Initial Environmental Examination

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MLD: Greater Malé Environmental Improvement and Waste Management Project

Outer Island Waste Management Improvements: Maafushi, South Male' Atoll

Prepared by the Ministry of Environment, Climate Change and Technology of the Republic of Maldives for the Asian Development Bank.

CURRENCY EQUIVALENTS
(as of 1 February 2021)

Currency unit	–	Rufiyaa (Rf)
Rf1.00	=	$0.06
$1.00	=	Rf 15.4

ABBREVIATIONS

ADB	-	Asian development bank
AHs	-	Affected households
BPEO	-	Best practicable environmental option
CDW	-	Construction and demolition waste
dB L_{eq}	-	Continuous noise equivalent level, expressed in decibels
DMS	-	Detailed measurement survey
EA	-	Executing agency
EMP	-	Environmental management plan
EPA	-	Environmental protection agency
EPPA	-	Environmental Protection and Preservation Act of 1993
ES	-	Environment specialist
GMEIWMP		Greater Malé Environmental Improvement and Waste Management Project
GOM	-	Government of the Republic of Maldives
GRC	-	Grievance redress mechanism
HHs	-	Households
IA	-	Implementing agency
IEE	-	Initial environmental examination
IMO	-	Independent monitoring organization
IRC	-	Inter-ministerial resettlement committee
IWMC	-	Island waste management centre
MECCT	-	Ministry of Environment, Climate Change and Technology
MF		Ministry of Finance
MMS		Maldives meteorological service
MNPHI		Ministry of National Planning, Housing and Infrastructure
NBS		National Bureau of Statistic
MPW/100ml	-	Most probable number (of bacteria) per 100 millilitres of water
NAPA	-	National Action Programme of Action (for climate change)
O&M	-	Operation and maintenance
PMDSC	-	Project Management, Design and Supervision Consultants
PMU	-	Project management unit
STELCO		State electric company
SWM		Solid waste management
RWMF	-	Regional waste management facility
WAMCO	-	Waste management corporation

NOTE

In this report, "$" refers to US dollars

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A. Introduction

1 The Greater Malé Environmental Improvement and Waste Management Project (GMEIWMP) will establish an integrated solid waste management system in Greater Malé and support Island Solid Waste Management Centers (ISWMCs) on 32 further inhabited islands in zone 3 which comprises the atolls of Alifu Alifu, Alifu Dhaalu, Kaafu, and Vaavu. Areas in which improvements will be introduced include collection, transfer, treatment using advanced waste-to-energy technology, disposal, recycling, dumpsite closure and remediation, and public awareness in reduce-reuse-recycle (3R); as well as institutional capacities for service delivery and environmental monitoring. The project will further improve climate change resilience and disaster risk management and contribute to reduced emissions into the environment.

2 The GMEIWMP will be implemented as two projects. Project 1 will comprise (i) improvements to the harbour and waste processing facilities on Thilafushi Island, including a construction and demolition waste (CDW) plant, recycling yard and end-of-life vehicle (ELV) dismantling workshop, (ii) an improved waste collection system (iii) improvements to transfer stations in Malé and Villingilli and Hulhumale, (iv) improvements to outer island waste management centres, (v) services for project management, design and supervision, (vi) services for awareness building and community outreach and (vi) a capacity building technical assistance (CDTA) for the environmental protection agency (EPA). Project 2 will comprise the construction of a new regional waste management facility (RWMF) including a waste to energy (WTE) plant and ash landfill, dumpsite rehabilitation and remediation, and project management and supervision support.

3 This initial environmental examination (IEE) was prepared for Maafushi Island IWMC based on information from the Feasibility Study and according to the ADB's Safeguard Policy Statement (2009) and the applicable legislation of the Republic of the Maldives, namely the Environmental Protection and Preservation Act (EPPA) of 1993, and the EIA Regulations (pursuant to the act) of 2007.

B. Existing Conditions of Maafushi Waste Management

4 In Maafushi waste is managed by means of open burning. Household waste collection is undertaken by a private party under a contract from Island Council. Households that are registered pay a fee and door to door collection is undertaken. In addition to the door to door, there are collection points where bins are placed. Registered households can dump their waste into these bins, and they are regularly transferred to the dumpsite on the island. An open truck is used to transfer wastes from households and collection points to waste dumpsite. At the waste dumpsite, there are no fences or any other structures. The only way of managing the waste in the island is through open burning to which Island Council get lot of complaints from the residents of the island. Maafushi Island has a lot of guesthouses and Island Council informed that when the waste is burnt, tourists complain about smoke and smell. The current waste management practices in the island are not appropriate. Therefore, Ministry of Environment, Climate Change and Technology proposes to build an ISWMC on the island to adopt more environment friendly and socially acceptable waste management practices on the island that would facilitate collection of waste from the households and business, manage the waste at the center and final transfer the residual waste to Thilafushi for final treatment and disposal. Currently, the island has one incinerator that is built in the area of the proposed IWMC. Accordingly, this incinerator will only be used until the transfer of waste from the island to the RWMF becomes operational.

C. Description of the subproject

5 The project involves constructing a new Island Solid Waste Management Center in Maafushi. The location proposed for the ISWMC is part of existing waste dump site on the southern side of the island near the football field. There is no fence or structures in the location. The proposed ISWMC is 26m x 34m. It will provide provision for storing different types of waste such as plastic, glass and metal. A concrete flooring will be made to handle waste and the leachate collected on the floor will be collected by a trench, treated in an oil trap and disposed into a septic tank. Small office building and water tank will be also built as part of the project. As part of the project waste collection bins and equipment will be provided to the island to improve waste collection and transport to the ISWMC. According to MECCT, waste generation has increased in Maafushi due to the high number of tourists visiting, and to manage waste there is a plan to operate the small incinerator on the island until waste transfer is operational, after which the incinerator will be decommissioned.

D. Impacts and Mitigation Measures

6 The report outlines environmental impacts of the proposed project that have been examined through a number of processes. These include consultations with the project development team, field surveys, observations and assessment, and field experience gained from similar projects implemented throughout the country. Potential positive and negative impacts on the environment have been considered. The assessment indicates environmental impacts, both during the construction and operation stage. Most of the environmental impacts of the project have been identified as resulting mainly from vegetation removal and potential air and water pollution. During the operational stage, impacts may arise during the transport of the waste to regional facility. Also, if the waste is not regularly transferred the smell and visual impacts may be felt by the community. Most of the negative impacts can be minimized by adopting best practices outlined in the mitigation measures of this report. The positive impacts include introduction of proper waste management system in the island. Proposed ISWMC will bring new employment opportunities as well and will benefit indirectly to the local tourism by making the island environment cleaner.

E. Categorization

7 ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB Safeguard Policy Statement (SPS), 2009. This IEE has been undertaken, which assesses in more detail the likely environmental impacts of the subproject and provides an environmental management plan (EMP) specifying the required mitigation and monitoring measures to ensure that these impacts are managed to acceptable levels. This IEE also emphasizes the need to incorporate pollution prevention and control technologies during the design, construction, and operation of the subproject and adhere to internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines.

F. Implementation Arrangement

8 The executing agency is the Ministry of Finance and Treasury. The implementing agency is the ministry of Environment, Climate Change and Technology, which will establish a PMU who will oversee overall project management with assistance from the PMDSC to implement the EMP.

9 For civil works, the Contractor will be required to (i) obtain all statutory clearances prior to commencement of civil works; (ii) establish an operational system for managing environmental impacts (iii) prepare a CEMP based on the EMP of this IEE, and submit to PMDSC for approval; (iv) carry out all of the monitoring and mitigation measures set forth in the approved CEMP; and (v) implement any corrective or preventative actions set out in safeguards monitoring reports that the executing agency or implementing agency will prepare from time to time to monitor

implementation of this IEE, EMP, and CEMP. The Contractor shall allocate a budget for compliance with these EMP measures, requirements and actions.

10 The island council will be responsible for the operation of the IWMC.

G. Environmental Monitoring

11 EMP compliance monitoring will be undertaken by the PMDSC with the help of the contractor and island council. Effects will be monitored by means of community feedback and laboratory testing.

12 A detailed environmental monitoring report is required to be compiled and submitted to the EPA based on the data collected for the monitoring the parameters included in the monitoring plan given in the EMP. the Contractor will submit weekly and monthly reports on the EMP implementation to the PMSDC/ PMU. The PMU with the support of PMDSC shall prepare semi-annual environmental monitoring reports to be submitted to ADB

H. Conclusion

13 Overall, the project will benefit island of Maafushi in the long term and will bring significant amount of environmental and socio-economic benefits, as it is conceived and designed to address environmental issues associated with existing practices of poor waste disposal including open burning of waste. The subproject will not have significant adverse environmental impacts and the impacts associated with the construction phase can be mitigated through effective implementation of the EMP.

1 Introduction

14 The Greater Malé Environmental Improvement and Waste Management Project (GMEIWMP) will establish an integrated solid waste management system in Greater Malé and support Island Waste Management Centers (IWMCs) on 32 further inhabited islands in zone 3 which comprises the atolls of Alifu Alifu, Alifu Dhaalu, Kaafu, and Vaavu. Areas in which improvements will be introduced include collection, transfer, treatment using advanced waste-to-energy technology, disposal, recycling, dumpsite closure and remediation, and public awareness in reduce-reuse-recycle (3R); as well as institutional capacities for service delivery and environmental monitoring. The project will further improve climate change resilience and disaster risk management and contribute to reduced emissions into the environment.

15 The GMEIWMP will be implemented as two projects. Project 1 will comprise (i) improvements to the harbour and waste processing facilities on Thilafushi Island, including a construction and demolition waste (CDW) plant, recycling yard and end-of-life vehicle (ELV) dismantling workshop, (ii) an improved waste collection system (iii) improvements to transfer stations in Malé and Villingilli and Hulhumale, (iv) improvements to outer island waste management centres, (v) services for project management, design and supervision, (vi) services for awareness building and community outreach and (vi) a capacity building technical assistance (CDTA) for the environmental protection agency (EPA). Project 2 will comprise the construction of a new regional waste management facility (RWMF) including a waste to energy (WTE) plant and ash landfill, dumpsite rehabilitation and remediation, and project management and supervision support.

16 This Environmental and Social Management Plan (ESMP) is prepared for the proposed waste management improvement project on the island of Maafushi. This EMP is undertaken in order to fulfil obligatory requirements of the National Environment Protection and Preservation Act, Law No. 4/93 and the EIA Regulations (pursuant to the act) of 2007 for the proposed development of Island Solid Waste Management Center (ISWMC) in K. Maafushi. This report has also been prepared to meet the IEE requirements according to the ADB's Safeguard Policy Statement (2009). The ESMP is based on design undertaken by Kocks Ingineure (Germany) in association with Water Solutions Ltd (Maldives), consultant to the Ministry of Environment, Climate Change and Technology and Energy (MECCT). No works will commence until approval of this report by EPA and ADB.

2 Description of the Project

2.1 Project Proponent

17 This project is proposed by the Government of the Maldives where the Ministry of Environment, Climate Change and Technology (MECCT) is the implementing agency. Within the Ministry, the Waste Management Department will be overall managing the project. ADB is financing the development of this project.

18 The Maldivian Government remains committed in solving the issues of solid waste management that are inherent in the greater Male' region. The Environmental Protection Agency (EPA) will oversee the enforcement of environmental standards during the development and operational phase of the project components.

2.2 Location and Study Area

19 Maafushi is located on the eastern rim of South Male' Atoll at the coordinates of 3°56'25.37"N and 73°29'22.86"E. It is in close proximity to Male' the Capital of Maldives. Maafushi can be reached by speedboat in about 30 minutes from Male'. Other than Maafushi, Guraidhoo and Gulhi are the only populated islands in South Male' Atoll. The following figures illustrate the location of Maafushi in South Male' Atoll

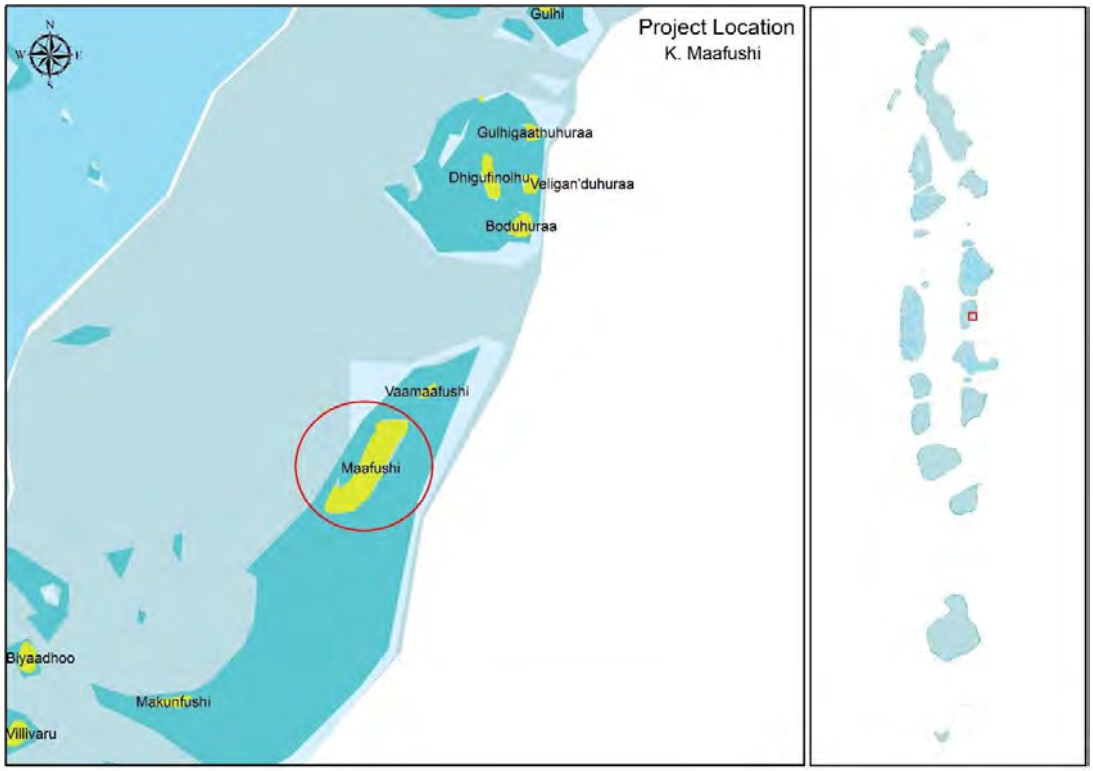


Figure 1: Location of Maafushi in South Male' Atoll

2.3 Need and justification for the project

20 Maldives has been facing serious issue of improper disposal of solid waste recent years due to, but not limited to, population increase, changing lifestyle, dependence on importation coupled with environmental challenges brought by the growing of economic industries such as tourism (Musthafa, 2019). The greater Male' area and its outer islands suffer from serious environmental pollution because of the inadequate collection and disposal of solid waste (ADB, 2018). Issue of improper waste management has deteriorated the liveability in the islands of Maldives. Zone 3 (Figure 2), where the project focuses, encompasses 35 inhabited islands including capital Male', Kaafu atoll, Vaavu atoll, Alifu Alifu and Alifu Dhaalu atoll.

21 The island does not have island waste management centre (IWMC). Waste is managed by means of open burning at the waste dumpsite. Household waste collection is undertaken by Island Council. Households that are registered pay a fee and door to door collection is undertaken. In addition to the door to door, there are collection points where bins are placed. Registered households can dump their waste into these bins, and they are regularly transferred to the dumpsite on the island. Others bring waste directly to dumpsite. An open truck is used to transfer wastes from households and collection points to waste dumpsite. Island Council get a lot of complaints from the residents and tourist from the guesthouses on the island. At the waste dumpsite there is some fencing surrounding the site where open burning takes place, with no other structures in the area. In the case of food waste, some is disposed of via sea dumping. Maafushi has an estimated 1,733 kg/d of waste produced as of 2018[1]. This figure has increased to an estimated 4500 kg/d in 2020[2].

[1] Water Solutions in association with Kocks Ingenieure (2018) Consultancy Services for Feasibility Study for an Integrated Solid Waste Management System for Zone III and Preparation of Engineering Design of the Regional Waste Management Facility at Thilafushi

[2] Water Solutions (2020) ENVIRONMENTAL IMPACT ASSESSMENT For the Installation of an Incinerator at Maafushi, Kaafu Atoll

Figure 2: Photos from Maafushi. (a) Drone photo of current waste dump site (b) open burning at waste dump site

2.4 Current waste management practices

22 Maafushi Island does not have an island waste management center. Waste is managed by open burning, in the south-eastern side of the island. As per island council, wastes are collected from 368 households, 25 restaurants, 41 shops, health center and 55 guesthouses. However, other infrastructure like dive schools, schools and powerhouse also has some input.

23 Waste management in Maafushi is managed by island council by contracting the waste collection work to a private party. Waste is collected using two methods; Door to Door (D2D) and Collection Points (CP), however individuals can directly dump the waste into the dumpsite if they wish to do it. The inhabitants must pay for this service. Total of 90 households are registered and they pay 100MVR per month for collection service. For CP 120 and 240 L bins are being used. Wastes collected are not segregated. There is a fence installed in the lagoon of this area and waste is dumped inside the fence. But some of the waste was observed to be escaping the fence to the marine environment. Food waste area being dumped into the ocean.

24 According to island council managing waste management service is quite difficult due to limited number of machineries. The only way to manage is by open burning. The island consists of 55 guesthouses, island council receive a lot of complaints from them/guest and nearby resorts because of the open burning practice.

25 Currently, there is an Incinerator installed on Maafushi within the proposed IWMC site: An Inciner8-700G incinerator of dimensions 6.04m x 1.91m x 5.75m. This incinerator has a capacity of 4 tons/d. The incinerator is not operational yet. Island Council has informed that they do not have the machinery required to feed the waste into the incinerator. According to commitment by MECCT, the incinerator will not be used as a part of the proposed ISWMC. Use of this incinerator will be stopped once the transfer of wastes to Thilafushi RWMF becomes operational.

Figure 3: Existing waste dumping area

2.5 Proposed project

26 The current waste management practices in the island are not appropriate. The council have identified a new site for a new IWMC on the eastern side of the island. The Ministry of Environment, Climate Change and Technology proposes to build an IWMC on the land proposed by the Island Council, to adopt more environment friendly and socially acceptable waste management practices on the island that would facilitate collection of waste from the

households and business, manage the waste at the center and final transfer the residual waste to Thilafushi for final treatment and disposal. The proposed location is 25m x 32m. Figures below shows the location of the site. Until the regular transfer of waste to Thilafushi is operational, the incinerator built in the proposed site for the IWMC will be used at its capacity to manage waste on the island according to the MECCT

Figure 4: Proposed location of ISWMC

Figure 5: Closeup of site boundary overlaid over a drone photo taken on 21 January 2021.

27 The proposed IWMC has a total area of 1492.2m^2. It is estimated that in the outer islands, household waste generated amounts to 0.6kg/inhabitant/day (Kocks and Water Solutions, 2020). The projected population of Maafushi for the current year of 2021 is 4026, with a projected 10% increase over the following 10 years (National Bureau of Statistics, 2014). The current IWMC design considers storage of an excess of expected waste for 1-2 weeks, with transport expected to happen once a week. Along with the area allocated for future expansion, the IWMC size will be able to provide appropriate storage of generated waste, with space in

excess in case normal functioning faces interruption, and for further waste management activities to take place.

28 As the population data is a projection based on the 2014 Census, some figures may be inaccurate to the current day and has been considered in the ISWMC design.

Table 1: Estimated population and waste generation data

Island Name	Plot Area (m^2)	Population 2021	Population 2031	Estimated Waste 2021 (kg/day)	Estimated Waste 2031 (kg/day)
K. Maafushi	1492.2	4026	4493	2415.6	2695.8

29 Calculations for determining sizes are included below.

Table 2: Maafushi ISWMC calculations

Residual waste (without recyclable): 26% + impurities from wrong segregation = 43% of total waste generated	1.46 t/d
Volume of one storage bin at ISWMC (240 l)	0.24 m³
Needed storage bins/day at ISWMC:	30 bins
Surface area need for 1 bin:	0.43 m²
Surface area need/day:	13.08 m²
Surface area foreseen for waste collection bins:	163 m²
Theoretical storage capacity on the Island for Maafushi:	12 days

30 **Transfer and Disposal of Solid Wastes from IWMC**. Waste collected and segregated at the IWMC site will be transported to the Regional Waste Management Facility (RWMF) in Thilafushi Island, where the approved Greater Male Waste-to-Energy Project (Phase 2) will be put in place. Initially, the segregated wastes will be transported by small dump trucks from the IWMC to the nearby port where solid waste transfer vessels are stationed. The wastes will then be loaded to these vessels and eventually brought to the RWMF.

31 As part of the overall solid waste management plan under the ongoing Greater Male Environmental Improvement and Waste Management Project (GMEIWMP) (Phase 1), a separate package has been approved to cater to the procurement of transfer vessels that will be used by the different IWMCs for the transport of waste to the RWMF. This package will be tendered for international competitive bidding through Package No. G/04 under the GMEIWMP's Procurement Plan. Currently, preparation for the tendering of this package is underway, and the final procurement is expected to coincide with the completion of the IWMCs, including the Maafushi IWMC. Nevertheless, in order to ensure efficient functioning of the system, the IWMC shall not operate until the transport scheme, including procurement of transfer vessels, as planned under the project is fully put in place.

32 Once the IWMC is completed and the transfer vessels are procured, the transport of segregated wastes from the IWMC to Thilafushi will be done once a week. [1] Vessels will have closed containers which will be loaded with the segregated wastes from the IWMC. The RWMF in Thilafushi is designed to have a dedicated landing ports for these transfer vessels from the different IWMCs, so that no disruption on the other normal daily activities of various locators in the island occurs. The transport of waste from IWMCs to Thilafushi will be a responsibility of WAMCO.

33 **Other waste streams**. Inert construction waste will be treated in a C&D plant and sold or re-used for development projects. Healthcare waste will be fully segregated from collection up to disposal.

34 **Management of Biodegradable Wastes**. All solid wastes sent to the IWMC will be segregated whenever possible according to the type of waste. Home composting bins will be provided to the households on the island to manage bio-degradable wastes. The produced compost can be used within the island or can be transported to the IWMC and Thilafushi for final disposal. The Island Council will be provided with training under the project on how to operationalize the composting component of the IWMC.

2.6 Components of the proposed project

35 The project proposes to construct a new Integrated Solid Waste Management Centre (ISWMC) in Maafushi Island. This centre will be used to manage the waste produced on the island before it is being transferred to regional waste management centre at Thilafushi. According to the Feasibility Report of the project, ISWMC is planned in such a way to present an additional value to the community in terms of living condition, working opportunities, business opportunities and environmental improvement (Kasdarli et al., 2018).

36 The ISWMC proposed for Maafushi will have the following components.

- Office for administration of the ISWMC
- Shedded platform for handling waste
- Dedicated areas for the conditioning of recyclables (plastics, cans, P&C): Baler facilities
- Dedicated areas to keep glass crusher.
- Dedicated area for temporary storage of residual waste and storage of bin
- Dedicated area for household hazardous waste
- Paved area for maneuvering vehicles
- Garage and storage area
- Container storage area
- Machine room
- Water tank for storage of rainwater/water from the island
- Utility provision: water supply/storage/handwashing, sewerage (soak pit), electricity (light
- poles, electrical plugs)

37 Following figure shows the main components of the proposed ISWMC in Maafushi.

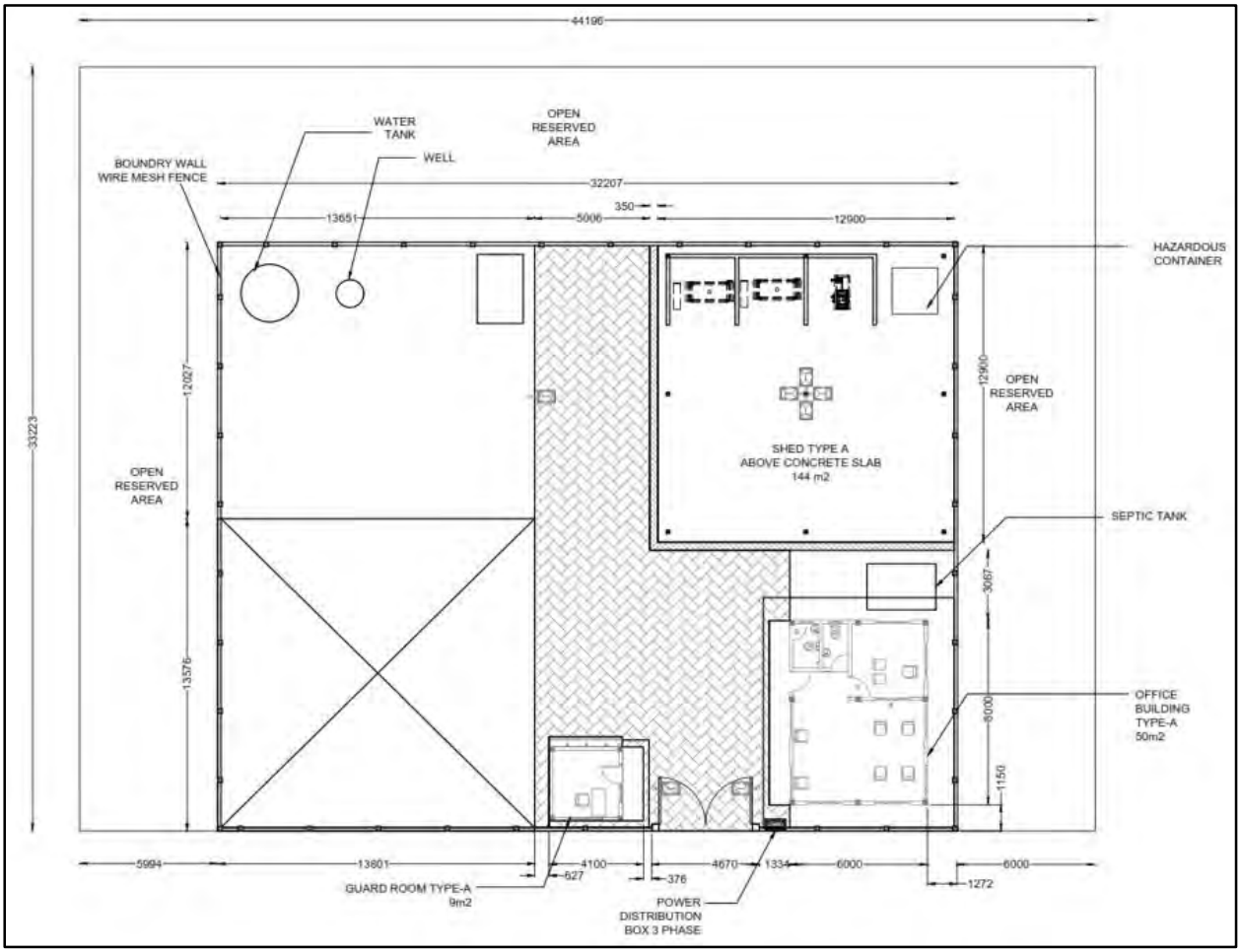


Figure 6: ISWMC concept of Maafushi Island

38 The proposed ISWMC has 2 main areas as described below.

39 Pavement area: This area will be paved using interlocking concrete blocks and mainly used for manoeuvring of vehicles and parking. This area can also be used as a free storage area. Total size of the area will be of 200m^2. Wet waste will not be handled or kept in the floor of this area as leachate can seep into ground in case of rain. Bins can be placed in this area for individual waste disposal services.

40 Shaded Area: In addition to the pavement area a shaded area with a concrete platform of the size of 144m^2 will be constructed. This area has a roof and is protected from rain. Major waste handling will be undertaken in this area. Waste will be segregated in this area and compacted/crushed using balers and crushers. This area has separate provisions of 7.5m2 each, for inorganic wastes. Waste such as plastic, metal and glass will be stored separately in the allocated area. Pavement is levelled so that water from the floor used for cleaning or other purposes will be collected in the trenches. This will mainly be of leachate. Leachate will be managed using a septic tank.

41 Hazardous waste storage area: Hazardous waste container of the size 7.5m^2.

42 Office building: For the staff small office of approximately 50m^2 will be constructed. This building will have 2 office rooms, a rest room and 2 toilets.

2.7 ISWM Strategy

2.7.1 Bio-degradable waste

43 As sufficient space is not available in the IWMC for bio-degradable waste treatment, home composting bins will be provided to households. With the exception of cooked or meat/fish food leftovers, organic waste from households can be composted in these bins, with compost from the bin being removed after about 6 to 8 weeks. However, once the Incinerator is decommissioned, placing a biodigester or enclosed composting system will be explored.

44 Ideally, the material to be composted is layered with structural materials (chipped tree trimmings, leaves etc.) which will enhance composting thus reducing the composting period and the formation of unpleasant odours. The compost from the bin can be used as a fertiliser at the home, excess could be given out or taken to ISWMC where it could be stored and transported to Thilafushi for final disposal.

45 Organic waste which cannot be composted will be transported with other streams of waste to the WTE plant, including excess compost which cannot be sold or used on the island. Until the WTE facility is operational this waste will be baled.

46 The system will have no impact on its surrounding. However, a capacity building program will be carried out to aid in home composting and raising awareness of the benefits of home composting.

Figure 7: Home composting bin to be used in households.

47 Calculation note:

- Average HH size : 6 people/HH,
- Daily biodegradable waste generation for home composting : 1,7 kg/day
- Daily biodegradable waste generation for home composting : 4,9 l/day
- Home composter volume : 274 l/(8 weeks) => 300 l Home composter

2.7.2 Transport and storage

48 Waste will be collected in the form of small bins, which would then be transported to the IWMC in an open dump truck. Household waste and construction waste will be collected from collection points, while guesthouse and hotel waste will be collected door to door. Waste other than typical household streams such as equipment like TVs or fridges can be collected through special pick-up services or brought to the IWMC by the resident themselves.

49 Design considers storage of waste for 1-2 weeks before being transferred to Regional Waste Management Facility (RWMF). Projects aims to have regular waste collection from outer islands at least once a week. In the case of Maafushi, island already has an incinerator installed. Once the operation of the incinerator starts, waste will be burned using the incinerator at its full

capacity. Once the Zone III waste project is fully operational, waste will be transferred regularly Thilafushi. Incinerator will then be decommissioned and removed according to the MECCT.

50 The island waste management center has been proposed as such that the facility will be able to manage and operate solid waste treatment at island level, even if the scheduled waste transfer is hindered due to the weather or other factors. The island waste management center has been designed with some elements of redundancy. The facility would have backup machineries, if one set of equipment is damaged as the center would be able to treat and manage waste at island level, till the broken machinery is repaired. If in such a situation, the scheduled facility waste transfer vessel is unable to arrive the island to collect the waste due to bad weather or other technical reason, the island waste management facility would be able to store the treated waste at the island waste management centre for a period of 4 to 6 weeks, till it could be collected and transferred to the Thilafushi. The Island Council, who will be operating the island waste management centre, will ensure that these wastes are removed from the island at a reasonable time.

51 The waste at the IWMC stored in 240 l bins and recyclables in bales will be transported on the collection truck from the IWMC to the harbour area, where it will be loaded onto the waste collection vessel. The vessel will then transport the waste to Thilafushi.

52 Further details including the route taken by the waste collection vessel can be found in Annex 16.

2.7.3 Final treatment and disposal

53 Waste Transfer Vessel would transport the waste containers collected from the outer islands to the Regional Waste Management Facility for Zone III (RWMF) in Thilafushi Island. At Thilafushi, when WTE facility at RWMF – Zone III becomes operational, the waste collected from the outer islands would managed as follows:

- Residual waste – treated at the Waste to Energy facility at Thilafushi
- Excess compost - temporarily stored at Thilafushi, make it available to agriculture sector and disposed if no interest to take it from Thilafushi.
- Bailed plastic – temporally stored at Thilafushi and provided to recyclers like Parley or others who export for recycling, residues after sorting at Parley sorting plant will be incinerated
- Metals (aluminium, tin cans) – to be handed over to scrap dealers based on Thilafushi
- Hazardous wastes – will be stored temporarily at Thilafushi for export according to Basel Convention or later incineration in the WtE if the waste management regulation provides for their incineration
- Crushed glass – will be processed with C&D waste in the C&D waste plant at Thilafushi and provided to construction industry for making aggregates for non-structural concrete applications or using it as base layer material.
- Non-marketable mineral residues from the C&D waste plant will be used as cover material for the residue landfill of the WtE plant

2.7.4 Management of waste during the transit period

54 Before the commissioning of the ISWMC at the islands, the Island Councils will ensure the wastes generated at the islands are brought to the future waste management area source segregated into recyclable plastic materials and residual waste to comply with the waste management regulation. The waste will be stockpiled in the area as different streams. Since for organic waste no treatment option is yet available, bio-waste will be commingled with residual waste. For the recyclables (mainly rigid plastics), Parley will be provided with balers to be used on the island during the transition phase. Once the ISWMCs are operational, the balers will be incorporated into the ISWMCs.

55 During the transit period before the delivery of the Outer Island Waste Collection Vessel, Ministry of Environment, Climate Change and Technology will provide collection of the waste from the outer islands in Zone III periodically using the WAMCO's waste collection vessels. The Ministry's

plan is to undertake the collection of waste from the islands on a route as described in Annex 16.

56 At Thilafushi, before the RWMF – Zone III becomes operational, the treated waste from the islands would be further treated and disposed as follows:

- Residual waste – The waste stream will be brought to Thilafushi in containers that are available at Thilafushi. The waste will be, if necessary, shredded and be baled and stored at Thilafushi for later incineration in the WTE plant, when it becomes operational.
- Baled plastic – temporally stored at Thilafushi and provide it to recyclers like Parley or others who export for recycling, residues from sorting will be baled.
- Excess compost – temporarily stored at Thilafushi, make it available to agriculture sector, bailed and temporarily stored, if no interest to take it from Thilafushi.
- Bailed plastic – temporally stored at Thilafushi and provide it to recyclers like Parley or others who export for recycling
- Crushed glass – temporarily stored at Thilafushi and provided to construction industry for making bricks and blocks of construction
- Mineral fraction will be used for interim dumping at the dump site

2.7.5 Machinery and Equipment

57 To operate the ISWMC machineries will be required that will be used to transport, handle, process and store waste at the ISWMC. Below is the list of the machineries that will be required for the operation of the ISWMCs. This equipment will be provided as part of the project. Training to use this equipment must be undertaken before the start of the operation phase.

a. Trucks
b. Bins
c. Containers
d. Glass crusher
e. Composting units
f. Hazardous waste containers
g. Balers
h. Siever
i. Shredder
j. Weighing device

2.8 Access Road

58 Regular transferring waste to the regional waste management center in Thilafushi is major part of this project. This part of the project will utilize heavy machineries and trucks to transfer waste from ISWMC to the harbour area of the island. Therefore, the main access road used for this purpose is identified in the diagram below.

Figure 8: Proposed road to be used to transport waste from ISWMC to harbour area

2.9 Temporary site setup location

59 The proposed project is a very small-scale construction project. Hence this project does not require an additional large area to set up the temporary site. Materials used for this project can be managed inside the proposed site. As for accommodation, workforce can be managed in rent houses in the island as the number of workforces is very minimum. In case of Maafushi, there are empty areas near the project site to store the construction materials and machineries.

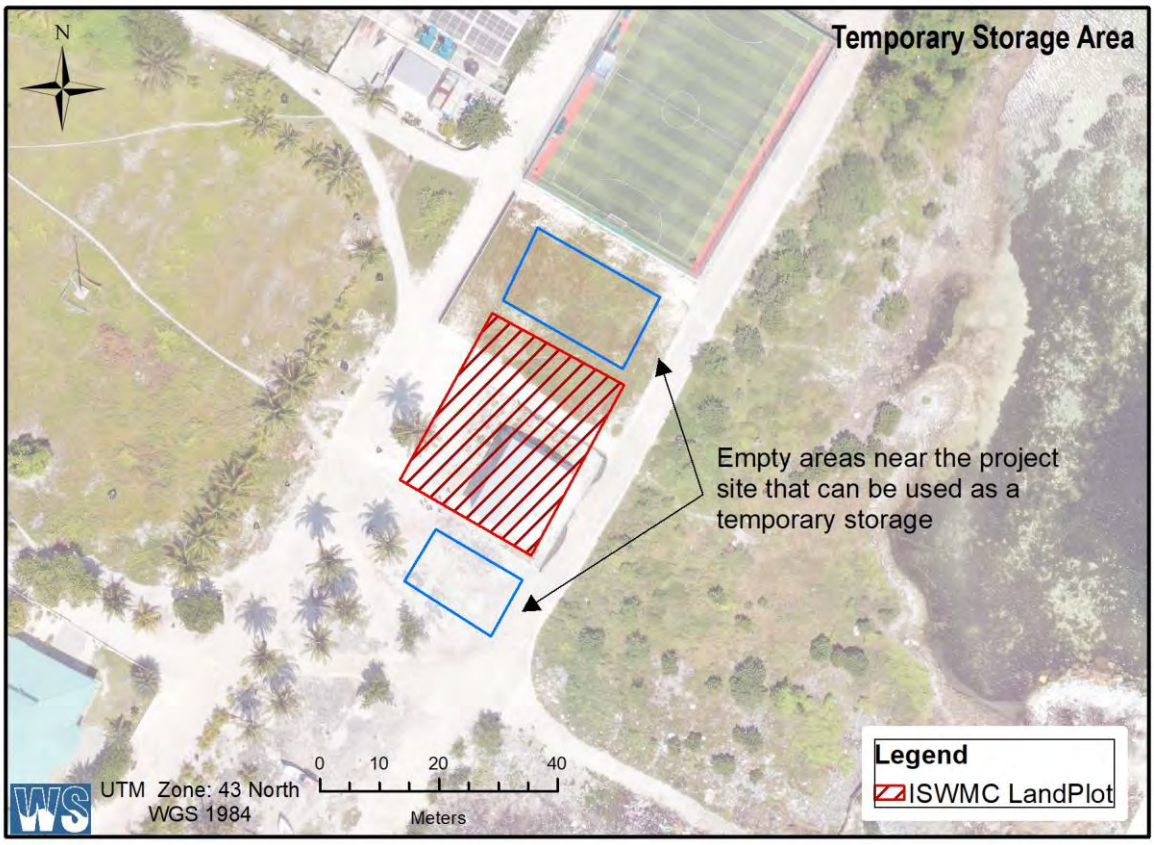


Figure 9: Empty area near the project site that can be used as a temporary material storage area

2.10 Clean up of the existing waste pile

60 The proposed site for the construction is an empty land. Therefore, site clearing will not be required.

2.11 Utility

61 Existing utility network of the island will be used for the ISWMC. Maafushi has an existing sewerage and water network in the island. The leachate collected from the concrete floor, where the waste will be handled, will be collected in a trench, and treated in a septic tank before its being diverted into the sewer network. Leachate will be treated by mean of settlement tank and anerobic filter as shown in the figure below.

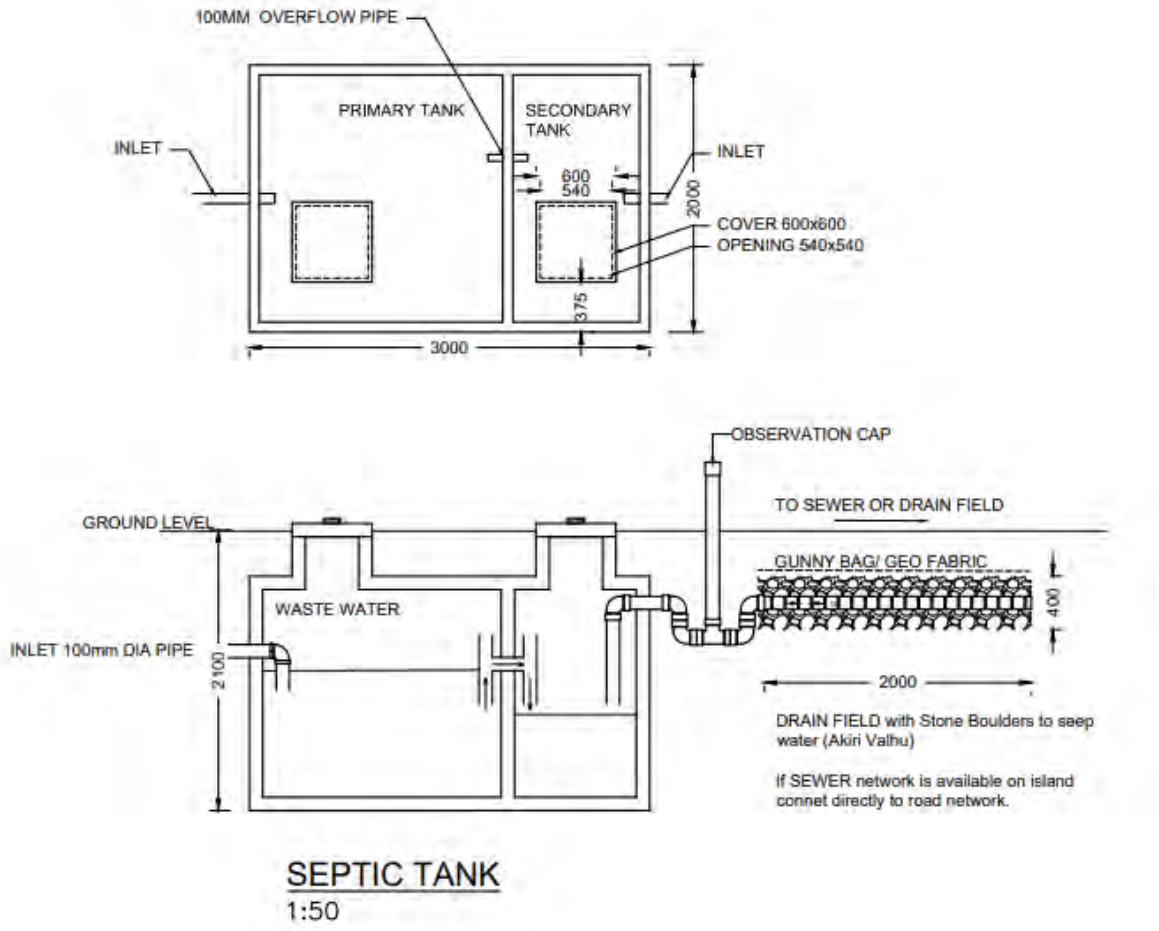


Figure 10: Septic tank proposed in the ISWMC

2.12 Assessment of compliance with selection criteria

62 The table below shows an assessment of compliance with the selection criteria

Table 3: Assessment of compliance with criteria

Criteria	Remarks	Comments
Pre-requisites		
(i) No subproject scope will include features that appear on schedule D of the EIA regulations (2007, updated 2012) (List of Development Proposals Requiring an Environmental Impact Assessment Study)	Development proposals on Schedule D of the EIA regulations related to solid waste management are landfills, incinerators and large-scale waste storage and separation facilities.	No subproject scope will features that appear in schedule D.
(ii) A IEE and EMP must be prepared for each subproject, which must	PMU to seek clearance from ADB on project siting if the criterion	EMP has been prepared in accordance with guidelines

	comply with EHS Guidelines on Waste Management Facilities	cannot be met due to space constraints.	
(iii)	Sites must not have any land acquisition or significant involuntary resettlement and social safeguard issues.	Verify land ownership records.	Land ownership has been verified with island council and no land acquisition is necessary
(iv)	Any new facility must not be sited in an environmentally sensitive area, including all areas within 30m of the shoreline, or within 30m of areas such as thickly vegetated areas that are known to be habitats for bird species of conservation value	The 30m distance should be exceeded where possible. The restriction may be reviewed depending on site availability and stakeholder consultation, and provision of design measures to prevent release of leachate into the sea or onto the vegetated area in the event of the capacity of the leachate collection tank being exceeded.	The proposed site is approximately 50m from the nearest shoreline.
(v)	No new facility to be sited within 500m of areas of cultural significance, such as ancient religious artifacts	Verification, through consulting island councils and the Ministry of Education , that no physical cultural heritage sites are situated within 500m of the IWMC site. The restriction may be reviewed on the basis of site availability and consultation with stakeholders. PMU to seek clearance from ADB on project siting if the criterion cannot be met due to space constraints. Provide for use of “chance find” procedures in the EMP, such that any artifacts are preserved for future generations	The site is not located within 500m of areas of cultural significance.
(vi)	Sites must have sufficient capacity to contain or handle volumes of waste projected to be generated over at least a 20 year planning horizon	To be assessed based on projections on growth in waste generation for each island	Based on population projections 10 years from now the proposed site will have a capacity well in excess of projected waste amounts, with capacity for further growth of the island.
(vii)	Sites must be at least 100m from residences, schools, clinics or mosques	The distance restriction may be reviewed depending on site availability and stakeholder consultation. PMU to seek clearance from ADB on project siting if the criterion cannot be met due to space constraints.	As no other plots are available in the islands Land Use Plan, the proposed site is approximately 60m from the nearest residences.

