ENVIRONMENTAL MANAGEMENT PLAN
FOR
THE ESTABLISHMENT OF ISLAND WASTE MANAGEMENT CENTER
IN
HA. MURAIDHOO, HA. THAKANDHOO, HA. MOLHADHOO, HDH. FINEY, HDH. HIRIMARADHOO, HDH. KURINBI AND HDH. VAIKARADHOO

PREPARED FOR
MINISTRY OF ENVIRONMENT AND ENERGY

PREPARED BY
MALDIVES ENERGY AND ENVIRONMENTAL COMPANY (MEECO)

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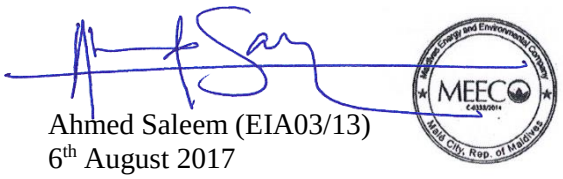
DECLARATION OF THE CONSULTANT AND PROPONENT

I certify that the statements made in this Environmental Management Plan are true, complete and correct to the best of my knowledge and available information at the time of writing this report.



Ahmed Saleem (EIA03/13)
6th August 2017

Proponent

The proponent of this project Ministry of Environment and Energy, Maldives has provided declaration letter attached in **Annex 1.**

CONSULTANT TEAM MEMBERS

This EMP report was prepared by a multi-speciality team of local experts. The team consisted Mr. Ahmed Saleem and Mr. Ali Hammadh registered EIA consultants with the Maldives Environment Protection Agency (EPA). The team members, their respective field of expertise and areas of contribution to the assessment is given in **Table 1**.

Table 1: The EMP Team

Name	Qualification	Designation/Field of Expertise	Contributing Area
Mr. Ahmed Saleem	MSc. Ecology & Environment	Lead EIA Consultant	• Overall administration of the EIA • Contributed to the various chapters • Report review
Mr. Ali Hammadh	BSc. Environmental Management	EIA Consultant	• Deputy Team Leader • Report writing and compile • Stakeholder consultations • Contributed to the various chapters of the report.
Mr. Maumoon Saleem	BSc. (Hons) Civil Engineering	Civil Engineer	• Data analysis • Data collection • Concept review • Stakeholder consultations • Contributed to the various chapters of the report.
Mr. Dinal Shalika		Surveyor	• Preparation of maps and charts
Mr. Muslih Mujtaba		A.Surveyor	• GIS analysis

NON-TECHNICAL SUMMARY

1. The Ministry of Environment and Energy has proposed a project to establish an Island Waste Management Centre (IWMC) in nineteen (19) islands of Zone One (Haa Alif, Haa Dhaal and Shaviyani) in order to manage waste generated, on an island level. This project is funded by the OPEC Fund for International Development (OFID) under the "Provision of Water Supply, Sanitation and Solid Waste Management Project". The proponent has requested consultancy services of MEECO for the preparation of an Environmental Management Plan (EMP) for the proposed project. Of the nineteen (19) islands. Maldives Environmental Protection Authority (EPA) screening process resulted in 14 islands being classified as requiring an EMP. This EMP includes 7 of the 14 islands, namely HA.Muraidhoo, HA. Molhadhoo, HA. Thakandhoo, HDH. Hirimaradhoo, HDH. Finey, HDH. Kurinbi and HDH. Vaikaradhoo.

2. Current state of waste management in the project islands are as follows:

   HA. Muraidhoo

   There is currently no waste management system in place in HA. Muraidhoo. No area has been demarcated or established to dispose of waste. Therefore, residents have been dumping waste at the periphery of the residential zones. These waste include plastic, organic waste, metals, and glass. Kitchen waste is thrown on the beach areas around the island. Along with the kitchen waste, metal cans and glassware are also dumped on the beaches. Nappies have been buried at the western beach of the island.

   The Island Council of Muraidhoo has developed a Waste Management Plan (WMP) in 2017 for the subsequent 5 years. The WMP has not been approved by the EPA as of date.

   HA. Thakandhoo

   There is currently no waste management system in place in HA. Thakandhoo. In 2014, the Island Council cleared two areas on both the northern and southern end of the island to be used as dumpsites. While there was cooperation within some residents of the island, the two areas established for waste dumping are unused as of today. This was mainly due to the lack of a budget and waste management equipment, in addition to a lack of cooperation from the residents. Therefore, residents have been disposing waste at the periphery of the residential zones.

   HA. Thakandhoo Island Council has formulated a Waste Management Plan (WMP) in 2017 for the next five years. The WMP has been approved by the EPA.

   HA. Molhadhoo

   Waste is currently dumped at one specified plot of land located 250m to the east of the islands residential zones. This plot is located 160m to the west islands wetlands. There is currently no waste management system with the lack of a waste collection service or staff at the dumpsite to handle waste sorting and disposal. Locals transport their waste to the designated area themselves, mostly in wheel barrows. The area demarcated for dumping waste is managed by the Council. Waste is sorted at the dumpsite as locals follow the Council's guidelines while dumping waste, with metal and construction waste, yard waste and sanitary waste dumped separately. Organic kitchen waste is regularly dumped to the sea with no specific areas allocated for this purpose. Sanitary wastes are buried and covered with sand in a ditch at the existing dumpsite, when the ditch is full the waste inside is burned and covered with sand reducing the volume of waste in the plot so that it can be used again.

The island does not have an established Waste Management Plan (WMP) as of yet. During field visit, the Council highlighted that the WMP is in the drafting stage

HDH. Finey

An area has been cleared in HDh. Finey to dump the waste. The area is currently next to the proposed IWMC site, with part of the footprint overlapping. The dump site is not fenced off. It was observed on the field visit that there was an attempt to separate waste types using sign boards. According to the Island Council, this was attempted during 2016. Although the separation has been attempted, it was noticed that due to lack of any waste management equipment or machinery, the stockpiles quickly became difficult to manage due to the sheer volume. Putrescible wastes such as kitchen wastes are not dumped in this area, and as is the norm in majority of the islands without a waste management system, they are dumped at certain beach areas. Even though a dumpsite has been allocated by the Council, biodegradable wastes such as green wastes are still burnt in some areas of the island.

HDh. Finey currently has no Waste Management Plan formulated as of the date of visit.

HDH. Hirimaradhoo

No area has been demarcated or established to dispose of waste. Waste has been dumped in places such as the area south of the football ground, and a considerable amount of tree trunks have been dumped at the periphery of the south-eastern beach area. Kitchen waste is thrown on the beach areas around the island. Along with the kitchen waste, metal cans and glassware are also dumped on the beaches.

The Island Council has formulated a Waste Management Plan (WMP) in 2017 for the next five years, although it has not been approved by the EPA as of date.

HDH. Kurinbi

The island currently has an Island Waste Management Center (IWMC), which was established during 2013. Although the infrastructure is present, the island currently has no equipment or machinery to manage the waste generated within the island. Waste such as plastics and metals cannot be reduced in volume, therefore the unmanaged waste is stockpiled inside the IWMC. Other types of (biodegradable) waste is burnt regularly near the IWMC. Waste is burnt every week except on Saturdays and Sundays. The residue from the burning is then taken and disposed of near the beach. Nappies are burnt in an enclosed container along with dry wastes. Composting was attempted previously, and the IWMC workers report that 6 bags (25 kg each) of compost was produced in 4 months.

HDH Kurinbi Island Council formulated a Waste Management Plan on 23 November 2015. The WMP was not approved by EPA at the time of visit

HDH. Vaikaradhoo

Vaikaradhoo Council has set guidelines for disposal of waste, and waste disposal is done on a set schedule on allocated days. It was noted that a minority do not follow these guidelines. Waste is dumped at a demarcated dumpsite, but there are no facilities within it, therefore the island faces difficulty in burning and reduction of waste. Kitchen waste is dumped at the coastal area. The current dumpsite was constructed under a UNDP project by Vaikaradhoo Il'haaru Jamiyya. The waste brought to the dumpsite is currently separated and stockpiled inside the dump site. The Island Council has allocated staff to conduct the separation, stockpiling and burning of waste in the dumpsite. Currently, there is no mechanism set up to transport unmanaged waste from the island.

HDH. Vaikaradhoo has formulated a Waste Management Plan (WMP) on 29 November 2016 for a period of 5 years. The WMP was not approved by EPA at the time of visit.

3. The project locations and site conditions for the islands are as follows:

HA. Muraidhoo

The proposed site for the construction of IWMC is located in the southern region of Muraidhoo. The site has been largely cleared of vegetation except for a few shrubs and young beach hibiscus shoots, and is accessible by the main road "Nala Magu" stretching from the harbour area towards the southern end of the island. The site is 26 m south of the recreational area of Muraidhoo, while the nearest coastal vegetation is at distance of 31 m from the site. The nearest residential area of the island is 215 m away from the site.

HA. Thakandhoo

The project site is located north of the residential area at 6°50'46.96"N, 72°59'42.17"E. An unpaved access path is present which connects to the residential areas from the western side. The project footprint falls on an area which includes 7 mature palm trees in addition to young vegetation including approximately 15 young palm trees and 2 juvenile palms. In addition to these, the site also contains sea lettuce and padanus shrubs. The site is 49 m from the closest coastal vegetation belt, and 73 m from the nearest residential area, which fits into the buffer zone recommended by the EPA. However, it should be noted that the site is approximately 10-15 m away from the wetlands in the north of the island, and therefore adjustment of the proposed site location is proposed to ensure at least a 15 m buffer.

HA. Molhadhoo

An area of 1000 sqm has been cleared for the construction of IWMC by the council. The plot is located at the south western side of the island. 500 sqm is the recommended size for the IWMC with regard to island's population. The site is accessible directly from the island's main road and it has been cleared of all vegetation. The closest residential area is at a distance of 99 m from the site. The vegetation line of the island is 52 m from the site. There is an empty plot of 4800 sqm next to the site which has been proposed to be leased out and used for industrial purposes. The council highlighted that this plot could also be used to construct an extension for the IWMC of the need arises in the future.

HDH. Finey

The proposed IWMC is located in the southwestern side of the island. The site is accessible by a main road stretching north to south through the Island. The site allocated has an area of 25 m by 25 m. The site location has been chosen in order to reduce the impact of odour due to monsoonal winds and proximity to residential locations. The project site has a buffer of 300+ m from the residential as well as the recreational areas, while the site is approximately 290 m from the wetlands, and 90 m from the coastal vegetation belt.

HDH. Hirimaradhoo

The proposed site is located in the southern region of HDH Hirimaradhoo. The site has been cleared and has no vegetation, and is accessible by the road "Mirihi Magu" The site is 138 m south of the recreational area of Hirimaradhoo, while the nearest coastal vegetation line is at distance of 49 m from the site. The nearest residential area of the island is 120+ m away from the site.

HDH. Kurinbi

HDh. Kurinbi currently has an IWMC constructed in the island. The Island Waste Management Centre (IWMC) infrastructure is located in the eastern side of the island. The site is accessible by a cleared road. The site complies with the EPA recommended buffers for the coastal vegetation (37 m), nearest freshwater well (114 m), nearest recreational / public area (132 m), wetlands (160+ m) and residential areas (165 m).

HDH. Vaikaradhoo

The project site is located in the south of HDH. Vaikaradhoo. Access roads are present on both sides of the site. The site is located next to the current waste dumpsite used in the island. The site has been cleared by the Island Council. Therefore, no vegetation, mature or young, is present on site. The site is at a distance of 57 m from the closest vegetation line, and the closest residential area is 130 m from the site.

4. The main activities involving the construction of the IWMC include shallow excavation, substructure and superstructure works as well as masonry works. The proposed design of the IWMC requires a shallow foundation due to the structure being a single story 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 construction phase of the project is expected to be completed within 10 weeks. The IWMC is made up of an equipment room, and separate areas to store metal waste, paper and cardboard, plastic waste, glass waste as well as hazardous waste.

5. The operational phase of the project includes waste collection from households, institutions, and public spaces, sorting, volume reduction and stockpiling of recyclables, composting of organics, and storage of hazardous waste. The IWMC has a capacity of 39 m^3 for composting, and approximately 7.9 m^3 capacity compartments for glass, plastic, metals and hazardous wastes.

6. Key activities anticipated to have a negative impact during construction phase are:

Table 2: Impacts envisaged during construction phase and proposed mitigations

Activity	Main Impacts	Major mitigations
Workers Influx and Settlement	Impacts on flora and fauna	Orient workers on sensitive sites, against catching birds and animals, damage to flora, workforce kept at minimum, littering prohibited.
	Impacts on resource use	Encourage choosing of local contractors,
	Sociocultural impacts	Encourage choosing of local contractors, ensure work permits, worker orientation.
Transportation of Materials	Marine and terrestrial pollution	Cleaning of litter, hazardous waste management and spill kits, secure loads.
	GHG Emissions	Obtain materials from closest source, buy materials in bulk, reduce wastage, use of well serviced, efficient, vehicles conforming to regulations.
	Roads deterioration	Include in agreement to repair any damages after project, Use the shortest route for transportation, only the required amount and size vehicles shall be used.
	Accidents & Injuries	Licensed drivers, avoid transportation at night, secure loads being transferred.
Site Demarcation and Fencing	Impacts on flora and fauna	Surveyors understand scope of works, qualified surveyors, accurate equipment used.

	Accidents & Injuries	Protective clothing, works done during daytime, insect repellent to be available
Site clearing and earthworks	Loss of vegetation	Setting out survey, demarcate the plot, fence off, vegetation targeted for removal marked
	Terrestrial pollution	Excavated material used as backfilling and grading.
	Accidents & Injuries	Licensed machine operators, secure loads being transferred.
	Noise	Provide PPE equipment, use well serviced plant and machinery, reduce vehicle idling time.
Construction	Material storage	Equipment fenced off, no new facilities developed, National Fire Code followed for handling fuel, firefighting equipments available.
	Terrestrial pollution	Temporary storage area set onsite, cleaning of litter, hazardous waste and spill kits, transfer all waste to Thilafushi
	Noise	Provide PPE equipment, use well serviced plant and machinery, reduce vehicle idling time.
	Impacts on flora and fauna	Setting out survey, demarcate the plot, fence off site.
	Accidents & Injuries	Occupational safety plan, orientation, PPE provided.
Waste Generation	Marine and terrestrial pollution	Waste management plan followed, follow 3R steps, municipal and sanitary waste managed, waste transported to Thilafushi after works are completed.
Resource Use	Water	Initiate rainwater harvesting and storage, practice water conservation.
	Electricity consumption	Use well maintained and efficient equipment

The impacts identified for the construction phase were all identified to be minor due to the scale of the works of the project.

Key activities anticipated to have a negative impact during operation phase were:

Table 3: Impacts envisaged during operational phase and proposed mitigations

Activity	Main Impacts	Major mitigations
Waste collection and transportation	Terrestrial pollution	Covered vehicles, littering is prohibited and impose penalties on littering.
	Climate impacts	Regularly service vehicles. Restrict use of vehicles only during stated time in WMP

	Accidents and injuries	Occupational safety plan, orientation, well trained personnel to use vehicles.
	Air quality	Well serviced vehicles, vehicle covered, spray water to suppress dust.
Waste management activities (sorting, reduction and composting)	Health impacts	Regular transport of unmanaged waste to a central waste management facility, provision of temporary storage for untransported waste, reduction of bio aerosol release to the atmosphere by best practices, siting of IWMC, provide protective clothing to workers.
	Groundwater impacts	HDPE linings provided through design, leachate collection system, usage of windrow covers, waste not stockpiled on the ground.
	Amenity impacts	Prohibit littering within the premises and en route to the site on the island, impose penalties for littering, regular cleaning and supervision of the IWMC, keep stockpiles of organics low, keep pest and vermin population low.
	Air quality impacts	Cover putrescible wastes, follow composting best practices
	Fire hazards	Formulate fire management plan, provide firefighting equipment and training, Naked flames shall not be allowed at IWMC, placing awareness signs at the premises.
	Noise and vibration impacts	Provide PPE, equipment well maintained and use scheduled
	Accidents and injuries	Formulate occupational safety plan, worker training, provide PPE, use licensed drivers and operators, placing a first aid kit at IWMC.
Waste generation	Groundwater pollution	Hazardous waste managed in closed containers, spill kits provided.
	Terrestrial pollution	Prohibit eating and cooking in IWMC
Resource consumption	Water	Ensure compost windrow is shaded during dry periods, use a spray hose to decrease water consumption,
	Electricity consumption	Ensure the equipment are properly serviced and maintained, use the shredders and compactors under a plan

Positive impacts are expected from the operation of the IWMC, which includes positive impacts to the overall health and well-being of the island community, and positive impacts on the groundwater, terrestrial and marine environment. The local economy is also envisaged to have such impacts due to the generation of jobs, business opportunities through transportation of waste, and income from selling of compost, and other recyclable materials such as metals, glass and plastics.

7. It is expected that approximately 20 - 30% of the waste generated within the islands can be managed at the IWMC. Therefore in order to avoid the IWMCs reaching capacity for storage and composting, it is recommended to conduct regular trips to transport unmanaged waste to a central waste management facility. In contingency for cases where transportation is delayed, it is recommended to provide 660 L wheelie bins within the premises to temporarily store the unmanaged organic waste. Within the given size of the IWMCs, 25 nos. of wheelie bins can be kept on site, which can store unmanaged organic waste while alternative transportation options are arranged.

8. It should be noted that without the proper assistance, financially (in terms of budgetary allowances) and technically (in terms of provision of trainings and equipment), the IWMC runs the risk of potentially turning into a dumpsite, exacerbating the possible negative impacts to the receptors. Provision of resources to the Island Councils, in the form of budgetary allocations, proper training and waste management equipment is seen as a central cog in ensuring the proper management of waste in the island. The proponent shall ensure the aforementioned assistance is provided to the IWMC.

9. Implementation of the Islands' Waste Management Plan, in addition to the Waste Management Regulations and Guidelines for the islands is seen as crucial in achieving proper waste management within the island. The Island Councils shall ensure the proper operation of the IWMC and waste management within the island through enforcing penalties on non-conformances to gazetted waste management regulations and guidelines for the islands. This will ensure the positive impacts envisaged through this EMP.

10. A reporting mechanism has been proposed for each island with this EMP, which includes the IWMC occupier, the Island Council, and the Proponent. Proper reporting of the IWMC operations within the mechanism can ensure the continued monitoring and evaluation of the operations, provision of required assistance, and provide crucial information for future planning and policy decisions for the Proponent.

11. The Proponent of the project, Ministry of Environment and Energy guarantees their commitment to undertake the necessary mitigation measures and monitoring during all stages of the project that has been proposed in the report.

12. In conclusion, the findings of the EMP shows that the proposed activities for this project has minor negative impacts during the construction phase, and minor negative impacts as well as positive impacts during the operational phase. With appropriate measures, the envisaged negative impacts can be mitigated, and the positive impacts enhanced. Given that the Proponent has committed to the mitigation actions it is anticipated that the project can be implemented with minimum negative environmental impacts, and ensure the positive impacts envisaged from this much-needed project.

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1 INTRODUCTION

Ministry of Environment and Energy, Maldives (MEE) has facilitated the "Provision of Water Supply, Sanitation and Solid Waste Management Project" financed by OPEC Fun for International Development (OFID) to establish Island Waste Management Centres (IWMC) in nineteen islands in Zone 1 (which consists of Haa Alif, Haa Dhaal and Shaviyani atolls).

The completion of the proposed project will result in the establishment of an IWMC in these nineteen islands (19), and the operation of the IWMC will be facilitated under the Waste Management Plan devised by the respective Island Council and approved by EPA.

The project will be implemented under the *Saafu Rajje Policy* formulated by MEE to:

1. Reduce the amount of waste produced and discarded;
2. reuse, items discarded as waste;
3. recycle waste to create value added products;
4. use waste to generate energy; and
5. dispose waste in an environmental responsible manner.

The main objectives of the policy are to:

- Ensure that all Maldivians understand the importance of waste management and create awareness with regard to the waste management policy;
- evolve and develop the society through awareness so that it strives to protect and manage the natural environment sustainably;
- ensure all aspects of civil life are hygienic;
- ensure that air pollution is controlled and prevented and
- ensure that Maldives retains its natural coastal and marine environment without pollution.

In order to achieve the objectives of *Saafu Raajje Policy* MEE has plans to implement a regional waste management system together with Island Level Waste Management systems based on previous studies that has been done on waste management in the Maldives. In this regard, the Ministry had procured consultants to conduct the feasibility study of the regional waste management system which would work congruently with the Island Waste Management System.

The scope of the proposed IWMC 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. The waste that is not manageable in the island level is planned to be transported to the proposed Regional Solid Waste Management Facility (RSWMF) of Zone 1. At the time of the report, design of the Regional Waste Management System (RWMS) had been commissioned by MEE and was ongoing.

The proposed IWMC will be financed by OFID and constructed by contractors procured by MEE locally. Prior to construction of IWMC, preliminary studies such as site selection/approval, environmental impact assessments and environmental management plans are to be completed. Therefore, proposed locations for IWMC was screened by EPA and Ministry of Housing and Infrastructure (MHI). The initial screening of the locations resulted in the following 14 islands listed below was classified as requiring an Environmental Management Plan (EMP).

- Ha. Muraidhoo
- Ha. Molhadhoo
- Ha. Thakandhoo

- H. Dh Nolhivaram
- H. Dh Neykurendhoo
- H. Dh Makunudhoo
- H. Dh Kurinbi
- H. Dh Hirimaradhoo
- H. Dh Kumundhoo
- H. Dh Vaikaradhoo
- H. Dh Finey
- Sh. Noomara
- Sh. Feevah

This report includes seven (7) of the aforementioned fourteen (14) islands, namely:

- Ha. Muraidhoo
- Ha. Molhadhoo
- Ha. Thakandhoo
- H. Dh Kurinbi
- H. Dh Hirimaradhoo
- H. Dh Vaikaradhoo
- H. Dh Finey

Hence, Maldives Energy and Environmental Company (MEECO) who was contracted for the task after being the successful bidder, prepared this document in accordance with the EIA Regulation 2012 to obtain the required environmental clearance for the proposed construction of IWMC accordance with the Regulation enforced by Environmental Protection Agency (EPA). This EMP provides an assessment of the proposed IWMC in terms of existing environmental conditions and potential environmental impacts on the island. The findings of this report are based on information collected from literature, site visit, professional expertise and judgements. For site investigations, a field visit was conducted during the months of April and May 2017.

1.1 OBJECTIVE OF THE EMP

The objective of the EMP study is:

a) To provide the ways by which the proponent will manage and control the works associated with the construction and operation of the IWMC;
b) to provide an assessment of the potential environmental effects of the proposal and determine which of these, if any are likely to result in a significant effect on the environment and to propose ways and means of avoiding, mitigating, and or compensating the perceived negative effects of the project; and
c) to provide necessary information to EPA applicable to the proposed development in line with the EIA Regulations.

1.2 EIA AND EMP IMPLEMENTING PROCESS

In general the objective of an EMP report is to address the environmental concerns of the developmental project. The EMP report will also help to promote informed environmental and sound decision making during the development of the project.

The aim of the EMP is to identify, describe and assess in an appropriate manner, proposed development, in accordance with the provisions of guidelines and regulations of the Government of Maldives, the direct, indirect and residual effects of the project on the physical and biological environment of project environment. The EMP would also provide the ways by which the proponent will manage and control the works associated with the construction and operation of the IWMC.

This EMP has been developed within the framework outlined in the EIA regulations 2012. This EMP establishes the environmental management controls to be followed by the developer, its employees, subcontractors and sub consultants in carrying out the construction and operation of the IWMC.

Once the decision note is issued from EPA the proponent is obligated to implement the EMP and matters highlighted in the decision note.

CHAPTER 1
HA. MURAIDHOO

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2 INTRODUCTION

2.1 BACKGROUND

HA Muraidhoo is an island in the administrative atoll of North Thiladhunmathi. Muraidhoo is oriented in a NW-SE direction, and has a land area of 40 ha. Muraidhoo has a population of 858 (Island Council, 2017) people. The number of plots allocated for households are 224, of which 112 houses the current residents of the island. The average size of families in the island is 5 persons.

There are two schools in Muraidhoo, of which Muraidhoo School provides education up to grade 10, and Muraidhoo Pre-School, which provides baby nursery and nursery education. Healthcare is provided in the island through the Muraidhoo Health Centre, and a pharmacy is run by State Trading Organisation (STO). The main source of income to the islanders come from agriculture, fisheries as well as working in resorts.

The island currently has no water supply system or central sewerage system. 24 hour electricity service is provided to the island by the utilities company FENAKA. The island is accessible by harbour, which is 300 ft long by 200 ft wide.

The island faces pressing issues such as pollution due to unmanaged waste, groundwater contamination, and erosion. The Island Council has stressed the fact that erosion has been occurring around the island, with the most prominent areas eroding at a reported 5 ft. per year. The groundwater is polluted throughout the residential areas of Muraidhoo due to the lack of central sewerage facilities, and it is deemed unusable in some areas. As for the waste situation, even though the Island Council of Muraidhoo has developed a Waste Management Plan (WMP) in 2017 for the subsequent 5 years, the island currently has no waste management centre, landfill or dumpsite. This has led to the pollution of the island's environment at the periphery of the residential areas as well as the coastal areas.

No waste audit specific to the island has been carried out in the past nor had the waste situation of the island been properly assessed. A waste audit for Zone 1 (which includes HA, HDh, and Sh. Atolls) conducted by MEECO in 2016 showed an average of 1.30 kg/capita/day of waste generation within the islands. Using this average, approximately 1.1 ton/day of waste is estimated to be generated within the island. In order to manage the waste situation at the island level, the proponent, Ministry of Environment and Energy (MEE) has proposed the project to establish an Island Waste Management Centre (IWMC) in HA Muraidhoo.

The proposed project is facilitated by MEE and financed by the OPEC Fund for International Development (OFID) under the "Provision of Water Supply, Sanitation and Solid Waste Management Project". The completion of the proposed project will result in the construction of an IWMC, and the operation of the IWMC will be facilitated under the Waste Management Plan devised by the Island Council and Approved by the Environment Protection Agency (EPA).

The proponent has requested consultancy services of MEECO for the preparation of an Environmental Management Plan (EMP) to comply with the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012. EPA has issued a decision statement on HA. Muraidhoo that an EMP would be suffice for the proposed IWMC construction and operation works.

The scope of the IWMC is to facilitate island level management of the waste generated within the island, which includes sorting, volume reduction and stockpiling of recyclables, composting of organics, and storage of hazardous waste. The waste that is not manageable in the island level (approximately 70% of the waste) is planned to be transported to a central waste management facility.

A field visit was conducted by the MEECO team to HA. Muraidhoo on 23rd April 2017 in addition to a consultation meeting with the Island Council on the same day. This report is based on the findings of the field visit, consultations, previous EMP's and experience of the consultant.

2.2 PROJECT SETTING

HA. Muraidhoo is an inhabited island belonging to the administrative atoll of North Thiladhunmathi. Situated in the southern region of the atoll at 6°50′23″N 73°09′54″E, the island is northwest of the nearest inhabited island of Baarah, which is approximately 4 km from the island. Muraidhoo is also in close proximity to the island of Utheem, which is of historical significance. Muraidhoo is approximately is 298.2 km from the capital Male'. The nearest airport is in HDh. Hanimaadhoo, approximately 8 km from the island.

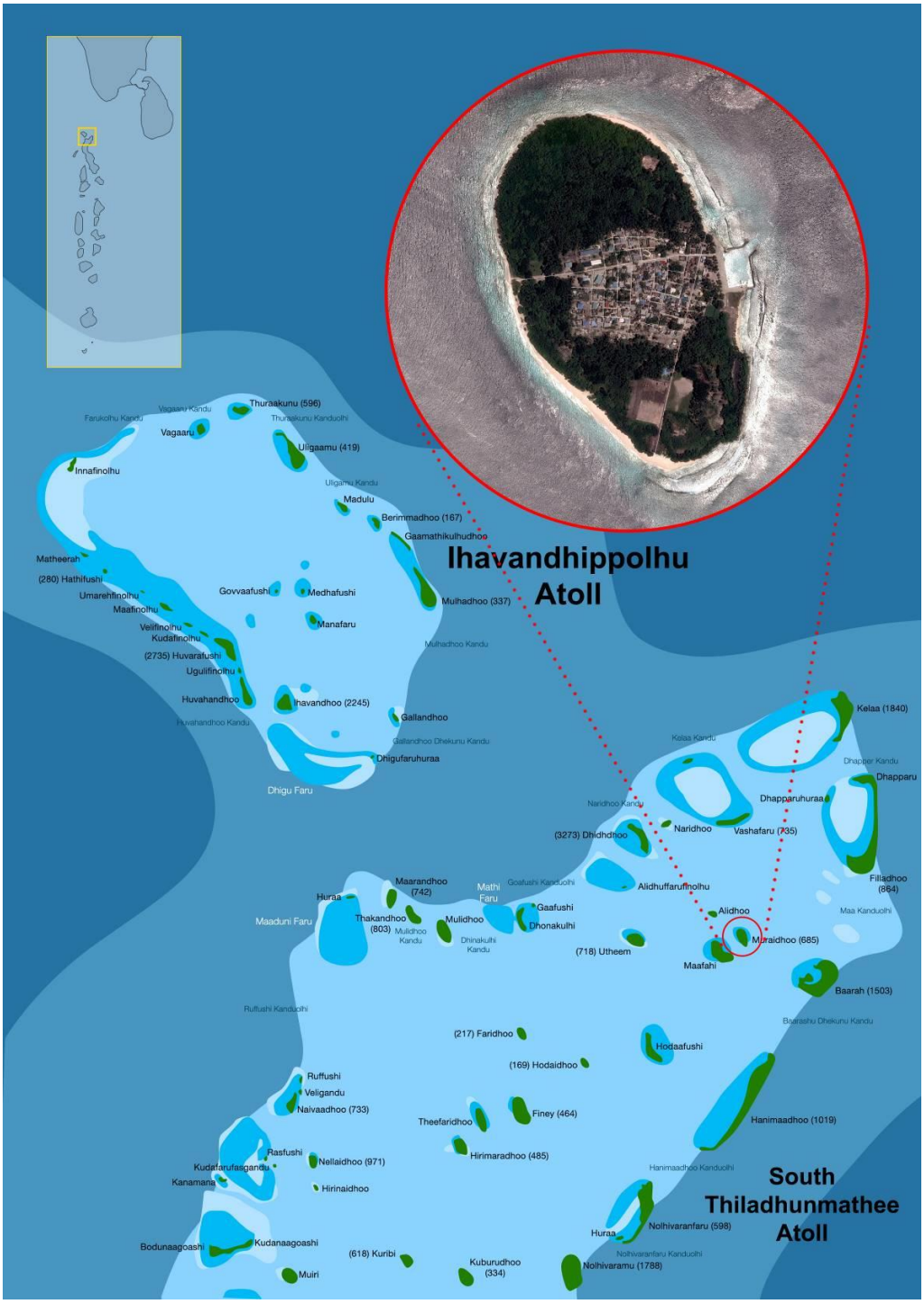

Figure 1: Project setting

2.2.1 Site Location

The proposed Island Waste Management Centre (IWMC) is located in the southern end of the island at 6°50'2.83"N, 73°10'5.35"E. The site is accessible by the main road (Nala Magu) stretching southwards from the harbour area.

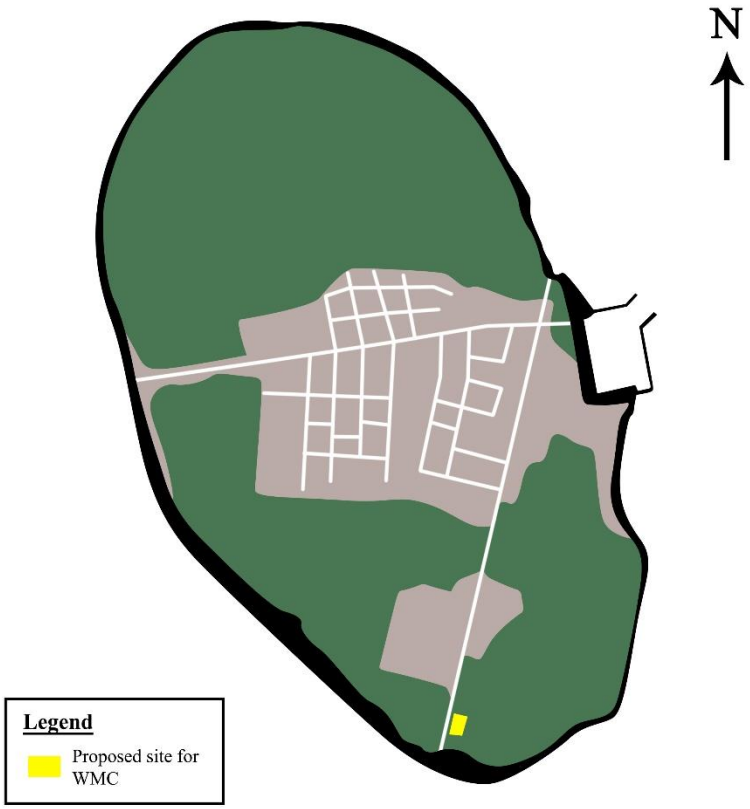

Figure 2: Proposed location for the waste management site on Muraidhoo Island

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2.3 CURRENT STATE OF WASTE GENERATION AND WASTE MANAGEMENT

2.3.1 Waste Generation in Zone 1 and HA. Muraidhoo

A waste audit conducted by MEECO in 2016 showed that the average waste generation of the islands in Zone 1 was 1.30 kg/capita/day.

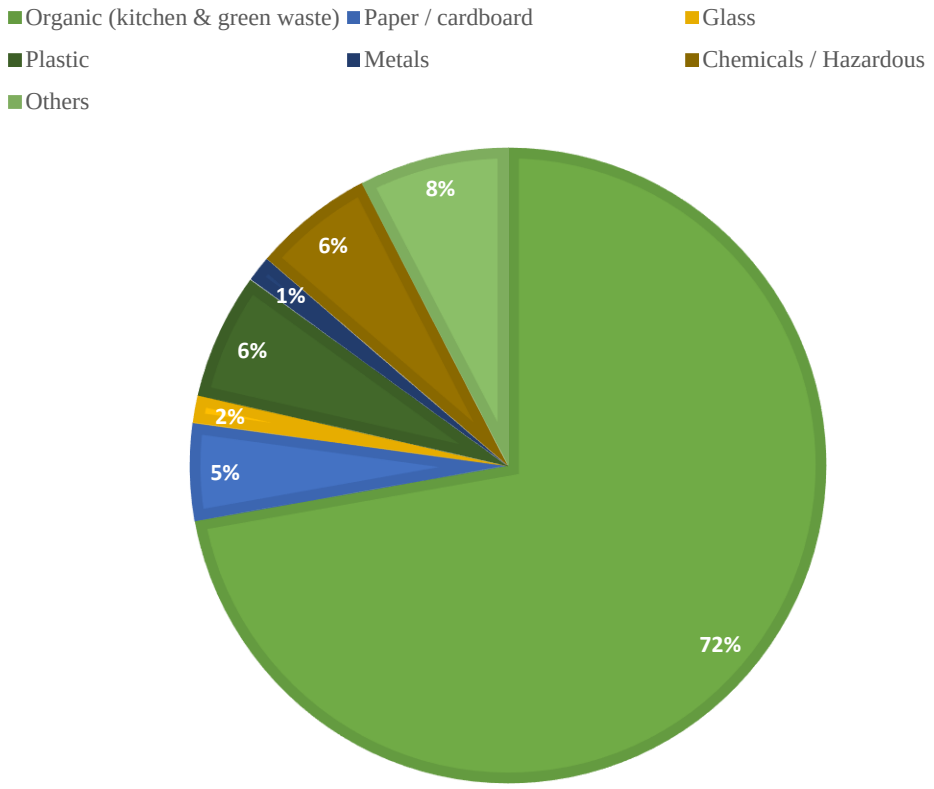

Figure 3: Waste Composition of Zone 1 (Source: MEECO, 2016)

The analysis shows that the majority of the waste generated includes organic wastes at 72%, which include kitchen and green wastes. This waste can be used in composting in addition to paper and cardboard wastes which are at 5% of the total waste generated. Recyclable materials such as plastic, metals, and glass make up 9% of the composition. Approximately 6% of the total waste generated is chemicals and hazardous waste. Using HA. Muraidhoo's current population, the daily waste generated can be estimated from this data.

Table 4: Estimated waste generation quantities of HA Muraidhoo

Waste Type	Zone One Average (%)	Muraidhoo Waste Generation (Kg/Day)
Organic (kitchen & green waste)	72.2	805.32
Paper / cardboard	4.94	55.10
Glass	1.42	15.84
Plastic	6.4	71.39
Metals	1.3	14.50
Chemicals / Hazardous	6.15	68.60
Others	7.58	84.55
Total	99.99	1115.29

2.3.2 Current state of waste management in HA. Muraidhoo

The majority of sources of waste in HA Muraidhoo are households, in addition to farming activities and clearing of land. There are no industrial activities conducted within the island.

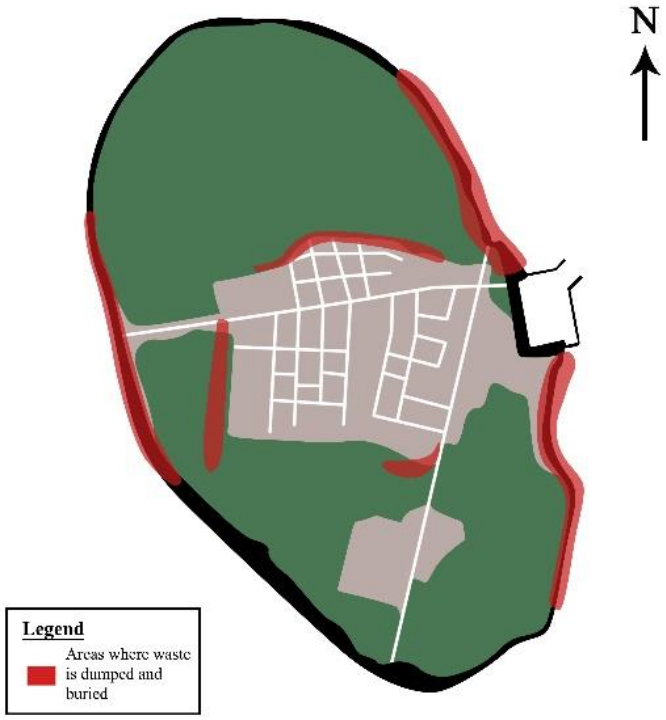

Figure 4: Areas where waste is currently disposed at

There is currently no waste management system in place in HA. Muraidhoo. No area has been demarcated or established to dispose of waste. Therefore, residents have been dumping waste at the periphery of the residential zones. These waste include plastic, organic waste, metals, and glass. Kitchen waste is thrown on the beach areas around the island. Along with the kitchen waste, metal cans and glassware are also dumped on the beaches. Nappies have been buried at the western beach of the island.

Figure 5: Current state of waste disposal in the island. The beach area of the western coast seen in photo C is where nappies are buried and kitchen waste is usually dumped

Issues that have arisen due to these practices include odour from rotting kitchen waste, spread of diseases and pollution of the beaches around the island.

2.4 WASTE MANAGEMENT PLAN OF HA. MURAIDHOO

Under the Waste Management Plan (WMP), the Island Council of Muraidhoo has highlighted that waste management is one of the most pressing issues for the island. The Council estimates that the majority (70%) of the waste is produced from the 112 households in the island. Household generated waste mainly include garden waste, kitchen waste and other categories such as nappies. The other contributors to the waste stream in Muraidhoo include the school (15%), health center (10%), power house (5%) and institutions (10%). The Council proposes the following targets to achieve in order to manage the aforementioned waste:

- Waste Management rules to be formulated and passed by the Council. Public awareness programs to be held to provide information regarding the newly formed rules.
- Implementation of a waste collection system
- Implementation of a waste recycling system
- Provision of dustbins to collect waste at various recreational areas.

In order to provide the waste collection service, the Council proposes the use of a vehicle which will operate every day from 9:00am to 12:00pm. The Council will monitor the aforementioned works.
The Council proposes the following fee system for the waste management works:

- Residential households: 150 MVR
- Vacant plots: 75 MVR
- Institutions and Businesses: 250 MVR
- Guest houses: 2000 MVR

<u>Administrative Arrangements</u>

- Muraidhoo Island Council and Waste Management Committee: Monitoring of the works of the waste management contractor
- Waste management contractor: collection and managing of waste.

3 DESCRIPTION OF THE PROJECT

3.1 THE PROPONENT

The proponent of the project is Ministry of Environment and Energy (MEE) of the government of the Maldives. The proposed activity is part of a greater project titled "Provision of Water Supply, Sanitation and Solid Waste Management Project" financed by the OFID.

3.2 PROJECT DURATION AND SCHEDULE

The proposed construction phase of the project is planned to be carried out in 10 weeks. This project was opened to bidders in June 2017 with a validity period of 90 days.

A tentative schedule of the work is found in **Table 5**.

Table 5: Work plan for IWMC

		Duration (days)	Weeks									
#	Activity		1	2	3	4	5	6	7	8	9	10
1	Mobilization	7										
2	Site clearing	4										
3	Excavation works	2										
4	Substructure and superstructure works	10										
5	Masonry works	10										
6	Plastering works	3										
7	Roofing works	7										
8	Structural steel works	7										
9	Electrical works	2										
10	Plumbing works	1										
11	Doors and windows	7										
12	Demobilization	2										

3.3 PROJECT DESCRIPTION

The proposed site plan is presented in **Figure 6**. Engineering details are provided in **Annex 2**.

The construction of the IWMC consists initially of mobilization and site clearing. The main works include shallow excavation, substructure and superstructure works as well as masonry works. The proposed design of the IWMC 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 operational phase of the project will include the daily collection of waste from the households and institutions, in addition to waste management works in the IWMC, which include;

- Sorting of waste;
- Storing of hazardous waste;
- Volume reduction of plastics, glass and metals;
- Stockpiling of sorted waste; and
- Composting of organic waste.

The IWMC is made up of an equipment room, and separate areas to store metal waste, paper and cardboard, plastic waste, glass waste as well as hazardous waste.

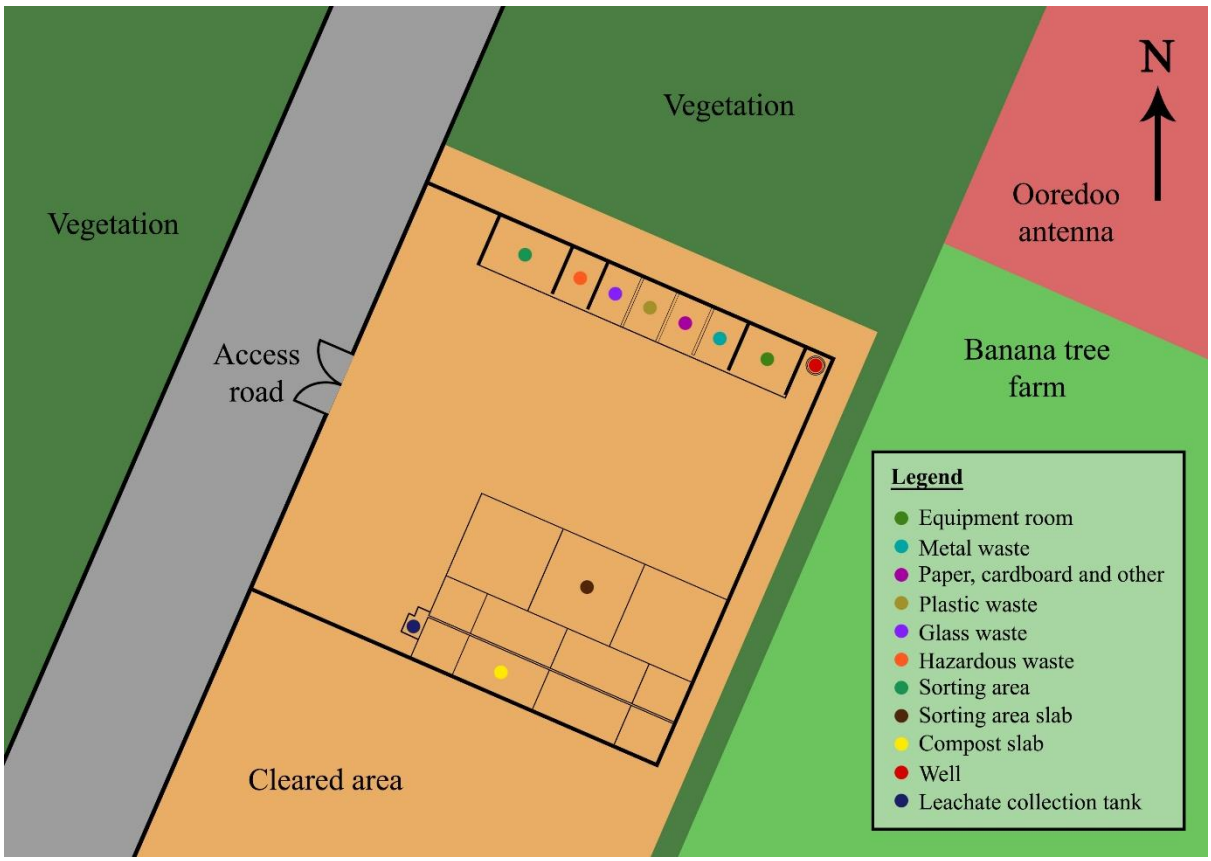

Figure 6: The site plan

3.3.1 Machinery

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

a) Lorry crane for placing of well;
b) Truck for transportation of materials;
c) Vibratory plate compactor;
d) Concrete mixer;
e) Concrete supply pump and piping; and
f) Daily 4" pump.

3.3.2 Mobilisation

As the amount of input materials are relatively minor, the construction materials shall be stored inside the demarcated site throughout the construction period

3.3.3 Demarcation and Fencing

Prior to beginning construction works, a survey shall be done by the contractor to demarcate the limits of the site, and the site shall be fenced off. Work shall be conducted within these limits.

3.3.4 Site clearance and levelling

The proposed site has already been cleared except for a few shrubs and weeds. Minimal site clearing works are therefore required, which include grubbing of roots. The site needs to be levelled in order to bring it to the formation level. As the site size is relatively small, a vibratory plate compactor may be used for the levelling of the ground.

3.3.5 Construction of Sorting Area Foundation

The footprint of the proposed site is 25 m by 25 m, of which the storage areas consists of a 3.15 m by 18.85 m area. The proposed foundation below the masonry walls of the structure is a line (strip) foundation.

3.3.6 Construction of Compost Slab and Sorting Area Slab

The compost slab and sorting area slabs has an area of 15 m by 10 m. The 100 mm thick reinforced concrete slabs are cast over ground beams B1, B2 and B3. The ground beams B1 and B2 have a depth of 0.3m while B3 has a depth of 0.4m from the top of the slab. B3 has a void on top of the beam centrally to receive a 100mm PVC pile cut in half sloping at 1% from the upper end to the lower end, connecting to the leachate tank at the end. Excavations will be done manually to receive the ground beams as per the drawings indicate. The maximum depth of excavation for the beams is 0.4m. The construction of the slab and ground beams include initially laying of HDPE membrane on the slab and beam footprint. Formwork will be added to the sides of the beams, and following that, the arrangement of the required reinforcing steel. Concrete will be poured for the ground beams, followed by the slabs. Concrete mixing will be done on site.

3.3.7 Construction of Leachate Tank

The leachate collection tank is located at the end of the compost slab. The leachate tank has an area of 1.1 m by 1.5 m and a depth of 1.09 m extending below ground. The valve junction of the leachate tank has a size of 0.8 m by 0.55m, and has a depth of 0.63 m. 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.

3.3.8 Construction of Perimeter Fence

The perimeter of the site covers a total length of 100 m, of which the whole length will 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 2.8m from ground level. The mesh is held together by 50 mm diameter GI pipes vertically 2 m centre to centre which are welded to three evenly spaced 38 mm GI pipes horizontally. The strip foundation below the masonry wall has a depth of 0.3 m with a 50 mm thick lean concrete placed below. Each vertical GI pipe is fixed to a 300 × 300 mm concrete footing with a depth of 0.6 m. The GI pipe is welded into a 200 × 200 mm plate. Therefore, the excavations done for the masonry wall strip foundation and GI pipe footing will be at 0.35 m and 0.6 m respectively. The trenches required to receive the strip foundation and footings will be excavated manually.

3.3.9 Construction of Well

A well is proposed to be constructed at the eastern corner of the IWMC. This well is 900 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. It is approximated from previous excavations and wells nearby that the depth of the water table will be at 0.6 m from ground level. 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.

3.3.10 Construction of Superstructure

The superstructure of the IWMC consists of the sorting area, storage area and the equipment room. The structure consists of a 3 m high wall separating the compartments. The roofing is supported by GI Pipes of diameter 38 mm and 75 mm. The roofing is made of LYSAGHT roofing sheets.

3.3.11 Labour Requirements and Availability

A 10 person workforce would be involved in the construction. Local construction contractors operate in the island, with two main groups of 5 and 4 people each. If the work is awarded to an outside contractor, there is the possibility of the work being subcontracted to these groups. If no such arrangements are made, labour accommodation will be arranged for the 10 person workforce in uninhabited houses.

3.3.12 Waste Management

Construction waste, which would mainly be excavated earth, nylon cement bags and general construction debris shall be collected and temporarily stockpiled within the project site. The small amounts of waste oil that may be generated from vehicles shall be disposed in closed containers. The waste shall be well secured to avoid any scattering due to strong winds.

Municipal waste produced by the workers are estimated at an average of 0.45 kg/capita/day which translates to 346.5 kg of waste for the duration of 11 weeks for the whole workforce.

After the construction works are done, the collected waste shall be transported to the waste management facility in Thilafushi.

3.3.13 Pollution and Control Measures

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

a) Machinery to be properly tuned and maintained to reduce emissions/spills/leaks;
b) Fuel storage, paint, lubricants will be stored securely and bunded; and
c) Spill kits would be made available on site to control any liquid spills.

3.3.14 Health and Safety Measures

The proposed project involves transportation as well as construction of the IWMC at the site. These works will include use of vehicles, machinery, and heavy materials, and the workers may be put in situations where there is a risk of injury. These risks need to be identified and managed through the implementation of health and safety guidelines for the site. Health and safety measures for the construction phase include and are not limited to:

a) The contractor would be briefed regarding the laws and regulations that need to be followed regarding the proposed works and would ensure that Health and Safety procedures are complied with at all times;
b) There would be a construction supervisor at the site;
c) Only experienced and licensed operators will be allowed to operate heavy machines;
d) First aid kit should be made available at the work site;
e) The work force would be equipped with all safety gears and warning signs would be provided;
f) Fire extinguishing equipment would be available at the site;
g) PPE should be provided to all workers and the use of PPE enforced;
h) Operation of any heavy machinery will need the assistance of a banksman as all times;
i) All heavy lifts must be supervised and slings inspected; and
j) All other similar environment personal safety and quality control measure to be in place and checked by a qualified personal and approved and maintained at all times.

3.3.15 Demobilization

The demobilization plan will commence in the last week of the contract.

3.4 OPERATIONAL PHASE

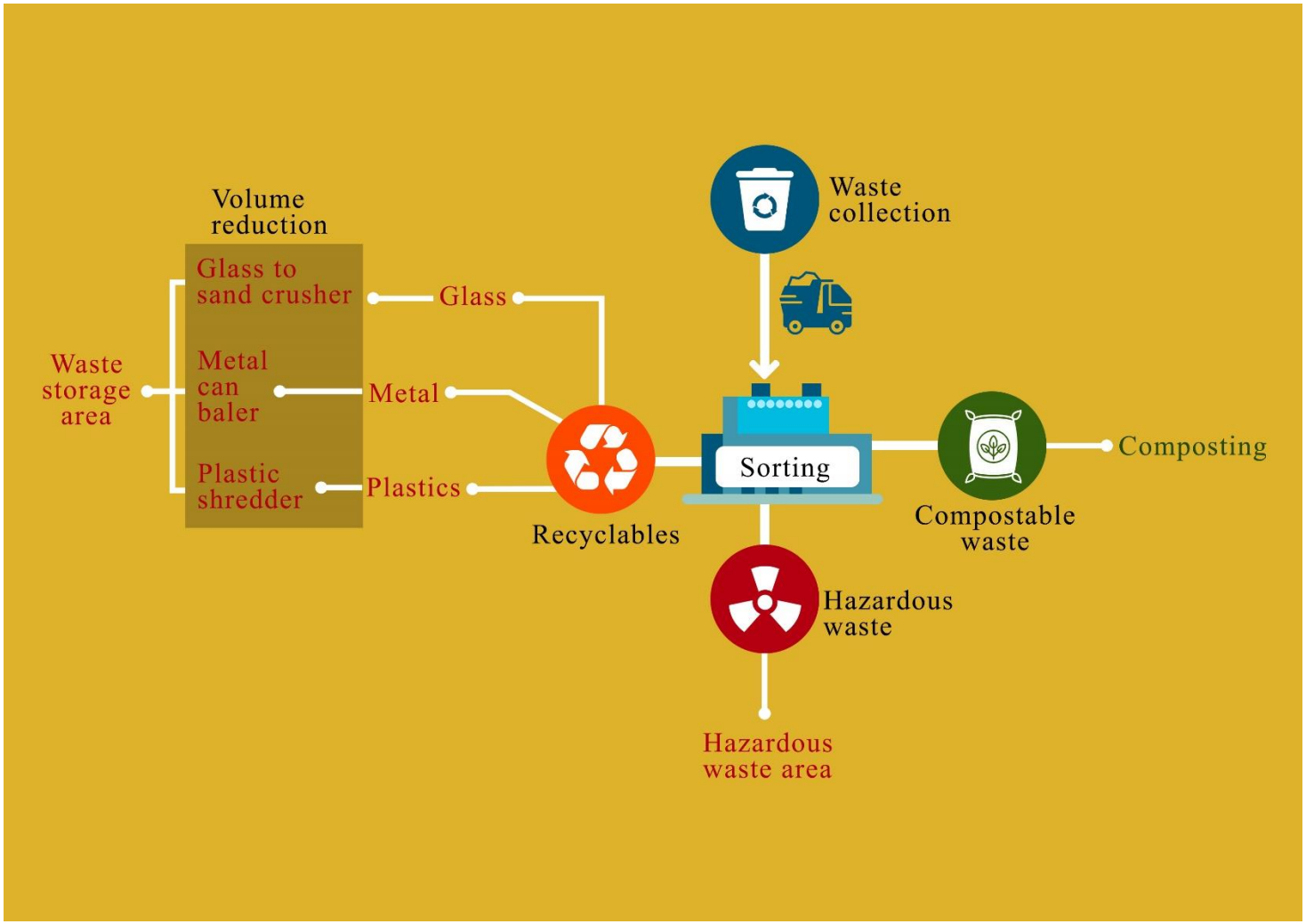

Figure 7: Operational phase flowchart of the IWMC of HA. Muraidhoo

The following section will highlight the operational aspects of the IWMC. This includes the machinery and equipment proposed to be used in the IWMC, in addition to the main activities to be carried out at the IWMC and within the island. The activities begin from the households and institutions, where the waste is generated. This waste is disposed of in the dustbins provided to the households as well as the dustbins placed at recreational areas and public spaces. During the operational hours, the designated vehicle will collect the dustbins and bring them the IWMC. This collected waste is 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.

3.4.1 Machinery and equipment proposed

During the operational phase of the IWMC, in addition to the collection of the waste and sorting, different activities such as composting, and waste volume reduction will be done. The proposed equipment for the IWMC include general equipment needed to handle the waste such as wheelbarrows, garden hoes, shovels, buckets and cultivators. These equipment will be used during the IWMC operation for handling as well as composting operations. A manual rotary compost screen is also included for the screening stage of the composting process.

Other equipment include waste volume reduction equipment such as a plastic shredder, metal can baler, vegetation shredder, and glass to sand crusher. The equipment and their specifications are detailed below.

Table 6: Equipment proposed for waste management works

Equipment	Details
Chainsaw	
Wheelbarrow	HDPE 6 cub. Ft.
Heavy Duty Gumboots	PVC or rubber
Heavy Duty Hand Safety Gloves	Rubber or Latex
Long Handled Flathead Steel Rake	Steel, 54 inches length
Long Handled Cultivator	Steel, 54 inches length
Garden Hoe	Steel, 57 inches length
19” Round Point Shovel	Steel
48” Square Point Shovel	Steel
19” D-Handle Square Point Shovel	Steel
20L Bucket	HDPE
40L Bucket	HDPE
Polypropylene Surgical Mask Box (50pcs)	Polypropylene
Weighing Bench Scale	50-75 kg capacity
Wheelie Bins	HDPE
Glass to Sand Crusher	0.5 to 1.0 tonne/hr, output 0.5mm and less, 2-5HP motor
Plastic Shredder	30-100Kg/hr Output material less than 10mm
Metal Can Baler	3 to 5 HP, 2m2 or more inside volume
Vegetation Shredder	Petrol / diesel driven multi vegetation shredder / chipper
Manual Rotary Compost Screen	1m to 1.5m drum

3.4.2 Waste Collection

According to the Waste Management Plan formulated by the Muraidhoo Council, the waste collection and IWMC operational works will be done by a third party under contract. Each house will be provided with 3 dustbins to sort the household generated waste. The waste will be collected every day from 9:00am to 12:00am from all households, using a vehicle during the said time frame.

3.4.3 Sorting

As per the IWMC site layout plan, a ground slab is dedicated for the sorting area. This sorting area is located next to the compost slab. Here, the collected waste will be kept, and sorted into their respective categories. In addition to this, a dedicated sorting area is also provided alongside the storage areas. The IWMC is designed to have separate storage areas for metal, paper and cardboard, plastic, glass, and hazardous waste. After sorting, the waste is stored in the respective location.

3.4.4 Composting

The IWMC is designed in order to facilitate the storing, sorting and reusing of the waste generated in the island. One of the main operations that will be conducted in the IWMC is the composting of the organic waste such as kitchen waste and garden 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 main constituents of a compost heap include kitchen and garden waste, along with water and air in the pore spaces between the constituent.

3.4.4.1 The Composting Process

After the incoming waste is 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.

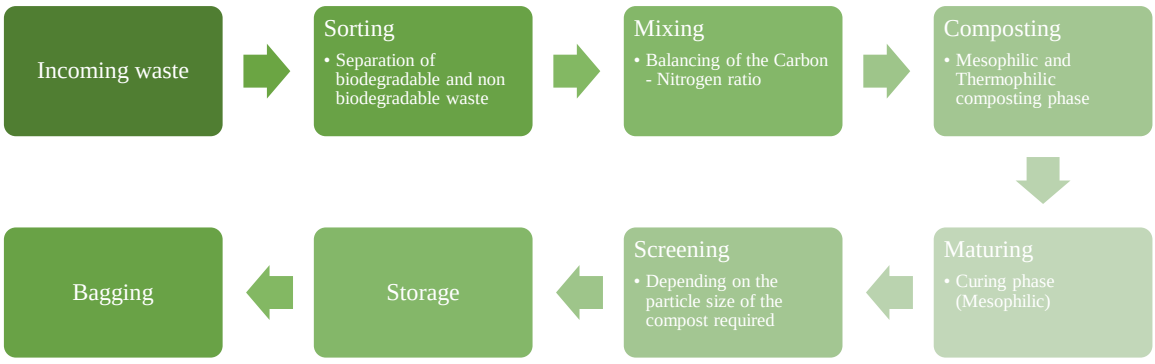

Figure 8: The composting process

3.4.4.2 Sorting of Incoming Waste

Incoming waste is required to be sorted to separate biodegradable and non-biodegradable waste. The use of 3 dustbins for each household as specified in the Waste Management Plan will streamline this process. Even though this is the case, further sorting of the biodegradable materials are done in order to separate garden waste, food waste and others such as scrap paper and cardboard. Hazardous waste and residues are kept in their respective compartments, as well as recyclables.

Table 7: Domestic Waste Categories

Incoming Domestic Waste			
Suitable for composting	**Not suitable for composting**		
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
Composting Process	**Storage**		

3.4.4.3 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.

Looking into the composition of compostable wastes from the Zone 1 Waste Audit, it is seen that the majority of compostable wastes constitute of garden (green) wastes. Garden wastes make up 64% of waste generated, while the second largest contributor to compostable wastes is kitchen wastes, at 28%. Printed paper and cardboard make up 5% of compostable waste while 2% of the category includes animal waste. This composition is important in determining the Carbon-Nitrogen ratio of the compost heap in order to provide optimum conditions for composting.

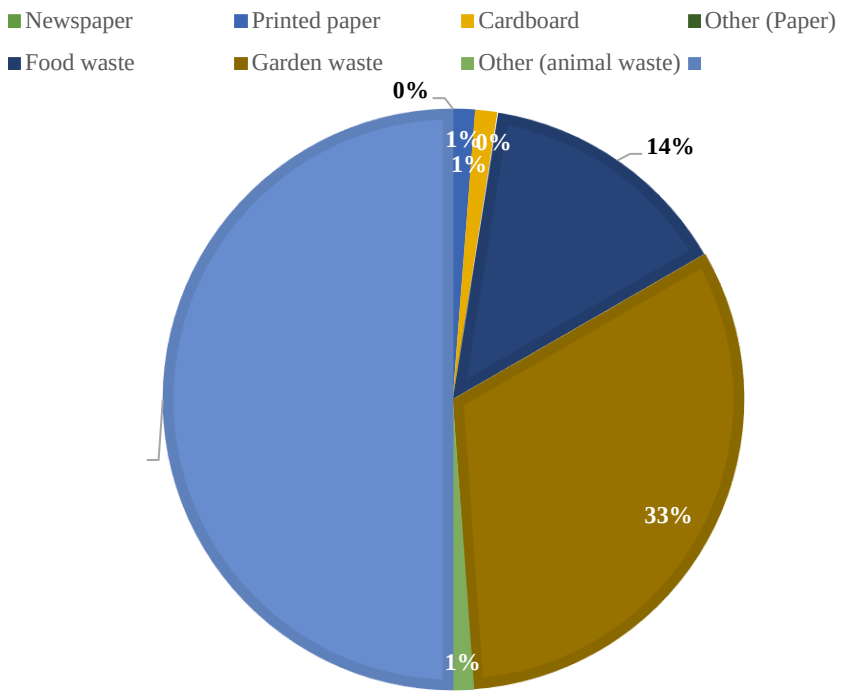

Figure 9: Composition of compostable waste for Zone 1

Table 8: Estimated compostable waste generation quantities of Zone 1

CATEGORY		Average Per Capita (kg/day)	Percentage
Primary	**Secondary**		
Paper & Cardboard	Newspaper	0.00	0.0%
	Printed paper	0.02	2.4%
	Liquid container	0.00	0.5%
	Cardboard	0.02	2.4%
	Other (Paper)	0.002	0.2%
Organics	Food waste	0.29	28.2%
	Garden waste	0.67	64.2%
	Other (animal waste)	0.02	2.2%
Total		1.04	100

Green wastes such as vegetable wastes (kitchen waste), and poultry manure have high Nitrogen values while brown wastes such as foliage, wood chips, bark and paper have high carbon values. From the waste audit, it is seen that 64.2% of the compostable waste produced is garden waste while 28.2% of the waste generated is food waste. Therefore, it can be said that the composition of compostable waste in the islands in Zone 1 is in favour of providing a high Carbon content compared to Nitrogen.

3.4.4.4 Composting and Maturing

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

Table 9: 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 (4 – 6)	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, the composting process can prolong to several months.

3.4.4.5 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. This slab is 15m long by 5m wide. 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 100mm 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 compost slab.

3.4.5 Volume Reduction

The incoming waste is sorted, and either used for composting, or stored in their respective compartments. 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.

3.4.6 Projected Capacity of the IWMC

The proposed IWMC is planned to manage the waste produced at the island level, with the unmanaged waste (approximately 70 – 75% of waste generated within the island to be transported to a central waste management facility. The projected capacity for 1 month's waste for the island of Muraidhoo is shown below.

Table 10: Projected waste management capacity for the waste generated in HA Muraidhoo in 1 month

Waste Type	Details	Amount	Unit
Organics	Composting capacity in IWMC. Assuming 1m height windrow with a width of 2m	39	m3
	Organic waste generated per month	37.17	m3
Paper waste	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	2.543	m3
Glass	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.731	m3
Plastics	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	3.295	m3
Metals	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.669	m3

As seen in **Table 10** the IWMC has the capacity to compost the waste generated in one month for the island. The remainder of waste types can be stored for longer than one month, and the capacity can be kept constant depending on the frequency of reduced material such as baled metal, crushed glass, and shredded plastic being procured by buyers.

Organic wastes make up the bulk of the waste stream in the islands, taking 72% of the total waste generated in the island. The composting capacity of the proposed compost slabs (assuming a windrow of 1 m height and 2 m width at the bottom and 1m width on top) is seen as 39 m^3. The estimated volume for the organic waste generated in a month in Muraidhoo is 37.17 m^3, which would take up the composting capacity of the IWMC for the succeeding 4 – 6 months. There is no additional storage space for the organic wastes provided in the facility.

Hazardous waste cannot be managed within the current setup of the IWMC, and therefore regular transportation of the waste shall be done.

3.5 PROJECT INPUTS AND OUTPUTS

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

Table 11: 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	29.66 m^3	Local Suppliers
		Reinforcement		
		Reinforcement T10	1.231 tons	Local Suppliers
		Reinforcement R6	0.19 tons	Local Suppliers
		Reinforcement T12	0.09 tons	Local Suppliers
		Formwork	135.66 m^2	Local Suppliers
		Masonry Works (200mm bricks)	205.8 m	Local Suppliers
		Structural Steel		
		50mm and 38mm GI Pipe for perimeter fence	77.4 m	Imported / purchased where available locally
		75mm GI pipe (flood light fixing poles and roof fixing)	18 Nos.	
		38mm GI bearer pipes	46.2 m	
		38mm GI purlin pipes	95 m	
		38mm GI pipes between columns	35.2 m	
		75mm GI pipe to support machine room door	3.5 m	
		Paint		
		Primer and 2 paint coats (Grey Color)	345.96 m^2	Local suppliers
		Electrical Components		
		3 Phase power sockets	4 Nos.	Local suppliers
		Single phase power sockets	3 Nos.	

		100 mm ceiling mount lights	1 Nos.	
		Wall mount exhaust fan	2 Nos.	
		500W flood light	2 Nos.	
		25 mm2 4 core power supply cable	290 m	
		Well water pump	1 Nos.	
		Metal doors for		
		Equipment room	1 Nos.	Local suppliers
		Hazardous waste area	1 Nos.	
		Waste yard entrance	1 Nos.	
		Plumbing		
		25mm PVC intake pipe		Local suppliers
		1/2 inch PVC pipe from pump to all distribution points	40.9m	
		Roofing		
		Storage area roof sheets	85.5 m^2	Local suppliers
		Flashing sheets	28 m	
		Lysaght gutter	19 m	
		50x50 PVC coated mesh fence	77.4 m^2	Local suppliers
		HDPE membrane	209.54 m^2	Imported / purchased where available locally
		Timber top cover	1 nos.	Local suppliers
		PVC pipe for leachate tank drain	15 m	Local suppliers
		600 x 900 5mm plastic sheet signboard	1 Nos.	Local suppliers
Operation	Equipment and Materials	Chainsaw	1	Imported / purchased where available locally
		Wheelbarrow	4	
		Heavy Duty Gumboots	5	
		Heavy Duty Hand Safety Gloves	5	
		Long Handled Flathead Steel Rake	3	
		Long Handled Cultivator	3	
		Garden Hoe	3	
		19” Round Point Shovel	3	
		48” Square Point Shovel	3	
		19” D-Handle Square Point Shovel	2	
		20L Bucket	3	

		40L Bucket	2	
		Polypropylene Surgical Mask Box (50pcs)	5	
		Weighing Bench Scale	1	
		Wheelie Bins	40	
		Glass to Sand Crusher	1	
		Plastic Shredder	1	
		Metal Can Baler	1	
		Vegetation Shredder	1	
		Manual Rotary Compost Screen	1	
	Waste	Waste generated within the island	Approximately 1115.29 kg of waste per day	Waste collected by vehicle from the waste bins within the island
	Fuel	Diesel		Local suppliers

Table 12: Project outputs

Stage	Output	Source / Type	Amount	Means of managing
Construction	Soil	Excavation for substructure	11.78 m^3	To be used back in the levelling and backfilling of site.
			209.54 m^2	
	Waste	Construction and clearing of vegetation		Collected in the temporary waste area and transported to Thilafushi after completion of the project
	Hazardous waste	Construction and clearing of vegetation		Collected as per hazardous waste management guidelines and transported to Thilafushi after completion of the project
	Municipal waste	Workers	346.5 kg	
	Dust	Excavation	Moderate amount of dust	
		Cement mixing	Moderate amount of dust	
	Green House Gases	Machinery		
		Concreting works	100.1kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
		Reinforcement	5311.1kg of CO2 indirect emissions (Ma et.al, 2016)	
		PVC Pipes	164.81kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
Operation	Compost	Open windrow composting	15.60 m^3 compost per cycle	Sold as fertilizer
	Crushed Glass	Glass crusher	0.731 m^3 per month	Crushed glass stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Compacted Metal	Metal baler	0.669 m^3 per month	Compacted metal stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Shredded plastic	Plastic shredder	3.295 m^3 per month	Shredded plastic stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	GHG	Electricity usage		N/A

4 EXISTING CONDITIONS

4.1 DESCRIPTION OF THE ENVIRONMENT

HA. Muraidhoo has a total land area of approximately 40 ha. The island is situated inside the Thiladhunmathi Atoll. The island is populated by 858 people, who have inhabited the central area of the island. Historically, people used to live in the northern areas of the island. Satellite imagery of the island from 2006 onwards show the spread out of residential areas towards the western side of the island. The island has a considerable amount of vegetation in the northern and southern areas. Banana farms are prominent on the southern area of the island. A wetlands consisting of small-leafed orange mangrove *(Bruguiera cylindrica Bl.)* trees are present at the south eastern side of island. The wetlands stretches to some extent along the eastern side of the island. The island consists of typical Maldivian flora and fauna such as coconut palms, breadfruit trees, beach hibiscus, portia, sea trumpet, pemphis, sea lettuce and screw pine.

The groundwater of the island has been polluted throughout the residential areas. The water has a strong odor, although clear in color. According to the Island Council, majority of the inhabited areas in the island has polluted groundwater. The island currently has no central sewerage system. There is widespread use of septic tanks within the island, which leads to the seepage of liquid waste into the groundwater lens. The depth of the groundwater lens varies from 0.3 m at the shallowest areas to 1.8m in the deepest areas.

The island sits on a saturated reef platform which decreases the amount of protection offered from the incoming wave energy. Island wide erosion was an important issue raised during the consultation meeting with the Island Council. The Island Council estimates a net loss of 5 ft of land per year in the most vulnerable areas.

Figure 10: Terrestrial vegetation of HA. Muraidhoo. A: Mangrove B: Banyan tree C: Banana D: Coastal vegetation belt including Sea Lettuce

Figure 11: Changes to the coastal region of Muraidhoo from 2006 to 2017

Morphology the island since 2006 is shown in **Figure 11**. From the figure, erosion is seen at the northeastern coastal area of the island. Erosion is also observed south of the harbor area, as well the southern coast of the island. Accretion is observed at the northwestern and western coast of the island. The island's harbor was constructed during 2007 which is the major coastal modification observed in the satellite imagery.

Figure 12: Coastal areas with the highest erosion rates, A,B and D: shoreline north of the harbor area. C: shoreline of the southern tip

4.2 PROJECT SITE

The project site is located in the southern region of HA Muraidhoo. An access road "Nala Magu" is present, which stretches from the harbour area of the island towards the southern tip of island. The site allocated has an area of 20 m by 20 m. Adjacent to the site is the land proposed to build the Sewerage Treatment Plant. The site location has been chosen in order to reduce the impact of odour due to monsoonal winds and proximity to residential locations.

The project site is at a significant distance from the residential areas. Areas close to the project site include Ooredoo antenna as well as the football pitch which is on the same road, north of the site. The closest freshwater well has been sealed off and unused. The site is also close to the southern coast of the island.

The site has been cleared except for a few shrubs and young beach hibiscus shoots. The ground condition of the site is observed to be generally good, although the southern part of the site was observed to consist of soft topsoil and the presence of voids was noted.

Figure 13: Site area with few shrubs and unpaved access road (B)

4.2.1 Site zoning recommendations by EPA

The EPA has provided recommendations for the optimum zoning of the IWMC site. The distances include, the site being at least 15 m from the coastal vegetation belt, at least 30 m from the nearest freshwater well, at least 40 m from the nearest recreational area and at least 30 m from the wetland area as well as the residential 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 13: Comparison between the proposed site location and EPA recommended distances

Location	Distance from site (m)	EPA Recommended Distance (m)
Coastal vegetation	31	15
Freshwater well (planned)	152.6	30
Recreational area	26	40
Wetlands	177.5	30
Residential area	214.9	30

As seen on**Table 13**, the site fulfils the EPA recommended buffers, except for the recreational area. The football field of the island is situated approximately 26 m from the site, while the EPA recommended distance is 40 m. The nearby banana tree farms should also be noted, as the closest distance between the site and the farm is 6m. Care should be taken to not cause any damage to the area during construction works as well as during the operational phase.

4.3 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were held for the project with the proponent MEE, enforcing agency EPA and the Island Councils of the respective islands. Meetings with MEE and EPA were held both before and after the survey trips in light of findings regarding some project islands. The initial meetings were mainly regarding the EIA project islands and scoping, although, due to the similar scope of works (except vegetation removal in the EMP islands' cases) the meetings included discussion of the project as a whole. Highlights of the meetings which apply to the EMP islands are presented below. Meeting attendances are provided in **Annex 3.**

4.3.1 Meeting with Proponent

- The proponent was consulted at the start of the assignment to discuss project scope and after field surveys to discuss findings of the initial field surveys.
- Proponent informed that MEE will be responsible for the construction of IWMC, while land clearance shall be undertaken by the respective Island Councils.

4.3.2 Meeting with EPA

- It was highlighted that waste management will not involve burning waste at the island level. Waste from islands will be transferred to the regional waste management center. Only organic waste will be managed at the island level to make compost. All necessary equipment required to manage waste at in the IWMC will be provided as part of the project.
- EPA informed that buffer distances recommended by EPA in the zoning form shall be kept in order to mitigate impacts.

4.3.3 Meeting with Island Council

- The Island Council stated that waste management is one of the most pressing issues for the island.
- The current state of waste management is that there is no demarcated area for waste disposal and the residents dispose of the waste at convenient locations in the periphery of the residential areas.
- The Island Council also pointed out various locations on the coastal areas of the island where waste is routinely disposed at, including but not limited to kitchen waste and plastic and metal containers.
- Nappies are buried at the western beach of the island.

- Most of the future residential zones are planned for the northern side of the island, and the IWMC is located in the south.
- The Island Council also mentioned the erosion that was occurring in the south – south east and eastern coastline.

5 ASSESSING THE LIKELY IMPACTS AND MITIGATION MEASURES

5.1 METHODOLOGY, NATURE AND IDENTIFICATION OF IMPACTS

Various impacts arising from the project such as direct, indirect and cumulative impacts have been identified. The methodology was based on:

a) Scoping meeting with stakeholders;
b) Observations made during the visit of the project island and site
c) Literature review of similar local and other EMPs; and
d) Findings from other similar projects in Maldives and experience of the Consultant.

Impacts on the environment were identified based on their location/attribute, magnitude and duration of the impact. Impacts were assessed based on their significance and categorized as negligible, minor moderate and adverse. A Leopold Matrix was used for this purpose, for both the construction and operation phase.

The Leopold Matrix was developed by Leopold et al. (1971). It is a quantified Matrix which consists of 100 project actions and 88 environmental characteristics, elements and conditions. Relevant environmental characteristics and project actions were used for the impact identification. First of all, all of the relevant activities of the project that may have an impact on the environment was identified and written on the top of the matrix. These were divided for both the implementation and operational phase of the project. The environmental characteristics that may be affected by the project is written at the left side of the matrix.

A slash is placed at the intersection with each item on the side of the matrix if an impact is possible. The upper left corner of each box where an impact is possible, a number from 1 to 10 is written as the *magnitude* of the possible impact. The number 1 represents the least possible impact and the number 10 represents the highest magnitude of the possible impact. No 0's are used in the Leopold Matrix. A + sign is placed before the number if the possible impact is a positive impact. No sign is placed before possible negative impacts. In the bottom right corner of the box, a number from 1 to 10 is written as the *importance* of the possible impact. 1 being the least important and 10 being of the greatest importance. In giving scores, the magnitude and importance of the activities were judged for their short term and long term impacts. The impacts with greater long term impacts were given higher scores compared to the impacts with more short term impacts.

5.2 POTENTIAL IMPACTS AND MITIGATION MEASURE FOR KEY IMPACTS

For every minor to moderate to major impact identified, a mitigation measure has been proposed and discussed below. The mitigation measures proposed would be strictly adhered to eliminate environmental impacts arising from the project, even before it occurs. The impacts and mitigation measures are detailed in the two stages, construction and operational stages as explained below.
The possible mitigation measures include:

a) Changes in work practices and increasing awareness;
b) Provision of environmental protection and health safety equipment; and
c) Environmental monitoring during construction phase and operational.

Mitigation measures suggested in the report will focus on the existing environmental conditions as well as impacts that may rise during operation of the IWMC.

Table 14: Impact Matrix for Construction Phase

	Envisaged impact factors	C1 Worker Influx and Settlement	C2 Transportation of materials	C3 Site Demarcation & Fencing	C4 Site Clearance and Earthworks	C5 Construction	C7 Waste Generation	C8 Resource Consumption (Water, Electricity)	Total (Impact Area)
Physical Components	Seawater	-2					-3		-5
		1					4		5
	Ground water	-3			-2	-3	-3	-5	-16
		1			3	4	3	5	16
	Air	-3	-3	-2	-3	-3	-2	-3	-19
		2	3	2	4	3	4	3	21
	Noise	-2		-1	-2	-2	-2		-9
		1		2	3	4	2		12
	Coastal Zone							-1	-1
								1	1
Biological Components	Flora	-2	-1		-2	-1	-2	-3	-11
		2	3		4	2	5	2	18
	Endangered species/protected areas		-2		-1				-3
			2		5				7
	Coral Reef						-1		-1
							1		1
	Fauna		-2		-2	-1	-2		-8
			2		4	3	3		12
Socio-Cultural Component	Aesthetics	-2	-3		-2	-5			-12
		2	3		3	5			13
	Accidents	-1	-7	-2	-1	-3	-2	-1	-17
		1	5	1	2	4	2	1	16
	Landscape				-1	-3			-4
					2	4			6
	Health/Well being	-1	-5	-1	-4	-3	-3		-17
		1	5	2	3	3	4		18
	Local economy	4	4	1	6	7		-2	20
		1	4	2	6	5		2	20
Total (Construction Activity/Risk)		-12	-19	-5	-14	-18	-20	-15	
		12	27	9	39	37	28	14	

5.2.1 Impacts and Mitigation from Construction Phase

5.2.1.1 C1 Worker Influx and Settlement

An estimated 10 workers will be required for this project. The influx of workers can have a negative impact to the environment such as damage to vegetation, sensitive areas, and fauna of the island. This can be both intentional and unintentional.

Worker related impacts can include the requirement of building a temporary worker's camp, which can then lead to the set up of temporary waste, sanitation and water systems for the workers. For the duration of the project, the workers related waste output is detailed in **section 3.3.12**. For this project, this impact can be reduced through the following mitigation measures. The project island currently has vacant properties as well as rooms to let in other houses, which can easily house the influx of 10 workers. Therefore no new facilities will be made for the accommodation of the workers. Other impacts include the increased use of resources by the workers in the island. This can be mitigated by choosing local contractors operating on the island. Currently, two groups operate on the island, which include 4 and 5 workers in the groups respectively.

In addition to this, when a new group of foreign workers arrive on the island conflicts can arise with the resident population in the instances where local culture is overlooked or not respected.

<u>Mitigation for impacts on flora and fauna</u>

- The contractor is required to keep the workforce as a minimum as possible, and to not bring in any surplus workers for the project;
- house rules shall be formulated by the contractor and workers shall be oriented on the rules and conduct during the project works;
- workers shall be given instructions on the sensitive and protected areas of the island;
- 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.

<u>Mitigation for impacts on resource use</u>

- Encourage choosing of local workers to reduce increased demand of resources.

<u>Mitigation for sociocultural impacts</u>

- Hire local workers where possible;
- orient foreign workers on communication, personal hygiene and sanitation in addition to the prevention of STDs and other infectious diseases; and
- ensure all foreign workers have their legal permits.

5.2.1.2 C2 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 . Reduction of the transportation distance from the source to the project island is proposed. As the resource sourcing hierarchy in **Figure 14** shows, the greatest importance shall be placed on sourcing

any available materials from within the island, with the next option being from within the north region, from islands such as HDh. Kulhudhuffushi. Site visits to the Zone 1 islands show possible sources for sand in islands (such as HDh. Kumundhoo, where a pile of excavated sand is present which can be procured for use in concreting works). 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.

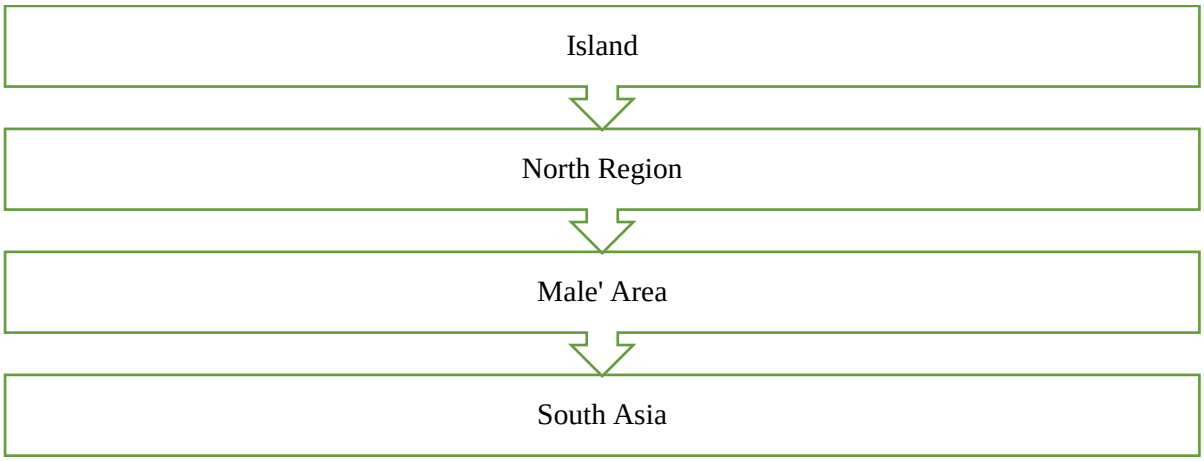

Figure 14: Material sourcing hierarchy proposed for the project

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 **Section 3.5** 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 CO_2 emissions result. Therefore, for this project, an estimated 100.1 kg of CO_2 emissions are expected for the concrete casted. 3136 kg of indirect CO_2 emissions (Defra / DECC, 2012) occur per tonne of PVC pipe produced. For this project, the amount of indirect CO_2 emissions is estimated at 164.8 kg. The greatest indirect CO_2 emissions are estimated from the usage of reinforcing steel. 1.5 tonnes of reinforcing steel are estimated to be used for this project, which can cause a release of indirect CO_2 emissions of 5311 kg (Ma et al, 2016). Due to the small scale of the construction, the estimated indirect CO_2 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 15: Impact on roads from heavy vehicle transport in an island in Maldives

For the purpose of this project, no heavy vehicles are proposed for either construction or earthworks. Although this is the case, a pickup truck will be used to transport the construction materials to 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.

Mitigation for climate impacts

- Sourcing of materials shall be done according to the hierarchy presented in **Figure 14**. 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;
- The contractor shall use serviced vehicles and plant equipment for the project;
- The contractor shall only use the needed amount of vehicles and plant for project; and
- The 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. Oversized heavy vehicles are not required for this project, therefore such vehicles shall not be used in the island for transportation and construction purposes;
- 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 direct route of the main road "Nala Magu" 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

- The vehicle drivers shall be licensed and competent;
- The loads being transferred shall be fully secured; and
- The transportation shall be done during day time.

Mitigation for marine and terrestrial pollution

- The contractor shall clean any littering on the terrestrial or marine environment caused during transportation;
- The contractor shall enforce strict policy against littering and appropriate penalties; and
- Spill kits shall be made available in cases of spillage of hazardous wastes, and hazardous waste storage shall be provided.

5.2.1.3 C3 Site Demarcation & Fencing

Site demarcation and preparation involves, land surveying of the area and setting out the limits of the project plot, and identifying trees that needs to be removed or relocated. This activity is considered to have minor environmental impacts as it is largely noninvasive.
However, improper or inaccurate demarcation and labelling could result in removal of untargeted trees which could result in having to remove more number of trees than that are required.

Mitigation Measures

- 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;
- accurate and reliable equipment shall be used to minimize errors;
- wearing, clothes/helmets to protect against thorns and freefalling coconuts and wearing protective clothing;
- carrying out the works during the day time; and
- ensure mosquito repellants are available for the workers.

5.2.1.4 C4 Site Clearing and Earthworks

The proposed site is few in vegetation, and has been mostly cleared. The site clearing works for this project will include minor works such as removing the small amount of shrubs and weeds, and levelling

of the ground using a compactor. The possible impacts due to site clearing and earthworks are similar to that of those during the construction stage, which is elaborated further in the following section.

Mitigation Measures

- Site shall be demarcated and fenced off prior to site clearing;
- Vegetation targeted for removal shall be marked prior to site clearing; and
- Excavated material used as backfilling and in grading of the site.

5.2.1.5 C5 Construction

Material Storage

This includes, storing all the vehicles, machineries, and tools required for the land clearance and IWMC construction. Due to the nature of the project, a lot of construction materials are not required. Apart from the vehicles and tools, fuel and water will be required for storage. Fuel will be stored on the cleared land in tanks that. Vehicles will be stored inside the fenced plot area. Tools and equipment will be stored in the tool shed within the fenced land plot. The project does not require land clearance or construction of extra building for material storage, hence the impacts arising from this activity is considered to be minimal. However, there is a risk of accidents, such as fires, oil spills and trespassing. These could be easily mitigated by implementing appropriate measures.

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 minor, due to the distance provided between the residential areas and the project site.

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 15: 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 61 dBA at 800 ft, which is the approximate distance from the centre of the IWMC to the nearest residential area. This is expected to further decrease taking into consideration the vegetation surrounding the proposed site, as well as the soil characteristics of the ground. It should also be noted that the FENAKA power plant is located further north in the same road as the proposed IWMC.

Noise during construction is determined to be a short term negative impact. Due to the distance of the project site and the surrounding vegetation, 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.

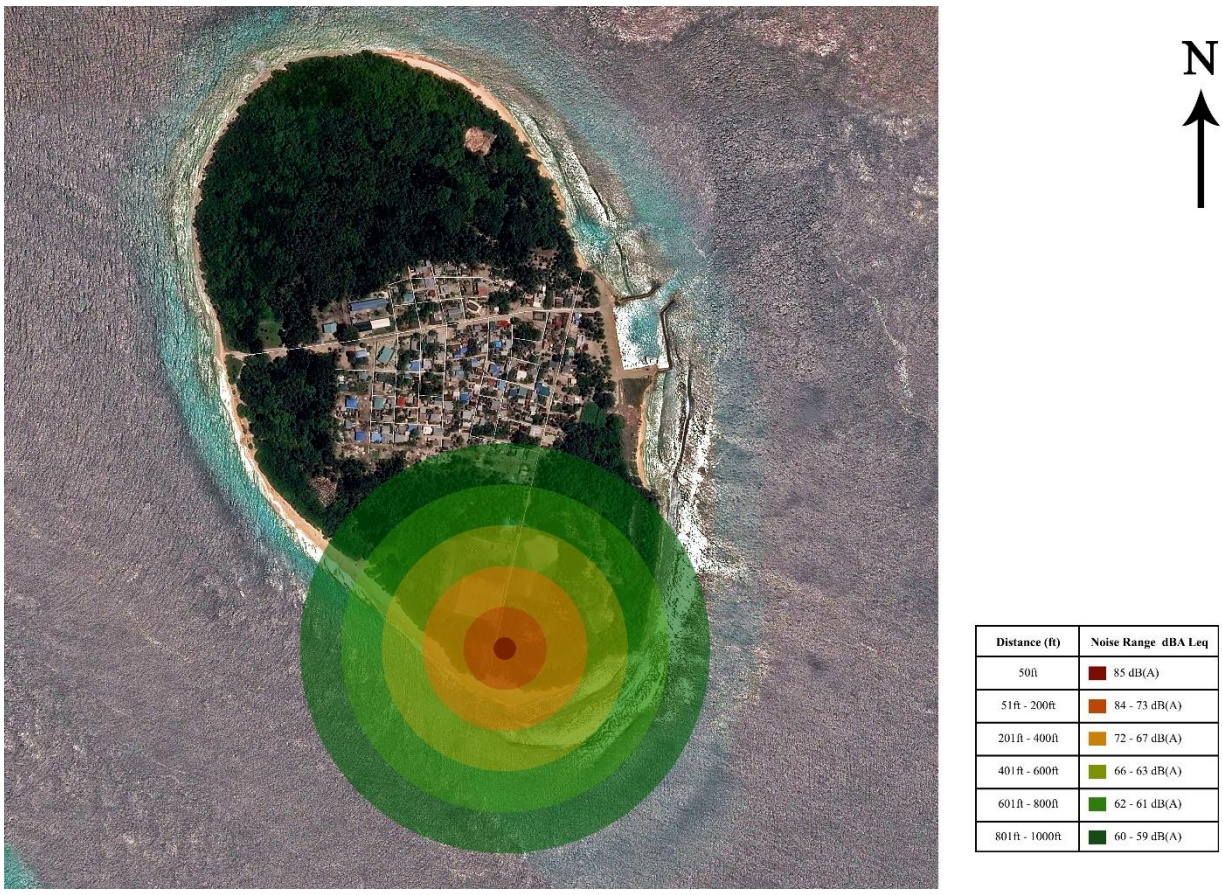

Figure 16: Noise range map for HA. Muraidhoo

Impact on vegetation

The proposed site in the island has already been cleared, and has no significant vegetation except for a few shrubs and roots. The proposed earthworks and construction of the IWMC is not expected to have any significant impacts upon the existing vegetation of the island. Although the site is cleared, the area surrounding the site consists of some vegetation as well as banana farms. No other structures, temporary, or permanent are proposed to be built for this project (such as workers' camp). Therefore the activities of this project is not expected to have a major impact on the vegetation of the island.

Accidents and injuries

Accidents and risks (hazards) are important elements that need to be properly assessed, identified and analysed for what could happen if a hazard or accident occurs during and post development of the project. There could be many risks (hazards) and accidents to consider associated with many possible scenarios that could unfold depending on time, magnitude and the location it occurs. Hazards during construction 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 trenches and seriously injuring themselves.
- being struck by moving equipment and vehicles.

Mitigation for material storage impacts

- Equipment shall be stored in fenced areas and maintained appropriately during the cause 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 Liquid Petroleum Gas (LPG) bottles and cleaning solvents and chemicals will be closed off from public access. Fire extinguishers and instruction in case of fire will be located in all the public, industrial and staff accommodation areas;
- portable extinguishers placed to be readily available when someone finds a fire;
- closed off non-public storage areas will be provided for inflammable goods (fuel drums, portable fuel containers, LP gas bottles, cleaning solvents etc.) with NO SMOKING, NO NAKED LIGHTS, HIGHLY FLAMMABLE sign boards in both English and Dhivehi languages;
- 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.

Mitigation for terrestrial pollution

- Set up a temporary waste disposal area within the project site;
- regularly collect litter and dispose at the temporary waste disposal area;
- hazardous waste shall be placed in enclosed containers;
- vehicle maintenance shall be carried out on paved areas; and
- after the construction works are completed, transfer all collected waste to Thilafushi

Mitigation for noise and vibration impacts

- Provide workers with noise cancelling headphones.
- use quieted equipment where possible, such as mufflers on engines;
- use of well serviced vehicles and plant; and
- switching off equipment and vehicles when not in use.

Mitigation for impact on vegetation

- Setting out survey shall be done by the contractor and the site limits shall be demarcated prior to any construction or clearing works;
- fence off the site in order to avoid the removal of any vegetation out of bounds of the project site; and
- allocate temporary stockpile area within the site, which is free from vegetation

Mitigation for accidents and injuries

- The contractor shall be required to develop occupational safety management plan, and safety guidelines shall be displayed in the work site at all times;
- occupational safety training should be given to all workers present on site;
- workers should be provided Personal Protective Equipment and the use of PPE shall be enforced;
- site visitors 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.

5.2.1.6 C6 Waste Generation

Solid waste generated during land clearance and IWMC construction work would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite. Waste burned onsite would generate smoke, possibly impacting negatively on ambient air quality and human health. On the other hand, if all site clearance waste is to be transported this would also result in requiring burning fossil fuels and would require significant finance. 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 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 and solvents. 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 1.2 kg will be produced daily if approximately 10 workers were active which equates to discharge of approximately 1,700 l/day of waste water. Sewage will be managed through existing sewage systems that have been installed in the islands.

Since there is no existing waste management system in the atoll or since there is no existing island level waste management dumpsites 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.

Mitigation Measures

- Ensure to manage waste as described in **Section 3.3.12** of the report;
- open defecation whether it's on land or on the beach shall be prohibited;
- waste other than sewage shall not be flushed down the toilet;
- ensure to reduce waste by following the 3R steps; and

- waste collected shall be transported to Thilafushi after the construction works have ended.

5.2.1.7 C7 Resource Use

During the construction phase, machineries and vehicles used will consume fuel. Notable impacts of this activity include, increased air pollution, risk of spillage, impacts to health/wellbeing and accidents. The primary pollutants generated due to power production from diesel based generator system include Nitrogen oxides (NO_X), Sulphur dioxide (SO_2), Carbon monoxide (CO), Hydrocarbons/ Polycyclic Aromatic Hydrocarbons (HC/PAH), Particles (PA) and Carbon dioxide (CO_2) in the form of emission although the exact amount is difficult to quantify.

The visible pollution generated by burning diesel contains elemental carbon as soot. The typical odour comes from polycyclic aromatic hydrocarbons, which also are cancer causing components.

Due to the scale of these activities, the machineries won't be used for long periods of time. This would significantly reduce the impact of electricity generation. IWMC construction stage as well as land clearance stage will not use heavy vehicles and equipment extensively.

Water used during construction will be sourced by the contractor from available groundwater wells. Water used for drinking and cooking will be purchased from local shops or collected from existing rainwater tanks or from the groundwater well in the island. Water and electricity consumption for the project is considered to be minor.

<u>Mitigation</u>

- Initiate rainwater collection and storage as early as possible into the project construction;
- turn off the tap while washing your hands;
- use salt water to wash dishes and only use rainwater to rinse them;
- water conservation devices shall be used;
- use well maintained, energy efficient equipment. The emission of carbon dioxide is directly related to the amount of fuel used. High efficiency is therefore important to reduce the amount of released carbon dioxide and consequently to reduce the global greenhouse effect;
- reduce idle time of machineries and vehicles. Switch them off after use;
- utilize day time hours for the construction when plenty of light is available; and
- FENAKA power supply will be used for electricity generating purposes.

Table 16: Impact identification matrix for operational phase

Envisaged impact factors		O1 Waste collection and transportation	O2 Waste sorting, separating, storing and compost making	O3 Waste Generation	O4 Resource consumption (water/electricity)	Total (Impact Area)
Physical Components	Seawater	4				4
		4				4
	Ground water	5	-2	-1		0
		3	2	5		12
	Air	-3	-2	-2	-3	-13
		5	3	2	4	16
	Noise	-3	-1			-4
		4	2			6
	Coastal Zone					0
						0
Biological Components	Flora	6	7	-1	-3	4
		2	6	1	4	18
	Fauna	5	5	-1	-3	3
		5	5	1	4	19
Socio-Cultural Component	Aesthetics	6	8			9
		6	6			17
	Accidents	-4	-4		-4	-18
		4	4		5	19
	Landscape	5	6	-1		5
		6	5	2		18
	Health/Well being	5	-3	-2	-6	-7
		6	5	2	8	23
	Cultural heritage					0
						0
	Local economy	-3	8	-2	-1	5
		9	2	4	1	19
Total (operational Phase Activity/Risk)		23	22	-10	-20	
		54	40	17	26	

5.2.2 Impacts and Mitigation from Operational Phase

5.2.2.1 O1 Waste Collection and Transportation

As stated in this report, currently HA. Muraidhoo has no landfill area demarcated for waste dumping. This has resulting in the public disposing of waste in various locations of the island, including the beaches and the periphery of the residential areas. These practices have resulted in the spread of diseases in the island. Current practices also include burning of the waste at various locations of the island, which leads to respiratory issues from inhalation of smoke. The successful implementation of the IWMC and the Waste Management Plan will reduce waste littered throughout the island, and prevent burning of waste at the island. This will lead to improved health and psychological well-being of the residents and visitors of Muraidhoo. It has been identified as a long term positive impact on the residents and visitors of Muraidhoo.

The Waste Management Plan (WMP) states that a vehicle will be used to collect the waste from each house daily. The vehicle used will cause GHG emissions from burning of fossil fuels. As per the WMP, waste collection will be done every day from 9:00am to 12:00pm. Transportation is done inland for the waste collection operations. This is identified as a minor impact in terms of noise, due to the fact that multiple vehicles are not used, and no receptor will be exposed to the noise for long durations of time.

Waste Collection and Transportation is identified to have a positive impact on the island.

Measures to ensure and enhance the positive impacts

- Waste management regulation and guidelines for the island shall state the penalties on persons that do not act according to the regulation and guidelines (i.e. littering, burning and dumping of wastes elsewhere), and Island Council shall enforce the penalties as prescribed;
- the proponent and Island Council shall follow the management plan provided with the EMP in order to monitor the operations of the IWMC, and bring about any necessary changes to the operations and policies, in addition to providing any needed technical assistance for the island;
- the proponent shall review the waste management operations within the islands regularly and update the National Waste Database;
- the operations shall be awarded to a contractor with the capacity to run the IWMC;
- the 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;
- polluter pays principle established in order to reduce the waste generation within the island;
- the proponent shall provide resources in terms of budgetary allocations, required equipment, and technical expertise to ensure the operation of the IWMC; and
- the proponent shall assist in creating markets / avenues where the IWMC's can generate income through selling compost and recycled metals, plastics and glass

Mitigation for terrestrial pollution

- Implement rules within the IWMC workers to impose penalties for any littering within the island due to improper handling of the waste and improper transport practices; and
- the status of the vehicle shall conform to the Waste Management Regulations 2013/R-58 and provide cover to the waste being transported in order to avoid littering.

Mitigation for accidents and injuries

- The vehicle should be driven by licensed drivers; and

- a strict schedule shall be stated in the WMP and followed in order to reduce the transportation frequency thus reducing the probability of accidents.

Mitigation for air quality impacts

- Spray the roads with water during the dry season to suppress dust; 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; and
- restricting the use of the vehicle only for the stated time in the Waste Management Plan;

5.2.2.2 O2 Waste Management Activities

Waste sorting, storing and composting make up the largest portion of the IWM concept. on top of reducing the volume of waste, these activities, convert waste to re-saleable and value added products. These activities will be carried out at the IWMC where employees will be trained to undertake these 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. Hazardous chemicals that get into the soil (contaminants) can harm plants when they take up the contamination through their roots. If humans eat plants and animals that have been in contact with polluted soils, there can be negative impact on their health.

All these impacts can be mitigated and prevented by the proposed IWM concept. However, if these activities are not properly implemented there is a risk of IWMC being deteriorated into a dump site where mixed waste are disposed, burned and buried. The risk is more prominent for islands where the population size is greater. This means without proper mitigation measures and regular transportation of waste out of the island to a central waste management facility, there is a greater risk of IWMC being overfilled. More so considering that IWMC is equipped to handle only about 20-30% of organic waste generated in the islands. This entails a loss of investment and a greater impact to environmental receptors if the site is moderately close to public areas. Moreover, impacts associated with composting sorting and storing waste has inherent negative impacts which will have to be properly managed, identified and mitigated to enhance and ensure the positive impacts of the proposed IWM are maintained and to prevent accumulation of negative impacts. Propensity of these impacts are greatest 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 IWMC 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. Mulle 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 / m^3 close to the composting site and dropped to background levels within 550m 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 / m^3), 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 17: 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 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 IWMC are not as large scale as the studies cited above. The composting capacity of the IWMC is expected to be two windrows of approximately 39 m^3, each batch to take around 4 – 6 months to mature. 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. The mitigations for these impacts are provided in this section. Impacts that may arise from the IWMC becoming a makeshift waste dumpsite for organics are also addressed in the section.

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. 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 odours.

The operation of the IWMC 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 IWMC), 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 IWMC 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 from composting

The main gas by product from the composting is CO2. In anaerobic conditions, methane is released into the atmosphere, which has a higher greenhouse warming potential compared to 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 dumped;

Amenity Impacts

The IWMC 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.

As the proposed site is close to the coastal area with little protection, wind can blow the materials off the compost heaps as well as the other stockpiled waste types out of the IWMC, which can degrade the local amenity. This impact is mitigated through the design of the IWMC perimeter walls which include a perimeter fence made of 50 × 50 PVC coated mesh.

Littering inside the IWMC can cause amenity issues such as tracking of litter on the wheels of the waste transport vehicles leaving the IWMC. 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 18: Odours generated from the composting process. Source: Goldstein (2002)

Compound	Description of smell	Detection limit for a particular odour panel ($\mu g/m^3$)
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

The current practices of dumping waste all around the island will be replaced with the collection and disposal of the waste at the proposed IWMC site. This site is 214 m away from the nearest residential site, and is located in such a way that the monsoonal winds will not carry the odour towards the residential areas. Therefore the impact of odour on the residential areas are deemed minimal.

Fire hazards

There is a possibility of fire hazards at the IWMC 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 IWMC.

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 16** can be used for this purpose too. The map shows that the noise reduces to a maximum level of 61 dBA near the residential areas. This

calculation does not take into account the dampening effects of the surrounding vegetation. Therefore, the long term negative impacts of noise would be borne by the employees of the IWMC, and the effects of noise to the residential areas are minimal

Workplace safety and accidents

The group of people most likely to be impacted by the IWMC 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 guidelines 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.

Mitigation for health impacts

- A distance of 214.9 m is available between the IWMC and the nearest residential area, which can act as a buffer zone;
- the siting of the IWMC is at the southern region of the island. Due to this location, the residential areas are well shielded from both the particulate matter that can disperse with the winds of the south west monsoon and the winds of the north east monsoon;
- the IWMC operator shall plan material handling processes in downwind of the residential zones;
- ponding shall be minimized at the site by grading of the ground;
- handling of compost shall be minimized;
- compost turning shall be done based on temperatures and not on schedules;
- material movements and compost turning shall be done during low winds. Weekends, holidays and times of the day when most people are likely to be outside (and use recreational / public spaces) shall be avoided when handling the materials and turning compost;
- add moisture to the compost to minimize dust;
- add a geofabric cover over the compost windrow to minimize release of bio aerosols; and
- workers shall follow the workplace safety mechanisms and guidelines set by the contractor and practice safety and personal hygiene when handling the compost.

Mitigation for 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.

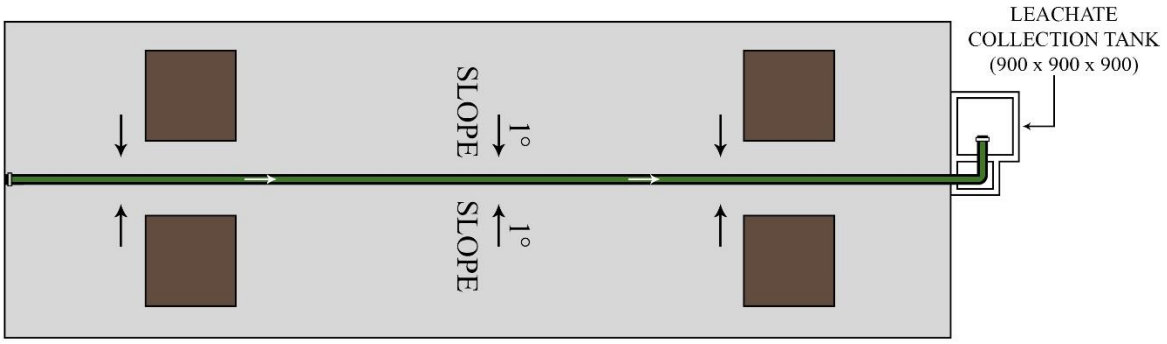

Figure 17: Compost slab design and leachate collection system (Plan view)

Mitigation for rainfall related leachate production

The current design of the IWMC consists of a composting slab is an open windrow composting system. The compost windrow is kept on the compost slab which is sloped in such a way that the leachate from the compost will collect at the pipe in the centre, which will propagate the leachate into the leachate collection tank (see **Figure 17**). While this scenario is ideal during fair weather, heavy rainfall and strong winds should also be considered. There is a possibility of heavy rainfall increasing the produced leachate, as well as the water collected over the composting slab propagating to the leachate collection tank. This can cause an overflow of the leachate collection tank, releasing its contents into the ground and subsequently the groundwater aquifer.

The rainfall can also cause the scattering of the compost materials, the increased water content in the compost windrow can cause another issue: the saturation of the windrow can decrease the available oxygen within the compost windrow, leading to anaerobic conditions.

- There is a valve placed at the inlet pipe which can be closed in instances where the leachate tank may overflow from heavy rainfall onto the compost slab;
- the 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;
- a 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.

Figure 18: Windrow cover being utilised in an open composting system (Source: Midwestbiosystems.com)

Keeping stockpiles of raw organics low

Stockpiles of raw organics (waiting to be processed or transported) can cause impacts such as foul odour from the biodegrading organics, leachate reaching and contaminating groundwater, issue of vermin and pests, and visual impacts from the stockpiles.

As per the design of the IWMC, there are compartments for the storage of all major waste types other than organic wastes. A dedicated slab is provided for the composting of the organic waste materials. As per the calculations in **Section 3.4.6** it is seen that the composting slab has the capacity for composting 1 month's organic waste produced in the island. As the composting process may take between 4 – 6 months (Halliburton, 2002), the remaining months' organic wastes can accumulate unmanaged and without any means of storage.

The consultant proposes the following mitigation measures:

- Arrangements to regularly transport the unmanaged waste to a central waste management facility; and
- in cases where the waste cannot be transported due to delays and unforeseen circumstances, it is not recommended to stockpile the unmanaged waste on the ground, without any cover. As per the area of the IWMC, there is a capacity to arrange up to 25 nos. 660 L wheelie bins to store unmanaged organic wastes. It is also recommended to separate the putrescible waste from the green waste while storing in the wheelie bins. While this mitigation is not the most ideal, it is seen as the option with the least impact, pertaining to the resources available to the islands and the difficulty in transportation. Alternative transfer arrangements shall be made within this duration.

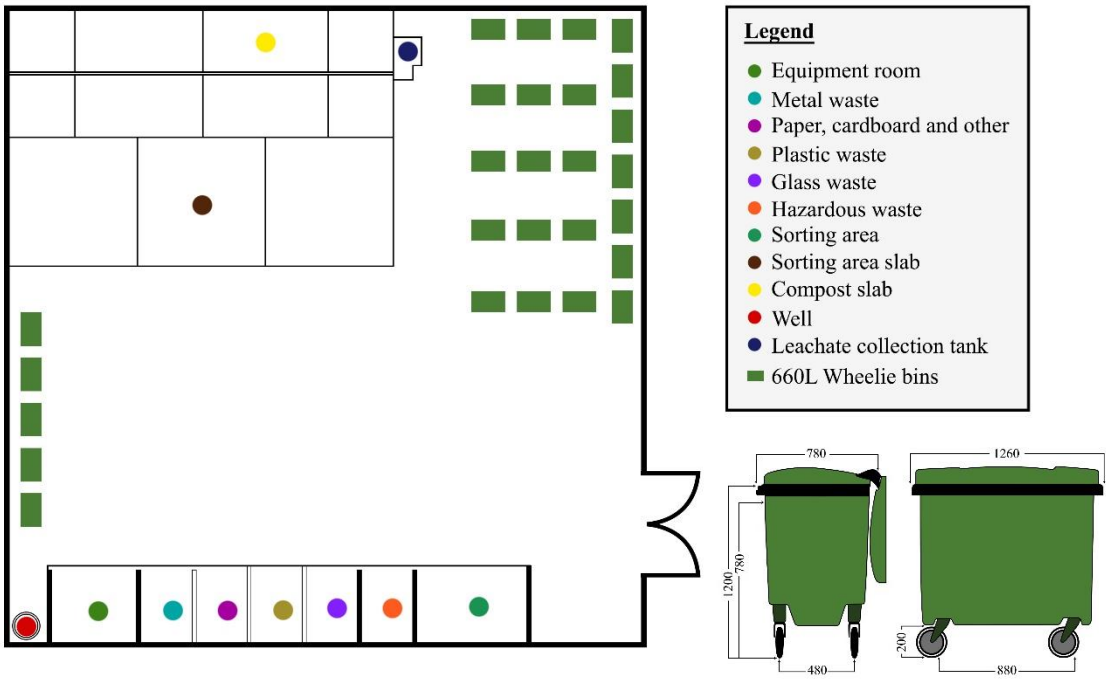

Figure 19: Proposed wheelie bin arrangement to provide for temporary storage of unmanaged organics

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. 660L wheelie 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 IWMC 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 IWMC, with the provision of a 2.8m high 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 IWMC. 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 IWMC.

Mitigation for odour 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 15cm 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.

Mitigation for fire hazards

- A fire management plan shall be developed by the IWMC occupier;
- adequate firefighting equipment shall be provided at the IWMC, and placed at locations easy to access;
- the IWMC occupier shall be able to show that firefighting capacity of the IWMC is sufficient to suppress and minimize the incidence and impact of fires; and
- workers shall be trained to use the firefighting equipment and able to manage fire outbreaks.
- 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.

Mitigation for workplace accidents

- The IWMC 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 and instructions to employees on how to operate any machinery;
- instruct employees on safe systems of work;
- 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.

Figure 20: Recommended protective clothing for waste management employees. Adapted From: Ministry of Health, Thailand. Bangkok, 1995. *noise cancelling headphones and safety glasses during use of machinery

Table 19: 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

5.2.2.3 O3 Waste Generation

Waste generated during the operational phase of the IWMC will be relatively low. These will include waste oil/batteries for waste management equipment. Since eating and cooking inside the IWMC will be prohibited, no mixed municipal waste will be generated during the operational phase of the project. Hence overall impact for this activity would have a minor negative impact on environmental receptors.

Mitigation Measures

- Closed containers shall be provided to manage hazardous wastes;

- spill kits shall be provided to manage oil spills; and
- prohibit eating/cooking in the IWMC.

5.2.2.4 O4 Resource Consumption

Water will mainly be required for washing equipment, work ware, hands etc. and to water the compost pile. Water required for moistening compost piles will be relatively small. As most of the moisture required for the compost pile will be sourced from the leachate collected from the leachate tank the volume of water required will be significantly less. It is estimated that approximately 200 -300 l/day of ground water will be required during the operational phase of the project. Since the volume of water required is relatively low, it is not expected to have a significant impact on groundwater.

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. Compactors and crushers will be 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 of 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 IWMC. Therefore. Electricity consumption of the IWMC 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.

<u>Mitigation Measures</u>

- 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.

Table 20: Impacts and proposed mitigation measures for the construction and operational phase of the project

No	Potential Risk/Impact	Receptor	Nature	Reversibility	Significance	Mitigation	Cost indication of measure
	Description	**Description**	**Positive**	**Reversible**	**Major Negative**	**Description**	**USD**
					Major Positive		
			Negative		**Moderate**		
				Irreversible	**Minor**		
CONSTRUCTION PHASE (C)							
C1	Impacts from worker influx and settlement (flora and fauna, resource use and sociocultural impacts)	People of Muraidhoo, and terrestrial and marine environment	negative	Reversible	**Minor**	• See **Section 5.2.1.1**	Included in the construction costs.
C2	Impacts from transportation of materials. (climate impacts, and impacts on roads)	Residents of Muraidhoo, terrestrial and marine environment, global environment	negative	Reversible	**Minor**	• See **Section 5.2.1.2**	Included in the construction costs.
C3	Impacts from site demarcation and fencing (Impacts on flora and fauna)	Local flora and fauna	Negative	reversible	**Minor**	• See **Section 05.2.1.3**	Included in the construction costs.
C4	Impacts from site clearing and earthworks (terrestrial pollution, vegetation removal)	Vegetation of the site and surrounding areas	Negative	Reversible	**Minor**	• See **Section 5.2.1.4**	Included in the construction costs.
C5	Impacts from construction works (vegetation impacts, noise and vibration, accidents	Workers and residents of Muraidhoo	Negative	Reversible	**Minor**	• See **Section 05.2.1.5**	Included in the construction costs

	and injuries, pollution from material storage)						
C6	Terrestrial pollution from construction waste generation	Residents of Muraidhoo, ecosystem	Negative	Reversible	**Minor**	• See **Section 5.2.1.6**	Included in the construction costs
C7	Impacts from resource use	Residents of Muraidhoo, ecosystem	Negative	Reversible	**Minor**	• See **Section 5.2.1.7**	Included in the construction costs
OPERATIONAL PHASE							
O1	Waste collection and transportation (Climate impacts, air quality, amenity impacts)	Residents and visitors to Muraidhoo	Positive	Reversible	**Minor**	• See **Section 05.2.2.1**	Costs borne by operations contractor
O2	Waste management activities (Public health, noise, groundwater, fire, accidents, odour impacts)	Mostly IWMC workers, residents and visitors to Muraidhoo,	Positive	Reversible	**Minor**	• See **Section 5.2.2.2**	Cost borne by operations contractor
O3	Waste generation (terrestrial pollution, groundwater contamination)	Residents and visitors to Muraidhoo	Negative	Reversible	**Minor**	• See **Section 5.2.2.3**	Cost borne by operations contractor
O4	Resource consumption (water and electricity)	Residents and visitors to Muraidhoo	Negative	Reversible	**Minor**	• See **Section 5.2.2.4**	Cost borne by operations contractor

6 PROJECT OPTION

6.1 ADVANTAGES AND DISADVANTAGES OF PROJECT OPTION

The advantages and disadvantages of conducting the project option are proposed below:

Table 21: Advantages and disadvantages of project option

Option	Environmental	Social	Economic
Project Option	The project does not involve any clearing of trees except for a few shrubs It will generate a small amount waste and GHG. This would have minor negative impacts on the soil and environment of the island. However almost all the foreseeable impacts of the project can be mitigated and kept at an acceptable level and the project will not result in a loss of a sensitive or critical habitat or species. As the island is currently facing major problems due to improper waste disposal, the project will control and prevent further pollution of the environment, and facilitate utilisation of land area more effectively.	Increased direct and indirect employment opportunities for the locals as the IWMC 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 hence pollution of the island will be stopped or controlled. During the operational phase of the project, smell dust and smoke will be emitted from the IWMC.	Enhanced opportunity for locals to start and diversify tourism related services, since a safe and clean island would facilitate and benefit any local tourism venture. The Island Council mentioned this during consultations. Direct contribution to government revenue through taxes and duties. Creation of job opportunities and skilled labour in the region. Development and expansion of agriculture and fisheries market in in the island. Price and profit from agricultural produce will become more competitive due to availability of compost. Potential to attract foreign currency by selling compost, scrap metal and other recyclables which would develop the national economy. More settlers will be attracted to the island, which would promote the development of local public services and infrastructure.

7 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT PLAN

7.1 SCOPE

The chapter would present in detail the management measures put in place by the proponent and the contractor to mitigate the environmental impacts that would arise from the project activities. The assessment of impacts and mitigation measures that would be put in place had been discussed in detail in the previous chapter. The main scope or objectives of the environmental management plan are to:

a) Produce a framework for anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions during pre-construction, construction and operational phase; and
b) Provide evidence of conformity to laws and regulations and requirements of enforcement agencies.

7.2 ENVIRONMENTAL MANAGEMENT SYSTEM

The environmental management framework for the proposed project is based on the standards and policies set out by the Environmental Protection Agency of the Maldives under EIA Regulation 2012.

a) Environmental Management Planning and establishment of key performance indicators: The EMP specifies environmental management measures and required performance standards;
b) IWMC construction and operations: The aspects of the construction and operation will be established and operated according with the EMP;
c) Monitoring and corrective action: The implementation of EMP measures will be monitored during operational stage and will be reported. Any inconsistencies between the EMP and its on-site implementation will be identified and addressed through corrective actions; and
d) Auditing, reviews and enhancement: The EMP will be reviewed. Improvements to the EMP will be made as necessary to achieve desired environmental outcomes.

7.3 ENVIRONMENTAL MANAGEMENT STRUCTURE

This sections detail the various parties involved in the implementation of the environmental plan and their responsibilities.

7.3.1 The Proponent, Ministry of Environment and Energy

MEE will be responsible for the execution of all the project activities within the required timeframe. MEE is also responsible of policy level decisions and provision of support regarding the waste management works undergone in the island as well as the regional level.

7.3.2 The Contractor

The contractor will undertake the project in accordance with the EMP and will report to the proponent and environment consultant about any unexpected environmental impact or health and hazard issues. During the construction stages, the contractor will follow all health and safety as well as pollution and waste control measures.

7.3.3 Environmental Consultant

The environmental consultant would prepare the EMP based on field visits and surveys and based on past project experiences in similar settings. If there are any modifications to be made to the EMP during any stages of the project, the consultant would do the modification and would conduct the environmental monitoring as the monitoring framework.

7.3.4 Environmental Protection Agency

The Environmental Protection Agency would review the monitoring reports submitted by the proponent and would continue with regulatory monitoring visits to the project site upon their needs.

7.3.5 Island Council

The Island Council will be responsible for the formulation and implementation of the Waste Management Plan (WMP) for a period of 5 years. HA Muraidhoo Council has created the WMP on 29th January 2017 and approved by EPA. The Island Council is responsible to ensure the progress of the Waste Management Plan and achievement of the set goals through implementing the plan. This includes overseeing the IWMC operations by either running the operations through the Council or awarding the work to a contractor.

As per the WMP of HA. Muraidhoo, the Island Council expects to award the work to a contractor and monitor the operations. The Island Council is also responsible for the compilation of the IWMC reports submitted by the contractor as well as producing an IWMC monitoring report in addition to reporting of public grievances. These reports are proposed to be submitted to the proponent bi-annually for review.

7.3.6 Operations Contractor (IWMC Occupier)

The operations contractor will be responsible in running the operations in accordance with the guidelines set by this EMP and the WMP of Muraidhoo Council. The responsibilities of the operations contractor include producing the IWMC operations reports and submitting the reports to the Island Council at the proposed regularities.

7.4 REPORTING

Reporting will be carried out on a timely manner to implement the environmental management plan and will cover details of site conditions, and operations. A detailed reporting mechanism for the IWMC operational works is provided in section 7.10.

7.5 ENVIRONMENTAL MANAGEMENT PLAN

A practical plan taking into consideration available resources is proposed to meet the aims and objectives of the EMP. One of the major risks to the investment and operation of the IWMC and island level waste management is the center itself which can be converted back into a dumpsite due to mismanagement as often seen in island level waste management endeavors all across the Maldives. This is partly due to the fact that a lot of linkages connecting island level waste management with regional level waste management are absent or unknown until it is much too late. As described in section 5.2.2.2, one of the main risks facing the current project is rapid accumulation of organic waste at the IWMC. Hence the proposed IWMC management plan aims to control and mitigate such risks without severe negative impacts

Table 22:Details of environmental management plan proposed for the IWMC

Activity	Phase	Measures	Time frame	Responsible person
Training of workers and contractors	Pre-construction, Pre-operation	Contractor and project workers are provided with detailed information on the project, impact mitigation measures, compliance with environmental permits and the EMP. Workers are also provided with the information on sensitive areas of the island and other environmental issues. Training of staff involved in the monitoring of the construction phase Training shall be provided to the workers of the IWMC on the waste management practices and mitigation measures in order to ensure the operations are run efficiently and effectively.	Prior to construction works Prior to operational phase	Proponent Environmental Consultant
Documenting non-conformances and corrective actions	Construction Operation	Non-conformances to the environmental regulations, permits and the EMP is monitored and documented. Corrective measures are taken and follow ups are done. IWMC operations reports and public grievances are compiled by the Island Council and reported to the proponent within the prescribed frequencies as stated in **Table 26**	Construction and Operation phase	Proponent Environmental Consultant Island Council
Supervision of activities	Construction Operation	The project activities are to be supervised by the proponent throughout the construction and operational phase to ensure the activities are carried out accordingly and the impacts are minimised. The proponent shall review the IWMC operations reports from the Island Councils, and provide the required support, bring about any necessary policy updates	Construction and Operation phase	Proponent Environmental Consultant

7.6 ENVIRONMENTAL MONITORING PLAN

Table 23: Monitoring plan for the construction and operation phase of the project

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
Ensuring that the project activities does not affect the quality of the groundwater	Establish baseline just before the construction works begin and continue monitoring as stated. Establish a groundwater monitoring stations and geo-reference it. Preferably close to the IWMC.	O	12,000 per trip	Potable water quality testing equipment and/ or by sending samples to the lab	During operational phase, bi annually	Proponent Environmental Consultant	Water quality report
Ensure waste generated at work site is audited and managed responsibly	Management of waste generated as described in **Section 3.3.12** of the report	C,O	Cost included in the project costs	Estimation of waste generated at project site and recording these data routinely. This includes quantifying and recording the amount of yard waste, hazardous waste and general waste stacked and stored for transportation.	Every two months	Construction contractor, operation contractor	Record sheets, photographs and quantity of waste processed at Thilafushi/ (nearest waste management center) and IWMC. If there are no significant discrepancies between the quantity of waste generated on site and processed at central waste management facility, it can be safely assumed that impacts of waste on the environment was reduced.
Monitoring Health and safety of workers and the public	Accidents during construction of IWMC, land clearance, operation of IWMC and maintenance of IWMC. Fire hazards and natural disaster events. Noise and smell complaints during operation and construction phase. Compost condition, output and quality	C, O	Cost included in the project cost	Keep records in a log book, or data sheet	Bi annually	Operational contractor Construction land clearance contractor	Measures to adapt and prevent accident and risks. Health assessment reports published or available from the local health center.

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
						Island Council MEE	Policy changes and upgrades. Compost quantity and quality. Income from selling compost.

7.7 RESOURCE REQUIREMENT FOR MONITORING

For the monitoring program to be successful, it is important that adequate financial and human resources are available and strong coordination among the key stakeholders is maintained.

The primary function of implementing the mitigation and monitoring plan will lie with the proponent and environmental consultant. Since the project at developmental and operational stage will be engaged by the proponent it will be the responsibility of the proponent to take care of the environmental safeguards at all stages of the project during implementation and at operational phase. The proponent should prepare an Environmental Action Plan, which states all measures for mitigation and enhancement and monitoring as described here in the EIA with their responsible organisation and person, planning, methodology, timing and other relevant aspects.

An independent registered environmental consultant shall be hired and contacted to undertake and audit the monitoring program prescribed in this report. Following each monitoring visit the consultant will prepare a report with clear recommendations and corrective measure if necessary. The report will have to be submitted to EPA for their review and actions.

7.8 MONITORING SCHEDULE

Table 23 highlights the monitoring plan in which responsibilities of main stakeholders has been assigned. In order to track and compile the findings of these measures an independent environmental consultant shall be tasked to audit the projects EMP. This is to

- Identify gaps in monitoring and mitigating impacts arising from the project;
- determine the challenges and resource inadequacies to implement the proposed EMP; and
- determine the current environmental condition and propose modification/upgrades to the initial EMP.

Monitoring frequency for various individual components given in **Table 23** shall be followed by all responsible parties. **Table 24** gives indicative timeline for the monitoring visits by third party consultant.

Table 24: Monitoring visit schedule

Visit	Indicative timeline	Indicative parameters to monitor	Reporting	Cost (MVR)/per report/island.
Visit 1	Prior to construction of IWMC	Set baseline for groundwater quality and noise	Submit summary report 1 to Proponent within 2 weeks	25,0000.00
Visit 2	During construction of IWMC	Monitor work method, waste management, Monitor health and safety of workers. Monitor impacts to nearby vegetation and ensure vegetation removal is as per set out survey. Review reports prepared by contractors.	Submit monitoring summary report 2 to Proponent (MEE) within 2 weeks	10,000.00

Visit 3	Two months into operation of the IWMC. Biannually for four years	Monitor water quality and noise. Monitor IWMC. This includes review of reports stated in **Table 26** to determine condition of IWMC. Monitor compost condition as described in **Table 26** and **Table 23**	Submit summary report 3 to Proponent within 2 weeks	25,000.00

As indicated, during the course of the Project implementation summary reports following each trip is expected to be submitted by the Project's environmental consultant. These environmental audits will provide a basis for assessing at least the shorter-term efficacy of the environmental measures and thereby provide lessons to be learned for future monitoring sessions and other projects with similar impacts. The consultant will prepare and submit the reports to Proponent. Based on the findings of the report, the management approach may be adapted and its efficacy will be determined in the consecutive monitoring trip.

7.9 MONITORING REPORT

Reporting will be carried out by the environmental consultant assigned for the purpose by the proponent. The report will include among other information;

- Details of what was being monitored;
- methodology of data collection and data analysis;
- major findings;
- effectiveness of the mitigation measures in place and
- recommendations and conclusions.

A detailed environmental monitoring and management report is required to be compiled and submitted to the EPA. In addition to this, regular site monitoring would be carried out by the proponent that requires maintaining logs of events as explained in this report. Enforcement officers from EPA may also visit the site for inspection from time to time.

7.9.1 Monitoring Report Format

The environmental monitoring report outlined in **Table 25** below will be used in reporting environmental monitoring to be carried out as given in the monitoring plan.

Table 25: Monitoring report format

Project Title:
Name of the Island:
Monitoring Date:
Period Covered:
Prepared by:
Contributions:

A. Introduction
Give a brief introduction about the project and the monitoring carried out
B. Methodology
Brief detail of the methodology applied for undertaking the monitoring assessment
C. Environmental Monitoring
a. Groundwater quality
Parameters given in the monitoring plan need to be assessed
b. Waste generation and management at IWMC
These include monitoring for pests and diseases as described.
D. Risks and Mitigations
Please indicate any critical unresolved risks that affect the course of the system operation, analyse the cause, assessing the potential impacts on the environment providing the proposed mitigation strategy
E. Problems Encountered
Indicate any problem areas encountered and any corrective measures that will have to be taken.
F. Recommendations and Adaptations as Solution
If specific recommendation is noted during the monitoring phase, specify it in the report
G. Conclusions
Reference
Appendix

7.10 IWMC OPERATIONS REPORTING MECHANISM

Table 26:Details of the reporting mechanism proposed for the IWMC

IWMC (Contractor)

Reporting	Details	Frequency
General report	Logs of the incoming waste	Monthly
	Classified by type and weight	
	Vehicle maintenance details	
	Machinery maintenance details	
	Machinery fuel usage details	
	Workplace injuries	
IWMC capacity	Details of the utilized and remaining capacity of IWMC	Every two months
	Leachate tank maintenance and capacity	
IWMC inventory status report	Details of the status of IWMC equipment	Bi-Annually
	Details of the status of emergency kits and firefighting equipment	
Compost output report	Details of amount and composition of input waste materials	Bi-Annually
	Details of compost output in weight	
Noise and odour complaints	Log of noise and odour complaints	Every two months
	Complaints to be provided along with weather conditions and incoming waste details coinciding with the dates of complaints	

Island Council (Municipal Unit)

Components	Details	Frequency
Public grievances	Log of public grievances regarding	Bi-Annually
	Fee structure	
	Waste Management operations	
	Noise and odor complaints	
IWMC monitoring	Monitoring report of the IWMC operations	Bi-Annually
Compilation of IWMC reports from operations contractor		Bi-Annually
Income report	Summary of IWMC operations income	Bi-Annually

MEE

Components	Frequency
Review of IWMC Reports from Councils	Bi-Annually
Update National Waste Database	
Policy updates from findings	
Provision of support to IWMCs	
Overview of the waste management system on island level and regional level	

8 RECOMMENDATIONS AND CONCLUSION

The construction and development of the IWMC at HA. Muraidhoo is a much needed project to provide waste management services to the island. The IWMC 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.

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 consultant's recommendations for the project include:

- To include this EMP as part of the contractor's contract and ensure the measures and recommendations brought forth are followed;
- Implement the work method and mitigation plan as prescribed in the report to the fullest;
- To conduct supervision and monitoring of the project works by the proponent;
- To conduct supervision and reporting of the project works by an independent consultant;
- To conduct stringent evaluation of contractor's capacity to undertake and complete the project;
- Ensure necessary clauses regarding the workers safety are fully implemented;
- 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 EMP has looked into the key factors that need to be considered during construction and operational stage. The study has identified the negative impacts of this project are minor.

The study also found that through the implementation of the proposed practical and cost effective mitigation measures almost all significant impacts can be brought to an acceptable level. This EMP will guide the proponent in implementing the project with conformity to EIA regulation 2012.

CHAPTER 2
HA THAKANDHOO

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9 INTRODUCTION

9.1 BACKGROUND

HA. Thakandhoo is part of the North Thiladhunmathi Atoll. The island is oriented in a NW-SE direction. The island has a land area of 43ha and is home to a wetlands of 2.4 ha. HA. Thakandhoo has a population of 960 (Island Council, 2017). The population consists of 487 females and 473 males. Of this, 289 are under the age of 18. The number of plots allocated for households are 159, of which 37 plots are vacant. The total area used for residential purposes is 30 ha. Thakandhoo is historically significant, with the "*Ali Thakurufaanu ziyaaraiy*" located in the island.

The island has a health centre with 3 health workers, 2 nurses and a doctor providing medical services to the population. The island also has been provided with machineries for telemedicine, although the services have not been started yet.

The island currently has no water supply system or a sewerage system. The residents of Thakandhoo use harvested rainwater for potable use. 24 hour electricity service is provided to the island by the utilities company FENAKA. The island is accessible by harbour, which is 300ft long by 200ft wide. The island does not have a waste management centre, nor is there a demarcated area currently being used as a dumpsite.

In 2014, the Island Council cleared two areas on both the northern and southern end of the island to be used as dumpsites. While there was cooperation within some residents of the island, the two areas established for waste dumping are unused as of today. This was due to the lack of a budget and waste management equipment, in addition to cooperation from residents. Therefore, residents have been disposing waste at the periphery of the residential zones, and kitchen waste is disposed of at the beach. These practices have led to the terrestrial pollution of the island, and dumping of kitchen wastes and other wastes in the nearshore area can lead to diseases, nutrient imbalances, smothering of corals toxicity impacts to marine flora and fauna (Halliburton, 2002). Waste reduction in the island is done by burning of stockpiled wastes intermittently.

No waste audit specific to the island has been carried out in the past nor had the waste situation of the island been properly assessed. A waste audit for Zone 1 (which includes HA, HDh, and Sh. Atolls) conducted by MEECO in 2016 showed an average of 1.30 kg/capita/day of waste generation within the islands. Using this average, approximately 1.2 ton/day of waste is estimated to be generated within the island. The majority of sources of waste in HA Thakandhoo are the 122 households, 5 government institutions, pharmacy, 1 café and 1 area for allocated for boat building. The main types of waste generated in the island are glass, paper, metal, plastics, organic and green waste. In order to manage the waste situation at the island level, the proponent, Ministry of Environment and Energy (MEE) has proposed the project to establish an Island Waste Management Centre (IWMC) in HA Thakandhoo.

The proposed project is facilitated by MEE and financed by the OPEC Fund for International Development (OFID) under the "Provision of Water Supply, Sanitation and Solid Waste Management Project". The completion of the proposed project will result in the construction of an IWMC, and the operation of the IWMC will be facilitated under the Waste Management Plan devised by the Island Council and Approved by EPA.

The scope of the IWMC is to facilitate island level management of the waste generated within the island, which includes sorting, volume reduction and stockpiling of recyclables, composting of organics, and storage of hazardous waste. The waste that is not manageable in the island level is planned to be transported to a central waste management facility.

The proponent has requested consultancy services of MEECO for the preparation of an Environmental Management Plan (EMP) to comply with the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012. EPA has issued a decision statement on HA. Thakandhoo that an EMP would be suffice for the proposed IWMC construction and operation works.

A field visit was conducted by the MEECO team to HA. Thakandhoo on 24rd April 2017 in addition to a consultation meeting with the Island Council on the same day. This report is based on the findings of the field visit, consultations, previous EMP's and experience of the consultant.

9.2 PROJECT SETTING

The island is located in 6°50′44″N 72°59′38″E, approximately 1km away from the nearest inhabited island Maarandhoo. The island is situated in the northern rim of Thiladhunmathi Atoll. The island is approximately 299.76km from the capital Male'. The distance to the closest airport in HDh. Hanimaadhoo is approximately 21.8km.

Figure 21: Project setting

9.2.1 Site Location

The proposed Island Waste Management Centre (IWMC) is located in the northeastern side of the island at 6°50'46.96"N, 72°59'42.17"E. The site is accessible by an access path which connects to the main roads of Thakandhoo from the western side of the island. This access path can accommodate transportation of vehicles for the project purposes. To the north and northwest of the site, a wetland area is present while the closest coastal region is to the northeast of the site.

