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Updated Environment and Social Management Plan for Establishment of Island Waste and Resouce Management Centre (IWRMC) in Th. Thimarafushi

PROPOSED BY: MINISTRY OF ENVIRONMENT

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Consultants Declaration

As the lead consultant of this ESMP,

This ESMP has been prepared according to the EIA Regulations. I hereby, declare that the content in this EIA is complete, true, and correct to the best information that I had while compiling this ESMP.

A handwritten signature in blue ink, consisting of a large, stylized 'H' followed by a series of loops and a long horizontal stroke extending to the right.

Name: Hamdhoon Mohamed (EIA P03/2017)

Executive Summary

This report discusses the findings of the Environmental and Social Assessment study undertaken by Environmental Consultant (Mr. Hamdhoon Mohamed) recruited by Ministry of Environment to establishment of Island Waste Management Centre (IWRMC) in Th. Thimarafushi. This report is prepared in accordance with Environmental Impact Assessment Regulation (2007) under the Environmental Protection and Preservation Act (1993) and the Amendments to the EIA regulation. The purpose of this ESMP report is to fulfill the requirements of the aforementioned law and regulation and conduct an assessment of possible impacts on the ecological, biophysical and socioeconomic environment arising from the proposed establishment of IWRMC in Th. Thimarafushi.

The main rationale of this project to provide a proper mean for disposal of solid waste accumulated in the dumpsites in Th. Thimarafushi. This project is expected to reduce the nuisance caused by smoke from open burning and reduce nuisance species such as house flies and rodents.

The proposed project will involve construction of IMWC in Th. Thimarafushi. Provision of the solid waste management equipment and establishment of fire safety equipment. An aerobic composting (Organic Waste Converter (OWC) technology machine will be established in the IWRMC for producing compost from organic waste. This ESMP will also cover operational aspects of IWRMC including collection and transportation of the waste and other waste management practices such as reducing the volume of waste and composting.

Key Impacts

The project will involve impacts both during the construction and the operational phase of the project. The main project activities which may result in impacts during the construction phase include; Influx and settlement of workers for the project construction activities, transportation of materials, Impacts from construction works, terrestrial pollution from construction waste generation and Impacts from resource use.

The main project activities during the operational phase which may have a significant impact on the environment include waste collection and transportation, waste management activities, Waste generation - terrestrial pollution, groundwater contamination and resource consumption.

The major socioeconomic impact is found to be positive. The reduced volume of solid waste accumulated will have public health benefits for the residents of Th. Thimarafushi.

Mitigation Measure

An Environmental and Social Management Plan has been proposed with mitigation measures and estimated cost for implementing the proposed mitigation measures.

Alternate technology and power sources for IWRMC operation.

Alternative technologies for managing organic waste have been analyzed. The technologies compared include manual composting (windrow system), anaerobic digestion system (bio-gas generation) and aerobic OWC technology (in-vessel composting). From the analysis, the aerobic OWC technology was found to be most appropriate for the IWRMC in Th. Thimarafushi.

Furthermore, alternative power source for the operational phase of the IWRMC has been explored. The alternative options explored include installation of solar photovoltaic cells, installation of a stand-alone generator and utilization of existing electricity grid in the island to meet the power requirements of the IWRMC. Based on analysis the most feasible option to meet the power requirements of IWRMC was found to be utilization of existing electricity grid in the island.

Environmental Management and Monitoring

A monitoring regime of environmental and social safeguards has been proposed taking into consideration the impacts and mitigation measures to be implemented. The important elements that require checks such as implementation of mitigation measures, groundwater quality and spillage assessment at the project site will be monitored according to the developed monitoring program during construction and operation period.

Although the project involves inevitable negative environmental impacts, such impacts are not serving as to not undertake the project. Mitigation measures have been proposed to adequately minimize the significant impacts. Hence, the project is justifiable in light of the socioeconomic conditions and anticipated benefits from the project which clearly outweigh the negative environmental impacts.

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CHAPTER 1: INTRODUCTION

The Ministry of Environment has proposed a project to establish an Island Waste Management Centre (IWRMC) in Th. Thimarafushi as a part of the World Bank Funded Maldives Clean Environment Project (MCEP). An Environmental and Social Management Plan (ESMP) for the establishment of IMWC in Th. Thimarafushi was elaborated by EIA consultant Mr. Ahmed Saleem in July 2018. This ESMP report will built on the aforementioned ESMP. The main rationale for elaboration of the updated ESMP is to consider the proposed changes to an aerobic technology using composting machine, while manual composting was covered in the initial ESMP.

1.1 Aims and Objectives of the project

The project is aimed to establish a IWRMC with aerobic technology using composting machine. In this regard the main objectives of the project are;

- Establish an IWRMC in Th. Thimarafushi with aerobic technology using composting machines;
- Improve the solid waste management practices in Th. Thimarafushi;
- Provide a safe disposal means for the hazardous waste generated in the island;
- Produce compost to cater local farming needs.

1.2 Current situation in solid waste management and project rationale

Waste management has been a significant challenge for the residents of Th. Thimarafushi. The high rate of the waste generated and lack of financial resources for sound management of the solid waste are two of the prime challenges faced by the island. Until recently, there was no area to dump waste and locals usually burnt and buried their waste in different areas of the island. The island council has now selected a specific area for dumping waste which is utilised by all the islanders (See **Figure 1**). This area is not demarcated. Since the dumpsite started being used by most of the islanders, dumping waste at various parts of the island has stopped. There is no separation of waste done at the dump site or households. Mixed waste is carried to the current dumpsite by locals and dumped into a trench. Mixed waste is burnt inside the trench and the ashes are buried covering the trench with sand. Some of the islands expatriate workers provide waste collection services for a fee of 100 MVR/month. The majority of waste generated is now buried in the trench at the dumpsite, this includes plastics, glass, metals, yard waste and sanitary waste. Kitchen waste is sometimes dumped into the lagoon. This waste may contain containers such as metal cans and plastic. Construction waste, mainly stones are stored in areas east and west of the islands harbour.

The Island Council noted that a waste management centre was constructed in Thimarafushi under Canadian Red Cross aid after the 2004 tsunami disaster. The waste management centre however, filled up within 2 weeks of use, as there was no way to reduce volume of the waste or transport residual waste out of the island.

The following **Table 1** illustrates the current situation of the dedicated dumpsite and some other waste management practices followed in Th. Thimarafushi in terms of the practices and resources dedicated for solid waste management.

Table 1: Current situation of solid waste management in Th. Thimarafushi

Facilities/Practices	Current Situation/Practices
Waste transportation	Waste collection service is provided by private parties
Harbor (accessibility)	Accessible to vessels and landing crafts
Vehicles for waste transportation	No vehicles for waste transport
Waste management equipment	No waste management equipment available
Dump site demarcated	Dump site is not demarcated
Separation of waste at dumpsite	Waste is not separated
Burning of waste	Mixed waste is burnt regularly
Burying of waste	Waste is buried to reduce volume
Dumping waste into the beach/sea	Kitchen waste is dumped into the lagoon
Presence of large waste piles	Dumpsite provided as relief aid during the 2004 Tsunami disaster (filled up within 2 weeks)
Pollution of inland/other areas	Terrestrial pollution of inland areas is controlled
Clinical waste management	Clinical waste is managed at the Health Centre
Public area waste collection	Council contracts Women's Committee to clean and collect waste from public areas.
Presence of waste bins	There are no waste bins
Presence of workers	Women's committee is contracted to operate the dumpsite
Electric connection at the dumpsite	No electric connection at the dumpsite



Figure 1: Areas where waste is currently disposed at Th. Thimarafushi (adapted from Saleem 2018)

There are no island waste management plan formulated for the island. During the stakeholder consultations, council highlighted the interest of operating the proposed IWRMC once the centre is

established. Hence, the proposed IWRMC is expected to bring a significant improvement to the solid waste management challenges of the island. The scope of the proposed IWRMC is to facilitate island level management of the waste generated within the island, which includes sorting of waste types, storage of hazardous wastes, volume reduction of inorganic waste, stockpiling and composting of the waste using aerobic technology using composting machine. The waste that is not manageable in the island level is to be transported to K. Thilafushi.

1.3 Project Proponent

The project proponent is Ministry of Environment. The Ministry of Environment is the implementing agency of the Maldives Clean Environment Project (MCEP) which is funded by the World Bank and will be funding the establishment of the IWRMC in Th. Thimarafushi. The following are the details of the proponent;

Ministry of Environment

Ameenah Magu, Maafannu, Male' 20392

Republic of Maldives

1.4 Desk Study Reviews

A literature review was conducted to acquire background information related to the site and the general environment of the island, as well as to identify possible environmental impacts of projects of similar settings. In this context, the following documents were reviewed:

- Environment and Social Management Plan (ESMP) for establishment of Island Waste Management Centre in Th. Thimarafushi (Saleem 2018).
- Environment and Social Management Plan (ESMP) for the upgrading of Island Waste Management Centre in N. Holhudhoo (Zuhair 2019).
- Environment and Social Management Plan (ESMP) for establishment of Island Waste Management Centre in Th. Kinbidhoo (Saleem 2018)
- Environment and Social Management Plan (ESMP) for establishment of Island Waste Management Centre in Th. Omadhoo (Saleem 2018)
- Environment and Social Management Plan (ESMP) for establishment of Island Waste Management Centre in M. Mulah (Saleem 2018)
- Maldives Clean Environment Project Environmental and Social Assessment and Management Framework (ESAMF) & Resettlement Policy Framework (RPF) (Ministry of Environment [ME] 2016).
- Environmental Impact Assessment (EIA) for establishment of water and sewerage system in Th. Thimarafushi (Musthafa 2016).

1.5 Report Preparation, Acknowledgements and Author Credits

This report is an update of the Environment and Social Management Plan (ESMP) for establishment of Island Waste Management Centre in Th. Thimarafushi prepared by Maldives Energy and Environment Company (MEECO) and authored by Environmental Consultant Mr. Ahmed Saleem. The author of this report gives due credit to the author of the initial ESMP.

The author would like to acknowledge the assistance and support received from the following people in organizing and undertaking field surveys and stakeholder consultations.

- Mr. Mareer Mohamed Husny (Fieldwork and Stakeholder Consultation Coordinator)
- Mr. Ahmed Hassaan Zuhair (Environment and Social Safeguards Specialist, MCEP)
- Mr. Eyman Ismail (Assistant Project Coordinator, MCEP)
- Mr. Ahmed Ibrahim (Vice President, Th. Thimarafushi Island Council)

CHAPTER TWO: LEGISLATIVE AND REGULATORY CONSIDERATION

This Chapter of the ESMP will describe various legislation and regulation which are applicable to the proposed establishment of IWRMC in Th. Thimarafushi. This chapter will consider the national requirements and requirements of World Bank Environmental and Social Safeguards.

2.1 National Legal and Regulatory Framework

The main legislation which is applicable to the proposed project is Environmental Protection and Preservation Act (Act no. 4/93). The most applicable regulations are Environmental Impact Assessment (EIA) Regulation (2012). The EIA regulation (2012) sets out the Environmental Assessment requirements at a national level. Part III of this regulation includes a description of the Screening Process applied to development proposals. Schedule D of the Regulations provides a screening list of all development types for which full EIA is mandatory. According to Schedule D included in Amendment 2 to the EIA regulations 2012, waste management practices that require preparation of an EIA are:

1. Projects involving operation of large incinerators with a capacity of more than 10 tons per day.
2. Development of large waste management centers that treats more than 10 tons of waste per day.
3. Projects that involve development of a landfill by using waste.

Proposed developments that do not fall within Schedule D are subject to manual screening by the Environmental Protection Agency (EPA), for which a Screening Form must be submitted providing relevant development details. Within 10 days, the EPA will decide whether the proposed development is approved, or needs further study, which may be required in the form of an EIA or Environmental Management Plan (EMP) (Ministry of Environment [ME], 2012). The proposed project is small scale and therefore is not listed under the Schedule D of the EIA Regulation. A screening process was followed and the screening decision from EPA was to prepare an EMP for the project and to submit for review and approval.

2.2 World Bank Environmental and Social Safeguards Requirements

MCEP is categorized under Environmental Category A as per the World Bank safeguards categorization process.

Therefore, following safeguard policies are applicable to the MCEP

1. OP 4.01 – Environmental Assessment to ensure any environmental impact associated with project activities are identified in time and mitigated.
2. OP 4.04 – Natural Habitats is triggered because all of the country's islands are surrounded by coral reefs which are significant natural habitats. The overall project will not conduct any activities within designated protected areas and project interventions will facilitate in mitigating pollution and degradation of such ecosystems due to inappropriate Solid Waste Management.
3. OP 4.12 - The interventions leading to the construction and expansion of IWRMCs could lead to future in case finds of involuntary loss of crop and / or land taking as a small percentage of communities rely on surrounding land for agriculture and livelihood thus proper due diligence measures to tackle any in case finds have to be inbuilt into project screening.

MCEP being a Category A project an Environmental and Social Assessment and Management Framework (ESMF) was formulated. It is mentioned in the ESMF of MCEP that prior to the approval of disbursement of funds for project sub-components, International Development Association (IDA) will have to clear all safeguards documentation. Therefore, although an EMP is required as per the local regulation, an Environmental and Social Management Plan (ESMP) will be developed for the proposed project and simultaneously submitted to the World Bank for approval. This document is prepared consistent to the ESAMF.

A separate land selection process was not followed for this project since the project is undertaken in an site that has also been reflected in the LUP approved by Ministry of National Planning, Housing and Infrastructure (MNPHI).

2.3 Other relevant legislations, regulations, policies, and guidelines

The following **Table 2** enlist other relevant legislations, regulations, policies and guidelines relevant to the proposed establishment of IWRMC in Th. Thimarafushi.

Table 2: Relevant laws, regulations, policies and guidelines and their applicability to the project

#	Relevant laws, regulations, policies and guidelines	Requirements	Applicability to the project
Legislations			
1	The Land Act (1/2002)	National	All transactions concerning the issuing, receiving, owning, selling, lease, utilizing and using Maldivian land shall be conducted in compliance with this Act.
2	Law on Cultural and Historical Places and Objects of the Maldives (27/79)	National	Requires proponents to develop provisions for managing chance finds through 'a chance find procedure' which will be applied in the event that cultural heritage is subsequently discovered. The client shall not disturb any chance find further until an assessment by competent professionals is made.
3	Employment Act (02/08)	National	• Worker shall not be forced to work for more than 48 hours per week. • Workers shall not be made to work for more than 6 days a week consecutively without providing 24 hours for rest. • Workers shall not be made to work continuously for more than 5 hours without providing a break for at least 30 minutes.

			• Salary should be paid to all permanent contract workers once a month. • Minimum 03 meals shall be provided to construction staff per day or appropriate meal break time shall be provided.
4	Immigration Act (01/07)	National	All expatriate workers must have proper work visas and work permit cards.
5	Utility Regulation Authority Act (2020)	National	The regulatory works for waste management has been transferred to newly established Utility Regulation Authority (URA).
Regulations			
6	Waste Management Regulation (R-58/2013).	National	The regulation reflects the following: - Sets standards for waste collection, transfer, treatment, storage, waste site management, landfills and managing hazardous waste. - Defines approval procedures for waste sites and waste transfer. - Standards and permits required for waste transport on land and sea, including transboundary movements. - Defines reporting and monitoring requirements and procedures. - Defines procedures to implement WMR and penalties for non-compliance. • The IWRMC was designed conforming to the provisions of Waste Management Regulation.
7	Land Use Planning Regulations and Guidelines (2005)	National	• The Land Use Plan (LUP) of Th. Thimarafushi has demarcated an area for IWRMC. • The LUP of islands are reviewed by MNPHI in consultation with MLSA and EPA. The LUP of Thimarafushi is approved by MNPHI. • Although the IWRMC is located at a close proximity to some residential houses, MNPHI has

			given consent to the land use given the scarcity of land and unavailability of an alternative location.
7	Coral mining regulation	National	Coral mining from house reef and atoll rim is banned.
8	Sand mining regulation	National	Sand should not be mined from any part of an inhabited island, beach or the newly reclaimed island beach. Sand should also not be mined from within 100 ft. of the shoreline
Policies			
9	National Waste Management Policy 2015	National	The establishment of an IWRMC is prerequisite to facilitate waste management at island level.
10	National Policy on Health Care Waste Management	National	- Stipulates that all health facilities have to be responsible for the safe management of health care waste in an environmentally sound manner that minimizes risk to the community and the staff involved in its management. - The IWRMC should not accept healthcare waste as it has to be managed separate from the general waste directly at the health center.
11	World Bank Performance Standard 8 – Cultural Heritage (2012)	World Bank	Requires burrower's to develop provisions for managing chance finds through 'a chance find procedure' which will be applied in the event that cultural heritage is subsequently discovered. The client shall not disturb any chance find further until an assessment by competent professionals is made.
Guidelines			
12	World Bank Group Environmental Health and Safety Guidelines for SWM Facilities	World Bank	Sets procedures to reduce the risk of accidents and injuries, minimize dust and air quality related impacts, reduce the probability spillage of oil and hazardous substances and leachate on site due to stormwater runoff during

			operations of waste management facilities.
13	Environmental Guidelines for Site Selection of Waste Management Centers (2017)	National	• Provides recommendation for optimum zoning of IWRMC sites. • Although the IWRMC is located at a close proximity to some residential houses, MNPHI in consultation with EPA has given consent to the land use given the scarcity of land and unavailability of an alternative location.

CHAPTER THREE: STUDY AREA

3.1 The Project Setting

Th. Thimarafushi is located at $02^{\circ}12'30.87''\text{N}$ and $73^{\circ}8'52.53''\text{E}$. Situated on the southeastern side of the atoll the island covers an area of about 19 ha naturally. In addition, 83 hectares of land has been reclaimed. The nearest inhabited island is Veymandoo roughly 4.9 km away. The nearest uninhabited island is Funaddu 1.17 km to the west of the island. COMO Maalifushi in Maalifushi is the closest resort to the island 19.12 km away. Thimarafushi Domestic Airport is located on the eastern side of the island's newly reclaimed areas and the airport is now operational. The **Figure 2** shows the location of Th. Thimarafushi in Thaa Atoll.

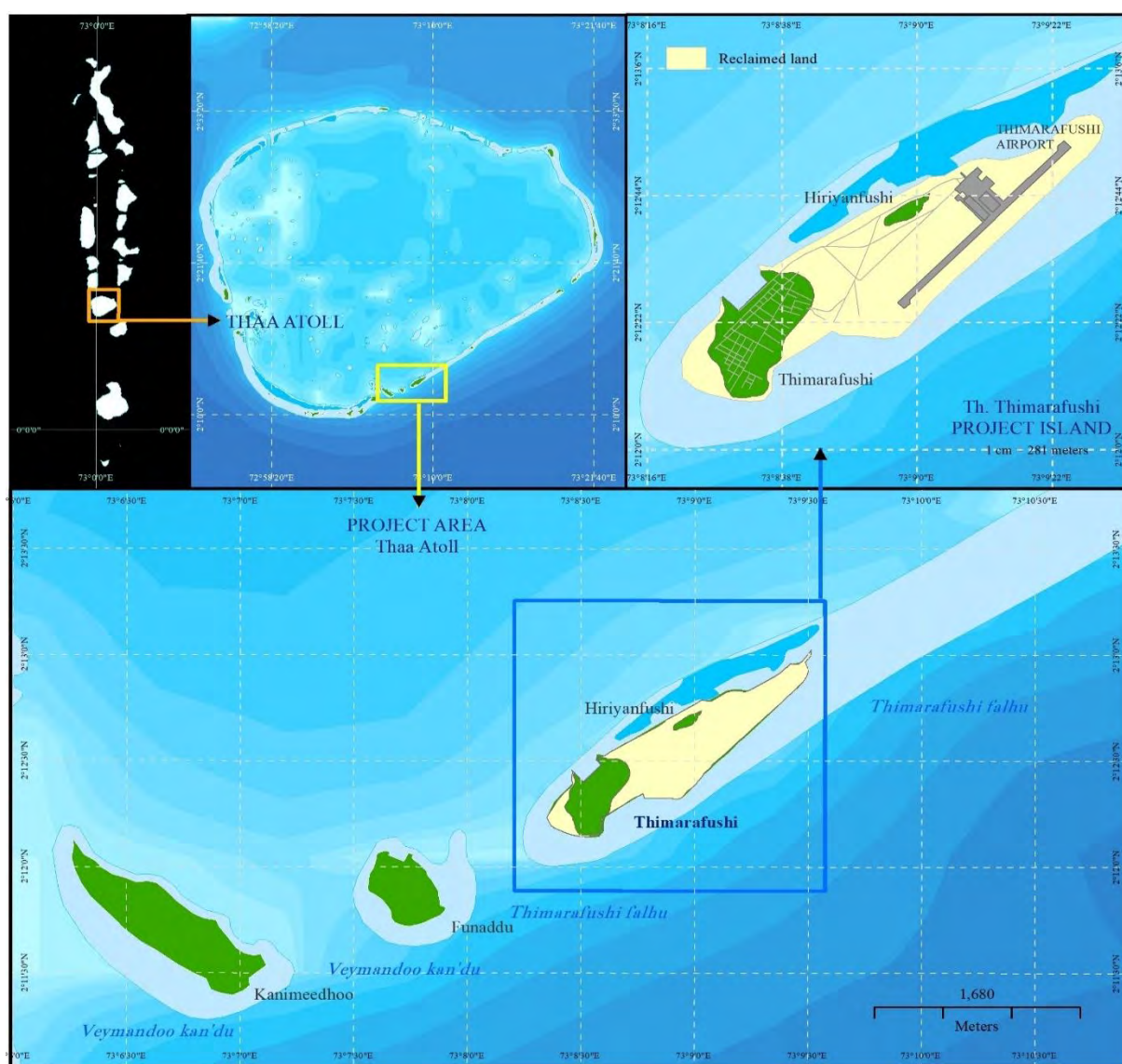


Figure 2: Location of Th. Thimarafushi (adapted from Saleem 2018)

3.2 Site Location

The proposed Island Waste Management Centre (IWRMC) is located at the south western side of the island. The plot falls on the island's newly reclaimed area. There is no vegetation at the site. The site is easily accessible. An A3 sized map of the site location is included in the Annex 02 of this report. The land approval letter from Maldives Land Survey Authority has been attached to the Annex 5 of this report.



Figure 3: Location of the IWRMC in Th. Thimarafushi

CHAPTER FOUR: PROJECT DESCRIPTION

4.1 Project Components

The proposed establishment of the IWRMC in Th. Thimarafushi involves the following components. Detailed information of each of the project component will be described in the chapter. The main components of the project are;

- General construction
- Aerobic System (Composting Machine) for composting
- Health and Fire Safety Measures
- Management of construction waste and waste oil
- Operation of IWRMC

4.1.1 General Construction

The development of the IWRMC consists initially of site selection, site approval, mobilization, site clearing followed by site construction. The works include shallow excavation, substructure and superstructure works as well as masonry works. The proposed design of the IWRMC requires a shallow foundation due to the structure being a single storey structure. After the structural works are done, masonry, plastering, roofing works are completed prior to the addition of the services components such as electricity and plumbing.

The proposed IWRMC is made up of an equipment room, and separate areas to store metal waste, paper and cardboard, plastic waste, glass waste, reusables as well as hazardous waste. Staff quarters as well as an office is included in the IWRMC. A mechanical composting area will be constructed which will contain the aerobic system (composting machine). The **Figure 4** is site plan for the proposed IWRMC in Th. Thimarafushi. An A3 sized map of the site plan is attached to the **Annex 01** of this report.

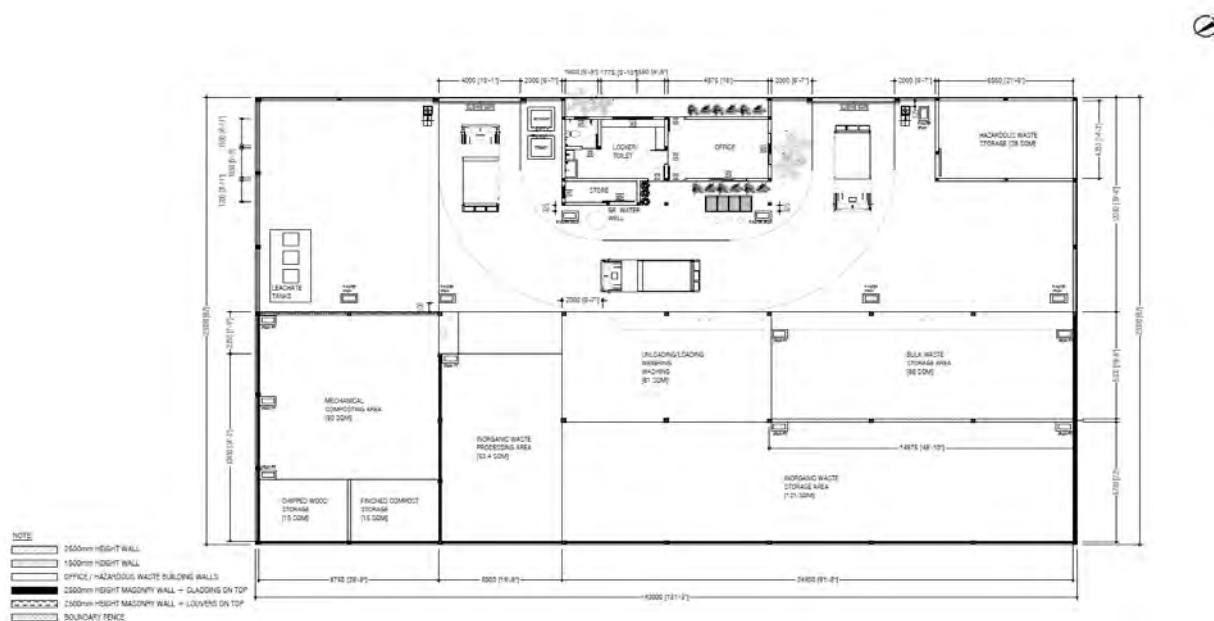


Figure 4: Site Plan for IWRMC in Th. Thimarafushi

4.1.1.1 Machinery

The following plants and equipment will be mobilized specifically for the project during construction phase.

- Truck for transportation of materials;
- Vibratory plate compactor;
- Concrete mixer;
- Concrete supply pump and piping; and
- Daily 4" pump.

4.1.1.2 Site Mobilization

As the amount of input materials are relatively minor, the construction materials shall be stored inside the demarcated site throughout the construction period. The workers if sourced from outside the island can be accommodated in the existing houses with a small rent. This is expected to eliminate the need for putting up a labour quarter and can be cost effective.

4.1.1.3 Demarcation and Site Clearance

Prior to beginning construction works, a survey shall be done by the contractor to demarcate the limits of the site. The site shall be fenced off and work shall be conducted within these limits. The site in the project island requires no removal of large trees as this site is located in the newly reclaimed area of the island. Minor clearance of some undergrowth is required at a corner of the site. Before the site clearance activities begin a professional surveyor will need to be engaged mark the boundaries using pegs. These control points will guide the construction crew during the entire process of site clearance.

4.1.1.4 General construction works

All construction works will follow the Annex 5 (page 89 to 115) of the ESMF Guidelines for IWRMC Establishment.

4.1.1.5 Foundation

The foundation for the proposed IWRMC consists of 300mm wide foundation beams. 300x300mm footings are proposed for the collection bay, in addition to the 450x450mm footings for the lamp post.

Excavation: Excavation will be undertaken to the required width, depths and dimensions of footings shown on the Drawings. Excavations will be done manually to receive the ground beams as per the drawings indicate. The foundation level will be defined as the level at the underside of the concrete. The base of the excavation will be compacted and trimmed to ensure that at no point the level is more than 25mm above or below the foundation level.

Any over-excavation of earth below foundation level will be backfilled and re-compacted. Surplus excavated material will be used in the construction of embankments or spoiled as directed by the project officer. The excavation will be kept free of water.

The deepest excavation expected from foundation works include the 700 mm excavation to receive the light post foundation.

Concreting Materials: Cement used will be Ordinary Portland Cement. All cement will be transported in watertight containers and will be protected from moisture until used. Caked or lumpy cement will not be used.

4.1.1.6 Construction of Leachate Tank

The leachate collection tank is located at the end of the compost slab. The leachate tank has an area of 2 m by 4 m and a depth of 1 m extending below ground. Excavation of the leachate tank area will be done to the required depth. Formwork is placed to the sides prior to placement of 10 mm reinforcing bars at 100 mm centre to centre distance, horizontally and vertically. The mixed concrete will be poured into the formwork and curing commences until the concrete reaches desired strength. The excavation can be done manually and the excavated material is stored on the side of plot.

4.1.1.7 Construction of Sorting Area

The sorting area is 4.85 m long by 4.0 m wide and 100 mm thick slab consisting of high tensile reinforcement placed at 200 mm centre to centre along the breadth and width. The slab rests on 300 mm thick concrete columns. The top of the sorting area is 750 mm above the floor finish level. Formwork is placed to the sides prior to placement of 10 mm reinforcing bars at 200 mm centre to centre distance, horizontally and vertically. The mixed concrete will be poured into the formwork and curing commences until the concrete reaches desired strength.

4.1.1.8 Construction of Perimeter Fence

The perimeter of the site is to be fenced except the gate area. The fencing includes a 150 mm thick masonry wall of 0.6 m height from ground level, followed by the PVC coated mesh fence of elevation 2.8 m from ground level. The mesh is held together by 50 mm diameter GI pipes vertically at equal centres which are welded to three evenly spaced 50 mm GI pipes horizontally. The strip foundation below the masonry wall has a depth of 0.6 m with a 50 mm thick lean concrete placed below. The trenches required to receive the strip foundation and footings will be excavated manually.

4.1.1.9 Construction of Well

A well is proposed to be constructed at the eastern corner of the IWRMC. This well is 1000 mm in diameter and the walls will be precast concrete while the base and top cover will be precast reinforced concrete. The pre-casting of the well will be done on site. Excavations will be done to a depth depending on the depth of the water table. After the excavation, the well base and body is fitted into the pit, and the top cover is laid on top of it. A lorry crane will be used to lower the body into position.

4.1.1.10 Construction of Superstructure

The superstructure of the IWRMC consists of the sorting area, storage area, staff quarters, office and the equipment room. The structure consists of a 4 m high wall for the office/equipment room building. The 150 mm masonry wall and roof beams are supported by reinforced concrete columns 150 x 150 mm size. The roofing is made of LYSAGHT roofing sheets. The roof truss is made of 50 mm GI pipe horizontal members and 25 mm GI pipe vertical members

4.1.1.11 Construction of Septic Tank

Construction of a septic tank is proposed to manage the sewage generated during the operational phase. The tank will be constructed to ensure water tightness. Waterproof paint will be used on the masonry wall.

The septic tank consists of a primary tank of 1.3 m by 1.3 m made of 150 mm brick wall, covered with 75 mm thick concrete with 6 mm reinforcing steel placed at 150 mm center to center. The primary tank is 2 m deep. The primary tank is connected by a 100 mm diameter PVC pipe to a secondary tank of the same dimensions filled with 1 m of coral stone and white sand filling. The bottom 1 m of this secondary tank is perforated with 25 mm equally distributed holes to allow for discharge of treated effluent.

4.1.1.12 Inspection of concrete works

Inspection of foundation, formwork and reinforcement will be made by the Proponent before concrete pouring is commenced.

4.1.1.13 Labour Requirements and Availability

A 10 person workforce would be involved in the construction. It is encouraged to choose workers from within the island, to reduce the impacts of influx of non-local workers. If no such arrangements are made, labour accommodation will be arranged for the 10 person workforce from existing houses.

4.1.1.14 Waste Management during construction phase

Construction waste, which would mainly be excavated earth, nylon cement bags and general construction debris shall be collected and temporarily stockpiled in the project site. The small amounts of waste oil that may be generated from vehicles shall be contained in closed containers and shall not be allowed to leak into the ground.

A description of how various types of wastes generated from the project will be managed is given below.