(viii) Sites must be least 100m from groundwater wells	The 100m limit is precautionary, however attention must be given in detailed design to ensure that the leachate collection tank is protected to exclude flood waters, including during storm situations, to ensure that leachate does not enter the groundwater lens. PMU to seek clearance from ADB on project siting if the criterion cannot be met due to space constraints.	As no other plots are available in the islands Land Use Plan, the proposed site is approximately 60m from the nearest groundwater well.
(ix) Sites must not intersect with power lines, water supply pipelines or sewer lines	Where these lie across proposed sites, they must be re- aligned to avoid the site	Site does not intersect with power, water, or sewer supply lines.
(x) For initiatives that require the use of machinery such as shredders and presses, there must be established access to technical expertise for servicing and spare parts must be regularly available in-country		The proposed machinery are simple and can be fixed and serviced by mechanics, and spare parts can be sourced from local service providers.
xi) Consensus from island communities on proposed improvements.	Records of consultations, issues raised, and measures taken to address them to be summarized in IEEs.	Meetings were held with all stakeholders
(xii) No other work, including road, pipeline, or power line improvements are planned at or near the proposed site	Island council to confirm. If such sites are planned, details must be taken account of in design to ensure adequate separation of the infrastructure	No other works are planned at or near the proposed site
(xiii) World Bank Group's Environmental, Health and Safety (EHS) Guidelines requires IWMCs to consider standard design of 110% volume and bunded for impermeable storage to avoid contaminated runoff entering the surface or groundwater.	Final detailed design to confirm capacity is 110% and bunded	The site is designed in such a way that no waste would be stored at the facility for long, as the waste will be removed from the island to the Regional Waste Facility. All waste handling areas will have impermeable flooring and the water collected on this platform will be collected in a trench and treated in a septic tank.
Preferable		
(i) Where IWMCs exist, any improvements should be to the	New sites may be necessary if existing site has	No existing IWMC exists on the island, and the proposed site is at the location of the currently

existing infrastructure, rather than replacement on new sites.	become unsuitable due to new developments around it or there is objection from communities to rehabilitate the existing IWMCs.	used waste dumpsite on the island where waste is openly burnt.
(ii) Removal of trees to be avoided where possible.	When mature trees (of diameter at breast height of 40cm or greater) must be removed, new trees must be planted of a number and species agreed with the island community	There is no vegetation on the proposed site and thus no removal of trees is necessary.
(iii) Where composting facilities are to be introduced or expanded, a high level of commitment from the community should be evident to ensure both cooperation in ensuring that waste to be composed is not contaminated and that compost will be purchased or used.	Evidence of commitment from the island community should be obtained.	The IWMC itself will not carry out composting. Instead home composting bins will be provided to the community and the island council has been informed of this plan

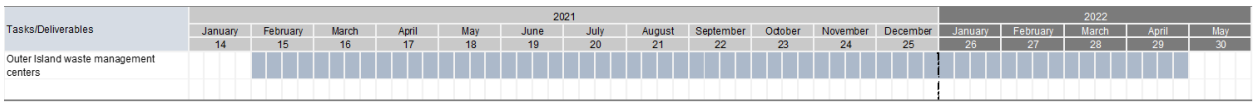
2.13 Project management

63 The project will be managed by Ministry of Environment, Climate Change and Technology by contracting the civil works to a contractor. The contractor will provide a daily work schedule for the project and will be responsible from hiring labourers, material, and civil works.

2.13.1 Project schedule

64 Total duration of the project is approximately 12 months. Construction of outer island waste management centers in the islands of Zone 3 will be carry out in parallel. Below is the construction schedule for the construction of ISWMC of Zone 3 islands. Master schedule for the whole project is attached as an Annex.

Table 4: Tentative Schedule



2.13.2 Emergency plan in case of spills (diesel, grease, and oil)

65 The project site will have contact numbers for the project manager to contact in case of any emergency. Everyone working on this project will have access to the project managers through mobile phones. To avoid any serious spillage, all fuelling activities should be undertaken on land. This would totally avoid any oil spillages to the marine environment. In case of a serious oil spill from a machinery due to a damage, all work will be immediately stopped, and everyone will be directed to focus their attention and effort to get the leaking stop, either through

mechanically or by any temporary means. The focus will then be to move the machinery to land if it happens on the sea.

2.13.3 Fuel management

66 All fuel used in the site should be acquired locally to avoid long term storage of fuel on the site. Short term fuel storage on site should be done in an impervious flooring surface or in a leak proof container.

2.13.4 Site safety and safety equipment

67 General precautionary site safety methods will be applied. All workers will be given instructions about health and safety at site. Safety shoes and hats will be provided to all workers. Gloves and boiler suits will be provided for workers when necessary. Earmuffs will be provided to labourers working in noisy environment. Site Supervisors will give a brief on daily basis before the work starts to all workers and all proper health and safety precautions will be implemented on site. Construction safety sign boards must be erected on site.

Figure 11: Sample sign board that can be used on the site.

68 If workers are traveling from an island with a community outbreak of COVID-19, they should be quarantined for 10 days. After 10 days. They should be tested for COVID-19 and their samples need to be sent for testing. If their tests were negative, they would be allowed to leave the premises. HPA guideline for “Travel related quarantine (furabandhu) guideline for groups of 10 or more people staying in shared accommodation” is attached as an annex.

2.13.5 Waste management

69 Waste generated during the construction stage will require adequate disposal, it is contractor’s responsibility for the disposal of wastes. However, with approval from the council, the waste can be managed in the island itself.

2.13.6 Communication

70 The project will be managed by Ministry of Environment, Climate Change and Technology. The contractor will submit weekly and monthly updates about construction work.

2.14 Project inputs and outputs

71 The project has inputs in terms of human resources, natural resources, and machinery. The main output of the project is ISWMC that would bring direct and indirect benefits to the local communities in terms of environmental, social, and economic development. The inputs and outputs are summarized in the following 1tables.

Table 5: Matrix of major inputs of the project

	Input Resource(s)	Amount / Type	How to obtain resource(s)
Construction period	Sit supervisor / engineer	1	Site supervisor should ideally be local. He/she should be present at the construction site during the construction period. He/she should regularly communicate with island council. It is important that the supervisor has a good understanding of local context, social and cultural norms.
	Construction workers	10 Maldivians and foreign (locals will be given preference)	Open bidding by advertising in local papers/other sources. Since minimal number of workers is used for the project, accommodation can be provided in rent houses/rooms.
	Water supply	100L per day	From the existing water network system of the island. Well water is also available from the football field near the project site.
	Electricity/Energy	Diesel-based electricity from island mains	Existing island grid.
	Construction materials	Cement, sand, gravel, pipes, bars, paint, roofing, electrical equipment etc.	Incorporated in the contract document and contractor to obtain it from local sources. Some of these materials will be available from the island as well.
	Construction machinery	Pickups, small trucks, wheelbarrows, and other general construction machinery.	Responsibility of the contractor to obtain the required machinery.
	Telecommunications	Mobile Phones	Already this service is available in the island
	Transport (sea)	-	Materials to be transported in supply vessels. Contractor to arrange.
	Food (during construction period)	Obtained from the island	Local purchase by the contractor
	Fuel	Diesel, Petrol, Lubricants	Local purchase by the contractor
Operation period	Equipment	Glass crusher, woodchipper, metal can baler, waste collection vehicle, plastic shredder	Provided under this project.
	Water	Desalinated water	Island already has an established water network.
	Power	-	Diesel-based electricity from island mains.
	Staff	Approximately 5	Staff includes drivers, workers, and a supervisor.
	Waste	Approximately 960 kg per day	Waste will be collected from households and businesses and transferred to regional waste management center.

Major types and anticipated quantities of project outputs is presented below.

Table 6: Matrix of major outputs of environmental significance during the project implementation

	Products and waste materials	Anticipated quantities	Method of disposal

Construction period	Construction waste	Moderate amount of construction waste. Existing waste pile on the site.	Construction waste must be reused as much as possible; rest can be transferred to Thilafushi.
	Noise	Only localised to the project environment.	Unavoidable during the construction stage but will be minimal.
	Air pollution	Limited quantities of dust in the construction area. Small quantities of air pollution from transportation of construction materials.	Mainly arising as, a result of dust emission from the construction work such as cement mixing, moving machinery and other processes. Only localised.
	Soil	Small quantity	Will be reused in the backfilling of the excavated areas.
	Waste oil	Small quantity	Barrelled and transferred to the regional waste management centre at the end of the construction period.
Operational period	Inorganic waste	Crushed glasses, shredded plastic, compacted metal	Transferred to regional waste management centre (Thilafushi). Weekly transfer is planned to avoid open burning.
	Compost	Moderate amount	Used locally for agricultural purpose and can be sold to nearby resorts/islands. Transferred to IWMC and Thilafushi for disposal if cannot be used.
	Air pollution	From the incinerator. Depends on the usage.	Localised

3 Policy Legal and Administrative Framework

3.1 Republic of Maldives Legislation for Environmental Management

72 The law governing the protection of the environment is the Environmental Protection and Preservation Act (EPPA) of 1993 (Act No 4/93). The law is brief, and sets out the principles for sustaining and extending the benefits of the environment of the Maldives for the people and coming generations. The EPPA confers powers on the MECCT to issue regulations and formulate policies for environmental protection and preservation. Such regulations include the EIA regulations of 2007, updated in 2012 (Regulation No. 2012/R-27).

73 Responsibilities and procedures for conducting environmental assessments, together with the requirements for environmental monitoring of projects, are set out in the EIA Regulations of 2012. All projects that may have an impact on the environment are referred to the Minister of Environment and Energy (EPPA 5(a).

74 The EIA Regulations assign primary responsibility for undertaking environmental assessment of projects to the project proponent and set out procedures, rights and responsibilities for the preparation and approval of EIAs. The Ministry of Environment, Climate Change and Technology and Energy (MECCT) undertakes review and approval of environmental assessment reports.

75 Project proponents are defined in the EIA regulations as a person, department or agency who is seeking to carry out or proposes to carry out a development proposal or is the owner or person having charge, management or control of a development proposal. EIA work must be carried out by registered consultants, and the procedures and requirements for registration are set out in Part V of the regulations.

76 The EIA regulations include a schedule (Schedule D) of investment project types that require an EIA. These include landfills, waste incinerators and large-scale waste storage projects. For project types not included schedule D, a screening form is submitted in a specified format on the basis of which the MECCT decides whether an Environmental Management Plan is required or if further information is required, in which case an Initial Environmental Examination (IEE) will be carried out. The IEE is completed according to a specified format. If the IEE finds that the project may cause a significant environmental impact, a full EIA is required

77 For schedule D projects and those identified by the IEE as requiring an EIA, a scoping meeting is convened by the MECCT to determine the specific Terms of Reference for the EIA. On completion of investigations and reporting, the EIA report is subject to review by MECCT, which invites comments from other relevant ministries and the public following which an environmental decision is made.

78 On submission of the screening application to EPA, EPA screened this project to prepare an Environmental Management Plan. The Environmental and Social Management Plan for the proposed island waste management center at Maafushi has been prepared on a specified format and reviewed for compliance by EPA.

79 The table below shows the relevant polices and regulations to the proposed project. Small brief about the policy/regulation is also provided.

#	Relevant laws, regulations, policies, and guidelines	Description
1	Environmental Protection and Preservation Act	The project conforms to the requirements of the Environmental Protection and Preservation Act of the Maldives, Law no. 4/93. The EMP has been undertaken in accordance with the EIA Regulation 2012 of the Maldives by registered consultants. The construction and operation phase of the proposed project will fully abide to the Environmental Preservation and Protection Act.

2	Protected Areas and Sensitive Areas	Under Article 4 of the Environment Protection and Preservation Act, the Ministry of Environment, Climate Change and Technology is vested with the responsibility of identifying and registering protected areas and natural reserves and drawing up of rules and regulations for their protection and preservation. The proposed project does not have any declared protected or sensitive area within the project boundary.
3	Environmental Impact Assessment Regulation 2012	The Ministry of Environment, Climate Change and Technology has issued EIA regulation on May 2012, which guides the process of undertaking the Environmental Impact Assessment in the Maldives – This guideline also provides a comprehensive outline of the EIA/EMP process, including the roles and responsibilities of the consultants and the proponents. Schedule D of the regulation underlines the projects/practices that require EIAs. Since the ISWMC does not fall within this list, a screening process was followed. Screening decision for this project is to prepare an EMP for this project. This EMP has been prepared in accordance with the guideline provided in the regulation.
4	National Waste Management Policy 2015	The key objective of the waste management policy would be the formulation and implementation of guidelines and means for solid waste management to maintain a healthy environment. The establishment of ISWMC is in line with this policy and is an important part of the Integrated Waste Management System.
5	Waste Management Regulation	WMR contains four main sections: (i) Waste management standards: Defines standards for waste collection, transfer, treatment, storage, waste site management, landfills and managing hazardous waste. (ii) Waste management Permits: Defines approval procedures for waste sites, (iii) Waste transfer: Standards and permits required for waste transport on land and sea, including transboundary movements, (iv) Reporting requirements: Defines reporting and monitoring requirements and procedures, (v) Enforcement: Defines procedures to implement WMR and penalties for non-compliance. The ISWMC proposed under this project was designed to conform the Waste Management Regulation.
6	Land Use Planning	The Land Use Planning Regulations and Guidelines (2005) include land use instruments such as inclusionary zoning and quotas. Land Use Plans (LUP) are prepared in consultation with the Ministry of National Planning, Housing, and Infrastructure, which does have allocations for residential areas as well as for different infrastructure and social needs.
7	Health and Safety in Construction Industry	Construction law was published in 2017 highlighting the rules regarding general construction industry in Maldives. This law includes the building code, permits, involvement of Maldivians in construction industry, inspecting quality of construction, quality of materials used in construction projects and payment regulations for workers. The proposed project should adhere to this law and should follow it throughout the construction stage.

8	Immigration Act	The Maldives Immigration Act (1/2007) establishes rules for the departure and entry of Maldivian nationals, and entry, departure, and deportation of foreign nationals. The 15th article of the act establishes work visa permit, which allows for foreign nationals to remain in the Maldives for the purpose of working for a permitted period. Foreign labourers of this project should have valid working visa for the whole duration of the project.
9	Employment Act	Employment Act (2/2008) determines the fundamental principles relating to employment in the Maldives, the rights and obligations of employers and employees, establishes a Labour Relations Authority and an Employment Tribunal to protect such rights, and makes provision for all other matters related to employment. Below is the list of points applicable to the project. • Worker shall not be forced to work for more than 48 hours per week. • Workers shall not be made to work for more than 6days a week consecutively without providing 24 hours for rest. • Workers shall not be made to work continuously for more than 5 hours without providing a break for at least 30 minutes. • Salary should be paid to all permanent contract workers once a month. • Minimum 03 meals shall be provided to construction staff per day or appropriate meal break time shall be provided.
10	Decentralization Act	The Decentralization Act establishes the local councils as highest authority in the locality and who shall have executive powers to be exercised in accordance with this Act. The Act establishes Atoll Councils, Island Councils and City Councils. This project will be monitored and overlooked by the Island Council. The project was also formulated together with the input from the Island Council.
11	Coral and Sand Mining	Coral mining from house reef and atoll rim has been banned through a directive from President's Office dated 26 September 1990. Sand should not be mined from any part of the existing Island, beach, or the newly reclaimed island beach.

3.2 ADB Environmental Safeguard Requirements

80 ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB SPS, 2009. This states that ADB requires environmental assessment of all ADB investments.

81 **Screening and categorization**. The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project; the sensitivity, scale, nature, and magnitude of its potential impacts; and the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impacts, and are assigned to one of the following four categories:

(i) **Category A.** Projects could have significant adverse environmental impacts. An EIA is required to address significant impacts.

(ii) **Category B.** Projects could have some adverse environmental impacts, but of lesser degree or significance than those in category A. An IEE is required to determine

whether significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

(iii) **Category C.** Projects are unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are reviewed.

(iv) **Category FI.** Projects involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all projects will result in insignificant impacts.

82 **Environmental management plan**. The SPS further requires the development of an environmental management plan (EMP) specifying the required mitigation and monitoring and who is responsible for implementation.

83 **Public disclosure**. ADB will post the safeguard documents on its website as well as disclose relevant information in accessible manner in local communities:

(i) for environmental category A projects, draft EIA report at least 120 days before Board consideration.

(ii) final or updated EIA and/or IEE upon receipt; and

(iii) environmental monitoring reports submitted by the Project Management Office (PMO) during project implementation upon receipt.

84 **Pollution Prevention and Control Technologies**. During the design, construction, and operation of the project the PMDCSC will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to projects.

Table 7: Applicable WHO Ambient Air Quality Guidelines

Table 1.1.1: WHO Ambient Air Quality Guidelines[7],[8]		
	Averaging Period	Guideline value in µg/m³
Sulfur dioxide (SO_2)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM_{10}	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

Table 8: World Bank Group's Noise Level Guidelines

Table 1.7.1- Noise Level Guidelines[54]		
	One Hour L_{Aeq} (dBA)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

85 **Requirements for the Project**. All statutory clearances will be obtained prior to commencement of civil works. IEEs will be prepared for each package involving civil works and EMP to be attached in the bid and contract documents. IEE will be submitted to ADB for review and approval prior to issuance of bid documents. Monitoring of EMP implementation by the EA is reported to ADB.

3.3 Applicable International Environmental Agreements

86 In addition to national laws, rules and regulations, the government of Maldives is also a signatory to various applicable international conventions. Those applicable to the project as a waste facility in a coastal area, are those relating to environmental pollution and biosafety, as follows:

(i) International Convention for the Prevention of Pollution of the Sea by Oil (1982),
(ii) Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal (1989),
(iii) Convention on Biological Diversity (1992),
(iv) United Nations Framework Convention on Climate Change (1992),
(v) Washington Declaration on Protection of the Marine Environment from Land Based Activities,
(vi) Kyoto Protocol to the United Nations Framework Convention on Climate Change (1998),
(vii) Cartagena Protocol on Biosafety (Maldives acceded on 2 September 2002),

4 Description of the Environment

4.1 Physical Resources

4.1.1 Geology, Topography and Soils

87 In common with all islands in the Maldives, Maafushi is a reef island that has formed mainly at the periphery of Kaafu Atoll by a process of deposition of shallow-water carbonates and successive coral deposits at the tidal level which gradually rose to reach the present-day level of the island. The underlying rock is variable in consistency, reflecting the growth patterns of the coral, which forms dense colonies (coral heads) and large voids between the heads. The unconsolidated sand and gravel on top of the rock layer is subject to seasonal conditions, particularly monsoons as well as wave action, and the beaches in their natural state are dynamic subject to continual erosion and accretion, making infrastructure around the island's coast vulnerable to erosion.

88 The island's soils are mainly sandy in texture, with a significant silt component formed as sand grains have ground against each other. Much of the inland part of the island has topsoil with an organic matter content, supporting thick vegetation in places as well as homes and gardens. The soils are free draining when uncompacted, have poor nutrient status and are alkaline. Surface relief is extremely low and below 2m above sea level.

4.2 General Environment of The Island

89 Maafushi is located in the east rim of South Male' Atoll. Cocoa island resort is located in the same lagoon as Maafushi. The nearest protected site is Guraidhoo kanduolhi located approximately 5km south of Maafushi.

90 The following is the summary of the general environment:

- A harbor is located on western side of the island,
- Beaches are observed primarily of the northern side of the island. This is the main tourist beach that is protected using a groyne field.
- The island has been fully compacted, there is no empty plots for future development,
- A reclamation project of a small plot of land off the southern coast has been completed but is yet to be developed.

Figure 12: General environment of the island

Figure 13: Reclaimed land off southern end of the Maafushi island

Table 9: Some key figures for Maafushi Island

Name of the island	**Maafushi**
GPS Coordinates	73°29'22.86"E, 3°56'25.37"N
Area of islands/Hectares	41.8
Distance to atoll capital/Km	51.2
Distance to Male'/Km	24.83
Is it on its own reef	No
Is it sharing reef with other islands	Yes
If sharing how many islands	1
Nearest distance to reef edge/Km	0.06
Longest distance to reef edge/Km	3
Area of the reef (including lagoon)/Sqkm	7.69
Nearest inhabited island	Guraidhoo
Nearest Airport	Velana International Airport
Nearest Resort	Anantara Dhigu Maldives

4.2.1 Climate

91 The Climate is tropical maritime, featuring two monsoon seasons, originating over the Indian Ocean to the southwest between May and September (Hulhangu), and the Bay of Bengal to the drier northeast between December and February (Iruvai). The southwest monsoon is the stronger and monthly rainfall typically exceeds 200mm towards the end of the southwest monsoon period and is lowest in February. Cyclones can occur, with the higher risk period being between October and January. The island can also experience “edge effects” of larger more distant cyclones. The United Nations (2007)3 estimate that there is a 10% probability of a level one storm on the Saffir-Simpson scale occurring over Kaafu Atoll in a 10-year period. Storms in

[3] United Nations Office for the Coordination of Humanitarian Affairs - Regional Office for Asia and the Pacific (OCHA ROAP) (2007) Maldives: Composite Hazard Map.

the level one category are described as being “very dangerous” with wind speeds likely in the range of 119 – 153 kph, and pressures below 100hPa, but not lower than 980 hPa.

92 Temperatures are relatively constant and range between 25oC and 30oC, with the hottest period occurring in March/April and the coolest, December/January. Monthly rainfall fluctuates between around 20mm in February to over 300mm in May and is over 200mm for most of the year.

93 The prevailing winds are predominantly westerly for much of the year, with easterly winds rare and south easterly winds almost non-existent. Winds are influenced by the monsoon patterns and west-south-westerly and westerly winds are the strongest over the year.

94 The tidal regime is semi-diurnal – two high and two low tides a day. The range for spring tides is approximately 1m and for neap tides, 0.3m while the extreme range between highest high water and lowest low water is 1.32m at the tidal gauge for the Malé area, on Hulhulé Island some 30 km north from Maafushi. Table 10 below gives the average tide levels at Hulhulé.

Table 10: Average tide levels at Hulhulé[4]

Tidal level	**Water level from mean sea level (m)**
Highest High Water (HHW)	0.62
Mean Highest High Water (MHHW)	0.34
Mean High Water (MHW)	0.33
Mean Low Water (MLW)	-0.36
Mean Lowest Low Water (MLLW)	-0.37
Lowest Low Water (LLW)	-0.72

95 Wave heights are also influenced by variations in atmospheric pressure and strong winds. Atmospheric pressure at sea level around Kaafu Atoll typically varies between 1011 and 1017 hPa, and an increase in air pressure of 1 hPa typically lowers the water level by 1cm. Lower pressures can occur in storm events, and may drop below 1000 hPa, entailing an increase of around 10cm or more, adding to effective storm wave heights.

96 Surface currents reflect tides and wind, and generally follow the monsoon pattern, with westward currents dominant from January to March, and the reverse between April and December.

4.2.2 Freshwater Resources

97 Natural freshwater sources on the island comprise rainwater collected from roofs and groundwater that accumulates through infiltration of rainwater into a freshwater lens that forms in underlying strata of the island, though the integrity of the lens and the quality of its water are threatened by the level of extraction and by pollution from human waste where proper sanitation facilities are not used. To get the baseline groundwater quality of the island, samples were taken from 3 locations: from the nearest well to the proposed IWMC site and from a control site.

[4] Source: University of Hawaii Sea Level Center Database, quoted in the Second National Communication of the Maldives to the United Nations Framework Convention on Climate Change. Ministry of Environment and Energy, 2016.

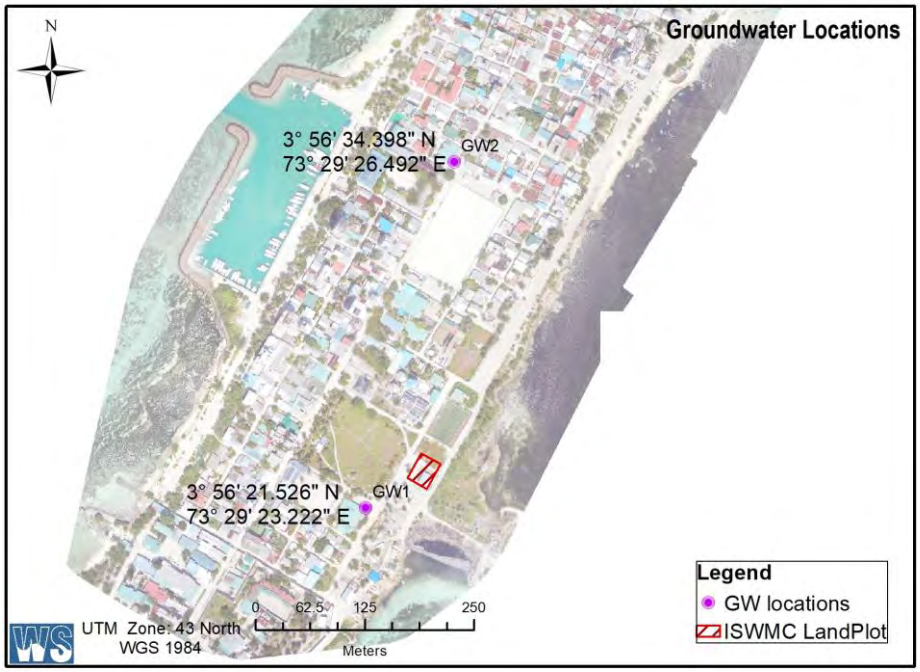


Figure 14: Groundwater sample locations

Table 11: Groundwater test results

	GW1	GW2	Unit
Conductivity	651	463	µS/cm
pH	7.75	7.82	-
Salinity	0.32	0.22	$^{0}/_{00}$
Temperature	23.1	23.8	oC
Nitrogen Ammonia	0.10	<0.02	Mg/L
Total Petroleum Hydrocarbon	<0.036	0.040	Mg/L

4.2.3 Marine Resources

98 Significant fishing recreational diving and other water supports such as surfing take place in the water around Maafushi and the island is considered to be a surfing and diving destination for tourists. The water quality is influenced by sewerage discharge and illegal dumping of solid waste (including from neighbouring islands and passing vessels).

4.2.4 Marine Sediment

99 Pollutants from waste, particularly hazardous waste, can accumulate in the sediment on the lagoon or sea floor on a small scale. While more industry as well as waste management takes place on Thilafushi Island at the southern edge of the atoll, some 31km away.

4.2.5 Air Quality

100 Air pollution sources include vehicle emissions, emissions of other plant and machinery including diesel power generators, and construction activity, as well as industrial activity, all of which are limited on Maafushi. Levels of ambient air quality studied on the more populated islands of Greater Malé at the south of the atoll by AECOM in 2010 on Malé, Hulhulé and Hulmumale[5] and compared with World Health Organization (WHO) standards for ambient air,

[5] AECOM in association with Water Solutions (2011). Expansion and Modernization of Malé International Airport: Social and Environmental Impact Assessment, prepared for GMR Malé International Airport Private Limited.

finding that the pollutants of potential concern did not exceed WHO guideline levels in terms of the average 24hr mean.

4.2.6 Noise

101 Sources of noise pollution are similar to those for air quality, again very limited on Maafushi while wind and waves can contribute significantly to ambient noise levels.

4.3 Ecological Resources

4.3.1 Marine Ecosystems

102 Coral ecosystems have significant ecological significance and occur within lagoon waters and on the periphery of the islands. The corals are vulnerable to pollutants in the water, changes in radiation, changes in turbidity and in nutrient levels. Corals are adapted to low nutrient levels, and in areas where sewage, grey water and food waste is released, which usually have relatively high phosphate and nitrate levels, algal growth will often flourish and suppress coral growth. Coral health can be gauged by established survey methods, such as the reef check protocol supported by the international NGO Reef Check[6] which provide standards to assess the coverage of coral and other substrates on the sea bed.

103 Pelagic fish form an important part of the local economy, both through commercial fishing activities and game fishing. Fishing activity focuses on areas known to be abundant and these occur throughout the Maldives waters, usually distant to the coast.

4.3.2 Avifauna

104 The Maldives has a diverse range of birds, including a significant seasonal population of migratory birds. The islands are important wintering grounds for a large number of migratory species that follow the Central Asian Flyway, a flyway covering a large continental area of Eurasia between the Arctic Ocean and the Indian Ocean, and comprising several important migration routes, extending from the northernmost breeding grounds in Siberia to the southernmost non-breeding wintering grounds in West and South Asia and the Indian Ocean Territory including the Maldives. Floating waste is a known hazard to birdlife on the atoll particularly when toxic waste is ingested or when articles such as plastic bags and string can cause birds to be debilitated or where they cause damage to the digestive system, or when it damages a natural habitat. These can travel considerable distances and therefore such waste released from more populated islands or from vessels can reach islands such as Maafushi and cause damage. The habitat of the white-breasted waterhen (*Amaurornis phoenicurus*) is known to be threatened by floating, uncollected solid waste[7].

4.3.3 Terrestrial Ecosystems

105 The present-day vegetation cover on the islands is substantially influenced by human habitation and has little biodiversity conservation significance. Vegetation is dominated by pan-tropical species such as coconut (*Cocos nucifera*), Goats foot creeper (*Ipomea pes-caprae*), hibiscus (*Hibiscus tiliaceus*) and beach calophyllum (*Calophyllum inophyllum*).

4.3.4 Protected Areas

106 There are 42 protected areas in the Maldives designated under the EPPA and covering around 24,500ha, or 0.2% of national territory totalling more than 24,494 hectares (0.2% of the national territory) designated under the Environment Protection and Preservation Act 4/93 (EPPA 4/93) to prevent over exploitation, and improve conservation and preservation, including banning of export of important baitfish as aquarium fish, protection of threatened marine species such as sharks, sea turtles, giant clams and black coral and also to enhance and sustain dive tourism.

[6] Hodgson, G., W. Kiene, J. Mihaly, J. Liebeler, C. Shuman, L. Maun and J. Hill (2006). Reef Check Instruction Manual: A Guide to Reef Check Coral Reef Monitoring Published by Reef Check, Institute of the Environment, University of California at Los Angeles.
[7] Common Birds of the Maldives. Live & Learn Environmental Education. www.livelearn.org

107 Two protected areas occur in the vicinity of Maafushi. The IUCN has not set a category for any of the sites.

Table 12: Protected areas in the vicinity of Greater Malé

Name	Type	Area	Notes	Location relative to Maafushi Island
Kandoomaa Thila (designated in 1999)	Reef	0.5 sq. km	Favoured as a dive site for sea life and rock features.	Approx 2.0 km to the north east (Atoll edge)
Guraidhoo Channel (designated in 1995)	Channel / reef	0.5 sq. km	Deep lagoon area	Approx 2.0 km to the South east (atoll edge

108 To assess the protected areas near the project site, the Integrated Biodiversity Assessment Tool (IBAT) was used to screen the protected areas and critical habitats that may exist around the project area (default area analysis of 50km radius). Results of the initial screening is attached as an Annex of this document.

4.4 Socio-Economic Factors

4.4.1 Population Levels

109 The population of Maafushi according to the 2014 census is 3,025. This is projected in the feasibility study for an Integrated Solid Waste Management System for Zone 3 to have reached around 4,026 at present day levels and to rise to 4,679 by 2035. The island has a number of guesthouses, serving a tourism market.

4.4.2 Economy

110 Maafushi's economic activity is dominated by the tourism guesthouse. The island has some tourism, primarily a collection of guesthouses and it is also the nearest inhabited island to some resorts in the area. Access to education, in keeping with the national average is good, with enrolment in primary education close to 100% and literacy rates at about 98%.

4.4.3 Public Health

111 Maafushi in general benefits both from relatively easier access to major health facilities in Malé and from the advances made in the sector over recent decades, which feature a rapid decline in maternal mortality rate, and eradication or heavy reduction of the incidence of a number of infectious diseases including leprosy, measles and lymphatic filariasis. However existing waste management practices, particularly regular burning of household waste including plastics, poses a mild risk to people living on the vicinity who regularly breathe air that contains smoke from the burning waste.

1.1 Project site and access road condition

112 ISWMC is located on eastern side of the island, behind the futsal pitch. The diagram below shows the proposed ISWMC area.

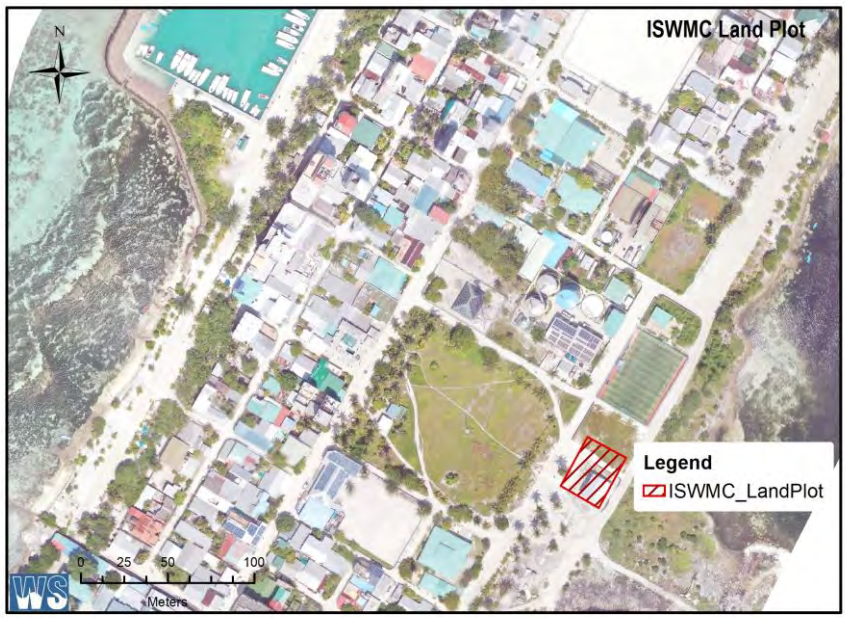


Figure 15: Proposed location for ISWMC

113 The project site can be accessed from northern side road. Northern side road is connected to the existing harbor. This road has already been cleared, so vegetation removal will not be required on the access road. The diagram below shows how the site can be accessed from harbor.

Figure 16: Access road from harbour

5 Anticipated Environmental Impacts and Mitigation Measures

5.1 Impact Identification

114 The potential impacts and mitigation measures have been identified through a site visit, interviews with stakeholders and review of designs for the IWMC and associated facilities.

115 In addition to the stakeholder consultation and primary and secondary data collected for this project, following reports has been reviewed to determine the possible impacts.

- EIA to the Installation of an Incinerator at Maafushi Island, Kaafu Atoll (Water Solutions, 2019)
- ESMP for the Proposed Construction and Operation of an Island Waste Management Centre in Dhonfanu, Baa Atoll (CDE, 2019)
- EMP for the Proposed Development of Island Waste Management Centerin Th. Vandhoo (Zuhair, 2017)
- EMP for the Proposed Island Waste Management Centre in Bodufulhadhoo, Alifu Alifu Atoll (Musthafa, 2019)
- ESMP for the Upgrading of Island Waste Management Center in R. Maakurathu (Zuhair, 2019)

116 The proposed ISWMC construction project at Maafushi Island is expected to have limited impacts on the existing terrestrial environment of the island. These include the vegetation, soil, and the groundwater of the island. The project is also expected to impact the livelihood of the beneficiaries and impact the existing society in many ways. Impact identification has been focused on the environment and socio-economic aspects. Impacts have also been identified for short and long term as well. It is only though identifying the likely impacts; the mitigation measures can be identified and implemented.

5.2 Method of Assessment

117 For detail impact analysis, environmental impact identification was made by a combination of matrices along with expert opinions and experiences from similar projects in the past. The environmental impacts were examined using an adaptation of the Leopold matrix method. The Leopold matrix (Leopold, 1971) implements a two-dimensional checklist, where the columns of the matrix contains the project's activities while the rows list the environmental receptors under the three main categories – Physical components, Biological components, and Socio-economic and Cultural components. This interaction matrix helps to identify impacts on individual factors of the three main categories of the impact. Furthermore, the sum of the magnitude from each impact activity and/or a certain environmental factor could be identified.

118 This method analyses three aspects of each action which may have an impact on the environment – Magnitude, Duration, and Probability.

- Probability – Likelihood of an impact to be produced from a said activity.
- Duration – Defines the duration of which the environmental impacts would persist.
- Magnitude – Defines the severity of the impact, for both positive and negative. A score is given from a scale of +10 to -10. +10 being major positive and -10 being major negative.

Table 13: Scale used to assess impact criteria

Evaluation criteria	Magnitude Score	Category
Probability	O	Impact is possible (Probability < 50%)
	M	Impact is likely (Probability >50%)
	X	Impact is certain (Probability = 100%)
Duration	T	The effects of the activity would not be identifiable within a few months of its completion.

	S	The effects of the activity would not be identifiable within months to a year of its completion.
	L	The effects of the activity would not be identifiable within multiple years of its completion.
	P	The effects of the activity will persists endlessly causing irreversible impacts.
Magnitude	9 & 10	Major Positive
	7 & 8	Moderate Positive
	5 & 6	Minor Positive
	-4 to 4	Negligible
	-5 & -6	Minor Negative
	-7 & -8	Moderate Negative
	-9 & -10	Major negative
Cumulative		Impacts that are cumulative

119 Significance of the impacts can be identified based on the criteria of probability, duration, and magnitude of the impacts. For each potential impact, there are many combinations of magnitude, duration, and likelihood that can occur. There is no universally accepted measure of significance. None of the criteria (probability, duration, and magnitude) should be considered more important than any other. Instead, they should be examined in an equal manner to help frame the rationale for deciding of significance. These are decided based on the consultant's experience and results of similar projects. In the case of this project, a team of consultants who have worked on similar projects in Maldives allocated scores based on the primary and secondary data. Table below shows the options to be considered to evaluate the significance of the impacts based on the 3 criteria.

Table 14: Scale used to assess the significance.

Probability	Duration	Magnitude	Significance
Possible (O)	Temporary (T)	Major Negative (-9 & -10)	Not significance
Likely (M)	Short Term (S)	Moderate Negative (-7 & -8)	Minor significance
Certain (X)	Long Term (L)	Minor Negative (-5 & -6)	Moderate significance
	Permanent (P)	Negligible (-4 to 4)	High significance
		Minor Positive (5 & 6)	
		Moderate Positive (7 & 8)	
		Major Positive (9 & 10)	

120 There is also uncertainty with the smooth continuation of this project. Minor or even major changes to the project's concept plan could alter the series of impacts. Major changes would require an additional EMP to be made.

5.3 Impact Boundary

121 Proposed project has components that will impact the environment of the project site. The physical impacts (such as direct habitat loss) will usually be felt within the project footprint and close proximity to project area. However, some impacts such as noise and impact on groundwater can be felt on a large area without proper mitigation measures. The indirect impact of a project can be observed from a larger area as well. For example, operation of ISWMC will help to keep the whole island clean improving the living condition. Also, other positive social impacts of ISWMC can be felt by the whole island in the long term.

5.4 Environmental Impacts Related to Location

122 The siting of the IWMC has been the identified by the island council and is subject both to approval from the Ministry of National Planning, Housing and Infrastructure and the national EIA process. The proposed site is distant from residential areas, but close to the shore and therefore containing leachate from stored waste and composting is important.

123 **Effects on the surrounding seawater and marine ecosystems.** The IWMC is to be located close to the shoreline. The risk of loss of waste or leachate IWMC will be mitigated by (i) ensuring that waste enters and leaves the IWMC on the landward side of the facility (ii) collecting and containing leachate at IWMC and (iii) that site security and management is ensured by the island council. The measures must ensure no deterioration of water quality in the vicinity of the IWMC.

124 **Effects on vegetation**. The area was sparsely vegetated with shrubs and no mature trees. As there are no mature trees in the surrounding area, no removal of trees will be undertaken.

125 **Surrounding land use.** The surrounding land is not inhabited though likely to be developed for recreational use. While improved management of the IWMC will reduce odour and attraction to pests such as rodents, the effect on existing land use can be mitigated by (i) ensuring security, regular cleaning operations and maintenance takes place and (ii) planning of further developments such that receptors such as dwellings are not placed close to the facility, and preferably separated by a belt of trees or open space.

126 **Impedance of traffic**. Due to low levels of traffic on Maafushi, the transport of waste to and from the facility is not expected to impede traffic.