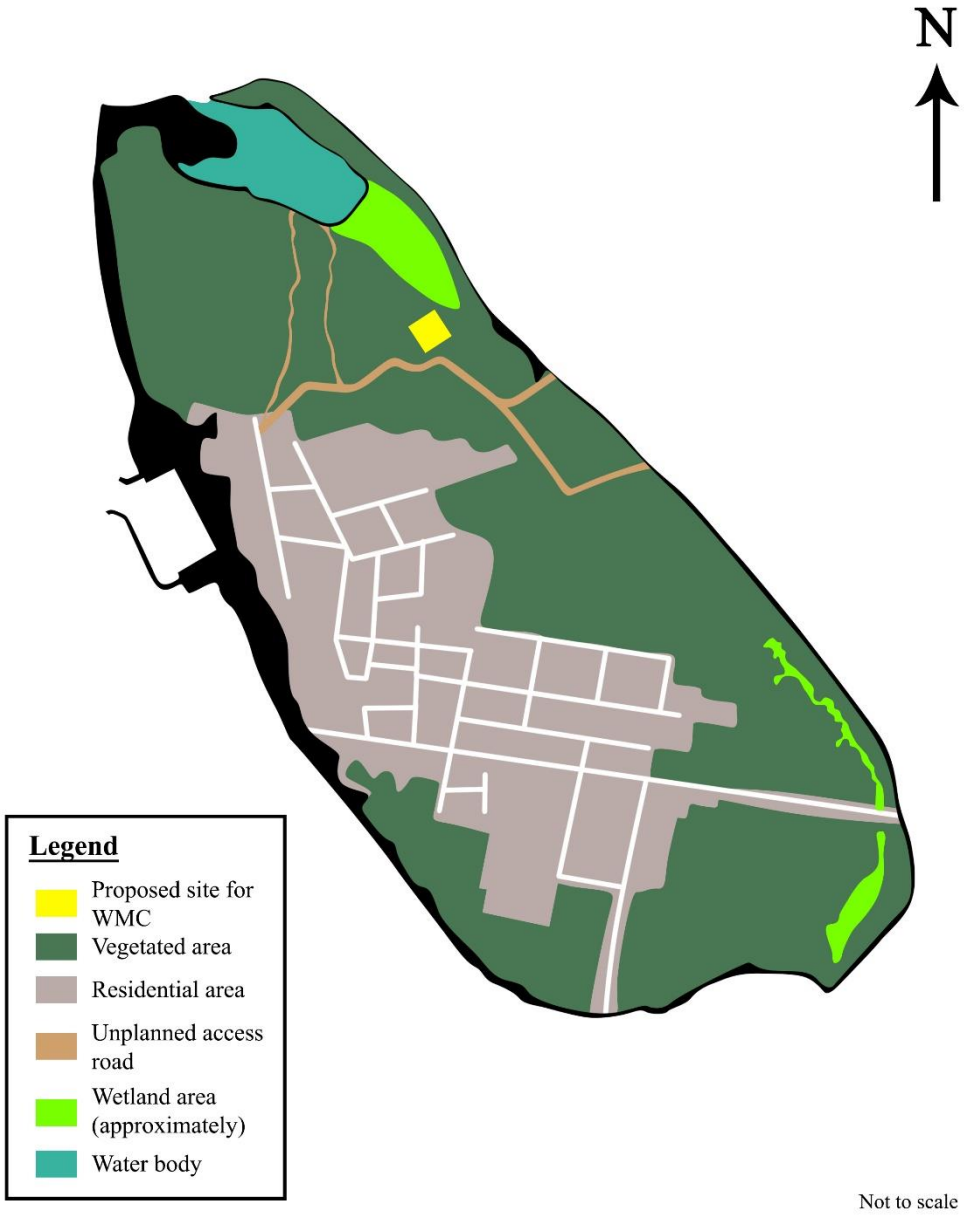

Figure 22: Proposed location for the waste management site on Thakandhoo Island

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9.3 CURRENT STATE OF WASTE GENERATION AND WASTE MANAGEMENT

9.3.1 Waste Generation in Zone 1 and HA. Thakandhoo

A waste audit conducted by MEECO in 2016 showed that the average waste generation of the islands in Zone 1 was 1.30 kg/capita/day.

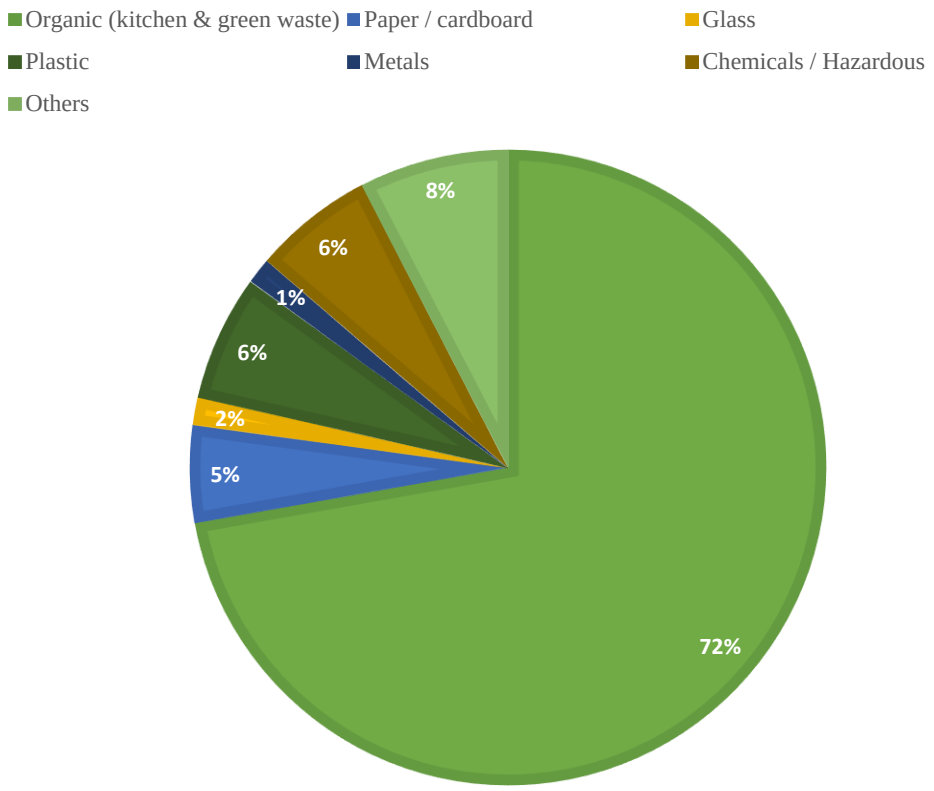

Figure 23: Waste Composition of Zone 1 (Source: MEECO, 2016)

The analysis shows that the majority of the waste generated includes organic wastes at 72%, which include kitchen and green wastes. This waste can be used in composting in addition to paper and cardboard wastes which are at 5% of the total waste generated. Recyclable materials such as plastic, metals, and glass make up 9% of the composition. Approximately 6% of the total waste generated is chemicals and hazardous waste. Using HA. Thakandhoo's current population, the daily waste generated can be estimated from this data.

Table 27: Estimated waste generation quantities of HA Thakandhoo

Waste Type	Zone One Average (%)	Thakandhoo Waste Generation (Kg/Day)
Organic (kitchen & green waste)	72.2	901.056
Paper / cardboard	4.94	61.6512
Glass	1.42	17.7216
Plastic	6.4	79.872
Metals	1.3	16.224
Chemicals / Hazardous	6.15	76.752
Others	7.58	94.5984
Total	99.99	1247.8752

9.3.2 Current state of waste management in HA. Thakandhoo

The majority of sources of waste in HA Thakandhoo are the 122 households, 5 government institutions, pharmacy, 1 café and 1 area for allocated for boat building. The main types of waste generated in the island are glass, paper, metal, plastics, organic and green waste. Institutions mainly generate paper and green waste while plastic, metal and glass make a minority of the waste generated. Household generated waste include organic waste, plastic, glass, metal and green waste. The health centre generates hazardous waste which is managed within the premises.

There is currently no waste management system in place in HA. Thakandhoo. No area has been demarcated or established to dispose of waste. In 2014, the Island Council cleared two areas on both the northern and southern end of the island to be used as dumpsites. While there was cooperation within some residents of the island, the two areas established for waste dumping are unused as of today. This was mainly due to the lack of a budget and waste management equipment, in addition to a lack of cooperation from the residents. Therefore, residents have been disposing waste at the periphery of the residential zones. As the amount of disposed waste increases in the island, the waste is burned to reduce volume. Kitchen waste is thrown on the beach areas around the island.

Figure 24: Current state of waste disposal in the island. Images A and B show the waste dumped and burned at the previously allocated landfill area at the northern side of the island while images C and D show the waste dumped at the southern side of the island, in close proximity to the shoreline.

9.4 WASTE MANAGEMENT PLAN OF HA. THAKANDHOO

HA. Thakandhoo Island Council has formulated a Waste Management Plan (WMP) in 2017 for the next five years. This WMP focuses on the targets required to be achieved for the island and how the targets will be reached. In addition, the current situation of waste management and waste generation in the island is detailed in the WMP. The Council proposes the following targets to achieve in order to manage the waste generated in the island:

- Waste management rules to be formulated and enforced by the Council;
- Public awareness programs on the economic and health benefits of keeping the island clean;
- Encourage the reduction of waste generation and recycling;

- Establishment of a waste management centre in the island;
- Provision of waste management equipment for the waste management centre and training of personnel on the use of the equipment;
- Establishment of a waste collection system to collect the household generated waste;
- Sorting of the waste collected and managing the sorted waste in an environmentally friendly manner;
- Establishment of a monthly fee system to facilitate the waste management operations;
- Making arrangements for regular cleaning of the public spaces and recreational areas; and
- Management of hazardous waste generated within the island.

Waste Management Mechanism

The Council proposes the sorting of the waste at household level, provision of waste collection services and a fee system within the WMP. These include:

- Sorting of waste into 6 categories in the household level;
    - Green waste
    - Metal
    - Glass
    - Nappies
    - Plastics
    - Kitchen waste
- Provision of waste collection services to the households, institutions, and business daily;
- The waste collection and waste management service will be provided by a contractor;
- Until the arrangements are made for unmanaged waste to be transported to a RSWMF for Zone 1, providing a way to reduce waste every 2 months;
- Establishing a fee system; and
- Collection and management of hazardous waste inside the IWMC.

Fee System

The Council proposes the following monthly fee system for the waste management works:

- Registered households: 100 MVR
- Registered Institutions and Businesses: 200 MVR

Roles and Responsibilities

- Thakandhoo Island Council and Waste Management Committee: waste management works and monitoring of the works of the waste management contractor.
- Waste management contractor: collection and managing of the IWMC.

10 DESCRIPTION OF THE PROJECT

10.1 THE PROPONENT

The proponent of the project is Ministry of Environment and Energy (MEE) of the government of the Maldives. The proposed activity is part of a greater project titled "Provision of Water Supply, Sanitation and Solid Waste Management Project" financed by the OFID.

10.2 PROJECT DURATION AND SCHEDULE

The proposed construction phase of the project is planned to be carried out in 10 weeks. This project was opened to bidders in June 2017 with a validity period of 90 days.

A tentative schedule of the work is found in **Table 28.**

Table 28: Work plan for IWMC

#	Activity	Duration (days)	Weeks									
			1	2	3	4	5	6	7	8	9	10
1	Mobilization	7										
2	Site clearing	4										
3	Excavation works	2										
4	Substructure and superstructure works	10										
5	Masonry works	10										
6	Plastering works	3										
7	Roofing works	7										
8	Structural steel works	7										
9	Electrical works	2										
10	Plumbing works	1										
11	Doors and windows	7										
12	Demobilization	2										

10.3 PROJECT DESCRIPTION

The proposed site plan is presented in **Figure 25**. Typical engineering details are provided in **Annex 2**.

The construction of the IWMC consists initially of mobilization and site clearing. The main works include shallow excavation, substructure and superstructure works as well as masonry works. The proposed design of the IWMC 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 operational phase of the project will include the daily collection of waste from the households and institutions, in addition to waste management works in the IWMC, which include;

- Sorting of waste;
- Storing of hazardous waste;
- Volume reduction of plastics, glass and metals;

- Stockpiling of sorted and reduced waste; and
- Composting of organic waste.

The IWMC is made up of an equipment room, and separate areas to store metal waste, paper and cardboard, plastic waste, glass waste as well as hazardous waste.

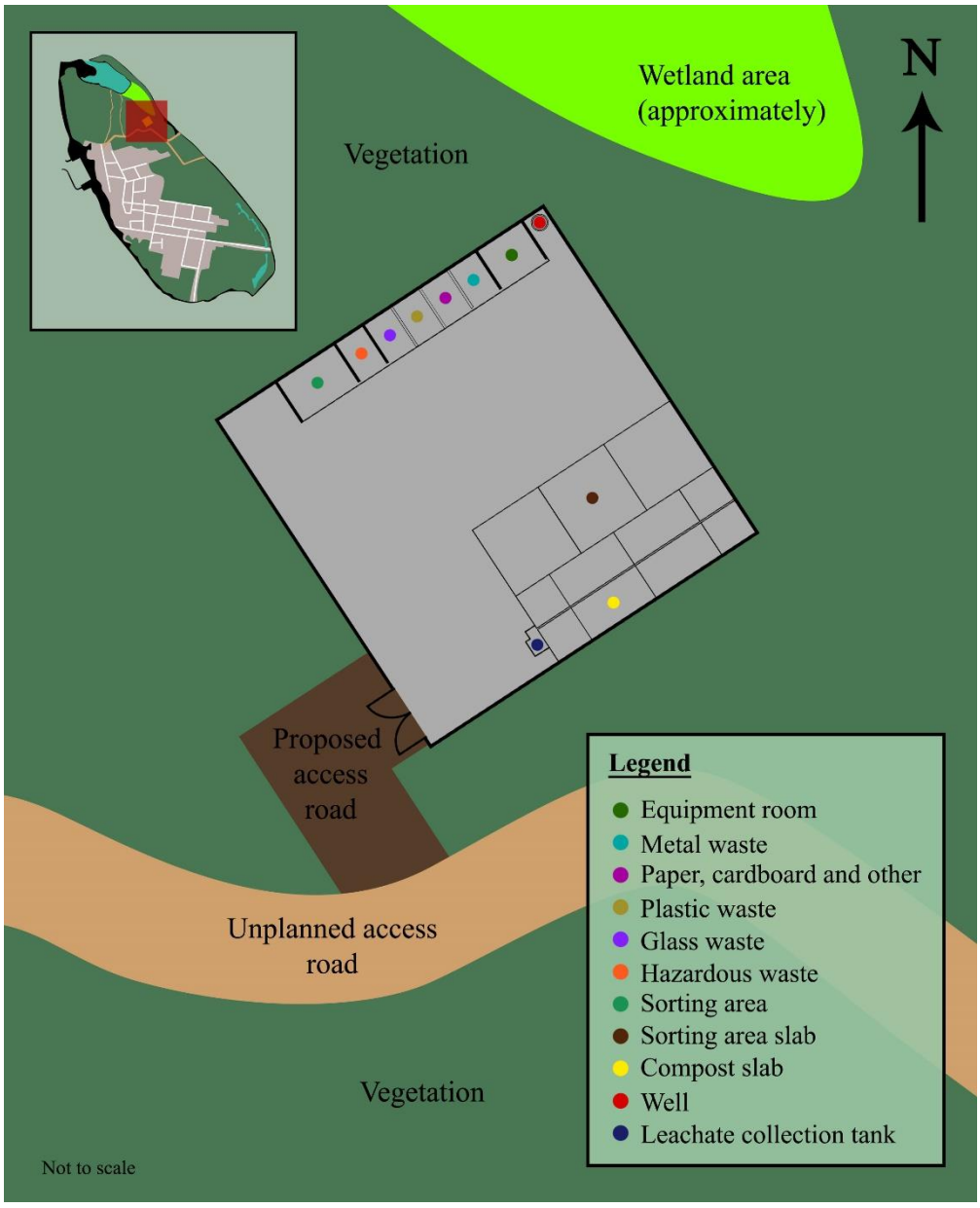

Figure 25: The site plan

10.3.1 Machinery

The following plant and equipment will be mobilized specifically for the project.

a) Lorry crane for placing of well;
b) Truck for transportation of materials;
c) Vibratory plate compactor;
d) Concrete mixer;
e) Concrete supply pump and piping; and
f) Daily 4" pump.

10.3.2 Mobilisation

As the amount of input materials are relatively minor, the construction materials shall be stored inside the demarcated site throughout the construction period

10.3.3 Demarcation and Fencing

Prior to beginning construction works, a survey shall be done by the contractor to demarcate the limits of the site, and the site shall be fenced off. Work shall be conducted within these limits.

10.3.4 Site clearance and levelling

The proposed site requires removal of vegetation, clearing and levelling of the land. The proposed site can be accessed by clearing a small strip of land connecting to the main access pathway to the site. This strip of land consists of 7 mature coconut palms (see **Figure 33**). Prior to removal, the compensation process must be followed for the privately owned coconut palms. The consultant proposes three options for the removal of these coconut palms;

1. **Option 1:** Procurement of parties that are willing to buy and replant the trees intersecting with the project area which include the IWMC and access road;
2. **Option 2:** Relocating trees within the source island.
3. **Option 3:** Removal of trees to be used as timber/firewood and compensating for trees lost by replanting 2 trees elsewhere

The site clearing and levelling works falls within the scope of the Island Council. As the site size is relatively small, a vibratory plate compactor may be used for the levelling of the ground.

10.3.5 Construction of Sorting Area Foundation

The proposed site consists of a 3.15 m by 18.85 m area. The proposed foundation below the masonry walls of the structure is a line (strip) foundation.

10.3.6 Construction of Compost Slab and Sorting Area Slab

The compost slab and sorting area slabs has an area of 15 m by 10 m. The 100 mm thick reinforced concrete slabs are cast over ground beams B1, B2 and B3. The ground beams B1 and B2 have a depth of 0.3m while B3 has a depth of 0.4m from the top of the slab. B3 has a void on top of the beam centrally to receive a 100mm PVC pile cut in half sloping at 1% from the upper end to the lower end, connecting to the leachate tank at the end. Excavations will be done manually to receive the ground beams as per the drawings indicate. The maximum depth of excavation for the beams is 0.4m. The construction of the slab and ground beams include initially laying of HDPE membrane on the slab and beam footprint. Formwork will be added to the sides of the beams, and following that, the arrangement of the required reinforcing steel. Concrete will be poured for the ground beams, followed by the slabs. Concrete mixing will be done on site.

10.3.7 Construction of Leachate Tank

The leachate collection tank is located at the end of the compost slab. The leachate tank has an area of 1.1 m by 1.5 m and a depth of 1.09 m extending below ground. The valve junction of the leachate tank has a size of 0.8 m by 0.55m, and has a depth of 0.63 m. 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.

10.3.8 Construction of Perimeter Fence

The whole length of the perimeter will 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 2.8m from ground level. The mesh is held together by 50 mm diameter GI pipes vertically 2 m centre to centre which are welded to three evenly spaced 38 mm GI pipes horizontally. The strip foundation below the masonry wall has a depth of 0.3 m with a 50 mm thick lean concrete placed below. Each vertical GI pipe is fixed to a 300 × 300 mm concrete footing with a depth of 0.6 m. The GI pipe is welded into a 200 × 200 mm plate. Therefore, the excavations done for the masonry wall strip foundation and GI pipe footing will be at 0.35 m and 0.6 m respectively. The trenches required to receive the strip foundation and footings will be excavated manually.

10.3.9 Construction of Well

A well is proposed to be constructed at the eastern corner of the IWMC. This well is 900 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.

10.3.10 Construction of Superstructure

The superstructure of the IWMC consists of the sorting area, storage area and the equipment room. The structure consists of a 3 m high wall separating the compartments. The roofing is supported by GI Pipes of diameter 38 mm and 75 mm. The roofing is made of LYSAGHT roofing sheets.

10.3.11 Labour Requirements and Availability

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

10.3.12 Waste Management

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 disposed in closed containers. The waste shall be well secured to avoid any scattering due to strong winds.

Municipal waste produced by the workers are estimated at an average of 0.45 kg/capita/day which translates to 346.5 kg of waste for the duration of 11 weeks for the whole workforce.

After the construction works are done, the collected waste shall be transported to the waste management facility in Thilafushi.

10.3.13 Pollution and Control Measures

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

a) Machinery to be properly tuned and maintained to reduce emissions/spills/leaks;

b) Fuel storage, paint, lubricants will be stored securely and bunded; and
c) Spill kits would be made available on site to control any liquid spills.

10.3.14 Health and Safety Measures

The proposed project involves transportation as well as construction of the IWMC at the site. These works will include use of vehicles, machinery, and heavy materials, and the workers may be put in situations where there is a risk of injury. These risks need to be identified and managed through the implementation of health and safety guidelines for the site. Health and safety measures for the construction phase include and are not limited to:

a) The contractor would be briefed regarding the laws and regulations that need to be followed regarding the proposed works and would ensure that Health and Safety procedures are complied with at all times;
b) There would be a construction supervisor at the site;
c) Only experienced and licensed operators will be allowed to operate heavy machines;
d) First aid kit should be made available at the work site;
e) The work force would be equipped with all safety gears and warning signs would be provided;
f) Fire extinguishing equipment would be available at the site;
g) PPE should be provided to all workers and the use of PPE enforced;
h) Operation of any heavy machinery will need the assistance of a banksman as all times;
i) All heavy lifts must be supervised and slings inspected; and
j) All other similar environment personal safety and quality control measure to be in place and checked by a qualified personal and approved and maintained at all times.

10.3.15 Demobilization

The demobilization plan will commence in the last week of the contract.

10.4 OPERATIONAL PHASE

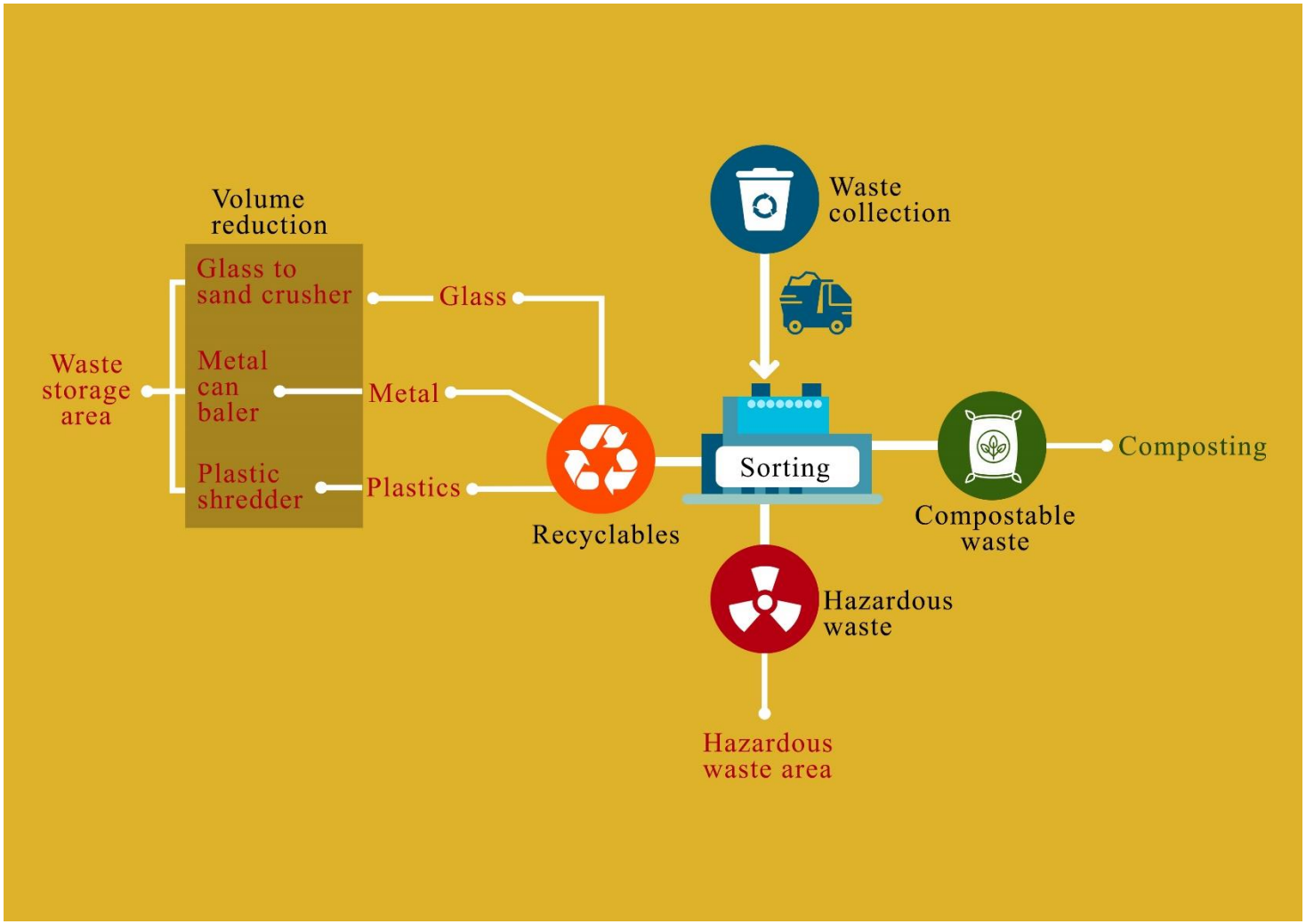

Figure 26: Operational phase flowchart of the IWMC of HA. Thakandhoo

The following section will highlight the operational aspects of the IWMC. This includes the machinery and equipment proposed to be used in the IWMC, in addition to the main activities to be carried out at the IWMC and within the island. The activities begin from the sources of waste, which will then be transported to the IWMC. This collected waste is 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.

10.4.1 Machinery and equipment proposed

During the operational phase of the IWMC, in addition to the collection of the waste and sorting, different activities such as composting, and waste volume reduction will be done. The proposed equipment for the IWMC include general equipment needed to handle the waste such as wheelbarrows, garden hoes, shovels, buckets and cultivators. These equipment will be used during the IWMC operation for handling as well as composting operations. A manual rotary compost screen is also included for the screening stage of the composting process.

Other equipment include waste volume reduction equipment such as a plastic shredder, metal can baler, vegetation shredder, and glass to sand crusher. The equipment and their specifications are detailed below.

Table 29: Equipment proposed for waste management works

Equipment	Details
Chainsaw	
Wheelbarrow	HDPE 6 cub. Ft.
Heavy Duty Gumboots	PVC or rubber
Heavy Duty Hand Safety Gloves	Rubber or Latex
Long Handled Flathead Steel Rake	Steel, 54 inches length
Long Handled Cultivator	Steel, 54 inches length
Garden Hoe	Steel, 57 inches length
19” Round Point Shovel	Steel
48” Square Point Shovel	Steel
19” D-Handle Square Point Shovel	Steel
20L Bucket	HDPE
40L Bucket	HDPE
Polypropylene Surgical Mask Box (50pcs)	Polypropylene
Weighing Bench Scale	50-75 kg capacity
Wheelie Bins	HDPE
Glass to Sand Crusher	0.5 to 1.0 tonne/ hr, output 0.5mm and less, 2-5HP motor
Plastic Shredder	30-100Kg/hr Output material less than 10mm
Metal Can Baler	3 to 5 HP, 2m2 or more inside volume
Vegetation Shredder	Petrol / diesel driven multi vegetation shredder / chipper
Manual Rotary Compost Screen	1m to 1.5m drum

10.4.2 Waste Collection

According to the Waste Management Plan formulated by the Thakandhoo Council, the waste collection and works will be done by a third party under contract. Dustbins will be kept at various public spaces.

10.4.3 Sorting

As per the IWMC site layout plan, a ground slab is dedicated for the sorting area. This sorting area is located next to the compost slab. Here, the collected waste will be kept, and sorted into their respective categories. In addition to this, a dedicated sorting area is also provided alongside the storage areas. The IWMC is designed to have separate storage areas for metal, paper and cardboard, plastic, glass, and hazardous waste. After sorting, the waste is stored in the respective location.

10.4.4 Composting

One of the main operations that will be conducted in the IWMC is the composting of the organic waste such as kitchen waste and garden 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 main constituents of a compost heap include kitchen and garden waste, along with water and air in the pore spaces between the constituent.

10.4.4.1 The Composting Process

After the incoming waste is 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.

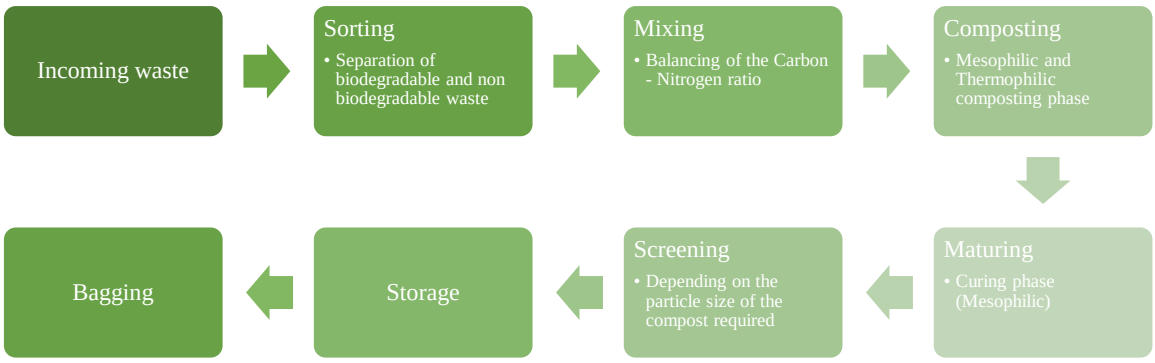

Figure 27: The composting process

10.4.4.2 Sorting of Incoming Waste

Incoming waste is required to be sorted to separate biodegradable and non-biodegradable waste. The sorting of the waste within each household as specified in the Waste Management Plan will streamline this process. Further sorting is done at the IWMC on the sorting slabs specified for the purpose. Hazardous waste and residues are kept in their respective compartments, as well as recyclables.

Table 30: Domestic Waste Categories

Incoming Domestic Waste			
Suitable for composting	**Not suitable for composting**		
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
Composting Process	**Storage**		

10.4.4.3 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 optimum, 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.

Looking into the composition of compostable wastes from the Zone 1 Waste Audit, it is seen that the majority of compostable wastes constitute of garden (green) wastes. Garden wastes make up 64% of waste generated, while the second largest contributor to compostable wastes is kitchen wastes, at 28%. Printed paper and cardboard make up 5% of compostable waste while 2% of the category includes animal waste. This composition is important in determining the Carbon-Nitrogen ratio of the compost heap in order to provide optimum conditions for composting.

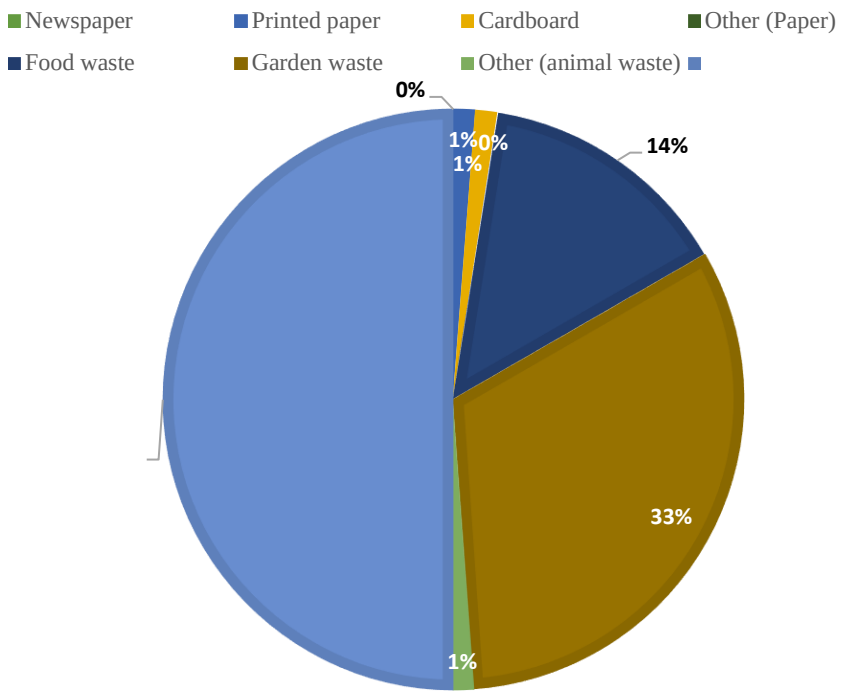

***Figure 28: Composition of compostable waste for Zone** 1*

Table 31: Estimated compostable waste generation quantities of Zone 1

CATEGORY		Average Per Capita (kg/day)	Percentage
Primary	**Secondary**		
Paper & Cardboard	Newspaper	0.00	0.0%
	Printed paper	0.02	2.4%
	Liquid container	0.00	0.5%
	Cardboard	0.02	2.4%
	Other (Paper)	0.002	0.2%
Organics	Food waste	0.29	28.2%
	Garden waste	0.67	64.2%
	Other (animal waste)	0.02	2.2%
Total		1.04	100

Green wastes such as vegetable wastes (kitchen waste), and poultry manure have high Nitrogen values while brown wastes such as foliage, wood chips, bark and paper have high carbon values. From the waste audit, it is seen that 64.2% of the compostable waste produced is garden waste while 28.2% of the waste generated is food waste. Therefore, it can be said that the composition of compostable waste in the islands in Zone 1 is in favour of providing a high Carbon content compared to Nitrogen.

10.4.4.4 Composting and Maturing

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

Table 32: 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 **Table 32**, the composting process can prolong to several months.

10.4.4.5 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. This slab is 15m long by 5m wide. 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 100mm 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 compost slab.

10.4.5 Volume Reduction

The incoming waste is sorted, and either used for composting, or stored in their respective compartments. 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.

10.4.6 Projected Capacity of the IWMC

The proposed IWMC is planned to manage a portion of the waste produced at the island level, with the unmanaged waste (approximately 70 – 75% of waste generated within the island to be transported to a central waste management facility). The projected capacity for 1 month's waste for the island of Thakandhoo is shown below.

Table 33: Projected waste management capacity for the waste generated in HA Thakandhoo in 1 month

Waste Type	Details	Amount	Unit
Organics	Composting capacity in IWMC. Assuming 1m height windrow with a width of 2m	39	m3
	Organic waste generated per month	41.59	m3
Paper waste	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	2.845	m3
Glass	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.818	m3
Plastics	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	3.686	m3
Metals	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.749	m3

As seen in **Table 33** the IWMC has the capacity to store the organic waste generated in less than one month for the island.

Organic wastes make up the bulk of the waste stream in the islands, taking 72% of the total waste generated in the island. The composting capacity of the proposed compost slabs (assuming a windrow of 1 m height and 2 m width at the bottom and 1m width on top) is approximated as 39 m^3. The calculated volume for the organic waste generated in a month in Thakandhoo is 41.59 m^3. Therefore, 28 days' worth of organic wastes produced in Thakandhoo would take up the composting capacity of the IWMC for the succeeding 4 – 6 months. There is no additional storage space for the organic wastes provided in the facility.

Hazardous waste produced in the island cannot be managed within the IWMC and regular transport is recommended.

10.5 PROJECT INPUTS AND OUTPUTS

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

Table 34: 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	29.66 m^3	Local Suppliers
		Reinforcement		
		Reinforcement T10	1.231 tons	Local Suppliers
		Reinforcement R6	0.19 tons	Local Suppliers
		Reinforcement T12	0.09 tons	Local Suppliers
		Formwork	135.66 m^2	Local Suppliers
		Masonry Works (200mm bricks)	205.8 m	Local Suppliers
		Structural Steel		
		50mm and 38mm GI Pipe for perimeter fence	77.4 m	Imported / purchased where available locally
		75mm GI pipe (flood light fixing poles and roof fixing)	18 Nos.	
		38mm GI bearer pipes	46.2 m	
		38mm GI purlin pipes	95 m	
		38mm GI pipes between columns	35.2 m	
		75mm GI pipe to support machine room door	3.5 m	
		Paint		
		Primer and 2 paint coats (Grey Color)	345.96 m^2	Local suppliers

		Electrical Components		
		3 Phase power sockets	4 Nos.	Local suppliers
		Single phase power sockets	3 Nos.	
		100 mm ceiling mount lights	1 Nos.	
		Wall mount exhaust fan	2 Nos.	
		500W flood light	2 Nos.	
		25 mm2 4 core power supply cable	290 m	
		Well water pump	1 Nos.	
		Metal doors for		
		Equipment room	1 Nos.	Local suppliers
		Hazardous waste area	1 Nos.	
		Waste yard entrance	1 Nos.	
		Plumbing		
		25mm PVC intake pipe		Local suppliers
		1/2 inch PVC pipe from pump to all distribution points	40.9m	
		Roofing		
		Storage area roof sheets	85.5 m^2	Local suppliers
		Flashing sheets	28 m	
		Lysaght gutter	19 m	
		50x50 PVC coated mesh fence	77.4 m^2	Local suppliers
		HDPE membrane	209.54 m^2	Imported / purchased where available locally
		Timber top cover	1 nos.	Local suppliers
		PVC pipe for leachate tank drain	15 m	Local suppliers
		600 x 900 5mm plastic sheet signboard	1 Nos.	Local suppliers
Operation	Equipment and Materials	Chainsaw	1	Imported / purchased where available locally
		Wheelbarrow	4	
		Heavy Duty Gumboots	5	
		Heavy Duty Hand Safety Gloves	5	
		Long Handled Flathead Steel Rake	3	

		Long Handled Cultivator	3	
		Garden Hoe	3	
		19” Round Point Shovel	3	
		48” Square Point Shovel	3	
		19” D-Handle Square Point Shovel	2	
		20L Bucket	3	
		40L Bucket	2	
		Polypropylene Surgical Mask Box (50pcs)	5	
		Weighing Bench Scale	1	
		Wheelie Bins	40	
		Glass to Sand Crusher	1	
		Plastic Shredder	1	
		Metal Can Baler	1	
		Vegetation Shredder	1	
		Manual Rotary Compost Screen	1	
	Waste	Waste generated within the island	Approximately 1248 kg of waste per day	Waste collected by vehicle from the waste bins within the island
	Fuel	Diesel		Local suppliers

Table 35: Project outputs

Stage	Output	Source / Type	Amount	Means of managing
Construction	Soil	Excavation for substructure	11.78 m^3	To be used back in the levelling and backfilling of site.
			209.54 m^2	
	Waste	Construction and clearing of vegetation		Collected in the temporary waste area and transported to Thilafushi after completion of the project
	Hazardous waste	Construction and clearing of vegetation		Collected as per hazardous waste management guidelines and transported to Thilafushi after completion of the project
	Municipal waste	Workers	346.5 kg	
	Dust	Excavation	Moderate amount of dust	
		Cement mixing	Moderate amount of dust	
	Green House Gases	Machinery		
		Concreting works	100.1kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
		Reinforcement	5311.1kg of CO2 indirect emissions (Ma et.al, 2016)	
		PVC Pipes	164.81kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
Operation	Compost	Open windrow composting	Approx. 15.6 m^3 of compost per full batch	Sold as fertilizer
	Crushed Glass	Glass crusher	Approx. 17.72 kg per day	Crushed glass stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Compacted Metal	Metal baler	Approx. 16.22 kg per day	Compacted metal stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central

				waste management facility
	Shredded plastic	Plastic shredder	Approx. 79.87 kg per day	Shredded plastic stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	GHG	Electricity usage		N/A

11 EXISTING CONDITIONS

11.1 DESCRIPTION OF THE ENVIRONMENT

Ha. Thakandhoo is part of the North Thiladhunmathi Atoll. The island has a land area of 43 ha .Of the 43 ha, approximately 30 ha has been used for residential purposes. The island has two wetlands with water bodies on the northern end and south eastern end. The wetlands take up an area of 2.4 ha, with the major wetland in the north of the island, connected to the *thundi* area.

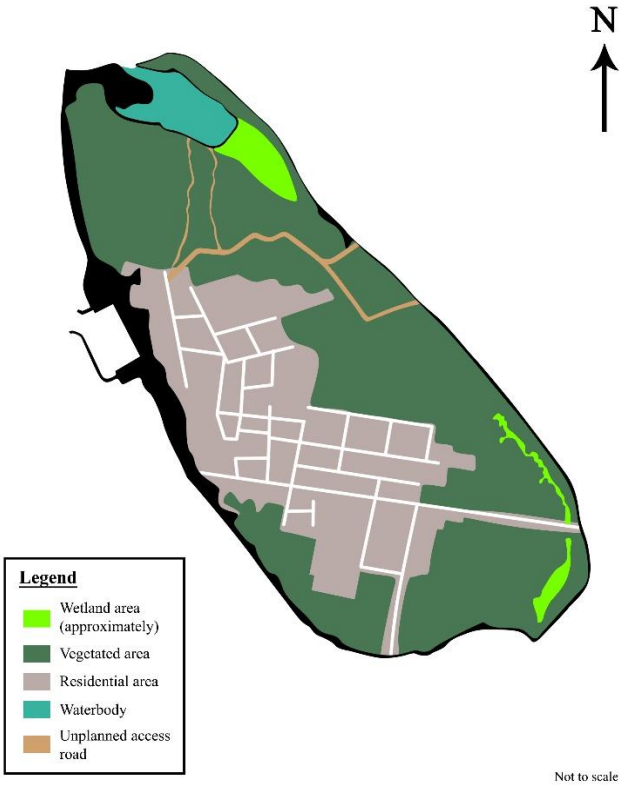

Figure 29: Terrestrial features of HA Thakandhoo

An area consisting of mangrove trees are also present in the island, starting from the south of the water body or *kulhi* in the northern side of the island. The wetlands area stretches southwards as approximated in **Figure 29**. The Island consists of typical Maldivian flora and fauna such as coconut palms, breadfruit trees, beach hibiscus, portia, sea trumpet, pemphis, sea lettuce and screw pine.

The groundwater of the island has been polluted throughout the residential areas. The water is reported to be high in salinity in some households in the northern side of the island, in addition to the presence of smell and turbidity on some households located centrally in the island. The island currently has no central sewerage system. Therefore sanitation practices leads to the seepage of liquid waste into the groundwater lens.

Island wide erosion was an important issue raised during the consultation meeting with the Island Council.

Figure 30: Terrestrial vegetation of HA. Thakandhoo. A: Mangrove B: Coconut palms C: Breadfruit tree D: Sea Lettuce

11.2 COASTAL MORPHOLOGY AND SHORELINE CHANGES

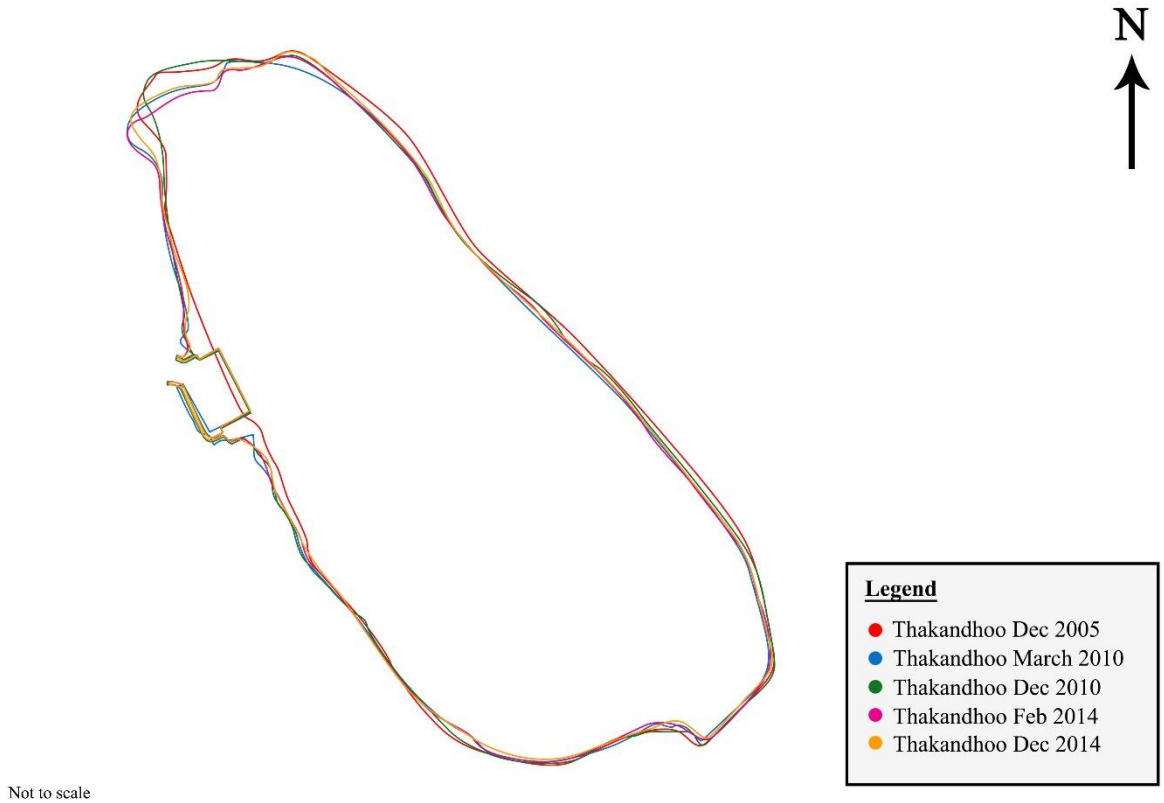

Figure 31: Changes to the coastal region of Thakandhoo from 2005 to 2014

The *thundi* area at the northern end of the island is seen as highly dynamic. The historical changes to the coastal area, taken from satellite imagery is shown in **Figure 31**. The shoreline changes for the period between 2005 and 2014 are shown for the months December, February and March, which covers the North East monsoon and the transitional period between the two monsoons, the *thundi* area is seen shifting towards a south westerly direction from the months of December to March.

The shoreline changes between 2005 and 2014 shows erosion at the shoreline north of the harbor. Erosion is also observed at the south west of end of the island.

Figure 32: Coastal areas of Thakandhoo. A: erosion observed in the shoreline closest to the proposed site. C: shoreline of the southern tip of the island

11.3 PROJECT SITE

The project site is located north of the residential area at 6°50'46.96"N, 72°59'42.17"E. An unpaved access path is present which connects to the residential areas from the western side. The access path stretches eastwards where it meets the proposed site. The width of the path varies between 3 – 6m and is accessible by vehicles. The access path intersects with a future planned road as seen in **Figure 33**. A clearing is proposed in alignment with this planned road to provide access to the site.

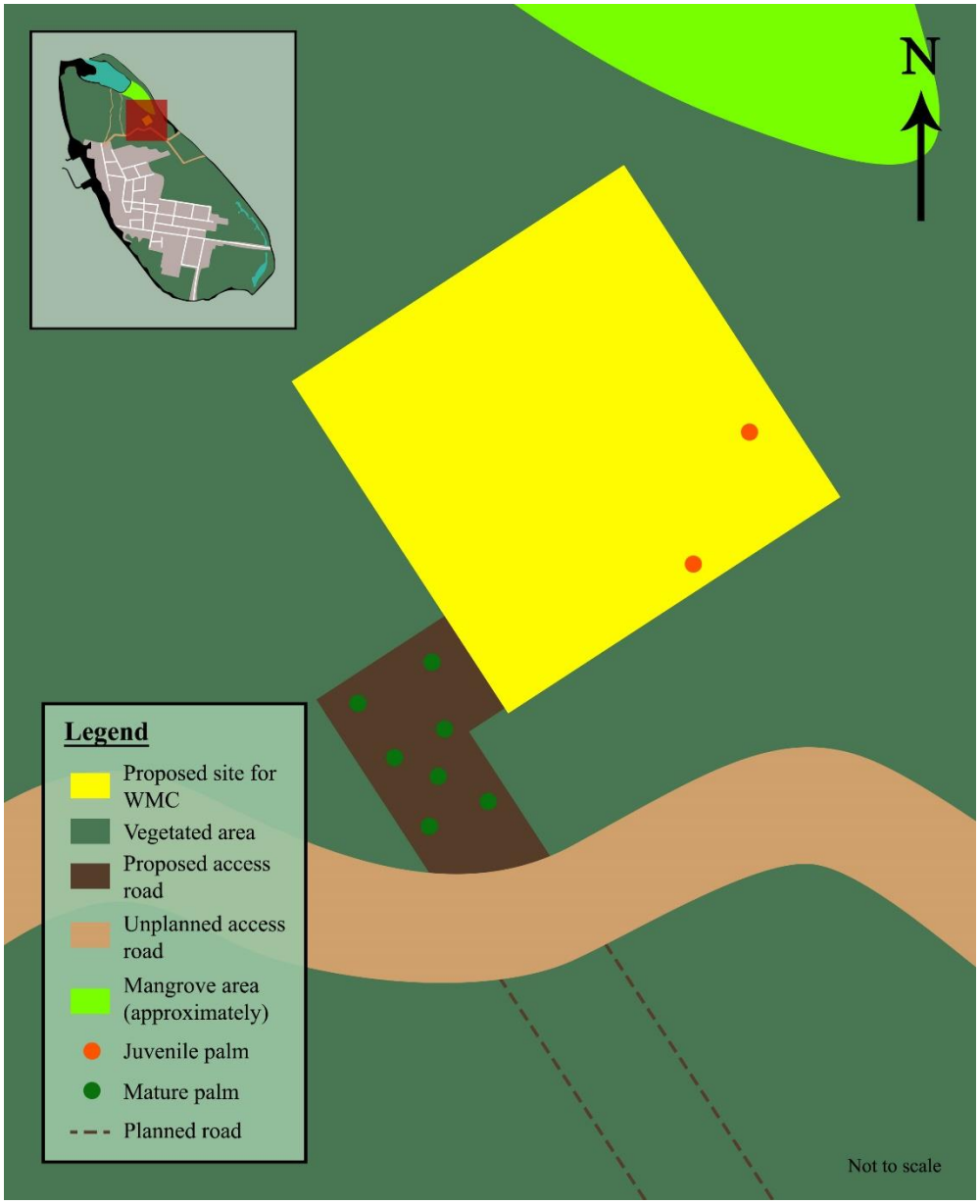

Figure 33: Site area including the proposed access road

The proposed clearing for the access road includes 7 mature palm trees in addition to shrubs. The proposed site was previously cleared (for utility purposes) yet was kept unused. Therefore, currently the site contains young vegetation including approximately 15 young palm trees and 2 juvenile palms. In addition to these, the site also contains sea lettuce and padanus shrubs.

Table 36: Vegetation survey of proposed site

Location	Scientific name /common name	Age class	Height	Diameter at breast height	Abundance	Dhivehi name
IWMC site	*Cocos nucifera* / Coconut palm	Young	-	-	Approx. 15	*Dhivehi ruh*
		Juvenile	7.2 m	83 cm	1	
		Juvenile	4.2 m	74 cm	1	
Access road segment to be cleared		Mature	-	-	7	

Figure 34: Site area with vegetation including young and juvenile coconut palms, sea lettuce, padanus shrubs and unpaved access road (D)

11.3.1 Site zoning recommendations by EPA

The EPA has provided recommendations for the optimum zoning of the IWMC site. The distances include, the site being at least 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 and at least 30 m from the wetlands as well as 60 m from the residential 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 37: Comparison between the proposed site location and EPA recommended distances

Location	Distance from site (m)	EPA Recommended Distance (m)
Coastal vegetation	49	30
Freshwater well	89	30
Recreational area	No recreational areas nearby	40
Wetlands	Approximately 10 -15 m	30
Residential area	73	60

As seen on **Table 37**, the site fulfils the EPA recommended distances, except for the wetlands area. The wetlands area is at a distance of approximately 10 - 15m from the site. The area surrounding the site is densely vegetated and contains mature palm trees. Care should be taken to not cause any damage to the area during construction works as well as during the operational phase. Therefore it is proposed to make an adjustment to the site location as shown in **Figure 35 and Annex 4** This can result in ensuring at least a distance of 17.6 m from the wetlands areas. Although, this moves the site portion out of the plot area, where an addition 5 – 10 coconut palms may fall in the footprint.

Figure 35: Proposed alteration to the site location in order to ensure a minimum of 15m distance from the wetlands area.

11.4 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were held for the project with the proponent MEE, enforcing agency EPA and the Island Councils of the respective islands. Meetings with MEE and EPA were held both before and after the survey trips in light of findings regarding some project islands. The initial meetings were mainly regarding the EIA project islands and scoping, although, due to the similar scope of works (except vegetation removal in the EMP islands' cases) the meetings included discussion of the project as a whole. Highlights of the meetings which apply to the EMP islands are presented below. Meeting attendance sheets are provided in **Annex 3**.

11.4.1 Meeting with Proponent

- The proponent was consulted at the start of the assignment to discuss project scope and after field surveys to discuss findings of the initial field surveys.
- Proponent informed that MEE will be responsible for the construction of IWMC, while land clearance shall be undertaken by the respective Island Councils.

11.4.2 Meeting with EPA

- It was highlighted that waste management will not involve burning waste at the island level. Waste from islands will be transferred to the regional waste management center. Only organic waste will be managed at the island level to make compost. All necessary equipment required to manage waste at in the IWMC will be provided as part of the project.
- EPA highlighted, relocation of trees within the island or outside of the island is preferred and requested the consultant to explore or identify options for which trees can be relocated as opposed to being removed for timber.
- EPA informed that buffer distances recommended by EPA in the zoning form shall be kept in order to mitigate impacts.

11.4.3 Meeting with Biodiversity Unit (Wetland and Mangrove Management Unit)

The meeting was held to discuss potential impacts to sensitive sites due to the project.

Meeting Summary

- The consultant highlighted that, the proposed and approved IWMC plot falls at a distance less than the recommended buffer from the wetland area (approx. 10 – 15m)
- The consultant informed that moving the site to provide at least would result in the requiring of the removal of 10+ trees (some of which are privately owned) for site clearance.
- Representative from EPA informed to detail these findings in the EIA report, which will be reviewed to make a decision.

11.4.4 Meeting with Island Council

- Island Council stated that two areas were previously located in the island as waste dump sites but there was a lack of cooperation from locals and they are unusable.
- The area for the proposed IWMC site was previously cleared to be used for utility purposes but was not utilized. Therefore this plot contains minimal vegetation compared to the surrounding areas.
- The Council plans to clear a main road which leads to the proposed IWMC site (which can provide access from the residential areas, in addition to the current access road which is an unplanned road). Process of compensating for privately owned trees has been started as the Council has now identified all private trees falling on to the path of the road. This planned road has 30+ palm trees privately owned.
- The Council stated that wetlands area is approximately 50 ft. from the proposed site.

11.4.5 Meeting with FENAKA (Thakandhoo Branch)

- As the current road is not an official planned road, FENAKA stated that they can provide a temporary electricity connection to the IWMC, as it is planned to only provide permanent electricity connection with the cleared road. 280 – 300ft of electricity cable would be required to provide electricity service to the IWMC from the planned road.

12 ASSESSING THE LIKELY IMPACTS AND MITIGATION MEASURES

12.1 METHODOLOGY, NATURE AND IDENTIFICATION OF IMPACTS

Various impacts arising from the project such as direct, indirect and cumulative impacts have been identified. The methodology was based on:

a) Scoping meeting with stakeholders;
b) Observations made during the visit of the project island and site
c) Literature review of similar local and other EMPs; and
d) Findings from other similar projects in Maldives and experience of the Consultant.

Impacts on the environment were identified based on their location/attribute, magnitude and duration of the impact. Impacts were assessed based on their significance and categorized as negligible, minor moderate and adverse. A Leopold Matrix was used for this purpose, for both the construction and operation phase.

The Leopold Matrix was developed by Leopold et al. (1971). It is a quantified Matrix which consists of 100 project actions and 88 environmental characteristics, elements and conditions. Relevant environmental characteristics and project actions were used for the impact identification. First of all, all of the relevant activities of the project that may have an impact on the environment was identified and written on the top of the matrix. These were divided for both the implementation and operational phase of the project. The environmental characteristics that may be affected by the project is written at the left side of the matrix.

A slash is placed at the intersection with each item on the side of the matrix if an impact is possible. The upper left corner of each box where an impact is possible, a number from 1 to 10 is written as the *magnitude* of the possible impact. The number 1 represents the least possible impact and the number 10 represents the highest magnitude of the possible impact. No 0's are used in the Leopold Matrix. A + sign is placed before the number if the possible impact is a positive impact. No sign is placed before possible negative impacts. In the bottom right corner of the box, a number from 1 to 10 is written as the *importance* of the possible impact. 1 being the least important and 10 being of the greatest importance. In giving scores, the magnitude and importance of the activities were judged for their short term and long term impacts. The impacts with greater long term impacts were given higher scores compared to the impacts with more short term impacts.

12.2 POTENTIAL IMPACTS AND MITIGATION MEASURE FOR KEY IMPACTS

For every minor to moderate to major impact identified, a mitigation measure has been proposed and discussed below. The mitigation measures proposed would be strictly adhered to eliminate environmental impacts arising from the project, even before it occurs. The impacts and mitigation measures are detailed in the two stages, construction and operational stages as explained below.
The possible mitigation measures include:

a) Changes in work practices and increasing awareness;
b) Provision of environmental protection and health safety equipment; and
c) Environmental monitoring during construction phase and operational.

Mitigation measures suggested in the report will focus on the existing environmental conditions as well as impacts that may rise during operation of the IWMC.

Table 38: Impact Matrix for Construction Phase

	Envisaged impact factors	C1 Worker Influx and Settlement	C2 Transportation of materials	C3 Site Demarcation & Fencing	C4 Site Clearance and Earthworks	C5 Construction	C6 Waste Generation	C7 Resource Consumption (Water, Electricity)	Total (Impact Area)
Physical Components	Seawater	-2					-3		-5
		1					4		5
	Ground water	-3			-2	-3	-3	-5	-16
		1			3	4	3	5	16
	Air	-3	-3	-2	-3	-3	-2	-3	-19
		2	3	2	4	3	4	3	21
	Noise	-2		-1	-2	-2	-2		-9
		1		2	3	4	2		12
	Coastal Zone							-1	-1
								1	1
Biological Components	Flora	-2	-1		-2	-2	-2	-3	-12
		2	3		4	2	5	2	18
	Endangered species/protected areas		-2		-1				-3
			2		5				7
	Coral Reef						-1		-1
							1		1
	Fauna		-2		-2	-3	-2		-9
			2		4	3	3		12
Socio-Cultural Component	Aesthetics	-2	-3		-2	-5			-12
		2	3		3	5			13
	Accidents	-1	-7	-2	-1	-3	-2	-1	-17
		1	5	1	2	4	2	1	16
	Landscape				-1	-3			-4
					2	4			6
	Health/Well being	-1	-5	-1	-4	-3	-3		-17
		1	5	2	3	3	4		18
	Local economy	4	4	1	6	7		-2	20
		1	4	2	6	5		2	20
Total (Construction Activity/Risk)		-12	-19	-5	-14	-20	-20	-15	
		12	27	9	39	37	28	14	

12.2.1 Impacts and Mitigation from Construction Phase

12.2.1.1 C1 Worker Influx and Settlement

An estimated 10 workers will be required for this project. The influx of workers can have a negative impact to the environment such as damage to vegetation, sensitive areas, and fauna of the island. This can be both intentional and unintentional.

Worker related impacts can include the requirement of building a temporary worker's camp, which can then lead to the set up of temporary waste, sanitation and water systems for the workers. For the duration of the project, the workers related waste output is detailed in **Section 10.3.12.** For this project, this impact can be reduced through the following mitigation measures. The project island currently has vacant properties as well as rooms to let in other houses, which can easily house the influx of 10 workers. Therefore no new facilities will be made for the accommodation of the workers. Other impacts include the increased use of resources by the workers in the island. This can be mitigated by choosing local contractors operating on the island.

In addition to this, when a new group of foreign workers arrive on the island conflicts can arise with the resident population in the instances where local culture is overlooked or not respected.

Mitigation for impacts on flora and fauna

- The contractor is required to keep the workforce as a minimum as possible, and to not bring in any surplus workers for the project;
- House rules shall be formulated by the contractor and workers shall be oriented on the rules and conduct during the project works;
- Workers shall be given instructions on the sensitive and protected areas of the island;
- 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

- Encourage choosing of local workers to reduce increased demand of resources; and
- Onsite generator for meeting electrical needs for the construction works

Mitigation for sociocultural impacts

- Hire local workers where possible;
- Orient foreign workers on communication, personal hygiene and sanitation in addition to the prevention of STDs and other infectious diseases; and
- Ensure all foreign workers have their legal permits.

12.2.1.2 C2 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 . Reduction of the transportation distance from the source to the project island is proposed. As the resource sourcing hierarchy in **Figure 36** shows, the greatest importance shall be placed on sourcing any available materials from within the island, with the next option being from within the north region, from islands such as HDh. Kulhudhuffushi. Site visits to the Zone 1 islands show possible sources for sand in islands (such as HDh. Hirimaradhoo, where a pile of excavated sand is present which can be procured for use in concreting works). 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.

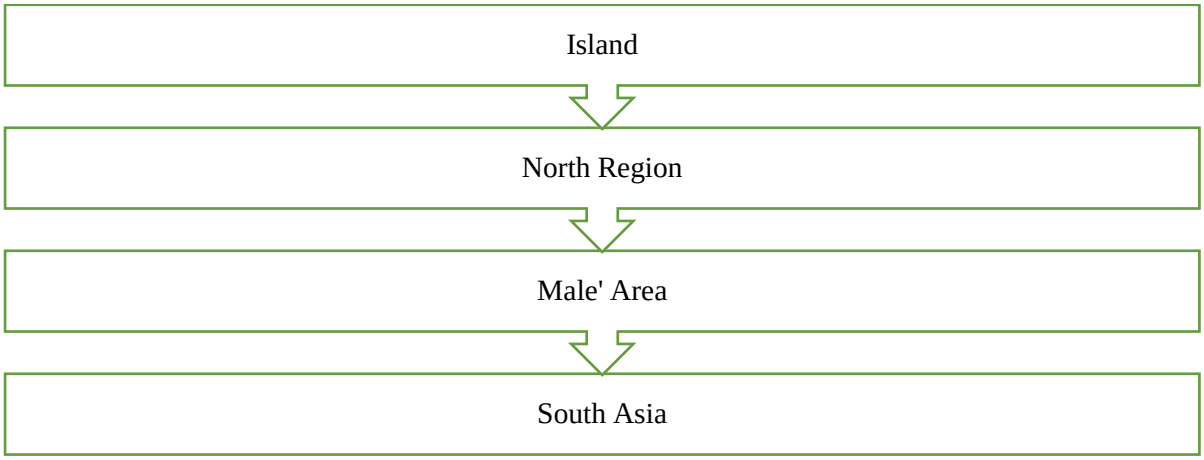

Figure 36: Material sourcing hierarchy proposed for the project

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 **Section 10.5** 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. Therefore for this project, an estimated 100.1 kg of CO2 emissions are expected for the concrete casted. 3136 kg of indirect CO2 emissions (Defra / DECC, 2012) occur per tonne of PVC pipe produced. For this project, the amount of indirect CO2 emissions are estimated at 164.8 kg. The greatest indirect CO2 emissions are estimated from the usage of reinforcing steel. 1.5 tonnes of reinforcing steel are estimated to be used for this project, which can cause a release of indirect CO2 emissions of 5311 kg (Ma et al, 2016). 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 37: Impact on roads from heavy vehicle transport in an island in Maldives

For the purpose of this project, no heavy vehicles are proposed for either construction or earthworks. Although this is the case, a pickup truck will be used to transport the construction materials to 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.

Mitigation for climate impacts

- Sourcing of materials shall be done according to the hierarchy presented in **Figure 36**.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;

- The contractor shall use serviced vehicles and plant equipment for the project;
- The contractor shall only use the needed amount of vehicles and plant for project; and
- The 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. Oversized heavy vehicles are not required for this project, therefore such vehicles shall not be used in the island for transportation and construction purposes;
- 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

- The vehicle drivers shall be licensed and competent;
- The loads being transferred shall be fully secured; and
- The transportation shall be done during day time.

Mitigation for marine and terrestrial pollution

- The contractor shall clean any littering on the terrestrial or marine environment caused during transportation;
- The contractor shall enforce strict policy against littering and appropriate penalties; and
- Spill kits shall be made available in cases of spillage of hazardous wastes, and hazardous waste storage shall be provided.

12.2.1.3 C3 Site Demarcation & Fencing

Site demarcation and preparation involves, land surveying of the area and setting out the limits of the project plot, and identifying trees that needs to be removed or relocated. This activity is considered to have minor environmental impacts as it is largely noninvasive.
However, improper or inaccurate demarcation and labelling could result in removal of untargeted trees which could result in having to remove more number of trees than that are required.

Mitigation Measures

- 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;
- accurate and reliable equipment shall be used to minimize errors;
- wearing, clothes/helmets to protect against thorns and freefalling coconuts and wearing protective clothing;
- carrying out the works during the day time; and
- ensure mosquito repellants are available for the workers.

12.2.1.4 C4 Site Clearing and Earthworks

The proposed site was previously cleared for the use of utilities. Although after clearing the site was left unused and unattended. Due to this, the site has been vegetated by young and juvenile trees including palms. The vegetation of the site has been detailed in the **Section 11.3**. While there are no mature trees of any sort in the site area, the surrounding areas have a number of mature coconut palms. Of those, 7 coconut palms fall into the footprint of the area required to be cleared for access to the site.

Article 8 (a) of Regulation on Cutting Down Trees requires permission be obtained from Ministry of Environment, Energy and Water, if more than 10 coconut palms that are of a six of 15 ft. (from base of the palm to the tip of the palm frond) are cut, uprooted or relocated to another island. The regulation also ensures the replacement of the vegetation that is lost by imposing the planting of two palms for every palm tree that is cut or uprooted (Article 2 (d)). As the number of palms requiring removal are less than 10, permission for approval is not required. If the coconut palms proposed for removal are privately owned, the compensation process must be followed prior to removal.

Mitigation Measures

- See 10.3.4 for the options provided for removing the mature coconut palms;
- Site shall be demarcated and fenced off prior to site clearing;
- Vegetation targeted for removal shall be marked prior to site clearing; and
- Excavated material used as backfilling and in grading of the site.

12.2.1.5 C5 Construction

Material Storage

This includes, storing all the vehicles, machineries, and tools required for the land clearance and IWMC construction. Due to the nature of the project, a lot of construction materials are not required. Apart from the vehicles and tools, fuel and water will be required for storage. Fuel will be stored on the cleared land in tanks that. Vehicles will be stored inside the fenced plot area. Tools and equipment will be stored in the tool shed within the fenced land plot. The project does not require land clearance or construction of extra building for material storage, hence the impacts arising from this activity is considered to be minimal. However, there is a risk of accidents, such as fires, oil spills and trespassing. These could be easily mitigated by implementing appropriate measures.

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 minor, due to the distance provided between the residential areas and the project site.

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 39: 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 72 dBA at 244 ft, which is the approximate distance from the centre of the IWMC to the nearest residential area. This is expected to further decrease taking into consideration the vegetation surrounding the proposed site, as well as the soil characteristics of the ground.

Noise during construction is determined to be a short term negative impact. Due to the distance of the project site and the surrounding vegetation, 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.

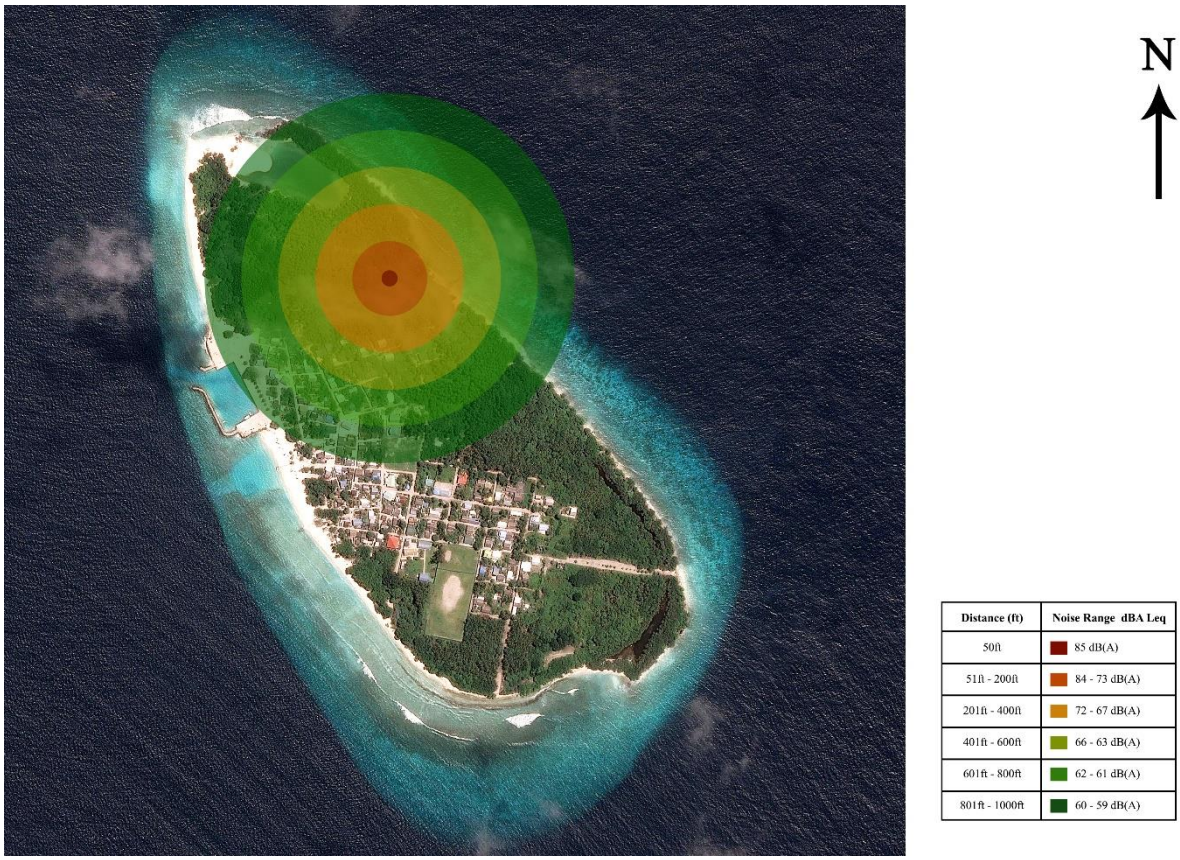

Figure 38: Noise range map for HA. Thakandhoo

Impact on vegetation

The impact and measures on vegetation have been discussed in **Section 12.2.1.4**. No other structures, temporary, or permanent are proposed to be built for this project (such as workers' camp). Therefore the activities of this project is not expected to have a major impact on the vegetation of the island.

Accidents and injuries

Accidents and risks (hazards) are important elements that need to be properly assessed, identified and analysed for what could happen if a hazard or accident occurs during and post development of the project. There could be many risks (hazards) and accidents to consider associated with many possible scenarios that could unfold depending on time, magnitude and the location it occurs. Hazards during construction 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 trenches and seriously injuring themselves.
- Being struck by moving equipment and vehicles.

Mitigation for material storage impacts

- Equipment shall be stored in fenced areas and maintained appropriately during the cause 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 Liquid Petroleum Gas (LPG) bottles and cleaning solvents and chemicals will be closed off from public access. Fire extinguishers and instruction in case of fire will be located in all the public, industrial and staff accommodation areas;
- portable extinguishers placed to be readily available when someone finds a fire;
- closed off non-public storage areas will be provided for inflammable goods (fuel drums, portable fuel containers, LP gas bottles, cleaning solvents etc.) with NO SMOKING, NO NAKED LIGHTS, HIGHLY FLAMMABLE sign boards in both English and Dhivehi languages;
- 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.

Mitigation for terrestrial pollution

- Set up a temporary waste disposal area within the project site;
- Regularly collect litter and dispose at the temporary waste disposal area;
- Hazardous waste shall be placed in enclosed containers;
- Vehicle maintenance shall be carried out on paved areas; and
- After the construction works are completed, transfer all collected waste to Thilafushi

Mitigation for noise and vibration impacts

- Provide workers with noise cancelling headphones.
- Use quieted equipment where possible, such as mufflers on engines;
- Use of well serviced vehicles and plant; and
- Switching off equipment and vehicles when not in use.

Mitigation for impact on vegetation

- Setting out survey shall be done by the contractor and the site limits shall be demarcated prior to any construction or clearing works;
- Fence off the site in order to avoid the removal of any vegetation out of bounds of the project site; and
- Allocate temporary stockpile area within the site, which is free from vegetation

Mitigation for accidents and injuries

- The contractor shall be required to develop occupational safety management plan, and safety guidelines shall be displayed in the work site at all times;
- Occupational safety training should be given to all workers present on site;
- Workers should be provided Personal Protective Equipment and the use of PPE shall be enforced;
- Site visitors 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.

12.2.1.6 C6 Waste Generation

Solid waste generated during land clearance and IWMC construction work would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite. Waste burned onsite would generate smoke, possibly impacting negatively on ambient air quality and human health. On the other hand, if all site clearance waste is to be transported this would also result in requiring burning fossil fuels and would require significant finance. 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.
On site generator and vehicle 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 and solvents. 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 1.2 kg will be produced daily if approximately 10 workers were active which equates to discharge of approximately 1,700 l/day of waste water. Sewage will be managed through existing sewage systems that have been installed in the islands

Since there is no existing waste management system in the atoll or since there is no existing waste dump in the island, 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.

Mitigation Measures

- Ensure to manage waste as described in **Section 10.3.12** of the report;
- open defecation whether it's on land or on the beach shall be prohibited;
- waste other than sewage shall not be flushed down the toilet;
- ensure to reduce waste by following the 3R steps; and
- waste collected shall be transported to Thilafushi after the construction works have ended.

12.2.1.7 C7 Resource Use

During the construction phase, machineries and vehicles used will consume fuel. Notable impacts of this activity include, increased air pollution, risk of spillage, impacts to health/wellbeing and accidents. The primary pollutants generated due to power production from diesel based generator system include Nitrogen oxides (NO_X), Sulphur dioxide (SO_2), Carbon monoxide (CO), Hydrocarbons/ Polycyclic Aromatic Hydrocarbons (HC/PAH), Particles (PA) and Carbon dioxide (CO_2) in the form of emission although the exact amount is difficult to quantify.

The visible pollution generated by burning diesel contains elemental carbon as soot. The typical odour comes from polycyclic aromatic hydrocarbons, which also are cancer causing components.

Due to the scale of these activities, the machineries won't be used for long periods of time. This would significantly reduce the impact of electricity generation. IWMC construction stage as well as land clearance stage will not use heavy vehicles and equipment extensively.

Water used during construction will be sourced by the contractor, from available groundwater wells. Water used for drinking and cooking will be purchased from local shops or collected from existing rainwater tanks or from the groundwater well in the island. Water and electricity consumption for the project is considered to be minor.

Mitigation

- Initiate rainwater collection and storage as early as possible into the project construction;
- turn off the tap while washing your hands;
- use salt water to wash dishes and only use rainwater to rinse them;
- water conservation devices shall be used;
- use well maintained, energy efficient equipment. The emission of carbon dioxide is directly related to the amount of fuel used. High efficiency is therefore important to reduce the amount of released carbon dioxide and consequently to reduce the global greenhouse effect;
- reduce idle time of machineries and vehicles. Switch them off after use;
- utilize day time hours for the construction when plenty of light is available; and
- FENAKA power supply will be used for electricity generating purposes.

Table 40: Impact identification matrix for operational phase

	Envisaged impact factors	O1 Waste collection and transportation	O2 Waste sorting, separating, storing and compost making	O3 Waste Generation	O4 Resource consumption (water/electricity)	Total (Impact Area)
Physical Components	Seawater	4				4
		4				4
	Ground water	5	-2	-1		0
		3	2	5		12
	Air	-3	-2	-2	-3	-13
		5	3	2	4	16
	Noise	-3	-1			-4
		4	2			6
	Coastal Zone					0
						0
Biological Components	Flora	6	7	-1	-3	4
		2	6	1	4	18
	Fauna	5	5	-1	-3	3
		5	5	1	4	19
Socio-Cultural Component	Aesthetics	6	8			9
		6	6			17
	Accidents	-4	-4		-4	-18
		4	4		5	19
	Landscape	5	6	-1		5
		6	5	2		18
	Health/Well being	5	-5	-2	-6	-10
		6	5	2	8	23
	Cultural heritage					0
						0
	Local economy	-3	8	-2	-1	5
		9	2	4	1	19
Total (operational Phase Activity/Risk)		23	20	-10	-20	
		54	40	17	26	

12.2.2 Impacts and Mitigation from Operational Phase

12.2.2.1 O1 Waste Collection and Transportation

As stated in this report, currently HA. Thakandhoo has no landfill area demarcated for waste dumping. This has resulting in the public disposing of waste in various locations of the island, including the beaches and the periphery of the residential areas. These practices have resulted in the spread of diseases in the island. Current practices also include burning of the waste at various locations of the island, which leads to respiratory issues from the inhalation of smoke. The successful implementation of the IWMC and the Waste Management Plan will lead to the reduction of the littering of waste throughout the island, and there will be no burning of waste at IWMC. This will lead to the improved health and psychological well-being of the residents and visitors of Thakandhoo. It has been identified as a long term positive impact on the residents and visitors of Thakandhoo.

Under the Waste Management Plan, a vehicle will be used to collect and transport the waste within the island daily, at a set schedule. This is identified as a minor impact in terms of noise, due to the fact that multiple vehicles are not used, and no receptor will be exposed to the noise for long durations of time.

Waste Collection and Transportation is identified to have a positive impact on the island.

<u>Measures to ensure and enhance the positive impacts</u>

- The Island Council shall formulate and gazette the Waste Management Regulation and Waste Management Guidelines for the island;
- The aforementioned regulation and guidelines shall state the penalties on persons that do not act according to the regulation and guidelines (i.e. littering, burning and dumping of wastes elsewhere), and Island Council shall enforce the penalties as prescribed;
- The proponent and Island Council shall follow the management plan provided with the EMP in order to monitor the operations of the IWMC, and bring about any necessary changes to the operations and policies, in addition to providing any needed technical assistance for the island;
- The proponent shall review the waste management operations within the islands regularly and update the National Waste Database;
- The operations shall be awarded to a contractor with the capacity to run the IWMC;
- The 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;
- Polluter pays principle established in order to reduce the waste generation within the island;
- The proponent shall provide resources in terms of budgetary allocations, required equipment, and technical expertise to ensure the operation of the IWMC; and
- The proponent shall assist in creating markets / avenues where the IWMC's can generate income through selling compost and recycled metals, plastics and glass.

<u>Mitigation for terrestrial pollution</u>

- Implement rules within the IWMC workers to impose penalties for any littering within the island due to improper handling of the waste and improper transport practices; and
- The status of the vehicle shall conform to the Waste Management Regulations 2013/R-58 and provide cover to the waste being transported in order to avoid littering.

Mitigation for accidents and injuries

- The vehicle should be driven by licensed drivers; and
- A strict schedule shall be stated in the WMP and followed in order to reduce the transportation frequency thus reducing the probability of accidents.

Mitigation for air quality impacts

- Spray the roads with water during the dry season to suppress dust;
- 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 Waste Management Plan;

12.2.2.2 O2 Waste Management Activities

Waste sorting, separating storing and composting make up the largest portion of the IWM concept. On top of reducing the volume of waste, these activities, convert waste to re-sable and value added products. These activities will be carried out in the IWMC where employees will be trained to undertake these 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. Hazardous chemicals that get into the soil (contaminants) can harm plants when they take up the contamination through their roots. If humans eat plants and animals that have been in contact with such polluted soils, there can be negative impact on their health.

All these impacts can be mitigated and prevented by the proposed IWM concept. However, if these activities are not properly implemented there is a risk of IWMC being deteriorated into a dump site where mixed waste are disposed, burned and buried. The risk is more prominent for islands where the population size is greater. This means without proper mitigation measures and regular transportation of waste out of the island to a central waste management facility, there is a greater risk of IWMC being overfilled. More so considering that IWMC is equipped to handle only about 20-30% of organic waste generated in the islands 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 IWMC 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 / m^3 close to the composting site and dropped to background levels within 550m 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 / m^3), 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 41: 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 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 IWMC are not as large scale as the studies cited above. The composting capacity of the IWMC is expected to be two windrows of approximately 39 m^3, each batch to take around 4 – 6 months to mature. 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 IWMC becoming a makeshift waste dumpsite for organics are also addressed in the section.

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. 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 odours.

The operation of the IWMC 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 IWMC), 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 IWMC 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 from composting

The main gas by product from the composting is CO2. In anaerobic conditions, methane is released into the atmosphere, which has a higher greenhouse warming potential compared to 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 dumped;

Amenity Impacts

The IWMC 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 IWMC, which can degrade the local amenity. This impact is mitigated through the design of the IWMC perimeter walls which include a perimeter fence made of 50 × 50 PVC coated mesh.

Littering inside the IWMC can cause amenity issues such as tracking of litter on the wheels of the waste transport vehicles leaving the IWMC. 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 42: Odours generated from the composting process (Source: Goldstein (2002))

Compound	Description of smell	Detection limit for a particular odour panel ($\mu g/m^3$)
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

The current practices of dumping waste all around the island will be replaced with the collection and disposal of the waste at the proposed IWMC site. This site is 73 m away from the nearest residential site, and is located in such a way that the strong monsoonal winds of southwest monsoon will not carry the odour towards the residential areas, although the winds of northeast monsoon can direct the odour towards residential areas. The impact of odour on the residential areas are deemed minimal due to the provided distances and siting of the IWMC.

Fire hazards

There is a possibility of fire hazards at the IWMC 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 IWMC.

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 38*** can be used for this purpose too. The map shows that the noise reduces to a maximum level of 72 dBA near the residential areas. This calculation does not take into account the dampening effects of the surrounding vegetation. Therefore, the long term negative impacts of noise would be borne by the employees of the IWMC, and the effects of noise to the residential areas are minimal

Workplace safety and accidents

The group of people most likely to be impacted by the IWMC 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 guidelines 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.

Mitigation for health impacts

- A distance of 73 m is available between the IWMC and the nearest residential area, which can act as a buffer zone (greater than EPA recommended buffer);
- The siting of the IWMC is at the northern region of the island. Due to this location, the residential areas are well shielded from the particulate matter that can disperse with the winds of the south west monsoon. Although it should be noted that due to the location, the winds of the north east monsoon can direct the particulate matter towards the residential areas. Even though this is the case, dense vegetation is observed between the residential areas and the site;
- The IWMC operator shall plan material handling processes in downwind of the residential zones;
- Ponding shall be minimized at the site by grading of the ground;
- Handling of compost shall be minimized;
- Compost turning shall be done based on temperatures and not on schedules;
- Material movements and compost turning shall be done during low winds. Weekends, holidays and times of the day when most people are likely to be outside (and use of recreational / public spaces) shall be avoided when handling the materials and turning compost;
- Add moisture to the compost to minimize dust;
- Add a geofabric cover over the compost windrow to minimize release of bio aerosols; and
- Workers shall follow the workplace safety mechanisms and guidelines set by the contractor and practice safety and personal hygiene when handling the compost.

Mitigation for 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.

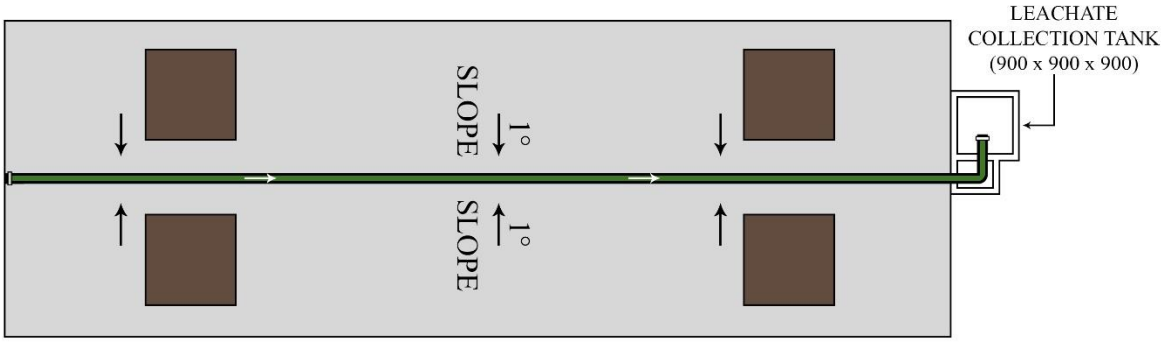

Figure 39: Compost slab design and leachate collection system (Plan view)

Mitigation for rainfall related leachate production

The current design of the IWMC consists of a composting slab is an open windrow composting system. The compost windrow is kept on the compost slab which is sloped in such a way that the leachate from the compost will collect at the pipe in the centre, which will propagate the leachate into the leachate collection tank (see **Figure 39**). While this scenario is ideal during fair weather, heavy rainfall and strong winds should also be considered. There is a possibility of heavy rainfall increasing the produced leachate, as well as the water collected over the composting slab propagating to the leachate collection tank. This can cause an overflow of the leachate collection tank, releasing its contents into the ground and subsequently the groundwater aquifer.

The rainfall can also cause the scattering of the compost materials, the increased water content in the compost windrow can cause another issue: the saturation of the windrow can decrease the available oxygen within the compost windrow, leading to anaerobic conditions.

- There is a valve placed at the inlet pipe which can be closed in instances where the leachate tank may overflow from heavy rainfall onto the compost slab;
- The 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
- A 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.

Figure 40: Windrow cover being utilised in an open composting system (source: Midwestbiosystems.com)

Keeping stockpiles of raw organics low

Stockpiles of raw organics (waiting to be processed or transported) can cause impacts such as foul odour from the biodegrading organics, leachate reaching and contaminating groundwater, issue of vermin and pests, and visual impacts from the stockpiles.

As per the design of the IWMC, there are compartments for the storage of all major waste types other than organic wastes. A dedicated slab is provided for the composting of the organic waste materials. As per the calculations in **Section 10.4.6** it is seen that the composting slab has the capacity for composting less than 1 month's organic waste produced in the island. As the composting process may take between 4 – 6 months (Halliburton, 2002), the remaining months' organic wastes can accumulate unmanaged and without any means of storage.

The consultant proposes the following mitigation measures:

- Arrangements to regularly transport the unmanaged waste to a central waste management facility; and
- In cases where the waste cannot be transported due to delays and unforeseen circumstances, it is not recommended to stockpile the unmanaged waste on the ground, without any cover. As per the area of the IWMC, there is a capacity to arrange up to 25 nos. 660 L wheelie bins to store unmanaged organic waste. It is also recommended to separate the putrescible waste from the green waste while storing in the wheelie bins. While this mitigation is not the most ideal, it is seen as the option with the least impact, pertaining to the resources available to the islands and the difficulty in transportation. Alternative transfer arrangements shall be made within this duration.

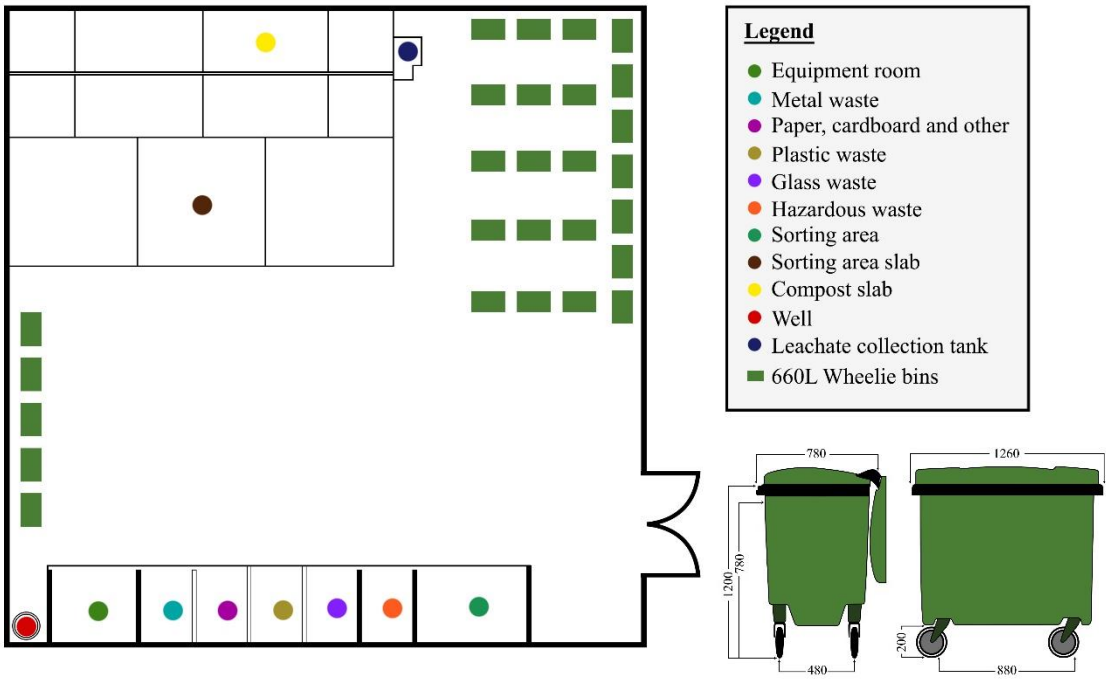

Figure 41: Proposed wheelie bin arrangement to provide for temporary storage of unmanaged organics

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. 660L wheelie 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 IWMC 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 IWMC, with the provision of a 2.8m high 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 IWMC. 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 IWMC.

Mitigation for odour 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 15cm 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.

Mitigation for fire hazards

- A fire management plan shall be developed by the IWMC occupier;
- Adequate firefighting equipment shall be provided at the IWMC, and placed at locations easy to access;
- The IWMC occupier shall be able to show that firefighting capacity of the IWMC is sufficient to suppress and minimize the incidence and impact of fires; and
- Workers shall be trained to use the firefighting equipment and able to manage fire outbreaks.
- 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.

Mitigation for workplace accidents

- The IWMC 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 and instructions to employees on how to operate any machinery;
- Instruct employees on safe systems of work;
- 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.

Figure 42: Recommended protective clothing for waste management employees. Adapted From: Ministry of Health, Thailand. Bangkok, 1995. *noise cancelling headphones and safety glasses during use of machinery

Table 43: 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

12.2.2.3 O3 Waste Generation

Waste generated during the operational phase of the IWMC will be relatively low. These will include waste oil/batteries for waste management equipment. Since eating and cooking inside the IWMC will be prohibited, no mixed municipal waste will be generated during the operational phase of the project. Hence overall impact for this activity would have a minor negative impact on environmental receptors.

Mitigation Measures

- Closed containers shall be provided to manage hazardous wastes;
- Spill kits shall be provided to manage oil spills; and
- Prohibit eating/cooking in the IWMC.

12.2.2.4 O4 Resource Consumption

Water will mainly be required for washing equipment, work ware, hands etc. and to water the compost pile. Water required for moistening compost piles will be relatively small. As most of the moisture required for the compost pile will be sourced from the leachate collected from the leachate tank the volume of water required will be significantly less. It is estimated that approximately 200 -300 l/day of ground water will be required during the operational phase of the project. Since the volume of water required is relatively low, it is not expected to have a significant impact on groundwater.

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 empties, therefore resulting in lower transportation costs. Compactors and crushers 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 IWMC. Therefore. Electricity consumption of the IWMC 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.

Mitigation Measures

- 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.

Table 44: Impacts and proposed mitigation measures for the construction and operational phase of the project

No	Potential Risk/Impact	Receptor	Nature	Reversibility	Significance	Mitigation	Cost
	Description	**Description**	**Positive**	**Reversible**	**Major Negative**	**Description**	**USD**
					Major Positive		
			Negative		**Moderate**		
				Irreversible	**Minor**		
CONSTRUCTION PHASE (C)							
C1	Impacts from worker influx and settlement (flora and fauna, resource use and sociocultural impacts)	People of Thakandhoo, and terrestrial and marine environment	negative	Reversible	**Minor**	• See **Section 12.2.1.1**	Included in the construction costs.
C2	Impacts from transportation of materials. (climate impacts, and impacts on roads)	Residents of Thakandhoo, terrestrial and marine environment, global environment	negative	Reversible	**Minor**	• See **Section 12.2.1.2**	Included in the construction costs.
C3	Impacts from site demarcation and fencing (Impacts on flora and fauna)	Local flora and fauna	Negative	reversible	**Minor**	• See **Section 12.2.1.3**	Included in the construction costs.
C4	Impacts from site clearing and earthworks (terrestrial pollution, vegetation removal)	Vegetation of the site and surrounding areas	Negative	Reversible	**Minor**	• See **Section 12.2.1.4**	Included in the construction costs.
C5	Impacts from construction works (vegetation impacts, noise and vibration, accidents and injuries, pollution from material storage)	Workers and residents of Thakandhoo	Negative	Reversible	**Minor**	• See **Section 12.2.1.5**	Included in the construction costs
C6	Terrestrial pollution from construction waste generation	Residents of Thakandhoo, ecosystem	Negative	Reversible	**Minor**	• See **Section 12.2.1.6**	Included in the construction costs
C7	Impacts from resource use	Residents of Thakandhoo, ecosystem	Negative	Reversible	**Minor**	• See **Section 12.2.1.7**	Included in the construction costs

OPERATIONAL PHASE							
O1	Waste collection and transportation (Climate impacts, air quality, amenity impacts)	Residents and visitors to Thakandhoo	Positive	Reversible	**Minor**	• See **Section 12.2.2.1**	Cost borne by operations contractor
O2	Waste management activities (Public health, noise, groundwater, fire, accidents, odour impacts)	Mostly IWMC workers, residents and visitors to Thakandhoo,	Positive	Reversible	**Minor**	• See **Section 12.2.2.2**	Cost borne by operations contractor
O3	Waste generation (terrestrial pollution, groundwater contamination)	Residents and visitors to Thakandhoo	Negative	Reversible	**Minor**	• See **Section 12.2.2.3**	Cost borne by operations contractor
O4	Resource consumption (water and electricity)	Residents and visitors to Thakandhoo	Negative	Reversible	**Minor**	• See **section 12.2.2.4**	Cost borne by operations contractor

13 PROJECT OPTION

13.1 ADVANTAGES AND DISADVANTAGES OF PROJECT OPTION

The advantages and disadvantages of conducting the project option are proposed below:

Table 45: Advantages and disadvantages of project option

Option	Environmental	Social	Economic
Project Option	The project involves clearing of approximately 7 mature coconut palms in addition to juvenile trees and shrubs in the proposed site It will generate a moderate amount waste and GHG and bring irreversible change to existing landscape. This would have negative impacts on the soil and biological environment of the island. However almost all the foreseeable impacts of the project can be mitigated and kept at an acceptable level and the project will not result in a loss of a sensitive or critical habitat or species. The project will control and prevent further pollution of the environment, and facilitate utilisation of land area more effectively.	Increased direct and indirect employment opportunities for the locals as the IWMC 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 hence pollution of the island will be stopped or controlled. The project will result in social discomfort as privately owned trees will be removed to clear the land for IWMC and access road. During the operational phase of the project, smell dust and smoke will be emitted from the IWMC.	Enhanced opportunity for locals to start and diversify tourism related services, since a safe and clean island would facilitate and benefit any local tourism venture. Direct contribution to government revenue through taxes and duties. Creation of job opportunities and skilled labour in the region. Development and expansion of agriculture and fisheries market in in the island. Price and profit from agricultural produce will become more competitive due to availability of compost. Potential to attract foreign currency by selling compost, scrap metal and other recyclables which would develop the national economy. More settlers will be attracted to the island, which would promote the development of local public services and infrastructure.

14 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT PLAN

14.1 SCOPE

The chapter would present in detail the management measures put in place by the proponent and the contractor to mitigate the environmental impacts that would arise from the project activities. The assessment of impacts and mitigation measures that would be put in place had been discussed in detail in the previous chapter. The main scope or objectives of the environmental management plan are to:

a) Produce a framework for anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions during pre-construction, construction and operational phase; and
b) Provide evidence of conformity to laws and regulations and requirements of enforcement agencies.

14.2 ENVIRONMENTAL MANAGEMENT SYSTEM

The environmental management framework for the proposed project is based on the standards and policies set out by the Environmental Protection Agency of the Maldives under EIA Regulation 2012.

a) Environmental Management Planning and establishment of key performance indicators: The EMP specifies environmental management measures and required performance standards;
b) IWMC construction and operations: The aspects of the construction and operation will be established and operated according with the EMP;
c) Monitoring and corrective action: The implementation of EMP measures will be monitored during operational stage and will be reported. Any inconsistencies between the EMP and its on-site implementation will be identified and addressed through corrective actions; and
d) Auditing, reviews and enhancement: The EMP will be reviewed. Improvements to the EMP will be made as necessary to achieve desired environmental outcomes.

14.3 ENVIRONMENTAL MANAGEMENT STRUCTURE

This sections detail the various parties involved in the implementation of the environmental plan and their responsibilities.

14.3.1 The Proponent, Ministry of Environment and Energy

MEE will be responsible for the execution of the project activities within the required timeframe. The scope of land clearance falls within the responsibility of the Island Council. MEE is also responsible of policy level decisions and provision of support regarding the waste management works undergone in the island as well as the regional level.

14.3.2 The Contractor

Contractors to construct the IWMC and clear land will be procured by MEE and Island Council respectively. The contractor will undertake the project in accordance with the EMP proposed in the EIA and will report to the proponent and environment consultant about any unexpected environmental impact or health and hazard issues. During the construction stages, the contractor will follow all mitigation and management measures proposed in the report, mainly waste management, pollution control, accident prevention and work methodology proposed.

14.3.3 Environmental Consultant

The environmental consultant would prepare the EMP based on field visits and surveys and based on past project experiences in similar settings. If there are any modifications to be made to the EMP during any stages of the project, the consultant would do the modification and would conduct the environmental monitoring according to the monitoring framework. The environmental consultants are also responsible for auditing the management/monitoring plan to identify gaps, limitation in management and propose remedial measures to ensure the project is sustainable.

14.3.4 Environmental Protection Agency

The Environmental Protection Agency would review the monitoring reports submitted by the proponent and would continue with regulatory monitoring visits to the project site upon their needs.

14.3.5 Island Council

The Island Council will be responsible for the following:

- Formulation and implementation of the Waste Management Plan (WMP) for a period of 5 years. HA Thakandhoo Council has created the WMP on 10th January 2017 and approved by EPA.
- Formulation and gazetting of Waste Management Regulations for the island;
- Formulation and gazetting of Waste Management Guidelines for the island;
- Responsible for the land clearing works of the proposed IWMC site; and
- Overseeing the operations of the IWMC

The Island Council is responsible to ensure the progress of the Waste Management Plan and achievement of the set goals through implementing the plan. This includes overseeing the IWMC operations by either running the operations through the Council or awarding the work to a contractor. As per the WMP of HA. Thakandhoo, the Island Council expects to award the work to a contractor and monitor the operations. The Island Council is also responsible for the compilation of the IWMC reports submitted by the contractor as well as producing an IWMC monitoring report as well as reporting of public grievances. These reports shall be submitted to the MEE bi-annually for review.

14.3.6 Operations Contractor (IWMC Occupier)

The operations contractor will be responsible in running the operations in accordance with the guidelines set by this EMP and the WMP of Thakandhoo Council. The responsibilities of the operations contractor include producing the IWMC operations reports and submitting the reports to the Island Council at the proposed regularities.

14.4 REPORTING

Reporting will be carried out on a timely manner to implement the environmental management plan and will cover details of site conditions, and operations. A detailed reporting mechanism for the IWMC operational works is provided in **Section 14.10**. Monitoring reporting shall be carried out during the stated time frames and frequencies in **Section 14.6**.

14.5 ENVIRONMENTAL MANAGEMENT PLAN

A practical plan taking into consideration available resources is proposed to meet the aims and objectives of the EMP. One of the major risks to the investment and operation of the IWMC and island level waste management is the center itself which can be converted back into a dumpsite due to mismanagement as often seen in island level waste management endeavors all across the Maldives. This is partly due to the fact that a lot of linkages connecting island level waste management with regional level waste management are absent or unknown until it is much too late. As described in **Section 12.2.2.2**, one of the main risks facing the current project is rapid accumulation of organic waste at the IWMC. Hence the proposed IWMC management plan aims to control and mitigate such risks without severe negative impacts

Table 46:Details of environmental management plan proposed for the IWMC

Activity	Phase	Measures	Time frame	Responsible person
Training of workers and contractors	Pre-construction, Pre-operation	Contractor and project workers are provided with detailed information on the project, impact mitigation measures, compliance with environmental permits and the EMP. Workers are also provided with the information on sensitive areas of the island and other environmental issues. Training of staff involved in the monitoring of the construction phase Training shall be provided to the workers of the IWMC on the waste management practices and mitigation measures in order to ensure the operations are run efficiently and effectively.	Prior to construction works Prior to operational phase	Proponent Environmental Consultant
Documenting non-conformances and corrective actions	Construction Operation	Non-conformances to the environmental regulations, permits and the EMP is monitored and documented. Corrective measures are taken and follow ups are done. IWMC operations reports and public grievances are compiled by the Island Council and reported to the proponent within the prescribed frequencies as stated in	Construction and Operation phase	Proponent Environmental Consultant Island Council
Supervision of activities	Construction Operation	The project activities are to be supervised by the proponent throughout the construction and operational phase to ensure the activities are carried out accordingly and the impacts are minimised. The proponent shall review the IWMC operations reports from the Island Councils, and provide the required support, bring about any necessary policy updates	Construction and Operation phase	Proponent Environmental Consultant

14.6 ENVIRONMENTAL MONITORING PLAN

Table 47: Impact management and monitoring plan for the construction and operation phase of the project

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
Ensuring that the project activities does not affect the quality of the groundwater	Establish baseline just before the construction works begin and continue monitoring as stated. Establish a groundwater monitoring stations and geo-reference it. Preferably close to the IWMC.	O	12,000 per trip	Potable water quality testing equipment and/ or by sending samples to the lab	During operational phase, bi annually	Proponent Environmental Consultant	Water quality report
Ensure waste generated at work site is audited and managed responsibly	Management of waste generated as described in **Section 10.3.12** of the report	C,O	Cost included in the project costs	Estimation of waste generated at project site and recording these data routinely. This includes quantifying and recording the amount of yard waste, hazardous waste and general waste stacked and stored for transportation.	Every two months	Construction contractor, operation contractor	Record sheets, photographs and quantity of waste processed at Thilafushi/ (nearest waste management center) and IWMC. If there are no significant discrepancies between the quantity of waste generated on site and processed at a central waste management facility, it can be safely assumed that impacts of waste on the environment was reduced.
Monitoring Health and safety of workers and the public	Accidents during construction of IWMC, land clearance, operation of IWMC and maintenance of IWMC. Fire hazards and natural disaster events. Noise and smell complaints during operation and construction phase. Compost condition, output and quality	C, O	Cost included in the project cost	Keep records in a log book, or data sheet	Bi annually	Operational contractor Construction land clearance contractor	Measures to adapt and prevent accident and risks. Health assessment reports published or available from the local health center.

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
						Island Council MEE	Policy changes and upgrades. Compost quantity and quality. Income from selling compost.

14.7 RESOURCE REQUIREMENT FOR MONITORING

For the monitoring program to be successful, it is important that adequate financial and human resources are available and strong coordination among the key stakeholders is maintained.
The primary function of implementing the mitigation and monitoring plan will lie with the proponent and environmental consultant. Since the project at developmental and operational stage will be engaged by the proponent it will be the responsibility of the proponent to take care of the environmental safeguards at all stages of the project during implementation and at operational phase. The proponent should prepare an Environmental Action Plan, which states all measures for mitigation and enhancement and monitoring as described here in the EIA with their responsible organisation and person, planning, methodology, timing and other relevant aspects.
An independent registered environmental consultant shall be hired and contacted to undertake and audit the monitoring program prescribed in this report. Following each monitoring visit the consultant will prepare a report with clear recommendations and corrective measure if necessary. The report will have to be submitted to EPA for their review and actions.

14.8 MONITORING SCHEDULE

Table 48 highlights the monitoring plan in which responsibilities of main stakeholders has been assigned. In order to track and compile the findings of these measures an independent environmental consultant shall be tasked to audit the projects EMP. This is to

- identify gaps in monitoring and mitigating impacts arising from the project;
- determine the challenges and resource inadequacies to implement the proposed EMP; and
- determine the current environmental condition and propose modification/upgrades to the initial EMP.

Monitoring frequency for various individual components given **Table 47** shall be followed by all responsible parties. **Table 48** gives indicative timeline for the monitoring visits by third party consultant.

Table 48: Monitoring visit schedule

Visit	Indicative timeline	Indicative parameters to monitor	Reporting	Cost (MVR)/per report/island.
Visit 1	Prior to construction of IWMC	Set baseline for groundwater quality and noise	Submit summary report 1 to Proponent within 2 weeks	25,0000.00
Visit 2	During construction of IWMC	Monitor work method, waste management, Monitor health and safety of workers. Monitor impacts to nearby vegetation and ensure vegetation removal is as per set out survey. Review reports prepared by contractors.	Submit monitoring summary report 2 to Proponent (MEE) within 2 weeks	10,000.00
Visit 3	Two months into operation of the IWMC.	Monitor water quality and noise. Monitor IWMC. This includes review of	Submit summary report 3 to Proponent within 2 weeks	25,000.00

	Biannually for four years	reports dated in **Table 50** or determine condition of IWMC. Monitor compost condition as described in **Table 47** and **Table 50**		

As indicated, during the course of the Project implementation summary reports following each trip is expected to be submitted by the Project's environmental consultant. These environmental audits will provide a basis for assessing at least the shorter-term efficacy of the environmental measures and thereby provide lessons to be learned for future monitoring sessions and other projects with similar impacts. The consultant will prepare and submit the reports to Proponent. Based on the findings of the report, the management approach may be adapted and its efficacy will be determined in the consecutive monitoring trip.

14.9 MONITORING REPORT

Reporting will be carried out by the environmental consultant assigned for the purpose by the proponent. The report will include among other information;

- Details of what was being monitored;
- Methodology of data collection and data analysis;
- Major findings;
- Effectiveness of the mitigation measures in place and
- Recommendations and conclusions.

A detailed environmental monitoring and management report is required to be compiled and submitted to the EPA. In addition to this, regular site monitoring would be carried out by the proponent that requires maintaining logs of events as explained in this report. Enforcement officers from EPA may also visit the site for inspection from time to time.

14.9.1 Monitoring Report Format

The environmental monitoring report outlined in **Table 49** below will be used in reporting environmental monitoring to be carried out as given in the monitoring plan.

Table 49: Monitoring report format

Project Title:
Name of the Island:
Monitoring Date:
Period Covered:
Prepared by:
Contributions:

A. Introduction
Give a brief introduction about the project and the monitoring carried out
B. Methodology
Brief detail of the methodology applied for undertaking the monitoring assessment
C. Environmental Monitoring
a. Groundwater quality
Parameters given in the monitoring plan need to be assessed
b. Waste generation and management at IWMC
These include monitoring for pests and diseases as described.
D. Risks and Mitigations
Please indicate any critical unresolved risks that affect the course of the system operation, analyse the cause, assessing the potential impacts on the environment providing the proposed mitigation strategy
E. Problems Encountered
Indicate any problem areas encountered and any corrective measures that will have to be taken.
F. Recommendations and Adaptations as Solution
If specific recommendation is noted during the monitoring phase, specify it in the report
G. Conclusions
Reference
Appendix

14.10 IWMC OPERATIONS REPORTING MECHANISM

Table 50:Details of the reporting mechanism proposed for the IWMC

IWMC (Contractor)

Reporting	Details	Frequency
General report	Logs of the incoming waste	Monthly
	Classified by type and weight	
	Vehicle maintenance details	
	Machinery maintenance details	
	Machinery fuel usage details	
	Workplace injuries	
IWMC capacity	Details of the utilized and remaining capacity of IWMC	Every two months
	Leachate tank maintenance and capacity	
IWMC inventory status report	Details of the status of IWMC equipment	Bi-Annually
	Details of the status of emergency kits and firefighting equipment	
Compost output report	Details of amount of input waste materials	Bi-Annually
	Details of compost output in weight	
Noise and odor complaints	Log of noise and odor complaints	Every two months
	Complaints to be provided along with weather conditions and incoming waste details coinciding with the dates of complaints	

Island Council (Municipal Unit, Waste Management Committee)

Components	Details	Frequency
Public grievances	Log of public grievances regarding	Bi-Annually
	Fee structure	
	Waste Management operations	
	Noise and odor complaints	
IWMC monitoring	Monitoring report of the IWMC operations	Bi-Annually
Compilation of IWMC reports from operations contractor		Bi-Annually
Income report	Summary of IWMC operations income	Bi-Annually

MEE

Components	Frequency
Review of IWMC Reports from Councils	Bi-Annually
Update National Waste Database	
Policy updates from findings	
Provision of support to IWMCs	
Overview of the waste management system on island level and regional level	

15 RECOMMENDATIONS AND CONCLUSION

The construction and development of the IWMC at HA. Thakandhoo is a much needed project to provide waste management services to the island. The IWMC 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.

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 consultant's recommendations for the project include:

- To include this EMP as part of the contractor's contract and ensure the measures and recommendations brought forth are followed;
- Implement the work method and mitigation plan as prescribed in the report to the fullest;
- To conduct supervision and monitoring of the project works by the proponent;
- To conduct supervision and reporting of the project works by an independent consultant;
- To conduct stringent evaluation of contractor's capacity to undertake and complete the project;
- Ensure necessary clauses regarding the workers safety are fully implemented;
- 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 EMP has looked into the key factors that need to be considered during construction and operational stage. The study has identified the following unavoidable terrestrial impacts due to proposed development works:

- Almost an irreversible change to the overall terrestrial environment as a result of the placement of the access road and IWMC footprint;

The study also found that through the implementation of the proposed practical and cost effective mitigation measures almost all significant impacts can be brought to an acceptable level. This EMP will guide the proponent in implementing the project with conformity to EIA regulation 2012.

CHAPTER 3
HA. MOLHADHOO

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16 INTRODUCTION

16.1 BACKGROUND

HA. Molhadhoo is part of the North Thiladhunmathi Atoll. The island is oriented in a NW-SE direction. The island has a land area of 118 ha. HA. Molhadhoo has a population of 374 (Island Council, 2017). The number of plots allocated for households are 130, of which 65 plots are vacant. Approximately 15ha of the island land is used as a residential zone.

The island has no harbour constructed and uses a wooden jetty as a main access point.

The island currently has no water supply system or a sewerage system. The residents of Molhadhoo use harvested rainwater for potable uses. 24-hour electricity service is provided to the island by the utilities company FENAKA. The main access point to the island is a wooden jetty that measures 75 m long and 4 m wide which and is located on the western side of the island. The island does not have a waste management centre and waste is dumped, buried and burnt at a site located east of the islands residential areas and maintained by the Council.

Tourists from the nearby resort Alidhoo frequently visit the island on local island excursions. The management of the resort helped refurbish the islands jetty and also helped establish the islands existing dumpsite. Although the island has no approved waste management plan, the islands Council with the cooperation of the islanders have managed locally generated waste fairly well even without proper means for disposal and recycling. Locals carry waste to the dumpsite mainly in wheelbarrows and waste is sorted at the dumpsite. Public spaces of the island are cleaned weekly under the Council's plan which includes hiring staff for the job at a rate of MVR 8000/month. All of the islands roads are cleared and cleaned twice a year by the Council. Although measures are taken to keep the islands residential areas, beaches, and forested areas clean waste inevitably gets washed up on the shore and dumping of organic/kitchen waste at the beach side is a common practice among the locals. This results in pollution of the beach areas and lagoons.

No waste audit specific to the island has been carried out in the past nor had the waste situation of the island been properly assessed. A waste audit for Zone 1 (which includes HA, HDh, and Sh. Atolls) conducted by MEECO in 2016 showed an average of 1.30 kg/capita/day of waste generation within the islands. Using this average, approximately 0.5 ton/day of waste is generated within the island. majority of sources of waste in HA. Molhadhoo are the 130 households, In order to manage the waste situation at the island level, the proponent, Ministry of Environment and Energy (MEE) has proposed the project to establish an Island Waste Management Centre (IWMC) in HA. Molhadhoo.

The proposed project is facilitated by MEE and financed by the OPEC Fund for International Development (OFID) under the "Provision of Water Supply, Sanitation and Solid Waste Management Project". The completion of the proposed project will result in the construction of an IWMC, and the operation of the IWMC will be facilitated under the Waste Management Plan devised by the Island Council and Approved by EPA.

The scope of the IWMC is to facilitate island level management of the waste generated within the island, which includes sorting, volume reduction and stockpiling of recyclables, composting of organics, and storage of hazardous waste. The waste that is not manageable in the island level shall be transported to a central waste management facility.

The proponent has requested consultancy services of MEECO for the preparation of an Environmental Management Plan (EMP) to comply with the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012. EPA has issued a decision statement on HA. Molhadhoo that an EMP would be suffice for the proposed IWMC construction and operation works.

A field visit was conducted by the MEECO team to HA. Molhadhoo on 4th May 2017 in addition to a consultation meeting with the Island Council on the same day. This report is based on the findings of the field visit, consultations, previous EMP's and experience of the consultant.

16.2 PROJECT SETTING

HA. Molhadhoo is an inhabited island belonging to the administrative atoll of North Thiladhunmathi (Ihavandhippolhu Atoll). Situated in the eastern region of the atoll at 7° 0'40.09"N, 72°59'54.01"E at the eastern edge of the atoll basin., the nearest inhabited island to Molhadhoo is Ha Uligam located approximately 3.1 km north of Molhadhoo. J resorts Alidhoo is located approximately 6 km to the west of Molhadhoo. The island is located approximately is 318 km from the capital Male'. Nearest airport is in HDh. Hanimaadhoo, approximately 35 km from the island.

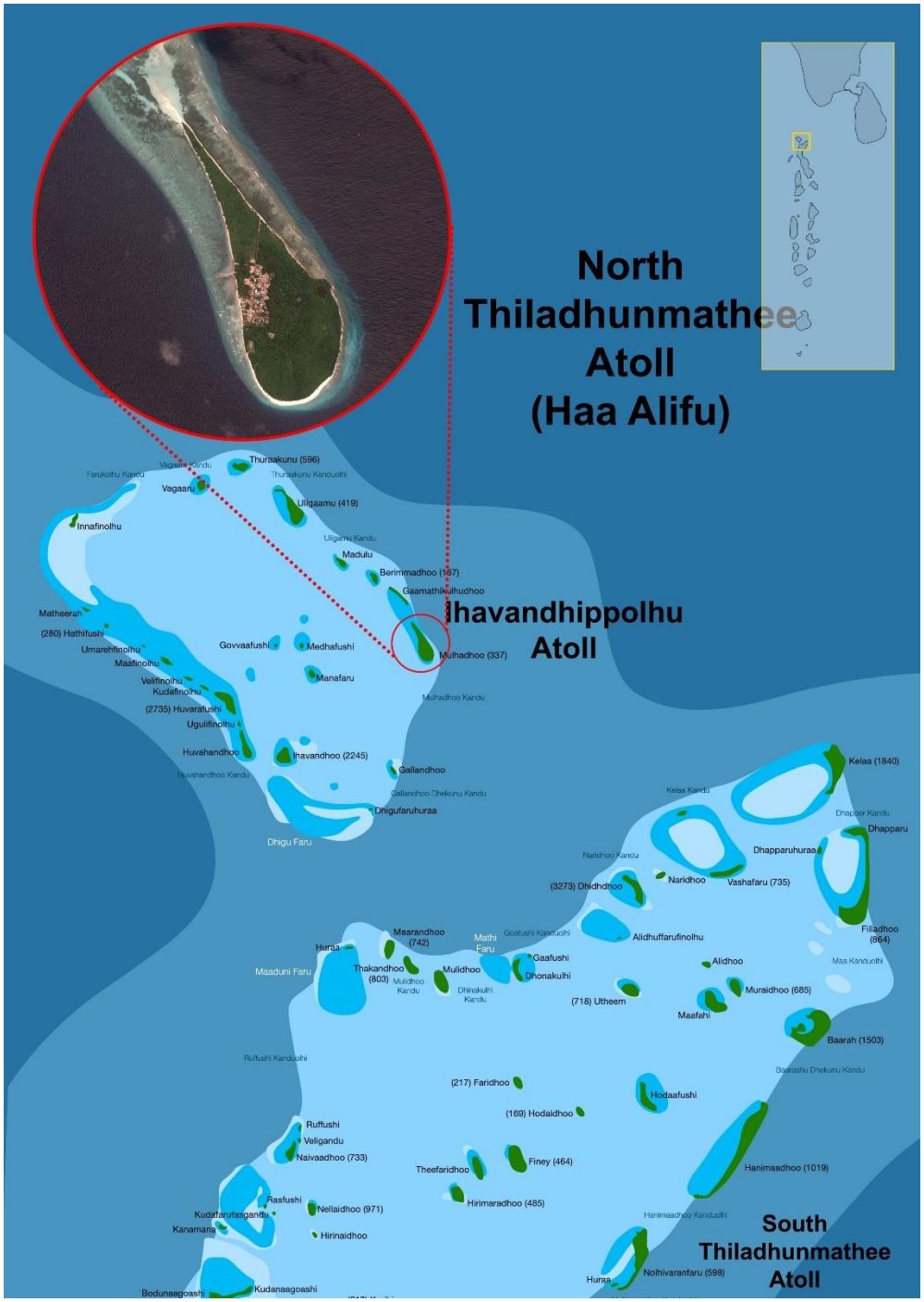

Figure 43: Project setting

16.2.1 Site Location

The proposed Island Waste Management Centre (IWMC) is located in the south-western end of the island at coordinates 7° 0'33.34"N, 72°59'46.37"E. The site is accessible by the main road of the island which stretches 1.5km through the islands residential areas oriented in the north – south direction. This is the longest road on the island and can be used to easily access all the residential areas. The road is approximately 10m wide and can be used by heavy vehicles.

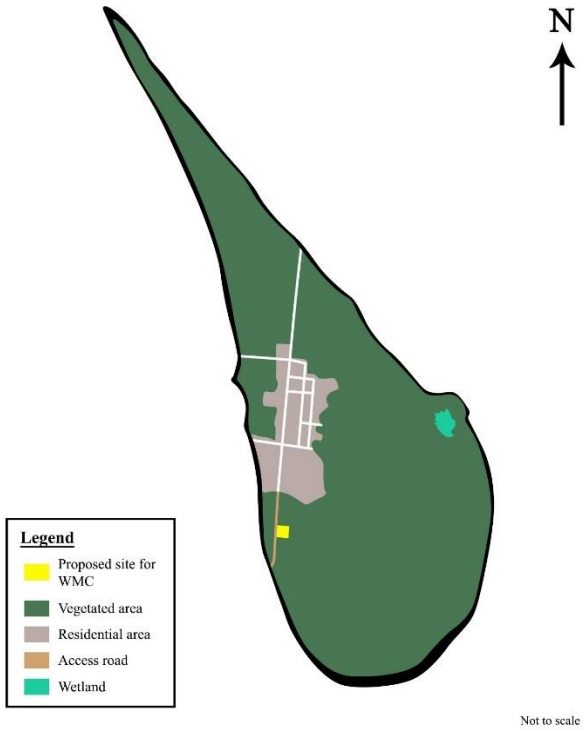

Figure 44: Proposed location for the waste management site on Molhadhoo Island

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16.3 CURRENT STATE OF WASTE GENERATION AND WASTE MANAGEMENT

16.3.1 Waste Generation in Zone 1 and HA. Molhadhoo

A waste audit conducted by MEECO in 2016 showed that the average waste generation of the islands in Zone 1 was 1.30 kg/capita/day.

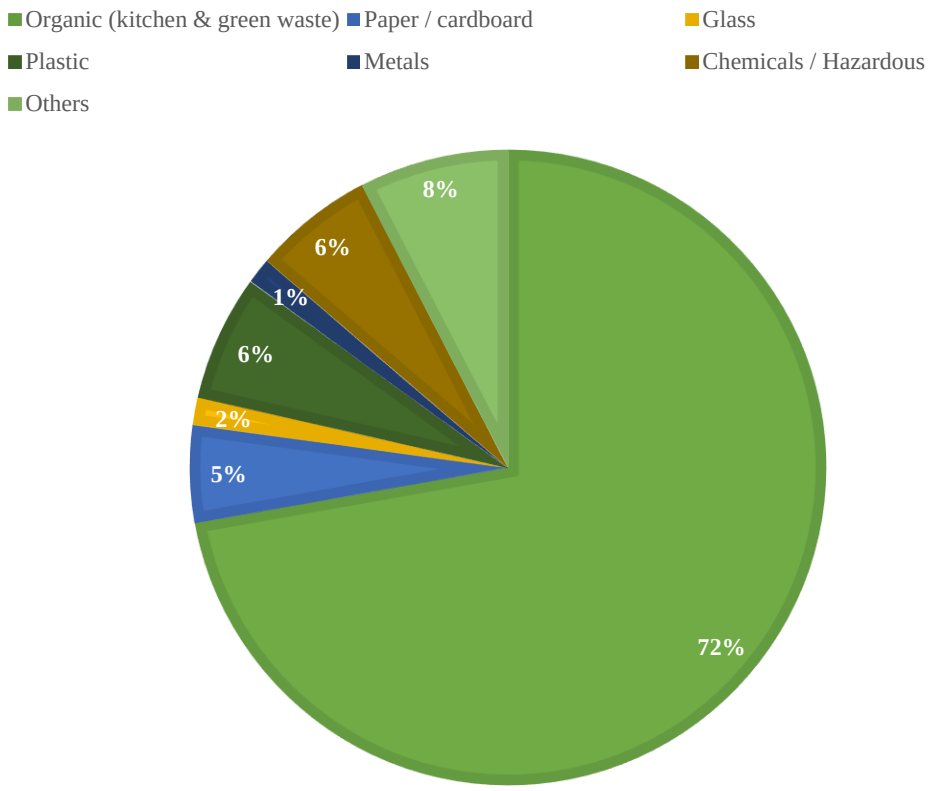

Figure 45: Waste Composition of Zone 1 (Source: MEECO, 2016)

The analysis shows that the majority of the waste generated includes organic wastes at 72%, which include kitchen and green wastes. This waste can be used in composting in addition to paper and cardboard wastes which are at 5% of the total waste generated. Recyclable materials such as plastic, metals, and glass make up 9% of the composition. Approximately 6% of the total waste generated is chemicals and hazardous waste. Using HA. Molhadhoo's current population, the daily waste generated can be estimated from this data.

Table 51: Estimated waste generation quantities of HA. Molhadhoo

Waste Type	Zone One Average (%)	Molhadhoo Waste Generation (Kg/Day)
Organic (kitchen & green waste)	72.2	351.0364
Paper / cardboard	4.94	24.01828
Glass	1.42	6.90404
Plastic	6.4	31.1168
Metals	1.3	6.3206
Chemicals / Hazardous	6.15	29.9013
Others	7.58	36.85396
Total	99.99	486.15138

16.3.2 Current state of waste management in HA. Molhadhoo

The majority of sources of waste in HA. Molhadhoo are households. There are no significant industrial activities conducted within the island.

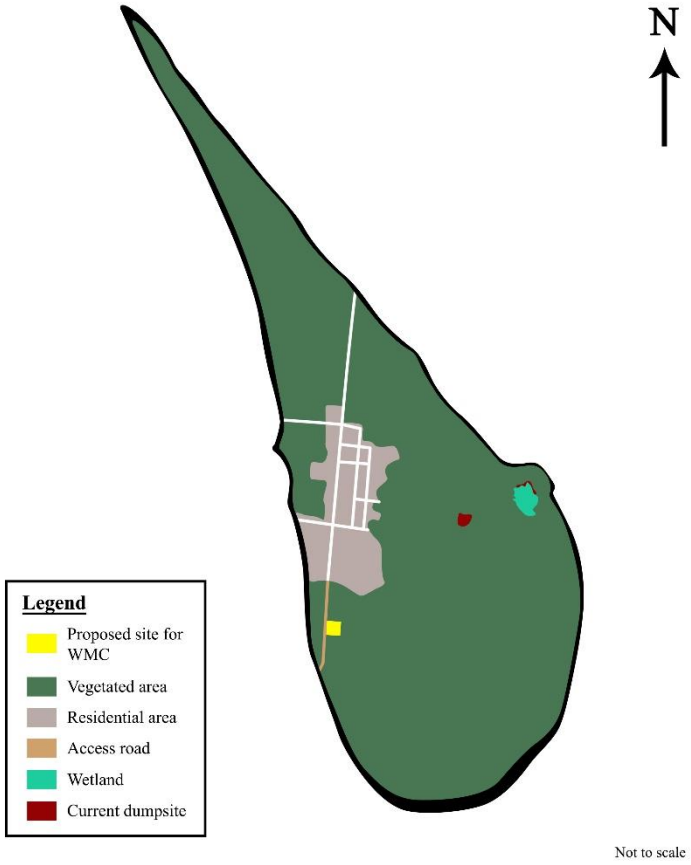

Figure 46: Areas where waste is currently disposed at

Waste is currently dumped at one specified plot of land located 250m to the east of the islands residential zones. This plot is located 160m to the west islands wetlands. There is currently no waste management system with the lack of a waste collection service or staff at the dumpsite to handle waste sorting and disposal. Locals transport their waste to the designated area themselves, mostly in wheel barrows. The area demarcated for dumping waste is managed by the Council. Waste is sorted at the dumpsite as locals follow the Council's guidelines while dumping waste, with metal and construction waste, yard waste and sanitary waste dumped separately. Organic kitchen waste is regularly dumped to the sea with no specific areas allocated for this purpose. Sanitary wastes are buried and covered with sand in a ditch at the existing dumpsite, when the ditch is full the waste inside is burned and covered with sand reducing the volume of waste in the plot so that it can be used again. The Council informed that the existing dumpsite is easy to use and that storage capacity at the site is not an immediate problem. Roads and public spaces of the island are cleaned by the Council regularly. The beaches of the island are kept fairly clean although some remnants of the waste that is dumped to the sea can be found scattered along the beaches in addition to waste that is carried ashore by the waves.

Figure 47: Current state of waste disposal in the island. (A) Waste dumped and washed up ashore at the western beach side (B) (C) (D) Waste at existing dumpsite.

As the existing dumpsite is an acceptable distance away from the residential areas issues regarding the site are not common at the island. However, as the site is not equipped with proper waste management equipment issues arise while disposing of hazardous waste, plastics as they are burnt at the site. Another issue that arises is the odour from rotting kitchen waste and sanitary waste which is potentially harmful for the locals.

16.4 WASTE MANAGEMENT PLAN OF HA. MOLHADHOO

The island does not have an established Waste Management Plan (WMP) as of yet. During field visit The Council highlighted that the WMP is in the drafting stage. The Council estimates that the majority (70%) of the waste is produced from the 112 households in the island. Household generated waste mainly include garden waste, kitchen waste and other categories such as nappies. The other contributors

to the waste stream in Molhadhoo include the school, health centre, power house and institutions. The Council proposes the following targets to achieve in order to manage the aforementioned waste:

- Waste Management rules to be formulated and passed by the Council. Public awareness programs to be held to provide information regarding the newly formed rules.
- Implementation of a waste collection system
- Implementation of a waste recycling system
- Provision of dustbins to collect waste at various recreational areas.
- Preparation of a Waste Management Plan that will be in use for a 5-year duration.
- Establishment of a waste management committee.

In order to provide the waste collection service, the Council proposes the use of a vehicle which will operate daily during times specified by the Council. The Council will monitor the aforementioned works.
The Council plans to fix different collection rates for the following sectors of the islands community.

- Residential households
- Vacant plots
- Institutions and Businesses
- Guest houses

Administrative Arrangements

- Molhadhoo Island Council and Waste Management Committee: Monitoring of the works of the waste management contractor
- Waste management contractor: collection and managing of waste.

17 DESCRIPTION OF THE PROJECT

17.1 THE PROPONENT

The proponent of the project is Ministry of Environment and Energy (MEE) of the government of the Maldives. The proposed activity is part of a greater project titled "Provision of Water Supply, Sanitation and Solid Waste Management Project" financed by the OFID.

17.2 PROJECT DURATION AND SCHEDULE

The proposed project is planned to be carried out in 10 weeks. This project is expected to be opened to bidders in June 2017 and the select party notified before the end of the validity period of 90 days.

A tentative schedule of the work is found in **Table 52**.

Table 52: Work plan for IWMC

#	Activity	Duration (days)	Weeks									
			1	2	3	4	5	6	7	8	9	10
1	Mobilization	7										
2	Site clearing	4										
3	Excavation works	2										
4	Substructure and superstructure works	10										
5	Masonry works	10										
6	Plastering works	3										
7	Roofing works	7										
8	Structural steel works	7										
9	Electrical works	2										
10	Plumbing works	1										
11	Doors and windows	7										
12	Demobilization	2										

17.3 PROJECT DESCRIPTION

The proposed site plan is presented in **Figure 48.** Engineering details are provided in **Annex 2**.

The construction of the IWMC consists initially of mobilization and site clearing. The main works include shallow excavation, substructure and superstructure works as well as masonry works. The proposed design of the IWMC 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 operational phase of the project will include the daily collection of waste from the households and institutions, in addition to waste management works in the IWMC, which include;

- Sorting of waste;
- Storing of hazardous waste;
- Volume reduction of plastics, glass and metals;

- Stockpiling of sorted waste; and
- Composting of organic waste.

The IWMC is made up of an equipment room, and separate areas to store metal waste, paper and cardboard, plastic waste, glass waste as well as hazardous waste.

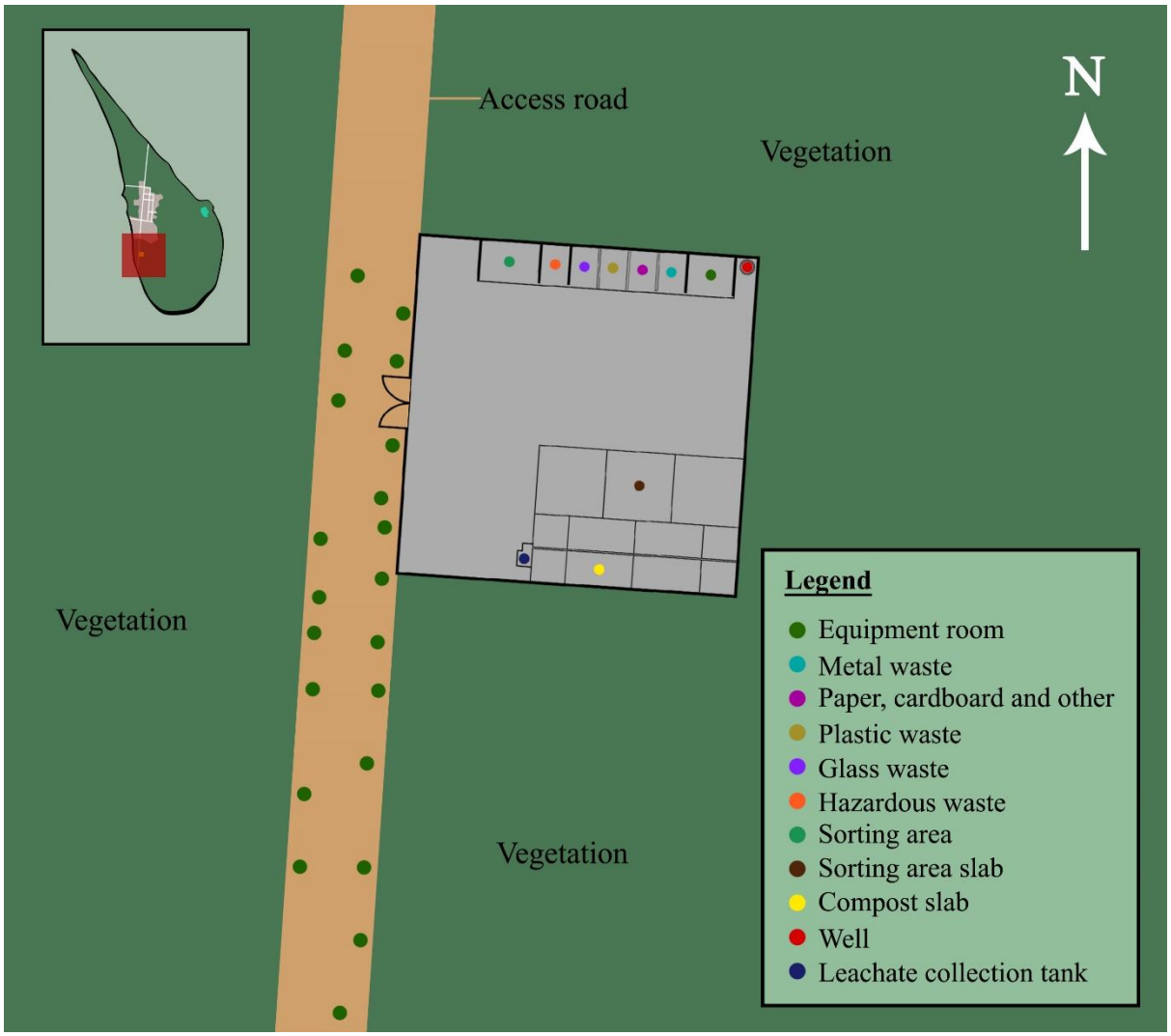

Figure 48: The site plan

17.3.1 Machinery

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

a) Lorry crane for placing of well;
b) Truck for transportation of materials;
c) Vibratory plate compactor;
d) Concrete mixer;
e) Concrete supply pump and piping; and
f) Daily 4" pump.

17.3.2 Mobilisation

As the amount of input materials are relatively minor, the construction materials shall be stored inside the demarcated site throughout the construction period

17.3.3 Demarcation and Fencing

Prior to beginning construction works, a survey shall be done by the contractor to demarcate the limits of the site, and the site shall be fenced off. Work shall be conducted within these limits.

17.3.4 Site clearance and levelling

The proposed site has already been cleared, except for weeds and saplings that have grown on the site after the land was cleared. Minimal site clearing works are therefore required, which include grubbing of roots and levelling in order to bring it to the formation level. As the site size is relatively small, a vibratory plate compactor may be used for the levelling of the ground.

17.3.5 Construction of Sorting Area Foundation

The footprint of the proposed site is 25 m by 25 m, of which the storage areas consists of a 3.15 m by 18.85 m area. The proposed foundation below the masonry walls of the structure is a line (strip) foundation.

17.3.6 Construction of Compost Slab and Sorting Area Slab

The compost slab and sorting area slabs has an area of 15 m by 10 m. The 100 mm thick reinforced concrete slabs are cast over ground beams B1, B2 and B3. The ground beams B1 and B2 have a depth of 0.3m while B3 has a depth of 0.4m from the top of the slab. B3 has a void on top of the beam centrally to receive a 100mm PVC pile cut in half sloping at 1% from the upper end to the lower end, connecting to the leachate tank at the end. Excavations will be done manually to receive the ground beams as per the drawings indicate. The maximum depth of excavation for the beams is 0.4m. The construction of the slab and ground beams include initially laying of HDPE membrane on the slab and beam footprint. Formwork will be added to the sides of the beams, and following that, the arrangement of the required reinforcing steel. Concrete will be poured for the ground beams, followed by the slabs. Concrete mixing will be done on site.