A. Biodegradable waste

Wastes such as leaves, branches, paper, and materials collected from the general cleaning of the site areas will be stored as described in **Figure 5**.

B. Non-biodegradable waste

Materials such as plastics and glass will have to be collected separately and transported to nearest waste management facility at the end of the project construction period. These will most likely be nylon cement bags, wrappings, steel/glass leftovers and other municipal waste generated at the construction site.

C. Kitchen waste

Food wastes and other biodegradable wastes generated in food preparation shall be buried in the ground. The pit dug to bury such wastes shall not reach the water table.

D. Hazardous waste

During construction phase, hazardous waste generated from machineries such as oils, solvents, batteries etc shall be sealed in labelled containers and shall be stored on paved hard surface before being transported to the nearest waste management facility. They shall be stored at the designated areas illustrated in **Figure 5**. It is essential to ensure that hazardous waste is fully contained and transported out of the island to nearest waste manage facility as quickly as possible. It is recommended to install signs in the designated temporary storage area.



Figure 5: Transportation route and storage area (adapted from Saleem 2018)

4.1.1.15 Pollution and Control Measures

The following measures will be taken to control pollution during construction stage.

- Machinery to be properly tuned and maintained to reduce emissions/spills/leaks;
- fuel storage, paint, lubricants will be stored securely and bunded; and
- spill kits would be made available on site to control any liquid spills;
- construction site will be wetted regularly to minimize impacts of dust; and

- e) all vehicles used for the project must have up to date road worthiness license.

4.1.1.17 Demobilization

The demobilization plan will commence in the last week of the contract. This would involve removing all items and personnel belonging to the contractor and handing over of the site to Ministry of Environment. Prior to demobilisation and site handover site inspection by the officials of the Ministry of Environment will take place to ensure that project has been completed to the full satisfaction of Ministry of Environment and scope of work fully completed. The demobilisation shall also involve removal of all residual waste generated from the project and repairing of any public property damaged during the project. These will be the responsibility of the contractor.

4.1.2 Aerobic System (Composting Machine) for composting

The proposed technology for the composting is aerobic composting (Organic Waste Converter (OWC) technology machine which involves initial 'in-vessel' processing of the waste unlike a normal windrow-based system. The main concept and processes involved in composting of organic waste using aerobic OWC system is described below.

4.1.2.1 Concept Design

The bio-degradable waste is chopped to the desired size; moisture is adjusted to 40-45%, using an organic absorbent (typically sawdust or shredded leaves), if required, and treated with Bioculum OWCTM [a formulation with 5 different Bacillus species] @ 1-2gm per kg of waste. The OWC machine has a running time of 15 – 30 minutes per batch, depending on unit and batch size. The treated waste is kept for composting and curing. This system has been designed for south Asian conditions as experienced in India and the Maldives.

It is claimed "that treatment, composting and curing is achieved within a short time of 10 to 12 days. Processing of waste through the OWC machine overcomes the problems of odour, leachate generation and ground water contamination associated with traditional methods of waste disposal. It converts unsightly and odorous garbage into a beneficial material devoid of foul odours and unsightly appearance. It is an innovative method for the bio-stabilization and beneficial conversion of organic waste. The organic material produced by this method not only provides nutrients to the plants, it also improves the organic-carbon content and moisture retaining capacity of the soil."

Advantages claimed for the OWC include:

- Simple and convenient to operate without the need for constant attention;
- Short processing times ensures economic in use with low energy consumption;
- Requires minimal maintenance;
- Beneficial to the environment.

4.1.2.2 Process Diagram



Pic 1: Segregate the waste



Pic 2: Input wet waste into OWC with Bioculum and Absorbent



Pic 3: After 15 minutes collect raw compost from OWC



Pic 4: Place raw compost in the curing system for 10-day maturation cycle

The pictures give an overview of the CWC process. If required, as shown in pic 1, waste can be further sorted and segregated. The waste is then added to the OWC unit, pic 2, together with the Bioculum, which is a bacterial powder that enhances the natural aerobic process. The Bioculum is added at the rate of 1 gm/kg of raw waste. Also added at this stage, if required, is the absorbent at a rate of up to 2 kg per batch. The OWC unit is operated for a period of 15 – 30 minutes, depending on size of unit and batch size, during which the waste, Bioculum and absorbent are mixed to achieve a homogenous consistency. The raw compost is discharged into crates of 25kg capacity, pic 3. The crates are then placed in curing racks for a period of 10 to 12 days, pic 4. The curing racks are equipped with an automatic fogging device that maintains moisture content at the correct level thereby ensuring curing is completed.

At the end of the curing period, the crates can be emptied with the cured compost ready for use; however, after emptying the crate, leaving the cured compost for a further seven days enhances the composts maturity, providing a higher quality product. Typically, the cured compost amounts to some 25 – 35%, by weight, of the raw waste input.

It is worth noting that the amount of waste that can be processed through the OWC each day is determined by the operating hours. This provides flexibility during times of unexpectedly high inputs or

following unanticipated outages. It also allows increasing throughputs to be accommodated at minimal cost. The critical sizing and potential pinch point is the curing system; however, additional racks and/or crates require only small areas of land and modest capital expenditure.

4.1.2.3 Requirements of feed waste types and activation requirements

The waste feed need to be segregated and only organic waste such as food waste, green waste and paper can be used for the feed. Absorbent material such as saw dust and dried leaves are required to maintain the moisture at 40 – 45%. Bioculum OWCTM which contain 5 different species of *Bacillus* bacteria is required for activation at a rate of 1 to 2 grams per kg of organic waste.

4.1.2.4 Bi-products and output of the process

One of the prime advantages of this method of composting is that it does not yield any bi-products and cured compost can be readily used for farming and gardening purposes. The organic material produced by this method not only provides nutrients to the plants, it also improves the organic-carbon content and moisture retaining capacity of the soil

4.1.3 Health and Safety Measures

The project involves many activities that can put workers as well as the general public to risk of injuries and accidents. However, with careful precautionary measures and good practices during the works can eliminate or reduce many of these risks. Health and safety measures for the construction phase include and are not limited to:

- Undertaking all relevant safety measure during construction works shall be part of the legal contract to undertake the works. The contractor shall be made to bear the responsibility to protect the workers as well as the general public from activities related to the project;
- Strict supervisor shall take place during construction and decommissioning phase of the project;
- Only experienced and licensed operators will be allowed to operate heavy machines;
- First aid kit should be made available at the work site;
- PPE should be provided to all workers and the work force would be required to use safety gears as appropriate;
- Fire extinguishing equipment would be available at the site;
- Operation of any heavy machinery will need the assistance of a banksman as all times;
- All heavy lifts must be supervised and slings inspected; and
- Appropriate safety signs shall be placed at the work site.

4.1.4 Operation of IWRMC

The following Section will briefly highlight the operational aspects of the IWRMC. This includes the machinery and equipment proposed to be used in the IWRMC, in addition to the main activities to be carried out at the IWRMC and within the island. The IWRMC activities begin from collecting waste generated at source and transporting it to the IWRMC. This collected waste will be pre-sorted into categories such as compostable waste, recyclable waste and hazardous waste. Compostable waste is used in making compost while glass, plastics and metals undergo volume reduction processes before being stored in their respective compartments. The hazardous waste is stored in the hazardous waste compartment. The **Figure 6** is the operational phase flow chart for IWRMC in Th. Thimarafushi.

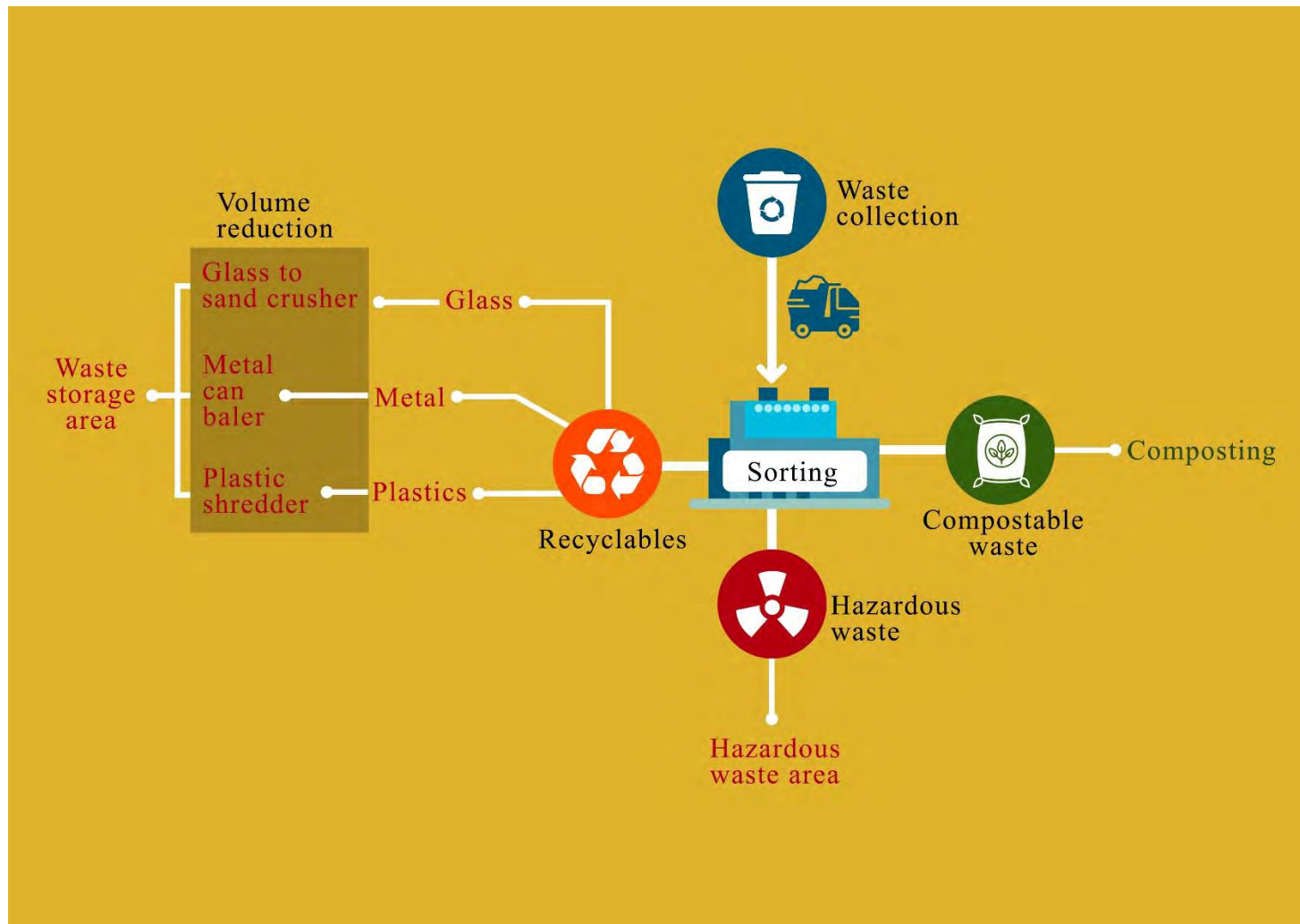


Figure 6: Operational Phase flowchart for Th. Thimarafushi IWRMC (adapted from Saleem 2018)

4.1.4.1 Machinery and equipment proposed

The IWRMC will require general equipment and tools needed to handle the waste. These include wheelbarrows, garden hoes, shovels, buckets and cultivators. This equipment will be used during the IWRMC operation for handling as well as composting operations. A OWC machine is also included for the composting process.

Other equipment required includes waste volume reduction equipment such as a plastic shredder, metal can baler, vegetation shredder, and glass to sand crusher. Typical equipment required is detailed below.

Table 3: Typical equipment proposed for waste management works (adapted from Saleem 2018)

Waste Management Equipment
Chainsaw
Wheelbarrow
Heavy Duty Gumboots
Heavy Duty Hand Safety Gloves
Long Handled Flathead Steel Rake
Long Handled Cultivator
Garden Hoe
Round Point Shovel
Square Point Shovel
20L Bucket
40L Bucket
Polypropylene Surgical Mask
Weighing Bench Scale
Wheelie Bins
Glass to Sand Crusher
Plastic Shredder
Metal Can Baler
Vegetation Shredder
Manual Rotary Compost Screen

4.1.4.2 Waste Collection

During the consultation meeting with the Council, it was learnt that the IWRMC operational works will be conducted by the Council. The waste will be collected from source using a vehicle.

4.1.4.2.1 Sorting of Incoming Waste

Incoming waste is required to be sorted to separate biodegradable and non-biodegradable waste. The separation of kitchen waste, yard waste and other types of waste at household level can streamline this process.

Table 4: Domestic Waste Categories

Incoming Domestic Waste			
Biodegradable materials	Hazardous materials	Others	Recyclables
Organics • Food waste • Garden waste • Animal waste Paper & Cardboard • Printed paper • Cardboard	• Paints & Solvents • Batteries • Cleaners • Expired medicine • Medical waste • Pesticides • Special (Nappies, tampons)	• Textiles • Wood • Inert (Dust/Dirt/Ash/Rock) • Liquid container	• Metal • Plastic • Glass

As per the IWRMC site layout plan, a slab is dedicated for the sorting area. Here, the collected waste will be kept, and further sorted into their respective categories. The IWRMC is designed to have separate storage areas for reusable waste, metal, paper and cardboard, plastic, glass, and hazardous waste. After sorting, the waste is stored in the respective location.

4.1.4.3 Composting

One of the main operations that will be conducted in the IWRMC is the composting of the organic waste such as kitchen waste and green waste. Composting uses the process of the slow decomposition of the organic matter by various microorganisms, in an optimised and controlled process. The process is controlled in terms of parameters such as input materials, temperature, moisture and pH. The finished product of composting can be sold as fertilizer, thus enabling the reuse of the waste collected within the island.

The composting process has been described in the section 4.1.2.2 of this report.

4.1.4.4 Leachate Management

As the process of composting occurs, leachate will be produced from the organic waste within the compost pile. The composting will be done on the specially constructed compost slab. The bottom of the slab and ground beams in this area have an HDPE membrane between the reinforced concrete and the ground.

In addition to this, the expansion joints of the compost slabs are filled with silicone and polythene joint filler foam. This ensures that the leachate does not leak into the ground. The compost slab is also designed with a 1° slope from both sides, towards the centre, where the ground beam is fitted with a 100 mm PVC pipe cut in half with 1% slope towards the leachate collection tank. The leachate is then collected in the dedicated leachate collection tank at the end of the mechanical composting area.

4.1.4.5 Volume Reduction

Prior to storage, volume reduction of the waste is conducted. This includes metal can baling using the metal can baler, plastic shredding using the plastic shredder, and glass bottle crushing using the glass to

sand crusher. The resulting reduced volumes of the waste is then easily stored in their respective compartments.

4.1.4.6 Sewage management

The 'primary tank' facilitates 'primary treatment'. The separation of liquids and solids by gravity - to take place. Raw sewage flows into the tank and the heavy solids, 'sludge', sink to the bottom, lighter solids, grease and oils or 'scum' float to the surface. Some of the sludge is degraded by naturally occurring anaerobic (without oxygen) bacteria. The liquid effluent flows to the secondary tank which is filled up to 1 m with coral stone and white sand layer. This tank is perforated at the bottom 1 m to allow for discharge of liquid effluent into the land.

The most environmentally sound method for disposing the domestic sludge is allowing it for drying in a sludge drying bed. The dry sludge can be used following appropriate treatment, as part of compost. Sludge will be dried on a sludge drying bed.

4.2 Project Inputs and Outputs

The **Table 5** below elaborates the approximate amount of resources that will be required for the project. These include workers, fuel, water, and construction materials.

Table 5: Project Inputs

Stage	Input	Source / Type	Estimated Amount	Means of obtaining the resources
Construction	Workers	Local and foreign	10	Encourage the use of local / regional workers
	Fuel	Diesel		Local Suppliers
	Water	Groundwater for non-potable use	Average 150 l/p/d	Groundwater wells present in the island
	Materials	Concrete including reinforcement and formwork	78 m ³	Local Suppliers
		Masonry Works (150 mm bricks)	553 m ²	Local Suppliers
		Structural Steel		
		50mm GI Pipe for perimeter fence	57 m	Imported / purchased where available locally
		75mm GI pipe (structural columns)	10 Nos.	
		Truss	23.45 m	
		75mm GI pipe for flood light fixing poles	2 Nos	

Paint		
Emulsion paint coating	1105 m ²	Local suppliers
Electrical Components		
3 Phase power sockets	6 Nos.	Local suppliers
20W LED lights	7 Nos.	
18W LED lights	3 Nos.	
Ceiling fan	3 Nos.	
AC	1 Nos.	
Exhaust fans	4 Nos.	
Well water pump	1 Nos.	
200W flood light	2 Nos.	
Metal doors for		Local suppliers
Equipment room	1 Nos.	
Hazardous waste area	1 Nos.	
Waste yard entrance	1 Nos.	
Plumbing		
Fresh water pipe network and plumbing fixtures		Local suppliers
Roofing		
Lysaght roofing sheets	286.6 m ²	Local suppliers
Flashing sheets	86.4 m	
Lysaght gutter		
Timber beams 150x75mm	59.7 m	
Timber beams 100x50mm	318.47 m	
Timber beams 50x38mm	477.70 m	

		50x50 PVC coated mesh fence	138.93 m ²	Local suppliers
		HDPE membrane	238 m ²	Imported / purchased where available locally
		Timber top cover	3 nos.	Local suppliers
		PVC pipe for leachate tank drain	15 m	Local suppliers
		600 x 900 5mm plastic sheet signboard	1 Nos.	Local suppliers
		Firefighting equipment and fire alarm system	1 Nos	Local suppliers
		Septic tank	1 Nos	Materials from local suppliers
Operation	Equipment and Materials	IWRMC tools	1	Imported / purchased where available locally
		Weighing Bench Scale	1	
		Glass to Sand Crusher	1	
		Plastic Shredder	1	
		Metal Can Baler	1	
		Vegetation Shredder	1	
		OWC Machine	1	
		Curing System	1	
		Bioculum	12 month supply	
	Waste	Waste generated within the island	Approximately 2.9 ton of waste per day	Waste collected by vehicle from the waste bins within the island
	Fuel	Diesel	5000-15000 L/month	Local suppliers
	Water	Freshwater	200-1000l/day	Groundwater

The following **Table 6** includes the project outputs and mean for managing the outputs.

Table 6: Project Outputs

Stage	Output	Source / Type	Amount	Means of managing
Construction				
	Land plot for IWRMC	Cleared land for construction of IWRMC	995 m ²	N/A

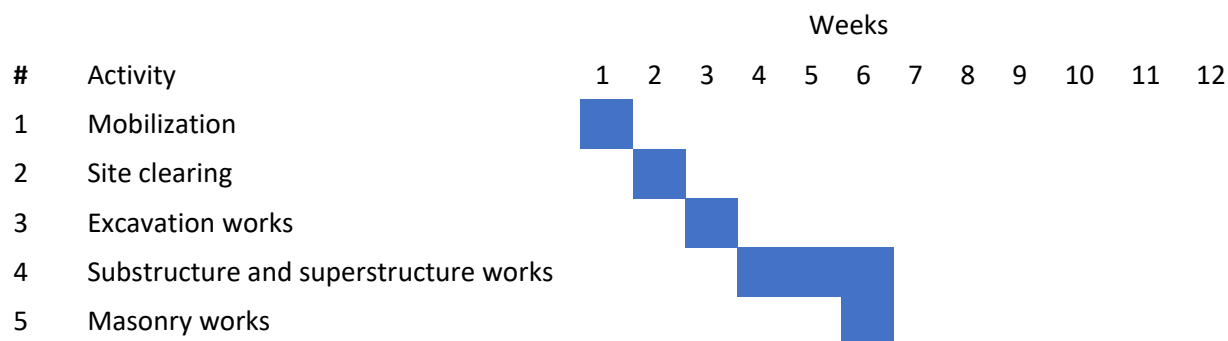
	Soil	Excavation for substructure	8.30 m ³	To be used back in the levelling and backfilling of site.
	Construction Waste	Construction works	Moderate amount of construction waste	Transfer all waste to nearest Waste management facility
	Site Clearance Waste	Green waste from clearance of undergrowth	Minor amounts	
	Hazardous waste	Construction and clearing of vegetation	Moderate amount of hazardous waste	
	Municipal waste	Workers	346.5 kg	
	Dust	Excavation	Moderate amount of dust	
		Cement mixing	Moderate amount of dust	
	Greenhouse gases	Machinery	Moderate amount of GHG from direct and indirect emissions	
		Concreting works	Moderate amount of GHG from direct and indirect emissions	
		Reinforcement	Moderate amount of GHG from direct and indirect emissions	
		PVC Pipes	Moderate amount of GHG from direct and indirect emissions	

Operation (based on presumption the IWRMC will be fully functional without major issue)	Compost	Aerobic In vessel Composting	33.24 m ³ of compost per full batch	Sold as fertilizer
	Green waste	Residual		
	Crushed Glass	Glass crusher	1.8 ton per month	Crushed glass stockpiled in the IWRMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Compacted Metal	Metal baler	0.9 ton per month	Compacted metal stockpiled in the IWRMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Shredded plastic	Plastic shredder	4.5 ton per month	Shredded plastic stockpiled in the IWRMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	GHG	Electricity usage		N/A

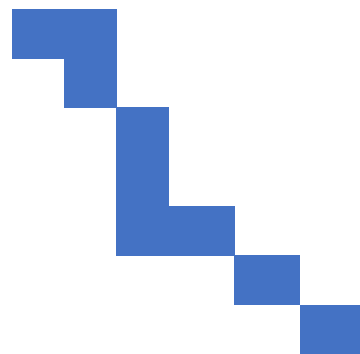
4.3 Project Schedule

The construction works of the proposed project is expected to be carried out in 12 weeks. A tentative schedule of the shortest duration of work is found in Table 7.

Table 7: The schedule for the construction phase of the project



- 6 Plastering works
- 7 Roofing works
- 8 Structural steel works
- 9 Electrical works
- 10 Plumbing works
- 11 Doors and windows
- 12 Demobilization



CHAPTER FIVE: EXISTING ENVIRONMENT

The existing environment is described based on photographic evidence provided by the island council. No detailed data collection and survey analysis techniques are used for this purpose as this is an ESMP, not a full ESIA report.

Information regarding existing environment of the project site and existing waste management practices within the island were obtained through photographic evidence provided by the island council and subsequent online meetings held with the Island Council. Due to the COVID19 pandemic situation the consultants were unable to conduct field visit and online meetings were conducted with Island council on 10th January 2021. Community survey were conducted with the assistance of island council.

5.1 Current Waste Management Practices

The rate of solid waste production depends on the socio-economic situation, the level of industrialization, type and numbers of industries, climate, and land use and therefore can vary from island to island. However such variations are not expected to be significantly different from island to island and therefore in making estimates waste audits conducted for similar islands can be safely applied. Hence, past waste audits had been used to estimate waste composition and quantities for Th. Thimarafushi.

According to the waste audit conducted in 2016 for Zone 1 (which includes HA, HDh, and Sh.) an average per capita waste generation was found to be 1.30 kg/person/day. The study also finds that, by far the most significant proportion of the waste is green and compostable (75%), plastics comprising of 6%, paper and cardboard making 5% of the waste, 1% metals, 6% hazardous waste, 1% glass and 6% attributed to all other types of waste.

In another waste audit study conducted by the Ministry of Environment and Energy in 2011 under the Maldives Environmental Management Project (MEMP) for five inhabited islands in the north central region of the Maldives (Hinnavaru, Naifaru, Eydhafushi, Maalhos, Lhohi), it was determined that 0.83 Kg of waste was generated/person/day. Similar to the above study it was revealed that organics was the largest component making 65% of the household waste stream, plastics comprising of 5%, paper and cardboard making 5% of the waste, 1% metals, 8% hazardous waste, 2% glass and 8% attributed to all other types of waste.

The estimated percentage of organic waste as well as the sum of the plastics, glass and metals for the for both zones were found to be very similar hence the averages of the two studies were taken and considered to be the estimated percentages of various types of waste generated in Thimarafushi Island as shown in **Figure 7**. Similarly, per capita waste generation for the island had been determined by taking the average per capita in the two studies above which is **1.07 Kg/person/day**. This finding is expected, since the lifestyle and food habits are similar for most of the inhabited islands across Maldives with the exception of Male' and few other cities.

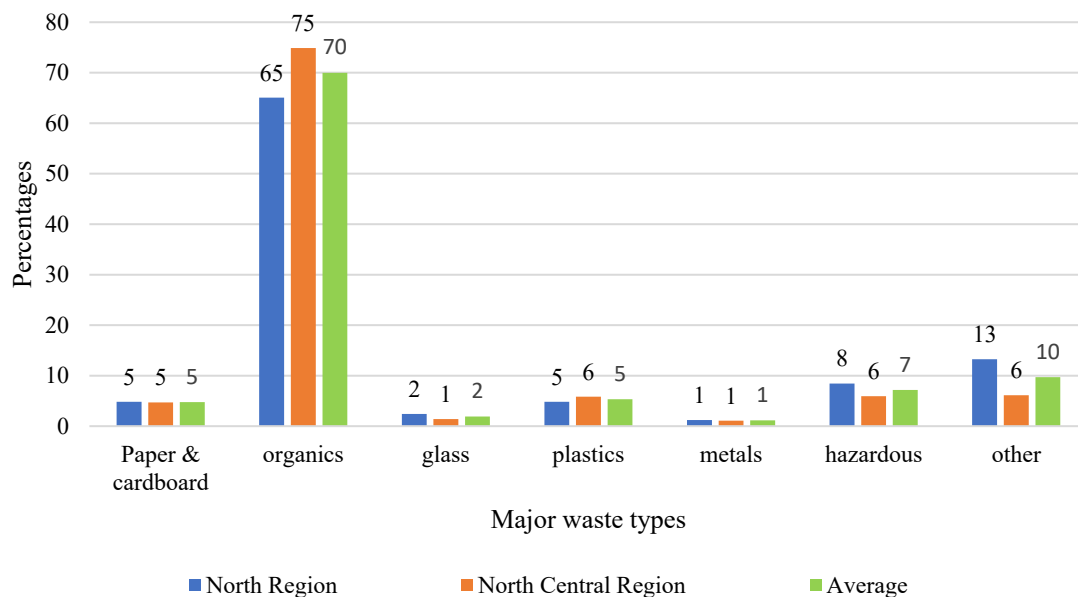


Figure 7: Waste composition comparison in two separate regions of the Maldives

Hence it is expected that the majority of the waste generated in the island to be organic wastes at 70%, which include kitchen and green wastes or compostable waste. Paper and cardboard wastes is estimated at 5% of the total waste generated. Recyclable materials such as plastic, metals, and glass make up 8% of the composition. Approximately 7% of the total waste generated is chemicals and hazardous waste and all other types are expected to be at 10%. Using these estimates and considering the current population of Th. Thimarafushi, the daily waste generation was determined as shown in **Table 8**.

Table 8: Estimated waste generation quantities of Th. Thimarafushi households (adapted from Saleem 2018)

Waste Type	Average (%)	Waste Generation (Kg/Person/Day)	Total (Kg/Day)
Organic (kitchen & green waste)	70	0.75	2089
Paper / cardboard	5	0.05	149
Glass	2	0.02	60
Plastic	5	0.05	149
Metals	1	0.01	30
Chemicals / Hazardous	7	0.07	209
Others	10	0.11	298
Total	100	1.07	2984

Hence it is estimated that a total of **2984 Kg** of solid waste will be generated daily at Thimarafushi.

Waste management has been a significant challenge for the residents of Th. Thimarafushi. The high rate of the waste generated and lack of financial resources for sound management of the solid waste are two of the prime challenges faced by the island. Until recently, there was no area to dump waste and locals usually burnt and buried their waste in different areas of the island. The island council has now selected a specific area for dumping waste which is utilised by all the islanders (See **Figure 8**). This area is not demarcated. Since the dumpsite started being used by most of the islanders, dumping waste at various parts of the island has stopped. There is no separation of waste done at the dump site or households. Mixed waste is carried to the current dumpsite by locals and dumped into a trench. Mixed waste is burnt inside the trench and the ashes are buried covering the trench with sand. Some of the islands expatriate workers provide waste collection services for a fee of 100 MVR/month. The majority of waste generated is now buried in the trench at the dumpsite, this includes plastics, glass, metals, yard waste and sanitary waste. Kitchen waste is sometimes dumped into the lagoon. This waste may contain containers such as metal cans and plastic. Construction waste, mainly stones are stored in areas east and west of the islands harbour.

The Island Council noted that a waste management centre was constructed in Thimarafushi under Canadian Red Cross aid after the 2004 tsunami disaster. The waste management centre however, filled up within 2 weeks of use, as there was no way to reduce volume of the waste or transport residual waste out of the island.

The following **Table 9** illustrates the current situation of the dedicated dumpsite and some other waste management practices followed in Th. Thimarafushi in terms of the practices and resources dedicated for solid waste management.

Table 9: Current situation of solid waste management in Th. Thimarafushi

Facilities/Practices	Current Situation/Practices
Waste transportation	Waste collection service is provided by private parties
Harbor (accessibility)	Accessible to vessels and landing crafts
Vehicles for waste transportation	No vehicles for waste transport
Waste management equipment	No waste management equipment available
Dump site demarcated	Dump site is not demarcated
Separation of waste at dumpsite	Waste is not separated
Burning of waste	Mixed waste is burnt regularly
Burying of waste	Waste is buried to reduce volume
Dumping waste into the beach/sea	Kitchen waste is dumped into the lagoon
Presence of large waste piles	Dumpsite provided as relief aid during the 2004 Tsunami disaster (filled up within 2 weeks)
Pollution of inland/other areas	Terrestrial pollution of inland areas is controlled
Clinical waste management	Clinical waste is managed at the Health Centre
Public area waste collection	Council contracts Women's Committee to clean and collect waste from public areas.
Presence of waste bins	There are no waste bins
Presence of workers	Women's committee is contracted to operate the dumpsite
Electric connection at the dumpsite	No electric connection at the dumpsite



Figure 8: Photographs taken from existing dumping sites in Th. Thimarafushi

5.2 Island Waste Management Plan

There is no Island Waste Management Plan (IWMP) formulated for Th. Thimarafushi. During the stakeholder consultation, the council highlighted formulation of IWMP as a top priority for the island.

5.3 Existing Environment at the Project Location

The proposed Island Waste Management Centre (IWRMC) is located at the south western side of the island. The plot is located in the islands newly reclaimed area. There is no vegetation at the site. The site is easily accessible. There is an area of sand stockpiled, a part of which the proposed IWRMC footprint lands on.



Figure 9: (A) & (B) Vegetation at the proposed site (C) Vegetation and reclaimed land near the plot (adapted from Saleem 2018)

5.3.1 Site zoning guidelines by EPA and MLSA

The EPA has provided guidelines for the optimum zoning of the IWRMC site. The distances include, the site being at least 20-30 m from the coastal vegetation belt, at least 30 m from the nearest freshwater well, at least 40 m from the nearest recreational area. The field surveys done on the island recorded the locations of the aforementioned categories and the comparison table for the actual distances and EPA recommendations are provided below:

Table 10: Comparison between the proposed site location and EPA recommended distances

Location	Distance from site (m)	EPA Recommended Distance (m)
Vegetation line	30.76	20-30
Freshwater well	50	30
Recreational area	204	40
Residential area	42	30

As seen on **Table 10**, the site meets all the recommendations of the EPA

5.3.2 Coastal Environment near project location

As the proposed site is located on the island's reclaimed land, the coastal areas near the project site lacks a natural vegetation line. The area has no shore protection, the introduced sand seems to have settled down properly forming a beach with the rocky substrate that was introduced while reclamation that slopes with a low gradient.

During the consultation meeting it was discussed that *udha* events effect the island's eastern and southern coastal areas. The current waste dump area is a dug up trench, and the soil from the trench is used as a protective wall to reduce any *udha* related flooding to the island from the eastern side. The *udha* event also effected the south western side of the island, where the IWRMC is proposed. It is recommended to construct a wall at the side of the IWRMC facing the lagoon, instead of establishing a fence which is subjected to rusting.