127 **Loss of land and effects on property**. No private property will be affected and land acquisition will be required and there is therefore no impact.

5.5 Environmental Impacts Related to Construction

128 Impact during the construction phase include impacts that arise from site preparation, mobilization, and from the construction activities. Waste generated during the construction is also a potential impact generating activity especially if not properly disposed. Positive sociocultural impacts will be felt during the construction by means of employment and negative impacts could arise from temporary traffic during mobilization. The table below shows the impact assessment matrix for the construction phase of the project.

Table 15: Impact assessment matrix of the construction phase

		Construction phase					
		Probability	**Duration**	**Magnitude**	**Direct or indirect**	**Significance**	**Cumulative**
Physical components	Air quality	O	T	-2	Direct	Minor significance	Cumulative from different project activities and other projects that fall within the same construction period.
	Noise	O	T	-2	Direct	Minor significance	Similar to air quality.
	Groundwater	M	S	-5	Direct	Moderate significance	Cumulative from different project activities
Biological components	Terrestrial environment	M	S	-5	Direct	Moderate significance	NA
	Protected / sensitive areas	NA	NA	NA	NA	-	NA
Socio-economic and cultural component	Health and safety of workforce	O	T	-5	Direct	Moderate significance	Cumulative from different project activities
	Health and safety of staff	NA	NA	NA	NA	-	NA
	Employment	X	S	8	Direct	High significance	Cumulative from different project activities
	Visual amenity	M	S	-3	Direct	Minor significance	NA
	Living standard	O	L	6	Indirect	Moderate significance	Cumulative from different project activities
Total impact magnitude				-3			

		Construction phase					
		Probability	Duration	Magnitude	Direct or indirect	Significance	Cumulative

129 **Site preparation**: Proposed land plot in Maafushi is located on the east side of the island near the football field. Excavations to form foundations for structures will involve making temporary stockpiles of material that will either be removed or re-used. To prevent the release of silt into sea contractors will be required to ensure that (i) excavated areas are rapidly refilled on completion of works, (ii) to place silt fences around temporary piles of excavated material and (iii) avoid excavation in wet weather to the extent practicable.

130 **Construction method**. The methods to be used for site preparation, and construction, as well as associated arrangements to ensure sound environmental management and safety at all times, are to be defined by the Contractor in a Contractor's Environmental Management Plan submitted to the PMDSC for approval.

131 **Transportation of construction machinery and materials**: Transportation of machinery and materials implies movement traffic that will lead to possible negative impacts to the surrounding area (dust, spillage, emissions, and noise) as well as disruption to the existing traffic flow of the island. Construction vehicle movements are not expected to impede traffic, as levels of traffic on the island are very low.

132 Improper storage of construction materials, especially gravel, sand, and cement, on the construction site could lead to inadvertent dispersal of materials during heavy rains or high winds. This could have a negative impact on the surrounding environment. As the proposed project sites are close to sea, there is a chance of lose materials dispersing to marine environment.

133 **Water pollution**. The use of vehicles and plant can cause risks of water pollution, in the event of leaks and spills of fuel, lubricants, hydraulic fluid or other fluids used for vehicle operation. To reduce risks and limit impacts the contractor will be required to ensure that vehicles and plant are maintained in sound operable condition, free of leaks and that the condition of vehicles and equipment is regularly checked. The contractor will prepare and submit a plan for spill management, including provision of spill kits, training/briefing of workers on procedures on handling spills and allocation of responsibility within the contractor's team for ensuring that spill kits are available and that workers know how to use them.

134 **Waste management**: Construction waste will include packaging of equipment, fuels, lubricants, materials, equipment and food and some rubble where existing structures need to be demolished. Some specialist lubricants and paint for marking may be hazardous. Contractors will be responsible for removing waste to Thilafushi. Approval from the PMDSC must be obtained prior to importing materials rated as hazardous under the Globally Harmonized System of Classification and Labelling of Chemicals.

135 **Noise pollution and vibration**. Construction operations, particularly excavations and compaction will cause noise and vibration, which will be potentially be a temporary use to some residents. To mitigate the impacts the contractors will be required to (i) identify households that are likely to be affected by noise and vibration (if any), (ii) provide information to these households on scheduled work (iii) limit construction activities to normal daylight working hours (iv) adhere to the planned work schedule and (iv) ensure that all construction equipment and vehicles are kept in good working order with working exhaust mufflers.

136 **Air and dust pollution**. Potential sources of air pollution are exhaust fumes from vehicles and plant, dust from transport of construction and waste materials and areas around work sites where soil and debris is deposited. The effect will be limited due to the largely open environment where dust and fumes will be rapidly dispersed by wind. However emissions will be mitigated by ensuring that vehicles and equipment to be well maintained and tuned and fitted with exhaust baffles.

137 **Community health and safety risks**. The use of plant and machinery, use of compressed air lines and cables and excavations are potentially hazardous but most work sites are within the transfer station areas where public access is restricted. The contractor will ensure that restrictions to access are enforced and provide notices to the public identifying hazards and, where warranted, erect safety barriers/covers around areas of open excavation. Personal protective equipment to be provided to the workforce, appropriate to each site. Given the COVID-19 related current health crisis in the Maldives, social impact may arise due to the workers who are coming from other islands with a community spread. With proper measures such impacts are avoidable.

138 **Socio-economic impacts**: Socio economic impacts of the project involves the positive and negative impacts that arise during the construction stage. Negative socio-economic related impacts may include traffic flow and during the transportation of construction materials. If such materials are piled on the harbour area for long term, it will be a nuisance to the harbour users. In case of this project, construction material will be very minimal and will be transported to site for storage since the site has lot of empty land space. Since the island does not have many vehicles, impact of traffic will be temporary and minute. However, impact could be cumulative and significant if multiple projects are taking place in the island at the same time.

5.6 Environmental Impacts Related to Operation

139 General. The IWMCs and management of them are intended specifically to address existing poor practices of open burning of waste and to ensure safe and efficient handling, collection of recyclables and shipment of waste to the RWMF at Thilafushi. Existing impacts that are addressed including smoke nuisance and health risk, damage to the habitat in the existing dump area, and reduced pest issues. The table below shows the impact assessment matrix for the operation phase of the project.

Table 16: Impact assessment matrix of the operation phase

		Operation phase					
		Probability	**Duration**	**Magnitude**	**Direct or indirect**	**Significance**	**Cumulative**
Physical components	Air quality	O	T	-2	Direct	Minor significance	Cumulative from different project activities and other projects that fall within the same construction period.
	Noise	O	T	-2	Direct	Minor significance	Similar to air quality.
	Groundwater	M	S	-3	Direct	Minor significance	Cumulative from different project activities
Biological components	Terrestrial environment	NA	NA	NA	NA	-	NA
	Protected / sensitive areas	NA	NA	NA	NA	-	NA
Socio-economic and cultural component	Health and safety of workforce	NA	NA	NA	NA	-	NA
	Health and safety of staff	O	T	-3	Direct	Minor significance	Cumulative from different project activities
	Employment	X	S	8	Direct	High significance	Cumulative from different project activities and from other projects undertaken in the island

		Operation phase					
		Probability	Duration	Magnitude	Direct or indirect	Significance	Cumulative
	Visual amenity	M	S	-2	Direct	Minor significance	NA
	Living standard	O	L	8	Indirect	High significance	Cumulative from other projects undertaken in the island
Total impact magnitude				4			

140 Most of the impacts that are envisaged to arise during the operational phase of the project are expected to be mostly positive if all the mitigation measures highlighted in the report are followed. However, there are few negative impacts that could arise during the operational stage mostly due to improper operational practice.

141 **Use of containers**. While containers provide a more efficient system of handling and loading waste, reducing potential losses into the sea, any breakages or mishandling of containers will result in significant discharge of waste into the sea. Operation and maintenance training must provide for instruction on maintenance of containers, loaders, cranes and vessels and sound operation including licensing of vehicle and plant operators and restrictions on operation during stormy weather.

142 **Waste management**: Construction of ISWMC will provide a sufficient solution for the current waste management issues of the island. Waste management center has dedicated areas to store the waste and dedicated areas to handle certain types of waste. This will improve the waste handling and management process of the island. The waste collected in the center will be packed and stored according to the guidelines provided by the authorities and hence spillage during transfer will be minimum. The project also aims to transfer waste from ISWMC to the regional waste management center in Thilafushi. Waste will not be stored in the ISWMC not more than a week after the start of the full operation of the Zone 3 waste management project. This will be a positive impact to the island waste management.

143 **Pests**. Although improvements will reduce access to them, the transfer stations will still be subject to pests such as birds and rodents. Numbers of these can be kept down by improved operation regimes, including site hygiene and regular cleaning of surfaces.

144 **Occupational health and safety**. Potential hazards to workers arise from the handling of compost, when workers can breathe micro-organisms that cause respiratory and other disorders, and accidents associated with the operation of collection trucks and loading containers into the vessels that take the waste to the RWMF at Thilafushi. Risks are mitigated by training in handling of compost and of machinery, and sound supervision and management of operation of the facilities. Personal protective equipment will be provided including a fire extinguisher on site.

145 **Delayed collection**. Waste can be accumulated due to delayed collection. This could cause the IWMC to reach maximum capacity and be unable to handle further waste production, and lead to problems with odour and pests. In the case of delays IWMC design allows storage of waste for 4-6 weeks until waste can be collected and transported. With proper handling of waste in containers any impacts from accumulation due to delays can be mitigated until transport.

5.7 Global, Transboundary and Cumulative Impacts

146 IWMCs are to be established, where they do not exist or are not operational, on each inhabitated island in zone 3 under the project and also elsewhere in the country. Operation of the IWMC and efficient removal of waste to the RMWF will reduce risks to the island and marine environment. Effective institution of sound management of the IWMCs and of waste collection and handling will provide a demonstration of good practice, of value to island councils and workers on other islands who need to develop capacities for improved waste management.

147 Capacity building for the island council will assist in the build-up of capabilities required to further improve and manage waste management facilities throughout the Maldives.

6 Analysis of Alternatives

6.1 Alternatives for the IWMC

148 As stated in section 0, there is an existing but a dumpsite on the island. The alternative of rehabilitating and extending this area and putting it back into operation has not been pursued, as the site requires the removal of the existing waste dump at the site which is not part of this project..

6.2 Alternatives within the Project Scope

149 Improvements to waste management on Maafushi envisages the use of containers, to receive waste from truck and transfer it to vessels. An alternative to this is an “open” system where trucks are offloaded mechanically, or they tip the waste to a central area or directly onto awaiting vessels. The use of containers however provides a much higher level of control, and greatly limits the risk of waste being lost to the sea during the offloading and loading processes.

6.3 The no project alternative

150 Under the “no project” scenario, the existing practice of open incineration of household waste will continue, even as volumes of waste generation grow with population and economic growth. It is unlikely that composting will be done on a community scale, foregoing the opportunity to reduce the volume of plant waste that can be composted and re-used. While the island council has made moves and/or expressed intention to raise public awareness on waste reduction and separation, the opportunity to support the council as well as schools and the wider community through the ICT component will also be foregone.

6.4 Composting alternatives

151 The table below shows the comparison of the types of composting that can be practiced in an ISWMC. All methods mentioned below require excess area within the ISWMC.

Table 17: Comparison of types of composting

Criteria	Open windrow composting simple	Mechanized/aerated composting	In-vessel composting	Anaerobic Digestion (AD)
Area needs	Requires large area of land	Requires large area of land	Minimal space is required	Requires large area of land
Simplicity of technology	The process relatively simple, the windrows are turned regularly. The process can take up to 12 weeks.	Complex compared to Open windrow composting. Air is supplied to the composting materials through perforated pipes embedded in each wind-row, thereby eliminating the need for turning.	Complex compared to aerated composting. More technologies and knowledge are required for the composting process.	Requires air tight containers or to bury the waste underground. There are new technologies that produce biogas using anaerobic digestion.
Maintenance	Low infrastructure set-up is required, so maintenance would be minimal.	More infrastructure maintenance then open windrow composting. Maintenance of pipes and machineries is required	High maintenance. Takes place in a confined space, which is usually a highly controlled, sealed chamber.	High maintenance if the new technology is used. Low maintenance if pits are used but require digging up.
Odor and leachate	Open windrow will generate leachate as well as odor	Aerated composting will also generate leachate as well as odor	Better maintenance of odor and leachate	Produces strong odour but can be avoided if practiced in air

				tight containers. If buried underground, there is a possibility of leachate seeping to groundwater.
Cost	Low-cost	Higher cost than open windrow composting	Higher cost than aerated composting	Cost depends on the type of AD adopted

7 Information Disclosure, Consultation and Participation

7.1 Consultations and information disclosure during design

152 Consultations took place between the consultants, a representative of MECCT and representatives of the island council and stakeholders on the island during a visit on 5th December 2019 and 21st January 2021. These consultations enabled the consultants and MECCT to understand the intentions and existing actions of the island council to improve waste management on the island and to gauge capacity development needs.

153 Below is a summary of the points discussed in the meeting.

- Currently waste is burned in the dumping site. Dump site is located east side of the island. Therefore, during burning smoke comes into the island especially if wind is from east direction.
- Residents and tourists visiting the island complain about the smoke.
- There is an incinerator installed in the island. This is not yet operational because council has no proper machinery to feed waste into it. This has been informed to the Ministry.
- Council manages island waste by using 5 staffs. 3 of them works in collection and they collect from households and collection points and transfer them to the waste dump site. A monthly fee is taken. 2 of the staff looks after the dump site.
- Council hopes that the proposed IWMC will end the current waste burning practices. Also, they want to regularly transfer waste to Thilafushi to make sure the ISWMC is not filled with waste that they cannot dispose without burning.

Table 18: List of people consulted

Name	Designation	Office
Usman Rasheed	President	Maafushi Island Council
Nasheedha Adam	Vice President	Maafushi Island Council
Ali Shanoon	Member	Maafushi Island Council
Chakir Kasdarli	Team Leader	Kocks Ingenieure
Ahmed Jameel	Deputy Team Leader	Water Solutions
Abdul Aleem	Environmental Safeguard	Water Solutions
Abdulla Fayaz	Civil Engineer	Water Solutions

7.2 Further Information Disclosure and Public Consultation

154 This report and a Dhivehi translation of the executive summary will be provided to commune officials for public disclosure. Stakeholders will be kept informed of construction activities that are likely to cause noise and dust nuisance and will be made aware of the grievance redress mechanism and consultations will take place regularly to gain feedback and ensure that impacts are being adequately managed.

8 Grievance Redress Mechanism

155 To ensure consultation, disclosure, and community engagement continues throughout project implementation, a grievance redress mechanism will be established based on existing mechanism. The grievance redress mechanism will allow for concerns and grievances about the waste management projects' social and environmental performance raised by individuals or groups and to facilitate resolution of those concerns and grievances. The Grievance Redress Mechanism includes 3 tiers. Every effort shall be given to find an amicable solution before higher tiers could be engaged. To facilitate such, following would be done by Ministry of Environment, Climate Change and Technology.

156 A register of grievances should be maintained at Island Council and Ministry of Environment, Climate Change and Technology.

First Tier (Island Council)

157 An individual or an interest group can contact Island Council for grievances.

- At the project location there will be an Information Board listing the names and contact telephones/emails.
- If the grievance cannot be resolved informally by contacting Island Council on (960) 6640073, or an aggrieved party must submit a complaint on the Tier I by sending an email to info@maafushi.gov.mv
- If the complaint is resolved within 15 days Island Council must communicate the decision to the aggrieved party in writing.
- If a complaint requires more time to address, this requirement must be communicated to the aggrieved party in writing and the aggrieved party must consent and sign-off the request for the extension to take effect. An extension can be made to an additional 15 days.
- A copy of the form should be provided to the aggrieved party as evidence of receipt. The complaint form should be available from the Island Council.
- The grievance redress committee (GRC) includes the island's representatives as well as project officers related to each island, as shown in the Figure 3 below.

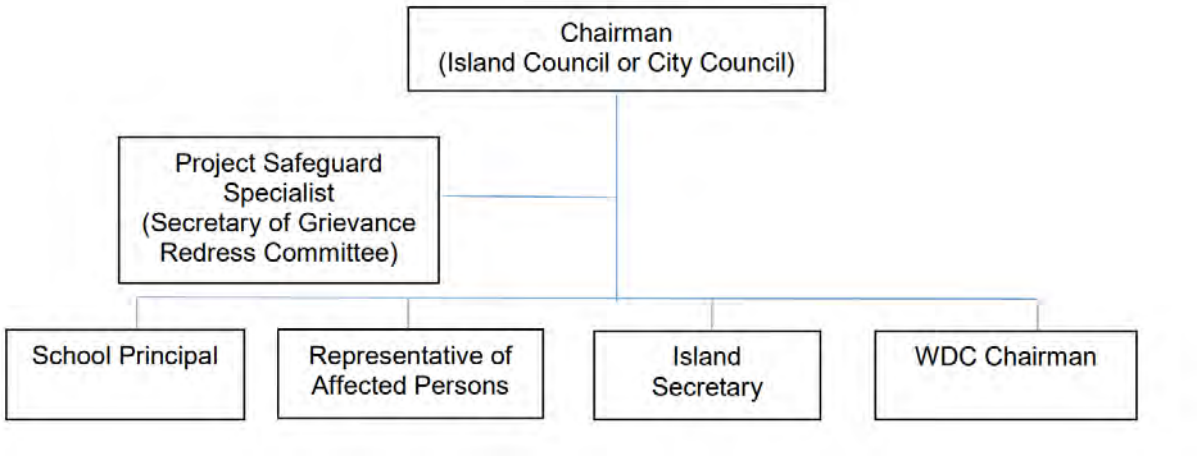


Figure 17: Grievance Redress Committee for first tier

Second Tier (Ministry of Environment, Climate Change and Technology)

158 If the grievance cannot be resolved through Tier 1, an aggrieved party must submit a complaint on the Tier 2 to Ministry of Environment, Climate Change and Technology.

- An aggrieved party must contact Ministry of Environment, Climate Change and Technology on (960) 3018300 sending a mail to secretariat@environment.gov.mv.
- The complaint will be screened to determine if it is related to the project.

- If Ministryfinds that the complaint is not related, the aggrieved party must be notified in w riting with a way forwarded including the necessary government institutions to follow up with
- If the Ministry of Environment, Climate Change and Technology finds the complaint is related, Ministry to start the Second-Tier process.
- A written notification by Ministry of Environment, Climate Change and Technology will be provided to the aggrieved party if a solution is reached within working 15 days.
- An acknowledgment of the receipt of the decision of Ministry of Environment, Climate Change and Technology in acceptance or denial of the decision Ministry of Environment, Climate Change and Technology must be provided by the aggrieved party within 10 days. If no acknowledgement is submitted from the aggrieved party, then the decision will be considered as accepted.
- If a satisfactory solution was not reached through the Tier II process, the aggrieved party may notify Ministry of Environment, Climate Change and Technology, in writing of the intention to move to Tier III.

Third Tier (Judiciary)

- An individual or an interest group has the option of going to established judiciary system of the Maldives.
- The legal system is accessible to all aggrieved persons.
- Assistance from the Ministry of Environment, Climate Change and Technology would be available only for vulnerable person as per this grievance redress mechanism.
- In cases where vulnerable person(s) are unable to access the legal system, the Attorney General´s office will provide legal support to the vulnerable person(s).
- The verdict of the Courts will be final.
- A vulnerable person(s) for the purpose of this project is a person who is poor, physically or mentally disabled/handicapped, destitute, and disadvantaged for ethnic or social reasons, an orphan, a widow, a person above sixty-five years of age, or a woman heading a household.

9 Environmental Management Plan

9.1 Objectives

159 This EMP sets out the needs for environmental management of transfer station improvements within the GMEIWMP in terms of institutional responsibilities to ensure mitigation and monitoring takes place during the pre-construction, construction and operation phases, meeting the requirements of the Government of the Maldives and the ADB's SPS.

160 A copy of the EMP must be kept on work sites at all times. This EMP will be included in the bid documents and will be further reviewed and updated during implementation. The EMP will be made binding on all contractors operating on the site and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

161 For civil works, the contractor will be required to (i) establish an operational system for managing environmental impacts (ii) carry out all of the monitoring and mitigation measures set forth in the EMP; and (iii) implement any corrective or preventative actions set out in safeguards monitoring reports that the employer will prepare from time to time to monitor implementation of this IEE and EMP. The contractor shall allocate a budget for compliance with these EMP measures, requirements and actions.

9.2 Institutional Responsibilities

162 The planning, design and construction of IWMCs is set through a process that covers data collection, consultations, involvement of the island council, approvals, EIA preparation, design and tender. A flow diagram for this process is given in Figure 18. This IEE will be updated to reflect the findings of the EIA carried out as part of this process, and also detailed design.

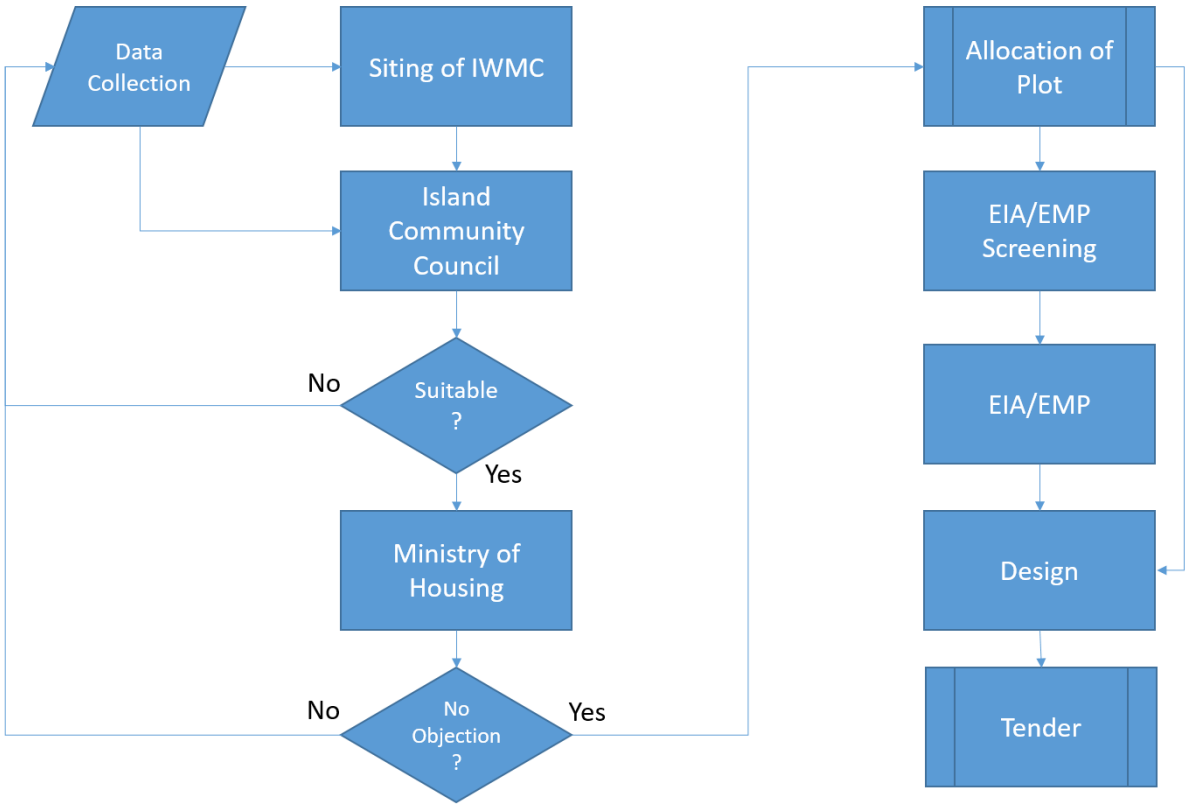


Figure 18: IWMC planning process

SOURCE: MECCT

163 The Executing Agency for the Greater Malé Environment Improvement and Waste Management Project (GMEIWMP) is the Ministry of Finance and Treasury (MOFT) and the implementing agency is the MECCT. Project Management, Design and Supervision Consultants (PMDSC) will have responsibility for overseeing project management. EMP implementation will be the responsibility of the island council, with support from the PMDSC.

9.2.1 Roles and Responsibilities of Project Implementation Organizations

164 The table below shows the roles and responsibilities of the Project Implementation Organizations

Table 19: Roles and Responsibilities

Project Implementing Organizations	Responsibilities
PMU	• Responsible for overall project management, implementation and monitoring • Monitors and ensures the compliance of covenants • Maintaining project accounts and project financial records • Reviews the reports submitted by the PMDSC with respect to detailed design, costs, safeguards, financial, economic, and social viability • Prepare, with the support of PMDSC, bidding documents request for proposals, and bid evaluation reports • Serves as point of contact with ADB and maintains project documents • Consolidates expenditures and prepare withdrawal applications for direct payment, reimbursements and use of advance account • Opens and manages advance account for ADB Grant • Organize project orientation for participating island councils • Establishment and maintaining of project website by disclosing progress reports, safeguard monitoring reports and design reports • Collect supporting documents and submit withdrawal applications to ADB via MOFT
PMDCSC	• surveys, studies and investigations; • concept design, detailed engineering and design; • bidding process support; • procurement and contract award; • construction supervision; • contract administration; • project management and monitoring; and • ensure compliance with social, environmental, and, occupational health and safety aspects.
Island Council	• Operators of solid waste services on outer islands • Responsible for management and O&M of Island Waste Management Centers • Monitors site in close cooperation with site engineers and environmental experts
Contractor	• complies with all applicable legislation, is conversant with the requirements of the EMP, and briefs staff about the requirements of same; • ensures any sub-contractors/ suppliers, comply with the environmental regulations of the EMP • provides environmental awareness training to staff; • bears the costs of any damages/ compensation resulting from non-adherence to the EMP or written site instructions;

	• conducts all activities in way to minimize effects on residents of the area, and the environment • ensures that its staff or engineers are informed in a timely manner of any foreseeable activities that will require input from the environment and safety officers (or equivalent); • appoints one full time environment and safety officer (or equivalent) for implementation of EMP • receives complaints from public and takes remedial measures

9.2.2 Capacities for Environmental Management

165 The regulatory body responsible for approving environmental impact assessments and issuing of permits is the responsibility of the Environmental Protection Agency (EPA), which has further responsibility for environmental research and conservation and development of facilities for waste, water supply and sanitation. This body is under the Ministry of Environment, Climate Change and Technology but funded and administered separately.

166 The EPA has few trained technical staff and the agency relies on external consultants for functions such as environmental monitoring for projects. The EPA clearly does not have resources for regular support to island councils and monitoring of their effectiveness in ensuring EMP implementation. The EPA will be reliant on the support of the PMDSC for overseeing EMP implementation.

9.2.3 Awareness Training on Compliance to Safeguard Requirements

167 The PMDSC will be responsible for ensuring compliance with safeguard aspects during the construction phase of the project. PMDSC will provide awareness material to the contractor. In addition to this training will be provided at the beginning of the works to the contractor. Afterwards periodical visits and monitoring will be held. The responsibility for further training during the operation will lie with the PACCB and PMU.

9.2.4 Institutional Arrangement during Operation and Maintenance

168 At the end of the construction, Island Council will take over the operation of the IWMC. Therefore, at the operation stage, island council will be the owner of the facility and will be responsible to implement the EMP during the operation and maintenance phase of the project. PMDSCS/PMU site engineers and environmental experts will be in close corporation with the island council during the process.

9.3 Impacts and Mitigation

169 Table 20 summarizes the potential impacts and mitigation measures in relation to location, construction and operation identified in the report.

Table 20: Environmental Management Plan

Impacts	Location	Mitigation Measures	Source of Funds	Responsibility for Implementation	Responsibility for Supervision
Pre-Construction Stage					
Effects on surrounding seawater and marine ecosystems	Sea surrounding the IWMC	(i) ensuring that waste enters and leaves the IWMC on the landward side of the facility (ii) detailed design to include both a system for collecting and containing leachate from piled household waste awaiting collection and from composting and (iii) site security and management to be ensured by the island council. The measures must ensure no deterioration of water quality in the vicinity of the IWMC.	Project funds	Island council	MECCT
Odor and attraction to pests	Nearest residential area	(i) ensuring security, regular cleaning operations and maintenance takes place and (ii) planning of further developments of the reclaimed land such that receptors such as dwellings are not placed close to the facility, and preferably separated by a belt of trees or open space.	Island council	Island council	MECCT
Construction stage impacts					
Noise pollution and vibration	Nearest residential area	Identifying potentially affected households, providing information on operations, limiting construction activities to daylight hours, adhering to schedule, maintenance of construction equipment and vehicles in good operable order.	Construction Cost	Contractor	PMDCSC
Construction waste	IWMC area	All solid waste must be disposed of at the RWEMF/Thilafushi. Importation of any materials rated as hazardous under the Globally Harmonized System of Classification and Labelling of Chemicals to be subject to approval by PMDSC, which will be conditional on stating adequate arrangements for disposal. Prohibit burning of construction and/or domestic waste. Conduct site clearance and restoration to original condition after the completion of construction works.	Construction Cost	Contractor	PMDCSC
Release of silt	IWMC construction site	Excavated areas to be rapidly refilled on completion of works. Use of silt fences around temporary piles of excavated material. Avoid excavation in wet weather to the extent practicable.	Construction Cost	Contractor	PMDCSC

Impacts	Location	Mitigation Measures	Source of Funds	Responsibility for Implementation	Responsibility for Supervision
Water pollution	IWMC construction site	Vehicles and plant are to be maintained in sound operable condition, free of leaks. The condition of vehicles and equipment will be periodically checked. Contractor to prepare and submit a plan for spill management, including provision of spill kits, training/briefing of workers on procedures on handling spills and allocation of responsibility within the contractor's team for ensuring that spill kits are available and that workers know how to use them.	Construction Cost	Contractor	PMDCSC
Community health and safety hazards	IWMC construction site and immediate surrounds	Restriction of access to work site, warning notices to the public on hazards, barriers when warranted. If the workforce is sourced from an island with COVID-19 community spread, the workers must be tested negative for COVID-19 before the start of the construction work.	Construction Cost	Contractor	PMDCSC
Occupational health and safety hazards	IWMC construction site	Contractor to focal point for health and safety at site and to ensure regular briefing of construction workforce on health and safety issues. Adequate personal protective equipment to be provided to the workforce.	Construction Cost	Contractor	PMDCSC
Impacts During Operation					
Risks of loss of containers and contents	Dock area	O&M training to include instruction on maintenance of containers, loaders, cranes and vessels and sound operation including licensing of vehicle and plant operators and restrictions on operation during stormy weather	Training budget	Contractor	MECCT
Pests: Rodents and birds	IWMC area	Maintenance of site cleanliness, minimizing storage time for putrescible waste, provision of enclosures for putrescible waste. Introduction of home composting limits attraction of pests to IWMC site.	Operation Cost	Island council	MECCT
Operator occupational health and safety	IWMC and dock area	Operators trained to recognize risks and hazards. Provision of personal protective equipment (Helmets, safety goggles etc.) Personal safety equipment issued and worn. Health and safety recognized as primary employer responsibility. Training carried out to operate equipment (balers, shredders etc.) Fire extinguishers will be provided as part of equipment.	Operation Cost	Island council	MECCT

Impacts	Location	Mitigation Measures	Source of Funds	Responsibility for Implementation	Responsibility for Supervision
Accumulation of waste due to delayed collection	IWMC area	Proper storage of waste within containers and use of machineries to reduce the volume of waste will allow IWMC to maintain capacity for up to 4-6 weeks in the case of a delay. Inform island council of the delayed collection so impacts can be addressed early.	Operation cost	Island Council	MECCT

9.4 Environmental Monitoring

9.4.1 Monitoring Plan

170 The design of the environmental monitoring system is based on an analysis of the key environmental performance issues associated with each stage of the project, set out in Table 21 below.

Table 21: Analysis of Environmental Monitoring Needs

Phase	Key Environmental Performance Issues	Environmental Performance Indicator	Means of Monitoring
Design/Preconstruction	Inclusion of mitigation measures in design/build and/or detailed design documentation and construction activities	Compliance with EMP design measures	Compliance monitoring
Construction	Adherence to provisions in the EMP to mitigate construction impacts	Compliance with EMP	Compliance monitoring
	Direct effects on communities from impacts such as accidental damage, dust generation, noise generation and safety	Views and opinions of communities	Community feedback Grievance redress mechanism
Operation	Effectiveness of IWMC, collection system and removal to RWMF	Cessation of practice of burning of waste, regular removal to RWMF, limited odor, effective pest control	Site observations Community feedback

171 Two areas of environmental monitoring are identified: compliance monitoring and community feedback, which are in addition to monitoring measures in the Design and Monitoring Framework for the project. These provide a means of gauging whether the stations operate more efficiently and with less loss of waste into the sea.

172 Compliance monitoring is required during detailed design and construction of the IWMC, to ensure that mitigation specified in the EMP is carried out to an adequate standard. Compliance monitoring is a function of the PMDSC and its cost of this monitoring is part of the running cost of the PMDSC.

173 Community feedback provides for the monitoring of environmental indicators gauged by public perception. Appropriate indicators are:

- Reduced incidence of nuisance of smoke from burning waste
- Clean area surrounding the IWMC
- Effectiveness of waste handling (regular collection and removal to RWMF)

174 Costs of environmental assessment and monitoring during construction are project costs. Environmental monitoring during operation is carried out by the island council, and costs will be met from O&M budgets prepared and managed by the island council.

Table 22: Environmental Monitoring Plan

Impact to be Monitored	Means of Monitoring	Construction Phase			Operation Phase		
		Frequency	**Responsible Agency**	**Indicative Annual Cost**	**Frequency**	**Responsible Agency**	**Indicative Annual Cost**
General Construct-ion Impacts	Comm-unity Feed-back	To be established by PMDSC	PMDSC	Included in project management and consultancy cost	To be established by MECCT	Island Council in collaboration with MECCT	Operational Cost
Compliance with EMP	Inspections	As set up by super-vising engineers	PMDSC	Included in project management and consultancy cost	To be established by MECCT	Island Council in collaboration with MECCT	Operational Cost
Occurrence of floating waste	Comm-unity Feed-back	To be established by PMDSC	PMDSC	To be determined in design ICT component of Project 1	To be established by MECCT	Island Council in collaboration with MECCT	Operational Cost
Groundwater quality	Conductivity, pH, salinity, temperature,	Every 6 months	PMDSC	Included in project management and consultancy cost	To be established by MECCT	Island Council in collaboration with MECCT	Operational Cost
Noise levels	Decibels (db)	Every 6 months	PMDSC	Included in project management and consultancy cost	To be established by MECCT	Island Council in collaboration with MECCT	Operational Cost
Waste generation	Amount of waste generate (tonnes)	Every 6 months	PMDSC	Included in project management and consultancy cost	To be established by MECCT	Island Council in collaboration with MECCT	Operational Cost
Accidents	No. of accidents	Every 6 months	PMDSC	Included in project management and consultancy cost	To be established by MECCT	Island Council in collaboration with MECCT	Operational Cost
Marine water quality (near the project site)	Conductivity, pH, salinity, temperature,	Every 6 months	PMDSC	Included in project management and consultancy cost	To be established by MECCT	Island Council in collaboration with MECCT	Operational Cost
Inspection of leachate collection system	Inspection	Every 6 months	PMDSC	Included in project management and consultancy cost	To be established by MECCT	Island Council in collaboration with MECCT	Operational Cost
Inspection of septic tank	Inspection	Every 6 months	PMDSC	Included in project management and consultancy cost	To be established by MECCT	Island Council in collaboration with MECCT	Operational Cost

9.4.2 Reporting

175 EMP compliance monitoring will be undertaken by the PMDSC with the help of the contractor and island council. Effects will be monitored by means of community feedback and laboratory testing.

176 A detailed environmental monitoring report is required to be compiled and submitted to the EPA based on the data collected for the monitoring the parameters included in the monitoring plan given in the EMP. To facilitate monitoring and enable responses to emerging issues, quarterly reports will be prepared by the PMDSC and MECCT. These reports will also be provided to PMU and PMU would report to ADB.

177 The report will include details of the site, data collection and analysis, quality control measures, sampling frequency and monitoring analysis and details of methodologies and protocols followed.

178 The monitoring report main headings are as follows:

1. Introduction
2. Methodology
3. Parameters measured.
4. Analysis and Results
5. Conclusion

179 The monitoring report will be submitted at the end of the construction stage and annually for 2 years during the operation stage.

9.4.3 Budget

180 To implement the components highlighted in Table above, provisional sum of 9,000 USD is estimated.

10 Recommendation and Conclusion

181 Developing an island waste management center in Maafushi would improve the current waste management practices in the island. Developing an ISWMC and adopting the practices highlighted in this report will help to alleviate the current waste related environmental pollution and public health issues of the island. Managing an ISMWC will also induce economic benefits as it will generate employment opportunities in the island.

182 This EMP is prepared in accordance with the EIA Regulations of 2012 from EPA. Since the proposed site for ISWMC in Maafushi is an area used by the island community to dump waste, and with no vegetation removal required, impact of it on the island terrestrial environment will be very minimal. Most of the negative impacts of the project can be avoided or minimized if the mitigation measures provided in the report are adhered.

183 The overall finding of the EMP is that the Project will result in significant environmental benefits, as it is conceived and designed to address environmental issues associated with existing practices of poor waste disposal including open burning of household and food waste. It will not have significant adverse environmental impacts and potential adverse impacts are manageable through the effective implementation of the EMP.

184 No further environmental assessment is therefore required, beyond the issues to be reviewed during detailed design however this EMP must be updated to reflect the EIA process to be undertaken as part of the MECCT supported IWMC Implementation.

185 It is recommended to include this EMP report in the contract of the construction and operation contractors. This will bind the contractor with an agreement to implement the mitigation measures provided in the report and to conduct the monitoring highlighted in the report.

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Annex 1: EIA Screening Decision from EPA

Environmental Protection Agency
އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ

203-ECA/438/2021/15:ނަންބަރު

ސްކްރީނިން ކުރުމުގެ ނިންމުން

Screening Decision

މިއީ ކ. މާފުށީގައި އައިލެންޑް ވޭސްޓް މެނޭޖްމަންޓް ސެންޓަރެއް ޤާއިމްކުރުމުގެ މަޝްރޫޢުގެ މަސައްކަތް ސްކްރީނިން ކުރުމަށްފަހު ނިންމިގޮތް
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This is an official document issued to **Ministry of Environment**, for communicating the decision made after screening of the project: **Construction of an Island Waste Management Center (IWMC) in Maafushi, Kaafu Atoll, Maldives.**

މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެއްޓަށް ނޭދެވޭ ބޮޑު އަސަރުތައް ކޮށްފާނެ ކަމަށް ފެނެއެވެ. ވީމާ، ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބެލުމުގެ ރިޕޯޓެއް ހުށަހަޅާށެވެ. This project is likely to cause significant negative environmental impacts. Hence, please submit an EIA report.	☐
މި މަޝްރޫޢުގެ މަސައްކަތުގެކުރިން ތިމާވެށީގެ ފުރަތަމަ ދިރާސާއެއް ހުށަހަޅާށެވެ. Submit an Initial Environmental Examination for this project.	☐
މި މަޝްރޫޢުގެ މަސައްކަތުގެކުރިން ތިމާވެށީގެ މެނޭޖްމަންޓް ޕްލޭނެއް ހުށަހަޅާށެވެ. Submit an Environmental Management Plan for this project.	√
މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެއްޓަށް ނޭދެވޭ ބޮޑު އަސަރުތައް ކޮށްފާނެ ކަމަށް ނުފެނެއެވެ. ވީމާ، މަޝްރޫޢުގެ މަސައްކަތްކުރިއަށް ގެންދިއުން އެންމެ ރަނގަޅުކަމުގައި ދަންނަވަމެވެ. This project is unlikely to have a significant negative impact on the environment. Hence, you may proceed with the project.	☐
މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެއްޓަށް ކޮށްފާނެ ނޭދެވޭ އަސަރުތައް ކުޑަކުރުމަށް މި އޭޖެންސީން އެންގޭ ފިޔަވަޅުތަކާއި މަސައްކަތް ކުރިއަށްގެންދަން ދަންނަވަމެވެ. The measures stipulated by this agency shall be used to mitigate the negative environmental impacts of the project.	☐

މިއީ ތިމާވެށީގެ ގޮތުން ކުރިއަށްދާ ސްކްރީނިންގެއް އެކެވެ. ވީމާ، މި މަސައްކަތް ކުރުމަށް ސަރުކާރުގެ އެހެން ކަމާބެހޭ އިދާރާތަކުން ހުއްދަ ހޯދުމަށްފަހު ކުރިއަށް ގެންދަން ދަންނަވަމެވެ. މިސްކްރީނިން ކުރުމުގެ ނިންމުމުގައި ލިޔެވިފައިވާ މުއްދަތަކީ ހަމަ ޖެހިފައި ކުރުމަށް ބާރުލިބިގެން ވާ އޮތޯރިޓީއަކުން ނިންމި ނިންމުން ތަންފީޒު ކުރުމަށް ދީފައިވާ މުއްދަތެވެ.

This is an environmental screening. Hence, obtain all necessary approvals/permits from other relevant government authorities before commencement of the project activities. The date of expiry stated in this Environmental Screening Decision Statement is the duration given to implement the decision made by this agency.