17.3.7 Construction of Leachate Tank

The leachate collection tank is located at the end of the compost slab. The leachate tank has an area of 1.1 m by 1.5 m and a depth of 1.09 m extending below ground. The valve junction of the leachate tank has a size of 0.8 m by 0.55m, and has a depth of 0.63 m. 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.

17.3.8 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 2.8m from ground level. The mesh is held together by 50 mm diameter GI pipes vertically 2 m centre to centre which are welded to three evenly spaced 38 mm GI pipes horizontally. The strip foundation below the masonry wall has a depth of 0.3 m with a 50-mm thick lean concrete placed below. Each vertical GI pipe is fixed to a 300 × 300 mm concrete footing with a depth of 0.6 m. The GI pipe is welded into a 200 × 200 mm plate. Therefore, the excavations done for the masonry wall strip foundation and GI pipe footing will be at 0.35 m and 0.6 m respectively. The trenches required to receive the strip foundation and footings will be excavated manually.

17.3.9 Construction of Well

A well is proposed to be constructed at the eastern corner of the IWMC. This well is 900 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.

17.3.10 Construction of Superstructure

The superstructure of the IWMC consists of the sorting area, storage area and the equipment room. The structure consists of a 3-m high wall separating the compartments. The roofing is supported by GI Pipes of diameter 38 mm and 75 mm. The roofing is made of LYSAGHT roofing sheets.

17.3.11 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 in vacant houses.

17.3.12 Waste Management

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 disposed in closed containers. The waste shall be well secured to avoid any scattering due to strong winds.

Municipal waste produced by the workers are estimated at an average of 0.45 kg/capita/day which translates to 346.5 kg of waste for the duration of 11 weeks for the whole workforce.

After the construction works are done, the collected waste shall be transported to the waste management facility in Thilafushi.

17.3.13 Pollution and Control Measures

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

a) Machinery to be properly tuned and maintained to reduce emissions/spills/leaks;
b) Fuel storage, paint, lubricants will be stored securely and bunded; and
c) Spill kits would be made available on site to control any liquid spills.

17.3.14 Health and Safety Measures

The proposed project involves transportation as well as construction of the IWMC at the site. These works will include use of vehicles, machinery, and heavy materials, and the workers may be put in situations where there is a risk of injury. These risks need to be identified and managed through the implementation of health and safety guidelines for the site. Health and safety measures for the construction phase include and are not limited to:

a) The contractor would be briefed regarding the laws and regulations that need to be followed regarding the proposed works and would ensure that Health and Safety procedures are complied with at all times;

b) There would be a construction supervisor at the site;
c) Only experienced and licensed operators will be allowed to operate heavy machines;
d) First aid kit should be made available at the work site;
e) The work force would be equipped with all safety gears and warning signs would be provided;
f) Fire extinguishing equipment would be available at the site;
g) PPE should be provided to all workers and the use of PPE enforced;
h) Operation of any heavy machinery will need the assistance of a banksman as all times;
i) All heavy lifts must be supervised and slings inspected; and
j) All other similar environment personal safety and quality control measure to be in place and checked by a qualified personal and approved and maintained at all times.

17.3.15 Demobilization

The demobilization plan will commence in the last week of the contract.

17.4 OPERATIONAL PHASE

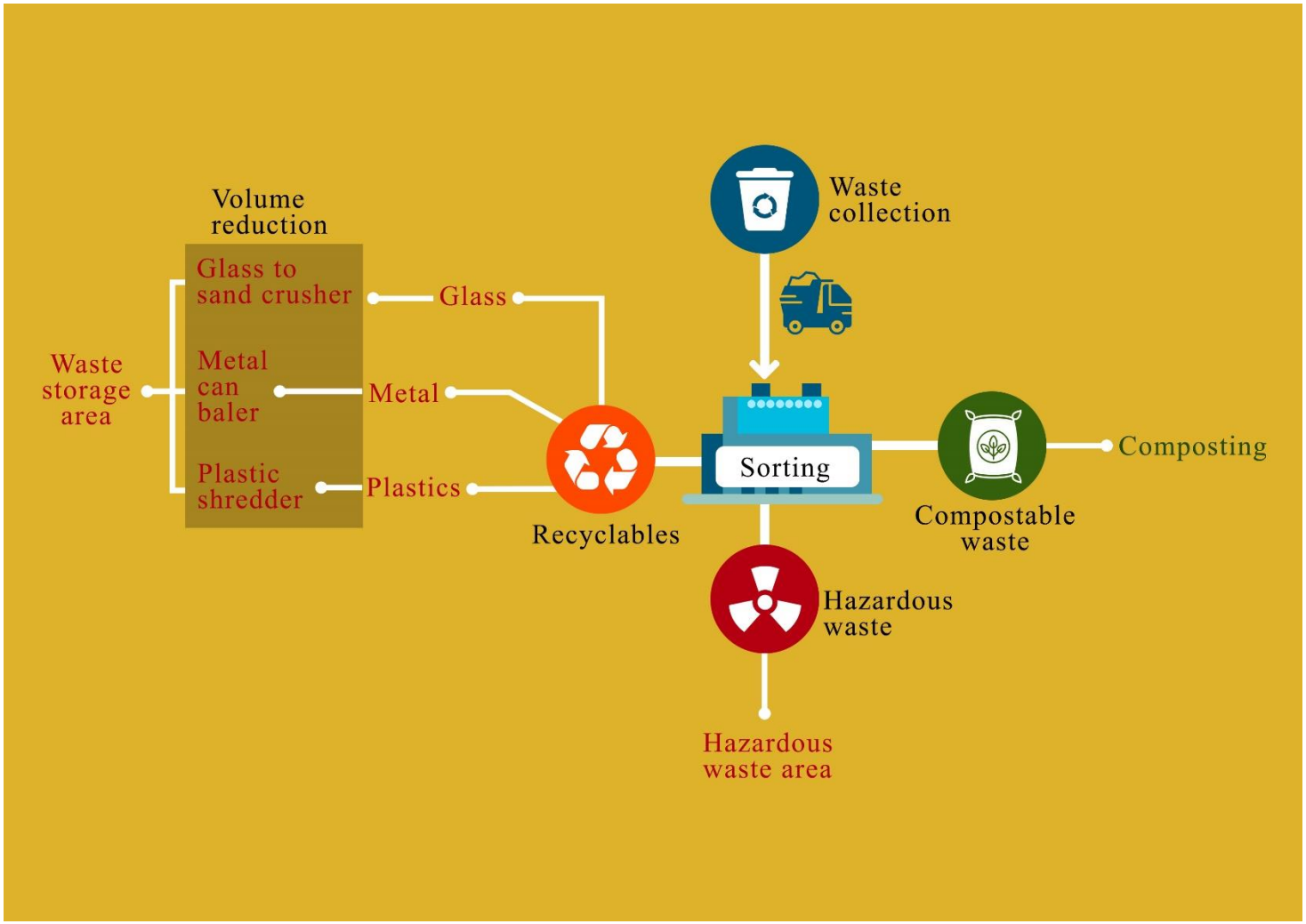

Figure 49: Operational phase flowchart of the IWMC of HA. Molhadhoo

The following Section will highlight the operational aspects of the IWMC. This includes the machinery and equipment proposed to be used in the IWMC, in addition to the main activities to be carried out at the IWMC and within the island. The activities begin from the households and institutions, where the waste is generated. This waste is disposed of in the dustbins in the households as well as the dustbins placed at recreational areas and public spaces. During the operational hours, the designated vehicle will collect the dustbins and bring them to the IWMC. This collected waste is 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.

17.4.1 Machinery and equipment proposed

During the operational phase of the IWMC, in addition to the collection of the waste and sorting, different activities such as composting, and waste volume reduction will be done. The proposed equipment for the IWMC include general equipment needed to handle the waste such as wheelbarrows, garden hose, shovels, buckets and cultivators. These equipment will be used during the IWMC operation for handling as well as composting operations. A manual rotary compost screen is also included for the screening stage of the composting process.

Other equipment includes waste volume reduction equipment such as a plastic shredder, metal can baler, vegetation shredder, and glass to sand crusher. The equipment and their specifications are detailed below.

Table 53: Equipment proposed for waste management works

Equipment	Details
Chainsaw	
Wheelbarrow	HDPE 6 cub. Ft.
Heavy Duty Gumboots	PVC or rubber
Heavy Duty Hand Safety Gloves	Rubber or Latex
Long Handled Flathead Steel Rake	Steel, 54 inches length
Long Handled Cultivator	Steel, 54 inches length
Garden Hoe	Steel, 57 inches length
19” Round Point Shovel	Steel
48” Square Point Shovel	Steel
19” D-Handle Square Point Shovel	Steel
20L Bucket	HDPE
40L Bucket	HDPE
Polypropylene Surgical Mask Box (50pcs)	Polypropylene
Weighing Bench Scale	50-75 kg capacity
Wheelie Bins	HDPE
Glass to Sand Crusher	0.5 to 1.0 tonne/ hr, output 0.5mm and less, 2-5HP motor
Plastic Shredder	30-100Kg/hr Output material less than 10mm
Metal Can Baler	3 to 5 HP, 2m2 or more inside volume
Vegetation Shredder	Petrol / diesel driven multi vegetation shredder / chipper
Manual Rotary Compost Screen	1m to 1.5m drum

17.4.2 Waste Collection

A proper waste collection method has to be planned out by the Island Council as part of the development of the islands Waste Management Plan (WMP). The Council is to determine the fee structures and collection schedule that is most feasible for the island.

17.4.3 Sorting

As per the IWMC site layout plan, a ground slab is dedicated for the sorting area. This sorting area is located next to the compost slab. Here, the collected waste will be kept, and sorted into their respective categories. In addition to this, a dedicated sorting area is also provided alongside the storage areas. The IWMC is designed to have separate storage areas for metal, paper and cardboard, plastic, glass, and hazardous waste. After sorting, the waste is stored in the respective location.

17.4.4 Composting

The IWMC is designed in order to facilitate the storing, sorting and reusing of the waste generated in the island. One of the main operations that will be conducted in the IWMC is the composting of the organic waste such as kitchen waste and garden 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 main constituents of a compost heap include kitchen and garden waste, along with water and air in the pore spaces between the constituent.

17.4.4.1 The Composting Process

After the incoming waste is 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.

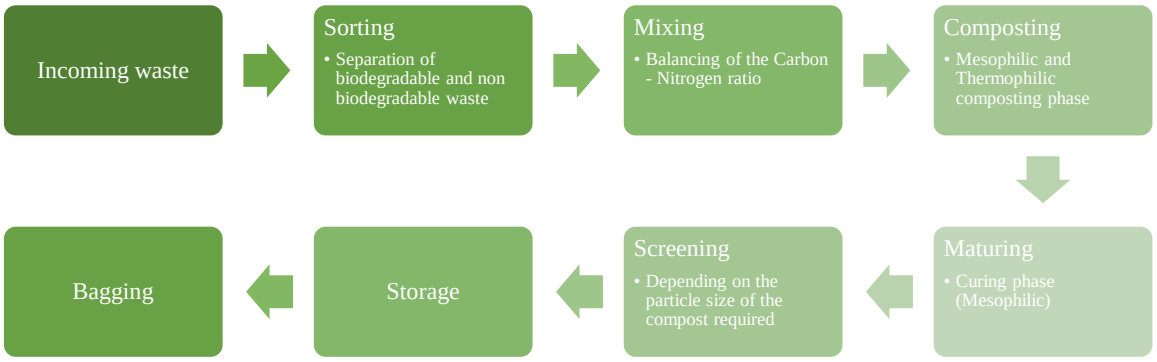

Figure 50: The composting process

17.4.4.2 Sorting of Incoming Waste

Incoming waste is required to be sorted to separate biodegradable and non-biodegradable waste. Biodegradable materials are further sorted in order to separate garden waste, food waste and others such as scrap paper and cardboard. Hazardous waste and residues are kept in their respective compartments, as well as recyclables. It is recommended that 3 dustbins are distributed to households in order to begin the waste sorting process at the source of waste generation.

Table 54: Domestic Waste Categories

Incoming Domestic Waste			
Suitable for composting	**Not suitable for composting**		
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
Composting Process	**Storage**		

17.4.4.3 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.

Looking into the composition of compostable wastes from the Zone 1 Waste Audit, it is seen that the majority of compostable wastes constitute of garden (green) wastes. Garden wastes make up 64% of waste generated, while the second largest contributor to compostable wastes is kitchen wastes, at 28%. Printed paper and cardboard make up 5% of compostable waste while 2% of the category includes animal waste. This composition is important in determining the Carbon-Nitrogen ratio of the compost heap in order to provide optimum conditions for composting.

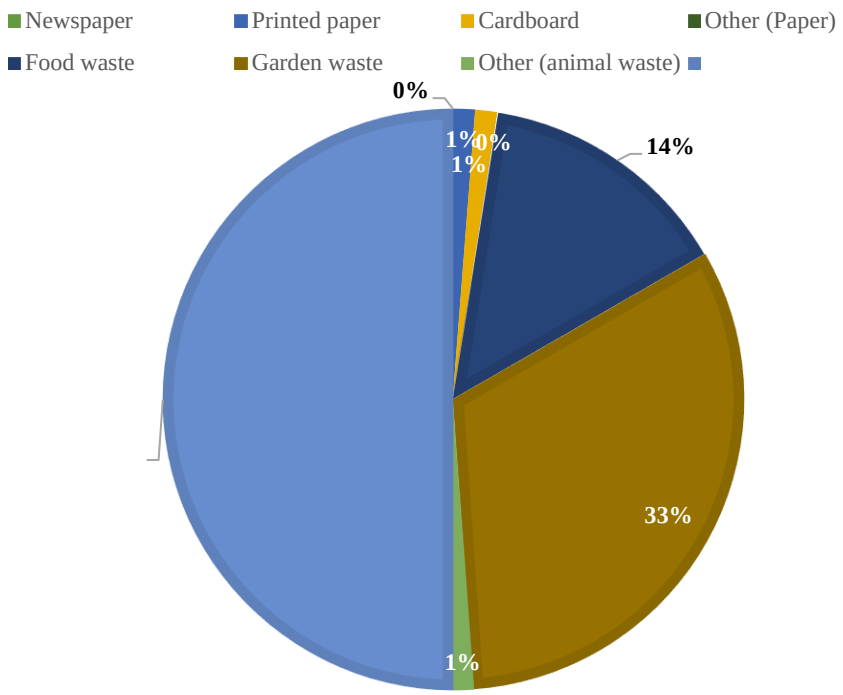

Figure 51: Composition of compostable waste for Zone 1

Table 55: Estimated compostable waste generation quantities of Zone 1

CATEGORY		Average Per Capita (kg/day)	Percentage
Primary	**Secondary**		
Paper & Cardboard	Newspaper	0.00	0.0%
	Printed paper	0.02	2.4%
	Liquid container	0.00	0.5%
	Cardboard	0.02	2.4%
	Other (Paper)	0.002	0.2%
Organics	Food waste	0.29	28.2%
	Garden waste	0.67	64.2%
	Other (animal waste)	0.02	2.2%
Total		1.04	100

Green wastes such as vegetable wastes (kitchen waste), and poultry manure have high Nitrogen values while brown wastes such as foliage, wood chips, bark and paper have high carbon values. From the waste audit, it is seen that 64.2% of the compostable waste produced is garden waste while 28.2% of the waste generated is food waste. Therefore, it can be said that the composition of compostable waste in the islands in Zone 1 is in favour of providing a high Carbon content compared to Nitrogen.

17.4.4.4 Composting and Maturing

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

Table 56: 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 56**, the composting process can prolong to several months.

17.4.4.5 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. This slab is 15m long by 5m wide. 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 100mm 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 compost slab.

17.4.5 Volume Reduction

The incoming waste is sorted, and either used for composting, or stored in their respective compartments. 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.

17.4.6 Projected Capacity of the IWMC

The proposed IWMC is planned to manage a portion of the waste produced at the island level, with the unmanaged waste (approximately 70 – 75% of waste generated within the island to be transported to the nearest RSWMF). The projected capacity for 1 month's waste for the island of Molhadhoo is shown below.

Table 57: Projected waste management capacity for the waste generated in HA. Molhadhoo in 1 month

Waste Type	Details	Amount	Unit
Organics	Composting capacity in IWMC. Assuming 1m height windrow with a width of 2m	39	m3
	Organic waste generated per month	10.5	m3
Paper waste	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	1.109	m3
Glass	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.319	m3
Plastics	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	1.436	m3
Metals	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	9.724	m3
Hazardous	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	1.380	m3

As seen in **Table 57** the IWMC has the capacity to store the organic waste generated in less than one month for the island. Wastes such as paper, glass, plastics, and hazardous wastes are produced in such quantities that, the calculations show that even up to 2 months of the aforementioned waste types can be stored in their respective compartments after volume reduction. Metals make up the smaller portion of the total domestic waste, and 3-4 months of wastes can be stored in the compartment.

Organic wastes make up the bulk of the waste stream in the islands, taking 72% of the total waste generated in the island. The composting capacity of the proposed compost slabs (assuming a windrow of 1 m height and 2 m width at the bottom and 1m width on top) is approximated as 39 m^3. The

calculated volume for the organic waste generated in a month in Molhadhoo is 16.50 m^3. It will take upto 32 days for the island to produce enough organic wastes to reach the IWMF's composting capacity.

17.5 PROJECT INPUTS AND OUTPUTS`

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

Table 58: 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	29.66 m3	Local Suppliers
		Reinforcement		
		Reinforcement T10	1.231 tons	Local Suppliers
		Reinforcement R6	0.19 tons	Local Suppliers
		Reinforcement T12	0.09 tons	Local Suppliers
		Formwork	135.66 m2	Local Suppliers
		Masonry Works (200mm bricks)	205.8 m	Local Suppliers
		Structural Steel		
		50mm and 38mm GI Pipe for perimeter fence	77.4 m	Imported / purchased where available locally
		75mm GI pipe (flood light fixing poles and roof fixing)	18 Nos.	
		38mm GI bearer pipes	46.2 m	
		38mm GI purlin pipes	95 m	
		38mm GI pipes between columns	35.2 m	
		75mm GI pipe to support machine room door	3.5 m	
		Paint		

		Primer and 2 paint coats (Grey Color)	345.96 m2	Local suppliers
		Electrical Components		
		3 Phase power sockets	4 Nos.	Local suppliers
		Single phase power sockets	3 Nos.	
		100 mm ceiling mount lights	1 Nos.	
		Wall mount exhaust fan	2 Nos.	
		500W flood light	2 Nos.	
		25 mm2 4 core power supply cable	290 m	
		Well water pump	1 Nos.	
		Metal doors for		
		Equipment room	1 Nos.	Local suppliers
		Hazardous waste area	1 Nos.	
		Waste yard entrance	1 Nos.	
		Plumbing		
		25mm PVC intake pipe		Local suppliers
		1/2 inch PVC pipe from pump to all distribution points	40.9m	
		Roofing		
		Storage area roof sheets	85.5 m2	Local suppliers
		Flashing sheets	28 m	
		Lysaght gutter	19 m	
		50x50 PVC coated mesh fence	77.4 m2	Local suppliers
		HDPE membrane	209.54 m2	Imported / purchased where available locally
		Timber top cover	1 nos.	Local suppliers
		PVC pipe for leachate tank drain	15 m	Local suppliers
		600 x 900 5mm plastic sheet signboard	1 Nos.	Local suppliers
Operation	Equipment and Materials	Chainsaw	1	Imported / purchased where available locally
		Wheelbarrow	4	
		Heavy Duty Gumboots	5	

		Heavy Duty Hand Safety Gloves	5	
		Long Handled Flathead Steel Rake	3	
		Long Handled Cultivator	3	
		Garden Hoe	3	
		19” Round Point Shovel	3	
		48” Square Point Shovel	3	
		19” D-Handle Square Point Shovel	2	
		20L Bucket	3	
		40L Bucket	2	
		Polypropylene Surgical Mask Box (50pcs)	5	
		Weighing Bench Scale	1	
		Wheelie Bins	40	
		Glass to Sand Crusher	1	
		Plastic Shredder	1	
		Metal Can Baler	1	
		Vegetation Shredder	1	
		Manual Rotary Compost Screen	1	
	Waste	Waste generated within the island	Approximately 486.15 kg of waste per day	Waste collected by vehicle from the waste bins within the island
	Fuel	Diesel		Local suppliers

Table 59: Project outputs

Stage	Output	Source / Type	Amount	Means of managing
Construction	Soil	Excavation for substructure	11.78 m3	To be used back in the levelling and backfilling of site.
			209.54 m2	
	Waste	Construction and clearing of vegetation		Collected in the temporary waste area and transported to Thilafushi after completion of the project
	Hazardous waste	Construction and clearing of vegetation		Collected as per hazardous waste management guidelines and transported to Thilafushi after completion of the project
	Municipal waste	Workers	346.5 kg	

	Dust	Excavation	Moderate amount of dust	
		Cement mixing	Moderate amount of dust	
	Green House Gases	Machinery		
		Concreting works	100.1kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
		Reinforcement	5311.1kg of CO2 indirect emissions (Ma et.al, 2016)	
		PVC Pipes	164.81kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
Operation	Compost	Open windrow composting	15.60m^3/cycles	Sold as fertilizer
	Crushed Glass	Glass crusher	0.21m^3	Crushed glass stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Compacted Metal	Metal baler	0.18m^3	Crushed glass stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Shredded plastic	Plastic shredder	0.9m^3	Crushed glass stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	GHG	Electricity usage		N/A

18 EXISTING CONDITIONS

18.1 DESCRIPTION OF THE ENVIRONMENT

HA. Molhadhoo has a total land area of approximately 118ha. The island is situated inside the Thiladhunmathi Atoll. The island is populated by 347 people, who have inhabited the central area of the island with a settlement footprint of less than 15 ha. The settlement area is located approximately 100 m from the western shoreline at the center of the island leaving considerable areas of vegetation to its south, north and east. Common Maldivian fauna such as breadfruit trees, beach hibiscus, sea trumpet, pemphis and coconut palms making up the majority of these vegetated areas. A mangrove area consisting of a water body with an area of 4500 m^2 is located on the eastern side of the island. The mangrove area was observed have an abundant population of relatively healthy mangrove plants including *Bruguiera cylindrica* (Kandoo), *Xylocarpus moluccensis* (marugas) and *Sonneraia acida* (Kulhlhavah). Red mangrove crabs were observed with burrows under the trees at the mangrove area.

The groundwater of the island is fairly clean throughout the residential areas. The water does not have a bad odor, and is clear in color. The island currently has no central sewerage system. There is widespread use of septic tanks within the island, which leads to the seepage of liquid waste into the groundwater lens. The depth of the groundwater lens varies from 0.4 m at the shallowest areas to 1.8m in the deepest areas.

The island is located at the eastern edge of the north Thiladhummathi atoll basin.

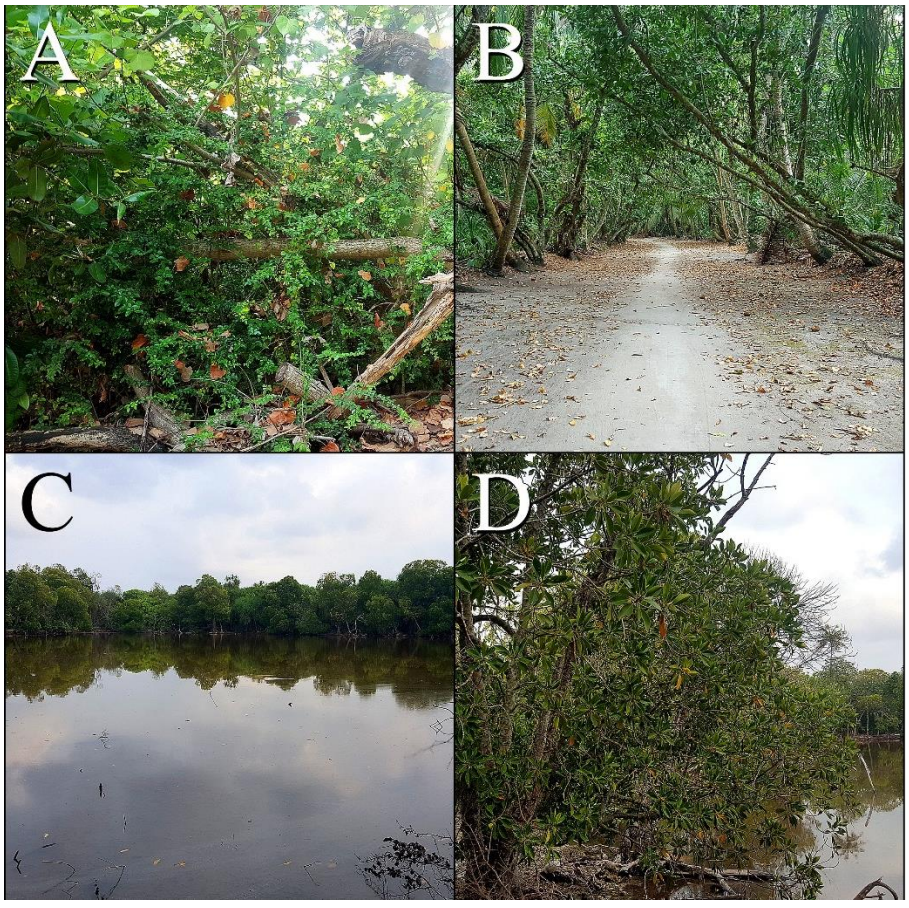

Figure 52: Terrestrial vegetation of HA. Molhadhoo. A: Vegetation infront of the proposed plot for IWMC B: Road that leads to the islands existing dumpsite C: Water body at the islands mangrove area D: Mangrove plants

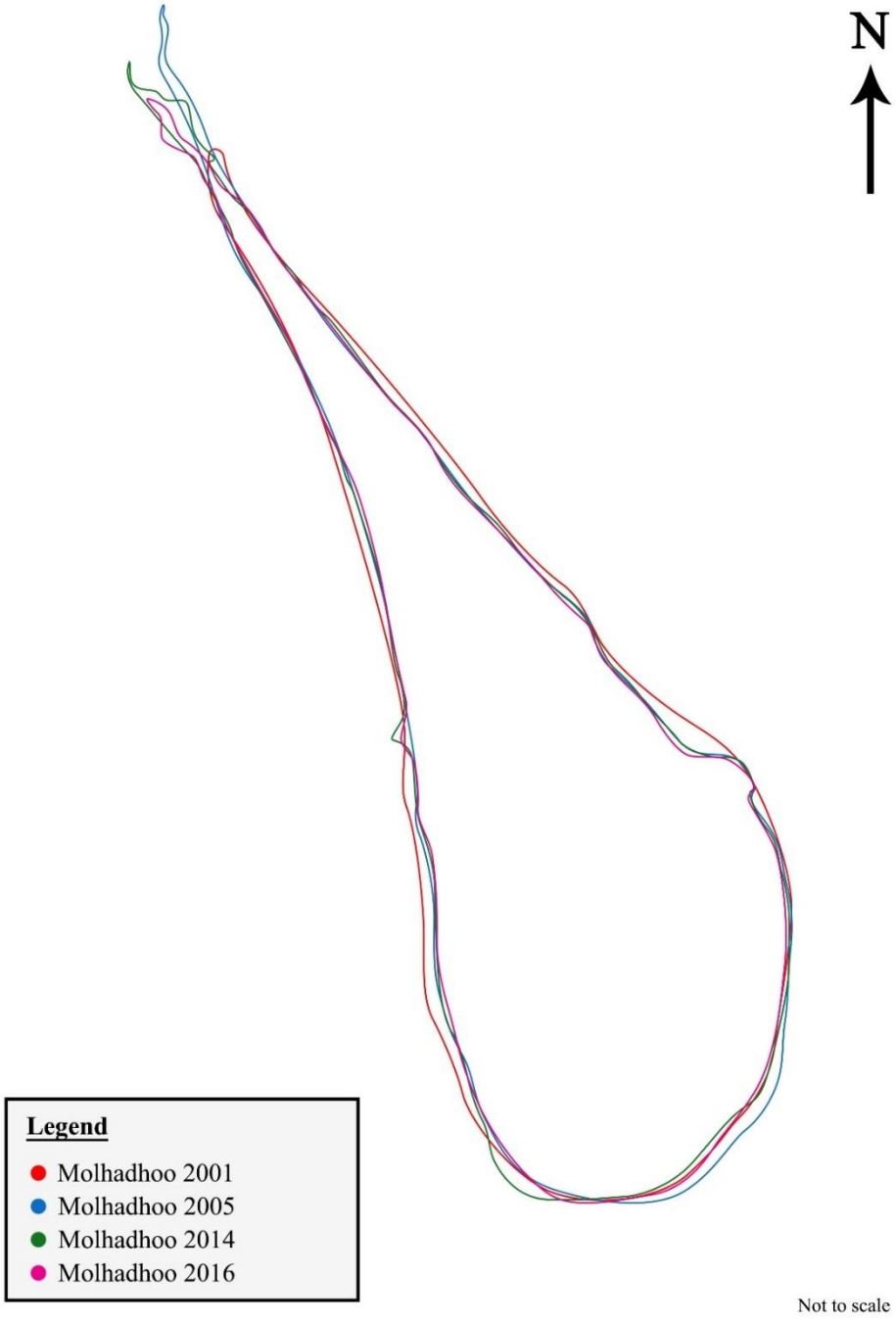

Figure 53: Changes to the coastal region of Molhadhoo (2001,2005,20014 and 2017)

Coastal dynamics of the island since 2001 is shown in **Figure 53**. From the figures, erosion is seen at the northeastern coastal area of the island. Erosion is also observed south of the harbor area, as well the southern coast of the island. As the island has not yet undergone a harbour construction project it is

relatively safe from coastal erosion which is usually observed in other islands. However, this causes the island to face complication in the process of transferring waste out of the island.

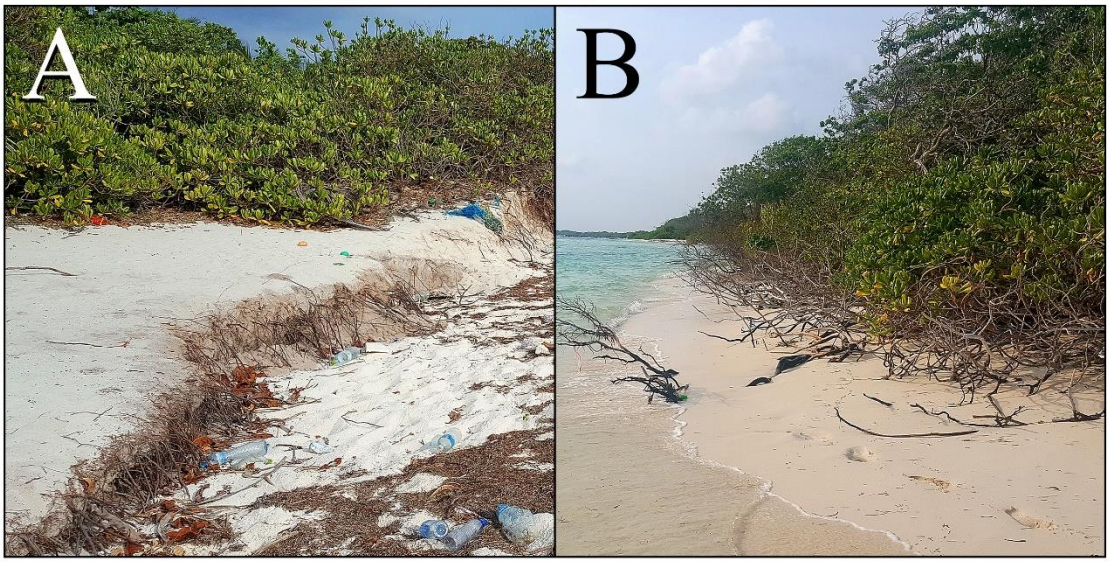

Figure 54: Coastal area closest to the proposed plot for IWMC(A and B)

18.2 PROJECT SITE

The project site is located in the south western side of HA. Molhadhoo. Accessible from the islands main road which stretches 1.3km across the islands residential areas in the North to South orientation. An IWMF of 500 m^2 has been proposed to be constructed on the plot with regard to the islands population. An area of 1000 m^2 has been demarcated for the construction of the IWMC. The site location has been chosen in order to reduce the impact of odour due to monsoonal winds and proximity to residential locations.

The project site is at a considerable distance from the residential areas. The closest area to the site is an empty plot located south of the plot. No public areas or residential plots are located in a 50 m radius from the site. The site is also close to the south western coast of the island with less than 50 m distance from the vegetation line.

The site has been cleared except for a weeds and saplings that have grown on the site after it the land clearance was done. Some large coconut palms, country almond trees and nit pitcha trees are located right outside the limits of the site. The ground condition of the site is generally good.

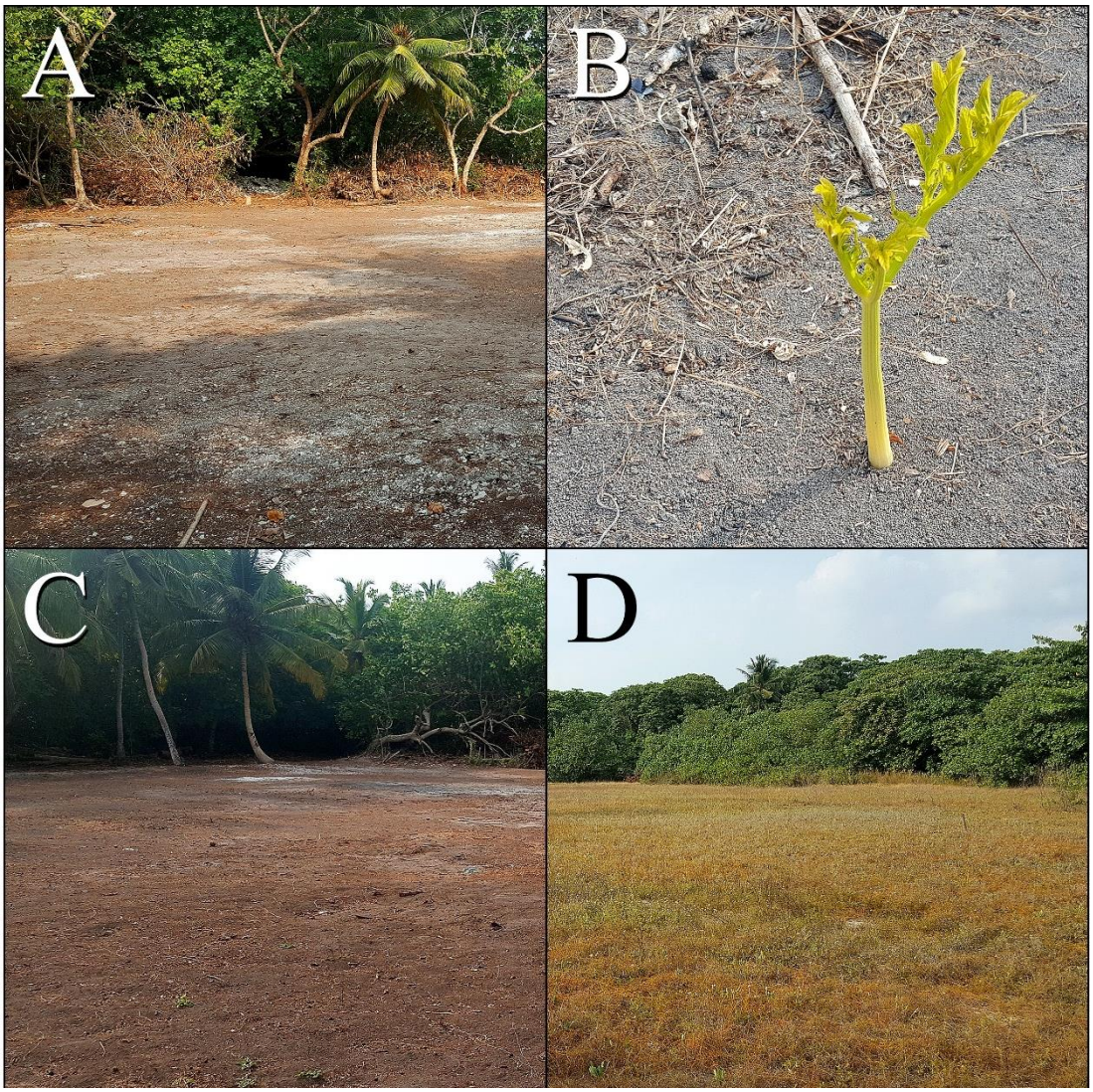

Figure 55: Proposed location for construction of IWMC. (A)Cleared plot for IWMC (B)sapling growing on cleared site (Cleared plot for IWMC) (D) Empty plot next to the land cleared for IWMF.

18.2.1 Site zoning recommendations by EPA

The EPA has provided recommendations for the optimum zoning of the IWMC site. The distances include, the site being at least 15 m from the coastal vegetation belt, at least 30 m from the nearest freshwater well, at least 40 m from the nearest recreational area and at least 30m from the mangrove area as well as the residential 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 60: Comparison between the proposed site location and EPA recommended distances

Location	Distance from site (m)	EPA Recommended Distance (m)
Coastal vegetation	52	15
Freshwater well (planned)	99	30
Recreational area	200 +	40
Mangrove area	700 +	30
Residential area	99	30

As seen on **Table 60**, the site fulfils the EPA recommended distances. The site is located 48m from the vegetation line at the nearest point. No residential areas or public spaces are located within a 50m radius of the site. The nearest freshwater well is located at the nearest household and is at a distance of 98m from the site. The proposed site is more than 700 m away from the mangroves of the island and more than 200 m away from recreational areas of the island.

18.3 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were held for the project with the proponent MEE, enforcing agency EPA and the Island Councils of the respective islands. Meetings with MEE and EPA were held both before and after the survey trips in light of findings regarding some project islands. The initial meetings were mainly regarding the EIA project islands and scoping, although, due to the similar scope of works (except vegetation removal in the EMP islands' cases) the meetings included discussion of the project as a whole. Highlights of the meetings which apply to the EMP islands are presented below. Stakeholder consultation attendance is attached in **Annex 3.**

18.3.1 Meeting with Proponent

- The proponent was consulted at the start of the assignment to discuss project scope and after field surveys to discuss findings of the initial field surveys.
- Proponent informed that MEE will be responsible for the construction of IWMC, while land clearance shall be undertaken by the respective Island Councils.

18.3.2 Meeting with EPA

- It was highlighted that waste management will not involve burning waste at the island level. Waste from islands will be transferred to the regional waste management center. Only organic waste will be managed at the island level to make compost. All necessary equipment required to manage waste at in the IWMC will be provided as part of the project.
- EPA informed that buffer distances recommended by EPA in the zoning form shall be kept in order to mitigate impacts.

18.3.3 Meeting with Island Council

- The Council mentioned that waste management is given a high priority in the Council's agenda. The Council also stated that implementing sustainable waste management practices at the island has been a challenge and that they are willing to work with the islanders in coming to a viable solution.
- Terrestrial pollution at the island is an issue that has already started getting better as the Council initiated various awareness programs for the locals.
- The main access point to island is a wooden jetty. The Council pointed out accessibility as the main issue in implementing operations of the IWMC as the island has no harbor.

- The Council mentioned that an alternative location for the landing craft (waste collection vessel) cannot be pointed out with confidence.
- The Council also pointed out that though the island lacks a water and sewerage facilities, water used at the island is in usable condition and rainwater harvesting is the main method of acquiring clean water for portable uses.
- The existing dumpsite has separate areas for burning, burying and storing large waste.
- The Council has no approved Waste Management Plan, and have not implemented any waste collection systems at the island. However, they mentioned that the island's terrestrial areas, including forested areas, roads, residential zones are cleaned by staff hired by the Council on contract basis.
- The island is frequently visited by tourists from the nearby resort on local island field trips. This has resulted in the resort's management helping keep the islanders in various ways. They helped excavate and prepare the existing dumpsite of Molhadhoo and also repaired the islands jetty and developed the access road to the island.
- The Council highlighted *fangivuyun*, fishing, import and retail businesses, welding and construction works as the island's main economic activities.

19 ASSESSING THE LIKELY IMPACTS AND MITIGATION MEASURES

19.1 METHODOLOGY, NATURE AND IDENTIFICATION OF IMPACTS

Various impacts arising from the project such as direct, indirect and cumulative impacts have been identified. The methodology was based on:

a) Scoping meeting with stakeholders;
b) Observations made during the visit of the project island and site
c) Literature review of similar local and other EMPs; and
d) Findings from other similar projects in Maldives and experience of the Consultant.

Impacts on the environment were identified based on their location/attribute, magnitude and duration of the impact. Impacts were assessed based on their significance and categorized as negligible, minor moderate and adverse. A Leopold Matrix was used for this purpose, for both the construction and operation phase.

The Leopold Matrix was developed by Leopold et al. (1971). It is a quantified Matrix which consists of 100 project actions and 88 environmental characteristics, elements and conditions. Relevant environmental characteristics and project actions were used for the impact identification. First of all, all of the relevant activities of the project that may have an impact on the environment was identified and written on the top of the matrix. These were divided for both the implementation and operational phase of the project. The environmental characteristics that may be affected by the project is written at the left side of the matrix.

A slash is placed at the interSection with each item on the side of the matrix if an impact is possible. The upper left corner of each box where an impact is possible, a number from 1 to 10 is written as the *magnitude* of the possible impact. The number 1 represents the least possible impact and the number 10 represents the highest magnitude of the possible impact. No 0's are used in the Leopold Matrix. A + sign is placed before the number if the possible impact is a positive impact. No sign is placed before possible negative impacts. In the bottom right corner of the box, a number from 1 to 10 is written as the *importance* of the possible impact. 1 being the least important and 10 being of the greatest importance. In giving scores, the magnitude and importance of the activities were judged for their short term and long term impacts. The impacts with greater long term impacts were given higher scores compared to the impacts with more short term impacts.

19.2 POTENTIAL IMPACTS AND MITIGATION MEASURE FOR KEY IMPACTS

For every minor to moderate to major impact identified, a mitigation measure has been proposed and discussed below. The mitigation measures proposed would be strictly adhered to eliminate environmental impacts arising from the project, even before it occurs. The impacts and mitigation measures are detailed in the two stages, construction and operational stages as explained below.
The possible mitigation measures include:

a) Changes in work practices and increasing awareness;
b) Provision of environmental protection and health safety equipment; and
c) Environmental monitoring during construction phase and operational.

Mitigation measures suggested in the report will focus on the existing environmental conditions as well as impacts that may rise during operation of the IWMC.

Table 61: Impact Matrix for Construction Phase

	Envisaged impact factors	C1 Worker Influx and Settlement	C2 Transportation of materials	C3 Site Demarcation & Fencing	C4 Site Clearance and Earthworks	C5 Construction	C6 Waste Generation	C7 Resource Consumption (Water, Electricity)	Total (Impact Area)
Physical Components	Seawater	-2					-3		-5
		1					4		5
	Ground water	-3			-2	-3	-3	-5	-16
		1			3	4	3	5	16
	Air	-3	-3	-2	-3	-3	-2	-3	-19
		2	3	2	4	3	4	3	21
	Noise	-2		-1	-2	-2	-2		-9
		1		2	3	4	2		12
	Coastal Zone							-1	-1
								1	1
Biological Components	Flora	-2	-1		-2	-2	-2	-3	-12
		2	3		4	2	5	2	18
	Endangered species/protected areas		-2		-1				-3
			2		5				7
	Coral Reef						-1		-1
							1		1
	Fauna		-2		-2	-3	-2		-9
			2		4	3	3		12
Socio-Cultural Component	Aesthetics	-2	-3		-2	-5			-12
		2	3		3	5			13
	Accidents	-1	-7	-2	-1	-3	-2	-1	-17
		1	5	1	2	4	2	1	16
	Landscape				-1	-3			-4
					2	4			6
	Health/Well being	-1	-5	-1	-4	-3	-3		-17
		1	5	2	3	3	4		18
	Local economy	4	4	1	6	7		-2	20
		1	4	2	6	5		2	20
Total (Construction Activity/Risk)		-12	-19	-5	-14	-20	-20	-15	
		12	27	9	39	37	28	14	

19.2.1 Impacts and Mitigation from Construction Phase

19.2.1.1 C1 Worker Influx and Settlement

An estimated 10 workers will be required for this project. The influx of workers can have a negative impact to the environment such as damage to vegetation, sensitive areas, and fauna of the island. This can be both intentional and unintentional.

Worker related impacts can include the requirement of building a temporary worker's camp, which can then lead to the set up of temporary waste, sanitation and water systems for the workers. For the duration of the project, the workers related waste output is detailed in **Section 17.3.12**. For this project, this impact can be reduced through the following mitigation measures. The project island currently has vacant properties as well as rooms to let in other houses, which can easily house the influx of 10 workers. Therefore no new facilities will be made for the accommodation of the workers. Other impacts include the increased use of resources by the workers in the island. This can be mitigated by choosing local contractors operating on the island.

In addition to this, when a new group of foreign workers arrive on the island conflicts can arise with the resident population in the instances where local culture is overlooked or not respected.

<u>Mitigation for impacts on flora and fauna</u>

- The contractor is required to keep the workforce as a minimum as possible, and to not bring in any surplus workers for the project;
- House rules shall be formulated by the contractor and workers shall be oriented on the rules and conduct during the project works;
- Workers shall be given instructions on the sensitive and protected areas of the island;
- 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 and worker accommodation premises.

<u>Mitigation for impacts on resource use</u>

- Encourage choosing of local workers to reduce increased demand of resources; and
- Onsite generator for meeting electrical needs for the construction works

<u>Mitigation for sociocultural impacts</u>

- Hire local workers where possible;
- Orient foreign workers on communication, personal hygiene and sanitation in addition to the prevention of STDs and other infectious diseases; and
- Ensure all foreign workers have their legal permits.

19.2.1.2 C2 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 . Reduction of the transportation distance from the source to the project island is proposed. As the resource sourcing hierarchy in **Figure 56** shows, the greatest importance shall be placed on sourcing any available materials from within the island, with the next option being from within the north region, from islands such as HDh. Kulhudhuffushi. Site visits to the Zone 1 islands show possible sources for sand in islands (such as HDh. Hirimaradhoo, where a pile of excavated sand is present which can be procured for use in concreting works). 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.

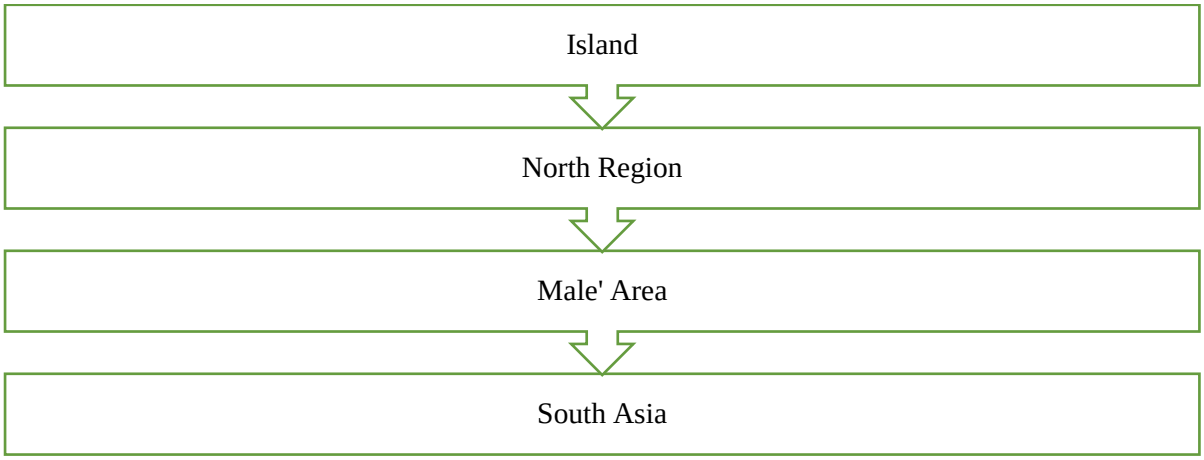

Figure 56: Material sourcing hierarchy proposed for the project

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 **Section 17.5** 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. Therefore for this project, an estimated 100.1 kg of CO2 emissions are expected for the concrete casted. 3136 kg of indirect CO2 emissions (Defra / DECC, 2012) occur per tonne of PVC pipe produced. For this project, the amount of indirect CO2 emissions are estimated at 164.8 kg. The greatest indirect CO2 emissions are estimated from the usage of reinforcing steel. 1.5 tonnes of reinforcing steel are estimated to be used for this project, which can cause a release of indirect CO2 emissions of 5311 kg (Ma et al, 2016). 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 57: Impact on roads from heavy vehicle transport in an island in Maldives

For the purpose of this project, no heavy vehicles are proposed for either construction or earthworks. Although this is the case, a pickup truck will be used to transport the construction materials to 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.

Mitigation for climate impacts

- Sourcing of materials shall be done according to the hierarchy presented in **Figure 56**.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;

- The contractor shall use serviced vehicles and plant equipment for the project;
- The contractor shall only use the needed amount of vehicles and plant for project; and
- The 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. Oversized heavy vehicles are not required for this project, therefore such vehicles shall not be used in the island for transportation and construction purposes;
- 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

- The vehicle drivers shall be licensed and competent;
- The loads being transferred shall be fully secured; and
- The transportation shall be done during day time.

Mitigation for marine and terrestrial pollution

- The contractor shall clean any littering on the terrestrial or marine environment caused during transportation;
- The contractor shall enforce strict policy against littering and appropriate penalties; and
- Spill kits shall be made available in cases of spillage of hazardous wastes, and hazardous waste storage shall be provided.

19.2.1.3 C3 Site Demarcation & Fencing

Site demarcation and preparation involves, land surveying of the area and setting out the limits of the project plot. As 1000 m^2 of land has already been cleared for construction of the plot, there are no large trees or shrubs that need to me removed from the plot, however different species of weeds and various saplings have started growing on the site after it was cleared and they need to be rooted and cleaned. This activity is considered to have minor environmental impacts as it is largely noninvasive. There are some large trees that fall right outside the site limits and they should be considered when the site is being demarked for construction of the IMFC so as to not damage any of these trees, improper or inaccurate demarcation and labelling could result in removal of untargeted trees.

Mitigation Measures

- 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;
- accurate and reliable equipment shall be used to minimize errors;
- wearing, clothes/helmets to protect against thorns and freefalling coconuts and wearing protective clothing;
- carrying out the works during the day time; and

- ensure mosquito repellants are available for the workers.

19.2.1.4 C4 Site Clearing and Earthworks

The ground at the proposed site has been cleared of all large trees and shrubs in association with this project, however it has now been vegetated by different species of weeds and saplings after the land was clearance. Hence, it is important that the land is cleared before construction of IWMC.

Mitigation Measures

- Site shall be demarcated and fenced off prior to site clearing;
- Vegetation targeted for removal shall be marked prior to site clearing; and
- Excavated material used as backfilling and in grading of the site.

19.2.1.5 C5 Construction

Material Storage

This includes, storing all the vehicles, machineries, and tools required for the land clearance and IWMC construction. Due to the nature of the project, a lot of construction materials are not required. Apart from the vehicles and tools, fuel and water will be required for storage. Fuel will be stored on the cleared land in tanks that. Vehicles will be stored inside the fenced plot area. Tools and equipment will be stored in the tool shed within the fenced land plot. The project does not require land clearance or construction of extra building for material storage, hence the impacts arising from this activity is considered to be minimal. However, there is a risk of accidents, such as fires, oil spills and trespassing. These could be easily mitigated by implementing appropriate measures.

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 minor, due to the distance provided between the residential areas and the project site.

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 62: 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 72 dBA at 250

ft, which is the approximate distance from the centre of the IWMC to the nearest residential area. This is expected to further decrease taking into consideration the vegetation surrounding the proposed site, as well as the soil characteristics of the ground.

Noise during construction is determined to be a short term negative impact. Due to the distance of the project site and the surrounding vegetation, 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.

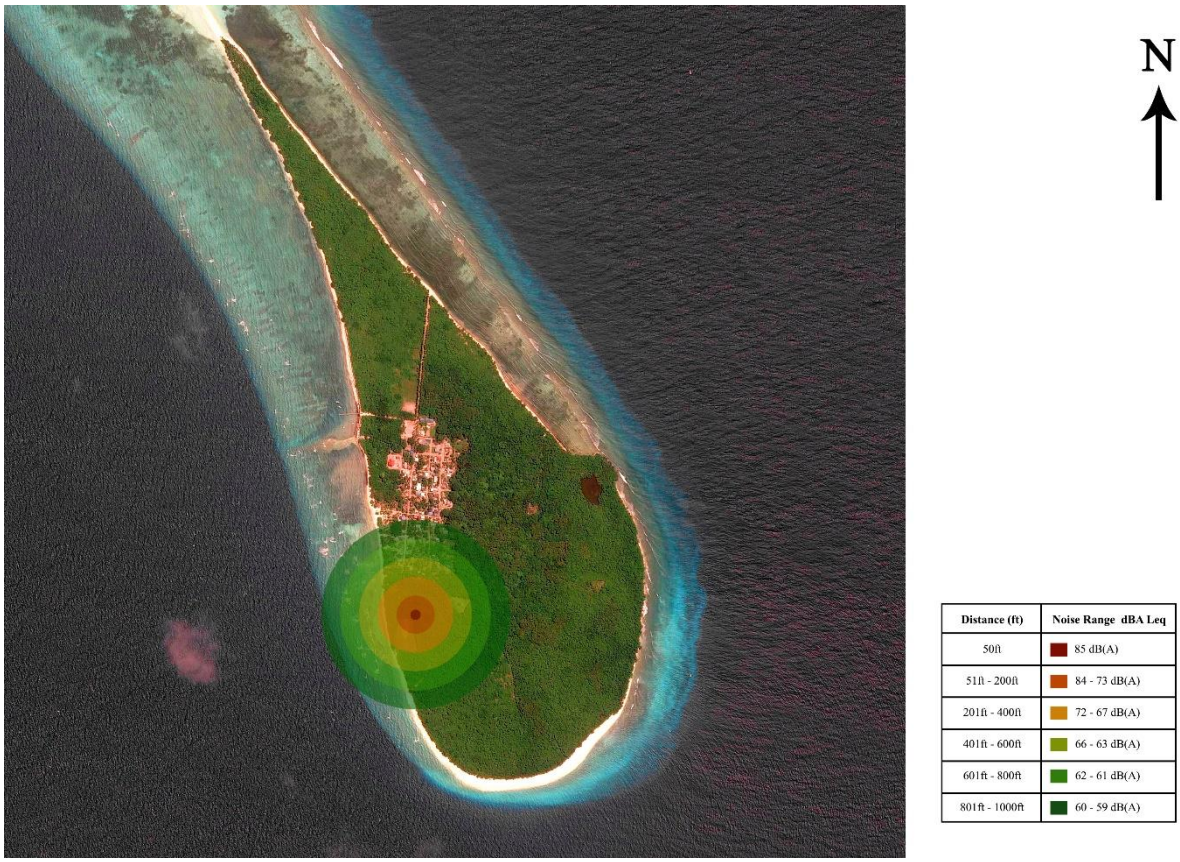

Figure 58: Noise range map for HA. Molhadhoo

Impact on vegetation

The impact and measures on vegetation have been discussed in **Section 19.2.1.4.** No other structures, temporary, or permanent are proposed to be built for this project (such as workers' camp). Therefore the activities of this project is not expected to have a major impact on the vegetation of the island.

Accidents and injuries

Accidents and risks (hazards) are important elements that need to be properly assessed, identified and analysed for what could happen if a hazard or accident occurs during and post development of the project. There could be many risks (hazards) and accidents to consider associated with many possible scenarios that could unfold depending on time, magnitude and the location it occurs. Hazards during construction 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 trenches and seriously injuring themselves.
- Being struck by moving equipment and vehicles.

Mitigation for material storage impacts

- Equipment shall be stored in fenced areas and maintained appropriately during the cause 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 Liquid Petroleum Gas (LPG) bottles and cleaning solvents and chemicals will be closed off from public access. Fire extinguishers and instruction in case of fire will be located in all the public, industrial and staff accommodation areas;
- portable extinguishers placed to be readily available when someone finds a fire;
- closed off non-public storage areas will be provided for inflammable goods (fuel drums, portable fuel containers, LP gas bottles, cleaning solvents etc.) with NO SMOKING, NO NAKED LIGHTS, HIGHLY FLAMMABLE sign boards in both English and Dhivehi languages;
- 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.

Mitigation for terrestrial pollution

- Set up a temporary waste disposal area within the project site;
- Regularly collect litter and dispose at the temporary waste disposal area;
- Hazardous waste shall be placed in enclosed containers;
- Vehicle maintenance shall be carried out on paved areas; and
- After the construction works are completed, transfer all collected waste to Thilafushi

Mitigation for noise and vibration impacts

- Provide workers with noise cancelling headphones.
- Use quieted equipment where possible, such as mufflers on engines;
- Use of well serviced vehicles and plant; and
- Switching off equipment and vehicles when not in use.

Mitigation for impact on vegetation

- Setting out survey shall be done by the contractor and the site limits shall be demarcated prior to any construction or clearing works;
- Fence off the site in order to avoid the removal of any vegetation out of bounds of the project site; and
- Allocate temporary stockpile area within the site, which is free from vegetation

Mitigation for accidents and injuries

- The contractor shall be required to develop occupational safety management plan, and safety guidelines shall be displayed in the work site at all times;
- Occupational safety training should be given to all workers present on site;
- Workers should be provided Personal Protective Equipment and the use of PPE shall be enforced;
- Site visitors 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.

19.2.1.6 C6 Waste Generation

Solid waste generated during land clearance and IWMC construction work would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite. Waste burned onsite would generate smoke, possibly impacting negatively on ambient air quality and human health. On the other hand, if all site clearance waste is to be transported this would also result in requiring burning fossil fuels and would require significant finance. 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.
On site generator and vehicle 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 and solvents. 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 1.2 kg will be produced daily if approximately 10 workers were active which equates to discharge of approximately 1,700 l/day of waste water. Sewage will be managed through existing sewage systems that have been installed in the islands

Since there is no existing waste management system in the atoll or since the existing island level waste management dumpsites are not sufficient 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.

Mitigation Measures

- Ensure to manage waste as described in **Section 17.3.12** of the report;
- open defecation whether it's on land or on the beach shall be prohibited;
- waste other than sewage shall not be flushed down the toilet;
- ensure to reduce waste by following the 3R steps; and
- waste collected shall be transported to Thilafushi after the construction works have ended.

19.2.1.7 C7 Resource Use

During the construction phase, machineries and vehicles used will consume fuel. Notable impacts of this activity include, increased air pollution, risk of spillage, impacts to health/wellbeing and accidents. The primary pollutants generated due to power production from diesel based generator system include Nitrogen oxides (NO_X), Sulphur dioxide (SO_2), Carbon monoxide (CO), Hydrocarbons/ Polycyclic Aromatic Hydrocarbons (HC/PAH), Particles (PA) and Carbon dioxide (CO_2) in the form of emission although the exact amount is difficult to quantify.

The visible pollution generated by burning diesel contains elemental carbon as soot. The typical odour comes from polycyclic aromatic hydrocarbons, which also are cancer causing components.

Due to the scale of these activities, the machineries won't be used for long periods of time. This would significantly reduce the impact of electricity generation. IWMC construction stage as well as land clearance stage will not use heavy vehicles and equipment extensively.

Water used during construction will be sourced by the contractor. Water used for drinking and cooking will be purchased from local shops or collected from existing rainwater tanks or from the groundwater well in the island. Water used for construction purposes will also be obtained from the islands groundwater using a well in close proximity of the construction site. Water and electricity consumption for the project is considered to be minor.

Mitigation

- Initiate rainwater collection and storage as early as possible into the project construction;
- turn off the tap while washing your hands;
- use salt water to wash dishes and only use rainwater to rinse them;
- water conservation devices shall be used;
- use well maintained, energy efficient equipment. The emission of carbon dioxide is directly related to the amount of fuel used. High efficiency is therefore important to reduce the amount of released carbon dioxide and consequently to reduce the global greenhouse effect;
- reduce idle time of machineries and vehicles. Switch them off after use;
- utilize day time hours for the construction when plenty of light is available; and
- FENAKA power supply will be used for electricity generating purposes.

Table 63: Impact identification matrix for operational phase

	Envisaged impact factors	O1 Waste collection and transportation	O2 Waste sorting, separating, storing and compost making	O3 Waste Generation	O4 Resource consumption (water/electricity)	Total (Impact Area)
Physical Components	Seawater	4				4
		4				4
	Ground water	5	-2	-1		0
		3	2	5		12
	Air	-3	-2	-2	-3	-13
		5	3	2	4	16
	Noise	-3	-1			-4
		4	2			6
	Coastal Zone					0
						0
Biological Components	Flora	6	7	-1	-3	4
		2	6	1	4	18
	Fauna	5	5	-1	-3	3
		5	5	1	4	19
Socio-Cultural Component	Aesthetics	6	8			9
		6	6			17
	Accidents	-4	-4		-4	-18
		4	4		5	19
	Landscape	5	6	-1		5
		6	5	2		18
	Health/Well being	5	-5	-2	-6	-10
		6	5	2	8	23
	Cultural heritage					0
						0
	Local economy	-3	8	-2	-1	5
		9	2	4	1	19
Total (operational Phase Activity/Risk)		23	20	-10	-20	
		54	40	17	26	

19.2.2 Impacts and Mitigation from Operational Phase

19.2.2.1 O1 Waste Collection and Transportation

Locals of Ha Molhadhoo transport their waste to the existing dumpsite manually with the use of wheelbarrows and other simple transportation equipment. As the Island Council has not yet established a waste management plan, it is recommended that one vehicle is used to collect and transport the waste within the island daily, at a set schedule. This is identified as a minor impact in terms of noise, due to the fact that multiple vehicles will not be in operation, and no receptor will be exposed to the noise for long durations of time

The successful implementation of the IWMC and the Waste Management Plan will lead to the reduction of the littering of waste throughout the island, and there will be no burning of waste at IWMC. This will lead to the improved health and psychological well-being of the residents and visitors of Molhadhoo. It has been identified as a long term positive impact on the residents and visitors of Molhadhoo.

Waste Collection and Transportation is identified to have a positive impact on the island.

Measures to ensure and enhance the positive impacts

- The Island Council shall formulate and gazette the Waste Management Regulation and Waste Management Guidelines for the island;
- The aforementioned regulation and guidelines shall state the penalties on persons that do not act according to the regulation and guidelines (i.e. littering, burning and dumping of wastes elsewhere), and Island Council shall enforce the penalties as prescribed;
- The proponent and Island Council shall follow the management plan provided with the EMP in order to monitor the operations of the IWMC, and bring about any necessary changes to the operations and policies, in addition to providing any needed technical assistance for the island;
- The proponent shall review the waste management operations within the islands regularly and update the National Waste Database;
- The operations shall be awarded to a contractor with the capacity to run the IWMC;
- The 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;
- Polluter pays principle established in order to reduce the waste generation within the island;
- The proponent shall provide resources in terms of budgetary allocations, required equipment, and technical expertise to ensure the operation of the IWMC; and
- The proponent shall assist in creating markets / avenues where the IWMC's can generate income through selling compost and recycled metals, plastics and glass.

Mitigation for terrestrial pollution

- Implement rules within the IWMC workers to impose penalties for any littering within the island due to improper handling of the waste and improper transport practices; and
- The status of the vehicle shall conform to the Waste Management Regulations 2013/R-58 and provide cover to the waste being transported in order to avoid littering.

Mitigation for accidents and injuries

- The vehicle should be driven by licensed drivers; and

- A strict schedule shall be stated in the WMP and followed in order to reduce the transportation frequency thus reducing the probability of accidents.

Mitigation for air quality impacts

- Spray the roads with water during the dry season to suppress dust;
- 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 Waste Management Plan;

19.2.2.2 O2 Waste Management Activities

Waste sorting, separating storing and composting make up the largest portion of the IWM concept. On top of reducing the volume of waste, these activities, convert waste to re-sable and value added products. These activities will be carried out in the IWMC where employees will be trained to undertake these 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. Hazardous chemicals that get into the soil (contaminants) can harm plants when they take up the contamination through their roots. If humans eat plants and animals that have been in contact with such polluted soils, there can be negative impact on their health.

All these impacts can be mitigated and prevented by the proposed IWM concept. However, if these activities are not properly implemented there is a risk of IWMC being deteriorated into a dump site where mixed waste are disposed, burned and buried. The risk is more prominent for islands where the population size is greater. 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 IWMC being overfilled. More so considering that IWMC is equipped to handle only about 20-30% of organic waste generated in the islands 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 IWMC 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 / m^3 close to the composting site and dropped to background levels within 550m 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 / m^3), 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 64: 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 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 IWMC are not as large scale as the studies cited above. The composting capacity of the IWMC is expected to be two windrows of approximately 39 m^3, each batch to take around 4 – 6 months to mature. 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 IWMC becoming a makeshift waste dumpsite for organics are also addressed in the Section.

<u>Impacts on groundwater</u>

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. 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 odours.

The operation of the IWMC 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 IWMC), 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 IWMC 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 from composting

The main gas by product from the composting is CO2. In anaerobic conditions, methane is released into the atmosphere, which has a higher greenhouse warming potential compared to 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 dumped;

Amenity Impacts

The IWMC 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.

As the proposed site is close to the coastal area with little protection, wind can blow the materials off the compost heaps as well as the other stockpiled waste types out of the IWMC, which can degrade the local amenity. This impact is mitigated through the design of the IWMC perimeter walls which include a perimeter fence made of 50 × 50 PVC coated mesh.

Littering inside the IWMC can cause amenity issues such as tracking of litter on the wheels of the waste transport vehicles leaving the IWMC. 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 65: Odours generated from the composting process (Source: Goldstein (2002))

Compound	Description of smell	Detection limit for a particular odour panel ($\mu g/m^3$)
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

This site is 99 m away from the nearest residential site, and is located in such a way that the monsoonal winds will not carry the odour towards the residential areas. Therefore the impact of odour on the residential areas are deemed minimal.

Fire hazards

There is a possibility of fire hazards at the IWMC 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 RSWMF) on the IWMC.

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 58** can be used for this purpose too. The map shows that the noise reduces to a maximum level of 63 dBA near the residential areas. This calculation does not take into account the dampening effects of the surrounding vegetation. Therefore,

the long term negative impacts of noise would be borne by the employees of the IWMC, and the effects of noise to the residential areas are minimal.

Workplace safety and accidents

The group of people most likely to be impacted by the IWMC 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 guidelines 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.

Mitigation for health impacts

- A distance of 99 m is available between the IWMC and the nearest residential area, which can act as a buffer zone;
- The siting of the IWMC is at the southern region of the island. Due to this location, the residential areas are well shielded from both the particulate matter that can disperse with the winds of the south west monsoon and the winds of the north east monsoon;
- Ponding shall be minimized at the site by grading of the ground;
- Handling of compost shall be minimized;
- Compost turning shall be done based on temperatures and not on schedules;
- Material movements and compost turning shall be done during low winds. Weekends, holidays and times of the day when most people are likely to be outside (and use of football grounds) shall be avoided when handling the materials and turning compost;
- Add moisture to the compost to minimize dust;
- Add a geofabric cover over the compost windrow to minimize release of bio aerosols;
- Workers shall follow the workplace safety mechanisms and guidelines set by the contractor and practice safety and personal hygiene when handling the compost.

Mitigation for 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;
- The leachate collected shall be reused to provide moisture to the compost heaps.

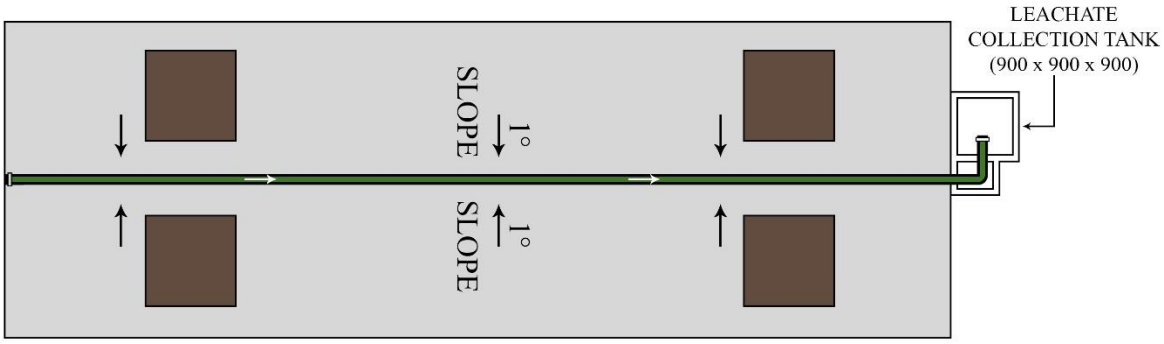

Figure 59: Compost slab design and leachate collection system (Plan view)

Mitigation for rainfall related leachate production

The current design of the IWMC consists of a composting slab is an open windrow composting system. The compost windrow is kept on the compost slab which is sloped in such a way that the leachate from the compost will collect at the pipe in the centre, which will propagate the leachate into the leachate collection tank (see **Figure 59**). While this scenario is ideal during fair weather, heavy rainfall and strong winds should also be considered. There is a possibility of heavy rainfall increasing the produced leachate, as well as the water collected over the composting slab propagating to the leachate collection tank. This can cause an overflow of the leachate collection tank, releasing its contents into the ground and subsequently the groundwater aquifer.

The rainfall can also cause the scattering of the compost materials, the increased water content in the compost windrow can cause another issue: the saturation of the windrow can decrease the available oxygen within the compost windrow, leading to anaerobic conditions.

- There is a valve placed at the inlet pipe which can be closed in instances where the leachate tank may overflow from heavy rainfall onto the compost slab;
- The 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;
- A 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.

Figure 60: Windrow cover being utilised in an open composting system (source: Midwestbiosystems.com)

Keeping stockpiles of raw organics low

Stockpiles of raw organics (waiting to be processed or transported) can cause impacts such as foul odour from the biodegrading organics, leachate reaching and contaminating groundwater, issue of vermin and pests, and visual impacts from the stockpiles.

As per the design of the IWMC, there are compartments for the storage of all major waste types other than organic wastes. A dedicated slab is provided for the composting of the organic waste materials. As per the calculations in **Section 17.4.6** it is seen that the composting slab has the capacity for composting less than 1 month's organic waste produced in the island. As the composting process may take between 4 – 6 months (Halliburton, 2002), the remaining months' organic wastes can accumulate unmanaged and without any means of storage.

The consultant proposes the following mitigation measures:

- Arrangements to regularly transport the unmanaged waste to a central waste management facility; and
- In cases where the waste cannot be transported due to delays and unforeseen circumstances, it is not recommended to stockpile the unmanaged waste on the ground, without any cover. As per the area of the IWMC, there is a capacity to arrange up to 25 nos. 660 L wheelie bins to store unmanaged organic wastes. It is also recommended to separate the putrescible waste from the green waste while storing in the wheelie bins. While this mitigation is not the most ideal, it is seen as the option with the least impact, pertaining to the resources available to the islands and the difficulty in transportation. Alternative transfer arrangements shall be made within this duration.

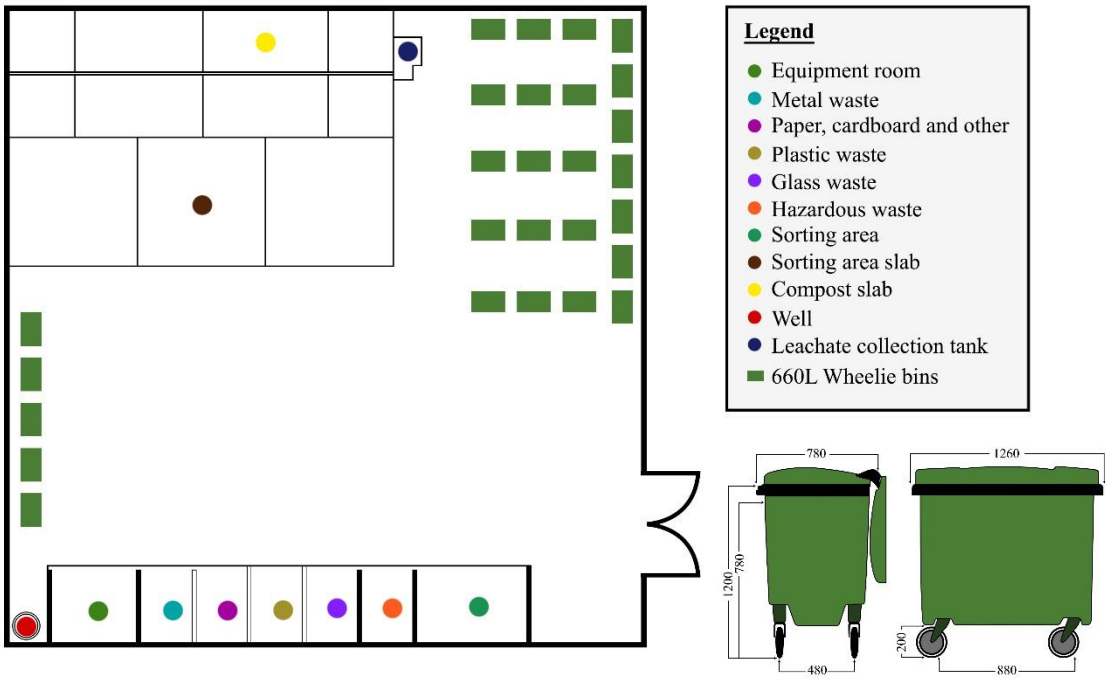

Figure 61: Proposed wheelie bin arrangement to provide for temporary storage of unmanaged organics

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. 660L wheelie 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 IWMC 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 IWMC, with the provision of a 2.8m high 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 IWMC. It is recommended to implement procedures to clean up the wind-blown litter after strong winds;
- Clear all litter within the premises daily and any litter that has been blown out of the IWMC.

Mitigation for odour 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 15cm 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.

Mitigation for fire hazards

- A fire management plan shall be developed by the IWMC occupier;
- Adequate firefighting equipment shall be provided at the IWMC, and placed at locations easy to access;
- The IWMC occupier shall be able to show that firefighting capacity of the IWMC is sufficient to suppress and minimize the incidence and impact of fires; and
- Workers shall be trained to use the firefighting equipment and able to manage fire outbreaks.
- 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.

Mitigation for workplace accidents

- The IWMC 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 and instructions to employees on how to operate any machinery;
- Instruct employees on safe systems of work;
- 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.

Figure 62: Recommended protective clothing for waste management employees. Adapted From: Ministry of Health, Thailand. Bangkok, 1995. *noise cancelling headphones and safety glasses during use of machinery

Table 66: 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

19.2.2.3 O3 Waste Generation

Waste generated during the operational phase of the IWMC will be relatively low. These will include waste oil/batteries for waste management equipment. Since eating and cooking inside the IWMC will be prohibited, no mixed municipal waste will be generated during the operational phase of the project. Hence overall impact for this activity would have a minor negative impact on environmental receptors.

Mitigation Measures

- Closed containers shall be provided to manage hazardous wastes;
- Spill kits shall be provided to manage oil spills; and
- Prohibit eating/cooking in the IWMC.

19.2.2.4 O4 Resource Consumption

Water will mainly be required for washing equipment, work ware, hands etc. and to water the compost pile. Water required for moistening compost piles will be relatively small. As most of the moisture required for the compost pile will be sourced from the leachate collected from the leachate tank the volume of water required will be significantly less. It is estimated that approximately 200 -300 l/day of ground water will be required during the operational phase of the project. Since the volume of water required is relatively low, it is not expected to have a significant impact on groundwater.

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 empties, therefore resulting in lower transportation costs. Compactors and crushers 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 IWMC. Therefore. Electricity consumption of the IWMC 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.

Mitigation Measures

- 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.

Table 67: Impacts and proposed mitigation measures for the construction and operational phase of the project

No	Potential Risk/Impact	Receptor	Nature	Reversibility	Significance	Mitigation	Cost
	Description	**Description**	**Positive**	**Reversible**	**Major Negative**	**Description**	**USD**
					Major Positive		
			Negative		**Moderate**		
				Irreversible	**Minor**		
CONSTRUCTION PHASE (C)							
C1	Impacts from worker influx and settlement (flora and fauna, resource use and sociocultural impacts)	People of Molhadhoo, and terrestrial and marine environment	negative	Reversible	**Minor**	• **See Section 19.2.1.1**	Included in the construction costs.
C2	Impacts from transportation of materials. (climate impacts, and impacts on roads)	Residents of Molhadhoo, terrestrial and marine environment, global environment	negative	Reversible	**Minor**	• **See Section 19.2.1.2**	Included in the construction costs.
C3	Impacts from site demarcation and fencing (Impacts on flora and fauna)	Local flora and fauna	Negative	reversible	**Minor**	• **See Section 19.2.1.3**	Included in the construction costs.
C4	Impacts from site clearing and earthworks (terrestrial pollution, vegetation removal)	Vegetation of the site and surrounding areas	Negative	Reversible	**Minor**	• **See Section 19.2.1.4**	Included in the construction costs.
C5	Impacts from construction works (vegetation impacts, noise and vibration, accidents	Workers and residents of Molhadhoo	Negative	Reversible	**Minor**	• **See Section 19.2.1.5**	Included in the construction costs

	and injuries, pollution from material storage)						
C6	Terrestrial pollution from construction waste generation	Residents of Molhadhoo, ecosystem	Negative	Reversible	**Minor**	• **See Section 19.2.1.6**	Included in the construction costs
C7	Impacts from resource use	Residents of Molhadhoo, ecosystem	Negative	Reversible	**Minor**	• **See Section 19.2.1.7**	Included in the construction costs
OPERATIONAL PHASE							
O1	Waste collection and transportation (Climate impacts, air quality, amenity impacts)	Residents and visitors to Molhadhoo	Positive	Reversible	**Minor**	• **See Section 019.2.2.1**	Cost borne by operations contractor
O2	Waste management activities (Public health, noise, groundwater, fire, accidents, odour impacts)	Mostly IWMC workers, residents and visitors to Molhadhoo,	Positive	Reversible	**Minor**	• **See Section 19.2.2.2**	Cost borne by operations contractor
O3	Waste generation (terrestrial pollution, groundwater contamination)	Residents and visitors to Molhadhoo	Negative	Reversible	**Minor**	• **See Section 19.2.2.3**	Cost borne by operations contractor
O4	Resource consumption (water and electricity)	Residents and visitors to Molhadhoo	Negative	Reversible	**Minor**	• **See Section 19.2.2.4**	Cost borne by operations contractor

20 PROJECT OPTION

20.1 ADVANTAGES AND DISADVANTAGES OF PROJECT OPTION

The advantages and disadvantages of conducting the project option are proposed below:

Table 68: Advantages and disadvantages of project option

Option	Environmental	Social	Economic
Project Option	The project does not involve any clearing of significant trees from the site. It will generate a small amount waste and GHG. This would have minor negative impacts on the soil and environment of the island. However almost all the foreseeable impacts of the project can be mitigated and kept at an acceptable level and the project will not result in a loss of a sensitive or critical habitat or species. The project will provide the island ways to control and prevent further pollution of the environment, and facilitate utilisation of land area more effectively.	Increased direct and indirect employment opportunities for the locals as the IWMC 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 hence pollution of the island will be stopped or controlled. During the operational phase of the project, smell dust and smoke will be emitted from the IWMC. However, the project site is located at an acceptable distance from residential and public areas.	Enhanced opportunity for locals to diversify tourism related services, since a safe and clean island would facilitate and benefit any local tourism venture. Direct contribution to government revenue through taxes and duties. Creation of job opportunities and skilled labour in the region. Expansion of agriculture market in in the island. Price and profit from agricultural produce will become more competitive due to availability of compost. Potential to attract foreign currency by selling compost, scrap metal and other recyclables which would develop the national economy. More settlers will be attracted to the island, which would promote the development of local public services and infrastructure.

21 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT PLAN

21.1 SCOPE

The chapter would present in detail the management measures put in place by the proponent and the contractor to mitigate the environmental impacts that would arise from the project activities. The assessment of impacts and mitigation measures that would be put in place had been discussed in detail in the previous chapter. The main scope or objectives of the environmental management plan are to:

a) Produce a framework for anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions during pre-construction, construction and operational phase; and
b) Provide evidence of conformity to laws and regulations and requirements of enforcement agencies.

21.2 ENVIRONMENTAL MANAGEMENT SYSTEM

The environmental management framework for the proposed project is based on the standards and policies set out by the Environmental Protection Agency of the Maldives under EIA Regulation 2012.

a) Environmental Management Planning and establishment of key performance indicators: The EMP specifies environmental management measures and required performance standards;
b) IWMC construction and operations: The aspects of the construction and operation will be established and operated according with the EMP;
c) Monitoring and corrective action: The implementation of EMP measures will be monitored during operational stage and will be reported. Any inconsistencies between the EMP and its on-site implementation will be identified and addressed through corrective actions; and
d) Auditing, reviews and enhancement: The EMP will be reviewed. Improvements to the EMP will be made as necessary to achieve desired environmental outcomes.

21.3 ENVIRONMENTAL MANAGEMENT STRUCTURE

This Sections detail the various parties involved in the implementation of the environmental plan and their responsibilities.

21.3.1 The Proponent, Ministry of Environment and Energy

MEE will be responsible for the execution of the project activities within the required timeframe. The scope of land clearance falls within the responsibility of the Island Council. MEE is also responsible of policy level decisions and provision of support regarding the waste management works undergone in the island as well as the regional level.

21.3.2 The Contractor

Contractors to construct the IWMC and clear land will be procured by MEE and Island Council respectively. The contractor will undertake the project in accordance with the EMP proposed in the EIA and will report to the proponent and environment consultant about any unexpected environmental impact or health and hazard issues. During the construction stages, the contractor will follow all mitigation and management measures proposed in the report, mainly waste management, pollution control, accident prevention and work methodology proposed.

21.3.3 Environmental Consultant

The environmental consultant would prepare the EMP based on field visits and surveys and based on past project experiences in similar settings. If there are any modifications to be made to the EMP during any stages of the project, the consultant would do the modification and would conduct the environmental monitoring according to the monitoring framework. The environmental consultants are also responsible for auditing the management/monitoring plan to identify gaps, limitation in management and propose remedial measures to ensure the project is sustainable.

21.3.4 Environmental Protection Agency

The Environmental Protection Agency would review the monitoring reports submitted by the proponent and would continue with regulatory monitoring visits to the project site upon their needs.

21.3.5 Island Council

The Island Council will be responsible for the following:

- As the island lacks an approved Waste Management Plan (WMP) the Council has to undertake the responsibilities of formulation and implementation of the Waste Management Plan (WMP) for a period of 5 years.
- Formulation and gazetting of Waste Management Regulations for the island;
- Formulation and gazetting of Waste Management Guidelines for the island;
- Plays a role in the site selection in collaboration with other responsible parties;
- Responsible for the land clearing works of the proposed IWMC site; and
- Overseeing the operations of the IWMC

The Island Council is responsible to ensure the progress of the Waste Management Plan and achievement of the set goals through implementing the plan. This includes overseeing the IWMC operations by either running the operations through the Council or awarding the work to a contractor. The Island Council is also responsible for the compilation of the IWMC reports submitted by the contractor as well as producing an IWMC monitoring report as well as reporting of public grievances. These reports shall be submitted to the MEE bi-annually for review.

21.3.6 Operations Contractor

The operations contractor will be responsible in running the operations in accordance with the guidelines set by this EMP and the WMP of Molhadhoo Council. The responsibilities of the operations contractor include producing the IWMC operations reports and submitting the reports to the Island Council at the proposed regularities.

21.4 REPORTING

Reporting will be carried out on a timely manner to implement the environmental management plan and will cover details of site conditions, and operations. A detailed reporting mechanism for the IWMC operational works is provided in **Section 21.10**. Monitoring reporting shall be carried out during the stated time frames and frequencies in **Section 21.6**.

21.5 ENVIRONMENTAL MANAGEMENT PLAN

A practical plan taking into consideration available resources is proposed to meet the aims and objectives of the EMP. One of the major risks to the investment and operation of the IWMC and island level waste management is the center itself which can be converted back into a dumpsite due to mismanagement as often seen in island level waste management endeavors all across the Maldives. This is partly due to the fact that a lot of linkages connecting island level waste management with regional level waste management are absent or unknown until it is much too late. As described in **Section 19.2.2.2**, one of the main risks facing the current project is rapid accumulation of organic waste at the IWMC. Hence the proposed IWMC management plan aims to control and mitigate such risks without severe negative impacts

Table 69:Details of environmental management plan proposed for the IWMC

Activity	Phase	Measures	Time frame	Responsible person
Training of workers and contractors	Pre-construction, Pre-operation	Contractor and project workers are provided with detailed information on the project, impact mitigation measures, compliance with environmental permits and the EMP. Workers are also provided with the information on sensitive areas of the island and other environmental issues. Training of staff involved in the monitoring of the construction phase Training shall be provided to the workers of the IWMC on the waste management practices and mitigation measures in order to ensure the operations are run efficiently and effectively.	Prior to construction works Prior to operational phase	Proponent Environmental Consultant
Documenting non-conformances and corrective actions	Construction Operation	Non-conformances to the environmental regulations, permits and the EMP is monitored and documented. Corrective measures are taken and follow ups are done. IWMC operations reports and public grievances are compiled by the Island Council and reported to the proponent within the prescribed frequencies as stated in **Table 73**	Construction and Operation phase	Proponent Environmental Consultant Island Council
Supervision of activities	Construction Operation	The project activities are to be supervised by the proponent throughout the construction and operational phase to ensure the activities are carried out accordingly and the impacts are minimised. The proponent shall review the IWMC operations reports from the Island Councils, and provide the required support, bring about any necessary policy updates	Construction and Operation phase	Proponent Environmental Consultant

21.6 ENVIRONMENTAL MONITORING PLAN

Table 70: Monitoring plan for the construction and operation phase of the project

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
Ensuring that the project activities does not affect the quality of the groundwater	Establish baseline just before the construction works begin and continue monitoring as stated. Establish a groundwater monitoring stations and geo-reference it. Preferably close to the IWMC.	O	12,000 per trip	Potable water quality testing equipment and/ or by sending samples to the lab	During operational phase, bi annually	Proponent Environmental Consultant	Water quality report
Ensure waste generated at work site is audited and managed responsibly	Management of waste generated as described in **Section 17.3.12** of the report	C,O	Cost included in the project costs	Estimation of waste generated at project site and recording these data routinely. This includes quantifying and recording the amount of yard waste, hazardous waste and general waste stacked and stored for transportation.	Every two months	Construction contractor, operation contractor	Record sheets, photographs and quantity of waste processed at Thilafushi/ (nearest waste management center) and IWMC. If there are no significant discrepancies between the quantity of waste generated on site and processed at regional waste management facility, it can be safely assumed that impacts of waste on the environment was reduced.
Monitoring Health and safety of workers and the public	Accidents during construction of IWMC, land clearance, operation of IWMC and maintenance of IWMC. Fire hazards and natural disaster events. Noise and smell complaints during operation and construction phase. Compost condition, output and quality	C, O	Cost included in the project cost	Keep records in a log book, or data sheet	Bi annually	Operational contractor Construction land clearance contractor	Measures to adapt and prevent accident and risks. Health assessment reports published or available from the local health center.

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
						Island Council MEE	Policy changes and upgrades. Compost quantity and quality. Income from selling compost.

21.7 RESOURCE REQUIREMENT FOR MONITORING

For the monitoring program to be successful, it is important that adequate financial and human resources are available and strong coordination among the key stakeholders is maintained.
The primary function of implementing the mitigation and monitoring plan will lie with the proponent and environmental consultant. Since the project at developmental and operational stage will be engaged by the proponent it will be the responsibility of the proponent to take care of the environmental safeguards at all stages of the project during implementation and at operational phase. The proponent should prepare an Environmental Action Plan, which states all measures for mitigation and enhancement and monitoring as described here in the EIA with their responsible organisation and person, planning, methodology, timing and other relevant aspects.
An independent registered environmental consultant shall be hired and contacted to undertake and audit the monitoring program prescribed in this report. Following each monitoring visit the consultant will prepare a report with clear recommendations and corrective measure if necessary. The report will have to be submitted to EPA for their review and actions.

21.8 MONITORING SCHEDULE

Table 69 highlights the monitoring plan in which responsibilities of main stakeholders has been assigned. In order to track and compile the findings of these measures an independent environmental consultant shall be tasked to audit the projects EMP. This is to

- identify gaps in monitoring and mitigating impacts arising from the project;
- determine the challenges and resource inadequacies to implement the proposed EMP; and
- determine the current environmental condition and propose modification/upgrades to the initial EMP.

Monitoring frequency for various individual components given **Table 70** shall be followed by all responsible parties. **Table 71** gives indicative timeline for the monitoring visits by third party consultant.

Table 71: Monitoring visit schedule

Visit	Indicative timeline	Indicative parameters to monitor	Reporting	Cost (MVR)/per report/island.
Visit 1	Prior to construction of IWMC	Set baseline for groundwater quality and noise	Submit summary report 1 to Proponent within 2 weeks	25,0000.00
Visit 2	During construction of IWMC	Monitor work method, waste management, Monitor health and safety of workers. Monitor impacts to nearby vegetation and ensure vegetation removal is as per set out survey. Review reports prepared by contractors.	Submit monitoring summary report 2 to Proponent (MEE) within 2 weeks	10,000.00
Visit 3	Two months into operation of the IWMC.	Monitor water quality and noise. Monitor IWMC. This includes review of	Submit summary report 3 to Proponent within 2 weeks	25,000.00

	Biannually for four years	reports dated in **Table 73** or determine condition of IWMC. Monitor compost condition as described **Table 70** and **Table 73**		

As indicated, during the course of the Project implementation summary reports following each trip is expected to be submitted by the Project's environmental consultant. These environmental audits will provide a basis for assessing at least the shorter-term efficacy of the environmental measures and thereby provide lessons to be learned for future monitoring sessions and other projects with similar impacts. The consultant will prepare and submit the reports to Proponent. Based on the findings of the report, the management approach may be adapted and its efficacy will be determined in the consecutive monitoring trip.

21.9 MONITORING REPORT

Reporting will be carried out by the environmental consultant assigned for the purpose by the proponent. The report will include among other information;

- Details of what was being monitored;
- Methodology of data collection and data analysis;
- Major findings;
- Effectiveness of the mitigation measures in place and
- Recommendations and conclusions.

A detailed environmental monitoring and management report is required to be compiled and submitted to the EPA. In addition to this, regular site monitoring would be carried out by the proponent that requires maintaining logs of events as explained in this report. Enforcement officers from EPA may also visit the site for inspection from time to time.

21.9.1 Monitoring Report Format

The environmental monitoring report outlined in **Table 72** below will be used in reporting environmental monitoring to be carried out as given in the monitoring plan.

Table 72: Monitoring report format

Project Title:
Name of the Island:
Monitoring Date:
Period Covered:
Prepared by:
Contributions:

A. Introduction
Give a brief introduction about the project and the monitoring carried out
B. Methodology
Brief detail of the methodology applied for undertaking the monitoring assessment
C. Environmental Monitoring
a. Groundwater quality
Parameters given in the monitoring plan need to be assessed
b. Waste generation and management at IWMC
These include monitoring for pests and diseases as described.
D. Risks and Mitigations
Please indicate any critical unresolved risks that affect the course of the system operation, analyse the cause, assessing the potential impacts on the environment providing the proposed mitigation strategy
E. Problems Encountered
Indicate any problem areas encountered and any corrective measures that will have to be taken.
F. Recommendations and Adaptations as Solution
If specific recommendation is noted during the monitoring phase, specify it in the report
G. Conclusions
Reference
Appendix

21.10 IWMC OPERATIONS REPORTING MECHANISM

Table 73:Details of the reporting mechanism proposed for the IWMC

IWMC (Contractor)

Reporting	Details	Frequency
General report	Logs of the incoming waste	Monthly
	Classified by type and weight	
	Vehicle maintenance details	
	Machinery maintenance details	
	Machinery fuel usage details	
	Workplace injuries	
IWMC capacity	Details of the utilized and remaining capacity of IWMC	Every two months
	Leachate tank maintenance and capacity	
IWMC inventory status report	Details of the status of IWMC equipment	Bi-Annually
	Details of the status of emergency kits and firefighting equipment	
Compost output report	Details of amount of input waste materials	Bi-Annually
	Details of compost output in weight	
Noise and odor complaints	Log of noise and odor complaints	Every two months
	Complaints to be provided along with weather conditions and incoming waste details coinciding with the dates of complaints	

Island Council (Municipal Unit, Waste Management Committee)

Components	Details	Frequency
Public grievances	Log of public grievances regarding	Bi-Annually
	Fee structure	
	Waste Management operations	
	Noise and odor complaints	
IWMC monitoring	Monitoring report of the IWMC operations	Bi-Annually
Compilation of IWMC reports from operations contractor		Bi-Annually
Income report	Summary of IWMC operations income	Bi-Annually

MEE

Components	Frequency
Review of IWMC Reports from Councils	Bi-Annually
Update National Waste Database	
Policy updates from findings	
Provision of support to IWMCs	
Overview of the waste management system on island level and regional level	

22 RECOMMENDATIONS AND CONCLUSION

The construction and development of the IWMC at HA. Molhadhoo is a much needed project to provide waste management services to the island. The IWMC 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.

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 consultant's recommendations for the project include:

- To include this EMP as part of the contractor's contract and ensure the measures and recommendations brought forth are followed;
- Implement the work method and mitigation plan as prescribed in the report to the fullest;
- To conduct supervision and monitoring of the project works by the proponent;
- To conduct supervision and reporting of the project works by an independent consultant;
- To conduct stringent evaluation of contractor's capacity to undertake and complete the project;
- Ensure necessary clauses regarding the workers safety are fully implemented;
- 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 EMP has looked into the key factors that need to be considered during construction and operational stage. The study has identified the possible negative impacts arising from this project and minor.

The study also found that through the implementation of the proposed practical and cost effective mitigation measures almost all significant impacts can be brought to an acceptable level. This EMP will guide the proponent in implementing the project with conformity to EIA regulation 2012.

CHAPTER 4
HDH. FINEY

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23 INTRODUCTION

23.1 BACKGROUND

HDH. Finey is administratively part of the South Thiladhunmathi Atoll. Finey lies to the southwest of Hodaidhoo and northeast of Hirimaradhoo. The island is geographically situated centrally in the atoll, with NW-SE orientation. Finey, which has a total land area of 118 ha, has a population of 568 as of 2017, per the Island Council. A wetland of 0.5 ha is located in the south eastern region of the island. Finey lies to the southwest of Hodaidhoo and northeast of Hirimaradhoo. Finey has a registered population of 568 as of 2017.

The island currently has no water supply system or a central sewerage system. 24 hour electricity service is provided to the island by the utilities company FENAKA. The island is accessible by harbour, which is 300 ft long by 200 ft wide. The island does not have a waste management centre, although an area has been cleared and is currently being used as a dumpsite.

The aforementioned dump site is not fenced off, although it is located at a considerable distance away from receptors. It was observed on the field visit that there was an attempt to separate waste types using sign boards. According to the Island Council, this was attempted during 2016. Although, it was noticed that due to lack of any technical capacity or equipment, the stockpiles have become difficult to manage due to the sheer volume. It was also observed that burning of green waste is practiced in some areas of the island. Putrescible wastes such as kitchen wastes are not dumped in this area, and as is the norm in majority of the islands without a waste management system, they are dumped at certain beach areas. Dumping of kitchen wastes and other wastes in the nearshore area can lead to diseases, nutrient imbalances, smothering of corals toxicity impacts to marine flora and fauna (Halliburton, 2002).

No waste audit specific to the island has been carried out in the past nor had the waste situation of the island been properly assessed. A waste audit for Zone 1 (which includes HA, HDH, and SH. Atolls) conducted by MEECO in 2016 showed an average of 1.30 kg/capita/day of waste generation within the islands. Using this average, approximately 0.74 ton/day of waste is estimated to be generated within the households of the island. The majority of sources of waste in HDH. Finey are the households, farms, and government institutions. The main types of waste generated in the island are organic waste including kitchen waste and green waste, glass, paper, metal, and plastics. In order to manage the waste situation at the island level, the proponent, Ministry of Environment and Energy (MEE) has proposed the project to establish an Island Waste Management Centre (IWMC) in HDH. Finey.

The proposed project is facilitated by MEE and financed by the OPEC Fund for International Development (OFID) under the “Provision of Water Supply, Sanitation and Solid Waste Management Project”. The completion of the proposed project will result in the construction of an IWMC, and the operation of the IWMC will be facilitated under the Waste Management Plan devised by the Island Council and Approved by EPA.

The scope of the IWMC is to facilitate island level management of the waste generated within the island, which includes sorting, volume reduction and stockpiling of recyclables, composting of organics, and storage of hazardous waste. The waste that is not manageable in the island level is planned to be transported to a central waste management facility.

The proponent has requested consultancy services of MEECO for the preparation of an Environmental Management Plan (EMP) to comply with the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012. EPA has issued a decision statement on HDH. Finey that an EMP would be suffice for the proposed IWMC construction and operation works.

A field visit was conducted by the MEECO team to HDH. Finey on 25th April 2017 in addition to a consultation meeting with the Island Council on the same day. This report is based on the findings of the field visit, consultations, previous EMP's and experience of the consultant.

23.2 PROJECT SETTING

HDH. Finey is located in 06°44′49″N 73°03′08″E, in the Thiladhunmathi Atoll. The island is administratively part of the South Thiladhunmathi Atoll. Finey lies to the southwest of Hodaidhoo and northeast of Hirimaradhoo. The island is geographically situated centrally in the atoll, with a NW-SE orientation. The island is approximately 288.91 km from the capital Male', and 13.1 km from the nearest airport in HDh. Hanimaadhoo.

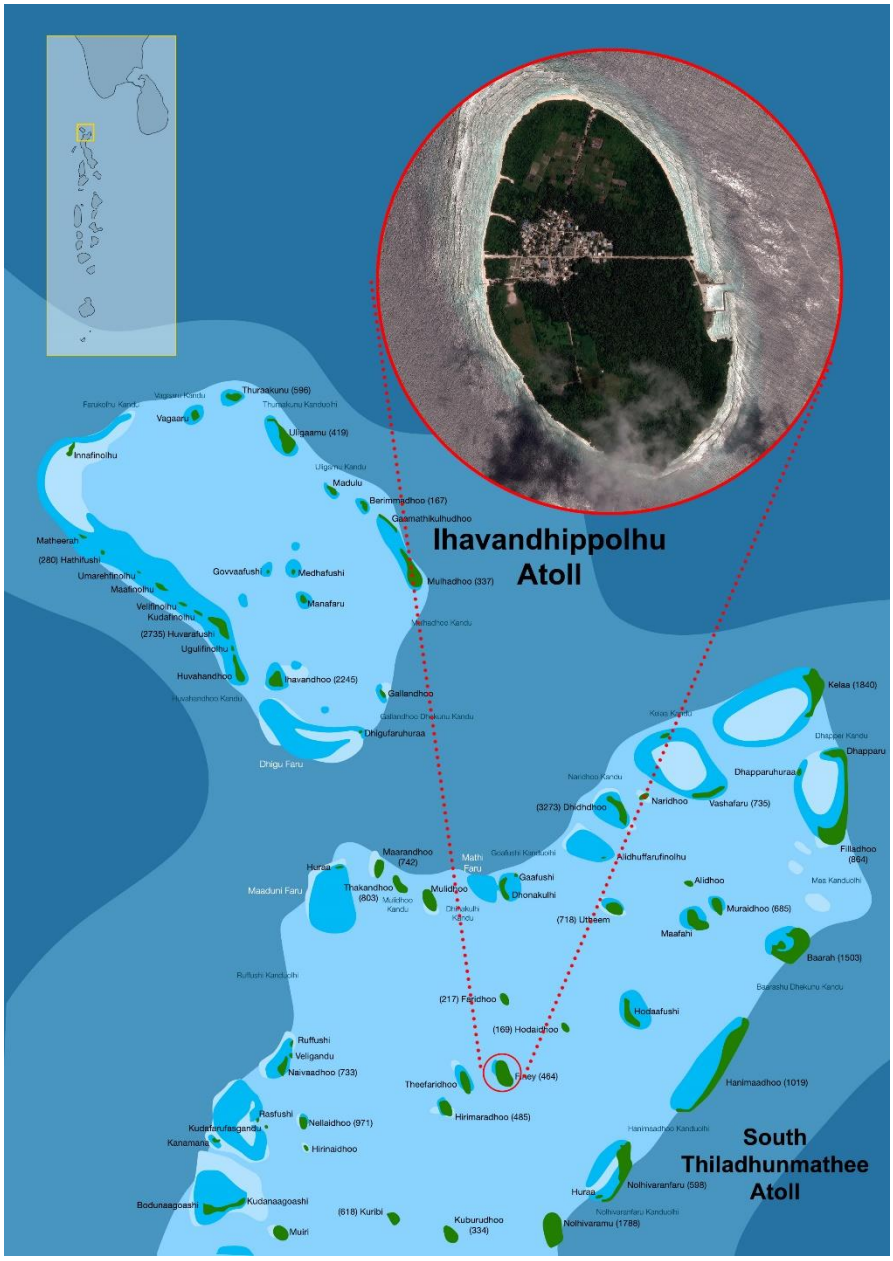

Figure 63: Project setting

23.2.1 Site Location

The proposed Island Waste Management Centre (IWMC) is located in the southwestern side of the island at 6°44'31.47"N, 73° 3'5.89"E. The site is accessible by a main road stretching north to south through the Island.

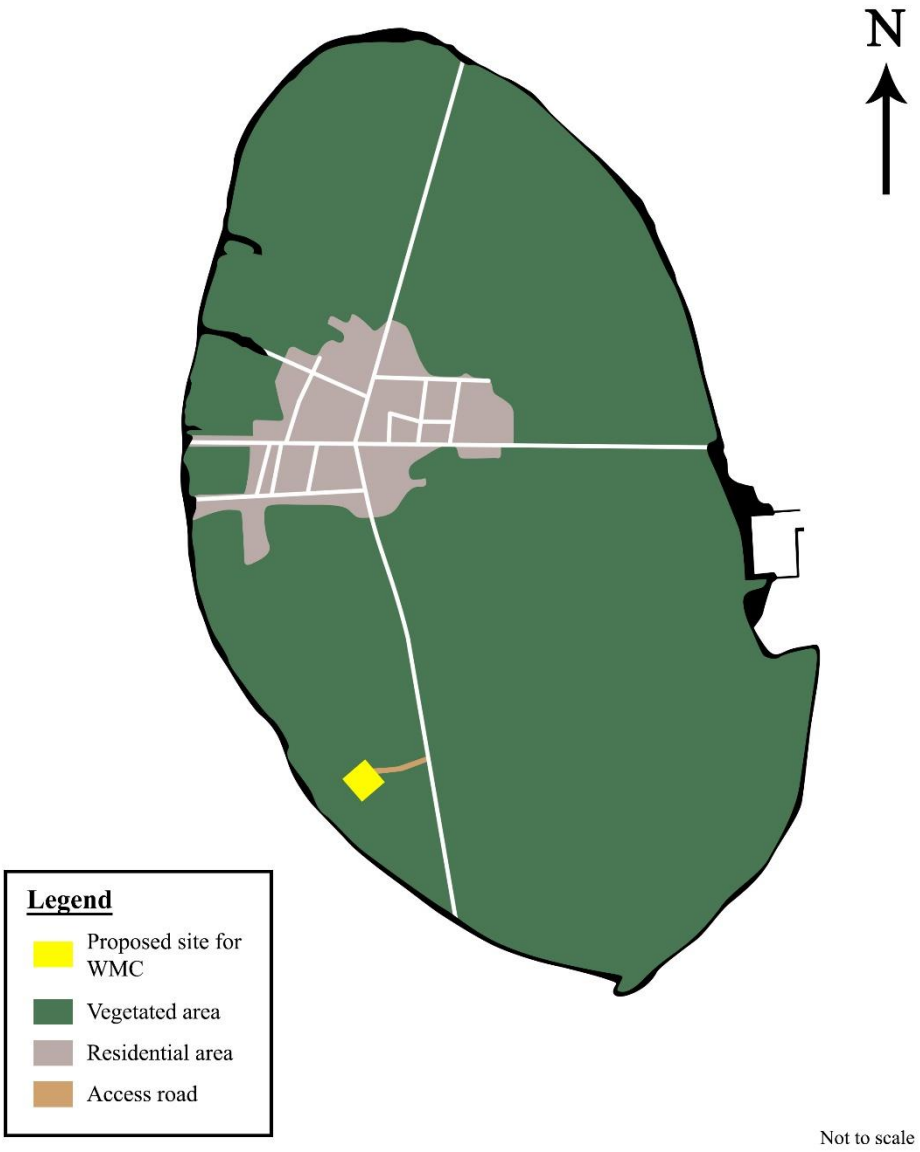

Figure 64: Proposed location for the waste management site on Finey

23.3 CURRENT STATE OF WASTE GENERATION AND WASTE MANAGEMENT

23.3.1 Waste Generation in Zone 1 and HDh. Finey

A waste audit conducted by MEECO in 2016 showed that the average waste generation of the islands in Zone 1 was 1.30 kg/capita/day.

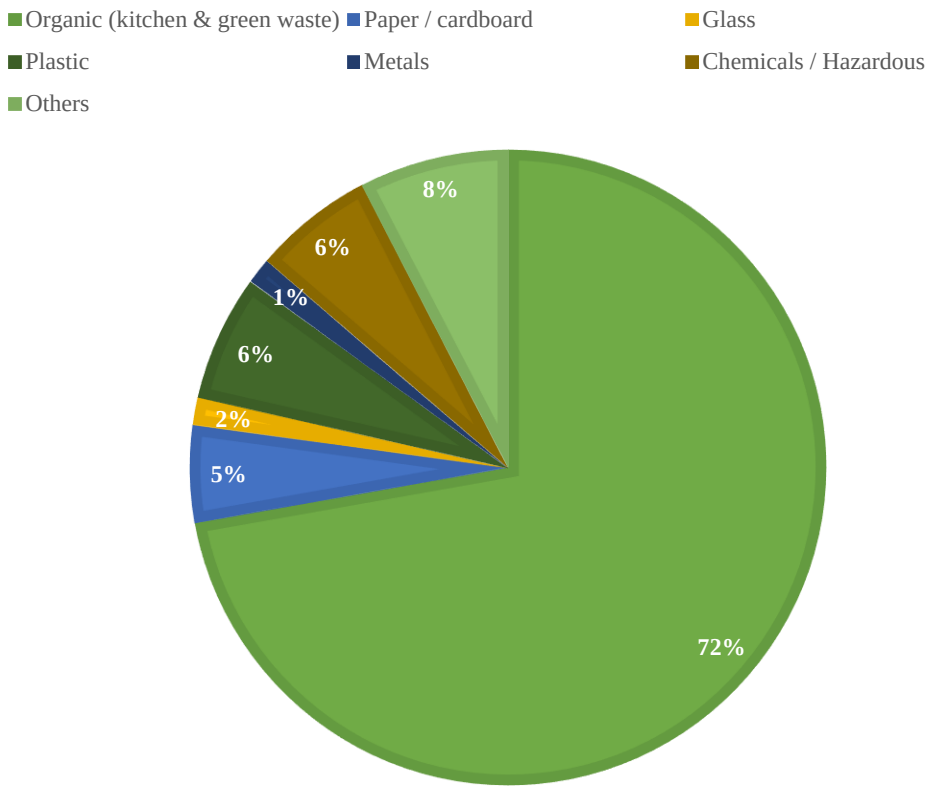

Figure 65: Waste Composition of Zone 1 (Source: MEECO, 2016)

The analysis shows that the majority of the waste generated includes organic wastes at 72%, which include kitchen and green wastes. This waste can be used in composting in addition to paper and cardboard wastes which are at 5% of the total waste generated. Recyclable materials such as plastic, metals, and glass make up 9% of the composition. Approximately 6% of the total waste generated is chemicals and hazardous waste. Using HDh. Finey's current population, the daily waste generated can be estimated from this data.

Table 74: Estimated waste generation quantities of HDh. Finey

Waste Type	Zone One Average (%)	Finey Waste Generation (Kg/Day)
Organic (kitchen & green waste)	72.2	533.1248
Paper / cardboard	4.94	36.47696
Glass	1.42	10.48528
Plastic	6.4	47.2576
Metals	1.3	9.5992
Chemicals / Hazardous	6.15	45.4116
Others	7.58	55.97072
Total	99.99	738.32616

23.3.2 Current state of waste management in HDh. Finey

The majority of sources of waste in HDh Finey are households and farms. Finey has a registered population of 568 as of 2017. While the domestic waste generated from these households may be relatively smaller in size compared to other islands of larger population, Finey is an island with significantly large land area compared to its population size. Therefore, farming is done extensively on the lands allocated for the purpose on both the northern and southern regions of the island, with the most prominent activities observed at the northern region. Due to this, it is expected that a substantial amount of green waste will be generated from the farms, in addition to the waste generated from the households.

Currently, an area has been cleared in HDh. Finey to dump the waste. The area is currently next to the proposed IWMC site, with part of the footprint overlapping. The dump site is not fenced off. It was observed on the field visit that there was an attempt to separate waste types using sign boards. According to the Island Council, this was attempted during 2016. Although the separation has been attempted, it was noticed that due to lack of any waste management equipment or machinery, the stockpiles quickly became difficult to manage due to the sheer volume. Putrescible wastes such as kitchen wastes are not dumped in this area, and as is the norm in majority of the islands without a waste management system, they are dumped at certain beach areas.

Even though a dumpsite has been allocated by the Council, biodegradable wastes such as green wastes are still burnt in some areas of the island.

Figure 66: Current waste dump in the island. A B and C show areas where nappies, plastics and metals have been segregated. D shows a mix of waste at the same dumpsite.

Without a proper waste management plan and equipment in place, the stockpiled waste will ultimately need to be reduced, and methods such as burning may be used to reduce the waste volume. Burying of rubbish is not practiced in the island.

Currently, the public areas are being cleaned by a contractor under a 1 year contract, and hospital waste produced at the health centre is burnt inside the centre itself.

Figure 67: biodegradable green waste is burnt in some areas of the island. A to D shows such an area observed during the survey trip

23.4 WASTE MANAGEMENT PLAN OF HDH. FINEY

HDh. Finey currently has no Waste Management Plan formulated as of the date of visit. The formulation of the WMP is crucial in providing the framework to conduct the proposed waste management activities that will be conducted with the establishment of the IWMC. Various consultations to project islands have revealed numerous challenges exist to formulate and implement the WMP. These challenges and risks are listed in **Table 75** with their immediate risks categorised.

Table 75: Risks and challenges to draft and implement Island WMP

	Risk Categorisation	Description	Adaptive Measures
Formulation of Waste Management Plan			
Lack of technical staff	High	Technical experts with knowledge of waste management and waste management planning	• MEE to train pool of people from the island with regard to waste management. • MEE to conduct capacity building workshops and island specific training programmes.
Lack of reliable information	Moderate	Information with regard to amount of waste generated from the island, including type of waste generated etc.	• Review of previous waste management studies. (See **Section 23.3.1** for waste generation estimates)
Understanding regional and local waste management concept	High	Lack of knowledge regarding the *Saaffu Raajje* waste management framework and strategy.	• MEE to conduct workshops briefing and lecturing Council and

Lack of knowledge with regard to IWMC operation	High	Poor understating of the activities undertaken at the IWMC. Poor understanding of the roles and responsibilities of IWMC workers and stakeholders.	relevant stakeholder with regard to nation-wide waste management framework. • MEE to utilise public media to conduct waste management awareness programs. • Share information with regard to past experience. • MEE should train selected members from the Council and community on how to operate and trouble shoot machineries. It is recommended to train a diverse group (Teachers, members from NGO's, Hospital etc.) of people (at least 5 from the island) so that students may be able to teach in the future. This will be important to address risk of losing technical staff during operational phase of the IWMC.
Poor knowledge of waste management progress/failure indicators.	High	Describes indicators such as volume/weight of incoming waste, compost output, equipment operation frequency, complain logs etc which can be tracked to better understand and strengthen waste management plan	
Unfamiliarity with the proposed waste management equipment	High	Inability to trouble shoot and operate proposed waste management equipment. Poor knowledge of when/how to operate the equipment.	
Lack of knowledge with regard to local businesses and household expendable income.	Minor	Poor understanding of the type and size of waste generated from businesses/industries. Poor understanding of the willingness to pay by the public. Poor understand of incentives to enable source separation.	• Council shall take initiative and conduct island wide surveys to determine the willingness to pay and type of waste generated from local business and industries if any. • Previous studies shall be referenced when drafting the waste management plan.
Implementation of Waste Management Plan			
Lack of vehicles	High	Lorries and pickups required for waste collection and transportation within the island.	• Council to raise funds to procure vehicles through better planning and budget control. • MEE to provide aid in procuring vehicles for waste collection. • Council to make contracts with vehicle leasing companies or individuals who own vehicles, for waste management. • Granting agencies or charities may be approached.
Lack of budget and financial capacity for start-up.	Moderate	In order to operate the IWMC, employees shall	• Council to make better financial plans and to

		be hired. Initial start-up cost of operation will be significant.	raise funds to start up waste management. • MEE to provide aid to start-up the waste management operations. • Obtain assistance/grants from charities and international authorities. • Council to make contracts with private/state companies to operate the IWMC.
Operational cost and income from waste services not feasible	Moderate	In islands where dwelling households and enterprises are low, operating a waste collection service and managing the IWMC may not be feasible to sustain.	• Council/MEE to identify feasibility of waste collection services. • Council to conduct intensive willingness to pay surveys. • MEE to review individual WMP's and categorise islands based on feasibility of implementing a waste collection and IWMC management plan with regards socio-economic condition of the island. • Council to increase fees in case income does not meet operational cost. • Lowering operational cost through effective management. • Devise a cost sharing scheme in the form of subsidies for islands. • Create a market to sell compost to increase income. • Plan regional waste management plans to encompass limitation at island levels waste management.
Lack of knowledge with regard to composting	High	Composting is the most significant aspect of island level waste management, hence knowledge regarding compost management will be vital to sustain island level waste management. Many of the Councils do not have experience with regard to composting.	• Awareness and capacity building as described above. • MEE to invite experts from related fields to share knowledge and past experience.
Unfamiliarity with the proposed waste management equipment	High	Same as above	

Poor knowledge of waste management progress/failure indicators and roles/responsibility of stakeholders	High	Same as above	Same as above

The analysis showed that, significant risks exist to draft/design the island level waste management plan and implement the waste management plan once the IWMC is constructed. This entails a higher risk for the overall failure of the IWMC during the operational phase which would result in accumulation of negative impacts detailed in **Section 26.2.2**. Hence, design and implementation of a thorough island specific waste management plan is identified to be crucial for the successful operation of the IWMC.

A standard operation procedure of the IWMC is not available for implementation in cases where an adequate WMP has not been prepared and approved by the time IWMC construction is completed. Hence the risk of IWMC's failing during the operational phase are very high.

In order to prevent conversion IWMC's into waste dumpsites as commonly observed in the Maldives, the report recommends to follow intermediary management steps as described in **Section 23.4.1**, until a workable and effective IWMP is prepared and approved.

23.4.1 Intermediary Waste Management Steps

Based on the analysis of prepared Waste Management Plans (WMP) and challenges faced by the Councils of the islands included in this project, to draft and implement WMP's, it is recommended to follow the intermediary waste management steps as a guideline in order to:

1. Prevent the IWMC from becoming a dump site. Uncontrolled waste disposal into the IWMC will quickly overfill the IWMC causing damage to the structure and resulting in burying and burning waste at the IWMC; and
2. act as a contingency in case WMP is not prepared by the time IWMC's are constructed.

The intermediary waste management steps shall be used as guideline to achieve the objectives described above.**Table 76** notes important aspects which shall be considered during the intermediary phase of IWMC implementation by significant stakeholders. It highlights the relative potential risk of IWMC failure as a result of not fulfilling the activity.

Table 76: Intermediary waste management steps

Activity	Responsible stakeholder	Recommendation	Activities potential risk contributing to IWMC failure
1. Establish IWMC management team	Island Council	Waste coordinator and 2-3 laborers	Major
2. Awareness and training	MEE	At least 5 selected people including assigned waste coordinator, Council employees, teachers etc shall be trained to manage the IWMC, operate and troubleshoot waste management equipment. The aim of the sessions shall be to equip participants with enough knowledge so that they can train other people. In order to accomplish this, a training course shall be designed where industry	Major

		experts shall share knowledge and past experience.	
3. Assign IWMC operating times	Island Council/ IWMC Management team/MEE	During the intermediary phase it is recommended to operate the IWMC for at least 6 hours.	Moderate
4. Establish waste collection criteria	Island Council/ IWMC Management team/MEE	Since, a waste collection system is unlikely to be designed during this stage, waste shall be taken to the IWMC by individuals during the IWMC operating hours. Waste shall be accepted when it has been separated into three constituent categories as follows: 1. Kitchen waste 2. Yard waste 3. Plastics metals, glass and others. Category 3 shall be sorted by the laborers and stored at the respective compartments while organic waste shall be used for composting or stored in bins.	Moderate
5. Install organic waste collection bins	MEE	The IWMC has enough space to store approximately 20-25 660L bins which will hold organic waste for approximately 1.5-2 weeks. These bins shall be provided prior to starting waste management operations	Major
6. Waste management activities			
a) Sorting	IWMC management team	Daily	Major
b) Metal compacting	IWMC management team	Rarely. Waste audits show that percentage of metals are very small hence it is likely that this activity will have to be performed rarely. An exact schedule for these activities, shall be drafted after assessing incoming waste streams for each island.	Minor
c) Plastic shredding	IWMC management team	Occasionally	Moderate
d) Bottle crushers	IWMC management team	Occasionally	Minor
e) Compost management	IWMC management team	Daily	Major
f) Determine amount of waste generated	IWMC management team	Weekly. This could be done using scales or by estimating volumes. This information will be useful to take preventive measures before the IWMC runs out of storage space. The reporting plan described in **Section 28.10** shall be followed during this stage as well.	Major

g) Maintenance of IWMC	IWMC management team	The IWMC shall be cleaned and maintained daily	Moderate
h) Regular transportation of waste from IWMC to Regional Center	MEE/Island Councils	MEE shall make the necessary arrangements to transport waste from the IWMC to a central waste management facility. MEE shall regularly monitor reports from respective IWMC's and plan ahead before the IWMC's run out of storage space. Inability to transport waste from the IWMC's during this phase of the operation could result in failure of the nationwide waste management concept. See **Section 23.3.1** which estimates monthly waste generated in the island.	Major
7. Enforce rules to stop disposal of waste into areas other than IWMC	Island Council	The Island Council shall enforce rules and penalties to prevent pollution of the environment. Public announcements shall be made to inform IWMC operating hours etc.	Moderate

24 DESCRIPTION OF THE PROJECT

24.1 THE PROPONENT

The proponent of the project is Ministry of Environment and Energy (MEE) of the government of the Maldives. The proposed activity is part of a greater project titled "Provision of Water Supply, Sanitation and Solid Waste Management Project" financed by the OFID.

24.2 PROJECT DURATION AND SCHEDULE

The proposed construction phase of the project is planned to be carried out in 10 weeks. This project was opened to bidders in June 2017 with a validity period of 90 days.

A tentative schedule of the work is found in **Table 77.**

Table 77: Work plan for IWMC

#	Activity	Duration (days)	Weeks									
			1	2	3	4	5	6	7	8	9	10
1	Mobilization	7										
2	Site clearing	4										
3	Excavation works	2										
4	Substructure and superstructure works	10										
5	Masonry works	10										
6	Plastering works	3										
7	Roofing works	7										
8	Structural steel works	7										
9	Electrical works	2										
10	Plumbing works	1										
11	Doors and windows	7										
12	Demobilization	2										

24.3 PROJECT DESCRIPTION

The proposed site plan is presented in **Figure 68**. Engineering details are provided in **Annex 2**.

The construction of the IWMC consists initially of mobilization and site clearing. The main works include shallow excavation, substructure and superstructure works as well as masonry works. The proposed design of the IWMC 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 operational phase of the project will include the daily collection of waste from the households and institutions, in addition to waste management works in the IWMC, which include;

- Sorting of waste;
- Storing of hazardous waste;
- Volume reduction of plastics, glass and metals;

- Stockpiling of sorted waste; and
- Composting of organic waste.

The IWMC is made up of an equipment room, and separate areas to store metal waste, paper and cardboard, plastic waste, glass waste as well as hazardous waste.

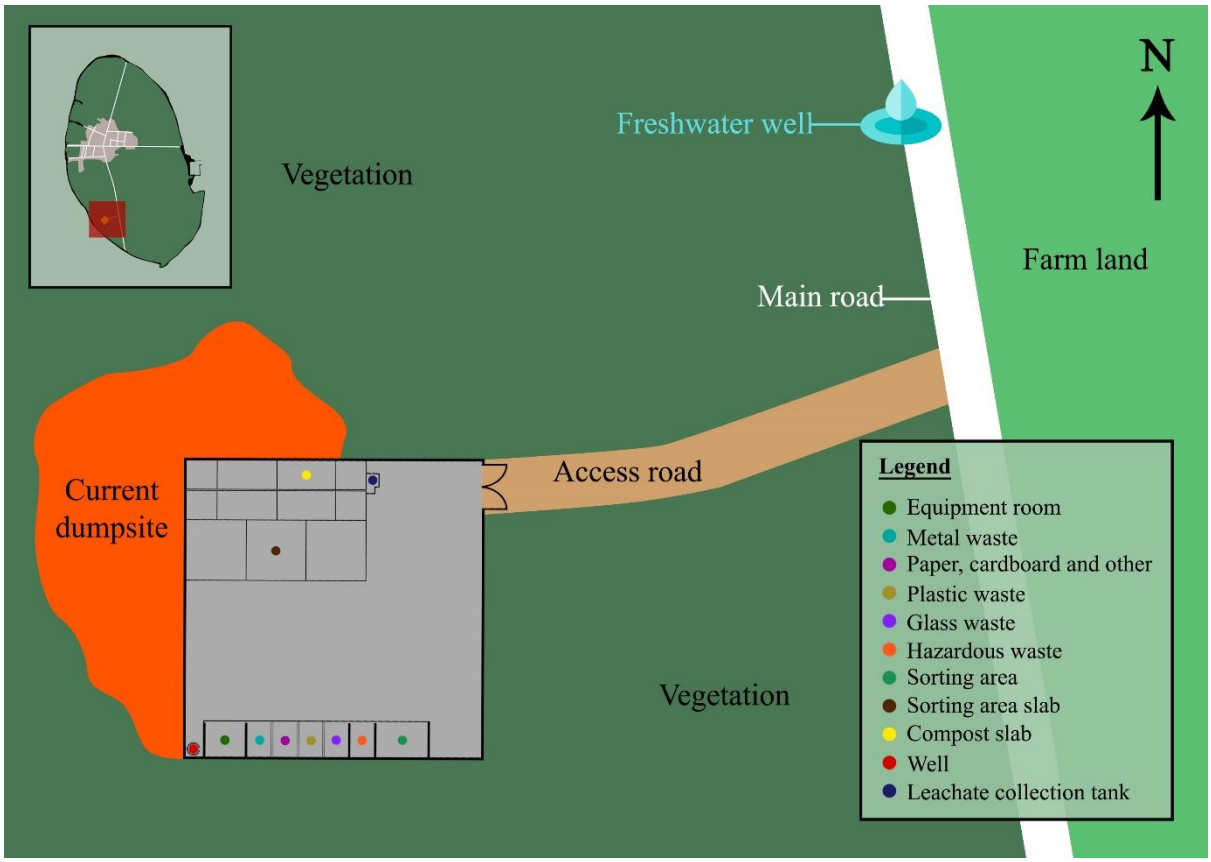

Figure 68: The site plan

24.3.1 Machinery

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

a) Lorry crane for placing of well;
b) Truck for transportation of materials;
c) Vibratory plate compactor;
d) Concrete mixer;
e) Concrete supply pump and piping; and
f) Daily 4" pump.

24.3.2 Mobilisation

As the amount of input materials are relatively minor, the construction materials shall be stored inside the demarcated site throughout the construction period

24.3.3 Demarcation and Fencing

Prior to beginning construction works, a survey shall be done by the contractor to demarcate the limits of the site, and the site shall be fenced off. Work shall be conducted within these limits.

24.3.4 Site clearance and levelling

The proposed site has already been cleared of vegetation except for a few shrubs and weeds. Although, part of the site is currently being used as a waste dump with small quantities of waste already dumped on the footprint of the site. The waste needs to be cleared to the side of the site (which is also used as a waste dump). Minimal vegetation clearing works are therefore required, which include grubbing of roots. The site needs to be levelled in order to bring it to the formation level. As the site size is relatively small, a vibratory plate compactor may be used for the levelling of the ground.

24.3.5 Construction of Sorting Area Foundation

The footprint of the proposed site is 25 m by 25 m, of which the storage areas consists of a 3.15 m by 18.85 m area. The proposed foundation below the masonry walls of the structure is a line (strip) foundation.

24.3.6 Construction of Compost Slab and Sorting Area Slab

The compost slab and sorting area slabs has an area of 15 m by 10 m. The 100 mm thick reinforced concrete slabs are cast over ground beams B1, B2 and B3. The ground beams B1 and B2 have a depth of 0.3m while B3 has a depth of 0.4m from the top of the slab. B3 has a void on top of the beam centrally to receive a 100mm PVC pile cut in half sloping at 1% from the upper end to the lower end, connecting to the leachate tank at the end. Excavations will be done manually to receive the ground beams as per the drawings indicate. The maximum depth of excavation for the beams is 0.4m. The construction of the slab and ground beams include initially laying of HDPE membrane on the slab and beam footprint. Formwork will be added to the sides of the beams, and following that, the arrangement of the required reinforcing steel. Concrete will be poured for the ground beams, followed by the slabs. Concrete mixing will be done on site.

24.3.7 Construction of Leachate Tank

The leachate collection tank is located at the end of the compost slab. The leachate tank has an area of 1.1 m by 1.5 m and a depth of 1.09 m extending below ground. The valve junction of the leachate tank has a size of 0.8 m by 0.55m, and has a depth of 0.63 m. 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.

24.3.8 Construction of Perimeter Fence

The whole length of the perimeter will 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 2.8m from ground level. The mesh is held together by 50 mm diameter GI pipes vertically 2 m centre to centre which are welded to three evenly spaced 38 mm GI pipes horizontally. The strip foundation below the masonry wall has a depth of 0.3 m with a 50 mm thick lean concrete placed below. Each vertical GI pipe is fixed to a 300 × 300 mm concrete footing with a depth of 0.6 m. The GI pipe is welded into a 200 × 200 mm plate. Therefore, the excavations done for the masonry wall strip foundation and GI pipe footing will be at 0.35 m and 0.6 m respectively. The trenches required to receive the strip foundation and footings will be excavated manually.

24.3.9 Construction of Well

A well is proposed to be constructed at the eastern corner of the IWMC. This well is 900 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.

24.3.10 Construction of Superstructure

The superstructure of the IWMC consists of the sorting area, storage area and the equipment room. The structure consists of a 3 m high wall separating the compartments. The roofing is supported by GI Pipes of diameter 38 mm and 75 mm. The roofing is made of LYSAGHT roofing sheets.

24.3.11 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 in vacant houses.

24.3.12 Waste Management

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 disposed in closed containers. The waste shall be well secured to avoid any scattering due to strong winds.

Municipal waste produced by the workers are estimated at an average of 0.45 kg/capita/day which translates to 346.5 kg of waste for the duration of 11 weeks for the whole workforce.

After the construction works are done, the collected waste shall be transported to the waste management facility in Thilafushi.

24.3.13 Pollution and Control Measures

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

a) Machinery to be properly tuned and maintained to reduce emissions/spills/leaks;
b) Fuel storage, paint, lubricants will be stored securely and bunded; and
c) Spill kits would be made available on site to control any liquid spills.

24.3.14 Health and Safety Measures

The proposed project involves transportation as well as construction of the IWMC at the site. These works will include use of vehicles, machinery, and heavy materials, and the workers may be put in situations where there is a risk of injury. These risks need to be identified and managed through the implementation of health and safety guidelines for the site. Health and safety measures for the construction phase include and are not limited to:

a) The contractor would be briefed regarding the laws and regulations that need to be followed regarding the proposed works and would ensure that Health and Safety procedures are complied with at all times;
b) There would be a construction supervisor at the site;
c) Only experienced and licensed operators will be allowed to operate heavy machines;
d) First aid kit should be made available at the work site;
e) The work force would be equipped with all safety gears and warning signs would be provided;

f) Fire extinguishing equipment would be available at the site;
g) PPE should be provided to all workers and the use of PPE enforced;
h) Operation of any heavy machinery will need the assistance of a banksman as all times;
i) All heavy lifts must be supervised and slings inspected; and
j) All other similar environment personal safety and quality control measure to be in place and checked by a qualified personal and approved and maintained at all times.

24.3.15 Demobilization

The demobilization plan will commence in the last week of the contract.

24.4 OPERATIONAL PHASE

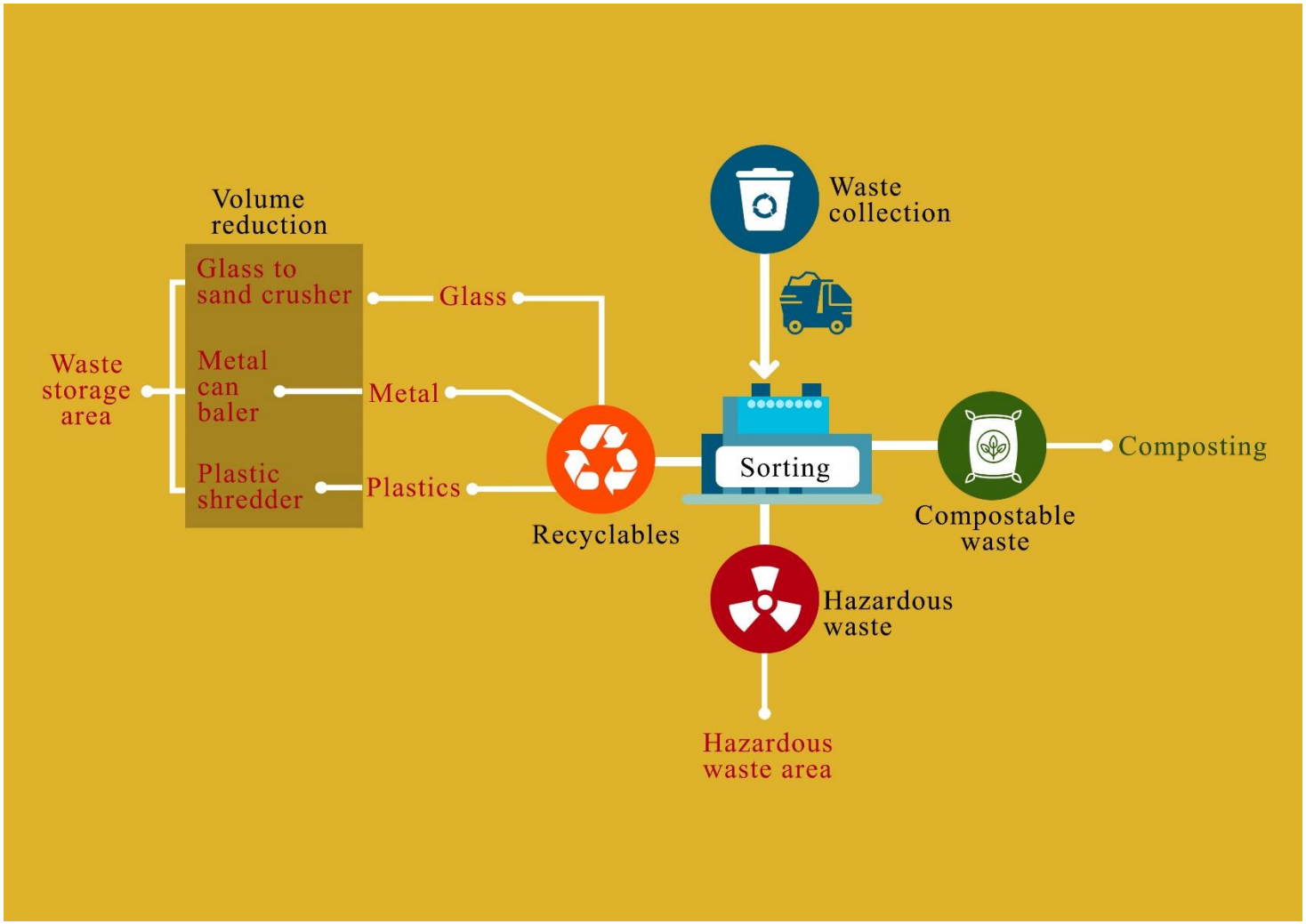

Figure 69: Operational phase flowchart of the IWMC of HDh. Finey

The following section will highlight the operational aspects of the IWMC. This includes the machinery and equipment proposed to be used in the IWMC, in addition to the main activities to be carried out at the IWMC and within the island. The activities begin from the sources of waste, which is then transported to the IWMC. This collected waste is 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.

24.4.1 Machinery and equipment proposed

During the operational phase of the IWMC, in addition to the collection of the waste and sorting, different activities such as composting, and waste volume reduction will be done. The proposed equipment for the IWMC include general equipment needed to handle the waste such as wheelbarrows, garden hoes, shovels, buckets and cultivators. These equipment will be used during the IWMC operation for handling as well as composting operations. A manual rotary compost screen is also included for the screening stage of the composting process.

Other equipment include waste volume reduction equipment such as a plastic shredder, metal can baler, vegetation shredder, and glass to sand crusher. The equipment and their specifications are detailed below.