Figure 10: (A) to (D) Coastal features near the project site (adapted from Saleem 2018)

5.4 Environmentally Protected Areas and Environmentally Sensitive Areas

The closest to the project site is *Veymandoo Beach* which is a turtle nesting site approximately 5.02 km southwest of the project location.

Since the project does not involve any proposed activity in the marine environment and due to distance between the project site and the Veymadoo Beach no adverse impact of the project

are anticipated on the Environmentally Sensitive Area. The **Figure 11** illustrates the proximity between the project site and the *Veymadoo Beach*.

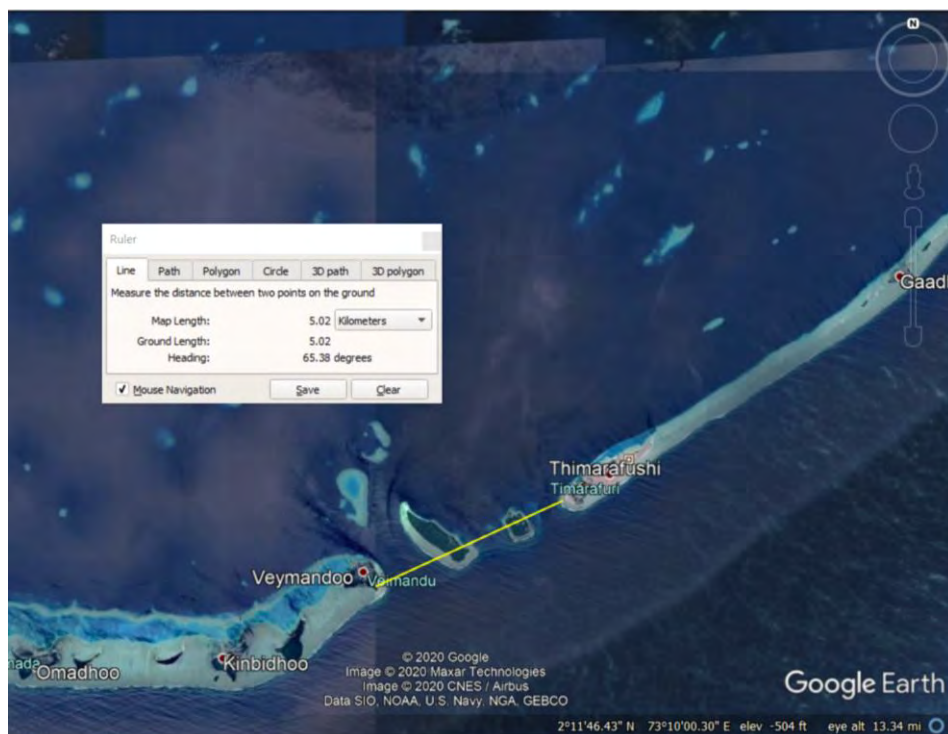


Figure 11: The distance between the project site and the nearest Environmentally Sensitive Area (Veymadoo Beach)

The following Table 11 provides more information about the MPA which is closest to the project location.

Table 11: The geographical coordinates and the distance between the project site and closest ESA

Name of the MPA	Geographical Coordinates	Distance from the project location
Veymadoo Beach	2°11'4.21"N 73° 5'51.60"E	5.02 km southwest of the project site

5.5 Areas of Historic and Cultural Significance

There are 2 mosques and 1 cemetery on the island. However, there are no mosques of cultural significance. The project site maintains a sufficient distance from the cemetery. The cemetery is located at the other side of the island approximately 290m away from the project site.

5.6 Socio-economic Environment

5.6.1 Population and population growth

The total population of Th. Thimarafushi estimated in 2014 census is 1,190 corresponding to 627 males and 563 females. The total number of foreigners were 89. The table below depicts comparison of total population with 2006 census.

Table 12: Population growth rates in Th. Thimarafushi

	Census 2006	Census 2014	Percentage change in population (2006 – 2014)
Total	1237	1190	-3.78%
Female	636	563	-11.47%
Male	601	627	+ 4.32%

5.6.2 Population Density

The total land area of Th. Thimarafushi is 20.5 hectare. The population density is 58 per hectare. The land area of Th. Thimarafushi has significantly increased due to land reclamation in 2013 for establishment of a regional airport.

5.6.3 Economic Activities

The main economic activity in which the island is engaged is fishing. The community is also involved in contract work, business and office jobs from public and private sector (Musthafa 2016).

5.6.4 Healthcare

Healthcare is provided by the Thimarafushi Health Centre and the island has one pharmacy.

5.6.5 Water Resources

The main sources of water used in the island is rainwater and groundwater. Most of the households have 1 to 3 rainwater harvesting tanks. While mostly rainwater is used for drinking and cooking purposes, some households and office buildings uses bottled water for drinking. For other purposes such as washing groundwater is used.

5.6.6 Energy and Sewerage

Power and sewerage of the island is managed by FENAKA Corporation Limited. The island is provided with 24 hour electricity. The island has a operational gravity sewer network which is operated and maintained by FENAKA Corporaion Limited.

5.6.7 Transportation and Infrastructure

The island has a 730 x 260 harbor and a domestic airport which was opened in 2013 is in operation.

5.6.8 Tourism Activities

There are 1 guesthouse operational in the island. There are no nearby resorts around Th. Thimarafushi.

CHAPTER SIX: ENVIRONMENTAL IMPACTS

6.1 Introduction

This section of the report provides a detail description of the methodology used to identify, predict and assess the environmental impacts due to construction phase and the operation phase of the proposed establishment of IWRMC in Th. Thimarafushi. First, the potential impact will be identified and then the identified impact will be evaluated to determine its level of significance. This section consists of the method used for impact assessment, the limitation and uncertainties, the justification for the method used for impact prediction and description of impacts during both construction and operation phase of the project.

6.2 Method Used for Impact Prediction

The impacts on the natural and social environment that may be caused due the project interventions are predicted and is distinguished from construction and operation phases of the project. A simple descriptive matrix has been utilized to predicted the aforementioned impacts. The impact prediction was done using expert judgement and professional opinions of the ESMP consultant and also the based on the information provided in the reviewed EIAs mentioned earlier in this report. Once the impacts have been predicted, a detailed description has been given for the purpose of understanding the nature and type of the impact.

An impact is any change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity. The evaluation of baseline data provides crucial information for the process of evaluating and describing how the project could affect the biophysical and socio-economic environment.

Impacts are described as a number of types as summarized in **Table 13**. Impacts are also described as associated, those that will occur, and potential, those that may occur;

Table 13: Types of Impacts (adapted from ERM 2008).

Nature or Type	Definition
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect	Impacts that result from other activities that are encouraged to happen as a consequence of the project (e.g. in-migration for employment placing a demand on resources).

Cumulative	Impacts that act together with other impacts (including those from concurrent or planned future third-party activities) to affect the same resources and/or receptors as the project.
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6.3 Analysis for Significance of the predicted impacts

The analysis of environmental impacts is done in terms of their level of significance. According to Environmental Resource Management 2008, Significance is a function of the magnitude of the impact and the likelihood of the impact occurring. Impact magnitude (sometimes termed severity) is a function of the extent, duration and intensity of the impact. The criteria used to determine significance are summarized in table 15. Once an assessment is made of the magnitude and likelihood, the impact significance is rated through a matrix process as shown in **Table 14** and **Table 15**. For ease of review, the significance rating is colour-coded in the text according to **Table 16**. Outlined in **Table 17** are the various definitions for the significance of an impact.

Significance of an impact is qualified through a statement of the degree of confidence. Confidence in the prediction is a function of uncertainties, for example, where information is insufficient to assess the impact. Degree of confidence is expressed as low, medium or high.

Table 14: Criteria used to assign level of significance

Magnitude – the degree of change brought about in the environment	
Extent	On-site: impacts that are limited to the Site Area only. Local: impacts that affect an area in a radius of 20 km around the development area. Regional: impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystems. National: impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences. Transboundary/International – impacts that affect internationally important resources such as areas protected by international conventions.
Duration	Temporary: impacts are predicted to be of short duration and intermittent/occasional. Short-term: impacts that are predicted to last only for the duration of the construction period. Long-term: impacts that will continue for the life of the project, but ceases when the project stops operating. Permanent: impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the project lifetime.

Intensity	BIOPHYSICAL ENVIRONMENT: Intensity can be considered in terms of the sensitivity of the biodiversity receptor (E.g.: habitats, species or communities). Negligible: the impact on the environment is not detectable. Low: the impact affects the environment in such a way that natural functions and processes are not affected. Medium: where the affected environment is altered but natural functions and processes continue, albeit in a modified way. High: where natural functions or processes are altered to the extent that it will temporarily or permanently cease.
	SOCIO-ECONOMIC ENVIRONMENT: Intensity can be considered in terms of the ability of project affected people/communities to adapt to changes brought about by the project. Negligible: There is no perceptible change to people's way of life. Low: People/communities are able to adapt with relative ease and maintain pre-impact livelihoods. Medium: Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support. High: Those affected will not be able to adapt to changes and continue to maintain pre-impact livelihoods.
Likelihood - the likelihood that an impact will occur	
Unlikely	The impact is unlikely to occur.
Likely	The impact is likely to occur under most conditions.
Definite	The impact will occur.

Table 15: Significance Rating Matrix

SIGNIFICANCE				
		LIKELIHOOD		
		Unlikely	Likely	Definite
MAGNITUDE	Negligible	Negligible	Negligible	Minor
	Low	Negligible	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major

Table 16: Significance Color Scale

Negative Ratings	Positive Ratings
Negligible	Negligible
Minor	Minor
Moderate	Moderate
Major	Major

Table 17: The definition of difference level of significance

Significance definitions	
Negligible significance	An impact of negligible significance is where a resource or receptor will not be affected in any way by a particular activity, or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background levels.
Minor significance	An impact of minor significance is one where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value.
Moderate significance	An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that “moderate” impacts have to be reduced to “minor” impacts, but that medium impacts are being managed effectively and efficiently.
Major significance	An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. A goal of the EIA process is to get to a position where the project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a development. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors, such as employment, in coming to a decision on the project.

6.4 Limitations and the uncertainties of the impact assessment methodology

The following aspects are considered as limitation and the uncertainties which may be involved in the impact assessment process;

- All the potential environmental aspects have been predicted and assumed for the proposed project development hence they may differ in the natural context such as site conditions and uncertainties in scales and magnitude.
- Expert judgement and professional opinion of the ESMP consultant were enhanced using the existing EIA reports of similar nature, however due to the unique nature of coastal processes,

lagoons and reef system in the Maldives each island is unique. Hence the predicted environmental impacts may vary from island to island.

6.5 Justification for the Methodology used

There are many various methodologies used for impact assessment in environmental context. One of the most commonly used methodologies include check lists and matrices such as Leopold Matrix (Lohani et al., 1997) The Leopold matrix was conceived by geologist Luna B. Leopold and his colleagues in 1971, as a response to the US Environmental Policy Act of 1969, which didn't give clear instructions to the Federal Government agencies for preparing an impact report or for examining the environmental effects of the projects that an agency plans. The Leopold matrix addressed this challenge by 'providing a system for the analysis and numerical weighting of probable impacts' (Josimovic et al., 2014).

According to the Leopold matrix method, ESMP should consist of three basic elements:

1. a listing of the effects on the environment that the proposed development may induce, including the estimate of the magnitude of each of the effects;
2. an evaluation of the importance of each of listed effects (e.g., regional vs. local); and
3. a summary evaluation, which is a combination of magnitude and importance estimates.

The impact assessment method used in this report is a matrix which is derived from the Leopold Matrix however this method uses a colour code to assign the significance level of each predicted impact. This method has been adapted from the Environmental Resource Management (2008).

Leopold Matrix is an effective impact assessment methodology which has been extensively used by EIA practitioners across the world. The colour coding enhance Leopold Matrix further. Since ESMP is a technical report which are read by both technical experts of different field as well as the general public, the colour coding of the significance level will enhance the report in a manner which would be easily comprehended by general public and people with no technical expertise in this field.

6.6 Impact Prediction

The environmental impacts of the proposed establishment of IWRMC in Th. Thimarafushi project are predicted in this section of the report by using a simple descriptive matrix. The following matrix distinguishes the types of environmental impacts that may be associated with various project actions on key environmental components and distinguishes whether these are impacts during construction period or during post-construction and operations period.

The following **Table 18** predicts the nature and types of environmental impacts based on the existing environmental condition of the islands and the surrounding environment;

Table 18: Impact Identification matrix for proposed establishment of IWRMC in Th. Thimarafushi

Project Activities	Natural Environment				Social Environment			
	Reef and Coastal Environment	Soil and groundwater	Lagoon and seawater	Air/Noise	Services and Infrastructure	Health and Safety	Employment	Costs to consumer/taxpayer
Construction Phase								
Influx and settlement of workers for the project construction activities (flora and fauna, resource use and sociocultural impacts)	Waste produced by the workforce may be affect reefs if not properly disposed via existing solid waste management regime. However, this impact is anticipated to be short term and work force will be few expatriate workers due to small nature of the project.	Increased burden on groundwater resources since workforce will utilize groundwater for various purposes. However, this impact is anticipated to be short term and work force will be few expatriate workers due to small nature of the project.	No significant impact	No significant impact	The expatriate workers and workers from other islands will relay of the existing services and infrastructure to meet their basic needs hence extra burden of the existing services and infrastructure. However, this impact is anticipated to be short term and work force will be few expatriate workers due to small nature of the project.	No significant impact	Expatriate workers and workers from other island will decrease the chance of employment for residents of Th. Thimarafushi	No significant impact
Transportation of materials. (climate	Potential oil spill from the	Operation of vehicles on	Potential oil spill from	GHG emissions	Unpaved roads in the	Temporary	No significant impacts	Remediation of road may require public

impacts, and impacts on roads)	cargo boat and during transport of material.	unpaved road may lead to soil compaction.	the cargo boat and during transport of material.	from the transportation processes and operation of vehicles may deteriorate air quality for short period of time.	island may be affected due to operation of vehicles and harbour will be utilized for unloading the construction material.	deterioration of air quality to operation of vehicles.		finance but heavy vehicles will not be used for construction phase.
Site demarcation and clearance (Impacts on flora and fauna)	No significant impacts	Removal of vegetation may cause temporary flooding at the project site during rainy season.	No significant impacts.	No significant impact.	No significant impact	No significant impact.	No significant impact	Compensation will be provided to any plant removed in the project site. But no large trees were found at the project site.
Impacts from construction works (air quality, noise and vibration, accidents and injuries, pollution from material storage)	Minor vibrations are anticipated due to construction activities, however, the project locations is far from the house reef of the island.	Oil spill during from vehicles and maintenance works may affect the groundwater quality. Pollution from material storage may affect the	No significant impact	Utilization of vehicles and tools which uses fossil fuel is expected to deteriorate the air quality at the vicinity of the project site.	Minor vibrations near the project site.	Noise pollution at the project site and residential areas in close vicinity to the project site.	No significant impact	No significant impact

		groundwater quality						
Terrestrial pollution from construction waste generation	No significant impact	Potential contamination of groundwater due to construction waste generated.	No significant impact	No significant impact	Since there are no established IWRMC in the island the construction waste will be managed on site at project location.	No significant impact	No significant impact	No significant impact
Impacts from resource use	No significant impact	Water used for construction works will be rain harvested or obtained from the existing resources in the island hence no impact on groundwater quality is anticipated	No significant impact	Electricity will be obtained from the existing grid of the island hence increase of GHG emission due to increase in power demand.	Electricity and water will be obtained existing systems in the island which may increase the burden of the existing system of the island.	No significant impact	No significant impact	No significant impact
Operational Phase								
Waste collection and transportation (Climate impacts, air quality, amenity impacts)	Establishment of waste collection bins, collection service and	Seepage of leachate from existing dump sites will be prevented and is	Establishment of waste collection bins, collection service and	The air quality of the island is expected to improve due to reduce	IWRMC will be additional infrastructure contributes to the island development.	Beneficial health impact due to improved air	The IWRMC would employ locals for its operation.	The council intends to collect a fee for sustainable operation of IWRMC

	transportation will decrease dumping of waste to lagoon environment.	expected to improve groundwater quality at the dumping sites over time.	transportation will decrease dumping of waste to lagoon environment.	open burning and accidental fires at dump sites.	The amenity of the island will improve due to lack of dumping sites around the island.	quality and reduces pests such as rodents	More farmers could utilize the compost prepared in the IWRMC	
Waste management activities (Public health, noise, groundwater, fire, accidents, odour impacts)	No significant impact	Public health impacts may be localized due to increase in house flies and rodents near the project area.	No significant impact	Temporary air quality deterioration due to accidental fires. Odour impacts may be felt at the vicinity of the project site.	Waste collection and transportation may affect other services if collection is done during the day.	Public health impacts may be localized due to increase in house flies and rodents near the project area.	Compost generated from OWC machines can be used readily for gardening and farming purposes.	Compost generated from IWRMC will be sold.
Waste generation (terrestrial pollution, groundwater contamination)	No significant impact.	Leachate may seep and contaminate groundwater during a flooding event. The leachate tank will prevent this in normal circumstances. If not properly de-slugged the	No significant impact	No significant impact	No significant impact	Indirect impacts of groundwater contamination	No significant impact	No significant impact

		sewerage may seep into group water and lead to groundwater contamination.						
Resource consumption (water and electricity)	No significant impact	Groundwater may be utilized for the operational purposes which will have impact on the contribute to saltwater intrusion to groundwater lens.	No significant impact	No significant impact	The electricity required for IWRMC operations will be obtained from the existing electricity grid of the island which put additional burden on the power needs of the island.	No significant impact	No significant impact	No significant impact

The above table illustrates project activities both during the construction and operational phase. The impacts of these project activities are predicted both for the biophysical environment of Th. Thimarafushi is also shown the **Table 18**. The following **Table 19** is a summary of project activities which has the greatest impact on both natural and social environment respectively. It can be noted that some of these impacts are considered to be positive.

Table 19: Main anticipated impacts for Establishment of IWRMC in Th. Thimarafushi

Phase of the project	Natural Environment	Social Environment
Construction Phase	• Influx and settlement of workers for the project construction activities (Negative Impacts) • Transportation of materials. (Negative Impacts) • Site demarcation and clearance (Negative Impacts) • Impacts from construction works (Negative Impacts) • Terrestrial pollution from construction waste generation (Negative impacts) • Impacts from resource use (Negative impacts)	• Influx and settlement of workers for the project construction activities (Negative Impacts) • Transportation of materials. (Negative Impacts) • Site demarcation and clearance (Negative Impacts) • Impacts from construction works (Negative Impacts) • Terrestrial pollution from construction waste generation (Negative impacts) • Impacts from resource use (Negative impacts)
Operational Phase	• Waste collection and transportation (Positive and Negative Impacts) • Waste management activities (Negative and Positive impacts) • Waste generation - terrestrial pollution, groundwater contamination (Negative impacts) • Resource consumption (water and electricity) (Negative impacts)	• Waste collection and transportation (Positive and Negative Impacts) • Waste management activities (Negative and Positive impacts) • Waste generation - terrestrial pollution, groundwater contamination (Negative impacts) • Resource consumption (water and electricity) (Negative impacts)

6.7 Description of impacts

6.7.1 Construction phase

6.7.1.1 Influx and settlement of workers for the project construction activities

A large number of work force is not expected for the project. An estimated 10-15 workers will be required for this project. Since resource consumption, waste generation and behavior related impacts on the environment are likely to have an incremental increase with additional people to the island. However,

even though minor workers related negative impacts can range from damage to flora and fauna of the island, impacts associated with resource utilization, waste generation and potentially negative social impacts. On the other hand, even though small, more people to the island could have a positive effect on the local economy.

The main impacts predicted on the bio-physical environment include;

- Waste produced by the workforce may be affect reefs if not properly disposed via existing solid waste management regime. However, this impact is anticipated to be short term and work force will be few expatriate workers due to small nature of the project;
- Increased burden on groundwater resources since workforce will utilize groundwater for various purposes. However, this impact is anticipated to be short term and work force will be few expatriate workers due to small nature of the project.

The main impacts predicted on the socio-economic environment include;

- The expatriate workers and workers from other islands will relay of the existing services and infrastructure to meet their basic needs hence extra burden of the existing services and infrastructure. However, this impact is anticipated to be short term and work force will be few expatriate workers due to small nature of the project;
- Expatriate workers and workers from other island will decrease the chance of employment for residents of Th. Thimarafushi

The following are the mitigation measures proposed;

Mitigation for impacts on flora and fauna

- The contractor is required to keep the workforce as minimum as possible, and to not bring in any surplus workers for the project;
- the project island currently has vacant properties as well as rooms to let in houses, which can easily house the influx of 10-15 workers. Therefore no new facilities will be made for the accommodation of the workers in order to avoid clearing of land or spending resources unnecessarily for making worker quarters;
- all construction workers and persons on site must be given specific instructions not to catch or harm birds and animals allow them to retreat into undisturbed areas and prohibit damaging vegetation that are not;
- rules shall be formulated by the contractor and workers shall be oriented on the rules and conduct during the project works;
- enclosed containers shall be provided to dispose of waste oil and other hazardous waste;
- workers shall be given instruction not to catch or harm any birds or animals present on the island, and not to damage any vegetation that is not already sanctioned for removal within the demarcated site bounds;
- littering shall be prohibited; and
- waste bins shall be placed within the site.

Mitigation for impacts on resource use

- Reducing, reusing and recycling of resources shall be encouraged through proper monitoring of worker activities and awareness; and
- Keep workforce to the minimum required.

Mitigation for sociocultural impacts

- hire local workers where possible;
- orient foreign workers on communication, personal hygiene and sanitation and infectious diseases; and
- ensure all foreign workers have their legal permits.

6.7.1.2 Transportation of materials

Transportation of construction materials from the source to the project island is identified as an activity with climate impacts, through the transportation of sea vessels, as well the transportation of the materials on land. The use of vessels and vehicles would require burning of fossil fuels which result in the release of greenhouse gases (GHG) into the atmosphere. The fuel usage of a supply barge is estimated at 1.3 kWh /t. As a general rule the longer distance would mean more fuel burnt and more GHGs produced. As the resource sourcing hierarchy in **Figure 12** shows, the greatest importance shall be placed on sourcing any available materials from within the island, with the next option being from within the region. Next in the hierarchy is Male' and the industrial areas in the zone, from where majority of the remaining materials can be sourced. Lastly, in cases where a proposed material cannot be obtained from within the country, only shall the contractor procure the material from a neighbouring country which is not likely due to relatively small volume of material requirement and commonly available nature of those. The multi-criteria impact magnitude for this activity was -22, which meant that it will have a moderately negative impact.

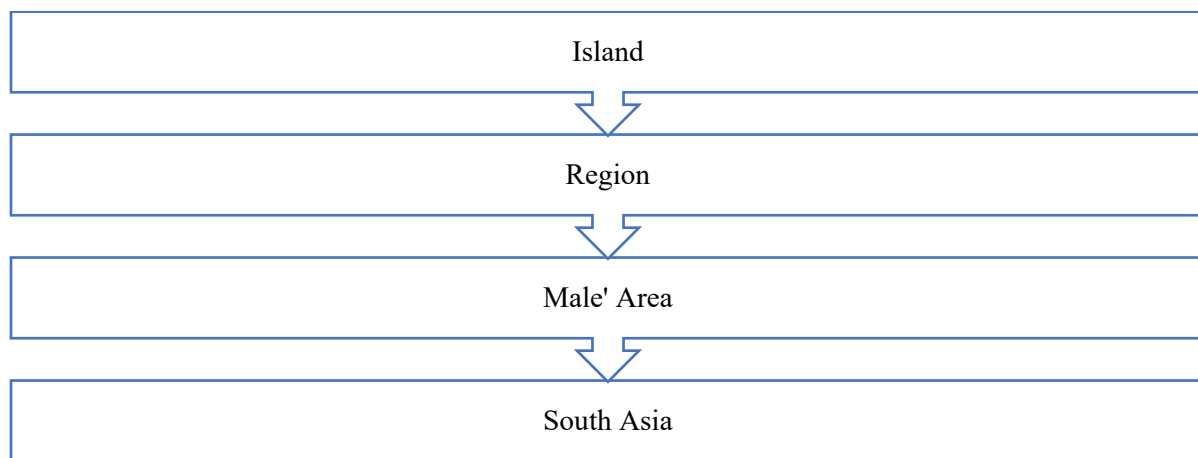


Figure 12: Material sourcing hierarchy proposed for the project (Adapted from Saleem 2018)

Along with the reduction in travel distances by choosing a close source, the number of trips to be made can magnify the distances travelled. The Proponent has produced the Bill of Quantities (BoQ) for the project works, which enables the contractor to purchase the required amount of materials in bulk, reducing the number of trips and wastage of materials. While the sea transport is expected to have the greatest impact of released GHG, the transport on land is expected to be minor, due to the short inland travel distances within the island.

The inputs of the project elaborated in the **Chapter 3** show the estimated amount of resources that will be used for the project. The use of resources for the project can have indirect impacts of GHG emissions from the production process. The main materials used in this project include concrete, reinforcing steel, structural steel, in addition to PVC pipes. Defra / DECC (2012) states that for every tonne of concrete casted, 135 kg of indirect CO₂ emissions result. Due to the small scale of the construction, the estimated indirect CO₂ emissions from material usage are minimal for this project.

The use of heavy vehicles on unpaved roads can cause compaction of the soil by the force applied by the tires of the vehicles. This can lead to the destruction of the soil structure, reduction of porosity, and thus reducing the water and air infiltration into the soil. The resulting soil is dense with few large pores and poor internal drainage (Wolkowski & Lowery, nd.). Roads impacted with the traffic from heavy vehicles can thus result in undulations and puddling.



Figure 13: Impact on roads from heavy vehicle transport in an island in Maldives (Adapted from Saleem 2018)

For the purpose of construction, no heavy vehicles are proposed. Although this is the case, a pickup truck will be used to transport the construction materials to the site, in addition to yard waste and construction waste from the site. The vehicle is not expected to cause major impacts on the road, force applied by the

pickup truck is expected to be lower than heavy vehicles and plant. The number of trips required are also reduced in the case of the proposed project, due to the small scale of construction.

Other impacts on roads due to transportation include the generation of dust during transportation, which can lead to impacts on the local air quality especially during dry weather. In addition to this, littering of construction materials from uncovered transportation vehicles can cause terrestrial pollution and amenity impacts.

The main impacts predicted on the bio-physical environment include:

- Potential oil spill from the cargo boat and during transport of material;
- Operation of vehicles on unpaved road may lead to soil compaction;
- GHG emissions from the transportation processes and operation of vehicles may deteriorate air quality for short period of time;

The main impacts predicted on the socio-economic environment include:

- Unpaved roads in the island may be affected due to operation of vehicles and harbour will be utilized for unloading the construction material;
- Remediation of road may require public finance but heavy vehicles will not be used for construction phase;

The following mitigation measures proposed:

Mitigation for climate impacts

- Sourcing of materials shall be done according to the hierarchy presented in Figure 12. Materials shall be obtained from the closest source;
- The materials shall be bought in bulk and transported to the island within a single trip where possible;
- Detailed BOQ has been produced by the Proponent, which shall be followed by the contractor when purchasing materials in order to reduce wastage of materials as well as the number of trips;
- The materials shall be stored on the project site to eliminate transportation of vehicles within the island throughout the construction phase;
- Idle time of the vehicles shall be avoided in order to reduce emissions;
- contractor shall use serviced vehicles and plant equipment for the project;
- contractor shall only use the needed amount of vehicles and plant for project; and
- vehicle used for the purpose should comply with the roadworthiness requirements of the Transport Authority and display the compliance stickers.

Mitigation for impacts on roads

- The contractor shall only bring in the necessary number of vehicles and plant to the island for the project;
- it shall be stated in the contract that any damages to the roads from transportation of construction materials and machinery shall be assessed after the civil works are completed, and the damages shall be repaired by the contractor;
- use the closest route from the harbor area to the site;
- cover the materials being transported to and from the site; and

- spray water on the road surface during dry periods to suppress dust.

Mitigation for accidents and injuries

- Vehicle drivers shall be licensed and competent;
- loads being transferred shall be fully secured; and
- transportation shall be done during day time as far as possible; and
- speed limits shall be observed when operating vehicles especially in residential areas.

Mitigation for marine and terrestrial pollution

- contractor shall clean any littering on the terrestrial or marine environment caused during transportation; and
- contractor shall enforce strict policy against littering and appropriate penalties; and

6.7.1.3 Site demarcation and clearance

Site demarcation and preparation involves surveying and setting the extents of the IWRMC. This activity is considered to have minor environmental impacts with multi-criteria impact analysis score of – 3 as it is largely noninvasive. However, improper or inaccurate demarcation could result in the IWRMC plot being set outside the limits as proposed by the EPA. It is important to ensure that the buffers proposed by the EPA are followed during site demarcation. The proposed site has no mature vegetation that requires clearance. Minor clearance of some undergrowth is required at a corner of the site. With proper planning, engaging qualified people and use of proper equipment, and with proper protective measures these impacts can be avoided. This activity is expected to have a minor impact overall.

The main impacts predicted on the bio-physical environment include;

- Removal of vegetation may cause temporary flooding at the project site during rainy season.

The main impacts predicted on the socio-economic environment include;

- Compensation will be provided to any plant removed in the project site. But no large trees were found at the project site.

The proposed mitigation measure include the following;

- During the initial set out survey, mark the limits of the plot as accurately as possible to avoid damaging or removing vegetation not intersecting with the plot;
- Ensure that the surveyors and helpers engaged in site demarcation properly understand the scope of works and recommendations of this report;
- qualified surveyors shall be engaged in site demarcation;
- hazardous waste used during site demarcation and fencing such as empty spray paint containers shall not be discarded haphazardly. These will have to be managed as per the **Section 0**.
- accurate and reliable equipment shall be used to minimize errors; and
- carrying out the works during the day time.

6.7.1.4 Impacts from construction works

There are a number sub-activities that can affect the environment related to construction of the IWRMC. Overall, the multi-criteria impact magnitude for this activity was -30, which meant that it will have a moderately negative impact.

Material Storage

At the initial stage all resources required for the construction of the site will have to be procured and stored. These include construction materials, vehicles, machineries, fuels, and tools required for IWRMC construction. Due to the nature of the project, even though a large volume of construction materials are not required care must be taking in storing materials to avoid any potential damages to the environment. The improper siting of stockpiles and storage of sand, gravel, cement, fuel, etc., at the construction sites could lead to fine materials being lost, damaged during heavy rainfall events. This would not only represent a waste of resources but could also be a cause of project delays. Hazardous and flammable materials (e.g. fuel, paints, thinner, solvents, etc.) improperly stored and handled on the site are potential health hazards for construction workers and spilled chemicals would have the potential to contaminate soil and inhibit plant growth in localized areas.

Mitigation for material storage impacts

- Safe storage area should be identified and retaining structures put in place prior to the arrival and placement of material;
- the stockpiling of construction materials should be done in a such a way that the materials are not exposed to weather conditions and are properly controlled and managed by the site supervisors; and
- hazardous chemicals (e.g. fuels) should be properly stored in appropriate containers and these should be safely locked away. Conspicuous warning signs (e.g. 'No Smoking') should also be posted around hazardous waste storage and handling facilities.
- equipment shall be stored in fenced areas and maintained appropriately during the course of the project and no new such facilities shall be developed for the purpose of the project;
- National Fire Code (NFC) shall be strictly followed while handling, transporting and storing fuel. Inflammable goods such as fuel drums, portable fuel containers and cleaning solvents and chemicals will be closed off from public access.
- portable extinguishers placed to be readily available when someone finds a fire;
- fuel should be stored in well contained barrels and place over a concrete. This is to contain oil spills during storage and to prevent infiltration of oil into soil; and
- tool shed shall be locked and all the equipment, vehicles and tools must be accounted for.