Screening Institution: **Environmental Protection Agency of Maldives**

ސްކްރީނިން ކުރި އިދާރާ: އެންވަޔަރަމަންޓަލް ޕްރޮޓެކްޝަން
އޭޖެންސީ، ދިވެހިރާއްޖެ

Date of issue: **17th January 2021**
Date of Expiry: **17th January 2022**

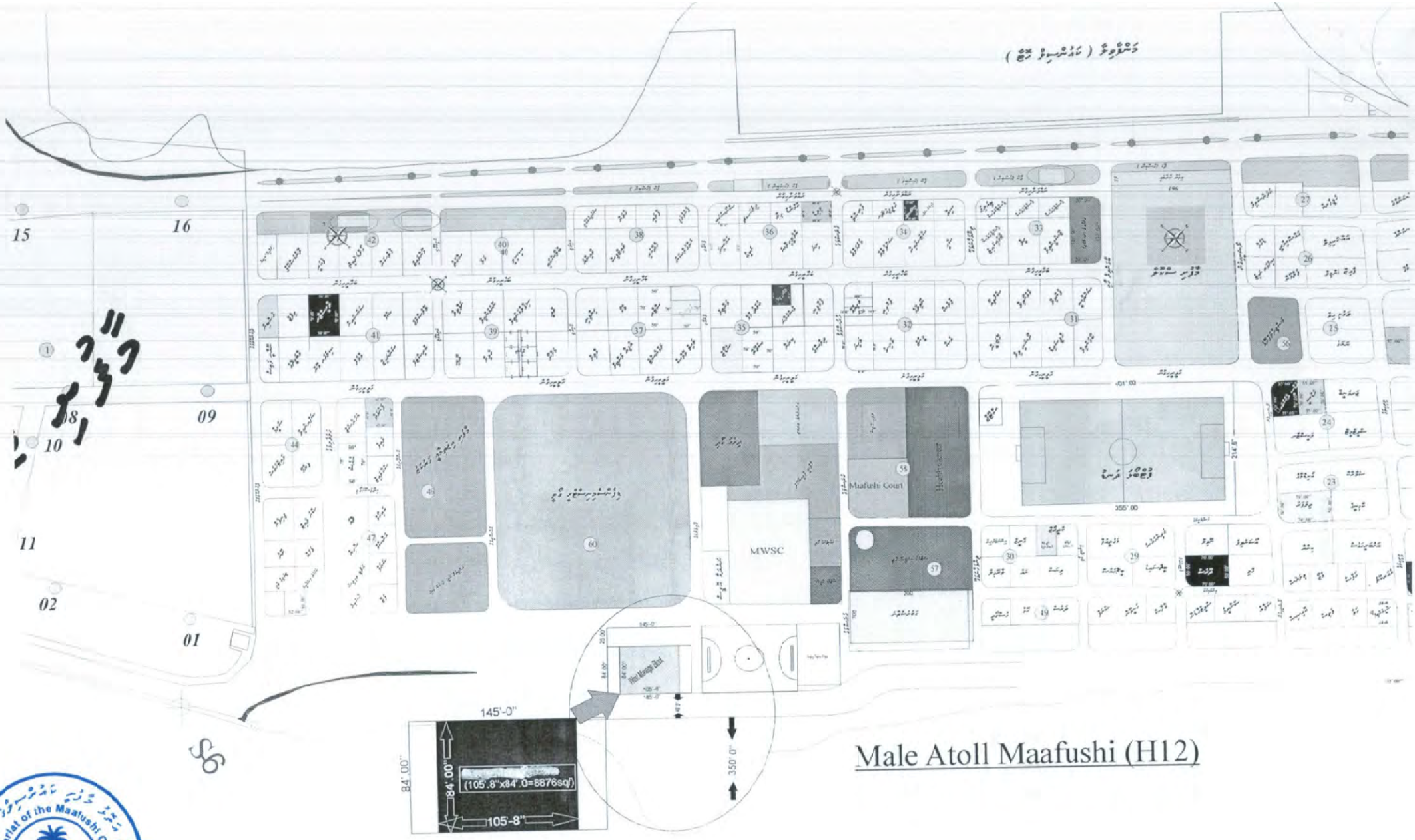
ދޫކުރި ތާރީޚު:17 ޖަނަވަރީ 2021
މުއްދަތު ހަމަވާ ތާރީޚު: 17 ޖަނަވަރީ 2022

Name: **Mr. Ibrahim Naeem**
Designation: **Director General**

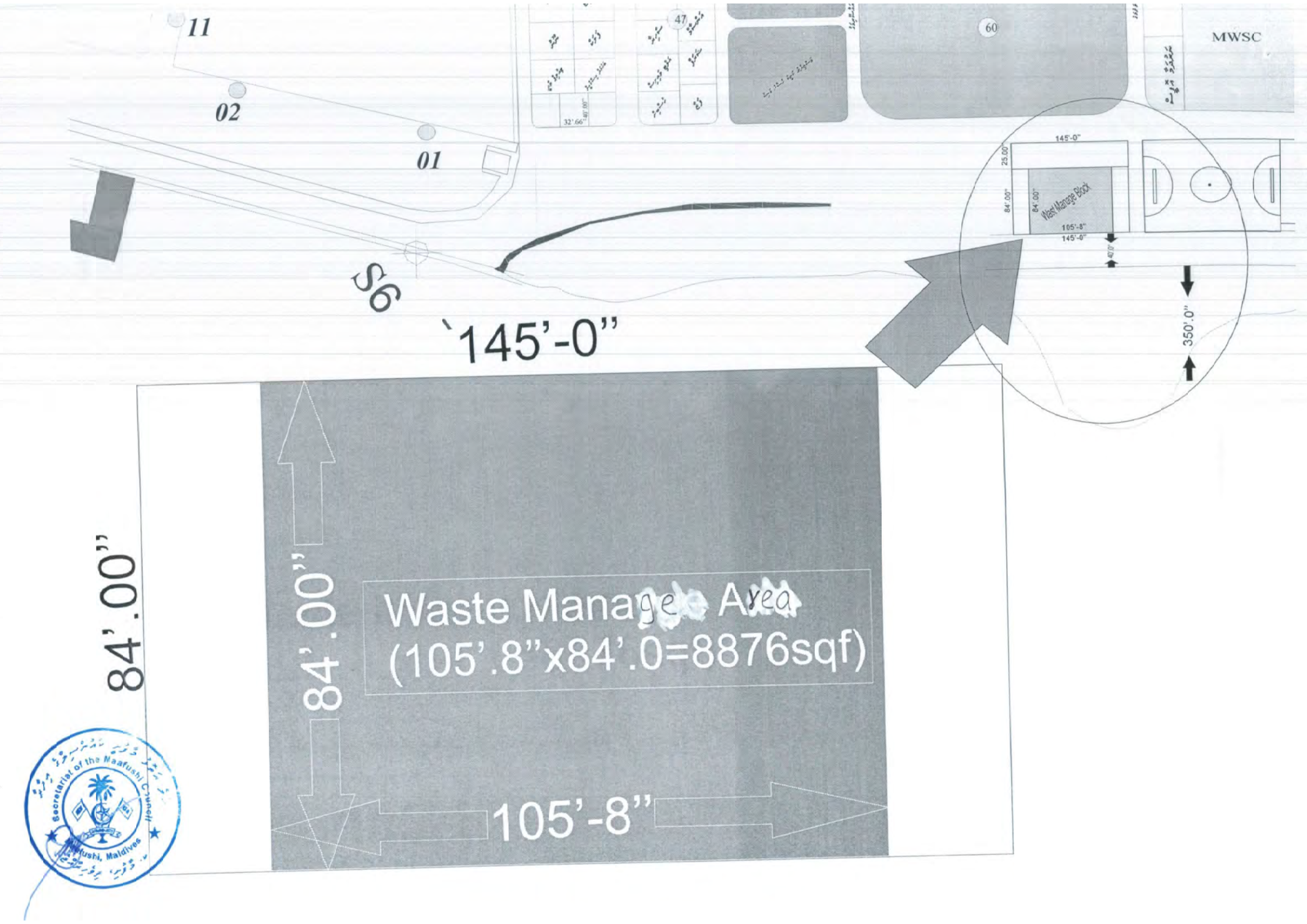
ނަން :އަލްފާޟިލް އިބްރާހިމް ނަޢީމް
މަޤާމު: ޑިރެކްޓަރ ޖެނެރަލް

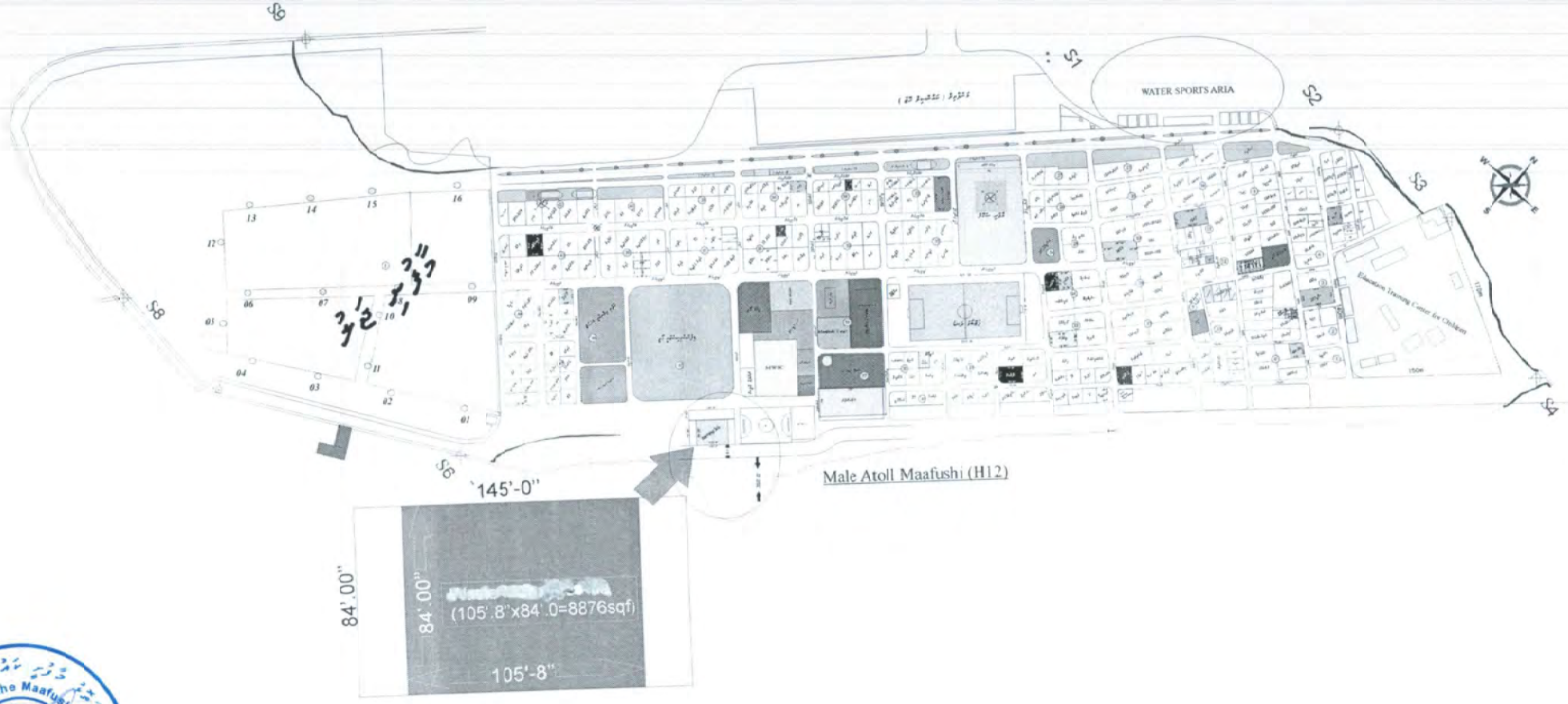
Signature: ސޮއި:

Annex 2: Approved Location for IWMC

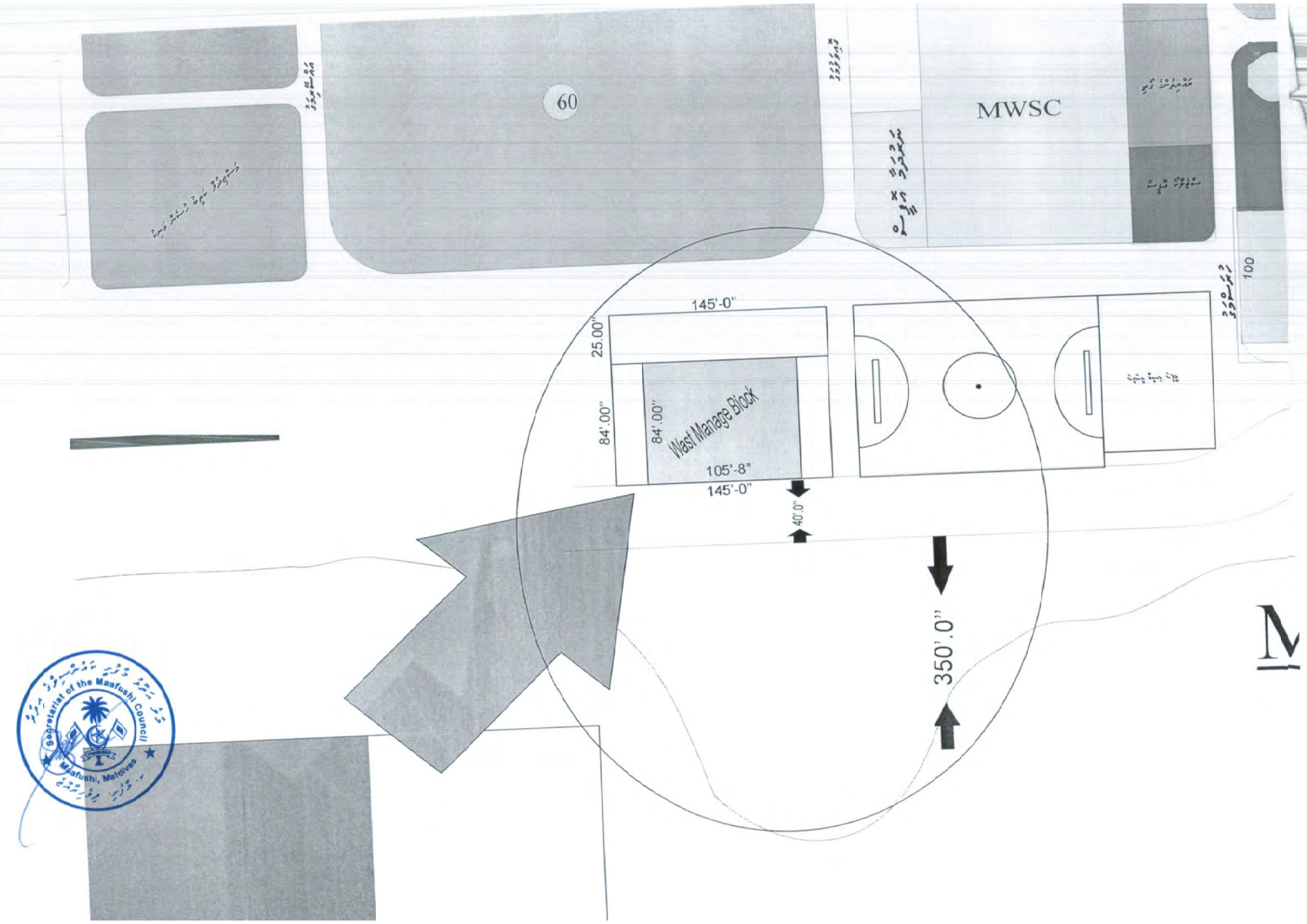


Male Atoll Maafushi (H12)


11
02
01
S6
`145'-0"
84'.00"
84'.00"
105'-8"
Waste Manage Area
(105'.8"x84'.0=8876sqf)
MWSC
145'-0"
25.00'
84'.00"
105'-8"
145'-0"
40'0"
350'.0"
Secretariat of the Maafushi Council
Maafushi, Maldives



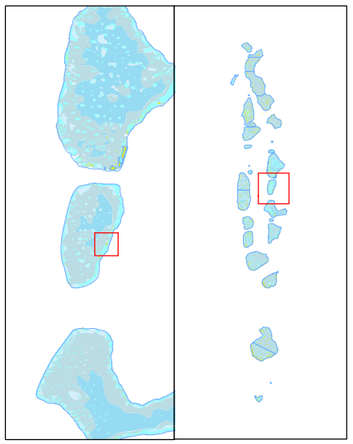
Secretariat of the Maafushi Council
Maafushi, Maldives


60
MWSC
100
145'-0"
25.00"
84'.00"
84'.00"
Mast Manage Block
105'-8"
145'-0"
40'.0"
350'.0"
Secretariat of the Maafushi Council
Maafushi, Maldives

Annex 3: Site Location

Legend

ISWMC LandPlot



Geodetic Parameters
Coordinate Systems :UTM Zone: 43 North
Projection :Transverse Mercator (TM)
Datum : WGS 1984

Scale: 1:1,678

Map Title: **IWMC Location Map**

Project: PMSDC Zone III Waste Project

Client: ME

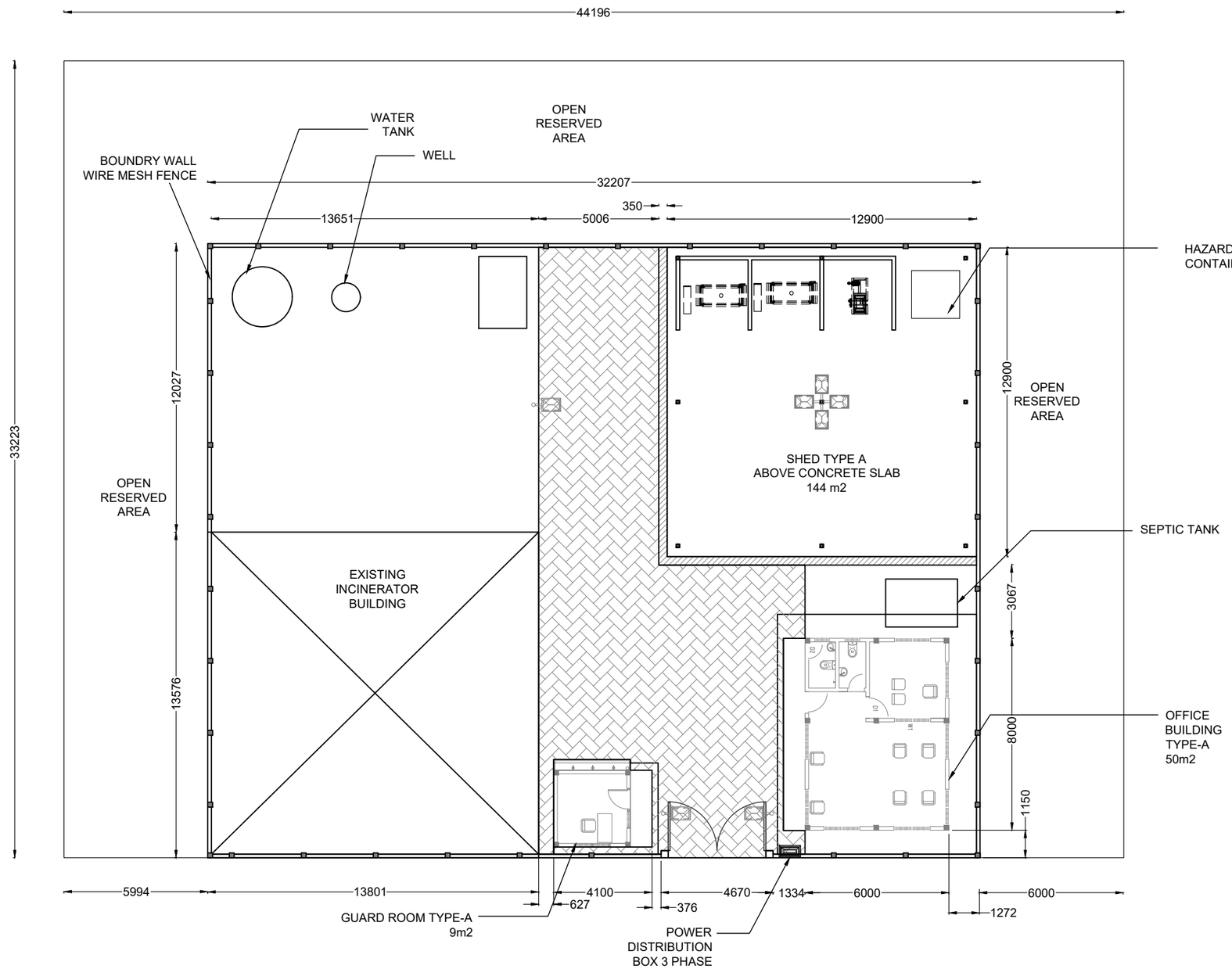
Consultant:

Water Solutions Pvt Ltd
4th Floor, M, Niyadhurumaage, Alimas Magu, Male', Maldives
Tel: +(960)3341643, Fax: +(960)331643
www.water-solutions.biz

Map Number : -

Purpose : **EIA**

Annex 4: Approved Concept Plan



SITE LAYOUT - K. MAAFUSHI

1:200

Ministry of Environment, Climate Change and Technology
Green Building, Handhuvareehigun
Rep of Maldives

KOCKS INGENIEURE
KOCKS CONSULT GMBH
Stegemannstr. 32-38
Tel: +49 261 1302-400
Email: info@kocks-ing.de

WATER SOLUTIONS PVT LTD
4th FL, M. Niadhurumaage
Tel: +960 3341643
Email: info@water-solutions.biz

Construction of Island Waste Management Centers
K. Maafushi

Site Layout

DESIGNED	KASDARLI
DRAFTED	JALEEL
CHECKED	FAYAZ
PROJECT#	213-98616

AMMENDMENTS

DESIGN

Scale	Paper
AS GIVEN	A3

Drawing No.
1

Annex 5: Stakeholder Attendance

بسم الله الرحمن الرحيم

Water Solutions Pvt. Ltd. Reg No: C-344/2005
M. Niyadhurumaage 4th Floor, Alimasmagu, Male', Maldives

Project: PMDCSC – Island Waste Management Center Survey – K. Maafushi

Date: 6th December 2019

Meeting Attendance Form

	Name	Designation	Office	Contact No.	Email	Signature
1	Usman Rasheed	President	Maafushi Island Council	9805855	k.maafushioffice@hotmail.	
2	Nasheedh Adam	Vice President	Maafushi Island Council	6640073	k.maafushioffice@hotmail.	
3	Ali Shamoon	member	Maafushi Island Council	6640073	k.maafushioffice@hotmail.	
4	Shakir Kasdarli	Team Leader	Kocks Engineer		kasdarli@kocks-eng.de	
5	Ahmed Jareel	Deputy team Lead	Water Solutions	7783771	ajr@water-solutions.biz	
6	Abdul Naeem	Environment safeguard	Water Solutions	7783502	anaeem@water-solutions.biz	
7	Abdulla Fayaz	Civil Engineer	water solution PVT	7823137	fayaz@water-solutions.biz	
8						
9						
10						
11						
12						
13						

Minutes of Meeting with Maafushi Island Council for SWM assessment

Date: 6/12/2019
Location: Maafushi Island Council

Participants

Name	Designation	Office
Usman Rasheed	President	Maafushi Island Council
Nasheedha Adam	Vice President	Maafushi Island Council
Ali Shanoon	Member	Maafushi Island Council
Chakir Kasdarli	Team Leader	Kocks Ingenieure
Ahmed Jameel	Deputy Team Leader	Water Solutions
Abdul Aleem	Environmental Safeguard	Water Solutions
Abdulla Fayaz	Civil Engineer	Water Solutions

Agenda

- Acquire general information regarding the island's households, commercial and social activities
- Assess the state of the islands solid waste management and collection, along with the state of their IWMC/dumpsite
- Assess the islands current waste management practices
- Identify the status of the islands harbor

Summary of points discussed

General Island Information

- Island has 368 households.
- The island also has a thriving commercial sector with a number of restaurants, shops and guesthouses.
- The island has education available up to Grade 112

Waste management

- Waste management is handled by island council, who hires 3 full time workers for waste collection and 2 workers to manage the dumpsite.
- This waste is collected either door to door or via collection points.
- This collection is done using a small pickup truck hired from a private party which transfers the waste to a dumpsite.

Dumpsite

- The collected waste is transported to a dumpsite where open burning of waste is done.
- There is a small fence surrounding the dumpsite.

Harbor

- Harbor does not have a ramp but is large enough to accommodate side loading of a vessel

Concerns

- The council expressed concern as to how long the project would take to become operational, as the current waste practices are already posing issues.
- The council expressed concern of the possibility of being unable to transport waste to Thilafushi once the project is operational, and what measures would have to be taken then.

Meeting was concluded with plans for a future visit and meeting to gather data for the EMP.

Minutes of Meeting with Maafushi Island Council during ESMP Data Collection

Date: 21/01/2021
Location: Maafushi Island Council

Participants

Name	Designation	Office
Ibrahim Faiz	Consultant	Water Solutions
Mohamed Umar	Consultant	Water Solutions
Mohamed Asif	Safeguard Specialist	Ministry of Environment
Usman Rasheed	President	Maafushi Island Council

Agenda

- Gather information required for the preparation of ESMP.
- Acquire general information regarding the current waste management practices.
- Assess the site proposed for construction of IWMC.

Summary of points discussed.

- Currently waste is burned in the dumping site. Dump site is located east side of the island. Therefore, during burning smoke comes into the island especially if wind is from east direction.
- There is an incinerator installed in the island. This is not yet operational because council has no proper machinery to feed waste into it. This has been informed to the Ministry. As well as we need proper training how to operate incinerator and information about waste management as well,
- Council manages island waste by using 5 staffs. 3 of them works in collection and they collect from households and collection points and transfer them to the waste dump site. A monthly fee is taken. 2 of the staff looks after the dump site.
- The proposed ISWMC is located near the dump site area and within the premises of the incinerator, so no further vegetation removal is required,

Annex 6: Quarantine Guidelines

ANNEX-1 Checklist for maintaining measures for group accommodation when going for "Furabandhu" quarantine

This form should be filled by the supervisor as a checklist if a group of 10 people or more who are sponsored by a company or an institution are going for "Furabandhu" quarantine.

1. Name of the company or institution who take guardianship of the quarantined people:

   _____

2. Name of responsible person from company or institution who will monitor and ensure that quarantine measures are followed by the group:

   _____

3. Purpose of travel of the group:

   _____

   _____

4. Number of people going for group quarantine: _____
5. Indicate the type of accommodation arranged for quarantine (tick where appropriate):
   I. Accommodation in rooms ☐
   II. Dormitories (halls) ☐

If accommodation is arranged in rooms:

6. Number of rooms where people are going to be quarantined: _____
7. Number of people who are going to be accommodated in a room: _____
8. Distance between beds: _____ feet.
9. Toilet/bathroom arrangements for occupants of each room:
   I. Separate toilet/bathroom for each room ☐
   II. Toilets or bathrooms will be shared by rooms ☐

If accommodation is arranged at a dormitories (halls):

10. Number of dormitories (halls): _____

11. Number of people accommodated in each dormitory (hall): _____

12. Distance between beds: _____ feet.

13. Number of toilets for each dormitory (hall): _____

14. Arrangement made to ensure separate dining of quarantined groups:

_____

_____

_____

15. Arrangement for waste collection and disposal from the quarantine site:

_____

_____

_____

16. Arrangement for providing access to communication for the quarantined people:

_____

_____

_____

17. Are the following materials available or measures in place at the rooms or dormitories for quarantine:

S.no	Details	Yes	No
I.	Availability of medical masks for symptomatic persons and people who share a room with a symptomatic person		
II.	Availability of a separate room or area for isolation of a symptomatic person		
III.	Availability of hand washing facility OR hand sanitizer in the living area		

IV.	Availability of detergent and bleach for cleaning of living areas and toilet		
V.	Availability of lidded and lined dustbins:		
VI.	Availability of information materials on prevention of COVID-19 such as signage and posters		

18. Any further remarks:

_____

_____

Details of the supervisor:

Name: _____ Contact number: _____

Date: _____

Annex 7: Groundwater Test Results

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
Quality Assurance Building, 1st Floor, Male' Hingun, Vilimale', Male' City, Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

LB-TEST-090

WATER QUALITY TEST REPORT

Report No: 500186033

Customer Information:
Water Solutions Pvt Ltd
M.Niyadhurumaage
Alimas Magu
Male' 20063

Report date: **01/02/2021**
Test Requisition Form No: **900191099**
Sample(s) Recieved Date: **26/01/2021**
Date of Analysis: **26/01/2021 - 27/01/2021**

Sample Description ~	Guraidhoo Groundwater 1 (GGW1)	Guraidhoo Groundwater 2 (GGW2)	Maafushi Groundwater 1 (MGW1)	**TEST METHOD**	**UNIT**
Sample Type ~	Ground Water	Ground Water	Ground Water		
Sample No	83216209	83216210	83216211		
Sampled Date ~	25/01/2021 04:00	25/01/2021 04:00	25/01/2021 04:00		
PARAMETER	**ANALYSIS RESULT**				
Physical Appearance	Clear with particles	Clear with particles	Clear with particles		
Conductivity *	630	689	651	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	µS/cm
pH *	7.11	7.48	7.75	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	0.31	0.34	0.32	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Temperature	23.8	23.5	23.1	Electrometry	°C
Nitrogen Ammonia	1.72	0.05	0.10	HACH Method 8038	mg/L
Total Petroleum Hydrocarbon (TPH)	0.073	0.120	<0.036 (LoQ 0.036 mg/L)	UV Fluorescence	mg/L

Keys: µS/cm : Micro Seimen per Centimeter, **‰** : Parts Per Thousand, **°C** : Degree Celcius, **mg/L** : Milligram Per Liter

Checked by

Aminath Sofa
Laboratory Executive

Approved by

Mohamed Eyman
Manager, Quality

Notes: Sampling Authority: Sampling was not done by MWSC Laboratory
This report shall not be reproduced except in full, without written approval of MWSC
This test report is ONLY FOR THE SAMPLES TESTED.
~ Information provided by the customer
*Parameters accredited by EIAC under ISO/IEC 17025:2017

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
Quality Assurance Building, 1st Floor, Male' Hingun, Vilimale', Male' City, Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

LB-TEST-090

WATER QUALITY TEST REPORT

Report No: 500186033

Customer Information:
Water Solutions Pvt Ltd
M.Niyadhurumaage
Alimas Magu
Male' 20063

Report date: **01/02/2021**
Test Requisition Form No: **900191099**
Sample(s) Recieved Date: **26/01/2021**
Date of Analysis: **26/01/2021 - 27/01/2021**

Sample Description ~	Maafushi Groundwater 2 (MGW2)	**TEST METHOD**	**UNIT**
Sample Type ~	Ground Water		
Sample No	83216212		
Sampled Date ~	25/01/2021 04:00		
PARAMETER	**ANALYSIS RESULT**		
Physical Appearance	Clear with particles		
Conductivity *	463	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	µS/cm
pH *	7.82	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	0.22	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Temperature	23.8	Electrometry	°C
Nitrogen Ammonia	<0.02 (LoQ 0.02 mg/L)	HACH Method 8038	mg/L
Total Petroleum Hydrocarbon (TPH)	0.040	UV Fluorescence	mg/L

Keys: µS/cm : Micro Seimen per Centimeter, **‰** : Parts Per Thousand, **°C** : Degree Celcius, **mg/L** : Milligram Per Liter

Checked by

Aminath Sofa
Laboratory Executive

Approved by

Mohamed Eyman
Manager, Quality

Notes: Sampling Authority: Sampling was not done by MWSC Laboratory
This report shall not be reproduced except in full, without written approval of MWSC
This test report is ONLY FOR THE SAMPLES TESTED.
~ Information provided by the customer
*Parameters accredited by EIAC under ISO/IEC 17025:2017

********** END OF REPORT **********

Annex 8: Atoll and Island Council Submission

Ibrahim Faiz <faiz@water-solutions.biz>

K. Maafushi: Waste Management Center EMP Report

2 messages

Yumin Naseem <yumin@water-solutions.biz>
To: info@maafushi.gov.mv
Cc: Ibrahim Faiz <faiz@water-solutions.biz>

Dear Sir/ Madam,

Please find the attached Environmental Management Plan and the receipt for the above mentioned project.

Best Regards,

--

Yumin Naseem
Junior Environmental Consultant

Water Solutions Pvt Ltd.
4th floor, M.Niyadhurumaage, Alimasmagu Male', 20205, Maldives
Mobile: (960) 7555722
Tel: (960) 3341643, (960) 3301643 , Ext : 1014
E-mail: yumin@water-solutions.biz
Website: www.water-solutions.biz
Social Media: @wsmaldives

2 attachments

2021-02-21 Maafushi ISWMC EMP.pdf
2861K

2021-02-21 WS-LTR-044 - K. Maafushi EMP Island Council Submission.pdf
356K

Yumin Naseem <yumin@water-solutions.biz> Sun, Feb 21, 2021 at 11:50 AM
To: info@maafushi.gov.mv
Cc: Ibrahim Faiz <faiz@water-solutions.biz>

Dear Sir/Madam,

Please disregard the previous report and find the attached updated report. Please sign the attached receipt and send it back to us as soon as possible.
Apologies for any inconvenience.

Regards,
[Quoted text hidden]

2 attachments

2021-02-21 WS-LTR-044 - K. Maafushi EMP Island Council Submission.pdf
356K

2021-02-21 Maafushi ISWMC EMP.pdf
12705K

Ibrahim Faiz <faiz@water-solutions.biz>

Waste Management Center EMP Reports: K. Maafushi & K. Guraidhoo

1 message

Yumin Naseem <yumin@water-solutions.biz>
To: secretariat@kaaf.gov.mv
Cc: Ibrahim Faiz <faiz@water-solutions.biz>

Dear Sir/ Madam,

Please find the attached link for the Environmental Management Plans for K. Maafushi and K, Guraidhoo. Please sign the attached receipt and send it back to us as soon as possible.

https://drive.google.com/drive/folders/1Y8QW14P3j7CrxfRzAmPhqHcPulkeec3N?usp=sharing

Best Regards,

--

Yumin Naseem
Junior Environmental Consultant

Water Solutions Pvt Ltd.
4th floor, M.Niyadhurumaage, Alimasmagu Male', 20205, Maldives
Mobile: (960) 7555722
Tel: (960) 3341643, (960) 3301643 , Ext : 1014
E-mail: yumin@water-solutions.biz
Website: www.water-solutions.biz
Social Media: @wsmaldives

2021-02-21 WS-LTR-046 - K. Atoll Council EMP Submission -.pdf
357K

Annex 9: Criteria for Planning and Design for Subprojects

Criteria for Planning and Design for Subprojects

Criteria		Remarks
Pre-requisites		
(i)	No subproject scope will include features that appear on schedule D of the EIA regulations (2007, updated 2012) (List of Development Proposals Requiring an Environmental Impact Assessment Study)	Development proposals on Schedule D of the EIA regulations related to solid waste management are landfills, incinerators and large-scale waste storage and separation facilities.
(ii)	A IEE and EMP must be prepared for each subproject, which must comply with EHS Guidelines on Waste Management Facilities	PMU to seek clearance from ADB on project siting if the criterion cannot be met due to space constraints.
(iii)	Sites must not have any land acquisition or significant involuntary resettlement and social safeguard issues.	Verify land ownership records.
(iv)	Any new facility must not be sited in an environmentally sensitive area, including all areas within 30m of the shoreline, or within 30m of areas such as thickly vegetated areas that are known to be habitats for bird species of conservation value	The 30m distance should be exceeded where possible. The restriction may be reviewed depending on site availability and stakeholder consultation, and provision of design measures to prevent release of leachate into the sea or onto the vegetated area in the event of the capacity of the leachate collection tank being exceeded.
(v)	No new facility to be sited within 500m of areas of cultural significance, such as ancient religious artifacts	Verification, through consulting island councils and the Ministry of Education, that no physical cultural heritage sites are situated within 500m of the IWMC site. The restriction may be reviewed on the basis of site availability and consultation with stakeholders. PMU to seek clearance from ADB on project siting if the criterion cannot be met due to space constraints. Provide for use of "chance find" procedures in the EMP, such that any artifacts are preserved for future generations
(vi)	Sites must have sufficient capacity to contain or handle volumes of waste projected to be generated over at least a 20 year planning horizon	To be assessed based on projections on growth in waste generation for each island
(vii)	Sites must be at least 100m from residences, schools, clinics or mosques	The distance restriction may be reviewed depending on site availability and stakeholder consultation. PMU to seek clearance from ADB on project siting if the criterion cannot be met due to space constraints.
(viii)	Sites must be least 100m from groundwater wells	The 100m limit is precautionary, however attention must be given in detailed design to

		ensure that the leachate collection tank is protected to exclude flood waters, including during storm situations, to ensure that leachate does not enter the groundwater lens. PMU to seek clearance from ADB on project siting if the criterion cannot be met due to space constraints.
(ix)	Sites must not intersect with power lines, water supply pipelines or sewer lines	Where these lie across proposed sites, they must be re-aligned to avoid the site
(x)	For initiatives that require the use of machinery such as shredders and presses, there must be established access to technical expertise for servicing and spare parts must be regularly available in-country	
(xi)	Consensus from island communities on proposed improvements.	Records of consultations, issues raised, and measures taken to address them to be summarized in IEEs.
(xii)	No other work, including road, pipeline, or power line improvements are planned at or near the proposed site	Island council to confirm. If such sites are planned, details must be taken account of in design to ensure adequate separation of the infrastructure
(xiii)	World Bank Group's Environmental, Health and Safety (EHS) Guidelines requires IWMCs to consider standard design of 110% volume and bunded for impermeable storage to avoid contaminated runoff entering the surface or groundwater.	Final detailed design to confirm capacity is 110% and bunded
Preferable		
(i)	Where IWMCs exist, any improvements should be to the existing infrastructure, rather than replacement on new sites.	New sites may be necessary if existing site has become unsuitable due to new developments around it or there is objection from communities to rehabilitate the existing IWMCs.
(ii)	Removal of trees to be avoided where possible.	When mature trees (of diameter at breast height of 40cm or greater) must be removed, new trees must be planted of a number and species agreed with the island community
(iii)	Where composting facilities are to be introduced or expanded, a high level of commitment from the community should be evident to ensure both cooperation in ensuring that waste to be composed is not contaminated and that compost will be purchased or used.	Evidence of commitment from the island community should be obtained.

Annex 10: Rapid Environmental Assessment Checklist

Rapid Environmental Assessment Checklist

Instructions:

(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES) for endorsement by the Director, RSES and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title: Outer Island Waste Management Improvements: Maafushi, kaafu Atoll

Sector Division:

Screening Questions	Yes	No	Remarks
A. Project Siting Is the project area…			
• Densely populated?		×	Maafushi has a resident population of 4026.
• Heavy with development activities?		×	Size of the island is 39.3 hectares. There is a land now reclaimed in the southeast side of the lagoon. This land will be connected to main island. Most of the island land has been used for development, mostly housing. There are 55 guest houses in the island. Most popular local tourism island in Maldives.
• Adjacent to or within any environmentally sensitive areas?		×	
• Cultural heritage site		×	
• Protected Area		×	
• Wetland		×	
• Mangrove		×	
• Estuarine		×	
• Buffer zone of protected area		×	
• Special area for protecting biodiversity		×	
• Bay		×	
B. Potential Environmental Impacts Will the Project cause…			

Screening Questions	Yes	No	Remarks
• impacts associated with transport of wastes to the disposal site or treatment facility	×		IWMC will consist of concrete platforms, shedded areas, segregated waste processing and storage areas, small office, and fencing. The Project will ensure island council will have the capacity to manage SWM by providing some machineries as well.
• Impairment of historical/cultural monuments/areas and loss/damage to		×	Not anticipated. No cultural or historical site near the project site.
• Degradation of aesthetic and property value loss?		×	The subproject will improve land aesthetics because of improved waste management infrastructure
• Nuisance to neighboring areas due to foul odor and influx of insects, rodents, etc.?	×		Likely. However, the EMP ensures good housekeeping and site management measures are included to mitigate the impacts at subproject site.
• Dislocation or involuntary resettlement of people?		×	Not anticipated.
• Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable		×	The project will benefit all sectors in the island.
• Risks and vulnerabilities related occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation?	×		OHS risks are inherent to construction activities. However, these risks can be reduced through implementation of good construction practices and adoption of internationally recognized OHS measures on OHS on construction activities and SWM operations. These are included in the EMP.
• Public health hazards from odor, smoke from fire, and diseases transmitted by flies, insects, birds and rats?	×		Project will not allow open burning of waste, therefore impacts from smoke is not anticipated. However, odor or pests could be a problem without proper housekeeping practices. EMP includes proper mitigation measures to reduce these impacts.
• Deterioration of water quality as a result of contamination of receiving waters by leachate from land disposal system?		×	Not applicable. The subproject will not include any land disposal system.

Screening Questions	Yes	No	Remarks
• Contamination of ground and/or surface water by leachate from land disposal system?		×	Not applicable. The subproject will not include any land disposal system.
• Land use conflicts?		×	Not anticipated.
• Pollution of surface and ground water from leachate coming from sanitary landfill sites or methane gas produced from decomposition of solid wastes in the absence of air, which could enter the aquifer or escape through soil fissures at places far from the landfill site?		×	Not applicable. The subproject will not include any landfill facility.
• Inadequate buffer zone around landfill site to alleviate nuisances?		×	Not applicable. The subproject will not include any landfill facility. There will be a boundary fence around IWMC.
• Road blocking and/or increased traffic during construction of facilities?		×	Not anticipated. Volume of traffic in the island is very low.
• Noise and dust from construction activities?	×		Few receptors in vicinity, high ambient noise levels and winds. Impact of noise can be avoided by undertaking activities during daytime when background noise is high. Nighttime works is not expected. Noise suppression gadgets may also be used. Dust emission can be avoided with the implementation of dust control measures such as sprinkling of water on sites. No significant volumes of spoil will be generated.
• Temporary silt runoff due to construction?	×		Run-off during construction will be more. However, impacts are temporary and short in duration. The EMP ensures measures are included to mitigate the impacts.
• Hazards to public health due to inadequate management of landfill site caused by inadequate institutional and financial capabilities for the management of the landfill operation?		×	Not applicable. The subproject will not include any landfill facilities.
• Emission of potentially toxic volatile organics from land disposal site?		×	Not applicable. The project will not include any landfill facilities. However, the IWMC design includes leachate collection and management.

Screening Questions	Yes	No	Remarks
• Surface and ground water pollution from leachate and methane gas migration?		×	Not applicable. The project will not include any landfill facilities. However, the IWMC design includes leachate collection and management.
• Loss of deep-rooted vegetation (e.g. tress) from landfill gas?	×		Only few trees need to be removed. EMP recommends to relocate to empty nearby site.
• Explosion of toxic response from accumulated landfill gas in buildings?		×	Not applicable. Landfill gas is not expected to be generated based on the quantity and type of waste.
• Contamination of air quality from incineration?	×		Not applicable to this project, but there is an incinerator installed in the island which is not operation yet. After start of operation it is anticipated to impact air quality.
• Public health hazards from odor, smoke from fire, and diseases transmitted by flies, rodents, insects and birds, etc.?	×		Limited public access; reduced exposure of pests to waste The operation of the IWMC will ensure community health hazards are avoided with the adoption of EHS guidelines on SWM as indicated in the EMP.
• Health and safety hazards to workers from toxic gases and hazardous materials in the site?	×		The EMP ensures occupational health and safety measures are included following relevant EHS guidelines. Fuels will be stored and handled properly as per EMP.
• Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		×	Due to small scale of the project, no significant increase in population of workers from overseas or off-island. Population influx due to project construction and operation is minimal.
• Social conflicts if workers from other regions or countries are hired?			Priority in employment will be given to local residents.
• Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?	×		The EMP ensures community health and safety measures are included following relevant EHS guidelines on waste management. Fuels will be stored and handled properly following EHS guidelines as included in the EMP.