Table 78: Equipment proposed for waste management works

Equipment	Details
Chainsaw	
Wheelbarrow	HDPE 6 cub. Ft.
Heavy Duty Gumboots	PVC or rubber
Heavy Duty Hand Safety Gloves	Rubber or Latex
Long Handled Flathead Steel Rake	Steel, 54 inches length
Long Handled Cultivator	Steel, 54 inches length
Garden Hoe	Steel, 57 inches length
19” Round Point Shovel	Steel
48” Square Point Shovel	Steel
19” D-Handle Square Point Shovel	Steel
20L Bucket	HDPE
40L Bucket	HDPE
Polypropylene Surgical Mask Box (50pcs)	Polypropylene
Weighing Bench Scale	50-75 kg capacity
Wheelie Bins	HDPE
Glass to Sand Crusher	0.5 to 1.0 tonne/ hr, output 0.5mm and less, 2-5HP motor
Plastic Shredder	30-100Kg/hr Output material less than 10mm
Metal Can Baler	3 to 5 HP, 2m2 or more inside volume
Vegetation Shredder	Petrol / diesel driven multi vegetation shredder / chipper
Manual Rotary Compost Screen	1m to 1.5m drum

24.4.2 Waste Collection

Through the consultation meeting with the Island Council, it was learned that the Council expects to award the IWMC management works to a contractor, who will be using a vehicle to collect the domestic, institutional and other wastes twice a day. Due to the lack of a WMP, the finer details have not been decided on yet.

24.4.3 Sorting

As per the IWMC site layout plan, a ground slab is dedicated for the sorting area. This sorting area is located next to the compost slab. Here, the collected waste will be kept, and sorted into their respective categories. In addition to this, a dedicated sorting area is also provided alongside the storage areas. The IWMC is designed to have separate storage areas for metal, paper and cardboard, plastic, glass, and hazardous waste. After sorting, the waste is stored in the respective location.

24.4.4 Composting

The IWMC is designed in order to facilitate the storing, sorting and reusing of the waste generated in the island. One of the main operations that will be conducted in the IWMC is the composting of the organic waste such as kitchen waste and garden 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 main constituents of a compost heap include kitchen and garden waste, along with water and air in the pore spaces between the constituent.

24.4.4.1 The Composting Process

After the incoming waste is 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.

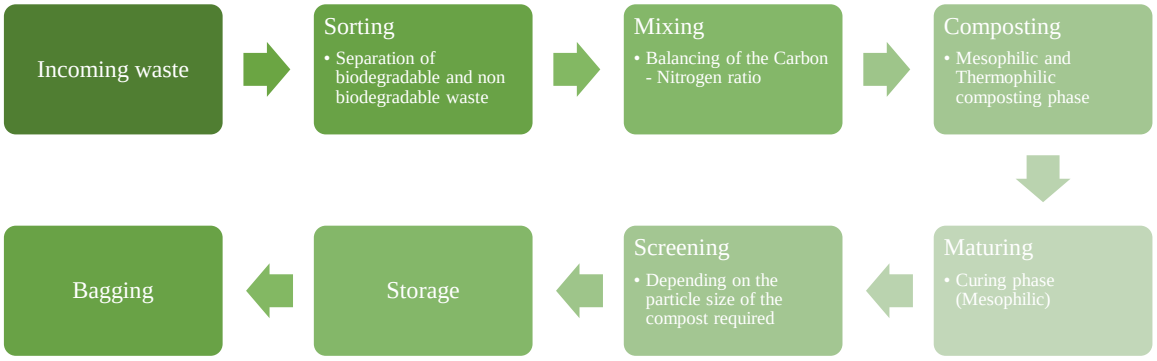

Figure 70: The composting process

24.4.4.2 Sorting of Incoming Waste

Incoming waste is required to be sorted to separate biodegradable and non-biodegradable waste. Even though the waste may be separated at household level, further sorting of the biodegradable materials are done in order to separate garden waste, food waste and others such as scrap paper and cardboard. Hazardous waste and residues are kept in their respective compartments, as well as recyclables.

Table 79: Domestic Waste Categories

Incoming Domestic Waste			
Suitable for composting	**Not suitable for composting**		
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
Composting Process	**Storage**		

24.4.4.3 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.

Looking into the composition of compostable wastes from the Zone 1 Waste Audit, it is seen that the majority of compostable wastes constitute of garden (green) wastes. Garden wastes make up 64% of waste generated, while the second largest contributor to compostable wastes is kitchen wastes, at 28%. Printed paper and cardboard make up 5% of compostable waste while 2% of the category includes animal waste. This composition is important in determining the Carbon-Nitrogen ratio of the compost heap in order to provide optimum conditions for composting.

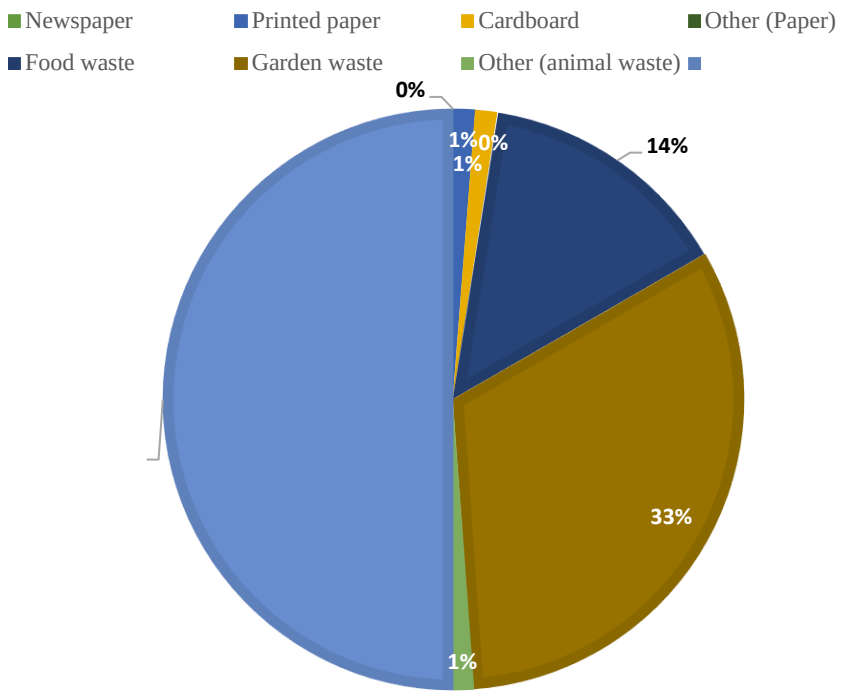

Figure 71: Composition of compostable waste for Zone 1

Table 80: Estimated compostable waste generation quantities of Zone 1

CATEGORY		Average Per Capita (kg/day)	Percentage
Primary	**Secondary**		
Paper & Cardboard	Newspaper	0.00	0.0%
	Printed paper	0.02	2.4%
	Liquid container	0.00	0.5%
	Cardboard	0.02	2.4%
	Other (Paper)	0.002	0.2%
Organics	Food waste	0.29	28.2%
	Garden waste	0.67	64.2%
	Other (animal waste)	0.02	2.2%
Total		1.04	100

Green wastes such as vegetable wastes (kitchen waste), and poultry manure have high Nitrogen values while brown wastes such as foliage, wood chips, bark and paper have high carbon values. From the waste audit, it is seen that 64.2% of the compostable waste produced is garden waste while 28.2% of the waste generated is food waste. Therefore, it can be said that the composition of compostable waste in the islands in Zone 1 is in favour of providing a high Carbon content compared to Nitrogen.

24.4.4.4 Composting and Maturing

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

Table 81: 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, the composting process can prolong to several months.

24.4.4.5 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. This slab is 15m long by 5m wide. 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 100mm 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 compost slab.

24.4.5 Volume Reduction

The incoming waste is sorted, and either used for composting, or stored in their respective compartments. 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.

24.4.6 Projected Capacity of the IWMC

The proposed IWMC is planned to manage a portion of the waste produced at the island level, with the unmanaged waste (approximately 70 – 75% of waste generated within the island to be transported to a central waste management facility). The projected capacity for 1 month's waste for the island of Finey is shown below.

Table 82: Projected waste management capacity for the waste generated for households in HDh. Finey in 1 month

Waste Type	Details	Amount	Unit
Organics	Composting capacity in IWMC. Assuming 1m height windrow with a width of 2m	39	m3
	Organic waste generated per month	24.61	m3
Paper waste	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	1.684	m3
Glass	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.484	m3
Plastics	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	2.181	m3
Metals	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.443	m3

As seen in **Table 82** the IWMC has the capacity to compost the organic waste generated in one and a half months for the island. Organic wastes make up the bulk of the waste stream in the islands, taking 72% of the total waste generated in the island. The composting capacity of the proposed compost slabs (assuming a windrow of 1 m height and 2 m width at the bottom and 1m width on top) is approximated as 39 m^3. The calculated volume for the domestic organic waste generated in a month in Finey is 24.61 m^3. Although this is the case, possible incoming green waste from farming activities need to factored in, which can result in approximately 1 month's organic wastes produced in Finey taking up the composting capacity of the IWMC for the succeeding 4 – 6 months. There is no additional storage space for the organic wastes provided in the facility.

Hazardous waste generated within the island, can be stored but cannot be managed, and regular transport is recommended

24.5 PROJECT INPUTS AND OUTPUTS

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

Table 83: 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	29.66 m3	Local Suppliers
		Reinforcement		
		Reinforcement T10	1.231 tons	Local Suppliers
		Reinforcement R6	0.19 tons	Local Suppliers
		Reinforcement T12	0.09 tons	Local Suppliers
		Formwork	135.66 m2	Local Suppliers
		Masonry Works (200mm bricks)	205.8 m	Local Suppliers
		Structural Steel		
		50mm and 38mm GI Pipe for perimeter fence	77.4 m	Imported / purchased where available locally
		75mm GI pipe (flood light fixing poles and roof fixing)	18 Nos.	
		38mm GI bearer pipes	46.2 m	
		38mm GI purlin pipes	95 m	
		38mm GI pipes between columns	35.2 m	
		75mm GI pipe to support machine room door	3.5 m	
		Paint		

		Primer and 2 paint coats (Grey Color)	345.96 m2	Local suppliers
		Electrical Components		
		3 Phase power sockets	4 Nos.	Local suppliers
		Single phase power sockets	3 Nos.	
		100 mm ceiling mount lights	1 Nos.	
		Wall mount exhaust fan	2 Nos.	
		500W flood light	2 Nos.	
		25 mm2 4 core power supply cable	290 m	
		Well water pump	1 Nos.	
		Metal doors for		
		Equipment room	1 Nos.	Local suppliers
		Hazardous waste area	1 Nos.	
		Waste yard entrance	1 Nos.	
		Plumbing		
		25mm PVC intake pipe		Local suppliers
		1/2 inch PVC pipe from pump to all distribution points	40.9m	
		Roofing		
		Storage area roof sheets	85.5 m2	Local suppliers
		Flashing sheets	28 m	
		Lysaght gutter	19 m	
		50x50 PVC coated mesh fence	77.4 m2	Local suppliers
		HDPE membrane	209.54 m2	Imported / purchased where available locally
		Timber top cover	1 nos.	Local suppliers
		PVC pipe for leachate tank drain	15 m	Local suppliers
		600 x 900 5mm plastic sheet signboard	1 Nos.	Local suppliers
Operation	Equipment and Materials	Chainsaw	1	Imported / purchased where available locally
		Wheelbarrow	4	
		Heavy Duty Gumboots	5	

		Heavy Duty Hand Safety Gloves	5	
		Long Handled Flathead Steel Rake	3	
		Long Handled Cultivator	3	
		Garden Hoe	3	
		19” Round Point Shovel	3	
		48” Square Point Shovel	3	
		19” D-Handle Square Point Shovel	2	
		20L Bucket	3	
		40L Bucket	2	
		Polypropylene Surgical Mask Box (50pcs)	5	
		Weighing Bench Scale	1	
		Wheelie Bins	40	
		Glass to Sand Crusher	1	
		Plastic Shredder	1	
		Metal Can Baler	1	
		Vegetation Shredder	1	
		Manual Rotary Compost Screen	1	
	Waste	Waste generated within the island	Approximately 738.33 kg of domestic waste per day	Waste collected by vehicle from the waste bins within the island
	Fuel	Diesel		Local suppliers

Table 84: Project outputs

Stage	Output	Source / Type	Amount	Means of managing
Construction	Soil	Excavation for substructure	11.78 m3	To be used back in the levelling and backfilling of site.
			209.54 m2	
	Waste	Construction and clearing of vegetation		Collected in the temporary waste area and transported to Thilafushi after completion of the project
	Hazardous waste	Construction and clearing of vegetation		Collected as per hazardous waste management guidelines and transported to Thilafushi after completion of the project

	Municipal waste	Workers	346.5 kg	
	Dust	Excavation	Moderate amount of dust	
		Cement mixing	Moderate amount of dust	
	Green House Gases	Machinery		
		Concreting works	100.1kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
		Reinforcement	5311.1kg of CO2 indirect emissions (Ma et.al, 2016)	
		PVC Pipes	164.81kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
Operation	Compost	Open windrow composting	15.60 m^3 compost per cycle	Sold as fertilizer
	Crushed Glass	Glass crusher	0.31 ton/month	Crushed glass stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Compacted Metal	Metal baler	0.29 ton/month	Compacted metal stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Shredded plastic	Plastic shredder	1.42 ton/month	Shredded plastic stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	GHG	Electricity usage		N/A

25 EXISTING CONDITIONS

25.1 DESCRIPTION OF THE ENVIRONMENT

Finey, which has a total land area of 118 ha, has a population of 568 as of 2017, per the Island Council. A wetland of 0.5 ha is located in the south eastern region of the island. Finey lies to the southwest of Hodaidhoo and northeast of Hirimaradhoo. The island is geographically situated centrally in the atoll, with NW-SE orientation. The island is observed to be densely vegetated, especially in the southern region. The residential area is concentrated to the eastern side of the island, with a relatively small population compared to the land size. The land in the northern region is utilised for farming activities with various crops grown. The island consists of typical Maldivian flora and fauna.

The island currently has no central sewerage system. There is widespread use of septic tanks within the island, which can lead to the seepage of liquid waste into the groundwater lens, resulting in pollution. The Island Council states that there are certain areas of the island with significant smell, especially where the water table is shallow. Salinity is not experienced in the residential areas.

Figure 72: Terrestrial vegetation of HDh. Finey. D: Wetlands of Finey

Figure 73: Changes to the coastal region of Finey from 2006 to 2016

The coastline of Finey is surrounded by beach of varying width from toe of the beach to the vegetation line. A stable broad beach was observed on the north – north eastern side of Finey. The beach on the southwestern side was thinly spread.

Figure 74: Coastal areas of Finey. A & B show a stable beach on the northeastern side. C shows exposed beachrock outcrop at the south-southwestern side. D is the harbor on the eastern side.

The beachrock outcrop was exposed on the south-southwestern coast of the island, which was connected to the existing beach. Coastal modifications include a harbor built on the eastern coast of the island.

25.2 PROJECT SITE

The project site is located in the south western region of Finey, next to the current waste dump. The area was cleared recently to be used as a waste dump, and part of the area contains some waste which needs to be cleared.

The site can be accessed by the main road which covers the length of the island, from the north towards the southern tip of island. The site allocated has an area of 25 m by 25 m. The site location has been chosen in order to reduce the impact of odour due to monsoonal winds and proximity to residential locations. The project site is at a considerable distance from the residential areas. Areas close to the project site include land leased for farming purposes, which is present on the opposite side of the main road. The closest freshwater well is used for farming purposes. The closest coastal area to the site is the southwestern coast of the island.

Figure 75: Site area with few shrubs and unpaved access road (C)

25.2.1 Site zoning recommendations by EPA

The EPA has provided recommendations for the optimum zoning of the IWMC site. The distances include, the site being at least 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 and at least 30 m from the wetlands and 60 m from the residential 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 85: Comparison between the proposed site location and EPA recommended distances

Location	Distance from site (m)	EPA Recommended Distance (m)
Coastal vegetation	91	30
Freshwater well (farming)	96	30
Recreational area	311	40
Wetlands	289	30
Residential area	323.5	60

As seen on **Table 85**, the site fulfils the EPA recommended buffers for all criteria, exceeding the distances stated in the zoning form. The proper siting of the IWMC can greatly reduce the magnitude of the impacts during both the construction and operational phase.

25.3 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were held for the project with the proponent MEE, enforcing agency EPA and the Island Councils of the respective islands. Meetings with MEE and EPA were held both before and after the survey trips in light of findings regarding some project islands. The initial meetings were mainly regarding the EIA project islands and scoping, although, due to the similar scope of works (except vegetation removal in the EMP islands' cases) the meetings included discussion of the project as a whole. Highlights of the meetings which apply to the EMP islands are presented below. Meeting attendance is provided in **Annex 3.**

25.3.1 Meeting with Proponent

- The proponent was consulted at the start of the assignment to discuss project scope and after field surveys to discuss findings of the initial field surveys.
- Proponent informed that MEE will be responsible for the construction of IWMC, while land clearance shall be undertaken by the respective Island Councils.

25.3.2 Meeting with EPA

- It was highlighted that waste management will not involve burning waste at the island level. Waste from islands will be transferred to the regional waste management center. Only organic waste will be managed at the island level to make compost. All necessary equipment required to manage waste at in the IWMC will be provided as part of the project.
- EPA informed that buffer distances recommended by EPA in the zoning form shall be kept in order to mitigate impacts.

25.3.3 Meeting with Island Council

- The Island Council stated that a dumpsite is present in the island, which overlaps part of the area allocated for the IWMC.
- Sorting of waste was also done in the aforementioned dumpsite in 2016, to some extent. The activity was not successful due to the lack of capacity and machinery to reduce waste volume. The current method of reduction is burning of organic wastes.
- All types of waste except kitchen waste is disposed of in this dumpsite. Kitchen waste is thrown on the beach areas.
- The Council has awarded a party a 1 year contract to clean public spaces.
- Clinical waste is burnt in the health center
- The Council stated that a waste management plan was not formulated at the time of the visit.

26 ASSESSING THE LIKELY IMPACTS AND MITIGATION MEASURES

26.1 METHODOLOGY, NATURE AND IDENTIFICATION OF IMPACTS

Various impacts arising from the project such as direct, indirect and cumulative impacts have been identified. The methodology was based on:

a) Scoping meeting with stakeholders;
b) Observations made during the visit of the project island and site
c) Literature review of similar local and other EMPs; and
d) Findings from other similar projects in Maldives and experience of the Consultant.

Impacts on the environment were identified based on their location/attribute, magnitude and duration of the impact. Impacts were assessed based on their significance and categorized as negligible, minor moderate and adverse. A Leopold Matrix was used for this purpose, for both the construction and operation phase.

The Leopold Matrix was developed by Leopold et al. (1971). It is a quantified Matrix which consists of 100 project actions and 88 environmental characteristics, elements and conditions. Relevant environmental characteristics and project actions were used for the impact identification. First of all, all of the relevant activities of the project that may have an impact on the environment was identified and written on the top of the matrix. These were divided for both the implementation and operational phase of the project. The environmental characteristics that may be affected by the project is written at the left side of the matrix.

A slash is placed at the intersection with each item on the side of the matrix if an impact is possible. The upper left corner of each box where an impact is possible, a number from 1 to 10 is written as the *magnitude* of the possible impact. The number 1 represents the least possible impact and the number 10 represents the highest magnitude of the possible impact. No 0's are used in the Leopold Matrix. A + sign is placed before the number if the possible impact is a positive impact. No sign is placed before possible negative impacts. In the bottom right corner of the box, a number from 1 to 10 is written as the *importance* of the possible impact. 1 being the least important and 10 being of the greatest importance. In giving scores, the magnitude and importance of the activities were judged for their short term and long term impacts. The impacts with greater long term impacts were given higher scores compared to the impacts with more short term impacts.

26.2 POTENTIAL IMPACTS AND MITIGATION MEASURE FOR KEY IMPACTS

For every minor to moderate to major impact identified, a mitigation measure has been proposed and discussed below. The mitigation measures proposed would be strictly adhered to eliminate environmental impacts arising from the project, even before it occurs. The impacts and mitigation measures are detailed in the two stages, construction and operational stages as explained below.
The possible mitigation measures include:

a) Changes in work practices and increasing awareness;
b) Provision of environmental protection and health safety equipment; and
c) Environmental monitoring during construction phase and operational.

Mitigation measures suggested in the report will focus on the existing environmental conditions as well as impacts that may rise during operation of the IWMC.

Table 86: Impact Matrix for Construction Phase

	Envisaged impact factors	C1 Worker Influx and Settlement	C2 Transportation of materials	C3 Site Demarcation & Fencing	C4 Site Clearance and Earthworks	C5 Construction	C6 Waste Generation	C7 Resource Consumption (Water, Electricity)	Total (Impact Area)
Physical Components	Seawater	-2					-3		-5
		1					4		5
	Ground water	-3			-2	-3	-3	-5	-16
		1			3	4	3	5	16
	Air	-3	-3	-2	-3	-3	-2	-3	-19
		2	3	2	4	3	4	3	21
	Noise	-2		-1	-2	-2	-2		-9
		1		2	3	4	2		12
	Coastal Zone							-1	-1
								1	1
Biological Components	Flora	-2	-1		-2	-1	-1	-3	-10
		2	3		4	2	5	2	18
	Endangered species/protected areas		-2		-1				-3
			2		5				7
	Coral Reef						-1		-1
							1		1
	Fauna		-2		-2	-2	-1		-8
			2		4	3	3		12
Socio-Cultural Component	Aesthetics	-2	-3		-2	-5			-12
		2	3		3	5			13
	Accidents	-1	-7	-2	-1	-3	-2	-1	-17
		1	5	1	2	4	2	1	16
	Landscape				-1	-3			-4
					2	4			6
	Health/Well being	-1	-5	-1	-4	-3	-3		-17
		1	5	2	3	3	4		18
	Local economy	4	4	1	6	7		-2	20
		1	4	2	6	5		2	20
Total (Construction Activity/Risk)		-12	-19	-5	-14	-18	-18	-15	
		12	27	9	39	37	28	14	

26.2.1 Impacts and Mitigation from Construction Phase

26.2.1.1 C1 Worker Influx and Settlement

An estimated 10 workers will be required for this project. The influx of workers can have a negative impact to the environment such as damage to vegetation, sensitive areas, and fauna of the island. This can be both intentional and unintentional.

Worker related impacts can include the requirement of building a temporary worker's camp, which can then lead to the set up of temporary waste, sanitation and water systems for the workers. For the duration of the project, the workers related waste output is detailed in **Section 24.3.12**. For this project, this impact can be reduced through the following mitigation measures. The project island currently has vacant properties as well as rooms to let in other houses, which can easily house the influx of 10 workers. Therefore no new facilities will be made for the accommodation of the workers. Other impacts include the increased use of resources by the workers in the island. This can be mitigated by choosing local workers operating on the island.

In addition to this, when a new group of foreign workers arrive on the island conflicts can arise with the resident population in the instances where local culture is overlooked or not respected.

<u>Mitigation for impacts on flora and fauna</u>

- The contractor is required to keep the workforce as a minimum as possible, and to not bring in any surplus workers for the project;
- House rules shall be formulated by the contractor and workers shall be oriented on the rules and conduct during the project works;
- Workers shall be given instructions on the sensitive and protected areas of the island;
- 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.

<u>Mitigation for impacts on resource use</u>

- Encourage choosing of local workers to reduce increased demand of resources; and
- Onsite generator for meeting electrical needs for the construction works

<u>Mitigation for sociocultural impacts</u>

- Hire local workers where possible;
- Orient foreign workers on communication, personal hygiene and sanitation in addition to the prevention of STDs and other infectious diseases; and
- Ensure all foreign workers have their legal permits.

26.2.1.2 C2 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 . Reduction of the transportation distance from the source to the project island is proposed. As the resource sourcing hierarchy in **Figure 76** shows, the greatest importance shall be placed on sourcing any available materials from within the island, with the next option being from within the north region, from islands such as HDh. Kulhudhuffushi. Site visits to the Zone 1 islands show possible sources for sand in islands (such as HDh. Hirimaradhoo, where a pile of excavated sand is present which can be procured for use in concreting works). 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.

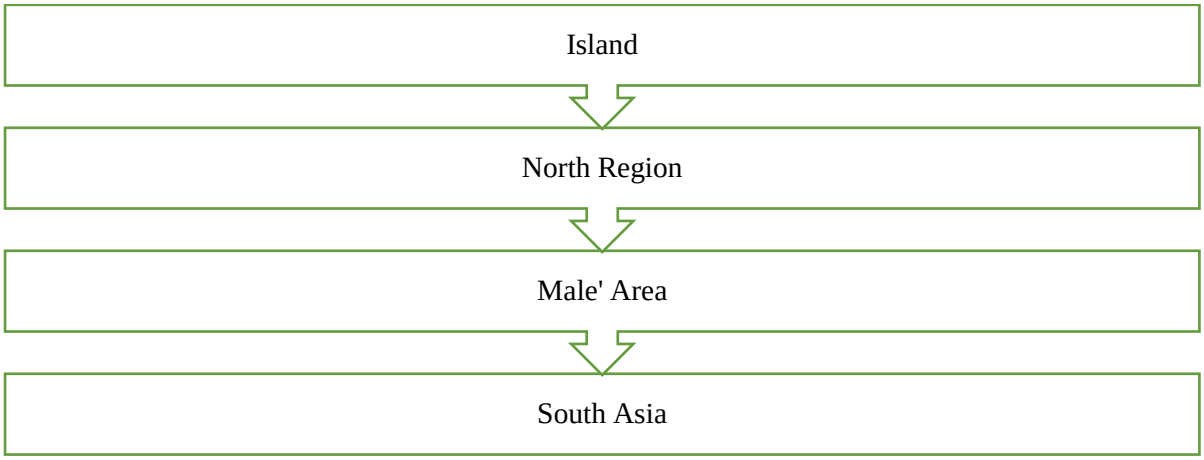

Figure 76: Material sourcing hierarchy proposed for the project

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 **Section 24.5** 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. Therefore for this project, an estimated 100.1 kg of CO2 emissions are expected for the concrete casted. 3136 kg of indirect CO2 emissions (Defra / DECC, 2012) occur per tonne of PVC pipe produced. For this project, the amount of indirect CO2 emissions are estimated at 164.8 kg. The greatest indirect CO2 emissions are estimated from the usage of reinforcing steel. 1.5 tonnes of reinforcing steel are estimated to be used for this project, which can cause a release of indirect CO2 emissions of 5311 kg (Ma et al, 2016). 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 77: Impact on roads from heavy vehicle transport in an island in Maldives

For the purpose of this project, no heavy vehicles are proposed for either construction or earthworks. Although this is the case, a pickup truck will be used to transport the construction materials to 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.

Mitigation for climate impacts

- Sourcing of materials shall be done according to the hierarchy presented in **Figure 76**. 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;

- The contractor shall use serviced vehicles and plant equipment for the project;
- The contractor shall only use the needed amount of vehicles and plant for project; and
- The 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. Oversized heavy vehicles are not required for this project, therefore such vehicles shall not be used in the island for transportation and construction purposes;
- 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

- The vehicle drivers shall be licensed and competent;
- The loads being transferred shall be fully secured; and
- The transportation shall be done during day time.

Mitigation for marine and terrestrial pollution

- The contractor shall clean any littering on the terrestrial or marine environment caused during transportation;
- The contractor shall enforce strict policy against littering and appropriate penalties; and
- Spill kits shall be made available in cases of spillage of hazardous wastes, and hazardous waste storage shall be provided.

26.2.1.3 C3 Site Demarcation & Fencing

Site demarcation and preparation involves, land surveying of the area and setting out the limits of the project plot, and identifying trees that needs to be removed or relocated. This activity is considered to have minor environmental impacts as it is largely noninvasive.
However, improper or inaccurate demarcation and labelling could result in removal of untargeted trees which could result in having to remove more number of trees than that are required.

Mitigation Measures

- 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;
- accurate and reliable equipment shall be used to minimize errors;
- wearing, clothes/helmets to protect against thorns and freefalling coconuts and wearing protective clothing;
- carrying out the works during the day time; and
- ensure mosquito repellants are available for the workers.

26.2.1.4 C4 Site Clearing and Earthworks

The proposed site has been cleared recently, and does not contain any mature vegetation on its footprint. Therefore no major site clearing works are required. Clearing would include grubbing of weeds and shrubs. The amount of excavation required for the earthworks is minimal, due to the structure having a shallow foundation. The excavated material are proposed to be used as backfilling and grading.

Mitigation Measures

- Site shall be demarcated and fenced off;
- Vegetation targeted for removal shall be marked prior to site clearing; and
- Excavated material used as backfilling and in grading of the site.

26.2.1.5 C5 Construction

Material Storage

This includes, storing all the vehicles, machineries, and tools required for the land clearance and IWMC construction. Due to the nature of the project, a lot of construction materials are not required. Apart from the vehicles and tools, fuel and water will be required for storage. Fuel will be stored on the cleared land in tanks that. Vehicles will be stored inside the fenced plot area. Tools and equipment will be stored in the tool shed within the fenced land plot. The project does not require land clearance or construction of extra building for material storage, hence the impacts arising from this activity is considered to be minimal. However, there is a risk of accidents, such as fires, oil spills and trespassing. These could be easily mitigated by implementing appropriate measures.

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 minor, due to the distance provided between the residential areas and the project site.

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 87: 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 59 dBA at 1000 ft,

which is the approximate distance from the centre of the IWMC to the nearest residential area as well as the recreational area. Therefore, the noise decays down to ambient levels, and even this is expected to further decrease taking into consideration the vegetation surrounding the proposed site, as well as the soil characteristics of the ground.

Noise during construction is determined to be a short term negative impact. Due to the distance of the project site and the surrounding vegetation, 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.

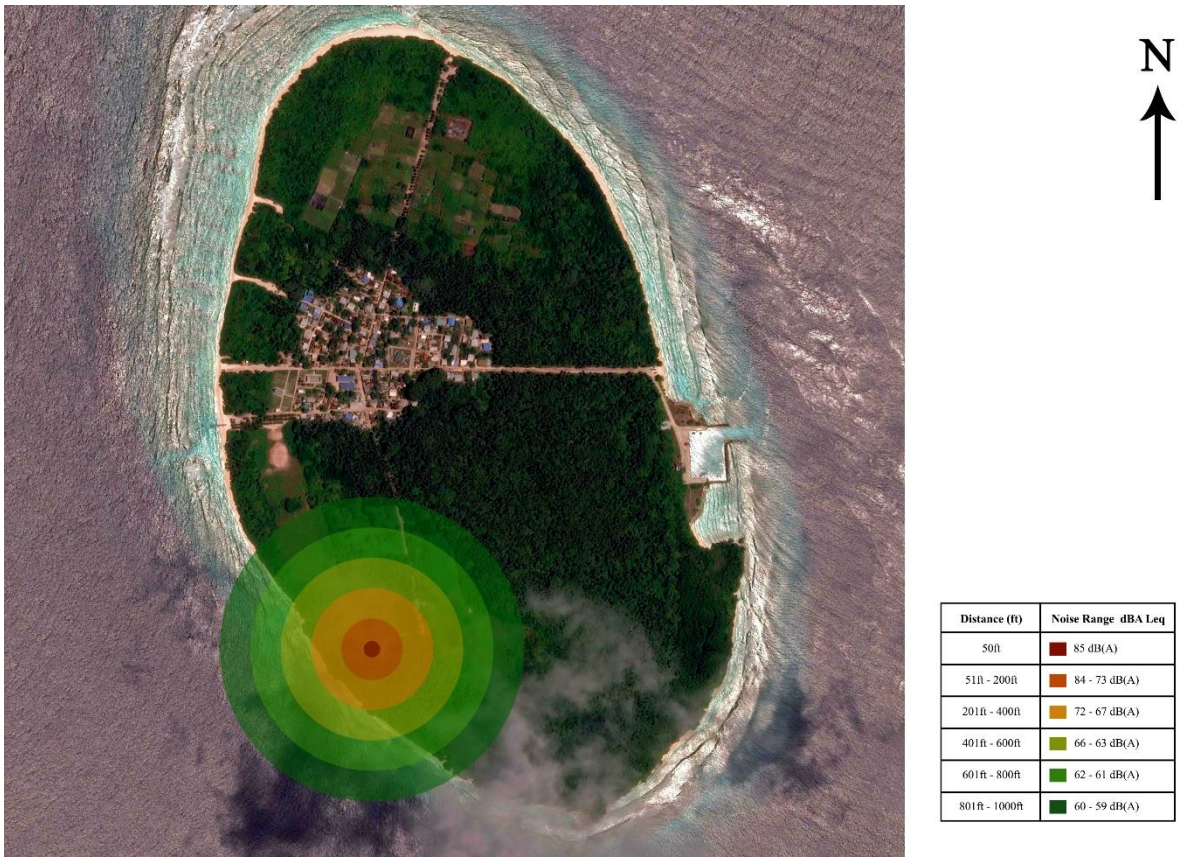

Figure 78: Noise range map for HDh. Finey

Impact on vegetation

The impact and measures on vegetation have been discussed in **Section 26.2.1.4**. No other structures, temporary, or permanent are proposed to be built for this project (such as workers' camp). Therefore the activities of this project is not expected to have a major impact on the vegetation of the island.

Accidents and injuries

Accidents and risks (hazards) are important elements that need to be properly assessed, identified and analysed for what could happen if a hazard or accident occurs during and post development of the project. There could be many risks (hazards) and accidents to consider associated with many possible scenarios that could unfold depending on time, magnitude and the location it occurs. Hazards during construction 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 trenches and seriously injuring themselves.
- Being struck by moving equipment and vehicles.

Mitigation for material storage impacts

- Equipment shall be stored in fenced areas and maintained appropriately during the cause 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 Liquid Petroleum Gas (LPG) bottles and cleaning solvents and chemicals will be closed off from public access. Fire extinguishers and instruction in case of fire will be located in all the public, industrial and staff accommodation areas;
- portable extinguishers placed to be readily available when someone finds a fire;
- closed off non-public storage areas will be provided for inflammable goods (fuel drums, portable fuel containers, LP gas bottles, cleaning solvents etc.) with NO SMOKING, NO NAKED LIGHTS, HIGHLY FLAMMABLE sign boards in both English and Dhivehi languages;
- 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.

Mitigation for terrestrial pollution

- Set up a temporary waste disposal area within the project site;
- Regularly collect litter and dispose at the temporary waste disposal area;
- Hazardous waste shall be placed in enclosed containers;
- Vehicle maintenance shall be carried out on paved areas; and
- After the construction works are completed, transfer all collected waste to Thilafushi

Mitigation for noise and vibration impacts

- Provide workers with noise cancelling headphones.
- Use quieted equipment where possible, such as mufflers on engines;
- Use of well serviced vehicles and plant; and
- Switching off equipment and vehicles when not in use.

Mitigation for impact on vegetation

- Setting out survey shall be done by the contractor and the site limits shall be demarcated prior to any construction or clearing works;
- Fence off the site in order to avoid the removal of any vegetation out of bounds of the project site; and
- Allocate temporary stockpile area within the site, which is free from vegetation

Mitigation for accidents and injuries

- The contractor shall be required to develop occupational safety management plan, and safety guidelines shall be displayed in the work site at all times;
- Occupational safety training should be given to all workers present on site;
- Workers should be provided Personal Protective Equipment and the use of PPE shall be enforced;
- Site visitors 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.

26.2.1.6 C6 Waste Generation

Solid waste generated during land clearance and IWMC construction work would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite. Waste burned onsite would generate smoke, possibly impacting negatively on ambient air quality and human health. On the other hand, if all site clearance waste is to be transported this would also result in requiring burning fossil fuels and would require significant finance. 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.
On site generator and vehicle 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 and solvents. 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 1.2 kg will be produced daily if approximately 10 workers were active which equates to discharge of approximately 1,700 l/day of waste water. Sewage will be managed through existing sewage systems that have been installed in the islands

Since there is no existing waste management system in the atoll or since the existing island level waste management dumpsites are not sufficient 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.

Mitigation Measures

- Ensure to manage waste as described in **Section 24.3.12** of the report;
- open defecation whether it's on land or on the beach shall be prohibited;
- waste other than sewage shall not be flushed down the toilet;
- ensure to reduce waste by following the 3R steps; and
- waste collected shall be transported to Thilafushi after the construction works have ended.

26.2.1.7 C7 Resource Use

During the construction phase, machineries and vehicles used will consume fuel. Notable impacts of this activity include, increased air pollution, risk of spillage, impacts to health/wellbeing and accidents. The primary pollutants generated due to power production from diesel based generator system include Nitrogen oxides (NO_X), Sulphur dioxide (SO_2), Carbon monoxide (CO), Hydrocarbons/ Polycyclic Aromatic Hydrocarbons (HC/PAH), Particles (PA) and Carbon dioxide (CO_2) in the form of emission although the exact amount is difficult to quantify.

The visible pollution generated by burning diesel contains elemental carbon as soot. The typical odour comes from polycyclic aromatic hydrocarbons, which also are cancer causing components.

Due to the scale of these activities, the machineries won't be used for long periods of time. This would significantly reduce the impact of electricity generation. IWMC construction stage as well as land clearance stage will not use heavy vehicles and equipment extensively.

Water used during construction will be sourced by the contractor from available groundwater wells. Water used for drinking and cooking will be purchased from local shops or collected from existing rainwater tanks or from the groundwater well in the island. Water and electricity consumption for the project is considered to be minor.

Mitigation

- Initiate rainwater collection and storage as early as possible into the project construction;
- turn off the tap while washing your hands;
- use salt water to wash dishes and only use rainwater to rinse them;
- water conservation devices shall be used;
- use well maintained, energy efficient equipment. The emission of carbon dioxide is directly related to the amount of fuel used. High efficiency is therefore important to reduce the amount of released carbon dioxide and consequently to reduce the global greenhouse effect;
- reduce idle time of machineries and vehicles. Switch them off after use;
- utilize day time hours for the construction when plenty of light is available; and
- FENAKA power supply will be used for electricity generating purposes.

Table 88: Impact identification matrix for operational phase

	Envisaged impact factors	O1 Waste collection and transportation	O2 Waste sorting, separating, storing and compost making	O3 Waste Generation	O4 Resource consumption (water/electricity)	Total (Impact Area)
Physical Components	Seawater	4				4
		4				4
	Ground water	5	-2	-1		0
		3	2	5		12
	Air	-3	-2	-2	-3	-13
		5	3	2	4	16
	Noise	-3	-1			-4
		4	2			6
	Coastal Zone					0
						0
Biological Components	Flora	6	7	-1	-3	4
		2	6	1	4	18
	Fauna	5	5	-1	-3	3
		5	5	1	4	19
Socio-Cultural Component	Aesthetics	6	8			9
		6	6			17
	Accidents	-4	-4		-4	-18
		4	4		5	19
	Landscape	5	6	-1		5
		6	5	2		18
	Health/Well being	5	-5	-2	-6	-10
		6	5	2	8	23
	Cultural heritage					0
						0
	Local economy	-3	8	-2	-1	5
		9	2	4	1	19
Total (operational Phase Activity/Risk)		23	20	-10	-20	
		54	40	17	26	

26.2.2 Impacts and Mitigation from Operational Phase

26.2.2.1 O1 Waste Collection and Transportation

HDh. Finey currently has a waste dumpsite. In 2016, it was attempted to separately stockpile types of wastes such as metals, plastics and nappies. Due to the lack of infrastructure, equipment and know-how, the initiative has not been very successful. Current practices also include burning of the biodegradable (green) waste at various locations of the island, which can lead to respiratory issues from the inhalation of smoke. The successful implementation of the IWMC and the Waste Management Plan will lead to the reduction of the littering of waste throughout the island, and there will be no burning of waste at IWMC. This will lead to the improved health and psychological well-being of the residents and visitors of Finey. It has been identified as a long term positive impact on the residents and visitors of Finey.

As planned by the Island Council, a vehicle will be used to collect and transport the waste within the island twice daily, at a set schedule. This is identified as a minor impact in terms of noise, due to the fact that no receptor will be exposed to the noise for long durations of time.

Waste Collection and Transportation is identified to have a positive impact on the island.

Measures to ensure and enhance the positive impacts

- The Island Council shall formulate a Waste Management Plan for the next five years (approved by EPA) prior to the operations of the IWMC begin;
- The Island Council shall formulate and gazette the Waste Management Regulation and Waste Management Guidelines for the island;
- The aforementioned regulation and guidelines shall state the penalties on persons that do not act according to the regulation and guidelines (i.e. littering, burning and dumping of wastes elsewhere), and Island Council shall enforce the penalties as prescribed;
- The proponent and Island Council shall follow the management plan provided with the EMP in order to monitor the operations of the IWMC, and bring about any necessary changes to the operations and policies, in addition to providing any needed technical assistance for the island;
- The proponent shall review the waste management operations within the islands regularly and update the National Waste Database;
- The operations shall be awarded to a contractor with the capacity to run the IWMC;
- The 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;
- Polluter pays principle established in order to reduce the waste generation within the island;
- The proponent shall provide resources in terms of budgetary allocations, required equipment, and technical expertise to ensure the operation of the IWMC; and
- The proponent shall assist in creating markets / avenues where the IWMC's can generate income through selling compost and recycled metals, plastics and glass.

Mitigation for terrestrial pollution

- Implement rules within the IWMC workers to impose penalties for any littering within the island due to improper handling of the waste and improper transport practices; and
- The status of the vehicle shall conform to the Waste Management Regulations 2013/R-58 and provide cover to the waste being transported in order to avoid littering.

Mitigation for accidents and injuries

- The vehicle should be driven by licensed drivers; and
- A strict schedule shall be stated in the WMP and followed in order to reduce the transportation frequency thus reducing the probability of accidents.

Mitigation for air quality impacts

- Spray the roads with water during the dry season to suppress dust;
- 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 Waste Management Plan;

26.2.2.2 O2 Waste Management Activities

Waste sorting, separating storing and composting make up the largest portion of the IWM concept. On top of reducing the volume of waste, these activities, convert waste to re-sable and value added products. These activities will be carried out in the IWMC where employees will be trained to undertake these 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. Hazardous chemicals that get into the soil (contaminants) can harm plants when they take up the contamination through their roots. If humans eat plants and animals that have been in contact with such polluted soils, there can be negative impact on their health.

All these impacts can be mitigated and prevented by the proposed IWM concept. However, if these activities are not properly implemented there is a risk of IWMC being deteriorated into a dump site where mixed waste are disposed, burned and buried. The risk is more prominent for islands where the population size is greater. This means without proper mitigation measures and regular transportation of waste out of the island to a central waste management centre, there is a greater risk of IWMC being overfilled. More so considering that IWMC is equipped to handle only about 20-30% of organic waste generated in the islands 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 IWMC 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 / m^3 close to the composting site and dropped to background levels within 550m 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 / m^3), 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 89: 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 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 IWMC are not as large scale as the studies cited above. The composting capacity of the IWMC is expected to be two windrows of approximately 39 m^3, each batch to take around 4 – 6 months to mature. 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 IWMC becoming a makeshift waste dumpsite for organics are also addressed in the section.

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. 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 odours.

The operation of the IWMC 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 IWMC), 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 IWMC 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 from composting

The main gas by product from the composting is CO2. In anaerobic conditions, methane is released into the atmosphere, which has a higher greenhouse warming potential compared to 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 dumped;

Amenity Impacts

The IWMC 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.

As the proposed site is close to the coastal area with little protection, wind can blow the materials off the compost heaps as well as the other stockpiled waste types out of the IWMC, which can degrade the local amenity. This impact is mitigated through the design of the IWMC perimeter walls which include a perimeter fence made of 50 × 50 PVC coated mesh.

Littering inside the IWMC can cause amenity issues such as tracking of litter on the wheels of the waste transport vehicles leaving the IWMC. 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 90: Odours generated from the composting process (Source: Goldstein, 2002)

Compound	Description of smell	Detection limit for a particular odour panel ($\mu g/m^3$)
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

The current practices waste management within the island will be replaced with the collection and disposal of the waste at the proposed IWMC site. This site is 300 m+ away from the nearest residential site, and is located in such a way that the monsoonal winds will not carry the odour towards the residential areas. Therefore the impact of odour on the residential areas are deemed minimal.

Fire hazards

There is a possibility of fire hazards at the IWMC 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 IWMC.

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 78** can be used for this purpose too. The map shows that the noise reduces to a maximum level of 59 dBA near the residential areas. This calculation does not take into account the dampening effects of the surrounding vegetation. Therefore, the long term negative impacts of noise would be borne by the employees of the IWMC, and the effects of noise to the residential areas are minimal

Workplace safety and accidents

The group of people most likely to be impacted by the IWMC 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 guidelines 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.

Mitigation for health impacts

- A distance of 300m+ is available between the IWMC and the nearest residential as well as the recreational area, which can act as a buffer zone. It is expected that airborne bioaerosols, if any, will have reduced to background levels at the distance;
- The siting of the IWMC is at the south western region of the island, while the residential zones are also located on the western side of the island. Due to this location, the residential areas are well shielded from both the particulate matter that can disperse with the winds of the south west monsoon and the winds of the north east monsoon;
- The IWMC operator shall plan material handling processes in downwind of the residential zones;
- Ponding shall be minimized at the site by grading of the ground;
- Handling of compost shall be minimized;
- Compost turning shall be done based on temperatures and not on schedules;
- Material movements and compost turning shall be done during low winds. Weekends, holidays and times of the day when most people are likely to be outside (and use of recreation / public spaces) shall be avoided when handling the materials and turning compost;
- Add moisture to the compost to minimize dust;
- Add a geofabric cover over the compost windrow to minimize release of bio aerosols;
- Workers shall follow the workplace safety mechanisms and guidelines set by the contractor and practice safety and personal hygiene when handling the compost.

Mitigation for 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.

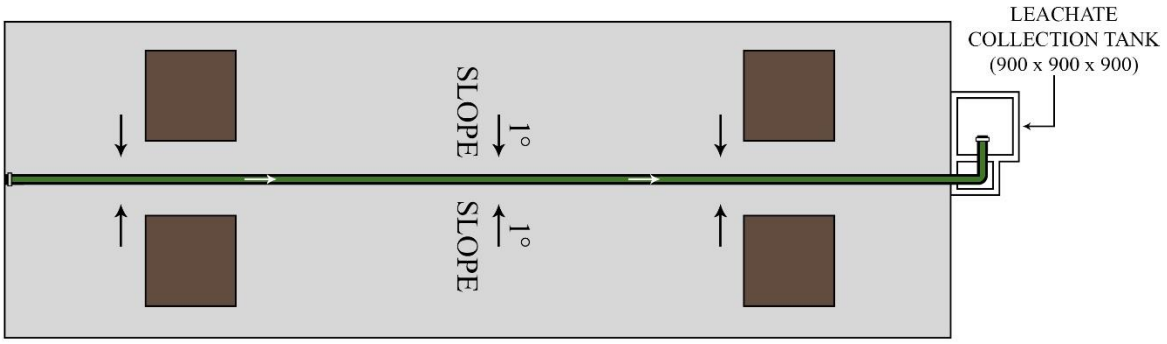

Figure 79: Compost slab design and leachate collection system (Plan view)

Mitigation for rainfall related leachate production

The current design of the IWMC consists of a composting slab is an open windrow composting system. The compost windrow is kept on the compost slab which is sloped in such a way that the leachate from the compost will collect at the pipe in the centre, which will propagate the leachate into the leachate collection tank **(See Figure 79**). While this scenario is ideal during fair weather, heavy rainfall and strong winds should also be considered. There is a possibility of heavy rainfall increasing the produced leachate, as well as the water collected over the composting slab propagating to the leachate collection tank. This can cause an overflow of the leachate collection tank, releasing its contents into the ground and subsequently the groundwater aquifer.

The rainfall can also cause the scattering of the compost materials, the increased water content in the compost windrow can cause another issue: the saturation of the windrow can decrease the available oxygen within the compost windrow, leading to anaerobic conditions.

- There is a valve placed at the inlet pipe which can be closed in instances where the leachate tank may overflow from heavy rainfall onto the compost slab;
- The 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;
- A 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.

Figure 80: Windrow cover being utilised in an open composting system (source: Midwestbiosystems.com)

Keeping stockpiles of raw organics low

Stockpiles of raw organics (waiting to be processed or transported) can cause impacts such as foul odour from the biodegrading organics, leachate reaching and contaminating groundwater, issue of vermin and pests, and visual impacts from the stockpiles.

As per the design of the IWMC, there are compartments for the storage of all major waste types other than organic wastes. A dedicated slab is provided for the composting of the organic waste materials. As per the calculations in **Section 24.4.6** it is seen that the composting slab has the capacity for composting approximately 1 month's organic waste produced in the island. As the composting process may take between 4 – 6 months (Halliburton, 2002), the remaining months' organic wastes can accumulate unmanaged and without any means of storage.

The consultant proposes the following mitigation measures:

- Arrangements to regularly transport the unmanaged waste to a central waste management facility; and
- In cases where the waste cannot be transported due to delays and unforeseen circumstances, it is not recommended to stockpile the unmanaged waste on the ground, without any cover. As per the area of the IWMC, there is a capacity to arrange up to 25 nos. 660 L wheelie bins to store unmanaged organic wastes. 25 nos. can provide for storage unmanaged organic waste. It is also recommended to separate the putrescible waste from the green waste while storing in the wheelie bins. While this mitigation is not the most ideal, it is seen as the option with the least impact, pertaining to the resources available to the islands and the difficulty in transportation. Alternative transfer arrangements shall be made within this duration.

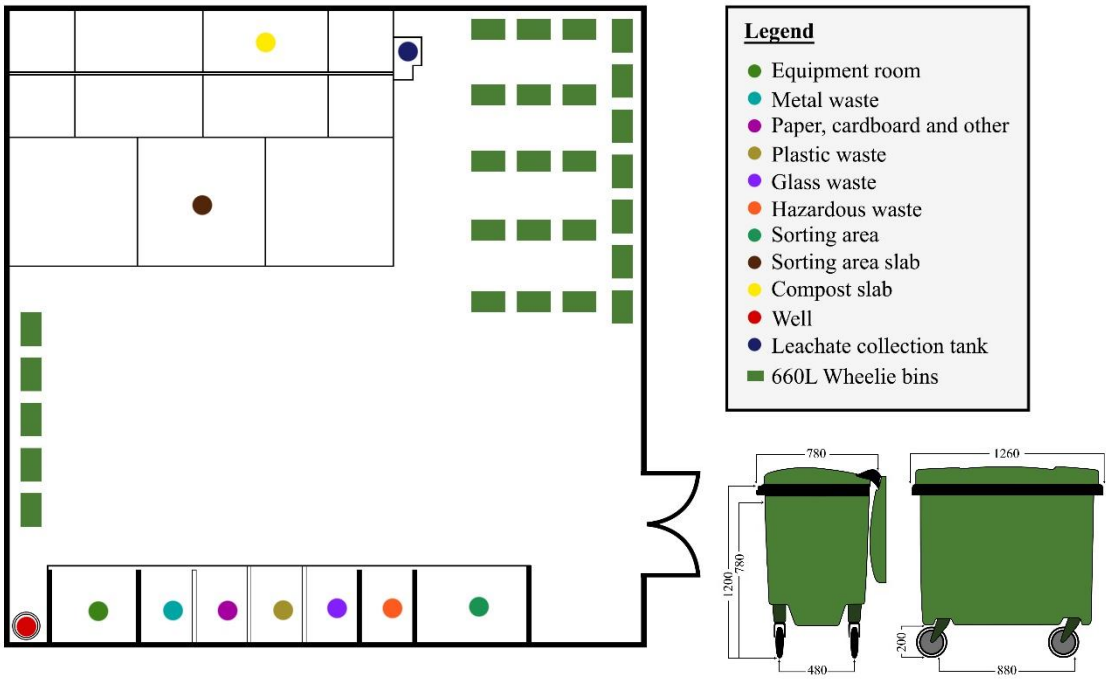

Figure 81: Proposed wheelie bin arrangement to provide for temporary storage of unmanaged organics

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. 660L wheelie 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 IWMC 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 IWMC, with the provision of a 2.8m high 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 IWMC. 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 IWMC.

Mitigation for odour 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 15cm 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.

Mitigation for fire hazards

- A fire management plan shall be developed by the IWMC occupier;
- Adequate firefighting equipment shall be provided at the IWMC, and placed at locations easy to access;
- The IWMC occupier shall be able to show that firefighting capacity of the IWMC is sufficient to suppress and minimize the incidence and impact of fires;
- Workers shall be trained to use the firefighting equipment and able to manage fire outbreaks; 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.

Mitigation for workplace accidents

- The IWMC 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 and instructions to employees on how to operate any machinery;
- Instruct employees on safe systems of work;
- 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.

Figure 82: Recommended protective clothing for waste management employees. Adapted From: Ministry of Health, Thailand. Bangkok, 1995. *noise cancelling headphones and safety glasses during use of machinery

Table 91: 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

26.2.2.3 O3 Waste Generation

Waste generated during the operational phase of the IWMC will be relatively low. These will include waste oil/batteries for waste management equipment. Since eating and cooking inside the IWMC will be prohibited, no mixed municipal waste will be generated during the operational phase of the project. Hence overall impact for this activity would have a minor negative impact on environmental receptors.

Mitigation Measures

- Closed containers shall be provided to manage hazardous wastes;
- Spill kits shall be provided to manage oil spills; and
- Prohibit eating/cooking in the IWMC.

26.2.2.4 O4 Resource Consumption

Water will mainly be required for washing equipment, work ware, hands etc. and to water the compost pile. Water required for moistening compost piles will be relatively small. As most of the moisture required for the compost pile will be sourced from the leachate collected from the leachate tank the volume of water required will be significantly less. It is estimated that approximately 200 -300 l/day of ground water will be required during the operational phase of the project. Since the volume of water required is relatively low, it is not expected to have a significant impact on groundwater.

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 empties, therefore resulting in lower transportation costs. Compactors and crushers 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 IWMC. Therefore. Electricity consumption of the IWMC 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.

<u>Mitigation Measures</u>

- 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.

Table 92: Impacts and proposed mitigation measures for the construction and operational phase of the project

No	Potential Risk/Impact	Receptor	Nature	Reversibility	Significance	Mitigation	Cost
	Description	**Description**	**Positive**	**Reversible**	**Major Negative**	**Description**	**USD**
					Major Positive		
			Negative		**Moderate**		
				Irreversible	**Minor**		
CONSTRUCTION PHASE (C)							
C1	Impacts from worker influx and settlement (flora and fauna, resource use and sociocultural impacts)	People of Finey, and terrestrial and marine environment	negative	Reversible	**Minor**	• See **section 26.2.1.1**	Included in the construction costs.
C2	Impacts from transportation of materials. (climate impacts, and impacts on roads)	Residents of Finey, terrestrial and marine environment, global environment	negative	Reversible	**Minor**	• See **section 26.2.1.2**	Included in the construction costs.
C3	Impacts from site demarcation and fencing (Impacts on flora and fauna)	Local flora and fauna	Negative	reversible	**Minor**	• See **section 026.2.1.3**	Included in the construction costs.
C4	Impacts from site clearing and earthworks (terrestrial pollution, vegetation removal)	Vegetation of the site and surrounding areas	Negative	Reversible	**Minor**	• See **section 26.2.1.4**	Included in the construction costs.
C5	Impacts from construction works (vegetation impacts, noise and vibration, accidents and injuries, pollution from material storage)	Workers and residents of Finey	Negative	Reversible	**Minor**	• See **section 026.2.1.5**	Included in the construction costs

C6	Terrestrial pollution from construction waste generation	Residents of Finey, ecosystem	Negative	Reversible	**Minor**	• See **section 26.2.1.6**	Included in the construction costs
C7	Impacts from resource use	Residents of Finey, ecosystem	Negative	Reversible	**Minor**	• See **section 26.2.1.7**	Included in the construction costs
OPERATIONAL PHASE							
O1	Waste collection and transportation (Climate impacts, air quality, amenity impacts)	Residents and visitors to Finey	Positive	Reversible	**Minor**	• See **section 26.2.2.1**	Cost borne by operations contractor
O2	Waste management activities (Public health, noise, groundwater, fire, accidents, odour impacts)	Mostly IWMC workers, residents and visitors to Finey,	Positive	Reversible	**Minor**	• See **section 26.2.2.2**	Cost borne by operations contractor
O3	Waste generation (terrestrial pollution, groundwater contamination)	Residents and visitors to Finey	Negative	Reversible	**Minor**	• 26.2.2.3	Cost borne by operations contractor
O4	Resource consumption (water and electricity)	Residents and visitors to Finey	Negative	Reversible		• See **section 26.2.2.4**	Cost borne by operations contractor

27 PROJECT OPTION

27.1 ADVANTAGES AND DISADVANTAGES OF PROJECT OPTION

The advantages and disadvantages of conducting the project option are proposed below:

Table 93: Advantages and disadvantages of project option

Option	Environmental	Social	Economic
Project Option	The project does not involve any clearing of trees except for a few weeds. The project site has been previously cleared It will generate a small amount waste and GHG. This would have minor negative impacts on the soil and environment of the island. However almost all the foreseeable impacts of the project can be mitigated and kept at an acceptable level and the project will not result in a loss of a sensitive or critical habitat or species. The project will provide the island ways to manage the waste which is currently stockpiled without no means of managing, in order to control and prevent further pollution of the environment, and facilitate utilisation of land area more effectively.	Increased direct and indirect employment opportunities for the locals as the IWMC 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 hence pollution of the island will be stopped or controlled. During the operational phase of the project, smell dust and smoke will be emitted from the IWMC. However, the project site is located at an acceptable distance from residential and public areas.	Enhanced opportunity for locals to start and diversify tourism related services, since a safe and clean island would facilitate and benefit any local tourism venture. Direct contribution to government revenue through taxes and duties. Creation of job opportunities and skilled labour in the region. Expansion of agriculture market in in the island. Agriculture is widely practiced in the island and therefore a huge demand is expected for the compost. Price and profit from agricultural produce will become more competitive due to availability of compost. Potential to attract foreign currency by selling compost, scrap metal and other recyclables which would develop the national economy. More settlers will be attracted to the island, which would promote the development of local public services and infrastructure.

28 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT PLAN

28.1 SCOPE

The chapter would present in detail the management measures put in place by the proponent and the contractor to mitigate the environmental impacts that would arise from the project activities. The assessment of impacts and mitigation measures that would be put in place had been discussed in detail in the previous chapter. The main scope or objectives of the environmental management plan are to:

a) Produce a framework for anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions during pre-construction, construction and operational phase; and
b) Provide evidence of conformity to laws and regulations and requirements of enforcement agencies.

28.2 ENVIRONMENTAL MANAGEMENT SYSTEM

The environmental management framework for the proposed project is based on the standards and policies set out by the Environmental Protection Agency of the Maldives under EIA Regulation 2012.

a) Environmental Management Planning and establishment of key performance indicators: The EMP specifies environmental management measures and required performance standards;
b) IWMC construction and operations: The aspects of the construction and operation will be established and operated according with the EMP;
c) Monitoring and corrective action: The implementation of EMP measures will be monitored during operational stage and will be reported. Any inconsistencies between the EMP and its on-site implementation will be identified and addressed through corrective actions; and
d) Auditing, reviews and enhancement: The EMP will be reviewed. Improvements to the EMP will be made as necessary to achieve desired environmental outcomes.

28.3 ENVIRONMENTAL MANAGEMENT STRUCTURE

This sections detail the various parties involved in the implementation of the environmental plan and their responsibilities.

28.3.1 The Proponent, Ministry of Environment and Energy

MEE will be responsible for the execution of the project activities within the required timeframe. The scope of land clearance falls within the responsibility of the Island Council. MEE is also responsible of policy level decisions and provision of support regarding the waste management works undergone in the island as well as the regional level.

28.3.2 The Contractor

Contractors to construct the IWMC and clear land will be procured by MEE and Island Council respectively. The contractor will undertake the project in accordance with the EMP proposed in the EIA and will report to the proponent and environment consultant about any unexpected environmental impact or health and hazard issues. During the construction stages, the contractor will follow all mitigation and management measures proposed in the report, mainly waste management, pollution control, accident prevention and work methodology proposed.

28.3.3 Environmental Consultant

The environmental consultant would prepare the EMP based on field visits and surveys and based on past project experiences in similar settings. If there are any modifications to be made to the EMP during any stages of the project, the consultant would do the modification and would conduct the environmental monitoring according to the monitoring framework. The environmental consultants are also responsible for auditing the management/monitoring plan to identify gaps, limitation in management and propose remedial measures to ensure the project is sustainable.

28.3.4 Environmental Protection Agency

The Environmental Protection Agency would review the monitoring reports submitted by the proponent and would continue with regulatory monitoring visits to the project site upon their needs.

28.3.5 Island Council

The Island Council will be responsible for the following:

- Formulation and implementation of the Waste Management Plan (WMP) for a period of 5 years.
- Formulation and gazetting of Waste Management Regulations for the island;
- Formulation and gazetting of Waste Management Guidelines for the island;
- Plays a role in the site selection in collaboration with other responsible parties;
- Responsible for the land clearing works of the proposed IWMC site; and
- Overseeing the operations of the IWMC

The Island Council is responsible to ensure the progress of the Waste Management Plan and achievement of the set goals through implementing the plan. This includes overseeing the IWMC operations by either running the operations through the Council or awarding the work to a contractor. As per the discussions with HDH. Finey Island Council expects to award the work to a contractor and monitor the operations. The Island Council is also responsible for the compilation of the IWMC reports submitted by the contractor as well as producing an IWMC monitoring report as well as reporting of public grievances. These reports shall be submitted to the MEE bi-annually for review.

28.3.6 Operations Contractor (IWMC Occupier)

The operations contractor will be responsible in running the operations in accordance with the guidelines set by this EMP and the WMP of Finey Council. The responsibilities of the operations contractor include producing the IWMC operations reports and submitting the reports to the Island Council at the proposed regularities.

28.4 REPORTING

Reporting will be carried out on a timely manner to implement the environmental management plan and will cover details of site conditions, and operations. A detailed reporting mechanism for the IWMC operational works is provided in **Section 28.10**. Monitoring reporting shall be carried out during the stated time frames and frequencies in **Section 28.6.**

28.5 ENVIRONMENTAL MANAGEMENT PLAN

A practical plan taking into consideration available resources is proposed to meet the aims and objectives of the EMP. One of the major risks to the investment and operation of the IWMC and island level waste management is the center itself which can be converted back into a dumpsite due to mismanagement as often seen in island level waste management endeavors all across the Maldives. This is partly due to the fact that a lot of linkages connecting island level waste management with regional level waste management are absent or unknown until it is much too late. As described in **Section 26.2.2.2**, one of the main risks facing the current project is rapid accumulation of organic waste at the IWMC. Hence the proposed IWMC management plan aims to control and mitigate such risks without severe negative impacts

Table 94:Details of environmental management plan proposed for the IWMC

Activity	Phase	Measures	Time frame	Responsible person
Training of workers and contractors	Pre-construction, Pre-operation	Contractor and project workers are provided with detailed information on the project, impact mitigation measures, compliance with environmental permits and the EMP. Workers are also provided with the information on sensitive areas of the island and other environmental issues. Training of staff involved in the monitoring of the construction phase Training shall be provided to the workers of the IWMC on the waste management practices and mitigation measures in order to ensure the operations are run efficiently and effectively.	Prior to construction works Prior to operational phase	Proponent Environmental Consultant
Documenting non-conformances and corrective actions	Construction Operation	Non-conformances to the environmental regulations, permits and the EMP is monitored and documented. Corrective measures are taken and follow ups are done. IWMC operations reports and public grievances are compiled by the Island Council and reported to the proponent within the prescribed frequencies as stated in **Table 98**	Construction and Operation phase	Proponent Environmental Consultant Island Council
Supervision of activities	Construction Operation	The project activities are to be supervised by the proponent throughout the construction and operational phase to ensure the activities are carried out accordingly and the impacts are minimised. The proponent shall review the IWMC operations reports from the Island Councils, and provide the required support, bring about any necessary policy updates	Construction and Operation phase	Proponent Environmental Consultant

28.6 ENVIRONMENTAL MONITORING PLAN

Table 95: Impact management and monitoring plan for the construction and operation phase of the project

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
Ensuring that the project activities does not affect the quality of the groundwater	Establish baseline just before the construction works begin and continue monitoring as stated. Establish a groundwater monitoring stations and geo-reference it. Preferably close to the IWMC.	O	12,000 per trip	Potable water quality testing equipment and/ or by sending samples to the lab	During operational phase, bi annually	Proponent Environmental Consultant	Water quality report
Ensure waste generated at work site is audited and managed responsibly	Management of waste generated as described in **Section 24.3.12** of the report	C,O	Cost included in the project costs	Estimation of waste generated at project site and recording these data routinely. This includes quantifying and recording the amount of yard waste, hazardous waste and general waste stacked and stored for transportation.	Every two months	Construction contractor, operation contractor	Record sheets, photographs and quantity of waste processed at Thilafushi/ (nearest waste management center) and IWMC. If there are no significant discrepancies between the quantity of waste generated on site and processed at a central waste management facility, it can be safely assumed that impacts of waste on the environment was reduced.
Monitoring Health and safety of workers and the public	Accidents during construction of IWMC, land clearance, operation of IWMC and maintenance of IWMC. Fire hazards and natural disaster events. Noise and smell complaints during operation and construction phase. Compost condition, output and quality	C, O	Cost included in the project cost	Keep records in a log book, or data sheet	Bi annually	Operational contractor Construction land clearance contractor	Measures to adapt and prevent accident and risks. Health assessment reports published or available from the local health center.

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
						Island Council MEE	Policy changes and upgrades. Compost quantity and quality. Income from selling compost.

28.7 RESOURCE REQUIREMENT FOR MONITORING

For the monitoring program to be successful, it is important that adequate financial and human resources are available and strong coordination among the key stakeholders is maintained.

The primary function of implementing the mitigation and monitoring plan will lie with the proponent and environmental consultant. Since the project at developmental and operational stage will be engaged by the proponent it will be the responsibility of the proponent to take care of the environmental safeguards at all stages of the project during implementation and at operational phase. The proponent should prepare an Environmental Action Plan, which states all measures for mitigation and enhancement and monitoring as described here in the EIA with their responsible organisation and person, planning, methodology, timing and other relevant aspects.

An independent registered environmental consultant shall be hired and contacted to undertake and audit the monitoring program prescribed in this report. Following each monitoring visit the consultant will prepare a report with clear recommendations and corrective measure if necessary. The report will have to be submitted to EPA for their review and actions.

28.8 MONITORING SCHEDULE

Table 95 highlights the monitoring plan in which responsibilities of main stakeholders has been assigned. In order to track and compile the findings of these measures an independent environmental consultant shall be tasked to audit the projects EMP. This is to

- identify gaps in monitoring and mitigating impacts arising from the project;
- determine the challenges and resource inadequacies to implement the proposed EMP; and
- determine the current environmental condition and propose modification/upgrades to the initial EMP.

Monitoring frequency for various individual components given in **Table 95** shall be followed by all responsible parties. **Table 96** gives indicative timeline for the monitoring visits by third party consultant.

Table 96: Monitoring visit schedule

Visit	Indicative timeline	Indicative parameters to monitor	Reporting	Cost (MVR)/per report/island.
Visit 1	Prior to construction of IWMC	Set baseline for groundwater quality and noise	Submit summary report 1 to Proponent within 2 weeks	25,0000.00
Visit 2	During construction of IWMC	Monitor work method, waste management, Monitor health and safety of workers. Monitor impacts to nearby vegetation and ensure vegetation removal is as per set out survey. Review reports prepared by contractors.	Submit monitoring summary report 2 to Proponent (MEE) within 2 weeks	10,000.00

Visit 3	Two months into operation of the IWMC. Biannually for four years	Monitor water quality and noise. Monitor IWMC. This includes review of reports dated in **Table 98** or determine condition of IWMC. Monitor compost condition as described in **Table 98** and **Table 95**	Submit summary report 3 to Proponent within 2 weeks	25,000.00

As indicated, during the course of the Project implementation summary reports following each trip is expected to be submitted by the Project's environmental consultant. These environmental audits will provide a basis for assessing at least the shorter-term efficacy of the environmental measures and thereby provide lessons to be learned for future monitoring sessions and other projects with similar impacts. The consultant will prepare and submit the reports to Proponent. Based on the findings of the report, the management approach may be adapted and its efficacy will be determined in the consecutive monitoring trip.

28.9 MONITORING REPORT

Reporting will be carried out by the environmental consultant assigned for the purpose by the proponent.
The report will include among other information;

- Details of what was being monitored;
- Methodology of data collection and data analysis;
- Major findings;
- Effectiveness of the mitigation measures in place and
- Recommendations and conclusions.

A detailed environmental monitoring and management report is required to be compiled and submitted to the EPA. In addition to this, regular site monitoring would be carried out by the proponent that requires maintaining logs of events as explained in this report. Enforcement officers from EPA may also visit the site for inspection from time to time.

28.9.1 Monitoring Report Format

The environmental monitoring report outlined in **Table 97** below will be used in reporting environmental monitoring to be carried out as given in the monitoring plan.

Table 97: Monitoring report format

Project Title:
Name of the Island:
Monitoring Date:
Period Covered:
Prepared by:
Contributions:

A. Introduction
Give a brief introduction about the project and the monitoring carried out
B. Methodology
Brief detail of the methodology applied for undertaking the monitoring assessment
C. Environmental Monitoring
a. Groundwater quality
Parameters given in the monitoring plan need to be assessed
b. Waste generation and management at IWMC
These include monitoring for pests and diseases as described.
D. Risks and Mitigations
Please indicate any critical unresolved risks that affect the course of the system operation, analyse the cause, assessing the potential impacts on the environment providing the proposed mitigation strategy
E. Problems Encountered
Indicate any problem areas encountered and any corrective measures that will have to be taken.
F. Recommendations and Adaptations as Solution
If specific recommendation is noted during the monitoring phase, specify it in the report
G. Conclusions
Reference
Appendix

28.10 IWMC OPERATIONS REPORTING MECHANISM

Table 98:Details of the reporting mechanism proposed for the IWMC

IWMC (Contractor)

Reporting	Details	Frequency
General report	Logs of the incoming waste	Monthly
	Classified by type and weight	
	Vehicle maintenance details	
	Machinery maintenance details	
	Machinery fuel usage details	
	Workplace injuries	
IWMC capacity	Details of the utilized and remaining capacity of IWMC	Every two months
	Leachate tank maintenance and capacity	
IWMC inventory status report	Details of the status of IWMC equipment	Bi-Annually
	Details of the status of emergency kits and firefighting equipment	
Compost output report	Details of amount of input waste materials	Bi-Annually
	Details of compost output in weight	
Noise and odor complaints	Log of noise and odor complaints	Every two months
	Complaints to be provided along with weather conditions and incoming waste details coinciding with the dates of complaints	

Island Council (Municipal Unit, Waste Management Committee)

Components	Details	Frequency
Public grievances	Log of public grievances regarding	Bi-Annually
	Fee structure	
	Waste Management operations	
	Noise and odor complaints	
IWMC monitoring	Monitoring report of the IWMC operations	Bi-Annually
Compilation of IWMC reports from operations contractor		Bi-Annually
Income report	Summary of IWMC operations income	Bi-Annually

MEE

Components	Frequency
Review of IWMC Reports from Councils	Bi-Annually
Update National Waste Database	
Policy updates from findings	
Provision of support to IWMCs	
Overview of the waste management system on island level and regional level	

29 RECOMMENDATIONS AND CONCLUSION

The construction and development of the IWMC at HDH. Finey is a much needed project to provide waste management services to the island. The IWMC 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.

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 consultant's recommendations for the project include:

- To include this EMP as part of the contractor's contract and ensure the measures and recommendations brought forth are followed;
- Implement the work method and mitigation plan as prescribed in the report to the fullest;
- To conduct supervision and monitoring of the project works by the proponent;
- To conduct supervision and reporting of the project works by an independent consultant;
- To conduct stringent evaluation of contractor's capacity to undertake and complete the project;
- Ensure necessary clauses regarding the workers safety are fully implemented;
- 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 EMP has looked into the key factors that need to be considered during construction and operational stage. The study has identified the negative impacts of the proposed project are minimal.

The study also found that through the implementation of the proposed practical and cost effective mitigation measures almost all significant impacts can be brought to an acceptable level. This EMP will guide the proponent in implementing the project with conformity to EIA regulation 2012.

CHAPTER 5
HDH. HIRIMARADHOO

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30 INTRODUCTION

30.1 BACKGROUND

HDH Hirimaradhoo is located in 6°43'29.7084" N, 73° 1'26.8536" E and belongs to the South Thiladhunmathi Atoll. The island is approximately 287.06 km from the capital Male'. The nearest airport is HDH. Hanimaadhoo, which is approximately 17 km from Hirimaradhoo. The nearest inhabited island is HDH. Finey which lies approximately 3.3km to the northeast of Hirimaradhoo. The island lies in a NW-SE orientation, and has a total land area of 43ha.

The population HDH. Hirimaradhoo is 550 (Island Council, 2017). The main economic activities of the island are construction work and traditional craft *fangiviyun*. Agricultural activities are also conducted in the island.

Drinking water supply and sewerage facilities are not provided in the island. 24 hour electricity service is provided to the island by the utilities company FENAKA. The island is accessible by a harbour 400 ft long and 200 ft wide. The harbour works started in 2013 and inaugurated in 2016. The island does not have a waste management centre, nor is there an area currently being used as a dumpsite.

Residents have been disposing waste at the periphery of the residential zones, and kitchen waste is disposed of at the beach. Notable areas where waste has been disposed of include south of the football grounds, and the southwestern beach of the island, where tree trunks have been dumped. These practices have led to the terrestrial pollution of the island, and dumping of kitchen wastes and other wastes in the nearshore area can lead to diseases, nutrient imbalances, smothering of corals toxicity impacts to marine flora and fauna (Halliburton, 2002). Waste reduction is done by burning of stockpiled wastes intermittently.

No waste audit specific to the island has been carried out in the past nor had the waste situation of the island been properly assessed. A waste audit for Zone 1 (which includes HA, HDH, and Sh. Atolls) conducted by MEECO in 2016 showed an average of 1.30 kg/capita/day of waste generation within the islands. Using this average, approximately 0.7 ton/day of waste is generated within the island. The majority of sources of waste in HDH Hirimaradhoo are the households, government institutions, and farming. In order to manage the waste situation at the island level, the proponent, Ministry of Environment and Energy (MEE) has proposed the project to establish an Island Waste Management Centre (IWMC) in HDH Hirimaradhoo.

The proposed project is facilitated by MEE and financed by the OPEC Fund for International Development (OFID) under the "Provision of Water Supply, Sanitation and Solid Waste Management Project". The completion of the proposed project will result in the construction of an IWMC, and the operation of the IWMC will be facilitated under the Waste Management Plan devised by the Island Council and Approved by EPA.

The scope of the proposed IWMC 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, stockpiling and composting of the waste. The waste that is not manageable in the island level is planned to be transported to a central waste management facility.

The proponent has requested consultancy services of MEECO for the preparation of an Environmental Management Plan (EMP) to comply with the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012. EPA has issued a decision statement on HDH. Hirimaradhoo that an EMP would be suffice for the proposed IWMC construction and operation works.

A field visit was conducted by the MEECO team to HDH. Hirimaradhoo on 26th April 2017 in addition to a consultation meeting with the Island Council on the same day. This report is based on the findings of the field visit, consultations, previous EMP's and experience of the consultant.

30.2 PROJECT SETTING

HDH Hirimaradhoo is located in 6°43'29.7084" N, 73° 1'26.8536" E and belongs to the South Thiladhunmathi Atoll. The island is approximately 287.06 km from the capital Male'. The nearest airport is HDH. Hanimaadhoo, which is approximately 17 km from Hirimaradhoo. The nearest inhabited island is HDH. Finey which lies approximately 3.3km to the northeast of Hirimaradhoo. The island lies in a NW-SE orientation, and has a total land area of 43 ha.

Figure 83: Project setting

30.2.1 Site Location

The proposed Island Waste Management Centre (IWMC) is located in the southern end of the island at 6°43'16.61"N, 73° 1'33.16"E. The site is accessible by Rah Dhebai Magu, as well as Mirihi Magu. The site is located next to cleared areas with excavated material stockpiled. Northwest of the site is the FENAKA powerhouse, while the football ground is Northeast of the site.

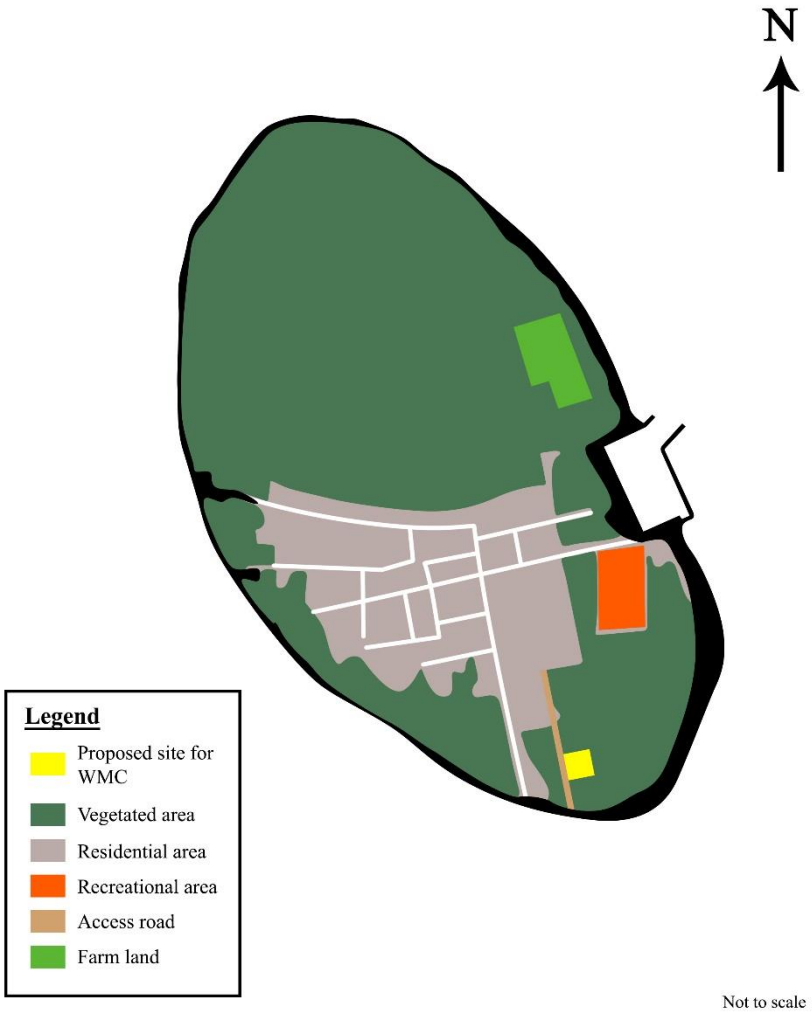

Figure 84: Proposed location for the waste management site on Hirimaradhoo Island

30.3 CURRENT STATE OF WASTE GENERATION AND WASTE MANAGEMENT

30.3.1 Waste Generation in Zone 1 and HDH. Hirimaradhoo

A waste audit conducted by MEECO in 2016 showed that the average waste generation of the islands in Zone 1 was 1.30 kg/capita/day.

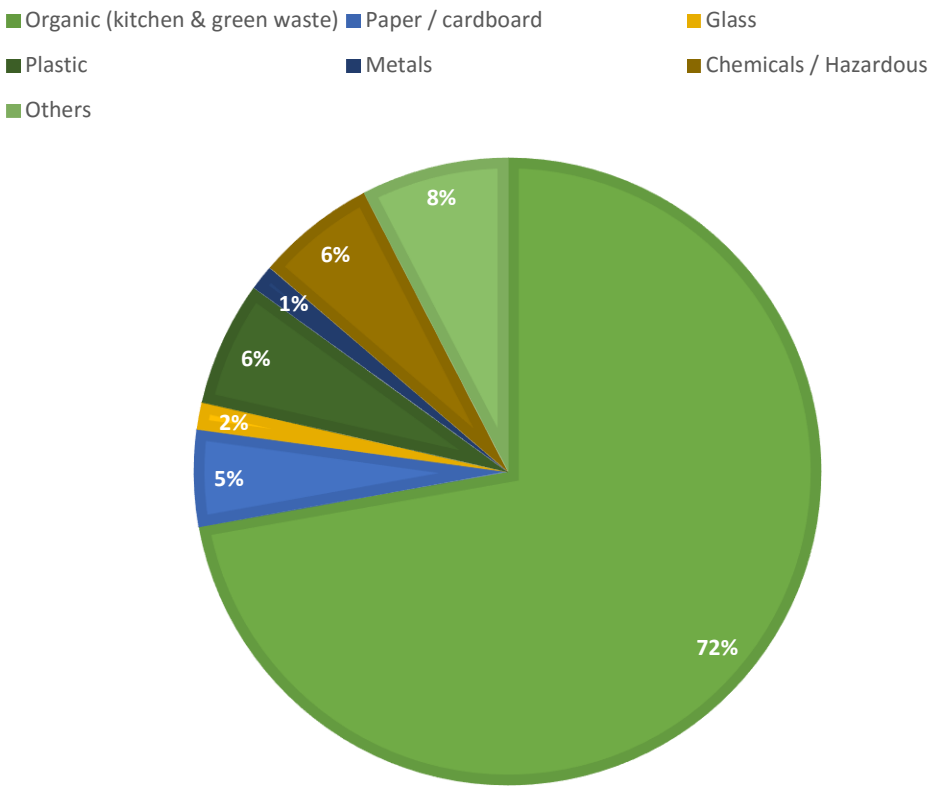

Figure 85: Waste Composition of Zone 1 (Source: MEECO, 2016)

The analysis shows that the majority of the waste generated includes organic wastes at 72%, which include kitchen and green wastes. This waste can be used in composting in addition to paper and cardboard wastes which are at 5% of the total waste generated. Recyclable materials such as plastic, metals, and glass make up 9% of the composition. Approximately 6% of the total waste generated is chemicals and hazardous waste. Using HDH. Hirimaradhoo's current population, the daily waste generated is estimated from this data.

Table 99: Estimated waste generation quantities of HDH Hirimaradhoo

Waste Type	Zone One Average (%)	Hirimaradhoo Waste Generation (Kg/Day)
Organic (kitchen & green waste)	72.2	516.23
Paper / cardboard	4.94	35.321
Glass	1.42	10.153
Plastic	6.4	45.76
Metals	1.3	9.295
Chemicals / Hazardous	6.15	43.9725
Others	7.58	54.197
Total	99.99	714.9285

30.3.2 Current state of waste management in HDH. Hirimaradhoo

The majority of sources of waste in HDH Hirimaradhoo are households, in addition to farming activities and clearing of land. There are no major industrial activities conducted within the island.

Currently there is no waste management system in place in HDH. Hirimaradhoo. No area has been demarcated or established to dispose of waste. Waste has been dumped in places such as the area south of the football ground, and a considerable amount of tree trunks have been dumped at the periphery of the south-eastern beach area. Kitchen waste is thrown on the beach areas around the island. Along with the kitchen waste, metal cans and glassware are also dumped on the beaches.

Figure 86: Current state of waste disposal in the island. The beach area of the southern coast seen in photo C Tree trunks are observed on the south eastern beach (A). B and D show waste dumped near the football ground

30.4 WASTE MANAGEMENT PLAN OF HDH. HIRIMARADHOO

The Island Council has formulated a Waste Management Plan (WMP) in 2017 for the next five years, to find a permanent solution to the waste problem in island, and to protect the environment while reducing the health effects of improper waste dumping, and to eliminate the social and economic issues that arise from it. This WMP focuses on the targets required to be achieved for the island and how the targets will be reached. In addition, the current situation of waste management and waste generation in the island is detailed in the WMP. The Council proposes the following goals to achieve in order to manage the waste generated in the island:

- Formulating and gazetting waste management regulations
- Create a sustainable waste management system
- Generate income from waste

- Separation of wastes at household level
- Use of 3R within the island
- Sorting of waste at the IWMC
- Setting up a mechanism to transport unmanaged waste from the island
- Reducing the amount of waste generated within the island
- Keeping the environment clean

Waste Management Mechanism

The Island Council plans to conduct the IWMC operations through a contractor. As per the WMP, the operations are planned to be run as follows:

- Operations are planned to begin in 2018
- Operating hours include weekdays 8 am to 5pm
- Sunday, Tuesday and Thursday – for collection of waste from households (morning 8 to 9)
- Burning of unmanaged waste – once a week
- Cleaning of the island – once a month

The transportation is planned to be done with the use of a vehicle, although households nearby are encouraged to transport household waste with wheelbarrows.

Fee System

The Council proposes the following monthly fee system for the waste management works:

- Households: 100 MVR
- Institutions and Businesses: 100 MVR

Roles and Responsibilities

- Fees: Council accounts department, waste management focal point appointed by the Council.
- Equipment maintenance: Island Council, IWMC Occupier

As the WMP is currently not approved by the EPA, the consultant recommends approval of the WMP prior to the operations of the IWMC. It is also recommended to ensure the WMP is in accord with the Saafu Raajje National Waste Management Policy (2015), and bring about necessary amendments.

31 DESCRIPTION OF THE PROJECT

31.1 THE PROPONENT

The proponent of the project is Ministry of Environment and Energy (MEE) of the government of the Maldives. The proposed activity is part of a greater project titled "Provision of Water Supply, Sanitation and Solid Waste Management Project" financed by the OFID.

31.2 PROJECT DURATION AND SCHEDULE

The proposed construction phase of the project is planned to be carried out in 10 weeks. This project has been opened to bidders in June 2017 with a validity period of 90 days.

A tentative schedule of the work is found in **Table 100**.

Table 100: Work plan for IWMC

		Duration (days)	Weeks									
#	Activity		1	2	3	4	5	6	7	8	9	10
1	Mobilization	7										
2	Site clearing	4										
3	Excavation works	2										
4	Substructure and superstructure works	10										
5	Masonry works	10										
6	Plastering works	3										
7	Roofing works	7										
8	Structural steel works	7										
9	Electrical works	2										
10	Plumbing works	1										
11	Doors and windows	7										
12	Demobilization	2										

31.3 PROJECT DESCRIPTION

The proposed site plan is presented in **Figure 87**. Engineering details are provided in **Annex 2.**

The construction of the IWMC consists initially of mobilization and site clearing. The main works include shallow excavation, substructure and superstructure works as well as masonry works. The proposed design of the IWMC 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 operational phase of the project will include the daily collection of waste from the households and institutions, in addition to waste management works in the IWMC, which include;

- Sorting of waste;
- Storing of hazardous waste;
- Volume reduction of plastics, glass and metals;

- Stockpiling of sorted waste; and
- Composting of organic waste.

The IWMC is made up of an equipment room, and separate areas to store metal waste, paper and cardboard, plastic waste, glass waste as well as hazardous waste.

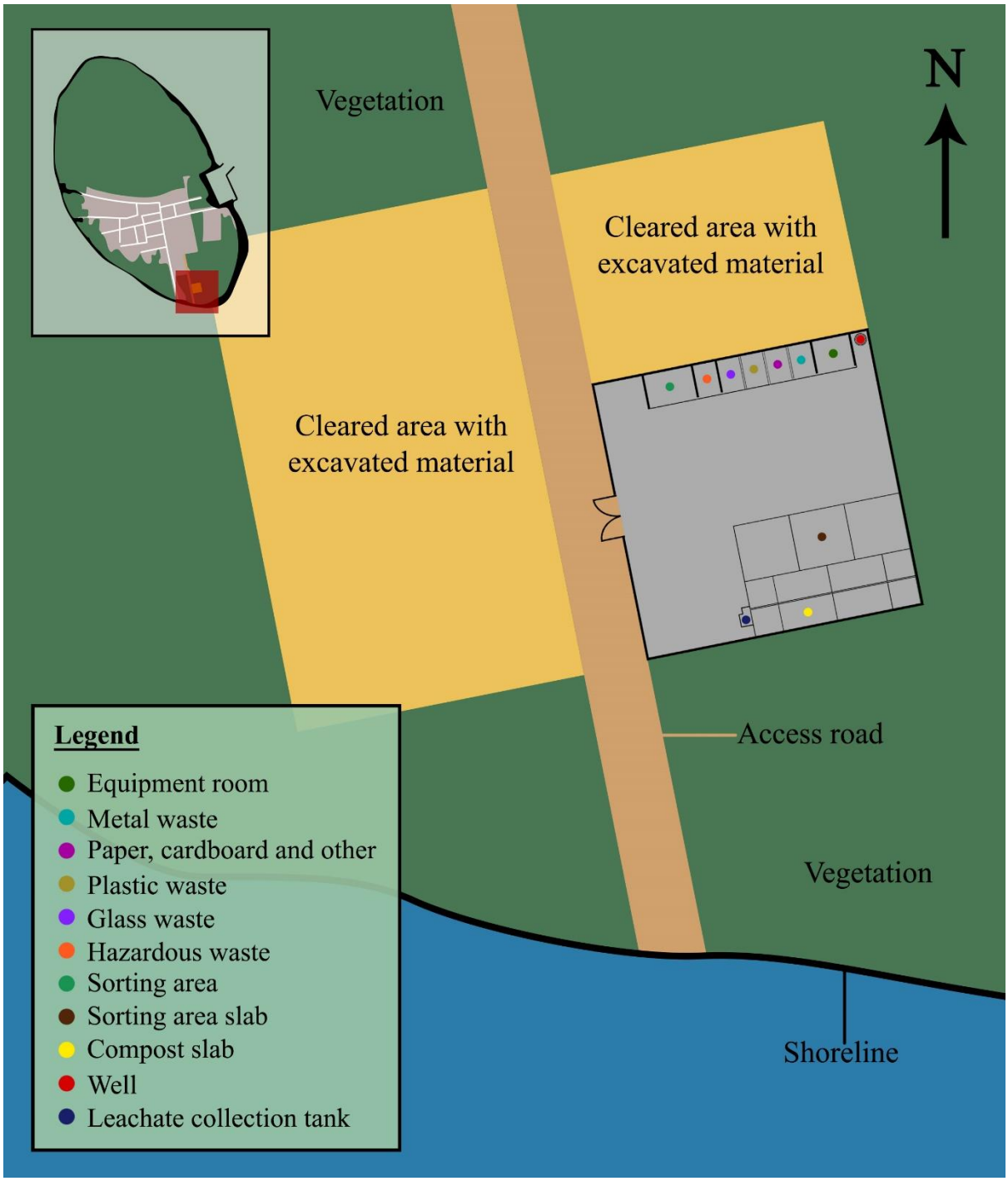

Figure 87: The site plan

31.3.1 Machinery

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

a) Lorry crane for placing of well;

b) Truck for transportation of materials;
c) Vibratory plate compactor;
d) Concrete mixer;
e) Concrete supply pump and piping; and
f) Daily 4" pump.

31.3.2 Mobilisation

As the amount of input materials are relatively minor, the construction materials shall be stored inside the demarcated site throughout the construction period

31.3.3 Demarcation and Fencing

Prior to beginning construction works, a survey shall be done by the contractor to demarcate the limits of the site, and the site shall be fenced off. Work shall be conducted within these limits.

31.3.4 Site clearance and levelling

The proposed site has already been cleared, and the formation level has been increased with backfilling of excavated material. The site needs to be levelled. As the site size is relatively small, a vibratory plate compactor may be used for the levelling of the ground.

31.3.5 Construction of Sorting Area Foundation

The footprint of the proposed site is 25 m by 25 m, of which the storage areas consists of a 3.15 m by 18.85 m area. The proposed foundation below the masonry walls of the structure is a line (strip) foundation.

31.3.6 Construction of Compost Slab and Sorting Area Slab

The compost slab and sorting area slabs has an area of 15 m by 10 m. The 100 mm thick reinforced concrete slabs are cast over ground beams B1, B2 and B3. The ground beams B1 and B2 have a depth of 0.3m while B3 has a depth of 0.4m from the top of the slab. B3 has a void on top of the beam centrally to receive a 100mm PVC pile cut in half sloping at 1% from the upper end to the lower end, connecting to the leachate tank at the end. Excavations will be done manually to receive the ground beams as per the drawings indicate. The maximum depth of excavation for the beams is 0.4m. The construction of the slab and ground beams include initially laying of HDPE membrane on the slab and beam footprint. Formwork will be added to the sides of the beams, and following that, the arrangement of the required reinforcing steel. Concrete will be poured for the ground beams, followed by the slabs. Concrete mixing will be done on site.

31.3.7 Construction of Leachate Tank

The leachate collection tank is located at the end of the compost slab. The leachate tank has an area of 1.1 m by 1.5 m and a depth of 1.09 m extending below ground. The valve junction of the leachate tank has a size of 0.8 m by 0.55m, and has a depth of 0.63 m. 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.

31.3.8 Construction of Perimeter Fence

The whole length of the perimeter will 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 2.8m from ground level. The mesh is held together by 50 mm diameter GI pipes vertically 2 m centre to centre which are welded to three evenly spaced 38 mm GI pipes horizontally. The strip foundation below the masonry wall has a depth of 0.3 m with a 50 mm thick lean concrete placed below. Each vertical GI pipe is fixed to a 300 × 300 mm concrete footing with a depth of 0.6 m. The GI pipe is welded into a 200 × 200 mm plate. Therefore, the excavations done for the masonry wall strip foundation and GI pipe footing will be at 0.35 m and 0.6 m respectively. The trenches required to receive the strip foundation and footings will be excavated manually.

31.3.9 Construction of Well

A well is proposed to be constructed at the eastern corner of the IWMC. This well is 900 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.

31.3.10 Construction of Superstructure

The superstructure of the IWMC consists of the sorting area, storage area and the equipment room. The structure consists of a 3 m high wall separating the compartments. The roofing is supported by GI Pipes of diameter 38 mm and 75 mm. The roofing is made of LYSAGHT roofing sheets.

31.3.11 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 in vacant houses.

31.3.12 Waste Management

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 disposed in closed containers. The waste shall be well secured to avoid any scattering due to strong winds.

Municipal waste produced by the workers are estimated at an average of 0.45 kg/capita/day which translates to 346.5 kg of waste for the duration of 11 weeks for the whole workforce.

After the construction works are done, the collected waste shall be transported to the waste management facility in Thilafushi.

31.3.13 Pollution and Control Measures

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

a) Machinery to be properly tuned and maintained to reduce emissions/spills/leaks;
b) Fuel storage, paint, lubricants will be stored securely and bunded; and
c) Spill kits would be made available on site to control any liquid spills.

31.3.14 Health and Safety Measures

The proposed project involves transportation as well as construction of the IWMC at the site. These works will include use of vehicles, machinery, and heavy materials, and the workers may be put in

situations where there is a risk of injury. These risks need to be identified and managed through the implementation of health and safety guidelines for the site. Health and safety measures for the construction phase include and are not limited to:

a) The contractor would be briefed regarding the laws and regulations that need to be followed regarding the proposed works and would ensure that Health and Safety procedures are complied with at all times;
b) There would be a construction supervisor at the site;
c) Only experienced and licensed operators will be allowed to operate heavy machines;
d) First aid kit should be made available at the work site;
e) The work force would be equipped with all safety gears and warning signs would be provided;
f) Fire extinguishing equipment would be available at the site;
g) PPE should be provided to all workers and the use of PPE enforced;
h) Operation of any heavy machinery will need the assistance of a banksman as all times;
i) All heavy lifts must be supervised and slings inspected; and
j) All other similar environment personal safety and quality control measure to be in place and checked by a qualified personal and approved and maintained at all times.

31.3.15 Demobilization

The demobilization plan will commence in the last week of the contract.

31.4 OPERATIONAL PHASE

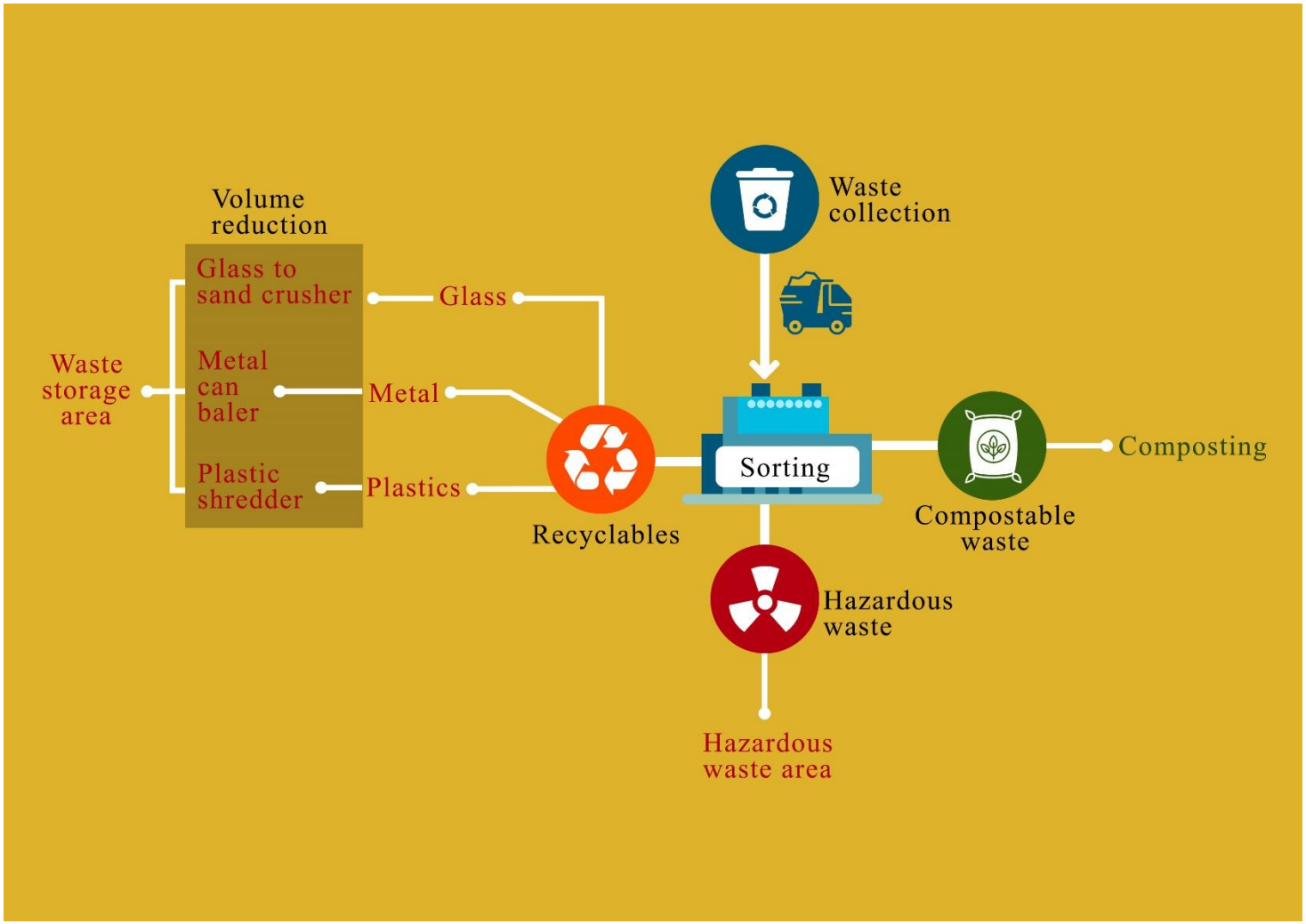

Figure 88: Operational phase flowchart of the IWMC of HDH. Hirimaradhoo

The following Section will highlight the operational aspects of the IWMC. This includes the machinery and equipment proposed to be used in the IWMC, in addition to the main activities to be carried out at the IWMC and within the island. The activities begin from the waste sources which are then transported to the IWMC. This collected waste is 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.

31.4.1 Machinery and equipment proposed

During the operational phase of the IWMC, in addition to the collection of the waste and sorting, different activities such as composting, and waste volume reduction will be done. The proposed equipment for the IWMC include general equipment needed to handle the waste such as wheelbarrows, garden hose, shovels, buckets and cultivators. These equipment will be used during the IWMC operation for handling as well as composting operations. A manual rotary compost screen is also included for the screening stage of the composting process.

Other equipment include waste volume reduction equipment such as a plastic shredder, metal can baler, vegetation shredder, and glass to sand crusher. The equipment and their specifications are detailed below.

Table 101: Equipment proposed for waste management works

Equipment	Details
Chainsaw	
Wheelbarrow	HDPE 6 cub. Ft.
Heavy Duty Gumboots	PVC or rubber
Heavy Duty Hand Safety Gloves	Rubber or Latex
Long Handled Flathead Steel Rake	Steel, 54 inches length
Long Handled Cultivator	Steel, 54 inches length
Garden Hoe	Steel, 57 inches length
19” Round Point Shovel	Steel
48” Square Point Shovel	Steel
19” D-Handle Square Point Shovel	Steel
20L Bucket	HDPE
40L Bucket	HDPE
Polypropylene Surgical Mask Box (50pcs)	Polypropylene
Weighing Bench Scale	50-75 kg capacity
Wheelie Bins	HDPE
Glass to Sand Crusher	0.5 to 1.0 tonne/ hr, output 0.5mm and less, 2-5HP motor
Plastic Shredder	30-100Kg/hr Output material less than 10mm
Metal Can Baler	3 to 5 HP, 2m2 or more inside volume
Vegetation Shredder	Petrol / diesel driven multi vegetation shredder / chipper
Manual Rotary Compost Screen	1m to 1.5m drum

31.4.2 Waste Collection

As per the WMP, it is expected that a vehicle will be used daily to collect the household, institutional and public area waste. A schedule is expected to be created through the WMP for the waste collection.

31.4.3 Sorting

As per the IWMC site layout plan, a ground slab is dedicated for the sorting area. This sorting area is located next to the compost slab. Here, the collected waste will be kept, and sorted into their respective categories. In addition to this, a dedicated sorting area is also provided alongside the storage areas. The IWMC is designed to have separate storage areas for metal, paper and cardboard, plastic, glass, and hazardous waste. After sorting, the waste is stored in the respective location.

31.4.4 Composting

The IWMC is designed in order to facilitate the storing, sorting and reusing of the waste generated in the island. One of the main operations that will be conducted in the IWMC is the composting of the organic waste such as kitchen waste and garden 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 main constituents of a compost heap include kitchen and garden waste, along with water and air in the pore spaces between the constituent.

31.4.4.1 The Composting Process

After the incoming waste is 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.

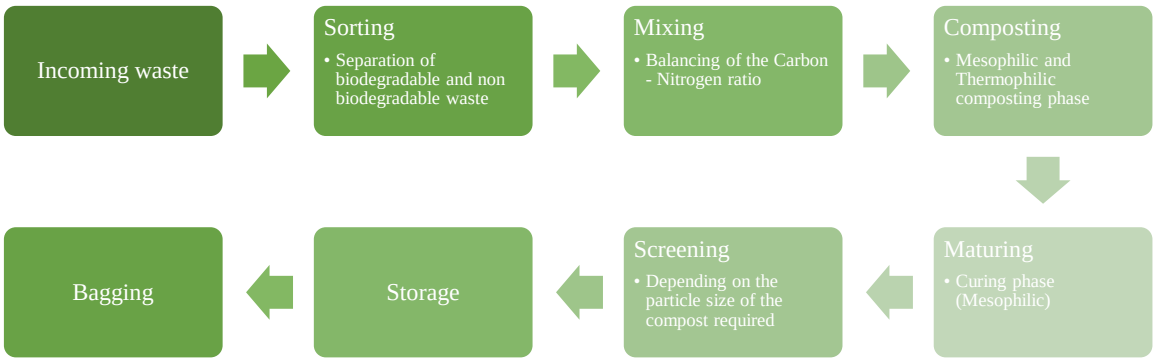

Figure 89: The composting process

31.4.4.2 Sorting of Incoming Waste

Incoming waste is required to be sorted to separate biodegradable and non-biodegradable waste. The separation of waste at household level will streamline this process

Table 102: Domestic Waste Categories

Incoming Domestic Waste			
Suitable for composting	**Not suitable for composting**		
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
Composting Process	**Storage**		

31.4.4.3 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.

Looking into the composition of compostable wastes from the Zone 1 Waste Audit, it is seen that the majority of compostable wastes constitute of garden (green) wastes. Garden wastes make up 64% of waste generated, while the second largest contributor to compostable wastes is kitchen wastes, at 28%. Printed paper and cardboard make up 5% of compostable waste while 2% of the category includes animal waste. This composition is important in determining the Carbon-Nitrogen ratio of the compost heap in order to provide optimum conditions for composting.

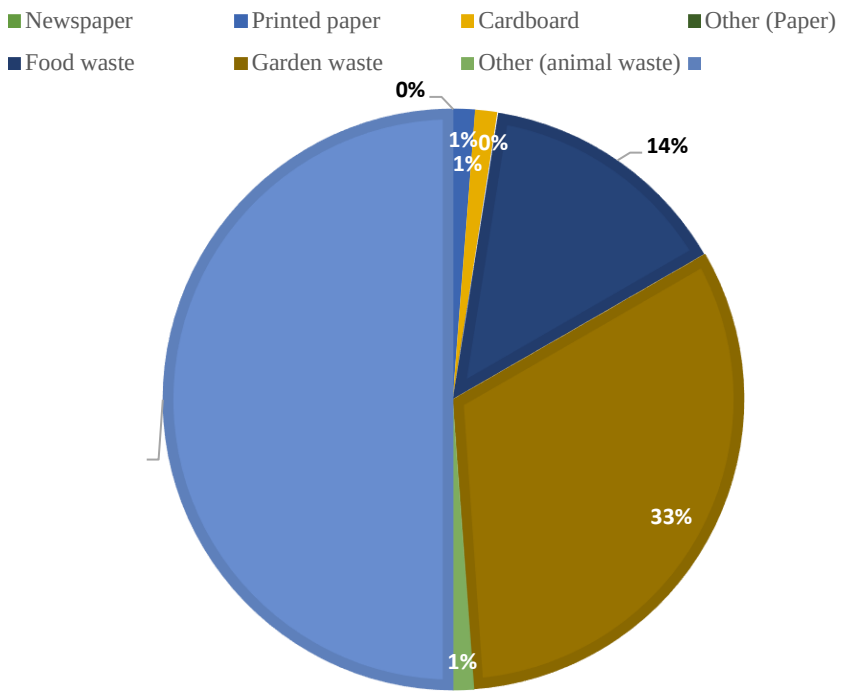

Figure 90: Composition of compostable waste for Zone 1

Table 103: Estimated compostable waste generation quantities of Zone 1

Category		Average Per Capita (kg/day)	Percentage
Primary	**Secondary**		
Paper & Cardboard	Newspaper	0.00	0.0%
	Printed paper	0.02	2.4%
	Liquid container	0.00	0.5%
	Cardboard	0.02	2.4%
	Other (Paper)	0.002	0.2%
Organics	Food waste	0.29	28.2%
	Garden waste	0.67	64.2%
	Other (animal waste)	0.02	2.2%
Total		1.04	100

Green wastes such as vegetable wastes (kitchen waste), and poultry manure have high Nitrogen values while brown wastes such as foliage, wood chips, bark and paper have high carbon values. From the waste audit, it is seen that 64.2% of the compostable waste produced is garden waste while 28.2% of the waste generated is food waste. Therefore, it can be said that the composition of compostable waste in the islands in Zone 1 is in favour of providing a high Carbon content compared to Nitrogen.

31.4.4.4 Composting and Maturing

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

Table 104: 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, the composting process can prolong to several months.

31.4.4.5 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. This slab is 15m long by 5m wide. 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 100mm 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 compost slab.

31.4.5 Volume Reduction

The incoming waste is sorted, and either used for composting, or stored in their respective compartments. 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.

31.4.6 Projected Capacity of the IWMC

The proposed IWMC is planned to manage a portion of the waste produced at the island level, with the unmanaged waste (approximately 70 – 75% of waste generated within the island) to be transported to a central waste management facility). The projected capacity for 1 month's waste for the island of Hirimaradhoo is shown below.

Table 105: Projected waste management capacity for the waste generated in HDH Hirimaradhoo in 1 month

Waste Type	Details	Amount	Unit
Organics	Composting capacity in IWMC. Assuming 1m height windrow with a width of 2m	39	m3
	Organic waste generated per month	23.83	m3
Paper waste	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	1.684	m3
Glass	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.484	m3
Plastics	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	2.181	m3
Metals	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.443	m3

As seen in **Table 105** the IWMC has the capacity to compost the household organic waste generated in 1.5 months in the island. Organic wastes make up the bulk of the waste stream in the islands, taking 72% of the total waste generated in the islands in Zone 1. The composting capacity of the proposed compost slabs (assuming a windrow of 1 m height and 2 m width at the bottom and 1m width on top) is approximated as 39 m^3. The calculated volume for the household organic waste generated in 1.5 months in Hirimaradhoo is 35.74 m^3. Therefore, 45 days' worth of household organic wastes produced in Hirimaradhoo would take up the composting capacity of the IWMC for the succeeding 4 – 6 months. This is not taking into account the green wastes that will be produced at the farms in Hirimaradhoo. There is no additional storage space for the organic wastes provided in the facility. Hazardous waste storage is provided in the IWMC, although hazardous waste cannot be managed in the island. Therefore, regular transport of hazardous waste is recommended.

31.5 PROJECT INPUTS AND OUTPUTS

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

Table 106: 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	29.66 m3	Local Suppliers
		Reinforcement		
		Reinforcement T10	1.231 tons	Local Suppliers
		Reinforcement R6	0.19 tons	Local Suppliers
		Reinforcement T12	0.09 tons	Local Suppliers
		Formwork	135.66 m2	Local Suppliers
		Masonry Works (200mm bricks)	205.8 m	Local Suppliers
		Structural Steel		
		50mm and 38mm GI Pipe for perimeter fence	77.4 m	Imported / purchased where available locally
		75mm GI pipe (flood light fixing poles and roof fixing)	18 Nos.	
		38mm GI bearer pipes	46.2 m	
		38mm GI purlin pipes	95 m	
		38mm GI pipes between columns	35.2 m	
		75mm GI pipe to support machine room door	3.5 m	
		Paint		
		Primer and 2 paint coats (Grey Color)	345.96 m2	Local suppliers

		Electrical Components		
		3 Phase power sockets	4 Nos.	Local suppliers
		Single phase power sockets	3 Nos.	
		100 mm ceiling mount lights	1 Nos.	
		Wall mount exhaust fan	2 Nos.	
		500W flood light	2 Nos.	
		25 mm2 4 core power supply cable	290 m	
		Well water pump	1 Nos.	
		Metal doors for		
		Equipment room	1 Nos.	Local suppliers
		Hazardous waste area	1 Nos.	
		Waste yard entrance	1 Nos.	
		Plumbing		
		25mm PVC intake pipe		Local suppliers
		1/2 inch PVC pipe from pump to all distribution points	40.9m	
		Roofing		
		Storage area roof sheets	85.5 m2	Local suppliers
		Flashing sheets	28 m	
		Lysaght gutter	19 m	
		50x50 PVC coated mesh fence	77.4 m2	Local suppliers
		HDPE membrane	209.54 m2	Imported / purchased where available locally
		Timber top cover	1 nos.	Local suppliers
		PVC pipe for leachate tank drain	15 m	Local suppliers
		600 x 900 5mm plastic sheet signboard	1 Nos.	Local suppliers
Operation	Equipment and Materials	Chainsaw	1	Imported / purchased where available locally
		Wheelbarrow	4	
		Heavy Duty Gumboots	5	
		Heavy Duty Hand Safety Gloves	5	

		Long Handled Flathead Steel Rake	3	
		Long Handled Cultivator	3	
		Garden Hoe	3	
		19” Round Point Shovel	3	
		48” Square Point Shovel	3	
		19” D-Handle Square Point Shovel	2	
		20L Bucket	3	
		40L Bucket	2	
		Polypropylene Surgical Mask Box (50pcs)	5	
		Weighing Bench Scale	1	
		Wheelie Bins	40	
		Glass to Sand Crusher	1	
		Plastic Shredder	1	
		Metal Can Baler	1	
		Vegetation Shredder	1	
		Manual Rotary Compost Screen	1	
	Waste	Waste generated within the island	Approximately 714 kg of household waste per day	Waste collected by vehicle from the waste bins within the island
	Fuel	Diesel		Local suppliers

Table 107: Project outputs

Stage	Output	Source / Type	Amount	Means of managing
Construction	Soil	Excavation for substructure	11.78 m3	To be used back in the levelling and backfilling of site.
			209.54 m2	
	Waste	Construction and clearing of vegetation		Collected in the temporary waste area and transported to Thilafushi after completion of the project
	Hazardous waste	Construction and clearing of vegetation		Collected as per hazardous waste management guidelines and transported to Thilafushi after completion of the project
	Municipal waste	Workers	346.5 kg	
	Dust	Excavation	Moderate amount of dust	
		Cement mixing	Moderate amount of dust	
	Green House Gases	Machinery		
		Concreting works	100.1kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
		Reinforcement	5311.1kg of CO2 indirect emissions (Ma et.al, 2016)	
		PVC Pipes	164.81kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
Operation	Compost	Open windrow composting	15.60 m^3 compost per cycle	Sold as fertilizer
	Crushed Glass	Glass crusher	0.315 m3 per month	Crushed glass stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Compacted Metal	Metal baler	0.443m^3 per month	Compacted metal stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central

				waste management facility
	Shredded plastic	Plastic shredder	2.181m^3 per month	Shredded plastic stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	GHG	Electricity usage		N/A

32 EXISTING CONDITIONS

32.1 DESCRIPTION OF THE ENVIRONMENT

HDH Hirimaradhoo is located in 6°43'29.7084" N, 73° 1'26.8536" E. The island lies in a NW-SE orientation, and has a total land area of 43 ha. A wetlands area consisting of mangrove trees (*Kandoofaa)* is present in the southeastern region of the island (see **Figure 91** (D)). The area has been extensively damaged due to the 2004 Indian Ocean tsunami.

The island is highly vegetated in the northern areas, with residential areas concentrated to the central and southern areas of the island. Land has been cleared in the eastern side of the island for agricultural purposes.
The island consists of typical Maldivian flora and fauna such as coconut palms, breadfruit trees, beach hibiscus, portia, sea trumpet, pemphis, sea lettuce and screw pine. Sea hibiscus plants were observed in abundance surrounding the proposed site.

Figure 91: Terrestrial vegetation of HDH. Hirimaradhoo. D shows the mangrove area in the southeastern region of the island. The mangrove area has been extensively damaged

Figure 92: Changes to the coastal region of Hirimaradhoo from 2006 to 2016

Changes to the shoreline of Hirimaradhoo from 2006 to 2016 is show in **Figure 92**. Major changes are seen to the coastline of the southeastern side of the island. The harbor dredging works started in 2013 and the harbor was inaugurated in 2016. Dredged material from the excavations were used to replenish the south eastern coastline, thus the observed changes. **Figure 93** (C and D) shows these aforementioned areas. **Figure 93** (A) shows the coastal area closest to the proposed site. An erosion scarp was visible at the time of visit. Beachrock outcrop was also visible at the south eastern coastal areas.

Figure 93: Coastal areas of HDH. Hirimaradhoo

32.2 PROJECT SITE

The proposed Island Waste Management Centre (IWMC) is located in the southern end of the island. The site is accessible by Rah Dhebai Magu, as well as Mirihi Magu. The site is located next to cleared areas with excavated material stockpiled. North West of the site is the FENAKA powerhouse, while the football ground is North East of the site. The site has an area of 25 m by 25 m.

The site has been cleared, and does not contain any vegetation whatsoever. The site and surrounding areas were previously used to agricultural purposes. The ground has been filled with excavated material up to the current level.

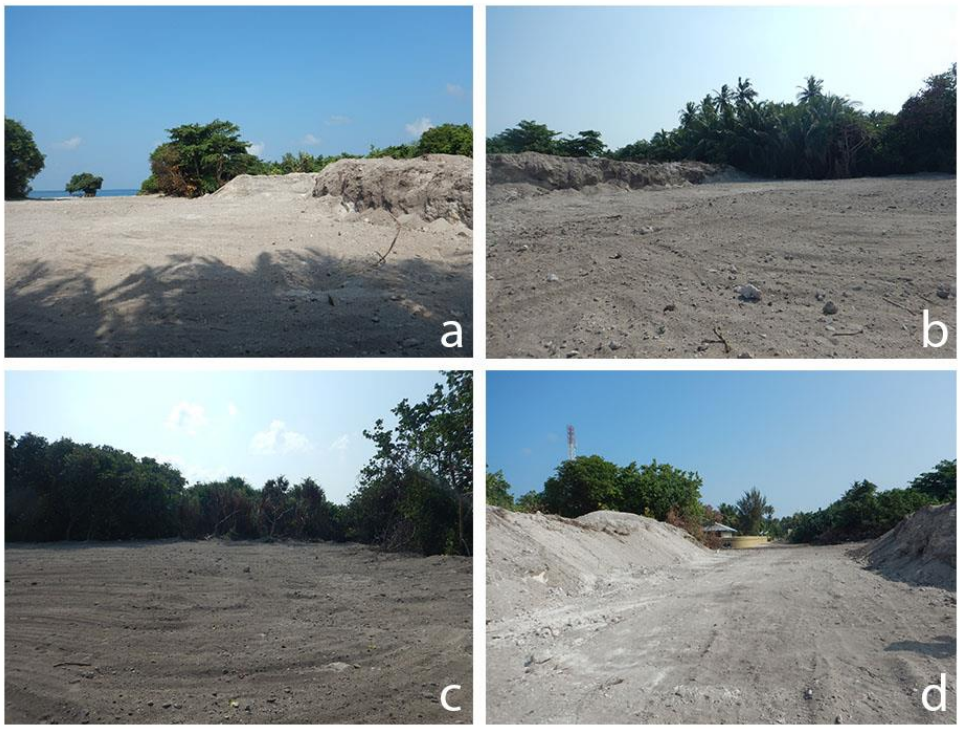

Figure 94: Site area with few shrubs and unpaved access road (B)

32.2.1 Site zoning recommendations by EPA

The EPA has provided recommendations for the optimum zoning of the IWMC site. The distances include, the site being at least 15 m from the coastal vegetation belt, at least 30 m from the nearest freshwater well, at least 40 m from the nearest recreational area and at least 30 m from the wetlands as well as the residential 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 108: Comparison between the proposed site location and EPA recommended distances

Location	Distance from site (m)	EPA Recommended Distance (m)
Coastal vegetation	49	15
Freshwater well	124	30
Recreational area	None nearby	40
Wetlands	111.5	30
Residential area	124	30

As seen on **Table 108**, the site fulfils the EPA recommended buffer distances. It should also be noted that the site has been located at the southern end of the island. As Maldives experiences strong westerly and south-westerly winds during the southwest monsoon, and north easterly winds during the northeast monsoon, the site is determined to be located in an optimum location where the impacts of odour and other possible health impacts due to particulate matter being carried by wind towards the residential areas are greatly reduced.

32.3 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were held for the project with the proponent MEE, enforcing agency EPA and the Island Councils of the respective islands. Meetings with MEE and EPA were held both before and after the survey trips in light of findings regarding some project islands. The initial meetings were mainly regarding the EIA project islands and scoping, although, due to the similar scope of works (except vegetation removal in the EMP islands' cases) the meetings included discussion of the project as a whole. Highlights of the meetings which apply to the EMP islands are presented below. Meeting attendances are provided in **Annex 3**

32.3.1 Meeting with Proponent

- The proponent was consulted at the start of the assignment to discuss project scope and after field surveys to discuss findings of the initial field surveys.
- Proponent informed that MEE will be responsible for the construction of IWMC, while land clearance shall be undertaken by the respective Island Councils.

32.3.2 Meeting with EPA

- It was highlighted that waste management will not involve burning waste at the island level. Waste from islands will be transferred to the regional waste management center. Only organic waste will be managed at the island level to make compost. All necessary equipment required to manage waste at in the IWMC will be provided as part of the project.
- EPA informed that buffer distances recommended by EPA in the zoning form shall be kept in order to mitigate impacts.

32.3.3 Meeting with Island Council

- Council stated that there are no dumpsites demarcated for waste disposal.
- Therefore, waste disposal is done at the periphery of the residential zones. A large number of tree trunks have been disposed in the southern beach area.
- An area has been cleared in the southern side of the island. This area was previously used for farming. The area has been filled to the current level using excavated sand.
- A wetlands area is present in the island, although the Council states that the area was heavily damaged during the 2004 tsunami
- The Council stated that the current harbor cannot be accessed by a barge, and another area needs to be used.

- The Council stated that the current site selected has been chosen considering issues such as wind directions propagating odors / particles towards residential zones.

33 ASSESSING THE LIKELY IMPACTS AND MITIGATION MEASURES

33.1 METHODOLOGY, NATURE AND IDENTIFICATION OF IMPACTS

Various impacts arising from the project such as direct, indirect and cumulative impacts have been identified. The methodology was based on:

a) Scoping meeting with stakeholders;
b) Observations made during the visit of the project island and site
c) Literature review of similar local and other EMPs; and
d) Findings from other similar projects in Maldives and experience of the Consultant.

Impacts on the environment were identified based on their location/attribute, magnitude and duration of the impact. Impacts were assessed based on their significance and categorized as negligible, minor moderate and adverse. A Leopold Matrix was used for this purpose, for both the construction and operation phase.

The Leopold Matrix was developed by Leopold et al. (1971). It is a quantified Matrix which consists of 100 project actions and 88 environmental characteristics, elements and conditions. Relevant environmental characteristics and project actions were used for the impact identification. First of all, all of the relevant activities of the project that may have an impact on the environment was identified and written on the top of the matrix. These were divided for both the implementation and operational phase of the project. The environmental characteristics that may be affected by the project is written at the left side of the matrix.

A slash is placed at the interSection with each item on the side of the matrix if an impact is possible. The upper left corner of each box where an impact is possible, a number from 1 to 10 is written as the *magnitude* of the possible impact. The number 1 represents the least possible impact and the number 10 represents the highest magnitude of the possible impact. No 0's are used in the Leopold Matrix. A + sign is placed before the number if the possible impact is a positive impact. No sign is placed before possible negative impacts. In the bottom right corner of the box, a number from 1 to 10 is written as the *importance* of the possible impact. 1 being the least important and 10 being of the greatest importance. In giving scores, the magnitude and importance of the activities were judged for their short term and long term impacts. The impacts with greater long term impacts were given higher scores compared to the impacts with more short term impacts.

33.2 POTENTIAL IMPACTS AND MITIGATION MEASURE FOR KEY IMPACTS

For every minor to moderate to major impact identified, a mitigation measure has been proposed and discussed below. The mitigation measures proposed would be strictly adhered to eliminate environmental impacts arising from the project, even before it occurs. The impacts and mitigation measures are detailed in the two stages, construction and operational stages as explained below.
The possible mitigation measures include:

a) Changes in work practices and increasing awareness;
b) Provision of environmental protection and health safety equipment; and
c) Environmental monitoring during construction phase and operational.

Mitigation measures suggested in the report will focus on the existing environmental conditions as well as impacts that may rise during operation of the IWMC.

Table 109: Impact Matrix for Construction Phase									
	Envisaged impact factors	C1 Worker Influx and Settlement	C2 Transportation of materials	C3 Site Demarcation & Fencing	C4 Site Clearance and Earthworks	C5 Construction	C6 Waste Generation	C7 Resource Consumption (Water, Electricity)	Total (Impact Area)
Physical Components	Seawater	-2					-3		-5
		1					4		5
	Ground water	-3			-2	-3	-3	-5	-16
		1			3	4	3	5	16
	Air	-3	-3	-2	-3	-3	-2	-3	-19
		2	3	2	4	3	4	3	21
	Noise	-2		-1	-2	-2	-2		-9
		1		2	3	4	2		12
	Coastal Zone							-1	-1
								1	1
Biological Components	Flora	-2	-1		-1	-1	-2	-3	-10
		2	3		4	2	5	2	18
	Endangered species/protected areas		-2		-1				-3
			2		5				7
	Coral Reef						-1		-1
							1		1
	Fauna		-2		-1	-3	-2		-9
			2		4	3	3		12
Socio-Cultural Component	Aesthetics	-2	-3		-2	-4			-11
		2	3		3	5			13
	Accidents	-1	-7	-2	-1	-3	-2	-1	-17
		1	5	1	2	4	2	1	16
	Landscape				-1	-3			-4
					2	4			6
	Health/Well being	-1	-5	-1	-4	-3	-3		-17
		1	5	2	3	3	4		18
	Local economy	4	4	1	6	7		-2	20
		1	4	2	6	5		2	20
Total (Construction Activity/Risk)		-12	-19	-5	-12	-18	-20	-15	
		12	27	9	39	37	28	14	

33.2.1 Impacts and Mitigation from Construction Phase

33.2.1.1 C1 Worker Influx and Settlement

An estimated 10 workers will be required for this project. The influx of workers can have a negative impact to the environment such as damage to vegetation, sensitive areas, and fauna of the island. This can be both intentional and unintentional.

Worker related impacts can include the requirement of building a temporary worker's camp, which can then lead to the set up of temporary waste, sanitation and water systems for the workers. For the duration of the project, the workers related waste output is detailed in **Section 31.3.12**. For this project, this impact can be reduced through the following mitigation measures. The project island currently has vacant properties as well as rooms to let in other houses, which can easily house the influx of 10 workers. Therefore no new facilities will be made for the accommodation of the workers. Other impacts include the increased use of resources by the workers in the island. This can be mitigated by choosing local contractors operating on the island.

In addition to this, when a new group of foreign workers arrive on the island conflicts can arise with the resident population in the instances where local culture is overlooked or not respected.

Mitigation for impacts on flora and fauna

- The contractor is required to keep the workforce as a minimum as possible, and to not bring in any surplus workers for the project;
- House rules shall be formulated by the contractor and workers shall be oriented on the rules and conduct during the project works;
- Workers shall be given instructions on the sensitive and protected areas of the island;
- 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

- Encourage choosing of local workers to reduce increased demand of resources; and
- Onsite generator for meeting electrical needs for the construction works

Mitigation for sociocultural impacts

- Hire local workers where possible;
- Orient foreign workers on communication, personal hygiene and sanitation in addition to the prevention of STDs and other infectious diseases; and
- Ensure all foreign workers have their legal permits.

33.2.1.2 C2 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 . Reduction of the transportation distance from the source to the project island is proposed. As the resource sourcing hierarchy in **Figure 95** shows, the greatest importance shall be placed on sourcing any available materials from within the island, with the next option being from within the north region, from islands such as HDH. Kulhudhuffushi. At the time of the site visit, HDH. Hirimaradhoo has a pile of excavated sand is present which can be procured for use in concreting works. 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.

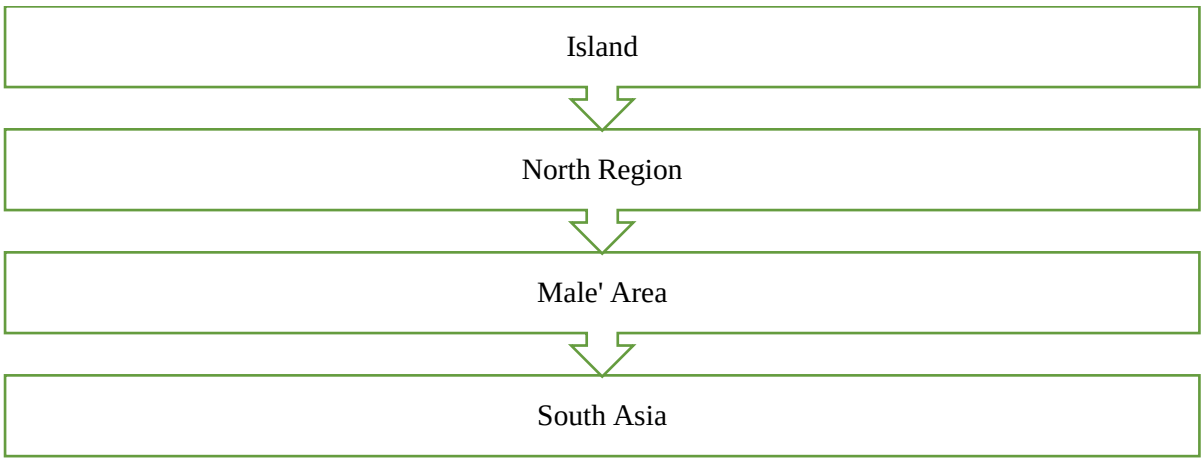

Figure 95: Material sourcing hierarchy proposed for the project

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 **Section 31.5** 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. Therefore for this project, an estimated 100.1 kg of CO2 emissions are expected for the concrete casted. 3136 kg of indirect CO2 emissions (Defra / DECC, 2012) occur per tonne of PVC pipe produced. For this project, the amount of indirect CO2 emissions are estimated at 164.8 kg. The greatest indirect CO2 emissions are estimated from the usage of reinforcing steel. 1.5 tonnes of reinforcing steel are estimated to be used for this project, which can cause a release of indirect CO2 emissions of 5311 kg (Ma et al, 2016). 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. At the time of visit, some roads of Hirimaradhoo were observed to be damaged by the use of heavy vehicles used in earthworks.

Figure 96: Impact on roads from heavy vehicle transport in an island in Maldives

For the purpose of this project, no heavy vehicles are proposed for either construction or earthworks. Although this is the case, a pickup truck will be used to transport the construction materials to 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.

Mitigation for climate impacts

- Sourcing of materials shall be done according to the hierarchy presented in **Figure 95**.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;
- The contractor shall use serviced vehicles and plant equipment for the project;
- The contractor shall only use the needed amount of vehicles and plant for project; and
- The 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. Oversized heavy vehicles are not required for this project, therefore such vehicles shall not be used in the island for transportation and construction purposes;
- 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

- The vehicle drivers shall be licensed and competent;
- The loads being transferred shall be fully secured; and
- The transportation shall be done during day time.

Mitigation for marine and terrestrial pollution

- The contractor shall clean any littering on the terrestrial or marine environment caused during transportation;
- The contractor shall enforce strict policy against littering and appropriate penalties; and
- Spill kits shall be made available in cases of spillage of hazardous wastes, and hazardous waste storage shall be provided.

33.2.1.3 C3 Site Demarcation & Fencing

Site demarcation and preparation involves, land surveying of the area and setting out the limits of the project plot, and identifying trees that needs to be removed or relocated. This activity is considered to have minor environmental impacts as it is largely noninvasive. As the proposed site has been cleared, there will be no further vegetation removal in Hirimaradhoo.
However, improper or inaccurate demarcation and labelling could result in removal of untargeted trees which could result in having to remove more number of trees than that are required.

Mitigation Measures

- 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;
- accurate and reliable equipment shall be used to minimize errors;
- wearing, clothes/helmets to protect against thorns and freefalling coconuts and wearing protective clothing;
- carrying out the works during the day time; and
- ensure mosquito repellants are available for the workers.

33.2.1.4 C4 Site Clearing and Earthworks

The site has been fully cleared of any vegetation, and does not contain any mature, juvenile or young vegetation. Neither does the site contain any weeds or shrubs. The site and surrounding areas were previously used to farming purposes, and the ground level was reported to be lower when used for farming, than observed during the field visit. The ground has been filled with excavated material up to the current level. Therefore for the proposed project, earthworks such as excavations for the foundation, well, leachate tank and grading of the IWMC will commence.

Mitigation Measures

- Site shall be demarcated and fenced off prior to earthworks; and
- Excavated material used as backfilling and in grading of the site.

33.2.1.5 C5 Construction

Material Storage

This includes, storing all the vehicles, machineries, and tools required for the land clearance and IWMC construction. Due to the nature of the project, a lot of construction materials are not required. Apart from the vehicles and tools, fuel and water will be required for storage. Fuel will be stored on the cleared land in tanks that. Vehicles will be stored inside the fenced plot area. Tools and equipment will be stored in the tool shed within the fenced land plot. The project does not require land clearance or construction of extra building for material storage, hence the impacts arising from this activity is considered to be minimal. However, there is a risk of accidents, such as fires, oil spills and trespassing. These could be easily mitigated by implementing appropriate measures.

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 minor, due to the distance provided between the residential areas and the project site.

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 110: 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 67 dBA at 400

ft, which is the approximate distance from the centre of the IWMC to the nearest residential area. This is expected to further decrease taking into consideration the vegetation, and obstacles surrounding the proposed site, as well as the soil characteristics of the ground. It should be noted that the FENAKA powerhouse is located further north than the proposed site, closer to the households.

Noise during construction is determined to be a short term negative impact. Due to the distance of the project site and the surrounding vegetation, 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.

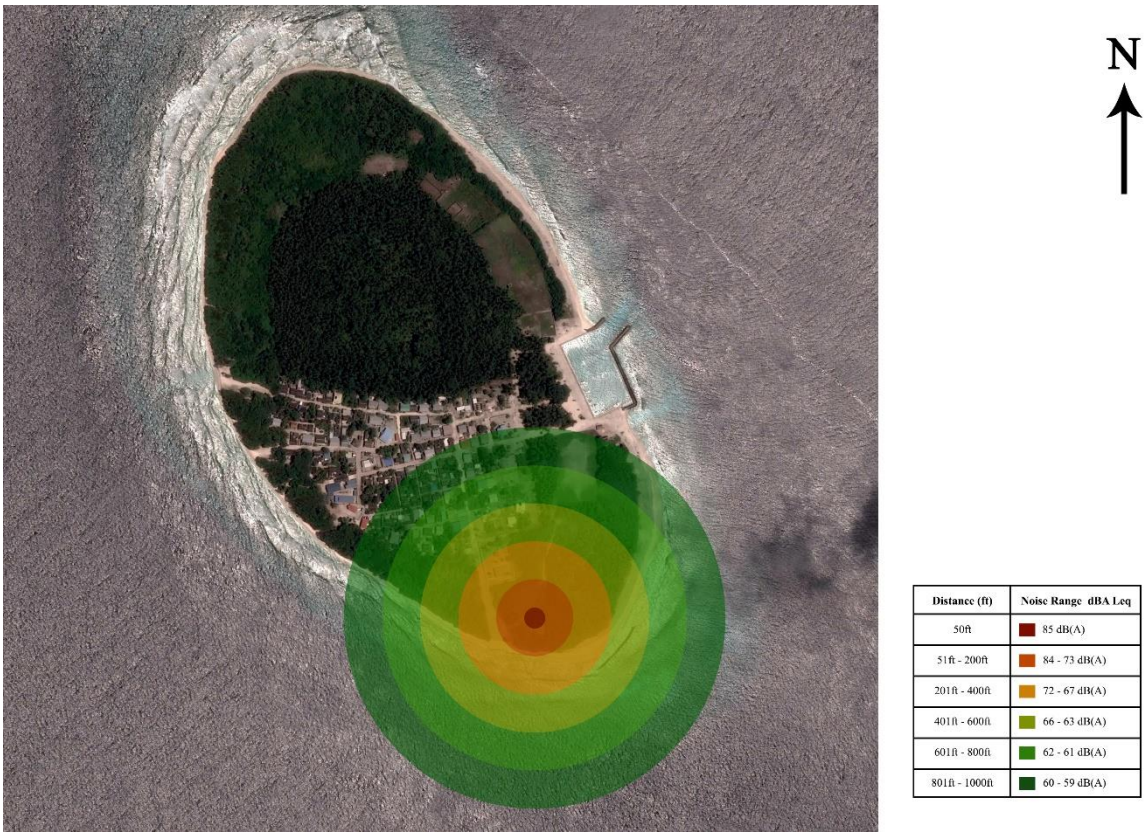

Figure 97: Noise range map for HDH. Hirimaradhoo

Impact on vegetation

The impact and measures on vegetation have been discussed in **Section 33.2.1.4**. No other structures, temporary, or permanent are proposed to be built for this project (such as workers' camp). Therefore the activities of this project is not expected to have a significant impact on the vegetation of the island.