Noise and vibration

It is important to identify the sources of noise and vibrations and the intensity of such impacts on the project island. The noise and vibration impacts are expected to be moderate as the nearest residential area to the project site is more than 42 m away.

The main source of noise from the construction phase of the project will be from the engines used in the machinery and vehicles. No high impact works such as pile driving or demolishing structures are part of

the proposed construction, therefore the impact noise is not a major source of noise pollution for this project. Typical noise level of construction equipment are detailed below:

Table 20: Typical construction equipment and their noise levels 50ft from the source

Equipment	Typical Noise Level (dBA) 50ft from source
Concrete mixer	85
Concrete pump	82
Concrete vibrator	76
Pump	76
Saw	76
Shovel	82
Tie Cutter	84
Truck	88

Assuming the highest noise produced during construction is at 85 dBA, a noise decay calculation was done using initial assumptions without factoring for dampening effects due to obstacles and vegetation. From the initial calculations, the noise levels are projected to decrease down to less than 73 dBA at the nearest residential area.

Noise during construction is determined to be a short-term negative impact. Due to the distance of the project site it is identified that noise impacts will be minimal to the residential zones, while the construction workers will be most affected by the noise impacts.



Figure 14: Noise range map for Th. Thimarafushi

Mitigation Measures

- Confine construction activities to day time, from 8 am to 6 pm. Ensure no construction activities occur during night time; and
- Use of ear muffs by workers during operation of heavy machinery.

Impact on vegetation

No large trees are to be removed as part of this project. Careless workmanship may result in damages to the vegetation during movement of materials and other project related activities during the construction phase.

Mitigation Measures

- Workers shall be informed to avoid damaging trees and disturbance to animals and to generally avoid engaging in destructive activities to the environment intentional or unintentional.

Accidents and injuries

For a construction project of this nature there can be a number of causes that can result in accidents and injuries to workers. Hence it is imperative to identify and put in measures to avoid accidents and injuries to workers during construction phase. Some of the likely causes include:

- inhalation of cement during the site cast and pre-casting of concrete: inhaling high levels of cement dust during construction can be irritating to the nose and throat. Prolonged exposure to cement dust can result in silicosis (CSAO, 2001);
- contact with concrete mix: concrete has caustic, abrasive and drying properties and prolonged contact with concrete allows the alkaline compounds such as calcium oxide to burn the skin;
- wet concrete trapped against the skin can cause first, second, or third degree burns;
- falling of heavy objects: constructions sites are prone to falling of heavy objects which can be fatal to workers;
- falls: workers may be under the risk of falling into open pits, trenches and seriously injuring themselves;
- Bodily injuries due to manual lifting of heavy items; and
- being struck by moving equipment and vehicles.

Mitigation measures

For all works the following safety measures will be required during the construction phase.

- Appropriate PPE will be worn at all times. This will typically include hard hats, eye protection,
- protective trousers, gloves and reflective clothing, hearing protection, masks and wet weather clothing as appropriate;
- first aid kit will be on site at all times;
- all plant will be operated by competent certified operators. Plant to be inspected regularly;
- have the appropriate certification;
- manual lifting operations will be kept to minimum by the use of mechanical means;

- site visitors should not be generally allowed to work site except when its essential in such cases shall be accompanied at all times and required PPE shall be provided;
- provide first aid services in the site;
- proper signage and fencing should be provided around the site;
- carry out works during good weather;
- well trained personnel to use machinery and vehicles;
- avoid transportation during night; and
- Securing any loads on vehicles during transportation.

6.7.1.5 Terrestrial pollution from construction waste generation

Solid waste generated during IWRMC construction work would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite. Overall, the multi-criteria impact magnitude for waste generation was -30, implying that it will have a moderately negative impact. Waste burned onsite would generate smoke, possibly impacting negatively on ambient air quality and human health. Solid waste, if allowed to accumulate, could cause localised conditions conducive to the breeding of nuisance and health-threatening pests such as mosquitoes. Poor construction waste management constitutes a short-term, possibly long-term, negative impact.

Vehicle, equipments and tools maintenance works will likely be the primary source of chemical wastes during the construction period. The majority of chemical waste produced is therefore expected to consist of waste oils, solvents and used batteries. Typical wastes may include the following:

- Solid wastes (Empty fuel/lubricant drums, used oil/air filters, scrap batteries, vehicle parts);
- and
- Liquid wastes (waste oils/grease, spent solvents/detergents and possibly spent acid/alkali from batteries maintenance).

However, the amount of chemical and hazardous waste produced will not be significant. Other construction waste includes, packaging, concrete, wood and steel in minor quantities.

Municipal wastes are also expected to be generated during the construction phase by the workers comprising of food wastes, packaging wastes and waste paper.

The amount of human waste generated per person is approximately 125 g/day, which means 1.9 kg will be produced daily if approximately 15 workers were active which equates to discharge of approximately 2,550 l/day of waste water. Sewage will be managed through existing septic tank systems that have been installed in the island.

Since there is no existing waste management system in the atoll and since there is no waste management practice in the island to accommodate the construction waste generated, the environmental receptors will have a significant burden from construction waste. Some of the hazardous oils if not disposed properly may cause health implications to the people and vegetation.

The main impacts on the bio-physical environment include;

- Potential contamination of groundwater due to construction waste generated.

The main impacts on the socio-economic environment include;

- Since there are no established IWRMC in the island the construction waste will be managed on site at project location.

Mitigation Measures

- avoiding cooking and eating at work site to eliminate food waste and kitchen waste. Hence food for workers can be arranged with existing services on the island;
- reusable inorganic waste (e.g. excavated sand) should be stockpiled away from drainage features and used for in filling where necessary;
- regular sweeping of the of the worksite to collect litter, empty cans etc which could become breeding ground for mosquitoes and other pests;
- open defecation whether it's on land or on the beach shall be prohibited;
- appropriate general site cleanliness related signboards could be placed on the worksite to give workers reminders on good waste management practices;
- ensure to reduce waste by following the 3R steps; and
- waste collected shall be transported to nearest waste management facility after the construction works have ended.

6.7.1.6 Impacts from resource use

As shown in the BoQ for the project various types of construction related resources are required for the project. Consumption of goods impacts the environment in many different ways. For instance materials used for the project would contribute, directly or indirectly through the product lifecycle, to climate change, pollution, and biodiversity loss and resource depletion locally or elsewhere in the world. The most important resource as far as the current project is concerned would be the allocation of land for the site. For the purpose of developing the waste management center at least 735 m² of land would be required which represent 0.8% of the existing area. Allotting a plot of land for waste management with permanent concrete structures developed would essentially will result in a loss of the options for alternative land use and thus represents an irreversible commitment of land resources. The loss of optional uses for the allocated land although is inevitable is considered a negative impact. Other resources required would include sand, water, power and construction materials required for the IWRMC development. Since the resource utilization is considered to be relatively small, and that it is not expected to significantly contribute to deplete the natural resources and would be a major source of GHG emission, the multi-criteria impact magnitude for this activity was -22, which meant that it will have a moderately negative impact.

Since it would be very difficult to precisely determine by how much exactly the current project would contribute to the depletion of each type of various natural resources required for the project at local and global levels and by how much it would have contributed to global climate change, general impacts that are normally associated with natural resource use can be applied in relative terms for the project.

The main impacts on the bio-physical environment include the following:

- Water used for construction works will be rain harvested or obtained from the existing resources in the island hence no impact on groundwater quality is anticipated;
- Electricity will be obtained from the existing grid of the island hence increase of GHG emission due to increase in power demand.

The main impacts on the socio-economic environment include

- Electricity and water will be obtained existing systems in the island which may increase the burden of the existing system of the island;

Mitigation Measures

- Resource conservation shall be given a high priority in all stages of project development through bulk purchasing, putting in place measures to avoid wastage, encouraging reuse and recycling;
- initiate rainwater collection and storage as early as possible into the project construction;
- careful store management and record keeping on use of materials;
- reduce idle time for vehicles and equipment's and switching off after use;
- use well maintained, energy efficient equipment and lights;
- sand shall not be mined from beaches and lagoons of the island for construction purposes, if coral sand is used it should be obtained from a government approved location;
- materials that are locally available shall be obtained as such instead of opting to bring those after a long haulage;
- materials shall be procured in bulk as much as possible;
- utilize day time hours for the construction when plenty of light is available; and
- FENAKA power supply will be used for electricity generating purposes.

6.7.2 Operational Phase Impacts

6.7.2.1 Waste collection and transportation

As stated in this report, waste management is a pressing issue at the island with a high rate of waste generation and lack of resources and budget to properly manage the waste. Until recently, there was no area to dump waste and locals usually burnt and buried their waste in different areas of the island. The island council has now selected a specific area for dumping waste which is utilised by all the islanders. This area is not demarcated. The practice of open burning of waste also takes place resulting to potential respiratory issues from the inhalation of smoke. A reliable, affordable and locally appropriate transport system is critical to collecting waste from houses, businesses and institutions. Equally important is an arrangement for marine transport to remove residual waste from the island in order to make the system complete and effective. The successful implementation of the IWRMC together with land and marine transfer arrangement are two important aspects to implement Waste Management Plan to make the island cleaner and healthier for the people to put a stop to littering and burning of waste in the island. This will lead to the improved health and psychological well-being of the residents and visitors of Thimarafushi. It has been identified as a long term positive impact on the residents and visitors of Thimarafushi.

The Council is considering to repair the previously used vehicle for the purpose of collecting and transporting the waste within the island daily, at a set schedule. At the moment there is no specific arrangement for marine transfer of residual waste from the island although by the time IWRMC is complete it is expected to have this arrangement in place.

While both land transport and marine transfer of waste are expected to have significant positive impacts, unregulated transport arrangements can result to environmental issues. If not properly managed likely environmental impacts include, noise, hardening of road surface, creation of puddles during wet season, and littering on the roads, bad odour during transport, and health issues to workers, vehicular emission, dust generation as a result. In the case of marine transport, there can be chances of dumping of waste intentional or unintentional en-route to the final disposal site in addition to engine emissions. However, these impacts can be effectively managed and negative impacts can be kept at an acceptable level.

Measures to ensure and enhance the positive impacts

- Proponent and Island Council shall follow the management plan provided with the ESMP in order to monitor the operations of the IWRMC, and bring about any necessary changes to the operations and policies, in addition to providing any needed technical assistance for the island;
- proponent shall review the waste management operations within the island regularly and update the National Waste Database;
- Island Council shall update the IWMP by consulting relevant stakeholders and get approval from EPA before commencement of construction works or at least prior to operationalization of the IWRMC;
- Island Council shall conduct awareness programs to the residents of the island regarding the best practices in waste management, as well as conduct programs to familiarize the residents with the gazetted regulations and guidelines to manage the waste within the island;
- regular awareness programs conducted to minimise waste generation and Polluter pays principle established in order to reduce the waste generation within the island;
- proponent shall provide resources in terms of required equipment and machinery, and technical expertise to ensure the operation of the IWRMC; and
- Proponent shall assist in creating markets / avenues where the IWRMC's can generate income through selling compost and recycled metals, plastics and glass.

Mitigation for terrestrial pollution

- Implement rules within the IWRMC workers to impose penalties for any littering within the island due to improper handling of the waste and improper transport practices;
- the status of the vehicles used shall conform to the Waste Management Regulations 2013/R-58 and provide cover to the waste being transported in order to avoid littering;
- during waste collection instead of stopping the vehicle at every house, the residential area can be divided into blocks and vehicle stops can be pre-determined and from where waste containers can be hand carried by the workers from respective houses to be loaded to the vehicle.

Mitigation for accidents and injuries

- Waste collecting workers shall wear appropriate clothing and PPE to avoid injuries in handling waste;
- vehicles should be driven by licensed drivers;
- records of the vehicle trips shall be properly maintained;
- speed limits shall be observed; and
- a strict schedule shall be stated in the IWMP and followed in order to reduce the transportation frequency thus reducing the probability of accidents.

Mitigation for air quality impacts

- Vehicle speed shall be kept appropriately to suppress dust;
- vehicles used shall be regularly washed and kept clean; and
- The waste being transported shall be covered to minimise the impact of odour on the public.

Mitigation for climate impacts

- Regular servicing of vehicles used to transport waste;
- ensuring the vehicle has roadworthiness certification from the Transport Authority;
- restricting the use of the vehicle only for the stated time in the IWMP;

Measures to prevent marine pollution

- Wastes destined to the nearest waste management facility will require to keep logs of waste being loaded from the island and unloaded at the nearest waste management facility. The records to be signed by the vessel captain and a copy returned to the waste management supervisor;
- vessels used shall have a certified captain and vessel should have valid seaworthiness certificate;
- vessels shall not be overloaded and waste containers shall be kept closed and shall not be allowed to flyaway due to wind and sea conditions; and
- Waste shall not be transferred during extreme weather conditions.

6.7.2.2 Waste management activities

In general, the operational phase of the project will greatly improve the existing waste management condition of the island preventing pollution and spread of diseases. These activities would prevent pollution of groundwater, coastal areas and forested areas which would prevent impacts to biodiversity, health and wellbeing of the public.

However, if these activities are not properly implemented there is a risk of IWRMC being deteriorated into a dump site where mixed waste are disposed, burned and buried. This means without proper mitigation measures and regular transportation of waste out of the island to a central facility, there is a greater risk of IWRMC being overfilled. This entails a loss of investment and a greater impact to environmental receptors as some sites are moderately close to public areas. Moreover, impacts associated with composting sorting and storing waste has inherent impacts which will have to be properly managed,

identified and mitigated to enhance and ensure the positive impacts of the proposed IWM. Propensity of these impacts are greater for the following environmental receptors:

- Groundwater;
- Climate/air; and
- Health and wellbeing: noise, odour and accidents/injuries

The following Sections describes the factors influencing these impacts and proposes measures to mitigate negative impacts and to ensure the overall positive impact of the IWRMC during operational phase.

Impacts on health

While overall positive impacts on public health are identified from this project, the negative impacts of running a waste management centre (especially one where composting is to be done) shall be highlighted. Composting can be a source of particulate matter in the atmosphere. The highest concentration of particulate matter in the air occur during the pre-treatment phase where the fresh organics are shredded and mixed. Particles also become airborne during the turning of the biodegrading compost heap to regulate the temperature.

Certain pathogens may also be transmitted via air during the composting process. These include *Legionella longbeachae*, *Aspergillus fumigatus*, *Mycobacterium tuberculosis* and *Hantavirus* (DEC NSW, 2004). Harrison (2007) has done a comprehensive literature review on the health effects of composting operations, which show increased concentrations of bio-aerosols within the vicinity of the composting facilities and related health effects to workers as well as affected public. Bunger et. al (2006) states that exposure to organic dust at composting workplaces is associated with acute and chronic respiratory health effects. Muller et. al (2006) and Wouters et. al (2006) agree with these findings, stating that changes were found in white blood cell counts, increase in neutrophils, decrease in oesinophils were measured in healthy subjects.

As for the association between the health symptoms and the distance from the site, Herr et. al (2004) showed that total bioaerosols were found at $> 10^5$ CFU / m³ close to the composting site and dropped to background levels within 550 m from the site. Herr et. al (2004) also showed from another study where higher than background concentrations were found within 200 m from an outdoor composting site ($> 10^5$ CFU / m³), and dropped to background concentrations at 300 m.

Wheeler et al (2001) stated that composting activities do not emit bio aerosols at levels that can be of a hazard to the public. Wheeler et al suggests a buffer zone of 250 m. The conservative values for the concentrations given by Wheeler at al includes:

Table 21: Background concentrations of bio aerosols (Source: Wheeler et al (2001))

Bio aerosol	Concentration
Total Bacteria	1000CFU/m3
Total Fungi	1000 CFU/m3
Gram-negative bacteria	300 CFU/m3
Inhalable dust	250 µg /m3

Wheeler et. Al; (2001) states the concentrations of bio aerosols exceed this limit where $10^5 - 10^6$ of bacteria and 10^3 and 10^4 of fungi have been measured, the concentrations drop to background levels at 250m distance from site. Although it should be noted that the expected composting operations in the IWRMC are not as large scale as the studies cited above. Therefore, the health impacts of the bio aerosols can be minimised by following the mitigation measures provided.

Other potential health effects can arise from the introduction of vermin or pests, putrescible wastes attracting flies, puddles allowing the breeding of mosquitoes. Impacts that may arise from the IWRMC becoming a makeshift waste dumpsite for organics are also addressed in the subsequent Sections of the report.

Impacts on groundwater

When organic waste is stockpiled for composting, there is potential for leachate production from the waste. This is especially prevalent in cases where the waste includes food, meat, fish and fatty sludges. This leachate can infiltrate into the ground and mix with the freshwater lens of the island, thus polluting the lens with high amounts of nutrients, which can introduce bacteria and other microbes. If the conditions are anaerobic, the resulting leachate can be acidic and cause the corrosion of metals and introduction of metallic compounds in the groundwater. If the conditions are aerobic, alkaline leachates will result with a low carbon – high nitrogen ratio. The main parameter in leachate that is considered to have a negative environmental impact is nitrogen that results from biodegradable waste.

Leachate production can increase during the rainy season, with the additional water from rain causing leachate from garden materials, wood and fibrous materials. Rain can also cause the stockpile to become anaerobic, thus resulting of undesirable odors.

The operation of the IWRMC is identified to have an overall positive impact of the groundwater of the island. While the aforementioned infiltration of leachate would still be an issue (if improperly managed at the IWRMC), it should be noted that the same waste has been dumped throughout the island without any measures, enabling the pollution of the groundwater with the leachate. Therefore, the proper operation of the IWRMC and the proper management of the collected waste will result in the reduction of the pollution of the groundwater from waste sources, thus improving the status of the groundwater in the island.

GHG emissions

The waste management activities will require power consumption for operation of the machines, lighting and pumping. Since the island's power system is fossil fuel based incremental increase in electrical energy consumption at the IWRMC will result in GHG emissions. However, the power consumption at IWRMC is expected to be small and therefore is not considered a significant issue. In addition, CO₂ which a GHG will be the main gas produced during the composting process in aerobic conditions while in anaerobic conditions, methane is released into the atmosphere, which has even a higher greenhouse warming potential compared than CO₂. In open systems, methane is not released in large quantities as long as the aerobic environment is maintained. (USEPA 2002). If the composting is well managed and kept in aerobic conditions, the methane production is reduced, which contributes to the reduction in global warming, as such waste would otherwise produce methane in a normal oxygen poor landfill or dump. It has been

debated that, the CO₂ produced from the degradation of the compost pile would have been produced anyway, in the longer term if kept in a landfill or dump.

Amenity impacts

The IWRMC operations can cause various negative amenity impacts from inappropriate management. This issue is especially exacerbated through improper handling of raw organics as well compost windrows. The potential negative impacts include:

- Odour pollution;
- Particulate matter;
- Vermin and pests;
- Litter;
- Fire; and
- Noise

Biodegrading organics as well as compost heaps can attract birds such as crows which can lead to noise problems, and the littering of organic waste scraps within the site as well as away from the site. The unprocessed organic wastes as well as the compost heaps can be an attraction to pests and vermin. These pests can be environmental as well as health hazards. Airborne dust from a poorly managed site can have a visual impact as well as public health impacts including respiratory issues.

Wind can blow the materials off the compost heaps as well as the other stockpiled waste types out of the IWRMC, which can degrade the local amenity. This impact is mitigated through the design of the IWRMC perimeter walls which include a perimeter fence made of 50 × 50 PVC coated mesh.

Littering inside the IWRMC can cause amenity issues such as tracking of litter on the wheels of the waste transport vehicles leaving the IWRMC. The litter can be deposited out on the roads of the island, which leads to issues such as visual impacts, odour, and possible contamination of groundwater from leachate.

Air quality impacts

Odour

Composting odours can originate from sulphur compounds, nitrogen compounds and volatile organic compounds. Ammonia is also commonly associated with unpleasant odour resulting from composting. If the composting is done under aerobic conditions, the main gaseous product is carbon dioxide. Gas compounds contributing to the odours of composting organics containing bio solids include dimethyl sulphide, dimethyl disulphide, dimethyl trisulphide, carbon disulphide and benzothiazole. These chemicals, while potentially toxic, are not present in high concentrations in open air composts. The gas methane is generated when the microbes do not get enough oxygen, and anaerobic biodegrading occurs. Methane gas has a strong and foul odour. The generation of ammonia, volatile amines, hydrogen sulphide and volatile organic compounds cause these odours.

Table 22: Odours generated from the composting process (Source: Goldstein (2002))

Compound	Description of smell	Detection limit for a particular odour panel ($\mu\text{g}/\text{m}^3$)
Sulphur compounds		
Dimethyl disulphide	Rotten cabbage	0.1
Dimethyl sulphide	Rotten cabbage	2.5
Carbon disulphide	Rotten pumpkin	24
Hydrogen sulphide	Rotten egg	0.7
Methane thiol	Pungent sulphur	0.04
Nitrogen compounds		
Ammonia gas	Medicinal	27
Trimethyl amine	Fishy	0.11
Volatile fatty acids		
Acetic acid	Sour (vinegar)	1019
Propionic acid	Rancid	28
Butyric acid	Putrid	0.3

Fire hazards

There is a possibility of fire hazards at the IWRMC coming from biogas emissions and human activities. Fires can pose a risk to the workers through explosions and suffocation from smoke, in addition to damage to equipment.

Possible fire hazards are caused by the following (DCE NSW, 2004)

- Spontaneous combustion;
- Sparks from welding;
- Lightning strikes;
- Cigarettes; and
- Arson

The most common causes of fire during composting activities are reported to be cigarettes, welding activities and spontaneous combustion (Rynk 2000). The cause of spontaneous combustion is when the decomposing organics self-heat to ignitable temperatures (DCE NSW, 2004). Although Rynk (2000) states that spontaneous combustion is more prevalent within large undisturbed piles containing raw organics, curing compost or finished compost rather than active composting. Therefore it is important to limit the storage of organics (meant for transport to a central waste management facility) on the IWRMC.

Noise and vibration impacts

The main sources of noise from the operation of waste management centres come from the material recovery machineries used and the operation of vehicles. According to the Health and Safety Executive UK, most material recovery facilities have noise levels exceeding 80 dBA and 85 dBA. Assuming a maximum noise level of 85 dBA, the noise decay map in Figure 14 can be used for this purpose too. From the initial calculations, the noise levels are projected to decrease down to less than 73 dBA at the nearest residential area.

Workplace safety and accidents

The group of people most likely to be impacted by the IWRMC operations are the workers at the site. The various operations such as transportation, collection, handling, sorting and storing of the wastes, in addition to the composting and volume reduction operations all pose different risks to the worker onsite. The impacts discussed above and their proposed mitigation measures can provide a level of safety to the workers. Even with these mitigation measures put in place, a proper workplace safety guideline shall be formulated by the contractor for all workers onsite to follow.

In addition to the impacts discussed above, other work related safety issues include falling stock or during lifting activities, moving vehicles and falls from height. The accidents can result in injuries of varying nature.

Impact to IWRMC from *udha* events

The proposed IWRMC is located 30 m from the vegetation line of the island, as directed by the MLSA.

As the IWRMC is located in the south western side of the island it is possible in the future that a swell or *udha* event may effect this area and cause flooding inside the IWRMC. Such an event occurring would cause damage to machinery and equipment in the IWRMC as well as potential damage to compost windrows causing a loss of investment and future revenue. With potential damage to waste management machinery and equipment the IWRMC works will be halted, leading to the site quickly overfilling with waste collected daily.

Mitigation for flooding from udha events

- elevate the ground level of the IWRMC by 0.6m using sand from the stockpiled dredged material next to the proposed IWRMC site;
- a wall shall be constructed on the lagoon-facing side of the IWRMC instead of a metal fence; and
- the proponent and Island Council to consider providing coastal protection to the adjacent coastal area in any potential coastal protection project.

Keeping pest and vermin populations low

- An area where waste (especially raw organics) is concentrated will naturally be an attraction to pests and vermin. In order to reduce the possible health hazards from such pests, their population shall be kept low with the following mitigation measures;
- unprocessed waste (including those waiting to be processed and unmanaged waste awaiting transportation) shall not be kept uncovered. Bins are provided to store such organic wastes. The bins are lidded, which controls both the possibility of odours emanating and the means of access to pests. The bins are also watertight in order to avoid the infiltration of water both into and out of the bin. The bins shall be designed to resist the action of organic acids and facilitate washing;
- covering the compost heap;
- ensure that the IWRMC surfaces are adequately drained to prevent the occurrence of ponds; and
- establish deterrence and eradication measures to control the outbreaks of pests or vermin.

Control of wind-blown litter

Wind-blown litter control is incorporated in the design of the IWRMC, with the provision of PVC coated mesh fence. Even with this mitigation measure in place, there is a possibility of wind-blown littering occurring. Such litter shall be cleaned by the occupier of the IWRMC. It is recommended to implement procedures to clean up the wind-blown litter after strong winds; and clear all litter within the premises daily and any litter that has been blown out of the IWRMC.

Mitigation for fire hazards

- A fire management plan shall be developed by the IWRMC occupier;
- Adequate firefighting equipment shall be provided at the IWRMC, and placed at locations easy to access. The current design of the IWRMC includes a fire alarm system as well as firefighting equipments;
- the IWRMC occupier shall be able to show that firefighting capacity of the IWRMC is sufficient to suppress and minimize the incidence and impact of fires;
- training and awareness raising on firefighting shall be conducted on a regular basis for the workers; and
- signs shall be kept on the premises stating that open flames are not permitted on site.

Mitigation for noise impacts

- Obtain noise data from supplier prior to purchase of machinery;
- enclose the noisy machinery with sound insulating enclosure;
- reduce duration of exposure by implementing job rotation; and
- provide employees with hearing protection if required.

Mitigation for workplace accidents

- The IWRMC occupier shall be required to develop occupational safety management plan, and safety guidelines shall be displayed in the work site at all times;
- provide clear instructions to the workers on:
 - The possible risks
 - Measures in place to control risks
 - Follow emergency procedures;
- provide proper training including manufacturer's safety instructions to employees on how to operate machinery;
- conduct proper and regular maintenance of machinery used;
- prior to maintenance, make sure the equipment is made safe and prevent access to dangerous parts. Make sure others are aware that maintenance is being carried out;
- machinery and vehicles should only be handled by employees with the proper credentials and training; and
- proper PPE should be provided at work. PPE should be used after all possible risks have been eliminated as much as possible and to manage any remaining risks.

Table 23: Operational phase hazards and suitable PPE

Hazard	Suitable PPE
Stock movement and falling items	• Safety shoes • Hard hats
Moving vehicles	• High-visibility jackets
Slips	• Safety shoes with slip resistant soles
Sharp edges	• Gloves • Forearm protection • Aprons • Hand pads • Thumb guards • Head protection
Noise	• Noise cancellation headphones

6.7.2.3 Waste generation - terrestrial pollution, groundwater contamination

Not considering the waste collected from the island, waste generated as a direct result of operations at IWRMC during the operational phase of the IWRMC will be relatively low. These will include waste oil/batteries for waste management equipment, yard cleaning waste, used spare parts, used clothes, etc. Since eating and cooking inside the IWRMC will be prohibited, no mixed municipal waste will be generated during the operational phase of the project.

The main impacts on the bio-physical environment include;

- Leachate may seep and contaminate groundwater during a flooding event. The leachate tank will prevent this in normal circumstances.
- If not properly de-slugged the sewerage may seep into group water and lead to groundwater contamination.

The main impacts on the socio-economic environment

- Indirect impacts of groundwater contamination

Mitigation Measures

- All wastes generated as a direct result of the waste management activities shall enter the waste management stream and managed as prescribed for different waste types; and
- prohibit eating/cooking in the IWRMC.

6.7.2.4 Resource consumption

Electricity, fuel and water will be directly required for the operation of the IWRMC. Water will be mainly sourced from the ground while electricity will be obtained from the island's mains.

A compactor and shredder/crusher can be used to reduce the volume of waste streams. The waste weight will remain the same so there will be no savings from the total amount of waste produced. However, savings will occur because waste volume will be reduced by approximately 80% which will decrease the

number of times the storage area is required to be emptied, therefore resulting in lower transportation costs.

Depending on the type of equipment's used such as chainsaws will require small volumes of fuel for operations. Most of these equipment's, however, are run very infrequently when enough waste has been separated and stored and are relatively efficient when run, meaning the amount of energy consumed by the compactor will be low. The running wattage mid-range compactors and shredders may range from 700 – 2000 watts, which means approximately 30-60 kW will be required to power all equipment simultaneously. However, this will not be the case since many of these equipment don't need to be switched on daily and at the same time. There may be periods where the only electricity required will be for switching on the lights at the IWRMC. Therefore. Electricity consumption of the IWRMC during the operational phase will be relatively low. The activity would have a minor negative impact on environmental receptors.

However, the following mitigation measures shall be implemented to reduce water and electricity consumption.

The main impacts on the bio-physical environment include the following;

- Groundwater may be utilized for the operational purposes which will have impact on the contribute to saltwater intrusion to groundwater lens.

The main impacts on the socio-economic environment include the following;

- The electricity required for IWRMC operations will be obtained from the existing electricity grid of the island which put additional burden on the power needs of the island.

Mitigation Measures

- It is strongly encouraged to install solar panels on the IWRMC roof to generate required power for the IWRMC;
- use solar lights in the premises;
- work shall be planned to be carried out during day times;
- ensure that the compost pile is shaded during dry periods to avoid rapid loss of moisture content;
- use a spray hose so that the surface area of water droplets is increased which would reduce the amount of water consumed;
- ensure that all equipment is serviced and kept clean daily, to reduce the amount of water required for cleaning;
- prepare a plan to switch on the compactors and shredders depending on the incoming waste stream to conserve electricity and
- make sure all equipment are properly serviced and maintained.

6.8 Impact Analysis and Evaluation

The following section will provide an analysis and evaluation of the previously described impacts on the biophysical and socio-economic environment in order to identify their significance.

The **Table 24** is an impact analysis table. From the **Table 24** it can be inferred that magnitude of the most of the negative impacts on the natural and social environment is moderate, or minor.

Table 24: Impact Analysis Matrix for proposed establishment of IWRMC in Th. Thimarafushi

Project Activity/ Impact	Extent	Duration	Intensity	Likelihood	Significance	Color Scale
Construction Phase						
Influx and settlement of workers for the project construction activities	Local	Short-term	Low	Likely	Minor	
Transportation of materials	Local	Short-term	Medium	Definite	Moderate	
Impacts from construction works	Local	Short-term	Low	Likely	Minor	
Terrestrial pollution from construction waste generation	Onsite	Short-term	Medium	Likely	Moderate	
Impacts from resource use	Local	Short-term	Medium	Definite	Moderate	
Operational Phase						
Waste collection and transportation	Local	Long-term	Medium	Definite	Moderate	
Waste management activities	Local	Long-term	Medium	Definite	Moderate	
Waste generation - terrestrial pollution, groundwater contamination	Local	Long-term	Medium	Definite	Moderate	
Resource consumption	Local	Long-term	Low	Likely	Minor	

CHAPTER SEVEN: MITIGATION MEASURES

One of the most important functions of an Environmental and Social Management Plan (ESMP) is to propose ways to manage the negative impacts that are likely to occur as a result of the proposed development. For this purpose, it is essential to identify mitigation measures to minimize impacts and identify cost of mitigation measures and parties that are responsible for implementation of these measures. As highlighted in the description provided in the chapter 6, most of the negative impacts envisaged for the proposed development occur during construction phase. Therefore, the proposed mitigation measures mostly focus on the construction phase of the project. However, the slight negative impacts envisaged for the operational phase are also taken into consideration and mitigation measures are proposed for these impacts as well.

7.1 Environmental Management Plan

Table 25 provides details of the key mitigation measures for various environmental and socioeconomic aspects that are impacted as a result of the project.