Screening Questions	Yes	No	Remarks
• Community safety risks due to both accidental and natural hazards, especially where the structural elements or components (e.g., landfill or incinerator) of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?	×		During construction and operation of IWMC, community health and safety risks will be managed by adopting the EHS guidelines as indicated in the EMP.

A Checklist for Preliminary Climate Risk Screening

Country/Project Title:

Sector:

Subsector:

Division/Department:

Screening Questions		Score	Remarks[a]
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather-related events such as floods, droughts, storms, landslides?	1	Site very close to the shoreline.
	Would the project design (e.g., the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc)?	1	Design needs to consider sea level rise.
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g., prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	1	
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s)?		
Performance of project outputs	Would weather/climate conditions, and related extreme events likely affect the performance (e.g., annual power production) of project output(s) (e.g. hydropower generation facilities) throughout their design lifetime?		

[a] If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high-risk project.

Result of Initial Screening (Low, Medium, High): Low Risk

Other Comments: _____

_____

Prepared by: Abdul Aleem

Annex 11: Grievance Redress Mechanism Complaint Form

Grievance Redress Mechanism Complaint Form

The Greater Malé Environmental Improvement and Waste Management Project welcomes complaints, suggestions, queries, and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.

Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

Date	**Place of registration**

Contact Information/Personal Details					
Name		**Gender**	**Male** **Female**	**Age**	
Home Address					
Village / Town					
District					
Phone no.					
E-mail					
Complaint/Suggestion/Comment/Question Please provide the details (who, what, where and how) of your grievance below: **If included as attachment/note/letter, please tick here:**					
How do you want us to reach you for feedback or update on your comment/grievance?					

FOR OFFICIAL USE ONLY

Registered by: (Name of official registering grievance)	
If – then mode: ■ **Note/Letter** ■ **E-mail** ■ **Verbal/Telephonic**	
Reviewed by: (Names/Positions of Official(s) reviewing grievance)	
Action Taken:	
Whether Action Taken Disclosed:	■ **Yes** ■ **No**
Means of Disclosure:	

GRIVENCES RECORD AND ACTION TAKEN

Sr. No.	Date	Name and Contact No. of Complainer	Type of Complain	Place	Status of Redress	Remarks

Annex 12: Detailed Tentative Project Schedule

IWMC Construction Schedule

	Weeks																														
Project components	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Mobilization																																
Preperation of site																																
Excavation works																																
Concrete structure works																																
Mansory works																																
Roofing works																																
Construction of fence and steel structures																																
Electrical works																																
Plumbing works																																
Plastering works																																
Doors and windows																																
landscaping, finishing works, site utilities																																
Demobilization																																

* Schedule provided is considering the worst case scenario. Construction of smaller IWMC may be completed in 6 months

Annex 13: Template for Monitoring Report

Template for Semi-Annual Environmental Monitoring Report

Introduction

- Overall project description and objectives
- Environmental category as per ADB Safeguard Policy Statement, 2009
- Environmental category of each subproject as per national laws and regulations
- Project Safeguards Team

Name	Designation/Office	Email Address	Contact Number	Roles
1. PMU				
2. Consultant				

- Overall project and sub-project progress and status
- Description of subprojects (package-wise) and status of implementation (preliminary, detailed design, on-going construction, completed, and/or O&M stage)

Package Number	Components/List of Works	Contract Status (specify if under bidding or contract awarded)	Status of Implementation (Preliminary Design/Detailed Design/On-going Construction/Completed/O&M)[31]	If On-going Construction	
				%Physical Progress	Expected Completion Date

[31] If on-going construction, include %physical progress and expected date of completion

Compliance status with National/State/Local statutory environmental requirements[32]

Package No.	Subproject Name	Statutory Environmental Requirements[33]	Status of Compliance[34]	Validity if obtained	Action Required	Specific Conditions that will require environmental monitoring as per Environment Clearance, Consent/Permit to Establish[35]

Compliance status with environmental loan covenants

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

Compliance status with the Environmental Management Plan

- Confirm if IEE/s require contractors to submit site-specific EMP/construction EMPs. If not, describe the methodology of monitoring each package under implementation.

Package-wise IEE Documentation Status

Package Number	Final IEE based on Detailed Design				Site-specific EMP (or Construction EMP) approved by Project Director? (Yes/No)	Remarks
	Not yet due (detailed not yet completed)	Submitted to ADB (Provide Date of Submission)	Disclosed on project website (Provide Link)	Final IEE provided to design Contractor/s (Yes/No)		

---

[32] All statutory clearance/s, no-objection certificates, permit/s, etc. should be obtained prior to award of contract/s. Attach as appendix all clearance obtained during the reporting period. If already reported, specify in the "remarks" column.

[33] Specify (environmental clearance? Permit/consent to establish? Forest clearance? Etc.)

[34] Specify if obtained, submitted and awaiting approval, application not yet submitted

[35] *Example: Environmental Clearance requires ambient air quality monitoring, Forest Clearance/Tree-cutting Permit requires 2 trees for every tree, etc.*

- For each package, provide name/s and contact details of contractor/s' nodal person/s for environmental safeguards.

Package-wise Contractor/s' Nodal Persons for Environmental Safeguards

Package Name	Contractor	Nodal Person	Email Address	Contact Number

- With reference to approved EMP/site-specific EMP/construction EMP, complete the table below

Summary of Environmental Monitoring Activities (for the Reporting Period)[36]

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Design Phase						
Pre-Construction Phase						
Construction Phase						
Operational Phase						

[36] Attach Laboratory Results and Sampling Map/Locations

Overall Compliance with EMP

No.	Sub-Project Name	EMP/ CEMP Part of Contract Documents (Y/N)	CEMP/ EMP Being Implemented (Y/N)	Status of Implementation (Excellent/ Satisfactory/ Partially Satisfactory/ Below Satisfactory)	Action Proposed and Additional Measures Required

Approach and methodology for environmental monitoring of the project

- Briefly describe the approach and methodology used for environmental monitoring of each sub-project.

Monitoring of environmental IMPACTS on PROJECT SURROUNDINGS (ambient air, water quality and noise levels)

- Discuss the general condition of surroundings at the project site, with consideration of the following, whichever are applicable:
    - Confirm if any dust was noted to escape the site boundaries and identify dust suppression techniques followed for site/s.
    - Identify if muddy water is escaping site boundaries or if muddy tracks are seen on adjacent roads.
    - Identify type of erosion and sediment control measures installed on site/s, condition of erosion and sediment control measures including if these are intact following heavy rain;
    - Identify designated areas for concrete works, chemical storage, construction materials, and refueling. Attach photographs of each area in the Appendix.
    - Confirm spill kits on site and site procedure for handling emergencies.
    - Identify any chemical stored on site and provide information on storage condition. Attach photograph.
    - Describe management of stockpiles (construction materials, excavated soils, spoils, etc.). Provide photographs.
    - Describe management of solid and liquid wastes on-site (quantity generated, transport, storage and disposal). Provide photographs.
    - Provide information on barricades, signages, and on-site boards. Provide photographs in the Appendix.
    - Indicate if there are any activities being under taken out of working hours and how that is being managed.

- Briefly discuss the basis for environmental parameters monitoring.
- Indicate type of environmental parameters to be monitored and identify the location.
- Indicate the method of monitoring and equipment used.

- Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements.

As a minimum the results should be presented as per the tables below.

Air Quality Results

Site No.	Date of Testing	Site Location	Parameters (Government Standards)		
			PM10 µg/m3	SO2 µg/m3	NO2 µg/m3

Site No.	Date of Testing	Site Location	Parameters (Monitoring Results)		
			PM10 µg/m3	SO2 µg/m3	NO2 µg/m3

Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Site No.	Date of Sampling	Site Location	Parameters (Monitoring Results)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Noise Quality Results

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Government Standard)	
			Day Time	Night Time

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Monitoring Results)

			Day Time	Night Time

Grievance Redress Mechanism

- Provide information on establishment of grievance redress mechanism and capacity of grievance redress committee to address project-related issues/complaints. Include as appendix Notification of the GRM (town-wise if applicable).

Complaints Received during the Reporting Period

- Provide information on number, nature, and resolution of complaints received during reporting period. Attach records as per GRM in the approved IEE. Identify safeguards team member/s involved in the GRM process. Attach minutes of meetings (ensure English translation is provided).

SUMMARY OF KEY ISSUES AND REMEDIAL ACTIONS

- Summary of follow up time-bound actions to be taken within a set timeframe.

APPENDIXES

- Photos
- Summary of consultations
- Copies of environmental clearances and permits
- Sample of environmental site inspection report
- all supporting documents including signed environmental site inspection reports prepared by consultants and/or contractors
- Others

SAMPLE ENVIRONMENTAL SITE INSPECTION REPORT

Project Name
Contract Number

NAME: _____ DATE: _____
TITLE: _____ DMA: _____
LOCATION: _____ GROUP: _____

WEATHER CONDITION:

_____

INITIAL SITE CONDITION:

_____

CONCLUDING SITE CONDITION:
Satisfactory ____ Unsatisfactory _____ Incident _____Resolved ____ Unresolved _____

INCIDENT:
Nature of incident:

_____

Intervention Steps:

_____

Incident Issues

Resolution

Project Activity Stage	Survey	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

Inspection

Emissions	Waste Minimization
Air Quality	Reuse and Recycling
Noise pollution	Dust and Litter Control
Hazardous Substances	Trees and Vegetation

Site Restored to Original Condition	Yes		No	

Signature

_____

Sign off

_____ _____

Annex 14: IBAT Screening Report

Integrated Biodiversity Assessment Tool

PROXIMITY REPORT
MAAFUSHI-0

Country: Maldives

Location: [3.9, 73.5]

Date of analysis: 25 March 2021 (GMT)

Size of site: 0 km^2

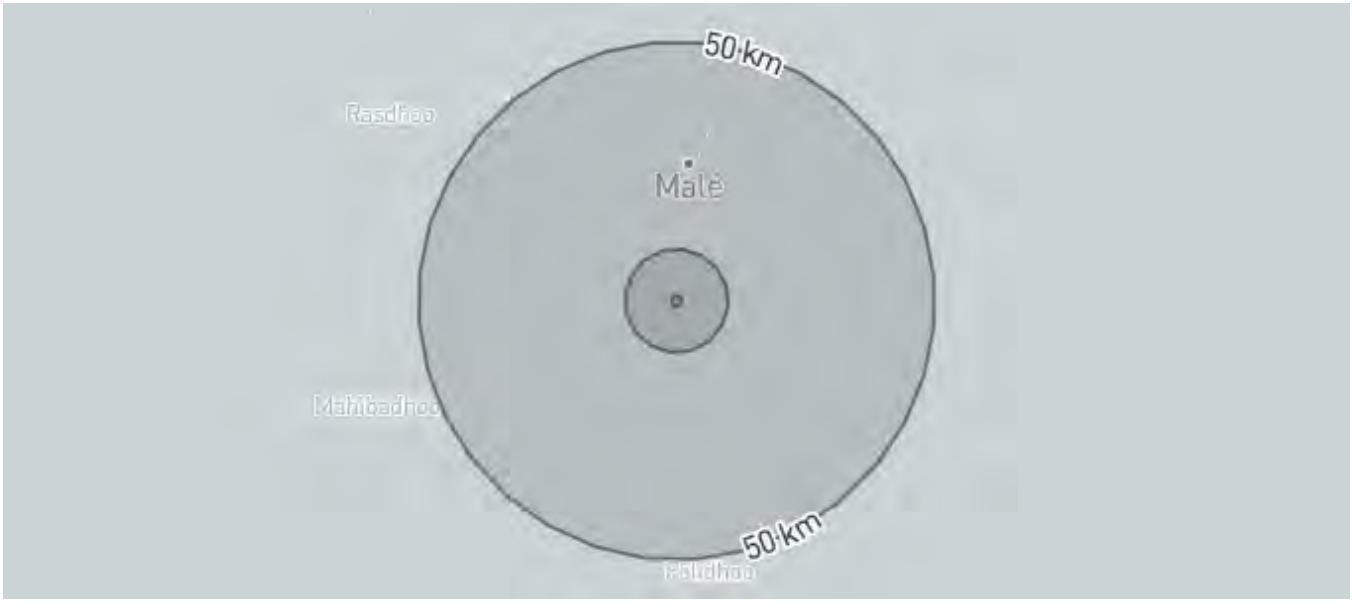
Buffers applied: 1 km | 10 km | 50 km

Generated by: Noime Walican

Organisation: ADB

Overlaps with:

Protected Areas	10
Key Biodiversity Areas	0
IUCN Red List	90



Displaying project location and buffers: 1 km, 10 km, 50 km

About this report

This report presents the results of [6274-15015] proximity analysis to identify the biodiversity features and species which are located within the following buffers: 1 km, 10 km, 50 km.

This report is one part of a package generated by IBAT on 25 March 2021 (GMT) that includes full list of all species, protected areas, Key Biodiversity Areas in CSV format, maps showing the area of interest in relation to these features, and a 'How to read IBAT reports' document.

WARNING: IBAT aims to provide the most up-to-date and accurate information available at the time of analysis. There is however a possibility of incomplete, incorrect or out-of-date information. All findings in this report must be supported by further desktop review, consultation with experts and/or on-the-ground field assessment. Please consult IBAT for any additional disclaimers or recommendations applicable to the information used to generate this report.

Please note, sensitive species data are currently not included in IBAT reports in line with the Sensitive Data Access Restrictions Policy for the IUCN Red List. This relates to sensitive Threatened species and KBAs triggered by sensitive species.

Data used to generate this report

- UNEP-WCMC and IUCN, 2021. Protected Planet: The World Database on Protected Areas (WDPA)[On-line], Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net - March 2021.
- BirdLife International (on behalf of the KBA Partnership), 2020. Key Biodiversity Areas - October 2020.
- IUCN, 2021. IUCN Red List of Threatened Species - January 2021.

Protected Areas

The following protected areas are found within 1 km, 10 km, 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Within buffer of
Guraidhoo Kandu	10 km
Banana reef (Gaathu Giri)	50 km
Embudhoo Kanduolhi	50 km
Giravaru Kuda Haa	50 km
Hans Hass Plave (Gulhi Falhu)	50 km
Huraa Mangrove Area	50 km
Lions Head (Thilafalhu Miyaruvani)	50 km
Mlyaru Kandu Region	50 km
Nassimo Thila (Lankan Thila)	50 km
Thanburudhoo Thila (HP Reef)	50 km

Key Biodiversity Areas

The following key biodiversity areas are found within 1 km, 10 km, 50 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

No KBAs within buffer distance

IUCN Red List of Threatened Species

The following threatened species are potentially found within 50km of the area of interest.

For the full IUCN Red List please refer to the associated csv in the report folder.

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Eretmochelys imbricata	Hawksbill Turtle	REPTILIA	CR	Decreasing	Terrestrial, Marine
Carcharhinus hemiodon	Pondicherry Shark	CHONDRICHTHYES	CR	Unknown	Marine
Carcharhinus longimanus	Oceanic Whitetip Shark	CHONDRICHTHYES	CR	Decreasing	Marine
Sphyrna lewini	Scalloped Hammerhead	CHONDRICHTHYES	CR	Decreasing	Marine
Sphyrna mokarran	Great Hammerhead	CHONDRICHTHYES	CR	Decreasing	Marine
Rhina ancylostoma	Bowmouth Guitarfish	CHONDRICHTHYES	CR	Decreasing	Marine
Rhynchobatus australiae	Bottlenose Wedgefish	CHONDRICHTHYES	CR	Decreasing	Marine
Balaenoptera musculus	Blue Whale	MAMMALIA	EN	Increasing	Marine
Carcharhinus obscurus	Dusky Shark	CHONDRICHTHYES	EN	Decreasing	Marine
Chelonia mydas	Green Turtle	REPTILIA	EN	Decreasing	Terrestrial, Marine
Rhincodon typus	Whale Shark	CHONDRICHTHYES	EN	Decreasing	Marine
Isurus oxyrinchus	Shortfin Mako	CHONDRICHTHYES	EN	Decreasing	Marine
Carcharhinus amblyrhynchos	Grey Reef Shark	CHONDRICHTHYES	EN	Decreasing	Marine
Stegostoma tigrinum	Zebra Shark	CHONDRICHTHYES	EN	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Aetomylaeus vespertilio	Ornate Eagle Ray	CHONDRICHTHYES	EN	Decreasing	Marine
Mobula tarapacana	Sicklefin Devilray	CHONDRICHTHYES	EN	Decreasing	Marine
Mobula thurstoni	Bentfin Devilray	CHONDRICHTHYES	EN	Decreasing	Marine
Isurus paucus	Longfin Mako	CHONDRICHTHYES	EN	Decreasing	Marine
Acropora rudis		ANTHOZOA	EN	Decreasing	Marine
Mobula kuhlii	Shortfin Devilray	CHONDRICHTHYES	EN	Decreasing	Marine
Alopias pelagicus	Pelagic Thresher	CHONDRICHTHYES	EN	Decreasing	Marine
Holothuria scabra	Golden Sandfish	HOLOTHUROIDEA	EN	Decreasing	Marine
Holothuria lessoni	Golden Sandfish	HOLOTHUROIDEA	EN	Decreasing	Marine
Holothuria nobilis	Black Teatfish	HOLOTHUROIDEA	EN		Marine
Mobula birostris	Giant Manta Ray	CHONDRICHTHYES	EN	Decreasing	Marine
Lethrinus mahsena	Sky Emperor	ACTINOPTERYGII	EN	Decreasing	Marine
Mobula mobular	Spinetail Devil Ray	CHONDRICHTHYES	EN	Decreasing	Marine
Carcharodon carcharias	White Shark	CHONDRICHTHYES	VU	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Caretta caretta	Loggerhead Turtle	REPTILIA	VU	Decreasing	Terrestrial, Marine
Lepidochelys olivacea	Olive Ridley	REPTILIA	VU	Decreasing	Terrestrial, Marine
Thunnus obesus	Bigeye Tuna	ACTINOPTERYGII	VU	Decreasing	Marine
Alopias vulpinus	Common Thresher	CHONDRICHTHYES	VU	Decreasing	Marine
Carcharhinus falciformis	Silky Shark	CHONDRICHTHYES	VU	Decreasing	Marine
Carcharhinus melanopterus	Blacktip Reef Shark	CHONDRICHTHYES	VU	Decreasing	Marine
Triaenodon obesus	Whitetip Reef Shark	CHONDRICHTHYES	VU	Decreasing	Marine
Urogymnus asperrimus	Porcupine Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Physeter macrocephalus	Sperm Whale	MAMMALIA	VU	Unknown	Marine
Nebrius ferrugineus	Tawny Nurse Shark	CHONDRICHTHYES	VU	Decreasing	Marine
Odontaspis ferox	Smalltooth Sand Tiger	CHONDRICHTHYES	VU	Decreasing	Marine
Epinephelus fuscoguttatus	Brown-marbled Grouper	ACTINOPTERYGII	VU	Decreasing	Marine
Taeniurops meyeni	Blotched Fantail Ray	CHONDRICHTHYES	VU	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Epinephelus polyphekadion	Camouflage Grouper	ACTINOPTERYGII	VU	Decreasing	Marine
Bolbometopon muricatum	Green Humphead Parrotfish	ACTINOPTERYGII	VU	Decreasing	Marine
Plectropomus areolatus	Squaretail Coralgrouper	ACTINOPTERYGII	VU	Decreasing	Marine
Pavona venosa		ANTHOZOA	VU	Unknown	Marine
Catalaphyllia jardinei		ANTHOZOA	VU	Unknown	Marine
Pectinia lactuca	Lettuce Coral	ANTHOZOA	VU	Unknown	Marine
Acropora acuminata		ANTHOZOA	VU	Decreasing	Marine
Montipora stilosa		ANTHOZOA	VU	Decreasing	Marine
Acropora hemprichii		ANTHOZOA	VU	Decreasing	Marine
Fungia seychellensis		ANTHOZOA	VU	Unknown	Marine
Porites nigrescens		ANTHOZOA	VU	Unknown	Marine
Montipora lobulata		ANTHOZOA	VU	Decreasing	Marine
Symphyllia hassi		ANTHOZOA	VU	Unknown	Marine
Acropora aspera		ANTHOZOA	VU	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Leptoseris yabei		ANTHOZOA	VU	Unknown	Marine
Euphyllia ancora		ANTHOZOA	VU	Unknown	Marine
Heliopora coerulea	Blue Coral	ANTHOZOA	VU	Decreasing	Marine
Acropora pharaonis		ANTHOZOA	VU	Decreasing	Marine
Caulastrea connata		ANTHOZOA	VU	Decreasing	Marine
Acropora horrida		ANTHOZOA	VU	Decreasing	Marine
Alveopora allingi		ANTHOZOA	VU	Unknown	Marine
Galaxea astreata		ANTHOZOA	VU	Unknown	Marine
Goniopora albiconus		ANTHOZOA	VU	Unknown	Marine
Turbinaria stellulata		ANTHOZOA	VU	Unknown	Marine
Anacropora puertogalerae		ANTHOZOA	VU	Decreasing	Marine
Pachyseris rugosa		ANTHOZOA	VU	Unknown	Marine
Physogyra lichtensteini		ANTHOZOA	VU	Unknown	Marine
Porites horizontalata		ANTHOZOA	VU	Unknown	Marine
Turbinaria peltata		ANTHOZOA	VU	Unknown	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Acropora anthocercis		ANTHOZOA	VU	Decreasing	Marine
Acropora palmerae		ANTHOZOA	VU	Decreasing	Marine
Leptoseris incrustans		ANTHOZOA	VU	Unknown	Marine
Acanthastrea brevis		ANTHOZOA	VU	Unknown	Marine
Pavona cactus		ANTHOZOA	VU	Unknown	Marine
Lobophyllia diminuta		ANTHOZOA	VU	Unknown	Marine
Turbinaria mesenterina		ANTHOZOA	VU	Unknown	Marine
Isopora cuneata		ANTHOZOA	VU	Decreasing	Marine
Acropora echinata		ANTHOZOA	VU	Decreasing	Marine
Urogymnus granulatus	Mangrove Whipray	CHONDRICHTHYES	VU	Decreasing	Marine
Pateobatis fai	Pink Whipray	CHONDRICHTHYES	VU	Decreasing	Marine
Alopias superciliosus	Bigeye Thresher	CHONDRICHTHYES	VU	Decreasing	Marine
Actinopyga miliaris	Harry Blackfish	HOLOTHUROIDEA	VU	Decreasing	Marine
Mola mola	Ocean Sunfish	ACTINOPTERYGII	VU	Decreasing	Marine

Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome
Mobula alfredi	Reef Manta Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Holothuria fuscogilva		HOLOTHUROIDEA	VU	Decreasing	Marine
Pterodroma arminjoniana	Trindade Petrel	AVES	VU	Stable	Terrestrial, Marine
Hydrobates matsudairae	Matsudaira's Storm-petrel	AVES	VU	Unknown	Terrestrial, Marine
Aetobatus ocellatus	Spotted Eagle Ray	CHONDRICHTHYES	VU	Decreasing	Marine
Oxymonacanthus longirostris	Harlequin Filefish	ACTINOPTERYGII	VU	Decreasing	Marine

Recommended citation

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How to use this report

This report provides an indication of the potential biodiversity-related features - protected areas, key biodiversity areas and species - close to the specified location. It provides an early indication of potential biodiversity concerns, and can provide valuable guidance in making decisions. For example, this information can be helpful when assessing the potential environmental risk and impact of a site, categorising investments/projects, preparing the terms of reference for an impact assessment, focusing attention on key species of conservation concern and sites of known conservation value, and reviewing the results of an impact assessment.

The report does not provide details of potential indirect, downstream or cumulative impacts. Furthermore, the report should be regarded as a "first-step", providing a set of conservation values sourced from global data sets, and is not a substitute for further investigation and due diligence, especially concerning national and/or local conservation priorities.

Annex 15: Biodiversity Impact Assessment

MLD: Greater Malé Environmental Improvement and Waste Management Project

Biodiversity Assessment, K. Maafushi

Prepared by Water Solutions Pvt Ltd

Contents

1 Introduction

1 The ADB Safeguard Policy Statement (ADB 2009) requires assessment of whether the project is planned in an area that may qualify as Critical Habitat or Natural Habitat. This assessment followed more detailed guidance in International Finance Corporation Performance Standard 6 and its recently updated accompanying guidance note (IFC 2012, 2019).

2 ADB SPS requires that any projects financed by ADB shall not implement project activities and components in area of critical habitat/s, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, ADB requires that the project implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. ADB SPS further requires the use of precautionary approach in the use, development, and management of renewable natural resources.

2 Definition of Critical Habitat

3 Critical habitat is defined in ADB SPS (2009) as a subset of both natural and modified habitat that deserves particular attention. Critical habitat includes areas with high biodiversity value, including (i) habitat required for the survival of critically endangered or endangered species; (ii) areas having special significance for endemic or restricted-range species; (iii) sites that are critical for the survival of migratory species; (iv) areas supporting globally significant concentrations or numbers of individuals of congregatory species; (v) areas with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services; and (vi) areas having biodiversity of significant social, economic, or cultural importance to local communities.

3 Areas of Analysis

4 Critical Habitat and Natural Habitat assessment ideally takes place across sensible ecological or political units that are sufficiently large to encompass all direct and indirect impacts from the project. These areas of analysis (AoAs) are thus often much broader than the direct project footprint. AoAs may be separate or combined, depending on the ecology of the biodiversity concerned.

5 Considering the extent of potential impacts on aquatic biodiversity from the Project an aquatic AoA was identified as the 50-km study area to make consistent with the default range in the IBAT Screening.

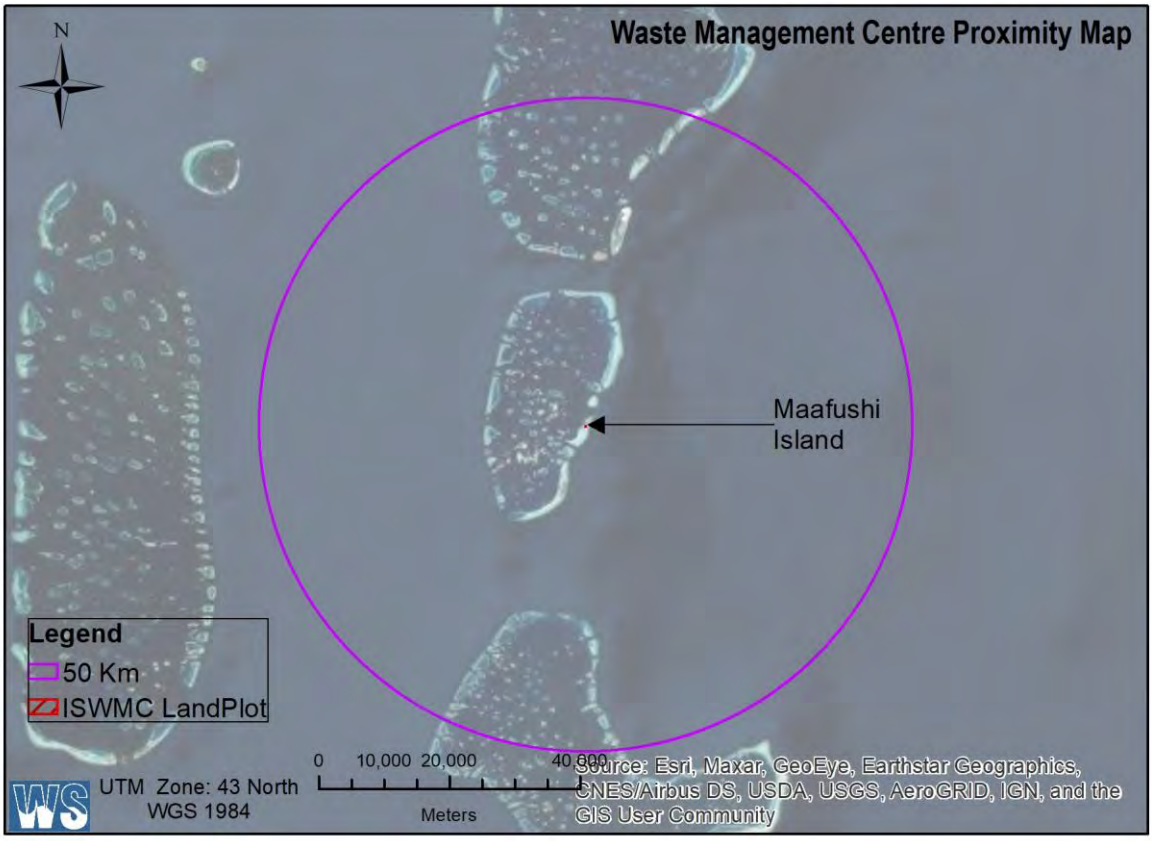

Figure 1: 50 Km buffer zone from Maafushi

6 Identification of AoAs does not mean that the project has any obligations across them. The aim of this Critical Habitat Assessment is to identify whether the broad units qualify as Critical Habitat and, if so, for which biodiversity features. This information helps to prioritize impact assessment and to focus mitigation efforts.

4 Thresholds of Critical Habitat

7 To identify if a certain species can qualify the project AoA as Critical Habitat, the IFC Guidance Note 6 (2019)[1] has been used.

5 Critical Habitat Screening and Assessment

8 Critical habitat screening considered critical habitat-qualifying biodiversity candidates identified within the EIA as actually or potentially present. In each case, reasons are identified for each biodiversity feature likely meeting or not meeting Critical Habitat. IBAT was used as the initial screening for critical habitat values. Performance Standard 6 (PS6) defines these values for critical habitat (PS6: para. 16) and legally protected and internationally recognized areas (PS6: para. 20). The IBAT was used to screen for known risks within a standard 50km buffer of the project area at Maafushi.

[1] https://www.ifc.org/wps/wcm/connect/5e0f3c0c-0aa4-4290-a0f8-4490b61de245/GN6_English_June-27-2019.pdf?MOD=AJPERES&CVID=mRQjZva

6 Criteria 1 – 3: Critically Endangered or Endangered Species, Endemic and/or Restricted-range Species Migratory or Congregatory Species

9 Habitat of significant importance to priority species can trigger critical habitat status. IBAT was used to create a preliminary list of priority species that could occur within the AoA. This list is drawn from the IUCN Red List of Threatened Species (IUCN RL). Due to the uncertainty surrounding the assessment at this preliminary stage, the list of species for which Critical Habitat may be triggered is still provisional and will require further analysis as reiterated in the conclusion.

10 The justification for the assessment has been provided in Table 1.

11 It should be noted that this list is preliminary and other species not currently included or poorly represented such as birds, fish, and invertebrates may come to light and require inclusion following monitoring and field surveys, continued desk study, and stakeholder engagement during project implementation.

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
Mammals								
Balaenoptera musculus	Blue Whale	EN	-	-	-	-	There has been only few sighting of Blue Whale in Maldives. Uncommon visitor to the Maldives	IBAT
Reptiles								
Eretmochelys imbricata	Hawksbill Turtle	CR	-	-	-	-	Some protected populations are stable or increasing, but the overall decline of the species, when considered within the context of three generations, has been in excess of 80%. The Hawksbill has a circumglobally distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic Ocean, Indian Ocean, and Pacific Ocean. Hawksbills are migratory and individuals undertake complex movements through geographically disparate habitats during their lifetimes. Hawksbill nesting occurs in at least 70 countries, although much of it now only at low densities. Their movements within the marine environment are less understood, but Hawksbills are believed to inhabit coastal waters in more than 108 countries (Groombridge and Luxmoore 1989, Baillie and Groombridge 1996)	IBAT
Chelonia mydas	Green Turtle	EN					Extensive subpopulation declines in all major ocean basins over the last three generations as a result of overexploitation of eggs and adult females at nesting beaches, juveniles and adults in foraging areas, and, to a lesser extent, incidental mortality relating to marine fisheries and degradation of marine and nesting habitats. The Green Turtle has a circumglobal distribution, occurring throughout tropical and, to a lesser extent, subtropical waters (Atlantic Ocean – eastern central, northeast, northwest, southeast, southwest, western central; Indian Ocean – eastern, western; Mediterranean Sea; Pacific Ocean – eastern central,	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							northwest, southwest, western central). Green turtles are highly migratory and they undertake complex movements and migrations through geographically disparate habitats. Nesting occurs in more than 80 countries worldwide (Hirth 1997). Their movements within the marine environment are less understood but it is believed that green turtles inhabit coastal waters of over 140 countries (Groombridge and Luxmoore 1989).	
Chondrichthyes								
Carcharhinus hemiodon	Pondicherry Shark	CR	-	-	-	-	The Pondicherry Shark (Carcharhinus hemiodon) is a small (to 102 cm total length) and very rare Indo-West Pacific whaler shark. It has a wide historic range from Oman to southern China, but known records are scattered, and it has only been reliably verified from a handful of countries. Given a lack of verifiable records since 1960, it is considered that the major population reduction would have occurred prior to the last three generation period (estimated at 27 years from a congener), therefore an assessment under criterion A is not appropriate. However, given the lack of records, the number of mature individuals is assumed to be <250 with no subpopulation >50 mature individuals, and the species is assessed as Critically Endangered (C2a(i)). Historically, the Pondicherry Shark ranged from the Arabian Sea (Oman) to the South China Sea (Garrick 1985). However, it had only been recorded from a limited number of individuals from widely-separated locations in the Indo-West Pacific including Oman (Muscat), Pakistan, India, Borneo, and Java (Garrick 1985). The Pondicherry Shark is represented by fewer than twenty specimens in museum collections, all collected prior to 1960. Historical reports from Sri Lanka have not been	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							verified while recent records (e.g. De Silva 2014) are erroneous.	
Carcharhinus longimanus	Oceanic Whitetip Shark	CR					The Oceanic Whitetip Shark was once one of the most abundant pelagic shark species in tropical seas worldwide but is now rare in some regions. The global population is estimated to have undergone a reduction of >98%, with the highest probability of >80% reduction over three generation lengths (61.2 years). Therefore, the Oceanic Whitetip Shark is assessed as Critically Endangered A2bd. The Oceanic Whitetip Shark occurs worldwide in tropical and temperate waters (Last and Stevens 2009, Ebert et al. 2013). The components of this project are not expected to have any impact on the species.	IBAT
Sphyrna lewini	Scalloped Hammerhead	CR					The Scalloped Hammerhead has a circumglobal distribution in coastal warm-temperate and tropical seas (Ebert et al 2013). The Scalloped Hammerhead has undergone steep declines in all oceans, with some signs of stabilization and possible recovery in response to management only in the Northwest Atlantic and Gulf of Mexico. The weighted global population trend estimated median reductions of 76.9–97.3%, with the highest probability of >80% reduction over three generation lengths (72.3 years), and is therefore assessed as Critically Endangered A2bd. Seasonal sightings have been observed by divers.	IBAT
Sphyrna mokarran	Great Hammerhead	CR	-	-	-	-	The global population is estimated to have undergone reductions of 50.9–62.4%, with the highest probability of >80% reduction over three generation lengths (71.1–74.4 years). There is a lack of data from the Pacific, limited regional representation of some time-series, intensive fisheries in data-poor regions that are suspected to have driven significant	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							declines, and uncertainty about levels of exploitation that are potentially similar to those of the Scalloped Hammerhead (S. lewini) (which has been assessed as globally Critically Endangered). Expert judgement elicitation thus used a precautionary approach and concurred with the highest probability of reduction of >80% over three generation lengths (71.1–74.4 years). The Great Hammerhead is therefore assessed as Critically Endangered A2bd. The Great Hammerhead ranges worldwide throughout tropical and warm temperate seas (Last and Stevens 2009, Ebert et al. 2013).	
Rhina ancylostoma	Bowmouth Guitarfish	CR	-	-	-	-	There is a high level of fisheries resource use and increasing fishing pressure across the range of the Bowmouth Guitarfish, and as a result, targeted and incidental fishing effort is placing significant pressure on all wedgefish species in the Indo-West Pacific. Where wedgefishes and giant guitarfishes have been targeted or exploited as incidental catch, severe declines, population depletions, and localized disappearances have occurred. Severe population reduction in the Bowmouth Guitarfish is inferred from actual levels of exploitation, as well as several historical accounts and contemporary datasets from Iran, Pakistan, India, Thailand, and Indonesia. While some parts of Australasia provide refuge from intense fishing effort, this proportion of the species' range is not considered to be large enough relative to the global range to lower the assessment. It is inferred that the Bowmouth Guitarfish has undergone a >80% population reduction over the last three generations (45 years) and it is assessed as Critically Endangered A2bd.	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							The Bowmouth Guitarfish is widespread in the Indo-West Pacific from South Africa through the Western Indian Ocean, the Arabian Sea, Southeast Asia, and extending north to Japan, south to Australia (where it is wide-ranging across the north of the continent), and east to New Caledonia (Last and Stevens 2009, Last et al. 2016).	
Rhynchobatus australiae	Bottlenose Wedgefish	CR	-	-	-	-	There is a high level of fisheries resource use and increasing fishing pressure across the range of the Bottlenose Wedgefish, and as a result, targeted and incidental fishing effort is placing significant pressure on all wedgefish species in the Indo-West Pacific. Where wedgefishes and giant guitarfishes have been targeted or exploited as incidental catch, severe declines, population depletions, and localized disappearances have occurred. Severe population reduction in the Bottlenose Wedgefish is inferred from actual levels of exploitation, as well as several historical accounts and contemporary datasets from Iran, Pakistan, India, Thailand, and Indonesia. While some parts of Australasia provide refuge from intense fishing effort, this proportion of the species' range is not considered to be large enough relative to the global range to lower the assessment. It is inferred that the Bottlenose Wedgefish has undergone a >80% population reduction over the last three generations (45 years) and it is assessed as Critically Endangered A2bd. The Bottlenose Wedgefish is widespread in the Indo-West Pacific from Mozambique through the Western Indian Ocean, the Arabian Sea, Southeast Asia, and extending north to Taiwan, south to Australia (where it is wide-ranging across the north of the continent), and east to the Solomon Islands (Last et al. 2016, Hylton et al. 2017). The species' distribution may not	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							be fully defined due to confusion with other members of the Rhynchobatus djiddensis species-complex.	
Carcharhinus obscurus	Dusky Shark	EN					The global population reduction is estimated to have undergone a reduction of 71.8%, with the highest probability of >80% reduction over three generation lengths (89.4–114 years). The areas with available abundance trend data are relatively small compared to the global distribution, and abundance trends are unknown in parts of its distribution. The overall estimated population reduction is steep and management in many parts of its range is lacking, including areas of intense exploitation, likely leading to steep inferred population reduction. However, management action in the Northwest Atlantic and Eastern Indian Ocean have resulted in the stabilization and possible slow recovery in these regions Therefore, the Dusky Shark is assessed as Endangered A2bd. However, components of this project are not expected to have any negative impacts. The Dusky Shark has a cosmopolitan but patchy distribution in tropical and warm temperate seas (Last and Stevens 2009, Ebert et al. 2013).	IBAT
Rhincodon typus	Whale Shark	EN	-	-	-	-	Based on count data, modelled population estimates and habitat availability, 75% of the global Whale Shark population is inferred to occur in the Indo-Pacific, and 25% in the Atlantic. A variety of datasets present declines of 40-92%, inferring an overall decline of 63% in the Indo-Pacific over the last 75 years (three generations), resulting in a subpopulation assessment of Endangered A2bd+4bd. In the Atlantic, the overall population decline is considered to be lower at ≥30%, resulting in a subpopulation assessment of Vulnerable A2b+4b. Given the bulk of the global population occurs in the Indo-Pacific, the	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							overall global decline is inferred to be ≥50%. Globally, the Whale Shark is therefore assessed as Endangered A2bd+4bd. The Whale Shark has a circumtropical distribution through all tropical and warm temperate seas, apart from the Mediterranean (Rowat and Brooks 2012). Their core distribution is between approximately 30°N and 35°S, with occasional seasonal penetration to the north and south (Colman 1997, Rowat and Brooks 2012, Sequeira et al. 2014). The northernmost records are from 44°N in the Bay of Fundy, Canada (Turnbull and Randell 2006) and the Sea of Okhotsk off Japan (Tomita et al. 2014), with the southernmost from 37°S in Victoria, Australia (Wolfson 1986). Whale Shark distribution is likely to be temperature limited, as they are rarely sighted in surface temperatures of less than 21°C (Iwasaki 1970, Colman 1997, Duffy 2002, Afonso et al. 2014, Tomita et al. 2014). Whale sharks are commonly found within Maldives. A possible resident population exists in ADh. Atoll which is outside the 50Km buffer zone. Sightings are rare within the 50km zone. The components of this project is not expected to have any impact on its population.	
Isurus oxyrinchus	Shortfin Mako	EN	-	-	-	-	Steep population declines have occurred in the north and south Atlantic, with declines also evident, though not as steep in the north Pacific and Indian Oceans. The south Pacific population appears to be increasing but with fluctuating catch rates. The weighted global population trend estimated a median decline of 46.6%, with the highest probability of 50–79% reduction over three generation lengths (72–75 years), and therefore the Shortfin Mako is assessed as Endangered A2bd. The Shortfin Mako (Isurus oxyrnchus) is widespread in temperate and tropical waters of all oceans (Ebert et al. 2013).	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
Carcharhinus amblyrhynchos	Grey Reef Shark	EN					The Grey Reef Shark is widespread in the tropical Indo-West and Central Pacific Oceans, and also occur in some parts of the Eastern Tropical Pacific Ocean (Last and Stevens 2009). This species is also threatened by declines in habitat quality of coral reefs due to climate change, destructive fishing practices, and poor water quality. Steep declines in population abundance have been reported in some parts of its range, while in others it appears to remain at high abundance. Based on baited remote underwater video station data from 254 reefs in 40 jurisdictions throughout its range the estimated global population reduction is 59.2% over three generation lengths (44 years). Therefore, the Grey Reef Shark is estimated to have undergone a population reduction of 50–79% over the last three generation lengths (44 years) due to levels of exploitation and declines in habitat quality, and it is assessed as Endangered A2bcd.	IBAT
Stegostoma tigrinum	Zebra Shark	EN					The Zebra Shark is found in inshore waters of the continental and insular shelves of the Western Pacific and Indian Oceans (Compagno 2001). By combining the subpopulation assessments according to relative area (the Indian Ocean-Southeast Asian subpopulation has approximately 70% of the available habitat; the Eastern Indonesian-Oceania subpopulation has approximately 30% of the available coastal habitat), and given the ongoing threats from fishing and habitat loss across much of its range and suspected reductions of over 50% of its population size within three generations, this species is assessed globally as Endangered.	IBAT
Aetomylaeus vespertilio	Ornate Eagle Ray	EN	-		-	-	The Ornate Eagle Ray has a sporadic distribution in the Indo-West Pacific from Mozambique, the Red Sea, India, the Maldives, Southeast Asia and the Philippines, China and	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							Taiwan, and across northern Australia (Bonfil and Abdallah 2004, Compagno et al. 2005, Last and Stevens 2009, Benjamin et al. 2012). In the Gulf of Thailand, eagle rays are now extremely rare, and this may be representative of other areas where the Ornate Eagle Ray occurs. In Australian waters the fishing pressure would not be very high but it is rarely observed there. It is suspected to have limiting life history parameters similar to other myliobatid rays, including low fecundity. The Ornate Eagle Ray is assessed as Endangered due to suspected population declines exceeding 50% over the last three generations (45 years) as a result of very high, ongoing (and increasing) levels of fishing pressure across the majority of its distribution.	
Mobula tarapacana	Sicklefin Devilray	EN					The Sicklefin Devilray has a patchy circumglobal distribution and is found in tropical, subtropical, and temperate waters of the Pacific, Atlantic, and Indian Oceans (Mendonça 2011, Couturier et al. 2012, Lawson et al. 2017). based on current and future potential levels of exploitation, steep declining trends in monitored populations, and the uncertainty of data in some regions, it is suspected that the Sicklefin Devilray global population has undergone a reduction of 50–79% over the past three generation lengths (38 years), with a further population reduction suspected over the next three generation lengths (2018–2056) due to ongoing demand for high-value products. The Sicklefin Devilray is therefore assessed as Endangered A2bd+3d.	IBAT
Mobula thurstoni	Bentfin Devilray	EN					The Bentfin Devilray has a circumglobal distribution and is found in tropical, subtropical, and temperate waters of the Pacific, Atlantic, and Indian Oceans (Couturier et al. 2012, Lawson et al. 2017).	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							based on current and future potential levels of exploitation, steep declining trends in monitored populations, and the uncertainty of data in some regions, it is suspected that the Bentfin Devilray global population has undergone a reduction of 50–79% over the past three generation lengths (38 years), with a further population reduction suspected over the next three generation lengths (2018–2056) due to ongoing demand for high-value products. The Bentfin Devilray is therefore assessed as Endangered A2bd+3d.	
Isurus paucus	Longfin Mako	EN	-	-	-	-	The Longfin Mako is widespread in tropical and warm temperate waters, and likely occurs in all oceans, although its distribution is poorly recorded (Ebert et al. 2013). The Longfin Mako is of serious conservation concern due to its apparent rarity, large maximum size, low fecundity, and continued, poorly-documented take in intensive fisheries. The limited available population trend data indicates strong declines and it is suspected to have undergone a population reduction of 50–79% globally over the last three generations (75 years), similar to its congener, the Shortfin Mako. The Longfin Mako is therefore assessed as Endangered A2d	IBAT
Mobula kuhlii	Shortfin Devilray	EN					The Shortfin Devilray has an Indo-West Pacific distribution from South Africa to the Solomon Islands (Lawson et al. 2017, Notarbartolo di Sciara et al. 2017, Chin et al. 2019). As presently known, the distribution is patchy, but it is most likely more wide-ranging than current confirmed records suggest. This species is often sighted by divers in Maldives. Based on current and future potential levels of exploitation, steep declining trends in monitored populations, and the uncertainty of data in some regions, it is suspected that the Shortfin Devilray global population has undergone a reduction	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							of 50–79% over the past three generation lengths (38 years), with a further population reduction suspected over the next three generation lengths (2020–2058) due to ongoing demand for high-value products, and it is assessed as Endangered A2bd+3d.	
Alopias pelagicus	Pelagic Thresher	EN					The Pelagic Thresher is oceanic and wide-ranging in the tropical and subtropical Indo-Pacific (Last and Stevens 2009, Ebert et al. 2013). The Pelagic Thresher is especially susceptible to fisheries exploitation because its epipelagic habitat occurs within the range of many largely unregulated and under-reported, small-scale and artisanal gillnet and longline fisheries, in which it is readily caught. The species is estimated to be declining in both the Pacific and Indian Oceans. Across its Indo-Pacific distribution, the Pelagic Thresher is estimated to have reduced by 50–79% over the last three generations (55.5 years), based on abundance data and levels of exploitation, and therefore the species is assessed as Endangered A2bd.	IBAT
Mobula birostris	Giant Manta Ray	EN					The Giant Manta Ray is circumglobal in tropical and temperate waters from the surface to 1,000 m depth (Last et al. 2016). Where Giant Manta Ray are protected (in over a dozen countries and territories), and hence where they are not being fished, the sighting trends appear stable. Over 700 individuals have been identified in the Maldives (mainly from the southern atolls). Elsewhere, however, very rapid declines have been noted in sightings records and landings where they are targeted or caught as bycatch; these range from 71 to 95% declines over 13- to 21-year periods (all less than one generation length of 29 years). It is suspected that the Giant Manta Ray has undergone a population reduction of 50–79% over the past	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							three generation lengths (87 years), with further population reduction suspected over the next three generation lengths (2018–2105) due to current and ongoing levels of exploitation, and a reduction in area of occupancy due to suspected local and regional extinctions, and it is assessed as Endangered A2bcd+A3d.	
Mobula Mobular	Spinetail Devilray	EN					The Spinetail Devil Ray is circumglobal in temperate and tropical waters throughout all oceans. Notably, it is present in the Mediterranean Sea but absent in the Red Sea (Notarbartolo-di-Sciara 1987, Notarbartolo di Sciara et al. 2017) and its occurrence is patchy throughout its distribution (Lawson et al. 2017). Based on actual levels of exploitation, steep declining population trends, a conservative life history, and the increasing trade demand, a global population reduction of 50–79% over the past three generation lengths (38 years) is suspected, with a further population reduction suspected over the next three generation lengths (2018–2056). The Spinetail Devil Ray is therefore assessed as Endangered (A2bd+3d).	IBAT
Holothuroidea								
Holothuria scabra	Golden Sandfish	EN	-	-	-	-	This is a commercially farmed species in the Maldives. However, data on population size and range is lacking. However, the components of this project is not expected to contribute to the threats listed in IUCN database.	IBAT
Holothuria lessoni	Golden Sandfish	EN	-	-	-	-	This is a commercially farmed species in the Maldives. However, data on population size and range is lacking. However, the components of this project is not expected to contribute to the threats listed in IUCN database.	IBAT

