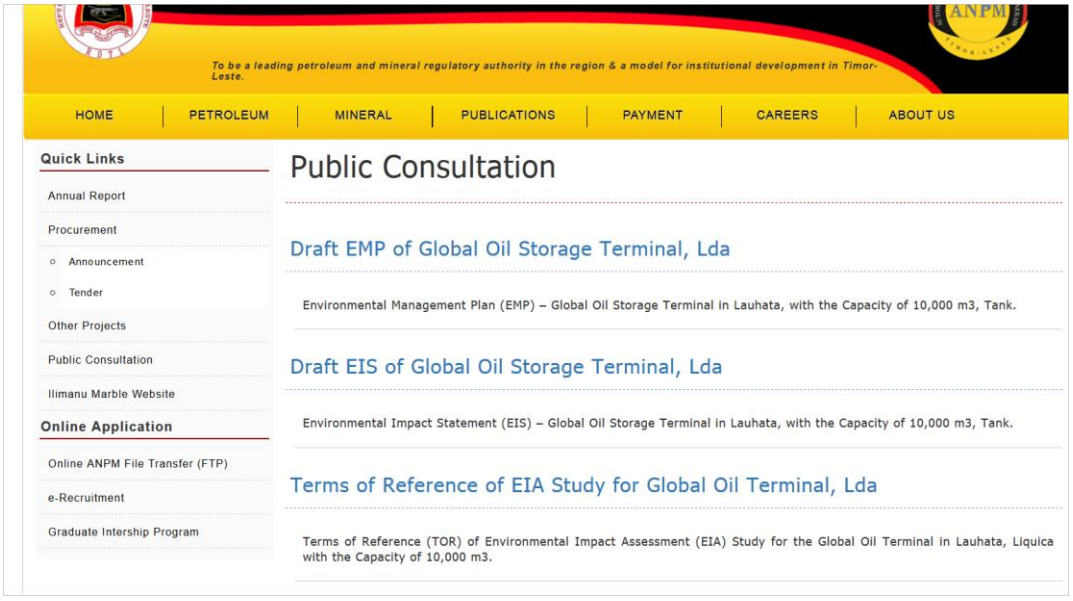


Figure 12.4. ANPM Webpage of Public Consultation

The Project Proponent published the draft report of EIS, EMP, and the approved TOR in the following website on the 29/2/2020

https://globalgroup.sg/announcement/public_consultation

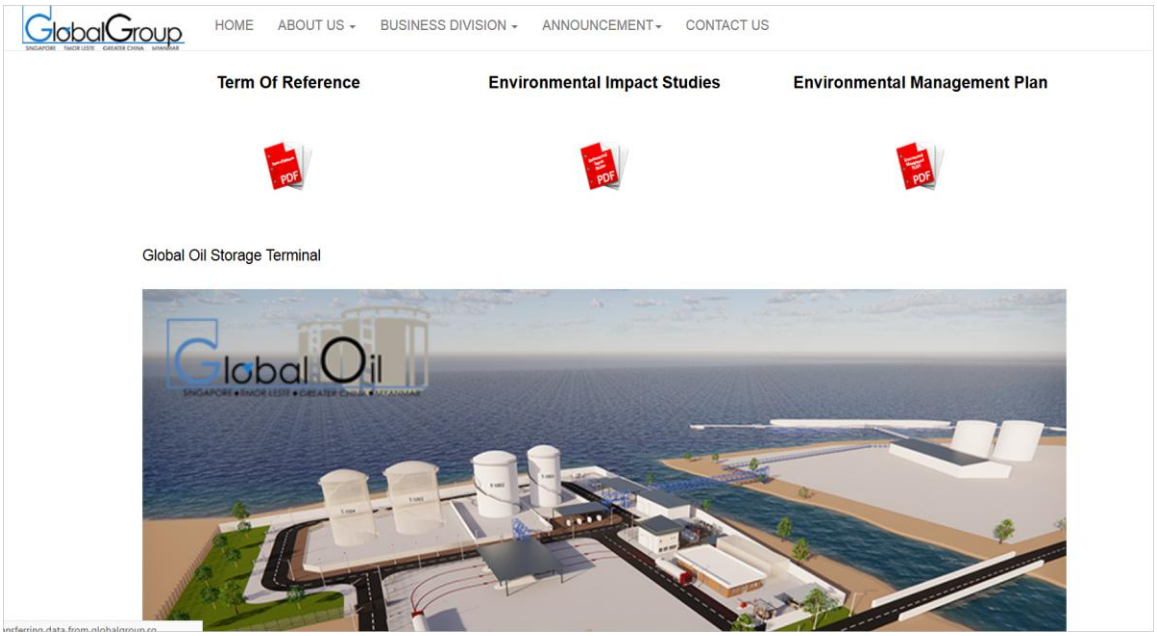
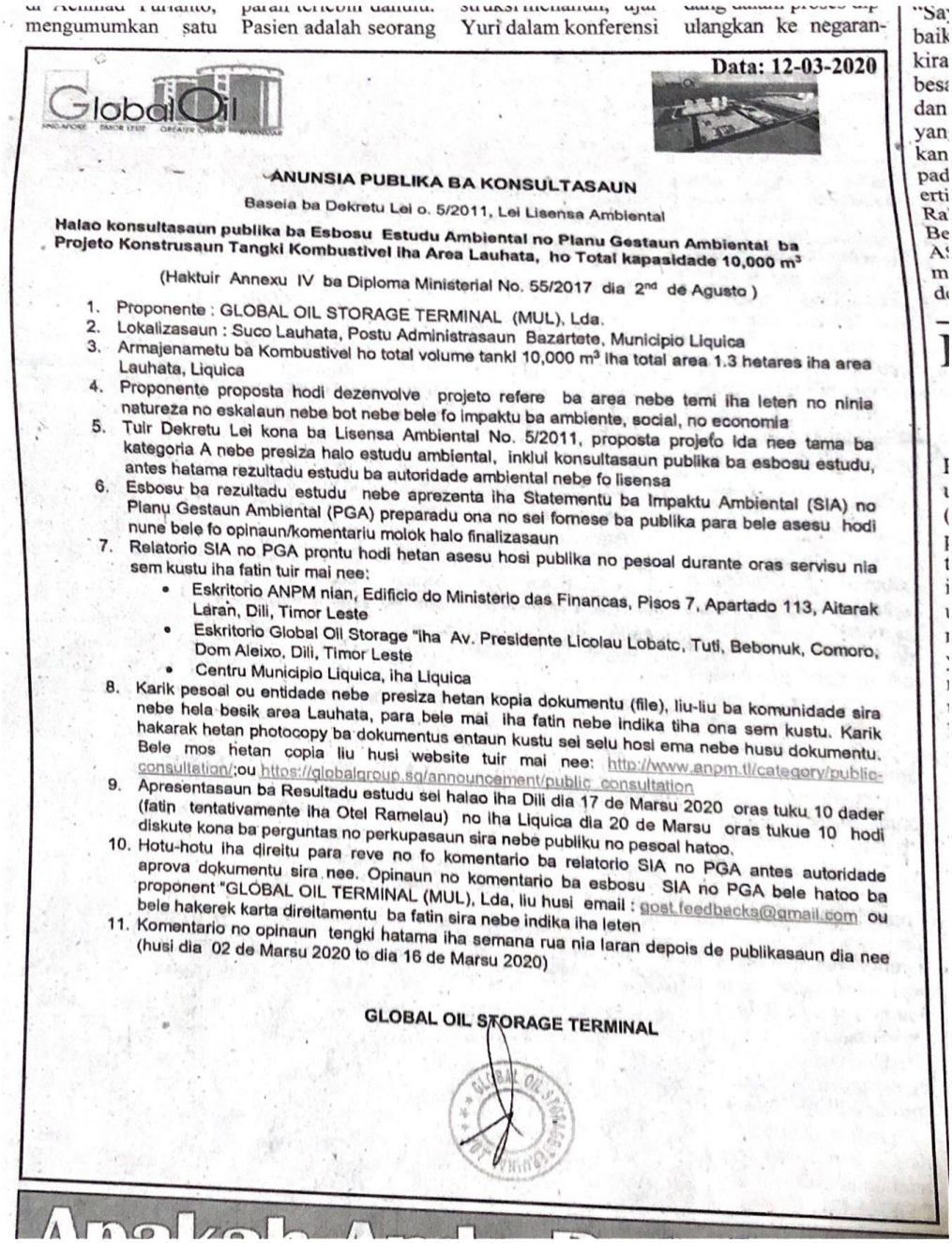


Figure. 12.5 Publication of Public Consultation in the Webpage of Global

- Information dissemination GMN TV, GNM Radio and GMN newspaper on the 2 – 16 of March 2020
- Publication in the GMN daily newspaper from 2 – 16 of March 2020 (the following figure is an example of publication in the Journal Nasional Diariu). Detail publication is provided in the annex document



mengumumkan satu Pasien adalah seorang Yuri dalam konferensi ulangkan ke negaran-

Data: 12-03-2020

GlobalOil

ANUNSIA PUBLIKA BA KONSULTASAUN

Baseia ba Dekretu Lei o. 5/2011, Lei Lisensa Ambiental

Halao konsultasaun publika ba Esbosu Estudu Ambiental no Planu Gestaun Ambiental ba Projeto Konstrusaun Tangki Kombustivel iha Area Lauhata, ho Total kapasidade 10,000 m³