Table 25: Proposed Mitigation measures for Establishment of IWRMC in Th. Thimarafushi

Environment Management Plan				
Impact	Mitigation Measure	Responsible Party	Cost of Mitigation	
Management of Impacts during Construction Phase				
1. Physical / Chemical				
Note: All construction activities should be undertaken in the presence of an experienced supervisor.				
Contamination of groundwater and soil due to chemical spillage and seepage	Hazardous waste such as waste oil and diesel should be stored in sealed containers and placed on an impermeable surface and transferred to the nearest regional waste management facility for final disposal. Stored containers should be regularly inspected to identify any leakages. Conspicuous warning signs (e.g. ‘No Smoking’) should also be posted around hazardous waste storage and handling facilities. Temporary area for storage of such waste is illustrated in the figure below. 	P: Contractor S: IC Supervisor	Cost associated with purchasing of containers and transport to K. Thilafushi	
Noise pollution due to	Ensure construction activities occur between 8 am and 6 pm.	P: Contractor	Cost associated	

construction activities and use of machinery	Construction workers should wear ear muffs when using machinery that produce significant noise and while undertaking welding and drilling activities.		with purchasing ear muffs
Negative impact on air quality during transfer of construction materials and progression of works	During transport of construction materials from the harbor to the site, all sand and aggregate should be transported in covered vehicles or wheelbarrows and vehicle movement should be via routes that are well away from community roads where possible. Transportation should be at low vehicular speeds and loading and unloading should be conducted within the site. All vehicles used in the project should have an up to date road worthiness certificate. All vehicles and machinery should be well tuned. Machines should be switched off when not in use. Ensure that construction site is regularly wetted to minimize impact of dust as a result of the project. Materials that are stockpiled at the location for long period of time should be covered to minimize impact of dust generation due to windy conditions. The contractor should not burn any waste.	P: Contractor	No cost involved.
Coastal erosion and loss of beach aesthetics due to sand mining	Ensure that all construction materials including sand are sourced in compliance with the national laws and regulation. Sand should not be sourced from the beach or lagoon of an inhabited island, tourist resort, or any protected island. This includes the area of the island designated by EPA for sand mining of local public use.	P: Contractor	Cost associated with purchasing sand from a reputable source (hardware shops) and transporting to the island.
Waste Management	Construction waste produced should be reused for the construction of the IWRMC as much as possible. The remaining reusable materials such as (metal bars and roofing sheets) should be given to the island community or the island council free of cost. Leaves of felled vegetation is to be sundried and left at the forest area for natural degradation. Any remaining C&D waste shall be disposed at the area designated by the council for C&D waste disposal.	P: Contractor S: Island Council	Cost associated with transport to K. Thilafushi

Littering and general waste generated by construction workers	Place a bin at the site to dispose general waste generated by the workers. Establish procedures for general waste disposal which should include actions to be taken if the procedures are breached.	P: Contractor	Cost associated with purchasing a bin
2. Biological			
Negative impacts to vegetation due to improper handling and driving during material transportation.	Workers will be informed to avoid damaging trees and disturbances to animals and to generally avoid engaging in destructive activities to the environment intentional or unintentional. Avoid roads with significant vegetation during transportation within the island. Avoid bringing heavy vehicles to the island where possible.	P: Contractor	No cost involved
Negative impact on fauna during material transport	Workers will be informed to avoid damaging trees and disturbances to animals and to generally avoid engaging in destructive activities to the environment intentional or unintentional. Materials shall be obtained from the closest source. The materials shall be brought in bulk and transported to the island within a single trip where possible. The materials shall be stored at the project site or in a close proximity to avoid unnecessary movement of vehicles within the island through the construction phase. Ensure that all construction materials imported to the island are free of any alien species or pests. Ensure that oils and paints are properly sealed prior to transportation. Ensure that materials are not kept beyond the height of the sides of the vessels and are properly covered, when transporting via sea.	P: Contractor	Cost associated with purchasing of containers designed for storing hazardous substances.
3. Health and Safety			
Occupational Health and Safety	All workers should be provided with safety gear and should ensure that safety gear is utilized at all times. This includes: safety hats, boots, glasses, masks and gloves. Ear muffs shall be provided where equipment or machinery that emit significant amount of noise is used (welding, drilling etc.).	P: Contractor	Cost associated with purchasing safety materials.

	Chemical-Liquid protective gloves should be used when handling any chemicals, waste oil or other liquid waste. First aid kit must be purchased and kept on site at all times No open electrical wiring or cables should be kept on site. Health and Safety briefing should be given to all construction workers. A safety inspection checklist should be prepared taking into consideration what the workers are supposed to be wearing and monitored monthly and recorded in the monitoring.		
Working Conditions and Labor	The maximum working hours of all construction workers should be 48 hours per week as per the Employment Act of Maldives. Meals should be provided to construction workers 3 times a day. Safe drinking water should be supplied to construction workers and must be made available at the work site and the labor camp. Appropriate sleeping arrangements shall be made for the construction workers. Temporary resting arrangements for the workers shall be facilitated at the work site. Provision of a resting facility for the workers Provision of toilet facilities which is accessible within 5 minutes working distance.	P: Contractor	
Management of COVID19	Travel permit must be taken from HPA for the workers if traveling from Male' or an island placed under COVID19 monitoring. The standard quarantine procedure must be followed as instructed by the authorities. Workers must be briefed about the safety protocols and social distancing measures that has to be enforced. The workers must perform frequent hand hygiene. All workers must wear face masks. The movement of workers must be restricted between the labor camp and work site as much as possible.	P: Contractor	Cost associated with purchasing soap, hand sanitizers etc. and printing of awareness materials.

	Daily body temperature of all the workers should be taken and log records maintained. If a worker is having a temperature of 37.8C or above or symptoms of flu that person must not report to work and should be self-isolated and respective authorities notified. Handwashing or hand sanitizing facilities must be established at the work site and the labor camp. Labor camp should facilitate social distancing. The beds should be kept at least 3 – 6 fts apart. COVID19 awareness materials should be displayed in the worksite and the labor camp. Construction tools should be cleaned using disinfecting solution (1:9 bleach solution) at the end of each day or when changing shifts (if shift-based work methodology is adopted).		
Health and safety of public	Demarcate the site boundary through taping or hoarding. Place sign boards to indicate that only authorized personnel are allowed entry. Make sure that the general public do not have access to the site and its vicinity. Regularly monitor for entrance of residents. Make sure that public chairs are not found at the vicinity of the site.	P: Contractor S: Island Council	Cost associated with designing and printing sign boards.
Fire hazard	Ensure that electrical wires are installed properly by a certified person. Ensure that portable extinguishers are readily available in case of an emergency fire. Flammable hazardous waste such as used oil and diesel must be labeled with hazardous waste and fire hazard signage and regularly inspected to identify any leakages. Conspicuous warning signs (e.g. 'No Smoking') should also be posted around hazardous waste storage and handling facilities. National Fire Code (NFC) shall be strictly followed while handling, transporting and storing fuel. Inflammable goods such as fuel drums, portable fuel containers and cleaning solvents and chemicals will be closed off from public access.	P: Contractor	Cost associated with hiring an expert electrician and purchasing of fire extinguishers
4. Sociological and Cultural			
Legal Issues	All expatriate workers must hold valid work permits	P: Contractor	Work Permit fees
Handling Environmental and Social	The contractor will appoint a suitably qualified Environmental Officer following the award of the contract. The Environmental Officer will be the primary point of contact for assistance with all environmental issues during the pre-construction and construction phases. He/ She shall be responsible for ensuring the implementation of ESMP.	P: Contractor	Cost associated

Issues during Construction	The contractor shall appoint a person responsible for community liaison and to handle public complaints regarding environmental/social related matters. All public complaints will be entered into the Complaints Register. The Environmental Officer will promptly investigate and review environmental complaints and implement the appropriate corrective actions to arrest or mitigate the cause of the complaints. A register of all complaints is to be passed to the Engineer within 24 hrs. They are received, with the action taken by the Environmental Officer on complains thereof; and The site supervisor may assume the on-site responsibility of the environment officer and community liaison officer, subject to being adequately trained and having thorough knowledge of the ESMP. Contractor shall prepare detailed Environmental Method Statement (EMS) clearly stating the approach, actions and manner in which the ESMP is implemented.		with hiring of staff.
Sociocultural conflict due to arrival of expatriate workers	Ensure that local workers are used as much as possible. If expatriate workers are used ensure that they respect the local culture. The contractor in collaboration with the Island Council shall undertake a training to sensitize the labor to the local context and customs. This training should also cover topics related to Gender-based violence. To mitigate conflict that may arise due to the arrival of expatriate workers, the consultant should develop a “Code of Conduct” outlining the set of rules that that the workers have to follow to persevere the social norms and religious values of the society. The Code of Conduct should also specify penalties for breaching these rules and should be thoroughly communicated to workers prior to mobilization.	P: Contractor S: Island Council	Cost associated with hiring staff
Code of Conduct and Communication	The “Code of Conduct” developed should also cover good environmental governance and responsibilities workers have to follow to safeguard the environment. Though the number may be minimal, code of conduct and awareness in HIV related issues need to be considered. The contractor should ensure that all communications to the workers are presented in the local language. If expatriate workers are employed communications should be made in a language that they understand. Information on the project and the GRM should be displayed in the project site board, council noticed board as well as other communal place as much as possible.	P: Contractor P: Island Council S: MCEP	Cost associated with developing materials.

Loss of source of sand for local public use due to sand mining from the area of the lagoon permitted for local public sand mining	Ensure that sand is not taken from the lagoon of the island.	P: Contractor	Cost associated with purchasing sand from a reputable source (hardware shops) and transporting to the island.
Grievance Redress Mechanism	The GRM established by the proponent should be implemented at the construction phase. Contact details of focal points of the contractor, Island Council and the proponent should be displayed at the project site in the project board, the Council Office and common places frequented by the public (such as schools, health center etc.). It is recommended to change the first point of contact to the contractor, followed by Island Council and the proponent. The community liaison officer of the contractor must maintain log records of the complains received and subsequent actions taken.	P: Contractor S: Island Council T: Proponent	Cost associated with printing of the GRM board and posters.
Onsite Resting and Sanitary Arrangements	The contractor should identify a toilet that the works can access within 5 mins from the project. This could be via renting a toilet from a nearby utility area / office building / house, installing portable toilets or by making back and forth transport readily available to the accommodation building	P: Contractor	Cost associated with site mobilization and site set-up
5. Economic			
Benefit to local economy	Ensure that construction materials are purchased from the island as much as possible. Preference shall be given to hire local construction workers from the island and the atoll or region.	P: Contractor	Cost associated with material purchase

<i>Management of Impacts during Operational Phase</i>			
1. Physical / Chemical			
Waste processing and storage.	Waste collection vehicles and transfer vessels must be secured from all sides to prevent spillage.	P: Island Council/ IWRMC Manger	Cost associated with IWRMC operation
Litter, odor and vector nuisance.	Provide composting training to all laborers and management staff of the facility.	P: ME S: MCEP	Cost of providing compost training
	Control of the incoming waste stream is necessary to ensure safe and effective processing, treatment, and disposal of the Waste and the quality of end products (e.g., quality compost). • Visually evaluate, weigh, and document incoming waste loads; • Conduct visual inspection of the incoming waste, along with sorting and removal procedures, can minimize this potential hazard; • Reject or, if the facility is equipped to process the waste, segregate potentially hazardous materials or wastes identified, including infectious waste, and manage as a hazardous or infectious waste, as applicable; • Analyze suspected hazardous materials before acceptance so that they are segregated relative to compatibility and so that they can be adequately treated and disposed of; • Separate recoverable secondary materials for recycling and organic waste for composting to the extent practical. • Waste that cannot be managed at island level must be processed (chipped, crushed or compacted) and stored in containers or jumbo bags and kept in the respective bays within the IWRMC for transportation to K. Thilafushi . • The jumbo bags and/or containers must be appropriately labeled to indicate the type of waste they contain. Maintain log records of all outgoing waste either in terms of weight or volume of jumbo bags and/or containers. The log sheets must be provided to the regional collection supervise or vessel caption.	P: Island Council / IWRMC Manager	Cost associated with purchasing jumbo bags and/or containers

Hazardous Waste Management and Transportation	Do not accept medical hazardous waste as it has to be managed by the island health center and incinerated separately. Types of hazardous waste managed at the health center mainly include needles, syringes, expired medicine and contaminated materials (cloth/gauze/disposable gloves). Other types of hazardous wastes generated within the households including small batteries, solvents, paints, used oils, pharmaceuticals and old lights which use mercury shall be managed at the IWRMC. Incoming hazardous waste to the IWRMC should be stored in the hazardous waste storage room and regularly transported to K. Thilafushi. The following measures must be taken during transportation of hazardous waste: • Use containers appropriate for the wastes they are intended to carry; • If drums or other containers are used to transport waste, containers should be in good condition and compatible with the waste and are adequately secured in the transport vehicle; • Adequately label all transport tanks and containers to identify the contents, hazards, and actions required in various emergency situations.  Tampons and nappies, while indicated as hazardous wastes in the ESMP, are biodegradable and can be composted. The high temperature of the composting process has been documented to eradicate any harmful pathogens containing potential biohazards.	P: Island Council /IWRMC Manager	Cost associated with purchasing containers designed to store hazardous waste and printing of labels.
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Marine Water Pollution and associated impacts to marine organisms due to potential spillage of waste to the sea during transfer of waste from the IWRMC to the K. Thilafushi (loading and unloading)	- The IWRMC operators and the island council should ensure implementation of the following measures prior to regional transfer: - All outgoing waste from the IWRMC shall be stored in bins or jumbo bags and properly labeled to indicate the type of waste. Below are some examples of the signages that can be used to label bins and jumbo bags:  - Maintain log records of all outgoing waste from the IWRMC either in terms of weight or volume of jumbo bags and bins and provide to WAMCO during regional collection.	P: Island Council /IWRMC Operators	Cost associated with printing the labels.
		P: Designated RWMF operator / regional waste collector	

	• WAMCO should make sure that the following measures are implemented during loading and unloading of waste into the collection vessel (landing craft) • Provide jumbo bags or bins required for regional collection to the councils. • Prepare a collection manual that gives instructions related to storage of waste for regional collection and share with the councils. The manual should clearly specify the types of waste that are accepted and not accepted for regional collection, categories to which waste has to be sorted and packaged by the councils (plastics, glass, nappies, metals, hazardous etc.) and any special requirements for packaging waste such as hazardous waste (sealed containers, proper signage etc.). • Prepare a schedule for regional collection and share with the respective councils. In addition to this, it is recommended to inform the exact date of regional collection to the respective council 3 days prior to arrival of the transfer vessel (landing craft). • Properly label the jumbo bags or bins to reflect the type of waste (if this has not been done by the councils). • Record data of all loaded waste in terms of weight or jumbo bags and bins (volume of the bags and bins must be specified). • Waste must not be kept in the open in any circumstance during transfer. • Hazardous waste (such as batteries, paint, thinner, fiber glass etc.) should be kept in the landing craft in sealed containers. The containers should be properly labeled with appropriate signs (for example hazardous, flammable, toxic etc.). Hazardous waste should be kept away from flammable waste such as wood, plastic and paper. • All waste loaded to the transfer vessel should be covered from the top to minimize potential for spillage during transport. • The height of loaded waste should not exceed the height of sides of the landing craft. In circumstances where excessive waste is absolutely necessary to be loaded, the sides should be lifted to meet this	P: Designated RWMF operator / regional waste collector P: Designated RWMF operator / regional waste collector Manager/Supervisor at K. Thilafushi P: Collection Supervisor P: Collection Supervisor P: Collection Supervisor P: Collection Supervisor P: Collection Supervisor	
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	requirement. - Log records of all unloaded waste (incoming waste to the K. Thilafushi) should be recorded either in terms of unloaded weight or volume of bins and jumbo bags for different categories of waste. - Maintaining log records of loaded and unloaded waste quantities are critical and compulsory as it can indicate the amount of waste lost to the sea during transfer (if any). - Give proper instructions and training to the staffs involved in regional collection - Loading shall be undertaken under the direct supervision of a qualified responsible staff. This staff or supervisor will monitor all activities related to regional collection and transfer and ensure that environmental compliance is achieved. - The waste transfer vessel must be equipped with firefighting equipment and smoke detectors. - The waste transfer vessel should be equipped with navigational safety equipment such as life vests. - The landing craft should be accompanied by a whaler to be used for accessing islands that do not have harbors.	P: Designated RWMF operator / regional waste collector /Supervisor at K. Thilafushi P: Designated RWMF operator / regional waste collector /Supervisor at K. Thilafushi P: Designated RWMF operator / regional waste collector P: Designated RWMF operator / regional waste collector P: Designated RWMF operator / regional waste collector P: Designated RWMF operator / regional waste collector P: Designated RWMF operator / regional waste collector	Cost of purchasing safety equipment Cost of purchasing whaler
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Noise pollution during waste management	- Depending on availability, battery operated vehicles can be used to provide collection services. - Waste handling works involving operation of machinery shall be undertaken during day time.	P: Island Council S: MCEP (for vehicle	Cost associated with purchasing collection vehicles
Air emissions from MSW collection and transport	- Emissions from on-road vehicles shall be regulated through national and regional programs; - All waste transport vehicles must have up to date road worthiness licenses. - Optimize waste collection routes to minimize distance traveled and overall fuel use and emissions - Drivers shall be instructed on the benefits of driving practices which reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits. - When the IWRMC and RWMF becomes operational no open burning shall be practiced.	P: Island Council S: EPA	Cost of training drivers
2. Social and Cultural			
Health and Safety of waste handling staffs	Provide workers with appropriate protective clothing, gloves, respiratory face masks and slip-resistant shoes for waste transport workers and hard-soled safety shoes for all workers to avoid puncture wounds to the feet. For workers near loud equipment, include noise protection such as ear muffs. For workers near heavy mobile equipment, buckets, cranes, and at the discharge location for collection trucks, include provision of hard hats; Establish engineering and materials norms for special facility and stationary equipment design requirements that minimize exposure to hazards (e.g., ventilation, air conditioning, enclosed conveyor belts, low loading and sorting heights, non-skid flooring, safety rails on stairs and walkways, spill protection and containment, noise control, dust suppression, gas alarm systems, fire alarm and control systems, and evacuation facilities).	P: Island Council	Cost of purchasing safety materials

Fire hazard	Burning of waste at the IWRMC should never be practiced under any circumstances. Naked flames shall not be allowed at the IWRMC. Ensure that waste management staffs are briefed of fire hazard management. Firefighting equipment, including clear aisles among windrows and access to an adequate water supply shall be made available with access to pumps. Smoking should be prohibited inside the premise of the IWRMC, placing awareness signs in the premise. Highly flammable areas such as those area allocated for the storage of paper, wood and cardboards, should be clearly marked with appropriate sign boards indicating the flammable nature of the waste. Installation of cameras, fire alarm system and hiring of security guard for 24hrs surveillance. Fire safety training on how to use the installed equipment and act in case of an emergency fire should be provided to the security guard and all the waste management staffs of the IWRMC	P: Island Council S: MCEP (for sign boards)	Cost of purchasing equipment Cost of printing and placing sign boards included with the overall project budget. Cost of purchasing cameras, alarms. MVR 10,000.00 Salary of security guard (approximately MVR 4000.00 per month)
Sociocultural conflict	Ensure that waste handling staffs are selected from the local community as much as possible. If expatriate workers are used ensure that they respect the local culture. Conduct a training to sensitize the labor to the local context and customs. This training should also cover topics related to Gender-based violence. Develop a “Code of Conduct” outlining the set of rules that that the workers have to follow to persevere the social norms and religious values of the society. The Code of Conduct should also specify penalties for breaching these rules and should be thoroughly communicated to workers prior to mobilization.	P: Island Council	Cost associated with hiring staffs
3. Economic			
Collection Fee	Ensure that the collection fees are feasible for the community. Undertake consultation meetings with stakeholders and set a suitable collection fee acceptable to the community.	P: Island Council	Cost associated with conducting stakeholder sessions

Employment Opportunities	Ensure that waste handling staffs are selected from the local community as much as possible.	P: Island Council	Cost associated with hiring staffs
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7.2 The cost of mitigation measures

The following **Table 26** and **Table 27** indicates the cost for implementation of the proposed mitigation measures.

Table 26: Cost estimate for implementation of the proposed mitigation measures (Construction Phase)

#	Item	Responsibility	Cost Estimate (MVR)
1	PPEs required for construction such as hard hats, gloves, safety shoes and safety harness.	Contractor	10,000.00
2	PPEs to mitigate COVID19 such as face masks, antibacterial soap, hand sanitizers, disinfectant cleaning liquid (bleach) and printing of awareness materials etc.	Contractor	5,000.00
3	Portable fire extinguisher for site	Contractor	2,000.00
4	Firefighting Equipment for the IWRMC (item included in BOQ): • 50KG DCP Trolley (nos 2) • 50LTR Foam Trolley (nos 1) • Wet Chemical 6Ltr with Cabinet for hazardous waste area (nos 1) • Water 9Ltr with Cabinet for Office Area – Outside (nos 1) • CO2 2KG with Cabinet for Office Area – Outside (nos 1)	Contractor	35,000.00
5	Project board and Construction Safety sign board	Contractor	3,000.00
6	IWRMC name board, cell labels and fire safety sign boards	Contractor	5,000.00
7	Bin for placing general waste	Contractor	1000.00
8	Site demarcation through hoarding	Contractor	1000.00
	Subtotal		62,000.00
	Contingency	10% of Sub-Total	6,200.00
	Total		68,200.00

Table 27: Cost Estimate for implementation of mitigation measures including trainings during operational phase

#	Item	Responsibility	Cost Estimate (MVR)
1	PPEs required for operations such as gloves, safety shoes and masks.	Island Council	10,000.00
2	Fire safety Training	Island Council	10,000.00
4	Yearly servicing of the firefighting equipment	Island Council	5,000.00
5	Community Mobilization and Awareness and other trainings (Gender, Composting etc)	MCEP	100,000.00
	Subtotal		125,000.00
	Contingency	10% of Sub-Total	12,500.00
	Total		137,500.00

CHAPTER EIGHT: TRAINING FOR ESMP IMPLEMENTATION

Training is essential for ensuring that the ESMP provisions are implemented efficiently and effectively. MCEP shall therefore ensure that all persons that have roles to play in the implementation of the ESMP are competent with appropriate education, training or experience. Similarly, the contractors shall be required to undertake general HSE awareness for their project workforce and specific training for those whose work may significantly have impact on the environment. The Island Council in collaboration with the MCEP shall also devise and execute training programs targeted for staffs of IWRMC to facilitate effective and sound management of waste during household collection and operations of the center. Furthermore, MCEP and the Island Council shall conduct community mobilization and public awareness programs to enhance knowledge of the community on good waste management practices and to promote implementation of 3R concept.

The following **Table 28** provided the recommended trainings for EMSP implementation.

Table 28: Proposed training recommendations for ESMP implementation

Training Activity	Anticipated Participants	Type of training and main content	Responsibility	Scheduling	Cost Estimate
Strengthening capacity of contractor on reporting and implementation of ESMP	Managing Director and Site Supervisor of Contractor	Meeting Reporting Template	Safeguards Specialist of MCEP	Pre-bid meeting Kick-off meeting	N/A
Strengthening PMU's capacity on compliance monitoring	Assistant Project Coordinators	Safeguards Specialist of MCEP	Safeguards Specialist of MCEP	Construction Phase	N/A
General Awareness Health, Safety and Environment (HSE)	Worker on Site	HSE Introduction / Orientation (site safety rules, PPE, Emergency response etc.) Daily tool box talk for workers at the start of each day's job.	Site Supervisor of Contractor	Preconstruction phase. Construction phase	N/A
Community Mobilization	Waste Management	Introduction to	Communications Specialist of	Preconstruction phase.	Travel cost of facilitators.

	Committee (WMC) Women Development Committee (WDC)	Waste Management Policy Introduction to Waste Management Regulation Roles of WMC Household waste segregation Door to Door campaign	MCEP		Designing and printing of training materials and flyers to be used for door to door campaign Development of audio-visual aids and documentary for training
Compost Training (Training on the composting processing using the compost machine, including its operations, maintenance and servicing)	IWRMC staffs	Introduction to compost preparation using organic waste Step by step guidance using OWC machine for composting	Zone-4 Project Coordinator of MCEP Project Management Unit Waste Management and Pollution Control Department of Ministry of Environment	Prior to commencement of operations	Travel cost of trainer .

			Island Council Communications Specialist of MCEP		
Fire safety training and drills	IWRMC staffs Nearby Residents of IWRMC	Introduction to Fire safety Hands on training of the equipment installed at IWRMC Details of safety procedures and evacuation plan during a fire	Maldives National Defense Force (MNDF) Fire and Rescue Island Council through retired firefighter	Prior to commencement of operations	Cost associated with training hall and refreshments Travel cost of trainer
Women Leadership in SWM training	Women Development Committee (WDC)	Enhancing women's participation in Solid Waste Management (SWM)	Zone-4 Project Coordinator of MCEP Project Management Unit	Zone-4 Project Coordinator of MCEP Project Management Unit	Travelling cost of trainers

CHATER NINE: PROJECT ALTERNATIVES

This section of the report contains the alternative means for the project in terms of Alternative technology options for the treatment of organic waste may include manual composting and anerobic digestion systems. Furthermore, the no project option was also explored in this section.

9.1 No Development Option

In the case of no project option, all foreseeable negative impacts as a result of the construction and operation of the IWRMC can be avoided. However, no project option would also mean continuation of the current state of waste management in the island. The people would continue to engage in unsustainable waste management practices. The island would not have an approved demarcated waste management area, waste would continue to be burned in open areas, and kitchen waste would continue to be dumped on beaches, lagoons and reefs. Allowing existing practices to continue would also mean no resource recovery and ultimately all resources getting lost in the “waste”. Allowing open dumping waste with no management would also mean increasing risks to human health, lowering aesthetic qualities and lowered quality of life. The aspiration of the people to move in the path of sustainable development would also be compromised. The positive effects of proceeding with the project far outweighs negative impacts associated with the project which can be managed and kept at an acceptable level. Hence, no development option of the project is rejected. **Table 29** below shows comparison of no development option with the development option at Th. Thimarafushi.

Table 29: Comparison of the no development option with development option

Option	Environmental	Social	Economic
No Project Alternative	All negative impacts associated with project avoided, however, the island environment may continue to slowly deteriorate due to pollution as a result of inadequate waste management. Land area will be rendered unusable or will be polluted by the residual waste remaining after burning and burying waste. Seepage of leachate into groundwater film as a result of burying waste in excavated pits. Risk of waste piles sliding as a result of heavy rain or flooding events. Increased pollution of beaches, lowered aesthetic values, pollution of the lagoon and coral reef.	Benefit to the society by the project will be missed and chances of polluting the island is high which could lead to health implications as well as visual negative impacts. Risk of waste coming into direct contact with children. Without a proper waste management system there is a risk of the island turning into a slum as a result of population increase and economic development.	No significant improvement to the local and regional economy. Jobs and income earning opportunities expected as a result of the project will not realize.

Project Alternative			
	The project will result in loss of alternative land use potential for the proposed site All impacts due to construction can be managed and maintained at acceptable level. The project will control and prevent further pollution of the environment, and thereby promote sustainable development of the island.	Increased direct and indirect employment opportunities for the locals during the construction phase in addition to when the IWRMC and waste management system becomes operational. Knowledge transfer and development of technical capacity with regard to waste management and compost making. More resources and manpower to manage the island would become available as a result of the project. The aesthetic qualities of the island would improve and thereby promote healthy and more enjoyable life on the island. During the operational phase of the project, smell, dust and particulate matter especially from composting activities may be emitted from the IWRMC. However due to the isolated nature of the site to the populated area of the island such impacts are not expected to be significant.	Enhanced opportunity for locals to start and diversify tourism related services, since a safe and clean island would facilitate attracting visitors to island. Creation of job opportunities and development of skills. Potential to get income by selling compost etc. which would develop the island's economy.

9.2 Alternative technology options for the treatment of organic waste

9.2.1 Manual Compositing (Windrow Based System)

This type of Composting technology uses the process of the slow decomposition of the organic matter by various microorganisms, in an optimised and controlled process. The process is controlled in terms of parameters such as input materials, temperature, moisture and pH. The finished product of composting can be sold as fertilizer, thus enabling the reuse of the waste collected within the island.

The main constituents of a compost heap include kitchen and garden waste, along with water and air in the pore spaces between the constituent.

9.2.1.1 The Composting Process of Manual Composting

After the incoming waste is properly sorted into compostable wastes and other wastes, mixing of the compostable waste is done. This mixing is done to provide an optimum Carbon-Nitrogen ratio for the process to occur. Prior to mixing, if the waste contains branches, twigs and such, they are fed into a wood chipper to reduce their size. After the mixing is completed, composting process begins on the composting slab as an open windrow compost. After the compost matures, screening is done depending on the particle size of the compost required. This compost is bagged and stored. These steps will be elaborated below.

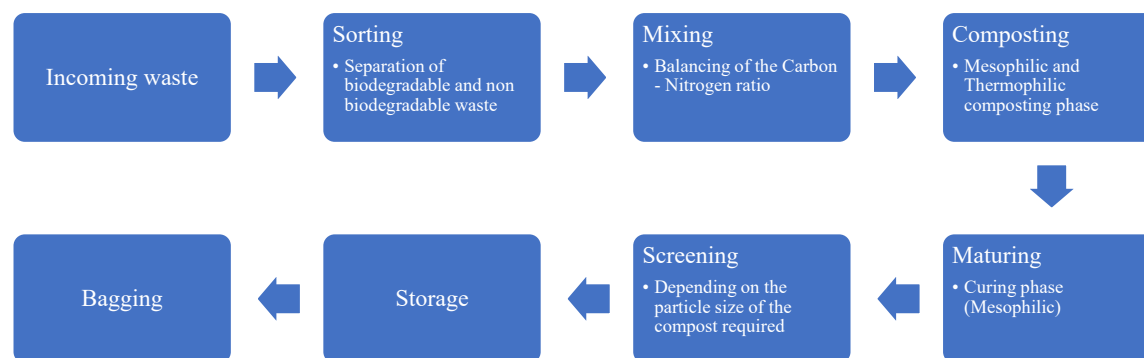


Figure 15: The composting process (adapted from Saleem 2018)

Mixing (Carbon – Nitrogen Ratio)

One of the most important factors in the process of composting being successful is the Carbon – Nitrogen ratio. Carbon is used for energy by the microbes in order to continue with the decomposition, while Nitrogen is needed by the microbes to grow and multiply. The optimum Carbon – Nitrogen ratio is 25 - 30:1 (DEC NSW, 2004). If the ratio is less than 30:1, it would result in the loss of Nitrogen as ammonia gas

which would result in undesirable odours. If the ratio is greater than 30:1, it results in the cooling of the compost and slow degradation of the pile.

Composting and Maturing

Thermophilic composting is the process of composting using thermophilic (heat-loving) bacteria. Thermophilic composting consists of three phases;

Table 30: The phases of composting

Stage	Temperature	Duration	Organisms
Mesophilic	Moderate, up to 40 °C	2 days	Initial decomposition is done by mesophilic organisms that thrive at moderate temperatures
Thermophilic	High, over 40 °C	Few days to several months	Mesophilic organisms become less competitive and replaced by thermophilic heat loving microbes. High temperatures break down proteins, fats, and complex carbs like cellulose and hemicellulose (major structural molecules in plants)
Mesophilic (curing or maturation phase)	Moderate, up to 40 °C	Several months	As the compounds decrease, compost temperature gradually decreases and mesophilic organisms take over again for the final curing of the remaining organic matter.

As seen from the **Table 30**, the composting process can prolong to several months.

9.2.1.2 Proposed Mitigation Measures

The following **Table 31** enlist the proposed mitigation measures for the envisaged impacts of the manual composting.