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
Holothuria nobilis	Black Teatfish	EN	-	-	-	-	This is a commercially farmed species in the Maldives. This species is found at low abundances in North Male' atoll (Muthiga 2008). However, data on population size and range is lacking. However, the components of this project is not expected to contribute to the threats listed in IUCN database. On August 2020 this species was designated as a protected species after CITES convention passed to include the species on its list. Harvesting and exporting of the species have been banned in the Maldives.	IBAT
Anthozoa								
Acropora rudis		EN	-	-	-	-	This species is found in the northern Indian Ocean and the central Indo-Pacific in Thailand, west Indonesia (Richards pers. comm.), Rodrigues (Fenner et al. 2004), Andamans, and American Samoa (Fenner pers. comm.). It has a disjuct distribution. The estimated habitat degradation and loss of 59% over three generation lengths (30 years) is the best inference of population reduction and meets the threshold for Endangered under Criterion A4ce. It will be important to reassess this species in 10 years' time because of predicted threats from climate change and ocean acidification.	
Actinopterygii								
Lethrinus mahsena	Sky Emperor	EN	-	-	-		This species is distributed in the western Indian Ocean from the Sea of Oman, Red Sea and East Africa, Madagascar, Aldabra, Seychelles and Mascarenes east to Sri Lanka. A record of this species from western Thailand (Satapoomin 2011) needs to be verified. Records from the central Pacific are likely misidentifications of L. atkinsoni (Carpenter and Allen	

Species Name	Common Name	Criteria 1 CR or EN Species	Criteria 2 Endemic / Restricted Range Species	Criteria 3 Migratory / Congregatory Species	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							1989). Its depth range is two to 100 m (Lieske and Myers 1994). As a long-lived and large emperor species, it is particularly susceptible to over-exploitation, and localised declines have been reported off Kenya and Egypt, as well as remote offshore islands including Mauritius and Rodrigues. Species-specific data quantifying population trends are limited, but where information is available (e.g., Rodrigues and Egypt), the data suggest population declines exceeding 60% over three generation lengths (45 years: 1973-2018). It is likely exploited at similar or higher levels throughout the vast majority of its range, such that the limited decline data available are considered indicative of its global status. Therefore, this species is listed as Endangered under Criterion A2bd.	

7 Criterion 4: Unique assemblages of species that are associated with key evolutionary processes

12 As is the case for the majority of Indo-Pacific islands, the Maldives Archipelago has been subject to long and extreme isolation that has allowed evolutionary processes to generate unique, endemic flora and fauna. Beyond this general context, however, there is no reason to believe that the terrestrial or aquatic AoA host particularly unusual or key evolutionary processes. Unique assemblages of species associated with key evolutionary processes thus do not qualify the Project area as Critical Habitat.

8 Criterion 5: Areas having biodiversity of significant social, economic, or cultural importance to local communities (including ecosystem services)

13 This additional assessment considers the ecosystem services from biodiversity in general. The assessment of significance of ecosystem services to local communities is assessed retrospectively in line with the consultation with local dive communities.

14 Ecosystem services affected by the project are prioritized when all three of the following criteria are met: (i) the project might affect the ability of others to benefit from the service; (ii) the affected service is important to beneficiaries' well-being; and (iii) beneficiaries do not have viable alternatives for that service.

15 The limited information presented does not give reason to believe that the Project terrestrial or aquatic AoA are sufficiently important to local people that they represent Critical Habitat under this criterion. However, it is beyond the scope of this assessment to collect additional information on ecosystem services, and then to assess which may qualify the project area as Critical Habitat.

9 Legally Protected Areas and Internationally Recognized Areas

16 **Embudhoo Kandu** "Also known as Embudhoo Express. The currents at the entrance of the channel attract pelagics, large napoleon and eagle rays. *Carcharhinus amblyrhynchos* (Grey reef Shark) are seen in the South corner. There are many caves and long shallow overhangs. Under the overhangs are numerous snout-spot grouper." (Protected areas list of Maldives, EPA). Embudhoo Kandu is located approximately 14 Km north of Maafushi Island.

17 **Guraidhoo Kanduolhi:** "The site is well known for sightings of Carcharhinus amblyrhynchos (Grey reef Shark) and Aetobatus narinari (Eagle ray). Most of the pelagic action can be seen on the ocean drop-off, where the oceanic water enters the channel. Inside the channel there are overhangs with plenty of sea fans and black coral bushes." (Protected areas list of Maldives, EPA). Guraidhoo Kanduolhi is located approximately 5 Km south of Maafushi Island.

10 Environmental Impacts

18 Potential environmental impact identification of the project on the IUCN Red List of species of concern identified in the IBAT screening was undertaken for the proposed activities necessary for the construction phase and the activities that will continue during the operational phase. The potential significant impacts during the construction phase and operational phase within the identified 50 km buffer zone are identified below.

10.1 Environmental Impacts during Construction Stage

i) Construction works

19 The general construction work of the project includes the construction of the waste management center. The total impact of the general construction activities is considered short-term and the magnitude of these impacts are negligible to the nearby protected areas (PA) and species within the PA.

20 The terrestrial species found within the 50 km buffer area are hawksbill and green turtles. However, the project activities will not impact their natural habitat. Hence, the proposed project will not have a significant, detrimental impact on the terrestrial fauna identified in the IBAT screening.

21 According to the IUCN Red List of species of concern identified in the IBAT screening, most of the organisms identified within the buffer zone of the project are marine. Hence, the proposed project will not have a significant, detrimental impact on the marine fauna identified in the IBAT screening.

22 Mitigation measures:

i. Using environmentally friendly methods during the construction.

ii. Timing of the activities as to reduce the impacts on the environment.

iii. Use safety measures when handling heavy machineries and tools

iv. Educate the workers and create awareness about good waste management and responsible behavior

ii) Transportation of construction materials

23 The transportation of construction material could result in accidental spillage of construction materials, oil and other chemical spills, including oil leaks from vehicles. Moreover, pollution of the lagoon and reef system can be caused by waterborne and windblown debris escaping from the construction as well as accidental oil/chemical spills. Waste and residue arising from the project activities can also affect the marine environment if they enter into the marine environment. However, this impact can be avoided with proper measures.

24 In additional to this, impact of solid waste can be detrimental to the marine and the terrestrial environment if they are not managed properly. Solid waste generated during the construction stage will include organic, inorganic and hazardous materials, all of which require adequate disposal. Negative impacts for the physical environment include accidental disposal of waste to coastal zones as well as the ocean, thus affecting the coral reefs. Leaching of waste water to land/soil is considered a possible impact and if it occurs, the impact would be long term. Improper waste management can have impacts on air, for example bad smell. Impacts of waste is however considered a temporary impact. All these impacts are avoidable if the proposed mitigation measures are adhered.

25 Mitigation measures:

i. Educate the workers and create awareness about good waste management and responsible behavior with regard to environmental care.

ii. Proper construction supervision of the workforce.

iii. It is advised to provide rain-water for drinking, thus reducing the need for mineral water and hence reducing the impact of plastic bottles and their management and disposal.

iv. The fuel storage will be done in a hard floor area with roof covering to avoid rain and heat.

v. All construction waste including hazardous materials will be stockpiled and stored on the island on a non-permeable flooring. Construction waste will be taken to Thilafushi at the end of the construction phase.

vi. Training of site personnel in proper waste management procedures and general environmental care.

vii. Vehicles should be serviced and maintained to avoid delays and excess emissions of pollutants.

viii. Construction materials shall not be transported during bad weather conditions.

ix. Materials for construction and equipment shall be stored at a designated area, temporary site. Sheds can be made on temporary site to protect the materials and equipment from rain and direct sunlight.

x. Ensure that no leaks and accidental spillages of oil occur from vehicles and that they are maintained adequately.

xi. Nominate a site manager, to be responsible for good site practices, arrangements for collection and effective disposal to an appropriate facility, of all wastes generated at the site during construction stage.

10.2 Environmental impacts during Operational Phase

iii) Transportation of waste

26 The overall impact of waste transfer from the island to Thilafushi is minor. These impacts are mostly temporary and have minor negative and minor positive impacts. If unmanaged, these impacts could escalate and can cause significant damage to the marine and terrestrial environment. Waste generated at the island will include organic, inorganic and hazardous materials, all of which require adequate disposal. Furthermore, waste management also involves sewage and wastewater.

27 In this project, it is anticipated that these are to be temporary impacts, and maintenance of proper waste management from this project will have a positive impact on the environment.

28 Mitigation measures:

i. Avoid transporting during bad weather.

ii. Transport waste in enclosed trucks and containers as proposed.

iii. Awareness about impact of waste to workers as well as to the surrounding environment.

iv. Proper supervision of the workforce.

v. Training of site personnel in proper waste management procedures and general environmental care.

vi. Vehicles should be serviced and maintained to avoid delays and excess emissions of pollutants.

vii. Oil spill contaminant equipment shall be installed in all vehicles

viii. Workers should be provided with and made compulsory to use safety gear and equipment while at work

iv) Waste Management in the facility

29 The maintenance and components of proper waste management in this project will have a significant positive impact on the terrestrial and marine environment. Putting an end to the open dumping and burning of waste will reduce the harm to humans and terrestrial organisms as a whole.

30 In addition to this, this project will reduce the impacts of marine debris that could result in ingestion and strangulation of marine animals. Furthermore, due to proper waste management practices from this project, it will reduce the destruction of marine organisms' habitats.

11 Concluding Statement

31 Following the critical habitat screening, it is not expected to cause impacts to the critically endangered and endemic species identified in the IUCN red list. Moreover, none of the protected areas found in the IBAT screening AoA meets the thresholds for Critical Habitat for species for which it was designated.

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Annex 16: Technical Report

TECHNICAL REPORT

Management of Waste from the inhabited Islands in Zone III

9th March 2022

The joint venture Kocks Consult GmbH (Germany) in association with Gopa Infra (Germany) and Water solutions pvt limited (Maldives) is awarded Project Management, Design and Construction Supervision Consultants (PMDCSC) for the Greater Male Environmental Improvement and Waste Management Project (GMEIWM) - Phase 1 in in December 2019 by the Ministry of Environment, Climate Change and Technology. The project GMEIWM will establish a sustainable solid waste management (SWM) system in the Greater Malé capital region and its inhabited outer islands by (i) establishing a modern waste collection, transfer, and disposal system, (ii) improving community-based outer island waste management systems, (iii) building institutional capacity for sustainable services delivery, and (iv) raising public awareness in reduce, reuse, recycle (3R) behaviors.

The PMDCSC consultant is the engineering and management consultant which will provide design, management and construction supervision services for the implementation of the GMEIWM) - Phase 1. This technical report is covers to the aspect of Outer Island waste management centers (ISWMCs) at inhabited islands for the management of waste generated at these islands in Zone III.

The strategy for the collection of waste generated at the island's households, transportation of waste from households to ISWMC, treatment of waste at the ISWMC and transportation of the treated and residual waste from the ISWMC to the Thilafushi Regional Waste Management Center for zone III is outlined in the Feasibility Study for an Integrated Solid Waste Management for Zone III (including Greater Male' Region)1

A new amendment to the Waste Management Regulation was published in September 2021 requiring the waste generated at the inhabited islands to be sorted into (i) organic and self-disposable waste, (ii) plastic bottle, (iii) metals and glass and (iv) other waste (residual waste).

The Ministry of Environment, Climate Change and Technology requested to review the ISWMC design for Zone III inhabited islands in the current context of the new waste management regulation, strategy for transporting the island level treated and residual waste before the waste transfer vessel from the project becomes operational. And how the waste taken to the Thilhafushi from ISWMC would be managed before the WTE facility becomes operational.

This report presents the outcome of this review and additional details of the proposed system at the ISWMC.

[1] Ministry of Environment and Energy (2018) Feasibility Study Report an Integrated Solid Waste Management for Zone III (including Greater Male' Region)

Definitions

Waste	is defined as any substance or object, which the Holder discards, or intends, or is required to discard.
Biodegradable waste	Means any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste, and paper and paperboard[2]
Bio-waste (wet waste)	Means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants. *If biodegradable waste is not collected or treated separately, then it is part of residual waste*
Construction and demolition waste	Waste resulting from construction or dismantling of buildings, roads and other structures of civil or industrial, which is not classified as hazardous waste,
Green Waste	Waste from plants
Household waste	Waste from domestic activities
Hazardous waste	Generic name for waste, which fall in the categories of waste defined as hazardous and/or have at least one constituent or a property which they are dangerous,
Household Hazardous waste	Waste from households, which is hazardous.
Inert waste	Means waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn, or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health.
ISWMC	Island Solid Waste Management Centers
Municipal waste	means waste from households, as well as other waste sources which, because of its nature or composition, is similar to waste from households,
Recyclable waste (dry waste)	Waste that may be material in a production process for obtaining the original or for other purposes,
Residual waste	All waste which is intended for further off-site treatment (incineration at Thilafushi). *Residual waste could include wet waste in case this fraction is not collected separately*
Similar Waste	from industry, trade, business or public administration, which composition and properties similar to household waste which is collected, transported, processed and stored with it
WEEE	Waste Electrical and Electronic Equipment.
Products	
Compost	the product resulting from the fermentation and aerobic / anaerobic or by microbial decomposition of organic component of waste subject composting

[2] It is worthwhile to note that biodegradable waste is wider than the bio-waste of the WFD. It further includes paper, cardboard, wood, textiles, etc.

Activities	
Collection	Gathering of waste, including the preliminary sorting and preliminary storage of waste for the purposes of transport to a waste treatment facility.
Separate collection	The collection where a waste stream is kept separately by type and nature so as to facilitate a specific treatment.
Disposal	Any waste management operation serving or carrying out the final treatment and disposal of waste
Final treatment	Incineration, Biological, physical, chemical treatment resulting in products or residues that are discarded, i.e. going to final disposal
Final disposal	Deposit into or onto land (e.g. landfill), including specially engineered landfill.

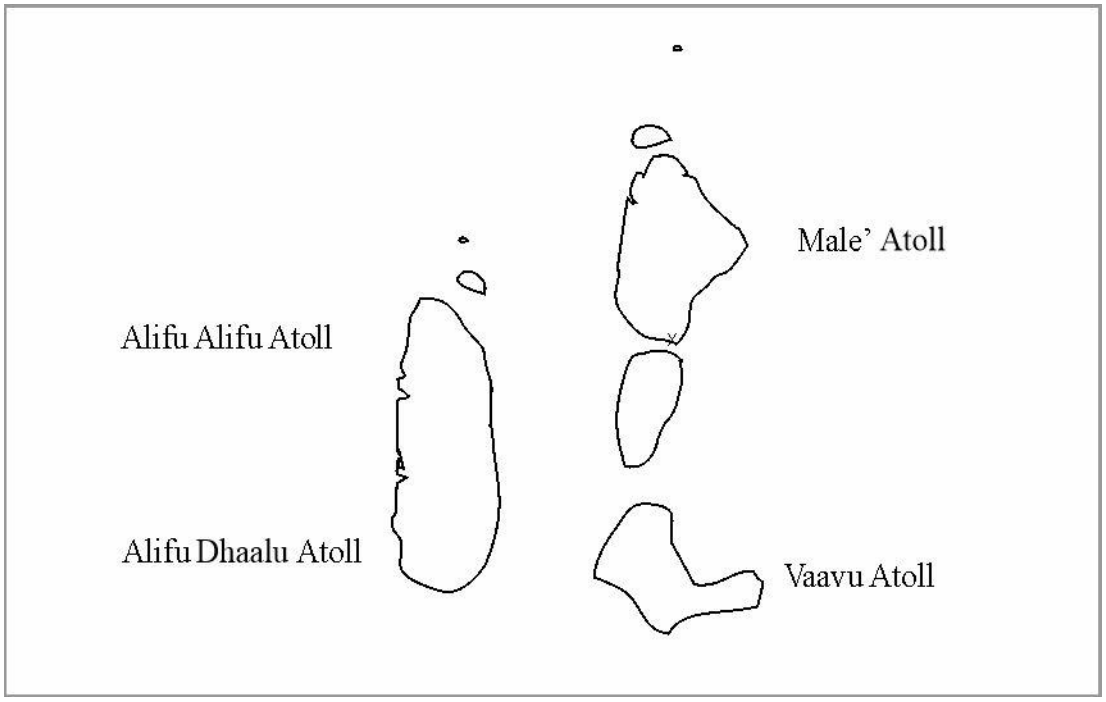


Figure 1: Zone III - Project catchment area

1 Strategy Proposed for Outer Island Waste Management

1.1 Waste collection and transport at the Islands

Waste generated at islands will be collected through a source segregation system. Main objective of the waste collection system at the island is to have waste streams at the ISWMC which are segregated and managed. An addendum was brought to the Solid Waste Management Regulation to enforce waste segregation. As per 5th addendum which was brought on 17th August 2021 to the Solid Waste Management Regulation, waste at the island, need to be segregated into followings parts.

- Organic and self-disposable waste
- Plastic bottle
- metals and glass
- Excluding waste types indicated above.

The Waste Management Regulation does not provide specifics that waste should be segregated at the source or at a central facility such as the Island Waste Management Centre.

Planning considerations for the inhabited islands are:

- 3 main generators are considered
  - Households (“HH waste”)
  - Commercial and small industries (“C&I waste”) generating waste similar to HH (this includes small shops, small markets, etc.)
  - Guesthouses/hotels (“GH/H waste”)
- Other waste streams (C&D, Health care waste, hazardous waste, etc.)
  - C&D waste stays on the island (it is expected that the quantities are not important and harmless)
  - Healthcare waste: not quantified. Support program by providing single use HCW bins
- Waste quantification and projections
  - HH waste: projection based on population statistics (demography, population growth etc.)
  - HH waste: 0.5 kg/inh/day
  - C&I waste: 10% of HH waste, for bigger island (ex. Maafushi): 15% of HH waste
  - GH/H: No of beds as per official statistics, 50% bed occupancy/year
  - GH/H waste: 2 kg/bed/day
- Trends in waste quantities: HH and C&I waste as per population growth, GH/H: constant as islands have limited development capacities so it is assumed that islands reached their limit in the development of this “source of income”
- Trends in waste composition: no changes (for planning purposes)
- Full bins need to be replaced by an empty one, therefore a certain amount of exchange bins have been considered in the calculation
- Bins could be deteriorated, therefore 10% of the calculated number of bins have been considered on top as replacement bins due to deterioration or vandalism.

Source segregation and primary collection system

- Island with sufficient land plot on ISWMC for biowaste treatment (windrow, aerated, in-vessel, AD) should have a 3 stream/bin system (standardised bins): biowaste, recyclable waste, residual waste
- Island with small land plot on ISWMC not sufficient for biowaste treatment should receive a home composter to each household and 2 bins: recyclables and residual bins
- Hotel/guesthouses should have 3 bins (standardised): biowaste, recyclables, residual waste
- Volume: biowaste bin (120 l), recyclable bin (240 l), residual waste bin (240 l)

Use of small bins (120 l, 240 l, up to 360 l)	
Advantages	Drawbacks
• Easy to handle, to manoeuvre, to load and to maintain • Easy to familiarise with • No need of special vehicles (RCV)	• More bins (for primary collection and for exchange • More space/footprint on the streets and on the ISWMCs

Level of “impurities” in the respective bins

Level of impurities case 1: 3 bins	
Stream 1: biodegradable waste	Level of impurity: Start 2023: 50% (25% of recyclables/25% of residual waste) End 2028: 20% (10% of recyclables/10% of residual waste)
Stream 2: Recyclable waste	Level of impurity Start (2023): 30% (15% of biowaste/15% of residual waste) End (2028): 10% (5% of biowaste/5% of residual waste)
Stream 3: Residual waste	Level of impurity Start (2023): 35% of biowaste/15% of recyclable waste) End (2028): 15% of biowaste/-% of recyclable waste)

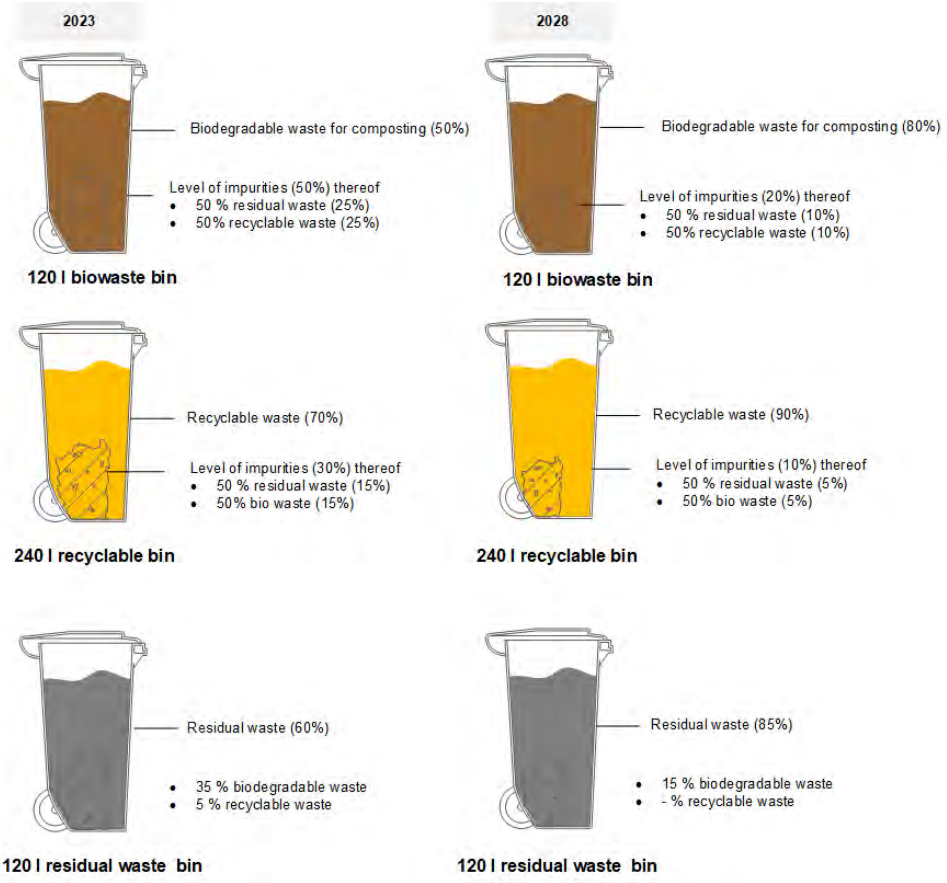


Figure 2: Level of impurity case 1: 3 bins

Level of impurities case 2: Home composter + 2 bins	
Stream 1: Home composting	Level of impurity: Start 2023: 20% (10% of recyclables/10% of residual waste) End 2028: 10% (5% of recyclables/5% of residual waste)
Stream 2: Recyclable waste	Level of impurity Start (2023): 30% (15% of biowaste/15% of residual waste) End (2028): 10% (5% of biowaste/5% of residual waste)
Stream 3: Residual waste	Level of impurity Start (2023): 5% biowaste + 20% recyclables End (2028): 5% biowaste + 5% recyclables

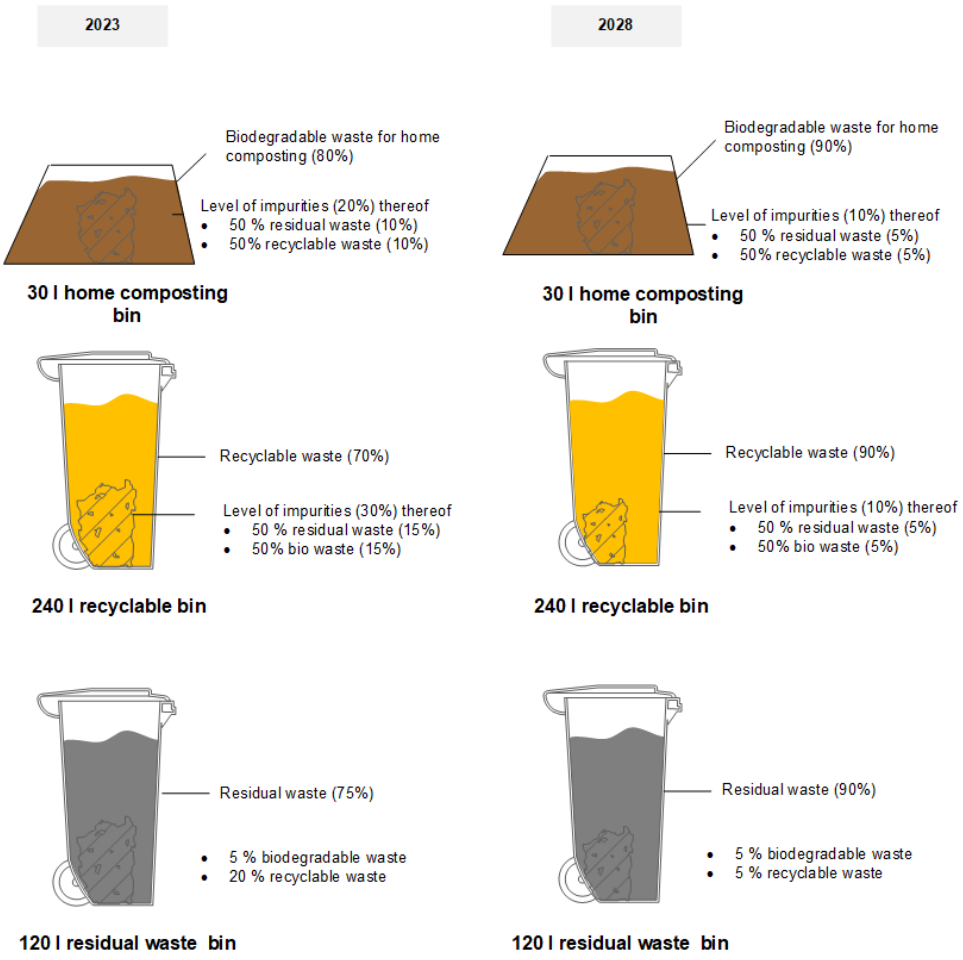


Figure 3: Level of impurity case 2: Home composting + 2 bins

Secondary collection system

The secondary collection has been planned to keep it simple. Islands are familiar with this type of collection, but it needs to be ensured that there is sufficient time for collection and exchanging the bins per day as well as transporting the residual waste bins ("burnable waste" bins) from the ISWMC to the harbour for the outer Island transfer to Thilafushi.

Collection system:

- HH and C&I Waste: collection point system
- GH/H waste: "door to door" system
- Other waste streams: on demand
- Collection "mode": exchange/swap bin system (a full bin is replaced by an empty bin)

Advantages	Drawbacks
• Simple system • Easy to get familiar with • Already used on the islands • Could be extended, optimised or changed easier (from Collection point to d2d as vice-versa) • With improvement of the system capacities became free as buffer	• Important numbers of bins • Footprint (collection point, bin storage) • System is focussed on simplicity rather than on efficiency

Collection frequency:

- Biowaste bin: 6/7 (for planning purposes), in case the bin is not full the frequency can be changed to every second day (3/7). For biowaste this should be the maximum allowable frequency
- Recyclable bin: 6/7 (for planning purposes), in case bin is not full the collection can be done until the bin is full
- Residual waste bin: 6/7 (for planning purposes in case the bin is not full the frequency can be changed to every second or 3rd day (3/7 or 2/7). For residual waste every 3rd day should be the maximum allowable frequency

Collection vehicle:

- Open dump truck with tailgate

Advantages	Drawbacks
• simple technology, • low costs, • low maintenance, • flexible for different waste streams and conditions (loose waste, bulky waste, bins, etc..)	• no waste compaction, • low efficiency (collection speed, etc..)
Tailgate	
• Ease the lifting • OHS is better • Bins with bigger volume (660-1100 l) could also be lifted	• Additional costs • Additional maintenance • Also limited lifting capacity (600 kg) • Risks of stand-by

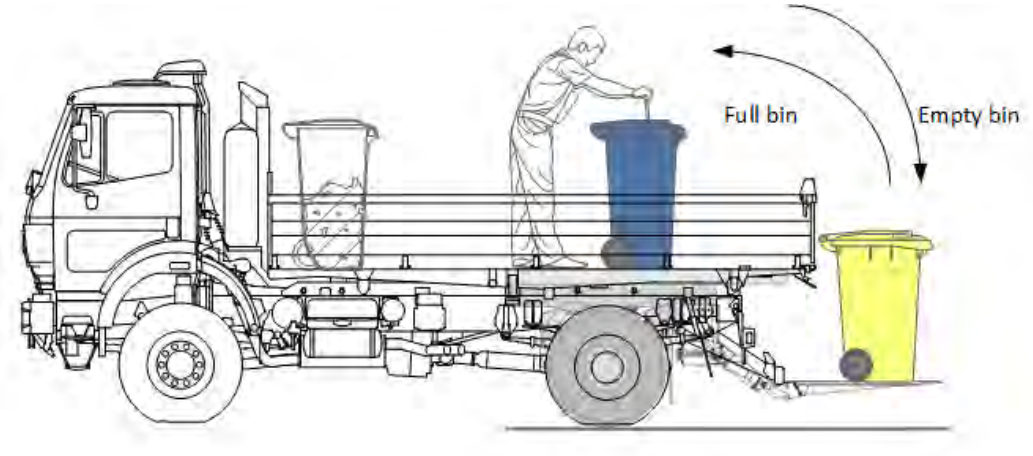


Figure 4: Open dump truck for waste bin collection with lifting tailgate

Other waste streams

Waste streams other than typical household waste like old electronic equipment (TV, fridges etc.), bulky waste, small hazardous waste (batteries, paints and solvents) could either be organised through special pick-up services with the same truck or could be brought the ISWMC directly by the citizens. When bulky waste is transported to ISWMC on the waste collection, it would be placed as lose materials on the truck and covered with tarpaulin to comply with the waste management regulations.

Summary of waste streams generated from the islands

Island	Waste trend (2033) kg/d	Total Biodegradable waste (2023) t/d	Total Biodegradable waste (2028) t/d	Recyclable waste except P&C (2023) in t/d	Recyclable waste except P&C (2028) in t/d	Residual waste (2023) in t/d	Residual waste (2028) in t/d	Total Biodegradable waste (2023) l/d	Total Biodegradable waste (2028) l/d	Recyclable waste except P&C (2023) in l/d	Recyclable waste except P&C (2028) in l/d	Residual waste (2023) in l/d including food leftovers	Residual waste (2028) in l/d including food leftovers
Alif Alif Atoll													
Bodufolhudhoo	768	0.33	0.37	0.11	0.13	0.16	0.18	1,076	1,121	1,944	2,448	992	1,178
Feridhoo	768	0.33	0.37	0.11	0.13	0.16	0.18	1,076	1,121	1,943	2,448	927	934
Himandhoo	722	0.29	0.33	0.11	0.12	0.15	0.17	988	1,025	1,847	2,344	867	893
Maalhos	744	0.33	0.37	0.11	0.12	0.15	0.17	1,063	1,112	1,860	2,325	901	889
Mathiveri	881	0.37	0.42	0.13	0.15	0.18	0.20	1,230	1,281	2,233	2,816	1,063	1,074
Rasdhoo	1,381	0.66	0.72	0.19	0.22	0.26	0.30	2,036	2,144	3,392	4,190	1,684	1,607
Thoddoo	2,260	1.08	1.18	0.32	0.36	0.43	0.49	3,324	3,497	5,561	6,878	2,754	2,637
Ukulhas	1,204	0.60	0.65	0.17	0.19	0.23	0.25	1,801	1,901	2,931	3,600	1,472	1,383
Alif Dhal Atoll													
Dhangethi	1,115	0.50	0.56	0.16	0.18	0.22	0.25	1,598	1,673	2,785	3,479	1,352	1,330
Dhiddhoo	219	0.10	0.11	0.03	0.04	0.04	0.05	312	327	549	687	265	262
Fenfushi	910	0.36	0.41	0.13	0.16	0.19	0.22	1,153	984	2,340	2,981	1,143	1,377
Hangnameedhoo	755	0.34	0.38	0.11	0.12	0.15	0.17	1,088	1,141	1,880	2,344	917	897
Maamigili	2,597	1.02	1.18	0.38	0.44	0.54	0.63	3,524	3,648	6,682	8,508	3,115	3,237
Mahibadhoo	2,188	0.88	1.01	0.32	0.37	0.45	0.52	2,997	3,108	5,600	7,109	2,628	2,707
Mandhoo	421	0.17	0.19	0.06	0.07	0.09	0.10	578	599	1,078	1,368	506	521
Kaafu Atoll													
Dhiffushi	1,659	0.73	0.83	0.22	0.26	0.30	0.35	2,259	2,458	3,788	4,881	1,874	1,870
Gulhi	883	0.42	0.46	0.14	0.15	0.19	0.20	1,347	1,369	2,348	2,837	1,139	1,085
Guraidhoo	1,991	0.89	0.99	0.29	0.32	0.39	0.45	2,848	2,983	4,964	6,207	2,410	2,373
Himmafushi	793	0.43	0.44	0.14	0.15	0.20	0.20	1,384	996	2,498	2,782	1,294	1,369
Huraa	1,214	0.59	0.64	0.18	0.20	0.25	0.27	1,888	1,424	3,143	3,803	1,699	1,941
Kaashidhoo	2,172	0.84	0.98	0.32	0.37	0.44	0.52	2,895	3,025	5,481	7,044	2,557	2,680
Maafushi	4,362	2.24	2.39	0.64	0.70	0.83	0.92	6,573	6,938	11,184	13,459	5,496	5,045
Thulusdhoo	1,701	0.83	0.89	0.26	0.29	0.35	0.38	2,543	2,632	4,631	5,540	2,415	2,743
Vaavu Atoll													
Felidhoo	634	0.27	0.31	0.09	0.11	0.13	0.15	866	703	1,596	2,012	818	972
Fulidhoo	624	0.31	0.34	0.09	0.10	0.12	0.13	926	984	1,498	1,849	755	711
Keyodhoo	958	0.39	0.44	0.14	0.16	0.19	0.22	Home composting		2,445	3,118	1,200	1,449
Rakeedhoo	739	0.17	0.25	0.07	0.10	0.09	0.14	Home composting		1,166	1,939	543	853
Thinadhoo	567	0.21	0.26	0.06	0.08	0.07	0.10	Home composting		1,005	1,457	570	755

Island Solid Waste Management Centres

Summary

Type	N° of Islands	Islands
Island with new ISWMC sufficient for biowaste treatment	11	K. Kaashidhoo, K Thulusdhoo, K. Huraa, K Himafushi, K Guraidhoo V Felidhoo, AA Thodhoo, AA Feridhoo, AA Himandhoo, A.Dh Hangnamedhoo, A. Dh Mahibadhoo,
Island with new ISWMC not sufficient for biowaste treatment (Home composter)	5	V Thinadhoo, V Keyodhoo, V Rakeedhoo, K. Maafushi, A. Dh Mamingili,

The Island waste management Centre is the main facility on the Island for the management of solid waste. Depending on the size provided by Islands, the ISWMC's have been developed to manage as much as possible in a proper and efficient manner the incoming waste flows.

From the actual Island assessment, it appears that due to difficulties in selling the relatively small number of recyclables and the lack of adequate conditioning equipment, most of the previous ISWMCs gets overfilled and became an uncontrolled dumpsite. To avoid this situation in the planned strategy, ISWMC's should be manned with proper equipment for the conditioning of recyclables (balers) but the valuable fractions should also be sent to a centralised facility for re-selling (Thilafushi).