Accidents and injuries

Accidents and risks (hazards) are important elements that need to be properly assessed, identified and analysed for what could happen if a hazard or accident occurs during and post development of the project. There could be many risks (hazards) and accidents to consider associated with many possible scenarios that could unfold depending on time, magnitude and the location it occurs. Hazards during construction 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 trenches and seriously injuring themselves.
- Being struck by moving equipment and vehicles.

Mitigation for material storage impacts

- Equipment shall be stored in fenced areas and maintained appropriately during the cause 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 Liquid Petroleum Gas (LPG) bottles and cleaning solvents and chemicals will be closed off from public access. Fire extinguishers and instruction in case of fire will be located in all the public, industrial and staff accommodation areas;
- portable extinguishers placed to be readily available when someone finds a fire;
- closed off non-public storage areas will be provided for inflammable goods (fuel drums, portable fuel containers, LP gas bottles, cleaning solvents etc.) with NO SMOKING, NO NAKED LIGHTS, HIGHLY FLAMMABLE sign boards in both English and Dhivehi languages;
- 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.

Mitigation for terrestrial pollution

- Set up a temporary waste disposal area within the project site;
- Regularly collect litter and dispose at the temporary waste disposal area;
- Hazardous waste shall be placed in enclosed containers;
- Vehicle maintenance shall be carried out on paved areas; and
- After the construction works are completed, transfer all collected waste to Thilafushi

Mitigation for noise and vibration impacts

- Provide workers with noise cancelling headphones.
- Use quieted equipment where possible, such as mufflers on engines;
- Use of well serviced vehicles and plant; and
- Switching off equipment and vehicles when not in use.

Mitigation for impact on vegetation

- Setting out survey shall be done by the contractor and the site limits shall be demarcated prior to any construction or clearing works;
- Fence off the site in order to avoid the removal of any vegetation out of bounds of the project site; and
- Allocate temporary stockpile area within the site, which is free from vegetation

Mitigation for accidents and injuries

- The contractor shall be required to develop occupational safety management plan, and safety guidelines shall be displayed in the work site at all times;
- Occupational safety training should be given to all workers present on site;
- Workers should be provided Personal Protective Equipment and the use of PPE shall be enforced;
- Site visitors 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.

33.2.1.6 C6 Waste Generation

Solid waste generated during land clearance and IWMC construction work would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite. Waste burned onsite would generate smoke, possibly impacting negatively on ambient air quality and human health. On the other hand, if all site clearance waste is to be transported this would also result in requiring burning fossil fuels and would require significant finance. 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.
On site generator and vehicle 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 and solvents. 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 1.2 kg will be produced daily if approximately 10 workers were active which equates to discharge of approximately 1,700 l/day of waste water. Sewage will be managed through existing sewage systems that have been installed in the islands

Since there is no existing waste management system in the atoll or since the existing island level waste management dumpsites are not sufficient 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.

<u>Mitigation Measures</u>

- Ensure to manage waste as described in **Section 31.3.12** of the report;
- open defecation whether it's on land or on the beach shall be prohibited;
- waste other than sewage shall not be flushed down the toilet;

- ensure to reduce waste by following the 3R steps; and
- waste collected shall be transported to Thilafushi after the construction works have ended.

33.2.1.7 C7 Resource Use

During the construction phase, machineries and vehicles used will consume fuel. Notable impacts of this activity include, increased air pollution, risk of spillage, impacts to health/wellbeing and accidents. The primary pollutants generated due to power production from diesel based generator system include Nitrogen oxides (NO_X), Sulphur dioxide (SO_2), Carbon monoxide (CO), Hydrocarbons/ Polycyclic Aromatic Hydrocarbons (HC/PAH), Particles (PA) and Carbon dioxide (CO_2) in the form of emission although the exact amount is difficult to quantify.

The visible pollution generated by burning diesel contains elemental carbon as soot. The typical odour comes from polycyclic aromatic hydrocarbons, which also are cancer causing components.

Due to the scale of these activities, the machineries won't be used for long periods of time. This would significantly reduce the impact of electricity generation. IWMC construction stage as well as land clearance stage will not use heavy vehicles and equipment extensively.

Water used during construction will be sourced by the contractor, from available groundwater wells. Water used for drinking and cooking will be purchased from local shops or collected from existing rainwater tanks or from the groundwater well in the island. Water and electricity consumption for the project is considered to be minor.

Mitigation

- Initiate rainwater collection and storage as early as possible into the project construction;
- turn off the tap while washing your hands;
- use salt water to wash dishes and only use rainwater to rinse them;
- water conservation devices shall be used;
- use well maintained, energy efficient equipment. The emission of carbon dioxide is directly related to the amount of fuel used. High efficiency is therefore important to reduce the amount of released carbon dioxide and consequently to reduce the global greenhouse effect;
- reduce idle time of machineries and vehicles. Switch them off after use;
- utilize day time hours for the construction when plenty of light is available; and
- FENAKA power supply will be used for electricity generating purposes.

Table 111: Impact identification matrix for operational phase

	Envisaged impact factors	O1 Waste collection and transportation	O2 Waste sorting, separating, storing and compost making	O3 Waste Generation	O4 Resource consumption (water/electricity)	Total (Impact Area)
Physical Components	Seawater	4				4
		4				4
	Ground water	5	-2	-1		0
		3	2	5		12
	Air	-3	-2	-2	-4	-14
		5	3	2	4	16
	Noise	-3	-1			-4
		4	2			6
	Coastal Zone					0
						0
Biological Components	Flora	6	7	-1	-3	4
		2	6	1	4	18
	Fauna	5	5	-1	-3	3
		5	5	1	4	19
Socio-Cultural Component	Aesthetics	6	8			9
		6	6			17
	Accidents	-4	-4		-6	-20
		4	4		5	19
	Landscape	5	6	-1		5
		6	5	2		18
	Health/Well being	5	-5	-2	-3	-7
		6	5	2	8	23
	Cultural heritage					0
						0
	Local economy	-3	8	-2	-1	5
		9	2	4	1	19
Total (operational Phase Activity/Risk)		23	20	-10	-20	
		54	40	17	26	

33.2.2 Impacts and Mitigation from Operational Phase

33.2.2.1 O1 Waste Collection and Transportation

As stated in this report, currently HDH. Hirimaradhoo has no dumpsite demarcated for waste dumping. This has resulting in the public disposing of waste in various locations of the island, including the southern beach and the periphery of the residential areas. Current practices also include burning of the waste at various locations of the island, which can lead to respiratory issues from the inhalation of smoke. The successful implementation of the IWMC and the Waste Management Plan will lead to the reduction of the littering and burning of waste throughout the island as well as marine pollution. This will lead to the improved health and psychological well-being of the residents and visitors of Hirimaradhoo, in addition to the improvement of the terrestrial and nearshore marine environments. It has been identified as a long term positive impact on the residents and visitors of Hirimaradhoo.

A vehicle will be used to collect and transport the waste within the island daily, at a set schedule. This is identified as a minor impact in terms of noise, due to the fact no receptor will be exposed to the noise for long durations of time.

Waste Collection and Transportation is identified to have a positive impact on the island.

Measures to ensure and enhance the positive impacts

- The Island Council shall get approval by the EPA for the Waste Management Plan formulated for the next five years
- The Island Council shall formulate and gazette the Waste Management Regulation and Waste Management Guidelines for the island;
- The aforementioned regulation and guidelines shall state the penalties on persons that do not act according to the regulation and guidelines (i.e. littering, burning and dumping of wastes elsewhere), and Island Council shall enforce the penalties as prescribed;
- The proponent and Island Council shall follow the management plan provided with the EMP in order to monitor the operations of the IWMC, and bring about any necessary changes to the operations and policies, in addition to providing any needed technical assistance for the island;
- The proponent shall review the waste management operations within the islands regularly and update the National Waste Database;
- The 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;
- Polluter pays principle established in order to reduce the waste generation within the island;
- The proponent shall provide resources in terms of budgetary allocations, required equipment, and technical expertise to ensure the operation of the IWMC; and
- The proponent shall assist in creating markets / avenues where the IWMC's can generate income through selling compost and recycled metals, plastics and glass.

Mitigation for terrestrial pollution

- Implement rules within the IWMC workers to impose penalties for any littering within the island due to improper handling of the waste and improper transport practices; and
- The status of the vehicle shall conform to the Waste Management Regulations 2013/R-58 and provide cover to the waste being transported in order to avoid littering.

Mitigation for accidents and injuries

- The vehicle should be driven by licensed drivers; and
- A strict schedule shall be stated in the WMP and followed in order to reduce the transportation frequency thus reducing the probability of accidents.

Mitigation for air quality impacts

- Spray the roads with water during the dry season to suppress dust;
- 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 Waste Management Plan;

33.2.2.2 O2 Waste Management Activities

Waste sorting, separating storing and composting make up the largest portion of the IWM concept. On top of reducing the volume of waste, these activities, convert waste to re-sable and value added products. These activities will be carried out in the IWMC where employees will be trained to undertake these 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. Hazardous chemicals that get into the soil (contaminants) can harm plants when they take up the contamination through their roots. If humans eat plants and animals that have been in contact with such polluted soils, there can be negative impact on their health.

All these impacts can be mitigated and prevented by the proposed IWM concept. However, if these activities are not properly implemented there is a risk of IWMC being deteriorated into a dump site where mixed waste are disposed, burned and buried. The risk is more prominent for islands where the population size is greater. This means without proper mitigation measures and regular transportation of waste out of the island to a central waste management facility, there is a greater risk of IWMC being overfilled. More so considering that IWMC is equipped to handle only about 20-30% of organic waste generated in the islands 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 IWMC 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 / m^3 close to the composting site and dropped to background levels within 550m 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 / m^3), 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 112: 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 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 IWMC are not as large scale as the studies cited above. The composting capacity of the IWMC is expected to be two windrows of approximately 39 m^3, each batch to take around 4 – 6 months to mature. 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 IWMC becoming a makeshift waste dumpsite for organics are also addressed in the Section.

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. 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 odours.

The operation of the IWMC 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 IWMC), 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 IWMC 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 from composting

The main gas by product from the composting is CO2. In anaerobic conditions, methane is released into the atmosphere, which has a higher greenhouse warming potential compared to 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 dumped;

Amenity Impacts

The IWMC 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.

As the proposed site is close to the coastal area with little protection, wind can blow the materials off the compost heaps as well as the other stockpiled waste types out of the IWMC, which can degrade the local amenity. This impact is mitigated through the design of the IWMC perimeter walls which include a perimeter fence made of 50 × 50 PVC coated mesh.

Littering inside the IWMC can cause amenity issues such as tracking of litter on the wheels of the waste transport vehicles leaving the IWMC. 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 113: Odours generated from the composting process (Source: Goldstein (2002))

Compound	Description of smell	Detection limit for a particular odour panel ($\mu g/m^3$)
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

The current practices of dumping waste all around the island will be replaced with the collection and disposal of the waste at the proposed IWMC site. This site is 124 m away from the nearest residential site, and is located in such a way that the monsoonal winds will not carry the odour towards the residential areas. Therefore the impact of odour on the residential areas are deemed minimal.

Fire hazards

There is a possibility of fire hazards at the IWMC 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 IWMC.

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 97** can be used for this purpose too. The map shows that the noise reduces to a maximum level of 67 dBA near the residential areas. This calculation does not take into account the dampening effects of the surrounding vegetation as well as obstacles. Therefore, the long term negative impacts of noise would be borne by the employees of the IWMC, and the effects of noise to the residential areas are minimal

Workplace safety and accidents

The group of people most likely to be impacted by the IWMC 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 guidelines 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.

Mitigation for health impacts

- A distance of 124 m is available between the IWMC and the nearest residential area, which can act as a buffer zone, and is greater than the buffer zone recommend by the EPA;
- The siting of the IWMC is at the southern region of the island. Due to this location, the residential areas are well shielded from both the particulate matter that can disperse with the winds of the south west monsoon and the winds of the north east monsoon;
- The IWMC operator shall plan material handling processes in downwind of the residential zones;
- Ponding shall be minimized at the site by grading of the ground;
- Handling of compost shall be minimized;
- Compost turning shall be done based on temperatures and not on schedules;
- Material movements and compost turning shall be done during low winds. Weekends, holidays and times of the day when most people are likely to be outside (and use of recreational / public spaces) shall be avoided when handling the materials and turning compost;
- Add moisture to the compost to minimize dust;
- Add a geofabric cover over the compost windrow to minimize release of bio aerosols;
- Workers shall follow the workplace safety mechanisms and guidelines set by the contractor and practice safety and personal hygiene when handling the compost.

Mitigation for 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.

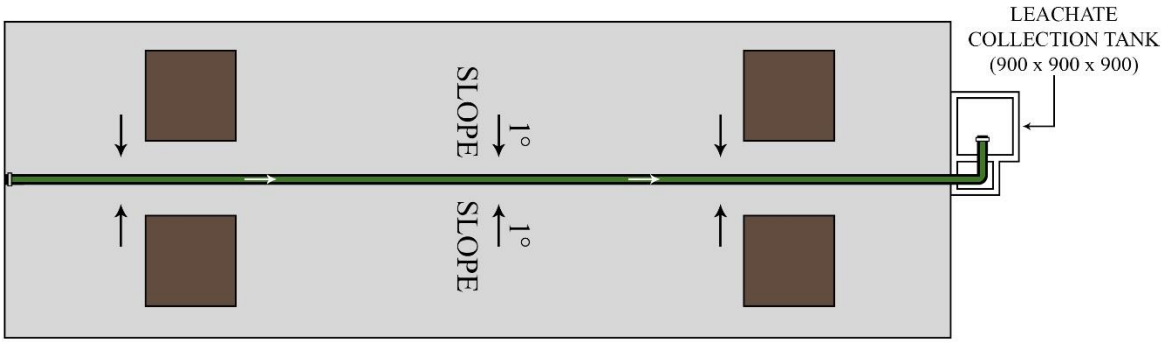

Figure 98: Compost slab design and leachate collection system (Plan view)

Mitigation for rainfall related leachate production

The current design of the IWMC consists of a composting slab is an open windrow composting system. The compost windrow is kept on the compost slab which is sloped in such a way that the leachate from the compost will collect at the pipe in the centre, which will propagate the leachate into the leachate collection tank (see **Figure 98**). While this scenario is ideal during fair weather, heavy rainfall and strong winds should also be considered. There is a possibility of heavy rainfall increasing the produced leachate, as well as the water collected over the composting slab propagating to the leachate collection tank. This can cause an overflow of the leachate collection tank, releasing its contents into the ground and subsequently the groundwater aquifer.

The rainfall can also cause the scattering of the compost materials, the increased water content in the compost windrow can cause another issue: the saturation of the windrow can decrease the available oxygen within the compost windrow, leading to anaerobic conditions.

- There is a valve placed at the inlet pipe which can be closed in instances where the leachate tank may overflow from heavy rainfall onto the compost slab;
- The 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;
- A 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.

Figure 99: Windrow cover being utilised in an open composting system (source: Midwestbiosystems.com)

Keeping stockpiles of raw organics low

Stockpiles of raw organics (waiting to be processed or transported) can cause impacts such as foul odour from the biodegrading organics, leachate reaching and contaminating groundwater, issue of vermin and pests, and visual impacts from the stockpiles.

As per the design of the IWMC, there are compartments for the storage of all major waste types other than organic wastes. A dedicated slab is provided for the composting of the organic waste materials. As per the calculations in Section 31.4.6 it is seen that the composting slab has the capacity for composting 1.5 month's organic waste produced in the island. As the composting process may take between 4 – 6 months (Halliburton, 2002), the remaining months' organic wastes can accumulate unmanaged and without any means of storage.

The consultant proposes the following mitigation measures:

- Arrangements to regularly transport the unmanaged waste to a central waste management facility; and
- In cases where the waste cannot be transported due to delays and unforeseen circumstances, it is not recommended to stockpile the unmanaged waste on the ground, without any cover. As per the area of the IWMC, there is a capacity to arrange up to 25 nos. 660 L wheelie bins to store unmanaged organic wastes. It is also recommended to separate the putrescible waste from the green waste while storing in the wheelie bins. While this mitigation is not the most ideal, it is seen as the option with the least impact, pertaining to the resources available to the islands and the difficulty in transportation. Alternative transfer arrangements shall be made within this duration.

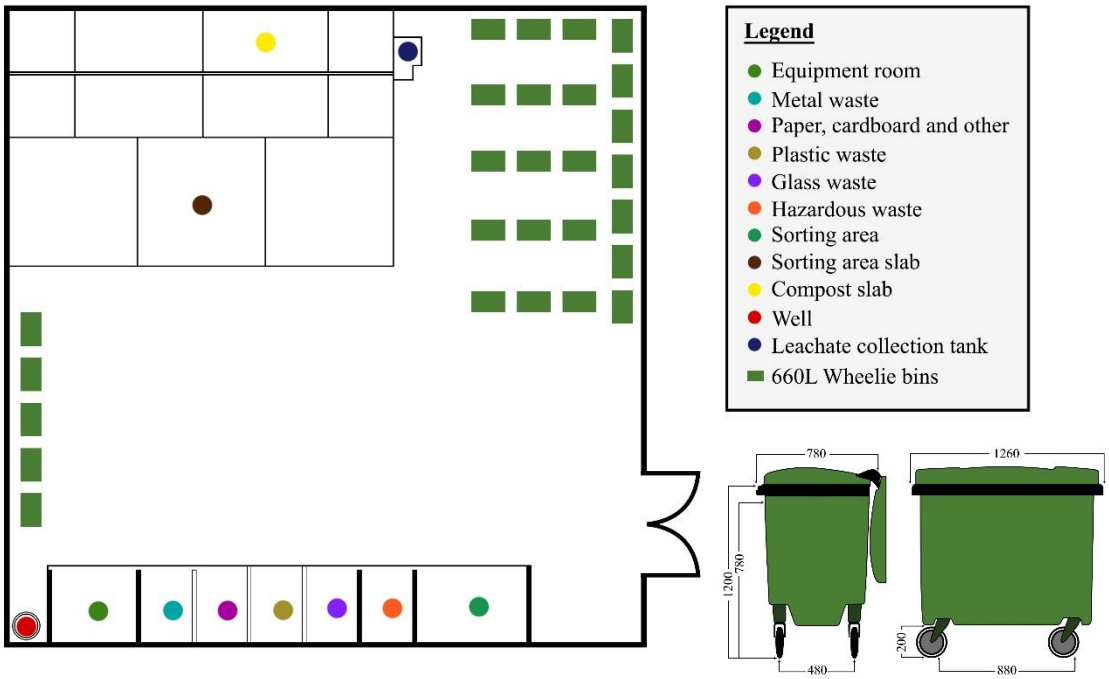

Figure 100: Proposed wheelie bin arrangement to provide for temporary storage of unmanaged organics

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. 660L wheelie 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 IWMC 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 IWMC, with the provision of a 2.8m high 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 IWMC. 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 IWMC.

Mitigation for odour 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 15cm 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 below 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.

Mitigation for fire hazards

- A fire management plan shall be developed by the IWMC occupier;
- Adequate firefighting equipment shall be provided at the IWMC, and placed at locations easy to access;
- The IWMC occupier shall be able to show that firefighting capacity of the IWMC is sufficient to suppress and minimize the incidence and impact of fires; and
- Workers shall be trained to use the firefighting equipment and able to manage fire outbreaks.
- 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.

Mitigation for workplace accidents

- The IWMC 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 and instructions to employees on how to operate any machinery;
- Instruct employees on safe systems of work;
- 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.

Figure 101: Recommended protective clothing for waste management employees. Adapted From: Ministry of Health, Thailand. Bangkok, 1995. *noise cancelling headphones and safety glasses during use of machinery

Table 114: 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

33.2.2.3 O3 Waste Generation

Waste generated during the operational phase of the IWMC will be relatively low. These will include waste oil/batteries for waste management equipment. Since eating and cooking inside the IWMC will be prohibited, no mixed municipal waste will be generated during the operational phase of the project. Hence overall impact for this activity would have a minor negative impact on environmental receptors.

Mitigation Measures

- Closed containers shall be provided to manage hazardous wastes;
- Spill kits shall be provided to manage oil spills; and
- Prohibit eating/cooking in the IWMC.

33.2.2.4 O4 Resource Consumption

Water will mainly be required for washing equipment, work ware, hands etc. and to water the compost pile. Water required for moistening compost piles will be relatively small. As most of the moisture required for the compost pile will be sourced from the leachate collected from the leachate tank the volume of water required will be significantly less. It is estimated that approximately 200 -300 l/day of ground water will be required during the operational phase of the project. Since the volume of water required is relatively low, it is not expected to have a significant impact on groundwater.

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 empties, therefore resulting in lower transportation costs. Compactors and crushers 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 doesn'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 IWMC. Therefore. Electricity consumption of the IWMC 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.

Mitigation Measures

- 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.

Table 115: Impacts and proposed mitigation measures for the construction and operational phase of the project

No	Potential Risk/Impact	Receptor	Nature	Reversibility	Significance	Mitigation	Cost
	Description	**Description**	**Positive**	**Reversible**	**Major Negative**	**Description**	**USD**
					Major Positive		
			Negative		**Moderate**		
				Irreversible	**Minor**		
CONSTRUCTION PHASE (C)							
C1	Impacts from worker influx and settlement (flora and fauna, resource use and sociocultural impacts)	People of Hirimaradhoo, and terrestrial and marine environment	negative	Reversible	**Minor**	• See **Section 33.2.1.1**	Included in the construction costs.
C2	Impacts from transportation of materials. (climate impacts, and impacts on roads)	Residents of Hirimaradhoo, terrestrial and marine environment, global environment	negative	Reversible	**Minor**	• See **Section 33.2.1.2**	Included in the construction costs.
C3	Impacts from site demarcation and fencing (Impacts on flora and fauna)	Local flora and fauna	Negative	reversible	**Minor**	• See **Section 033.2.1.3**	Included in the construction costs.
C4	Impacts from site clearing and earthworks (terrestrial pollution, vegetation removal)	Vegetation of the site and surrounding areas	Negative	Reversible	**Minor**	• See **Section 33.2.1.4**	Included in the construction costs.
C5	Impacts from construction works (vegetation impacts, noise and vibration, accidents	Workers and residents of Hirimaradhoo	Negative	Reversible	**Minor**	• See **Section 033.2.1.5**	Included in the construction costs

	and injuries, pollution from material storage)						
C6	Terrestrial pollution from construction waste generation	Residents of Hirimaradhoo, ecosystem	Negative	Reversible	**Minor**	• See **Section 33.2.1.6**	Included in the construction costs
C7	Impacts from resource use	Residents of Hirimaradhoo, ecosystem	Negative	Reversible	**Minor**	• **See Section 33.2.1.7**	Included in the construction costs
OPERATIONAL PHASE							
O1	Waste collection and transportation (Climate impacts, air quality, amenity impacts)	Residents and visitors to Hirimaradhoo	Positive	Reversible	**Minor**	• See **Section 033.2.2.1**	Cost borne by operations contractor
O2	Waste management activities (Public health, noise, groundwater, fire, accidents, odour impacts)	Mostly IWMC workers, residents and visitors to Hirimaradhoo,	Positive	Reversible	**Minor**	• See **Section 33.2.2.2**	Cost borne by operations contractor
O3	Waste generation (terrestrial pollution, groundwater contamination)	Residents and visitors to Hirimaradhoo	Negative	Reversible	**Minor**	• 33.2.2.3	Cost borne by operations contractor
O4	Resource consumption (water and electricity)	Residents and visitors to Hirimaradhoo	Negative	Reversible	**Minor**	• See **Section 33.2.2.4**	Cost borne by operations contractor

34 PROJECT OPTION

34.1 ADVANTAGES AND DISADVANTAGES OF PROJECT OPTION

The advantages and disadvantages of conducting the project option are proposed below:

Table 116: Advantages and disadvantages of project option

Option	Environmental	Social	Economic
Project Option	The project does not involve any clearing of trees. The project site has been previously cleared It will generate a small amount waste and GHG. This would have minor negative impacts on the soil and environment of the island. However almost all the foreseeable impacts of the project can be mitigated and kept at an acceptable level and the project will not result in a loss of a sensitive or critical habitat or species. The project will provide the island ways to control and prevent further pollution of the environment, and facilitate utilisation of land area more effectively.	Increased direct and indirect employment opportunities for the locals as the IWMC 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 hence pollution of the island will be stopped or controlled. During the operational phase of the project, smell dust and smoke will be emitted from the IWMC. However, the project site is located at an acceptable distance from residential and public areas.	Enhanced opportunity for locals to start and diversify tourism related services, since a safe and clean island would facilitate and benefit any local tourism venture. Direct contribution to government revenue through taxes and duties. Creation of job opportunities and skilled labour in the region. Expansion of agriculture market in in the island. Agriculture is practiced in the island and therefore local demand is expected for the compost. Price and profit from agricultural produce will become more competitive due to availability of compost. Potential to attract foreign currency by selling compost, scrap metal and other recyclables which would develop the national economy. More settlers will be attracted to the island, which would promote the development of local public services and infrastructure.

35 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT PLAN

35.1 SCOPE

The chapter would present in detail the management measures put in place by the proponent and the contractor to mitigate the environmental impacts that would arise from the project activities. The assessment of impacts and mitigation measures that would be put in place had been discussed in detail in the previous chapter. The main scope or objectives of the environmental management plan are to:

a) Produce a framework for anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions during pre-construction, construction and operational phase; and
b) Provide evidence of conformity to laws and regulations and requirements of enforcement agencies.

35.2 ENVIRONMENTAL MANAGEMENT SYSTEM

The environmental management framework for the proposed project is based on the standards and policies set out by the Environmental Protection Agency of the Maldives under EIA Regulation 2012.

a) Environmental Management Planning and establishment of key performance indicators: The EMP specifies environmental management measures and required performance standards;
b) IWMC construction and operations: The aspects of the construction and operation will be established and operated according with the EMP;
c) Monitoring and corrective action: The implementation of EMP measures will be monitored during operational stage and will be reported. Any inconsistencies between the EMP and its on-site implementation will be identified and addressed through corrective actions; and
d) Auditing, reviews and enhancement: The EMP will be reviewed. Improvements to the EMP will be made as necessary to achieve desired environmental outcomes.

35.3 ENVIRONMENTAL MANAGEMENT STRUCTURE

This Sections detail the various parties involved in the implementation of the environmental plan and their responsibilities.

35.3.1 The Proponent, Ministry of Environment and Energy

MEE will be responsible for the execution of the project activities within the required timeframe. The scope of land clearance falls within the responsibility of the Island Council. MEE is also responsible of policy level decisions and provision of support regarding the waste management works undergone in the island as well as the regional level.

35.3.2 The Contractor

Contractors to construct the IWMC and clear land will be procured by MEE and Island Council respectively. The contractor will undertake the project in accordance with the EMP proposed in the EIA and will report to the proponent and environment consultant about any unexpected environmental impact or health and hazard issues. During the construction stages, the contractor will follow all mitigation and management measures proposed in the report, mainly waste management, pollution control, accident prevention and work methodology proposed.

35.3.3 Environmental Consultant

The environmental consultant would prepare the EMP based on field visits and surveys and based on past project experiences in similar settings. If there are any modifications to be made to the EMP during any stages of the project, the consultant would do the modification and would conduct the environmental monitoring according to the monitoring framework. The environmental consultants are also responsible for auditing the management/monitoring plan to identify gaps, limitation in management and propose remedial measures to ensure the project is sustainable.

35.3.4 Environmental Protection Agency

The Environmental Protection Agency would review the monitoring reports submitted by the proponent and would continue with regulatory monitoring visits to the project site upon their needs.

35.3.5 Island Council

The Island Council will be responsible for the following:

- Formulation and implementation of the EPA approved Waste Management Plan (WMP) for a period of 5 years.
- Formulation and gazetting of Waste Management Regulations for the island;
- Formulation and gazetting of Waste Management Guidelines for the island;
- Plays a role in the site selection in collaboration with other responsible parties;
- Responsible for the land clearing works of the proposed IWMC site; and
- Overseeing the operations of the IWMC

The Island Council is responsible to ensure the progress of the Waste Management Plan and achievement of the set goals through implementing the plan. This includes overseeing the IWMC operations by either running the operations through the Council or awarding the work to a contractor. As per the consultation meeting with the Island Council of HDH. Hirimaradhoo, the Island Council expects to conduct the IWMC operational works. The Island Council is also responsible for the compilation of the IWMC reports submitted by the contractor as well as producing an IWMC monitoring report as well as reporting of public grievances. These reports shall be submitted to the MEE bi-annually for review.

35.3.6 Operations Contractor (IWMC Occupier)

As per the consultation meeting with the Island Council, it was learnt that the Island Council plans to conduct the waste management works through a contractor.
The IWMC occupier will be responsible in running the operations in accordance with the guidelines set by this EMP and the approved WMP of Hirimaradhoo Council. The responsibilities of the occupier include producing the IWMC operations reports and submitting the reports at the proposed regularities.

35.4 REPORTING

Reporting will be carried out on a timely manner to implement the environmental management plan and will cover details of site conditions, and operations. A detailed reporting mechanism for the IWMC operational works is provided in Section 35.10. Monitoring reporting shall be carried out during the stated time frames and frequencies in Section 35.6.

35.5 ENVIRONMENTAL MANAGEMENT PLAN

A practical plan taking into consideration available resources is proposed to meet the aims and objectives of the EMP. One of the major risks to the investment and operation of the IWMC and island level waste management is the center itself which can be converted back into a dumpsite due to mismanagement as often seen in island level waste management endeavors all across the Maldives. This is partly due to the fact that a lot of linkages connecting island level waste management with regional level waste management are absent or unknown until it is much too late. As described in **Section 33.2.2.2**, one of the main risks facing the current project is rapid accumulation of organic waste at the IWMC. Hence the proposed IWMC management plan aims to control and mitigate such risks without severe negative impacts

Table 117:Details of environmental management plan proposed for the IWMC

Activity	Phase	Measures	Time frame	Responsible person
Training of workers and contractors	Pre-construction, Pre-operation	Contractor and project workers are provided with detailed information on the project, impact mitigation measures, compliance with environmental permits and the EMP. Workers are also provided with the information on sensitive areas of the island and other environmental issues. Training of staff involved in the monitoring of the construction phase Training shall be provided to the workers of the IWMC on the waste management practices and mitigation measures in order to ensure the operations are run efficiently and effectively.	Prior to construction works Prior to operational phase	Proponent Environmental Consultant
Documenting non-conformances and corrective actions	Construction Operation	Non-conformances to the environmental regulations, permits and the EMP is monitored and documented. Corrective measures are taken and follow ups are done. IWMC operations reports and public grievances are compiled by the Island Council and reported to the proponent within the prescribed frequencies as stated in **Table 118.**	Construction and Operation phase	Proponent Environmental Consultant Island Council
Supervision of activities	Construction Operation	The project activities are to be supervised by the proponent throughout the construction and operational phase to ensure the activities are carried out accordingly and the impacts are minimised. The proponent shall review the IWMC operations reports from the Island Councils, and provide the required support, bring about any necessary policy updates	Construction and Operation phase	Proponent Environmental Consultant

35.6 ENVIRONMENTAL MONITORING PLAN

Table 118: Impact management and monitoring plan for the construction and operation phase of the project

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
Ensuring that the project activities does not affect the quality of the groundwater	Establish baseline just before the construction works begin and continue monitoring as stated. Establish a groundwater monitoring stations and geo-reference it. Preferably close to the IWMC.	O	12,000 per trip	Potable water quality testing equipment and/ or by sending samples to the lab	During operational phase, bi annually	Proponent Environmental Consultant	Water quality report
Ensure waste generated at work site is audited and managed responsibly	Management of waste generated as described in **Section 31.3.12** of the report	C,O	Cost included in the project costs	Estimation of waste generated at project site and recording these data routinely. This includes quantifying and recording the amount of yard waste, hazardous waste and general waste stacked and stored for transportation.	Every two months	Construction contractor, IWMC Occupier	Record sheets, photographs and quantity of waste processed at Thilafushi/ (nearest waste management center) and IWMC. If there are no significant discrepancies between the quantity of waste generated on site and processed at a central waste management facility, it can be safely assumed that impacts of waste on the environment was reduced.
Monitoring Health and safety of workers and the public	Accidents during construction of IWMC, land clearance, operation of IWMC and maintenance of IWMC. Fire hazards and natural disaster events. Noise and smell complaints during operation and construction phase. Compost condition, output and quality	C, O	Cost included in the project cost	Keep records in a log book, or data sheet	Bi annually	IWMC Occupier Construction land clearance contractor	Measures to adapt and prevent accident and risks. Health assessment reports published or available from the local health center.

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
						Island Council MEE	Policy changes and upgrades. Compost quantity and quality. Income from selling compost.

35.7 RESOURCE REQUIREMENT FOR MONITORING

For the monitoring program to be successful, it is important that adequate financial and human resources are available and strong coordination among the key stakeholders is maintained.
The primary function of implementing the mitigation and monitoring plan will lie with the proponent and environmental consultant. Since the project at developmental and operational stage will be engaged by the proponent it will be the responsibility of the proponent to take care of the environmental safeguards at all stages of the project during implementation and at operational phase. The proponent should prepare an Environmental Action Plan, which states all measures for mitigation and enhancement and monitoring as described here in the EIA with their responsible organisation and person, planning, methodology, timing and other relevant aspects.
An independent registered environmental consultant shall be hired and contacted to undertake and audit the monitoring program prescribed in this report. Following each monitoring visit the consultant will prepare a report with clear recommendations and corrective measure if necessary. The report will have to be submitted to EPA for their review and actions.

35.8 MONITORING SCHEDULE

Table 118 highlights the monitoring plan in which responsibilities of main stakeholders has been assigned. In order to track and compile the findings of these measures an independent environmental consultant shall be tasked to audit the projects EMP. This is to

- identify gaps in monitoring and mitigating impacts arising from the project;
- determine the challenges and resource inadequacies to implement the proposed EMP; and
- determine the current environmental condition and propose modification/upgrades to the initial EMP.

Monitoring frequency for various individual components given **Table 118** shall be followed by all responsible parties. **Table 119** gives indicative timeline for the monitoring visits by third party consultant.

Table 119: Monitoring visit schedule

Visit	Indicative timeline	Indicative parameters to monitor	Reporting	Cost (MVR)/per report/island.
Visit 1	Prior to construction of IWMC	Set baseline for groundwater quality and noise	Submit summary report 1 to Proponent within 2 weeks	25,0000.00
Visit 2	During construction of IWMC	Monitor work method, waste management, Monitor health and safety of workers. Monitor impacts to nearby vegetation and ensure vegetation removal is as per set out survey. Review reports prepared by contractors.	Submit monitoring summary report 2 to Proponent (MEE) within 2 weeks	10,000.00
Visit 3	Two months into operation of the IWMC.	Monitor water quality and noise. Monitor IWMC. This includes review of	Submit summary report 3 to Proponent within 2 weeks	25,000.00

	Biannually for four years	reports dated in **Table 118** or determine condition of IWMC. Monitor compost condition as described in **Table 118** and **Table 118**		

As indicated, during the course of the Project implementation summary reports following each trip is expected to be submitted by the Project's environmental consultant. These environmental audits will provide a basis for assessing at least the shorter-term efficacy of the environmental measures and thereby provide lessons to be learned for future monitoring sessions and other projects with similar impacts. The consultant will prepare and submit the reports to Proponent. Based on the findings of the report, the management approach may be adapted and its efficacy will be determined in the consecutive monitoring trip.

35.9 MONITORING REPORT

Reporting will be carried out by the environmental consultant assigned for the purpose by the proponent. The report will include among other information;

- Details of what was being monitored;
- Methodology of data collection and data analysis;
- Major findings;
- Effectiveness of the mitigation measures in place and
- Recommendations and conclusions.

A detailed environmental monitoring and management report is required to be compiled and submitted to the EPA. In addition to this, regular site monitoring would be carried out by the proponent that requires maintaining logs of events as explained in this report. Enforcement officers from EPA may also visit the site for inspection from time to time.

35.9.1 Monitoring Report Format

The environmental monitoring report outlined in **Table 120** below will be used in reporting environmental monitoring to be carried out as given in the monitoring plan.

Table 120: Monitoring report format

Project Title:
Name of the Island:
Monitoring Date:
Period Covered:
Prepared by:
Contributions:

A. Introduction
Give a brief introduction about the project and the monitoring carried out
B. Methodology
Brief detail of the methodology applied for undertaking the monitoring assessment
C. Environmental Monitoring
a. Groundwater quality
Parameters given in the monitoring plan need to be assessed
b. Waste generation and management at IWMC
These include monitoring for pests and diseases as described.
D. Risks and Mitigations
Please indicate any critical unresolved risks that affect the course of the system operation, analyse the cause, assessing the potential impacts on the environment providing the proposed mitigation strategy
E. Problems Encountered
Indicate any problem areas encountered and any corrective measures that will have to be taken.
F. Recommendations and Adaptations as Solution
If specific recommendation is noted during the monitoring phase, specify it in the report
G. Conclusions
Reference
Appendix

35.10 IWMC OPERATIONS REPORTING MECHANISM

Table 121:Details of the reporting mechanism proposed for the IWMC

IWMC (Occupier)

Reporting	Details	Frequency
General report	Logs of the incoming waste	Monthly
	Classified by type and weight	
	Vehicle maintenance details	
	Machinery maintenance details	
	Machinery fuel usage details	
	Workplace injuries	
IWMC capacity	Details of the utilized and remaining capacity of IWMC	Every two months
	Leachate tank maintenance and capacity	
IWMC inventory status report	Details of the status of IWMC equipment	Bi-Annually
	Details of the status of emergency kits and firefighting equipment	
Compost output report	Details of amount of input waste materials	Bi-Annually
	Details of compost output in weight	
	Log of noise and odor complaints	

Island Council (Municipal Unit, Waste Management Committee)

Components	Details	Frequency
Public grievances	Log of public grievances regarding	Bi-Annually
	Fee structure	
	Waste Management operations	
	Noise and odor complaints	
IWMC monitoring	Monitoring report of the IWMC operations	Bi-Annually
Compilation of IWMC reports from operations contractor		Bi-Annually
Income report	Summary of IWMC operations income	Bi-Annually

MEE

Components	Frequency
Review of IWMC Reports from Councils	Bi-Annually
Update National Waste Database	
Policy updates from findings	
Provision of support to IWMCs	
Overview of the waste management system on island level and regional level	

Noise and odor complaints	Complaints to be provided along with weather conditions and incoming waste details coinciding with the dates of complaints	Every two months

36 RECOMMENDATIONS AND CONCLUSION

The construction and development of the IWMC at HDH. Hirimaradhoo is a much needed project to provide waste management services to the island. The IWMC 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.

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 consultant's recommendations for the project include:

- To include this EMP as part of the contractor's contract and ensure the measures and recommendations brought forth are followed;
- Implement the work method and mitigation plan as prescribed in the report to the fullest;
- To conduct supervision and monitoring of the project works by the proponent;
- To conduct supervision and reporting of the project works by an independent consultant;
- To conduct stringent evaluation of contractor's capacity to undertake and complete the project;
- Ensure necessary clauses regarding the workers safety are fully implemented;
- 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 EMP has looked into the key factors that need to be considered during construction and operational stage. The study has identified that the negative impacts identified for this project were minor.

The study also found that through the implementation of the proposed practical and cost effective mitigation measures all impacts can be brought to an acceptable level. This EMP will guide the proponent in implementing the project with conformity to EIA regulation 2012.

CHAPTER 6
HDH. KURINBI

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37 INTRODUCTION

37.1 BACKGROUND

HDH. Kurinbi is an island belonging to the South Thiladhunmathi Atoll. The island has a land area of 32 ha. The island has a mangrove area present in the south. As per the Island Council, HDH. Kurinbi has a population of 725. Of the 187 households, currently 96 are inhabited.

The island is accessible by a harbor 300 ft in length and 200 ft in width. A preschool and a school that provides education up to the secondary level is present in the island. The students participate in the O'Level examinations after completion of the secondary level. A health center is provided with a doctor and nurses. Three mosques are located in the island, one for women and two for men. The *hukuru miskiy* in the island has been recently constructed. There are 81 employees currently in civil service and institutions serving in the island.

Drinking water supply and central sewerage facilities are not provided in the island. 24 hour electricity service is provided to the island. The island currently has an Island Waste Management Center (IWMC). Although the infrastructure is present, the island currently has no equipment or machinery to manage the waste generated within the island. This has led to the IWMC being reduced to a location where inorganic wastes are stockpiled. Other types of wastes are burnt, buried or confiscated of on the beach areas.

These practices have led to negative impacts within island, and dumping of kitchen wastes and other wastes in the nearshore area can lead to diseases, nutrient imbalances, smothering of corals toxicity impacts to marine flora and fauna (Halliburton, 2002). Waste reduction is done by burning of stockpiled wastes intermittently.

No waste audit specific to the island has been carried out in the past nor had the waste situation of the island been properly assessed. A waste audit for Zone 1 (which includes HA, HDH, and Sh. Atolls) conducted by MEECO in 2016 showed an average of 1.30 kg/capita/day of waste generation within the islands. Using this average, approximately 0.94 ton/day of waste is generated within the island households. The majority of sources of waste in HDH. Kurinbi are the households, government institutions, and public areas. The main types of waste generated in the island are organic and garden waste, metals, plastics, glass and large tree trunks. In order to manage the waste situation at the island level, the proponent, Ministry of Environment and Energy (MEE) has proposed the project to provide waste management equipment and machineries for the Island Waste Management Centre (IWMC) in HDH. Kurinbi.

The proposed project is facilitated by MEE and financed by the OPEC Fund for International Development (OFID) under the "Provision of Water Supply, Sanitation and Solid Waste Management Project". The completion of the proposed project will result in an operational IWMC, and the operation of the IWMC will be facilitated under the Waste Management Plan devised by the Island Council and Approved by EPA.

The scope of the IWMC is to facilitate island level management of the waste generated within the island, which includes sorting, volume reduction and stockpiling of recyclables, composting of organics, and storage of hazardous waste. The waste that is not manageable in the island level is planned to be transported to a central waste management facility.

The proponent has requested consultancy services of MEECO for the preparation of an Environmental Management Plan (EMP) to comply with the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012. EPA has issued a decision statement on HDH. Kurinbi that an EMP would be suffice for the proposed IWMC operation works.

A field visit was conducted by the MEECO team to HDH. Kurinbi on 27th April 2017 in addition to a consultation meeting with the Island Council on the same day. This report is based on the findings of the field visit, consultations, previous EMP's and experience of the consultant.

37.2 PROJECT SETTING

HDH. Kurinbi is situated centrally in the South Thiladhunmathi Atoll, at the location 6°39'55.8468" N, 72°59'47.7528" E. The island is approximately 281.5km from the capital Male' and approximately 22.3 km from the airport island HDH. Hanimaadhoo. Kurinbi lies to the north west of the formerly inhabited island of Kuburudhoo. The island is approximately 8.4 km to the northwest of the neighboring HDH. Kulhudhuffushi. Other neighboring inhabited islands include Nellaidhoo, Hirimaradhoo and Nolhivaran.

Figure 102: Project setting

37.2.1 Site Location

The established Island Waste Management Centre (IWMC) infrastructure is located in the eastern side of the island at 6°39'51.76"N, 72°59'57.56"E. The site is accessible by a cleared road.

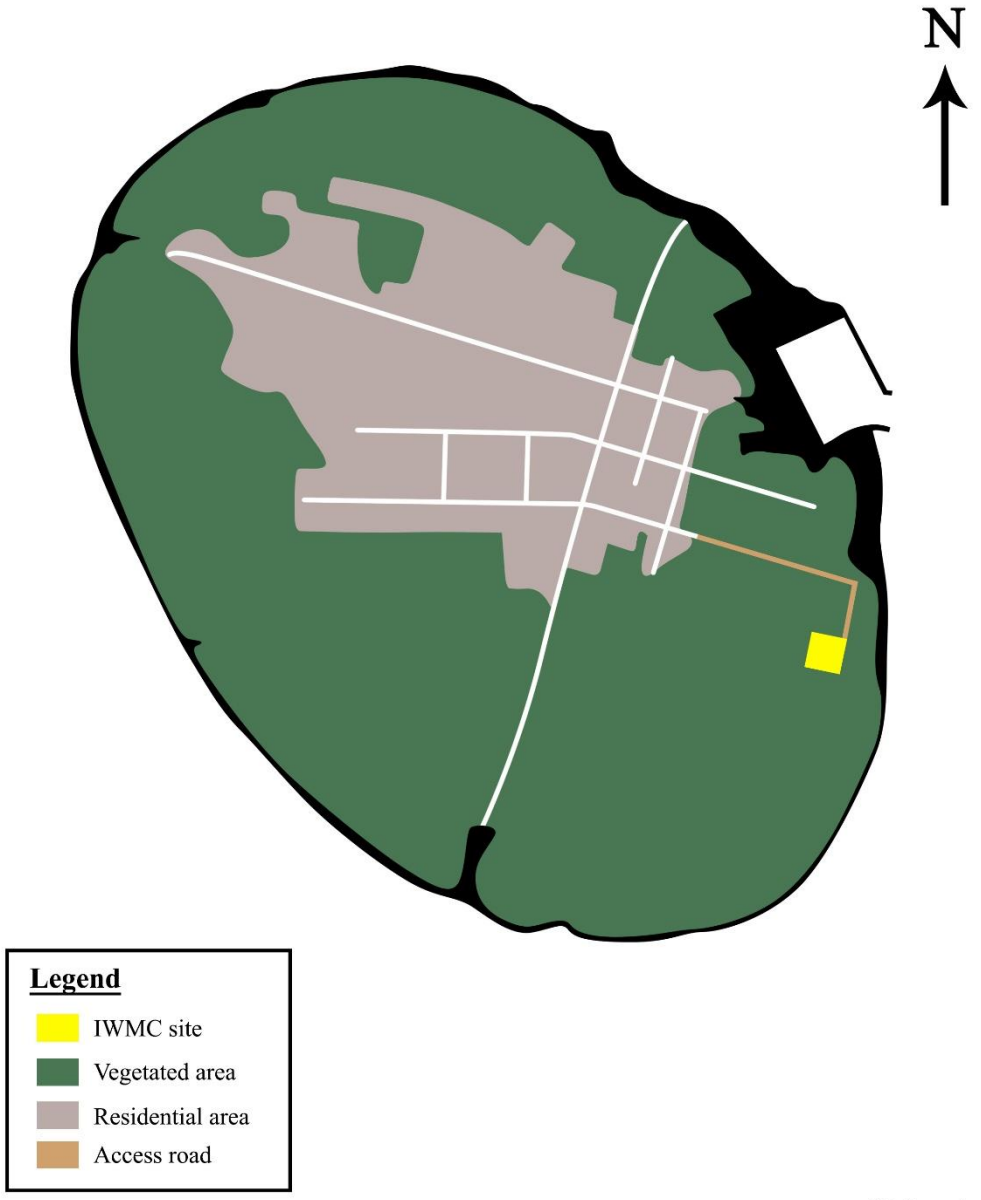

Figure 103: Location for the waste management site on Kurinbi Island

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37.3 CURRENT STATE OF WASTE GENERATION AND WASTE MANAGEMENT

37.3.1 Waste Generation in Zone 1 and HDH. Kurinbi

A waste audit conducted by MEECO in 2016 showed that the average waste generation of the islands in Zone 1 was 1.30 kg/capita/day.

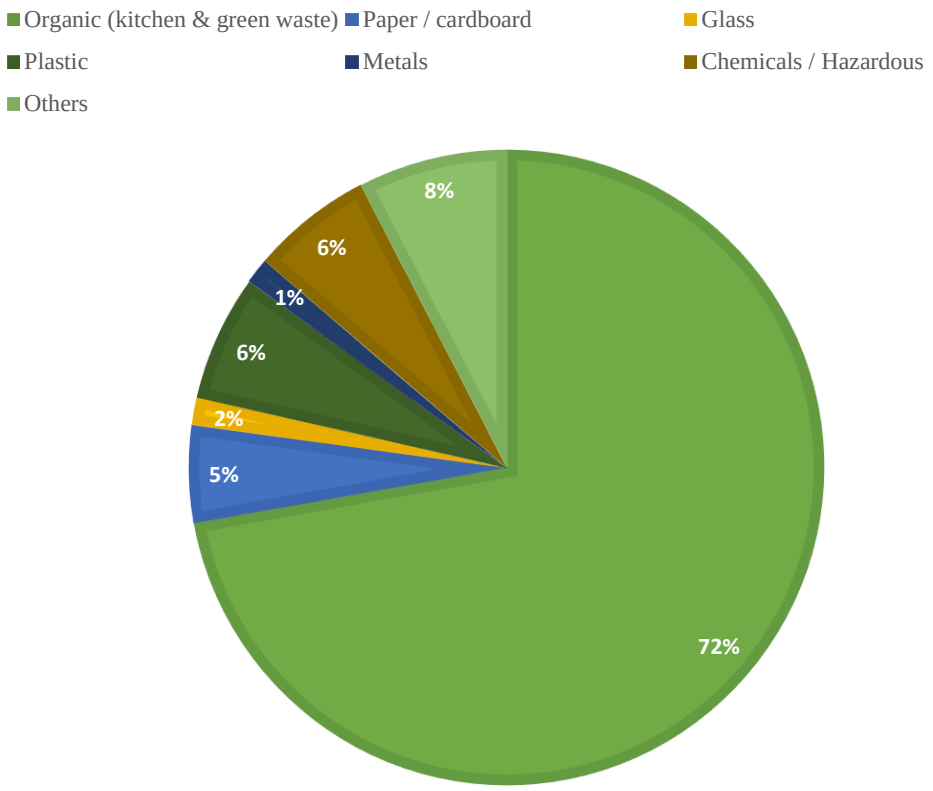

Figure 104: Waste Composition of Zone 1 (Source: MEECO, 2016)

The analysis shows that the majority of the waste generated includes organic wastes at 72%, which include kitchen and green wastes. This waste can be used in composting in addition to paper and cardboard wastes which are at 5% of the total waste generated. Recyclable materials such as plastic, metals, and glass make up 9% of the composition. Approximately 6% of the total waste generated is chemicals and hazardous waste. Using HDH. Kurinbi's current population, the daily waste generated per capita can be estimated from this data.

Table 122: Estimated waste generation quantities of HDH. Kurinbi

Waste Type	Zone One Average (%)	Kurinbi Waste Generation (Kg/Day)
Organic (kitchen & green waste)	72.2	680.485
Paper / cardboard	4.94	46.5595
Glass	1.42	13.3835
Plastic	6.4	60.32
Metals	1.3	12.2525
Chemicals / Hazardous	6.15	57.96375
Others	7.58	71.4415
Total	99.99	942.40575

37.3.2 Current state of waste management in HDH. Kurinbi

The majority of sources of waste in HDH. Kurinbi are households, public areas and institutions. Activities conducted in Kurinbi include construction, carpentry, farming and reef fishing on a small scale. These activities are also expected to generate waste in addition to the household waste estimate in **Table**

The island currently has an Island Waste Management Center (IWMC), which was established during 2013. Although the infrastructure is present, the island currently has no equipment or machinery to manage the waste generated within the island. Waste such as plastics and metals cannot be reduced in volume, therefore the unmanaged waste is stockpiled inside the IWMC. Other types of (biodegradable) waste is burnt regularly near the IWMC. Waste is burnt every week except on Saturdays and Sundays. The residue from the burning is then taken and disposed of near the beach. Nappies are burnt in an enclosed container along with dry wastes. Composting was attempted previously, and the IWMC workers report that 6 bags (25 kg each) of compost was produced in 4 months.

Currently 3 employees work at the IWMC. No records have been kept on the waste types and amount managed. The residents take the household wastes to the IWMC on wheelbarrows or pickups.

Figure 105: Current state of waste disposal in the island. A & B: Plastics and metals stockpiled inside the IWMC. C: Burning of organic waste. D: Container used to burn nappies.

During the consultation meeting with the Island Council, it was learnt that the current management of the IWMC in the current situation was not feasible, especially without the proper equipment and machinery. The Island Council stated that there is consideration to award the works to a third party under contract, and provide the waste collection service with a vehicle. This can lead to the establishment of a fee system, which has not been created under the current Waste Management Plan.

37.4 WASTE MANAGEMENT PLAN OF HDH. KURINBI

HDH Kurinbi Island Council formulated a Waste Management Plan on 23 November 2015. The WMP was not approved by EPA at the time of visit. A Waste Management Symposium was held on 17 – 19 July 2016 which included a workshop to create Waste Management Plans for the respective islands. The WMP for Kurinbi was formulated prior to the symposium and thus may require further revision with regard to the Saafu Raajje National Waste Management Policy (2015).

HDH. Kurinbi Island Council has formulated the WMP in order to facilitate management of the generated waste on an island level, to create an environment free of pollution from dumping of waste, and increasing the health and well-being of the populace from the activities.

The main goals have been highlighted by the Island Council in the WMP:

- Become capable of sustainably managing the waste generated on an island level.
- Making of compost and marketing the product the farmers of the island and other islands.
- Become an exemplary island in island level waste management

Strategies to reach the goals are as follows:

- Creating awareness within the island
  - Providing leaflets regarding waste management to all households once a month or once every two months
  - Conducting workshops on waste management twice a year to schoolchildren and the general population
- Segregating the areas allocated to dispose of the waste types
  - Usage of appropriate signs
- Formulate a plan to manage kitchen waste
  - Enforcement of rules against the dumping of kitchen waste on the beach areas
- Formulating a sound mechanism to oversee the works of the IWMC
  - Council and institutions to hold meetings regarding the formulation of a system to effectively oversee the IWMC works
- A safe mechanism set up to manage waste that is collected at the IWMC
  - Provision of machineries for the IWMC
- Arrangement to transport metals stockpiled in the IWMC
  - Discuss with potential buyers to sell scrap metal
- Making compost from the waste generated in the island.
  - Provide information, training and a market for composting

As per the WMP, the IWMC and its operations will be conducted through a contractor. Roles and responsibilities of the IWMC occupier include separation of wastes, and management of the IWMC overall.

The WMP states that the Council does not plan to take any fee from the households because a transportation service is not provided in the island.

38 DESCRIPTION OF THE PROJECT

38.1 THE PROPONENT

The proponent of the project is Ministry of Environment and Energy (MEE) of the government of the Maldives. The proposed activity is part of a greater project titled "Provision of Water Supply, Sanitation and Solid Waste Management Project" financed by the OFID.

38.2 PROJECT DURATION

As the IWMC has already been established in HDH. Kurinbi, the project component for the island includes supply of waste management equipment, machinery and dustbins to the island. The proponent has announced awarding of the project to supply and deliver composting equipment and dustbins to 15 islands in HA, HDH, and SH, on April 2017, for a duration of 4 months.

38.3 PROJECT DESCRIPTION

The established site plan is presented in **Figure 106.** The project includes the provision of waste management equipment to the island in order to enable the implementation of the WMP of the island and the operations of the IWMC.

The operational phase of the project will include the waste transport from the households and institutions, in addition to waste management works in the IWMC, which include;

- Sorting of waste;
- Storing of hazardous waste;
- Volume reduction of plastics, glass and metals;
- Stockpiling of sorted waste; and
- Composting of organic waste.

The IWMC is made up of an equipment room, and separate areas to store metal waste, paper and cardboard, plastic waste, glass waste as well as hazardous waste.

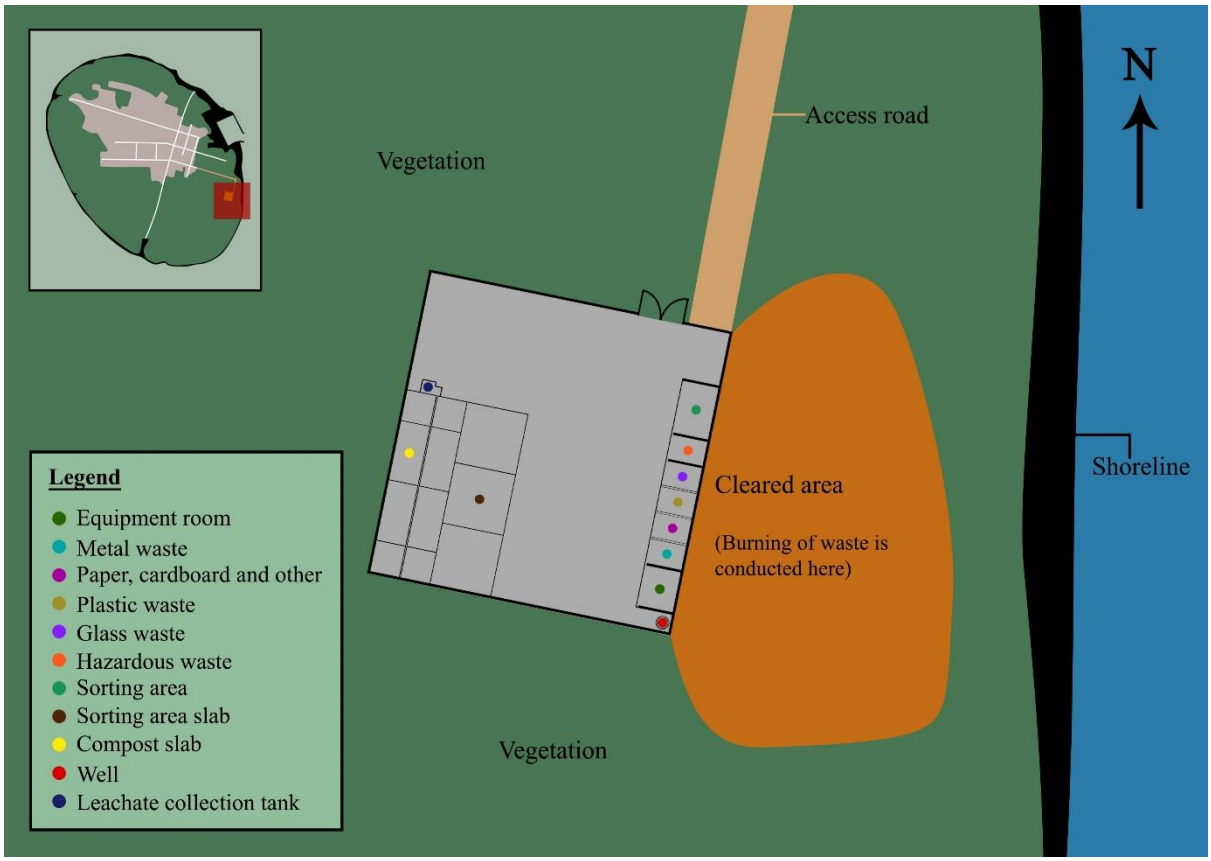

Figure 106: The site plan

38.4 OPERATIONAL PHASE

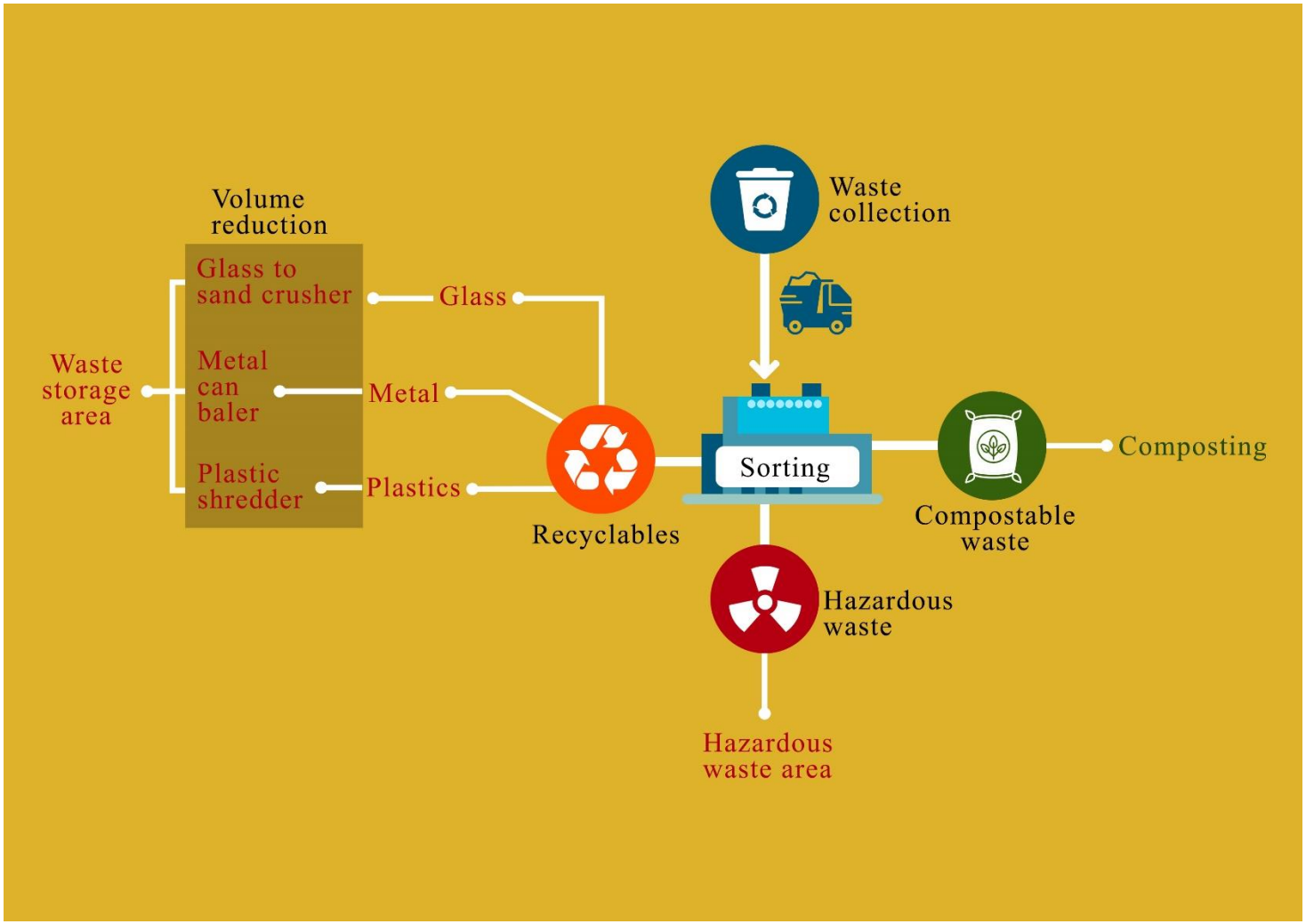

Figure 107: Operational phase flowchart of the IWMC of HDH. Kurinbi

The following Section will highlight the operational aspects of the IWMC. This includes the machinery and equipment proposed to be used in the IWMC, in addition to the main activities to be carried out at the IWMC and within the island. The activities begin from the sources of waste where waste is generated. This waste is collected and transported the IWMC. This collected waste is 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.

38.4.1 Machinery and equipment proposed

During the operational phase of the IWMC, in addition to the collection of the waste and sorting, different activities such as composting, and waste volume reduction will be done. The proposed equipment for the IWMC include general equipment needed to handle the waste such as wheelbarrows, garden hoes, shovels, buckets and cultivators. These equipment will be used during the IWMC operation for handling as well as composting operations. A manual rotary compost screen is also included for the screening stage of the composting process.

Other equipment include waste volume reduction equipment such as a plastic shredder, metal can baler, vegetation shredder, and glass to sand crusher. The equipment and their specifications are detailed below.

Table 123: Equipment proposed for waste management works

Equipment	Details
Chainsaw	
Wheelbarrow	HDPE 6 cub. Ft.
Heavy Duty Gumboots	PVC or rubber
Heavy Duty Hand Safety Gloves	Rubber or Latex
Long Handled Flathead Steel Rake	Steel, 54 inches length
Long Handled Cultivator	Steel, 54 inches length
Garden Hoe	Steel, 57 inches length
19” Round Point Shovel	Steel
48” Square Point Shovel	Steel
19” D-Handle Square Point Shovel	Steel
20L Bucket	HDPE
40L Bucket	HDPE
Polypropylene Surgical Mask Box (50pcs)	Polypropylene
Weighing Bench Scale	50-75 kg capacity
Wheelie Bins	HDPE
Glass to Sand Crusher	0.5 to 1.0 tonne/ hr, output 0.5mm and less, 2-5HP motor
Plastic Shredder	30-100Kg/hr Output material less than 10mm
Metal Can Baler	3 to 5 HP, 2m2 or more inside volume
Vegetation Shredder	Petrol / diesel driven multi vegetation shredder / chipper
Manual Rotary Compost Screen	1m to 1.5m drum

38.4.2 Waste Collection

As per the current practice in Kurinbi, households transport their own waste to the IWMC. This has been stated in the current WMP too. Although, this situation may change with a revision of the WMP and the decision to award the work to a contractor, who will be collecting the waste from the households.

38.4.3 Sorting

As per the IWMC site layout plan, a ground slab is dedicated for the sorting area. This sorting area is located next to the compost slab. Here, the collected waste will be kept, and sorted into their respective categories. In addition to this, a dedicated sorting area is also provided alongside the storage areas. The IWMC is designed to have separate storage areas for metal, paper and cardboard, plastic, glass, and hazardous waste. After sorting, the waste is stored in the respective location.

38.4.4 Composting

The IWMC is designed in order to facilitate the storing, sorting and reusing of the waste generated in the island. One of the main operations that will be conducted in the IWMC is the composting of the organic waste such as kitchen waste and garden 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 main constituents of a compost heap include kitchen and garden waste, along with water and air in the pore spaces between the constituent.

38.4.4.1 The Composting Process

After the incoming waste is 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.

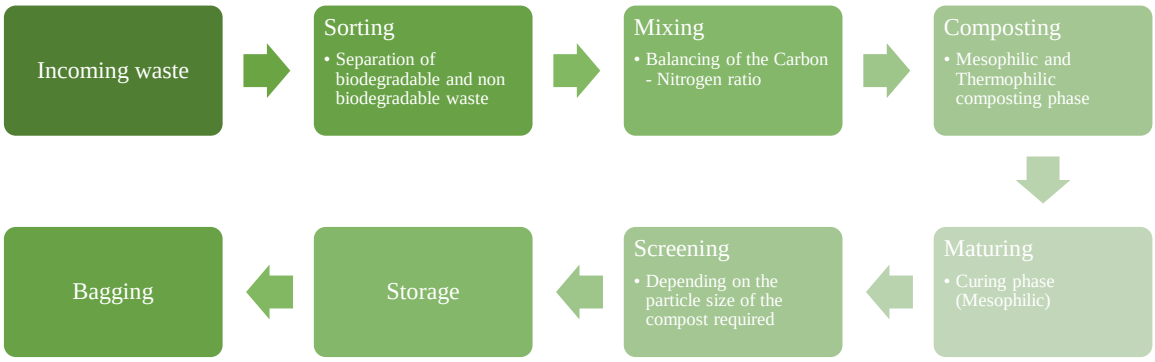

Figure 108: The composting process

38.4.4.2 Sorting of Incoming Waste

Incoming waste is required to be sorted to separate biodegradable and non-biodegradable waste in order to conduct composting.

Table 124: Domestic Waste Categories

Incoming Domestic Waste			
Suitable for composting	**Not suitable for composting**		
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
Composting Process	**Storage**		

38.4.4.3 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.

Looking into the composition of compostable wastes from the Zone 1 Waste Audit, it is seen that the majority of compostable wastes constitute of garden (green) wastes. Garden wastes make up 64% of waste generated, while the second largest contributor to compostable wastes is kitchen wastes, at 28%. Printed paper and cardboard make up 5% of compostable waste while 2% of the category includes animal waste. This composition is important in determining the Carbon-Nitrogen ratio of the compost heap in order to provide optimum conditions for composting.

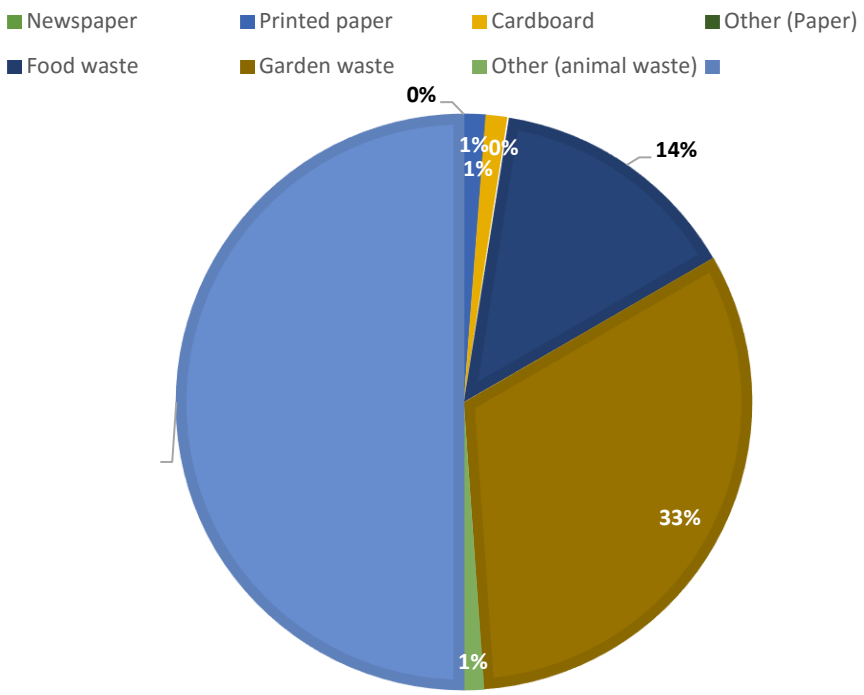

Figure 109: Composition of compostable waste for Zone 1

Table 125: Estimated compostable waste generation quantities of Zone 1

CATEGORY		Average Per Capita (kg/day)	Percentage
Primary	**Secondary**		
Paper & Cardboard	Newspaper	0.00	0.0%
	Printed paper	0.02	2.4%
	Liquid container	0.00	0.5%
	Cardboard	0.02	2.4%
	Other (Paper)	0.002	0.2%
Organics	Food waste	0.29	28.2%
	Garden waste	0.67	64.2%
	Other (animal waste)	0.02	2.2%
Total		1.04	100

Green wastes such as vegetable wastes (kitchen waste), and poultry manure have high Nitrogen values while brown wastes such as foliage, wood chips, bark and paper have high carbon values. From the waste audit, it is seen that 64.2% of the compostable waste produced is garden waste while 28.2% of the waste generated is food waste. Therefore, it can be said that the composition of compostable waste in the islands in Zone 1 is in favour of providing a high Carbon content compared to Nitrogen.

38.4.4.4 Composting and Maturing

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

Table 126: 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, the composting process can prolong to several months.

38.4.4.5 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. This slab is 15m long by 5m wide. 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 100mm 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 compost slab.

38.4.5 Volume Reduction

The incoming waste is sorted, and either used for composting, or stored in their respective compartments. 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.

38.4.6 Projected Capacity of the IWMC

The proposed IWMC is planned to manage a portion of the waste produced at the island level, with the unmanaged waste (approximately 70 – 75% of waste generated within the island to be transported to the nearest RSWMF). The projected capacity for 1 month's waste for the island of Kurinbi is shown below.

Table 127: Projected waste management capacity for the waste generated in HDH. Kurinbi in 1 month

Waste Type	Details	Amount	Unit
Organics	Composting capacity in IWMC. Assuming 1m height windrow with a width of 2m	39	m3
	Organic waste generated per month	31.41	m3
Paper waste	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	2.149	m3
Glass	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.618	m3
Plastics	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	2.181	m3
Metals	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	0.566	m3

As seen in **Table 127** the IWMC has the capacity to compost the organic waste generated in just over one month for the island. Organic wastes make up the bulk of the waste stream in the islands, taking 72% of the total waste generated in the island. The composting capacity of the proposed compost slabs (assuming a windrow of 1 m height and 2 m width at the bottom and 1m width on top) is approximated as 39 m^3. The calculated volume for the organic waste generated in a month in Kurinbi is 31.41 m^3. Therefore, just over one month's worth of organic wastes produced in Kurinbi would take up the composting capacity of the IWMC for the succeeding 4 – 6 months. There is no additional storage space for the organic wastes provided in the facility.

38.5 PROJECT INPUTS AND OUTPUTS

The table below elaborates the approximate amount of resources that will be required for the project.

Table 128: Project inputs

Stage	Input	Source / Type	Estimated Amount	Means of obtaining the resources
Operation	Equipment and Materials	Chainsaw	1	Imported / purchased where available locally
		Wheelbarrow	4	
		Heavy Duty Gumboots	5	
		Heavy Duty Hand Safety Gloves	5	
		Long Handled Flathead Steel Rake	3	
		Long Handled Cultivator	3	
		Garden Hoe	3	
		19" Round Point Shovel	3	
		48" Square Point Shovel	3	
		19" D-Handle Square Point Shovel	2	
		20L Bucket	3	
		40L Bucket	2	
		Polypropylene Surgical Mask Box (50pcs)	5	
		Weighing Bench Scale	1	
		Wheelie Bins	40	
		Glass to Sand Crusher	1	
		Plastic Shredder	1	
		Metal Can Baler	1	
		Vegetation Shredder	1	
		Manual Rotary Compost Screen	1	
	Waste	Waste generated within the island	Approximately 942 kg of waste per day	Waste collected by vehicle from the waste bins within the island
	Fuel	Diesel		Local suppliers

Table 129: Project outputs

Stage	Output	Source / Type	Amount	Means of managing
Operation	Compost	Open windrow composting	15.60 m^3 compost per cycle	Sold as fertilizer
	Crushed Glass	Glass crusher	0.4 ton per month	Crushed glass stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central

				waste management facility
	Compacted Metal	Metal baler	0.37 ton per month	Compacted metal stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Shredded plastic	Plastic shredder	1.42 ton per month	Shredded plastic stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	GHG	Electricity usage		N/A

39 EXISTING CONDITIONS

39.1 DESCRIPTION OF THE ENVIRONMENT

HDH. Kurinbi has a total land area of 32 ha. Of this, approximately 9 ha has been utilised for residential purposes. 16 ha of the island as seen on satellite imagery has highly vegetated areas. The remaining areas have been cleared for farming purposes, in addition to recreational areas such as the football ground and other sports grounds. The island has a wetland area present in the south. The residential area is concentrated to the central and northern regions of the island. The farms are present at the northern region of the island, while the recreational areas are situated in the southern parts of the island.

The Island Council states that the groundwater has degraded within the island to the point where 80 % of the households experience odour and coloration in the groundwater to some extent. The island currently has no central sewerage system. There is widespread use of septic tanks within the island, which leads to the seepage of liquid waste into the groundwater lens.

Figure 110: Terrestrial vegetation of HDH. Kurinbi

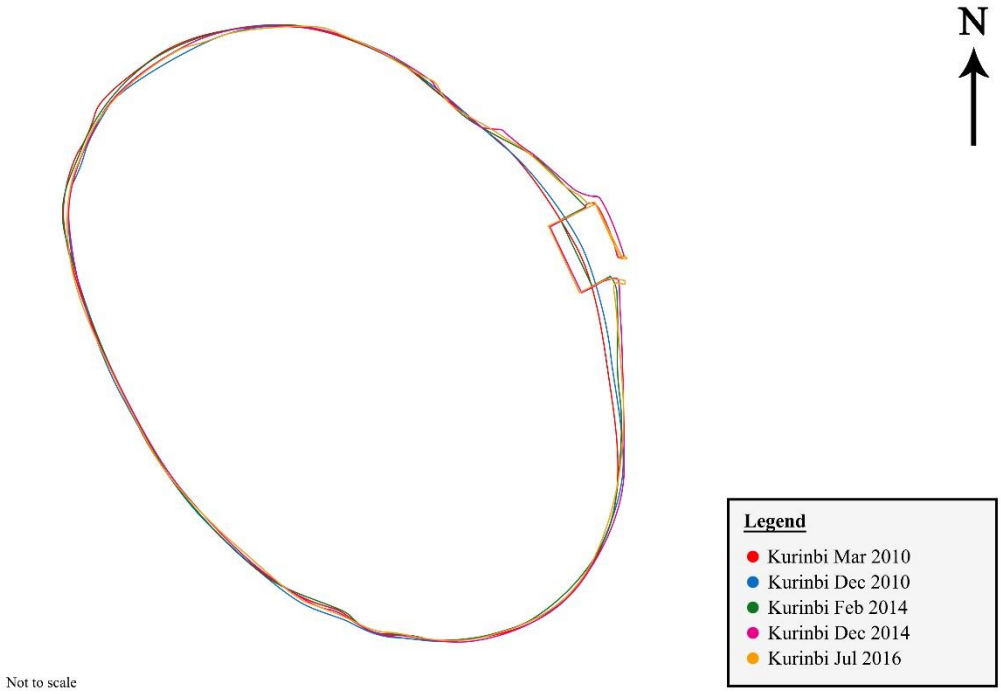

Figure 111: Changes to the coastal region of Kurinbi from 2010 to 2016

Major changes to the coastal area of the island is seen as the development of a harbor on the eastern side of the island. After the harbor was constructed, it is observed that the excavated sand has been used to provide replenishment of the beach area on both sides of the harbor.

Figure 112: Coastal area closest to the IWMC

39.2 PROJECT SITE CONDITIONS

The established Island Waste Management Centre (IWMC) infrastructure is located in the eastern side of the island. The site is accessible by a cleared road. The closest building / area to the site is the FENAKA powerhouse, which is situated approximately 80 m north west of the IWMC. The site location has been chosen in order to reduce the impact of odour due to monsoonal winds and proximity to residential locations.

As the IWMC has already been constructed in this island, a vegetation survey of the area was not required.

Figure 113: The project site with the constructed IWMC

39.2.1 Site zoning recommendations by EPA

The EPA has provided recommendations for the optimum zoning of the IWMC site. The distances include, the site being at least 15 m from the coastal vegetation belt, at least 30 m from the nearest freshwater well, at least 40 m from the nearest recreational area and at least 30m from the wetlands as well as the residential 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 130: Comparison between the IWMC and EPA recommended distances

Location	Distance from IWMC (m)	EPA Recommended Distance (m)
Coastal vegetation	37.6	15
Freshwater well	114.3	30
Recreational area	132.6	40
Wetlands	165.07	30
Residential area	165.58	30

As seen on **Table 130**, the IWMC has been constructed within the EPA recommended buffers.

39.3 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were held for the project with the proponent MEE, enforcing agency EPA and the Island Councils of the respective islands. Meetings with MEE and EPA were held both before and after the survey trips in light of findings regarding some project islands. The initial meetings were mainly regarding the EIA project islands and scoping, although, due to the similar scope of works (except vegetation removal in the EMP islands' cases) the meetings included discussion of the project as a whole. Highlights of the meetings which apply to the EMP islands are presented below. Stakeholder consultation attendance is attached in **Annex 3.**

39.3.1 Meeting with Proponent

- The proponent was consulted at the start of the assignment to discuss project scope and after field surveys to discuss findings of the initial field surveys.
- Proponent informed that MEE will be responsible for the construction of IWMC, while land clearance shall be undertaken by the respective Island Councils.

39.3.2 Meeting with EPA

- It was highlighted that waste management will not involve burning waste at the island level. Waste from islands will be transferred to the regional waste management center. Only organic waste will be managed at the island level to make compost. All necessary equipment required to manage waste at in the IWMC will be provided as part of the project.
- EPA informed that buffer distances recommended by EPA in the zoning form shall be kept in order to mitigate impacts.

39.3.3 Meeting with Island Council

- The Council stated that IWMC infrastructure is already present in the island. IWMC work was begun in 2013.
- A waste management plan was formulated by the Council to register the IWMC. Waste management regulations and were formulated by referring to LGA regulations
- The waste management plan was formulated in 2015 before the Saafu Raajje Symposium in the same year
- No equipment are currently available in the IWMC. 3 people work at the IWMC on contract
- The Council attempted to make compost previously
- Biodegradable waste is burnt as well as plastics and nappies
- Currently, waste transportation is done by the households themselves, using wheelbarrows
- The Island Council is in need of a vehicle to provide waste management services
- Island Council believes that waste management works cannot be conducted by the Council itself, and is considering to outsource the works to a contractor

40 ASSESSING THE LIKELY IMPACTS AND MITIGATION MEASURES

40.1 METHODOLOGY, NATURE AND IDENTIFICATION OF IMPACTS

Various impacts arising from the project such as direct, indirect and cumulative impacts have been identified. The methodology was based on:

a) Scoping meeting with stakeholders;
b) Observations made during the visit of the project island and site
c) Literature review of similar local and other EMPs; and
d) Findings from other similar projects in Maldives and experience of the Consultant.

Impacts on the environment were identified based on their location/attribute, magnitude and duration of the impact. Impacts were assessed based on their significance and categorized as negligible, minor moderate and adverse. A Leopold Matrix was used for this purpose, for the operation phase.

The Leopold Matrix was developed by Leopold et al. (1971). It is a quantified Matrix which consists of 100 project actions and 88 environmental characteristics, elements and conditions. Relevant environmental characteristics and project actions were used for the impact identification. First of all, all of the relevant activities of the project that may have an impact on the environment was identified and written on the top of the matrix. These were divided for both the implementation and operational phase of the project. The environmental characteristics that may be affected by the project is written at the left side of the matrix.

A slash is placed at the interSection with each item on the side of the matrix if an impact is possible. The upper left corner of each box where an impact is possible, a number from 1 to 10 is written as the *magnitude* of the possible impact. The number 1 represents the least possible impact and the number 10 represents the highest magnitude of the possible impact. No 0's are used in the Leopold Matrix. A + sign is placed before the number if the possible impact is a positive impact. No sign is placed before possible negative impacts. In the bottom right corner of the box, a number from 1 to 10 is written as the *importance* of the possible impact. 1 being the least important and 10 being of the greatest importance. In giving scores, the magnitude and importance of the activities were judged for their short term and long term impacts. The impacts with greater long term impacts were given higher scores compared to the impacts with more short term impacts.

40.2 POTENTIAL IMPACTS AND MITIGATION MEASURE FOR KEY IMPACTS

For every minor to moderate to major impact identified, a mitigation measure has been proposed and discussed below. The mitigation measures proposed would be strictly adhered to eliminate environmental impacts arising from the project, even before it occurs. The impacts and mitigation measures are detailed in the operational stage as explained below.
The possible mitigation measures include:

a) Changes in work practices and increasing awareness;
b) Provision of environmental protection and health safety equipment; and
c) Environmental monitoring during operational phase.

Mitigation measures suggested in the report will focus on the existing environmental conditions as well as impacts that may rise during operation of the IWMC.

Table 131: Impact identification matrix for operational phase

	Envisaged impact factors	O1 Waste collection and transportation	O2 Waste sorting, separating, storing and compost making	O3 Waste Generation	O4 Resource consumption (water/electricity)	Total (Impact Area)
Physical Components	Seawater	4				4
		4				4
	Ground water	5	-2	-1		0
		3	2	5		12
	Air	-3	-2	-2	-3	-13
		5	3	2	4	16
	Noise	-3	-1			-4
		4	2			6
	Coastal Zone					0
						0
Biological Components	Flora	6	7	-1	-3	4
		2	6	1	4	18
	Fauna	5	5	-1	-3	3
		5	5	1	4	19
Socio-Cultural Component	Aesthetics	6	8			9
		6	6			17
	Accidents	-4	-4		-4	-18
		4	4		5	19
	Landscape	5	6	-1		5
		6	5	2		18
	Health/Well being	5	-5	-2	-6	-10
		6	5	2	8	23
	Cultural heritage					0
						0
	Local economy	-3	8	-2	-1	5
		9	2	4	1	19
Total (operational Phase Activity/Risk)		23	20	-10	-20	
		54	40	17	26	

40.2.1 Impacts and Mitigation from Operational Phase

40.2.1.1 O1 Waste Collection and Transportation

Even though HDH. Kurinbi currently has an IWMC constructed, the island lacks the necessary equipment and machinery to effectively manage the waste generated within the island. Current practices include stockpiling glass, plastic and metals, and burning of organic waste near the IWMC, which leads to respiratory issues from the inhalation of smoke. The successful implementation of the IWMC and the Waste Management Plan will lead to the reduction of the littering of waste, stockpiling and burning. This will lead to the improved health and psychological well-being of the residents and visitors of Kurinbi. It has been identified as a long term positive impact on the residents and visitors of Kurinbi.

Currently, waste is transported to the IWMC by the households themselves using pickups or wheelbarrows. As per consultation with the Island Council, there is an indication that a vehicle may be used to collect the waste in the future at set schedules. This is identified as a minor impact in terms of noise, due to the fact that multiple vehicles are not used, and no receptor will be exposed to the noise for long durations of time.

Waste Collection and Transportation is identified to have a positive impact on the island.

<u>Measures to ensure and enhance the positive impacts</u>

- The Island Council shall review the current Waste Management Plan and bring about necessary revisions in agreement with the Saafu Raajje Waste Management Policy;
- The Island Council shall enforce gazetted penalties (under the Waste Management Regulations) on persons that do not act according to the regulation and guidelines (i.e. littering, burning and dumping of wastes elsewhere);
- The proponent and Island Council shall follow the management plan provided with the EMP in order to monitor the operations of the IWMC, and bring about any necessary changes to the operations and policies, in addition to providing any needed technical assistance for the island;
- The proponent shall review the waste management operations within the islands regularly and update the National Waste Database;
- The operations shall be awarded to a contractor with the capacity to run the IWMC;
- The 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;
- Polluter pays principle established in order to reduce the waste generation within the island;
- The proponent shall provide resources in terms of budgetary allocations, required equipment, and technical expertise to ensure the operation of the IWMC; and
- The proponent shall assist in creating markets / avenues where the IWMC's can generate income through selling compost and recycled metals, plastics and glass.

<u>Mitigation for terrestrial pollution</u>

- Implement rules within the IWMC workers to impose penalties for any littering within the island due to improper handling of the waste and improper transport practices; and
- The status of the vehicle used for transport shall conform to the Waste Management Regulations 2013/R-58 and provide cover to the waste being transported in order to avoid littering.

Mitigation for accidents and injuries

- The vehicle should be driven by licensed drivers; and
- A strict schedule shall be stated in the WMP and followed in order to reduce the transportation frequency thus reducing the probability of accidents.

Mitigation for air quality impacts

- Spray the roads with water during the dry season to suppress dust;
- 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 scheduled times;

40.2.1.2 O2 Waste Management Activities

Waste sorting, separating storing and composting make up the largest portion of the IWM concept. On top of reducing the volume of waste, these activities, convert waste to re-sable and value added products. These activities will be carried out in the IWMC where employees will be trained to undertake these activities.

In general, the operational phase of the project will greatly improve the existing waste management condition of the island. These activities would prevent pollution of groundwater, coastal areas and forested areas which would prevent impacts to biodiversity, health and wellbeing of the public. Hazardous chemicals that get into the soil (contaminants) can harm plants when they take up the contamination through their roots. If humans eat plants and animals that have been in contact with such polluted soils, there can be negative impact on their health.

All these impacts can be mitigated and prevented by the proposed IWM concept. However, if these activities are not properly implemented there is a risk of IWMC being deteriorated into a dump site where mixed waste are disposed, burned and buried (as is currently the case of HDH Kurinbi, without the required equipment and machinery in place). The risk is more prominent for islands where the population size is greater. This means without proper mitigation measures and regular transportation of waste out of the island to a central waste management facility, there is a greater risk of IWMC being overfilled. More so considering that IWMC is equipped to handle only about 20-30% of organic waste generated in the islands 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 IWMC 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 / m^3 close to the composting site and dropped to background levels within 550m 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 / m^3), 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 132: 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 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 IWMC are not as large scale as the studies cited above. The composting capacity of the IWMC is expected to be two windrows of approximately 39 m^3, each batch to take around 4 – 6 months to mature. 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 IWMC becoming a makeshift waste dumpsite for organics are also addressed in the Section.

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. 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 odours.

The operation of the IWMC 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 IWMC), 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 IWMC 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 from composting

The main gas by product from the composting is CO2. In anaerobic conditions, methane is released into the atmosphere, which has a higher greenhouse warming potential compared to 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 dumped;

Amenity Impacts

The IWMC 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.

As the proposed site is close to the coastal area with little protection, wind can blow the materials off the compost heaps as well as the other stockpiled waste types out of the IWMC, which can degrade the local amenity. This impact is mitigated through the design of the IWMC perimeter walls which include a perimeter fence made of 50 × 50 PVC coated mesh.

Littering inside the IWMC can cause amenity issues such as tracking of litter on the wheels of the waste transport vehicles leaving the IWMC. 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 133: Odours generated from the composting process (Source: Goldstein (2002))

Compound	Description of smell	Detection limit for a particular odour panel ($\mu g/m^3$)
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

This site is 166 m away from the nearest residential site, and is located in such a way that the monsoonal winds will not carry the odour towards the residential areas. Therefore the impact of odour on the residential areas are deemed minimal.

Fire hazards

There is a possibility of fire hazards at the IWMC 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 RSWMF) on the IWMC.

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 114** can be used for this purpose. The map shows that the noise reduces to a maximum level of 65 dBA near the residential areas. This calculation does not take into account the dampening effects of the surrounding vegetation. Therefore, the long term negative impacts of noise would be borne by the employees of the IWMC, and the effects of noise to the residential areas are minimal

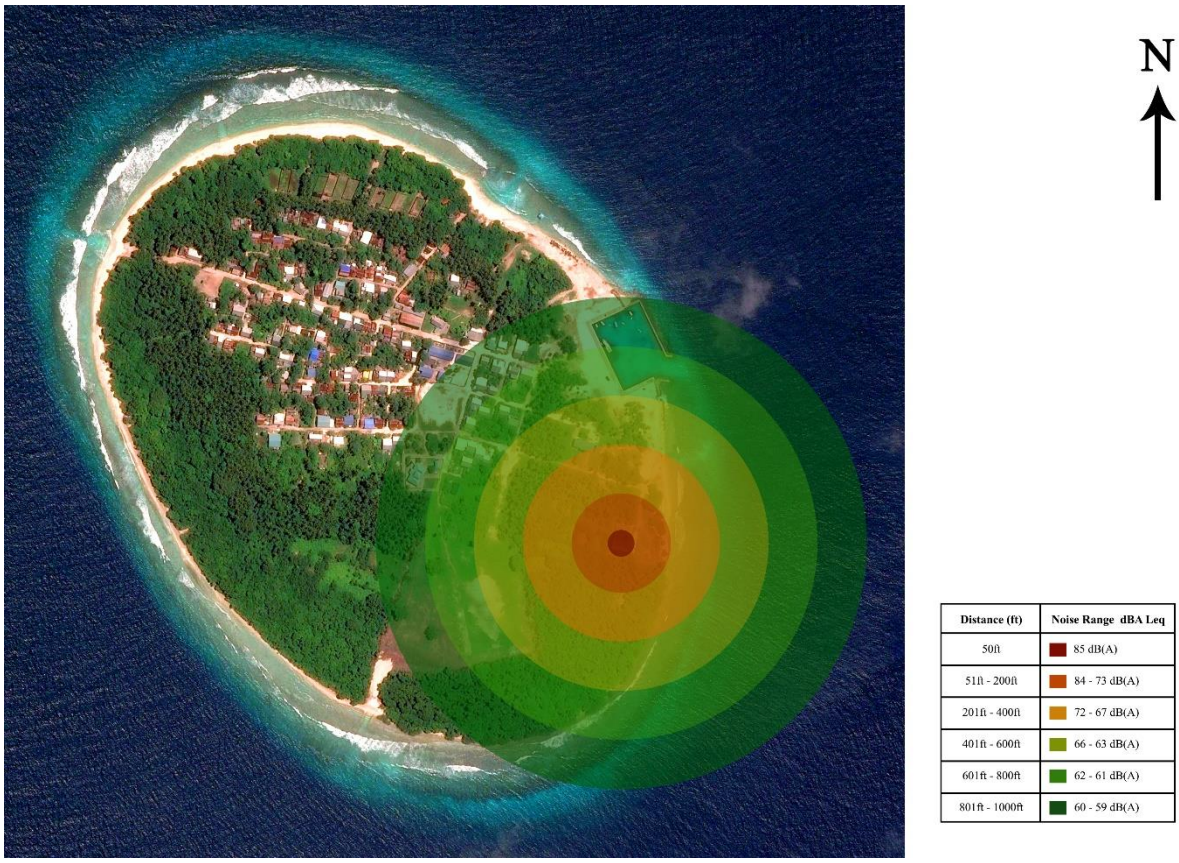

Figure 114: Noise map for HDH. Kurinbi

Workplace safety and accidents

The group of people most likely to be impacted by the IWMC 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 guidelines 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.

Mitigation for health impacts

- A distance of 166 m is available between the IWMC and the nearest residential area, which can act as a buffer zone;
- The siting of the IWMC is at the eastern side of the island. The residential areas are north west of the IWMC. Due to this location, the residential areas are well shielded from both the particulate matter that can disperse with the winds of the south west monsoon and the winds of the north east monsoon;
- Ponding shall be minimized at the site by grading of the ground;
- Handling of compost shall be minimized;
- Compost turning shall be done based on temperatures and not on schedules;
- Material movements and compost turning shall be done during low winds. Weekends, holidays and times of the day when most people are likely to be outside (and use of recreational / public spaces) shall be avoided when handling the materials and turning compost;
- Add moisture to the compost to minimize dust;
- Add a geofabric cover over the compost windrow to minimize release of bio aerosols;
- Workers shall follow the workplace safety mechanisms and guidelines set by the contractor and practice safety and personal hygiene when handling the compost.

Mitigation for 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.

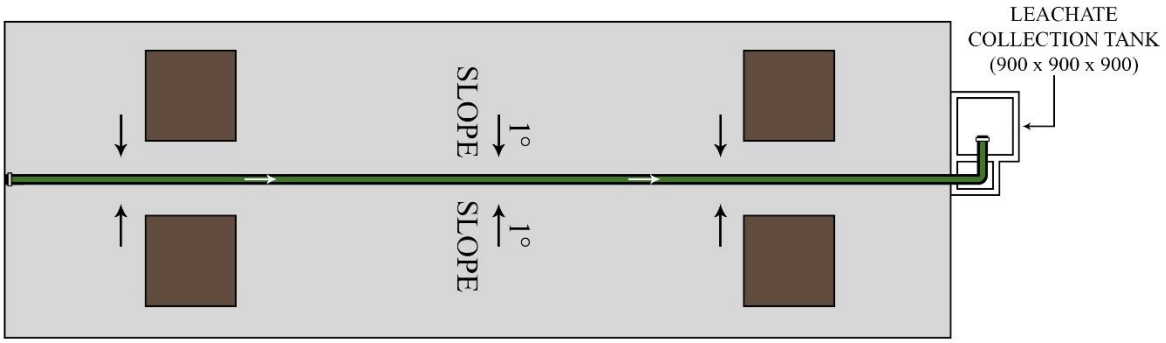

Figure 115: Compost slab design and leachate collection system (Plan view)

Mitigation for rainfall related leachate production

The current design of the IWMC consists of a composting slab is an open windrow composting system. The compost windrow is kept on the compost slab which is sloped in such a way that the leachate from the compost will collect at the pipe in the centre, which will propagate the leachate into the leachate collection tank (see **Figure 115**). While this scenario is ideal during fair weather, heavy rainfall and strong winds should also be considered. There is a possibility of heavy rainfall increasing the produced leachate, as well as the water collected over the composting slab propagating to the leachate collection

tank. This can cause an overflow of the leachate collection tank, releasing its contents into the ground and subsequently the groundwater aquifer.

The rainfall can also cause the scattering of the compost materials, the increased water content in the compost windrow can cause another issue: the saturation of the windrow can decrease the available oxygen within the compost windrow, leading to anaerobic conditions.

- There is a valve placed at the inlet pipe which can be closed in instances where the leachate tank may overflow from heavy rainfall onto the compost slab;
- The 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;
- A 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.

Figure 116: Windrow cover being utilised in an open composting system (source: Midwestbiosystems.com)

Keeping stockpiles of raw organics low

Stockpiles of raw organics (waiting to be processed or transported) can cause impacts such as foul odour from the biodegrading organics, leachate reaching and contaminating groundwater, issue of vermin and pests, and visual impacts from the stockpiles.

As per the design of the IWMC, there are compartments for the storage of all major waste types other than organic wastes. A dedicated slab is provided for the composting of the organic waste materials. As per the calculations in **Section 38.4.6** it is seen that the composting slab has the capacity for composting over 1 month's organic waste produced in the island. As the composting process may take between 4 – 6 months (Halliburton, 2002), the remaining months' organic wastes can accumulate unmanaged and without any means of storage.

The consultant proposes the following mitigation measures:

- Arrangements to regularly transport the unmanaged waste to a central waste management facility; and
- In cases where the waste cannot be transported due to delays and unforeseen circumstances, it is not recommended to stockpile the unmanaged waste on the ground, without any cover. As per the area of the IWMC, there is a capacity to arrange up to 25 nos. 660 L wheelie bins to store unmanaged organic wastes. It is also recommended to separate the putrescible waste from the green waste while storing in the wheelie bins. While this mitigation is not the most ideal, it is seen as the option with the least impact, pertaining to the resources available to the islands and the difficulty in transportation. Alternative transfer arrangements shall be made within this duration.

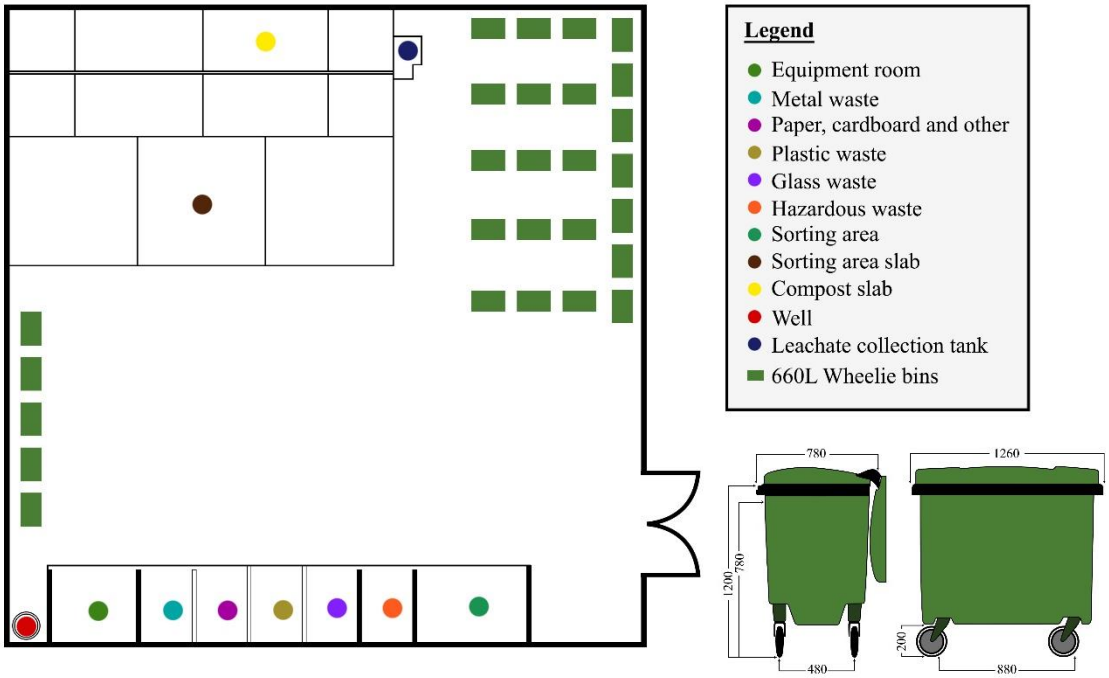

Figure 117: Proposed wheelie bin arrangement to provide for temporary storage of unmanaged organics

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. 660L wheelie 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 IWMC 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 IWMC, with the provision of a 2.8m high 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 IWMC. 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 IWMC.

Mitigation for odour 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 15cm 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.

Mitigation for fire hazards

- A fire management plan shall be developed by the IWMC occupier;
- Adequate firefighting equipment shall be provided at the IWMC, and placed at locations easy to access;
- The IWMC occuper shall be able to show that firefighting capacity of the IWMC is sufficient to suppress and minimize the incidence and impact of fires; and
- Workers shall be trained to use the firefighting equipment and able to manage fire outbreaks.
- 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.

Mitigation for workplace accidents

- The IWMC 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 and instructions to employees on how to operate any machinery;
- Instruct employees on safe systems of work;
- 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 134: 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

Figure 118: Recommended protective clothing for waste management employees. Adapted From: Ministry of Health, Thailand. Bangkok, 1995. *noise cancelling headphones and safety glasses during use of machinery

40.2.1.3 O3 Waste Generation

Waste generated during the operational phase of the IWMC will be relatively low. These will include waste oil/batteries for waste management equipment. Since eating and cooking inside the IWMC will be prohibited, no mixed municipal waste will be generated during the operational phase of the project. Hence overall impact for this activity would have a minor negative impact on environmental receptors.

Mitigation Measures

- Closed containers shall be provided to manage hazardous wastes;
- Spill kits shall be provided to manage oil spills; and
- Prohibit eating/cooking in the IWMC.

40.2.1.4 O4 Resource Consumption

Water will mainly be required for washing equipment, work ware, hands etc. and to water the compost pile. Water required for moistening compost piles will be relatively small. As most of the moisture required for the compost pile will be sourced from the leachate collected from the leachate tank the volume of water required will be significantly less. It is estimated that approximately 200 -300 l/day of ground water will be required during the operational phase of the project. Since the volume of water required is relatively low, it is not expected to have a significant impact on groundwater.

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 empties, therefore resulting in lower transportation costs. Compactors and crushers 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 IWMC. Therefore. Electricity consumption of the IWMC 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.

Mitigation Measures

- 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.

Table 135: Impacts and proposed mitigation measures for the operational phase of the project

No	Potential Risk/Impact	Receptor	Nature	Reversibility	Significance	Mitigation	Cost
	Description	**Description**	**Positive**	**Reversible**	**Major Negative**	**Description**	**USD**
					Major Positive		
			Negative		**Moderate**		
				Irreversible	**Minor**		
OPERATIONAL PHASE							
O1	Waste collection and transportation (Climate impacts, air quality, amenity impacts)	Residents and visitors to Kurinbi	Positive	Reversible	**Minor**	• **See Section 040.2.1.1**	Cost borne by IWMC occupier
O2	Waste management activities (Public health, noise, groundwater, fire, accidents, odour impacts)	Mostly IWMC workers, residents and visitors to Kurinbi,	Positive	Reversible	**Minor**	• **See Section 40.2.1.2**	Cost borne by IWMC occupier
O3	Waste generation (terrestrial pollution, groundwater contamination)	Residents and visitors to Kurinbi	Negative	Reversible	**Minor**	• **See Section 40.2.1.3**	Cost borne by IWMC occupier
O4	Resource consumption (water and electricity)	Residents and visitors to Kurinbi	Negative	Reversible	**Minor**	• **See Section 40.2.1.4**	Cost borne by IWMC occupier

41 PROJECT OPTION

41.1 ADVANTAGES AND DISADVANTAGES OF PROJECT OPTION

The advantages and disadvantages of conducting the project option are proposed below:

Table 136: Advantages and disadvantages of project option

Option	Environmental	Social	Economic
Project Option	The project does not involve any clearing of trees or construction work. The IWMC has been already constructed. Minor negative impacts are expected on the environment of the island during the operational phase. However almost all the foreseeable impacts of the project can be mitigated and kept at an acceptable level and the project will not result in a loss of a sensitive or critical habitat or species. The project will provide the island ways to control and prevent further pollution of the environment, and facilitate utilisation of land area more effectively.	Increased direct and indirect employment opportunities for the locals as the IWMC 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 hence pollution of the island will be stopped or controlled. During the operational phase of the project, smell dust and smoke will be emitted from the IWMC. However, the project site is located at an acceptable distance from residential and public areas.	Enhanced opportunity for locals to start and diversify tourism related services, since a safe and clean island would facilitate and benefit any local tourism venture. Direct contribution to government revenue through taxes and duties. Creation of job opportunities and skilled labour in the region. Expansion of agriculture market in in the island. Price and profit from agricultural produce will become more competitive due to availability of compost. Potential to attract foreign currency by selling compost, scrap metal and other recyclables which would develop the national economy. More settlers will be attracted to the island, which would promote the development of local public services and infrastructure.

42 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT PLAN

42.1 SCOPE

The chapter would present in detail the management measures put in place by the proponent and the contractor to mitigate the environmental impacts that would arise from the project activities. The assessment of impacts and mitigation measures that would be put in place had been discussed in detail in the previous chapter. The main scope or objectives of the environmental management plan are to:

a) Produce a framework for anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions during operational phase; and
b) Provide evidence of conformity to laws and regulations and requirements of enforcement agencies.

42.2 ENVIRONMENTAL MANAGEMENT SYSTEM

The environmental management framework for the proposed project is based on the standards and policies set out by the Environmental Protection Agency of the Maldives under EIA Regulation 2012.

a) Environmental Management Planning and establishment of key performance indicators: The EMP specifies environmental management measures and required performance standards;
b) IWMC operations: The aspects of the operation will be established and operated according with the EMP;
c) Monitoring and corrective action: The implementation of EMP measures will be monitored during operational stage and will be reported. Any inconsistencies between the EMP and its on-site implementation will be identified and addressed through corrective actions; and
d) Auditing, reviews and enhancement: The EMP will be reviewed. Improvements to the EMP will be made as necessary to achieve desired environmental outcomes.

42.3 ENVIRONMENTAL MANAGEMENT STRUCTURE

This Sections detail the various parties involved in the implementation of the environmental plan and their responsibilities.

42.3.1 The Proponent, Ministry of Environment and Energy

MEE will be responsible for the execution of the project activities within the required timeframe. The scope of land clearance falls within the responsibility of the Island Council. MEE is also responsible of policy level decisions and provision of support regarding the waste management works undergone in the island as well as the regional level.

42.3.2 Environmental Consultant

The environmental consultant would prepare the EMP based on field visits and surveys and based on past project experiences in similar settings. If there are any modifications to be made to the EMP during any stages of the project, the consultant would do the modification and would conduct the environmental monitoring according to the monitoring framework. The environmental consultants are also responsible for auditing the management/monitoring plan to identify gaps, limitation in management and propose remedial measures to ensure the project is sustainable.

42.3.3 Environmental Protection Agency

The Environmental Protection Agency would review the monitoring reports submitted by the proponent and would continue with regulatory monitoring visits to the project site upon their needs.

42.3.4 Island Council

The Island Council will be responsible for the following:

- Formulation and implementation of the Waste Management Plan (WMP) for a period of 5 years. HDH. Kurinbi Council has created the WMP on 23rd November 2015. The WMP has not been approved by the EPA at the time of visit.
- Formulation and gazetting of Waste Management Regulations for the island. The Waste Management Regulations and Guidelines have also been formulated by the Island Council. It is recommended to review the Regulations and Guidelines in light of the Saafu Raajje Waste Management Policy;
- Overseeing the operations of the IWMC

The Island Council is responsible to ensure the progress of the Waste Management Plan and achievement of the set goals through implementing the plan. This includes overseeing the IWMC operations by either running the operations through the Council or awarding the work to a contractor. The Island Council is also responsible for the compilation of the IWMC reports submitted by the contractor as well as producing an IWMC monitoring report as well as reporting of public grievances. These reports shall be submitted to the MEE bi-annually for review.

42.3.5 Operations Contractor (IWMC Occupier)

The IWMC Occupier will be responsible in running the operations in accordance with the guidelines set by this EMP and the WMP of Kurinbi Council. The responsibilities of the Occupier include producing the IWMC operations reports and submitting the reports to the Island Council at the proposed regularities.

42.4 REPORTING

Reporting will be carried out on a timely manner to implement the environmental management plan and will cover details of site conditions, and operations. A detailed reporting mechanism for the IWMC operational works is provided in **Section 42.10**. Monitoring reporting shall be carried out during the stated time frames and frequencies in **Section 42.6**.

42.5 ENVIRONMENTAL MANAGEMENT PLAN

A practical plan taking into consideration available resources is proposed to meet the aims and objectives of the EMP. One of the major risks to the investment and operation of the IWMC and island level waste management is the center itself which can be converted back into a dumpsite due to mismanagement as often seen in island level waste management endeavors all across the Maldives. This is partly due to the fact that a lot of linkages connecting island level waste management with regional level waste management are absent or unknown until it is much too late. As described in **Section 40.2.1.2**, one of the main risks facing the current project is rapid accumulation of organic waste at the IWMC. Hence the proposed IWMC management plan aims to control and mitigate such risks without severe negative impacts

Table 137:Details of environmental management plan proposed for the IWMC

Activity	Phase	Measures	Time frame	Responsible person
Training of workers and contractors	Pre-operation	Contractor and project workers are provided with detailed information on the project, impact mitigation measures, compliance with environmental permits and the EMP. Workers are also provided with the information on sensitive areas of the island and other environmental issues. Training of staff involved in the monitoring of the operation phase Training shall be provided to the workers of the IWMC on the waste management practices and mitigation measures in order to ensure the operations are run efficiently and effectively.	Prior to operational phase	Proponent Environmental Consultant
Documenting non-conformances and corrective actions	Operation	Non-conformances to the environmental regulations, permits and the EMP is monitored and documented. Corrective measures are taken and follow ups are done. IWMC operations reports and public grievances are compiled by the Island Council and reported to the proponent within the prescribed frequencies as stated in **Table 141**	Operation phase	Proponent Environmental Consultant Island Council
Supervision of activities	Operation	The project activities are to be supervised by the proponent throughout the operational phase to ensure the activities are carried out accordingly and the impacts are minimised. The proponent shall review the IWMC operations reports from the Island Councils, and provide the required support, bring about any necessary policy updates	Operation phase	Proponent Environmental Consultant

42.6 ENVIRONMENTAL MONITORING PLAN

Table 138: Monitoring plan for the operation phase of the project

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
Ensuring that the project activities does not affect the quality of the groundwater	Establish baseline just before the operation works begin and continue monitoring as stated. Establish a groundwater monitoring stations and geo-reference it. Preferably close to the IWMC.	O	12,000 per trip	Potable water quality testing equipment and/ or by sending samples to the lab	During operational phase, bi annually	Proponent Environmental Consultant	Water quality report
Monitoring Health and safety of workers and the public	Accidents during operation of IWMC and maintenance of IWMC. Fire hazards and natural disaster events. Noise and smell complaints during operation phase. Compost condition, output and quality	O	Cost included in the project cost	Keep records in a log book, or data sheet	Bi annually	Operational contractor Island Council MEE	Measures to adapt and prevent accident and risks. Health assessment reports published or available from the local health center. Policy changes and upgrades. Compost quantity and quality. Income from selling compost.

42.7 RESOURCE REQUIREMENT FOR MONITORING

For the monitoring program to be successful, it is important that adequate financial and human resources are available and strong coordination among the key stakeholders is maintained.

The primary function of implementing the mitigation and monitoring plan will lie with the proponent and environmental consultant. Since the project at developmental and operational stage will be engaged by the proponent it will be the responsibility of the proponent to take care of the environmental safeguards at all stages of the project during implementation and at operational phase. The proponent should prepare an Environmental Action Plan, which states all measures for mitigation and enhancement and monitoring as described here in the EIA with their responsible organisation and person, planning, methodology, timing and other relevant aspects.

An independent registered environmental consultant shall be hired and contacted to undertake and audit the monitoring program prescribed in this report. Following each monitoring visit the consultant will prepare a report with clear recommendations and corrective measure if necessary. The report will have to be submitted to EPA for their review and actions.

42.8 MONITORING SCHEDULE

Table 137 highlights the monitoring plan in which responsibilities of main stakeholders has been assigned. In order to track and compile the findings of these measures an independent environmental consultant shall be tasked to audit the projects EMP. This is to

- identify gaps in monitoring and mitigating impacts arising from the project;
- determine the challenges and resource inadequacies to implement the proposed EMP; and
- determine the current environmental condition and propose modification/upgrades to the initial EMP.

Monitoring frequency for various individual components given in **Table 138** shall be followed by all responsible parties. **Table 139** gives indicative timeline for the monitoring visits by third party consultant.

Table 139: Monitoring visit schedule

Visit	Indicative timeline	Indicative parameters to monitor	Reporting	Cost (MVR)/per report/island.
Visit 1	Prior to operation of IWMC	Set baseline for groundwater quality and noise	Submit summary report 1 to Proponent within 2 weeks	25,0000.00
Visit 2	Two months into operation of the IWMC. Biannually for four years	Monitor water quality and noise. Monitor IWMC. This includes review of reports dated in **Table 138** or determine condition of IWMC. Monitor compost condition as described **Table 138** and **Table 141**	Submit summary report 2 to Proponent within 2 weeks	25,000.00

As indicated, during the course of the Project implementation summary reports following each trip is expected to be submitted by the Project's environmental consultant. These environmental audits will provide a basis for assessing at least the shorter-term efficacy of the environmental measures and thereby provide lessons to be learned for future monitoring sessions and other projects with similar impacts. The consultant will prepare and submit the reports to Proponent. Based on the findings of the report, the management approach may be adapted and its efficacy will be determined in the consecutive monitoring trip.

42.9 MONITORING REPORT

Reporting will be carried out by the environmental consultant assigned for the purpose by the proponent. The report will include among other information;

- Details of what was being monitored;
- Methodology of data collection and data analysis;
- Major findings;
- Effectiveness of the mitigation measures in place and
- Recommendations and conclusions.

A detailed environmental monitoring and management report is required to be compiled and submitted to the EPA. In addition to this, regular site monitoring would be carried out by the proponent that requires maintaining logs of events as explained in this report. Enforcement officers from EPA may also visit the site for inspection from time to time.

42.9.1 Monitoring Report Format

The environmental monitoring report outlined in **Table 140** below will be used in reporting environmental monitoring to be carried out as given in the monitoring plan.

Table 140: Monitoring report format

Project Title:
Name of the Island:
Monitoring Date:
Period Covered:
Prepared by:
Contributions:

A. Introduction
Give a brief introduction about the project and the monitoring carried out
B. Methodology
Brief detail of the methodology applied for undertaking the monitoring assessment
C. Environmental Monitoring
a. Groundwater quality
Parameters given in the monitoring plan need to be assessed
b. Waste generation and management at IWMC
These include monitoring for pests and diseases as described.
D. Risks and Mitigations
Please indicate any critical unresolved risks that affect the course of the system operation, analyse the cause, assessing the potential impacts on the environment providing the proposed mitigation strategy
E. Problems Encountered
Indicate any problem areas encountered and any corrective measures that will have to be taken.
F. Recommendations and Adaptations as Solution
If specific recommendation is noted during the monitoring phase, specify it in the report
G. Conclusions
Reference
Appendix

42.10 IWMC OPERATIONS REPORTING MECHANISM

Table 141:Details of the reporting mechanism proposed for the IWMC

IWMC (Contractor)

Reporting	Details	Frequency
General report	Logs of the incoming waste	Monthly
	Classified by type and weight	
	Vehicle maintenance details	
	Machinery maintenance details	
	Machinery fuel usage details	
	Workplace injuries	
IWMC capacity	Details of the utilized and remaining capacity of IWMC	Every two months
	Leachate tank maintenance and capacity	
IWMC inventory status report	Details of the status of IWMC equipment	Bi-Annually
	Details of the status of emergency kits and firefighting equipment	
Compost output report	Details of amount of input waste materials	Bi-Annually
	Details of compost output in weight	
Noise and odor complaints	Log of noise and odor complaints	Every two months
	Complaints to be provided along with weather conditions and incoming waste details coinciding with the dates of complaints	

Island Council (Municipal Unit, Waste Management Committee)

Components	Details	Frequency
Public grievances	Log of public grievances regarding	Bi-Annually
	Fee structure	
	Waste Management operations	
	Noise and odor complaints	
IWMC monitoring	Monitoring report of the IWMC operations	Bi-Annually
Compilation of IWMC reports from IWMC occupier		Bi-Annually
Income report	Summary of IWMC operations income	Bi-Annually

MEE

Components	Frequency
Review of IWMC Reports from Councils	Bi-Annually
Update National Waste Database	
Policy updates from findings	
Provision of support to IWMCs	
Overview of the waste management system on island level and regional level	

43 RECOMMENDATIONS AND CONCLUSION

The operation of the IWMC at HDH. Kurinbi is a much needed project to provide waste management services to the island. The IWMC 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.

The 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 operation of the project. Strict considerations are to be given to the pollution control as well as health and safety measures

The consultant's recommendations for the project include:

- To include this EMP as part of the contractor's contract and ensure the measures and recommendations brought forth are followed;
- Implement the mitigation plan as prescribed in the report to the fullest;
- To conduct supervision and monitoring of the project works by the proponent;
- To conduct supervision and reporting of the project works by an independent consultant;
- To conduct stringent evaluation of contractor's capacity to undertake the project;
- Ensure necessary clauses regarding the workers safety are fully implemented;
- Enforcement agency to make an effort to make at least one visit to the project site during the operational phase to ensure environmental compliance of the project activities; and
- Proponent appoints a focal point to coordinate activities relating to monitoring and reporting.

This EMP has looked into the key factors that need to be considered during construction and operational stage. The study has identified the negative impacts of this project are minor.

The study also found that through the implementation of the proposed practical and cost effective mitigation measures all impacts can be brought to an acceptable level. This EMP will guide the proponent in implementing the project with conformity to EIA regulation 2012.

CHAPTER 7
HDH. VAIKARADHOO

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44 INTRODUCTION

44.1 BACKGROUND

HDh. Vaikaradhoo is situated centrally in the southern region of South Thiladhunmathi atoll, with the geographic coordinates of 6°33' N, 72°57' E. Vaikaradhoo has a high population compared to islands in HDH. Atoll, with a population of 1825 as at November 2016. The population comprises of 491 children, 666 people between 18 and 35 years of age, 556 people between the ages 35 and 65, and 112 over 65. The island has a width of 751 m and a length of 1.8 km. The inhabited area is approximately 28 ha. Of the 511 households in the island, 182 are occupied.

The health center provides medical services to the population through 1 doctor and 4 nurses. STO pharmacy is present in the island, and Aasandha service is available through the pharmacy. Education is provided in the island from preschool to secondary school, at the HDH. Atoll School. A total of 231 students enrolled in the school in 2016. The main economic activity conduced in the island is agriculture. In addition to this, fisheries, traditional craft *fangiviyun,* civil service work, construction works, and carpentry works are conducted. The island has 3 mosques. Recreational activities include football, volleyball, *bashi,* netball, badminton, and traditional recreational activities such as *Maali* and *Bodumas beynun.*

Harvested rainwater is used for drinking, and 380 nos. of 2500 liter water tanks are used in the households. In addition to this, 34 community water tanks are placed in the island. Sanitation practices include usage of septic tanks, as there is currently no central sewerage system in the island. There is a demarcated dumpsite in the island, but there are no facilities within it, therefore the island faces difficulty in waste management. Waste is currently separated and stockpiled inside the dump site, while organic waste is burnt and kitchen waste is disposed of at the beach areas.

These practices have led to issues such as mosquito breeding, vermin and pests, cuts and bruises from shards of glass, groundwater pollution, air pollution from burning of organic wastes, damage to coral reef environments, and amenity issues such as foul odours. Dumping of kitchen wastes and other wastes in the nearshore area can lead to diseases, nutrient imbalances, smothering of corals toxicity impacts to marine flora and fauna (Halliburton, 2002).

No waste audit specific to the island has been carried out in the past nor had the waste situation of the island been properly assessed. A waste audit for Zone 1 (which includes HA, HDh, and Sh. Atolls) conducted by MEECO in 2016 showed an average of 1.30 kg/capita/day of waste generation within the islands. Using this average, approximately 2.3 ton/day of waste is generated within the island. The majority of sources of waste in HDH. Vaikaradhoo are the 254 households, 21 shops, and 7 government institutions. In order to manage the waste situation at the island level, the proponent, Ministry of Environment and Energy (MEE) has proposed the project to establish an Island Waste Management Centre (IWMC) in HDH. Vaikaradhoo.

The proposed project is facilitated by MEE and financed by the OPEC Fund for International Development (OFID) under the “Provision of Water Supply, Sanitation and Solid Waste Management Project”. The completion of the proposed project will result in the construction of an IWMC, and the operation of the IWMC will be facilitated under the Waste Management Plan devised by the Island Council and Approved by EPA.

The scope of the IWMC is to facilitate island level management of the waste generated within the island, which includes sorting, volume reduction and stockpiling of recyclables, composting of organics, and storage of hazardous waste. The waste that is not manageable in the island level shall be transported to a central waste management facility.

The proponent has requested consultancy services of MEECO for the preparation of an Environmental Management Plan (EMP) to comply with the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012. EPA has issued a decision statement on HDH. Vaikaradhoo that an EMP would be suffice for the proposed IWMC construction and operation works.

A field visit was conducted by the MEECO team to HDH. Vaikaradhoo on 28th and 29th April 2017 in addition to a consultation meeting with the Island Council during the time period. This report is based on the findings of the field visit, consultations, previous EMP's and experience of the consultant.

44.2 PROJECT SETTING

HDh. Vaikaradhoo is situated centrally in the southern region of South Thiladhunmathee Atoll, at the location 6°33' N, 72°57' E. The island is approximately 270.4km from the capital Male'. The island is 34.17km from the airport island of HDh. Hanimaadhoo. The nearest inhabited island is HDh. Neykurendhoo, which lies to the east of Vaikaradhoo at a distance of 1.5km.

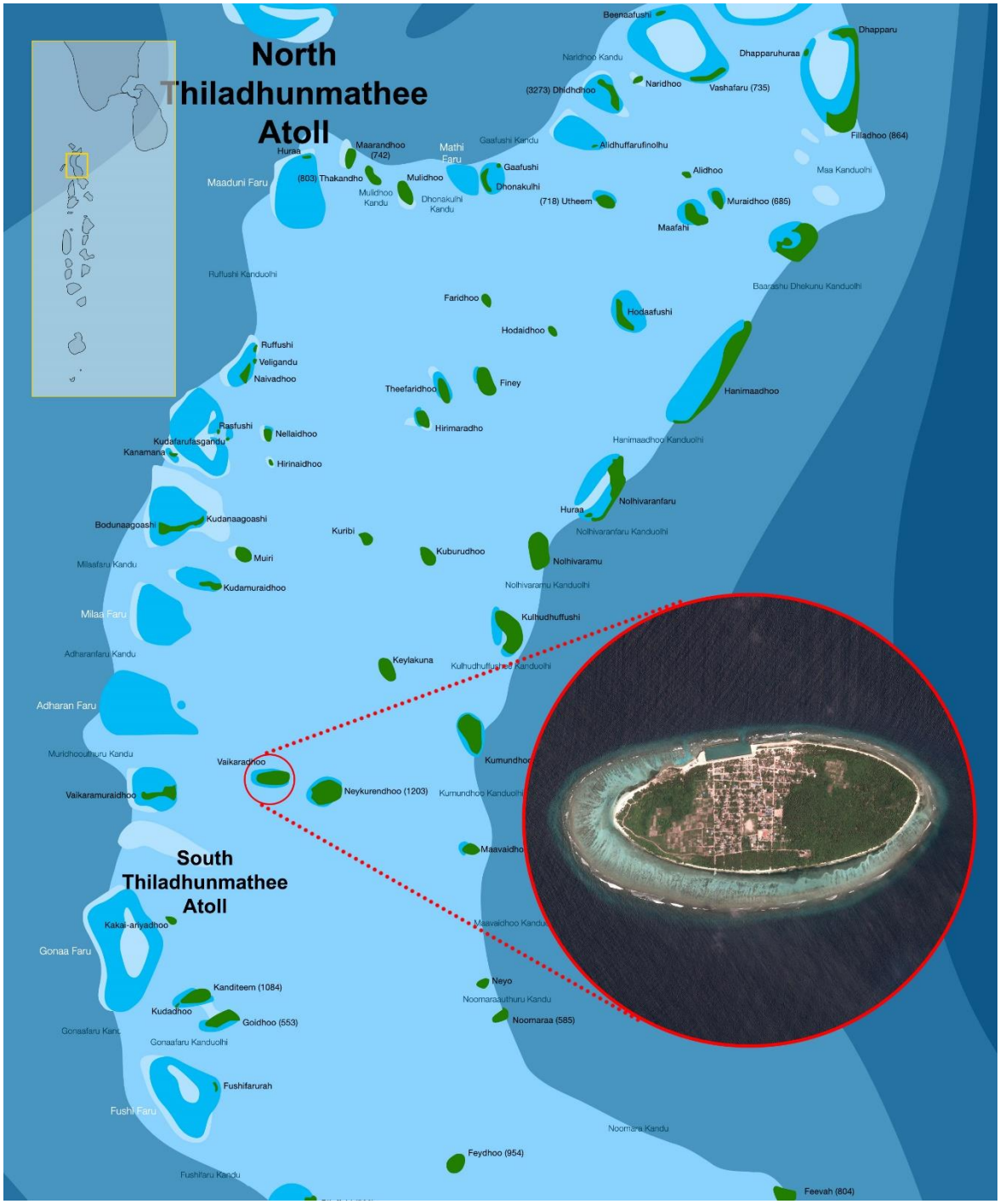

Figure 119: Project setting

44.2.1 Site Location

The proposed Island Waste Management Centre (IWMC) is located in the southern region of the island at 6°32'50.36"N, 72°57'19.82"E. The IWMC is proposed to be constructed to the east of the existing waste dump used in the island.

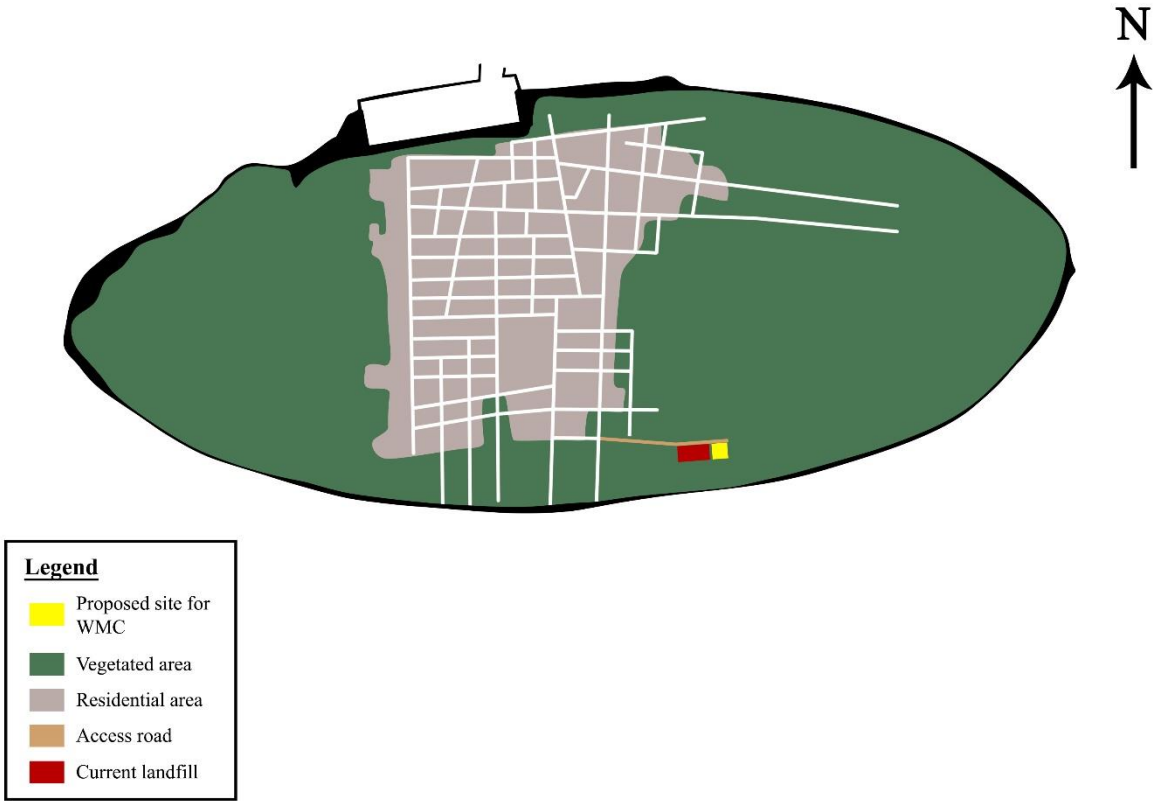

Figure 120: Proposed location for the waste management site on Vaikaradhoo Island

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44.3 CURRENT STATE OF WASTE GENERATION AND WASTE MANAGEMENT

44.3.1 Waste Generation in Zone 1 and HDH. Vaikaradhoo

A waste audit conducted by MEECO in 2016 showed that the average waste generation of the islands in Zone 1 was 1.30 kg/capita/day.

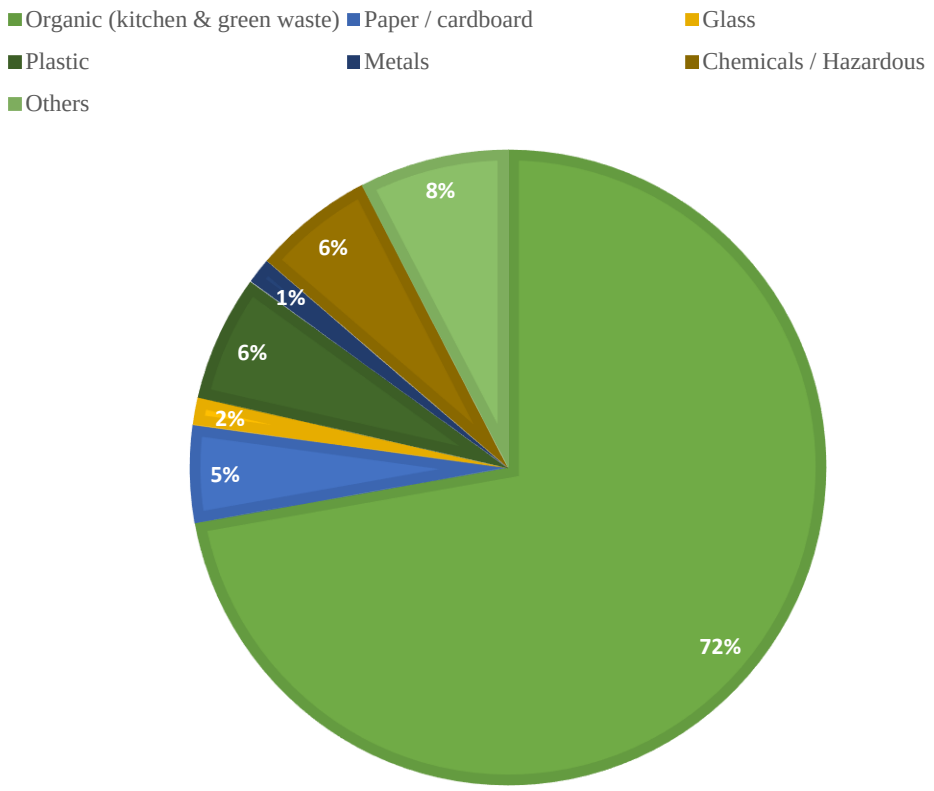

Figure 121: Waste Composition of Zone 1 (Source: MEECO, 2016)

The analysis shows that the majority of the waste generated includes organic wastes at 72%, which include kitchen and green wastes. This waste can be used in composting in addition to paper and cardboard wastes which are at 5% of the total waste generated. Recyclable materials such as plastic, metals, and glass make up 9% of the composition. Approximately 6% of the total waste generated is chemicals and hazardous waste. Using HDH. Vaikaradhoo's current population, the daily waste generated can be estimated from this data.

Table 142: Estimated waste generation quantities of HDH. Vaikaradhoo

Waste Type	Zone One Average (%)	Vaikaradhoo Waste Generation (Kg/Day)
Organic (kitchen & green waste)	72.2	1712.945
Paper / cardboard	4.94	117.2015
Glass	1.42	33.6895
Plastic	6.4	151.84
Metals	1.3	30.8425
Chemicals / Hazardous	6.15	145.90875
Others	7.58	179.8355
Total	99.99	2372.26275

44.3.2 Current state of waste management in HDH. Vaikaradhoo

Vaikaradhoo Council has set guidelines for disposal of waste, and waste disposal is done on a set schedule on allocated days. It was noted that a minority do not follow these guidelines. The main sources of waste in the island is highlighted in **Table 143**.

Table 143: The main sources of waste in HDH. Vaikaradhoo

Source	No.
Households	254
Shops	21
Café / Restaurant	2
Carpentry	3
Institutions	7
Boat yard	2
Communications	2
Clubs / Societies	1

Waste is dumped at a demarcated dumpsite, but there are no facilities within it, therefore the island faces difficulty in burning and reduction of waste. Kitchen waste is dumped at the coastal area. The current dumpsite was constructed under a UNDP project by Vaikaradhoo Il'haaru Jamiyya. The waste brought to the dumpsite is currently separated and stockpiled inside the dump site. The Island Council has allocated staff to conduct the separation, stockpiling and burning of waste in the dumpsite. Currently, there is no mechanism set up to transport unmanaged waste from the island.

Figure 122: Current state of waste disposal in the island. Waste is mainly being disposed of at the demarcated dumpsite (A, B and C). Although, dumping of waste occur elsewhere.

Issues that have arisen due to improper waste management include:

- Mosquito breeding, vermin and pests, cuts and bruises from shards of glass;
- Groundwater pollution, air pollution from burning of organic wastes, damage to coral reef environments from waste dumped on beaches and nearshore; and
- Amenity issues: odours, unsightly, disadvantage against local tourism to the island.

44.4 WASTE MANAGEMENT PLAN OF HDH. VAIKARADHOO

HDH. Vaikaradhoo has formulated a Waste Management Plan (WMP) on 29 November 2016 for a period of 5 years. The main purpose of the WMP is for Vaikaradhoo to solve the issues of waste management by managing the waste produced in the island in an environmentally sound and sustainable manner. The Island Council aims to achieve the goals stated within the WMP in the 5 year period.