Table 31: The proposed mitigation measures for the manual composting

Envisaged Impact	Proposed Mitigation Measures
Impacts on health and safety	• handling of compost will be minimized; • compost turning will be done based on temperatures and not on schedules; • compost turning will be done using windrow turning equipment; • adding moisture to the compost to minimize dust; • placing a geo-fabric cover over the compost windrow to minimize release of bio aerosols; and • workers will wear appropriate safety clothing, follow the workplace safety mechanisms and guidelines set by the contractor and practice safety and personal hygiene when handling the compost.
Impacts on groundwater	• The composting area has a dedicated composting slab made of reinforced concrete, along with an HDPE lining between the

	soffit of the slab and the ground. Concrete is an inert and highly impermeable material, and with the combination of HPDE lining, the possibility of leachate leaking directly from the compost slab is low; • The composting slab is designed to have a slope towards the centre from both sides, which will propagate any leachate produced towards the 100 mm PVC pipe, which in turn drains into the leachate collection tank; • Regular turning of the compost pile can help minimise the quantity of leachate produced; and • The leachate collected shall be reused to provide moisture to the compost heaps.
Impacts from Rainfall related leachate production	• A valve is placed at the inlet pipe which can be closed in instances where the leachate tank may overflow from heavy rainfall onto the compost slab; • Compost slab is raised through design, to avoid any ingress of water which may otherwise be possible from puddles and possible inundating due to heavy rain; and • Windrow cover shall be used to mitigate the impacts from rainfall. The cover shall be made of geofabric and allow for the air circulation while protecting the compost. The advantages of the cover include moisture control, which reduces leaching and nutrient loss, as well as reducing water loss from the sun and wind. In order to keep the cover in place during strong winds, weights attached to ropes shall be placed on top of the cover at regular intervals.
Odor Impacts	• Covering of rapidly biodegradable organics. Rapidly biodegradable organics include grass clippings, food and animal organics and organic sludges. The exposure of such organics to the atmosphere should be kept at a minimum. In open air composting such as the proposed technique for the IWMC, piles of compost can be covered by a 15 cm thick layer of fresh compost in the curing stage. The microbes present in this layer of compost help reduce the odour of the compost pile underneath; • Keep the moisture levels of the compost pile optimum, which promotes free airspace and results in aerobic respiration; • Avoid uncontrolled emissions of biogas from the compost pile by keeping the pile well aerated; • Keep the carbon – nitrogen ratio at an optimum level (this is achieved at the mixing stage) to decrease the amount of ammonia produced; and • Keep records of complaints about odours, and correlate with weather conditions and categories of organics used.

9.2.2 Anaerobic Digestion System

The anaerobic digestion system described in this section is Plug Flow Reactor (PFR).

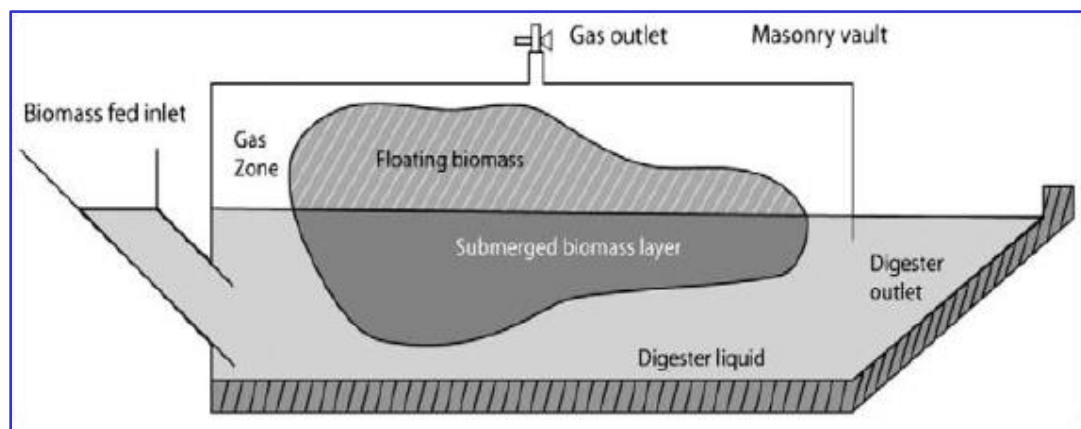


Figure 16: Design of Plug flow type biogas plant

The Plug Flow Reactor (PFR), as shown in the **Figure 16**, is a sealed tank that can be constructed from either:

- Fibre Reinforced Plastic (FRP) – with a 20-year life expectancy and guarantee
- Stainless steel – with a 15-year life expectancy and guarantee; or
- Masonry – with a potential 25-year life.

9.Composting process for anerobic digestion

Having been filled with the required quantity of water, the bacterial inoculum is added and the activation is allowed to complete. Waste can then be added through the inlet. The plant can accept food waste and green waste. If the waste is predominantly food waste, up to 20% green waste can be added. It should be noted that this does not work in reverse. If the waste stream is mainly green waste, food waste cannot be added so the plant becomes suitable only for 100 % green waste. Also, because of the bacterial sensitivity, over-feeding of waste can stop the reaction. Thereafter, the unit will need to be re-set, including being cleaned out and a fresh supply of water and bacterial inoculum added, with 30 days to re-activate the process. It is claimed the system can cope with 15 - 20% non-segregated waste contaminated with glass, plastic and metal (although, it is accepted that metal can destroy the bacteria).

The system relies on the majority of waste floating within the digester liquid, allowing the bacterial decomposition reaction, thereby liberating the biogas. The system maintains a pH of 6.8 to ensure decomposition. In BIOEN's Bio-methanation technology one ton of bio-waste is reduced to less than 100kg in a 30-day retention time. Biogas production is claimed at up 60m³/Tonne Per Day (TPD), depending on the particular waste stream.

The agro-residues and leafy material containing lignin does not get digested completely and comes out of the digester at the end of 30-day retention time. This material can be removed out of the digester and dried to obtain compost of high nutrient value. From 1TPD of biodegradable waste fed into a biogas plant around 30-40kg of wet compost (6-10kg dry) compost can be achieved. The wet compost has to be extracted from the vessel with the digester liquid and then requires secondary processing under aerobic conditions.

The digester liquid is also high in nutrients and can be used as fertilizer. The process assumes that the moisture content of the raw waste feed is sufficient to maintain the liquid level in the reactor vessel, thereby allowing digester liquid to be drawn-off for use as a liquid fertiliser.

The biogas produced can be used directly for cooking or can be converted to electricity. Using our highly efficient IR biogas stoves along with a biogas compressor (2-5Kg/cm²) the biogas can be efficiently used as a substitute for LPG. The excess biogas produced can also be converted to electricity through a biogas generator. For each m³ of biogas generated 1-1.5kW of electricity can be generated.

It should be noted that not all food waste – eg: bones, egg shells – decompose in the reactor but sink to the bottom and remain there. This necessitates shutting down the system at 3 – 4-year intervals to clean out the reactor and refresh the system, followed by 30-day re-activation.

The reactor has limited flexibility. It can operate at below its rated capacity without damaging the process, but outputs will be reduced, correspondingly. It cannot operate above its rated capacity. At the point at which a small increase in throughput is required, an additional reactor will be required.

9.2.2.1 Proposed Mitigation Measures

The following **Table 32** enlist the proposed mitigation measures for the envisaged impacts of the anaerobic digestion systems.

Table 32: Mitigation measures for Anaerobic Digestion

Envisaged Impact	Proposed Mitigation Measures
Leachate and Runoff	• Maximize recycling of wastewater to the reactor; • Operate an anaerobic digester under thermophilic digestion conditions, in order to increase the pathogen destruction, biogas production rate (hence higher energy recovery) and the retention time.
Fire Safety	• Collect biogas for use or treatment (e.g. energy recovery or flaring); • Provide a fire alarm system, including temperature sensors in the waste being treated; • Design the facility for access by firefighting equipment, including clear aisles among windrows and access to an adequate water supply.

9.2.3 Comparison of alternative technologies

The following **Table 33** provide a comparison between the manual composting, anaerobic digestion system and aerobic OWC technology.

Table 33: Comparison between different technologies for composting of organic waste

Technology for Composting	Advantages	Disadvantages
Aerobic OWC Technology (In vessel Composting)	• Simple and convenient to operate without the need for constant attention; • Short processing times ensures economic in use with low energy consumption; • Requires minimal maintenance;	• Require a significant proportion of organic absorbents such as saw dust or dried leaves. • Requires activation inoculum (bioculum)
Manual Composting	• Does not require any activation inoculum. • Low capital cost	• Require large space for windrow systems; • Composting curing process is very slow require approximately 4 months. • Piles need to be turned frequently every 5 days, which makes it extremely labor intensive. • The issue of odor, flies and rodents will exist. • High processing time means low changes to generate sufficient income from it. • Generate leachate especially during rainy weather.
Anaerobic Digestion System	• Digester liquid can be utilized as fertilizers • Bio-gas produced can be utilized as a LPG replacement	• High capital cost • Require constant maintenance

		• Not all types of organic waste can be utilized for composting
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9.2.4 Justification for the proposed technology

The proposed composting technology of aerobic OWC technology is the most appropriate composting technology for IWRMC in Th. Thimarafushi. The technology is simple and convenient and require short processing time so that more compost can be produced and made available for the farming and gardening process in the island.

The Manual Composting requires a large space (including for compost drying) which can be utilized for other waste management activities such as sorting of waste transferred to IWRMC and placement of other waste management equipment. Furthermore, windrow system process is extremely slow which take approximately 4 months for compost maturing.

The anaerobic technology requires significant capital cost and requires constant maintenance. Furthermore, some types of the organic waste cannot be utilized for the composting process.

CHAPTER TEN: MONITORING AND REPORTING

This section of the report will provide the institutional arrangement for safeguards monitoring, monitoring regime, reporting procedures, implementation schedule, contractual measures and grievance redress mechanism (GRM).

10.1 Institutional Arrangements for Safeguards Monitoring

The following **Figure 17** illustrates the proposed institutional arrangement for the safeguards monitoring including ESMP implementation. The **Table 34** identifies different roles and responsibilities of the different parties involved in safeguards monitoring.

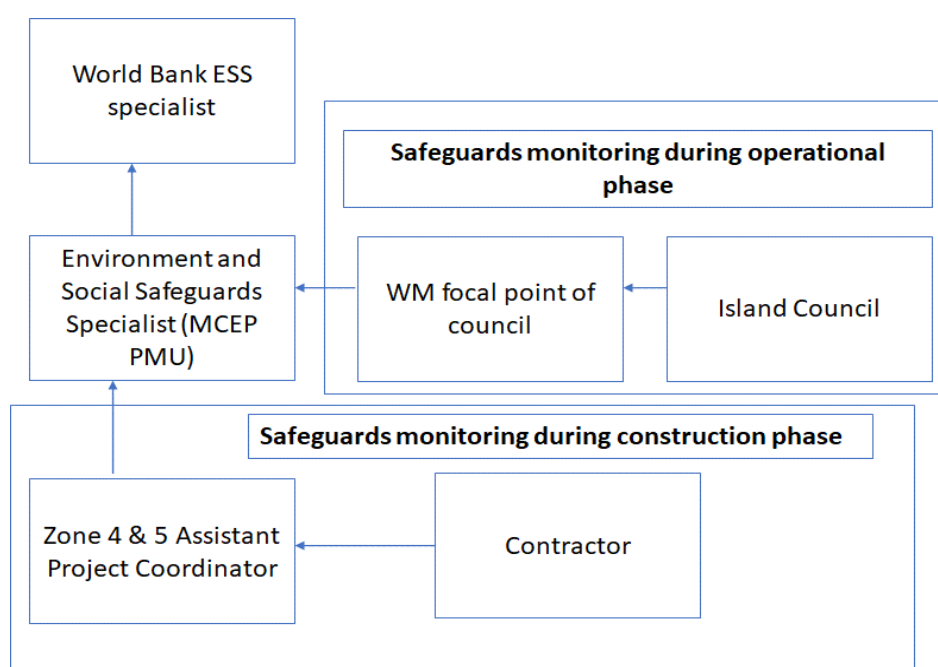


Figure 17: Institutional arrangement for safeguards monitoring

Table 34: Key roles and responsibilities for safeguards monitoring

Entity	Key Roles and Responsibilities
World Bank ESS specialists	1. Guide the ESS specialist of MCEP PMU on safeguard monitoring; 2. Ensure the quality of the monitoring reports 3. Approve the ESMP and monitoring reports.
ESS specialist – MCEP PMU	1. Implementation of Tier 2 of proposed GRM 2. Ensure compliance of the contractor for the proposed ESMP.

	3. Ensure the quality of the monitoring reports submitted by Zone 4 & 5 assistant project coordinator and contract. 4. Train Zone 4 & 5 APC and WM focal point of council and island council on monitoring of safeguards 5. Provide reporting template for the interim and operational phase monitoring reports. 6. Prepare Final monitoring report including all monitoring activities throughout project implementation.
Zone 4 & 5 Assistant Project Coordinator (APC) of MCEP PMU	1. Prepare two interim monitoring report. 2. Verification of accuracy of the monthly progress reports submitted by the contractors.
WM focal point of island council	1. Operational phase monitoring report including activities implemented during operations of the IWRMC.
Contractor	1. Implementation of ESMP prescribed in this report 2. Monthly monitoring progress reports (3 to 6) prepared consistent to the template provide by the ESS Specialist of MCEP
Island Council	1. Assist WM focal point to prepare operational phase monitoring report including activities implemented during operations of the IWRMC. 2. Implementation of Tier 1 of GRM

10.1 Prescribed Monitoring Regime

The inclusion of a monitoring plan in the ESMP is essential to assess the effect of the project on natural and cultural environment. It is a tool used to measure the accuracy of predictions and to determine whether the proposed mitigation measures have been effectively carried out by the proponent as recommended in the ESMP. Another important aspect of environmental monitoring is its capacity to determine unforeseen impacts that have not been predicted during the impact identification stage. It should be noted that adopting of mitigation measures do not guarantee unforeseen impacts.

The main key objectives of the environmental and social monitoring plan are to:

1. determine whether the proposed mitigation measures in this management plan are followed during the construction phase of the project.
2. analyse the effectiveness of the operation of IWRMC in terms of spillage prevention and overall

cleanliness of the island.

The monitoring plan for the ESMP is presented in **Table 35**. Monitoring results shall be documented with preventive/corrective actions to be implemented.

Table 35: Proposed Monitoring Programme for Establishment of IWRMC in Th. Thimarafushi

Aspect	Parameter	Frequency	Responsible Party	Cost of Monitoring (MVR)
Construction Phase				
Implementation of mitigation measures during construction	Records of successful implementation of mitigation measures	Monthly during construction period	Contractor MCEP	18,000 cost of traveling to the island
Groundwater Quality	Visual observations and perceptions of nearby residents. Salinity, smell, color of water of the groundwater well within the IWRMC	Once during mobilization prior to construction and once after completion of the project	Contractor MCEP	9,000 Cost of traveling to the island
Grievance	Log records of number of complaints received and actions taken during construction phase	Throughout construction phase	Island Council MCEP	9000
Operational Phase				
Implementation of mitigation measures during operations of the IWRMCs	Records of successful implementation of mitigation measures.	6 months after commencement of operations	Island Council / IWRMC Operator	Included in the operational cost

Spillage Assessment	Waste Collection Arrangements	Once when the project is completed and one year after project completion	Island Council / IWRMC Operator	Included in Operational Cost
	Littering around the island (Beach, harbor area and other public areas)			
	Spillage during transfer to IWRMC			
	Any Spillage within the IWRMC			
	Proper use of IWRMC			
	Spillage during transfer to regional waste facility		WAMCO	
Groundwater Quality	Visual observations and perceptions of nearby residents. Salinity, smell, color of water of the groundwater well within the IWRMC.	6 months after commencement of operations	Island Council, IWRMC Operator	Included in Operational Cost
Grievance	Log records of number of complaints received and actions taken during operational phase	Throughout the operational phase	Island Council	Included in Operational Cost

10.2 Reporting Procedures

The reporting procedures presented in **Table 36** have been developed in order to ensure that the proponent is able to receive feedback from the implementation of the ESMP on an ongoing basis and to take rapid corrective actions if there are issues of non-conformance.

Table 36: Proposed reporting arrangement for monitoring of safeguards during construction and operational phase of IWRMC in Th. Thimarafushi

Phase	Prepared By	Approved By	Deliverable	Accountability
Construction	Contractor	Zone 4 & 5 Assistant Project Coordinators ESS Specialist – MCEP PMU	Monthly monitoring progress reports (3 to 6) prepared consistent to the template provide by the ESS Specialist of MCEP. These reports should indicate the level of implementation of mitigation measures and must be accompanied	Contractor. To be attached with interim payment claims made by the contractor. Payments to be released subject to timely submission of the monitoring reports.
	Zone 4 & 5 Assistant Project Coordinators	ESS Specialist – MCEP PMU	Two (2) interim reports prepared consistent to the template provide by the ESS Specialist of MCEP. Verification of accuracy of the monthly progress reports submitted by the contractors.	MCEP PMU APC should submit report to ESS Specialist for review and verification.
Completion of Construction and demobilization of contractor from site	ESS Specialist – MCEP PMU	World Bank ESS specialists Submitted to EPA for their perusal	Final monitoring report including all monitoring activities throughout project implementation.	MCEP PMU. Report to be submitted to the World Bank and EPA.
6 months after commencement of operations	WM focal point of council	Island Council ESS Specialist – MCEP PMU Submitted to EPA for their perusal	Operational phase monitoring report including activities implemented during operations of the IWRMC.	Island Council. Report to be submitted to EPA.

10.2 Implementation Schedule

The activities related to environmental management and monitoring have to be integrated in the overall construction schedule. The project construction phase is estimated to be completed in 3 months. The implementation schedule is presented in **Table 37**.

Table 37: Implementation Schedule for Safeguards Monitoring and Reporting

Activity	Responsible Party	Pre-construction phase (Weeks)						Construction phase (Months)			Operational Phase (Months)					
		1	2	3	4	5	6	1	2	3	1	2	3	4	5	6
Clearance and formal disclosure of ESMP	MCEP PMU															
Inclusion of ESMP in bid document	MCEP PMU															
Finalization of Engineering Designs	MCEP PMU															
Inclusion of ESMP in the contract document	MCEP PMU															
Disclosure of GRM in project sites	MCEP PMU/ Island Council															
ESMP briefing to Contractor at kickoff meeting	MCEP PMU															
Contractor's ESMP monitoring reports	Contractor															
Compliance check / Interim monitoring reports (3 nos)	MCEP PMU															
Preparation and submission of consolidated monitoring report	MCEP PMU															
Preparation and submission of operational phase ESMP report	Island Council															

10.3 Contractual Measures

Implementing the mitigation measures are an obligation of the contractor during the construction phase of the project. The EPA and World Bank approved ESMP should form part of the contract and the mitigation matrix shall be extracted from the ESMP and reflected as an appendix to the contract. In addition to this, the following clauses should be incorporated in to the contract document of the selected contractor as condition of the contract to ensure effective, timely and stringent implementation of the ESMP.

1. Retention payment will be released after defects are rectified and compensating for any significant environmental and social safeguards violations.
2. Payment claims made by the Contractor should be accompanied by progress reports that reflect works completed and Environmental and Social mitigation measures implemented. Payments will only be released after verifying the authenticity of these reports.
3. The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract. Fundamental breaches of Contract shall include, but shall not be limited to, the following:
 - If the Contractor fails to implement the mitigation measures proposed in the ESMP of the project.
 - If the Contractor fails to submit staff list and valid work permits of the expatriate staffs within 10 days of signing the agreement.

10.4 Grievance Redress Mechanism (GRM)

Based on the ESAMF, MCEP has formulated a Grievance Redress Mechanism (GRM). GRM is established to receive and facilitate grievances of the affected persons during the implementation of the project.

Island Councils were consulted on the progress regarding setting of focal points and availability of the GRM forms at the Council. Thimarafushi Council stated that the Council would make the forms available physically at its office as well as publicly displayed. The Council has nominated a waste management focal point for this purpose. (Ahmed Ali - 7947969) The Council does not have a website, although work is underway on creating a Facebook page, in which a link to the GRM forms will also be provided.

Following are the details of the GRM developed by the MCEP. GRM at tier 2 will be managed by the ESS Officer of MCEP. Tier 2 GRM forms will be made accessible from the respective council office and MEE front office and is published in MEE website. Below are the links.

English page:

<http://www.environment.gov.mv/v2/en/download/7189>

Dhivehi page:

<http://www.environment.gov.mv/v2/dv/download/7191>

The following **Table 38** provides detail information of the Grievance Redress Mechanism for MCEP.

Table 38: Details of the Grievance Redress Mechanism developed by the MCEP

Tier of Grievance Mechanism	Nodal Person for Contact	Contact Communication and other facilitation by the project	Timeframe to address grievance
First Tier: Island Council	Island Council will be the first point of contact for any grievances. The staff designated as the waste management focal point by the island council will manage grievances on behalf of the council.	GRM should be publicly displayed in the construction site as well as the council office. GRM should also be outlined in official website and/or social media pages of Council, MEE (and/or the project), including contact details of the nodal person in each tier. Grievances can be addressed informally by contacting the council through email / telephone / in person. If the grievance cannot be resolved informally, an aggrieved party must submit a complaint on the Tier I Complaint Form. A copy of the form (with the council seal) should be provided to the aggrieved party as evidence of receipt. Electronic version of the complaint form should be available from the websites and/or social media pages of MEE and the council. Physical copies of the form should be available from the council front office. Council will provide assistance to fill the form for those who cannot write. The council should keep separate registries for informal and formal complaints and maintain records of all complaints received. The council will discuss the matter with the Women's Development Committee and other relevant stakeholders (Farmers, Fishermen, School,	15 working days

		Health Center etc.), where deemed necessary and attain views of them. If such meetings are arranged, the date, time, location or venue, list of participants (with contact details) and a summary of the main outcome of the consultation must be annexed to the written decision issued by the council. If the complaint is resolved within 15 working days, the council must communicate the decision to the aggrieved party in writing. The aggrieved party must acknowledge the receipt of decision and submit their agreement or disagreement with the decision within 10 working days. If no acknowledgement is submitted from the aggrieved party within this period, then the decision will be considered as accepted. If a complaint requires more time to address, this requirement must be communicated to the aggrieved party in writing and the aggrieved party must consent and sign-off the request for the extension to take effect. An extension can be made to an additional 15 working days. The staff designated as the waste management focal point by the island council will manage and provide feedback for grievances submitted to the council.	
Second Tier: Ministry of Environment and Energy (MEE)	Environmental and Social Safeguards officer at the Project Management Unit (PMU) will be the focal point.	If the grievance cannot be resolved through Tier 1 to the satisfaction of the aggrieved party or if the issue is outside the jurisdiction of the council (issues related to RWMF), an aggrieved party may submit a	15 working days

		complaint on the Tier 2 Complaint Form. A copy of the form (with MEE seal) should be provided to the aggrieved party as evidence of receipt. Electronic version of the complaint form should be available from the websites and/or social media pages of MEE and the council. Physical copies of the form should be available from the council and MEE front office. A copy of the Tier 1 Complaint Form should be submitted with the Tier 2 Complaint Form. MEE will forward the grievance to PMU. PMU screens the grievance and determine if its related to MCEP. If it is unrelated, the aggrieved party must be notified in writing and the way forward must be outlined to them including the necessary government institutions to follow up. Environment and Social Safeguards Officer at the PMU will be the contact person in processing a grievance through the Second Tier. PMU will discuss the matter with EPA and other relevant institutions, where deemed necessary and attains views of them. PMU will also arrange site visits and hold onsite discussions and meetings if necessary. The PMU will be responsible to ensure that there is no cost imposed on the aggrieved person, due to the grievance mechanism at the second tier. If the complaint is resolved within 15 working days, the	
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		PMU must communicate the decision to the aggrieved party in writing. The aggrieved party must acknowledge the receipt of decision and submit their agreement or disagreement with the decision within 10 working days. If no acknowledgement is submitted from the aggrieved party, then the decision will be considered as accepted. If a complaint requires more time to address, this requirement must be communicated to the aggrieved party in writing and the aggrieved party must consent and sign-off the request for the extension to take effect. An extension can be made to an additional 15 working days. If the grievance is not resolved to the satisfaction of the aggrieved party within 15 working days of submission of the grievance to tier 2 then the aggrieved party may notify the MEE, in writing, of the intention to move to tier 3.	
Third Tier: Judiciary Power / Assistance to Vulnerable Persons beyond the Project's Grievance Redress Mechanism	Judiciary system is an option for an aggrieved person and/or community in case that the other tiers have not been effective	The legal system is accessible to all aggrieved persons. Assistance from the PMU of MCEP is available only for vulnerable person(s)* as per this grievance mechanism. In cases where vulnerable person(s) are unable to access the legal system, the Attorney General's office will provide legal support to the vulnerable person(s). The PMU must assist the vulnerable person(s) in getting this support from Attorney General's Office. PMU must also ensure that there is no cost imposed on the aggrieved person if the person	As per established Judicial Procedure

		belongs to the vulnerable groups. The list of vulnerable groups is as defined in the footnote but may be further defined by MEE. The verdict of the Courts will be final.	
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*Vulnerable person(s): A vulnerable person(s) for the purpose of this project is a person who is poor, physically or mentally disabled/handicapped, destitute, and disadvantaged for ethnic or social reasons, an orphan, a widow, a person above sixty years of age, or a woman heading a household.

CHAPTER ELEVEN: GENDER ANALYSIS AND GENDER ACTION PLAN

This section of the report will describe the gender analysis and main barriers which may prevent women getting the intended benefits of the proposed project. Due to lack of site-specific data from Th. Thimarafushi, general data for Maldives will be utilized for this gender analysis.

10.1 Gender Analysis and Barrier faced by Women

The prime legislature which is aimed to ensure the gender equality and women's empowerment in the country is Gender Equality Act (2016) which came into force in 2017. The main aim of this legislation is to eliminate discrimination based on sex or gender, including ending violence against women. The Act promoted gender equality in all aspects of public and family life. It also outlined duties and responsibilities on State and private parties, prohibited victimization and introduced remedies for gender-based discrimination. A national gender policy was developed in 2019 which includes five strategic goals; 1) Leadership and Governance; 2) Economic Empowerment, 3) Institutional Gender Mainstreaming 4) Gender Based Violence and 5) Access to Justice (Ministry of Gender, Family and Social Services 2020). The Strategic Action Plan (SAP) 2019-2023 included a "Gender Equality" subsector under the "Good Governance" sector. It recognized that "despite advancements in legal and policy framework including the passage of a domestic violence, a sexual harassment act and gender equality law, administrative, budgetary and human resource constraints restrict the implementation of these laws to achieve gender equality". The policy priorities of the Gender Equality subsector focused on "increasing women's representation in decision-making, minimizing sexual harassment, domestic violence, eliminating barriers for women to participate in economic activity including cultural barriers by promoting shared care work and household responsibilities.

Maldives is a signatory to the Convention on the Elimination of all forms of Discrimination Against Women (CEDAW) which was ratified in 1993. In a Global Ranking on gender gap issues, the Maldives is ranked number 113 out of a total of 149 countries, according to the World Economic Forum's Global Gender Gap Report 2018.

In the Maldives, the labor force participation rate of women was 42.2% when compared with men (75.1%) in 2019 (National Bureau of Statistics 2019). The women's share in wage employment was 39% and majority of the women work as employees (69%) and entrepreneurs (26%). In 2018, the Gender Parity Index (GPI) for found to be 0.93 for pre-primary level enrollment, 0.95 for primary level enrollment, 1.19 for upper secondary level enrollment and 0.89 for lower secondary level enrollment indicating a disparity in the favor of boys in all enrollment level except for the upper secondary level enrollment. However, one in every four women has experienced some form of violence in Maldives indicating gender-based violence is prevalent in the country.

The ESMF of MCEP consist a Gender Development Plan which identifies the following Gender Issues, Strategies and Proposed activities relevant to the project. The following **Table 39** provides the Gender Development Plan for MCEP.

Table 39: Gender Development Plan for MCEP

Gender issues	Strategy	Proposed Activities
Lack of awareness	Awareness campaign about the project for the community focusing on the vulnerable group including women.	Formation of women groups around specific project areas. Share information about the project benefits with local community.
Low Level of literacy	Support functional literacy campaign and develop extension programs to take the benefits from the project as per the needs of illiterates.	Undertake literacy programs as built- in activities coordinated with literacy programs. Develop the implementing strategies to communicate real time information specifically for economically weaker section. Develop audio-visual aids and documentary for training programs about the project for illiterate women groups.
Excluded from Opportunities and because of social boundaries as a result low level of participation in decision making process	Rapport building with Women Development Office at District or local level involving them in Program. Gender sensitization to all stakeholders including project entities. Ensure Women's participation during meetings, project implementation and monitoring.	Carry out meetings and interaction program with and orientation to women in the community. Conduct leadership training for women members of commodity groups.
Lack of knowledge / access to technical knowhow	Promote need based technical awareness and support services.	Organize training on technologies. Provide opportunities of exposure or study visit to women's group to develop their leadership capacity.

Disparity in Wages	Accord Priority Employment to women in project generated construction activities. Promote equal wages for equal work.	Inform women groups regarding proposed construction works. Identify women interested to Work; assess their skills and involve them as per their capabilities. Monitor women wage rate and do the needful to ensure wage equality for similar type of construction works. Inclusion of the above elements in the contractors' document.
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10.2 Gender Action Plan

The following gender action plan (**Table 40**) has been proposed based on the gender development plan of the MCEP. All the cost involved in implementation of Gender Action Plan has been considered in the cost estimates for the trainings.

Table 40: Proposed Gender Action Plan

Gender Activities/ Action	Indicators/Targets	Responsible Agency for implementation	Timeline
Ensure that women benefit from expanded and improved SWM collection, transfer and disposal services	At least 563 women (census 2014) have access to the improved SWM facility.	MCEP PMU	Operational Phase
Carry out meetings and interaction program with and orientation to women in the community. Inform women groups regarding proposed construction works.	05% of the female population of the island are consulted.	P: Communications Specialist of MCEP S: ESS Specialist of MCEP	Pre-construction Phase

Develop audio-visual aids and documentary for training programs about the project for illiterate women groups.	Two audio-visual aids developed for compost and fire safety training.	Communication Specialist of MCEP PMU	Monitoring trips
Conduct leadership training for women members of community groups.	One leadership training conducted for WDC on SWM.	P: Communications Specialist of MCEP S: ESS Specialist of MCEP	Monitoring trips
Identify women interested to Work; assess their skills and involve them as per their capabilities.	20% of staff employed in IWRMC are female particularly waste collection and transport.	Island Council/ Ministry of Environment	Operational Phase

CHAPTER TWELVE: STAKEHOLDER CONSULTATIONS

12.1 Introduction

Involvement of stakeholders is crucial for the effective implementation of the proposed project. An integral part of this ESMP has been consultation with all relevant parties including public consultation, and relevant government authorities. This chapter aims to summarize the stakeholder consultations that were conducted for this ESMP.

12.2 Summary of consultations with Island Council

All the meetings for this ESMP, was undertaken virtually due to COVID-19. The main findings from the stakeholder consultations are summarized in below **Table 41** and **Table 42**.

Table 41: Summary of the main findings of the consultations with Th. Thimarafushi island council

Items	Description
Date of Consultations	12 January 2021 (Tuesday) 1300 – 1400
Venue	Online Platform (google meet)
Name of Stakeholders	- Mr. Ahmed Ibrahim (Vice President, Island Council, P: 9990397) - Mr. Ahmed Ali (Administrative staff, Island Council P: 7947969)
Language of communication	Dhivehi
Introduction	The objective of this meeting was to inform and undertake consultation on the current waste management practices on the islands and including endorse the IMWC proposed under the project.
Summary of discussion	General Waste Management Issues in the island: - The problems associated to waste management in the island is one of the significant environmental problem faced by the island. The island does not have established waste management plan or collection system. In order to manage waste management of the island, the council have designated a land where communities can discard or dump waste. The council with its limited resources are practicing waste management issue through open burning and burial of waste. Currently there is no infrastructure at the site. - The rationale for allocating land for the waste management is distanced from the residential area which would not cause any significant impact to the communities during waste management sites. - The island does not have an approve waste management plan, however a draft of the plan is already drafted. Removal of Vegetation from the site - The designated land site for the IWRMC does not have any vegetation that needs to be removed. The area is already cleared.