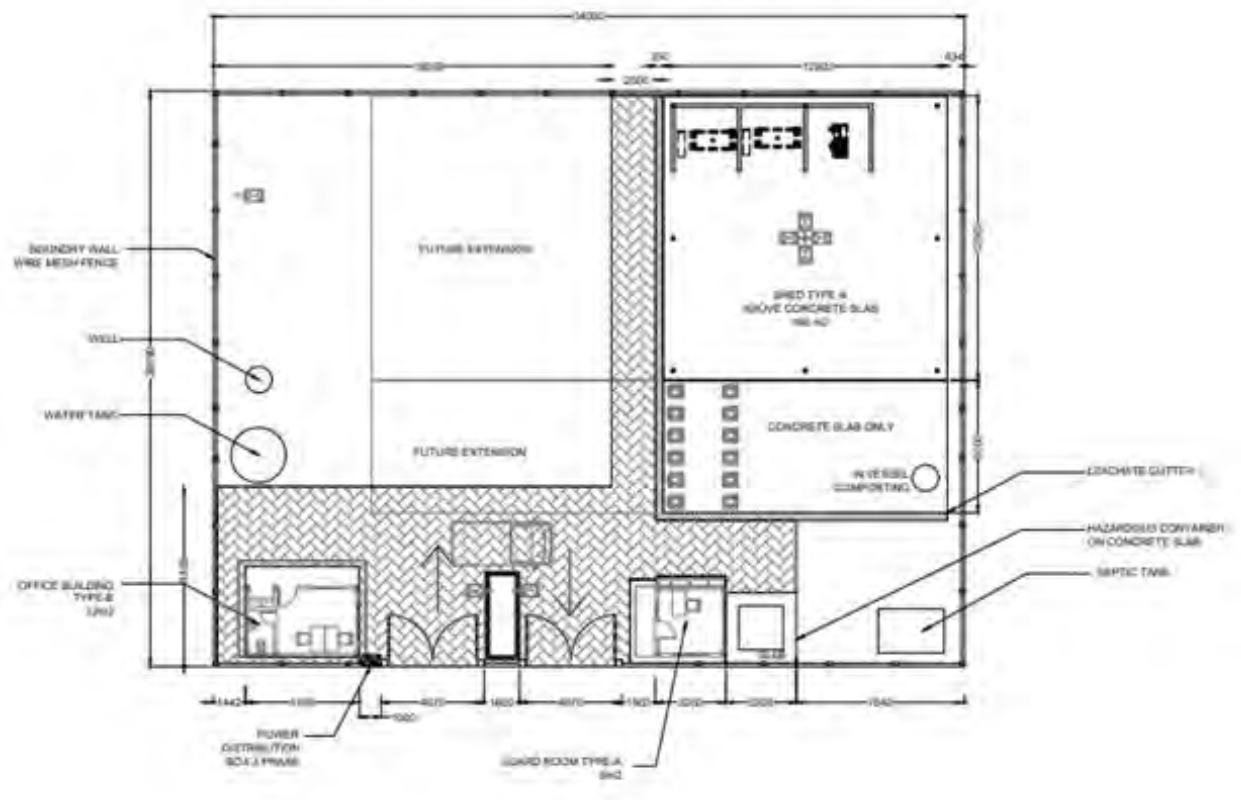


Figure 5: Example of an ISWMC (Guriaidhoo)

The proposed ISWMC has:

- Pavement area: ISWMC would have some area that would be paved using interlocking concrete blocks. Waste would not be handled or kept in the floor of this area. Bins can be placed in this area for individual waste disposal services.
- Concrete platform: ISWMC would have an area with a concrete platform. This area would be covered with a roof to protect from rain and direct sun. Major waste handling / treatment would be undertaken in this area. Waste would be handled, segregated in this area. This area would have bays for waste compactor, glass crusher and bailer for treatment of inorganic waste streams. Waste such as plastic, metal and glass will be stored separately in the allocated area. The sieve would be able to sieve the shredded waste. Part of the concrete platform is allocated as such an in vessel composter could be installed at the ISWMC. Concrete platform is levelled so that water from the platform used for cleaning or other purposes will be collected in the perimeter trench of the platform. This will mainly be of leachate. Leachate will be managed and treated using a septic tank.
- Hazardous waste storage area: Hazardous waste container would store the small quantity of the hazardous waste generated from the households at the island.
- Office building: ISWMC would have a small office that would have office rooms, a rest room and toilets.

1.2 Biowaste treatment at ISWMC

The Ministry has requested to include in vessel composting as the method for biowaste treatment at the ISWMCs. In vessel composting, a type of aerobic composting carried out in enclosed container or vessel.

The bio-degradable waste collected from the households (mainly kitchen waste, food waste and food leftovers) will be treated in the enclosed vessel where mechanical mixing would be carried out for the treatment of in an aerobic environment. This system minimizes odors and process time by controlling environmental conditions such as airflow, temperature, and oxygen concentration. Due to the closes system odors are highly minimised (no attraction of insects and rodents) and the temperature in the system is optimised (no vermins)

The advantage of this system is that it would minimise odour, leachate, faster throughput, lower labor costs and smaller area to carry out the operations. The system does not generate leachate which requires further treatment.

The islands that would be provided with biowaste treatment at the ISWMC includes K. Kaashidhoo, K Tholoosdhoo, K. Huraa, K Himafushi, K Guraidhoo V Felidhoo, AA Thodhoo, AA Feridhoo, AA Himandhoo, A.Dh Hangnamedhoo and A. Dh Mahibadhoo

1.3 Home Composting Bins at Island Households

Home composting bins at the households is a preferred technical option available at island level, where the area available is not sufficient to have a biowaste treatment at the ISWMC. Home Composting bin is not a new technology, and it has been practiced for many years around the world as a simple and low-cost method to manage household organic waste.

Home composting through home composting bins is being introduced to some islands in Zone III as a means of reducing the biowaste waste being discarded and sent to the Thilhafushi for final treatment and disposal. Biowaste stream generated at the islands need to be handled, treated and managed quickly as it cannot be stored at the ISWMC for more than few days due to generation of leachate and odour.

Available home composting bins vary from simple pit /heap methods to complex bin or rotating drum designs. Bin composting system is a convenient system which can be placed in a very limited space available at the the island households. The system has no impact on the surrounding. However, in Maldives, household composting bins has not been used in the islands for the management and treatment of biowaste stream generated from the households

and will require a dedicated capacity building program to make people aware of the benefits. Home composting encourages the community involvement on waste management activities, and it facilitates easy transferring of source separation concepts to the people. Via home composting collection costs on the islands will be reduced.

Figure 6: Home Composting Bin to be used in the households

Cooked or meat/fish food leftovers, however, should not be composted as these will attract vermin and would cause the formation of ammonia and worm and nematodes related problems at the bin.

The compost from the bin could be removed after about 6 to 8 weeks subject to the mode of operating the composting bin. Ideally, the material to be composted is layered with structural materials (chipped tree trimmings, leaves etc.) which will enhance composting thus reducing the composting period and the formation of unpleasant odours (H2S or mercaptans). The compost from the bin can be used as a fertiliser at the home, excess could be given out or taken to ISWMC where it could be stored and transported to Thialfushi for final disposal.

The Home Composting Bin fits to the overall waste management approach on the islands that can be characterised as easy management practices. The selected compost bins can be installed easily at every household, should have a drain for any excess moisture (porous bottom pad), the bin should be protected from external weather conditions such as rain and wind, retain the temperature inside, easy to add waste and remove compost from the bin, keeps away pest like rats and crows and should be durable. Education and awareness raising on the use of the home composting bin would be carried out to the household members.

Calculation note:
Average HH size : 6 people/HH,
Daily biodegradable waste generation for home composting : 1,7 kg/day
Daily biodegradable waste generation for home composting : 4,9 l/day
Home composter volume : 274 l/(8 weeks) => 300 l Home composter

Islands that would be provided with home composting bins are V Thinadhoo, V Keyodhoo, V Rakeedhoo,

1.4 Temporarily storage of treated waste at ISWMC

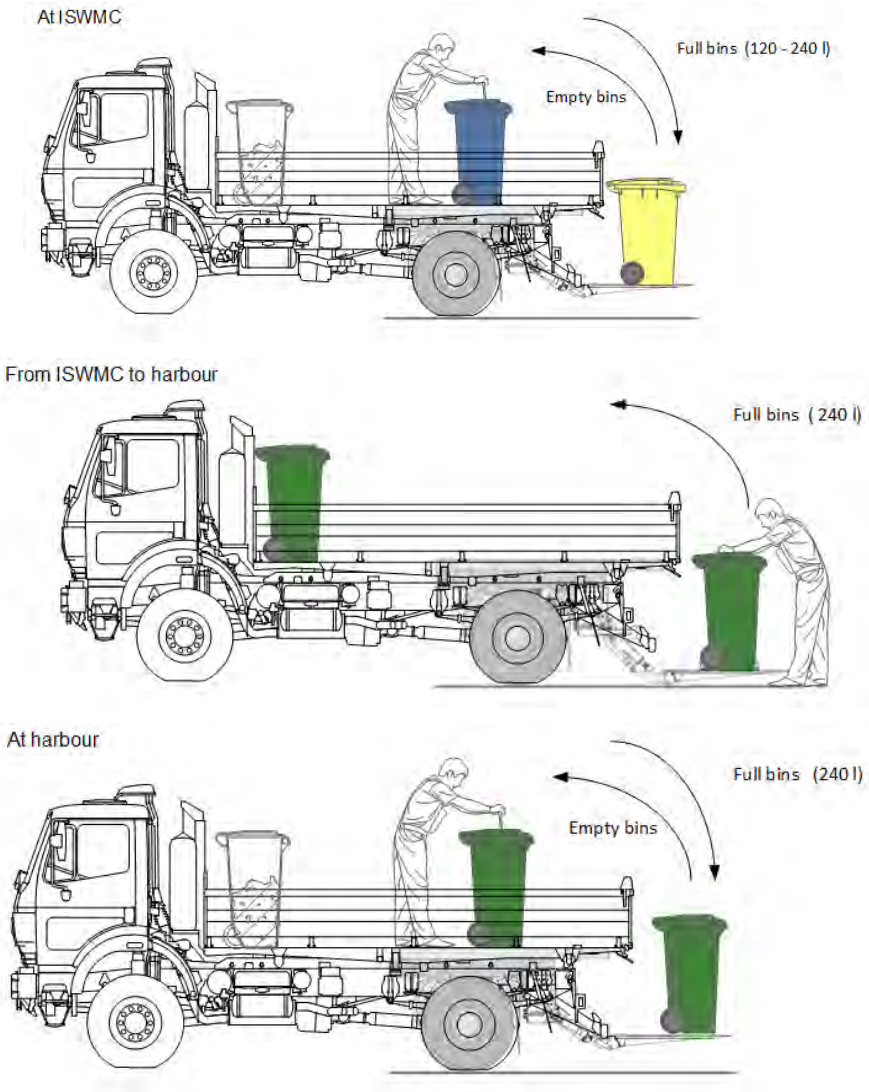
Solid waste collected from the island would be treated and stored at the ISWMC. These waste includes:

- The residual waste (remaining biowaste after remaining of “wet” waste)
- The remaining waste (paper, cardboard, impurities, napkins, etc)
- Treated biowaste from household compost bins or in-vessel treatment
- Baled recyclables (plastic bottles, plastics, metal etc.)
- Bulky waste
- Small quantities of hazardous waste from households
- at the ISWMC will be stored in closed bins at the ISWMC. will be stored in closed bins. and will be stored

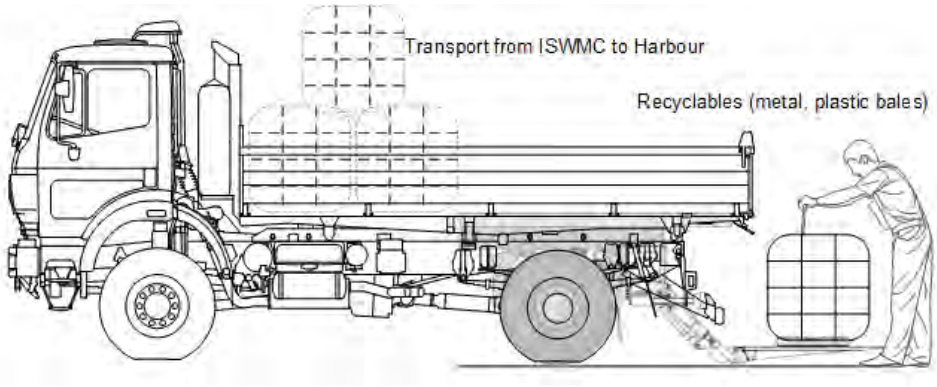
The treated waste streams could be temporarily stored at the ISWMC for a period of 14 - 28 days before these are transported to the Regional Waste Management Facility on outer island waste collection vessel.

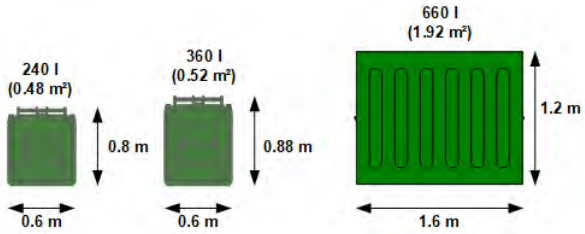
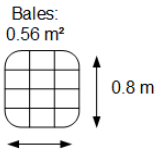
Transportation of treated waste from ISWMC to Harbour

The treated waste at the ISWMC would be stored temporarily in 240 l residual bins or recyclables in bales. These bins and bales will be loaded on the collection truck and taken to the harbour area of the island where it would be loaded on the waste transferring vessel to Thilafushi.



Advantages	Drawbacks
• Simple system • Easy to get familiar with • Same truck as for collection • Flexible (different type of collection bins, receptacles, bales) • System is independent from the vessel	• Important numbers of bins (depending on the storage time on the island) • Time consuming • Needs a careful loading/unloading system (bin-mobile bin tipper-container)



Truck cargo surface	4,8 m²
Bin surface	
Bale surface	
Number of bins per cargo surface which could be transported per trip	240 l bins : approx. 11 (2640 l) 360 l bins: approx 10 (3600 l) 660 l bins : approx 3 (1980 l) Which means that for transporting the waste in 660 l bins we need approx. 1,5-2 times more trips
Number of bales per cargo surface which could be transported per trip	1 row : 9 2 rows: approx. 16

At Island harbour

Table 1: Management of waste streams at the island harbour

Waste stream	Transfer	Priority
Residual waste fraction	Unload into open top Ro/Ro containers with the support of waste bin tippers	Top priority main waste stream, vessel is dedicated mainly for this stream
Recyclables bales	Stored on the vessel deck (empty space) or under deck with the support of the crane	Not priority, only if space remains on the vessel or the amount is important on the island. Alternative collection through another vessel is also possible (special collection tour)
Hazardous waste (HH)	Stored under deck (exchange bin system)	Not priority, only if space remains on the vessel or the amount is important on the island. Alternative collection through another vessel is also possible (special collection tour)
HCW (single use receptacles)	Stored under deck	Priority stream. Depends on how hospitals and health care facilities ensure the supply chain
Glass (big bags)	Stored on the vessel deck or under deck with the support of the crane	Not priority, only if space remains on the vessel or the amount is important on the island. Alternative collection through another vessel is also possible (special collection tour)
Other streams (conditioned)	Stored on or under deck	Not priority, only if space remains on the vessel or the amount is important on the island. Alternative collection through another vessel is also possible (special collection tour)

Harbour configurations (Outer Islands zone)

Table 2: Status of the harbour at the inhabited islands in Zone III.

Harbour configuration	Sizes/alternative for landing	Islands
No harbour/beach landing	beach landing possible	A.Dh. Mandhoo
Jetty (wood)	beach landing possible	V Fulidhoo
Harbour quay wall without landing craft ramp	Smallest size: 90 x 60 m	AA. Feridhoo (beach landing also possible)
	In between:	K. Dhiffushi, K. Himmafushi, K. Huraa, K. Kaashidhoo, K. Tholoosdhoo, K. Guraidhoo, K. Maafushi, K. Gulhi, V. Thinadhoo, V. Rakeedhoo (ongoing), AA Bodulfuhadhoo, AA Malhos, AA. Mathiveri, AA. Rasdhoo, AA Thodhoo, AA Himandhoo, A.Dh Digurah, A.Dh. Fenfushi, A.Dh. Hanyamedhoo, A.Dh. Kunburudhoo, A.Dh. Mahibadhoo, Adh Omandhoo, A.Dh Dhangethi
	Biggest harbour: 628 x 211	A Dh.Maamingili
Harbour quay wall with landing craft ramp		K.Gaafrau, V Felidhoo,, V. Keyodhoo, AA Dhidhoo, AA Ukulhas,

1.5 Waste transfer using outer Island waste collection vessel

After the arrival of the wate collection vessel to the island, the residual bins will be emptied in the big container of the vessel. Bins will be then cleaned and will be used as replacement of the disposed bins which again needs to be filled with residual waste.

The waste transfer on the Islands will be made mostly by side loading into the dedicated waste collection vessel. The Island waste operator (Island Council or third party) is responsible for bringing the different waste fractions to the docking place at the island harbour from the ISWMC.

- Residual waste fraction: regular schedule of the vessel
- Baled recyclables (plastic bottles, plastics, metal etc.): when the capacities at the ISWMC are reached
- Bulky waste (other waste stream): on demand

Islands would use their own equipment to bring the waste (bins, pick-up, loader as part of the ISWMC equipment) and will be supported by the specific vessel equipment: the bin tipper and the crane.

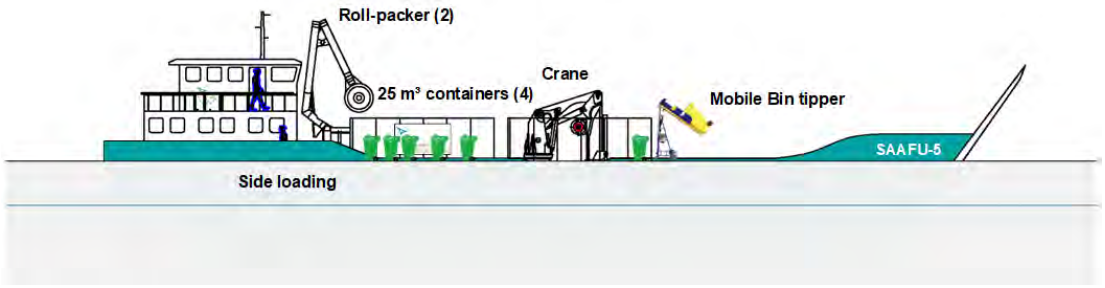


Figure 6: Side loading at Outer Island harbour

In special cases where a landing craft ramp is available the loading could also be made from the front. The Island waste operator could therefore enter the vessel with its bins and truck where an unloading could be arranged.

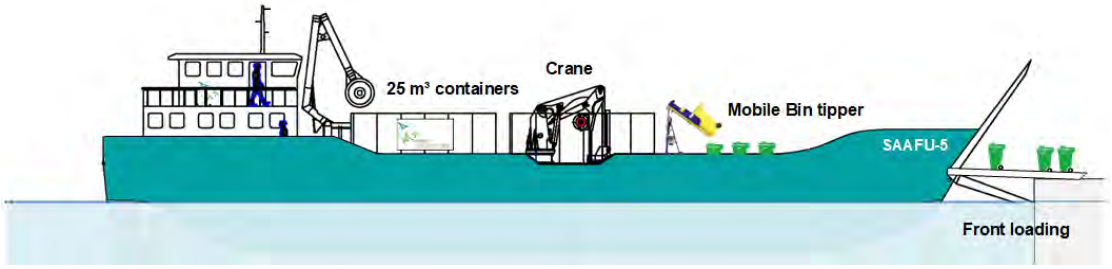


Figure 7: Front loading at Outer Island harbour

Vessel configuration

The vessel has been designed to keep the flexibility and simplicity for different options and situations. It includes.

- Vessel entering and manoeuvring at the island harbours.
- Side loading at harbour quaywall at the island
- Front loading from a beach and harbour with the landing craft ramp
- Front space can accommodate a truck (skip or Ro/Ro truck) with an additional container (skip, Ro/Ro) mounted on the truck
- Front area can accommodate the lifting of the Ro/Ro containers by the respective truck at Thilafushi

The vessel has a length of approx. 41 m (with raised ramp) and a width of 11 m. The main deck has a footprint of 200 m² and can accommodate the containers for the residual waste and other left space could be used for different receptacles. Load capacity of the upper deck is 150 tons. The lower deck is intended for miscellaneous purposes (bins, equipment, eventually bales etc.). The following equipment is part of the vessel configuration:

- 4 Ro/Ro open top containers with tarpaulin. suggestion for the start 25 m³ but could also be increased up to 41 m³)
- 1 crane with lifting capacity of min. 15 t at boom length of 7 m
- 2 fixed mounted roll packers
- 2 mobile bin tippers (discharging height up to 3.00 m)

Load capacity of the upper deck: min. 150 tons without safety factors

- Front space should be able to accommodate a truck (skip or Ro/Ro truck) with an additional container (skip, Ro/Ro) mounted on the truck
- Front area should also be able to accommodate the lifting of the Ro/Ro containers by the respective truck at Thilafushi

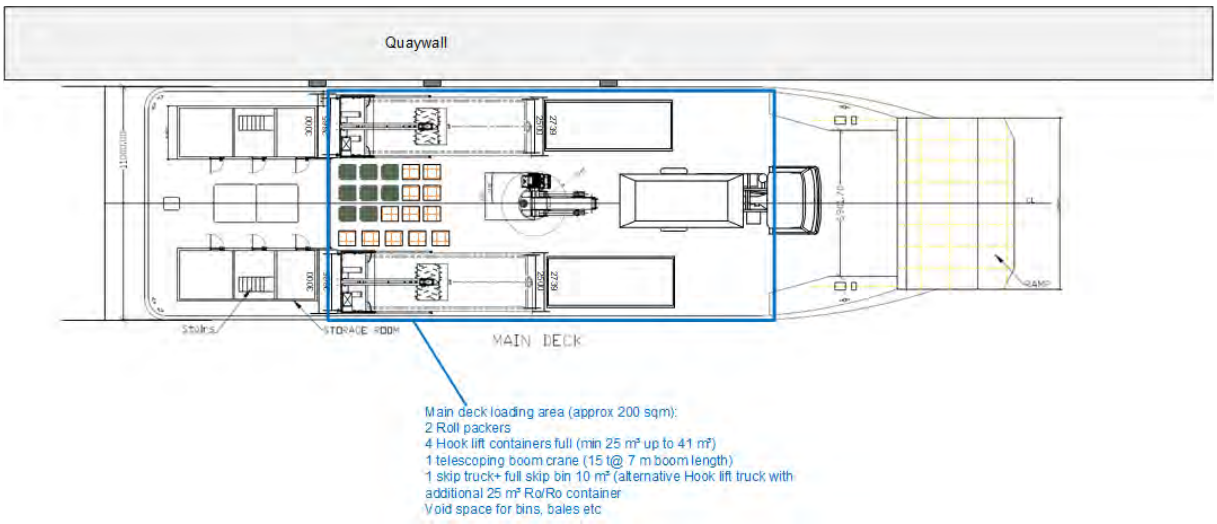


Figure 8: Vessel arrangement for transportation of waste from islands to Thilafushi.

Routing

The attached figures show the proposed routes for the waste collection vessel collecting waste from the ISWMC at the islands and transferring the waste to the regional waste management facility at Thilafushi

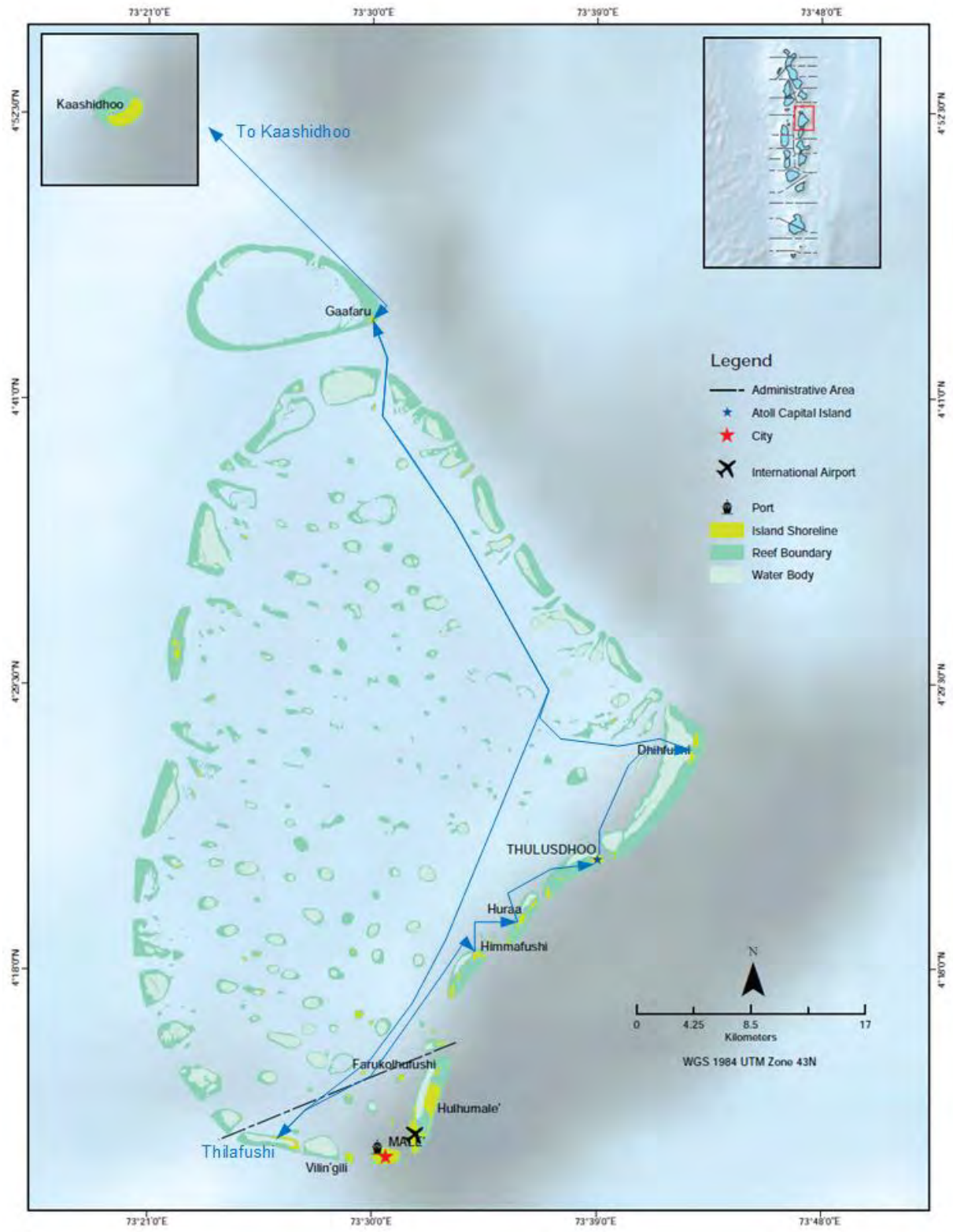


Figure 9: Waste collection route North Male' Atoll

Figure 10: Waste collection route Sout Male' Atoll to Vavuu Atoll

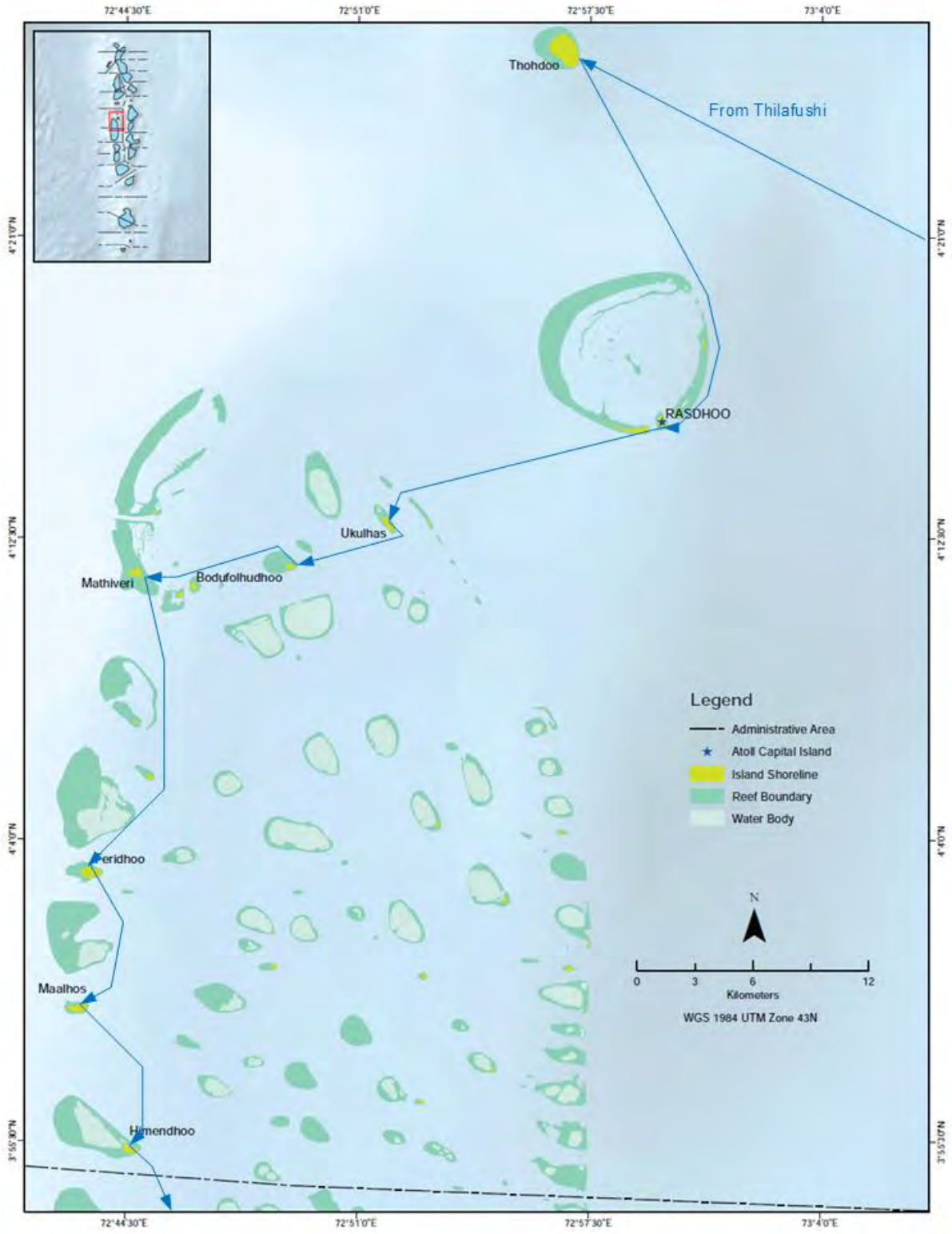


Figure 11: Waste collection route Alif Alif Atoll

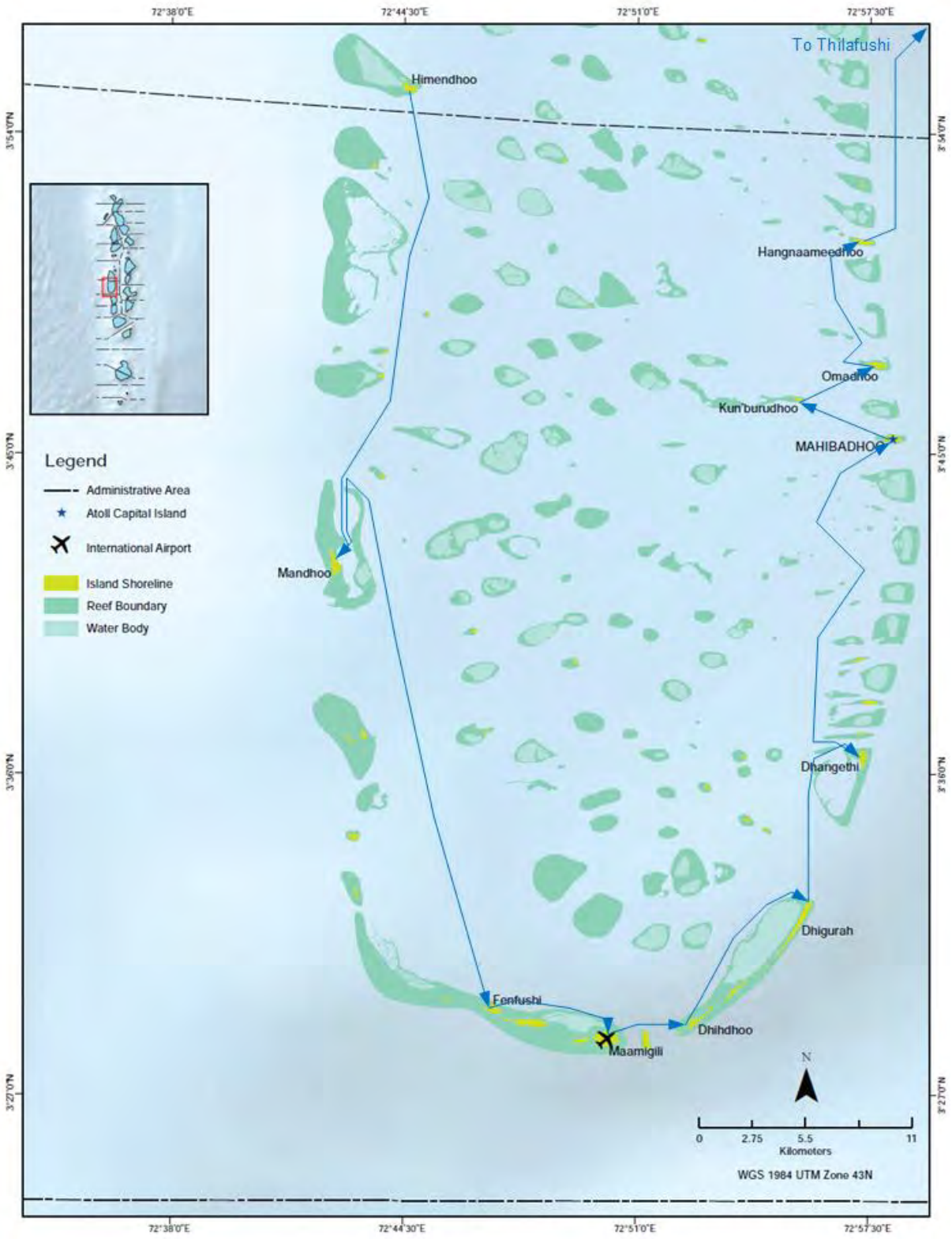


Figure 12: Waste collection route Alif Dhal Atoll

1.6 Final Treatment and Disposal of waste from ISWMC

Waste Transfer Vessel would transport the waste containers collected from the outer islands to the Regional Waste Management Center for Zone III (RWMC) in Thilafushi Island. At Thilhafushi, when WTE facility at RWMC – Zone III becomes operational, the waste collected from the outer islands would managed as follows:

- Residual waste – treated at the Waste to Energy facility at Thilafushi
- Excess compost - temporarily stored at Thilafushi, make it available to agriculture sector and disposed if no interest to take it from Thilafushi.
- Bailed plastic – temporally stored at Thilafushi and provided to recyclers like Parley or others who export for recycling, residues after sorting at Parley sorting plant will be incinerated
- Metals (aluminium, tin cans) – to be handed over to scrap dealers based on Thilafushi
- Hazardous wastes – will be stored temporarily at Thilafushi for export according to Basel Convention or later incineration in the WtE if the waste management regulation provides for their incineration
- Crushed glass – will be processed with C&D waste in the C&D waste plant at Thilafushi and provided to construction industry for making aggregates for non-structural concrete applications or using it as base layer material.
- Non-marketable mineral residues from the C&D waste plant will be used as cover material for the residue landfill of the WtE plant

Figure 13: Suggested organisation at Thilafushi harbour

To manage the incoming waste streams properly, WAMCO is requested to set-up an effective material flow management to accommodate the needs of both incoming waste materials and exiting marketable recyclables (minerals and metals from C&D waste processing and from the WtE).

1.7 Management of Waste from Islands during Transit Period

Collection of Waste at the Island

Before the commissioning of the ISWMC at the islands, the Island Councils will ensure the wastes generated at the islands are brought to the future waste management area source segregated into recyclable plastic materials and residual waste to comply with the waste management regulation. The waste will be stockpiled in the area as different streams. Since for organic waste no treatment option is yet available, bio-waste will be commingled with residual waste. For the recyclables (mainly rigid plastics), Parley will be provided with balers to be used on the island during the transition phase. Once the ISWMCs are operational, the balers will be incorporated into the ISWMCs.

Transfer of Waste from Islands to Thilafushi

During the transit period before the delivery of the Outer Island Waste Collection Vessel, Ministry of Environment, Climate Change and Technology will provide collection of the waste from the outer islands in Zone III periodically using the WAMCO's waste collection vessels. The Ministry's plan is to undertake the collection of waste from the islands on a route as described in section "Routing" in the previous section of this document.

Management, Treatment and Final Disposal of Waste at Thilafushi

Waste Transfer Vessel would transport the waste containers collected from the outer islands to the Regional Waste Management Center for Zone III (RWMC) in Thilafushi Island. At Thilhafushi, before the RWMC – Zone III becomes operational, the treated waste from the islands would be further treated and disposed as follows:

- Residual waste – The waste stream will be brought to Thilafushi in containers that are available at Thilafushi. The waste will be, if necessary, shredded and be baled and stored at Thilafushi for later incineration in the WTE plant, when it becomes operational.
- Baled plastic – temporally stored at Thilafushi and provide it to recyclers like Parley or others who export for recycling, residues from sorting will be baled.
- Excess compost – temporarily stored at Thilafushi, make it available to agriculture sector, bailed and temporarily stored, if no interest to take it from Thilafushi.
- Bailed plastic – temporally stored at Thilafushi and provide it to recyclers like Parley or others who export for recycling
- Crushed glass – temporarily stored at Thilafushi and provided to construction industry for making bricks and blocks of construction
- Mineral fraction will be used for interim dumping at the dump site

Referenced Documents

ZONE III SWM Strategy Report, 2020, Project Management, Design and Construction Supervision Consultants (Firm) for the Greater Male Environmental Improvement and Waste Management Project - Phase 1

Kasdarli, C., Lorson, H., & Beckmann, K.-H. (2018). Feasibility study Report for the RSWMF at Thilafushi. Retrieved from Ministry of Environment, Climate Change and Technology, Republic of the Maldives:

ADB. (2018). Proposed Grant and Technical Assistance Grant and Administration of Grant Republic of Maldives: Greater Male' Environmental Improvement and Waste Management Project Retrieved from Asian Development Bank https://www.adb.org/sites/default/files/project-documents/51077/51077-002-rrp-en.pdf

Annex

OUTER ISLAND WASTE MANAGEMENT STRATEGY: KAASHIDHOO

ISWMC plot sufficient for biodegradable waste treatment (In-vessel Composting)

General data

Inhabitants (2019)	2,478
Population growth [%]	3.20%
Households	380
Guesthouses (beds)	5 (54)
Hotels	See guesthouses
Restaurants	4
Commercials/small industry	22 shops, 1 boat building factory
Public institutions	1 primary school, 5 administration building, 5 mosques, 2 telecommunications, 1 water supply service, 1 health centre and 1 powerhouse

Waste quantification for bin dimensioning in t/d (net)

Total waste	2023	1.7	t/d
Biodegradables (total)		*0.8*	*t/d*
Recyclables (except P&C)		*0.4*	*t/d*
Residual waste		*0.5*	*t/d*
Total waste	2028	1.9	t/d
Biodegradables (total)		*1.0*	*t/d*
Recyclables (except P&C)		*0.4*	*t/d*
Residual waste		*0.6*	*t/d*

Waste quantification for bin dimensioning in l/d and m³/d (with impurities in each stream and food leftovers considered *as residual waste*)

Total waste	2023	11,708	l/d	12	m³/d
Biowaste bin (windrow composting)		*2,708*	*l/d*	3	*m³/d*
Recyclables (except P&C)		*6,179*	*l/d*	6	*m³/d*
Residual waste (including food leftovers)		*2,821*	*l/d*	3	*m³/d*
Total waste	2028	13,614	l/d	14	m³/d
Biowaste bin (windrow composting)		*2,328*	*l/d*	2	*m³/d*
Recyclables (except P&C)		*7,865*	*l/d*	8	*m³/d*
Residual waste (including food leftovers)		*3,421*	*l/d*	3	*m³/d*

Alternative: streams for bin dimensioning in l/d and m³/d considering food leftovers treated in In-vessel composting	Total waste 2023 11,811 l/d 12 m³/d *Biowaste bin (in-vessel composting) 2,895 l/d 3 m³/d* *Recyclables (except P&C) 6,184 l/d 6 m³/d* *Residual waste 2,732 l/d 3 m³/d* Total waste 2028 13,777 l/d 14 m³/d *Biowaste bin (in vessel composting) 3,025 l/d 3 m³/d* *Recyclables (except P&C) 7,867 l/d 8 m³/d* *Residual waste 2,886 l/d 3 m³/d*
Primary collection	
Collection mode	Collection point system for HH "Door 2 door" for Guesthouses and Hotels (1 set per GH/hotel) Exchange bin system (full bin replaced by empty bin)
HH and C&I Bins	120 l for biowaste 240 l for recyclable waste and residual waste
GH/Bins	120 l for biowaste 240 l for recyclable waste and residual waste
Reserve (for maintenance, deterioration, etc.)	10%
Collection frequency stream 1 (biowaste)	6/7 (for calculation), min. every second day
Collection frequency stream 2 (recyclables)	6/7 (for calculation) or depending on the filling grade
Collection frequency stream 3 (residual)	6/7 (for calculation), min. every 3rd day

Source segregation and primary collection

The amount of the different type of bins depends also on the which treatment is proposed at the ISWMC of Kaashidhoo, particularly the type of biodegradable waste treatment and respective feedstock:

- Open and aerated windrow composting considers garden waste (green waste) and certain type of kitchen waste. Cooked food leftovers, meat, poultry and similar food waste is not recommended for this type of biowaste treatment
- In-vessel composting, and anaerobic digestion might consider food leftovers and similar food waste to a certain extent.

This might lead to another distribution of bins (food leftovers will also increase the density of the residual waste).
Considering both alternatives the following number of bins have been calculated:

Type of bin	Alternative 1 : food/meal leftovers considered as residual waste)	Alternative 2: food/meal leftovers considered as biowaste to be treated
Biodegradable waste bins	26 (120 l bins) Exchange bins : 26 (120 l bins)	29 (120 l bins) Exchange bins : 29 (120 l bins)

Type of bin	Alternative 1 : food/meal leftovers considered as residual waste)	Alternative 2: food/meal leftovers considered as biowaste to be treated
	Replacement bins : 6 (120 l bins) *Total : 58 bins*	Replacement bins : 6 (120 l bins) *Total : 64 bins*
Recyclable waste bins	38 (240 l bins) Exchange bins : 38 (240 l bins) Replacement bins : 8 (240 l bins) *Total : 84 bins*	38 (240 l bins) Exchange bins : 38 (240 l bins) Replacement bins : 8 (240 l bins) *Total : 84 bins*
Residual waste bins	17 (240 l bins) Exchange bins : 17 (240 l bins) Replacement bins : 4 (240 l bins) *Total : 38 bins*	14 (120 l bins) Exchange bins : 14 (120 l bins) Replacement bins : 3 (240 l bins) *Total : 31 bins*
GH/Hotel bins	10 Biowaste bins (120 l) 10 recyclable bins (240 l) 10 residual bins (240 l) According MoE: To be procured on their own expenses (Private operators)	
Collection points (HH)	17 collection points with 3 different type of bins  16 collection points with 2 different type of bins  5 collection point with 2 different type of bins but with bio waste bin twice  *Total: 38 collection points*	14 collection points with 3 different type of bins  19 collection points with 2 different type of bins  and 5 collection point with 2 different type of bins but with bio waste bin twice  *Total: 38 collection points*
GH/H	Separate collection route (door to door or on demand)	

Note:

Standardised bins exist in various sizes:

- 2 wheeled bins : 60 l 80 l, 120 l, 140 l, 240 l, 360 l
- 4 wheeled bins : 550 l, 660 l, 770 l and 1100 l

Most common sizes used are 120 l-360 l for 2 wheeled bins and 660-1100 l for 4 wheeled bins

Smaller bins (2 wheeled up to 240 l) have the advantage to be easier to handle and lift by hand and do not need a special vehicle (higher invest, higher maintenance costs). Main inconvenient is the need of more bins and the more time for the collection and handling.