(Haktuir Annexu IV ba Diploma Ministerial No. 55/2017 dia 2nd de Agusto)

1. Proponente : GLOBAL OIL STORAGE TERMINAL (MUL), Lda.
2. Lokalizasaun : Suco Lauhata, Postu Administrasaun Bazartete, Municipio Liquica
3. Armajenametu ba Kombustivel ho total volume tanki 10,000 m³ iha total area 1.3 hetares iha area Lauhata, Liquica
4. Proponente proposta hodi dezenvolve projeto refere ba area nebe temi iha leten no ninia natureza no eskalaun nebe bot nebe bele fo impaktu ba ambiente, social, no economia
5. Tuir Dekretu Lei kona ba Lisensa Ambiental No. 5/2011, proposta projeto Ida nee tama ba kategoria A nebe presiza halo estudu ambiental, inklui konsultasaun publika ba esbosu estudu, antes hatama rezultadu estudu ba autoridade ambiental nebe fo lisensa
6. Esbosu ba rezultadu estudu nebe aprezenta iha Statementu ba Impaktu Ambiental (SIA) no Planu Gestaun Ambiental (PGA) preparadu ona no sei fomese ba publika para bele asesu hodi nune bele fo opinaun/komentariu molok halo finalizasaun
7. Relatorio SIA no PGA prontu hodi hetan asesu hosi publika no pesoal durante oras servisu nia sem kustu iha fatin tuir mai nee:
   - Eskritorio ANPM nian, Edificio do Ministerio das Financas, Pisos 7, Apartado 113, Aitarak Laran, Dili, Timor Leste
   - Eskritorio Global Oil Storage "iha Av. Presidente Licolau Lobato, Tuti, Bebonuk, Comoro, Dom Aleixo, Dili, Timor Leste
   - Centru Municipio Liquica, iha Liquica
8. Karik pesoal ou entidade nebe presiza hetan kopia dokumentu (file), liu-liu ba komunidade sira nebe hela besik area Lauhata, para bele mai iha fatin nebe indika tiha ona sem kustu. Karik hakarak hetan photocopy ba dokumentus entaun kustu sei selu hosi ema nebe husu dokumentu. Bele mos hetan copia liu husi website tuir mai nee: http://www.anpm.tl/category/public-consultation/;ou https://globalgroup.sg/announcement/public_consultation
9. Apresentasaun ba Resultadu estudu sei halao iha Dili dia 17 de Marsu 2020 oras tuku 10 dader (fatin tentativamente iha Otel Ramelau) no iha Liquica dia 20 de Marsu oras tukue 10 hodi diskute kona ba perguntas no perkupasaun sira nebe publiku no pesoal hatoo.
10. Hotu-hotu iha direitu para reve no fo komentario ba relatorio SIA no PGA antes autoridade aprova dokumentu sira nee. Opinaun no komentario ba esbosu SIA no PGA bele hatoo ba proponent "GLOBAL OIL TERMINAL (MUL), Lda, liu husi email : gost.feedbacks@gmail.com ou bele hakerek karta direitamentu ba fatin sira nebe indika iha leten
11. Komentario no opinaun tengki hatama iha semana rua nia laran depois de publikasaun dia nee (husi dia 02 de Marsu 2020 to dia 16 de Marsu 2020)

GLOBAL OIL STORAGE TERMINAL

Figure. 12.6 Copy of Publication in Jornal Nasional Diario

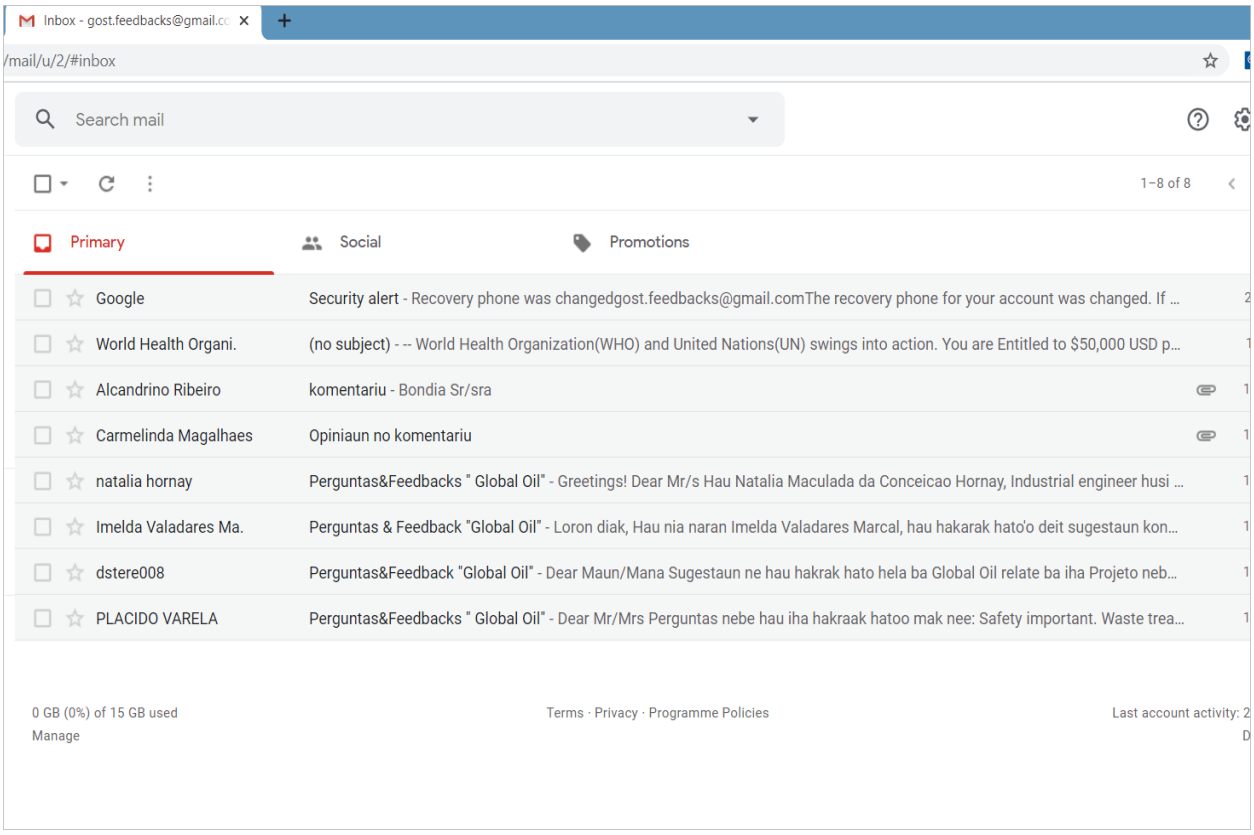
Result of Public Review

The information disseminated through the following means of publication was expected to be reviewed by the public and community affect by the project.

- Global website
- ANPM website
- Sent comment through the email
- Global office
- ANPM office
- Liquica Municipal Center

In general, the online publication in the website of Global Oil Storage Terminal, LDA, was reviewed by some students who were interested in the business development and environmental concern. The EIS and EMP reports were generally reviewed and comments were provided in through the email. There are four people who sent the comments related to the development of the oil storage terminal. People in the Liquica municipality have a maximum participation in the review. Around 30 people have an opportunity to see the document and provide the comment. The following table shows the comment provided through the email that established by the company

Table: Summary of Comment provided in the email



In general all the feedbacks are positive and support the project development and also suggested to better manage the negative impacts of the environment. The detail of each comment can be found the annexes (public consultation resources)

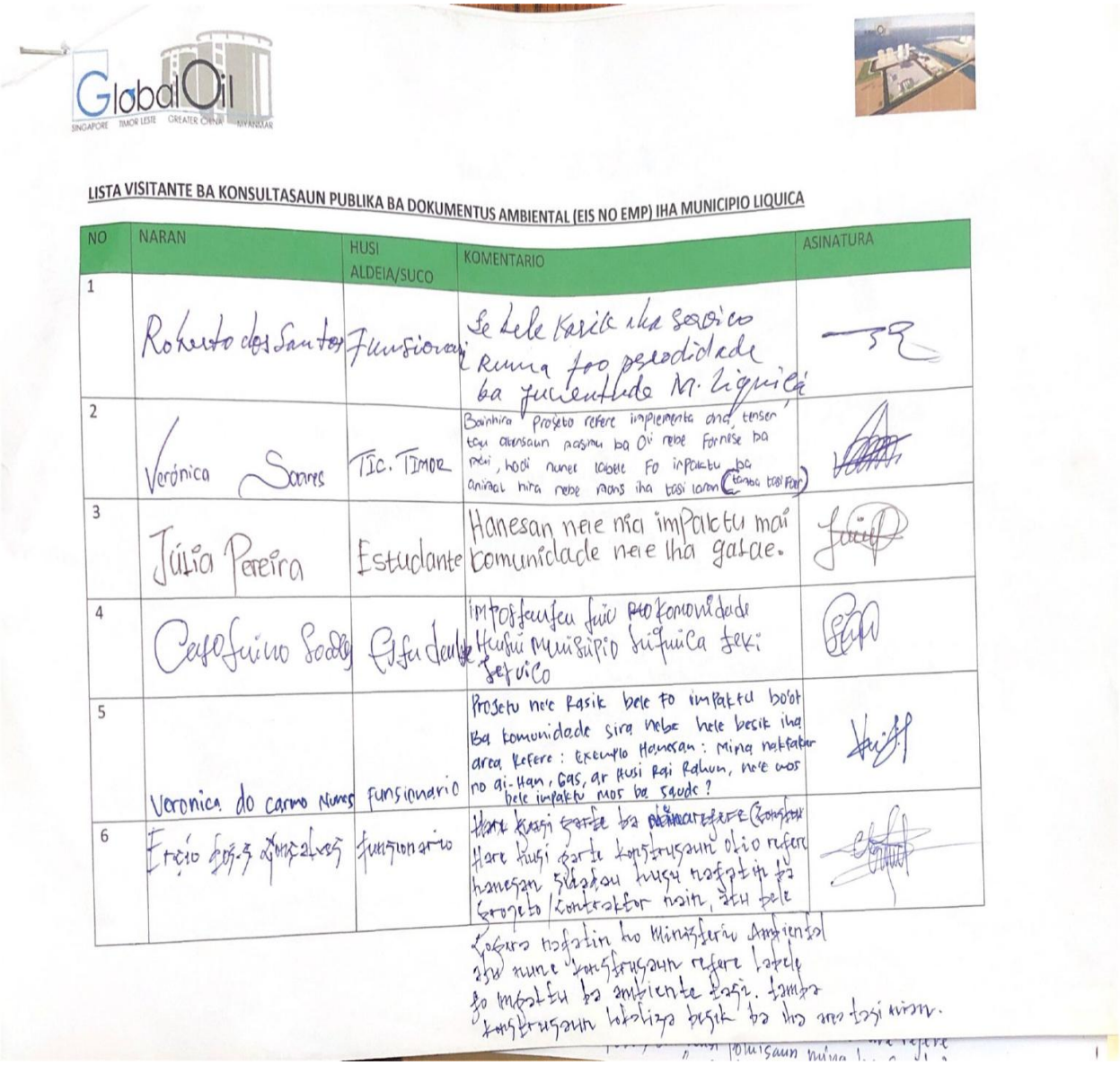
Beside the online resources, the hardcopy of the EIS and EMP report available in the center of Liquica Municipality, were also reviewed by many visitors. Many visitors in the Liquica municipal center got a chance to have a look at the report and provide the comment and feedback. In overall, feedbacks were positive about the project but concern about the negative impacts of the project development. The following table provides the detail list of visitors and comment provided in the hardcopy during the visit.

Table 12.3: Summary of Comment provided by Community and Public Sector in Liquica Municipality

No	Name	Concern/Questions
1	**Sr. Roberto do Santos.** Public servant	If any job, the youth in Liquica should be a priority
2	Sra. Veronica Soares, TIC Timor	After the realization of the project, the project owner should pay attention to the pollution in the sea
3	Sra. Julia Pereira, Student	Is there any impact to the community??
4	Sra. Veronico do Carmo Nunes, Public servant	The project will generate the environmental impacts to the community and marine water from oil spill, particulate matter, and gases
5	Sr. Ercio Dosanto Gonsalves, Public servant	Suggest to the project owner to comply the requirement of environmental protection from DNMA to minimize the impact during the implementation of the project (construction and operation)
6	Sr. Leandro Gonsalves da Sila, Public servant	The project shall contribute positively to the community from the job creation to reduce the unemployment but the impact should be minimize
7	Sr. Mario M. do Santos, Public servant	My personal opinion to the project development but need to minimize the impact to the community
8	Sr. Gilberto S. do Santos, Staff MAE	This project is important to contribute the Timor – Leste economic and job creation
9	Sra. Ausonia dos Santos da Concencao, Community of Suco Loidahau	I feel happy because the project can create job and other opportunity
10	Sr. Miquiel Soares, Intern	The project is important for the job creation to us as young generation
11	Sr. Alexandrino do Santos, Youth	The Global oil should provide the good quality of job to the young people
12	Sr. Segismundo Boavida do Santos, Public servant	Suggest to the company (Global Oil) to coordinate with the local government, community, especially community members that affected by the project to avoid any misunderstanding information related to the project
13	Sr. Mateus Doutel Gonsalves, Community memebers of Suco Manumeta	In my opinion, as people from Liquica, good collaboration from Global oil, Community members, and local Government (Land and Property) is the key to succeeded the project development
14	Sr. Alexandre do Santos, Public	Happy with the project development but hope that the project will benefit first to us as local community of Liquica

	Servant , MAE	
16	Sr. Laurindo do Santos Reis da Silva, Public servant, Liquica	This is a good investment because the project will contribute to the Timor Leste national income in taxa payment
17	Sra. Bernardete d.s da Concencao, DNAL- MAE	The project will create the job for the young people who have no job but need to minimize the pollution
18	Sra. Nelco Fatima Maia, Intern student	This project is good for the people of Liquica and will be a new history for the development in Liquica
19	Sr. Nicolau da C.B, public servant of Liquica	The project will contribute to the economic development but need to considered and manage the negative environmental impacts
20	Sra. Eldina do Santos Nunes, DNAL-MAE	The positive impacts will be realized in the implementation of the project. However, my suggestion would be to minimize the impacts of pollution from oil, specially to the groundwater well and marine water body
21	Sr. Faustino do Santos, Public Servant	This is a good investment in the future for Liquica, as it will contribute the income to the local
22	Sra. Apolaria S. de Jesus, Student	How much budget is required to realize this investment project?
23	Sr. Nicolau do Santos, Juventude	The project will contribute positive to the economic. However, the project will also contribute negatively to the environment: • Disturb the ecosystem of marine, coral, and coastal area • This is good for the tourism area
24	Sr. Abel de Sousa, Public Servant	This investment to our Municipio is good because it can create the job and other opportunities
25	Sra. Belgia A. Correa, Administrasaun iha Liquica	The project will contribute positively to Liquica. If realize, please prioritize the job for Liquica people before other Municipio
26	Sr. Jose N. Serrao, Public Servant in Liquica	Happy and appreciate to the company's effort to invest in our area. Ask to manage the negative impacts

Table 12.4: List of Attendance of Public Review in Liquica Municipal Center



LISTA VISITANTE BA KONSULTASAUN PUBLIKA BA DOKUMENTUS AMBIENTAL (EIS NO EMP) IHA MUNICIPIO LIQUICA

NO	NARAN	HUSI ALDEIA/SUCO	KOMENTARIO	ASINATURA
1	Roberto dos Santos	Funsionario	Se bele kasik iha serviço rumu foo periodidade ba juventude M. Liquiçá	
2	Verónica Soares	TIC. TIMOR	Bainhira projeto refere implementa ona, tenser tau atensaun nasinu ba Oli rebe fornise ba mai, hodi nunes labele fo impaktu ba animal hira rebe mans iha tasi laran (tanba tasi Fan)	
3	Júlia Pereira	Estudante	Hanesan nee nia impaktu mai komunidade nee iha gatae.	
4	Cesofrino Soares	Estudante	impostfenfu fui ba komunidade husi municipio liquica tekiteq	
5	Veronica do carmo Nunes	funsionario	Projetu nee kasik bele fo impaktu boot ba komunidade sira rebe hela besik iha area refere: exemplo Hanesan: mina natfatur no ai-han, gas, ar husi rai laluan, nee nos bele impaktu mos ba saude?	
6	Frésio dos Santos	funsionario	Hare husi parte konstrusaun oio refere hanesan sistema husu natfatin ba projeto/kontraktor nain, atu bele fasilita natfatin ho Ministerio Ambiensal atu nunes konstrusaun refere labele fo impaktu ba ambiente tasi. tamba konstrusaun hatoliza besik ba iha area tasi nian.	

Total 23 people got an opportunity to review the EIS and EMP document in the center of Municipio Liquica. The detail of each person with the comment and signature can be found in annex documents.

12.2.4 Presentation of the EIS and EMP Result to Public

The public and community consultation on the draft report of EIS and EMP was conducted on July 1, 2020 in the center of Municipality of Liquica. The workshop meeting was considered successful as it got a maximum participation from various important government agencies that are important to the project

such as fire department, fisheries, land and properties, water resources, ANPM, environmental authority (DNMA) and local government representative.

The audiences were provided a comprehensive explanation on the rule of EIS and EMP document as public contract that will be used throughout the project implementation stages to monitor and evaluate the project implementation and quality of the surrounding environment. The submission of EIS and EMP document by the project owner to the regulatory agency means that the project owner agreed to implement the result of the study. The baseline data related to the receiving environment such as marine water, coral, fisheries, wetland, mangrove, tourism spot, groundwater storage, river water, soil, and sediment deposition are among the most important baseline data that was collected during the preparation of EIS and EMP reports.

The baseline data is used to derive the impact assessment of the project development stages to the environment. The impact during the construction such as dust, sedimentation, and OHS are considered temporary and can be managed on the site to minimize the risk and impact to the people and environment. The impacts during the operation such as flooding, oil spill, fire hazard, groundwater impacts, are among the major impacts that should be taking into consideration in the project development in order to ensure the sustainability of the project. Proper design and construction with the recommended codes such as API, NFPA, and ISO, are very important to ensure the system that will be designed and constructed are resilient, sustain, and able to avoid various impacts such as spill, fire, another hazard to occur.

Proper SOP and well trained operator will lead to safety in operation and sustainability which is the commitment of the Global Oil Storage Terminal. All the recommendation by ANPM in the form of various CODES and study will be elaborated in the design, construction and operation of the project development

Further detail information on the public and community consultation result can be found in the annexes (public consultation resources), including the number of invited people and total attendance of the meeting.

Table. 12.5 Detail Information on the Questions and Answer

No	Name	Concern/Questions	Respond/Future Follow up
1	**Sr. Claudo Silva**. Husi Bombeiros, Secretary of State of Civil Protection	• Recommended to the company (Global Oil Storage) to coordinate with Bombeiros to make sure that all the fire hose and connections are compatible to the fire fighter system of fire department • It would be better if the fire department will see the design and construction of the fire management equipment • Proper fire hydrant system is required • Clear Layout of access in and out of the facility in case fire event • Reserve water and foam • Fire uniform	The recommendation is considered and project owner will collaborate with the fire department seeking to advise on the design and management of the fire management system later on during the operation or prior to the operation of the facility
2	Sr. Jose Pereira do Santos - Biodiversity unit	• Biodiversity inside the marine water and social economic assessment for the coastal community • People who loss the job or income in case distaste such as oil spill	The economic and social impact assessment has already carried out, especially calculating the income loss. For example total production of salt in Ulmera every year, so that the figure can be used as baseline information in the future if the salt production must stop in case major oil spill. The figure of economic loss shall be used to pay the compensation from the project owner to the community affected. Similarly, the fisheries, coral, and other income associate the coastal community
3	Sr. Hermenegildo, NGOs – Sociedade Civil	• From Aipelo to Ulmera is considered as area protection so it is not proper to construct the fuel storage in this area • Tourism schematic in this area of protection would bring better income to the community and local government	• It is the government right to decide on the location of the project. The protected zone does mean no project at all. Instead, the identification of sensitive resources needs to be carried out and action needs to be taken in managing the resources on one hand, while the project is being realized. • There is already jetty that need an investment to leverage the benefit of jetty or integrated business model. The government and community have already permit the construction and operation of jetty and also

			along the Liquica coastal area is considered as industrial zone
4	Sr. Jose Barros, Community members and land owner	• Land issue is under judicial review so we will wait for the result • The project will bring benefit to the local community of Lauhata so I support the project development	The information was Noted and happy to hear the support from the community
5	Sr. Nelson Madeira, DNCP - DNMA	• Concern about the government agency involve in the environmental licensing. ANLA is not involved because they received the documents • Required to implement the catchment management to reduce the flooding risk	• Catchment management such as re-forestation and protection of the river are important to reduce the flooding risk. The catchment modeling was carried out as part of the study to know the level of flooding for future flood protection • ANPM responded the role of ANPM in involving the environmental licensing of major project relate to the petroleum and mineral resources • The technical team of evaluation will be formed and EIS and EMP document will be shared also the ANLA
6	Sr. Carlos , DNCP - DNMA	• Groundwater impacts assessment: land subsidence, sea water intrusion • What kind of water source to be utilized by the project • Reduce the pollution by planting tree	Groundwater source will be utilized by the project with the total capacity required 2500 L/day. The groundwater study was carried by the EIA team and concluded that the groundwater is brackish at the salinity level 500 – 10000 mg/L. For the project development, the water treatment shall be carried out to meet the standard of utilization and ensure the sustainability of equipment uses in the project The planting tree is a good suggestion and should be elaborated by the project owner. In fact the buffer zone surround the project boundary will be constructed to protect the overall project and reduce the risk of gas emission

7	Sr. Rui Pires – DNB (Biodiversity)	• Development is need in our country but need to considered and study all the impacts • Oil spill in other country, the company will pay the penalty. How about in Timor – Leste. Who is responsible for the spill? Government of company? • Baseline data should be strong and consultation to the impacted community should be carried out • How about cross border to other country	The baseline data was established as part of the EIA study and common practice worldwide that the company should be responsible with any damage caused by the business. That's why the study carried out the modeling to know the spill area or impacted area so that regular monitoring will be conducted by the government and community and project owner. The government shall involve also in the cross border to other country. In case major emergency of oil spill, the company (Global Oil), perhaps need help from government and also from regional if the spill is too large to be handled internally.
8	Sr. Alberto F. Pereira, DNTM – Aportil	• The presentation did not mentioned to high tide and low tide in relation to the port/jetty construction • West season and east season	Tidal measurement was carried by the study as information to design and construct the supporting infrastructure in the coastal area. However, the data is only 1 month. What is important from the data is to know the highest high tide and the lowest of low tide (extreme condition). Nevertheless, the port/jetty is already constructed and perhaps the navigation data will be useful for vessel movement
9	Department of Procurement of Liquica	• Asking the establishment of Bombeiros Liquica- fire team • ANPM – national standard for design and construction of fuel storage system	The establishment of local fire department has already recommended to the superior in national office so perhaps it is just the matter of time. The standard everywhere is almost the same. They all derived from American or British Petroleum. The application in the local need to be adjusted and this is the work of the design engineer and project owner

In general the meeting provided the positive feedback related to the project development and required the project owner to manage and minimize the negative environmental and social impacts.

12.3Recommendation of Future Consultation

Continues consultation, especially to the affected people would be necessary to remind them regarding the potential impact. Particularly, related to the emergency response planning s and evacuation.

- The project owner to continue engage public and community during the project implementation to ensure that the EMP has already being implemented,
- The public and community interest in the project is very low and even with the advertisement of two weeks' time, only limited people provide the interest and comment. Perhaps in the future, comment from expertise would be required to comment critically the document regarding the content in relation to the legal framework of Timor – Leste.

13 DIFFICULTIES ENCOUNTERED

In general no difficulties was encountered during the preparation of EIS report, except that the parameters measurements such as physical, chemical, and biological, were conducted in Indonesia, as no laboratory in Timor – Leste that provides the measurement required. Some important documents that should be really helpful and would have accelerate the process of the preparation of EIS document. Up to this production of final report, the documents were not available.

- Feasibility study document, which describe the business case, including the commercial viability, local resource availability, and other justification on the business modality
- Detail Engineering design (DED) document, which should provide the detail information of the layout of the facility, including the design standard, so that the EIS can refer to it and be certain that the recommended mitigation measure will be more real. With the exact layout of the facility in DED, it is possible to design the emergency route exit route
- No Emergency response planning document, especially to response to the major hazard such as major oil spill and the fire management system. This document is a separate document that should be developed by the project owner as an internal document for the guideline in the operation. Perhaps this document will be developed at later stage of project implementation
- Covic-19, which caused delay in the implementation of public consultation to share the result of EIA study

The air qualities and water quality measurement however, was conducted by the Institute of Technology Bandung (ITB), which experience some difficulty such as in Alfandega, where the instrument used to measure the air quality having some minor issue.

14 CONCLUSION AND RECOMMENDATION

The environmental impact assessment (EIA) was carried out by this study, as a basis to prepare this EIS document, by collecting the baseline environmental information (topographic, climate information, water resources, marine water quality, sediment, soil, etc.), modeling of hydrologic system, groundwater assessment, and geo-technical site investigation, scenario of oil spill trajectory modeling, and bio-physical assessment, and socio-economic data collections.

The environmental impact assessment study concludes several important major impacts, where the mitigation measures have already being proposed in this document.

- The project is not located in any area that is protected by the law of area protection in Timor – neither Leste nor a major sensitive receptor that will be jeopardized by this project development. The land size is matched with the proposed capacity of the fuel storage and the ownership of the land will be solved by the project owner.
- Flooding due to high frequency rainfall such as 50 –year of ARI or beyond could affect the existence of the fuel storage facility (the integrity of facility and could produce multiply impacts such as oil spill). However, this kind of event is considered rare and if it shall occur, it should be consider emergency. The primary and secondary containment should be design to be able to protect flood water event at 100 –years of frequency.
- Major Oil spill in Jetty and Piping system (failure). If the major spill occurs in jetty and no proper mitigation measures, the fate/oil can be quickly dispersed by marine current and wind to move away from the point of origin. Potentially, uncontrollable major spill will pollute most of the north coasts of Liquica between 10 and 40 KM. Along the way, coral reef, fishery, mangrove, wetland, and marine flora and fauna will be affected. The mitigation measures to prevent the spill would be most cost effective way to minimize the impact. The least cost effective mitigation measures will be to manage the spill that already causes a lot of damage (coral, fisheries, mangrove, wetland, beach, protected area, etc.)
- Major fire hazard is always being considered as affected the severe hazard that have already being faced by many fuel terminal system around the world. Therefore, many lesson learned have already identified, such as the major cause of fire hazard in the fuel terminal system. Overtime, various operator, academia, and regulatory, have already improved their understanding of the fire hazard and method to mitigate the impacts. As it is an emergency, the emergency response planning document should be prepared by Global Oil Terminal, LDA, as a guidebook to manage the fire hazard within the facility and link to the external communication, including the fire equipment requirement, competent fire management team.
- As the fuel terminal will store the gasoline, the vapor loss during the operation of the fuel storage, which mainly the Volatile Organic Carbons (VOCs), which will contribute to the air quality degradation. Technical and non-technical approaches was proposed to mitigate the VOCs impacts, including the prevention of leaking, minimize vapor loss by some other control mechanism, and absorb the VOCs that already emitted by planting the tree in the buffer zone area
- The impacts during the construction period is temporary and could be mitigated onsite in order to minimize the risk to people, environment, and ecosystem

- Occupational Health and Safety (OHS) is considered a critical element to be considered in the environmental management plan and this indicator has already been integrated into the preparation of EIS

Successful operation of the fuel terminal system, will be measured by how well the impacts and risk are managed. If the impacts is managed well with the budget and plan, then the project is success and also profitable.

The following table provides the summary of estimated cost of mitigation measures of the impacts that already being identified.

Table. Summary of Cost Estimation of EMP (CAPEX and OPEX)

Stage of Project Implementation	Estimated cost (CAPEX)	OPEX - Without major Incident	OPEX with Major Incident
Construction of Phase 1 A	$ 155,000	0	
Operation of Phase 1 A	$ 1,730,000	$343,000.00	$ 17,000,000.00
Construction of Phase 1 B	$ 120,000.00	0	
Operation of Phase 1 A and 1 B	-		
Decommissioning	$ 285,000	0	0
Total Cost	$1,885,000	$343,000.00	$17,000,000.00

Note: Major Capital expenditure has been construction of flood protection (Storm runoff and coastal water), equipment to retain oil spill (Boomer, skimmer, etc.) and fire equipment system.

Given the readiness of project owner to be responsible for the impacts and potential major loss and many positive impacts that will be realized by the development of the project, it is recommended to the project owner, to continue the project development into the construction phase.

- The project viable due to location near the jetty so the project owner does not need to construct the jetty
- Project owner is very confident economically and financially that the proposed project development is a good business cases and produce good return on investment, while at the same time the environmental and social impacts can be mitigated.

Therefore, it is also recommend to the government to endorse this business development in the proposed project area. It is also recommend to the project owner to read and follow all the recommendation written in the EIS and EMP documents.

15 NON-TECHNICAL SUMMARY

Global Oil Terminal LDA proposes the new fuel terminal facility, with the total fuel storage capacity of 10,000 KL in a total land area of 1.3 HA in the Suco Lauhata, Postu Administrasaun of Bazartete, and Municipality of Liquica. The land has already secured by the project owner with the company who has a formal right to utilize the land under the contract with the Government of Timor – Leste, through the Ministry of Justice (land and property). Government of Timor – Leste has already established the regulation that makes a mandatory for every major development to conduct the environmental impact assessment and submit the report in the format of EIS and EMP to the relevant government agency for the approval prior to the commencement of the project development. For the fuel storage development, the ANPM, require the environmental impact statement submit and approval prior to the project location approval.

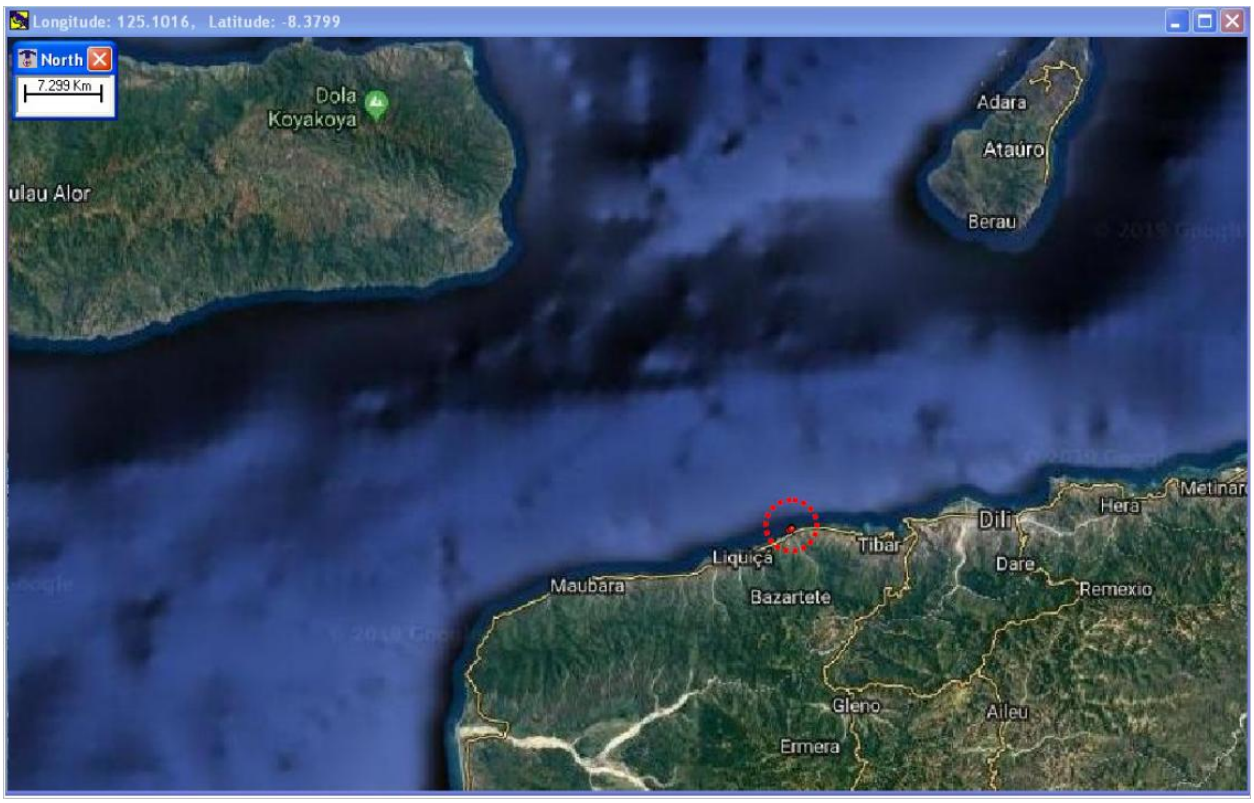


Figure. 20.1 Project Location in Liquica

Figure. Project Layout and Component

Prior to the decision on the investment, the project owner has conducted the market analysis on the supply and demand of the fuel in Timor – Leste and the trend in the future, which conclude the potentiality of business in the fuel storage and distribution to support the Timor- Leste development forward. The project owner has also experience operating in Timor – Leste since 2014 with same modality of business except smaller moveable storage of fuel. By combining the experience and market trend analysis, the project owner decide to pursue the new development the North Coast of Liquica, particularly in the Suco Lauhata. The proposed design capacity of fuel storage capacity and outflow of fuel into the existing marker is projected as follow:

Table: Market Projection of Inflow and Outflow Fuel in Proposed Fuel Storage Terminal

Type of Product	Rate Inflow, KL/day	Rate of Sale, KL/day
Gasoline	180	180
Diesel fuel	150	150

The oil storage terminal expected to receive the feed of fuel from foreign country in the bulk amount via vessel tank, where the unloading of fuel will be done through the existing jetty belongs to Timor Cement, SA, once every two weeks' time. In general the operation process of fuel terminal facility consist of the following

1. Fuel unloading in the existing jetty
2. Fuel storing system in the storage tanks
3. Fuel pumping from the fuel storage system to fuel filling station in the storage facility
4. Fuel pumping to the fuel truck of the costumer

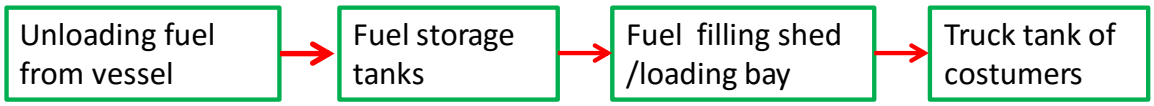


Figure 20.2. Process flow Diagram of Main Component of Project

The above mentioned processes will be supported by the other supporting facility such as piping system, fire management equipment including fire pool, office and administration, control system, and other

Considering the capacity of fuel storage is 10,000 m^3, which is considered a largest capacity of fuel storage in Timor – Leste, compares to the existing one (ETO, Lairara, and PITSA), the scale is large, which will be turned also the large impact of environmental health, and safety. According to the Timor – Leste regulatory framework, every major project development is required to conduct the environmental impact assessment study in order to identify the major environmental and social impacts from the development.

This proposed project development will be implemented according to general project lifecycle, which consist of project planning and preparation, construction, operation and maintenance, and decommission phases. The construction stage of the project was divided into two phases

- Phase 1 A , with the capacity of the fuel storage tank only limit to 5,000 m^3
- Phase 1 B, with additional expansion volume of storage tank volume of 5000 m^3

The following table shows the proposed tentative implementation plan and time schedule of the project implementation. The constructions of the phase 1 B of project shall be decided based on the market demand grow in the future and decision will be made in the future.

Table Summary of Project Implementation Schedule of Global Oil Terminal Facility

Stage	Year								
	2019	2020	2021	2022	2023	2024	2025	----	2055
Planning and Preparation									
Procurement and Construction									
Operation and Maintenance									
Decommission									???