	Similarly, the access roads are cleared and maintained by the council. ▪ The council have designated person (Vice President of the council) who is in charge of the waste management practices of the island. This focal person would be acting as the nodal person under the Tier I for any GRM related issues of the island. Proposed composting technology ▪ The council welcome the proposed technology by the Project Proponent as it would enable production of an usable material (compost) from the otherwise not usable waste material.
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Table 42: Summary of the main findings of the FENAKA Corporation

Items	Description
Date of Consultations	12 January 2021 (Tuesday) 1300 – 1400.
Venue	Online Platform (google meet)
Name of Stakeholders	▪ Ahmed Mueen, Senior Supervisor, P: 9892167
Language of communication	Dhivehi
Introduction	The objective of this meeting was to inform and undertake consultation on the current waste management practices on the islands and including endorse the IMWC proposed under the project.
Summary of discussion	Electricity connection ▪ The island have enough installed capacity that could cater to the demand of all electrical need of the proposed project during constructional and operational phase.

12.3 Household Perception Survey

The public consultations were conducted through a questionnaire sent to the council, as no physical survey was undertaken due to COVID-19. The questionnaire is annex in Annex 06 along with the respondent sheets. Approximately 15 household were surveyed in accordance with the TOR for this consultancy assignment. The findings from the survey is discussed below.

12.3.1 Demographical Characteristics

Even though the survey is done at household level, demographic information of those households were taken. It was noted that represented households comprise of 30 females, 43 males and 24 children. **Figure 18** shows the households represented in the way. It is also noted that majority of the forms were filled by females.

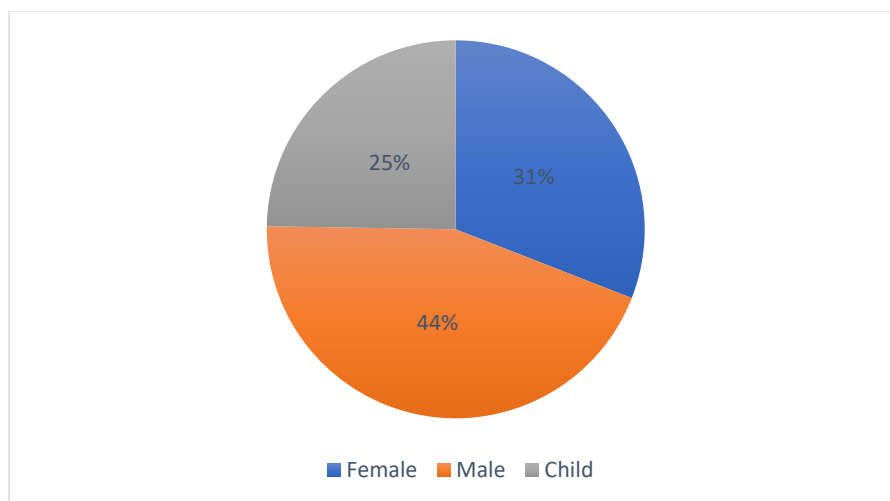


Figure 18: Demographic characteristic of the survey

12.3.2 Waste generation and collection pattern

It is observed from the survey that approximately 2 kilogram of organic waste is generated from individual household. Similarly, 1 kilogram of inorganic waste is generated. The organic waste stream of the community can be estimates as 40 - 60% of the waste volume. Majority of the residential community does undertake waste segregation at household level (53% of the survey communities) (See **Figure 19**). The main containers that are used in the waste collection are dustbins. Each individual household take their daily waste generated to the site individually as there is no system established.

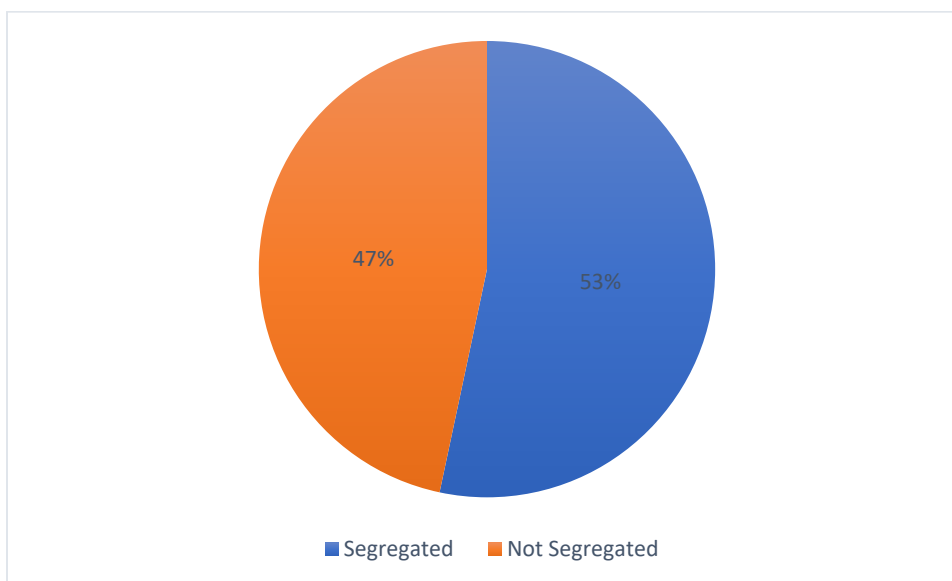


Figure 19: Waste segregation practiced at Th. Thimarafushi

12.3.3 Waste Management practice

Currently all the waste that is generated from the households are dumped at the site with no adequate waste management. The council have designated an area for dumping waste, and council undertake open burning to ensure that waste is managed in some efficient manner.

12.3.4 Satisfaction over the existing waste management

Given that there is no existing waste collection system on the island, private waste collecting parties operate within the island. They provide services to the community for a fee of 100 MVR per month. Survey indicated that approximately 82% of the responded is not satisfied with the proposed location (See **Figure 20**). The reasons associated includes lack of adequate waste management options available at the site. Moreover, the site is located within the close proximity of the residential area. Hence during the open burning process, the communities near by including the football ground is severely impacted.

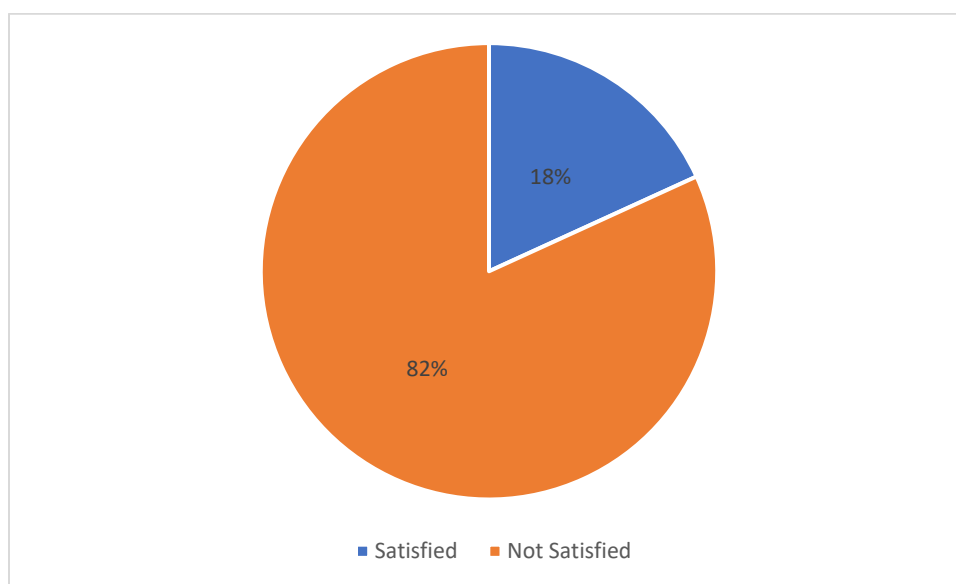


Figure 20: Communities satisfaction over the proposed IWRMC

12.3.4 Composting Technology and compost demand

The communities are aware of the benefits associated with the composting technology that is to be installed at their IWRMC. Some residents have indicated waste management machineries they would require improving on effective management of waste in the island. Furthermore, during the stakeholder consultation with council, they noted that composting would enhance proper waste management of the organic waste.

12.3.5 IWRMC Needs or requirement

Most of the community household indicated that they would require can compactor, to shredder both plastic and green shredder. Furthermore, the residents also require additional equipment such as wheel burrows and gloves.

CHAPTER THIRTEEN: RECOMMEDATIONS AND CONCLUSION

The construction and development of the IWRMC at Th. Thimarafushi is a much-needed project to provide waste management services to the island. The IWRMC will be an improvement to the current waste disposal practices conducted in the island, while reducing the environmental pollution and providing health and economic benefits to the island.

Although the project is perceived to yield significant environmental and human health benefits and contribute towards achieving sustainable development goals, it should be understood that these benefits as outcomes would depend on smooth operations of the waste management system as a whole. In order for the system to function sustainably adequate resources in particular financial resources shall be made available. Part of the required funding could be obtained through introducing a fee structure for the service and sale of metals and compost. However these revenue sources are not likely to be adequate enough for the entire operation. Hence, support from the government will be critical to maintain the system functional. Unavailability of the funds could mean breakdown of the transport system which could ultimately collapse the waste management service. Regular removal of residual waste from the island will have to be ensured as a key aspect of the project implementation. Residual waste will be transported to K. Thilafushi by WAMCO where a waste management facility is being established through funding of Asian Development Bank (ADB).

Based on past experiences gained from projects of similar nature, it is also important to undertake a one off clean up activity of the island that includes removal of existing stockpile of waste. Failing to undertake this could lead to overloading of the waste management centre resulting failure to carry out the operational activities in the planned manner.

The construction and operational impacts that might arise from the project should be managed, mitigated and monitored on a continuous basis and should adhere to the EIA regulation all throughout the construction and operation of the project. Strict considerations are to be given to the pollution control as well as health and safety measures

The main recommendations for the project include:

- Plan a one off clean up activity prior to the official opening of the waste management centre;
- Island Council shall formulate an IWMP and obtain approval from the EPA.
- the proponent and island council to consider providing coastal protection to the adjacent coastal area in any potential coastal protection project;
- plan and have in place a sea transfer arrangement to remove residual waste from the site on a regular basis;
- carryout necessary training for the waste management personnel in particular in the area of composting;
- adequate awareness raising of the general public particularly women and vulnerable groups on the operation and functioning of the new waste management centre and sensitising the public on the rules and procedures that would come into effect with regards to the new waste management system;
- implementing fee for service system;
- strengthening enforcement capacity of the local authorities;

- provision of adequate financial and technical support at least for the initial 3 years into the project implementation to the island council;
- determine an operational plan for the centre that takes into account details of all aspects of operating, managing and sustaining the service;
- conduct supervision and monitoring of the project works by the Proponent;
- enforcement agency to make an effort to make at least one visit to the project site during the construction phase to ensure environmental compliance of the project activities; and
- proponent appoints a focal point to coordinate activities relating to monitoring and reporting.

This ESMP has looked into the key factors that need to be considered during construction and operational stage and identified all likely environmental impacts. Among other temporary and highly localised minor negative environmental impacts, the study has identified the following unavoidable moderately negative terrestrial impacts due to proposed development works:

- Almost an irreversible change the overall terrestrial environment as a result of the placement of the IWRMC footprint;
- generation of construction waste as a result of construction works.

The study also found that through the implementation of the proposed practical and cost-effective mitigation measures almost all identified impacts can be brought to an acceptable level. The study found no evidence of the project resulting loss of endangered or protected species or habitat.

Thus based on the findings, it is concluded that the benefits on the environment and human health greatly outweighs the negative effects resulting from the implementation of the project.

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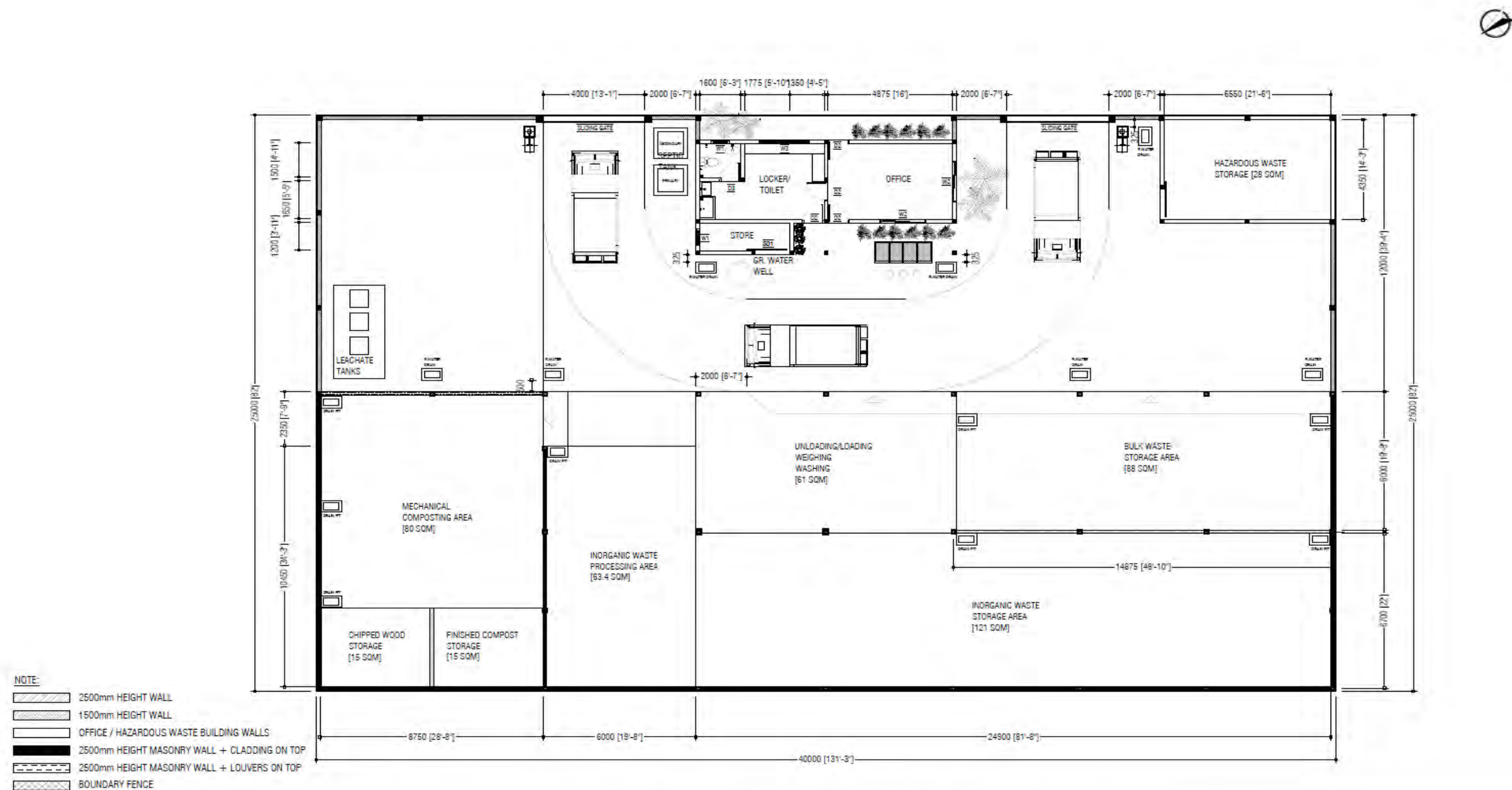
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ANNEX 1: SITE PLAN



PREPARED BY	PROJECT	DESIGN BY	NOTES / AMENDMENTS
	CONSTRUCTION OF ISLAND WASTE MANAGEMENT CENTRE TH. THIMARAFUSHI	AFRAZ	MECHANICAL COMPOSTING FOR ORGANIC WASTE MANAGEMENT
MCEP MINISTRY OF ENVIRONMENT GREEN BUILDING, HANDHUVAREE HIGUN, MAAFANNU, MALÉ (20392), REPUBLIC OF MALDIVES, TEL: + 960-3018431, + 960-3018300, FAX: + 960-328301	TITLE	STRUCTURE BY	
	FLOOR PLAN	AFRAZ	
	CLIENT DEPARTMENT	DRAWN BY	
	WMPC DEPARTMENT	AFRAZ	
PAPER SIZE	A3	SCALE	1:150
PAGE NO.	02	DWG NO.	THIM-A1-02
		DATE	03.10.2020

ANNEX 2: A3 LOCATION PLAN



ANNEX 3: PROPONENT DECLARATION AND COMMITMENT LETTER

Ministry of Environment

Male', Republic of Maldives.

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ދިވެހިސަރުކާރުގެ ގެޒެޓް - ދިވެހިރާއްޖޭގެ ޖުމްހޫރިއްޔާ

Date: 18 January 2021

No: 438-WMPC/203/2021/16

Mr. Ibrahim Naeem,
Director General,
Environmental Protection Agency,
Green Building, Handhuvaree Hingun, Maafannu,
Male', 20392, Maldives.

Dear Sir,

Sub: Commitment to undertake Mitigation and Environmental Monitoring

The Environmental and Social Management Plan (ESMP) prepared for the proposed establishment of the Island Waste and Resource Management Centre (IWRMC) in Th. Thimarafushi has been prepared in accordance with the EIA Regulations 2012 and its amendments, issued by the Ministry of Environment.

We would like to confirm our commitment to the proposed mitigation measures and the monitoring programme that has been highlighted in the ESMP report prepared for the above referenced project.

Sincerely,

Anru Adam,
Assistant Director



Green Building, Handhuvaree Hingun,
Maafannu, Male', 20392, Republic of Maldives.
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secretariat@environment.gov.mv
www.twitter.com/ENVgovMV
www.facebook.com/environment.gov.mv

ANNEX 4: TRANSLATION OF ESMP MATRIX TO DHIVEHI LANGUAGE

[illegible]

[illegible]

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مرکزہ نمبر: 431-LIS/391/2018/3

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ANNEX 6: QUESTIONNAIRE USED FOR HOUSEHOLD SURVEY

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مفتی محمد رفیع



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ANNEX 8: ADDITIONAL INFORMATION TO EPA, SUPPLEMENTARY ESMP TO WORLD BANK & DECISION STATEMENT FROM EPA

Additional Information for the Updated Environmental and Social Management Plan for proposed establishment of Island Waste Resources Management Centre at Th. Thimarafushi

As per the requested through your letter 203-ECA/438/2021/26 (dated: 03 February 2021) regarding the additional information for the ESMP for proposed establishment of Island Waste Resources Management Centre at Th. Thimarafushi, please find the information below;

1. The proposed project location is near the seashore. Please give reasons as to why an alternative site was not given.

The location of the Island Waste Resources Management Centre (IWRMC) was selected by island council in consultation with the island community and is approved by Maldives Land Survey Authority (MLSA) and incorporated in the Land Use Plan of the island, hence there is no further alternative feasible location to propose as alternative site. The Land Approval Letter was attached in the Annex 5 of the report.

2. How will the current waste dumping site be decommissioned and rehabilitated?

The procedures to follow closure of small open dump sites are provided in the following Annex 1 of this Additional Information Request. However, the in-place closure method is not practicable in the context of Maldives, due to land scarcity, depth of water lens and potential for marine pollution. Hence, the only feasible option for cleanup is evacuation method, which involves removing the existing waste piles and transferring to a regional facility for treatment and final disposal.

ANNEX ONE – ENVIRONMENTAL CLOSURE OF SMALL OPEN DUMP SITES

Guidelines for Environmental Closure of Small Open Dump Sites

The following guidelines are developed in line with recommendations made via the Guidelines for Design and Operation of Municipal Solid Waste Landfills in Tropical Climates prepared by the International Solid Waste Association in 2013 and have been amended to suite the project context.

1. Environmental Closure Methods

In the context of the Maldives and current solid waste management practices the following two principle 3 methods should be adopted to environmentally close the current waste management locations. Field evaluations have shown that these sites contain small open dump sites, where inorganic waste material such plastics, glass metal have been mixed with garden waste and soil.

1. Closing by covering the waste (in-place method)
2. Closing by removing the waste from the site (evacuation method)

However, in the context of the Maldives the

Which option to use should be explored via the feasibility studies to be conducted for each island, taking into consideration the sustainability and affordability of waste management options in the local context, all the while remaining cognizant of trying to affect real improvement in relation to the actual and potential environmental effects of the dump site?

When choosing a closure/upgrading method it should be borne in mind, that it is not always the most technically advanced solution that is the most appropriate. Depending on the situation, simple improvements of operational aspects (such as applying cover soil and eliminating open burning) can often result in marked site performance and greatly reduced environmental impacts. The key principle should always be to keep things simple and sustainable in a local context, while maximizing actual improvement in environmental performance.

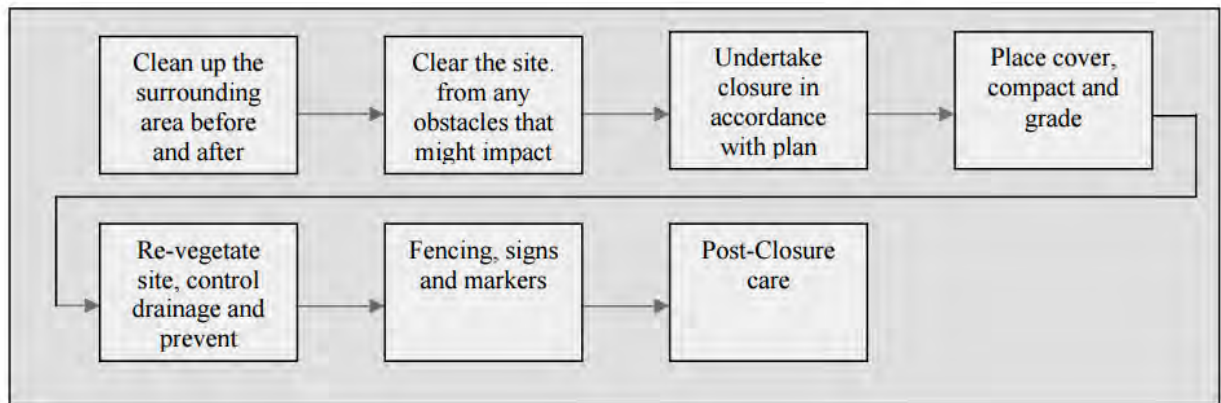
1.1. In-Place Closure

This method is the most commonly used option. The solid waste is left at the site and covered with a layer of local soil and re-vegetated. The function of the cover layer is to:

- Reduce waste exposure to wind and vectors
- Prevent people and animals from scavenging
- Control odor
- Minimize the risk of fires
- Stop people from using the site
- Control infiltration of rainwater / surface water
- Control migration of landfill gas
- Serve as growth medium for vegetation
- Support suitable post-closure activities

The ability of the cover layer to limit infiltration of water into the dump is an essential environmental protection measure. This is achieved through a suitable combination of cover soil type, thickness, slope and vegetation. In other than very arid conditions a clay cover layer is best suited as it minimizes leachate production, and controls landfill gas migration and odor. The durability of the cap layer and the degree of resistance that the cover offers to infiltration are important design considerations. What constitutes a suitable cap design is site specific and depends on the climate, locally available soil materials and plant

types, the extent of protection necessary for the local aquifer and surface water systems etc. Typical operational steps for in-place closing of an open dump are shown in the figure below.



When deciding on a suitable final contour for the closed dump, consideration should to be given to the management of surface water and erosion in the Post- closure period. Post closure care may be defined as requirements placed upon solid waste management facilities after closure to ensure environmental impacts are controlled and public health and safety are adequately maintained, for a specified number of years after closure (typically 20 years may be considered and appropriate period of time for Post-closure care of an open dump).

1.1.1. Basic Principles of In-Place Closure

The following steps need to be adhered to during the closure process:

- The dumpsite should be cleaned up and demarcated in a manner that will prohibit public access in order to avoid risk to the public. Recyclables should be separated to be managed appropriately.
- After closing the site to public access, the facility and surrounding area should be cleaned up so that any waste piles or piles of metallic materials, burnable materials, debris, and windblown paper are consolidated and placed in a final disposal cell for final covering.
- Particular attention should be given to any environmentally sensitive areas where waste may have been piled too steeply, may have been placed in or next to wetlands or beaches, or where wastes have been placed in drainage ways or in areas that impede surface water drainage.
- Site closure should help moderate the environmental impact of such improper disposal.
- As appropriate, waste materials may need to be moved or relocated to higher portions of the site, or the waste may be placed in appropriate areas to help sloping of the closed site.
- It is important to promote surface water drainage from landfill areas in order to keep surface water from filtering into and through the garbage, thus creating a hazard of ground water and surface water degradation.
 - A primary concern of site closure is the slope of filled portions of the site to promote surface water runoff without causing ponding or severe erosion of the final cover.
- The slope or grade of the land and the length strongly affects soil erosion of the slope.
 - Final slopes of filled portions of the landfill site should be at least 2 percent in grade and should not exceed 8 percent in grade.
 - Slopes of up to 12 percent may be used where the slope length is short and run off is not concentrated or increased by adjacent slopes.
- Terraces, waterways, diversions or other measures should be used as appropriate to minimize soil erosion. The USDA Universal Soil Loss Equation may be used to predict soil loss and the life of the cover.

1.1.2. Application of a Final Cover in In-Place Closure

- After the open landfilled areas have been sloped and all waste buried, compacted, and covered, an inert waste landfill site should be covered with at least 20-25 inches of clay-rich soil and 36 inches for municipal solid waste landfills that contain organic matter.
- In the Maldives due to the lack of abundant clay-rich soil, more dense sandy soil may be used.
- This final cover of soil should be placed in layers.
 - The first or deepest being about 12 inches for inert waste landfills or 18 inches for municipal solid waste landfills, which should be carefully compacted in six-inch lifts to minimize surface water infiltration. Compaction testing of this "barrier layer" may be required to ensure the soil material be properly placed.
 - An additional 12-18 inch of soil material should be placed over the compacted clay layer to help protect it from damage due to erosion, plant roots, vehicular traffic, freezing and thawing, etc. This "buffer layer" also provides a rooting depth for the final vegetative cover.
 - Based on site conditions, additional layers may be desirable. At least six inches of topsoil or suitable plant growth material such as compost, should be spread over the site.
 - Where possible Soil nutrient testing of the topsoil is suggested. Soil pH, nitrogen, potassium, phosphorous, conductivity, bulk density, and organic matter are suggested parameters.
 - Based on this analysis, appropriate organic matter may be added to the topsoil to increase fertility.

1.1.3. Site Revegetation and Long Term Management

- The site should be revegetated when practicable to a mixture of native grass or shrub species as recommended by the local environmental protection agency.
- Tree plantings may be placed around the landfill site, however, unless special precautions are taken, trees should not be planted on top of the landfill and should not be planted in positions which will cause excessive soil drifting on the landfill.
- Tree plantings help improve the aesthetics of the landfill site and may improve the site for long term use as wildlife habitat, scenic areas, etc.
- As appropriate, the landfill site may need additional covering applied, additional erosion control structures installed, and/or reseeded of the vegetative cover.
- In the post-closure period there may be regulatory requirements to establish a monitoring programme to assess risks over the long term. The basic principles are as follows, to:
 - Maintain the Integrity of the Cover layer through regular maintenance to address:
 - Settlement, cap subsidence, slope instability and vegetation cover
 - Storm water run-off / run-on drainage controls, and drain and cap erosion
 - Operate, Monitor and Maintain
 - Leachate management system (if any)
 - Landfill gas controls and wells (if any)
 - Groundwater wells; stream sampling (if any)

1.2. Evacuation Method-Removing Waste

- With this method the solid waste in the open dump is excavated and disposed off-site (typically to a sanitary landfill, or a waste incineration plant). As no sanitary landfills are currently located in the Maldives the final disposal option will be incineration at the Regional Waste Management Center in the North in Vandhoo Island in the Raa Atoll.
- Where possible, from the large amounts of accumulated cans, bottles, metal and plastic waste found in the dumpsites of inhabited islands the option of sourcing them to recyclers or companies that partake in resource recovery should be explored.

- For all such material that can be incinerated as per the National Incineration guidelines, the MEE along with WAMCO should facilitate with the IWMC and organize for the material to be transported accordingly to the incineration plant at Vandhoo.
In the event that transportation to the Vandhoo facility will not be financially viable a second option is, once a site for the Regional Waste Management Center for Zone IV has been established, an onsite storage facility should be constructed and all material that can be incinerated should be transported via barge to this location and stored. The material can be sourced for initial testing and commissioning of the incinerator.
- All material that cannot be incinerated nor has a recyclable/resource value should be sorted should be either incorporated in to the existing open dump site prior to In-Place Closure.
- In the case of the small-medium scale open dump piles that are mixed with soil and other organic matter, unless properly sorted, incineration will not be an option. Thus for these In-Place Closure should be adopted.

ADDITIONAL INFORMATION (WORLD BANK SAFEGUARDS
REQUIREMENTS)

UPDATED ENVIRONMENTAL AND SOCIAL MANAGEMENT
PLAN FOR ESTABLISHMENT OF ISLAND WASTE RESOURCE
MANAGEMENT CENTRE IN TH. THIMARAFUSHI

PREPARED FOR
MINISTRY OF ENVIRONMENT

PREPARED BY
HAMDHOON MOHAMED

FEBRUARY 2021

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The interventions do not create any resettlement impacts such as loss of lands, assets and livelihoods to households, since project does not involve removal of any large trees from the project site or access road.	3
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1. Resettlement impacts

Chapter 6 on Environmental Impacts;

The interventions do not create any resettlement impacts such as loss of lands, assets and livelihoods to households, since project does not involve removal of any large trees from the project site or access road.

2. Culturally Sensitive Areas



3. Stakeholder consultation for selection of location for IWRMC

The following are revision of Chapter 11 on Stakeholder consultations.

Given that there is no existing waste collection system on the island, private waste collecting parties operate within the island. They provide services to the community for a fee of 100 MVR per month. Survey indicated that approximately 82% of the responded is not satisfied with the proposed location (See **Figure 1**). The reasons associated includes lack of adequate waste management options available at the site. Moreover, the site is located within the close proximity of the residential area. Hence during the open burning process, the communities near by including the football ground is severely impacted.

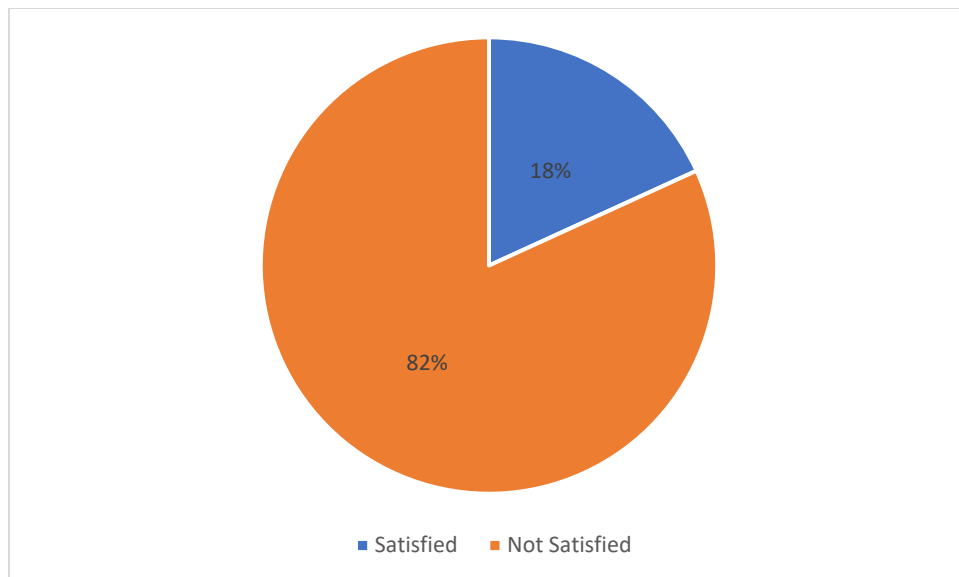


Figure 1: Communities satisfaction over the proposed IWRMC

12.3.4 Composting Technology and compost demand

The communities are aware of the benefits associated with the composting technology that is to be installed at their IWRMC. Some residents have indicated waste management machineries they would require improving on effective management of waste in the island. Furthermore, during the stakeholder consultation with council, they noted that composting would enhance proper waste management of the organic waste.