The main goals stated in the WMP include:

- Formulating rules and guidelines to manage the waste on an island level;
- Creating awareness on the economic and social advantages of the reduction of waste pollution;
- Reducing the amount of waste produced in the island, and encouraging reusing of materials;
- Obtaining waste management equipment for the IWMC, and providing the required training;
- Separation of waste at the IWMC and managing of the waste in an environmentally friendly manner;
- Provide the IWMC services sustainably with the collection of a monthly fee;
- Making arrangements to clean the public spaces in the island; and
- Formulating a system to manage special types of waste.

The Council plans to manage waste in the following manner:

- Separation of waste into 5 categories at the household level;
- Provision of waste transportation service to households and institutions daily;
- Waste transport, waste management, and management of the equipment at the IWMC will be contracted to a local business / partnership / local investment or club / society;
- A fee system will be set up; and
- Until the arrangement to transport to Regional Solid Waste Management Facility is set up, unmanaged waste will be transported every 3 months to Thilafushi. With the arrangements for the RSWMF in place, transportation to be done twice a month to the RSWMF.

The main roles and responsibilities stated in the WMP include:

- Island Council is responsible to create a Waste Management Committee within the stakeholders of the island, and implement the Waste Management Plan based on the consultations with the Waste Management Committee;
- Island Council member to be appointed as the chair of the Waste Management Committee;
- Island Council shall formulate and enforce the Waste Management Regulations and Guidelines based on the consultations with the Waste Management Committee;
- Waste transport, waste management, and management of the equipment at the IWMC to be contracted to a local business / partnership / local investment or club / society;

- Island Council and Waste Management Committee to monitor the IWMC works once a day, during the first three months, and twice a week in the subsequent months; and
- Obtaining technical and financial assistance from the Proponent and technical assistance from the EPA.

Table 144: Fee structure proposed

Nos.	Source	Fee (MVR)
254	Households	100
21	Shops	120
2	Café / Restaurants	130
3	Carpentry	130
7	Institutions	200
2	Boat yard	150

45 DESCRIPTION OF THE PROJECT

45.1 THE PROPONENT

The proponent of the project is Ministry of Environment and Energy (MEE) of the government of the Maldives. The proposed activity is part of a greater project titled "Provision of Water Supply, Sanitation and Solid Waste Management Project" financed by the OFID.

45.2 PROJECT DURATION AND SCHEDULE

The proposed construction phase of the project is planned to be carried out in 10 weeks. This project is has been opened to bidders on June 2017 with a validity period of 90 days.

A tentative schedule of the work is found in **Table 145**.

Table 145: Work plan for IWMC

#	Activity	Duration (days)	Weeks									
			1	2	3	4	5	6	7	8	9	10
1	Mobilization	7										
2	Site clearing	4										
3	Excavation works	2										
4	Substructure and superstructure works	10										
5	Masonry works	10										
6	Plastering works	3										
7	Roofing works	7										
8	Structural steel works	7										
9	Electrical works	2										
10	Plumbing works	1										
11	Doors and windows	7										
12	Demobilization	2										

45.3 PROJECT DESCRIPTION

The proposed site plan is presented in **Figure 123.** Engineering details are provided in **Annex 2**.

The construction of the IWMC consists initially of mobilization and site clearing. The main works include shallow excavation, substructure and superstructure works as well as masonry works. The proposed design of the IWMC 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 operational phase of the project will include the daily collection of waste from the households and institutions, in addition to waste management works in the IWMC, which include;

- Sorting of waste;
- Storing of hazardous waste;
- Volume reduction of plastics, glass and metals;

- Stockpiling of sorted waste; and
- Composting of organic waste.

The IWMC is made up of an equipment room, and separate areas to store metal waste, paper and cardboard, plastic waste, glass waste as well as hazardous waste.

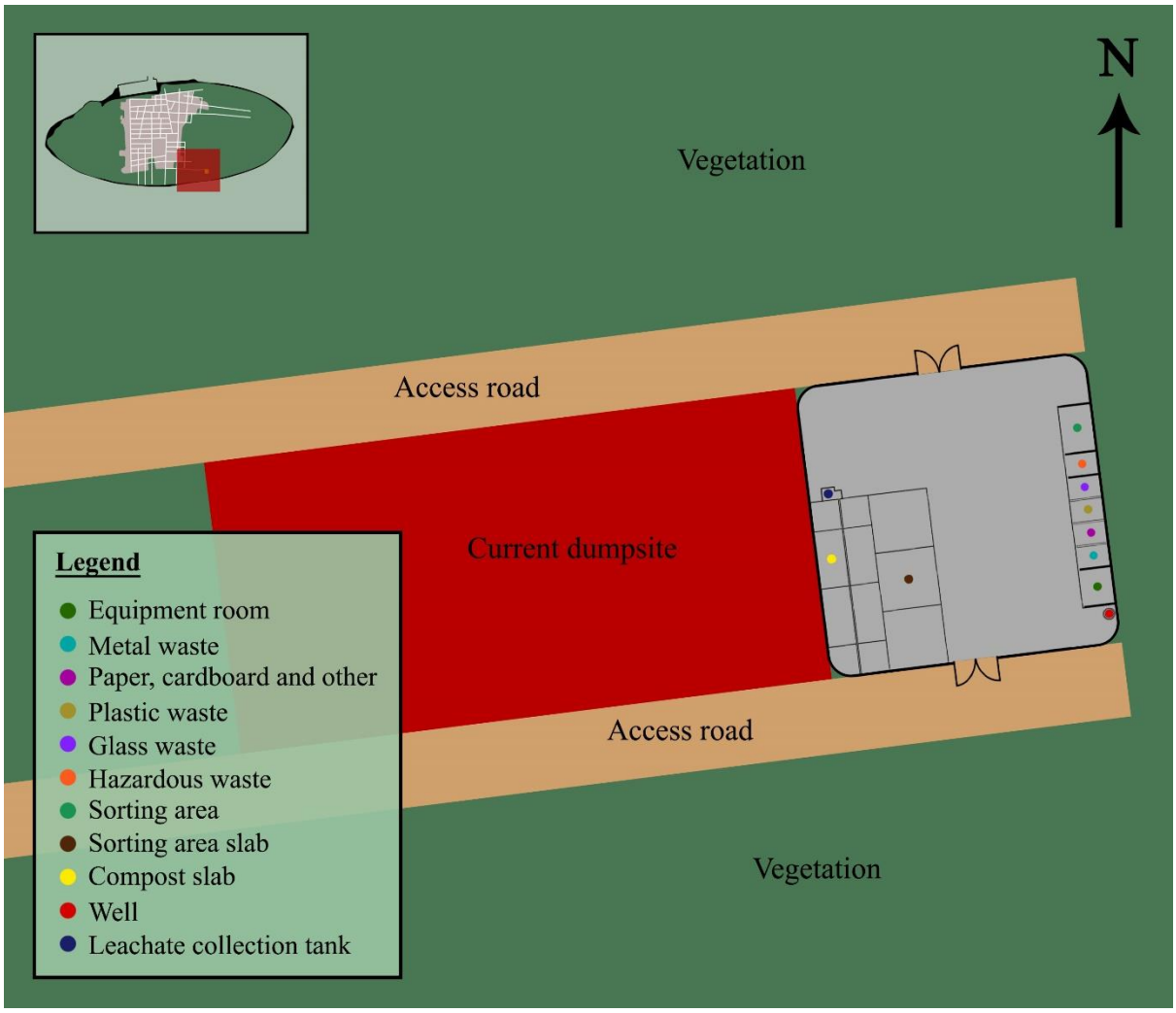

Figure 123: The site plan

45.3.1 Machinery

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

a) Lorry crane for placing of well;
b) Truck for transportation of materials;
c) Vibratory plate compactor;
d) Concrete mixer;
e) Concrete supply pump and piping; and
f) Daily 4" pump.

45.3.2 Mobilisation

As the amount of input materials are relatively minor, the construction materials shall be stored inside the demarcated site throughout the construction period

45.3.3 Demarcation and Fencing

Prior to beginning construction works, a survey shall be done by the contractor to demarcate the limits of the site, and the site shall be fenced off. Work shall be conducted within these limits.

45.3.4 Site clearance and levelling

The proposed site has already been cleared. As the site size is relatively small, a vibratory plate compactor may be used for the levelling of the ground.

45.3.5 Construction of Sorting Area Foundation

The footprint of the proposed site is 28.6 m by 28.6 m, of which the storage areas consists of a 3.15 m by 18.85 m area. The proposed foundation below the masonry walls of the structure is a line (strip) foundation.

45.3.6 Construction of Compost Slab and Sorting Area Slab

The compost slab and sorting area slabs has an area of 15 m by 10 m. The 100 mm thick reinforced concrete slabs are cast over ground beams B1, B2 and B3. The ground beams B1 and B2 have a depth of 0.3m while B3 has a depth of 0.4m from the top of the slab. B3 has a void on top of the beam centrally to receive a 100mm PVC pile cut in half sloping at 1% from the upper end to the lower end, connecting to the leachate tank at the end. Excavations will be done manually to receive the ground beams as per the drawings indicate. The maximum depth of excavation for the beams is 0.4m. The construction of the slab and ground beams include initially laying of HDPE membrane on the slab and beam footprint. Formwork will be added to the sides of the beams, and following that, the arrangement of the required reinforcing steel. Concrete will be poured for the ground beams, followed by the slabs. Concrete mixing will be done on site.

45.3.7 Construction of Leachate Tank

The leachate collection tank is located at the end of the compost slab. The leachate tank has an area of 1.1 m by 1.5 m and a depth of 1.09 m extending below ground. The valve junction of the leachate tank has a size of 0.8 m by 0.55m, and has a depth of 0.63 m. 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.

45.3.8 Construction of Perimeter Fence

The whole length of the perimeter will 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 2.8m from ground level. The mesh is held together by 50 mm diameter GI pipes vertically 2 m centre to centre which are welded to three evenly spaced 38 mm GI pipes horizontally. The strip foundation below the masonry wall has a depth of 0.3 m with a 50 mm thick lean concrete placed below. Each vertical GI pipe is fixed to a 300 × 300 mm concrete footing with a depth of 0.6 m. The GI pipe is welded into a 200 × 200 mm plate. Therefore, the excavations done for the masonry wall strip foundation and GI pipe footing will be at 0.35 m and 0.6 m respectively. The trenches required to receive the strip foundation and footings will be excavated manually.

45.3.9 Construction of Well

A well is proposed to be constructed at the eastern corner of the IWMC. This well is 900 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.

45.3.10 Construction of Superstructure

The superstructure of the IWMC consists of the sorting area, storage area and the equipment room. The structure consists of a 3 m high wall separating the compartments. The roofing is supported by GI Pipes of diameter 38 mm and 75 mm. The roofing is made of LYSAGHT roofing sheets.

45.3.11 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 in vacant houses.

45.3.12 Waste Management

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 disposed in closed containers. The waste shall be well secured to avoid any scattering due to strong winds.

Municipal waste produced by the workers are estimated at an average of 0.45 kg/capita/day which translates to 346.5 kg of waste for the duration of 11 weeks for the whole workforce.

After the construction works are done, the collected waste shall be transported to the waste management facility in Thilafushi.

45.3.13 Pollution and Control Measures

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

a) Machinery to be properly tuned and maintained to reduce emissions/spills/leaks;
b) Fuel storage, paint, lubricants will be stored securely and bunded; and
c) Spill kits would be made available on site to control any liquid spills.

45.3.14 Health and Safety Measures

The proposed project involves transportation as well as construction of the IWMC at the site. These works will include use of vehicles, machinery, and heavy materials, and the workers may be put in situations where there is a risk of injury. These risks need to be identified and managed through the implementation of health and safety guidelines for the site. Health and safety measures for the construction phase include and are not limited to:

a) The contractor would be briefed regarding the laws and regulations that need to be followed regarding the proposed works and would ensure that Health and Safety procedures are complied with at all times;
b) There would be a construction supervisor at the site;
c) Only experienced and licensed operators will be allowed to operate heavy machines;
d) First aid kit should be made available at the work site;
e) The work force would be equipped with all safety gears and warning signs would be provided;
f) Fire extinguishing equipment would be available at the site;

g) PPE should be provided to all workers and the use of PPE enforced;
h) Operation of any heavy machinery will need the assistance of a banksman as all times;
i) All heavy lifts must be supervised and slings inspected; and
j) All other similar environment personal safety and quality control measure to be in place and checked by a qualified personal and approved and maintained at all times.

45.3.15 Demobilization

The demobilization plan will commence in the last week of the contract.

45.4 OPERATIONAL PHASE

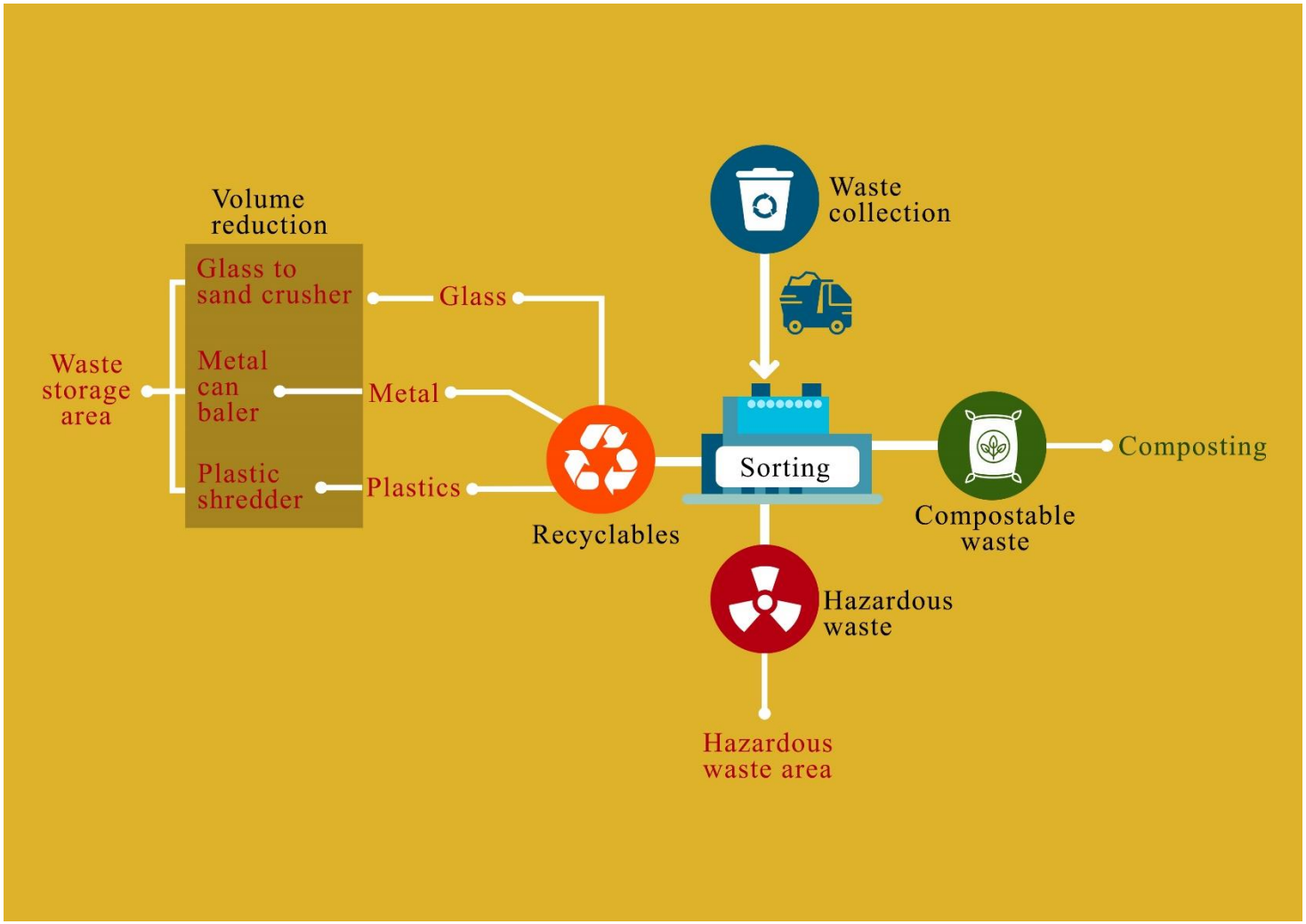

Figure 124: Operational phase flowchart of the IWMC of HDH. Vaikaradhoo

The following section will highlight the operational aspects of the IWMC. This includes the machinery and equipment proposed to be used in the IWMC, in addition to the main activities to be carried out at the IWMC and within the island. The activities begin from the sources, which are then collected and transported to the IWMC. This collected waste is 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.

45.4.1 Machinery and equipment proposed

During the operational phase of the IWMC, in addition to the collection of the waste and sorting, different activities such as composting, and waste volume reduction will be done. The proposed equipment for the IWMC include general equipment needed to handle the waste such as wheelbarrows, garden hoes, shovels, buckets and cultivators. These equipment will be used during the IWMC operation for handling as well as composting operations. A manual rotary compost screen is also included for the screening stage of the composting process.

Other equipment include waste volume reduction equipment such as a plastic shredder, metal can baler, vegetation shredder, and glass to sand crusher. The equipment and their specifications are detailed below.

Table 146: Equipment proposed for waste management works

Equipment	Details
Chainsaw	
Wheelbarrow	HDPE 6 cub. Ft.
Heavy Duty Gumboots	PVC or rubber
Heavy Duty Hand Safety Gloves	Rubber or Latex
Long Handled Flathead Steel Rake	Steel, 54 inches length
Long Handled Cultivator	Steel, 54 inches length
Garden Hoe	Steel, 57 inches length
19” Round Point Shovel	Steel
48” Square Point Shovel	Steel
19” D-Handle Square Point Shovel	Steel
20L Bucket	HDPE
40L Bucket	HDPE
Polypropylene Surgical Mask Box (50pcs)	Polypropylene
Weighing Bench Scale	50-75 kg capacity
Wheelie Bins	HDPE
Glass to Sand Crusher	0.5 to 1.0 tonne/ hr, output 0.5mm and less, 2-5HP motor
Plastic Shredder	30-100Kg/hr Output material less than 10mm
Metal Can Baler	3 to 5 HP, 2m2 or more inside volume
Vegetation Shredder	Petrol / diesel driven multi vegetation shredder / chipper
Manual Rotary Compost Screen	1m to 1.5m drum

45.4.2 Waste Collection

According to the Waste Management Plan formulated by the Vaikaradhoo Council, the waste collection and IWMC operational works will be done by a third party under contract. Each house will be sorting the waste produced at household level. The waste will be collected daily from all households, institutions and other sources using a vehicle.

45.4.3 Sorting

As per the IWMC site layout plan, a ground slab is dedicated for the sorting area. This sorting area is located next to the compost slab. Here, the collected waste will be kept, and sorted into their respective categories. In addition to this, a dedicated sorting area is also provided alongside the storage areas. The IWMC is designed to have separate storage areas for metal, paper and cardboard, plastic, glass, and hazardous waste. After sorting, the waste is stored in the respective location.

45.4.4 Composting

The IWMC is designed in order to facilitate the storing, sorting and reusing of the waste generated in the island. One of the main operations that will be conducted in the IWMC is the composting of the organic waste such as kitchen waste and garden 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 main constituents of a compost heap include kitchen and garden waste, along with water and air in the pore spaces between the constituent.

45.4.4.1 The Composting Process

After the incoming waste is 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.

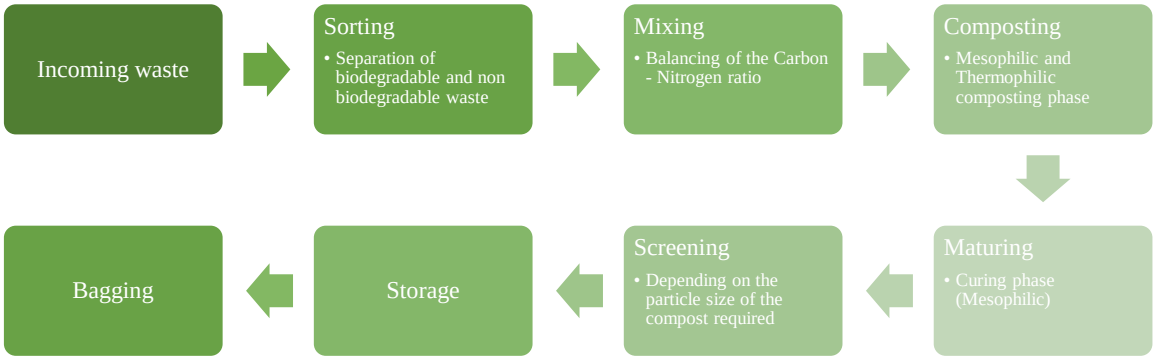

Figure 125: The composting process

45.4.4.2 Sorting of Incoming Waste

Incoming waste is required to be sorted to separate biodegradable and non-biodegradable waste. The sorting of waste at each household as specified in the Waste Management Plan will streamline this process. Hazardous waste and residues are kept in their respective compartments, as well as recyclables.

Table 147: Domestic Waste Categories

Incoming Domestic Waste			
Suitable for composting	**Not suitable for composting**		
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
Composting Process	**Storage**		

45.4.4.3 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.

Looking into the composition of compostable wastes from the Zone 1 Waste Audit, it is seen that the majority of compostable wastes constitute of garden (green) wastes. Garden wastes make up 64% of waste generated, while the second largest contributor to compostable wastes is kitchen wastes, at 28%. Printed paper and cardboard make up 5% of compostable waste while 2% of the category includes animal waste. This composition is important in determining the Carbon-Nitrogen ratio of the compost heap in order to provide optimum conditions for composting.

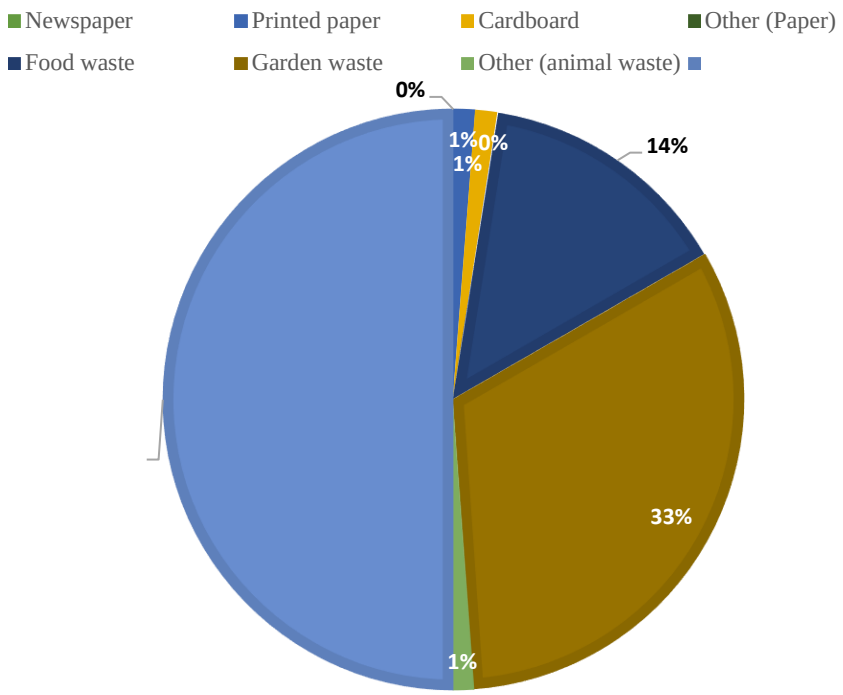

Figure 126: Composition of compostable waste for Zone 1

Table 148: Estimated compostable waste generation quantities of Zone 1

CATEGORY		Average Per Capita (kg/day)	Percentage
Primary	**Secondary**		
Paper & Cardboard	Newspaper	0.00	0.0%
	Printed paper	0.02	2.4%
	Liquid container	0.00	0.5%
	Cardboard	0.02	2.4%
	Other (Paper)	0.002	0.2%
Organics	Food waste	0.29	28.2%
	Garden waste	0.67	64.2%
	Other (animal waste)	0.02	2.2%
Total		1.04	100

Green wastes such as vegetable wastes (kitchen waste), and poultry manure have high Nitrogen values while brown wastes such as foliage, wood chips, bark and paper have high carbon values. From the waste audit, it is seen that 64.2% of the compostable waste produced is garden waste while 28.2% of the waste generated is food waste. Therefore, it can be said that the composition of compostable waste in the islands in Zone 1 is in favour of providing a high Carbon content compared to Nitrogen.

45.4.4.4 Composting and Maturing

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

Table 149: 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 149**, the composting process can prolong to several months.

45.4.4.5 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. This slab is 15m long by 5m wide. 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 100mm 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 compost slab.

45.4.5 Volume Reduction

The incoming waste is sorted, and either used for composting, or stored in their respective compartments. 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.

45.4.6 Projected Capacity of the IWMC

The proposed IWMC is planned to manage a portion of the waste produced at the island level, with the unmanaged waste (approximately 70 – 75% of waste generated within the island to be transported to the nearest RSWMF). The projected capacity for 1 month's waste for the island of Vaikaradhoo is shown below.

Table 150: Projected waste management capacity for the waste generated in HDH. Vaikaradhoo in 1 month

Waste Type	Details	Amount	Unit
Organics	Composting capacity in IWMC. Assuming 1m height windrow with a width of 2m	39	m3
	Organic waste generated per month	79.06	m3
Paper waste	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	5.409	m3
Glass	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	1.555	m3
Plastics	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	7.008	m3
Metals	Storage capacity (2.5m by 3.15m compartment assuming height of pile 1.5m	7.875	m3
	Waste generated bulk density after volume reduction 0.65 tons/m3	1.424	m3

As seen in **Table 150** the IWMC has the capacity to compost the organic waste generated in less than one month for the island. Organic wastes make up the bulk of the waste stream in the islands, taking 72% of the total waste generated in the island. The composting capacity of the proposed compost slabs (assuming a windrow of 1 m height and 2 m width at the bottom and 1m width on top) is approximated as 39 m^3. The calculated volume for the organic waste generated in a month in Vaikaradhoo is 79.06 m^3. Therefore, 15 days' worth of organic wastes produced in Vaikaradhoo would take up the composting capacity of the IWMC for the succeeding 4 – 6 months. There is no additional storage space for the organic wastes provided in the facility.

45.5 PROJECT INPUTS AND OUTPUTS

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

Table 151: 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	29.66 m3	Local Suppliers
		Reinforcement		
		Reinforcement T10	1.231 tons	Local Suppliers
		Reinforcement R6	0.19 tons	Local Suppliers
		Reinforcement T12	0.09 tons	Local Suppliers
		Formwork	135.66 m2	Local Suppliers
		Masonry Works (200mm bricks)	205.8 m	Local Suppliers
		Structural Steel		
		50mm and 38mm GI Pipe for perimeter fence	77.4 m	Imported / purchased where available locally
		75mm GI pipe (flood light fixing poles and roof fixing)	18 Nos.	
		38mm GI bearer pipes	46.2 m	
		38mm GI purlin pipes	95 m	
		38mm GI pipes between columns	35.2 m	
		75mm GI pipe to support machine room door	3.5 m	
		Paint		
		Primer and 2 paint coats (Grey Color)	345.96 m2	Local suppliers

		Electrical Components		
		3 Phase power sockets	4 Nos.	Local suppliers
		Single phase power sockets	3 Nos.	
		100 mm ceiling mount lights	1 Nos.	
		Wall mount exhaust fan	2 Nos.	
		500W flood light	2 Nos.	
		25 mm2 4 core power supply cable	290 m	
		Well water pump	1 Nos.	
		Metal doors for		
		Equipment room	1 Nos.	Local suppliers
		Hazardous waste area	1 Nos.	
		Waste yard entrance	1 Nos.	
		Plumbing		
		25mm PVC intake pipe		Local suppliers
		1/2 inch PVC pipe from pump to all distribution points	40.9m	
		Roofing		
		Storage area roof sheets	85.5 m2	Local suppliers
		Flashing sheets	28 m	
		Lysaght gutter	19 m	
		50x50 PVC coated mesh fence	77.4 m2	Local suppliers
		HDPE membrane	209.54 m2	Imported / purchased where available locally
		Timber top cover	1 nos.	Local suppliers
		PVC pipe for leachate tank drain	15 m	Local suppliers
		600 x 900 5mm plastic sheet signboard	1 Nos.	Local suppliers
Operation	Equipment and Materials	Chainsaw	1	Imported / purchased where available locally
		Wheelbarrow	4	
		Heavy Duty Gumboots	5	
		Heavy Duty Hand Safety Gloves	5	
		Long Handled Flathead Steel Rake	3	

		Long Handled Cultivator	3	
		Garden Hoe	3	
		19” Round Point Shovel	3	
		48” Square Point Shovel	3	
		19” D-Handle Square Point Shovel	2	
		20L Bucket	3	
		40L Bucket	2	
		Polypropylene Surgical Mask Box (50pcs)	5	
		Weighing Bench Scale	1	
		Wheelie Bins	40	
		Glass to Sand Crusher	1	
		Plastic Shredder	1	
		Metal Can Baler	1	
		Vegetation Shredder	1	
		Manual Rotary Compost Screen	1	
	Waste	Waste generated within the island	Approximately 2372 kg of waste per day	Waste collected by vehicle from the waste bins within the island
	Fuel	Diesel		Local suppliers

Table 152: Project outputs

Stage	Output	Source / Type	Amount	Means of managing
Construction	Soil	Excavation for substructure	11.78 m3	To be used back in the levelling and backfilling of site.
			209.54 m2	
	Waste	Construction and clearing of vegetation		Collected in the temporary waste area and transported to Thilafushi after completion of the project
	Hazardous waste	Construction and clearing of vegetation		Collected as per hazardous waste management guidelines and transported to Thilafushi after completion of the project
	Municipal waste	Workers	346.5 kg	
	Dust	Excavation	Moderate amount of dust	
		Cement mixing	Moderate amount of dust	

	Green House Gases	Machinery		
		Concreting works	100.1kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
		Reinforcement	5311.1kg of CO2 indirect emissions (Ma et.al, 2016)	
		PVC Pipes	164.81kg of CO2 indirect emissions (DEFRA/DECC, 2012)	
Operation	Compost	Open windrow composting	15.60 m^3 compost per cycle	Sold as fertilizer
	Crushed Glass	Glass crusher	0.731 m^3 per month	Crushed glass stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Compacted Metal	Metal baler	0.669 m^3 per month	Compacted metal stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	Shredded plastic	Plastic shredder	3.295 m^3 per month	Shredded plastic stockpiled in the IWMC compartment prior to sale. Unmanaged waste transferred to central waste management facility
	GHG	Electricity usage		N/A

46 EXISTING CONDITIONS

46.1 DESCRIPTION OF THE ENVIRONMENT

HDH. Vaikaradhoo has a total area of 103 ha. The inhabited area is sparsely vegetated with an area of 28 ha. Eastern region of the island has comparatively denser vegetation, while in the western region, a large area has been cleared and in use of agricultural purposes. Land is also used for agriculture on a smaller scale in the north western part of the island, which also includes taro pits or *olhu.* Further east of the agricultural plots, a wetland area is present.

The groundwater condition in the residential areas was reported as generally good, with the water table at an average of 4 ft below ground.

The island lies closer to the north eastern edge of the reef platform. Therefore, the southern and western regions are more protected from the offshore waves due to the large area of shallow reef present after the reef edge.

Figure 127: Terrestrial vegetation of HDH. Vaikaradhoo

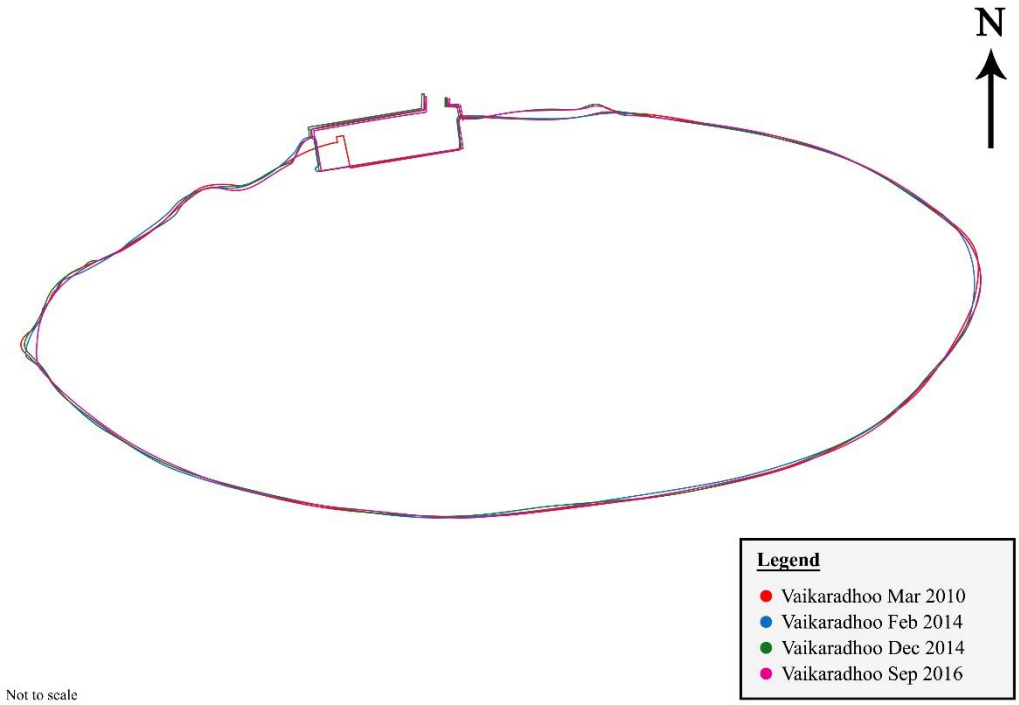

Figure 128: Changes to the coastal region of Vaikaradhoo from 2006 to 2017

Major changes to the shoreline of Vaikaradhoo was not observed from the satellite imagery from 2010 to 2016. The harbor modification works is observed to have been done since 2010, with the harbor increased in both length and width.

Figure 129: Selected photos of coastal areas of Vaikaradhoo (A & B: coastal area closest to the site, C & D: Northertn coastal area, west of the harbor)

46.2 PROJECT SITE

The project site is located in the south of HDH. Vaikaradhoo. Access roads are present on both sides of the site. The site is located next to the current waste dumpsite used in the island.

The site has been cleared by the Island Council. Therefore, no vegetation, mature or young, is present on site.

Figure 130: Site area for the construction of the IWMC

46.2.1 Site zoning recommendations by EPA

The EPA has provided recommendations for the optimum zoning of the IWMC site. The distances include, the site being at least 15 m from the coastal vegetation belt, at least 30 m from the nearest freshwater well, at least 40 m from the nearest recreational/public area and at least 30m from the wetlands as well as the residential 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. As seen on **Table 153**, the site fulfils the EPA recommended buffers

Table 153: Comparison between the proposed site location and EPA recommended distances

Location	Distance from site (m)	EPA Recommended Distance (m)
Coastal vegetation	56.9	15
Freshwater well	130	30
Recreational / public area	None nearby	40
Mangrove area	500	30
Residential area	130	30

46.3 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were held for the project with the proponent MEE, enforcing agency EPA and the Island Councils of the respective islands. Meetings with MEE and EPA were held both before and after the survey trips in light of findings regarding some project islands. The initial meetings were mainly regarding the EIA project islands and scoping, although, due to the similar scope of works (except vegetation removal in the EMP islands' cases) the meetings included discussion of the project as a whole. Highlights of the meetings which apply to the EMP islands are presented below. Stakeholder consultation attendance is attached in **Annex 3.**

46.3.1 Meeting with Proponent

- The proponent was consulted at the start of the assignment to discuss project scope and after field surveys to discuss findings of the initial field surveys.
- Proponent informed that MEE will be responsible for the construction of IWMC, while land clearance shall be undertaken by the respective Island Councils.

46.3.2 Meeting with EPA

- It was highlighted that waste management will not involve burning waste at the island level. Waste from islands will be transferred to the regional waste management center. Only organic waste will be managed at the island level to make compost. All necessary equipment required to manage waste at in the IWMC will be provided as part of the project.
- EPA informed that buffer distances recommended by EPA in the zoning form shall be kept in order to mitigate impacts.

46.3.3 Meeting with Island Council

- The Council stated that currently waste is dumped in the demarcated dumpsite (which is next to the proposed IWMC site). There is no mechanism to manage the waste accumulated within the dump site. Organic waste is burnt while plastics and metals are stockpiled in the dumpsite.
- A waste management plan has been formulated but not approved by the EPA yet
- Council plans to conduct IWMC management works
- Council plans on implementing a fee mechanism once IWMC is operational
- Council plans on transporting unmanaged waste to the Regional Waste Management Center
- Council also plans to generate income from composting
- Awareness programs have been planned to be conducted to raise awareness within the island regarding waste management.

47 ASSESSING THE LIKELY IMPACTS AND MITIGATION MEASURES

47.1 METHODOLOGY, NATURE AND IDENTIFICATION OF IMPACTS

Various impacts arising from the project such as direct, indirect and cumulative impacts have been identified. The methodology was based on:

a) Scoping meeting with stakeholders;
b) Observations made during the visit of the project island and site
c) Literature review of similar local and other EMPs; and
d) Findings from other similar projects in Maldives and experience of the Consultant.

Impacts on the environment were identified based on their location/attribute, magnitude and duration of the impact. Impacts were assessed based on their significance and categorized as negligible, minor moderate and adverse. A Leopold Matrix was used for this purpose, for both the construction and operation phase.

The Leopold Matrix was developed by Leopold et al. (1971). It is a quantified Matrix which consists of 100 project actions and 88 environmental characteristics, elements and conditions. Relevant environmental characteristics and project actions were used for the impact identification. First of all, all of the relevant activities of the project that may have an impact on the environment was identified and written on the top of the matrix. These were divided for both the implementation and operational phase of the project. The environmental characteristics that may be affected by the project is written at the left side of the matrix.

A slash is placed at the intersection with each item on the side of the matrix if an impact is possible. The upper left corner of each box where an impact is possible, a number from 1 to 10 is written as the *magnitude* of the possible impact. The number 1 represents the least possible impact and the number 10 represents the highest magnitude of the possible impact. No 0's are used in the Leopold Matrix. A + sign is placed before the number if the possible impact is a positive impact. No sign is placed before possible negative impacts. In the bottom right corner of the box, a number from 1 to 10 is written as the *importance* of the possible impact. 1 being the least important and 10 being of the greatest importance. In giving scores, the magnitude and importance of the activities were judged for their short term and long term impacts. The impacts with greater long term impacts were given higher scores compared to the impacts with more short term impacts.

47.2 POTENTIAL IMPACTS AND MITIGATION MEASURE FOR KEY IMPACTS

For every minor to moderate to major impact identified, a mitigation measure has been proposed and discussed below. The mitigation measures proposed would be strictly adhered to eliminate environmental impacts arising from the project, even before it occurs. The impacts and mitigation measures are detailed in the two stages, construction and operational stages as explained below.
The possible mitigation measures include:

a) Changes in work practices and increasing awareness;
b) Provision of environmental protection and health safety equipment; and
c) Environmental monitoring during construction phase and operational.

Mitigation measures suggested in the report will focus on the existing environmental conditions as well as impacts that may rise during operation of the IWMC.

Table 154: Impact Matrix for Construction Phase

	Envisaged impact factors	C1 Worker Influx and Settlement	C2 Transportation of materials	C3 Site Demarcation & Fencing	C4 Site Clearance and Earthworks	C5 Construction	C6 Waste Generation	C7 Resource Consumption (Water, Electricity)	Total (Impact Area)
Physical Components	Seawater	-2					-3		-5
		1					4		5
	Ground water	-3			-2	-3	-3	-5	-16
		1			3	4	3	5	16
	Air	-3	-3	-2	-2	-3	-2	-3	-18
		2	3	2	4	3	4	3	21
	Noise	-2		-1	-2	-2	-2		-9
		1		2	3	4	2		12
	Coastal Zone							-1	-1
								1	1
Biological Components	Flora	-2	-1		-1	-1	-2	-3	-10
		2	3		4	2	5	2	18
	Endangered species/protected areas		-2		-1				-3
			2		5				7
	Coral Reef						-1		-1
							1		1
	Fauna		-2		-2	-2	-2		-8
			2		4	3	3		12
Socio-Cultural Component	Aesthetics	-2	-3		-2	-5			-12
		2	3		3	5			13
	Accidents	-1	-7	-2	-1	-3	-2	-1	-17
		1	5	1	2	4	2	1	16
	Landscape				-1	-3			-4
					2	4			6
	Health/Well being	-1	-5	-1	-4	-3	-3		-17
		1	5	2	3	3	4		18
	Local economy	4	4	1	6	7		-2	20
		1	4	2	6	5		2	20
Total (Construction Activity/Risk)		-12	-19	-5	-10	-20	-20	-15	
		12	27	9	39	37	28	14	

47.2.1 Impacts and Mitigation from Construction Phase

47.2.1.1 C1 Worker Influx and Settlement

An estimated 10 workers will be required for this project. The influx of workers can have a negative impact to the environment such as damage to vegetation, sensitive areas, and fauna of the island. This can be both intentional and unintentional.

Worker related impacts can include the requirement of building a temporary worker's camp, which can then lead to the set up of temporary waste, sanitation and water systems for the workers. For the duration of the project, the workers related waste output is detailed in **Section 45.3.12**. For this project, this impact can be reduced through the following mitigation measures. The project island currently has vacant properties as well as rooms to let in other houses, which can easily house the influx of 10 workers. Therefore no new facilities will be made for the accommodation of the workers. Other impacts include the increased use of resources by the workers in the island. This can be mitigated by choosing local contractors operating on the island.

In addition to this, when a new group of foreign workers arrive on the island conflicts can arise with the resident population in the instances where local culture is overlooked or not respected.

Mitigation for impacts on flora and fauna

- The contractor is required to keep the workforce as a minimum as possible, and to not bring in any surplus workers for the project;
- House rules shall be formulated by the contractor and workers shall be oriented on the rules and conduct during the project works;
- Workers shall be given instructions on the sensitive and protected areas of the island;
- 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

- Encourage choosing of local workers to reduce increased demand of resources; and
- Onsite generator for meeting electrical needs for the construction works

Mitigation for sociocultural impacts

- Hire local workers where possible;
- Orient foreign workers on communication, personal hygiene and sanitation in addition to the prevention of STDs and other infectious diseases; and
- Ensure all foreign workers have their legal permits.

47.2.1.2 C2 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 . Reduction of the transportation distance from the source to the project island is proposed. As the resource sourcing hierarchy in **Figure 131** shows, the greatest importance shall be placed on sourcing any available materials from within the island, with the next option being from within the north region, from islands such as HDh. Kulhudhuffushi. Site visits to the Zone 1 islands show possible sources for sand in islands (such as HDh. Hirimaradhoo, where a pile of excavated sand is present which can be procured for use in concreting works). 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.

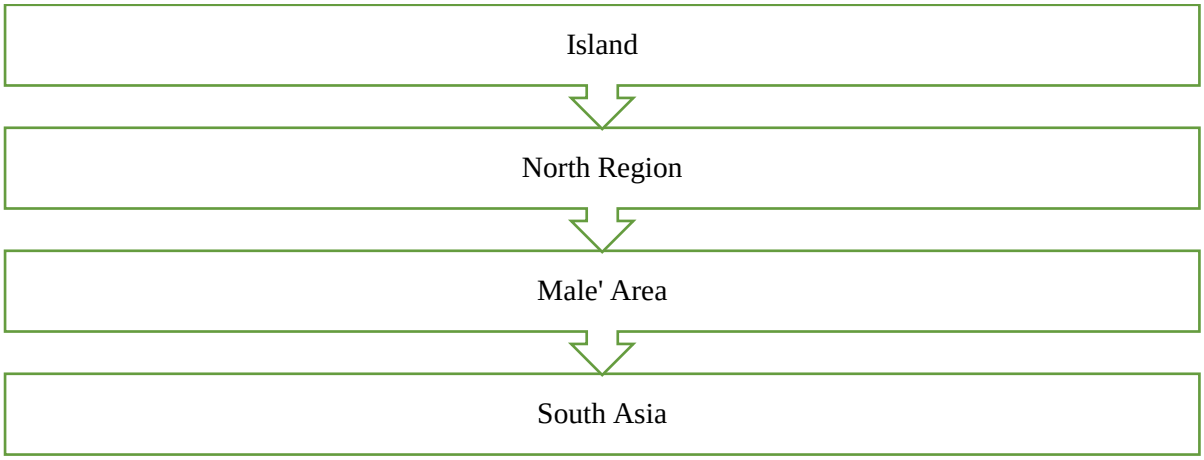

Figure 131: Material sourcing hierarchy proposed for the project

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 **section 45.5** 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. Therefore for this project, an estimated 100.1 kg of CO2 emissions are expected for the concrete casted. 3136 kg of indirect CO2 emissions (Defra / DECC, 2012) occur per tonne of PVC pipe produced. For this project, the amount of indirect CO2 emissions are estimated at 164.8 kg. The greatest indirect CO2 emissions are estimated from the usage of reinforcing steel. 1.5 tonnes of reinforcing steel are estimated to be used for this project, which can cause a release of indirect CO2 emissions of 5311 kg (Ma et al, 2016). 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 132: Impact on roads from heavy vehicle transport in an island in Maldives

For the purpose of this project, no heavy vehicles are proposed for either construction or earthworks. Although this is the case, a pickup truck will be used to transport the construction materials to 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.

Mitigation for climate impacts

- Sourcing of materials shall be done according to the hierarchy presented in **Figure 131**.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;

- The contractor shall use serviced vehicles and plant equipment for the project;
- The contractor shall only use the needed amount of vehicles and plant for project; and
- The 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. Oversized heavy vehicles are not required for this project, therefore such vehicles shall not be used in the island for transportation and construction purposes;
- 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

- The vehicle drivers shall be licensed and competent;
- The loads being transferred shall be fully secured; and
- The transportation shall be done during day time.

Mitigation for marine and terrestrial pollution

- The contractor shall clean any littering on the terrestrial or marine environment caused during transportation;
- The contractor shall enforce strict policy against littering and appropriate penalties; and
- Spill kits shall be made available in cases of spillage of hazardous wastes, and hazardous waste storage shall be provided.

47.2.1.3 C3 Site Demarcation & Fencing

Site demarcation and preparation involves, land surveying of the area and setting out the limits of the project plot. This activity is considered to have minor environmental impacts as it is largely noninvasive. However, improper or inaccurate demarcation could result in removal of untargeted trees which could result in having to remove more number of trees than that are required.

Mitigation Measures

- 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;
- accurate and reliable equipment shall be used to minimize errors;
- wearing, clothes/helmets to protect against thorns and freefalling coconuts and wearing protective clothing;
- carrying out the works during the day time; and
- ensure mosquito repellants are available for the workers.

47.2.1.4 C4 Site Clearing and Earthworks

Site clearing works have been completed prior to the site visit to Vaikaradhoo. There will be no impact on vegetation due to earthworks, if the site is demarcated and site bounds are fenced off prior to the earthworks.

47.2.1.5 C5 Construction

Material Storage

This includes, storing all the vehicles, machineries, and tools required for the land clearance and IWMC construction. Due to the nature of the project, a lot of construction materials are not required. Apart from the vehicles and tools, fuel and water will be required for storage. Fuel will be stored on the cleared land in tanks that. Vehicles will be stored inside the fenced plot area. Tools and equipment will be stored in the tool shed within the fenced land plot. The project does not require land clearance or construction of extra building for material storage, hence the impacts arising from this activity is considered to be minimal. However, there is a risk of accidents, such as fires, oil spills and trespassing. These could be easily mitigated by implementing appropriate measures.

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 minor, due to the distance provided between the residential areas and the project site.

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 155: 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 67 dBA at 426.5 ft, which is the approximate distance from the centre of the IWMC to the nearest residential area. This is expected to further decrease taking into consideration the vegetation surrounding the proposed site, as well as the soil characteristics of the ground.

Noise during construction is determined to be a short term negative impact. Due to the distance of the project site and the surrounding vegetation, 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.

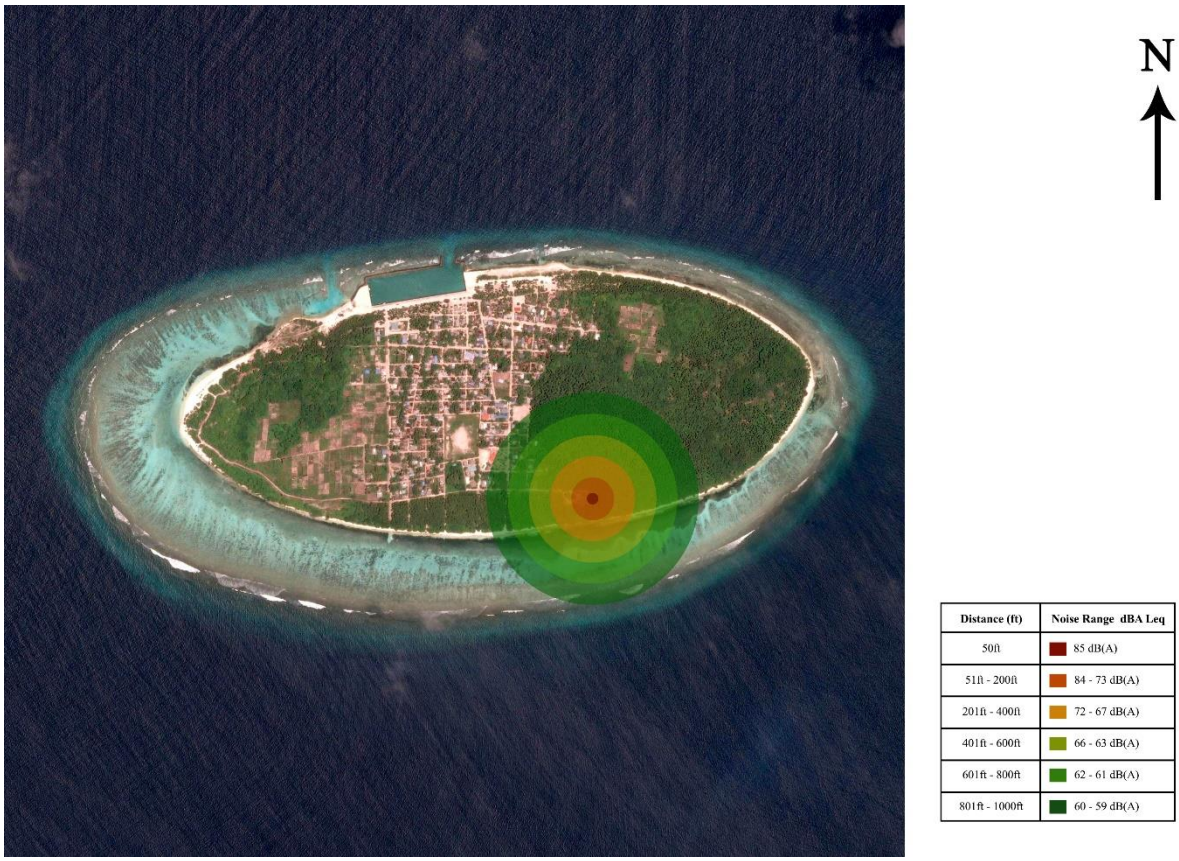

Figure 133: Noise range map for HDH. Vaikaradhoo

Impact on vegetation

The impact and measures on vegetation have been discussed in **Section 47.2.1.4.** No other structures, temporary, or permanent are proposed to be built for this project (such as workers' camp). Therefore the activities of this project is not expected to have a major impact on the vegetation of the island.

Accidents and injuries

Accidents and risks (hazards) are important elements that need to be properly assessed, identified and analysed for what could happen if a hazard or accident occurs during and post development of the project. There could be many risks (hazards) and accidents to consider associated with many possible scenarios that could unfold depending on time, magnitude and the location it occurs. Hazards during construction 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 trenches and seriously injuring themselves.
- Being struck by moving equipment and vehicles.

Mitigation for material storage impacts

- Equipment shall be stored in fenced areas and maintained appropriately during the cause 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 Liquid Petroleum Gas (LPG) bottles and cleaning solvents and chemicals will be closed off from public access. Fire extinguishers and instruction in case of fire will be located in all the public, industrial and staff accommodation areas;
- portable extinguishers placed to be readily available when someone finds a fire;
- closed off non-public storage areas will be provided for inflammable goods (fuel drums, portable fuel containers, LP gas bottles, cleaning solvents etc.) with NO SMOKING, NO NAKED LIGHTS, HIGHLY FLAMMABLE sign boards in both English and Dhivehi languages;
- 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.

Mitigation for terrestrial pollution

- Set up a temporary waste disposal area within the project site;
- Regularly collect litter and dispose at the temporary waste disposal area;
- Hazardous waste shall be placed in enclosed containers;
- Vehicle maintenance shall be carried out on paved areas; and
- After the construction works are completed, transfer all collected waste to Thilafushi

Mitigation for noise and vibration impacts

- Provide workers with noise cancelling headphones.
- Use quieted equipment where possible, such as mufflers on engines;
- Use of well serviced vehicles and plant; and
- Switching off equipment and vehicles when not in use.

Mitigation for impact on vegetation

- Setting out survey shall be done by the contractor and the site limits shall be demarcated prior to any construction or clearing works;
- Fence off the site in order to avoid the removal of any vegetation out of bounds of the project site; and
- Allocate temporary stockpile area within the site, which is free from vegetation

Mitigation for accidents and injuries

- The contractor shall be required to develop occupational safety management plan, and safety guidelines shall be displayed in the work site at all times;
- Occupational safety training should be given to all workers present on site;
- Workers should be provided Personal Protective Equipment and the use of PPE shall be enforced;
- Site visitors 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.

47.2.1.6 C6 Waste Generation

Solid waste generated during land clearance and IWMC construction work would negatively impact the site and surrounding environment if not properly managed and disposed of at an approved dumpsite. Waste burned onsite would generate smoke, possibly impacting negatively on ambient air quality and human health. On the other hand, if all site clearance waste is to be transported this would also result in requiring burning fossil fuels and would require significant finance. 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.
On site generator and vehicle 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 and solvents. 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 1.2 kg will be produced daily if approximately 10 workers were active which equates to discharge of approximately 1,700 l/day of waste water. Sewage will be managed through existing sewage systems that have been installed in the islands

Since there is no existing waste management system in the atoll or since the existing island level waste management dumpsite is not sufficient 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.

<u>Mitigation Measures</u>

- Ensure to manage waste as described in **Section 45.3.12** of the report;
- open defecation whether it's on land or on the beach shall be prohibited;
- waste other than sewage shall not be flushed down the toilet;
- ensure to reduce waste by following the 3R steps; and
- waste collected shall be transported to Thilafushi after the construction works have ended.

47.2.1.7 C7 Resource Use

During the construction phase, machineries and vehicles used will consume fuel. Notable impacts of this activity include, increased air pollution, risk of spillage, impacts to health/wellbeing and accidents. The primary pollutants generated due to power production from diesel based generator system include Nitrogen oxides (NO_X), Sulphur dioxide (SO_2), Carbon monoxide (CO), Hydrocarbons/ Polycyclic

Aromatic Hydrocarbons (HC/PAH), Particles (PA) and Carbon dioxide (CO_2) in the form of emission although the exact amount is difficult to quantify.

The visible pollution generated by burning diesel contains elemental carbon as soot. The typical odour comes from polycyclic aromatic hydrocarbons, which also are cancer causing components.

Due to the scale of these activities, the machineries won't be used for long periods of time. This would significantly reduce the impact of electricity generation. IWMC construction stage as well as land clearance stage will not use heavy vehicles and equipment extensively.

Water used during construction will be sourced by the contractor, which will be obtained from available groundwater wells. Water used for drinking and cooking will be purchased from local shops or collected from existing rainwater tanks or from the groundwater well in the island. Water and electricity consumption for the project is considered to be minor.

Mitigation

- Initiate rainwater collection and storage as early as possible into the project construction;
- turn off the tap while washing your hands;
- use salt water to wash dishes and only use rainwater to rinse them;
- water conservation devices shall be used;
- use well maintained, energy efficient equipment. The emission of carbon dioxide is directly related to the amount of fuel used. High efficiency is therefore important to reduce the amount of released carbon dioxide and consequently to reduce the global greenhouse effect;
- reduce idle time of machineries and vehicles. Switch them off after use;
- utilize day time hours for the construction when plenty of light is available; and
- FENAKA power supply will be used for electricity generating purposes.

Table 156: Impact identification matrix for operational phase

	Envisaged impact factors	O1 Waste collection and transportation	O2 Waste sorting, separating, storing and compost making	O3 Waste Generation	O4 Resource consumption (water/electricity)	Total (Impact Area)
Physical Components	Seawater	4				4
		4				4
	Ground water	5	-2	-1		0
		3	2	5		12
	Air	-3	-2	-2	-3	-13
		5	3	2	4	16
	Noise	-3	-1			-4
		4	2			6
	Coastal Zone					0
						0
Biological Components	Flora	6	7	-1	-3	4
		2	6	1	4	18
	Fauna	5	5	-1	-3	3
		5	5	1	4	19
Socio-Cultural Component	Aesthetics	6	8			9
		6	6			17
	Accidents	-4	-4		-4	-18
		4	4		5	19
	Landscape	5	6	-1		5
		6	5	2		18
	Health/Well being	5	-5	-2	-6	-10
		6	5	2	8	23
	Cultural heritage					0
						0
	Local economy	-3	8	-2	-1	5
		9	2	4	1	19
Total (operational Phase Activity/Risk)		23	20	-10	-20	
		54	40	17	26	

47.2.2 Impacts and Mitigation from Operational Phase

47.2.2.1 O1 Waste Collection and Transportation

HDH. Vaikaradhoo currently has a waste dump site allocated in the island, and guidelines set for waste disposal. Although the majority of the population adheres to the guidelines, a minority still dump waste elsewhere. Kitchen is dumped on the beach areas, organic waste is burned on site and other wastes are stockpiled inside the dumpsite. These practices have resulted in issues such as mosquito breeding, vermin and pests, injuries, groundwater pollution, damage to coral reefs and amenity issues. The successful implementation of the IWMC and the Waste Management Plan will lead to the reduction of the littering and burning of waste. This will lead to the improved health and psychological well-being of the residents and visitors of Vaikaradhoo. It has been identified as a long term positive impact on the residents and visitors of Vaikaradhoo.

Under the Waste Management Plan, a vehicle will be used to collect and transport the waste within the island daily. This is identified as a minor impact in terms of noise, due to the fact that multiple vehicles are not used, and no receptor will be exposed to the noise for long durations of time.

Waste Collection and Transportation is identified to have a positive impact on the island.

<u>Measures to ensure and enhance the positive impacts</u>

- The waste management regulation and guidelines of Vaikaradhoo shall state the penalties on persons that do not act according to the regulation and guidelines (i.e. littering, burning and dumping of wastes elsewhere), and Island Council shall enforce the penalties as prescribed;
- The proponent and Island Council shall follow the management plan provided with the EMP in order to monitor the operations of the IWMC, and bring about any necessary changes to the operations and policies, in addition to providing any needed technical assistance for the island;
- The proponent shall review the waste management operations within the islands regularly and update the National Waste Database;
- The operations shall be awarded to a contractor with the capacity to run the IWMC;
- The 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;
- Polluter pays principle established in order to reduce the waste generation within the island;
- The proponent shall provide resources in terms of budgetary allocations, required equipment, and technical expertise to ensure the operation of the IWMC; and
- The proponent shall assist in creating markets / avenues where the IWMC's can generate income through selling compost and recycled metals, plastics and glass.

<u>Mitigation for terrestrial pollution</u>

- Implement rules within the IWMC workers to impose penalties for any littering within the island due to improper handling of the waste and improper transport practices; and
- The status of the vehicle shall conform to the Waste Management Regulations 2013/R-58 and provide cover to the waste being transported in order to avoid littering.

Mitigation for accidents and injuries

- The vehicle should be driven by licensed drivers; and
- A strict schedule shall be stated in the WMP and followed in order to reduce the transportation frequency thus reducing the probability of accidents.

Mitigation for air quality impacts

- Spray the roads with water during the dry season to suppress dust;
- 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 Waste Management Plan;

47.2.2.2 O2 Waste Management Activities

Waste sorting, separating storing and composting make up the largest portion of the IWM concept. On top of reducing the volume of waste, these activities, convert waste to re-sable and value added products. These activities will be carried out in the IWMC where employees will be trained to undertake these 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. Hazardous chemicals that get into the soil (contaminants) can harm plants when they take up the contamination through their roots. If humans eat plants and animals that have been in contact with such polluted soils, there can be negative impact on their health.

All these impacts can be mitigated and prevented by the proposed IWM concept. However, if these activities are not properly implemented there is a risk of IWMC being deteriorated into a dump site where mixed waste are disposed, burned and buried. The risk is more prominent for islands where the population size is greater. This means without proper mitigation measures and regular transportation of waste out of the island to a central waste management facility, there is a greater risk of IWMC being overfilled. More so considering that IWMC is equipped to handle only about 20-30% of organic waste generated in the islands 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 IWMC 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 / m^3 close to the composting site and dropped to background levels within 550m 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 / m^3), 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 157: 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 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 IWMC are not as large scale as the studies cited above. The composting capacity of the IWMC is expected to be two windrows of approximately 39 m^3, each batch to take around 4 – 6 months to mature. 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 IWMC becoming a makeshift waste dumpsite for organics are also addressed in the section.

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. 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 odours.

The operation of the IWMC 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 IWMC), 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 IWMC 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 from composting

The main gas by product from the composting is CO2. In anaerobic conditions, methane is released into the atmosphere, which has a higher greenhouse warming potential compared to 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 dumped;

Amenity Impacts

The IWMC 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 IWMC, which can degrade the local amenity. This impact is mitigated through the design of the IWMC perimeter walls which include a perimeter fence made of 50 × 50 PVC coated mesh.

Littering inside the IWMC can cause amenity issues such as tracking of litter on the wheels of the waste transport vehicles leaving the IWMC. 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 158: Odours generated from the composting process (source: Goldstein (2002))

Compound	Description of smell	Detection limit for a particular odour panel ($\mu g/m^3$)
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

This site is 130m away from the nearest residential site. Therefore the impact of odour on the residential areas are deemed minimal.

Fire hazards

There is a possibility of fire hazards at the IWMC 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 RSWMF) on the IWMC.

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 133** can be used for this purpose too. The map shows that the noise reduces to a maximum level of 67 dBA near the residential areas. This calculation does not take into account the dampening effects of the surrounding vegetation. Therefore, the long term negative impacts of noise would be borne by the employees of the IWMC, and the effects of noise to the residential areas are minimal

Workplace safety and accidents

The group of people most likely to be impacted by the IWMC 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 guidelines 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.

Mitigation for health impacts

- A distance of 130m is available between the IWMC and the nearest residential area, which can act as a buffer zone;
- The siting of the IWMC is at the southern region of the island. Due to this location, the residential areas are well shielded from both the particulate matter that can disperse with the winds of the south west monsoon and the winds of the north east monsoon;
- Ponding shall be minimized at the site by grading of the ground;
- Handling of compost shall be minimized;
- Compost turning shall be done based on temperatures and not on schedules;
- Material movements and compost turning shall be done during low winds. Weekends, holidays and times of the day when most people are likely to be outside (and use of recreational / public spaces) shall be avoided when handling the materials and turning compost;
- Add moisture to the compost to minimize dust;
- Add a geofabric cover over the compost windrow to minimize release of bio aerosols;
- Workers shall follow the workplace safety mechanisms and guidelines set by the contractor and practice safety and personal hygiene when handling the compost.

Mitigation for 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.

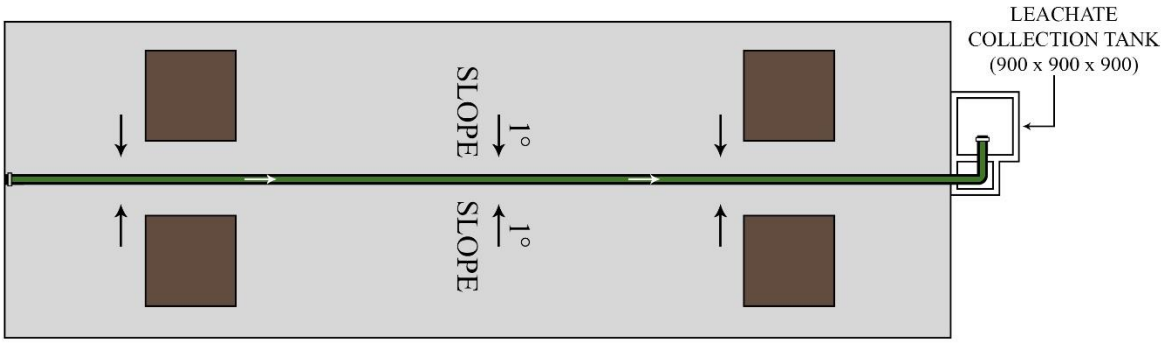

Figure 134: Compost slab design and leachate collection system (Plan view)

Mitigation for rainfall related leachate production

The current design of the IWMC consists of a composting slab is an open windrow composting system. The compost windrow is kept on the compost slab which is sloped in such a way that the leachate from the compost will collect at the pipe in the centre, which will propagate the leachate into the leachate collection tank (see **Figure 134**). While this scenario is ideal during fair weather, heavy rainfall and strong winds should also be considered. There is a possibility of heavy rainfall increasing the produced leachate, as well as the water collected over the composting slab propagating to the leachate collection tank. This can cause an overflow of the leachate collection tank, releasing its contents into the ground and subsequently the groundwater aquifer.

The rainfall can also cause the scattering of the compost materials, the increased water content in the compost windrow can cause another issue: the saturation of the windrow can decrease the available oxygen within the compost windrow, leading to anaerobic conditions.

- There is a valve placed at the inlet pipe which can be closed in instances where the leachate tank may overflow from heavy rainfall onto the compost slab;
- The 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;
- A 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.

Figure 135: Windrow cover being utilised in an open composting system (source: Midwestbiosystems.com)

Keeping stockpiles of raw organics low

Stockpiles of raw organics (waiting to be processed or transported) can cause impacts such as foul odour from the biodegrading organics, leachate reaching and contaminating groundwater, issue of vermin and pests, and visual impacts from the stockpiles.

As per the design of the IWMC, there are compartments for the storage of all major waste types other than organic wastes. A dedicated slab is provided for the composting of the organic waste materials. As per the calculations in **Section 45.4.6** it is seen that the composting slab has the capacity for composting 15 days' organic waste produced in the island. As the composting process may take between 4 – 6 months (Halliburton, 2002), the remaining months' organic wastes can accumulate unmanaged and without any means of storage.

The consultant proposes the following mitigation measures:

- Arrangements to regularly transport the unmanaged waste to a central waste management facility;
- If the above is not possible, arrangements to regularly transport the unmanaged waste to Thilafushi, as proposed in the WMP of Vaikaradhoo; and
- In cases where the waste cannot be transported due to delays and unforeseen circumstances, it is not recommended to stockpile the unmanaged waste on the ground, without any cover. As per the area of the IWMC, there is a capacity to arrange up to 25 nos. 660 L wheelie bins to store unmanaged organic wastes. It is also recommended to separate the putrescible waste from the green waste while storing in the wheelie bins. While this mitigation is not the most ideal, it is seen as the option with the least impact, pertaining to the resources available to the islands and the difficulty in transportation. Alternative transfer arrangements shall be made within this duration.

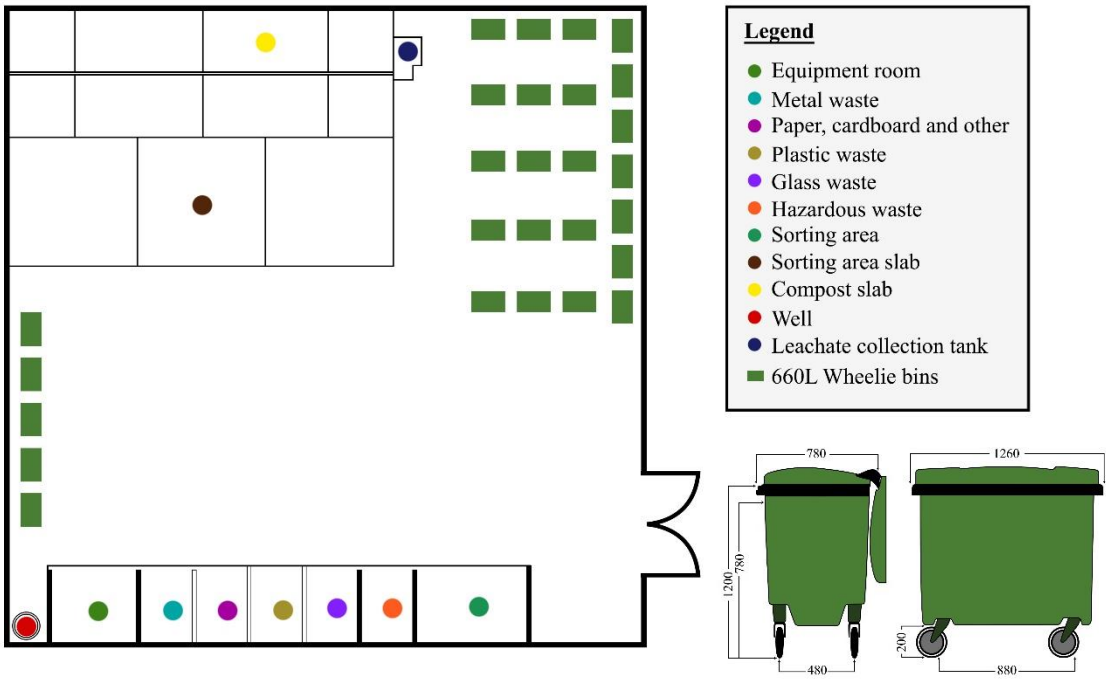

Figure 136: Proposed wheelie bin arrangement to provide for temporary storage of unmanaged organics

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. 660L wheelie 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 IWMC 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 IWMC, with the provision of a 2.8m high 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 IWMC. 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 IWMC.

Mitigation for odour 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 15cm 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.

Mitigation for fire hazards

- A fire management plan shall be developed by the IWMC occupier;
- Adequate firefighting equipment shall be provided at the IWMC, and placed at locations easy to access;
- The IWMC occupier shall be able to show that firefighting capacity of the IWMC is sufficient to suppress and minimize the incidence and impact of fires; and
- Workers shall be trained to use the firefighting equipment and able to manage fire outbreaks.
- 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.

Mitigation for workplace accidents

- The IWMC 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 and instructions to employees on how to operate any machinery;
- Instruct employees on safe systems of work;
- 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.

Figure 137: Recommended protective clothing for waste management employees. Adapted From: Ministry of Health, Thailand. Bangkok, 1995. *noise cancelling headphones and safety glasses during use of machinery

Table 159: 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

47.2.2.3 O3 Waste Generation

Waste generated during the operational phase of the IWMC will be relatively low. These will include waste oil/batteries for waste management equipment. Since eating and cooking inside the IWMC will be prohibited, no mixed municipal waste will be generated during the operational phase of the project. Hence overall impact for this activity would have a minor negative impact on environmental receptors.

Mitigation Measures

- Closed containers shall be provided to manage hazardous wastes;
- Spill kits shall be provided to manage oil spills; and
- Prohibit eating/cooking in the IWMC.

47.2.2.4 O4 Resource Consumption

Water will mainly be required for washing equipment, work ware, hands etc. and to water the compost pile. Water required for moistening compost piles will be relatively small. As most of the moisture required for the compost pile will be sourced from the leachate collected from the leachate tank the volume of water required will be significantly less. It is estimated that approximately 200 -300 l/day of ground water will be required during the operational phase of the project. Since the volume of water required is relatively low, it is not expected to have a significant impact on groundwater.

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 empties, therefore resulting in lower transportation costs. Compactors and crushers 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 IWMC. Therefore. Electricity consumption of the IWMC 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.

Mitigation Measures

- 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.

Table 160: Impacts and proposed mitigation measures for the construction and operational phase of the project

No	Potential Risk/Impact	Receptor	Nature	Reversibility	Significance	Mitigation	Cost
	Description	**Description**	**Positive**	**Reversible**	**Major Negative**	**Description**	**USD**
					Major Positive		
			Negative		**Moderate**		
				Irreversible	**Minor**		
CONSTRUCTION PHASE (C)							
C1	Impacts from worker influx and settlement (flora and fauna, resource use and sociocultural impacts)	People of Vaikaradhoo, and terrestrial and marine environment	negative	Reversible	**Minor**	• **See section 47.2.1.1**	Included in the construction costs.
C2	Impacts from transportation of materials. (climate impacts, and impacts on roads)	Residents of Vaikaradhoo, terrestrial and marine environment, global environment	negative	Reversible	**Minor**	• **See section 47.2.1.2**	Included in the construction costs.
C3	Impacts from site demarcation and fencing (Impacts on flora and fauna)	Local flora and fauna	Negative	reversible	**Minor**	• **See section 047.2.1.3**	Included in the construction costs.
C4	Impacts from site clearing and earthworks (terrestrial pollution, vegetation removal)	Vegetation of the site and surrounding areas	Negative	Reversible	**Minor**	• **See section 47.2.1.4**	Included in the construction costs.
C5	Impacts from construction works (vegetation impacts, noise and vibration, accidents	Workers and residents of Vaikaradhoo	Negative	Reversible	**Minor**	• **See section 047.2.1.5**	Included in the construction costs

	and injuries, pollution from material storage)						
C6	Terrestrial pollution from construction waste generation	Residents of Vaikaradhoo, ecosystem	Negative	Reversible	**Minor**	• **See section 47.2.1.6**	Included in the construction costs
C7	Impacts from resource use	Residents of Vaikaradhoo, ecosystem	Negative	Reversible	**Minor**	• **See section 47.2.1.7**	Included in the construction costs
OPERATIONAL PHASE							
O1	Waste collection and transportation (Climate impacts, air quality, amenity impacts)	Residents and visitors to Vaikaradhoo	Positive	Reversible	**Minor**	• **See section 047.2.2.1**	Cost borne by operations contractor
O2	Waste management activities (Public health, noise, groundwater, fire, accidents, odour impacts)	Mostly IWMC workers, residents and visitors to Vaikaradhoo,	Positive	Reversible	**Minor**	• **See section 47.2.2.2**	Cost borne by operations contractor
O3	Waste generation (terrestrial pollution, groundwater contamination)	Residents and visitors to Vaikaradhoo	Negative	Reversible	**Minor**	• **47.2.2.3**	Cost borne by operations contractor
O4	Resource consumption (water and electricity)	Residents and visitors to Vaikaradhoo	Negative	Reversible	**Minor**	• **See section 47.2.2.4**	Cost borne by operations contractor

48 PROJECT OPTION

48.1 ADVANTAGES AND DISADVANTAGES OF PROJECT OPTION

The advantages and disadvantages of conducting the project option are proposed below:

Table 161: Advantages and disadvantages of project option

Option	Environmental	Social	Economic
Project Option	The project does not involve any clearing of trees as the site has been cleared prior It will generate a small amount waste and GHG. This would have minor negative impacts on the soil and environment of the island. However almost all the foreseeable impacts of the project can be mitigated and kept at an acceptable level and the project will not result in a loss of a sensitive or critical habitat or species. The project will provide the island ways to control and prevent further pollution of the environment, and facilitate utilisation of land area more effectively.	Increased direct and indirect employment opportunities for the locals as the IWMC 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 hence pollution of the island will be stopped or controlled. During the operational phase of the project, smell dust and smoke will be emitted from the IWMC. However, the project site is located at an acceptable distance from residential and public areas.	Enhanced opportunity for locals to start and diversify tourism related services, since a safe and clean island would facilitate and benefit any local tourism venture. Direct contribution to government revenue through taxes and duties. Creation of job opportunities and skilled labour in the region. Expansion of agriculture market in in the island. The island currently practices agriculture widely and a high local demand is expected for the compost produced. Price and profit from agricultural produce will become more competitive due to availability of compost. Potential to attract foreign currency by selling compost, scrap metal and other recyclables which would develop the national economy. More settlers will be attracted to the island, which would promote the development of local public services and infrastructure.

49 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT PLAN

49.1 SCOPE

The chapter would present in detail the management measures put in place by the proponent and the contractor to mitigate the environmental impacts that would arise from the project activities. The assessment of impacts and mitigation measures that would be put in place had been discussed in detail in the previous chapter. The main scope or objectives of the environmental management plan are to:

a) Produce a framework for anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions during pre-construction, construction and operational phase; and
b) Provide evidence of conformity to laws and regulations and requirements of enforcement agencies.

49.2 ENVIRONMENTAL MANAGEMENT SYSTEM

The environmental management framework for the proposed project is based on the standards and policies set out by the Environmental Protection Agency of the Maldives under EIA Regulation 2012.

a) Environmental Management Planning and establishment of key performance indicators: The EMP specifies environmental management measures and required performance standards;
b) IWMC construction and operations: The aspects of the construction and operation will be established and operated according with the EMP;
c) Monitoring and corrective action: The implementation of EMP measures will be monitored during operational stage and will be reported. Any inconsistencies between the EMP and its on-site implementation will be identified and addressed through corrective actions; and
d) Auditing, reviews and enhancement: The EMP will be reviewed. Improvements to the EMP will be made as necessary to achieve desired environmental outcomes.

49.3 ENVIRONMENTAL MANAGEMENT STRUCTURE

This sections detail the various parties involved in the implementation of the environmental plan and their responsibilities.

49.3.1 The Proponent, Ministry of Environment and Energy

MEE will be responsible for the execution of the project activities within the required timeframe. The scope of land clearance falls within the responsibility of the Island Council. MEE is also responsible of policy level decisions and provision of support regarding the waste management works undergone in the island as well as the regional level.

49.3.2 The Contractor

Contractors to construct the IWMC and clear land will be procured by MEE and Island Council respectively. The contractor will undertake the project in accordance with the EMP proposed in the EIA and will report to the proponent and environment consultant about any unexpected environmental impact or health and hazard issues. During the construction stages, the contractor will follow all mitigation and management measures proposed in the report, mainly waste management, pollution control, accident prevention and work methodology proposed.

49.3.3 Environmental Consultant

The environmental consultant would prepare the EMP based on field visits and surveys and based on past project experiences in similar settings. If there are any modifications to be made to the EMP during any stages of the project, the consultant would do the modification and would conduct the environmental monitoring according to the monitoring framework. The environmental consultants are also responsible for auditing the management/monitoring plan to identify gaps, limitation in management and propose remedial measures to ensure the project is sustainable.

49.3.4 Environmental Protection Agency

The Environmental Protection Agency would review the monitoring reports submitted by the proponent and would continue with regulatory monitoring visits to the project site upon their needs.

49.3.5 Island Council

The Island Council will be responsible for the following:

- Formulation and implementation of the Waste Management Plan (WMP) for a period of 5 years. HDH. Vaikaradhoo Council has created the WMP on 29th November 2016.
- Formulation and gazetting of Waste Management Regulations for the island;
- Formulation and gazetting of Waste Management Guidelines for the island;
- Plays a role in the site selection in collaboration with other responsible parties;
- Responsible for the land clearing works of the proposed IWMC site; and
- Overseeing the operations of the IWMC

The Island Council is responsible to ensure the progress of the Waste Management Plan and achievement of the set goals through implementing the plan. This includes overseeing the IWMC operations. As per the WMP of HDH. Vaikaradhoo, the Island Council expects to award the work to a contractor and monitor the operations. The Island Council is also responsible for the compilation of the IWMC reports submitted by the contractor as well as producing an IWMC monitoring report as well as reporting of public grievances. These reports shall be submitted to the MEE bi-annually for review.

49.3.6 Operations Contractor (IWMC Occupier)

The operations contractor will be responsible in running the operations in accordance with the guidelines set by this EMP and the WMP of Vaikaradhoo Council. The responsibilities of the operations contractor include producing the IWMC operations reports and submitting the reports to the Island Council at the proposed regularities.

49.4 REPORTING

Reporting will be carried out on a timely manner to implement the environmental management plan and will cover details of site conditions, and operations. A detailed reporting mechanism for the IWMC operational works is provided in **Section 49.10**. Monitoring reporting shall be carried out during the stated time frames and frequencies in **Section 49.6**.

49.5 ENVIRONMENTAL MANAGEMENT PLAN

A practical plan taking into consideration available resources is proposed to meet the aims and objectives of the EMP. One of the major risks to the investment and operation of the IWMC and island level waste management is the center itself which can be converted back into a dumpsite due to mismanagement as often seen in island level waste management endeavors all across the Maldives. This is partly due to the fact that a lot of linkages connecting island level waste management with regional level waste management are absent or unknown until it is much too late. As described in **Section 47.2.2.2**, one of the main risks facing the current project is rapid accumulation of organic waste at the IWMC. Hence the proposed IWMC management plan aims to control and mitigate such risks without severe negative impacts

Table 162:Details of environmental management plan proposed for the IWMC

Activity	Phase	Measures	Time frame	Responsible person
Training of workers and contractors	Pre-construction, Pre-operation	Contractor and project workers are provided with detailed information on the project, impact mitigation measures, compliance with environmental permits and the EMP. Workers are also provided with the information on sensitive areas of the island and other environmental issues. Training of staff involved in the monitoring of the construction phase Training shall be provided to the workers of the IWMC on the waste management practices and mitigation measures in order to ensure the operations are run efficiently and effectively.	Prior to construction works Prior to operational phase	Proponent Environmental Consultant
Documenting non-conformances and corrective actions	Construction Operation	Non-conformances to the environmental regulations, permits and the EMP is monitored and documented. Corrective measures are taken and follow ups are done. IWMC operations reports and public grievances are compiled by the Island Council and reported to the proponent within the prescribed frequencies as stated in **Table 166**	Construction and Operation phase	Proponent Environmental Consultant Island Council
Supervision of activities	Construction Operation	The project activities are to be supervised by the proponent throughout the construction and operational phase to ensure the activities are carried out accordingly and the impacts are minimised. The proponent shall review the IWMC operations reports from the Island Councils, and provide the required support, bring about any necessary policy updates	Construction and Operation phase	Proponent Environmental Consultant

49.6 ENVIRONMENTAL MONITORING PLAN

Table 163: Monitoring plan for the construction and operation phase of the project

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
Ensuring that the project activities does not affect the quality of the groundwater	Establish baseline just before the construction works begin and continue monitoring as stated. Establish a groundwater monitoring stations and geo-reference it. Preferably close to the IWMC.	O	12,000 per trip	Potable water quality testing equipment and/ or by sending samples to the lab	During operational phase, bi annually	Proponent Environmental Consultant	Water quality report
Ensure waste generated at work site is audited and managed responsibly	Management of waste generated as described in **Section 45.3.12** of the report	C,O	Cost included in the project costs	Estimation of waste generated at project site and recording these data routinely. This includes quantifying and recording the amount of yard waste, hazardous waste and general waste stacked and stored for transportation.	Every two months	Construction contractor, operation contractor	Record sheets, photographs and quantity of waste processed at Thilafushi/ (nearest waste management center) and IWMC. If there are no significant discrepancies between the quantity of waste generated on site and processed at central waste management facility, it can be safely assumed that impacts of waste on the environment was reduced.
Monitoring Health and safety of workers and the public	Accidents during construction of IWMC, land clearance, operation of IWMC and maintenance of IWMC. Fire hazards and natural disaster events. Noise and smell complaints during operation and construction phase. Compost condition, output and quality	C, O	Cost included in the project cost	Keep records in a log book, or data sheet	Bi annually	Operational contractor Construction land clearance contractor	Measures to adapt and prevent accident and risks. Health assessment reports published or available from the local health center.

Objective	Activity	Phase	Cost (MVR)	Method	Time frame	Responsible person	Verifiable indicator
						Island Council MEE	Policy changes and upgrades. Compost quantity and quality. Income from selling compost.

49.7 RESOURCE REQUIREMENT FOR MONITORING

For the monitoring program to be successful, it is important that adequate financial and human resources are available and strong coordination among the key stakeholders is maintained.
The primary function of implementing the mitigation and monitoring plan will lie with the proponent and environmental consultant. Since the project at developmental and operational stage will be engaged by the proponent it will be the responsibility of the proponent to take care of the environmental safeguards at all stages of the project during implementation and at operational phase. The proponent should prepare an Environmental Action Plan, which states all measures for mitigation and enhancement and monitoring as described here in the EIA with their responsible organisation and person, planning, methodology, timing and other relevant aspects.
An independent registered environmental consultant shall be hired and contacted to undertake and audit the monitoring program prescribed in this report. Following each monitoring visit the consultant will prepare a report with clear recommendations and corrective measure if necessary. The report will have to be submitted to EPA for their review and actions.

49.8 MONITORING SCHEDULE

Table 155 highlights the monitoring plan in which responsibilities of main stakeholders has been assigned. In order to track and compile the findings of these measures an independent environmental consultant shall be tasked to audit the projects EMP. This is to

- identify gaps in monitoring and mitigating impacts arising from the project;
- determine the challenges and resource inadequacies to implement the proposed EMP; and
- determine the current environmental condition and propose modification/upgrades to the initial EMP.

Monitoring frequency for various individual components given in **Table 163** shall be followed by all responsible parties. **Table 164** gives indicative timeline for the monitoring visits by third party consultant.

Table 164: Monitoring visit schedule

Visit	Indicative timeline	Indicative parameters to monitor	Reporting	Cost (MVR)/per report/island.
Visit 1	Prior to construction of IWMC	Set baseline for groundwater quality and noise	Submit summary report 1 to Proponent within 2 weeks	25,0000.00
Visit 2	During construction of IWMC	Monitor work method, waste management, Monitor health and safety of workers. Monitor impacts to nearby vegetation and ensure vegetation removal is as per set out survey. Review reports prepared by contractors.	Submit monitoring summary report 2 to Proponent (MEE) within 2 weeks	10,000.00
Visit 3	Two months into operation of the IWMC.	Monitor water quality and noise. Monitor IWMC. This includes review of	Submit summary report 3 to Proponent within 2 weeks	25,000.00

	Biannually for four years	reports dated in **Table 166** to determine condition of IWMC. Monitor compost condition as described **Table 163**and **Table 166**		

As indicated, during the course of the Project implementation summary reports following each trip is expected to be submitted by the Project's environmental consultant. These environmental audits will provide a basis for assessing at least the shorter-term efficacy of the environmental measures and thereby provide lessons to be learned for future monitoring sessions and other projects with similar impacts. The consultant will prepare and submit the reports to Proponent. Based on the findings of the report, the management approach may be adapted and its efficacy will be determined in the consecutive monitoring trip.

49.9 MONITORING REPORT

Reporting will be carried out by the environmental consultant assigned for the purpose by the proponent. The report will include among other information;

- Details of what was being monitored;
- Methodology of data collection and data analysis;
- Major findings;
- Effectiveness of the mitigation measures in place and
- Recommendations and conclusions.

A detailed environmental monitoring and management report is required to be compiled and submitted to the EPA. In addition to this, regular site monitoring would be carried out by the proponent that requires maintaining logs of events as explained in this report. Enforcement officers from EPA may also visit the site for inspection from time to time.

49.9.1 Monitoring Report Format

The environmental monitoring report outlined in **Table 165** below will be used in reporting environmental monitoring to be carried out as given in the monitoring plan.

Table 165: Monitoring report format

Project Title:
Name of the Island:
Monitoring Date:
Period Covered:
Prepared by:
Contributions:

A. Introduction
Give a brief introduction about the project and the monitoring carried out
B. Methodology
Brief detail of the methodology applied for undertaking the monitoring assessment
C. Environmental Monitoring
a. Groundwater quality
Parameters given in the monitoring plan need to be assessed
b. Waste generation and management at IWMC
These include monitoring for pests and diseases as described.
D. Risks and Mitigations
Please indicate any critical unresolved risks that affect the course of the system operation, analyse the cause, assessing the potential impacts on the environment providing the proposed mitigation strategy
E. Problems Encountered
Indicate any problem areas encountered and any corrective measures that will have to be taken.
F. Recommendations and Adaptations as Solution
If specific recommendation is noted during the monitoring phase, specify it in the report
G. Conclusions
Reference
Appendix

49.10 IWMC OPERATIONS REPORTING MECHANISM

Table 166:Details of the reporting mechanism proposed for the IWMC

IWMC (Contractor)

Reporting	Details	Frequency
General report	Logs of the incoming waste	Monthly
	Classified by type and weight	
	Vehicle maintenance details	
	Machinery maintenance details	
	Machinery fuel usage details	
	Workplace injuries	
IWMC capacity	Details of the utilized and remaining capacity of IWMC	Every two months
	Leachate tank maintenance and capacity	
IWMC inventory status report	Details of the status of IWMC equipment	Bi-Annually
	Details of the status of emergency kits and firefighting equipment	
Compost output report	Details of amount of input waste materials	Bi-Annually
	Details of compost output in weight	
Noise and odor complaints	Log of noise and odor complaints	Every two months
	Complaints to be provided along with weather conditions and incoming waste details coinciding with the dates of complaints	

Island Council (Municipal Unit, Waste Management Committee)

Components	Details	Frequency
Public grievances	Log of public grievances regarding	Bi-Annually
	Fee structure	
	Waste Management operations	
	Noise and odor complaints	
IWMC monitoring	Monitoring report of the IWMC operations	Bi-Annually
Compilation of IWMC reports from operations contractor		Bi-Annually
Income report	Summary of IWMC operations income	Bi-Annually

MEE

Components	Frequency
Review of IWMC Reports from Councils	Bi-Annually
Update National Waste Database	
Policy updates from findings	
Provision of support to IWMCs	
Overview of the waste management system on island level and regional level	

50 RECOMMENDATIONS AND CONCLUSION

The construction and development of the IWMC at HDH. Vaikaradhoo is a much needed project to provide waste management services to the island. The IWMC 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.

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 consultant's recommendations for the project include:

- To include this EMP as part of the contractor's contract and ensure the measures and recommendations brought forth are followed;
- Implement the work method and mitigation plan as prescribed in the report to the fullest;
- To conduct supervision and monitoring of the project works by the proponent;
- To conduct supervision and reporting of the project works by an independent consultant;
- To conduct stringent evaluation of contractor's capacity to undertake and complete the project;
- Ensure necessary clauses regarding the workers safety are fully implemented;
- 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 EMP has looked into the key factors that need to be considered during construction and operational stage. The study has identified the negative impacts of this project are minor.

The study also found that through the implementation of the proposed practical and cost effective mitigation measures almost all impacts can be brought to an acceptable level. This EMP will guide the proponent in implementing the project with conformity to EIA regulation 2012.

REFERENCES

Bunger, J., B. Schappler-Scheele, R. Hilgers, and E. Hallier. 2006. A 5-Year Follow-Up Study on Respiratory Disorders and Lung Function in Workers Exposed to Organic Dust from Composting Plants. International Archives of Occupational and Environmental Health. Online: http://www.springerlink.com/content/82u23r2371414873/fulltext.pdf

Deparment of Environment and Conservation (NSW) 2004, Environmental Guidelines: Composting and related organics processing facilities

Saleem, A., Hartman, M., Hammad, A., Kawsar, S., Hoogduin, L. 2016. Environmental Impact Assessment for the proposed coastal protection at Gn. Fuvahmulah.

Goldstein N 2002, Getting to Know the Odour Compounds, *Biocycle*, July, pp 42–44.

Health and Safety Executive UK 2017, "Noise In Material Recovery Facilities (Mrfs)". Hse.gov.uk. N.p., 2017. Web. 5 June 2017.

Halliburton 2002. Strategy for Solid Wasre Manamegent in Vaavu and Baa Atolls, Maldives. Conservation and Sustainable Use of Biodiversity Associated with Coral Reefs of Maldives

Herr, C. E. W., A. zur Nieden, H. Seitz, S. Harpel, D. Stinner, N. I. Stilianakis, and T. F. Eikmann. 2004. Bioaerosols in Outdoor air — Statement of Environmental Medical Assessment Criteria on the Basis of an Epidemiological Cross Sectional Study. Gefahrstoffe Reinhaltung Der Luft. 64(4):143-152.

Herr, C. E. W., A. zur Nieden, N. I. Stilianakis, and T. F.Eikmann. 2004. Health Effects Associated With Exposure to Residential Organic Dust. American Journal of Industrial Medicine. 46:381-385.

Muller, T., R. A. Jorres, E. M. Scharrer, H. Hessel, D. Nowak, and K. Radon. 2006. Acute Blood Neutrophilia Induced by Short-Term Compost Dust Exposure in Previously Unexposed Healthy Individuals. International Archives of Occupational and Environmental Health. 79:477-482.

Ma, F., Sha, A., Yang, P., 1 and Huang Y. 2016. The Greenhouse Gas Emission from Portland Cement Concrete Pavement Construction in China, International Journal of Environmental Research and Public Health.

Rynk R 2000, Fires at composting facilities: causes and conditions, Biocycle, January pp 55–58.

Wheeler, P. A., I. Stewart, P. Dumitrean, and B. Donavan. 2001. Health Effects of Composting — A Study of Three Compost Sites and Review of Past Data. Technical Report P1-315. UK Environment Agency.

Wouters, I. M., S. Spaan, J. Douwes, G. Doekes, and D.Heederik. 2006. Overview of Personal Occupational Exposure Levels to Inhalable Dust, Endotoxin, β(1-3)-Glucan and Fungal Extracellular Polysaccharides in the Waste Management Chain. Annuals of Occupational Hygiene. 50(1):39-53.

ANNEX 1: DECLARATION OF PROPONENT

ANNEX 2: APPROVED CONCEPT PLAN

ANNEX 3: STAKEHOLDER ATTENDANCE

ANNEX 4: A3 SITE LOCATION

ANNEX 5: COMMITMENT LETTER OF PROPONENT

ANNEX 6: CV'S

ANNEX 7: DECLARATION OF AUTHORS

ANNEX 8: WASTE MANAGEMENT PLAN OF ISLANDS

ANNEX 9: IWMC SITE SELECTION FORMS AND EPA DS

بسم الله الرحمن الرحيم

Ministry of Environment and Energy
Male', Republic of Maldives.

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މާލެ، ދިވެހިރާއްޖެ.

Date: 02nd August 2017

No: 438-WMPC/203/2017/95

Mr Ibrahim Naeem
Director General
Environmental Protection Agency
Handhuvaree Higun, Green Building,
Male', Maldives

Dear Sir,

<u>Sub: Declaration of the Proponent</u>

As the proponent of the proposed project, we inform you that we have read and reviewed the EMP report, and to the best of our knowledge all non-technical information provided in the report are accurate and complete.

Yours Sincerely,

Ahmed Murthaza
Director General

Green Building, Handhuvaree Hingun,
Maafannu, Male', 20392, Republic of Maldives.
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މާފަންނު، މާލެ، 20392، ދިވެހިރާއްޖެ.
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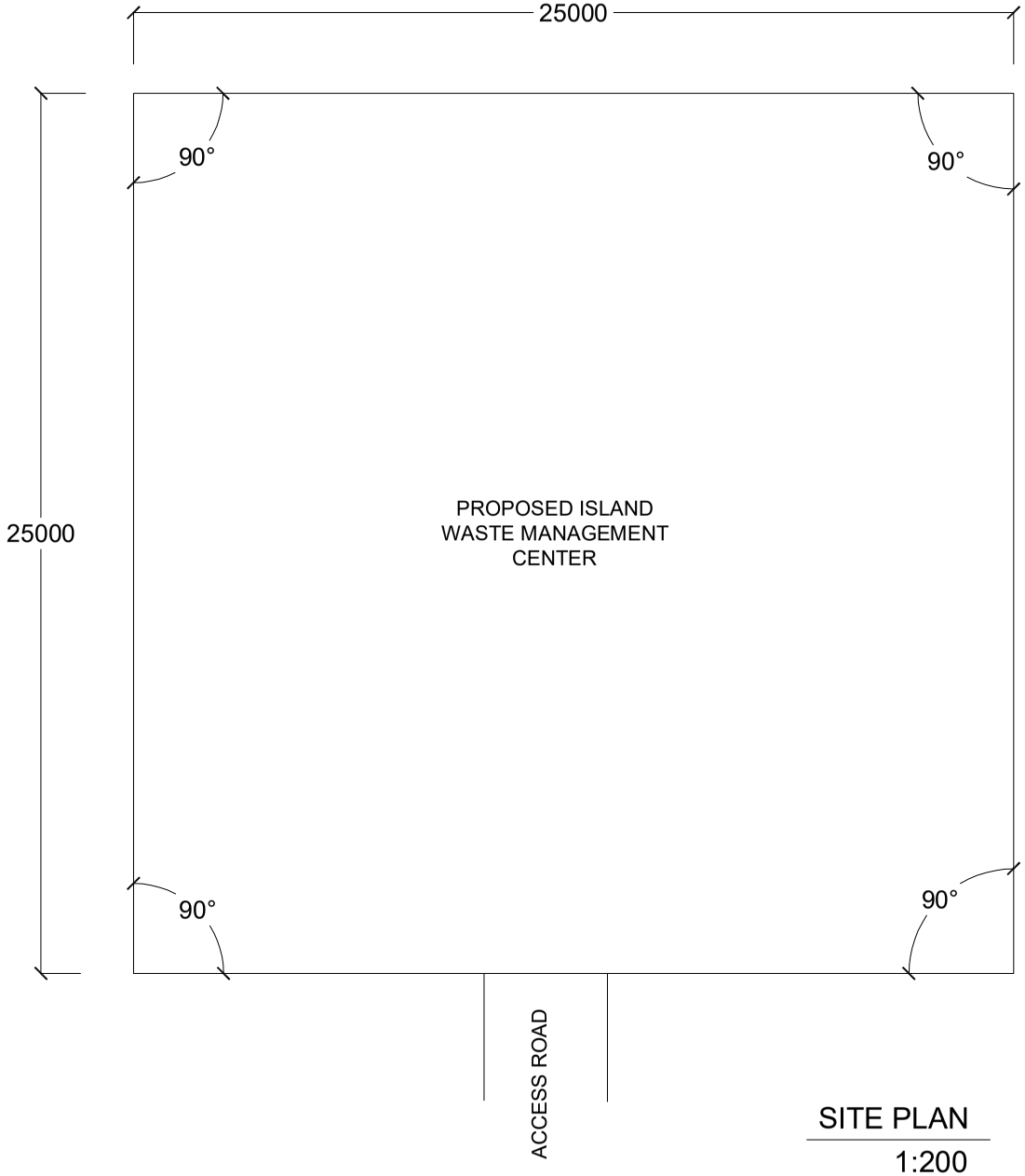
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT

H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER

SOLID WASTE MANAGEMENT COMPONENT
OFID PROJECT
MINISTRY OF ENVIRONMENT AND ENERGY

HANDHUVAREE HINGUN MALE' 20-01
REPUBLIC OF MALDIVES



SITE PLAN

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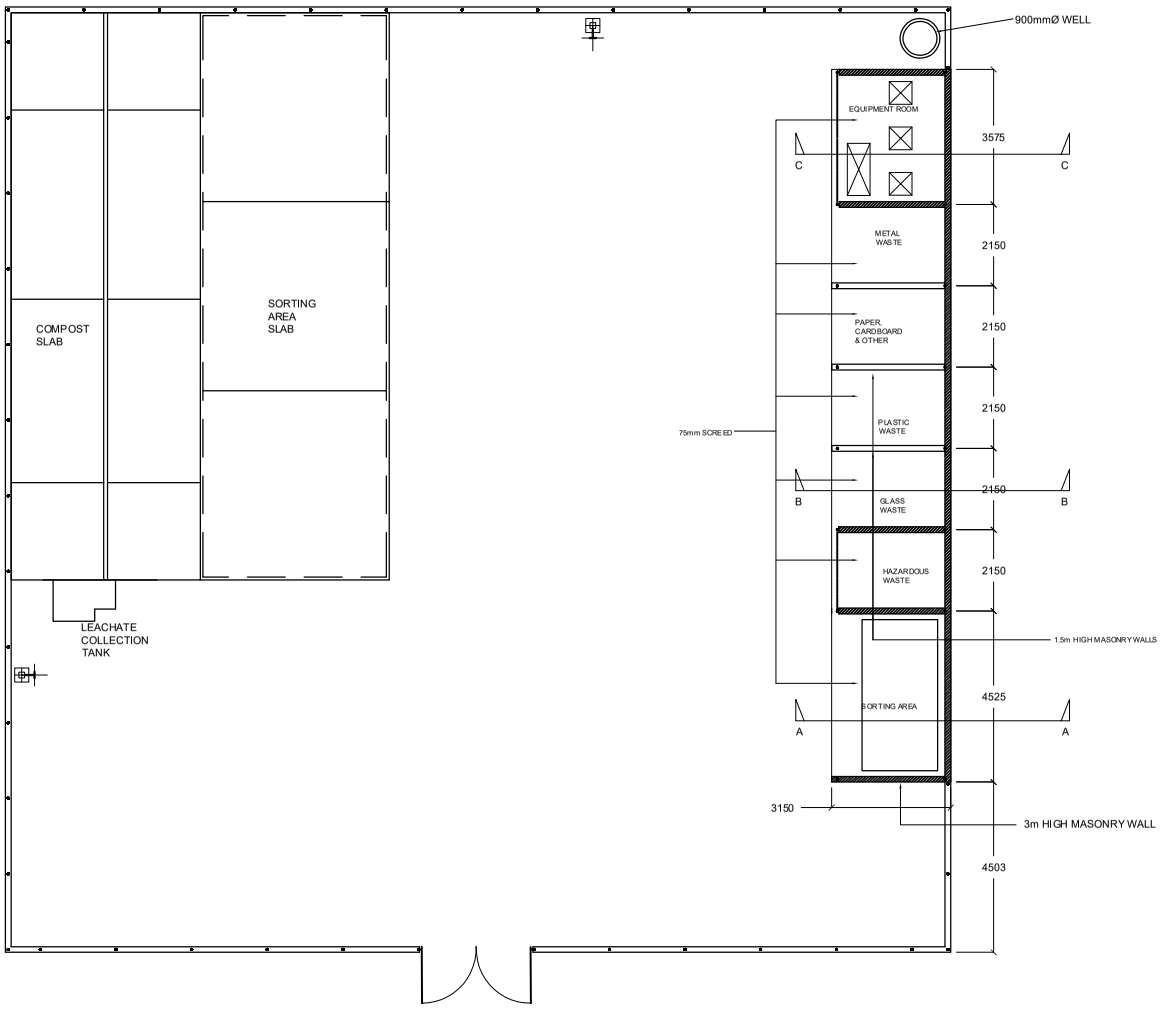
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



IWMC LAYOUT

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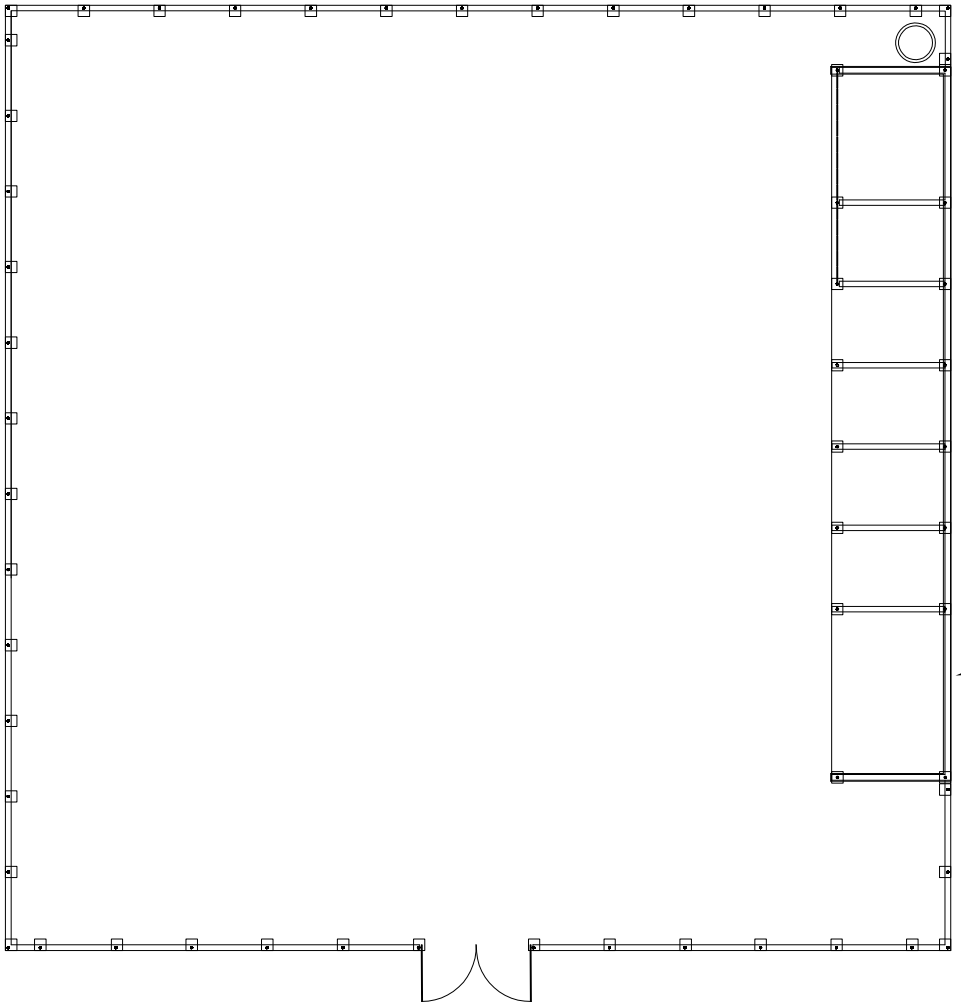
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN, MALE' 20-01 REPUBLIC OF MALDIVES



FENCE FOUNDATION AND COLLECTION
AREA FOUNDATION

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PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT

OPEC FUND FOR INTERNATIONAL DEVELOPMENT

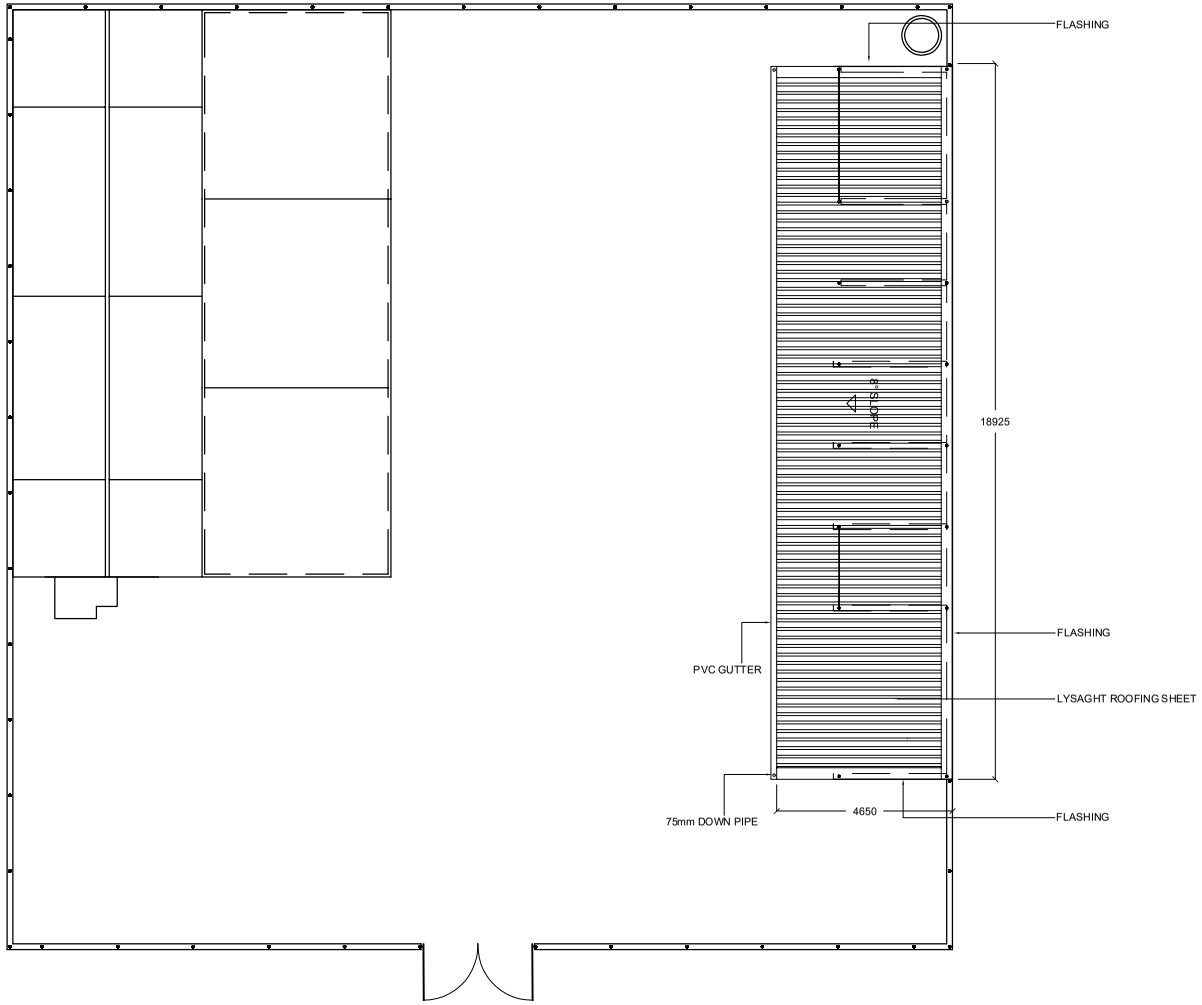
PROJECT:

H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER

SCALE: AS SHOWN

DATE: APR 2017

SOLID WASTE MANAGEMENT COMPONENT
OFID PROJECT
MINISTRY OF ENVIRONMENT AND ENERGY
HANDHUVAREE HINGUN MALE' 20-01
REPUBLIC OF MALDIVES



IWMC LAYOUT

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PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT

OPEC FUND FOR INTERNATIONAL DEVELOPMENT

PROJECT:

H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER

SCALE: AS SHOWN

DATE: APR 2017

SOLID WASTE MANAGEMENT COMPONENT
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MINISTRY OF ENVIRONMENT AND ENERGY
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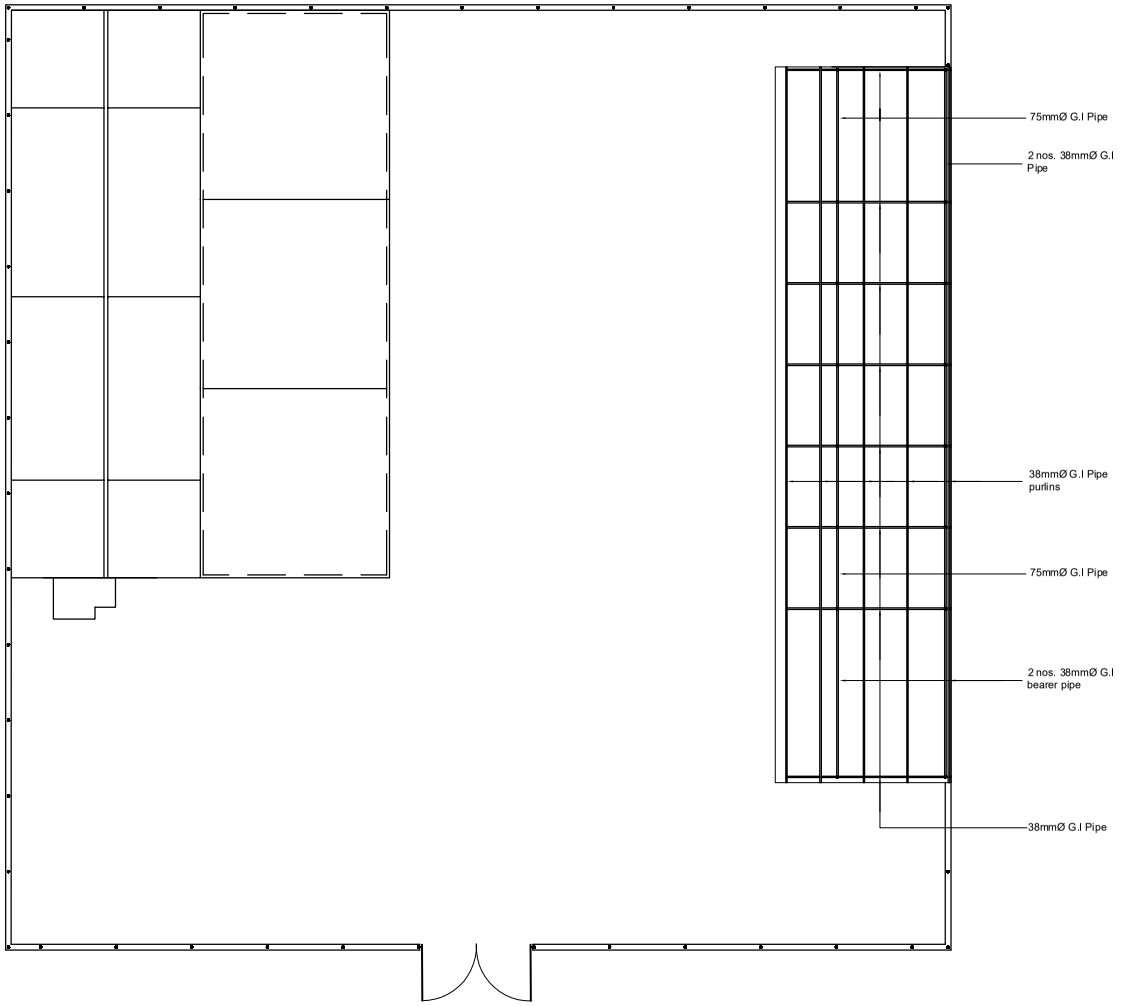

ROOF FRAMING LAYOUT

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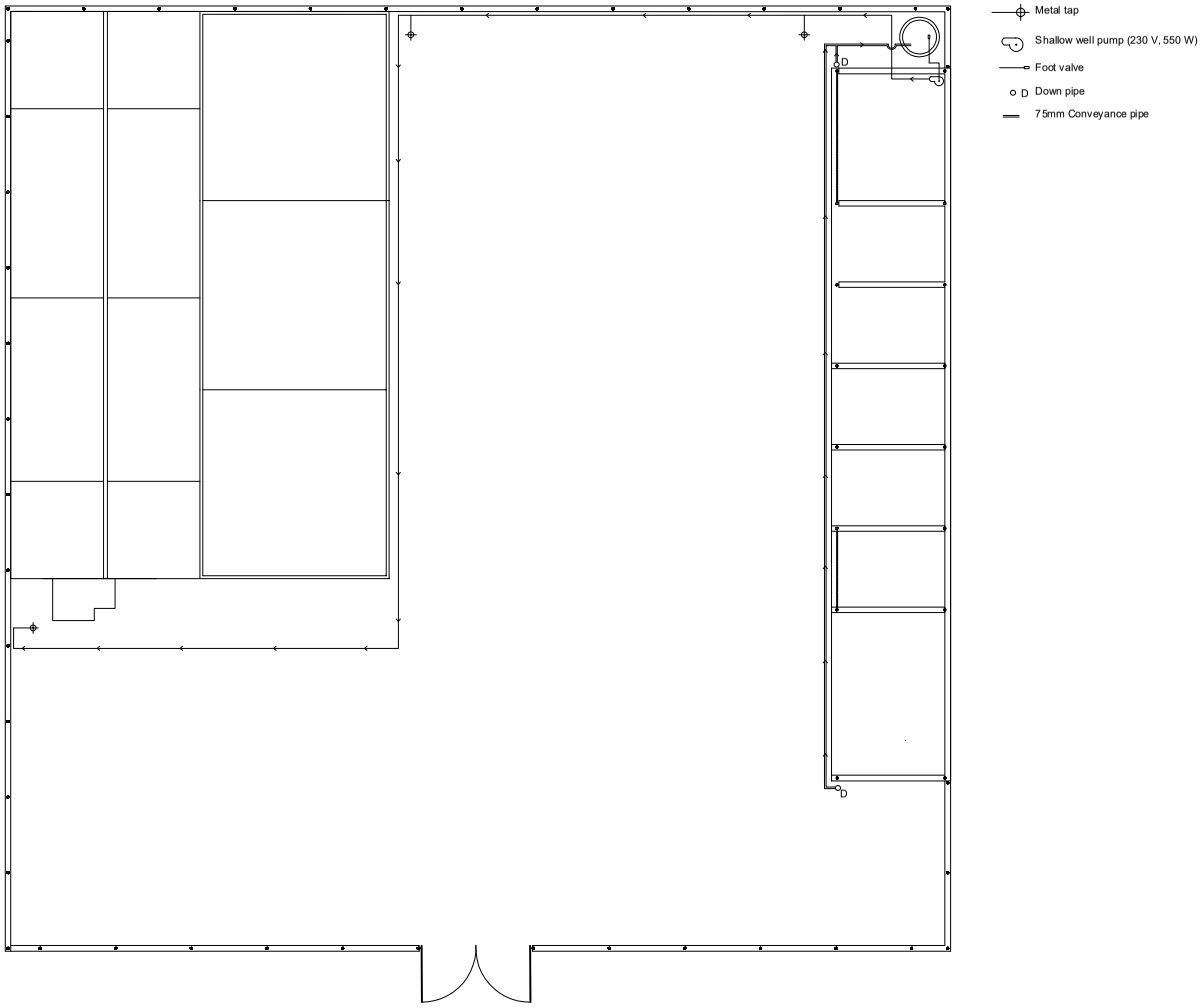
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



PLUMBING LAYOUT

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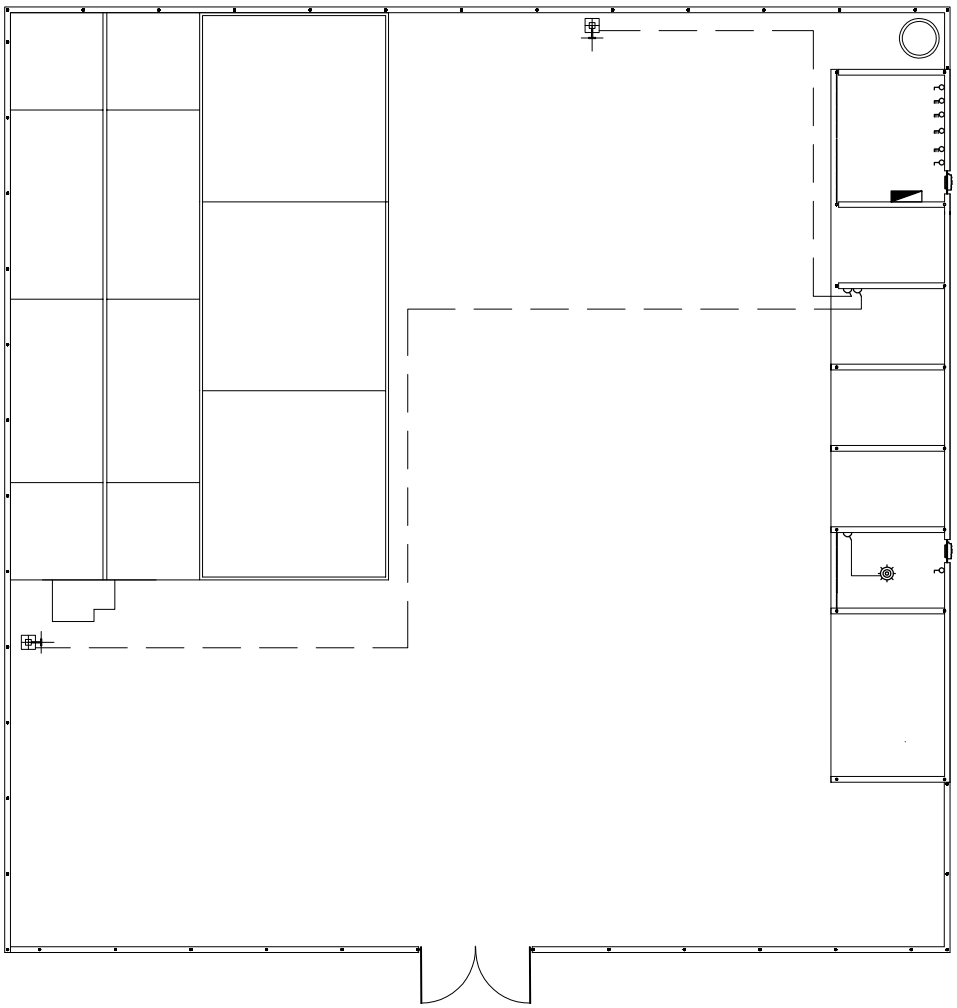
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



230 V, 250 W)
(14" blade diameter,
EXHAUST FAN

WEATHER PROOF SWITCH

[1.5m ABOVE GROUND]
1 PHASE POWER POINTS

[1.5m ABOVE GROUND]
3 PHASE POWER POINTS

100W ENERGY SAVING LIGHT

DISTRIBUTION BOARD

ELECTRICAL LAYOUT

1:200

PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT

OPEC FUND FOR INTERNATIONAL DEVELOPMENT

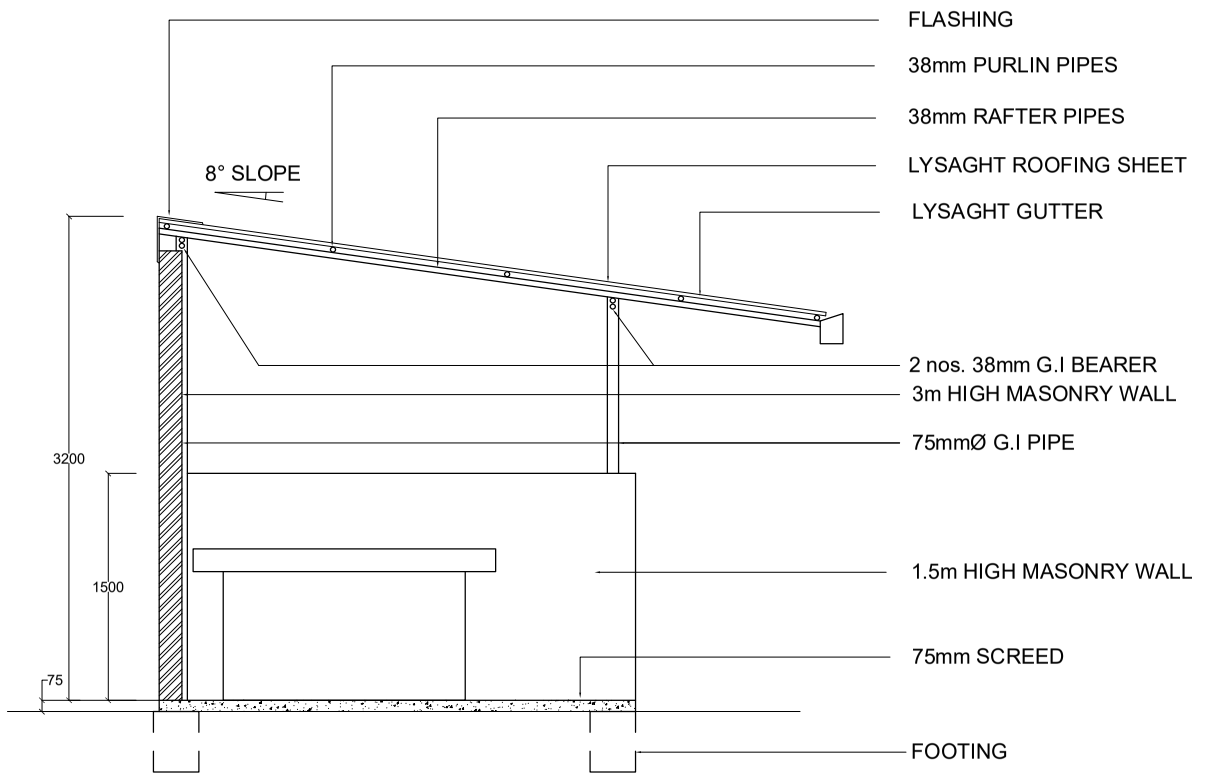
PROJECT:

H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER

SCALE: AS SHOWN

DATE: APR 2017

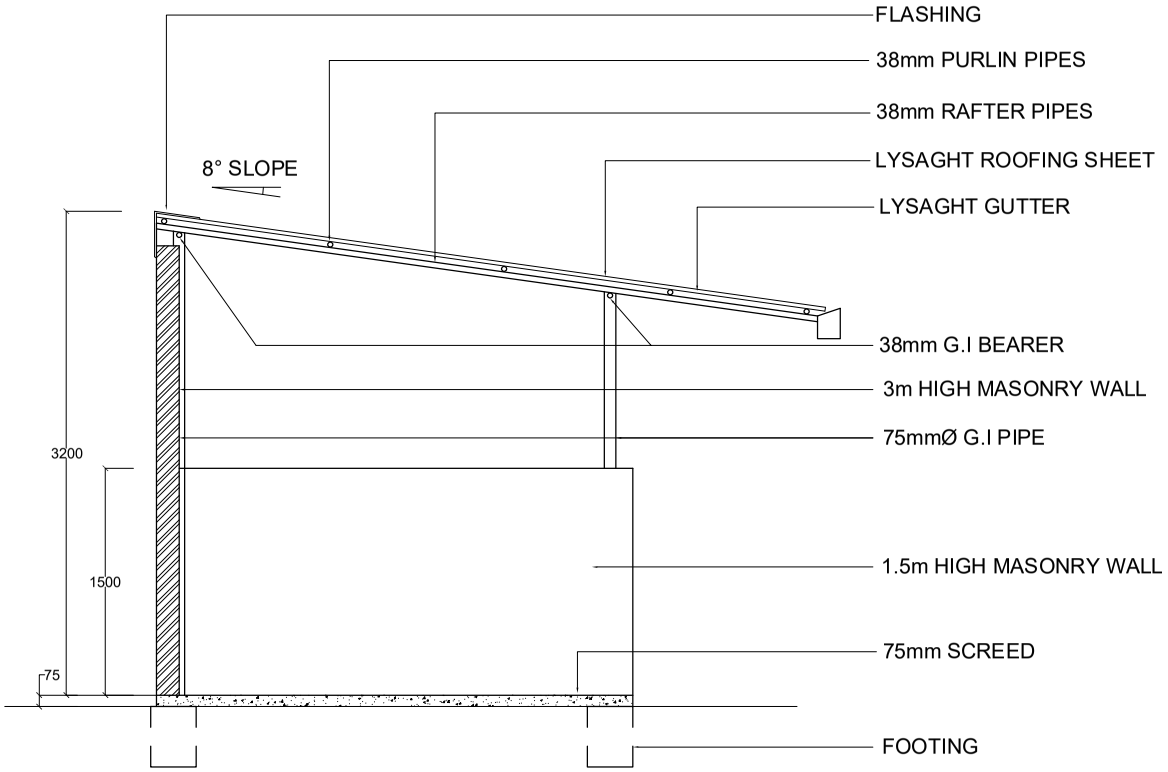
SOLID WASTE MANAGEMENT COMPONENT
OFID PROJECT
MINISTRY OF ENVIRONMENT AND ENERGY
HANDHUVAREE HINGUN MALE' 20-01
REPUBLIC OF MALDIVES



SECTION A

1:50

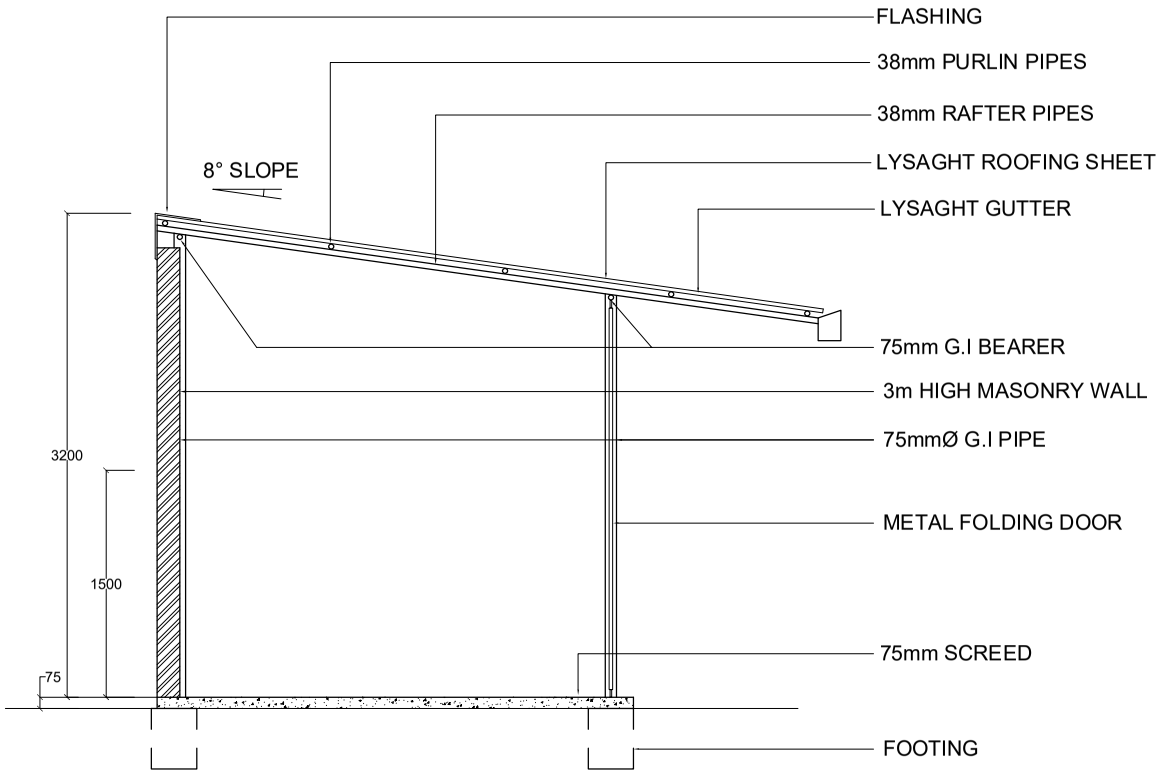
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



SECTION B

1:50

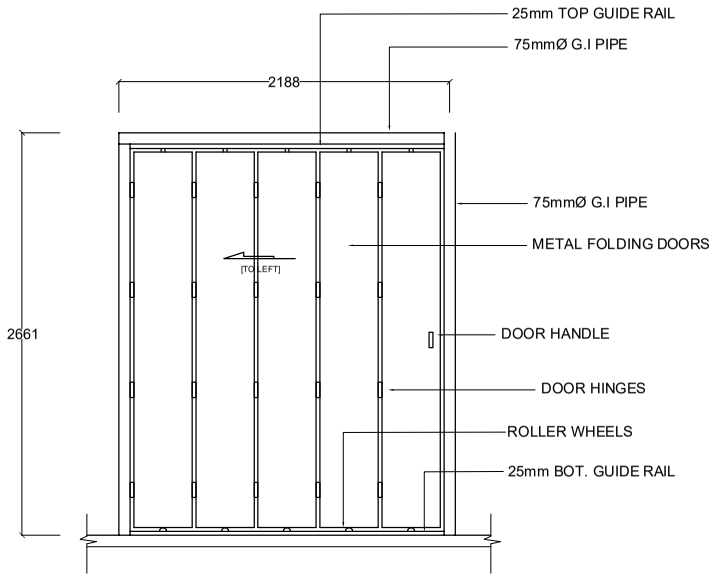
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



SECTION C

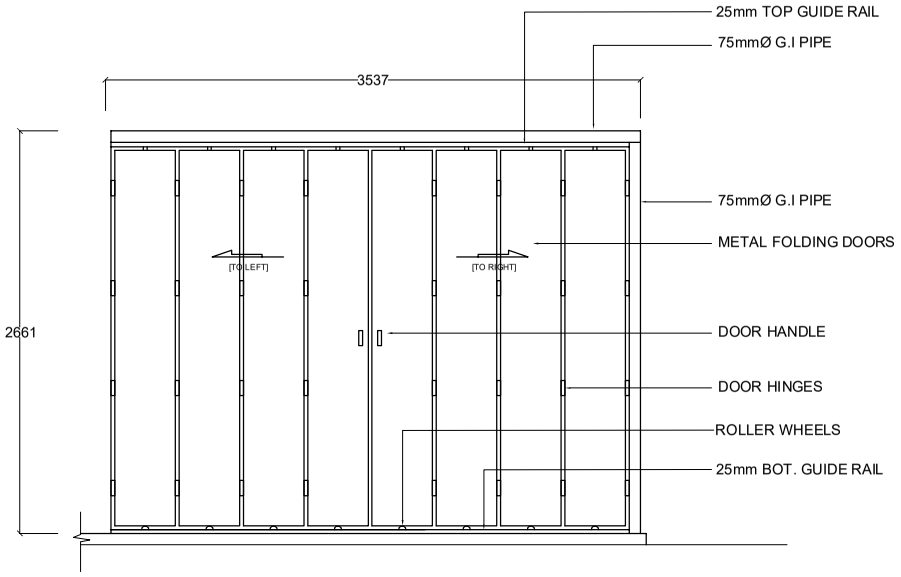
1:50

PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



HAZARDOUS WASTE AREA
FOLDING DOOR DETAIL

1:50



EQUIPMENT ROOM
FOLDING DOOR DETAIL

1:50

PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT

OPEC FUND FOR INTERNATIONAL DEVELOPMENT

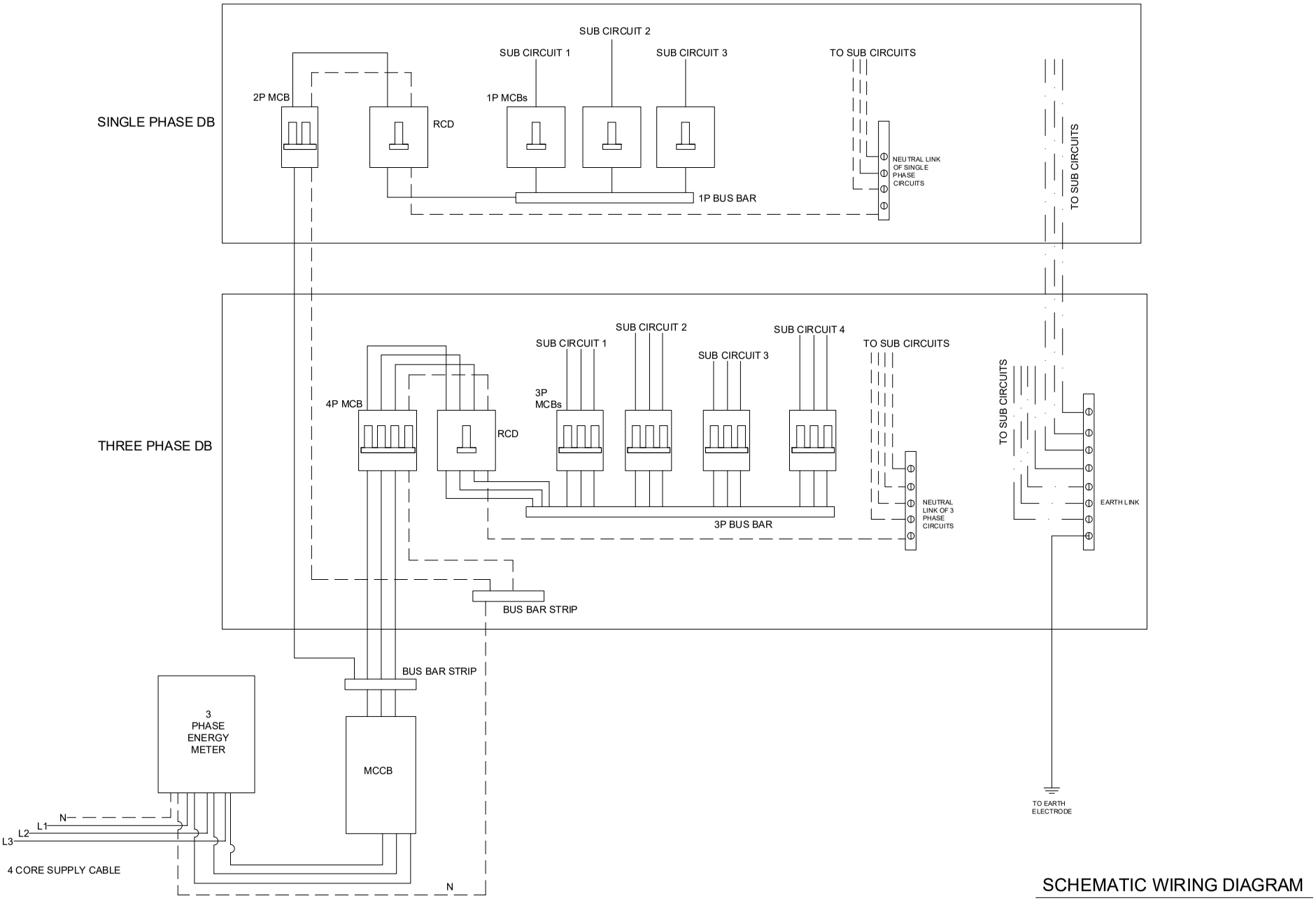
PROJECT:

H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER

SCALE: AS SHOWN

DATE: APR 2017

SOLID WASTE MANAGEMENT COMPONENT
OFID PROJECT
MINISTRY OF ENVIRONMENT AND ENERGY
HANDHUVAREE HINGUN, MALE' 20-01
REPUBLIC OF MALDIVES



SCHEMATIC WIRING DIAGRAM

PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT

OPEC FUND FOR INTERNATIONAL DEVELOPMENT

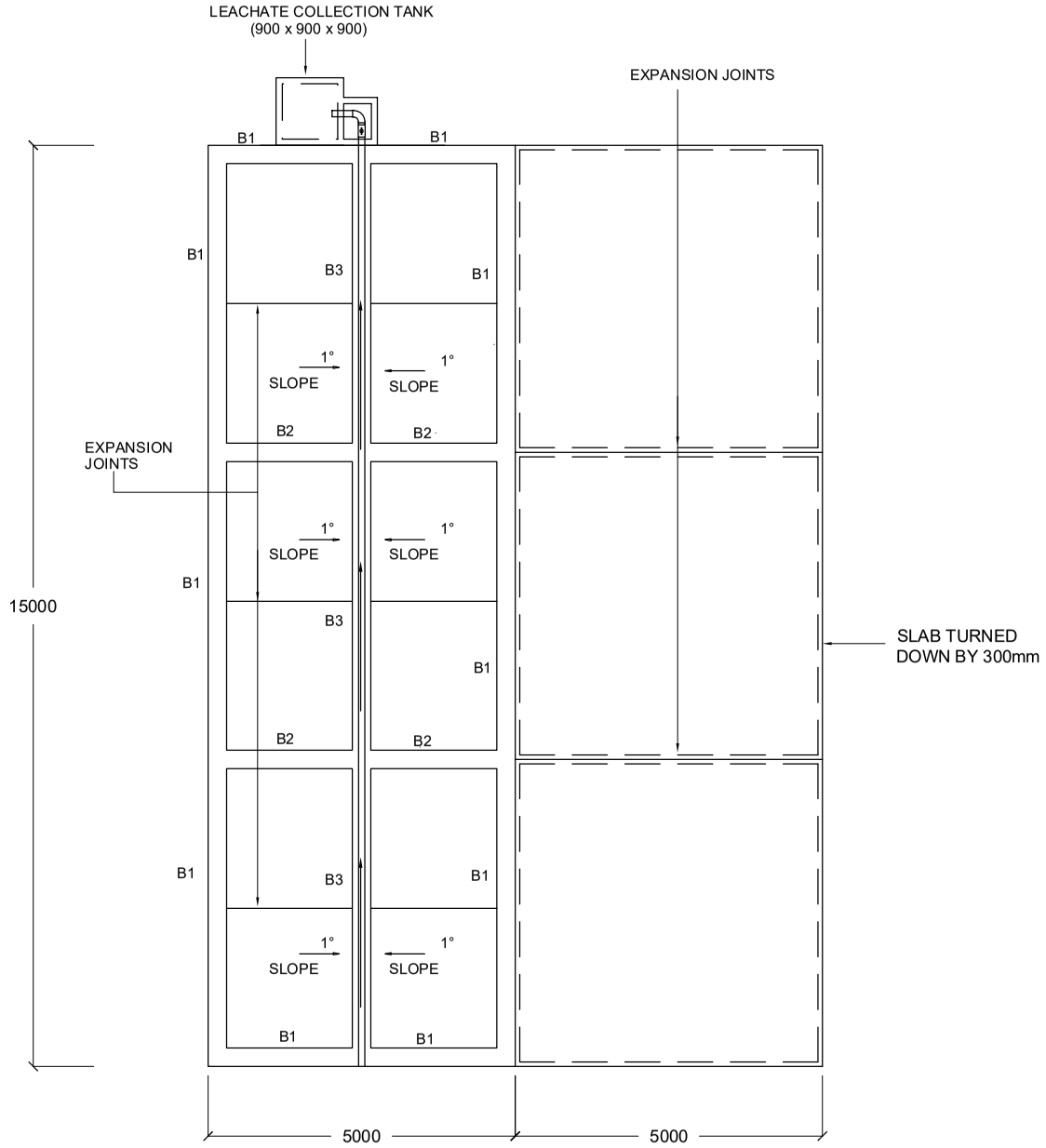
PROJECT:

H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER

SCALE: AS SHOWN

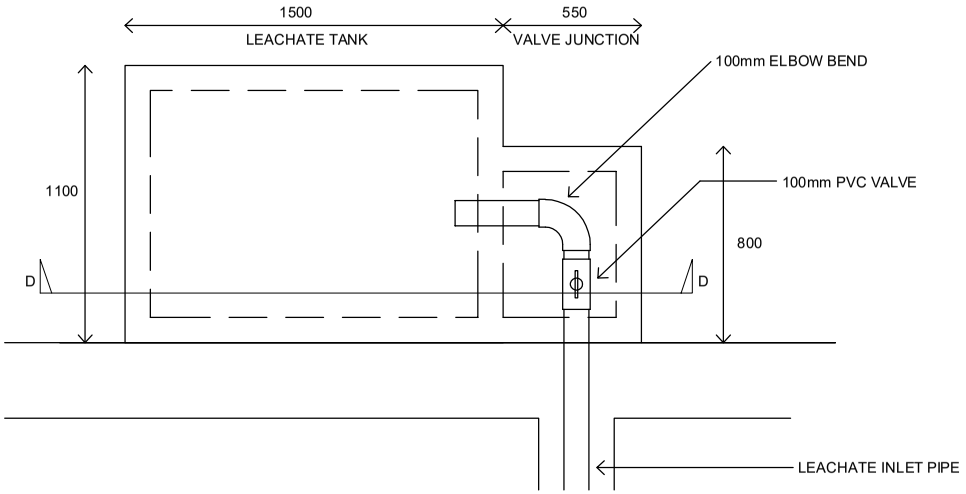
DATE: APR 2017

SOLID WASTE MANAGEMENT COMPONENT
OFID PROJECT
MINISTRY OF ENVIRONMENT AND ENERGY
HANDHUVAREE HINGUN MALE' 20-01
REPUBLIC OF MALDIVES

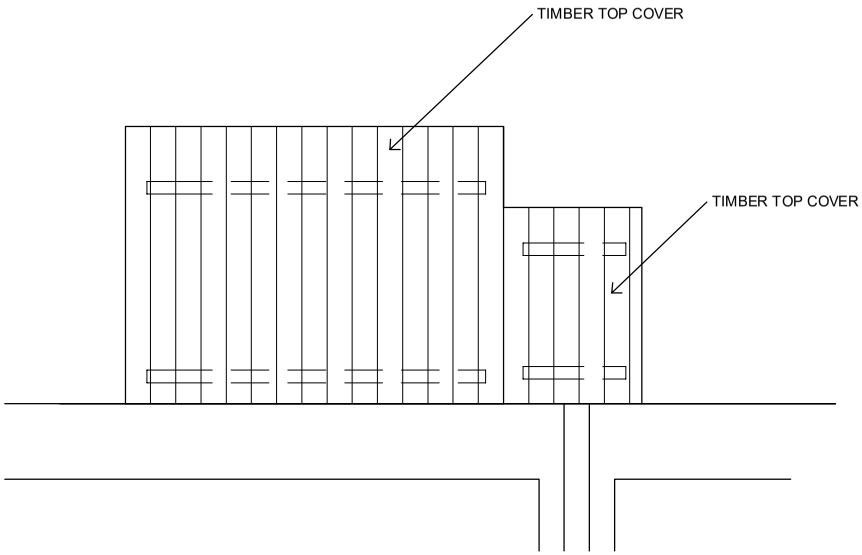


COMPOST SLAB AND SORTING AREA SLAB

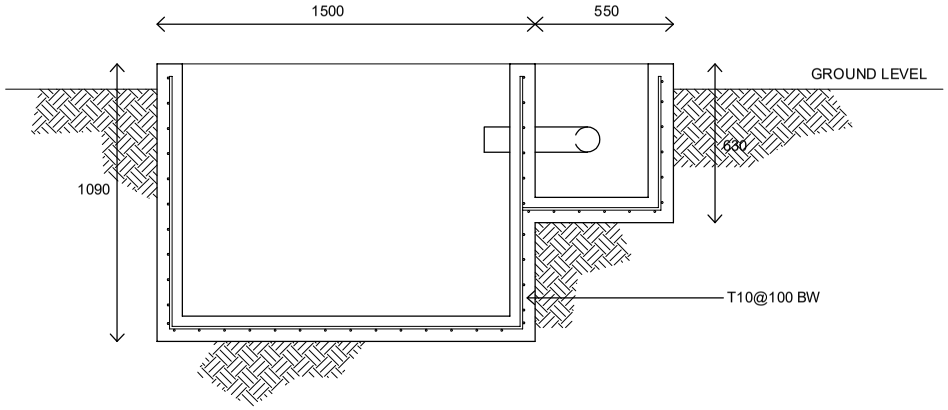
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



LEACHATE TANK DETAIL
1:30

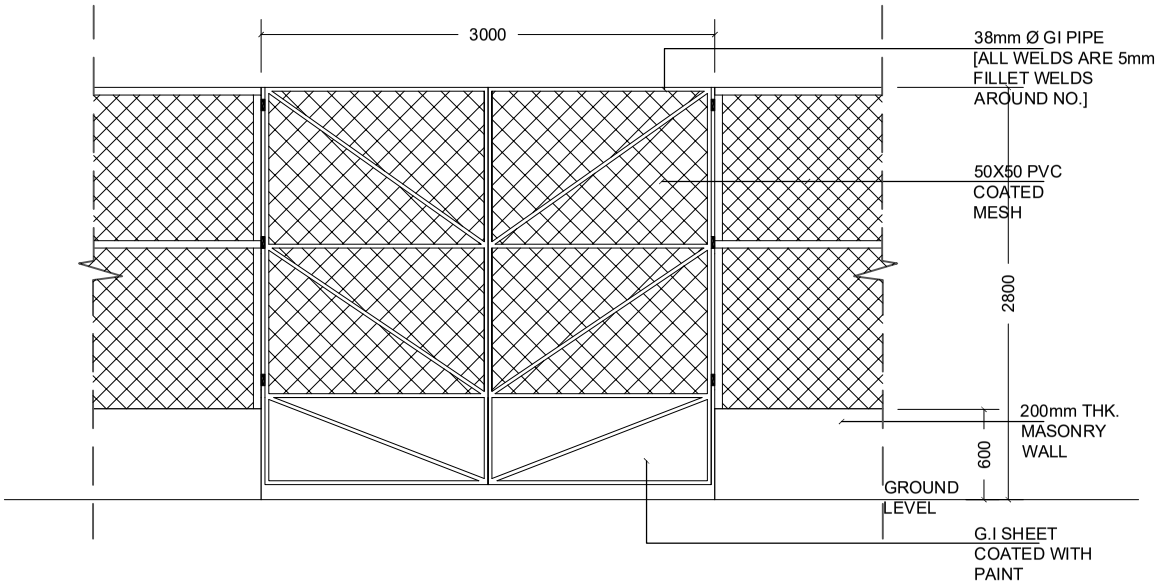


LEACHATE TANK COVER
1:30



SECTION D
1:30

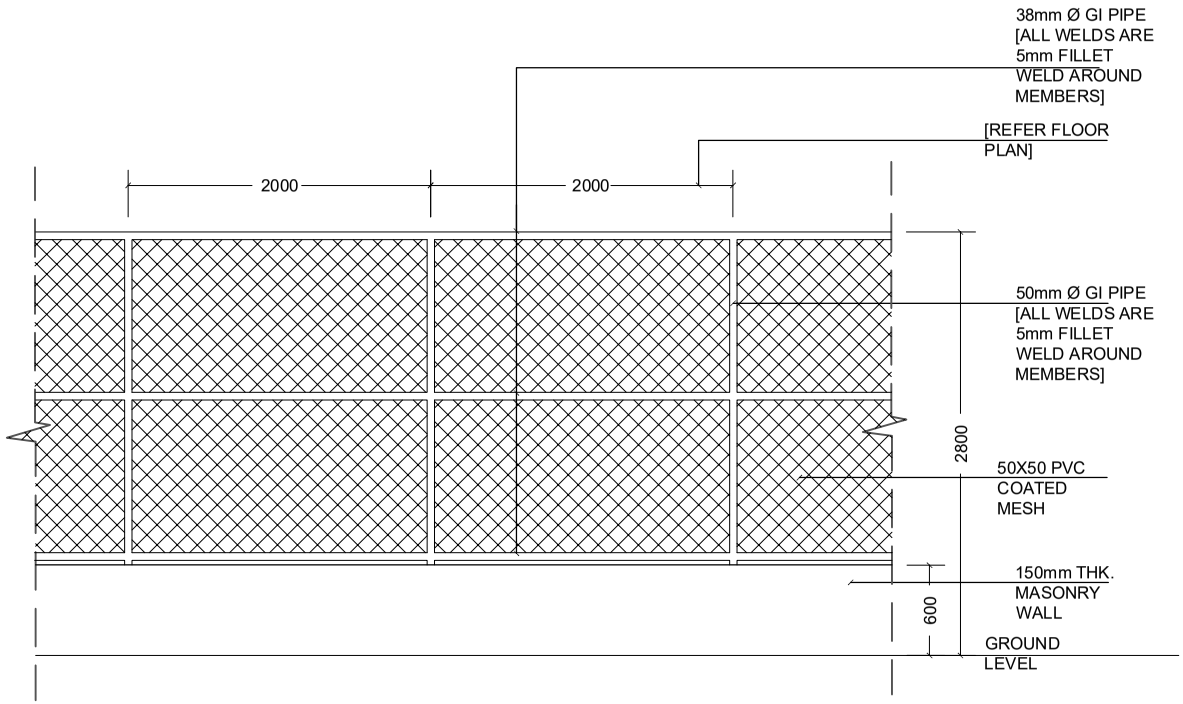
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



ENTRANCE / EXIT GATE

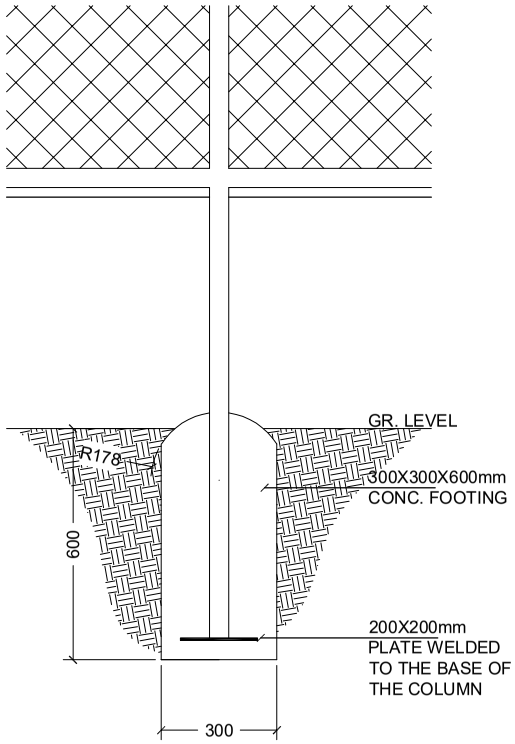
1:50

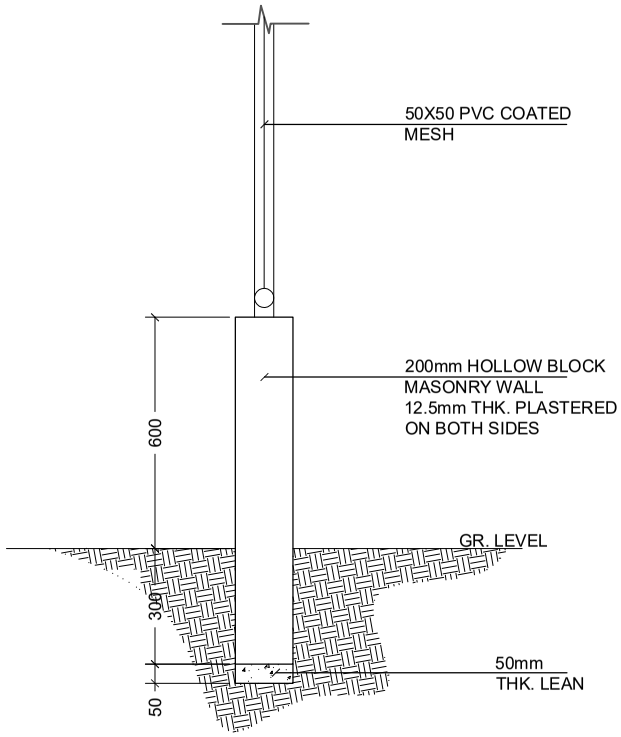
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



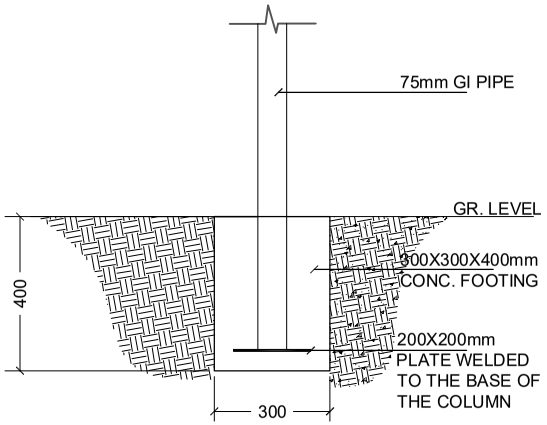
PERIMETER FENCE
1:50

PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES

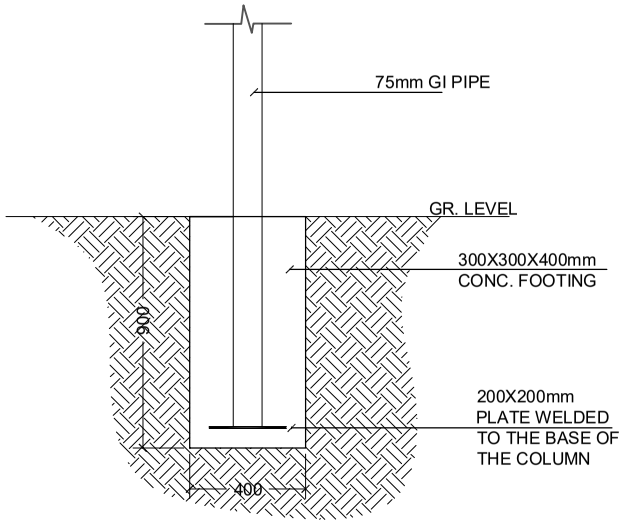




PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES

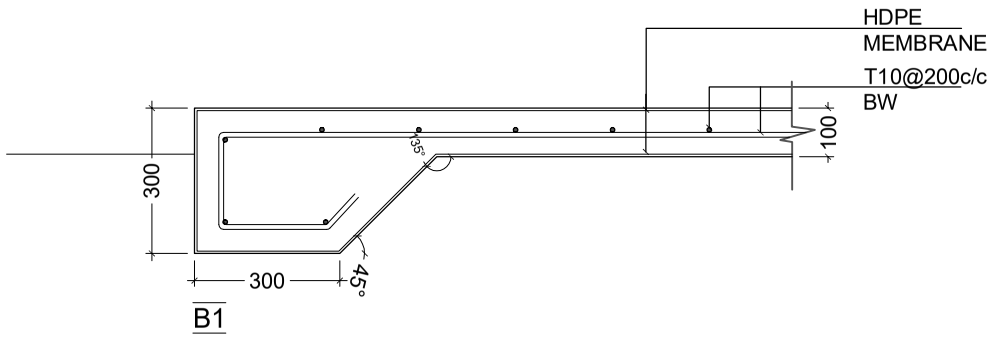


WASTE SORTING AREA

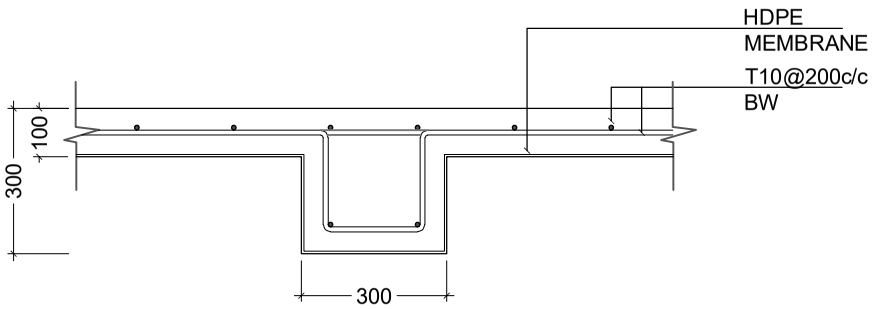


LIGHT POST FOUNDATION

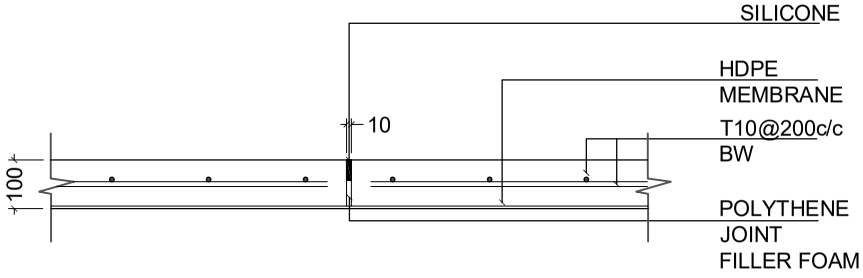
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



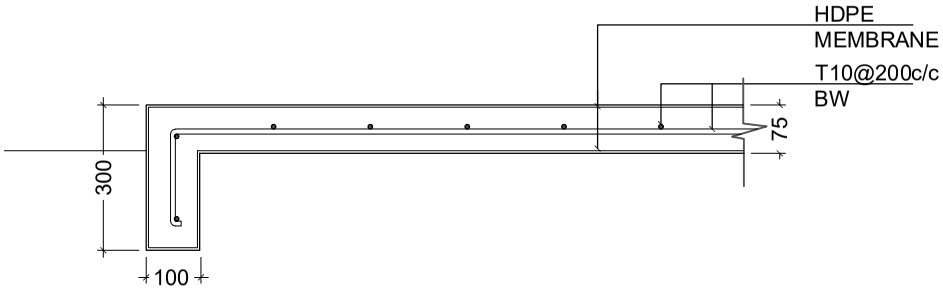
B1



B2

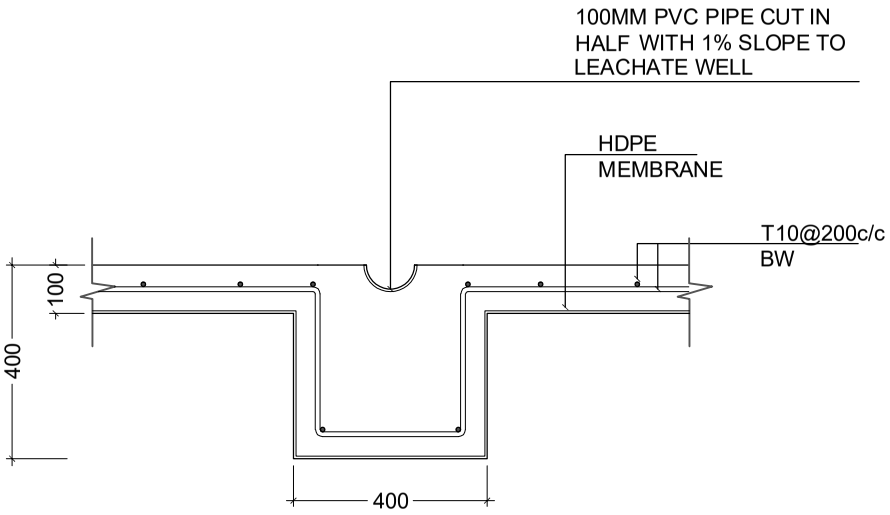


COMPOST BED SLAB DETAIL

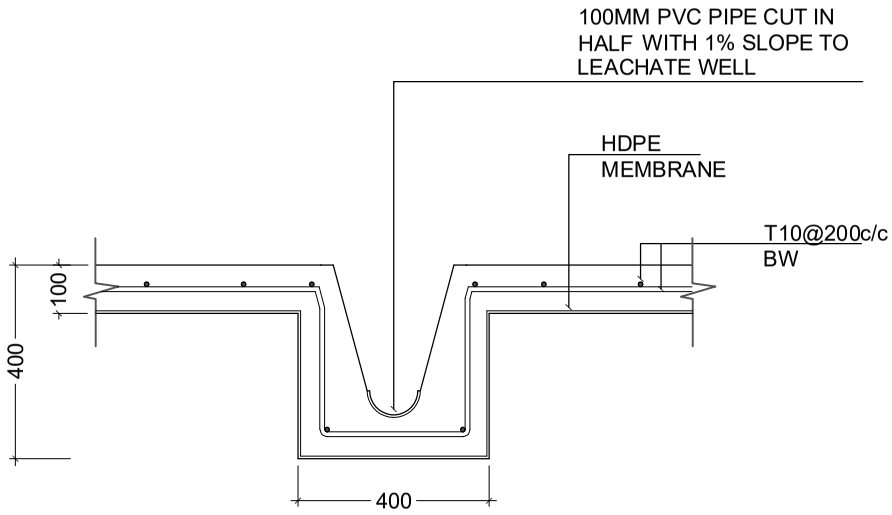


SORTING BED SLAB TURNED DOWN DETAIL

PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES

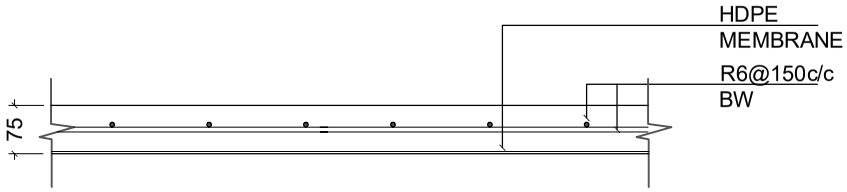


UPPER END

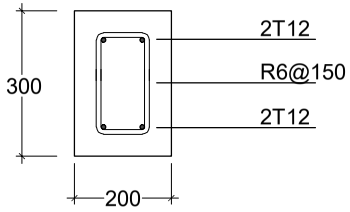


LOWER END

B3

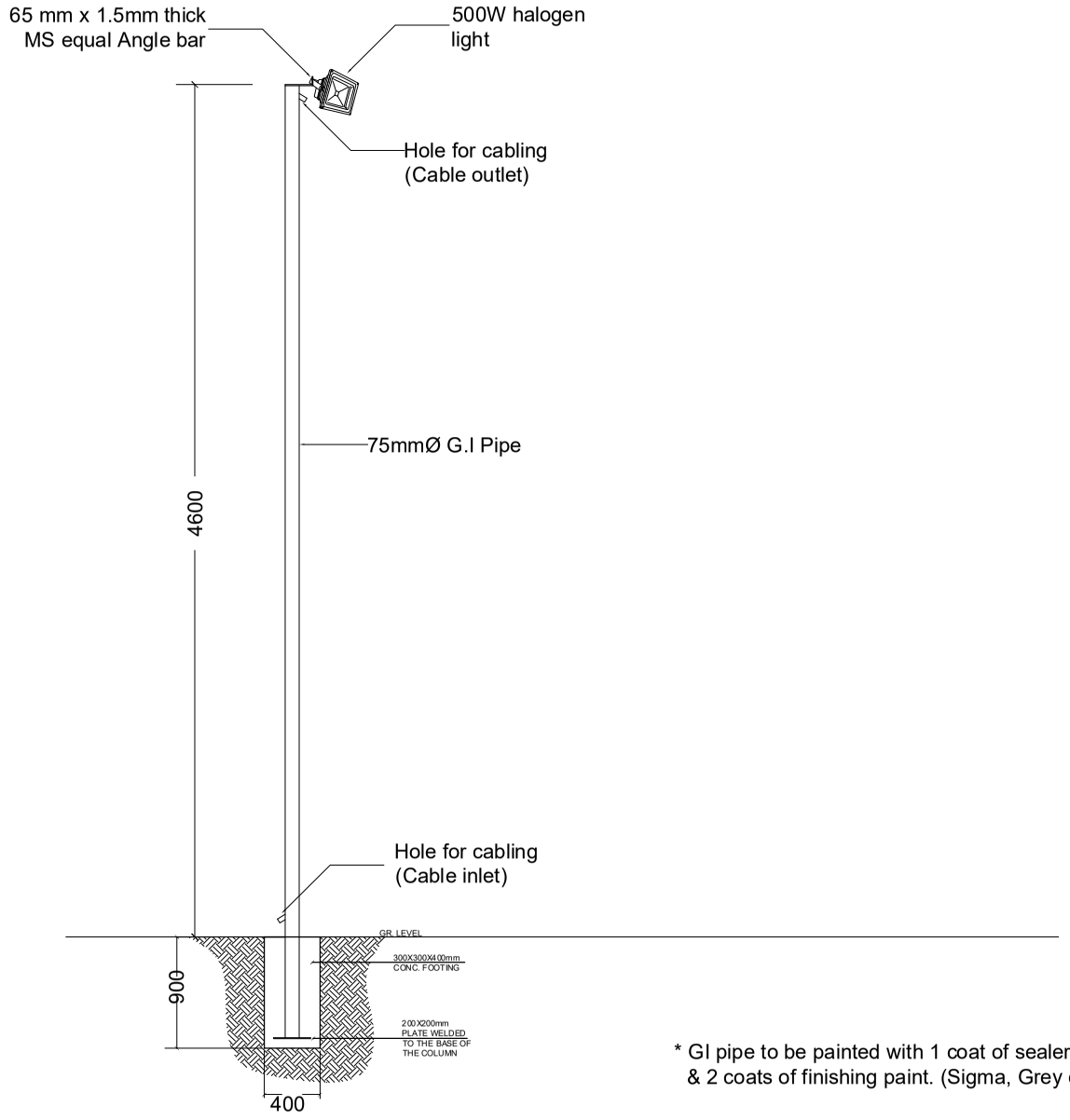


STORAGE AREA GROUND SLAB



LINE FOOTING

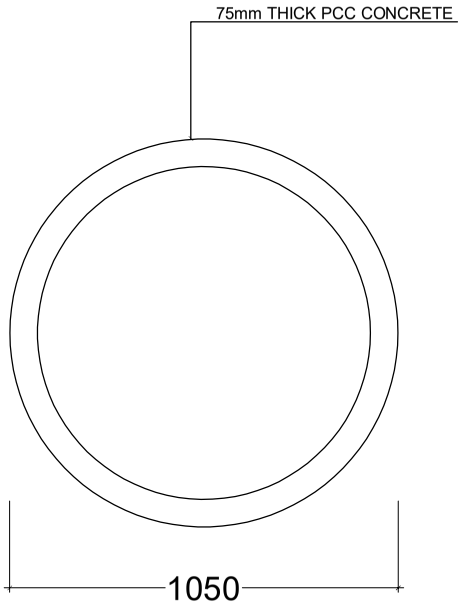
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



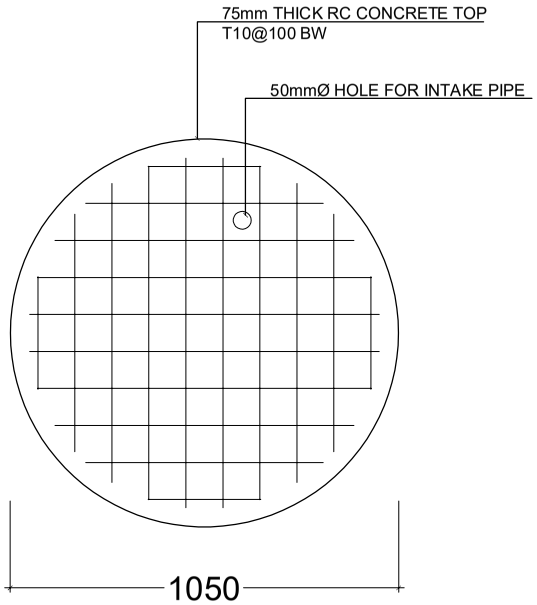
* GI pipe to be painted with 1 coat of sealer
& 2 coats of finishing paint. (Sigma, Grey colour)

LIGHT POST DETAIL

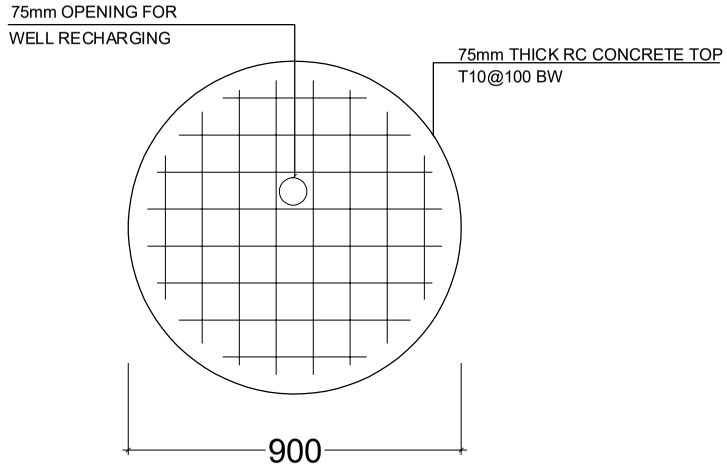
PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



GROUND WATER WELL

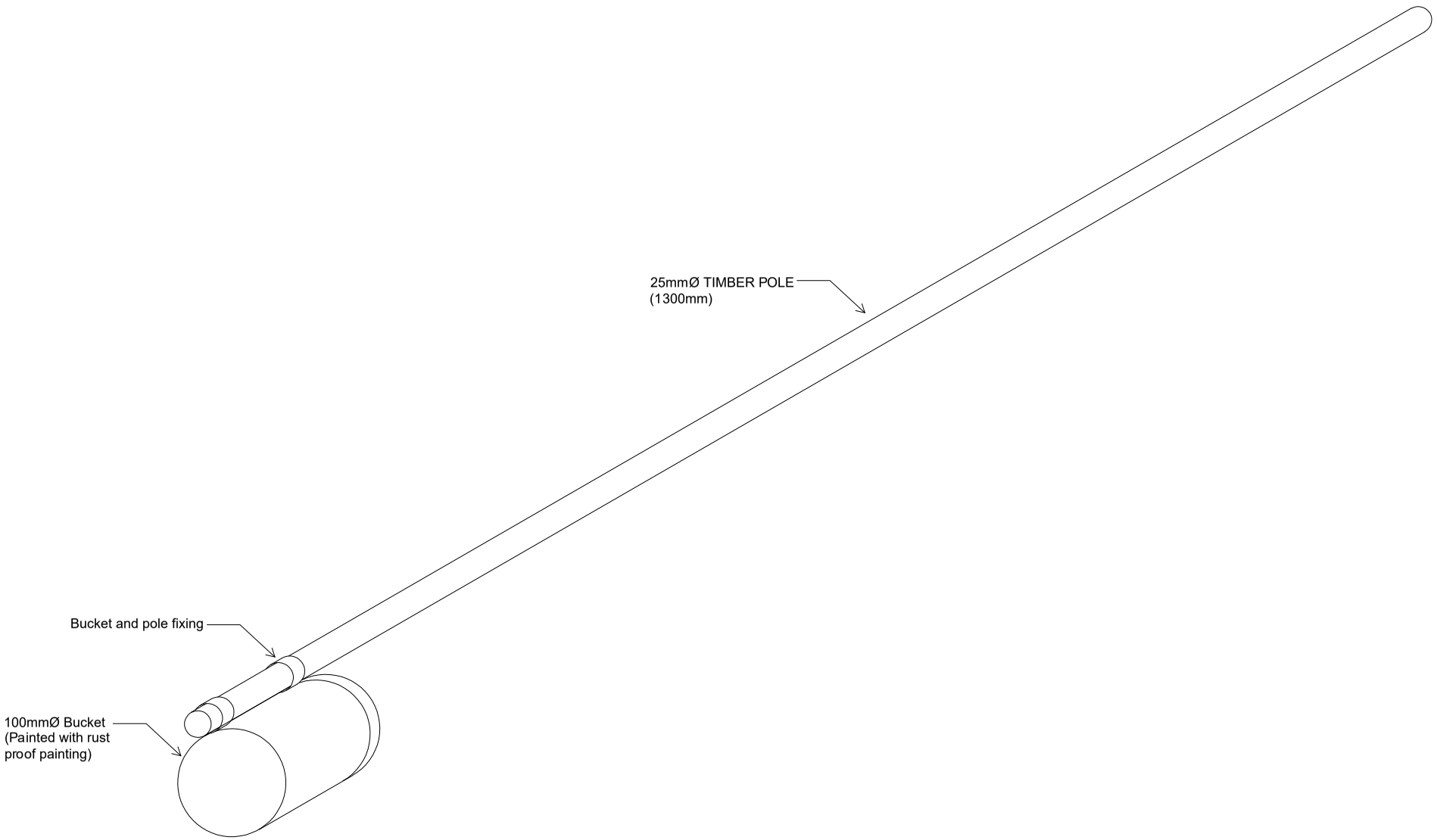


GROUND WATER WELL - TOP



GROUND WATER WELL - BASE

PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES



DHAANI FOR LEACHATE TANK

PROVISION OF WATER SUPPLY SANITATION AND SOLID WASTE MANAGEMENT PROJECT OPEC FUND FOR INTERNATIONAL DEVELOPMENT	PROJECT: H.A THAKANDHOO ISLAND WASTE MANAGEMENT CENTER	SCALE: AS SHOWN DATE: APR 2017	SOLID WASTE MANAGEMENT COMPONENT OFID PROJECT MINISTRY OF ENVIRONMENT AND ENERGY HANDHUVAREE HINGUN MALE' 20-01 REPUBLIC OF MALDIVES

MEECO
2nd Floor, Aakakaage-1, Galolhu
Alikilegefaanu Magu
Male', 20129
Republic of Maldives
(960) 301-0855
(960) 301-0844
info@meeco.com.mv

Key Plan

Notes :

* PROJECTION :- UTM84-43N
* UNITES ARE METERS
* SITE PLAN = 622.98sqm
* FROM THE SITE

:- DISTANCE TO BUILDING = 332.47m
:- DISTANCE TO EWELL = 152.59
:- DISTANCE TO PWELL = 152.59m
:- DISTANCE TO CLOSEST WETLAND = 177.53m
:- DISTANCE TO CLOSEST FARM = 6.13m
:- DISTANCE TO FOOTBALL GROUND = 28.59m
:- DISTANCE TO CLOSEST RESIDENT AREA = 214.88m
:- DISTANCE TO SHORE/VEGETATION LINE = LHS 31.17m

LEGEND

	VEGETATION LINE
	FOOTBALL GROUND
	FARM
	SITE PLAN
	BUILDING
RES	RESIDENTIAL AREA
WET	WETLAND

SCALE :	1:2000
SURVEYED BY :	MAUMOON SALEEM (ENGINEER)
DATE OF SURVEY :	2017/04/23
DRAWN BY :	DINAL (SURVEYOR)
CHECKED BY :	DINAL (SURVEYOR / ENGINEER)
DATE OF SUBMIT :	201/ 08/01

LOCATION
MURAIDHOO
HAA ALIFU ATOLL

PROJECT : WASTE MANAGEMENT PROJECT ZONE 01

DRAWING TITLE : PLOT DRAWING

DRAWING No : 2017/066

SHEET No : 01 OF 01

REV	DESCRIPTION	BY	DATE

MEECO

2nd Floor, Aakakaage-1, Galolhu
Alikilegefaanu Magu
Male', 20129
Republic of Maldives
(960) 301-0855
(960) 301-0844
info@meeco.com.mv

Key Plan

Notes :

* PROJECTION :- UTM84-43N
* UNITES ARE METERS
* SITE PLAN = 625sqm
* PLOT SIZE = 810.965sqm
* FROM THE SITE

:- DISTANCE TO CLOSEST BUILDING = 73.10m
:- DISTANCE TO WELL = 89.36m
:- DISTANCE TO CLOSEST MANGROVE AREA = 17.60m
:- DISTANCE TO CLOSEST DISTRIBUTION BOX = 81.50m (ELECTRICAL)
:- DISTANCE TO DISTRIBUTION BOX = 203.47m (ELECTRICAL)
:- SIZE OF MANGROVE AREA = 8650.49sqm (APPROXIMATELY)
:- DISTANCE TO SHORE/VEGETATION LINE = RHS 48.98m

* 17.6% FREE LAND TAKES FOR SITE.

LEGEND

	HWL
	SITE PLAN
	PLOT AREA
	DESIGN ROAD
	ACCESS ROAD
	MANGROVE AREA
P	PERMANENT BUILDING
DB	DISTRIBUTION BOX
	ADDITIONAL AREA

SCALE :	1:1250
SURVEYED BY :	MAUMOON SALEEM (ENGINEER)
DATE OF SURVEY :	2017/04/24
DRAWN BY :	DINAL (SURVEYOR)
CHECKED BY :	DINAL (SURVEYOR / ENGINEER)
DATE OF SUBMIT :	2017/08/02

LOCATION
THAKANDHOO
HAA ALIFU ATOLL

PROJECT : WASTE MANAGEMENT PROJECT ZONE 01

DRAWING TITLE : PLOT DRAWING

DRAWING No : 2017/070

SHEET No : 01 OF 01

REV	DESCRIPTION	BY	DATE

MEECO
2nd Floor, Aakakaage-1, Galolhu
Alikilegefaanu Magu
Male', 20129
Republic of Maldives
(960) 301-0855
(960) 301-0844
info@meeco.com.mv

Key Plan

Notes :

* PROJECTION :- UTM84-43N
* UNITES ARE METERS
* SITE PLAN = 625sqm
* PLOT SIZE = 776.19sqm
* FROM THE SITE
:- DISTANCE TO CLOSEST BUILDING = 99.14m
:- DISTANCE TO CLOSEST EMPTY AREA = 2.000m
:- DISTANCE TO POWERHOUSE = 133.71m
:- DISTANCE TO SHORE/VEGETATION LINE = LHS 52.91m

LEGEND

	LWL
	PLOT AREA
	SITE PLAN
	EMPTY BLOCK
	PERMANENT BUILDING
	POWERHOUSE
P	PERMANENT BUILDING
PH	POWERHOUSE

SCALE :	1:1250
SURVEYED BY :	MAUMOON SALEEM (SURVEYOR)
DATE OF SURVEY :	2017/05/04
DRAWN BY :	DINAL (SURVEYOR)
CHECKED BY :	DINAL (SURVEYOR / ENGINEER)
DATE OF SUBMIT :	2017/08/01

LOCATION
MOLHADHOO
HAA ALIFU ATOLL

PROJECT : WASTE MANAGEMENT PROJECT ZONE 01

DRAWING TITLE : PLOT DRAWING

DRAWING No : 2017/071

SHEET No : 01 OF 01

REV	DESCRICTION	BY	DATE

MEECO
2nd Floor, Aakakaage-1, Galolhu
Alikilegefaanu Magu
Male', 20129
Republic of Maldives
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(960) 301-0844
info@meeco.com.mv

Key Plan

Notes :

* PROJECTION :- UTM84-43N
* UNITES ARE METERS
* PLOT SIZE = 1975.81sqm
* SITE PLAN = 625sqm
* FROM THE SITE

:- DISTANCE TO FARM AREA = 86.46m
:- DISTANCE TO WETLAND = 289.71m
:- DISTANCE TO CLOSEST RESIDENT AREA = 323.52m
:- DISTANCE TO FOOTBALL GROUND = 310.61m
:- DISTANCE TO SHORE/VEGITATION LINE = LHS 91.84m

LEGEND

	HWL
	ACCESS ROAD
	PLOT AREA
	FARM AREA
	SITE PLAN
WET	WETLAND (MARSH AREA)

SCALE :	1:1250
SURVEYED BY :	MAUMOON SALEEM (ENGINEER)
DATE OF SURVEY :	2017/04/25
DRAWN BY :	DINAL (SURVEYOR)
CHECKED BY :	DINAL (SURVEYOR / ENGINEER)
DATE OF SUBMIT :	2017/07/28

LOCATION
FINEY
H.DH

PROJECT : WASTE MANAGEMENT PROJECT ZONE 01

DRAWING TITLE : PLOT DRAWING

DRAWING No :2017/062

SHEET No : 01 OF 01

REV	DESCRICTION	BY	DATE

MEECO
2nd Floor, Aakakaage-1, Galolhu
Alikilegefaanu Magu
Male', 20129
Republic of Maldives
(960) 301-0855
(960) 301-0844
info@meeco.com.mv

Key Plan

Notes :

* PROJECTION :- UTM84-43N
* UNITES ARE METERS
* PLOT SIZE = 1077.43sqm
* SITE PLAN = 625sqm

* FROM THE SITE

:- DISTANCE TO MANGROVE AREA = 111.57m
:- DISTANCE TO CLOSEST RESIDENT AREA = 123.66m
:- DISTANCE TO SHORE/VEGITATION LINE = CL 49.30m

LEGEND

	HWL
	PLOT AREA
	RESIDENTIAL AREA
	SITE PLAN

SCALE :	1:1250
SURVEYED BY :	MAUMOON SALEEM (ENGINEER)
DATE OF SURVEY :	2017/04/26
DRAWN BY :	DINAL (SURVEYOR)
CHECKED BY :	DINAL (SURVEYOR / ENGINEER)
DATE OF SUBMIT :	2017/07/30

LOCATION
HIRIMARADHOO
H.DH

PROJECT : WASTE MANAGEMENT PROJECT ZONE 01

DRAWING TITLE : PLOT DRAWING

DRAWING No : 2017/063

SHEET No : 01 OF 01

REV	DESCRICTION	BY	DATE

MEECO
2nd Floor, Aakakaage-1, Galolhu
Alikilegefaanu Magu
Male', 20129
Republic of Maldives
(960) 301-0855
(960) 301-0844
info@meeco.com.mv

Key Plan

Notes :

* PROJECTION :- UTM84-43N
* UNITES ARE METERS
* PLOT SIZE = 625sqm

* FROM THE PLOT

:- DISTANCE TO MANGROVE AREA = 165.07m
:- DISTANCE TO FOOTBALL GROUND = 132.67m
:- DISTANCE TO WELL = 114.34m
:- DISTANCE TO CLOSEST RESIDENT AREA = 165.58m
:- DISTANCE TO VEGETATION/SHORELINE = RHS
= 37.62m

LEGEND

	HWL
	PLOT AREA
	FOOTBALL GROUND
RES	RESIDENTIAL AREA
MAN	MANGROVE AREA
	ACCESS ROAD/FOOTPATH

SCALE :	1:1250
SURVEYED BY :	MAUMOON SALEEM (ENGINEER)
DATE OF SURVEY :	2017/04/27
DRAWN BY :	DINAL (SURVEYOR)
CHECKED BY :	DINAL (SURVEYOR / ENGINEER)
DATE OF SUBMIT :	2017/07/30

LOCATION
KURINBI
HAA DHAAL ATOLL

PROJECT : WASTE MANAGEMENT PROJECT ZONE 01

DRAWING TITLE : PLOT DRAWING

DRAWING No : 2017/065

SHEET No : 01 OF 01

REV	DESCRICTION	BY	DATE

MEECO
2nd Floor, Aakakaage-1, Galolhu
Alikilegefaanu Magu
Male', 20129
Republic of Maldives
(960) 301-0855
(960) 301-0844
info@meeco.com.mv

Key Plan

Notes :

* PROJECTION :- UTM84-43N
* UNITES ARE METERS
* SITE PLAN = 820.8sqm
* PLOT SIZE = 866.53sqm
* FROM THE SITE

:- DISTANCE TO HISTORICAL AREA = 94.21m

:- DISTANCE TO MARICULTURE FARM = 141.02m

:- DISTANCE TO RESIDENTIAL AREA = 130.11m

:- DISTANCE TO SHORE/VEGETATION LINE = CL 56.88m

LEGEND

	HWL
	LANDFILL
	JAADI (HISTORICAL AREA)
	MARICULTURE FARM
RES	RESIDENTIAL AREA
	SITE PLAN
	PLOT AREA

SCALE :	1:1000
SURVEYED BY :	MAUMOON SALEEM (ENGINEER)
DATE OF SURVEY :	2017/04/28
DRAWN BY :	DINAL (SURVEYOR)
CHECKED BY :	DINAL (SURVEYOR / ENGINEER)
DATE OF SUBMIT :	2017/08/02

LOCATION
VAIKARADHOO
HAA DHALU ATOLL

PROJECT : WASTE MANAGEMENT PROJECT ZONE 01

DRAWING TITLE : PLOT DARWING

DRAWING No : 2017/071

SHEET No : 01 OF 01

REV	DESCRICTION	BY	DATE

بسم الله الرحمن الرحيم

Ministry of Environment and Energy
Male', Republic of Maldives.

މިނިސްޓްރީ އޮފް އެންވަޔަރަންމަންޓް އެންޑް އެނަރޖީ
މާލެ، ދިވެހިރާއްޖެ.

Date: 2nd August 2017

No: 438-WMPC/203/2017/97

Mr Ibrahim Naeem
Environmental Protection Agency
Handhuvaree Higun, Green Building,
Male', Maldives

Dear Sir,

Sub: Commitment of the Proponent

As the proponent of the proposed project, we confirm our commitment to finance and implement all construction and operational phase mitigation measures proposed in the EMP report and conduct the environmental monitoring program and overall management of the IWMC as specified in the report.

Sincerely,

Ahmed Murthaza
Director General

MINISTRY OF ENVIRONMENT AND ENERGY
REPUBLIC OF MALDIVES

LED SAVES

Green Building, Handhuvaree Hingun,
Maafannu, Male', 20392, Republic of Maldives.
+(960) 301 8300
+(960) 301 8301
www.environment.gov.mv

ގްރީން ބިލްޑިންގ، ހަނދުވަރީ ހިނގުން،
މާފަންނު، މާލެ، 20392، ދިވެހިރާއްޖެ.
secretariat@environment.gov.mv
www.twitter.com/ENVgovMV
www.facebook.com/environment.gov.mv

ކުނި މެނޭޖް ކުރުމުގެ ޕްލޭން

1. **ކުނި މެނޭޖްކުރުމާއިބެހޭ ކޮމިޓީ**
   - ☆ ހިރިމަރަދޫ ކައުންސިލްގެ ރައީސް އަލްފާޟިލް މުޙައްމަދު ވަހީދު
   - ☆ ހިރިމަރަދޫ ކައުންސިލްގެ ނައިބު ރައީސް އަލްފާޟިލް މުޙައްމަދު އަރުޝަން
   - ☆ ހިރިމަރަދޫ ކައުންސިލްގެ މެމްބަރު އަލްފާޟިލް ޙުސައިން ފިރާޤު
   - ☆ ހިރިމަރަދޫ ކައުންސިލް އިދާރާގެ އެޑްމިނިސްޓްރޭޓިވް އޮފިސަރ (ވަޒީފާ ޖެންޑަރފޯކަލްޕޮއިންޓާ) އަލްފާޟިލް ޙަސަން ނިޒާރު
   - ☆ ހިރިމަރަދޫ ކައުންސިލް އިދާރާގެ އެޑްމިނިސްޓްރޭޓިވް އޮފިސަރ އަލްފާޟިލާ ފާތިމަތު ހަރޫޝާ
   - ☆ ހިރިމަރަދޫ ކައުންސިލް އިދާރާގެ އެސިސްޓެންޓް ފައިނޭންސް އޮފިސަރ އަލްފާޟިލް އިބްރާހީމް އަޙްމަދު
   - ☆ ހިރިމަރަދޫ ކައުންސިލް އިދާރާގެ އެސިސްޓެންޓް އިންފޮމޭޝަން ޓެކްނޮލޮޖީ އޮފިސަރ އަލްފާޟިލާ ޢާރިފާ ޢަބްދުﷲ
   - ☆ ހިރިމަރަދޫ ސިއްޙީ މަރުކަޒުގެ އެޑްމިނިސްޓްރޭޓަރ އޮފް ހެލްތު ސަރވިސަސް އަލްފާޟިލް އަޙްމަދު ޝަރީފް
   - ☆ ހިރިމަރަދޫ ސިއްޙީ މަރުކަޒުގެ ފެމިލީ ހެލްތު ވޯކަރ އަލްފާޟިލާ އާމިނަތު ޢައިޝާ
   - ☆ ހިރިމަރަދޫ ސްކޫލްގެ ޕްރިންސިޕަލް އަލްފާޟިލް އިލްޔާސް

2. **ޕްލޭން ހިންގުންހިންގާނޭ ބަލަހައްޓާ ފަރާތް**
   - ☆ ހިރިމަރަދޫ ކައުންސިލް

3. **ޕްލޭން އެކުލަވާލުމުގެ މަޤްޞަދު**
   - ☆ ކުނީގެ މައްސަލަތަކަށް ދާއިމީ ހައްލެއް ހޯދުމާއި ރައްކާތެރި އަދި ދެމެހެއްޓެނިވި ގޮތެއްގައި ކުނި މެނޭޖްކުރުން
   - ☆ ތިމާވެށި ހިމާޔަތްކުރުމާއި ސިއްޙީ މައްސަލަތައް ކުޑަކުރުން
   - ☆ ކުނީގެ ސަބަބުން ދިމާވާ އިޤްތިޞާދީ އަދި އިޖުތިމާޢީ މައްސަލަތައް ކުޑަކުރުން
   - ☆ ރައްޔިތުން ހޭލުންތެރި އަހުލުވެރިކުރުވުން

4. **ސަރަޙައްދު**
   - ☆ ނަހަ ޑުރި ހިރިމަރަދޫ

5. **ކުނި މެނޭޖްކުރުމުގައި ބަރުދަނާ ވަސީލަތްތަކާއި**
   - ☆ ކުނި މެނޭޖްކުރުމުގެ ޒިންމާއާއި ހަވާލު ބައިވެރިކުރުން

- ☆ ދެމެހެއްޓެނިވި ނިޒާމަކަށް ހަދައި، ހިންގާ ބެލެހެއްޓުން
- ☆ ކުންޏަކީ މަންފާ ލިބޭ އެއްޗެކަށް ހެދުން
- ☆ ޤާބިލިއްޔަތު ތަރައްޤީކުރުމާއި ކުނީގެ ބަލަހައްޓަން ފަހިކުރުން
- ☆ 3R ބޭނުންކުރުން
- ☆ ކުނިކޮށިގައި ކުނީގެ ބަލަހައްޓަން ފަހިކުރުން
- ☆ ރަށުން ކުނި ބޭރުކުރެވޭނެ ނިޒާމެއް ޤާއިމުކުރުން
- ☆ އުފެއްދޭ ކުނީގެ މިންވަރު މަދުކުރުން
- ☆ ރަށުގެ ވިލި ނަޒާފަތް ބެހެއްޓުން
- ☆ ރަށުގެ ވަލުތެރެއާއި އަތިރިމައްޗާއި ދޫދު ކުނިން ތަޞައްރުފުވިޔަ ނުދިނުން

6. މަޢުލޫމާތު އެއްކުރުން

☆ ރަށުގައި އުފެދޭ ކުނީގެ ވައްތަރު

- އޯގޭނިކް ނުވަތަ ދިރުންހުރުންނަތަކެތީގެ ތަރުކީބުން އުފެދިގެން އަންނަ އަދިއެހެނަސް ނެތި ފަސާދަވާގޮތުގެ ކުނި
  - ✓ ފަތާއި ގޮޅި ގަސްގަސްގެ ފަދަ ތަކެތި
  - ✓ ތޮކިލާވާފައި ނުވަތަ ރޮދާ ހުންނަ ކާބޯތަކެތި
  - ✓ މޭވާއި ތަރުކާރީ
  - ✓ ބޮނބި
- މަހުގެ އުފެއްދުންތަކެއް
  - ✓ މަހުގެ ބޮލާއި ކަރިފަތި
  - ✓ މަރުވެފައި ހުންނަ މަސް ފަދަ ނުބައިވަސް ދުވާ ތަކެތި
- ނުރައްކާތެރި ކުނި
  - ✓ ބެޓެރި
  - ✓ ސިލިންޑަރު
  - ✓ ބޭނުންކޮށްފައި ހުންނަ އައިޕޮޓާ
  - ✓ ދިޔާރަ އެކުލެވޭ ތަކެތި
- ސިއްހީ ހިދުމަތުން އުފެދޭ ކުނި
  - ✓ ދުވަސްހަމަވެފައި ހުންނަ ބޭސް
  - ✓ ބޭނުންކޮށްފައިހުންނަ ސިރިންޖާއި ސިރިންޖުކަށި
  - ✓ ބޭނުންކޮށްފައި ހުރަސް ބެންޑޭޖާއި ކަފު ފަދަ ތަކެތި

- ޕްލާސްޓިކް
  - ✓ ފުޅި
  - ✓ ޕްލާސްޓިކް ކޮތަޅު
  - ✓ ޕްލާސްޓިކް ގޮނޑިއާއި މޭޒު
- މަޢުދަނުގެ ބާވަތްތައް
  - ✓ އެކަތަ
  - ✓ ދަގަނޑު
  - ✓ އެލުމިނިއަމް
  - ✓ ތޮއި
  - ✓ ރަންވަންތި
  - ✓ ހުސްކޮށްފައި ހުންނަ ދަޅު ފަދަ ތަކެތި
- ބިއްލޫރި
- ބަނދުކޮށްފައި ހުންނަ ނާރިފަދަ ތަކެތި
- ބާލިފައި ހުންނަ އެހެނިހެން ތަކެތި

☆ ކުނީގެ ކޮންމެ ވައްތަރަކުން އުފެދޭ މިންވަރު

- މިސާލު
  - ✓ އޯގަނިކް ކުނި = 60%
  - ✓ މަޢުދަނުގެ ކުނި = 5%
  - ✓ ޕްލާސްޓިކް ކުނި = 15%
  - ✓ ބަނދުކޮށްފައި ހުންނަ ނާރު = 15%
  - ✓ އެހެނިހެން ކުނި = 5%

☆ އާންމުގޮތެއްގައި ކުނި އުފެއްދާ ތަންތަން

- ގޭބިސީތައް
- ވިޔަފާރިކުރާ ތަންތަން
- ސިއްހީ ހިދުމަތްދޭ ތަންތަން
- އިޖުތިމާއީ ސަރަހައްދުތައް ސާފުކުރުމުގެ ތެރެއިން
- ދަނޑުވެރިކަން

- ގޭދޮރު ބިނާކުރުމާއި އިމާރާތްކުރުން

7. މިހާރު ކުންޏާއިމެދު އަމަލުކުރާ ގޮތް

☆ އަތިރިމައްޗަށާއި ފޫދަށް ކުނިއެޅުން

☆ މަގުމައްޗަށް ކުނިއެޅުން

☆ ވަޅުތެރެއަށް ކުނިއެޅުން

8. ރަށުގައި މިހާރު ކުންނާއިމެދު އަމަލުކުރާ ގޮތުގެ ސަބަބުން ދިމާވާ މައްސަލަތައް

- ސިއްހީ މައްސަލަތައް
  - މަދިރި އުފެދުން
  - މީހާ ބިނަވުން
  - ބިއްލޫރާއި ދަގަނޑުގެ ބާވަތްތަކުގެ ސަބަބުން ތަންތަން ކަފައިގެން ދިއުން
  - ޖިސްމާނީ އަނިޔާ ލިބުން
  - އިންފެކްޝަން އުފެދުން
- ތިމާވެށްޓަށް ދިމާވާ މައްސަލަތައް
  - ފެންފަރަށް ބަޔޮއްޓަރުވުން
  - ކުނިއެންދުމުގެ ސަބަބުން ވައި ނުސާފުވެ ބަޔޮއްޓަރުވުން
  - ކުނިއެޅުމުގެ ސަބަބުން ފަރުތަކާއި މުރަކަތަކަށް ގެއްލުން ލިބުން
- މަންޒަރު ފެންނަ ގޮތުން ކުރާ ނޭދެވޭ އަސަރު
- ނުބައި ވަސްދުވުމާއި މަޑަމަތި ހުތުރުވުމުގެ ސަބަބުން ރަށަށް ޒިޔާރަތްކުރާ ފަތުރުވެރިންނަށް ރަށްތެރެ ދައްކާލުމަށް ޖެހިލުންވުން

9. ކުނި މެނޭޖުކުރުމުގެ މަސައްކަތް ކުރިއަށް ގެންދެވިދާނެ ތަފާތު ގޮތްތައް

☆ 3R

- ކުނި މަދުކުރުމަށްޓަކައި ކުނި ނުއުފެއްދުން (ރިޑިއުސް)

✓ ކުނިކަހައިގެން ނޭގޭ ފަށްފަދަ ތަކެތި ގާދު ގެދުރަން ނުވަތަ ގަސް ބުޅަން އެޅުމަން ބޭނުންކުރުން

✓ ޑުރިގަނޭ ފަދަ ތަކެތި މަދުގެ އަތިރިމަތި ފަރަގަކުރުމަން ބޭރެއްޗެން

✓ ބާޒާރުކުރުމަށް ޕްލާސްޓިކް ކޮތަޅުގެ ބަދަލުގައި ފޮތި ކޮތަޅު ބޭނުންކުރުން

- ✓ ޕްލާސްޓިކްގައި ހުންނަ ތަކެތި ގެންދުމުގައި ކުނި ކޮންޓެއިނަރުން މިންވަރު މަދު އެއްޗެއްސަށް އިސްކަންދިނުން
- ✓ އެކި ކަންކަމަށް ބޭނުންކުރާ ސާމާނު ބޭނުންކޮށްފައި އަނބުރާ ދޫކޮށް ހެދުން
- ✓ އެއްފަހަރު ބޭނުންކޮށްފައި އެއްލާލާ އެއްޗެހީގެ ބަދަލުގައި ތަކުރާރުކޮށް ބޭނުންކުރެވޭނެ އެއްޗެހި ހޯދުން
- ✓ މަސައްކަތްތަކުގައި ބޭނުންކުރާ ސާމާނާއި ހެދުން ފަދަ ތަކެތި ހަލާކުވުމުން މަރާމާތުކޮށްގެން ބޭނުންކުރުން
- ✓ އެއްޗެހި ގަންނައިރު ގަނޑުކޮށް ގަތުން

- އެއްފަހަރަށްވުރެ ގިނަ ފަހަރު އަލުން ބޭނުންކުރުން، ތަކެތި އެއްއެއްޗެއް ގެންނަންޖެހޭ މިންވަރު މަދުކުރުން (ރިޔޫސް)
  - ✓ ކުނި ބޭނުންކުރެވޭގޮތް ހޯދުމަށް، ގަސްގެހީގެ ފަތާއި ދަނޑުވެރިކަމަށް ހޯދާ ބޭނުންކުރުން
  - ✓ ގޮދުރަވާއި ފަތްފަތް ތަކެތި ކުނިކޮށް، ގަސްތަކަށް ދޫކޮށްލެވޭ އެއްޗެއް ބޭނުންކުރުން
  - ✓ ޕްލާސްޓިކް ކޮތަޅު އެއްގަމުގައި ބަރުދުގެ ތަކެތި ގެންދިއުމަށް ބާޒާރުކުރުމަށް ބޭނުންކުރުން
  - ✓ ބިއްލޫރި އާއި ޕްލާސްޓިކް ފުޅި ދަނޑުވެރިކަމުގައި ކާބޯތަކެތި ރައްކާކުރުމަށް ބޭނުންކުރުން
  - ✓ ބާރު ދަގަނޑުން އެއްގަމަށް ބޭސްކޮށް އަޅާލަން ބޭނުންކުރުމަށް ހިންގާއިރު ބޭނުންކުރުމަށް ބޭނުންކުރުން
  - ✓ މާލެ ފަދަ ތަކެތި ދޫކޮށް ސަލާމަތްކުރުމަށް ޕްލާސްޓިކް ފުޅި ފަދަ ތަކެތި ކަނޑުމަށް ބޭނުންކުރުން

- ކުނީގެ ގޮތުގައި ނައްތާލެވޭ ތަކެތި، އެއްޗެއްގެ ގޮތުން އައު އެއްޗެއް އުފެއްދުން (ރިސައިކަލް)
  - ✓ ޕްލާސްޓިކް ނަގައި މަދުގަދަ މާލެއަށް ފޮނުވައިގެން އެހެން އެއްޗެހި ހެދުން
  - ✓ ޕްލާސްޓިކާއި މަދުގަދަ މާލެއަށް އެކަށަގެން އެހެން ވިއްކާލި ކުރުން، ނަގަމަ ރިސައިކަލް ކުރާ ފަރާތްތަކަށް ހަވާލު ކުރުން

- ✓ އިންސިނަރޭޓަރ
- ✓ ކުނިނައްތާލުމުގެ މެތަޑު

- ކުނީގެ މިންވަރު ކުނޑިފަދަ ހިލޭ ދަތުރުކުރުމުގައި އާމްދަނީ ކުނި (ދަނޑު އެއްގަމަ ނުދިއުމަށް މާލޭ ކުނިބެހެއްޓުމަށް ނަގާ ވަކި ދަތުރުފަދަ ސަރުކާރުގެ އެހީއާއެކު) އެކަށަ
- ތަކެތިގައި ކައިރިން ގަބޫލްކުރާ ރިސައިކަލިން ފަރާތްތަކަށް ހިސާބުގައި ކުނި ވަކިކުރުން
- ގޮތުގައި ކުނި ބައިތަކުގެ ގަރުހިތާ ބަލަހައްޓާ ބޮޑު ވާހަކަ ހޯދާ ކުނިވަގުތެއްގައި ބޭނުންކުރުން
- ސަރަހައްދީ ކުނި މެނޭޖްކުރުމުގެ ފެސިލިޓީއަކީ ކުނި ގެންދިޔުން

★ ކުނި ރަނގަޅަށް މެނޭޖްކުރުމަށްޓަކައި ކުނީގެ ތެރޭގައި ހިމެނޭ އެކި ބައިބަޔަށް ވަކިކޮށްލުން

- ކޮންމެ ގެއެއްގައި ނުވަތަ ފިހާރައެއްގައި ނުވަތަ އޮފީހެއްގައި އެކި ވައްތަރުގެ ކުނި އަޅާނެ ވަކި ކޮންޓެއިނަރު ނުވަތަ ޖަލްބަން ބެހެއްޓުން. މިފަދަ ޖަލްބަންތަކުގެ ކުލަ ކުލަކުން ނުވަތަ ނިޝާނެއް ބޭނުންކުރުން
- ކުނިކޮށްޓަށް ކުނި އަޅައިދޭ ކުނި އުކާ ގެއިން ނުވަތަ އެކަމާ ހަވާލުވެހުންނަ ކޮންޓްރެކްޓަރ އެކުނި ވަކިކުރުން
- ތަކެތި ވައްތަރުގެ ކުނި ތަކެތި ދުވަސްތަކުގައި ގޭގެއިން ނަގުން
- ކުނި ކޮށީގައި ކުނީގެ ބާވަތްތައް ވަކިކުރުން

★ ރިސައިކަލް ކުރެވޭ ތަކެތި ގެންދާނީ ކޮންތާކަށް އަދި ކިހާ މުއްދަތަކަށް

- ރިސައިކަލް ކުރުމުގެ ވިޔަފާރި ކުރާ ފަރާތްތައް ދެނެގަތުން
- ކުނީގެ ގޮތުގައި އުފެދިފައިވާ ރިސައިކަލް ކުރެވިދާނެ ތަކެތި ގަނަނަ ފަރާތްތައް ރަށުގައި އުޅޭނަމަ ބެލުން
- ރަށުން ކުޑަ އަގެއްގައި ގަނެގެން އެތަކެތި މާލެއަށް ނުވަތަ ރާއްޖެއިން ބޭރަށް ގެންގޮސް ވިއްކުމަށް ޝައުގުވެރިވާނެ ބައިމީހުން އުޅޭނަމަ ބެލުން
- މިފަދަ ސާމާނު ގެރަންކޮންފުއްޔާ ބަޔައްޓާނީ ކޮންތަނެއްގައިކަން
- ގެރަން ފުރުން ކިހާ މުއްދަތެއް ނަގާނެކަން

10. ކުނިއުފުލުން

★ ކުނި އުފުލާނީ ފިހާރާ ބޭނުންކޮށްގެން

ކުނިއުފުލުމުގައި ސަމާލުކަން ދޭންޖެހޭ ކަންތައްތައް

- ކުނި ކޮންޓެއިނަރު ނުވަތަ ރިސައިކަލް ކުރާ ތަނާއި ދެމެދު ހުރި ދުރުމިން
- ކައިރީގައި ހުންނަ ގޭގެއިން ވީވީ ބަޔަށް ނުވަތަ ބާޒާރުގައި ކުނިއުފުލުން
- އިޖްތިމާޢީ ސަރަހައްދުތަކުގައި ކުނި އަޅާނެ ޖަލްބަން އާއި ރިސައިކަލް ކުރެވޭނެ އެއްޗެހި އަޅާނެ ބިން ބެހެއްޓުން
- ރައްޔިތުން ގުޅިގެން، ނުވަތަ ބައަކަށް ކޮންޓްރެކްޓް ކޮށްގެން އާންމުކޮށް ކުނި އުފުލާ ސިސްޓަމެއް ޤާއިމުކުރުން
- ކުނީގެ ބައިބައި ވަކިކުރުމަށް ހިތާވަރު ދިނުމުގެގޮތުން ކުނީގެ އެކި ބައިބައި ވަކިކޮށްގެން ތަކެތި ދުވަހެއްގައި އުފުލުން
- ރިސައިކަލް ކުރެވޭ ސާމާނު އުފުލާ ނިޔުމަށްފަހު، ބާކީވާ ތަކެތީގެ ކުނި އުފުލުން
- ކުނި އުފުލުމާއި ބެހޭގޮތުން އެކުލެވޭ މެނޭޖްކުރުން ހިނގާ ގަވާއިދެއް ލިޔުން ގެންގުޅުން

11. ކުނިމެނޭޖް ކުރުމަށް ބޭނުންކުރާނެ ވަސީލަތްތައް

- ކުނި މެނޭޖްކުރާނެ ކުނި ކޮށިއެއް
- ކުނި އުފުލުމަށްޓަކައި ޕިކްއަޕް
- ކުނި ކަޑިކޮށް ކޮށާ މެޝިން
- މަޑުކަރު ފިއްތާ މެޝިން: ދަގުފަދަ ތަކެތި ފިއްތުމަށް
- ބޮއްތަލި ފުނޑުކުރާ މެޝިން: ބޮއްތަލި ފުޅި ފަދަ ތަކެތި ފުނޑުކުރުމަށް
- ޕްލާސްޓިކް ކޮށާ މެޝިން: ޕްލާސްޓިކް ފުޅިފަދަ ތަކެތި ކުދިކޮށް ކޮށާލުމަށް
- ވީލްބެރޯ
- ބޯނިކުޅެ ހަރާ މެޝިން
- ރިސައިކަލް ކުރެވިދާނެ ކުނި ރަށުން ބޭރުކުރާނެ ދޯނިއެއް
- ކުނި ކޮށިބަން ކަރަންޓުދިނުމަށް ޖެނެރޭޓަރެއް
- ނަޖިހު ފަދަތަކެތި ރައްކާކޮށްބެހެއްޓުމަށް އަންދާލާފައި ގޮތެއް
- ރިސައިކަލްކުރެވޭނެ ކުނިކޮށޭނެ ބާވާ ހިޔާ ކުނި އަންދާލާފައިން ތަނަށް އެއްކުރަނީ

12. މަސައްކަތްކުރުމަށް ބޭނުންކުރާ އާލާތް ހިންގާ މަރާމާތްކުރުމުގެ ޒިންމާ ނަގާނެ ފަރާތް

☆ ކައުންސިލް އިދާރާ

☆ ކުނި ކޮށި ބެލެހެއްޓުމަށް ކޮންޓްރެކްޓް އުސޫލުން ހަވާލުކުރާ ފަރާތް

13. ވަސީލަތްތައް ހޯދުމަށް ޚަރަދުކުރުމަށް އަދި ހިންގާ ބެލެހެއްޓުމަށް ބޭނުންވާނެ ފައިސާ ހޯދުން

☆ ކުރަންޖެހޭ ހަރަދުތަކުގެ ތަފާސީލު

- މުވައްޒަފުންގެ މުސާރަ
- އާލާތް ގަތުމުގެ ހަރަދު
- ހިންގުމުގެ ހަރަދު
- މަރާމާތުކުރުމުގެ ހަރަދު
- ކުނިކޮށި މަރާމާތުކުރުމުގެ ހަރަދު ފަދަ ހަރަދުތައް ހިމެނޭ

☆ ފައިސާ ހޯދުމަށް ކުރެވިދާނެ ބައެއް ކަންކަން

- މަސައްކަތަށް ބޭނުންވާ އާލާތް ހޯދުމަށް ޑޯނަރުން ފަންޑާ ހޯދުން ނުވަތަ މިނިސްޓްރީ އޮފް އެންވަޔަރަންމަންޓް އެންޑް އެނަރޖީގައި މިކަމަށް އެދުން
- ރަށުތެރޭގެ އެކައުންޓު ގައި ހުރި ފައިސާ ބޭނުންކުރުން
- ކުނި އުކާލުމަށް ދައްކާ ފީގެ ތެރެއިން ހަމަޖެއްސުން
  - ✓ އުކާލާ ކޮންމެ ކުނި ކޮތަޅަކަށް ކަނޑައެޅޭ ފީއެއް
  - ✓ ސާފުކޮށް ވަކި ކޮށްފައި ހުށަހަޅާ ރީސައިކަލް ކުރެވޭ ތަކެއްޗަށް ކުޑަ ފީއެއް
  - ✓ ކޮންމެ ގެއަކުން ދައްކަންޖެހޭ މަހުފީއެއް
  - ✓ ވިޔަފާރި ތަކާއި ސަރުކާރު ތަންތަން ފަދަ ގިނައިން ކުނި އުފައްދާ ފަރާތްތަކުން ނަގާ ފީ ބޮޑުކުރުން
- ކައުންސިލުގެ ހުނަރު ސިނާއީ މަސައްކަތްތަކާ ރަށްރަށާއި ގުޅިގެން މަސައްކަތްކުރުން
- ސަރުކާރު ނުވަތަ އަމިއްލަ ޖަމާޢަތްތަކާއި ގުޅިގެން މިކަމަށް ފައިސާ ހޯދުން
- އެމް.އެފް.އެލްސީގެ "ވީ ލީސް" އަށް އެދުން

14. ރަށުގެތެރޭގައި ކުނި މެނޭޖްކުރުމަށް ހޭލުންތެރިކުރުވުން

☆ ހޭލުންތެރި ކުރުމުގެ ކެމްޕޭނެއް ރާވާ ހިންގާނެ ގޮތެއް:

- ޒ- ޖ – ޒ ކެމްޕޭނެއް ކުރުން
- ކުނި ރަށުގެތެރޭގައި މެނޭޖްކުރުމަށް ކުރެވިދާނެ ކަންތައްތަކާއި ބާރުލެވުން ރައްޔިތުންގެ ދައުރުގައި މަޢުލޫމާތު ދެއްވުމަށް ޖަލްސާތައް ބޭއްވުން
- ޕޯސްޓަރު، ލީފް މަޢުލޫމާތު ކަރުދާސް ފަދަ ވަސީލަތްތަކުން ތައްޔާރުކޮށް ގެތަކުގައި ބެހުން ހޭލުންތެރި ކުރުވުން
- ކަންޏަށާ ވަކިވަކި ފަރުދުންނާއި ސްކޫލް މަދަރުސާތަކާއި ވިޔަފާރި ހިންގާ ފަރާތްތަކާއި އެކު މަޝްވަރާ ބައްދަލުވުންތައް ބޭއްވުން
- ސްކޫލް އާއި ކްލާސްތަކުގައި ރަށުގެތެރޭގައި ކުނި މެނޭޖްކުރުމާއި ބެހޭ މުޙާޟަރާ ދެއްވުން
- ރަށުގެތެރޭގައި ކުނި މެނޭޖްކުރާ ފަރާތްތަކުގެ އަގު ވަޒަންކުރުން
- ރަށުގެތެރޭގައި ކުނި މެނޭޖްކުރާ ފަރާތްތަކާއިމެދު ފިޔަވަޅުއެޅުން

15. ކުނިކޮށި ހިންގާނެ ގޮތް

☆ ކުނިކޮށި ހިންގަން ފަށާނީ 2018 ގައި

☆ ކުނިކޮށީގެ މަސައްކަތް ހިންގާނީ ހަފްތާގެ ކޮންމެ ދުވަހަކު ހެނދުނު 08:00ން ހަވީރު 17:00އަށް

- ☆ ކުންޏާއި ރިސައިކަލް ކުރެވިދާނެ ތަކެތި ގޭގެއިން ނަގާނެ އަދި ކުނިކޮށްޓަށް ބަލައިގަންނާނީ އާދިއްތަ، އަންގާރަ އަދި ބުރާސްފަތި ދުވަހު ހެނދުނު 08:00ން 09:00އަށް
- ☆ ކުންޏާއި ރިސައިކަލް ކުރެވިދާނެ ތަކެތި ކުނިކޮށިން ބޭރުކުރާނީ މަހަކު އެއްފަހަރު
- ☆ އަންދާފައިވާ ކުނި އަންދާނީ ހަފްތާއަކު އެއްފަހަރު
- ☆ ހަރުތެރެ ސާފުކުރާނީ މަހަކު އެއްފަހަރު

16. ނަގާނެ ފީއެއް ކަނޑައެޅުން

- ގޭބިސީ = 100 ރުފިޔާ
- ފިހާރަތަކުން = 100 ރުފިޔާ
- ރައްޔިތުންގެ އިމާރާތްތަކާއި ސަރުކާރުގެ މުއައްސަސާ / އޮފީހީ ކުންފުނި = 100 ރުފިޔާ

17. ފީނުމާއި އެކަން ބެހެއްޓުމުގެ ޒިންމާ ނަގާނެ ފަރާތް

- ކައުންސިލްގެ އެކައުންޓަށް ޖަމާކުރަން
- ކުނި މެނޭޖްކުރުމަށް ބޭނުންކުރަން ކައުންސިލުން ކަނޑައަޅާ ފީގެ ޕޮއިންޓް

18. ކުނި މެނޭޖްކުރުމުގެ މަސައްކަތްކުރިއަށް ދާނެ ގޮތް ކަނޑައެޅުން

- ☆ މަސައްކަތް ފެށުން 08:00
- ☆ ކުނިއަންދާ އަދި ސާފުކުރުން
- ☆ ކުނި ކޮޅިގައި ހުންނަ އެހެނިހެން ކުނި މެނޭޖްކުރުން
- ☆ ގޭގެއިން ކުނި ސޯޓްކޮށް ގެންދިއުން
- ☆ ބަދިގެ ކުންޏާއި ފަތްކުނި ބޯނުން ކޮއްގެން ގޮތު ތަޅައިގެން ކުރުން
- ☆ ކުރިން ހަދާފައިވާ ގޮތު ފުރޮޅުން
- ☆ މަސް މަހިގައި ބަހައްޓާފައި ހުންނަ ޖަހާބިންތައް ނަގުން
- ☆ މަސައްކަތް ނިންމުން 05:00

19. ކުނި މެނޭޖްކުރުމާބެހޭ ޕްރޮޕޯސަލް މަޢުލޫމާތު ފޯރުކޮށްދިނުން

- ☆ ރައްޔިތުންގެ މެދުގައި އަންގުރުވާ އިމާރާތް ކުރުމާއި، މަޝްވަރާ ބައްދަލުވުން ބޭއްވުން
- ☆ ޕޯސްޓަރ ފަދަ ތަކެތި ބޯޑުތަކުގައި ހަރުކުރެވިގެން އުފެއްދުން
- ☆ ރަށުގެ ކުނި މެނޭޖުކުރުމާ ބެހޭ ޕްރޮޕޯސަލް ދިރިއުޅުމަށް ހިފާނެ ހަރަކާތްތަކުގެ ފުރިހަމަ ހުށަހެޅުން

✩ ކައިރިގައި ހުންނަ ރަށްރަށާއި އެއްގޮތް ކައުންސިލާއި މަޝްވަރާކުރުން

20. ޕްލޭން ނިންމާ އުމައްޑެން އަމަލުކުރަން ފެށުން

✩ ޕްލޭން ނިންމުމަށްފަހު އެއަށް އަމަލުކުރަން ފަށާނީ ރަށު ކައުންސިލްގެ ސޮއި ލިބުމަށްފަހު

21. ކުނި މެނޭޖްކުރުމާބެހޭ ޕްލޭން މުރާޖަޢާކޮށް އިސްލާހު ކުރުން

✩ ޕްލޭން އިސްލާހު ކުރަން ޖެހިދާނެ ހާލަތްތައް

- ރަށުގެ އާބާދީއަށް ބަދަލުއައުން
- ރަށުގައި އުފެދޭ ކުނީގެ ބާވަތްތަކަށް ބަދަލު އައުން
- ހިންގުމަށް ހިނގާ ހަރަދުތަކެއްފަދަ ތަކެއްޗަށް ބަދަލުއައުން

✩ ޕްލޭނަށް އިސްލާހު ގެނެވޭނީ

- ކޮންމެ 3 އަހަރަކުން
- ކުދި ކުދި ބަދަލުތަކަށް ގެނެނެ އުސޫލުތަކަށް (އިއުލާންކުރުމުން)
- ބޮޑެތި އިސްލާހުތަކަށް ގެނެނެ އުސޫލުތަކަށް (ހާއްސަ ކޮމެޓީއެއް އެކުލަވާލުން ، އާންމުކޮށް އިއުލާން ކުރުން)

ކުނި މެނޭޖްކުރުމުގެ ޕްލޭން

ހދ. ކުރިނބީ، ދިވެހިރާއްޖެ

23 ނޮވެމްބަރު 2015

މިއީ ކުރިއަށް އޮތް 5 (ފަހެއް) އަހަރު ދުވަހުގެ މުއްދަތަށް ތައްޔާރުކުރެވިފައިވާ ޕްލޭން އެކެވެ.

ތިލަދުންމަތީ ދެކުނުބުރީ ކުރިނބީ ކައުންސިލްގެ އިދާރާ

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Ameenee Magu, Hdh.Kurin'bi, Republic of Maldives ހައްދުންމަތީ ދެކުނުބުރީ ކުރިނބީ ކައުންސިލްގެ އިދާރާ، އަމީނީމަގު، ހދ.ކުރިނބީ، ދިވެހިރާއްޖެ
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بسم الله الرحمن الرحيم

ތައާރުފު

މިއީ ރަށުގައި އުފެދިފައިވާ ކުރި ނައްތާލާފައިން ރަނގަޅު ނިޒާމެއް ނެތުމުން ތަފާތު ފަރާތްތަކުގެ ބޭނުމަށް ރަނގަޅަށްތަކުގައި އިސްރާފުކުރުގެ ސަބަބުން ރަށުގެ ގޮތުގައި ރަށު ތަރައްޤީ ކުރުމުގެ ގޮތުން އުނދަގޫތަކާއި ތައްޔާރު ކުރެވިފައިވާ ޕްލޭންކަމެވެ. މި ޕްލޭންގައި ރަށުގެ ވަނަވަރާއި، ޕްލޭންގެ މައިގަނޑު މަޤްޞަދު އަދި ހާސިލްކުރަން ބޭނުންވާ ނަތީޖާތަކާއި ބޭނުންތަކުން އަދި އަމާޒުތަކުވެސް ވާނެއެވެ.

ރަށުގެ ވަނަވަރު

ކުރިނބީ އަކީ ހދ.އަތޮޅުގެ ދެކުނުބުރީގައި، އަތޮޅުގެ ވެރިރަށާއި 5 މޭލު ދުރުގައި އޮންނަ ރަށެކެވެ. ދިގުމިނުގައި 800 މީޓަރު އަދި ފުޅާމިނުގައި 540 މީޓަރު ހުންނަ މިރަށުގެ ބޮޑުމިނުގައި 32 ހެކްޓަރުހުރެވެ. ރަށުގެ އުސްމިނުގައި 1.5 މީޓަރުހުންނަ މިރަށަކީ ރަށް ވަށައިގެން ހުޅަ އޮންނަ ފަރު ގަސް ހެދިފައިވާ، ރަށުގެ ދެކުނުން ފަރާތުގައި ބޮޑު ކަނޑުފަށް އޮންނަ ގާތްގަނޑު ރަށެކެވެ. ކުރިނބީއާއި އެންމެ ކައިރީގައިވާ ރަށަކީ ހދ. ކުޅުދުއްފުށްޓެވެ. މިރަށަކީ މާލެއާ މުންޑިރިސް ގަޑިއިރުގެ ފަތުރުކަމެވެ. ދިވެހިރާއްޖޭގެ ވެރިރަށް މާލެއާއި މިރަށާއި ދުރުމިނަކީ 280.5 ކިލޯމީޓަރެވެ. ކުރިނބީއަށް ދިވެހިރާއްޖޭގައި ކޯޑަކީ B-10 އެވެ. ރަށުގެ އާބާދީގައި 725 މީހުން ހިމެނެއެވެ، ގިނަ ބައިވަރު ރަށުން ބޭރުގައި ދިރިއުޅެމުންދެއެވެ. މީހުން ދިރިއުޅެމުން 187 ގޭގެ ދުރުކުރެވިފައިވާއިރު ގޯތިގަނޑު ނަގައިދީފައިވާ 96 ފަރާތަކަށް ގޯތިގައި މީހުން ދިރިއުޅެމުންދެއެވެ.

ރަށުގައި ޕްރީސްކޫލާއި ސާނަވީ ތައުލީމުދޭ ސްކޫލެއް ހުންނައިރު މިސްކޫލުގައި ގްރޭޑް 10 ނިންމައި އޯލެވެލް ހެދުމުގެ ފުރުސަތު ލިބެއެވެ. ރަށުގައި ސިއްޙީ ޚިދުމަތް ދިނުމަށް ހެލްތު ސެންޓަރެއް ހުންނައިރު، ޑޮކްޓަރަކާއި ނަރުހުންގެ ޚިދުމަތް ލިބެއެވެ. އަންހެނުންގެ މިސްކިތަކާއި ފިރިހެނުންގެ ދެ މިސްކިތް ހުރިއިރު، ފަހުން އިމާރާތްކޮށްފައިވާ ހުކުރު މިސްކިތަކީ ކުރިއަށް އޮތް 15 ފަހަރަށް އަރަތަ އެއްފަސް ދެމިގެންވާ ނަމާދު ބާއްވާލެވޭނެ މިސްކިތެކެވެ. ސަރުކާރުގެ އިދާރާތަކާއި ތަރުތީބުގައި 81 މުވައްޒަފުން ރަށުގައި މަސައްކަތްކުރެއެވެ. މުވާސަލާތީ ހިދުމަތްދޭ 2 ކުންފުނި ކަމުގައިވާ ދިރާގާއި ވަތަނިއްޔާގެ ޚިދުމަތް މިރަށުގައި ހުރެއެވެ. ކުރިނބީގައި ފުޓްބޯޅަ ދަނޑެއްކަމުގައި ޖަމްޢިއްޔާތަކުގެ

Ameenee Magu, Hdh.Kurin'bi, Republic of Maldives ތިލަދުންމަތީ ދެކުނުބުރީ ކުރިނބީ ކައުންސިލްގެ އިދާރާ، އަމީނީމަގު، ހދ.ކުރިނބީ، ދިވެހިރާއްޖެ
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މަދުރަސާއެއް ހުރިއިރު، ޖަމާޢަތުގެ ކުރިއެރުމަށް މަސައްކަތްކުރާ ޖަމްޢިއްޔާއެއް ހަރަކާތްތެރިވެމުންދެއެވެ. 1994 ވަނަ އަހަރުން ފެށިގެން ކަރަންޓު ދެމުންއަންނަ ކުރިނބީ އިންޖީނުގެއިން 2005 ވަނަ އަހަރުން ފެށިގެން 24 ގަޑިއިރު ކަރަންޓުގެ ޚިދުމަތް ދެމުން ގެންދެއެވެ. ރަށަށް ރާއްޖެއަށް ދަތުރުކުރުމަށް ދަތިތަކެއްހުރުމުން، 2011 ވަނަ އަހަރުން ފެށިގެން، 300 ފޫޓާއި 200 ފޫޓުގެ ބަނދަރެއްގެ މަސައްކަތްކުރަމުން އެބަދެއެވެ. ރާއްޖެއިން ދިމާވާ ގޮތުގައި ކުރިއަށްއޮތް 6 މަސްދުވަހުގެ ތެރޭގައި މިމަސައްކަތް ފުރިން ނިމުމަކަށް ގެނެވޭނެއެވެ.

ކުރިނބީއަކީ ޖަމާޢަތުގެ މަސައްކަތްތަކުގައި ބައިވެރިވާ ރަށެކެވެ. އިޖްތިމާޢީ ކަންކަމާއި، ވަޒީފާގެ ކަންކަމާއި، ދީނީ ތަޢުލީމީ ކަންކަމާއި، ތަރައްޤީގެ ދާއިރާތަކުގައި މިރަށުގެ ރައްޔިތުން އަމިއްލަ ބާރުގައި މަސައްކަތްކުރެއެވެ. މިރަށް ނަމަވެސް ފަރުމަތީގެ މަސައްކަތް ކުރުމުގައި ބޭނުންކުރެވެއެވެ. ބޮޑެތި، ބަނދަރުތަކާއި، ފަޅުގެ ގިނަބަޔަށް ހައްދުކުރާ ދަނޑުވެރިކަމަށް ބޭނުންކުރެވޭ ބިން، މިރާ، ކަރާ، ކަރަބޮޅު، ކާށިދިޔާ، ބައްޕަ، ބަނބުކެޔޮ، ބަނބުކެޔޮ ހައްދާ ތަންތަނެވެ. ރަށުގެ ރައްޔިތުން، ފެނުގެ ބޭނުމަށް ފެންމަކިނު، ކަނޑުމަތީގެ ފެން ބޭނުންކުރުމަށް އަންހެނުން އާއްމު ދިރިއުޅުމުގައި ކުރުމަށް ކުރާ މަސައްކަތެވެ. ރަށުގައި ވަގުތުރިޔާ 5 ފޮޓޯ ހުރިއިރު މިޑްލްސްކޫލް އާއްމު ދިރިއުޅުމަށް ބޭނުންވާ ގޮތަށް ވަޒީފާ ހިންގުން ހުށައެވެ. މިގެ އިމާރާތް ރަށުގައި 1 ކޮޓަރި ހިންގަމުންދެއެވެ. ކުރީގެ ދަރިވަރުތަކުން ކޮންމެ 5 އިންޖީނުގެ ގެންގޮސްފައިވާ، ގޮތުގައި 160 އަހަރުގެ ދިގު ބައިސްކަލުގައި 20 ސައިކަލު ގެންގޮސްފައެވެ. މިގެ އިމާރާތް 1.5 ބަނގުރު 2 ފިހާރައި 1 އެންބިއުލާންސް ދެއްވައެވެ.

ކުރިނބީއަކީ މަސައްކަތްތެރި ހާލަތު ފެނުންތެރި ރައްޔިތުން ދިރިއުޅެމުންދާ ރަށެކެވެ. ރައްޔިތުން އިސްނަގައިގެން ތަރައްޤީއަށް ގިނަ މަސައްކަތްތަކެއް ކުރަމުންދާ ރަށެކެވެ. މިރަށުގެ ހުރި ސްކޫލްތަކާއި، އިންޖީނުގެއާއި، ޖަމާޢަތުގެ މަދަރުސާއާއި، ރަށުގެ ހުޅުދުއްވާ ބަނދަރުގައި ފެންނަން އެބައުޅެވެ.

ޚުލާޞާގެ މައިގަނޑު މަޤްސަދު

ރަށު ފެންވަރުގައި އުފެދޭ ކުރި ނަގާފައި ދިޔަ ތަރައްޤީއަށް ގޮތްއަގައި ކުރި މާޒީގެ ކުރުމުގެ، ސިޔާސީ ދާއިރާތަކުގެ ޒާތީމަޢުލޫމާތު، ކުރިން ރައްކާތެރިވެދިނުމާ މާޢާރާތުގެ ހައްލުފެނިފައިވާ ރަށުގެ ގޮތުގައި ބެލުން.

Ameenee Magu, Hdh.Kurin'bi, Republic of Maldives ތިލަދުންމަތީ ދެކުނުބުރީ ކުރިނބީ ކައުންސިލްގެ އިދާރާ، އަމީނީމަގު، ހދ.ކުރިނބީ، ދިވެހިރާއްޖެ
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ހާސިލްކުރަން ބޭނުންވާ ނަތީޖާ

ކުރިނބީއަކީ ރަށު ފެންވަރުގައި އުފެދޭ ކާރިސާތަކާ، ދުވަހުއްޓެނިވި ގޮތެއްގައި ކާރިސާ މެނޭޖް ކުރެވި، ރަނގަޅުން އުޅޭ ކުރިން ގަސްކާނާއާއި އެހެނިހެން ތަކެތި އުފައްދާ، ރަށުގެ ދަނޑުވެރިންނާ އެހެން ރަށްތަކަށް މާކެޓް ކުރުވުން ރަށެއްގެ ގޮތުގައި ވެގެން ދިއުން. އަދި މިކަމުގެ ސަބަބުން ކުރިނބީއަކީ ކާރިސާ މެނޭޖް ކުރުމުގެ ދާއިރާއިން ފާހަގަކުރެވޭ ނަމޫނާ ރަށަކަށް ވެގެން ދިއުން.

މަޝްވަރާ

މި ޕްލޭން އެކުލަވާލުމުގައި ކުރިނބީ ކައުންސިލާއި، ކައުންސިލްގެ އިދާރީ މުވައްޒަފުންނާއި، އަދި ކުރިނބީގެ ޒުވާނުންގެ ބައިވެރިވުމާއި އެކުލަވާލާފައިވާ ކޮމިޓީތަކުގެ މަޝްވަރާ މައުލޫމާތާއި ހިއްސާ ހިމެނިފައިވާނެއެވެ. މިގޮތުން މިކޮމިޓީތަކުގެ ބައިވެރިވުމުގެ ކަމާގުޅޭ ފަރާތްތަކުން ބޭއްވި ވަރަށް މަޝްވަރާ ޖަލްސާއެއްގައި މައުލޫމާތު ހިއްސާ ބަދަލުކުރެވި އެ މައުލޫމާތު ހިއްސާކޮށް މި ޕްލޭނުގައި ހިމެނިފައިވާނެއެވެ.

ކާރިސާ މެނޭޖް ކުރުމުގެ ހާލަތު

ރަށުގެ ކުރިން އުފެދޭ ތަންތަނުގެ ތެރޭގައި ގެގެއާއި ގޯތިތެރެއާއި، މަގުމައްޗާއި އިޖްތިމާޢީ ސަރަހައްދުތައް ހިމެނެއެވެ. ރަށުގައި ކުރިމަތިވާން ހުރިތަނަށް ވިސްނާލާއިރު އަންދާޒާކޮށް ކުރި ފިޔަވަޅު އެޅުމުގެ ބަލިމަޑު ކުރިން ނަގާފައިވާ އިންތިޒާމުތައް ހަމަޖެހިފައި ނުވެއެވެ. އެގޮތުން ދަރަނިވެރި ބަލަހައްޓަމުން، ބޭނުންވާ ފުރިހަމަ ތައްޔާރީ ނެތުމުގެ ބޭނުންކުރާ މުސީބާތް ނަތީޖާގެ ސަބަބުން އުފެދޭ ތަކެތި ކުރީގެ އަސަރުތަކުގައި ވަކި ސަރަހައްދުތަކަށް ޖެހޭކަމުން ގެއްލުންވެއެވެ.

އަންދާޒާކުރާ ކުރީ ހަމަވާގެ ހާދިސާ ދުވަހާއި ހާސިލް ދުވަސް ފިޔަވައި ކުރިން ދުވަހަކީ އަންދާޒާކޮށް ގެންދެއެވެ. ހާދިސާ ދުވަހު އެ ހަމަވާގައި އެންމެން ހުރިހާ ކުރުމުގެ އަދިވެސް ނަގައި ކުރިމަތިލާއި ދިމާ ފަސޭހަކަމުގައި އެކަމަށް ހުސްވަ ކުރިޔަށް ސަރަހައްދުން އަވަސްއެވެ. ނަމަ އަންދާޒާ ކުރިމަތިވާ ކަމުގައި ތެޔޮ ވާތީއެވެ. ދަތުރު ތަނަވަސްގައި ހިލަ ކުރިމަތި އުޅެނީއެވެ.

Ameenee Magu, Hdh.Kurin'bi, Republic of Maldives ތިލަދުންމަތީ ދެކުނުބުރީ ކުރިނބީ ކައުންސިލްގެ އިދާރާ، ހދ.ކުރިނބީ، ދިވެހިރާއްޖެ
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އެންމެ ގާތުގައި ކުނިގެންދެވޭނެ އުކާލާނީ ރޯގަސްފަދަ ތަކެއްޗާއި، ހިހިކުނީގެ ބާވަތްތަކާއި، ދަގަނޑުގެ ބާވަތްތަކާއި، ޕްލާސްޓިކާއި، ބިއްލޫރި ފުޅިފުޅި ތަކެއްޗާއި، ބެޓެރީ ގަސްތުބެ ފަދަ ތަކެއްޗާއި، ޓޮކްސިކާއި ހިހި ކުނި އަދި މިންވަރުގެ ގޭގައިން ބައިވެގެން ނުވަތަ ބޭނުން ނިމިގެން އުކާލާފާ ތަކެއްޗެވެ. މިގޮތުން ކުނި ކޮށާބަން އުކާލާފާ ކުނީގެ މިންވަރަކީ ބަލާއިރު ހަފްތާއަކު މެދުވެރިން 30 ބަނޑުގެ ކުނި އުކާލާފާ ކަމަށް އަންދާޒާ ކުރެވިފައިވެއެވެ.

ކުނި މެނޭޖު ކުރުން

ރަށުކަތިރި ގޮތުގައި ކުނި ނައްތާލުމަށް ކުރިއާލާފައިވާ ވަސީލަތްތަކާއި އެވަސީލަތްތައް ބޭނުންކުރާނެގޮތް:

ވަސީލަތްތައް	ވަސީލަތްތައް ބޭނުންކުރާނެގޮތް
ކުނޑިމަތީ އެންމެ ރަށުތެރެއިން ހުސްކޮށްދޭ ކުރުވުން	1- މަހަކު 1 ފަހަރު ނުވަތަ 2 މަހުން 1 ފަހަރު ރަށުގެ ކޮންމެ ގެއަކުން ކުނި ރަށުގެ ގޮތުގައި ނައްތާލުމަށް (މަޝްވަރާކޮށް ހިފުން) ބޭނުންވާ ބައިން.
	2- ކޮންމެ އަހަރަކު 2 ފަހަރު ސާފުކުރުމުގެ ކުރިންނާއި ފަހުން ރަށުތެރެއިން ކުނި މެނޭޖު ކުރުމުގެ ގޮތުގައި ވޯކްޝޮޕް، ސެމިނަރު ބޭއްވުން.
ކުނިއުކާލާ ގޮއްސާކުރުވުމާއި ސަރަހައްދު ވަކިކުރުން	ކުނި ކޮށާބަން ކުނި އުކާލާ ގޮއްސާ ކުރުވުމާއި ސަރަހައްދުތަކުގައި އުކާލާ ގޮއްސާ ކުރުވުމާއި ބޭނުން ހަރުކުރުން.
ކުނިވާ ޖާގައިގެ ކުނި ރަށުކަތިރި ގޮތުގައި ނައްތާލެވޭނެ ނިޒާމެއް ޤާއިމް ކުރުން	ރަށުގެ ގޮތުގައި ކުނިވާ ޖާގައިގެ ކުނިއުކާލުން ހުއްޓުވުން.
ކުނި ކޮނޑު ބެލެހެއްޓުމަށް ހަރުދަނާ ނިޒާމެއް ޤާއިމް ކުރުން	ރަށުގެ ކުނި ކޮނޑު ބެލެހެއްޓުމަށް ރަށުގެ ހިނގާ މުއައްސަސާތަކާއި ކައުންސިލާ ގުޅިގެން ކުނި ކޮނޑު ބެލެހެއްޓުން ރަށުގެ ނިޒާމެއް ޤާއިމް ކުރުމަށް މަސައްކަތްކުރުމަށް ބައްދަލުވުމެއް ބޭއްވުން.
ކުނި ކޮށާބަން އުކާލާފާ ކުނި ރަށުކަތިރި ގޮތުގައި ނައްތާލެވޭނެ ނިޒާމެއް ޤާއިމް ކުރުން	ކުނި ކޮށާބަން ބޭނުންވާ މެޝިނަރީ ހޯދުން. ކުނި ކޮނޑު ދެމެހެއްޓެނިވި ގޮތުގައި ބެލެހެއްޓުމަށް ބޭނުންވާ މެޝިނަރީ ހޯދުމަށް ބޭނުންވާ މަސްދަރު އެހެނިހެން ކުރުވާ ޖަމްޢިއްޔާތަކާއި ކައުންސިލުން [illegible] ފައިސާ ހޯދުމަށް ހަރަކާތްތެރިވުން.

ތިލަދުންމަތީ ދެކުނުބުރީ ކުރިނބީ ކައުންސިލްގެ އިދާރާ، އަމީނީމަގު، ހދ.ކުރިނބީ، ދިވެހިރާއްޖެ Ameenee Magu, Hdh.Kurin'bi, Republic of Maldives
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ކުރި ޓޫރިޒަމް ހުނަރު ތަރައްޤީއާއި، އެގްރިކަލްޗަރ އަދި ބިޒްނަސްފަދަ ވަކި ތަރުހީބު ދެވޭނެ ކުރުން	ތަރައްޤީއަށް އެފަދަ ތަކެތި ގެންނަ ފޮރަމްތަކާއި މަޝްވަރާކުރާ އެވަކި ތަރުހީބު ދޭނެ ބޭރުކުރުމުގެ އިންތިޒާމު ހަމަޖެއްސުން.
ރަށުގައި އުފެދޭ ކުނިން ގަސްކާނާ އުފެއްދުން	އުކާލެވޭ ކުނިފުޅާގެ ކުނޑި ގަސްގަހުގެ ފަތް ބޭނުންކޮށްގެން ގަސްކާނާ އުފެއްދުމަށްޓަކައި ބޭނުންވާ ތަކެތި ހޯދުމާއި ތަމްރީނު ދިނުމާއި، އެމަސައްކަތްތަކުގައި ބައިވެރިވާން ބޭނުންވާ ފަރާތްތަކަށް ގަސްކާނާ އުފެއްދުމަށް ދަސްކޮށްދީ މާކެޓު ކުރުމަށް ނިޒާމު ޤާއިމުކުރުން

(ހ) މި ޕްލޭނުގެ މުއްދަތުގެ ތެރޭގައި ރަށުގައި އުފެދޭ ކުނީގެ މިންވަރު މަދުކުރުމަށް ކުނީގެ މިންވަރުގެ ދިރާސާއެއް އެއްބަސްވެވޭނެ ގޮތަށް އަމަލުކުރުމަށް ކުރެވޭނެއެވެ.

(ށ) ކުނި ކޮށުމަށް އުކާލެވޭ ކުނީގެ ތެރެއިން ނައްޓާލެވޭ ޖާގައެއް ކުނިހަރު ނައްތާލާ ޖާގައެއް ކަނޑައަޅާނެއެވެ. އަދި ނައްޓާލުމަށް ޖާގައެއް ކުނި ތަރުތީބުން ބޭނުންކުރެވޭނެ ގޮތަށް ނިންމާލުމުގެ ސަރަހައްދެއް އެތަކެއް ވަކި ގޮތެއްގެ ވަކި ސަރަހައްދެއްގައި ބެހެއްޓުމެވެ.

(ނ) ވަޒީ އުމުރާއި މަސައްކަތުގެ ދަރަޖަ 3 މުވައްޒަފުން ތައްޔާރުކޮށް ކުނި ގޮތަށް ބެލެހެއްޓުމުގެ ކަންތައް ކުރިއަށް ދިޔަކަމުގައި ވިޔަސް މަސައްކަތް ކުރުމަށް ކުނީގެ މިންވަރާއި ބާވަތަށް ބެލުމަށް ނުވެއެވެ.

(ރ) އުކާލާ ކުނީގެ މިންވަރު މަދުކުރުމަށް ކަމާބެހޭ ހޯދުންތެރިކަމުގެ ޕްރޮގްރާމަށް ހިންގުން.

(ބ) ކުނި ކޮށުމަށް އުކާލާ ކުނިފުޅާގެ ކުނޑި ގަސްގަހުގެ ފަތް ބޭނުންކޮށްގެން ގަސްކާނާ އުފެއްދުމަށް ބޭނުންވެއެވެ. މިގޮތުން ކާޑު ހެދުމަށް ބޭނުންވާ މެޝިނަރީ ނެތުމުގެ ސަބަބުން އެކަން ކުރެވޭނެ އަދި މުޅި ކުރިއަށް ނުދެވެއެވެ.

(ޅ) ކުނިއުފެއްދުން ތަމްރީނުކުރުމަށް ކުނި ޓާނގެ ތަފްޞީލު ސަރަހައްދުތަކުގައި ފެނުން އެކި ބާވަތުގެ ކުނި (ދަޅު، ބިއްލޫރި ފުޅި، ޕްލާސްޓިކް ފުޅި ފަދަ ތަކެތި) ކުނި ޓާނގެ ތަފްޞީލު ސަރަހައްދުތަކުން ޖަމާކުރުން.

ތިލަދުންމަތީ ދެކުނުބުރީ ކުރިންބީ ކައުންސިލްގެ އިދާރާ، ހދ.ކުރިންބީ، އަމީނީމަގު، ދިވެހިރާއްޖެ Ameenee Magu, Hdh.Kurin'bi, Republic of Maldives
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(ކ) ކުނި މެނޭޖްކުރާ ސަރަހައްދުން ކުނި އުފުލުމަށް އަދި މިހާތަނަށް ވަކި އިންތިޒާމެއް ހަމަޖެއްސާފައެއް ނުވެއެވެ. މިހާރު ކުނިއުކާލުމުގެ ކަންތައްތައް ކުރިއަށް ގެންދަނީ ކޮންމެ ގޭއަކުންވެސް އުފައްދާ ކުނި އަމިއްލައަށް ގޭތެރޭގައި ނުވަތަ ކުޑި ފިހާރެއްގައި ކުނި ކޮށްޓަން ކުނި އުފުލައިގެންނެވެ.

(އ) ކުނި މެނޭޖް ކުރުމަށް މިހާރު އެއްވެސް ވަސީލަތެއް ކަނޑައެޅިފައެއް ނުވެއެވެ.

(ވ) ރަށުގެ ކުނި މެނޭޖް ކުރުމުގެ ކަންތައްތައް ބެލެހެއްޓުމަށް ކައުންސިލްގެ ފަރާތުން އައުޓްސޯސް ކުރުމަށް ބަޔަކާ ހަވާލު ކުރެވިގެންނެވެ. އަދި ކުނި ގޮނޑު ބަލަހައްޓާ ފަރާތުގެ މަސްއޫލިއްޔަތަކީ ކުނި ގޮނޑަށް ކުނި އަޅާއިރު އެކެއްޗަކާ ކުނިތަކެއް ވަކި އިންތިޒާމުކޮށް ކުނި ކޮށްޓަން އަދި ކުނި ގޮނޑު ބަލަހައްޓާށެވެ.

ކުނި މެނޭޖް ކުރުމުގެ މަސައްކަތްތަކަށް ފީ ނަގާނެ މިންވަރާއި އުސޫލު

ދެމެހެއްޓެނިވި ގޮތެއްގައި ކުނި މެނޭޖްކުރުމަށްޓަކައި ރަށުގެ ކޮންމެ ގެއަކުން ކުނި އުކާލުމަށް ހަމަޖެހިފައިވާ އެބައެއްގެ އަމިއްލަ ވިޔަފާރިގައި ކަމަށްވާތީ ކައުންސިލުން އެއްވެސް ފީއެއް ނެގުމުގެ ހިސާބުން ނެގޭނެތެވެ. އެކަނި ނަމަވެސް ކުނި އުކާލުމުގައި އަމަލުކުރަމުން ގެންދަނީ ކުނި އުކާލުމާއި ނަޒާފާތުގެ އުސޫލުން ތައްޔާރުކުރުން، އެއުސޫލުގައިވާ ގޮތުގެ މަތީންނެވެ.

ތަންފީޒު ކުރުން

މި ޕްލޭން ތަޢާރަފްކުރަނީ ކައުންސިލުން ފާސްކުރުމާއެކު މި ޕްލޭނުގެ ދަށުން ހުރިހާ ޤަވާއިދުތަކާއި، އުސޫލުތައް ހަދަމުންދާނަމަ، ބޭނުންވާ ސާމާނާއި، މުވައްޒަފުންނަށް ތަމްރީނުދިނުމަށް، މި ޕްލޭނަށް އަމަލު ކުރަން ފެށޭނެއެވެ.

ދިވެހިން ދިވެހީންގެ ގޮތުގައި - މިނިވަންކަމުގެ އަހަރު

Ameenee Magu, Hdh.Kurin'bi, Republic of Maldives ތިލަދުންމަތީ ދެކުނުބުރީ ކުރިނބީ ކައުންސިލްގެ އިދާރާ، އަމީނީމަގު، ހދ.ކުރިނބީ، ދިވެހިރާއްޖެ
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ޓުވާން ތަޢާރަފު ކުރި ތާރީޚް: 29 ޖެނުއަރީ 2017

ޓުވާން މުއްދަތު: މަދުވެގެން 5 އަހަރު

ޓުވާންގެ ނަން: ހއ.މުރައިދޫ ކުނި ފެންސް ކުރުމާއި ބެހޭ ޓުވާން

އެގްޒެކެޓިވް ސަމަރީ(ރަށުގެ ތަޢާރަފް)

ހއ. މުރައިދޫ، ހއ.މުރައިދޫ އަކީ ދިވެހިރާއްޖޭގެ އެއްމެ އުތުރުން އޮންނަ އަތޮޅަށް ނިސްބަތްވާ ގާތަމި ރަށެކެވެ. ރަށުގެ އާބާދީ އަކީ 883 މީހުންނެވެ. އޭގެ 434 ފިރިހެނުންނާއި 449 އަންހެނުންނެވެ. އާބާދީގެ ނިސްބަތަށް ބަލާއިރު ރަށަކީ ބިމުގެ ގޮތުން ޖާގަ އޮތް ރަށަކަށް ވިޔަސް (ރަށުގެ ވަށައިގެން ފަޅުތެރި ގާތަކީ ރަނގަޅު ފަރު ރަށުގެ ވަށައިގެން ހުރި ގިރުމުގެ މައްސަލަ ވަނީ ވަރަށް ބޮޑެތި ދިމާވެފައެވެ.) ރަގަޅުކުރުމަށް ގޮތުން ރަށްވަށައިގެން ބޮޑު ގިނަ ސަރަހައްދު ތަކެއް އަރަރަށް 5 ވަރަކަށް ފޫޓު ގިރުމުން ދުރުކުރަން ހަލާ ކުރެވިފައެވެ.

ހަލާ ފުރުމަށްޓަކައި ޖަމާކުރި ފެންވަރުގެ 300 ފޫޓު ދިގު 200 ފޫޓު ފުޅާ ކުޅަ ބަނދަރެއް އޮވެއެވެ. ނަމަވެސް (ބަނދަރުގެ ކުޅަކުރުމުތަކާއި ހެދިފައިވާގޮތުން ބަނދަރުގެ ބޭރުން އުޅަނދު ފެރިހަމަ ގޮތުގައި ބޭރުން ނުކުރެވި) ކަމުގައި ދަށްނިވުމަކީ ކުރަކަން ނުވާނެއެވެ. ނަމަވެސް މާލޭ އަށް ބަލާއިރު މިބަނދަރު ހުރީ ކުރިން މުރައިދޫ އަކީ ފޮނުވާ ވަރަށް ދަތި އަދި އުމާމް ހިތްމަފުށި އުތުރު ހިތޭ ހުރިހާ ޙާލު ވެރިކަންކަން. އޭގެ އާއިލާ އުޅޭ މަސްތަ އަދި ދަރިއަކު އެއްދުވަހާ އެއްވެގެންދާ ނިޒާމު ހަދިސާވެސް މާލޭގެ ތިރީގައި ވަނީ ގެއްލިފައެވެ.

ރަށުގެ އާމްދަނީ ހޯދުމަށްޓަކައި ކަނޑު އަށް މަސައްކަތަށް (ފަތުރުވެރިކަމަށް ކުރެވޭ ދަނޑުވެރިކަން ކުރެވޭނެ). ރަށުގެ އާބާދީގެ ގިނަ ބައެއް އާބާދީ ހަރަދަށް ދިޔުމުން ބަނދަރު ބަރުކާތެއް ހަރުގަނޑު އަދި ކަނޑުތަކެއް މަސައްކަތެއް ކުރަމުންދާކަމަށް ވެސް ދަރިވަރުން ޖަހާ އަރުވާލައި.

ޖަވާބުން ފެނަކަ ކުރުވެސް ވަރަށް އެކުވެރި ކުޅިވަރަށް ލޯބި ކުޅަ ޖަވާބުންގެ ގޮތުގައެވެ. އާބާދީ ކުޅަ ރަށަކަށް ވިޔަސް ކުޅިވަރުގެ މައިދާނުގެ ހާލަތު އަކީ ފެނަކަ ކޮންމެވެސް ރަނގަޅު ކަމަކަށް ނުވެއެވެ. ދެ ޖިންސުގެ ޖަވާބުންނަށް ވެސް ހއ. ހރ. އާބާދީ ބޮޑެތި ރަށްރަށުގެ ހިނގާ އަދި ކުޅިވަރު މުބާރާތް ތަކުގައި ރަށް ފެންވަރުގެ އަދި އަތޮޅު ފެންވަރުގެ ތަފާތު ބޮޑެތި ކާމިޔާބީތައް ހޯދުމުން އަންނަ ޖަވާބުން ތަކެއް އެބަ ހުރެއެވެ. ދުވަހުން ދުވަހަށް ކޮށްދޭ ނަތީޖާއެއް ކުރުމުގައި ގެނެސްދީފައިވާ ރަނގަޅު ފެންވަރުގެ ފެށިގެން ދިރިއުޅުން ގެނެސްދިނުމަށް ރަށުގެ އެކަތިގެންވާ ކުޅުނަށް ވަރަށް ބޭނުންތައް ކުރެވިފައެވެ. މި ޖަވާބުންގެ އުނދަގޫ ބޭބޭ ޖާގަ ދިނުމަށް އިސްތިޒާޖާއި ދިރިއުޅުން ދިނުމަށް ވެސް ވާލެއެވެ. އެ ޖަވާބުންގެ އުންމީދު ބޭބޭ އުފެދިފައި ހުރި ޒަމާނީ ފެންވަރުގެ ފެނި ކަތިރަ މުޅިރަށުގެ ރުހުން ހަމަވާނެއެވެ. މިކަމާ ސަރުކާރުން މާދާނު ދަނޑު ވަރުގަދަ ކުރަމުންނެވެ. އަދި ދަރު ނޫން މުސްތަޤްބަލުގައި އަމާޒު މަސައްކަތެއް ފޮނުވާ ކަމުގެ ފެނިގެ މަސައްކަތުވެސް ދިމާވެއެވެ.

ރަށުގައި ހަރަކާތްތެރިވާ ޖަމިއްޔާ އަކީ ބަނާ އިސް ދިރުނުގައި ހަރަކާތް ތެރިވެސް އެންމެ ޖަމިއްޔާ އެކެވެ. ޖަމިއްޔާގެ އުމުރު ވާ ދިގު ނޫނު ކަމުގައި ވިޔަސް ރަށުގެ ތަރައްޤީ އަށް ބަނާއި މި ކުޅަ ދުވަސް ކުރެވޭ ތެރެއިގައި އެކަށީގެން ވާވަރަށް ހަރަކާތްތެރިވެފައި ވާނެ ބަސްމަގުދީފައެވެ. އެގޮތުން ރަށުގެ ބަނދަރުމަތީ ޖިސްމާނީ ކުރުމައި، ބޯޑު ފިހާރައާއި އެކުލާއި، އަތުކުރުން ހަދުން ތެރި ކުރުމަކަށް ބަނާއި ތަފާތު ހިންގާލެވުނު ވަނީ ހިންގާފައި ވެއެވެ.

ރަށުގައި ޓީވީ ހޯލެއް އަދި ސަލާމަތީފައެވެ. ސަލާމަތި ދިރުމުގެ ފެންވަރަށް ބަލާއިރު އެންމެ ރަނގަޅު ކަމުގައި ނުވިޔަސް ކުރިއަށް ތަކެތި ހަމަޖެހުމުން އަންނަ ކަމުގައި ފެނަކަ ކުރެވިފައެވެ.

ރަށުގެ ސިވިލް ހާލަތަށް ބަލާއިރު ރަށުގައި ހުރީ ސްކޫލާއި އަދި ބޭސް ފަރުވާދޭ ހުރިހާ ތަނެވެ. ނަމަވެސް އެއްވެ އެކަތިވެ ވާ ގޮތުގައި އާންމުންނަށް ދިރިއުޅުން ފަސޭހަކޮށްދިނުމަށް ފިޔަވަޅުގައި ދަތި ތަކެއް ހުރިކަން ފާހަގަ ކުރެވިއްޖެއެވެ. އެގޮތުން ޒިންމާދާރު ފަރާތްތަކާއި ދެ ނަފުސުން ދިރިއުޅުމަށް ފިޔަވަޅު ހިފުމަށް ޖަހައިދޭން އެކަށީގެންވާ ބޭސް ފަރުވާ ދިނުމުގެ ނިޒާމެއް ނެތެވެ.

މިރަށަށް 24 ގަޑިއިރު ކަރަންޓުގެ ހިދުމަތް ދެވެން ގެންދާ ރަށެކެވެ. ކަރަންޓުގެ ހާލަތު ކުރިން ގެސްޓު ނަމަވެސް މިހާރު ރަނގަޅު އަދި ޖަނަރޭޓަރު ދެމުން މިހާރު ރަށުގެ ކަރަންޓުގެ ހާލަތު ރަނގަޅު ކަމުގައި ބެލެވެއެވެ.

މިރަށުގެ ނަރުދަމާ ނިޒާމެއް ނެތުމުގެ ސަބަބުން ރަށުގެ ފެންފަރާތަށް ވަނީ ވަރަށް ބޮޑަށް ނަޖިސްވެ ފެންވަރަށް ބާރުން ނުރައްކާ ވަރަށް ބޮޑެއް ކުރިމަތިވެފައިވެއެވެ. މި މައްސަލަ ސަރުކާރުގެ ސަމާލު ކަމަށް ވަނީ ގެނެސްފައެވެ. އަދި މިކަމަށް ދާއިމީ ހައްލެއް ވަރަށް އަވަސް މުސްތަޤްބަލެއްގައި ލިބެން ކަމުގެ ދިރި ސިފައަށް ވަނީ ސަރުކާރުން ދީފައެވެ. މިއީ މިރަށުގެ ރައްޔިތުން ވަރަށް ބޮޑު އިންތިޒާރެއްގެ ނިމުން އަންނާނެ ދުވަހެކެވެ. މިރަށު ރައްޔިތުން ތިބީ މިކަމުގެ އިންތިޒާރުގައެވެ.

މިރަށަށް ދިއުމަށްފަހު އެއްމެ ބޮޑު އެއް މައްސަލަ އަކީ ރަށުގައި އުޅޭ ކުދި ނަރުދަމާ ލުޔެއް ނިޒާމެއް ގެއިލާ ކުރުމަށް ނުވުމުން ވެ.މިކަމުގެ ސަބަބުން ރަށުގެ އެކި ދިމާލަށް އަދި ދޫނިން ކުދި އުޅުމުގެ ސަބަބުން ރަށުގެ ގޯސް ދަތުރު ހަޖޫމާއި އަދި ރަށުތެރޭ ބައެއް ސަރަހައްދުގައި ކުނި ވަސް ދުވުމާއި ރަށުގައި ތަފާތު ވައްތަރުގެ ބަލިމަޑުކަން ފެތުރުމުން ދާ ކަމުގައި ފާހަގަ ކުރެވެއެވެ.

މި ދުވަސްވަރު މައިގަނޑު މަޖިލީހަށް ކުރިއަށް އޮތް 5 އަހަރު ތެރޭގައި މުހައްދު ކުނީގެ ހާލަތު މިހާރަށް ވުރެން ރަގަޅު ގޮތުގައި ކުނި މެނޭޖް ކުރުމެވެ. އަދި ރަގަޅު ފެންވަރެއްގައި ރިސައިކަލް ކުރާ ކައުންސިލް އަށް އާމްދަނީ ހޯދުން ގޮތްއަށް ރާވާ ހިންގުމެވެ. އަދި ކުންފުނި ބެހެއްޓުން މިރަށުގެ ރައްޔިތުންނަށް ހޭލުންތެރި ބަޔަކަށް ހެދުމެވެ.

މަޝްވަރާ

ކުނި މެނޭޖް ކުރުމުގެ ޚިދުމަތް ހެދުމުގައި މިރަށުގެ ސަރުކާރު މިދެންނެވި މުއައްސަސާތަކާއި ބައްދަލު ކޮށް މަޝްވަރާ ކުރެވިފައި ވެއެވެ.

މުޙައްމަދު ސުލޫކް

މުޙައްމަދު ސިވިލްމަރުކަޒު

މުޙައްމަދު ފަހުމީ ކާމިލްސަން

މުޙައްމަދުގެ އަންހެން ކަބުލުން

ކައުންސިލް ބައްދަލުވުން ތަކުގައި ކުނި ނައްތާލުމާއި ބެހޭގޮތުން މަޝްވަރާކުރެވިފައި ވެއެވެ. މިގޮތުން ކައުންސިލުން ވަކި ގަޑިތަކެއް ކަނޑައެޅުން ބައްދަލުވުންތަކެއް ބާއްވައިފައިވެއެވެ. މުއައްސަސާ ތަކުގެ އިސްވެރިޔާއި ބައްދަލު ކުރެވިފައިވެއެވެ.

ޚިދުމަތް ތައްޔާރުކުރުމުގެ މަސައްކަތް ކުރިއަށް ގެންގޮސްފައިވާ ކުނި މެނޭޖް ކުރުމުގެ ޚިދުމަތުގެ ވޯކްޝޮޕުގައި ކުރިއަށް ދިޔަ ގޮތަށް އެއްވެފައިވާ ޚިދުމަތުގެ ވޯކްޝޮޕު ގޮތަށް. އެގޮތުން ވަކި ގަޑިތަކާއި ބައްލަވައިގަތުން ރިޕޯޓުކުރުން ޚާއްޞަ ރިސައިކަލް ކުރުން ގޮތް ކަނޑައެޅިފައެވެ. އަދި ކުނިކޮށި ބެހެއްޓުން ރައްޔިތުން ހޭލުންތެރި ކުރުމަށް މައުލޫމާތު ދިނުމުގައި ސިވިލް މަރުކަޒުގެ އެހީތެރިކަން ލިބިފައިވެއެވެ.

ކަނޑުމަސްވެރިކަމުގެ ހާލަތު

ކަނޑުކަންތައް އެކުލަވާ ނިޒާމުގެ ސަރަހައްދުން ރާއްޖޭގެ ރައްޔިތުން ކަނޑު އަޅުވެތިކުރާ ރާއްޖޭގެ ވަރުގަދަ ޢާއި ސަރަހައްދުތަކެކެވެ. ނަމަވެސް ހުސްފެހިވުން އެފަދަ ނިޒާމުތަކުގައި ކަނޑު ވިޔަފާރިކަން އަދި އަންނަނިވިއެވެ.

ށިފިވަދު ތަކެތި އުފެދުން ރާއްޖޭގެ އަތިރިމަތީ އާއި ސަރަހައްދު ތަކުގައި ޓެސްޓިން ބޭއްވުންކުރެވިފައެވެ.

ރާއްޖޭގެ ގަނޑުދޮރުން ބަދިގެން އުފާވާ ކަނޑުގެ ސަރަހައްދު ރާއްޖޭގެ ގޮދުރު ވަރަށް ބޮޑުން ވަނީ ހަލާކުވެފައެވެ.

ރާއްޖެއަށް އެންމެ ގިނައިން ކަނޑު އުފެއްދިޔަ މަހުން ދިރި އާލާ ގޮތެއްވެއެވެ. މިގޮތުން މަހުން ދިރިއުޅޭ 112 ގެއިން 70% ކަނޑު އުފެއްދެއެވެ. މިގޮތުން ގޯސްކުރާތަކުގައި އެންމެ ގިނައިން އުފެދޭ ކަނޑު ބޮވެތިތަކާ ފަތުކަނޑުތަކާއި، ނިފިރާއި އަދި ބަދިގެ ކަނޑުތަކެވެ. އަދި ސޮކުފުން 15% ކަނޑު އުފެއްދެން ހުރިތިފުސްކަނޑުތަކުން 10% ކަނޑުއުފެއްދެއެވެ. އަދި އިންޑިއަންގައިން 5% ކަނޑުއުފެއްދެއެވެ. މިގޮތުން ކައުންސިލް އިދާރާއިން 10% ކަނޑުއުފެއްދެއެވެ. އެގޮތުން ސަރުކާރު މުވައްސަސާތަކުން އެންމެ ގިނައިން އުފައްދާ ކަނޑުތަކަކީ ފަތު ކަނޑުތަކާއި، ކަރުދާހެވެ. މިކަނޑުތައް ނައްތާލުމަކީ ވިޔަފާރި އަދި އައްޓަރާ ބެހޭގޮތުން އަންނަނިވިގެންނެވެ.

ރާއްޖެއަށް މަހުން ދިރިއުޅޭ ގެތަކުންނާއި ސަރުކާރު މުވައްސަސާތަކުން މަހާއީގެ މައްޗަށް 5000 ކިލޯގެ ކަނޑު އުފެއްދެއެވެ. ނަމަވެސް މިއުފެއްދޭ ކަނޑު މަސްރޫ ކުރާން ވަސީލަތެއް ނެތެވެ.

ލަނޑުދަނޑިތައް

- ކައުންސިލް އިން ކަނޑު މަސްރޫކުރުމާއި ބެހޭ ގަވާއިދެއް ހެދުމާއި އެކު ބެހޭ މައުލޫމާތު ދިނުމާއި އެކު ފަރާތްތަކާ ހިއްސާކުރުން
- ގޭގެއިން ކުނިކަސް ކަނޑުތަކުން އިންތިޒާމު ހަމަޖެހުމާއި އަހުލުވެރިކަން ބޮޑުކުރުން
- ކަނޑު ރިސައިކަލް ކުރުމުން ގެތެރެއިން ހޯދުން
- ރާއްޖޭގެ އިޖްތިމާއީ ސަރަހައްދުތަކުގައި ކަނޑު އުފެދުން ކޮންޓްރޯލްކުރުން

ލަނޑުދަނޑި 1	ކައުންސިލް އިން ކަނޑު މަސްރޫކުރުމާއި ބެހޭ ގަވާއިދެއް ހެދުމާއި އެކު ބެހޭ މައުލޫމާތު ދިނުމާއި އެކު ފަރާތްތަކާ ހިއްސާކުރުން						
މުހިއްމު ނަތީޖާ	ކަނޑު އަޅުވެތިކުރުމާ ގުޅޭ މަޢުލޫމާތު ފަރާތްތަކަށް ހިއްސާކުރުމާއި ގަވާއިދުތަކާއި އުސޫލުތަކާއި ގުޅޭ މަޢުލޫމާތު ފެތުރުން						
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަމާޒު ކުރާ މުއްދަތު	ކުރިޔަށް ހަރަދު	އަޕްރޫސަރަކު ކޮސްޓް
ވޭސްޓް މެނޭޖްމަންޓް ކޮމިޓީއެއް އެކުލަވާލުން	ސަރުކާރާއި، ރާއްޖޭގެ ހަރަކާތްތެރިވާ ޖަމިއްޔާތައް	ކައުންސިލް ޖަމިއްޔާ، ރާއްޖޭގެ ސަރުކާރު މުވައްސަސާ	ކައުންސިލް އިދާރާ	4 މަސް	-	-
ކަނޑުމަސްވެރިކަމުގެ ހާލަތުގެ އަހަރީ ރިޕޯޓު ތައްޔާރުކޮށް ހަދައި އެންމެ ފަހުގެ އަދަދު ހޯދައި ގުޅޭ ފަރާތްތަކާއި ހިއްސާކުރުން/ރާއްޖޭގައި	ރައްޔިތުންނާ ބައްދަލުކުރުން، އާންމުން އަހުލުވެރި ވުމުގައި އިޙްލާސް ބޭނުންކުރުން	ކައުންސިލް އިދާރާ	ކައުންސިލް އިދާރާ			

އިއުލާންކުރުން						
ކުނި ވެންޓް ކުރުމުގައި އަމަލުކުރާނެ އުސޫލުތަކާއި، ގަވާއިދުތަކަށް ތައާރަފްވުން އަށްވެދިނުކުރުވުން	ތައާރަފްވުމަށް ބައްދަލު ކުރުން، ޕްރޮގްރާމް		ކައުންސިލް އިދާރާ			

ލަނޑުދަނޑި 2	ގޭގެއިން ޖަމާކުރާ ކުނިކުނި އިންތިޒާމު ހަރުދަނާ އުސޫލެއްގެ ދަށުން ބޭރުކުރުމަށް ކުނި ނަގާ ކުރުން					
މަޤްޞަދު އެއް ހާސިލް	ރަށުގެ ވެށިތަކާއި އަދި ސާފުތާހިރުކަމަށް ކުނިއަކުން ގެއްލުން ދެނުވުން					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަމާޒު ކުރާ މުއްދަތު	ކެޕިޓަލް ހަރަދު	އޮޕަރޭޝަނަލް ކޮސްޓް
ގޭގެއިން ޖަމާކުރާ ކުނި ނަގާ އުސޫލު ހެދުން	ކުނިޖަހާ އުސޫލުން މަސައްކަތް ކުނިދޫކުރާ ފަރާތްތައް ހޯދުން	ކުލަބް ޖަމިއްޔާ، ޖަމާޢަތް ސަރުކާރު މުވައްސަސާ	ކައުންސިލް އިދާރާ	2 މަސް	-	20000.00
ގޭގެއިން ޖަމާކުރާ ކުނި ނަގާ އުސޫލު ހޭލުންތެރިކަން ހޯދުން	ވޯކްޝޮޕްތަކާއި ސެމިނަރ ކުރުވުން	ކުލަބް ޖަމިއްޔާ، ޖަމާޢަތް ސަރުކާރު މުވައްސަސާ	ކައުންސިލް އިދާރާ	1 ހަފްތާ	-	5000.00

ލަނޑުދަނޑި 3	ކުނި ރިސައިކަލް ކުރުމުގެ ގޮތްތައް ހޯދުން					
މަޤްޞަދު އެއް ހާސިލް	އާބާދީ ކުނިން އެއްވެސް ބޭނުމަކަށް ބޭނުން ނުކުރުން					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަމާޒު ކުރާ މުއްދަތު	ކެޕިޓަލް ހަރަދު	އޮޕަރޭޝަނަލް ކޮސްޓް
ކުނި ރިސައިކަލް ކުރުމަށް ބާރު ލައްވުމާއި ހޭލުންތެރިކަން ދިނުން	ކަމާބެހޭ މުހިންމުފަރާތާއި ކުލަބް ޖަމިއްޔާތައް	ކުލަބް ޖަމިއްޔާ، ޖަމާޢަތް ސަރުކާރު މުވައްސަސާ	ކައުންސިލް އިދާރާ	1 މަސް	-	-

ލަނޑުދަނޑި 4	ރަށުގެ އިޖްތިމާޢީ ސަރަހައްދުތަކުގައި ކުނި އަޅާލުން ގެންދިއުން					
މަޤްޞަދު އެއް ހާސިލް	ރަށުގެ އިޖްތިމާޢީ ސަރަހައްދުތަކަށް ދަނޑު، ފަޅު، ޖަނގަލި ފަދަތަންތަނުގައި އަޅާލުން ގެންދިއުން					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަމާޒު ކުރާ މުއްދަތު	ކެޕިޓަލް ހަރަދު	އޮޕަރޭޝަނަލް ކޮސްޓް
ހޭލުންތެރިކަން ހުށަހެޅޭނެ ޕްރޮގްރާމެއް ކުރުން	ވޯކްޝޮޕްތަކާއި ސެމިނަރ ކުރުވުން	ކުލަބް ޖަމިއްޔާ، ޖަމާޢަތް ސަރުކާރު މުވައްސަސާ	ކައުންސިލް އިދާރާ	1 މަސް	-	-
ރަށުގެ އިޖްތިމާޢީ ސަރަހައްދުތަކުގައި ޑަސްޓްބިންތައް ބެހެއްޓުން		ކުލަބް ޖަމިއްޔާ، ޖަމާޢަތް ސަރުކާރު މުވައްސަސާ	ކައުންސިލް އިދާރާ		15000.00	

އިސްތިފާދާކުރުމަށް ދަނޑުދަނޑުގައި ހަސްފަތާލް ހަދާގައި އުފެދޭ ކުނި މިދަރުސްގާ މިންވަރަށް މަދު ކުރުވާނެއެވެ.