In the year 2019 -2020, the preparation work for the project implementation that include, design, environmental study, permitting requirement, land issue, and other contractual agreement should be resolved by this stage. Starting the year of 2020, the procurement started (assuming that necessary permit will be granted in the year of 2020). The construction of the proposed development facility will comment at the in the mid-year of 2021 and completed in the 2023. By 2023, the commission test to commence the operation can start and the facility shall come to a full operation by the year of 2024. Assuming that the service life of the proposed development facility is 30 –years and after that the project owner can decide if the operation shall be extended or terminated

The environmental impacts assessment (EIA) study was carried out by reviewing all the legal framework in Timor – Leste that are relevant to the project development, baseline environmental data collection and analysis of the impacts that potentially occur during each phase of the project implementation, including the several modeling of the environmental parameters that could be generate major impacts to the environment as a result of the operation of the proposed project development. The summary of important baseline data collection consists of the following:

- Baseline air quality and noise level in the project area and in the community center
- Baseline of groundwater quality from various existing wells (belong to community) and groundwater well that was constructed by the project owner
- Baseline data of soil quality (top soil) measures in term of Total Petroleum Hydrocarbon (TPH) and lead (Pb)
- Marine water quality (physical, chemical, biological, and ecological indicator) for various sites along the north coast of Liquica
- Bottom sediment quality measures in terms of TPH and Pb, for various location along North Coast of Liquica
- Direct diving survey in several spots along the North Coast to observe the existence of coral, fishery, and other important marine resources
- Traffic survey on the existing national road of Dili – Liquica

These baseline data and information is very important not only for the current environmental impacts assessment (EIA) but also the information or data can be used as reference for the future monitoring system on the environmental quality.

Major potential impacts that assessed by this study include the following

- Flooding impacts to the project development from the existing river, as the project location is next to the river bank
- Marine water quality from soil erosion and sedimentation (during the construction)
- Potential oil spill that can pollute the marine water and damaged various coastal resources (Mangrove, wetland, salt pan, beach, etc.)
- Fire hazard
- Minor oil spill in land surface (in the storage area)
- Groundwater utilization and potential impact to the aquifer and other water resources

There are other minor impacts that could be mitigated onsite during the project implementation. This impact includes:

- Noise and vibration
- Air quality degradation due to PM and other gases from internal combustion
- Occupation health and safety

Based on the baseline information and analysis, the mitigation measures were proposed to help minimize, eliminate, or controlling the impacts.

- The proposed project development will be constructed based on the Good Industry Practice (GIP) with high standard of safety requirement. The ANPM recommended following the American Petroleum Institute (API) for the tank design and other supporting facilities. With this option it is expected that the impact such as oil spill related to equipment failure, operation error, lighting, etc., can be eliminated. Furthermore, the ANPM also recommended designing the fire management system (equipment, water, pump, foams, and team) according to NFPA codes. It is hope that by most of the minor impacts such as oil spill, leakage in the pipe and in the tank, as well as provide a better condition to response to the emergency event
- Major oil spill in jetty can be considered as a major accident, where the technical mitigation measures must be prepared, including the equipment (Boom, skimmer, absorbent, etc.) and well trained team to provide effective and efficient response in this condition. In case this proposed technical mitigation measures fail, then contingency plan, to mitigate and restore the impacted coastal area including cleaning the debris, compensation of the damaged that could be caused by the oil spill
- Minor hazard impacts can be eliminated by proper design of the system that fire proof and internal well equipped fire management team that already trained well in responding the fire emergency response.
- Major fire hazard might go well beyond the ability of internal team to be handled and the project owner will seek the external assistance from national level or regional assistance. In the case of major fire accident, where the whole tank yard would be completely on fire, the contingency planning of fire response should be taken.
- The elevated floor level and river training work would minimize the impacts of riverine flooding from high frequency of rainfall. Larger frequency would be considered as emergency, which would be response with the emergency evacuation system
- The rate of water utilization is reasonable small but the continuous monitoring program should be conducted in order to detect earlier the trend of problem so that action would be taken to minimize the larger impact in the longer term

The economic and social impacts assessment suggested that the project development would provide more economic and social benefit to the country and community, in the normal condition (without major incident), as the project will generate high economic and financial return and job creation that the country is needed. The technical and non-technical mitigation measures, as presented in the EIS and EMP, would ensure the risk to the environment is minimum, which will translate into the project sustainability in term of financial and while at the same time ensure the quality of environment. The proposed technical and non-technical approaches to only be effectively implemented by the project owner only with the proper monitoring system by relevant government agencies, as well as the community members.

To ensure the effective implementation, the monitoring system would be needed such as monitoring the flow rate whenever transfer the fuel (from jetty to fuel storage system and fuel storage to the fuel

tanker), groundwater quality, surface water quality (at the drainage), and ambient air quality parameters. Furthermore, the project implementation would also need to follow proper occupational health and safety to reduce OHS impacts to the workers and community. The following table shows the summery of impacts and mitigation measure related to the OHS. The OHS issue related to petroleum product handling, related primarily to chemical hazard, fire and explosion, and confined space such as underground tank

15. SUMARION NON TEKNIKU

Global Oil Terminal LDA, proposta fasilidade foun ba fornesimentu mina ho total kapasidade kumulativu hamutuk 10,000 m^3, iha total rai hamutuk hetares 1.3 iha Suco Lauhata, Postu adminsitrasaun Bazartete, Municipio Liquica (Figure 20.1). Projetu nain asegura tiha ona rai pedasu nebe sei uja husi kompania seluk (Cement Timor SA) nebe iha tiha ona direitu atu utiliza rai refere husi Ministerio das Justica. Iha parte seluk, Guverno Timor – Leste, establese tiha ona regulamentu nebe obriga para projeto dezenvolimentu nebe maior no bot tengki halo estudu ambiental no submete resultadu estudu refere ba orgun Guverno nebe relevante hodi hetan lisensa antes hahu konstrusaun ba projeto bot sira. Estudu ambiental nee importante hodi analiza risku nebe probavelmentu sei mosu durante implemetasaun projeto nomos propoin meus hodi minimiza impaktu sira nee. Wainhira, impaktu sira nee bele identifika iha inisiu de projeto, entaun meus para minimiza nee bele planeia kedas, inklui rekusu hira maka tengki aloka para implementa asaun sira nee. Meius ida nee sei redus kustu sira nebe la nesesariu, wainhira laiha planu, hodi responde eventu balun nebe karik akontese. Ba projeto sira nebe liga ba mina no minarais, resultadu estudu ambiental sira nee sei submete ba ANPM hodi hetan aprovasaun molok projeto refere komesa.

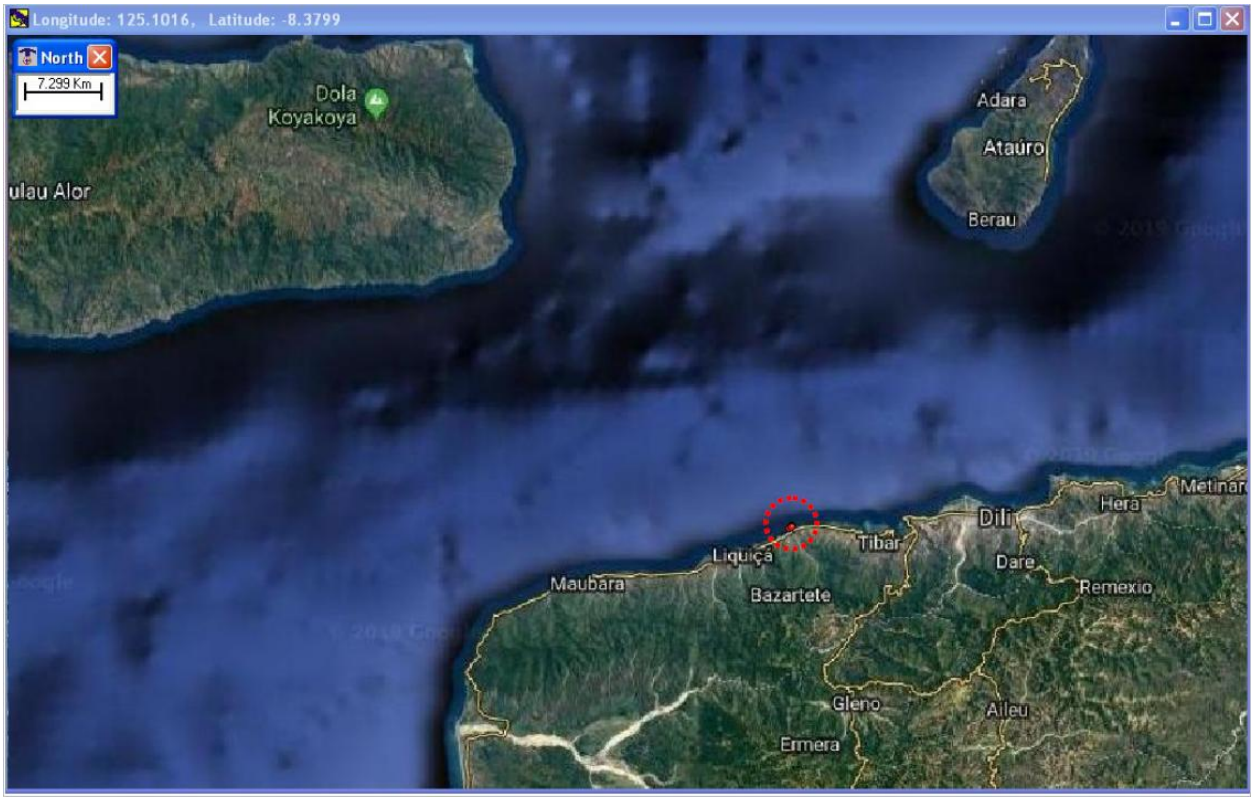


Figura. 20.1 Lokalizasaun Projeto iha Liquica

Figure. Layout no Komponente husi Projeto

Antes foti desizaun hodi avansa iha investimentu ida nee, projeto nain halo tiha ona estudu ba merkado kona ba suplai no demand ba produtu mina (gsasolina no gasoel) iha Timor – Leste no ninia prospektiva ba oin, no kongklui katak, potensial bot tebes ba negosio mina iha Timor – Leste, wainhira iha tangka fornesedor, entaun sei hetan vantagem bot liu hodi eleva ninia benefisio no lukru. Projeto nain mos iha tiha ona esperiensia iha Timor – Leste desde 2014 halao negosio ho modalidade negosio nebe hanesan, maibe ho eskalaun natoon no depot/tanki nebe movel. Kombinasaun esperiensia no estudu analiza markadu nebe konvensidu, projeto nain desidi hodi realiza investimento ida nee iha parte Liquica, partikularmente iha Suco Lauhata, ba esklaun nebe bot hanesan temi dadauk.

Proposta kapasidade deseinu mina nebe tama husi ponte kais no sai husi fornesedor tangki, bele hare iha tabela tuir mai nee.

Tabela: Projeksaun no Propoin Fluxu ba Mina tama no sae husi Proposta Depot Mina iha Lauhata

Tipe Produtu	Fluxu Tama, KL/dia	Fluxu Sai/fan, KL/dia
Gasolina	180	180
Gasoel	150	150

Fornesimento (Depot) mina nee sei simu mina liu husi ro nebe sei mai husi rai liur liu husi ponte kais nebe iha tiha ona, dala ida kada semana rua. Ponte kais nee, konstrui husi Timor Cement SA, nebe projeto nain sei aluga wainhira uja. Em geral, prosesu operasaun depot mina nee kompostu husi parte tuir mai nee:

5. Bongkar (unloading) mina husi ro iha ponte kais/jetty
6. Armajemamentu mina iha tangki laran (temporariamente)
7. Bompa sai mina husi tangki ba parte nebe prepara ona (filling station) hodi ense ba tanki kostumer sira
8. Pompa mina ba tangki kostumer sira

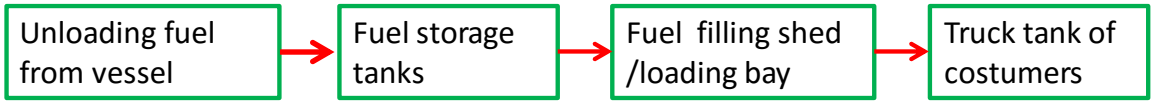


Figure. Fluxu Mina husi Fatin id aba Fatin Seluk iha Fasilidade nia Laran

Prosesu sira nebe temi iha leten nee, presiza apoiu fasilidade importante, henesan kanu/kanalizasaun, bee mos, oficina, Bombeiros, sistema kontrola, nomos seluk tan nebe esensial para prosesu transportasaun mina husi ponte kais mai tanki, nomos husi tangki bot ba tanki kostumer sira bele lao ho efisiente, nomos seguru, no sustentavel. Detailmentu ba komponente no "l***ayout***" ba fasilidade bele hare iha dokumentu iha EIS/EMP no dokumentus ba DED.

Hare husi aspeitu volume tanki nebe atu konstrui nebe provolta, 10,000 m^3, ida nee konsidera bot, no tuir informasaun nebe iha, proposta ida sei sai depot nebe bot liu duke depot sira nebe iha tiha ona hanesan ETO, Laiara, no PITSA. Tamba ninia eskalaun bot, liu-liu fornese mina nee, hanesan tipu material/kimiku nebe pergozu (Hazardous), entaun ninia presenza iha area ida nee sei hamosu impaktu ambiental, saude, no seguransa, nebe presiza tama konta. Temi tiha ona iha leten katak, tuir regulamentu nebe em vigor iha Timor – Leste, projeto bot nebe iha impaktu bot presiza halo estudu antes komesa.

Tuir orario nebe projeto nain propoin, katak projeto implementasaun sei lao tuir ciclu ba projeto, nebe komesa husi preparasaun no planeamento, pois mak halo deseinu no konstrusaun, antes ba operasaun no manutensaun ba fasilidade. Bele mos, too ikus, projeto nee taka, wainhira projeto refere ladun fo benefisiu (benefisio ekonomiku no finanseira) nebe espera ou karik Guverno desidi hapara projeto ida nee tamba halo violasaun ba lei ruma no halo aat ambiente nebe iha no identifika liu husi provas nebe rigorous husi parte nebe indepedente.

Maibe konstrusaun ba fasilidade tomak sei halo tuir etapa 2:

- Etapa 1 A , ho kapasidade tanki hamutuk 5,000 m^3
- Etapa 1 B, ho kapasidade adisional tangki hamutuk 5000 m^3

Tabela tuir mai sei hatudu tentativamentu kona ba orario de implementasaun husi inisiu to operasaun no manutensaun. Konstrusaun etapa 1 B sei desidi baseia ba merkadu ba oin; tinan lima mai, merkadu aumentu bot, entaun konstrusaun ba faze 1 B bele komesa.

Tabela Sumario ba Orario Implementasaun ba Projeto Fasilidade Global Oil Terminal

Faze	Tinan								
	2019	2020	2021	2022	2023	2024	2025	----	2055
Planeamento no preparasaun									
Aprovisionmento no Konstrusaun									
Operasaun no Manutensaun									
Dekomisaun/Taka									???

Preparasuan no planeamentu hahu husi 2019 – 2020, inklui deseinu, estudu de viabilidade, estudu ambiental no lisensa, titlu ba rai, nomos kontratu obrigatorio seluk nebe kompania/ema husi rai liur tengki kumpri hodi halao installasaun no operasaun tangka ba kombustivel mina nian iha Timor – Leste. Depois de preparasaun no planeamento remata, konstrusaun sei komesa iha medio 2021 no kompleta etapa 1 A iha 2023. Iha 2023 nia laran, espera katak konstrusaun kompleta tiha ona no bele halo testing (trial operation) kona ba operasaun fasilidade ida nee antes tama ba operasaun lolos iha 2024. Hanoin, katak Vida moris husi fasilidade ida nee provolta 30 anos. Depois de tinan ida nee (30 anos), projeto nain bele desidi hodi kontinua ou para operasaun no sobu fasilidade ida nee, depois hetan aseitasaun husi Guverno no entidade nebe relevante.

Estudu ambiental nebe halo tiha ona ba projeto ida nee kompostu husi reve dokumentu legais no regulamentu sira nebe presiza para kumpri no ninia ligasaun ba projeto ida nee rasik. Enkuadramentu legal sira nee importante no sei kesi metin no fo garantia ba investimentu ida nee ba projeto nain iha parte ida. Nomos iha parte seluk, husi projeto nain bele kumpri hodi nune bele asegura, kualidade ambiental, saude no seguransa, liu-liu durante operasaun iha tinan barak nia laran in Timor – Leste nia teritorio. Estudu mos halo tiha ona mapamentu ba reskursu importante nebe iha, liu-liu iha area branka nebe potensialmentu sei afeita husi projeto ida nee rasik. Inklui halao simulasaun, karik sei iha mina fakar iha ponte kais karik, area nebe afeita nee too iha nebe. Sumario kona ba base de dadus nebe establese tiha ona, hanesan fasparte husi estudu ambiental ida aprezenta tuir mai nee:

- Informasaun kona ba kualidade ar (udara) no baruilu (noise) iha area projeto nee, inklui iha centru komunidade hanesan area nebe simu impaktu
- Estudu kona ba bee iha rai okos, inklui kualidade bee iha rai okos husi perspektiva bee konsumu nian, no husi perpektiva polusaun husi produtu petrokimiku nian
- Base de dadus kona ba kualidade solo (top soil) iha area projeto laran nomos iha fatin nebe besik area nebe bele simu ***cross*** contaminasaun iha future. Parametru nebe sukat mak, Total ***Petroleum Hydrocarbon*** (TPH), no ***lead*** (Pb). Elementu kimiku rua nee, hanesan sasukat ida para hatene, sei karik iha kontaminasaun husi produtu mina ba rai no ambiental seluk
- Sukat no establese base de dadus ba kualidade tasi bee (sukat husi parametru fiziku, kimiku, biologia, nomos indikador ba ekologia) iha fatin 5 nebe provavelmentu sae hanesan referensia ba futura karik iha transporta kontaminasaun ruma husi fasilidade ida nee

- Establese dadus kona ba kualidade sediment iha rai okos (***bottom sediment***) hodi uja hanesan referensia ba futura karik iha kontaminasaun tama tiha ona iha tasi laran, depois de tinan barak, mosu hanesan dopositu ida rai okos iha tasi laran.
- Survey direitamente husi ekipa iha tasi laran (Diving team) hodi observa rekursu saida mak importante iha tasi laran hanesan koral, ikan, budu tasi, no seluk tan.
- Teste kona ba rai husi aspeita fiziku, kimiku, husi rai leten too, 50 meter (kuandu hetan tiha ona fatuk bot mak para). Dadus ida nee importante ba konstrusaun pondasi nomos, selesaun material konstrusaun nebe sei uja hodi sustenta ho seguru ba tinan barak nian

Informasaun sira nebe establese tiha ona nee, laos deit importante para halao analiza ba impaktu ambiental sira nebe halo dadaun nee, maibe mos, importante liu hanesan referensia ba futura hodi gere no monitor kualidade ambiente durante operasaun ba fasilidade ida nee. Komparasaun ba kualidade ambiente iha futura ho dadus referensia ida nee sei fo informasaun kona ba kontribusaun husi projeto ida nee ba kualidade ambiente.

Husi analiza ba impaktu sira nebe posivelmente sei mosu durante implementasaun ba projeto sumariza tuir mai nee, baseia ba eskalaun husi impaktu (Impaktu bot/maior no impaktu kiik ou menor)

- Tamba projeto nee rasik sei lokaliza besik mota ninin, entaun risku boot nebe presiza konsidera no tengki tau atensaun durante halo deseinu no konstrusaun ba projeto nee mak inundasaun husi mota. Liu-liu, husi udan nebe ninia frequencia bot, hanesan dalan ida ba tinan 50 ba leten.
- Kualidade tasi been nebe bele afeitadu husi erosaun husi rai rahun durante konstrusaun, nebe presiza tau matan no atensaun tamba bele estraga coral no fo disturbansia ba biodiversidade iha marina nia laran
- Iha eventu ida nebe la espera, maibe bele akontense, hanesan, mina fakar durante ro hatama mina husi ponte kais. Kuandu, kuantidade mina fakar nee bot, entaun bele fo impaktu ba biodiversidade iha marina nia laran, nomos bele estraga rekursu iha area kosteira hanesan ai paraba, tasi ibun/fatin rekreasi, nomos industria kiik, hanesan ikan, masin, no seluk tan.
- Tamba tipu projeto ida nee, fornese combustivel, entaun, kestaun ai han (kebakaran) nee, importante tebes para konsidera iha deseinu no konstrusaun ba fasilidade ida nee. Identifikasaun kona ba parte husi fasilidade nebe sei afeita ahi han, nebe akontense iha fatin barak bele sai hanesan lisaun ou informasaun diak, para bele estuda hodi evita kazu nebe hanesan iha futura.
- Mina fakar iha area fasilidade durante halao operation hanesan transfere mina husi fatin ida ba fatin seluk. Provavelmente, mina fakar sempre iha no presiza meus para halo minimizasaun nomos elimina
- Tamba projeto ida nee rasik sei esplora bee husi rai okos, hodi sustente ninia operasaun, entaun presiza halo analiza kona ba kuantidade no kualidade bee iha rain okos.

Iha mos impaktu nebe ninia eskalaun ladun bot nebe bele minimize iha fatin durante implementasaun ba projeto.

- Baruilu no vibrasaun
- Kualidade ar/udara husi rai rahun nomos gas emisaun nebe mai husi makina nebe uja mina
- Siguransa saude, ambiental, durante execusaun service iha projeto ida nee
- Minimiza foer nebe produce iha area projeto nia laran

Impaktu bot nomos kiik nebe analiza no identifika tiha ona, sei minimiza, hodi nune bele mantein kualidade ambiente nebe hanesan antes projeto nee hahu. Sumario ba asaun nebe importante para implementa antes no durante implementasaun ba projeto mak aprezenta tuir mai:

- Impaktu barak nebe temi ona nee, bele minimiza no elimina liu husi deseinu no konstrusaun ba komponente ida-ida, tuir padraun nebe diak iha industria mina nian, nebe konsidera tiha ona padraun nebe ass tebes ba kestaun Siguransa, liu-liu ba tangki mina no apoiu fasilidade seluk. ANPM rekomenda tiha ona, para deseinu no konstrusaun ba komponente husi terminal mina nee tuir padraun husi "***American Petroleum Institute***" (API). Iha kodiku lubuk ida nebe presiza konsidera iha deseinu no konstrusaun nebe projeto nain tengki tuir no ANPM sei halo verifikasaun ba deseinu sira nee. Wainhira tuir padraun API ida nee, bele asegura katak, failansu balun hanesan eror iha operasaun, ekipamento nebe eror, liu-liu kausa mina fakar liu husi kebocoran bele elimina ou minimiza. Iha parte seluk ANPM mos rekomenda tiha ona ba kompania sira nebe iha depot mina, para deseinu sira nia jestaun be ahi han ruma, tuir padraun/kodiku husi ***NFPA (National Fire Prevention Association***)
- Mina fakar iha ponte kais ho kuantidade bot nee konsidera hanesan emergensia, nebe ninia impaktu bele minimiza liu husi mitigasaun tekniku hanesan ***oil boomer***, ***skimmer***, ***absorbent***, nebe sei bele halao husi ekipa tekniku nebe treinadu tiha ona hodi responde emergensia nee ho efisiente no lalais. Iha kasu nebe meius tekniku sira karik faila, entaun, planu kontingensia tengki uja para ajuda minimiza no ***offset*** ninia impaktu sira nee, inklui hamos area branka, re-plante ai paraba nebe hetan estraga, selu kompensasaun, ba komunidade no ema nebe afeitadu
- Risku nebe kiik bele elimina husi deseinu nebe regorozu hanesan ***fire proof*** no ekipa interna nebe treinadu ho ekipamentu nebe sofistikadu hodi gere no hamate incidente sira antes sai bot no fo ameasa.
- Iha kazu, ahi han ba fasilidade nebe labele ona kontrola husi ekipa interna, entaun projeto nain sei komunika husi ekipa esterna, hanesan nasional no ***regional*** para bele hetan ajuda. Iha kazu, depot mina tangki nee ahi han hotu no kria, impaktu nebe fo impaktu seluk (***domino effect***), entaun asuransi maka tengki tama konta tamba eventu ida nee hanesan disastru nebe bot tebes
- Amiasa inundasaun husi mota sei bele minimiza husi servsiu hadia mota no kontrui drainagem nebe adekuadu hodi bele foti bee ho kapasidade bot nebe rezulta husi udan ben nebe frekuensia bot 50 ba leten. Liu ida ina, hanesan emergensia nebe asuransi maka sei tama konta ninia estragus. Iha fasilidade nia laran mos presiza ateru rai too nivel hanesan estrada para udan been labele nalehun no estraga fasilidade durante operasaun
- ***Demand*** ba bee mos husi projeto nee kiik no utilizasaun bee husi rai okos, la kria impaktu nebe siknifikante maibe presiza ***monitor*** no kontrola kuantidade bee nebe supa sai husi rai okos. Kontrola nee importante hodi asegura sustantabilidade ba kuantidade bee iha rai okos ba tempu naruk nian

Avaliasaun impaktu economiku no social hatudu katak, dezenvolvimentu projeto ida nee, sei fornese benefisiu ekonomia no social nebe bot ba projeto nain no nasaun no komunidade, tuir kondisaun normal (hanesan laiha acidente ruma nebe siknifikante), tamba projeto refere sei hamosu retornu ekonomia no finaseiro nebe bot ba projeto nain no iha parte seluk kria opportunidade servisu ba juventude nebe nasaun presiza. Iha mos efeitu multiplikador nebe projeto nee rasik bele kria iha lokal husi investimentu bot ida nee, hanesan ***supply chain industry*** seluk.

Iha paste seluk, metodu tekniku nomos jestaun nebe proposta bele uja para gere impaktu ambiental nebe identifika tiha ona, nebe aprezenta tiha ona iha EIS no EMP. Implementasaun ba jestaun

ambiental nebe diak bele asegura katak risku sira nee bele gere no minimiza hodi mantein kualidade ambiental pelumenus hanesan ba kondisaun antes projeto nee komesa. Proposta tekniku no jestaun nee bele lao ho efetivu no efikas, wainhira iha monitorizasaun nebe rigorozu husi projeto nain, nomos liu-liu hetan inspesaun husi parte orgaun Guverno nebe relevante no komunidade hotu nebe besik fasilidade nee.

Monitorizasaun ba parametru hanesan kuantidade bee husi rai okos nebe supa sai, balansiu material (mina) transfere husi fatin ida ba fatin seluk, kualidade bee rai okos, kualidade bee husi mota, kualidade ar, kualidade tasi been, maka hanesan ***monitoring*** parametrus nebe presiza halo husi tempu ba tempu seluk, hodi nune fornese provas katak, atividade projeto lao seguru no la fo impaktu negative ruma ba ambiente. Importante mos, ba projeto nain para tau atensaun makas ba seguransa servisu no saude, hodi asegura servisu tuir padraun servisu hodi minimize incidente ba servisu nian.

16. REFERENCES

17.LIST OF ANNEXES (PROVIDED IN DIGITAL FILES)