Different combinations are therefore possible depending on the amount of waste, the availability of maintenance facilities and spare parts and the financial affordability of the island

Secondary collection

Main rationale for the secondary collection is to improve the existing system and to keep it as simple as possible (from technical point of view) and affordable (from financial point of view). All Islands are having a “rural” character with single housings and the roads are unpaved.

A tentative secondary waste collection route have been developed:

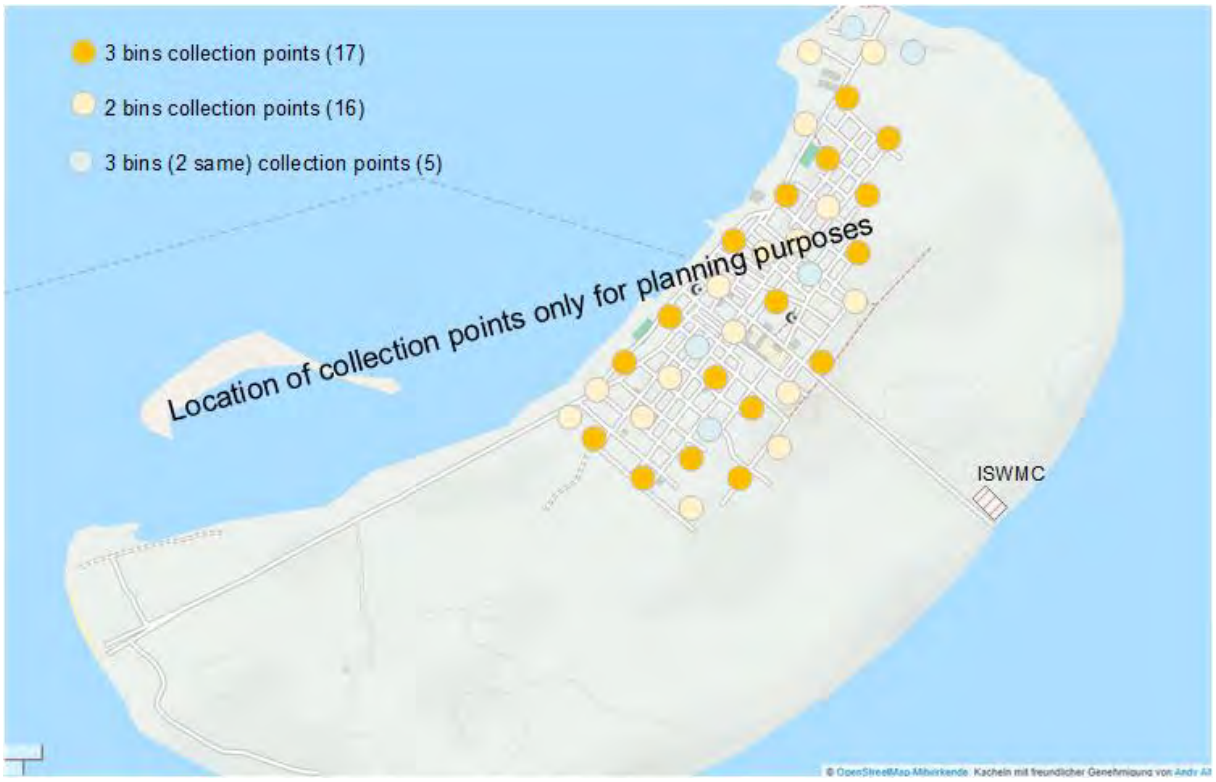
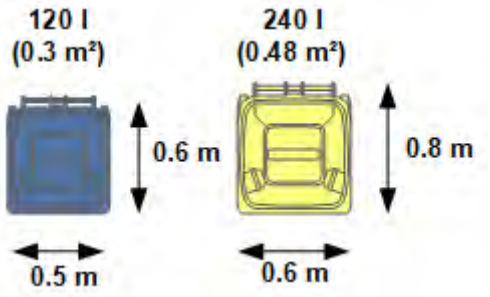


Figure 14: Tentative HH waste collection route (only for equipment dimensioning purposes)

Truck cargo surface	4,8 m²
Bin surface	
Assumption (worst case)	All bins are filled 100% at the collection point
Number of collection points per trip (2 x 120 l + 1 x 240 l)	4 collection points per trip
Number of trips	10 trips
Average distance to ISWMC (round trip)	2,36 km
Truck speed	10 km/h
Collection time (without loading/unloading	140 min (2 h 21 min)
Loading/unloading (3 min per collection point)	114 min (1 h 54 min)
Total collection time	255 min (4 h 15 min) < 8 hrs ✓
Note	The truck can be use approx. 3-4 hrs/day for other purposes (transport of residual waste bins to the harbour, for example). As the transfer vessel is supposed to come earliest every 5 days there should be enough time to transport the residual waste bins to the harbour

ISWMC

The Island council of Kaashidhoo have provided sufficient land for an ISWMC with biowaste treatment. Dimensioning was made for the worst case

Based on the previous assumptions (level of impurity) and considering that on the ISWMC an additional screening, sorting of the different waste streams could be undertaken the following mass balances (for the 2 alternatives: windrow composting/In-vessel composting) have been developed:

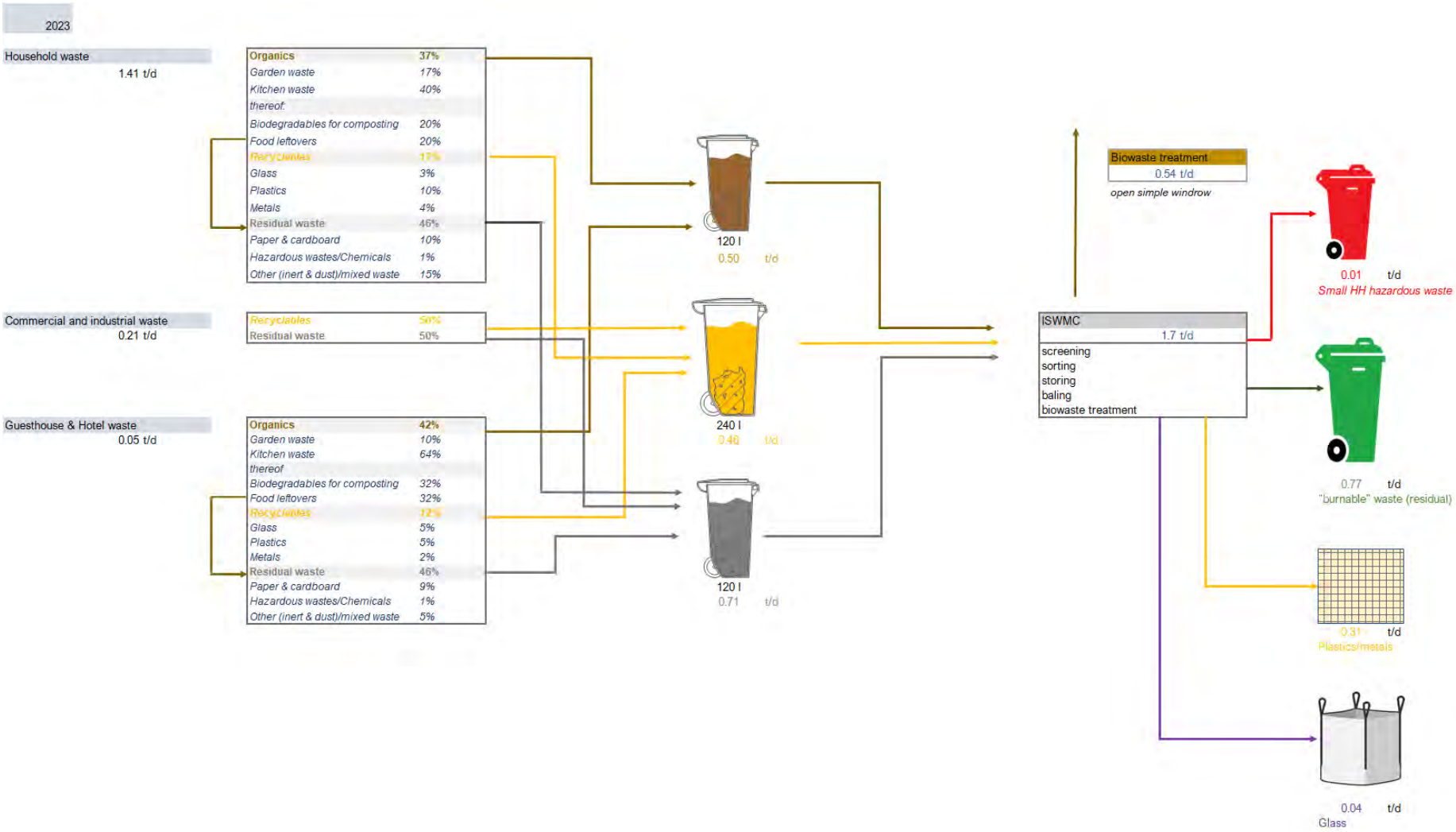


Figure 15: Mass balance 2023 at ISWMC (with windrow composting)

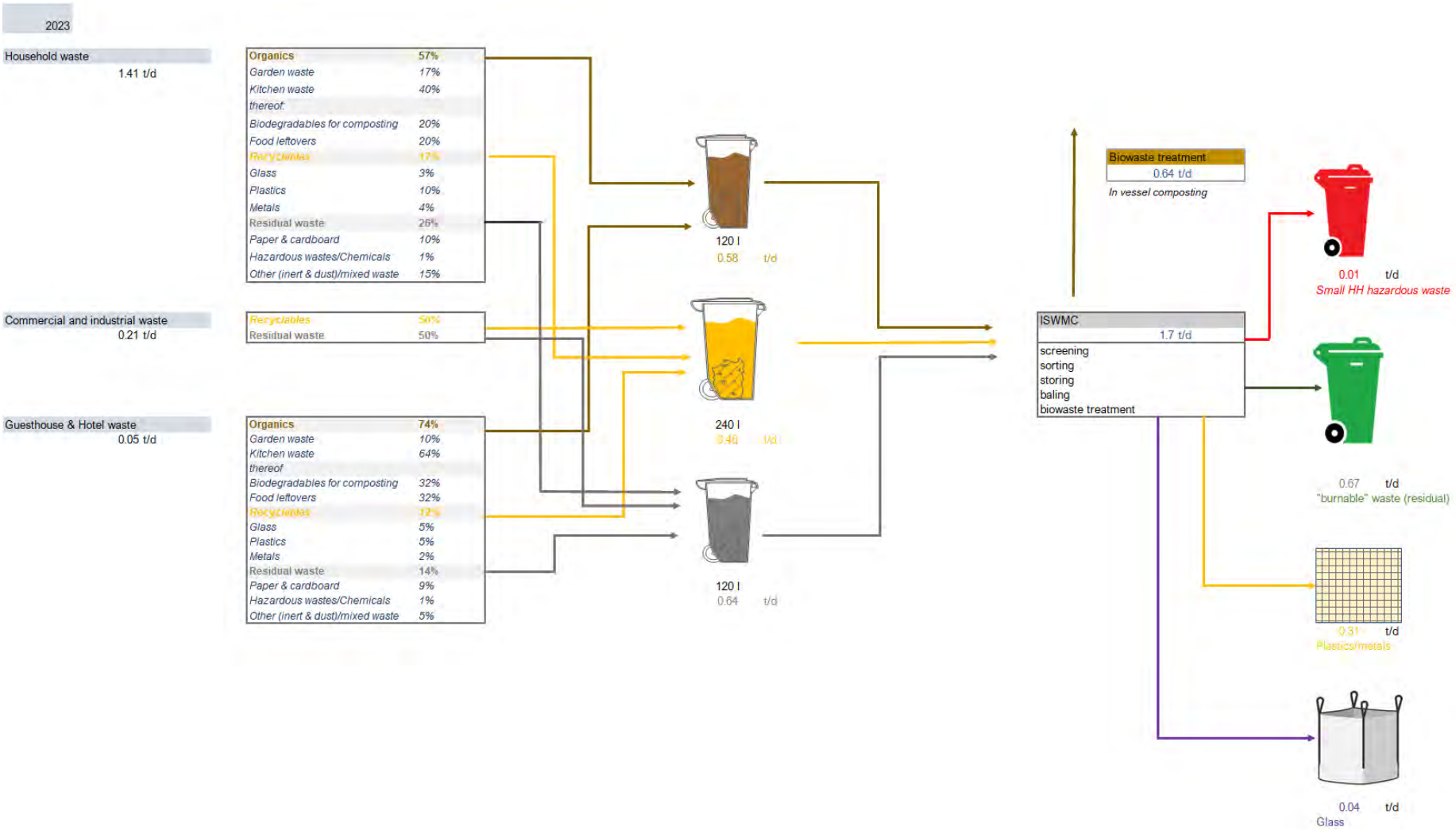


Figure 16: Mass balance 2023 at ISWMC (with In-vessel composting)

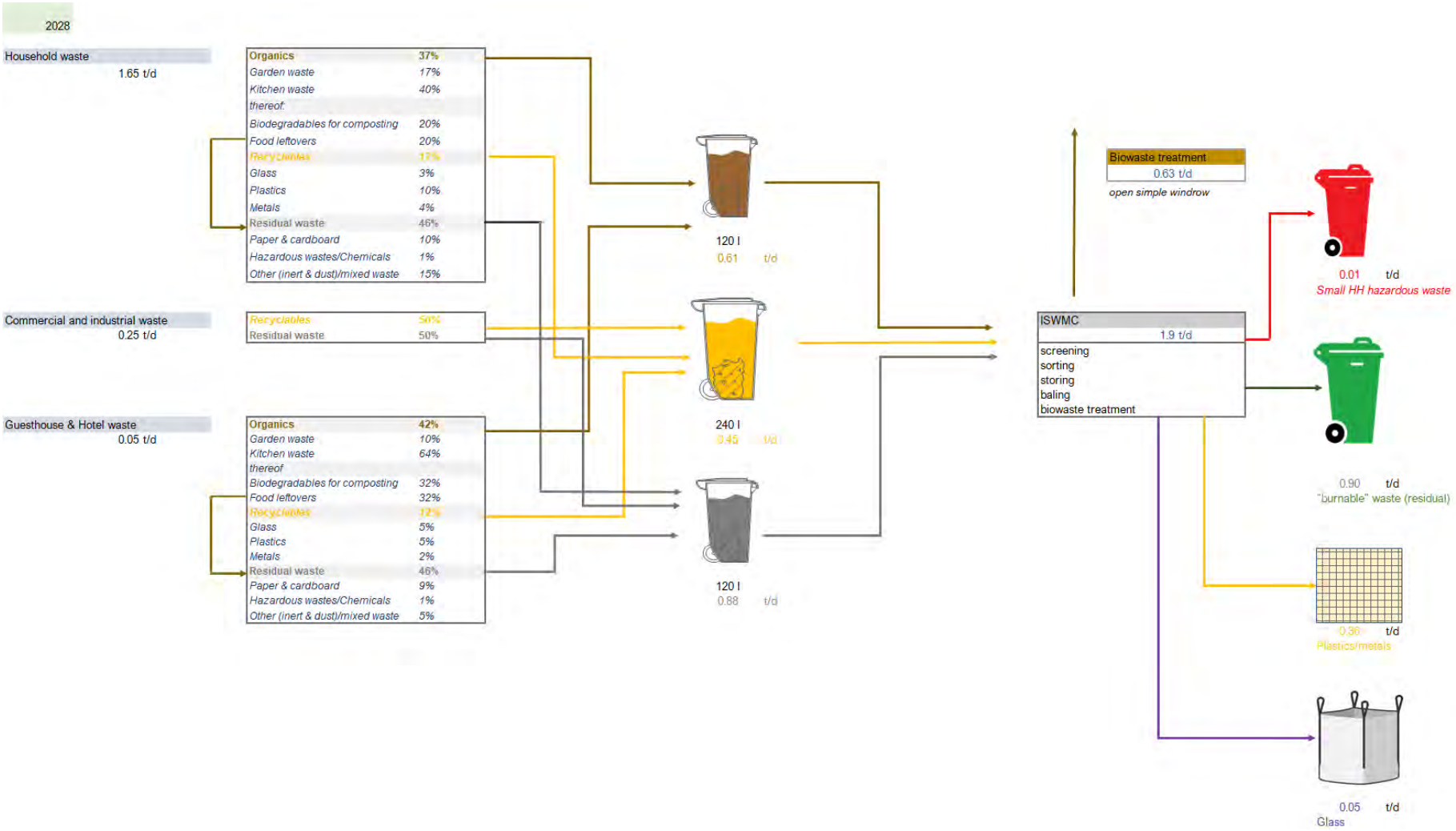


Figure 17: Mass balance 2028 at ISWMC (with windrow composting)

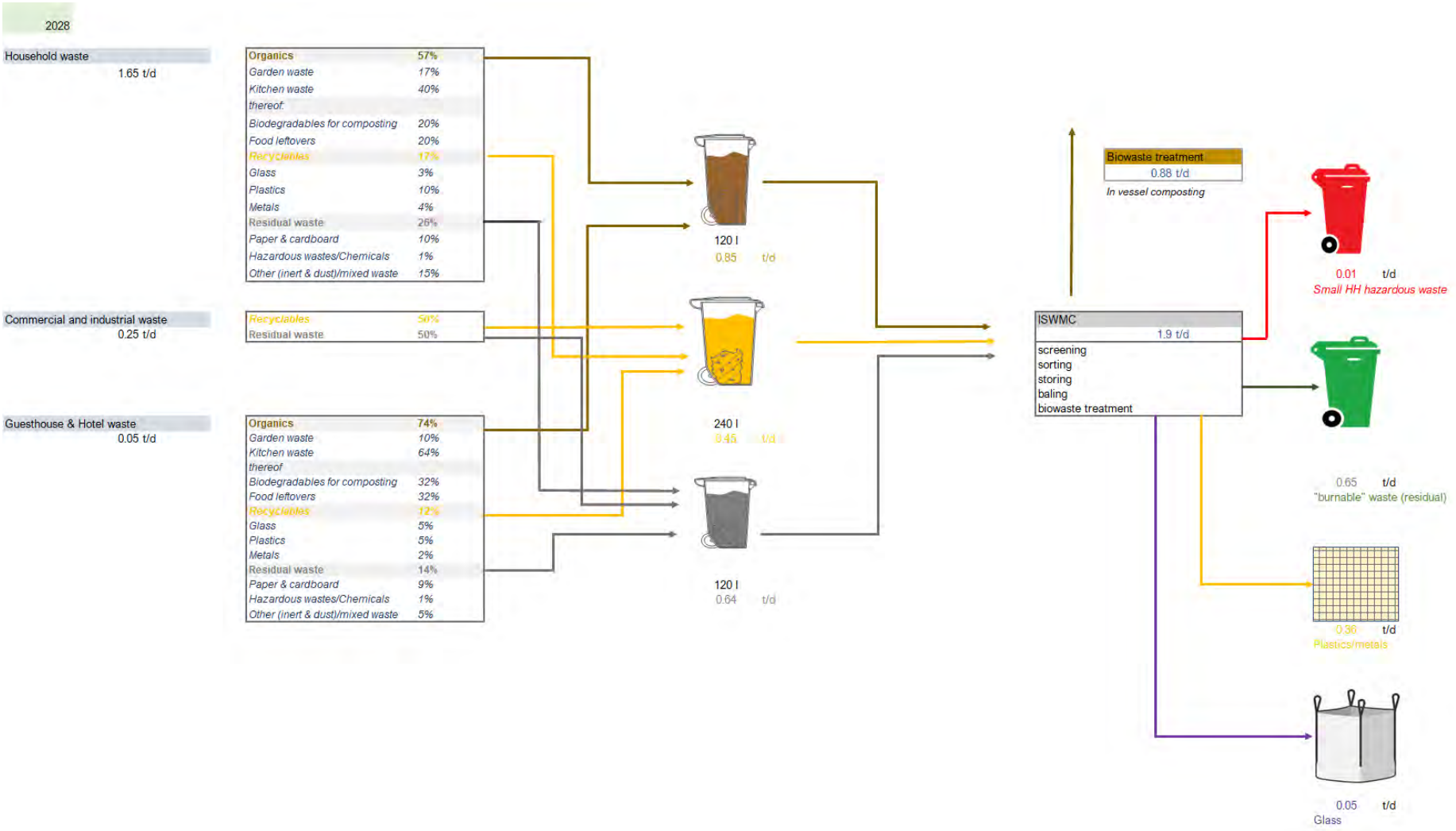


Figure 18: Mass balance 2028 at ISWMC (with In-vessel composting)

Mass balance (Kaashidhoo) at and after ISWMC

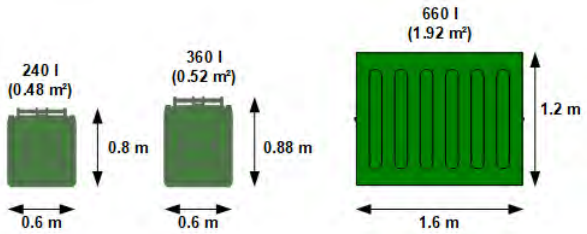
Output stream	2023	2028	Destination	Frequency
Biowaste for windrow composting (t/d)	0.54	0.63	Open or aerated windrow composting	Daily (continuous feedstock)
Biowaste for in-vessel composting (t/d)	0.64	0.88	In vessel composter	Every week/intermediate feedstock (storage capacity)
Residual waste/burnable waste (with food leftover)	0.77	0.90	Harbour/Thilafushi	As per optimised vessel collection frequency but not earlier than 5 days
Residual waste/burnable waste (without food leftover)	0.67	0.65	Harbour/Thilafushi	As per optimised vessel collection frequency but not earlier than 5 days
Recyclables (plastic bales, metal can bales) (t/d)	0.31	0.36	Harbour/Thilafushi or direct to potential off takers	Periodically, depending on the capacity on the vessel (below deck)
Glass (crushed and packed in big bags) (t/d)	0.04	0.05	Harbour/Thilafushi	Periodically (when dedicated big bag is full)
Small hazardous waste (t/d)	< 0.01	0.01	Harbour/Thilafushi	Periodically (when dedicated bins are full)

“Packaging”/receptacles at ISWMC

Output stream	Volume/weight	Receptacle/packaging	Amount
Residual waste/burnable waste (worst case)	3.60 m³/d (0.90 t/d at a density of 0.25 t/m³)		Storage time 5 days • 75 bins (240 l) or • 50 bins (360 l) or • 27 bins (660 l)
Recyclables	0.36 t/d	Bales : bale size approx. 80 x 70 x 60 cm (L x W x H) (0.33 m³) 80 kg/bale	Approx. 5 bales/day (1,7 m³)
Glass (crushed)	0.04 t/d	Big bags (volume 90 x 90 x 100 = 0,81 m³)/capacity 200 kg	Glass density after crushing : 1,1 t/m³ 0,036 m³/d 1 big bag/week

Output stream	Volume/weight	Receptacle/packaging	Amount
Small hazardous waste	0.01 t/d ~ 10 kg/d	 120 l bins	8 x 120 l bins Nominal capacity: 40~48 kg Capacity at ISWMC approx. for 32 days

Transport from ISWMC to the harbour

Truck cargo surface	4,8 m²
Bin surface	
Assumption (worst case)	All bins are filled 100%
Number of bins per trip (240 l)	11 bins
Number of bins per trip (360 l)	10 bins
Number of bins per trip (660 l)	3 bins
Number of bales per trip (capacity of the truck 1 to)	5 bales
Number of trips needed	• 240 l bins : 8 trips • 360 l bins : 5 trips • 660 l bins: 9 trips • Bales: 5 trips (in case of 5 days loading)
Average distance harbour/ ISWMC (round trip)	2 km
Truck speed	20 km/h
transport time (without loading/unloading)	• 240 l bins : 48 min • 360 l bins : 30 min • 660 l bins: 54 min • Bales: 30 min
Loading/unloading (1.5 min per bin at ISWMC and 1.5 min at harbour)	• 240 l bins : 3 h 45 min Split in 5 days : approx.. 45 min /day • 360 l bins : 2 h 30 min Split in 5 days : approx.. 30 min /day • 660 l bins: 1 h 21 min Split in 5 days : approx.. 16 min /day • Bales: 1 h 45 min Split in 5 days : approx.. 21 min /day
Conclusion	1 dump truck is sufficient for the entire collection system in Kaashidhoo. Depending on type of bin size chosen the work could be done either in approx. 30-45 min/day

Waste transfer from harbour to waste transfer vessel

Process	1 mobile bin tipper	2 mobile bin tipper
Arrival/docking/manoeuvring	10 minutes	
Installation of mobile tipper	10 minutes	+ additional 10 minutes*
Tipping		
240 l bins (2 bins at 1 time) tipping cycle 20 s	13	7
360 l bins (1 bins at 1 time) tipping cycle 20 s	17	9
660 l bins (1 bins at 1 time) tipping cycle 30 s	14	7
Dismantling of mobile tippers and departure	10 min	Additional 10 min
Total time	~45 min	~39 min

*during installation of second mobile tipper, tipping with 1st tipper can start

OUTER ISLAND WASTE MANAGEMENT STRATEGY: THINADHOO (LOWEST CASE)

An Island with home composting bins with no in-vessel composting at ISWMC

General data

Inhabitants (2019)	211 inh.
Population growth [%]	8.80 %
Households	77
Guesthouses (beds)	9 (172)
Hotels	See Guesthouses
Restaurants	1
Commercials/small industry	13 shops
Public institutions	1 administration building,1 mosque, 1 telecommunication, 1 powerhouse
Waste quantification for bin dimensioning in t/d (net)	Total waste 2023 — 0.3 t/d *Biodegradables (total)* — *0.2 t/d* *Recyclables (except P&C)* — *0.1 t/d* *Residual waste* — *0.1 t/d* Total waste 2028 — 0.4 t/d *Biodegradables (total)* — *0.2 t/d* *Recyclables (except P&C)* — *0.1 t/d* *Residual waste* — *0.1 t/d*
Waste quantification for bin dimensioning in l/d and m³/d (with impurities in each stream and food leftovers considered *as residual waste*)	Total waste 2023 — 1,575 l/d — 2 m³/d *Recyclables (except P&C)* — *1,005 l/d* — *1 m³/d* *Residual waste (including food leftovers)* — *570 l/d* — *1 m³/d* Total waste 2028 — 2,213 l/d — 2 m³/d *Recyclables (except P&C)* — *1,457 l/d* — *1 m³/d* *Residual waste (including food leftovers)* — *755 l/d* — *1 m³/d*
Primary collection	
Collection mode	Home composting (1 HC bin per HH) Collection point system Exchange bin system (full bin replaced by empty bin)
Bins (suggestion)	240 l for residual waste 240 l for recyclable waste
Reserve (for maintenance, deterioration, etc.)	10%
Collection frequency stream 2 (recyclables)	6/7 (for calculation) or depending on the filling grade
Collection frequency stream 3 (residual)	6/7 (for calculation), min. every 3rd day

Source segregation

Thinadhoo council did not provide a sufficient plot for a biowaste treatment at the ISWMC.

Suggestion:

- 30 l bin for home composting (not collected)

+2 stream system, with standardised bins

- 240 l bin for recyclable waste (plastics, plastic bottles, metals and glass could be collected in one stream and then separated at the ISWMC)
- 240 l bin for residual waste

Primary collection

Type of bin	food/meal leftovers considered as residual waste)
Home composting waste bins	77 (30 l bins) Exchange bins : N/A Replacement bins : N/A *Total : 77 bins*
Recyclable waste bins	8 (240 l bins) Exchange bins : 8 (240 l bins) Replacement bins : 2 (240 l bins) *Total : 18 bins* **note : it is suggested to provide min. 10 bins per Island*
Residual waste bins	4 (240 l bins) Exchange bins : 4 (240 l bins) Replacement bins : 1 (240 l bins) *Total : 9 bins* **note : it is suggested to provide min. 10 bins of each type per Island*
GH/Hotel bins	9 recyclable bins (240 l) 9 residual bins (240 l) According MoE: To be procured on their own expenses (Private operators)
Collection points	4 collection points with 2 different types of bins 
GH/Hotel	Separate collection route

Note:

Standardised bins exist in various sizes:

- 2 wheeled bins : 60 l 80 l, 120 l, 140 l, 240 l, 360 l
- 4 wheeled bins : 550 l, 660 l, 770 l and 1100 l

Most common sizes used are 120 l-360 l for 2 wheeled bins and 660-1100 l for 4 wheeled bins

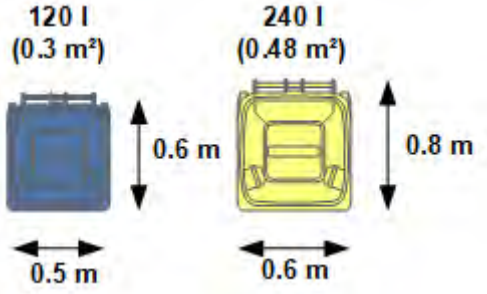
Smaller bins (2 wheeled up to 240 l) have the advantage to be easier to handle and lift by hand and do not need a special vehicle (higher invest, higher maintenance costs). Main inconvenient is the need of more bins and the more time for the collection and handling.

Different combinations are therefore possible depending on the amount of waste, the availability of maintenance facilities and spare parts and the financial affordability of the island

Secondary collection

The secondary collection should be kept simple. Islands are familiar with this type of collection, but it needs to be ensured that there is sufficient time for collection and exchanging the bins per day as well as transporting the residual waste bins ("burnable waste" bins) from the ISWMC to the harbour for the outer Island transport/transfer. Otherwise, an additional vehicle might be needed. A tentative secondary waste collection route have been developed:

Figure 19: Tentative collection route (only for equipment dimensioning purposes)

Truck cargo surface	4,8 m²
Bin surface	
Assumption (worst case)	All bins are filled 100% at the collection point

Number of collection points per trip (1 x 120 l + 1 x 240 l)	all collection points in 1 trip
Number of trips	1 trips
Average distance to ISWMC (round trip)	0.5 km
Truck speed	10 km/h
Collection time (without loading/unloading	3 min
Loading/unloading (3 min per collection point)	12 min
Total collection time	24 min < 8 hrs ✓
Note	The truck can be use approx. 6-7 hrs/day for other purposes (transport of residual waste bins to the harbour, for example). As the transfer vessel is supposed to come earliest every 5 days there should be enough time to transport the residual waste bins to the harbour

ISWMC

The Island council of Thinadhoo have not provided sufficient land for an ISWMC with biowaste treatment. Dimensioning was made for the worst case

Based on the previous assumptions (level of impurity) and considering that on the ISWMC an additional screening, sorting of the different waste streams could be undertaken the following mass balances have been developed:

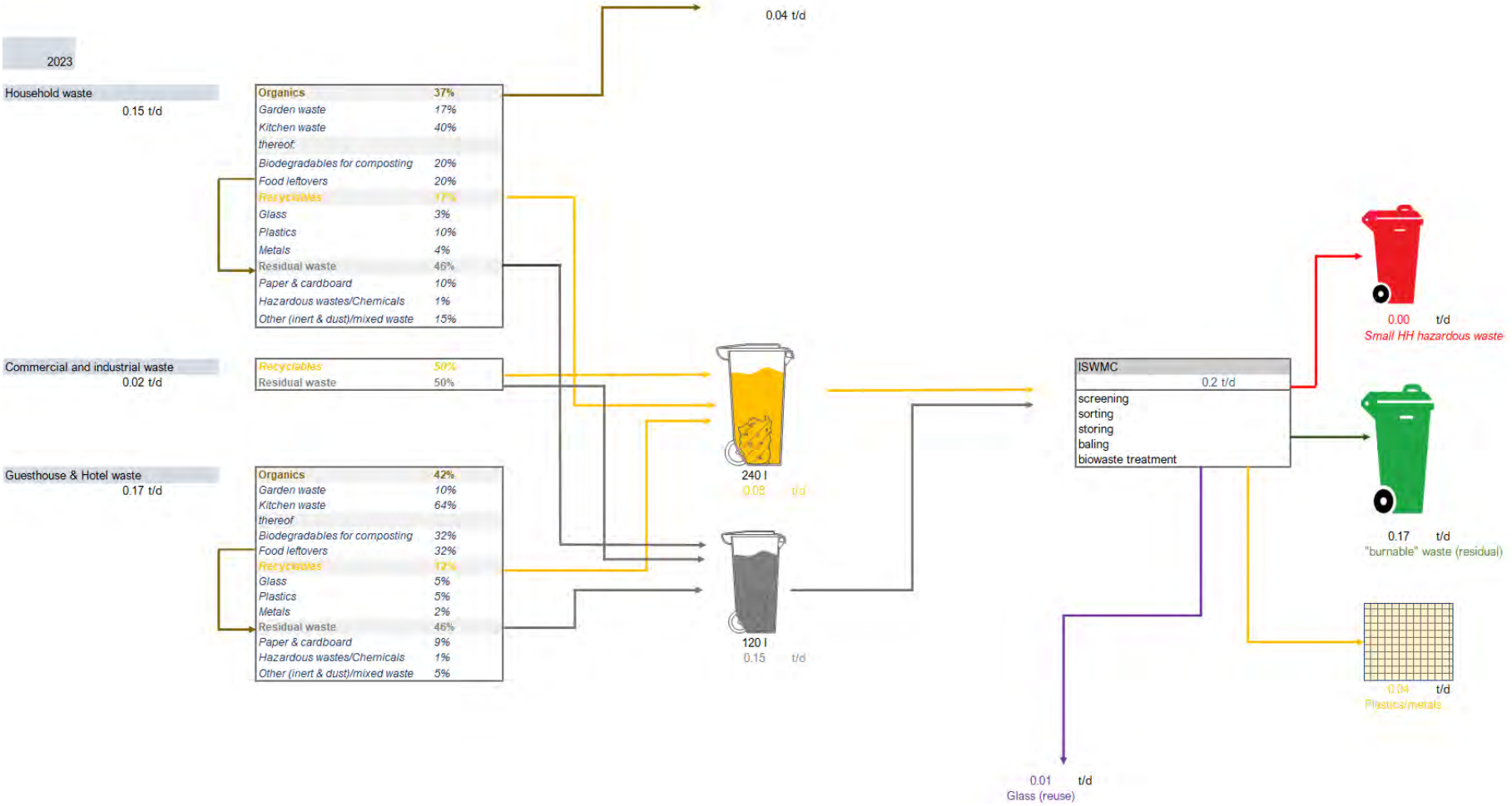


Figure 20: Mass balance 2023 at ISWMC

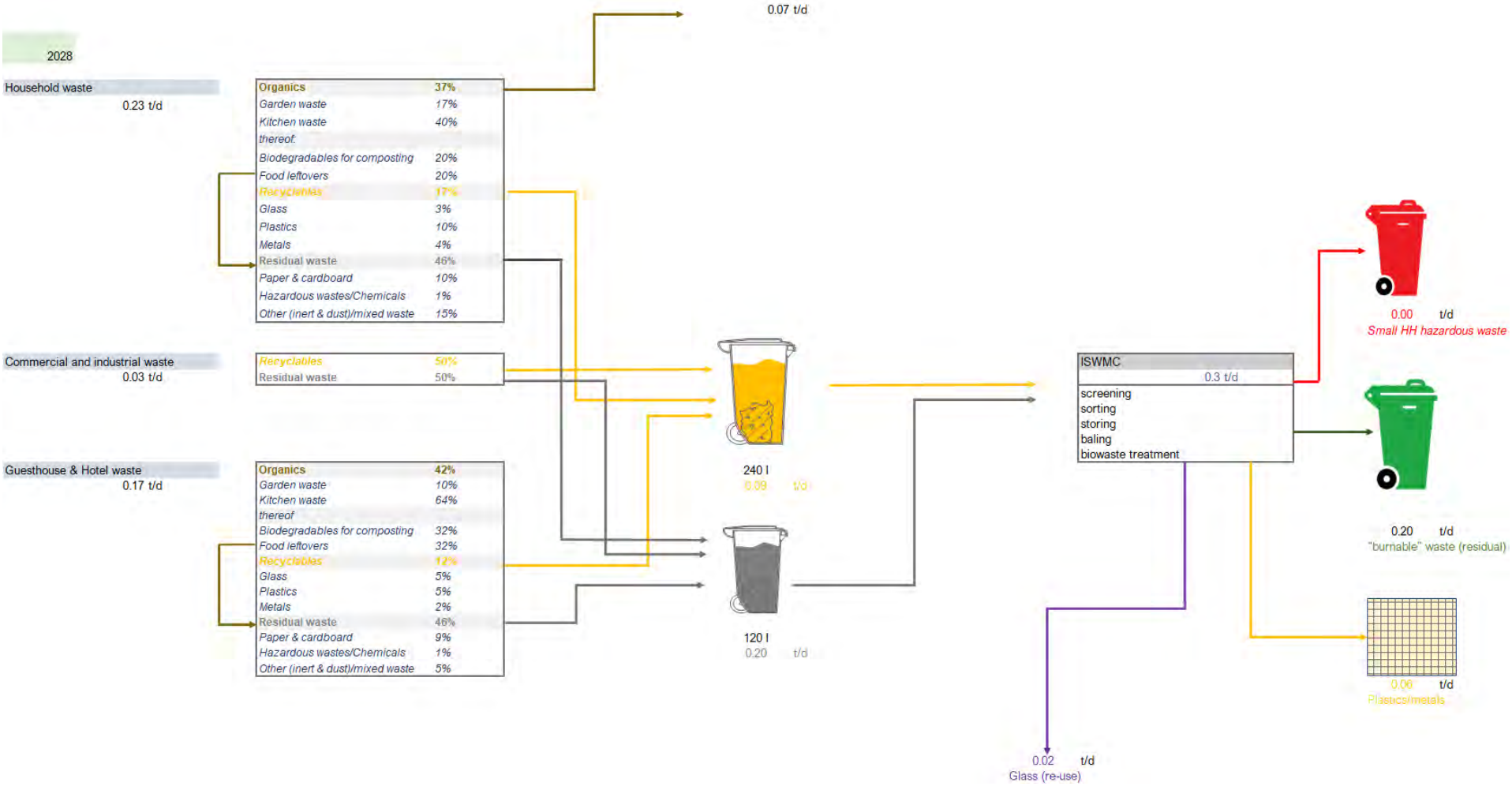


Figure 21: Mass balance 2028 at ISWMC

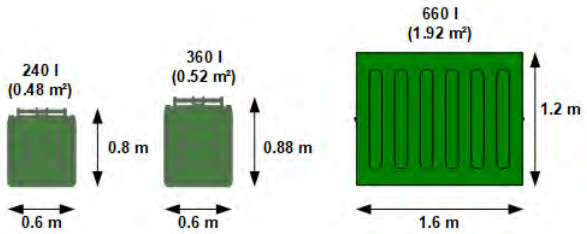
Mass balance (Thinadhoo) at and after ISWMC

Output stream	2023	2028	Destination	Frequency
Residual waste/burnable waste (with food leftover) t/d	0.17	0.20	Harbour/Thilafushi	As per optimised vessel collection frequency but not earlier than 5 days
Recyclables (plastic bales, metal can bales) (t/d)	0.04	0.06	Harbour/Thilafushi or direct to potential off takers	Periodically, depending on the capacity on the vessel (below deck)
Glass (re-using) (t/d)	<0.01	0.02	Island	N/A
Small hazardous waste (t/d)	< 0.00	0.00 (negligible)	Harbour/Thilafushi	Periodically (when dedicated bins are full)

“Packaging”/receptacles at ISWMC

Output stream	Volume/weight	Receptacle/packaging	Amount
Residual waste/burnable waste (worst case)	0.82 m³/d (0,20 t/d at a density of 0.25 t/m³)		Storage time 5 days • 17 bins (240 l) or • 11 bins (360 l) or • 6 bins (660 l)
Recyclables	0.06 t/d	Bales : bale size approx. 80 x 70 x 60 cm (L x W x H) (0.33 m³) 80 kg/bale	Approx. 1 bale/day (0.33 m³)
Small hazardous waste	< 10 kg/d	 120 l bins	5 x 120 l bins Nominal capacity: 40~48 kg/bin

Transport from ISWMC to the harbour

Truck cargo surface	4,8 m²
Bin surface	
Assumption (worst case)	All bins are filled 100%
Number of bins per trip (240 l)	11 bins
Number of bins per trip (360 l)	10 bins
Number of bins per trip (660 l)	3 bins
Number of bales per trip (capacity of the truck 1 to)	5 bales
Number of trips needed	• 240 l bins: 2 trips • 360 l bins: 1 trip • 660 l bins: 2 trips • Bales: 1 trip (in case of 5 days loading)
Average distance harbour/ ISWMC (round trip)	0.2 km
Truck speed	20 km/h
transport time (without loading/unloading)	• 240 l bins: 1 min • 360 l bins: 1 min • 660 l bins: 1 min • Bales: 1 min
Loading/unloading (1.5 min per bin at ISWMC and 1.5 min at harbour)	• 240 l bins: 21 min • 360 l bins: 21 min • 660 l bins: 21 min • Bales: 3 min
Conclusion	1 dump truck is highly sufficient for the entire collection system in Thinadhoo.

Waste transfer from harbour to waste transfer vessel

Process	1 mobile bin tipper	2 mobile bin tipper
Arrival/docking/manoeuvring	10 minutes	
Installation of mobile tipper	10 minutes	N/A
Tipping		
240 l bins (2 bins at 1 time) tipping cycle 20 s	2 min	N/A
360 l bins (1 bins at 1 time) tipping cycle 20 s	2 min	N/A
660 l bins (1 bins at 1 time) tipping cycle 30 s	2 min	N/A
Dismantling of mobile tippers and departure	10 min	N/A
Total time	~35 min	N/A

*during installation of second mobile tipper, tipping with 1st tipper can start