ނަޝީ 7%

ދަނޑުގެ 5%

ބިއްލޫރި 2%

ލަކުޑި 5%

ބަދިގެކުނި 10%

ޕްލާސްޓިކް 6%

ކުނި ރިސައިކަލް ނުވަތަ ކުނި މަދު ކުރުމުގެ އިންތިޒާމު އަދި މިންވަރު

ކުނިރިސައިކަލް ކުރާ ގޮތް ދަސްކޮށްދިނުމަށްޓަކައި ކަމާބެހޭ ބޭފުޅުން ގެންނެވުން ހައްދައިދީ ކައުންސިލުން މަސައްކަތް ކުރުން.
އަދި މިމަސައްކަތުގެ އަޅާ ގައި ކުނި ރިސައިކަލް ކުރާ ގޮތަށް އުފެދޭ ކުނީގެ މިންވަރު 5% އަށް މަދުކުރުން.

ކުނި ފެންޑާ ކުރާނެ ގޮތަކަށް ނުވަތަ އުސޫލު

ކުނިގެ ގެއަކަށްވެސް ކުނި އަޅާނެ 3ގޮސްބިން ދިނުމަށްފަހު އެ ގޮސްބިންތަކަށް ކުނި އަޅާ ގޮތަށް ހަމަޖެއްސުން، އެގޮތުން ކުނިގެ ގޮސްބިންކަށްވެސް އަލަށްޖެހޭ ކުނި ވަކިކުރުން،

އެނޑުކަމަށް ކުނިބަކެޓް އުސޫލުން ހަމަލު ކުނިފައިވާ ފަރާތުން ކުނިގެ ދުވަހު 9.00 ން 12.00 އާ ދެމެދު ގޭގޭއަށް ގޮސް ކުނި އަޅާފައިވާ ގޮސްބިމަށް ނަގަމުން ގެން ކުނިކުންބަން ގެންދިއުން، އަދި އެއްއަށްފަހު އެކިބާވަތްތަކުގެ ކުނިތައް ވަކިކުރުން.

- ❖ ކުނި އުފެދުމަށް ހަމަޖެހިފައިވާ ވިޔަފާރިތަށް ބޭނުން ކުރެވޭނެ ކަޑައެޅި ވަކި ވަގުތު ތަކެއްގައި
- ❖ ރަށުގެ ފެންޑާކުރުމުގެ ކަނޑަނާ ބަލަހައްޓާއި އެކަށް ޖާގަތަކު ކުރާ ފަރާތަކީ ކައުންސިލް އިދާރާ

ކުނި ޖަމާކުރުމުގެ ޖަމާކުރުމުގެ އިންތިޒާމު ހަމަޖެއްސުންތަކް

ކުނި ޖަމާކުރާ ސަރަހައްދުގައި ދަނޑުގެއި، ގުކުނީ، ޕްލާސްޓިކް، ބިއްލޫރި، އަދި ނުރައްކާތެރި ކުނިބޭނުއެއްވުމަށް ވަކިތަންއާ ހާއްސަ ކުރެވިފައި ހުންނާނެއެވެ. މިމަސައްކަތް ކުރާނީ ކުނިބަރުކަށް އުސޫލުން މިސައްކަތް ހަވާލުކުރެވިފައިވާ ފަރާތެއްނެވެ.

ކުދި ވެންޗަރުކުރުމަށް ބޭނުން ކުރައްވަން ފަސޭހަކުރާ ވަސީލަތްތައް

- ކާޑު ތަށްޓަރު ކުރުމަށް ބޭނުންވާ ތަކެތި
- އަލިފާން ނިއްވާން ނިޒާމެއް
- ކޮމްޕިއުޓަރ
- ސްޓިކް ބުރުޝް
- ސްޓިކް ސްޓުޖް
- އަންގި.
- މާސްކް

ފީގެ މިންވަރާއި އުސޫލް

ފީގެ ގޮތުގައި ކައުންސިލުން ނެގުމަށް ހަމަޖެހިފައިވަނީ

- ❖ އާންމުން ދިރިއުޅޭ ގެއަކުން -/150
- ❖ މީހުން ދިރިނުޅޭ ފުރާޅުތަކުން/ގުދަނު ތަކުން -/75
- ❖ ސަރުކާރުގެ އިދާރާތަކާއި ވިޔަފާރި ފިހާރަގެ އަތުން-/250
- ❖ ގެސްޓް ހައުސް ވިޔަފާރި ކުރާ ފަރާތްތަކުން -/2000

ދެންނެވިފައިވާ އުސޫލުން ކުނިގެ މަހަކުވެސް ފީ ނަގަމުންދާނެއެވެ.

ތަމްރީނު ކުރުން

- ތަމްރީނުކުރާނެ ގޮތް

ކުދި ވެންޗަރުކުރުމުގެ މަސައްކަތް ކުރައްނަ ގެންދިއުމަށް މިއިދާރާއިން ނިންމާފައިވަނީ ކޮންޓްރެކްޓް އުސޫލުން މީހުން ނަގައިގެން، އެމީހުންގެ މަސައްކަތް ކައުންސިލް އިދާރާއިން މޮނިޓަރ ކުރާގޮތަށެވެ.

- އެކިފަރާތްތަކުގެ ދައުރު
  - ✓ ކައުންސިލް އިދާރާއި ވެސްޓްމެނޭޖްމަންޓް ކޮމިޓީ: ކޮންޓްރެކްޓް އުސޫލުން މަސައްކަތް ހަވާލުކުރުމުގައިވާ ފަރާތުގެ މަސައްކަތް މޮނިޓަރކުރުން
  - ✓ ކޮންޓްރެކްޓް އުސޫލުން މަސައްކަތް ހަވާލުކުރެވޭ ފަރާތުގެ ޒިންމާ: ކުނި ގޭގެއިން ކަލެކްޓް ކުރުމާއި އެކުނި ވަކި ކުރުމާއި، އަދި ބަލަހައްޓަންގެ ކުނި ވައިކުރުން

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ފިހުރިސްތު

1. ތަޢާރަފު
2. މަޤްޞަދު
3. މަސްއޫލިއްޔަތު
4. ރަށުގެ ތަޢާރަފު ކުނިމުގެ މަސައްކަތް ކުރިއަށް ދިޔަގޮތް
5. ކުނި މެނޭޖްކުރުމުގެ ހާލަތު
6. ކުނި އުފެދޭ މިންވަރު
7. އުފެދޭ ކުނީގެ ބާވަތްތައް
8. ކުނި އުފެދޭ މިންވަރު
9. ކުނި މެނޭޖްކުރުމަށް ގޭއިން ކުނިތައް ކުނި ވަކިކުރުން
10. ކުނި މެނޭޖްކުރުން
11. ފެސިލިޓީ
12. ފެސިލިޓީތައް ހިންގާ ގޮތް
13. ކުނި ޓްރާންސްޕޯޓް ކުރާނެ އިންތިޒާމު
14. ކުނި މެނޭޖްކުރާނެ ގޮތްތައް ނުވަތަ އުސޫލުތައް
15. އަމިއްލަ ފަރާތުން މެނޭޖްކުރާ ކުނީގެ މިންވަރު
16. ވޭސްޓް މެނޭޖްމަންޓް ޕްރޮޖެކްޓް/ކައުންސިލުން ބޭނުން އުޅެން ފަރާތްތަކުން ހިމެނޭގޮތަށް މެނޭޖްކުރާ ކުނީގެ ބާވަތް އަދި މިންވަރު
17. ކުނި މަތިކުރުމަށް އަގު ނިންމުން
18. ކުނި ރީސައިކަލް ނުވަތަ ކުނި މަތިކުރުމުގެ އިންޖީނުތައް އަދި މިންވަރު
19. ކުނި އެއްކޮށް ޖަމާކުރާ ގޮތްތަކާއި އިންޖީނު
20. ކުނި މެނޭޖްކުރާ ސަރަހައްދުން ކުނި އުފާ ގޮތް
21. ކުނި މެނޭޖްކުރުމަށް ބޭނުންކުރާ ވަސީލަތްތައް ފަސޭހަކޮށްދޭ ތަކެތި
22. ރަށުގައި މެނޭޖްކުރުމުގެ ކަންތައް ބެލެހެއްޓުން ފަރާތްތަކާއި މަސައްކަތް ކުރަން ކަނޑައަޅާ ފަރާތް
23. ޕްލޭން ހިންގާފައި އުސޫލުތައް
24. މޮނިޓަރިންގ ކުރުން
25. އެކި ފަރާތްތަކުގެ ދައުރު
26. ކައުންސިލްގެ ޒިންމާ
27. ކޮންޓްރެކްޓް އުސޫލުން މަސައްކަތް ނަގާ ފަރާތުގެ ޒިންމާ
28. އެނެކްސް 1 (ކުނި ނައްތާލުމުގައި ހަރަކާތްތެރިވާ ފަރާތްތައް)

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ތައާރަފު

ތިލަދުންމަތީ އުތުރުބުރީ ތަކަންދޫއަކީ 43 ހެކްޓަރުގެ ބޮޑުމިނުގައި ހުރި ރަށެކެވެ. އިދާރީގޮތުން ރަށަކީ ދާއިރާ ނަންބަރު A-13 (254) އެވެ. ރަށުގެ ރަޖިސްޓްރީ ކުރެވިފައިވާ އާބާދީއަކީ 960 އެވެ. އޭގެ 487 އަންހެނުންނާއި 473 ފިރިހެނުންނެވެ. 18 އަހަރުން ދަށުގެ ކުދިންގެ އަދަދަކީ 289 އެވެ. ރަށުގައި 159 ގެ ހުންނައިރު މީހުން ދިރިއުޅޭ 37 ގެ ހުރެއެވެ. މީހުން ދިރިއުޅުމަށް ބޭނުންކުރާ ބިމުގެ ބޮޑުމިނަކީ 30 ހެކްޓަރެވެ. ރަށުގެ މީހުން އާއްމުކޮށް ބޯފެނަށް ބޭނުންކުރަނީ ވާރޭފެނެވެ. ރަށަށް ކަރަންޓުގެ ހިދުމަތް ދެމުން ގެންދަނީ ފެނަކަ ކޯޕަރޭޝަނުގެ ފަރާތުންނެވެ. ރަށަށް ނަރުދަމާގެ ހިދުމަތް ސަރުކާރުން 2012 ވަނަ އަހަރު ބަޖެޓުގައި، ޕްރޮޖެކްޓްތަކުގެ ދައުލަތުން 2012 ވަނަ އަހަރުން ނިޒާމުގެ މަސައްކަތް ފެށިފައި 2012 ވަނަ އަހަރު ސަރުކާރުން ހަވާލުކުރި 07 ޕްރޮޖެކްޓަކީ ރަށުގެ ތަރައްޤީއަށް ބޭނުންވާ މަސައްކަތެއް ކަމަށް ފާހަގަކުރެވިފައިވާ ކަމެކެވެ.

ރަށުގެ ސިއްހީ ހިދުމަތް ބަލައިނުލައި، ރަށަށް ސިއްހީ ހިދުމަތް ފޯރުކޮށްދިނުމަށް ތަކަންދޫ ސިއްހީ މަރުކަޒު ހިންގަމުންދެއެވެ. ރަށުގެ ސްކޫލުގައި 3 ގްރޭޑް ލެވެލްއާއި، 02 ނަރުސުންނާއި ޑޮކްޓަރެއްގެ ހިދުމަތް ސިއްހީ މަރުކަޒުން ލިބެމުން ދެއެވެ. ރަށުން ބޭރުގެ ހިދުމަތް ލިބެން ހުރިގޮތް ރަނގަޅު ނޫނެވެ.

ރަށުގެ އިޤްތިޞާދީ ހަރަކާތްތަކަކީ ބޮޑާއިރު ރަށުގައި 3 މިސްކިތް ހުރެއެވެ. ރަށުގެ ރައްޔިތުންގެ މަސައްކަތަކީ މަސްވެރިކަމާއި ދަނޑުވެރިކަމެވެ. އަދި މިހާރުވެސް ރަށުގައި ބޭރުގެ މީހުން ހަރަދުކޮށް 300 ފޫޓް އާއި 200 ފޫޓްގެ ބަނދަރެއް ހުރެއެވެ. ރަށަށް ބޭނުންވާ ޚިދުމަތްތައް ލިބޭނެ ނިޒާމެއް ޤާއިމުކުރުމަށް މަސައްކަތްކުރަމުންދެއެވެ.

(ރަށަށް ތިމާވެށީގެ ގޮތުން ވަރަށް ބޮޑު ނުރައްކާ ހުރެއެވެ. ރަށުގެ ވަށައިގެން ކެނޑިފައިވާ ގޮތުން ރަށަށް ގޯސް ހާލަތުގައި ހުރި ރަށެކެވެ. ރަށުގެ ކުރިއެރުމަށް ބޭނުންވާ ތަރައްޤީގެ މަސައްކަތްތައް ރަނގަޅަށް ކުރިއަށް ގެންދިއުމަށް ސަރުކާރުގެ އެހީ ބޭނުންވެއެވެ. އަދި ރަށުގެ ރައްޔިތުންގެ ފުރިހަމަ ބައިވެރިވުމާއެކު ރަށު ތަރައްޤީކުރުމުގެ މަސައްކަތް ކުރިއަށް ގެންދެވޭނެ ގޮތް ހޯދުމަށް ރައްޔިތުންގެ މަޝްވަރާ ލިބިގެން މި ޕްލޭން ހަދާފައި ވެއެވެ.)

ވިޝަން

(ކައުންސިލުގެ ވިޝަނަކީ ތަކަންދޫ އަކީ ތަރައްޤީވެފައިވާ ރަށެއް ކަމުގައި ހެދުމަށް ވިސްނާ އަޅާ ފިޔަވަޅެވެ) ކައުންސިލުގެ ރައްޔިތުންގެ ބޭނުންތަކާ ގުޅޭ މަޝްރޫއުތައް ހިންގައި، ރަށުގެ ތަރައްޤީއަށް މަސައްކަތް ކުރުމާއި "ތަކަންދޫ ކައުންސިލުގެ ރޭވުން" އަކީ ވަރަށް މުހިންމު ލިޔުމެކެވެ. މި ރޭވުމުގެ ތެރޭގައި ރައްޔިތުންގެ ހިއްސާ އެތައް ކަމެއްގައި ލިބިފައިވާކަމާއި ރައްޔިތުންގެ ބޭނުންތަކާ އެކަށީގެންވާ ގޮތަށް ކައުންސިލުގެ ތަރައްޤީގެ ރޭވުން ކޮށްފައިވާ ބޭނުމަކީ ރައްޔިތުންނާ ގުޅިގެން ކައުންސިލުން ހިންގާ ހުރިހާ މަޝްރޫއުތަކެއް ތަކަންދޫ ކައުންސިލުގެ ރޭވުމުގެ ތެރޭގައި ހިމެނުމެވެ. އަދި ރައްޔިތުންގެ ހިއްސާ ހޯދުމަށް ކުރާ މަސައްކަތުގެ ތެރޭގައި ރައްޔިތުން ބައިވެރިކޮށް ކުރިއަށް ގެންދާ ކަމެކެވެ.

APPROVED

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<u>މަޝްވަރާ</u>

އިސް ރަށުގެ ފަރާތުން އެކި ޒުވާން ބޭފުޅުން އެކަން ހަމަޖެހޭ ކުރިއަށްގެންދާ މަސައްކަތާ ގުޅޭ ތަފާސް ކުރަނީ ރަށުގެ މަސައްކަތު ތެރޭ ވަރަށް ބޮޑު ބަދަލުތަކެއް ބޭނުންވާ ކަމުގައި، މަޝްވަރާގެ ކޮމިޓީ، މަސްއޫލިއްޔަތު ހަވާލުވެފައިވާ ފަރާތްތަކުން، އާ ކަމެއް ކުރުމަށް ކުރިއަށް ގެންދެވޭނެކަމަށް ބުނެފައިވެއެވެ. އެފަދަ ތަރައްޤީ ޕްރޮޖެކްޓް ހިމެނޭ ގޮތުން ތަރައްޤީކުރުމުގެ މަސައްކަތް ކުރުމުގެ ފުރުޞަތު ލިބުމުގެ ކުރިން ބޭނުންވާ ތަރައްޤީ ކުރެވޭނެ ގޮތްތައް ދިރާސާ ކުރުމަށް ފޯރުކޮށްދިނުން އެހެން ތަރައްޤީއަށް އާ އަދަދެއް ހިމަނާ ކުރިއަށް ގެންދެވޭނެ ގޮތް ބަލާ ކުރިއަށް ގެންދެވެމުންދާކަމަށް ބުނެފައިވެއެވެ.

ރަށުގެ އާބާދީ ބޮޑުވުމާއެކު ރަށުގެ މުޅި ތަރައްޤީއަށް ކުރެވޭ އަސަރު ހުއްޓުވުމަށް ރަށުގެ ރާއްޖޭގެ ރަށްތަކުގެ ތެރޭގައި ވަރަށް ގިނަ ރަށްރަށުގައި އެކި ބަދަލުތަކެއް ކުރުމަށް ކުރިން ކުރެވުނު މަސައްކަތް ކުރިއަށް ގެންދެވޭނެކަމަށް ބުނެފައިވެއެވެ. އަދި ބަނދަރު އެ ސަރަހައްދުގެ ޙާލަތަށް ބަލާއިރު މިހާރުގެ ބަނދަރު ބޮޑުކުރުމުގެ ބޭނުން ޒުވާނުން އަދި މަސައްކަތްތެރިން ހިމެނޭ ގޮތަށް ކުރިއަށް ގެންދިއުން ވަރަށް މުހިއްމު ކަމެއްކަމަށް ބުނެފައިވެއެވެ. ކަމަކީ ތަރައްޤީގެ ކުރިއެރުމުގެ ފުރުޞަތު ހޯދުމުގެ ފުރުޞަތެއް ކަމަށް ބުނެފައިވެއެވެ.

އެންމެ އެކަށީގެންވާ ގޮތުގެ މަތިން ރަށުގެ ތަރައްޤީ ޕްލޭން ހިމެނޭ ރަށުގެ ޕްރޮޖެކްޓް އެއްގޮތް ރަށުގެ ތަރައްޤީ ކުރުމުގެ މަސައްކަތް ކުރިއަށް ގެންދެވޭނެ ގޮތް ހޯދިފައިވާ މަސައްކަތުގެ ގޮތުން ރަށުގެ (2017 އިން 2022 އަށް) ރަށުގެ ތަރައްޤީގެ ދެ މަސައްކަތްތައް ހިމެނޭ ގޮތަށް ކުރުމަށް ބަލާފައިވާ ޕްރޮޖެކްޓް ކުރިއަށް ގެންދިއުމަށް ހިމެނޭ ގޮތަށް އެކަށައަޅާފައިވެއެވެ.

<u>ޕްރޮޖެކްޓް ތަންފީޛު ކުރުމުގެ މަސައްކަތް ކުރާނެ ތަރުތީބު</u>

5 އަހަރުގެ ރަށު ތަރައްޤީކުރުމުގެ ޕްރޮޖެކްޓް ތަޢާރުފުކޮށް ކުރަން ފެށުމުގެ ކުރިން ރަށުގެ ސަރަޙައްދު މުއްސަނދިކުރުމަށް ތަރައްޤީ ކުރުމުގެ މަސައްކަތްތަކަށް އެކި ބަދަލުތައް ގެނައުމާއެކު ކުރިއަށް ގެންދެވޭނެ ތަރައްޤީ ކުރުމުގެ ބަދަލުތަކެއް ހިމެނޭ ގޮތަށް ރާވާފައިވެއެވެ. ބަދަލުގެ ޕްރޮޖެކްޓުގެ ތަރައްޤީ ކުރުމަށް ކުރިއަށް ގެންދެވޭ ޕްރޮޖެކްޓް ތަޢާރުފު ކުރުމުގެ ރަށުގެ އެކި އެކި ސަރަހައްދުގެ ތަރައްޤީ ހިމެނޭ ގޮތަށް ރާވާފައިވެއެވެ.

ޖާގަގެ ކަން އެ ސަރަހައްދު ތަރައްޤީގެ ރަށުގެ ހާލަތު ބަލައި ބަދަލުކުރާނެއެވެ. ޖުމްލަ ގޮތެއްގައި މިނޫން ޕްރޮޖެކްޓްތައް ޕްރޮޖެކްޓް ހިމެނޭ ގޮތަށް ރާވާ ތަރައްޤީކުރުމުގެ ކުރިއަށް

މި 5 އަހަރުގެ ޕްރޮޖެކްޓް ތަޢާރުފުކުރެވުނު ފަހުން ތަރައްޤީކުރުމުގެ ކުރިއަށް ގެންދެވޭނެ ޕްރޮޖެކްޓް ހިނގާނެއެވެ.

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ކުނި މެނޭޖްކުރުމުގެ ހާލަތު

މިހާރުގައި ކުނި މެނޭޖްކުރުމުގެ ގޮތުން މި ވަނީ މަސައްކަތް ތަކެއް ކުރެވިފައި ނުވާ ވަށްގަނޑެއް ނެތި ރަށުގެ ކުނި މެނޭޖް ކުރުމަށްޓަކައި ކުނި ޖަހާ ސަރަހައްދެއް ކަނޑައަޅާފައިވާ ނަމަވެސް ކުނި ނަގާ ސިސްޓަމެއް ގާއިމުކޮށްފައެއް ނުވެއެވެ. މިކަމުގައި ރަށުގެ ކުނިމެނޭޖްކުރުމަށް 2014 ވަނަ އަހަރު ރަށުގެ 2 ސަރަހައްދެއް ސާފުކޮށް ކުނިއުކުމަށް ހަމަޖެއްސުމަށް ފެށިއެވެ. ކައުންސިލުން ރަށުގެ ކުނި މެނޭޖްކުރުމަށް އެއްބަސްވެ ޓީމެއް ހެދުމަށް ނިންމާ، ރަށު ކުނި މެނޭޖްކުރުމުގެ ހާލަތު ރަނގަޅު ކުރުމަށް އެކި ފަރާތްތަކުން މަސައްކަތް ކުރަމުން ގެންދެއެވެ. އަދި ރަށުގެ ސަރަހައްދުތަކުގައި ނުވަތަ ރަށު ކުނި ޖަހާ ސަރަހައްދުގައި ކުނި އަންދައިލުމުގެ ސަބަބުން ދުމާއި ވައިގެ ފެހިކަން ގެއްލި، ތިމާވެއްޓަށް ގެއްލުންތަކެއް ލިބެމުން ދިޔަ ހާލަތުގައި ކުނި އުކުމަށްޓަކައި ޚާއްސަ ސަރަހައްދެއް ކަނޑައަޅައިދިނުމަށް ރަށުގެ ސަރަހައްދުގައި ބިމެއް ނެތުމުގެ ސަބަބުން ކުނި މެނޭޖްކުރުމުގެ ގޮތުން އަންނަމުންދަނީ މިސާލުގެ ގޮތުން ނަގަމުގެ ކުރެވޭ މަސައްކަތްތަކެވެ.

ކުނި އުފެދޭ ތަންތަން

ކުނިތަކުގެ ތެރެއިން އެކި ކުނި އުފެދޭ ބާވަތްތަކެވެ. އެހެން ނަމަވެސް ކުނި އުފެދޭ މިންވަރު ބެލިޔަސް ތަފާތު ތަންތަނެވެ. މިގޮތުން ގޯތިތަކުން ފެށިގެން ކުނި އުފެދޭ ކުނީގެ މިންވަރު ދެވަނަ ބޮޑު ފަސްފުށް ކުނި އުފެދޭ ކުނި ހިމެނެއެވެ. މި ރަށުގައި ސަރުކާރުގެ 5 މުއައްސަސާ އެއް ރަށުގެ އެކި މުއައްސަސާ ތަކުގައި ވެސް ސަރަހައްދު އުފެދޭ ކުނި ހިމެނެއެވެ. އަދި 1 ކާޑު ހުރެއެވެ. މިރަށުގައި ހުންނަ އިން 1 ފާރމަސީ ހުރެއެވެ. މީގެ އިތުރުން ރަށްރަށުގެ ރޭޑިއޯ ސްޓޭޝަނެއް 6 ވިޔަފާރި އަދި 1 ކާފޭ ހުރެއެވެ. މިރަށުގައި ޖުމްލަ ގޯތި 122 ގެ ހުރެއެވެ. އަދި ހަމަ އެހެންމެ އެ ރަށު ފަޅު ފަރުން ބަނދަރުން 1 ބިން ދޫކޮށްދީފައިވެއެވެ. މިގޮތަށް ކުނިގެ ތަރައްޤީ ވެސް އެތެރެއަށް ކުރާ މަސައްކަތާއި ގުޅިގެން ތަފާތު އެތަކެއް ކުނި އުފެދޭ ތަންތަނެވެ.

އުފެދޭ ކުނީގެ ބާވަތްތައް

މިރަށުގައި އުފެދޭ ކުނީގެ ބާވަތްތަކުގެ ތެރޭގައި ބިއްލޫރި، ކާޑުބޯޑު، ދަގަނޑުގެ ބާވަތްތައް، ޕްލާސްޓިކް، ގަސްގަހާގެ ފަތްފޮޅި ފަދަ ތަކެތީގެ ތެރެއިން ކުނި ގިނައިން ދޫކުރެވިފައި އުފެދެއެވެ.

މުއައްސަސާ ތަކުން އުފެދޭ ކުނީގެ ތެރޭގައި އެންމެ ގިނައިން ހިމެނެނީ ކާޑުބޯޑާއި ގަސްގަހާގެ ފަތްފޮޅި. މެދުން ނަގައިފިނަމަ ޕްލާސްޓިކް، ދަގަނޑު އަދި ބިއްލޫރި ހިމެނެއެވެ. ގޭބިސީތަކުން އުފެދޭ ކުނީގެ ތެރޭގައި ޕްލާސްޓިކް، ބިއްލޫރި، ދަގަނޑުގެ ބާވަތްތައް، ގަސްގަހާގެ ފަތްފޮޅި ހިމެނެއެވެ. ކާނާ ބުއިމުގެ ތަކެތީގެ ކުނިވެސް ހިމެނެއެވެ. އަދި އިން އުފެދޭ ކުނީގެ ތެރޭގައި ބިއްލޫރި، ތަފާތު ބާވަތްތަކުގެ ދަގަނޑު، ޕްލާސްޓިކް، ގަސްގަހާގެ ފަތް އަދި ގިނަ އަދަދަކަށް ކުނިވާތީގެ ކުނިވެސް ހިމެނެއެވެ.

ވިޔަފާރި ކުރާ ތަންތަނުން އުފެދޭ ކުނީގެ ތެރޭގައި ޕްލާސްޓިކާއި ކާޑުބޯޑު ހިމެނެއެވެ. ހަމައެއާއެކު ބަނދަރުގައި ދެމިތިބޭ ބޯޓުތަކުން އުފެދޭ ކުނީގެ ތެރޭގައި ކާޑުބޯޑު، ފުޅި، ދަގަނޑު، ޓިން، ގަސްގަހާގެ ފަތް އަދި ޕްލާސްޓިކް ގިނަވެ ހިމެނެއެވެ. ނަމަވެސް ސިޓީ މެނޭޖްމަންޓް ކުރުމުގެ އިތުރުން ނުރައްކާތެރި ކުނި އުފެދެއެވެ.

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<u>ކުރީ އަހަރު ހިނގާފައި</u>

ފަހުގެ މަސައްކަތް ތަރުތީބު އަހަރު ކުރީގެ ހިނގާދިޔަ ބޯޑުއިމްތިޙާނު ޕްރީސްކޫލްގެ ގްރޭޑްތައް 03 ބެޗް ކުރީ އުފައްދާފައިވާ ބެއްލާލައިން 01 ބެޗް، މައުލޫމާތު ގްރޭޑްތައް 02 ބެޗް އަދި ފައުންޑޭޝަން ކުރީގެ ގްރޭޑްތައް 05 އުފައްދާފައެވެ. އަދި ހަމައެއާއެކު ކަރުދާހުގެ ގްރޭޑްތައް 02 ބެޗުގެ ކުރީ އުފައްދާފައެވެ. މީގެއިތުރުން ނަރުސަރީގައި ކުރިބޭނުމުގެ ތަރުހީބުގައި 01 ބެޗް ކުރީ މަހަކު އުފައްދާފައެވެ.

އަހަރަކު އުފެދޭ ކުރީގެ ހިނގާދިޔަ ބޯޑުގެ މައުލޫމާތުގެ ގްރޭޑްތައް 24 ބެޗުގެ ކުރިއުފައްދާފައިވާ ޕްރީސްކޫލްގެ ގްރޭޑްތައް 36 ބެޗް، ބެއްލާލާއިރުގެ ގްރޭޑްތައް 12 ބެޗް އުފައްދާފައެވެ. އަދި ފައުންޑޭޝަނުގެ ކުރީގެ ގްރޭޑްތައް 60 ބެޗް ކުރީ އުފައްދާ ކަމަށް އަންދާޒާކުރެވިފައެވެ.

<u>ކުރި މަސައްކަތުގައި ގޮތުގެ ކަންތައް ހުރި ވަސީލަތްތައް</u>

ކުރި އަހަރު ވަކި ސަރަހައްދެއް ގޮތުގެ ކުރެވިފައި ނުވާއިރު ކުރި ހަރުގެތައް އެއްވަސް ދިނުމުގެ ބޭނުމެއް ވެސް ނެތެވެ.

<u>ކުރި މަސައްކަތް:</u>

<u>ވަނީ ދަށުގައި:</u>

- ތަރުގައި ކުރި މަސައްކަތްކުރުމުގެ ހަރުދަނާ ފޯމެއްތަކެއްކަމުގައި އުސޫލުތަކެއް އެކުލަވާލައި ތަންފީޛުކުރުން
- ދަރި ސްކޫލަށް ބައިވެރިވުން އިސްތިސްނާވާގޮތުގައި އިޖްތިމާޢީގޮތުންނާއި ސިޔާސީގޮތުން ހުރި ފަރާތްތަކަށް ދައްކާލުން ކުރުމަށް ތިބުންކުރުވުން.
- ތަރުގައި އުފެދޭ ކުރީގެ ހިނގާދޭ މަޢުލޫމާތު އަދަދު ބޭނުންކުރެވޭގޮތަށް ތަރުތީބު ބެލުންކުރުމުގެ އާދަ އަދާކުރުވުން.
- ތަރުގައި މިހާތަނަށް އެކަށީގެންވާ ކުރިކުރުކުރިކުރެވޭ ގޮތުގެކުރެވިފައި ނުވާތީ ކުރި މަސައްކަތުގެ މަޢުލޫމާތު ގޮތުގެކުރުން
- ކުރި މަސައްކަތް މަޢުލޫމާތު ބެލުންކުރުމަށް ވަސީލަތް މަސައްކަތް އިސްލާހުކުރުމަށް ހެދުމާއި އިސްލާހުކުރުމަށް ބެލުންކުރުމަށް އެކަށީގެންވާ އިންތިޒާމެއް ގޮތުގެ މިހެން ތަރުތީބުކުރުން.
- ގޮވައިލުމާއި އެހީތެރިވުމަށް ތަރުތީބުތަކުގައި އުފެދޭ ކުރި، ވަކި އިންތިޒާމުކުރުން ކުރިކުރުމަށް ގެންދިއުމަށް، ހަރުދަނާ ނިޒާމެއް ގޮތުގެކުރުން
- ތަރުގައި އުފެދޭ ކުރި ތަރުތީބުކުރުމަށް ބައިބަދަލު ބެލެނިވެރިން ޖަމާކުރުމާއި، ކުރިކުރިގައި ބެލުމަށް އަދި ތިމާވެށީގައި ތަރުތީބުކުރުމުގެ އުސޫލުގެ ދަށުން ކުރި މަސައްކަތްކުރުން

ފޯން: 6500034 ފެކްސް: 6500102 އީމެއިލް: thakandhoo@hotmail.com

ތކ ކައުންސިލުގެ ޒުވާން - ޖިންސީ އެއްވަރުކަމުގެ ޕޮލިސީ ކައުންސިލުގެ ޖަލްސާ (2017/1/10)

- ހަރުދަނާ ނިޒާމެއްގެ ދަށުން މަސައްކަތް ކުރެވޭނެ ގޮތް ކައުންސިލުގެ ހިދުމަތްތައް ދެމެހެއްޓެނިވި އުސޫލަކުން ފޯރުކޮށްދިނުން.
- އާއްމު އިޖްތިމާއީ ސަރަހައްދުތަށް ސާފުތާހިރުކުރުން ބެލެހެއްޓުން އިންތިޒާމެއް ހަމަޖެއްސުން
- ރާއްޖެ/ ނަރުހަކުޅުގެ ކައުންސިލް ބާވަތްތަށް ރައްކާތެރިކަމާއި ވެށިދަށުވާން އުސޫލެއް ގާއިމުކޮށް ތަރައްގީކުރުން.

ފަރާތްތަކުގެ ރޯލް ކަނޑައެޅުން

ފަރާތްތަކުގެ 1	ދަށުގައި ކައި ކައުންސިލުގެ ހަރުދަނާ ގޮތުގައި ކަނޑައެޅޭ އުސޫލުތަށް ތަރައްގީ ކުރުން					
މެދުމުއްދަތު އަމާޒު	ދަށުގައި ކައި ކައުންސިލުގެ ހަރުދަނާ ގޮތުގައިވާ ހިދުމަތް ދޭ					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަމާޒުކުރާ މުއްދަތު	ބަޖެޓު ހަރަދު	އަޅާކިޔާނެ ނަތީޖާ
ފޯސްޓް މަސްވެރިން އާއްމުކޮށް ހަރަކާތްތެރިވުން	މުއައްސަސާތައް، އިޖްތިމާއީ ސަރަހައްދު ސާފުކުރާ އަދަދުން	ކައުންސިލް، މުއައްސަސާތައް އިޖްތިމާއީ ސަރަހައްދު ސާފުކުރާ އަދަދުން ކަރުދާހުން	ކައުންސިލް އިދާރާ	2016 އިން 2021 އަށް		
ކައިރިމަސްވެރިކަމުގެ އަމަލުކުރާނެ އުސޫލު ތައްޔާރުކުރުން ފޯރުކޮށްދިނުމުގެ ބައިވެރިވާ ފަރާތްތަކާ / ދަށުގައި އިސްލާހުކުރުން	ދައުލަތުގެ މުއައްސަސާތައް، ތަމްރީނު ދިނުން	ކައުންސިލް އިދާރާ، ފޯސްޓް މަސްވެރިން ކްލަބް	ކައުންސިލް އިދާރާ	2016 އިން 2021 އަށް		
ކައިރިމަސްވެރިކަމުގެ އަމަލުކުރާނެ އުސޫލު ތައްޔާރުކުރުން ދައުލަތުގެ އިސްލާހުކުރުން	ޕްރޮޖެކްޓް، މުއައްސަސާތައް	ކައުންސިލް އިދާރާ، ފޯސްޓް މަސްވެރިން ކްލަބް	ކައުންސިލް އިދާރާ	2016 އިން 2021 އަށް		
ކައިރިމަސްވެރިކަމުގެ އަމަލުކުރާނެ އުސޫލު ތައްޔާރުކޮށް ތަރައްގީކުރުން	ކައުންސިލް އިދާރާ، ފޯސްޓް މަސްވެރިން ކްލަބް	ކައުންސިލް އިދާރާ	ކައުންސިލް އިދާރާ	2016 އިން 2021 އަށް		

ފަރާތްތަކުގެ 2	ރަށު ސާފުތާހިރު ބެލެހެއްޓުމުގެ އިންތިޒާމުތަކާއި އިޖްތިމާއީ ސަރަހައްދުތައް ހަރުދަނާކުރުމަށް ބައިވެރިވުން ބާރުއަޅައި ހަރަކާތްތެރިވުން					
މެދުމުއްދަތު އަމާޒު	އާއްމު ތަނުތަކުގެ އިޖްތިމާއީ ސަރަހައްދު ސާފުކުރުން					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަމާޒުކުރާ މުއްދަތު	ބަޖެޓު ހަރަދު	އަޅާކިޔާނެ ނަތީޖާ
ދައުލަތުން އަމާޒުކުރާ ރަށުގެ ސާފުތާހިރުކަމުގެ ހަރަކާތްތައް	މުއައްސަސާތައް، ޕްރޮޖެކްޓް، ވޮލަންޓިއަރުން	ކައުންސިލް، މުއައްސަސާތައް އިޖްތިމާއީ ސަރަހައްދު ސާފުކުރާ އަދަދުން ކަރުދާހުން	ކައުންސިލް އިދާރާ، ފޯސްޓް މަސްވެރިން ކްލަބް	2016 އިން 2021 އަށް		
ސާފުތާހިރުކަމުގެ ދިރިއުޅުންތައް އަމާޒުކުރާ ރަށުގެ ސާފުތާހިރުކުރުމުގެ ހަރަކާތްތައް	ވޮލަންޓިއަރުން، ހުރިހާ ފަރާތްތަކުގެ ބައިވެރިވުން	ކައުންސިލް، ސްކޫލް، ފޯސްޓް މަ. ކްލަބް	ދަށުގައި ކައުންސިލް، ފޯސްޓް މަސްވެރިން ކްލަބް، ސްކޫލް	2016 އިން 2021 އަށް		

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ENVIRONMENTAL PROTECTION AGENCY
Male', Rep of Maldives
APPROVED

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[illegible] 3

[illegible]

ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		

[illegible] 4

[illegible]

ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		

[illegible] 5

[illegible]

ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		

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[illegible] 6	[illegible]					
[illegible]	[illegible]					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		

[illegible] 7	[illegible]					
[illegible]	[illegible]					
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] 4 [illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		
[illegible]	[illegible]	[illegible]	[illegible]	2016 އިން 2021 އަށް		

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ފޯނު: 6500034 ފެކްސް: 6500102 އީމެއިލް: thakandhoo@hotmail.com

ލަނޑުދަނޑި 8	ހަމަހަމަ ފުރުސަތު ދިނުމާއެކު ކުޑަކުދިންނާއި ޒުވާނުން ތަކަ ތަރައްޤީކުރުމުގެ ކުރިއެރުމުގައި އެކުލަވާލެވޭ ޕްރޮގްރާމްތައް					
މިހާރު އޮތް ހާލަތު	އެގޮތަށް އެކުލަވާލެވިފައިވާ ނުވާ					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަމަލުކުރާ މުއްދަތު	ހަރަދުވާ ގޮތް	ނަތީޖާ ވަޒަންކުރާ ގޮތް
މަސައްކަތް ޢާންމުކުރުމަށް އެކުލަވާލުން	އެކުލަވާލެވޭ ހުނަރު	ކައުންސިލް، ވޯކްޝޮޕް މ.ޝާދީ	ކައުންސިލް، އިދާރާ، ވޯކްޝޮޕް މ.ޝާދީ	2016 އިން 2021 އަށް		
ޒުވާނުންގެ އެކުލަވާލުމަށް ކަސްރަތުކުރާނެ ޕާރކު ހެދުން	ބަނޑުބުރިން، އިމާރާތް	ކައުންސިލް، ވޯކްޝޮޕް މ. ޝާދީ	ރަށުކައުންސިލް، ވޯކްޝޮޕް މ.ޝާދީ،	2016 އިން 2021 އަށް		
ކުޑަކުދިންގެ އިންތިޒާމުތައް ރާވައި ހަރަކާތްތެރިވުން	އެކަމަށް ކަނޑައެޅޭ ބަޖެޓް ދޫކުރަނީ	ކައުންސިލް، ވޯކްޝޮޕް މ.ޝާދީ	ކައުންސިލް، އިދާރާ، ވޯކްޝޮޕް މ.ޝާދީ	2016 އިން 2021 އަށް		

ލަނޑުދަނޑި 9	ރަށުގެ ދިރިއުޅުމުގައި ސަލާމަތީ ކަންކަމުގެ ބަހައްޓާ ގޮތް އިންތިޒާމުތަކުގެ ހަރަކާތްތެރިވުން					
މިހާރު އޮތް ހާލަތު	ސަލާމަތީ އެކުލަވާ ބަނޑަރު ދޫކުރި					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަމަލުކުރާ މުއްދަތު	ހަރަދުވާ ގޮތް	ނަތީޖާ ވަޒަންކުރާ ގޮތް
ރަށު ގޮތުގެ ކުރިއެރުމަށް ރާވާ ސަލާމަތީ ކަންކަމުގެ ބަހައްޓާ ގޮތް ކޮށްފައިވާ	ގެސްޓްހައުސް	ރައްޔިތުން، ކައުންސިލް، ވޯކްޝޮޕް މ.ޝާދީ	ކައުންސިލް، އިދާރާ، ވޯކްޝޮޕް މ.ޝާދީ	2016 އިން 2021 އަށް		
ފެހިކަން ހޯދުން	ކައުންސިލް ބަޖެޓް، ކަމާބެހޭ ސަރުކާރުގެ މިނިސްޓްރީތައް، ޖަމްޢިއްޔާ ޖަމާޢަތްތައް	ކައުންސިލް، ވޯކްޝޮޕް މ. ޝާދީ، ޖަމްޢިއްޔާ ޖަމާޢަތް، ކަމާބެހޭ ސަރުކާރުގެ މިނިސްޓްރީތައް	ރަށުކައުންސިލް، ވޯކްޝޮޕް މ.ޝާދީ،	2016 އިން 2021 އަށް		

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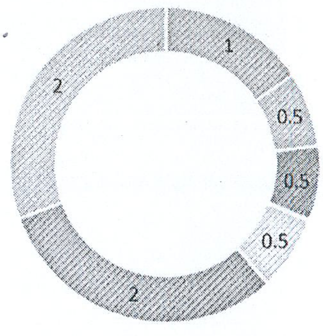
ލަނޑުދަނޑި 10	ރަށުގެ ދިރިއުޅުމުގެ ފެންވަރު ރަނގަޅުކުރުމަށް އިޤްތިޞާދީ ފުރުޞަތުތައް ތަރައްގީކުރުން					
މަގުސަދު ޙާޞިލުކުރުމަށް	އިޤްތިޞާދު ހަރުދަނާ ކުރުން					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޖަވާބުދާރީ ފަރާތް	ހަރަކާތް ކުރާނެ މުއްދަތު	ކުރިއަށް ގެންދަނީ	އަމަލުކުރާނެ ގޮތް
ރަށުގެ ދިރިއުޅުމުގައި ތަކަންދޫ ކައުންސިލާ ގުޅިގެން އިޤްތިޞާދީ ތަރައްގީއަށް މަސައްކަތްކުރުން	ރަށުގެ ކުރިއެރުމުގެ ވަސީލަތް	ސިވިލް ސޮސައިޓީ ޖަމްޢިއްޔާތައް، ކައުންސިލް، ވުޒާރާ މަސްއޫލު	ކައުންސިލް އިދާރާ، ވުޒާރާ މަސްއޫލު	2016 އިން 2021 އަށް		
ސަރުކާރު މަސައްކަތްކުރުން ތަރައްގީގެ ބޭނުން އެކުލެވޭ އަމަލުތަކުގައި ފަރުދުންގެ ބައިވެރިވުން ރަށުގެ ދިރިއުޅުމުގެ ފެންވަރު މަތިކުރުމަށް ކުރިއެރުވުން	ފައިސާ، އިންސާނީ	ކައުންސިލް، ވުޒާރާ މަ. ސްއޫލު	ދައުލަތުގެ ކައުންސިލް، ވުޒާރާ މަ. ސްއޫލު	2016 އިން 2021 އަށް		

ތކ އިޤްތިޞާދުގެ ފަންނުގެ ސަރަޙައްދު

އިޤްތިޞާދީ މިންވަރު އަހަރަކަށް (%)



ތކ ފުރިހަމަ ކުރަންޖެހޭ ވަޒީފާ ނުވަތަ ރޯނުގެ

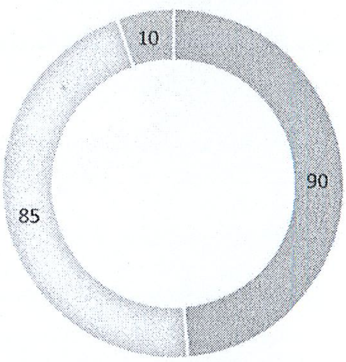
- ބޯޓު ފުރިހަމަކުރުމުގައި 5 ބޯޓުކަނެކް ރަށު މަސް ކުޑަކުރުން، އޭގެ މަސްވެރި، ދަނޑު، ފަރު، ސާޅީ، ފުރާސްޓްރަކްޗަރ ބޮޑުކުރުން، ކޮންސްޓްރަކްޝަން އަދި އެހެނިހެން ހުނަރު ކުރިއެރުވުން.
- ފުރުސަތުތަކާއި، ބޯޓުސިސްޓަމް މިނިސްޓްރީގެ ތަނުތަކުން ދިރާސާކޮށް 1 ފަހަރު ރަށު އަހަރުތަކުގެ ހިދުމަތް ފުރިހަމަ ދިނުން.

thakandhoo@hotmail.com :އީމެއިލް 6500102 :ފެކްސް 6500034 :ފޯން

- ކުނިކޮށިބަން ކުނި ގެންދިއުމާއި ކުނި މެނޭޖްކުރުމުގެ ހިދުމަތް ދެވޭނީ ކައުންސިލުގެ އުސޫލުން ބަލައިގެން ދިޔުމަށެވެ.
- ހދ.ހނ އަދި ހ މ 3 އަތޮޅުގެ ކުނި ޖަމާކުރާ ވޭސްޓް މެނޭޖްމަންޓް ފެސިލިޓީ ގާއިމް ކުރެވުނުދުވަހުން ކޮންމެ 2 މަހުން 1 މަހު ނައްތާލާ ކުނި ނައްތާލުން.
- ހިދުމަތް ދިނުމަށް ފަރާތްތަކުގެ އަތުން ކޮންމެ މަހަކު ނަގާނީ ފީއެއް ކައުންސިލުގައި ތަންފީޒު ކުރުން.
- ނަރުދަމާގައި ކުނި ކުނިކޮށިގެ ވަކި ސަރަހައްދަކުން ޖަމާކޮށް ނައްތާލާ ކުނި ނައްތާލާނީ އެވެ. އަދި ކުނިވާ ޗެމްގެ ކުންފުނި އެހެނިހެން ކުނި ދުވާލަކު 1 ފަހަރު ގޯތިއިން ނެގުން ދޫކުރެވޭ.

އެކްޓިވިޓީން މެނޭޖްކުރާ ކުނީގެ މިންވަރު

މިންވަރު (%)



ވޭސްޓް މެނޭޖްމަންޓް ފެސިލިޓީ / ކައުންސިލުން ރާވާ އެކަން ޕްރޮގްރާމްތަކުން ދުރާލާ ކުރެވޭ ކުނީގެ ބޮޑުމިން މިންވަރު

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ފުޑްކުނި، ކާޑްބޯޑު އަދި އެހެނިހެން ކުނީގެ 50% އިންސައްތަ މެނޭޖްކުރެވޭނެއެވެ.

ކުނި މަދުކުރުމަށް އަޅާ ފިޔަވަޅު

ރީ-ޔޫސް އަދި ރިސައިކަލް ކުރުމަށް ބައްޓަންކުރެވޭ ޕްރޮގްރާމް ކުރުވުން

ކުނި ރިސައިކަލް ކުރެވޭ ކުނި މަދުކުރުމުގެ އިންތިޒާމް އަދި މިންވަރު

ކުނިކޮށްޕާސްކުރުމުގައި ގެދޮރުތަކުން ނެގޭ ކުނި ބަދަލުކުރުމުގައި ދަނޑުވެރިކަމުގެ މަސައްކަތްތަކުގައި ފަސްކުރުމަށް ޖާގަ ދިނުމަށް ހުރި ކައުންސިލުގެ ބޭނުންތަކަށް ދިރާސާކުރުމަށް ފަރުވާތެރިވާނެ. ލޯކަލް ކުނި އިސްތިޢުމާލުކުރުމަށް ޑީޒަލް ހާކަ ކަމުގެ ގޮތުގައި ފުރުސަތު ހޯދުމަށް ކުރިއަށް ގެންދާ ބާރުތައް މަސައްކަތްތަކަށް ވާނެ.

ކުނި އެއްކުރާ ޖާގަކުރުން ގޮތްތަކާއި އިންތިޒާމް

ބޮޑެތި އުކާލާ ކާޑުބޯޑު ބާވަތްތަކާއި، ދަނޑު، ސޯޑާ، ފުޅި، ވަޅުކަށި، ދަގަނޑު، ވަޔަރު، ކަރުދާސް، ފޮތި އަދި ޕްލާސްޓިކުގެ ބާވަތްތައް ބައިބައިކޮށް ކުނިކޮށްޓަށް ޖަމާކުރެވޭނެއެވެ. މިގޮތުން ކުރުމަށް ނިންމާފައިވާ އެކި ސަރަހައްދު ތަކުގައި ޖެހިފައިވާ ބަހައްޓައިގެންނެވެ.

ކުނި މެނޭޖްކުރާ ސަރަހައްދު ކުނި އުފުލުން

ކޮންޓެއިނަރު އުފުލުން ބަހައްޓާ ހަފްތާއަކު ދުވާލަކު 1 ފަހަރު ގޮސްގެން ކުނި ނަގައި ކުނިކޮށްޓަށް ޖަމާކުރުން.

ކުނި މެނޭޖްކުރުން ބޭނުންކުރާ ޒަރީޢާ ވަސީލަތްތައް

ވަސީލަތް މެނޭޖްމަންޓް ސައިޓުގައި އަދި ކުނި ނަގާނެ ވަސީލަތް ތަކެއްގައި ދެންނެވިފައިވާ ތަކެތި.

ބާވަތް
ޕިކަޕް
އެކްސްކަވޭޓަރ
އިންސިނަރޭޓަރ
ޝްރެޑަރ
ބޮޓްލް ކްރަޝަރ މެޝިން
ކަރުދާސް ފުދާ މެޝިން
ފޯކް ލިފްޓަރ
ވީލްބަރޯ
އުދާނު
ޖެނެރޭޓަރ
ޖެސްޓިން (ޕިކަޕްގައި ބަހައްޓާ)

APPROVED

ޖެސްޓިން (ސަރަހައްދުގައިވާ ބަޔަކު)
އަންގި
ސްކޫލް ސްޓޭޖް
ޖެސްޓިން ކެޓަގަރީ
ސްކޫލް ގްރޭޑް
ކްލާސް
އަޑިޝަން ނަންބަރު ސަނަދު

ތަކަންދޫ މުބާރާތުގެ ކަންކަން ބެލުމަށްޓަކައި ފޯމު ހުށަހަޅާނީ ކައުންސިލް އިދާރާ ފޯމް

ތަކަންދޫ ކައުންސިލްގެ ކަންކަން ބެލުމަށްޓަކައި ފޯމު ހުށަހަޅާ ކައުންސިލް، ވޯޓު މުބާރާތުގެ ގަވާއިދު އިޢުލާން ކުރެވޭނެ ގޮތް މި މަސައްކަތް ނިންމާ ފަހުން.

ވިނަރު ކަނޑައަޅާ އުސޫލު

ދުވަހުގެ ތެރޭގައި ތަކަންދޫ ކައުންސިލްގެ މަސައްކަތް ކުރާނެ ގޮތުގެ ވިނަރު ކަނޑައަޅާ އިޢުލާން ކުރެވޭނެއެވެ. މިގޮތުން ކައުންސިލްގެ ދާއިރާ ގޮތުން ބޮޑު މުބާރާތުގެ ބޭސިކް ކެޓަގަރީގެ ޖުމްލަ 100.00 ރުފިޔާގެ ފައިސާ ނަގައިދޭން ކަނޑައަޅާފައެވެ. އަދި ތަކަންދޫ ހުރި ހުރިހާ ގޮތުން ބައިވެރިވުމަށް ޖޯޑުތަކުގައި ކައުންސިލުން ވެސް ބޭސިކް ގޮތަށް ބައިވެރިވާ ޖުމްލަ 200 ރުފިޔާ ދޭނެ ގޮތުގައި ދެއްކުމަށް ނިންމާފައެވެ.

ބައިވެރިވުން

ތަކަންދޫ ކައުންސިލްގެ ބޭފުޅުންގެ އިތުރުން މުބާރާތުގައި ބައިވެރިވުން ވިދާޅު، ތަކަންދޫ ކައުންސިލް ހުރިހާ ބައިވެރިވުމަށް ފުރުޞަތު އަންނަނިވި ގޮތަށް ވޯޓު ތަކަންދޫގެ ބޭފުޅުން އެކުލަވާލެވިފައެވެ.

- އިދާރީ ސަރަހައްދު ކައުންސިލް ބާވަތުގެ މެމްބަރުން 2 ބާވަތުން
- 1 ކައުންސިލް މެމްބަރު
- ކައުންސިލްގެ އިދާރީ 2 މުވައްޒަފުން
- ސިޔާސީ ޕާޓީތަކުގެ 2 މުވައްޒަފުން
- ފުލުހުން ކޯޓުތަކުގެ 2 މުވައްޒަފުން

- ސްކޫލުގެ 2 މުވައްޒަފުން
- ފާރިމަސީގެ މުވައްޒަފެއް
- ކޯޓުގެ މުވައްޒަފެއް
- ކަނޑު ކުލަބް ޖަމްޢިއްޔާ އަކުން އެއް ބޭފުޅަކު

އެހީ ފަހިކޮށްދޭ ފަރާތް

ކައުންސިލް: ކުނިމެނޭޖްކުރުމުގެ އެންމެހާ މަސައްކަތްތައް ރަށުގެ ބޭރުން ކުރުމާއި ތަރައްޤީ ކުރަން

ފެނަކަ ކޯޕަރޭޝަން: ފެނާއި އިލެކްޓްރިސިޓީ ޚިދުމަތްދިނުން

ސިއްޙީ މަރުކަޒު: ސިއްޙީ ޚިދުމަތް ފޯރުކޮށްދިނުން

ސަރުކާރު: ޤާނޫނީ ޚިދުމަތް ދިނުން

ކައުންސިލުގެ ޚިޔާލު

- ކައުންސިލް އިން އިސްނަގައިގެން ރަށުގެ އެކި ފަރާތްތަކުގެ ބައިވެރިވުމާއެކު ވޭސްޓް މެނޭޖްމަންޓް ކުރުމަށް އަންގައިދިނުމާއި ކުނީގެ މަސްއަލަގެ މައްސަލަ ޙައްލު ކުރުމަށް އިސްކަންދެވޭނެ ގޮތަކަށް ތަރައްޤީ ކުރުން.
- ވޭސްޓް މެނޭޖްމަންޓް ކުނީގެ ތަރީޤާ ކަމަށް ކައުންސިލް ދެކެނީ އެއް ހަމަޖެހުމެއް.
- ކުނިމެނޭޖްކުރުމުގައި އަމަލުކުރަން ގަވާއިދާއި އުސޫލު ވޭސްޓް މެނޭޖްމަންޓް ކުނި އާއި ކައުންސިލާއި ގުޅިގެން ހަރަކާތް ތެރިވެ ކައުންސިލުން އެކަން ތަރައްޤީކުރުމުގެ މަސައްކަތް ކުރުން.
- ކުނިކޮށީގެ މަސައްކަތް ހިންގާ ނިޒާމު ގާތް ބެލުމުގެ ގޮތުން ވޭސްޓް މެނޭޖްމަންޓް ކުނިތަކުން އެތަނަށް ޖާގަދެވޭނެ އިސްތިޢުމާލުކުރަން އަވަސްއެއް ފަހިކޮށްދޭނެ ގޮތެއް.

ENVIRONMENTAL PROTECTION AGENCY
Male', Rep of Maldives
APPROVED

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[illegible] (2017/1/10)

[illegible]

[illegible]

APPROVED

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ކުނި މެނޭޖްކުރުމުގެ ޕްލޭން

ވައިކަރަދޫ

ތިލަދުންމަތީ ދެކުނުބުރި

" ނަލަނަލަ ވައިކަރަދޫއަކަށް - މަގޭ ފަރުދީ ބައްގު، މަގޭ ފަރުދީ ޒިންމާ "

ޕްލޭން އެކުލަވާލެވުނު ތާރީޚް: 29 ނޮވެމްބަރ 2016

ޕްލޭނުގެ މުއްދަތު: 5 އަހަރު

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بسم الله الرحمن الرحيم

ހދ. ވައިކަރަދޫގައި ތަރައްޤީކުރުމަށްޓަކައި ކުރި މުސްތަޤުބަލުގެ ޕްލޭން

ތަޢާރަފު

މިއީ ހދ. ވައިކަރަދޫ ކައުންސިލްގައި މިނިސްޓްރީ އޮފް އެންވަޔަރަންމަންޓް އެންޑް އެނަރޖީއިން ހިންގާ ލޯކަލް އެންވަޔަރަންމަންޓަލް ޕްރޮޖެކްޓްސް އެޖެންސީއާ ގުޅިގެން، ހދ.ވައިކަރަދޫ ތަރައްޤީގެ ބައިވެރިވުމާއެކު ވައިކަރަދޫގައި ތަރައްޤީކުރުމަށްޓަކައި ކުރި މުސްތަޤުބަލުގެ ގޮތުން އެކުލަވާލެވޭ ޕްލޭނެކެވެ. މިޕްލޭނުގެ ދަށުން ހދ.ވައިކަރަދޫގައި އޮތީ ކުރި ޒަމާނުގައި ކުރަންޖެހޭ އިޤްތިޞާދީ، ޖަމާޢަތީ، ވެށިމަސައްކަތާއި އަދި ޖުމުލަކޮށް އިންސާނީ ތަރައްޤީގެ އެއްބަސްވުމާއި ޕްލޭނިންގއަށް ތަރައްޤީ ބިނާކުރާ ގޮތުގައި އެކަށައަޅާފައިވާ ކަންތައްތައް ހިމެނޭ ގޮތުގައި ކަނޑައަޅާފައި ވާނެއެވެ.

ރަށުގެ ވަޞްފު

ތިލަދުންމަތީ އަތޮޅުބޮޑުގައި ޖަޒީރާ ރަށްތަކުގެ އުތުރުފަރާތުގައި ދުވަނަ އުތުރުން ރާއްޖޭގެ ދެކުނުބުރީ ވައިކަރަދޫއަކީ ރަށްތަކުގެ ތެރޭގައި ހިމެނޭ ރަށެކެވެ. ރާއްޖެތެރޭގައި ރަށުގެ އަތޮޅު ފުޅާމިނުގައި ދިރިއުޅުމުގެ ފަސޭހަތަކާއި ތަރައްޤީ ވެފައިވެއެވެ. އެހެންކަމުން ރަށުގެ މީހުން އާބާދީއާއި ފަހިވެފައިވާ ދިރިއުޅުމުގެ ފުރުސަތު އެތައް ގުނައެއް ބޮޑުވެ ދިރިއުޅުމަށް ރަނގަޅު ރަށެކެވެ. އާބާދީގެ ނިސްބަތުން ބޮޑު ރާއްޖެއެއް ދިރިއުޅޭ ވައިކަރަދޫގައި، 2016 ނޮވެމްބަރ 28ގެ ނިޔަލަށް ރަށްވެހިންގެ ގޮތުގައި 1825 މީހުން ރަޖިސްޓަރީ ކުރެވިފައިވެއެވެ. އޭގެ 18 އަހަރުން ދަށުގެ 491 ކުދިންނާއި، 18 އަހަރާއި 35 އަހަރާއި ދެމެދުގެ 666 ޒުވާނުންނާއި 35 އަހަރާއި 65 އަހަރާއި ދެމެދުގެ 556 ބޮޑު އުމުރުގެ މީހުންނާއި، 65 އަހަރުން މަތީގެ 112 މީހުންނެވެ.

ރަށުގެ ފުޅާމިނުގައި 2465 ފޫޓު ހުންނައިރު ދިގުމިނުގައި 6031 ފޫޓު ހުރެއެވެ. މިގޮތުރައިން ދިރިއުޅުމަށް ބޭނުންކުރާ ބިމުގެ ބޮޑުމިނަކީ ގާތްގަނޑަކަށް 3032360 އަކަފޫޓެވެ. ރަށުން މިހާތަނަށް ދޫކޮށްފައިވާ ގޯތީގެ ޢަދަދަކީ 511 އެވެ. މިގޮތުގައިން މީހުން ދިރިއުޅެމުންދަނީ 182 ގޭގައެވެ. ރަށުގައި 24 ގަޑިއިރު ކަރަންޓުގެ ޚިދުމަތް ލިބެންހުރެއެވެ. ބޯފެނަށްޓަކައި ޚާއްޞަކޮށް ބޭނުންކުރަނީ ވާރޭފެން ކަމަށްވާއިރު މީގެން ތަރައްޤީކުރުމަށް ޚާއްޞަ ގޭގޭގައި 2500 ލީޓަރުގެ 380 ކޮޅުން ބަހައްޓާފައިވާއިރު ޚާއްޞަ ބޭނުން ކުރުމަށް 34 ކުދިއެއްގެ ތާނގީ ބަހައްޓާފައިވެއެވެ. ނަރުދަމާގެ ގޮތުގައި އަދި ބޭނުންކުރުމުން ގިނަގުނަ ސެޕްޓިކް ޓޭންކް ބަހައްޓައިގެން ނަޖިސް ބަލަން ހިނގާ ގޮތަށް ހުނަރު ތިމާވެށީ ބަރަށްޓަކާ ނިޒާމުކަނެވެ. 2015 ވަނަ އަހަރާއި 2016 ވަނަ އަހަރުގެ ދަށުނޑުގެ ބަޖެޓުގައި ވައިކަރަދޫގެ ނަރުދަމާގެ މަޝްރޫޢު ހިންގުމަށް ފައިސާ މަސައްކަތްކުރެވި 2016 ވަނަ އަހަރު ފުރަން އިތުރުވެސް ފަރުމާއެއް ނުވެއެވެ.

މިރަށުގައި ގޯއްޗާކުރިމަތިވާ ސިއްހީ މަރުކަޒުން ޖަނަވަރާއި 4 ނަރުހުންގެ ޚިދުމަތް އެކަށީގެންވާ ގޮތުގައި ލިބެމުން ދެއެވެ. އެސް.ޓީ.އައިން ހިންގާ ބޭސްފިހާރައިން ފާސްކުރި ޚިދުމަތް ތަރައްޤީކުރުމަށް ލިބެމުންދެއެވެ.

Secretariat of the Vaikaradhoo Council, Thuh'koiHingun, H Dh. Vaikaradhoo- 02140, Rep of Maldives. ދިވެހިރާއްޖެ ،02140 - ހދ. ވައިކަރަދޫ، ތުއްކޮއިހިނގުން، އިދާރާ، ވައިކަރަދޫ ކައުންސިލްގެ
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ޕްރީސްކޫލްތައް ނަމޫނާ ޕްރީސްކޫލްގެ ސްޓާފުމީހުންނާއި ދިރާސާކުރަނިވި ހަމައެކަނި ޕްރީސްކޫލް ޢިމާރާތް ހުރި ގޮތް ބަލައި ނިންމުމުގެ ގޮތުން ރާއްޖޭގެ 20 ކުދިން ބޭނުން ކުރެވޭ ސަރުކާރު ޕްރީސްކޫލްތަކުގެ ތެރެއިން ކަމާއި ގުޅޭ، ޕްރީސްކޫލްއާ ހަމައެކަނި ކުދިން ކިޔަވައިދިނުމަށް ސިޓީ އެހެން ހުރިހާ ތަނެއް ވެސް ކިޔަވައިދިނުމަށް ހަމަޖައްސާފައި ނެތް. ކުރިން މަޝްރޫޢުގެ ގޮތުގައި ކިޔަވައިދިނުމަށް މަދަރުސާގެ 1 ފެށި 10 ގުނަ ހަމައެކަނި ހިނގަމުންދާ ކިޔަވައިދިނުމުގެ ތެރެއިން ދަރިވަރުންގެ އަދަދަކީ 231 އެވެ. އެގޮތުން ކުދިންނަށް ޖާގަ ދޭނެ ކްލާސްރޫމު މަދުވެ ކުލާސްތަކުގެ ތަނަވަސްކަމާ ދޭތެރޭ ދަތިތަކެއް ކުރިމަތިވެފައިވާތީ، ސަރުކާރުގެ ފަރާތުން ޕްރީސްކޫލް ޢިމާރާތެއް ހެދުމަށް ފެށިއްޖެ އެވެ.

މިޢިމާރާތަކީ 3 މިސްރާބު ހުރި 250x900 ފޫޓުގެ ބޮޑުމިނުގައި ހަދާފައިވާ ޢިމާރާތެކެވެ. ބޮޑު ކްލާސްރޫމު 3 ފަހަރަކު ކުދިން ކިޔަވައިދެވޭ ގޮތަށް ހަދާފައިވާ ތަނެކެވެ. ޢިމާރާތުގެ އެތެރޭ ފަރުގެ ފަރާތްތަކަށް ޓައިލްސް އަޅާ، ކުލަޖަހައި، ބޭނުންތެރި ސާމާނު ހޭދަކޮށް ނިމިފައެވެ.

ޢިމާރާތަށް 4 ޓޮއިލެޓާއި ހަމަ ކިޔަވައިދިނުމުގެ، އެހެން ބޭނުންތަކަށް ބޭނުންކުރާ ތަންތަން ހިމެނޭ ގޮތަށް ޑިޒައިން ކުރެވިފައިވާ ސަރުކާރުގެ ފަރާތުން ފަހި ޝަރުތުތަކަށް ރިޢާޔަތްކޮށް، ކިޔަވައިދޭ ދަރިވަރުންނަށް ބޭނުންވާ ފަރުނީޗަރު، ބޯޑު، ކޮމްޕިއުޓަރު، ތަޢުލީމީ ވަސީލަތްތައް ހޯދުމަށް ބަޖެޓުން ހިމެނެއެވެ.

ޕާސްކޫލްތަކަށް ބޭނުންވާ މައިގަނޑު މަޝްރޫޢު

ހދ. ވައިކަރަދޫގައި ބައްލަވާ އަދި ދުވަސްކޮޅެއް ދެވިފައިވާ މަހުން ތިލަފުށުގައި ރަށުގެ މުސްތަޤްބަލު ބޮޑުކުރުމަށް ކުރީގެ މަސައްކަތްތަކުގެ ތެރެއިން ޕްރީސްކޫލު ސާފުކުރުމަށް ހުރި މަސައްކަތުގެ ގޮތުގައި ތަނަވަސް ހިމެނޭ. އަދި ކުރިއަށް 5 އަހަރު ތެރޭގައި ޕްރީސްކޫލް ޢިމާރާތް ތަރައްޤީކުރުމަށް ފުރުޞަތު ދޭނެ ގޮތަށް ރާވާފައިވެއެވެ.

ޚިދުމަތް އެކުލަވާލާ ކުރުވުމުގެ ކުރިއަށް

މިދާއިރާގައި 2016 ގައި ވައިކަރަދޫ ކައުންސިލު އިދާރާ ހުޅުވުން ބޮޑު ފުރުޞަތު ކުރީގެ ދިރާސާތަކަށް ބޭނުންކޮށް އެކުލަވާލެވިފައިވާ ކައުންސިލުގެ ބަޖެޓު ޚަރަދު ކުރުމުގެ ޕްލޭނާއި މަސައްކަތްތަކެއް ފުރިހަމައަށް ނިމުނު ހިސާބަށް ގެނެވިފައި ވެއެވެ. ޚިދުމަތް އެކުލަވާލާ ބޭނުން ކުރަންޖެހޭ ކުރިން ކައުންސިލު ވައިކަރަދޫ ރަށުގެ މިންގަނޑު ބަލައިގަތުމަށް އެކުލަވާލެވި ބަޖެޓުގެ ތެރެއިން މިއަހަރު ނިމުމަށް ބޭނުންވާ ހިސާބުތަކުގެ ތަފްސީލު ބޭނުންވާ މަޝްވަރާ ހިމެނެއެވެ. ދިރާސާކުރުމުގައި ބައިވެރިވާ ފަރާތްތަކުގެ ލިސްޓު މިޚިދުމަތުގެ އެކްސެސް 1 ގައި އެވަނީއެވެ.

Secretariat of the Vaikaradhoo Council, Thuh'koiHingun, H Dh. Vaikaradhoo- 02140, Rep of Maldives. ދިވެހިރާއްޖެ 02140 - ހދ. ވައިކަރަދޫ، ތުހްކޮއިހިނގުން، އިދާރާ، ވައިކަރަދޫ ކައުންސިލްގެ
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މިހާރުގެ ހާލަތު

- ކައުންސިލުން ކުނިއުކާލުމުގެ އިންތިޒާމުކޮށް ކަނޑައެޅި، ކަނޑައެޅިފައިވާ ވަކި ދުވަސްތަކެއްގެ ވަކި ގަޑިތަކެއްގައި ކުނިއުކާލުމުގެ ކަންތައްތައް ކުރިއަށް ގެންދެއެވެ.
- ކުނިކޮށި ހެދިފައިވާ ނަމަވެސް އެތަން ރަނގަޅަށް ތަރުތީބުކޮށްފައި ނުވާތީ، ކުނި އެންދުމާއި ނައްޓާލުމުގައި ދަތިތަކާކުރިމަތިވެއެވެ.
- މިހާރުވެސް ކުނިތައް ހުންނަނީ ބައި ބައިކޮށް ވަކިކުރުމަކާ ނުލައި ކުނިކޮށިގައި ކުނި ހުރީ ބައިބައިކޮށް ވަކިނުކުރެވިފައެވެ.
- ކުނި މެނޭޖްކުރުމަށް ޚިދުމަތް ފޯރުކޮށްދިނުމަށް އިދާރީގޮތުން ސްޓާފް ހިނގާ ކައުންސިލުން މުވައްޒަފުން ލައިގެން ކުނި ވަކި ކުރުމާއި އެންދުމާއި މެނޭޖްކުރުމުގެ ކަންކަން ކުރިއަށް ގެންދެއެވެ.
- މިހާރު ބޮޑުން ކުނިބޮޑުކުރާ ކުނިކޮށްޓަކީ ޑީ.އެން.ޖީ.ޕީގެ ޕްރޮޖެކްޓްތަކެއްގެ ދަށުން ވައިކަރަދޫ އިމާރާތް ޖަމުޢިއްޔާގެ ފަރާތުން އިމާރާތް ކޮށްފައިވާ ކުނިކޮށްޓެކެވެ.
- ސަރުކާރުން ކުނީގެ ބާވަތްތައް ރަށުން ބޭރުކުރާނެ ގޮތެއް ހަމަޖެހިފައެއް ނުވެއެވެ.
- ކުނި އުކާލުމުގެ އިންތިޒާމުތައް އުކާލާތާ އެންމެ ކުރުކޮށްފައިވާ ވިސްނުމެއް، ބައެއް މަދު ފަރާތްތަކުން އެއްއެއްގޮތަކަށް އަމަލުކުރަމުން ނުދާކަން ފާހަގަ ކުރެވެއެވެ. ނަމަވެސް މިކަމަށް ހެދިފައިވާ އުސޫލުތަކަށް ތާއީދު ގޮތަކަށް ދެން ރަށްރަށުން ތަޅާ އެގޮތަށް އަމަލުކުރަމުންދާކަން ފާހަގަ ކުރެވެއެވެ.
- ކުނިފާ ޖެހޭގެ ކުނި މިހާރު އުކާލުން ގެންދަނީ ރަށުގެ ގޮނޑުދޮށަށެވެ.

ކުނި އުފެދޭ ތަންތަން

ގޭބިސީ	254	ސަރުކާރުގެ އިދާރާތައް/ އިޖްތިމާޢީ ހިދުމަތް	07
ވިޔަފާރި (ފިހާރަތައް)	21	އޭޖީ ހަރުގެ	02
ކާފޭ/ ރެސްޓޯރެންޓް	02	ބޭރީ ވިޔަފާރި (ދިރާގު/ވަތަނިއްޔާ)	02
ވަޑާންގެ	03	ޖަމިއްޔާ ޖަމާޢަތްތައް	01

އުފެދޭ ކުނީގެ ބާވަތްތައް

- ގޭންގުޅިން ކުނި (ފުޅިކުނޑި، ބަލިގޭ ބާލި) ދުވާލަކު އެވްރެޖްކޮށް 350 ކިލޯއަށްވުރެ ގިނަ
- ދަނޑުގެ އަދި މަސްދަނޑުގެ ބާވަތް ދުވާލަކު އެވްރެޖްކޮށް 25 ކިލޯ
- ބިއްލޫރި ދުވާލަކު އެވްރެޖްކޮށް 22 ކިލޯ
- ޕްލާސްޓިކް ދުވާލަކު އެވްރެޖްކޮށް 16 ކިލޯ
- ނަރުއާދާރު ކުނި އަދި އެހެނިހެން ކުނި ދުވާލަކު އެވްރެޖްކޮށް 12 ކިލޯ

ވައިކަރަދޫ ކައުންސިލްގެ އިދާރާ، ތުއްކޮއިހިނގުން، ހދ. ވައިކަރަދޫ - 02140، ދިވެހިރާއްޖެ. Secretariat of the Vaikaradhoo Council, Thuh'koiHingun, H Dh. Vaikaradhoo- 02140, Rep of Maldives.
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މިހާރުގެ ކުނިގެ ހާލަތު ހުރި ގޮތުން ދިމާވާ މައްސަލަތައް

- ބިމަށް މައްސަލަތަކުގެ ތެރޭގައި، މަދިރި އުފެދުން، މީރު ގިނަވުން، ބައްޓަރީފަދަ ތަކެތިން ކަވައިގެން ގޮސް ޖިސްމާނީ އަނިޔާތައް އިންފެކްޝަން އުފެދުން.
- ތިމާވެއްޓަށް ދިމާވާ މައްސަލަތަކުގެ ތެރޭގައި: ހިރުފުސްފަދަ ތަކެތި އެއްކުރުމުން، ކުނި އަންދާލުމުގެ ސަބަބުން ވައި ނުސާފުވެ ތަކެތި އެއްކުރުމުން، ފެންތަކާއި މުދާތަކަށް އަދި މަސްވެރިކަމަށް ދިރުން ނެތި ދިއުން.
- މަންޒަރު ފެންނަ ގޮތުން ކުޑަ އަސަރު: ނަބައި ވަސް ދުވުމާއި މަދަމަތި ހުރިހާ ތަނުގައި ރީތިކަމަށް ބާރު ކުޑަ ދިމާވެފައި ހުރުން.

ކުނިމެނޭޖްކުރުމުގެ ފަސް އަހަރުގެ މަގްސަދުތައް

- 5 އަހަރުގެ މުއްދަތުގެ ތެރޭގައި އަދަދު ގާބިލް ތަކެއް މިހުން ދިރިއުޅުން ފުރުމާއި އެކި އެކި ސިފައި މަސައްކަތާއި ގުޅުން ބިނާކުރުމުގެ މަސައްކަތާއި ގުޅިގެން މިހާރު އުފެދޭ ކުނީގެ ނިސްބަތުން ދުވާލަކަށް 18 ޕަސެންޓް ކުނިގެ ބާވަތްކަންފަސް އިތުރުވެގެންދާނެއެވެ.
- އުފެދޭ ކުނީގެ ބޮޑުބައިގެ ފަހަރާ ކުނި ކަލަން ވުޒުން ކާރުހަދައިގެން މި ބާވަތުގެ ކުނި އެކި މެނޭޖްކުރެވޭނެއެވެ.
- ދަނޑުގައި މަސްދަނާއި ޕްލާސްޓިކް އަދި ބައްޓަރީގެ ބާވަތްތައް މެނޭޖްކުރުމަށް، ރިސައިކަލް ކުރަން ބޭނުންވާ ވެސްޓަށް ބޭނުން ކުނިގެން 75 ޕަސެންޓް މެނޭޖްކުރެވޭނެއެވެ.
- ކުނި މެނޭޖްކުރުމުގެ މަސައްކަތް 5 އަހަރު ދުވަހުގެ ތެރޭގައި ކޮންޓްރެކްޓް އުޅުއްވުމުގެ ފުރިހަމަ އެއްބަސްވުން ހަމައެކަނި އުފެދޭ ހުރިހާ ކުނިއެއްގެ 100 ޕަސެންޓް މެނޭޖްކުރެވޭނެއެވެ. މި ގޮތުން ފަހަރާ ކުނި، ބައްޓަރީ މަދުން އަދި ޕްލާސްޓިކާއި ނުރައްކާތެރި ކުނި ވަސް ހުރެދާނެ ގޮތަށް މެނޭޖްކުރެވޭނެއެވެ.
- ވައިކަރަދޫގެ ކުނި މެނޭޖްކުރުމުގެ އެންމެހައި ކަންކަން ބަލަހައްޓާ ކައުނިއަށް ފަރާތަކީ ވައިކަރަދޫ ކައުންސިލްއެވެ. އެގޮތުން ސަރުކާރުގެ ކައުންސިލް ބަޖެޓުގައި ކުނީގެ ދަރުން މިމަސައްކަތް ކުރުމަށް ކޮންޓްރެކްޓް އުޅުއްވުމުގެ ޚަރަދުން ކައުންސިލްގެ ބަޖެޓުގެ ދަށުންނެވެ.

ލަނޑުދަނޑިތައް

1. ރަށުގައި ކުނި މެނޭޖްކުރުމުގެ ހަރުދަނާ ފާލަނުތަކަކާއި އުސޫލުތަކެއް އެކުލަވާލައި ތަންފީޒުކުރުން
2. ރަށު ސަރަހައްދު ބެލެހެއްޓުން އިމްތިޔާޒުތަކަކާއި އިޖުތިމާޢީގޮތުން ހުރި ފައިދާތަކަށް ރައްޔިތުން ހޭލުންތެރިކުރުވުން.
3. ރަށުގައި އުފެދޭ ކުނީގެ މިންވަރު މަދުކުރުމާއި އަލުން ބޭނުންކުރެވޭފަދަ ތަކެތި ބޭނުންކުރުމުގެ އާދަ އަހަރެންނަށްވުން.
4. ކުނިކޮށިން ރެގިއުލަރުކޮށް ބައި ބޭނުން ކުރަން ފެށުން.
5. ކުނި މެނޭޖްކުރާ މަރުކަޒުގައި ބޭނުންކުރުމަށް ވާސްތާ މެނޭޖްމަންޓު އިކުއިޕްމަންޓް ހޯދުމާއި އިކުއިޕްމަންޓް ބޭނުންކުރުމަށް އެކަށީގެންވާ އިންޖީނުއަރުން ޓްރެއިނިންގ ދިނުން މަސައްކަތް ކުރުން.
6. ގެގެއިންނާއި އުފެއްދުންތަކުން ތަންތަނުގައި އުފެދޭ ކުނި، ކުނިކޮށްޓަށް ގެންދިއުމަށް އިންތިޒާމުކުރުމަށްފަހު ހަރުދަނާ ނިޒާމެއް ޤާއިމުކުރުން.
7. ރަށުގައި އުފެދޭ ކުނި ރަސްމީ ތައްޔާރުކޮށް ބައިބަހަން ބައިކަނޑައިގެން ޖަމާކުރުމާއި، ކުނިކޮށްޓައި ރަސްމީ ތަނަކަށް އަދި

ތަރައްޤީއަށް ރައްޔިތުންގެ އަޞްލަށް ޓަކައި ކައުންސިލުން

8. ހަރުދަނާ ނިޒާމެއްގެ ދަށުން މަސައްކަތް ކުރުމަށް ކައުންސިލްގެ މުވައްޒަފުންނަށް ތަމްރީނު ފޯރުކޮށްދިނުން.

9. އަތޮޅު އިދާރާއާ ސަރުކާރުގެ ސިފައިން ބޭނުންކުރެވޭނެ އިންތިޒާމެއް ހަމަޖެއްސުން.

10. ހެލްތް ކައުންސިލްގެ ބައިވެރިވުން އާއްމުކޮށް ގެންދިއުމަށް ތަރުޖަމާކުރުން.

ލަނޑުދަނޑިތައް ހާސިލުކުރާނެ ގޮތް

ލަނޑުދަނޑި 1	ރަށުގެ ކައުންސިލްގެ ހިދުމަތް ފޯރުކޮށްދޭ ފެންވަރު އިތުރުކޮށް ކައުންސިލްގެ އިދާރީ ނިޒާމް ހަރުދަނާކުރުން					
މިހާރު އޮތް ހާލަތު	ކައުންސިލްގެ އިދާރީ ނިޒާމް ހަރުދަނާ ނޫން.					
ހަރަކާތްތައް	ލަނޑުދަނޑިތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަދާކުރާ މުއްދަތު	ކޮންމެ އަހަރަކު	ޖުމްލަ ޚަރަދު
ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ އާއި ގުޅިގެން ހަރަކާތްތެރި ކުރުން	ކައުންސިލްގެ ޕްލޭންތައް، ސަރުކާރުގެ ހަރަކާތްތަކާ ގުޅޭ ކަންތައް ބެލެހެއްޓުން	ރަށު ކައުންސިލް، ކައުންސިލް އިދާރާ	ރަށު ކައުންސިލް	5 އަހަރު	6000/- ރުފިޔާ	32000/- ރުފިޔާ
ކައުންސިލްގެ މުވައްޒަފުންގެ ޤާބިލްކަން އިތުރުކުރުމަށް ތަމްރީނު ދިނުން	ރައްޔިތުންނަށް ބޭނުންވާ ހިދުމަތްތައް ފޯރުކޮށްދިނުން	ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ، ރަށު ކައުންސިލް، އިދާރާ	ރަށު ކައުންސިލް	1 އަހަރު	1300/- ރުފިޔާ	1300/- ރުފިޔާ
ކައުންސިލްގެ މުވައްޒަފުންގެ ޤާބިލްކަން އިތުރުކުރުމަށް ތަމްރީނު ދިނުން	ޕްރޮގްރާމް، ބައިވެރިވާ ފަރާތްތައް	ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ، ރަށު ކައުންސިލް، ސަރުކާރުގެ އިދާރާތައް	ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ	5 އަހަރު	7000/- ރުފިޔާ	7000/- ރުފިޔާ
ކައުންސިލްގެ މުވައްޒަފުންގެ ޤާބިލްކަން އިތުރުކުރުން	ރަށު ކައުންސިލް، ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ	ރަށު ކައުންސިލް،	ރަށު ކައުންސިލް	5 އަހަރު	8000/- ރުފިޔާ	16000/- ރުފިޔާ

ލަނޑުދަނޑި 2	ރަށުގެ ސަލާމަތާއި ހިމާޔަތް ކަށަވަރުކުރުމަށް ރައްޔިތުންގެ ބައިވެރިވުމާއެކު ހަރަކާތްތައް ހިންގުން.					
މިހާރު އޮތް ހާލަތު	އަމާން ސަލާމަތީ ނިޒާމެއް ރަށުގައި ނެތް.					
ހަރަކާތްތައް	ލަނޑުދަނޑިތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަދާކުރާ މުއްދަތު	ކޮންމެ އަހަރަކު	ޖުމްލަ ޚަރަދު
ރައްޔިތުންގެ އަމާންކަން ހިފެހެއްޓުމަށް ކަންތައްތައް ރޭވުން	ޕްރޮގްރާމް، ބައިވެރިވާ ފަރާތްތައް، ސަރުކާރުގެ ހަރަކާތްތައް	ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ، ރަށު ކައުންސިލް، ސަރުކާރުގެ އިދާރާތައް، ހދ. އަތޮޅު ކައުންސިލް، ސަލާމަތީ ޚިދުމަތް	ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ	5 އަހަރު	8000/- ރުފިޔާ	15000/- ރުފިޔާ
ސަލާމަތީ ރޭވުންތައް ހަރުދަނާކުރުން	ޕްރޮގްރާމް، ބައިވެރިވާ ފަރާތްތައް، ސަރުކާރުގެ ހަރަކާތްތައް	ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ، ރަށު ކައުންސިލް، ސަރުކާރުގެ އިދާރާތައް، ހދ. އަތޮޅު ކައުންސިލް	ސަލާމަތީ ފަރާތް	5 އަހަރު	4000/- ރުފިޔާ	12000/- ރުފިޔާ

ލަނޑުދަނޑި 3	ރަށުގެ ތިމާވެށި ރައްކާތެރިކޮށް، ކުނި މެނޭޖްކުރުމުގެ ނިޒާމް ހަރުދަނާކުރުން (3R).					
މިހާރު އޮތް ހާލަތު	މިހާރު އެކަށީގެންވާ ނިޒާމެއް ނެތް.					
ހަރަކާތްތައް	ލަނޑުދަނޑިތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަދާކުރާ މުއްދަތު	ކޮންމެ އަހަރަކު	ޖުމްލަ ޚަރަދު
ކުނި މެނޭޖްކުރުމުގެ ނިޒާމް ހަރުދަނާކުރުމަށް ކުނިކޮށި ބިނާކުރުން	ކުނި މެނޭޖްމަންޓް ސެންޓަރު	ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ، ރަށު ކައުންސިލް	ރަށު ކައުންސިލް	5 އަހަރު	6000/- ރުފިޔާ	13000/- ރުފިޔާ
ރަށު ތިމާވެށި ރައްކާތެރިކުރުމަށް ހޭލުންތެރިކަން އިތުރުކުރުން	ބައިވެރިވުން، ޕްރޮގްރާމް	ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ، ރަށު ކައުންސިލް	ރަށު ކައުންސިލް	5 އަހަރު	4000/- ރުފިޔާ	8000/- ރުފިޔާ
ތިމާވެށީގެ ހާލަތު ދެނެގަތުމަށް ދިރާސާކުރުން	މިނިސްޓްރީ އޮފް އެންވަޔަރަމަންޓް، ތިމާވެށި	ލޯކަލް ގަވަރމަންޓް އޮތޯރިޓީ، ރަށު ކައުންސިލް	ރަށު ކައުންސިލް	5 އަހަރު	4000/- ރުފިޔާ	14000/-

ވައިކަރަދޫ ކައުންސިލްގެ އިދާރާ، ތުއްކޮއިހިނގުން، ހދ. ވައިކަރަދޫ - 02140، ދިވެހިރާއްޖެ. Secretariat of the Vaikaradhoo Council, Thuh'koiHingun, H Dh. Vaikaradhoo- 02140, Rep of Maldives.
Phone: (+960)6520046 Fax: (+960)6520556 Email: info@vaikaradhoo.gov.mvWebsite: www.vaikaradhoo.gov.mvPO Box: RC-047

ރުފިޔާ				ހދ. އަތޮޅު މަދަރުސާ	ޕްރައިމަރީ ކުލާސްތައް ސްކޫލް ތަފާތުކުރާއިރު ބާރުގެ ކަނޑައެޅުން	މަދަރުސާގެ ސްކޫލް ކުދިންނަށް އަމާޒުކޮށް ހިންގުން

ލަނޑުދަނޑި 4	ގ. ކުނިކުނި ބޭރުކުރާ އުސޫލު ބަދަލުކުރުން
މިހާރު އޮތް ހާލަތު	އާބާދީގެ ބޮޑުބައެއް ކުނި ކަނޑަށް އަޅާ ނުވަތަ ރަށުގައި އަންދާލަނީ

ޖުމްލަ ހޭދަވާނެ ބަޖެޓް	އަހަރީ ޚަރަދު	ނިންމާނެ މުއްދަތު	ޒިންމާވާ ފަރާތް	ބައިވެރިވާ ފަރާތްތައް	ވަސީލަތްތައް	ހަރަކާތްތައް
75000/- ރުފިޔާ	14000/- ރުފިޔާ	1 އަހަރު	ރަށު ކައުންސިލް	ވެށި މެނޭޖްމަންޓް ކޮމިޓީ، ރަށުކައުންސިލް، ޑޮނަރ	ކުނިކޮށި ބޭނުންކުރަން ފެންވަރު ކަނޑައެޅުން، ކައުންސިލުން ފޯރުކޮށްދިނުން، ރައްޔިތުންނާ ޝަރީކުކުރުން، ޑޮނަރ އަދި އަންނަ ކުރަހަނުގެ ގޮތުން، އިޖުތިމާޢީ މަސައްކަތްތެރިން ފޯރުކޮށްދިނުން	ކުނިކޮށި ކުރަންޖެހޭ މަސައްކަތްތައް ކަނޑައެޅުމަށް ހިންގާ ޕްރޮގްރާމް ބޭއްވުން
10000/- ރުފިޔާ	5000/- ރުފިޔާ	1 އަހަރު	ވެށި މެނޭޖްމަންޓް ކޮމިޓީ	ވެށި މެނޭޖްމަންޓް ކޮމިޓީ، ރަށުކައުންސިލް، ޑޮނަރ	މީހުން، ވަސީލަތް	މަސައްކަތްތަކުގެ ފުރިހަމަ ތަމްރީނު ދިނުން

ލަނޑުދަނޑި 5	ކުނި މެނޭޖްކުރުމުގައި ތަމްރީނުދީ ވެށި މެނޭޖްމަންޓް ޕްލޭންތަކެއް ހަދައި އެކަށައަޅާ ކަނޑައެޅިފައިވާ އުސޫލުތަކުގެ މަތިން ކަމުދާ މިންވަރަށް ކުރިއަށް ގެންދިއުން.
މިހާރު އޮތް ހާލަތު	ކުނި މެނޭޖްކުރުމަށް ތަމްރީނު ލިބިފައިވާ މީހުން ނެތް.

ޖުމްލަ ހޭދަވާނެ ބަޖެޓް	އަހަރީ ޚަރަދު	ނިންމާނެ މުއްދަތު	ޒިންމާވާ ފަރާތް	ބައިވެރިވާ ފަރާތްތައް	ވަސީލަތްތައް	ހަރަކާތްތައް
800000/- ރުފިޔާ	80000/- ރުފިޔާ	5 އަހަރު	ޑޮނަރ	ޑޮނަރ، ވެށި މެނޭޖްމަންޓް ކޮމިޓީ	ޑޮނަރ	ކުނި މެނޭޖްކުރުމުގެ މަސައްކަތް ތަންފީޒުކުރުމަށް ރަނގަޅު ވެށި މެނޭޖްމަންޓް ސެންޓަރެއް (ވެށި މެނޭޖްމަންޓް އެކުގައި ހަދަން)
30000/- ރުފިޔާ	2000/- ރުފިޔާ	5 އަހަރު	ރަށު ކައުންސިލް	ރަށުކައުންސިލް، ވެށި މެނޭޖްމަންޓް ކޮމިޓީ، ޑޮނަރ	ޑޮނަރ	ކުނިކޮށި ވެށި މެނޭޖްމަންޓް ޕްލޭން ތަންފީޒުކުރުމަށް ހޭލުންތެރިކުރުން
20000/- ރުފިޔާ	4000/- ރުފިޔާ	5 އަހަރު	ޑޮނަރ	ވެށި މެނޭޖްމަންޓް ކޮމިޓީ، ރަށުކައުންސިލް، ޑޮނަރ	މަސައްކަތްކުރާނެ މީހުން ހޯދުން ޑޮނަރ	ވެށި މެނޭޖްމަންޓް ތަމްރީނު ސެޝަންތައް މީހުން ތަމްރީނުކުރުން

ލަނޑުދަނޑި 6	ގެއިން ކުނިކޮށި ކުނިކޮށި ކުރަން ދާއިރާގައި ޤަވާޢިދު، ކުނި ވަކިކޮށް ގެންގޮސް މެނޭޖްކުރުމުގެ ނިޒާމެއް ހަމަޖެހުން
މިހާރު އޮތް ހާލަތު	ކުނި ގެނައުމަށް ހަމަޖެހިފައިވާ ކުނި އުކާލާތަނެއް

ޖުމްލަ ހޭދަވާނެ ބަޖެޓް	އަހަރީ ޚަރަދު	ނިންމާނެ މުއްދަތު	ޒިންމާވާ ފަރާތް	ބައިވެރިވާ ފަރާތްތައް	ވަސީލަތްތައް	ހަރަކާތްތައް
55000/- ރުފިޔާ	40000/- ރުފިޔާ	5 އަހަރު	ރަށުކައުންސިލް	ރަށު ކައުންސިލް، ވެށި މެނޭޖްމަންޓް ކޮމިޓީ، ޑޮނަރ	ފިނޯ، ޓްރެކްޓަރ، ވީލްބެރޯ ހޯދުން	ކުނިއުކާލާތަން ހަމަޖެހުމާއި ގެއިން ކުނި ނަގައި ގެނައުމުގެ ނިޒާމް ގާއިމްކުރުން

ލަނޑުދަނޑި 7	ރަށުގައި ދިރިއުޅޭ ރަށުގެ ކުނި ކަނޑައެޅިފައިވާ ތަނަކަށް ގެންގޮސް ވަކިކުރުން، ކުނިކޮށި ހަރުދަނާކުރުމަށް ބޭނުންވާ ތަކެތި ހަމަޖެހުން، ރަށުގެ ކުނި މެނޭޖްކުރުން
މިހާރު އޮތް ހާލަތު	ގެއިން ކުނިކޮށި ޑަސްޓްބިން ބޭނުންކޮށްގެން ކުނި އެއްކުރާ

ޖުމްލަ ހޭދަވާނެ ބަޖެޓް	އަހަރީ ޚަރަދު	ނިންމާނެ މުއްދަތު	ޒިންމާވާ ފަރާތް	ބައިވެރިވާ ފަރާތްތައް	ވަސީލަތްތައް	ހަރަކާތްތައް
4000/- ރުފިޔާ	3000/- ރުފިޔާ	5 އަހަރު	ރަށުކައުންސިލް، ޑޮނަރ	ވެށި މެނޭޖްމަންޓް ކޮމިޓީ، ކޮމިއުނިޓީ، ޑޮނަރ	ޑަސްޓްބިން ހޯދުން	ގޯތި ގެދޮރުގައި ކުނި 5 ބައަށް ވަކިކޮށް އެއްކުރުމުގެ ނިޒާމް ގާއިމްކުރުން
20000/- ރުފިޔާ	8000/- ރުފިޔާ	5 އަހަރު	ރަށުކައުންސިލް	ވެށި މެނޭޖްމަންޓް ކޮމިޓީ، ރަށުކައުންސިލް، ޑޮނަރ	ޑަސްޓްބިން، ފިނޯ، މީހުން	ރަށުގެ ޢާއްމު ތަންތަނުގައި ޑަސްޓްބިން ހަރުކުރުން
4000/- ރުފިޔާ	30000/- ރުފިޔާ	5 އަހަރު	ރަށު ކައުންސިލް	ވެށި މެނޭޖްމަންޓް ކޮމިޓީ، ރަށުކައުންސިލް، ޑޮނަރ	ވަސީލަތް، މީހުން	ރަށުގެ މަގުތަކާއި ޢާއްމު ތަންތަން ސާފުކުރުން
5500/- ރުފިޔާ	45000/- ރުފިޔާ	5 އަހަރު	ރަށުކައުންސިލް، ޑޮނަރ	ވެށި މެނޭޖްމަންޓް ކޮމިޓީ، ޑޮނަރ	ޑަސްޓްބިން، ފިނޯ، ވީލްބެރޯ، ޓްރެކްޓަރ	ކުނިއުކާލާ ތަނަށް ކުނި ގެންގޮސް ކުނި ވަކިކުރުމުގެ ނިޒާމް ގާއިމްކުރުން
2000/- ރުފިޔާ	20000/- ރުފިޔާ	3 އަހަރު	ރަށުކައުންސިލް، ޑޮނަރ	ވެށި މެނޭޖްމަންޓް ކޮމިޓީ، ޑޮނަރ	ޑަސްޓްބިން ހޯދުން	ރަށުގެ ކުނި ކުނިއުކާލާ ތަނަށް ގެންދިއުމަށް ޑަސްޓްބިން ހަރުކުރުން
3500/- ރުފިޔާ	12000/-	5 އަހަރު	ރަށުކައުންސިލް	ޑޮނަރ، ވެށި މެނޭޖްމަންޓް ކޮމިޓީ	މީހުން ކުނިކޮށި	ކުނިކޮށި ހަރުދަނާކުރުމަށް ބޭނުންވާ ތަކެތި

Secretariat of the Vaikaradhoo Council, Thuh'koiHingun, H Dh. Vaikaradhoo- 02140, Rep of Maldives. ވައިކަރަދޫ ކައުންސިލްގެ އިދާރާ، ތުއްކޮއިހިނގުން، ހދ. ވައިކަރަދޫ - 02140، ދިވެހިރާއްޖެ
Phone: (+960)6520046 Fax: (+960)6520556 Email: info@vaikaradhoo.gov.mvWebsite: www.vaikaradhoo.gov.mvPO Box: RC-047

ސަރަހައްދުތައް ކުނިގަނޑު އުކާލަން އެސެސްމެންޓެއް ފާހަގަކުރުން	ރައްޔިތުންނާއި ޙިއްސާކުރުން	ކޮމިޓީ	މުޅި		ރުފިޔާ	

ލަނޑުދަނޑި 8	ހަރުދަނޑި ނިޒާމުގެ ދަށުން މުޅި ރަށުގެ ކުނި ނަގައި ކުނި މެނޭޖްކުރުމުގެ ހިދުމަތް ދިރުވައި އެސެސްމެންޓް ފާހަގަކުރުން.					
މިހާރު އޮތް ހާލަތު	ފެށިފައެއް ނުވޭ					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަންދާޒާކުރާ މުއްދަތު	ކެޕިޓަލް ޚަރަދު	ދެމެހެއްޓުމަށް ކުރާ ޚަރަދު
މަގުމަތި ސާފުކުރުމާއި ކުނިކޮށީގެ މަސައްކަތްތައް	ރަށުކައުންސިލް، ކުލަބު ޖަމާޢަތްތައް، ސަރުކާރުގެ އިދާރާތައް، ކުންފުނިތައް،	ފުލުހުން ގޭބީސީތަކާއި ކޮމިޓީ، ކުލަބު ޖަމާޢަތްތައް،	ރަށުކައުންސިލް	5 އަހަރު	6000/- ރުފިޔާ	5000/- ރުފިޔާ
ފެނުގައި އުކާލާ ކުނީގެ ރައްޔިތުންނަށް އަހުލުވެރިކުރުން	ރައްޔިތުން ބައިވެރިކުރުން	މުދާ، ފުލުހުން ގޭބީސީތައް ކޮމިޓީ،	ރަށުކައުންސިލް	5 އަހަރު	3000/- ރުފިޔާ	6000/- ރުފިޔާ
ޕީ ހެދުމުގެ އިންތިޒާމްތައް ހަމަޖެއްސުމުގައި ހަރަކާތްތެރިވުން	ރައްޔިތުންނާއި ޙިއްސާކުރުން، ފާހަގަކުރާ ގޮތުގެ މަޢުލޫމާތު، ފައިސާ ބަލައިގަންނަ އިންތިޒާމު ކައުންސިލުގައި ހަމަޖެއްސުން،	ފުލުހުން ގޭބީސީތައް ކޮމިޓީ ،	ރަށުކައުންސިލް	5 އަހަރު	4000/- ރުފިޔާ	6000/- ރުފިޔާ

ލަނޑުދަނޑި 9	އާއްމު ތަނތަނުގައި ސަރަހައްދުތައް ސާފުކުރުމަށް ބޭނުންކުރާ ވަސީލަތްތައް އިންތިޒާމުކޮށް ހަމަޖެއްސުން					
މިހާރު އޮތް ހާލަތު	އާއްމު ސާފުކުރުމުގެ ވަސީލަތް ސަރަހައްދުތައް ކުނިކަމުން ގެންދޭ					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަންދާޒާކުރާ މުއްދަތު	ކެޕިޓަލް ޚަރަދު	ދެމެހެއްޓުމަށް ކުރާ ޚަރަދު
ކުނި ޖަމާކުރުމުގެ ތަކެތި ސަރަހައްދުތަކުގައި ޖެހުން ބަހައްޓުން	ބަޖެޓް ހޯދުން	ރަށު ކައުންސިލު، ސިޔާސީ މުއައްސަސާތަކާއި ފަރާތްތައް، ވިޔަފާރިވެރިން، އެހީތެރި ފަރާތްތައް	ރަށު ކައުންސިލް	5 އަހަރު	12000/- ރުފިޔާ	2500/- ރުފިޔާ
ވީލްބެރޯ ހޯދުން	ބަޖެޓް ހޯދުން	ރަށުކައުންސިލު، ސިޔާސީ މުއައްސަސާތަކާއި ފަރާތްތައް، ވިޔަފާރިވެރިން، އެހީތެރި ފަރާތްތައް	ރަށު ކައުންސިލް	5 އަހަރު	85000/- ރުފިޔާ	4000/- ރުފިޔާ

ލަނޑުދަނޑި 10	ހުސްކޮށް ކުނީގެ ބޭފުޅުންގެ ހަރަކާތްތައް އިސްލާހު ގެއްލުން ތަންފީޒުކުރުން					
މިހާރު އޮތް ހާލަތު	ސިޔާސީ މުއައްސަސާތަކާއި ތަޢުލީމީ ގޮތުން ބައިވެރިވުން އާލާވާ ހުސް ކުނި އަންދާލުމުގެ ސަބަބުން ދިމާވާ ގެއްލުން ވިލުގެ ދައްކާ					
ހަރަކާތްތައް	ވަސީލަތްތައް	ބައިވެރިވާ ފަރާތްތައް	ޒިންމާވާ ފަރާތް	އަންދާޒާކުރާ މުއްދަތު	ކެޕިޓަލް ޚަރަދު	ދެމެހެއްޓުމަށް ކުރާ ޚަރަދު
ސިޔާސީ މުއައްސަސާތަކާއި ތަޢުލީމީ ބައިވެރިވުމުގެ އެއްބަސްވުމެއްގައި އޮފީސް ފަރާތްތަކުން އެކުލަވާ ހުސް ކުނީގެ ބޭނުންތައް އަޅުވާފައިވާ ތަނުން ބޭނުން ކުރާކަން މޮނިޓަރ ހެދުން		ސިޔާސީ މުއައްސަސާތަކާ ތަޢުލީމީ ބައިވެރިން	ރަށު ކައުންސިލް	5 އަހަރު	4000/- ރުފިޔާ	1500/- ރުފިޔާ

ކުނި މެނޭޖްކުރުމުގައި ބޭނުންކުރާނެ މައިގަނޑު އުސޫލުތައް

1. ގޭބީސީގެ ފެންވަރުގައި 5 ބައަކަށް ކުނި ވަކިކުރުން. އެއީ ބަދިގެއިން އުކާލާ ކާބޯތަކެތީގެ ބާވަތްތައް ނޫނީ ދަގަނޑު ޕްލާސްޓިކްގެ ބާވަތްތައް ވަކިކޮށް އެހެނިހެން ކުނިބާވަތް އެއްކުރުން. އަދި މިގޮތުން އެއްކުރާ ބާވަތްތައް ކުނިކޮށިގައި އިތުރު ބައިތަކަށް ވަކިކުރުމަށްޓަކައި (މިސާލަކަށް: ފޮތްކުނި، ތަކެތި، ދަގަނޑު، ފުޅި، ކަރުދާސް...)

2. ގޭބީސީތަކާއި ވިޔަފާރިތަކާއި އަދި މުވައްސަސާތަކުން ދުވާލަކު 1 ފަހަރު ކުނި އުކާލުމުގެ ހިދުމަތް ފޯރުކޮށްދިނުން.

3. ކުނިކޮށްބަރު ކުނިގެންދިއުމާއި، ކުނިކޮށީގެ ވަސީލަތްތައް ބެލެހެއްޓުމާ އަދި ހިންގުމަށް ރަށުގެ އަމިއްލަ ކުންފުންޏެއް، ޕްރައިވެޓް ސެކްޓަރު، ލޯކަލް އިންވެސްޓްމަންޓް ނުވަތަ ޖަމްޢިއްޔާ/ ޖަމާޢަތްތަކާއި ހަވާލުކުރެވޭނެވެ.

4. ހިދުމަތަށް ކުނިގެއްސޭ ފީއެއް ކަނޑައި ގޭބީސީތަކާއި ވިޔަފާރިތަކާއި އަދި މުވައްސަސާތަކުން ކައުންސިލަށް ނެގުމުގެ އިންތިޒާމް ހަމަޖައްސައި އެކަން ތަންފީޒުކުރުން.

Secretariat of the Vaikaradhoo Council, Thuh'koiHingun, H Dh. Vaikaradhoo- 02140, Rep of Maldives. ވައިކަރަދޫ ކައުންސިލްގެ އިދާރާ، ތުއްކޮއިހިނގުން، ހދ. ވައިކަރަދޫ – 02140، ދިވެހިރާއްޖެ
Phone: (+960)6520046 Fax: (+960)6520556 Email: info@vaikaradhoo.gov.mvWebsite: www.vaikaradhoo.gov.mvPO Box: RC-047

5. ހދ. އަތޮޅުގައި ޤާއިމުކުރެވޭ ރީޖަނަލް ވޭސްޓް މެނޭޖްމަންޓް ފެސިލިޓީ ޤާއިމުކުރެވެންދެން، ކޮންމެ 3 މަހުން 1 މަހު، ރަށުގައި ނައްތާނުލެވޭ ކުނި ތިލަފުށިއަށް ގެންދިއުން. ރީޖަނަލް ފެސިލިޓީ ޤާއިމުކުރެވުމުން މަހަކު 2 ފަހަރު އެފެސިލިޓީއަށް ފޮނުވުން.

6. ސިއްހީ ދާއިރާގެ ކުނި (ކްލިނިކަލް ވޭސްޓް) ސިއްހީ މަރުކަޒުގައި ނައްތުން. އެފަދަ ތަކެތި ކުނިކޮށިން އެކަނިކުރުން.

މިޕްލޭން ތަންފީޒުކުރުމުގައި އަޅާ ފިޔަވަޅުތަކާ ދައުރު

1. ރަށު ކައުންސިލްގެ ފަރާތުން އިސްނަގައިގެން ރަށުގެ މުހިއްމު ދާއިރާތަކުން ބޭފުޅުން ބައިވެރިކޮށްގެން ވޭސްޓް މެނޭޖްމަންޓް ކޮމިޓީއެއް އެކުލަވާލައި އެކޮމިޓީގެ މަޝްވަރާގެ މަތިން މިޕްލޭން ތަންފީޒުކުރަމުން ދިއުން.
2. ވޭސްޓް މެނޭޖްމަންޓް ކޮމިޓީގެ ޓާމްސްއޮފްރެފަރެންސް އެއްގެ ގޮތުގައި ރަށު ކައުންސިލްގެ ފުލްބޯޑަށް ހަމަޖެއްސުން.
3. ރަށުގައި ކުނި މެނޭޖްކުރުމުގައި ހަރަކާތްތެރިވާ ފަރާތްތަކުގެ ދައުރުތަކާއި އުސޫލުތައް ވޭސްޓް މެނޭޖްމަންޓް ކޮމިޓީގެ މަޝްވަރާއާއިއެކު އެކުލަވާލައި، އެއުސޫލުތައް ތަންފީޒުކުރުމުގެ މަސްއޫލިއްޔަތު ރަށު ކައުންސިލުން ކުރުން.
4. ކުނިކޮށްޓަށް ކުނިގެންދިއުމާއި، ކުނިކޮށީގެ މަސައްކަތްތަކުގެ ބަޖެޓް އަދި ހިންގާނީ ރަށުގެ އަމިއްލަ ކުނިފަންޑެއް، ޕްރޮސެސިންގ، ލޯކަލް އިންވެސްޓްމަންޓެއް ނުވަތަ ޕަބްލިކް/ ޕްރައިވެޓް ޕާޓްނަރޝިޕުން ހޯދުން.
5. ފުރަތަމަ 3 މަސްދުވަހުގެ ތެރޭގައި ދުވާލަކު 1 ފަހަރު ކުނިކޮށީގެ މަސައްކަތް ހިނގާ ނުހިނގާގޮތް ރަށުކައުންސިލުން ވޭސްޓް މެނޭޖްމަންޓް ކޮމިޓީގެ ފަރާތުން ބެލުން. އަދި 4 ވަނަ މަހުން ފެށިގެން ހަފްތާއަކު ދެފަހަރު މަސައްކަތް ހިނގާ ނުހިނގާގޮތް ބަލައި އިސްލާހުކުރަންވީ ކަންތައްތައް ފާހަގަކޮށް އަމަލުކުރަމުން ދިއުން.
6. މިޕްލޭން ތަންފީޒުކުރުމުގައި އެންވަޔަރަމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީއާއި މިނިސްޓްރީ އެންވަޔަރަމަންޓަލް މެނޭޖްމަންޓް ޕްރޮޖެކްޓްގެ ފަރާތުން މާލީ ފަންނީ އެހީތެރިކަން ލިބިދިނުން.

ޚިދުމަތަށް ދޭ ނަގާ މިންވަރާއި އުސޫލު

އަދަދު	ކުނިއުފެދޭ ތަންތަން	ރުފިޔާ
254	ގޭބިސީ	100
21	ކުދި ވިޔަފާރި (ފިހާރަތައް)	120
2	ކެފޭ/ ރެސްޓޯރަންޓް	130
3	ވަރކްޝޮޕް	130
7	ސަރުކާރުގެ އިދާރާތައް/ އިޖުތިމާއީ ޚިދުމަތް/ ފަރަހަ	200
2	އެޓު ހަރުގެ(ދޯނި ބަނދެއި މަރާމާތުގެ ހަރަކާތް)	150

ވައިކަރަދޫ ކައުންސިލްގެ އިދާރާ، ތުއްކޮއިހިނގުން، ހދ. ވައިކަރަދޫ – 02140، ދިވެހިރާއްޖެ
Secretariat of the Vaikaradhoo Council, Thuh'koiHingun, H Dh. Vaikaradhoo- 02140, Rep of Maldives.
Phone: (+960)6520046 Fax: (+960)6520556 Email: info@vaikaradhoo.gov.mvWebsite: www.vaikaradhoo.gov.mvPO Box: RC-047

2	ބޭބީ ޑައިޕަރ (ދިރާގު/ވަޓަނިއްޔާ)	150
2	ޓަމިއްނާ ޓަގާއަޕްޓަރ	100

އެނެކްސް 1

ހދ.ވައިކަރަދޫގެ ކުނިމެނޭޖްކުރުމުގެ ޕްލޭން ހެދުމާއި ޕްލޭން ހިންގާ ބެލެހެއްޓުމާއިބެހޭ ކޮމިޓީ

1)- އަލްފާޟިލް އިބްރާހީމް ވަސީމް އަހަން، ހދ. ވައިކަރަދޫ (ވައިކަރަދޫ ކައުންސިލް)
2)- އަލްފާޟިލް އިބްރާހީމް ވަޙީދު ވޭރު، ހދ. ވައިކަރަދޫ (ވައިކަރަދޫ ކައުންސިލް)
3)- އަލްފާޟިލް ޢަބްދުالله މުޙައްމަދު ޢައްޒާ، ހދ. ވައިކަރަދޫ (ވައިކަރަދޫ ކައުންސިލް)
4)- އަލްފާޟިލް ޙުސައިން މުޙައްމަދު ދަފްތަރު ނަންބަރު ހސ 3043 މާލެ (ވައިކަރަދޫ ކައުންސިލް)
5)- އަލްފާޟިލް އަޙްމަދު ޢާރިފު ވިލާދީސޯސަން، ހދ. ވައިކަރަދޫ (ވައިކަރަދޫ ކައުންސިލް)
6)- އަލްފާޟިލް މުޙައްމަދު ރިޟްވީ ސައިމާގެ، ހދ. ވައިކަރަދޫ (ހދ. އަތޮޅު މަދަރުސާ)
7)- އަލްފާޟިލް މުޙައްމަދު ޝަފީޤު ކަނބަރު، ހދ. ވައިކަރަދޫ (ހދ. އަތޮޅު މަދަރުސާ)
8)- އަލްފާޟިލް އަޙްމަދު ސާމިރު ޙުސައިން މާފަރު، ހދ. ވައިކަރަދޫ (ވައިކަރަދޫ ސިއްޙީމަރުކަޒު)
9)- އަލްފާޟިލް އަބްދުލްލަޠީފު އަލީ ނުދުންގެ، ހދ. ވައިކަރަދޫ (ވައިކަރަދޫ ސިއްޙީމަރުކަޒު)
10)- އަލްފާޟިލް އަލީ ޝާކިރު ކުޅެފަރު، ހދ. ވައިކަރަދޫ (ފެނަކަ ކޯޕަރޭޝަން ވައިކަރަދޫ ބްރާންޗް)
11)- އަލްފާޟިލް ޙަސަން ނަސީމް ކޮށަނޅުވިލާ، ހދ. ވައިކަރަދޫ (ހދ. އަތޮޅު މަދަރުސާ ޕީ ޓީ އޭ)
12)- އަލްފާޟިލް މުޙައްމަދު ފަތުޙީ ގުރަގޮޅި، ހދ. ވައިކަރަދޫ (ހދ. އަތޮޅު މަދަރުސާ ޕީ ޓީ އޭ)
13)- މިސްޓަރ ޖޯއެލްފިލިޕް ރާޖު (ހދ. އަތޮޅު މަދަރުސާގެ ސައިންސް އެންޑް އިންވަޔަރަންމަންޓް ކްލަބް)
14)- އަލްފާޟިލް މުޙައްމަދު ޢަޒީޒު މިވަރު، ހދ. ވައިކަރަދޫ (ވިޝަން ޖަމްޢިއްޔާ)
15)- އަލްފާޟިލް އަލީ މުހުސިނު ނޫރިޔާ، ހދ. ވައިކަރަދޫ (ވިޔަފާރިވެރިއެއް)
16)- އަލްފާޟިލް މުޙައްމަދު ޢާރިފު ފަސްދިގާ، ހދ. ވައިކަރަދޫ (ވިޔަފާރިވެރިއެއް)
17)- އަލްފާޟިލާ ފާޠިމަތު ޢަނާނާ ކުރިބޮޅި، ހދ. ވައިކަރަދޫ (ކުނިކަނި)
18)- އަލްފާޟިލް މުޙައްމަދު އާމިރު އަޒްމީ، ހދ. ވައިކަރަދޫ (ރައްޔިތުންގެ ފޯރަމް)
19)- އަލްފާޟިލް މުޙައްމަދު ރާމިޒު ދޫރިމާރުގެ، ހދ. ވައިކަރަދޫ (ރައްޔިތުންގެ ފޯރަމް)

ވައިކަރަދޫ ކައުންސިލްގެ އިދާރާ، ދުވޮއިހިނގުން، ހދ. ވައިކަރަދޫ - 02140، ދިވެހިރާއްޖެ
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އެނެކްސް 2

ކުނި މެނޭޖްކުރުމަށް ބޭނުންވާ އިކުއިޕްމަންޓްތަކުގެ ލިސްޓު

ކުނި އުފުލާ ޓްރަކް (އިސްޓުޓު 5-8-12 އޮފް 2)	1	
ކުނި އުފުލުމަށް ބަކާއި ދަމާ ގާޑިޔާ	2	
ޕްލާސްޓިކް ޝޮވެލް	2	
ދަތް ފިއްތާ ގުޝިން	2	
ގްލާސް ކްރަޝަރ	2	
މެއުދަން ވިރުވައިގެން ތަކެތި ހަދާ މެޝިން	2	
ޕްލާސްޓިކު ވިރުވައިގެން ތަކެތި ހަދާ މެޝިން	2	
ވޭޓް މީޓަރ	2	
ޕްލާސްޓިކް ޑަސްޓްބިން	40	
އުދުލި	15	
އަޕްރަނު	10	
މަހަސްދަމި	15	
ވިލްބަރޯ	6	
ބާލިދީ (ޕްލާސްޓިކް)	10	
އަންގި (ކެމިކަލް ޕްރޮޓެކްޓިވް)	20	ޑަޒަން
ތާސިދީ	2	
ދޮރި (ބޫޓު)	4	
ޕްރޮޓެކްޓިވް ސޫޓު	2	ޑަޒަން
އަޔަރފޯން ނިއްވާ ސާމާނު	2	ސެޓު
ގޮގްލްސް	2	ޑަޒަން
ސޭފްޓީ ބޫޓު	2	ޑަޒަން
ސޭފްޓީ ހެލްމެޓް	2	ޑަޒަން

ވައިކަރަދޫ ކައުންސިލްގެ އިދާރާ، ތުއްކޮއިހިނގުން، ހދ. ވައިކަރަދޫ - 02140، ދިވެހިރާއްޖެ. Secretariat of the Vaikaradhoo Council, Thuh'koiHingun, H Dh. Vaikaradhoo- 02140, Rep of Maldives.
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ކުނިމެނޭޖް ކުރުމުގެ ނިޒާމުގައި ޚިދުމަތައިގެން ލިބޭނެކަމަށް ލަފާކުރާ އާމްދަނީ

#	ތަފްސީލު	ރޭޓު	އަދަދު	ޖުމްލަ
1	ގޭބިސީ ތަކުން	100.00	254	25400.00
2	ކުނި ވިޔަފާރި (ފިހާރަތައް)	150.00	21	3150.00
3	ކެފޭ/ ރެސްޓޯރަންޓް	150.00	2	300.00
4	ވަޑާންގެ	150.00	3	450.00
6	ސަރުކާރުގެ އިދާރާތައް/ އިޖުތިމާއީ ޖަމްޢިއްޔާ	200.00	7	1400.00
7	އޮޑި ހަދާގެ	150.00	2	300.00
8	ބޮޑެތި ވިޔަފާރި (ދިރާގު/ވަޓަނިއްޔާ)	150.00	2	300.00
9	ޖުމްއާމިސްކިތް / ޖަމާޢަތްމިސްކިތް	100.00	1	100.00
	ޖުމްލަ			**31400.00**

ކުނި މެނޭޖުކުރުމަށް ހިނގާނެ ޚަރަދު

ކުނި މެނޭޖުކުރުމަށް ބޭނުންވާ އިކުއިޕްމަންޓްތައް ލިބުމާއި އެކު ދުވަހުން ދުވަހަށް ކުނިމެނޭޖުކުރުމުގެ ކަންކަން ކުރުމަށް މަހަކު ހިނގާނެކަމަށް އަންދާޒާކުރެވޭ ޚަރަދުތަކުގެ ތަފްސީލް ތިރީގައި އެވަނީއެވެ.

#	ތަފްސީލު	ރޭޓު	އަދަދު	ޖުމްލަ
1	ކުނި މެނޭޖުކުރުމުގެ މުވައްޒަފުންގެ މުސާރަ	4100.00/-ރ	4	ރުފިޔާ 16400.00
2	ކުނި މެނޭޖުކުރުމުގެ ނިޒާމުގެ ކަރަންޓް ޚަރަދު	5000.00/-ރ	1	ރުފިޔާ 5000.00
3	ކުނި މެނޭޖުކުރުމުގެ ވެހިކަލްގެ ފިއުލް	3500.00/-ރ	1	ރުފިޔާ 3500.00
4	ކުނި މެނޭޖުކުރުމުގެ އިކުއިޕްމަންޓް މަރާމާތު ޚަރަދު	2000.00/-ރ	1	ރުފިޔާ 2000.00
5	ކުނި އުފުލުމުގެ ޚަރަދު	4000.00/-ރ	1	ރުފިޔާ 4000.00
	ޖުމްލަ			**ރުފިޔާ 30900.00**

ކުނިމެނޭޖް ކުރުމުގެ ނިޒާމުގައި ބޭނުން ކުރާ ސްލޯގަން

"ސާފުސާފު ވައިކަރަދޫއަކަށް - މަގޭ ފެހުރި ބަނޑުގެ، މަގޭ ފެހުރި ޖަންގާ"

ސަފަރު 12ގެ 12

بسم الله الرحمن الرحيم

Environmental Protection Agency

އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ

EPA ENVIRONMENTAL PROTECTION AGENCY

ނަންބަރު: 203-EIARES/438/2016/78

ސްކޯޕިން ކުރުމަށްފަހު ނިންމިގޮތް

މިއީ ހއ. މާރަނދޫ ސްކޫލް ފުޓްބޯލް ދަނޑަށް ސިންތެޓިކް ޓާފްއެޅުމުގެ މަޝްރޫއުއާ ގުޅިގެން ސްކޯޕިން ކުރުމަށްފަހު ނިންމިގޮތް އެންވަޔަރަމަންޓަލް ކޮންސަލްޓަންޓާއި މިނިސްޓްރީ އާއި އެންވަޔަރަންމަންޓަލް އެޖެންސީ އަށް ފޮނުވާ ލިޔުމެވެ.

☐	މި މަޝްރޫއުގެ ސަބަބުން ތިމާވެށްޓަށް ނޭދެވޭ ބޮޑު އަސަރުތައް ކުރާނެ ކަމަށް ފެނެއެވެ. ވީމާ، ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބެލުމަށް ދިރާސާއެއް ހުށަހަޅާށެވެ.
☐	މި މަޝްރޫއުގެ މަސައްކަތްތަކަށް ތިމާވެށީގެ ފުރަތަމަ ދިރާސާއެއް ހުށަހަޅާށެވެ.
V	މި މަޝްރޫއުގެ މަސައްކަތްތަކަށް ތިމާވެށީގެ މެނޭޖްމަންޓް ޕްލޭނެއް ހުށަހަޅާށެވެ.
☐	މި މަޝްރޫއުގެ ސަބަބުން ތިމާވެށްޓަށް ނޭދެވޭ ބޮޑު އަސަރުތައް ކުރާނެ ކަމަށް ނުފެނެއެވެ. ވީމާ، މަޝްރޫއުގެ މަސައްކަތްތައް ކުރިއަށް ގެންދިއުމަށް އެއްވެސް ހުރަހެއް ނެތެވެ.
☐	މި މަޝްރޫއުގެ ސަބަބުން ތިމާވެށްޓަށް ކުރާނެ އަސަރުތަކާ ގުޅިގެން މިނިސްޓްރީން އެއްވެސް މަސައްކަތެއް ކުރުމަށް ހުއްދަ ނުދެވޭނެއެވެ.

ސްކޯޕިން ކުރި އިދާރާ: އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ

ނަން: އިބްރާހިމް ނަޢީމް

ސޮއި:

މަޤާމު: ޑިރެކްޓަރ ޖެނެރަލް

ތާރީޚު: 5 ޖޫން 2016

ފޯމް ނަ. 001

ނަންބަރު: 203-EIARES/438/2016/79

ސްކޯޕިން ކުރުމަށްފަހު ނިންމިގޮތް

މިއީ ހއ. މުރައިދޫ ސޮލިޑް ވޭސްޓް މެނޭޖްމަންޓް ސިސްޓަމް ޕްރޮޖެކްޓުގެ މަޝްރޫއާއި ގުޅިގެން ސްކޯޕިން ކުރުމަށްފަހު ނިންމިގޮތް އެންގުމަށްޓަކައި މިނިސްޓްރީ އޮފް އެންވަޔަރަންމަންޓް އެންޑް އެނަރޖީއަށް ފޮނުވައި ދަންނަވަމެވެ.

- [ ] މި މަޝްރޫއުގެ ސަބަބުން ތިމާވެށްޓަށް ނުރައްކާ ބޮޑު އަސަރުތައް ކުރާނެ ކަމަށް ފެންނާތީ. ވީމާ، ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބަޔާންކުރާ ރިޕޯޓެއް ހުށަހަޅަންވާނެއެވެ.
- [ ] މި މަޝްރޫއުގެ މަސައްކަތްތަކަށް ތިމާވެށީގެ ފުރަތަމަ ދިރާސާއެއް ހުށަހަޅަންވާނެ.
- [x] މި މަޝްރޫއުގެ މަސައްކަތްތަކަށް ތިމާވެށީގެ މެނޭޖްމަންޓް ޕްލޭނެއް ހުށަހަޅަންވާނެ.
- [ ] މި މަޝްރޫއުގެ ސަބަބުން ތިމާވެށްޓަށް ނުރައްކާ ބޮޑު އަސަރުތައް ކުރާނެ ކަމަށް ނުފެންނާތީ. ވީމާ، މި މަޝްރޫއުގެ މަސައްކަތް ކުރިއަށް ގެންދިއުން އެންމެ ރަނގަޅުކަމުގައި ދަންނަވަމެވެ.
- [ ] މި މަޝްރޫއުގެ ސަބަބުން ތިމާވެށްޓަށް ކުރާނެ އަސަރުތައް ކުޑަކުރުމަށް މިނިސްޓްރީން އަންގާ ފިޔަވަޅުތަކާއިއެކު މަސައްކަތް ކުރުމަށް ހުއްދަ ދެވޭނެކަމަށް ދަންނަވަމެވެ.

ސްކޯޕިން ކުރި އިދާރާ: އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އޭޖެންސީ

ނަން: އިބްރާހިމް ނައީމް

ސޮއި:

މަޤާމު: ޑިރެކްޓަރ ޖެނެރަލް

ތާރީޚު: 5 މޭ 2016

އީ.އެސް.އޭ 001

Environmental Protection Agency

އެންވަޔަރަމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ

ނަންބަރު: 203-EIARES/438/2016/73

ސްކޯޕިންގ ކުރުމަށްފަހު ނިންމުމެވެ

މިއީ ހދ. ކުރިނބީގައި ސޯލިޑް ވޭސްޓް މެނޭޖްމަންޓް ސިސްޓަމް ޤާއިމްކުރުމުގެ މަޝްރޫއާއި ގުޅިގެން ސްކޯޕިންގ ކުރުމަށްފަހު ނިންމުމެވެ
އެންމެފަހުގައި މިނިސްޓްރީ އޮފް އެންވަޔަރަމަންޓް އެންޑް އެނަރޖީއަށް ފޮނުވި ރަސްމީ ލިޔުމެވެ.

☐	މި މަޝްރޫއުގެ ސަބަބުން ތިމާވެއްޓަށް ނުރައްކާ ބޮޑު އަސަރުތައް ކުރިމަތިވާނެ ކަމަށް ފެނެއެވެ. މީގެ، ތިމާވެއްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބައްލަވައިދޭ ރިޕޯޓެއް ހުށަހަޅަންވާނެ.
☐	މި މަޝްރޫއުގެ މަސައްކަތްތަކަށް ތިމާވެށީގެ ފުރިހަމަ ދިރާސާއެއް ހުށަހަޅަންވާނެ.
√	މި މަޝްރޫއުގެ މަސައްކަތްތަކަށް ތިމާވެށީގެ މެނޭޖްމަންޓް ޕްލޭނެއް ހުށަހަޅަންވާނެ.
☐	މި މަޝްރޫއުގެ ސަބަބުން ތިމާވެއްޓަށް ނުރައްކާ ބޮޑު އަސަރުތައް ކުރިމަތިވާކަން ނުފެނެއެވެ. މީގެ، މަޝްރޫއުގެ މަސައްކަތްކުރިއަށް ގެންދިއުން އެންމެ ރަނގަޅުކަމުގައި ދަންނަވަމެވެ.
☐	މި މަޝްރޫއުގެ ސަބަބުން ތިމާވެއްޓަށް ކުރިމަތިވާ އަސަރުތައް ކުޑަކުރުމަށް މިނިސްޓްރީން އަންގާ ފިޔަވަޅުތަކާއި މަސައްކަތް ކުރިއަށްގެންދާކަމަށް ދަންނަވަމެވެ.

ސްކޯޕިންގ ކުރި އިދާރާ: އެންވަޔަރަމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ

ނަން: އިބްރާހީމް ނަޢީމް — ސޮއި:

މަޤާމު: ޑިރެކްޓަރ ޖެނަރަލް — ތާރީޚު: 5 މެއި 2016

އީ.ސީ.އޭ 004

Environmental Protection Agency

އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ

ނަންބަރު: 203-EIARES/438/2016/100

ސްކޯޕިންގ ކޮމިޓީގެ ނިންމުން

މިއީ ހދ. ވައިކަރަދޫގައި ވޭސްޓް ޑްރެޖިންގ ސެންޓަރ މަސްދޫއާއި ގުޅޭގޮތުން ސްކޯޕިންގ ކޮމިޓީގެ ނިންމުން އެންވަޔަރަންމަންޓަލް މިނިސްޓްރީ އޮފް އެންވަޔަރަންމަންޓް އެންޑް އެނަރޖީއަށް ދަންނަވާ ރަސްމީ ލިޔުމެވެ.

☐	މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެށްޓަށް ނޭދެވޭ ބޮޑު އަސަރުތައް ކޮށްފާނެ ކަމަށް ފެނެއެވެ. ވީމާ، ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބަޔާންކުރާ ރިޕޯޓެއް ހުށަހަޅަންވާނެއެވެ.
☐	މި މަޝްރޫޢުގެ މަސައްކަތްތަކަށް ތިމާވެށީގެ ފުރިހަމަ ދިރާސާއެއް ހުށަހަޅަންވާނެއެވެ.
√	މި މަޝްރޫޢުގެ މަސައްކަތްތަކަށް ތިމާވެށީގެ ބޭސްލައިން ޑޭޓާ ހުށަހަޅަންވާނެއެވެ.
☐	މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެށްޓަށް ނޭދެވޭ ބޮޑު އަސަރުތައް ކޮށްފާނެ ކަމަށް ނުފެނެއެވެ. ވީމާ، މި މަޝްރޫޢުގެ މަސައްކަތް ކުރިއަށް ގެންދިއުމަށް އެއްވެސް ހުރަހެއް ނެތްކަމުގައި ދަންނަވަމެވެ.
☐	މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެށްޓަށް ކޮށްފާނެ އަސަރުތައް ކުޑަކުރުމަށް މިނިސްޓްރީން އަންގާ ފިޔަވަޅުތަކާއި މަސައްކަތް ކުރުމުގެ ހުއްދަ ދޫކުރާނަމަ ދަންނަވަމެވެ.

މިއީ ތިމާވެށީގެ ގޮތުން ކުރިމަތިވާ ސްކޯޕިންގ ކޮމިޓީގެ ނިންމުމެވެ. ވީމާ، މި މަސައްކަތް ކުރުމަށް ސަރުކާރުގެ އެހެން ކަމާބެހޭ އިދާރާ ތަކުން ނަގަންޖެހޭ ހުއްދަ ހޯދުމަށްފަހު ނަގަންޖެހޭނެކަމުގައި ދަންނަވަމެވެ.

ސްކޯޕިންގ ކޮމިޓީ އިދާރާ: އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ

ނަން: ހަމީދު އަހުމަދު

ސޮއި:

މަޤާމު: ޑިރެކްޓަރ، އެންވަޔަރަންމަންޓް އެސެސްމަންޓް

ތާރީޚު: 23 މޭ 2016

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Environmental Protection Agency
އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ

ނަންބަރު: 203-EIARES/438/2017/62

ސްކޯޕިންގ ކޮމެޓީގެ ނިންމުން

މިއީ ހދ.ހިރިމަރަދޫގައި ކުރިއަށްގެންދާ މަދަރުސާގެ ޢިމާރާތްކުރުމުގެ މަޝްރޫޢުގެ ސްކޯޕިންގ ކޮމެޓީގެ ނިންމުން އެންވަޔަރަމަންޓް މިނިސްޓްރީ އާއި އެންވަޔަރަންމަންޓަލް އެޖެންސީ އެއްބަސްވެވުނު ގޮތުގެ ނިންމުމެވެ.

☐	މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެށްޓަށް ނުރައްކާ ބޮޑު އަސަރުތައް ކޯރުން ކަމަށް ފެނުނެވެ. ވީމާ، ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބެލުމަށް ދިރާސާއެއް ހެދުމަށް ނިންމުނެވެ.
☐	މި މަޝްރޫޢުގެ މަސައްކަތްތަކަށް ތިމާވެށީގެ ފުރިހަމަ ދިރާސާއެއް ހެދުމަށް ނިންމުނެވެ.
V	މި މަޝްރޫޢުގެ މަސައްކަތްތަކަށް ތިމާވެށީގެ މެނޭޖްމަންޓް ޕްލޭނެއް ހެދުމަށް ނިންމުނެވެ.
☐	މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެށްޓަށް ނުރައްކާ ބޮޑު އަސަރުތައް ކޯރުން ނުފެނެއެވެ. ވީމާ، މި މަޝްރޫޢުގެ މަސައްކަތްތަކަށް ގެނެސްދިން އިސްލާހު އެކުލެވޭ ގޮތުގައި ހުއްދަ ދޫކުރެވޭނެއެވެ.
☐	މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެށްޓަށް ކުރާ އަސަރުތައް ކުޑަކުރުމަށް ދިރާސާކުރެވުން އެކުލެވޭ ޕްލޭނަކާއެކު މަސައްކަތް ކުރިއަށްގެންދާގޮތަށް ހުއްދަ ދޫކުރެވޭނެއެވެ.

މިއީ ތިމާވެށީގެ ޤާނޫނު ކުރިއަށްދާ ސްކޯޕިންގއާއި ބެހޭ އުސޫލެވެ. ވީމާ، މި މަސައްކަތް ކުރުމަށް ސަރުކާރުގެ އެހެން ދާއިރާތަކުން ބޭނުންވާ ހުއްދަތައް ހޯދުމަށް ފަހު ހުއްދަ ދޫކުރެވޭނެއެވެ.

ސްކޯޕިންގ ކުރި ފަރާތް: އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ

ނަން: އިބްރާހީމް ނައީމް

މަޤާމު: ޑިރެކްޓަރ ޖެނެރަލް

ސޮއި:

ތާރީޚް 09 މޭ 2017

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