12.3.5 IWRMC Needs or requirement

Most of the community household indicated that they would require can compactor, to shredder both plastic and green shredder. Furthermore, the residents also require additional equipment such as wheel burrows and gloves.

12.3.6 Selection of the site for IWRMC

The community consultations were conducted by the island council during selection of the local of IMRMC and consensus of the island community was obtained prior to approval of the location by Maldives Land Survey Authority (MLSA) and incorporation into Land Use Plan of the island. The corresponding letter from the MLSA was attached in the Annex 05 of the initial ESMP.

4. Labour Management Guidelines and Code of Conduct for the Contractor

The following is an additional chapter of the ESMP which describes the Labor Management Plan for the proposed project of establishment of IWRMC in Th. Omadhoo. The Code of Conduct is Annex 8 of the report.

CHAPTER FOURTEEN: LABOR MANAGEMENT PLAN

The project anticipates some environmental and social impacts due to influx of Labor hence, the following Table 45 prescribes the labor management guidelines for the contractor. However, the anticipated number of the labor for the project is approximately 15 – 20 workers.

Aspect	Prescribed Guidelines	Implementation Responsibility	Monitoring Responsibility
Terms and Conditions	• List of workers to be utilized in relation to the project, with proof of employment will be required to be submitted to PMU by all investors/contractors. • Construction work can only commence once the following conditions are met: - o Toolbox training completed by all staff employed by the contractor - o All the required Personal Protective Equipment are acquired by the contractor for all workers • Any newly employed party by the contractor will be required to complete the toolbox prior to commencing any physical work.	P: Contractor	MCEP PMU

	• As per the provisions of the employment, all parties employed by any contracted party will be above 16 years of age. For those between 16 to 18 years of age, consent of the parent will be required as per the Employment Act. In addition, all other provisions of the act highlighted previously regarding employment of a minor will apply. • All contractors and investors will be required to provide document evidence (passport, identity card or birth certificate) confirming age of employees to MCEP PMU prior to involving them on activities of the project. In addition, for minors consent of the parent will be provided in writing together with evidence of legal guardianship. • Maximum working hours for staff will not exceed the maximum limit set in the employment act, i.e. 48 hours a week. To confirm this, monthly attendance and duty sheets need to be submitted to PMU during the construction phase. • An internal transparent and accountable system will be established within the company to tackle issues of sexual harassment, physical and psychological harassment and workplace bullying. Details of this system will be shared with PMU prior to signing any contracts or agreements. • The leave policy of the company will be shared and confirmed that it is in line with national laws and regulations. • All foreign parties employed by all contractors/investors will have valid work permit. The work permit details will be shared with MCEP PMU.		
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	•All vehicles used by any contractor/investor for the purpose of the project will have valid registration, insurance and road worthiness. •All contracted staff will be made aware of grievance redress mechanism available for the staff specified under this LMP.		
Working and Living Condition	• Entry and exit from site/workplace will be strictly controlled. • Separate male and female toilet facilities will be provided at all project offices, field/construction sites. • Potable drinking water and handwashing facilities will be available at all project offices and field/construction sites. • All provisions that are required under Health and Safety Regulation for Construction Industry (2019/R156) will be strictly adhered to. • Working environment will be clean, hygienic and safe. All project offices will be free of pests. Where pests are detected pest control measures will be taken immediately. - o Fire detection and firefighting equipment will be available at all project offices. - o Emergency evacuation plan will be established for all project offices and staff will be made aware of the plan and periodic simulation exercises that needs to be implemented. - o Adequate safety signs will be installed at the work site giving clear direction. These will be provided in addition to English in the language of the workforce. • Construction work site will be demarcated & fenced, and warning signs will be displayed both in English and Dhivehi. • When procuring sea-vessels for travelling, in addition to cost, safety considerations will be given a priority, including the size	P: Contractor	Island Council

	of the vessels, and only sea-vessels that have lifejackets available, will be procured. - o Some form of identification will be there identifying the staff belonging to project when attending meetings and sites. - o Work tasks will be rearranged or numbers of workers on the worksite will be reduced to allow social/physical distancing, or rotating workers through a 24-hour schedule - o		
COVID19 Impacts	• Adequate PPE will be provided to workers, including: - o Facemasks, gloves, etc., if possible, to prevent COVID-19 spread - o Lifejackets to workers when travelling by sea. - o Hard hats (through contractors, investors or project directly) - o Enclosed shoes will be worn by all staff (safety shoes are preferable). - o Safety harness will be provided (through contractors, investors or project directly) when climbing heights at project sites.	P: Contractor	COVID19 Taskforce of Island
Worker Accommodation	• Accommodation arrangements will be reviewed, to see if they are adequate and designed to reduce contact with the community • Male and Female workforce will be housed separately	P: Contractor	Island Council

	• Constant and reliable electricity supply will be made available. In addition, sufficient lighting and cooling systems will be established • Shower and toilet facilities will be available at the accommodation site. A minimum ratio of 01 toilet/shower per 20 workers will be maintained. Separate facilities will be provided for men and women. • Toilet and drainage will be connected to local sewer system, where not available septic tanks will be used for treatment prior to disposal. • Individual bedding will be provided to all workers. o Storage space for individual belongings will be provided for all workers. • Designated locations for waste disposal with clearly marked bins will be established. Bins will be emptied daily and the site will be cleaned daily. • Meals to the site will be prepared from a Health Protection Agency (HPA) certified facility (whether food is prepared on site or offsite) o Monthly inspection to determine pest infestation on the site will be carried out.		
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ANNEX 8: SAMPLE CODE OF CONDUCT FOR CONTRACTOR

CODES OF CONDUCT

Three Codes of Conduct are presented below:

- i. **Company Code of Conduct:** Commits the company to addressing EHS, OHS and GBV issues;
- ii. **Manager's Code of Conduct:** Commits managers to implementing the Company Code of Conduct, as well as those signed by individuals; and,
- iii. **Individual Code of Conduct:** Code of Conduct for everyone working on the project, including managers.

Company Code of Conduct
Implementing ESHS and OHS Standards
Preventing Gender Based Violence

The company is committed to ensuring that the project is implemented in such a way which minimizes any negative impacts on the local environment, communities, and its workers. This will be done by respecting the environmental, social, health and safety (ESHS) standards, and ensuring appropriate occupational health and safety (OHS) standards are met. The company is also committed to creating and maintaining an environment where children under the age of 18 will be protected, and where Sexual Exploitation and Abuse (SEA) and sexual harassment have no place. Improper actions towards children, SEA and sexual harassment are acts of Gender Based Violence (GBV) and as such will not be tolerated by any employee, sub-contractors, supplier, associate, or representative of the company.

Therefore, to ensure that all those engaged in the project are aware of this commitment, the company commits to the following core principles and minimum standards of behavior that will apply to all company employees, associates, and representatives, including sub-contractors and suppliers, without exception:

General

1. The company—and therefore all employees, associates, representatives, sub-contractors and suppliers—commits to complying with all relevant national laws, rules and regulations.
2. The company commits to full implementing its ‘Contractors Environmental and Social Management Plan’ (C-ESMP) as approved by the client.
3. The company commits to treating women, children (persons under the age of 18), and men with respect regardless of race, color, language, religion, political or other opinion, national, ethnic or social origin, property, disability, birth or other status. Acts of GBV are in violation of this commitment.
4. The company shall ensure that interactions with local community members are done with respect and non-discrimination.
5. Demeaning, threatening, harassing, abusive, culturally inappropriate, or sexually provocative language and behavior are prohibited among all company employees, associates, and its representatives, including sub-contractors and suppliers.
6. The company will follow all reasonable work instructions (including regarding environmental and social norms).
7. The company will protect and ensure proper use of property (for example, to prohibit theft, carelessness or waste).

Health and Safety

8. The company will ensure that the project’s OHS Management Plan is effectively implemented by company’s staff, as well as sub-contractors and suppliers.
9. The company will ensure that all persons on-site wear prescribed and appropriate personal protective equipment, preventing avoidable accidents, and reporting conditions or practices that pose a safety hazard or threaten the environment.
10. The company will:

- i. prohibit the use of alcohol during work activities.
 - ii. prohibit the use of narcotics or other substances which can impair faculties at all times.
11. The company will ensure that adequate sanitation facilities are available on site and at any worker accommodations provided to those working on the project.
 12. The company will not hire children under the age of 18 for construction work, or allow them on the work site, due to the hazardous nature of construction sites.

Gender Based Violence

13. Acts of GBV constitute gross misconduct and are therefore grounds for sanctions, which may include penalties and/or termination of employment and, if appropriate, referral to the Police for further action.
14. All forms of GBV, are unacceptable, regardless of whether they take place on the work site, the work site surroundings, at worker's camps or within the local community.
15. Sexual harassment of work personnel and staff (e.g. making unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature) are acts of GBV and are prohibited.
16. Sexual favors (e.g. making promises of favorable treatment such as promotions, threats of unfavorable treatment such as losing a job, payments in kind or in cash dependent on sexual acts) and any form of humiliating, degrading or exploitative behavior are prohibited.
17. The use of prostitution in any form at any time is strictly prohibited.
18. Sexual contact or activity with children under 18—including through digital media—is prohibited. Mistaken belief regarding the age of a child is not a defense. Consent from the child is also not a defense or excuse.
19. Unless there is full consent¹ by all parties involved in the sexual act, sexual interactions between the company's employees (at any level) and members of the communities surrounding the work place are prohibited. This includes relationships involving the withholding/promise of actual provision of benefit (monetary or non-monetary) to community members in exchange for sex (including prostitution). Such sexual activity is considered "non-consensual" within the scope of this Code.
20. In addition to company sanctions, legal prosecution of those who commit acts of GBV will be pursued if appropriate.
21. All employees, including volunteers and sub-contractors are highly encouraged to report suspected or actual acts of GBV by a fellow worker, whether in the same company or not. Reports must be made in accordance with project's GBV Allegation Procedures.
22. Managers are required to report and act to address suspected or actual acts of GBV as they have a responsibility to uphold company commitments and hold their direct reports responsible.

Implementation

¹ **Consent:** refers to when an adult makes an informed choice to agree freely and voluntarily to do something. There is **no** consent when agreement is obtained through the use of threats, force or other forms of coercion, abduction, fraud, manipulation, deception, or misrepresentation; the use of a threat to withhold a benefit to which the person is already entitled, or; a promise made to the person to provide a benefit. In accordance with the United Nations Convention on the Rights of the Child, the World Bank considers that consent cannot be given by children under the age of 18, even if national legislation of the country into which the Code of Conduct is introduced has a lower age. Mistaken belief regarding the age of the child and consent from the child is not a defense.

To ensure that the above principles are implemented effectively the company commits to:

23. Ensuring that all managers sign the project's 'Manager's Code of Conduct' detailing their responsibilities for implementing the company's commitments and enforcing the responsibilities in the 'Individual Code of Conduct'.
24. Ensuring that all employees sign the project's 'Individual Code of Conduct' confirming their agreement to comply with ESHS and OHS standards, and not to engage in activities resulting in GBV, child endangerment or abuse, or sexual harassment.
25. Displaying the Company and Individual Codes of Conduct prominently and in clear view at workers' camps, offices, and in public areas of the work space. Examples of areas include waiting, rest and lobby areas of sites, canteen areas and health clinics.
26. Ensuring that posted and distributed copies of the Company and Individual Codes of Conduct are translated into the appropriate language of use in the work site areas as well as for any international staff in their native language.
27. Ensuring that an appropriate person is nominated as the company's 'Focal Point' for addressing GBV issues, including representing the company on the GBV Complaints Team (GCT) which is comprised of representatives from the client, contractor(s), the supervision consultant, and local GBV Service Provider.
28. Ensuring that an effective GBV Action Plan is developed in consultation with the GCT which includes as a minimum:
 - i. **GBV Allegation Procedure** to report GBV issues through the project Grievance Redress Mechanism (Section 4.3 Action Plan);
 - ii. **Accountability Measures** to protect confidentiality of all involved (Section 4.4 Action Plan); and,
 - iii. **Response Protocol** applicable to GBV survivors and perpetrators (Section 4.7 Action Plan).
29. Ensuring that the company effectively implements the agreed final GBV Action Plan, providing feedback to the GCT for improvements and updates as appropriate.
30. Ensuring that all employees attend an induction training course prior to commencing work on site to ensure they are familiar with the company's commitments to ESHS and OHS standards, and the project's GBV Codes of Conduct.
31. Ensuring that all employees attend a mandatory training course once a month for the duration of the contract starting from the first induction training prior to commencement of work to reinforce the understanding of the project's ESHS and OHS standards and the GBV Code of Conduct.

I do hereby acknowledge that I have read the foregoing Company Code of Conduct, and on behalf of the company agree to comply with the standards contained therein. I understand my role and responsibilities to support the project's OHS and ESHS standards, and to prevent and respond to GBV. I understand that any action inconsistent with this Company Code of Conduct or failure to act mandated by this Company Code of Conduct may result in disciplinary action.

Company name: _____

Signature: _____

Printed Name: _____

Title: _____

Date: _____

Manager's Code of Conduct

Implementing ESHS and OHS Standards

Preventing Gender Based Violence

The company is committed to ensuring that the project is implemented in such a way which minimizes any negative impacts on the local environment, communities, and its workers. This will be done by respecting the environmental, social, health and safety (ESHS) standards, and ensuring appropriate occupational health and safety (OHS) standards are met. The company is also committed to creating and maintaining an environment where children under the age of 18 will be protected, and where Sexual Exploitation and Abuse (SEA) and sexual harassment have no place. Improper actions towards children, SEA and sexual harassment are acts of Gender Based Violence (GBV) and as such will not be tolerated by any employee, sub-contractors, supplier, associate, or representative of the company.

Managers at all levels have a responsibility to uphold the company's commitment. Managers need to support and promote the implementation of the Company Code of Conduct. To that end, managers must adhere to this Manager's Code of Conduct and also to sign the Individual Code of Conduct. This commits them to supporting the implementation of the Contractor's Environmental and Social Management Plan (C-ESMP), the OHS Management Plan, and developing systems that facilitate the implementation of the GBV Action Plan.

Managers need to maintain a safe workplace, as well as a GBV-free environment at the workplace and in the local community. Their responsibilities to achieve this include but are not limited to:

Implementation

1. To ensure maximum effectiveness of the Company and Individual Codes of Conduct:
 - i. Prominently displaying the Company and Individual Codes of Conduct in clear view at workers' camps, offices, and in public areas of the work space. Examples of areas include waiting, rest and lobby areas of sites, canteen areas and health clinics.
 - ii. Ensuring all posted and distributed copies of the Company and Individual Codes of Conduct are translated into the appropriate language of use in the work site areas as well as for any international staff in their native language.
2. Verbally and in writing explain the Company and Individual Codes of Conduct to all staff.
3. Ensure that:
 - i. All direct reports sign the 'Individual Code of Conduct', including acknowledgment that they have read and agree with the Code of Conduct.

- ii. Staff lists and signed copies of the Individual Code of Conduct are provided to the OHS Manager, the GBV Complaints Team (GCT), and the client.
- iii. Participate in training and ensure that staff also participate as outlined below.
- iv. Put in place a mechanism for staff to:
 - (a) report concerns on ESHS or OHS compliance; and,
 - (b) confidentially report GBV incidents through the Grievance Redress Mechanism (GRM)
- v. Staff are encouraged to report suspected or actual ESHS, OHS, GBV issues, emphasizing the staff's responsibility to the Company and the country hosting their employment, and emphasizing the respect for confidentiality.
4. In compliance with applicable laws and to the best of your abilities, prevent perpetrators of sexual exploitation and abuse from being hired, re-hired or deployed. Use background and criminal reference checks for all employees nor ordinarily resident in the country where the works are taking place.
5. Ensure that when engaging in partnership, sub-contractor, supplier or similar agreements, these agreements:
 - i. Incorporate the ESHS, OHS, GBV Codes of Conduct as an attachment.
 - ii. Include the appropriate language requiring such contracting entities and individuals, and their employees and volunteers, to comply with the Individual Codes of Conduct.
 - iii. Expressly state that the failure of those entities or individuals, as appropriate, to ensure compliance with the ESHS and OHS standards, take preventive measures against GBV, to investigate allegations thereof, or to take corrective actions when GBV has occurred, shall not only constitute grounds for sanctions and penalties in accordance with the Individual Codes of Conduct but also termination of agreements to work on or supply the project.
6. Provide support and resources to the GCT to create and disseminate internal sensitization initiatives through the awareness-raising strategy under the GBV Action Plan.
7. Ensure that any GBV complaint warranting Police action is reported to the Police, the client and the World Bank immediately.
8. Report and act in accordance with the agreed response protocol any suspected or actual acts of GBV.
9. Ensure that any major ESHS or OHS incidents are reported to the client and the supervision engineer immediately, non-major issues in accordance with the agreed reporting protocol.
10. Ensure that children under the age of 18 are not present at the construction site, or engaged in any hazardous activities.

Training

11. The managers are responsible to:
 - i. Ensure that the OHS Management Plan is implemented, with suitable training required for all staff, including sub-contractors and suppliers; and,
 - ii. Ensure that staff have a suitable understanding of the C-ESMP and are trained as appropriate to implement the C-ESMP requirements.
12. All managers are required to attend an induction manager training course prior to commencing work on site to ensure that they are familiar with their roles and responsibilities in upholding the GBV elements of these Codes of Conduct. This training will be separate from the induction training course required of all employees and will provide managers with the necessary understanding and technical support needed to begin to develop the GBV Action Plan for addressing GBV issues.
13. Managers are required to attend and assist with the project facilitated monthly training courses for all employees. Managers will be required to introduce the trainings and announce the self-evaluations, including collecting satisfaction surveys to evaluate training experiences and provide advice on improving the effectiveness of training.

14. Ensure that time is provided during work hours and that staff prior to commencing work on site attend the mandatory project facilitated induction training on:
 - i. OHS and ESHS; and,
 - ii. GBV required of all employees.
15. During civil works, ensure that staff attend ongoing OHS and ESHS training, as well as the monthly mandatory refresher training course required of all employees to on GBV.

Response

16. Managers will be required to take appropriate actions to address any ESHS or OHS incidents.
17. Regarding GBV:
 - i. Provide input to the GBV Allegation Procedures and Response Protocol developed by the GCT as part of the final cleared GBV Action Plan.
 - ii. Once adopted by the Company, managers will uphold the Accountability Measures set forth in the GBV Action Plan to maintain the confidentiality of all employees who report or (allegedly) perpetrate incidences of GBV (unless a breach of confidentiality is required to protect persons or property from serious harm or where required by law).
 - iii. If a manager develops concerns or suspicions regarding any form of GBV by one of his/her direct reports, or by an employee working for another contractor on the same work site, s/he is required to report the case using the GRM.
 - iv. Once a sanction has been determined, the relevant manager(s) is/are expected to be personally responsible for ensuring that the measure is effectively enforced, within a maximum timeframe of 14 days from the date on which the decision to sanction was made by the GCT.
 - v. If a Manager has a conflict of interest due to personal or familial relationships with the survivor and/or perpetrator, he/she must notify the Company and the GCT. The Company will be required to appoint another manager without a conflict of interest to respond to complaints.
 - vi. Ensure that any GBV issue warranting Police action is reported to the Police, the client and the World Bank immediately
18. Managers failing address ESHS or OHS incidents, or failing to report or comply with the GBV provisions may be subject to disciplinary measures, to be determined and enacted by the cCompany's CEO, Managing Director or equivalent highest-ranking manager. Those measures may include:
 - i. Informal warning.
 - ii. Formal warning.
 - iii. Additional Training.
 - iv. Loss of up to one week's salary.
 - v. Suspension of employment (without payment of salary), for a minimum period of 1 month up to a maximum of 6 months.
 - vi. Termination of employment.
19. Ultimately, failure to effectively respond to ESHS, OHS, and GBV cases on the work site by the company's managers or CEO may provide grounds for legal actions by authorities.

I do hereby acknowledge that I have read the foregoing Manager's Code of Conduct, do agree to comply with the standards contained therein and understand my roles and responsibilities to prevent and respond to ESHS, OHS, and GBV requirements. I understand that any action inconsistent with this Manager's Code of Conduct or failure to act mandated by this Manager's Code of Conduct may result in disciplinary action.

Signature: _____

Printed Name: _____

Title: _____

Date: _____

Individual Code of Conduct
Implementing ESHS and OHS Standards
Preventing Gender Based Violence

I, _____, acknowledge that adhering to environmental, social, health and safety (ESHS) standards, following the project's occupational health and safety (OHS) requirements, and preventing Gender Based Violence (GBV) is important.

The Company considers that failure to follow ESHS and OHS standards, or to partake in activities constituting GBV—be it on the work site, the work site surroundings, at workers' camps, or the surrounding communities—constitute acts of gross misconduct and are therefore grounds for sanctions, penalties or potential termination of employment. Prosecution by the Police of those who commit GBV may be pursued if appropriate.

I agree that while working on the project I will:

1. Consent to Police background check.
2. Attend and actively partake in training courses related to ESHS, OHS, and GBV as requested by my employer.
3. Will wear my personal protective equipment (PPE) at all times when at the work site or engaged in project related activities.
4. Take all practical steps to implement the contractor's environmental and social management plan (C-ESMP).
5. Implement the OHS Management Plan.
6. Adhere to a zero-alcohol policy during work activities, and refrain from the use of narcotics or other substances which can impair faculties at all times.
7. Treat women, children (persons under the age of 18), and men with respect regardless of race, color, language, religion, political or other opinion, national, ethnic or social origin, property, disability, birth or other status.
8. Not use language or behavior towards women, children or men that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate.
9. Not sexually exploit or abuse project beneficiaries and members of the surrounding communities.
10. Not engage in sexual harassment of work personnel and staff—for instance, making unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature is prohibited. E.g. looking somebody up and down; kissing, howling or smacking sounds; hanging around somebody; whistling and catcalls; in some instances, giving personal gifts.
11. Not engage in sexual favors—for instance, making promises of favorable treatment (e.g. promotion), threats of unfavorable treatment (e.g. loss of job) or payments in kind or in cash, dependent on sexual acts—or other forms of humiliating, degrading or exploitative behavior.
12. Not use prostitution in any form at any time.

13. Not participate in sexual contact or activity with children under the age of 18—including grooming, or contact through digital media. Mistaken belief regarding the age of a child is not a defense. Consent from the child is also not a defense or excuse.
14. Unless there is the full consent² by all parties involved, I will not have sexual interactions with members of the surrounding communities. This includes relationships involving the withholding or promise of actual provision of benefit (monetary or non-monetary) to community members in exchange for sex (including prostitution). Such sexual activity is considered “non-consensual” within the scope of this Code.
15. Consider reporting through the GRM or to my manager any suspected or actual GBV by a fellow worker, whether employed by my company or not, or any breaches of this Code of Conduct.

With regard to children under the age of 18:

16. Bring to the attention of my manager the presence of any children on the construction site or engaged in hazardous activities.
17. Wherever possible, ensure that another adult is present when working in the proximity of children.
18. Not invite unaccompanied children unrelated to my family into my home, unless they are at immediate risk of injury or in physical danger.
19. Not use any computers, mobile phones, video and digital cameras or any other medium to exploit or harass children or to access child pornography (see also “Use of children's images for work related purposes” below).
20. Refrain from physical punishment or discipline of children.
21. Refrain from hiring children for domestic or other labor below the minimum age of 14 unless national law specifies a higher age, or which places them at significant risk of injury.
22. Comply with all relevant local legislation, including labor laws in relation to child labor and World Bank’s safeguard policies on child labor and minimum age.
23. Take appropriate caution when photographing or filming children (See Annex 2 for details).

Use of children's images for work related purposes

When photographing or filming a child for work related purposes, I must:

24. Before photographing or filming a child, assess and endeavor to comply with local traditions or restrictions for reproducing personal images.
25. Before photographing or filming a child, obtain informed consent from the child and a parent or guardian of the child. As part of this I must explain how the photograph or film will be used.
26. Ensure photographs, films, videos and DVDs present children in a dignified and respectful manner and not in a vulnerable or submissive manner. Children should be adequately clothed and not in poses that could be seen as sexually suggestive.
27. Ensure images are honest representations of the context and the facts.
28. Ensure file labels do not reveal identifying information about a child when sending images electronically.

² **Consent** is defined as the informed choice underlying an individual’s free and voluntary intention, acceptance or agreement to do something. No consent can be found when such acceptance or agreement is obtained using threats, force or other forms of coercion, abduction, fraud, deception, or misrepresentation. In accordance with the United Nations Convention on the Rights of the Child, the World Bank considers that consent cannot be given by children under the age of 18, even if national legislation of the country into which the Code of Conduct is introduced has a lower age. Mistaken belief regarding the age of the child and consent from the child is not a defense.

Sanctions

I understand that if I breach this Individual Code of Conduct, my employer will take disciplinary action which could include:

1. Informal warning.
2. Formal warning.
3. Additional Training.
4. Loss of up to one week's salary.
5. Suspension of employment (without payment of salary), for a minimum period of 1 month up to a maximum of 6 months.
6. Termination of employment.
7. Report to the Police if warranted.

I understand that it is my responsibility to ensure that the environmental, social, health and safety standards are met. That I will adhere to the occupational health and safety management plan. That I will avoid actions or behaviors that could be construed as GBV. Any such actions will be a breach this Individual Code of Conduct. I do hereby acknowledge that I have read the foregoing Individual Code of Conduct, do agree to comply with the standards contained therein and understand my roles and responsibilities to prevent and respond to ESHS, OHS, GBV issues. I understand that any action inconsistent with this Individual Code of Conduct or failure to act mandated by this Individual Code of Conduct may result in disciplinary action and may affect my ongoing employment.

Signature: _____

Printed Name: _____

Title: _____

Date: _____

DECISION STATEMENT

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APPROVAL OF THE ENVIRONMENTAL MANAGEMENT PLAN

Number: 203-ECA/438/2021/27 : ستره ستره

[illegible]

*This Environmental Decision Statement is issued for the purpose of communicating the decision regarding the **Environmental and Social Management Plan for the Proposed Establishment of an IWRMC at Thimarafushi, Thaa Atoll**, which was submitted for evaluation on **10^h January 2021** and submitted additional information on **08th February 2021** by **Ministry of Environment**. The environmental consultant of this project is **Mr. Hamdhoon Mohamed (EIA P03/2017)**.*

1. This Environmental Decision Statement has been issued on behalf of the Environmental Protection Agency (hereinafter referred to as the Ministry) pursuant to the Environmental Impact Assessment Regulations 2012 (2012/R-27) to advise that the Ministry has decided that the proposed project can proceed according to the Environmental Management Plan.

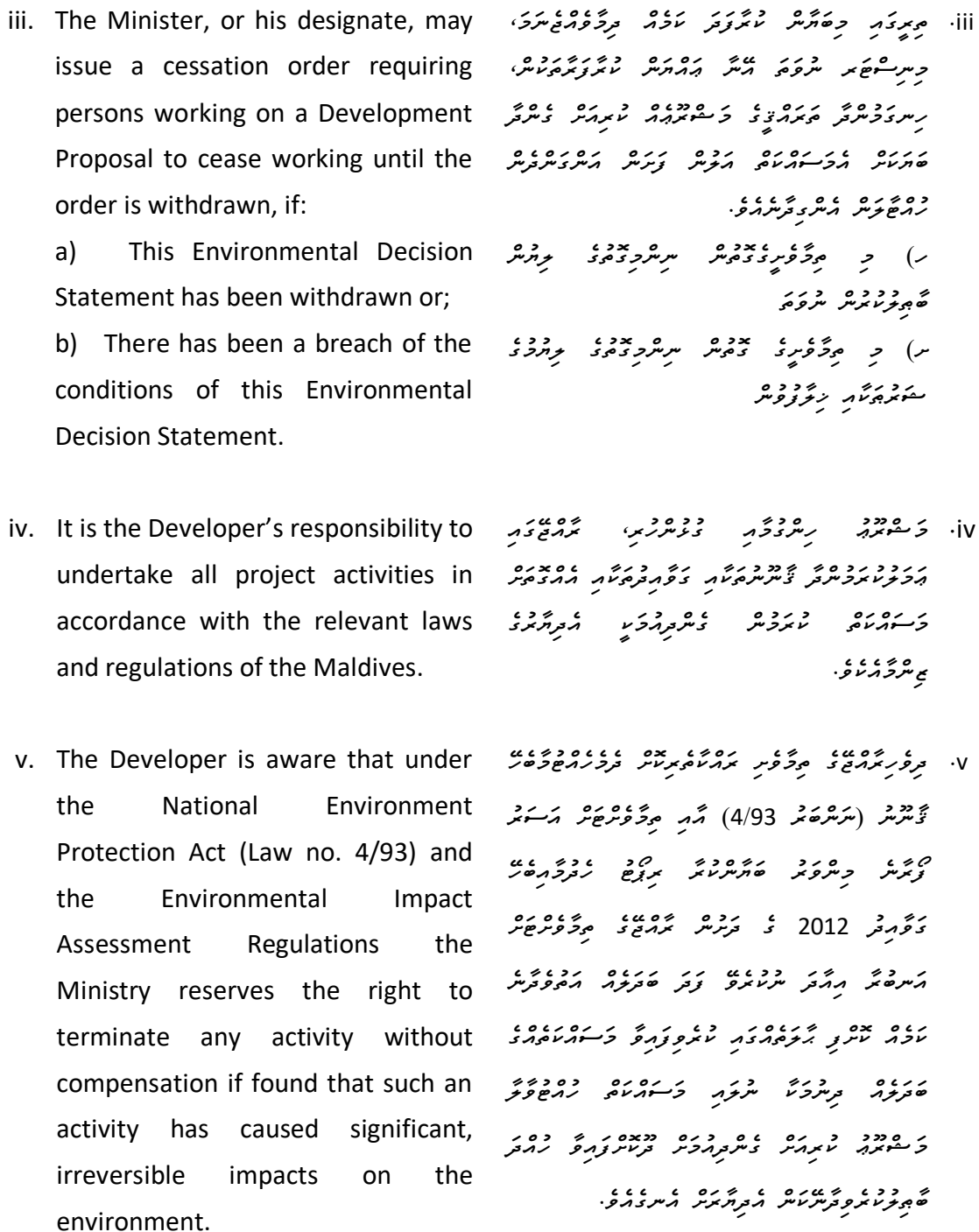
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Noting that



2. The decision has been made by the Ministry on the following conditions:

- i. In the event the project activity has not commenced **within one (1) year** from the date of issue, or if the duration of this Environmental Decision Statement has not been extended, this Environmental Decision Statement shall be considered null and void.
- ii. In the event the project activities have been delayed for more than one (1) year due to unforeseen circumstances, the Ministry shall have the discretion to extend the duration of the Environmental Decision Statement, or to terminate it. In such circumstances the proponent shall write to the Minister for an extension clearly stating out the reasons for the delay.





- vi. All mitigation measures proposed in the EMP report for all the phases of the project shall be fully implemented.
- vii. The date of expiry stated in this Environmental Decision Statement is the duration given to commence the project activities approved under this Environmental Decision Statement.
- viii. Once the project activities have started, the Proponent must inform the Environmental Protection Agency, the date of commencement of project activities.

Date of initial Issue: 14th February 2021

تاریخ مبدی: 14 فبروری 2021

Date of expiry: 14th February 2022

تاریخ ختم: 14 فبروری 2022

Name: Mr. Ibrahim Naeem

نام: ابراہیم نعیم

Designation: Director General

تصدیق: ڈی جی

Signature:

تصدیق: