ENVIRONMENT IMPACT ASSESSMENT

FOR THE PROPOSED

TOURIST RESORT DEVELOPMENT PROJECT

IN MURAVANDHOO ISLAND, RAA ATOLL

May 2014

Prepared for

Ifuru Investments Private Limited

Consultant

CDE Consulting, Maldives

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List of Abbreviations

COADS	Comprehensive Ocean-Atmosphere Data Set
DO	Dissolved Oxygen
EIA	Envrionmental Impact Assessment
GPS	Global Positioning System
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
IUCN	International Union for Conservation of Nature
KWp	Kilowatt peak
MEE	Ministry of Environment and Energy
MHI	Ministry of Housing and Infrastructure
MoTAC	Ministry of Tourism, Arts and Culture
MoTCA	Ministry of Tourism and Civil Aviation
MSL	Mean Sea Level
MWSC	Maldives Water and Sewerage Company
NAPA	National Adaptation Programme of Action
NE	North East
NEAP II	National Environmental Action Plan II
NW	North West
PV	PhotoVoltaic
SAP	Strategic Action Plan
SE	South East
SW	South West
TDS	Total Suspended Solids
ToR	Term of Reference
UNFCCC	United Nations Framework Convention on Climate Change and the Kyoto Protocol

Acknowledgements

The lead author of this report is Dr. Ahmed Shaig

Additional assessments were undertaken by the following team members.

Dr. Simad Saeed (Social environment specialist)

Ms. Nashiya Saeed (Social environment specialist)

Field assistance was provided by the following members

Mohamed Nishaman (Terrestrial Environment Surveys)

Mr. Ali Moosa Didi (Surveying)

The curriculum vitae's of the EIA consultants are attached in Appendix J of this report.

Lead Consultant's Declaration

I certify that statements made in this Environment Impact Assessment are true, complete and correct to the best of my knowledge and available information.

Dr Ahmed Shaig

Proponent's Declaration

As the proponent of the proposed project, I guarantee that I have read the report thoroughly and that to the best of my knowledge all information provided here is accurate and complete.

Ahmed Waheed

Executive Summary

The purpose of this document is to fulfil the requirements to get necessary environmental clearance from the Environmental Protection Agency (EPA) to implement the proposed resort development project in Muravandhoo Island, Raa Atoll. Muravandhoo Island was initially leased for tourism in 2011 in conjunction with the proposed airport development project in Ifuru. In addition, a resort and a marina were to be developed in Madivaafaru Island. Both these islands were awarded on the condition that Ifuru Island Airport be operational before the resort opens. Ifuru airport is nearing completion and is scheduled to open in mid-2014. The proponent of this project is Ifuru Investments Pvt Ltd. The project is a joint venture between the Government of Maldives and Ifuru Investments to partly to ensure that the Ifuru airport is operation and partly to ensure that more beds are operational in Raa Atoll.

The main rationale for the project is to develop tourism in the outer atolls of the Maldives to increase the tourism bed capacity and their contribution to the local and national economic growth. Tourism development lags behinds in Raa Atoll and this project is expected to increase the speed of development in the atoll. The objective of this project is to develop and operate a five star resort on Muravandhoo Island.

The project broadly involves the development and operation of a stand-alone 200 bed resort. The proposed project covers seven main components: construction of island transport infrastructure; construction of the back-of-the-house and administrative infrastructure; construction of guest rooms; construction of guest facilities; construction of utilities – sewerage, power and water infrastructure; landscaping and; resort operations. The project is estimated to take 24 months to complete.

All project designs are in conformance to the laws and regulations of the Maldives, and relevant international conventions that Maldives is party to. The key laws and regulations applicable to this project are: Environmental Protection and Preservation Act, Decentralization Act, Tourism Act, tourism resort development regulations, Environmental Impact Assessment Regulation 2012, Waste Management Regulation, Regulation on Cutting Down and Uprooting Trees and Dewatering Regulation. Approvals have been granted for the concept by the Ministry of Tourism. Further approvals are required before construction and operations.

It is a small island approximately 485 m long and 300 m wide (at its widest point), and has a land area of approximately 9.9 Ha within low tide line in March 2014. The island is generally in pristine condition, apart from its terrestrial environment. Parts of its vegetation are mature with areas of coconut dominated forests and sub littoral thickets. Most of the coconut palms and a number of other trees have been planted. The water quality is poor. There are naturally occurring

deep areas allowing easy access to the island. Its reef condition is best on the northern side but the southern side is in moderately good condition as well.

The beach environment on the eastern and southern side is in poor condition with very limited dry beach and ongoing erosion. Severe erosion is prevalent on the Southwest areas of the island and the Northeast corner. Erosion mitigation and beach mitigation will be required.

The negative impacts from this project are typical impacts associated with resort development in Maldives. The most significant impact from this project during construction stage would be the damage to coral reef doe to over water construction activities, removal of limited vegetation, excavation and dewatering, changes to coastal processes due to coastal developments, degradation of the terrestrial and marine environment due to the worker activities, lost marine life due to overwater construction and disposal of waste. Main social impacts include potential conflicts with the atoll public if equal job opportunity is not available for construction stage or operations stage of the resort.

Negative impacts during operations stage are the impacts on marine flora and fauna due to potentially high number of vessels using the lagoon, impacts on the beach due significant erosion and accretion patterns and social impacts associated with foreign workers or general lack of opportunities.

Apart from the impacts from this project on the environment, the coastal environment itself will have a major impact on the project itself. Erosion is likely to continue and if left unprotected, it will pose challenges and economic losses for the operation of the property. Beach will have to be created artificially in some areas to use the proposed beach villas as classified. If the coastal structures are erected, it will reduce the aesthetic beauty of the island and will permanently alter the coastal processes.

The project mainly has positive socio-economic benefits, including increased direct and indirect job opportunities and tourism growth.

The key mitigation measures proposed for the construction stage include finding options to mitigate severe erosion on the island. A number of mitigation measures have been proposed in this assessment to mitigate the most significant impacts associated with the development, including reef clearance, worker activities, vegetation removal, marine construction, excavation works and utilities operation.

Alternative options were evaluated for the activities that are identified to have significant impacts on the project. Alternative options have been proposed mitigate erosion and preference has been given to shore protection and consideration to undertake beach replenishment. Alternative options assessment for beach replenishment showed that more detailed assessments

are required and additional approvals are recommended once more details are available. An alternative jetty has also been recommended on the south as the northern side may not be accessible year-round.

Consultations were held with the island councils and public of Ugoofaaru, Dhuvaafaru and Maakurathu. This project has strong support from the island communities and all site plans have been seen by the Island Councils. There is a general dissatisfaction due to the slow pace of resort development projects in the atoll.

The Environmental Management Plan (EMP) for this project is designed to produce a framework for anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions. In addition, provide evidence of compliance to legislation, policies, guidelines and requirements of relevant authorities.

Monitoring plan is designed to assess any changes to the physical environment as well as operational aspects of the resort. The total cost of mitigation and monitoring are estimated between US$15,000 per year.

The main conclusion of this report is to move forward with the proposed development after with the proposed alternatives and the suggested mitigation measures.

ސާދާ ޚުލާސާ

މި ދިރާސާ ރިޕޯޓަކީ ރ . މުރަވަންދޫ ގައި 200 އެނދުގެ ރިސޯޓެއް ތަރައްޤީ ކުރުމުގެ މަޝްރޫޢުއިން ތިމާވެށްޓަށް ކޮށްފާނެ އަސަރު ވަޒަންކުރުމުގެ ގޮތުން ތައްޔާރުކުރެވިފައިވާ އީ.އައި.އޭ ރިޕޯޓެވެ. މިމަޝްރޫޢުގެ ޑިވެލޮޕަރަކީ އިފުރު އިންވެސްޓްމަންޓްސް ޕްރައިވެޓް ލިމިޓެޑް އެވެ. މަޝްރޫޢުގެ ކޮންސަލްޓަންޓަކީ ވަރަށްގިނަ ވަކިވަކި ކޮންސަލްޓަންޓުންނެވެ. މިރިޕޯޓުގެ މައިގަނޑު ބޭނުމަކީ މަޝްރޫޢުގެ އިތުރު ބައިތަކެއް ހިންގުމަށްޓަކައި ބޭނުންވާ ތިމާވެށީގެ ހުއްދަދޭއިރު ބޭނުންވާ މަޢުލޫމާތުތައް އެންވަޔަރަމަންޓް ޕްރޮޓެކްޝަން އެޖެންސީއަށް ހުށަހެޅުމެވެ.

މިމަޝްރޫޢުގެ މައިގަނޑު ބޭނުމަކީ މުރަވަންދޫގައި ފަސް ތަރީގެ ރިސޯޓެއް ގާއިމު ކުރުމެވެ. މިގޮތުން މިރަށް ހިންގުމަށް ބޭނުންވާ ހުރިހާ ވަސީލަތްތައް ގާއިމު ކުރެވޭނެއެވެ. މީގެ ތެރޭގައި ރިސޯޓަށް ތައާރަފުކުރުމުގެ ވަސީލަތްތަކާއި، ރިސޯޓް ހިންގުމަށް ބޭނުންވާ ބެކް އޮފިސް ހައުސް ވަސީލަތްތަކާއި، ގެސްޓް ކޮޓަރިތަކާއި، ގެސްޓުން ބޭނުންކުރާ ވަސީލަތްތަކާއި، ޔުޓިލިޓީތައް ގާއިމުކުރެވޭނެއެވެ. ރަށް ހުޅުވި ނިމުމުން ރިސޯޓްގެ ގޮތުގައި ހިންގާނެއެވެ.

ތިމާވެށްޓަށް ކޮށްފާނެ އަސަރު ދެނެގަތުމަށްޓަކައި ކުރިއަށްގެންދާ ދިރާސާ ރިޕޯޓަށް ކަމާއި ބެހޭ އިދާރާތަކުން ހުއްދަ ލިބުމާއިއެކު މަސައްކަތްކުރަން ކޮންސްޓްރަކްޝަން ކަނޑައެޅި މަސައްކަތް ފަށައިގަނެވޭނެއެވެ. މިމަޝްރޫޢު ހިނގާނެކަމަށް ލަފާކުރެވިފައިވާ މުއްދަތަކީ ގިނަވެގެން 3 އަހަރު ދުވަހެވެ.

މިމަޝްރޫޢުގެ ބައިތަކެއް ރާއްޖޭގެ ގާނޫނާއި ގަވާއިދަށް ފެތެއެވެ. މީގެ އިތުރުން މަސައްކަތް ފެށުމުގެ ކުރިންނާއި ރިސޯޓް ހިންގަން ފެށުމުގެ ކުރިން ނަގަން ޖެހޭ ހުއްދަތަކެއް ވެއެވެ. އެހުއްދަތަކާއި މިރިޕޯޓްގައި ފާހަގަކުރެވިފައިވާނެއެވެ.

މިދިރާސާގައި މިސަރަހައްދުގެ މިރަށުގެ ހާލަތަށް ބަލާލެވިފައިވާނެއެވެ. މިގޮތުން ފާހަގަ ކުރެވުނު ގޮތުގައި މިރަށަކީ ގާބިލު ބަދަލުތަކެއް ގެނެވިފައިވާ ރަށެއް ނޫނެވެ. ރަށުގެ ބޮޑުމިނަކީ 9.9 ހެކްޓަރެވެ. އަދި ފަރުގެ ބޮޑުމިނަކީ 81 ހެކްޓަރެވެ. ފަރުގެ ހާލަތު އާންމު ގޮތެއްގައި ވަރަށް ރަނގަޅެވެ. އުތުރު ފަރާތުގެ ފަރުމަތީންނާއި ފަރުގެ އަރިމަތީގައި ދިރިހުރި މުރަކަ އެބަހުއްޓެވެ. ރަށަށް ތަފާތު ގޮތްގޮތުން ފަރުގެ އުތުރު ފަރާތުން ފަސޭހައިން ޖެޓީއެއް އަޅައިގެން ބޭނުން ކުރެވޭނެއެވެ. ރަށުގެ ގަސްފަރަފަ ވަނީ ރަނގަޅަށް ހުރިފައެވެ. ރަށުގައި ގިނައިން ހުރި ރުއް ރޮނގު ކުދި ސަޅިގެ ގަސް ތަކެވެ. މިރަށުގައި ގިނަ ގަސްތަކަކީ އިންދާފައިވާ ގަސްތަކަށްވުރެ ފާހަގަކުރެވިފައެވެ.

މިރަށުގެ އިރުމަތީގާއި ދެކުނުން ފަރާތުން ވަނީ ބޯއެއް ގިރާފާ ފައެވެ. އަދި މިހާރުވެސް ދަނީ ގިރަމުންނެވެ. އެހެންކަމުން މި ސަރަހައްދުތަކުގައި ރަނގަޅު ބީޗެއް ނެތެވެ. ރަށްގިރުން ހުއްޓުވުމަށާއި

މިދިރާސާއިން ފާހަގަކުރެވުނު މުހިއްމުކަންތައްތަކުގައި މިމަޝްރޫޢުގެ ސަބަބުން އަމަލީ މަސައްކަތްތަކުގެ މަރުހަލާގައި ތިމާވެއްޓަށް ކޮށްދާނެ ނޭދެވޭ އަސަރުތަކުގެ ތެރޭގައި ގަސްގަހާ ގެއްލުން އަސަރުކުރުން، ކޮންމެ ފެން ހިންދުމުގެ ފެންގަނޑު ބަހައްޓައިދެވުން ދިޔުމުގެ ފެންސަތަ އެއްބަސް، އެޖެގަރުވުން ދަތުގެ ވިސްނައުއްސުރުމެއް، ދުވަހު ކަމާބެހޭ ކާރިޔާ ނިޒާމް، ބުރަތަކުގައި އިމާރާތްތަކުރުމާއި ހަރު ސާމާނު ސާފުކުރުމުގެ މަޢުލޫމާތު ލިބިދާނެކަމުގެ ގޮތުން ވަނީ އަސަރު ކުރާނެ ސަބަބުން ސަރަހައްދުން އަސަރު ކުރާނެ ވެދާނެއެވެ. މިފަދަ އަސަރުތަކަކީ މިރިޒޯޓުގައި ބަދަލުކުރާ ތަރައްގީއާއި ތަރައްގީގެ ވަގުތީ ކުރާ ކަމެއް ކުރެވިދާނެ ކަމެއް ކަމުގައި ވަނީ ފާހަގަ ކުރެވިފައެވެ.

މަޝްރޫއުގެ ސަރަހައްދުން ދަނޑިވަޅު ބެލުމުގެ އިމާރާތުގެ ތަރައްޤީ ކުރުމަށް ދަރަޖަ ރޯމާޓީރިއަލް ކޮށް ގެއްލުމުގެ ރާވައި އެކްސް ކޮމާކީޓެވެ. މި މާއްދާތަކަކީ ދިވެހިރާއްޖޭން ގެއްލުމުގެ ވަކި ޝަރުތުތަކަށް ދަމާ ޤާނޫނީ ގޮތަކުން މެދުވެރިކުރެވޭ ކަމެވެ. މިގޮތުން ރަށްގިރާފައިވާކަމަށް މިރަށަށް ކުރާ ކަނޑަކީ ނޭޝަނަލް ގައިޑްލައިނާއި ޤާނޫނާއި ރަށްތަކުގެ ރިސޯޓު ގެއްލުމެއް ދެމެހެއްޓެނިވި ކަނޑަށް ބަލާ ކަމެއް ކުރާނެ ކަމެކެވެ.

މި ދިރާސާގައި މަޝްރޫޢުގެ ގެންދިޔުން ބަރުމަތީކަން ބެލުމަށް ވަނީ ބަލައިގަނެފައެވެ. މިގޮތުން ގޮސްދާނެ ހިމާޔަތް ކުރުމަށް ތަރުތީބުކޮށްފައި ގެނެސް ގޮތަށް ރަނގަޅު ކުރުމަށް ބަލައިގަންނަ ފަރާތްތަކަށް ބޮޑު ރިޕޯޓިންގ ޕްރޮގްރާމް ހިމެނެއެވެ. އަދި ދިވެހިރާއްޖޭގައި އިތުރު ތާޖިރުން ނުވަތަ އެކި ވަރުގެ ވަނީ ބަލާފައެވެ.

މިރިޕޯޓުގައި ބައިނަލްއަޤްވާމީ ބެލުމުގެ އިރުޝާދުތަކުގެ ދިރާސާތަކެއް ތަފާތު ފަރާތްތަކުން ދިރާސާކުރުމަށް ޢަމަލުކުރެވޭ ތަޖުރިބާގައި ދެއްވި ރިޕޯޓާއި އަދި މި ރިޕޯޓުގައި ބައިނަލްއަޤްވާމީ ކަމެއް ކުރިމަތިވެދާނެ ގޮތުގައި ޢާއްމުކޮށް ދަނޑިވަޅުތަކުގައި މަޝްރޫޢުގެ އެކި މަރުހަލާތަކުގައި މިފަދަ ކަންކަމަށް ސަމާލުކަން ރަސްމީކޮށް ބެލުމަށް ރަމްޒީ ހިފައިވާނެއެވެ. މިގޮތުން ޚާއްޞަކޮށް ރަމްޒީ ހިފައިވާ ބައިވެރިވާ ދަރިވަރުން މިރިޕޯޓުގައި ހިމަނައިވާނެއެވެ.

މި ރިޕޯޓުގައި ބިމާއިގެން ކުރާ އަސަރު މިންވަރު ކުރާނެ ގޮތް ޕްރޮޖެކްޓު ރިޕޯޓު ހުށަހަޅައިވާނެއެވެ. މި ޕްރޮޖެކްޓުގައި މަޢުލޫމާތު ދިނުމާ ކުރަނީ ވަގުތީ، ޖިންސީ ނަމަވެސް ފަރާތްތަކުގައި، ޓެކްސީން ކުރުމަށް، ރިޕޯޓު ކުރުމަށް، ކަމާބެހޭ ފަރާތްތަކުގެ ބައިވެރިވުން ގެންދާނެ ދާއިރާތަކާއި ހިމާޔަތް ދަރަޖައިގެ ބަޔާން ކުރެވިފައި ވާނެއެވެ.

މިދިރާސާގައި އުސޫލާ، ދުވާފަރު އަދި މާކުރަތު ކަމެއްސާއި ބައިނަލްއަޤްވާމީ ހިމާޔަތް ބައިވެރިވެފައިވާނެއެވެ. އަދި އެގޮތުން މާކުރަތުގެ ބައެއް ރަށްތަކުގެ ހިމާޔަތް ގޮތަށް ޤަބޫލުކުރެވެއެވެ. މިމަޝްރޫޢަށް މިރަށް ރަށުގެ ރައްޔިތުންގެ ތަރައްގީ ވަރަށް ބޮޑެވެ.

މިމަޝްރޫޢު މުރަވަންދޫގައި ކުރިއަށް ގެންދާނަމަ މި މަޝްރޫޢުގެ ސަބަބުން ރަށުގެ ވެށްޓަށް ބަދަލުތަކެއް އައުން އެކަށީގެންވެއެވެ. އެހެންނަމަވެސް މިދެންނެވި އަސަރުތައް ކުޑަކުރުމުގެ ގޮތުން ފާހަގަކުރެވިފައިވާ ކަންކަމަށް ސަމާލުވެ މަޝްރޫޢު ކުރިއަށް ގެންގޮސްދިނަމަ ދެންނެވިފަދަ ބަދަލުތަކުގެ ސަބަބުން ކުރާ ނުރައްކާ އަސަރުތައް ވަރަށް ބޮޑަށް ކުޑަކުރެވިދާނެއެވެ. އެހެންކަމުން މަތީގައި ދެންނެވި ބަޔާންކުރެވިފައިވާ ކަންކަމަށް ރިޢާޔަތްކޮށް ބަލާއިރު ޖުމްލަގޮތެއްގައި މިމަޝްރޫޢުއަކީ ރ. އަތޮޅު ތަރައްޤީވުމަށް ނުހުރަސް ފައިދާ ހުރި މަޝްރޫޢެކެވެ.

1 INTRODUCTION

1.1 Purpose of the EIA

This Environment Impact Assessment (EIA) report is an evaluation of the potential environmental, socio-economic and natural impacts of the proposed resort development project in Muravandhoo, Raa Atoll. Muravandhoo is an undeveloped uninhabited island leased for resort development.

This document is submitted by the proponent to EPA to fulfil the requirements for an EIA under Article 5 of the Environment Protection and Preservation Act (4/93). The EIA Regulations 2012 has been used as the basis for preparing this document.

This report provides the background to the proposed project components as well as an assessment of their likely environmental and social impacts, both beneficial and adverse. The proposed enhancement and mitigation measures are outlined where necessary together with an environment management plan and a monitoring programme.

1.2 Project Proponent

The proponent of this project is Ifuru Investments Private Limited. Ifuru Investments is a company formed in 2011 to develop the Ifuru Airport in Raa Atoll and associated hotel and resort developments in Raa Atoll. Mr. Ahmed Waheed, G. Vaffushi, Male', is the majority shareholder and the Government of Maldives is a minor shareholder of the company. The projects currently in planning or development stages under Ifuru Investments are R. Madivaafaru resort development project, R. Ifuru airport development project and R. Ifuru airport hotel development project.

1.3 Project background and rationale

Development of tourism in all atolls of the Maldives has been the priority of the Maldivian Government over the last twenty years. However, development of resorts and hotels in Raa Atoll has lagged behind the new developments in atolls such as Baa, Lhaviyani and Noonu Atolls. Muravandhoo Island is one of the few resorts/hotels planned in Raa Atoll.

Muravandhoo Island was initially leased for tourism in 2011 in conjunction with the proposed airport development project in Ifuru. Both these islands were awarded on the condition that Ifuru Island Airport be operational before the resort opens. Ifuru airport is nearing completion and is scheduled to open in mid-2014.

The project is a joint venture between the Government of Maldives and Ifuru Investments to partly to ensure that the Ifuru airport is in operation and partly to ensure that more beds are operational in Raa Atoll.

The benefits of tourism to the development of the surrounding local economies and standard of living are well documented in other parts of the Maldives. Its benefits to the Raa Atoll population, along with the existing resorts, are expected to be substantial.

The lease of Raa Island is consistent with the Third and Fourth Tourism Master Plan which stipulates incremental increase in bed capacity for the Southern region. The amounts of beds allocated still lags behind the Master Plan.

1.4 Project Scope Summary

The project mainly involves the construction and operation of a stand-alone 200 bed (100 rooms) resort island.

The proposed project covers nine main components:

1. Construction of island transport infrastructure
2. Construction of the back-of-the-house and administrative infrastructure
3. Construction of guest rooms
4. Construction of guest facilities
5. Construction of utilities – Sewerage, power and water infrastructure
6. Landscaping
7. Resort operations

See Project Description chapter for more details.

1.5 Aim and Objectives

The aim of this project is to develop and operate a five-star tourist resort on Muravandhoo Island, Raa Atoll. The specific objectives are:

1. Development of the necessary infrastructure for the functioning of a stand-alone 200 bed resort island.
2. Operation of a 5 star rated resort island.

1.6 Consultants, Contractors and Government Institutions

All the EIA related work is undertaken by consultants from CDE Consulting. Design criteria and technical specifications have been developed Group X Private Limited. The contractor has not been identified at the time of submission of this report.

The project contractor has not been finalised yet.

The project is financed by private equity and bank loans. The project is executed by Ifuru Investments Private Limited.

The Government agency relevant to this development is Ministry of Tourism.

1.7 EIA Scope and Terms of Reference

The scope of this EIA is broadly based on the EIA Regulations 2012. The assessment more specifically adheres to the Terms of Reference (ToR) issued by the Environmental Protection Agency on 24 February 2014. The ToR is based on scoping meetings held between the stakeholders on 19 February 2014. A copy of the ToR is attached in Appendix A.

The EIA report contains the following main aspects:

- A description of the project including the need for the project, how the project will be undertaken, full description of the relevant parts of the project, methodology used in the assessment, implementation schedules, site plans and summary of project inputs and outputs *(Chapter 1 and 2).*
- A description of the pertinent national and international legislation, World Bank safeguard policies, regulations and policies that are relevant and applicable to the project and a demonstration of how the project conforms to these aspects *(Chapter 3).*
- Information about the exiting baseline environmental conditions of the site. These include coastal and marine environment of the site and natural hazard vulnerability of the site *(Chapter 4).*
- An assessment of the potential impacts during both construction and operational stages of the project as well as identification and cost of the potential mitigation measures to prevent or reduce significant negative impacts during both construction and operation stages of the project *(Chapter 5 & 6).*
- Assessment of alternatives for the proposed project *(Chapter 7)*
- Environment Management Plan (Chapter 8)
- Details of the environmental monitoring plan *(Chapter 9).*

- Potential gaps in information *(Chapter 10)*
- Main conclusions (Chapter 11)

1.8 Assessment Methodology

1.8.1 General Approach

This EIA is broadly guided by the EIA Regulations 2012.

This report has been prepared to ensure that the significant environmental and social impacts of the proposed project at the preconstruction, construction, operation and demobilising stages have been considered and assessed at the project planning phase.

The process followed in the preparation of this EIA report consists of six parts. These are: scoping consultations; literature review; field surveys; stakeholder consultations; analysis of results; and compilation of the assessment in the form of a report.

In order to conduct a broad based and inclusive study, the proponent and the consultant have from the onset ensured the exercise is participatory. As such, discussions have been held with community members in the projects area and relevant stakeholders with the assistance and coordination of the proponent.

1.8.2 The Study Area

The area impacted by projects like these can be quite wide particularly when the socio-economic impacts are considered. The study area of this project considers that the entire island and reef system of the island will be affected by the development and that the nearby inhabited islands will experience the bulk of the socio-economic change.

Based on the results of the initial scoping of potential environmental impacts and the identification of sensitive aspects of the environment we have identified the following geographical areas likely to be affected at the various stages of the Project:

- During construction temporary and permanent impacts will occur primarily on Muravandhoo Island and its reef system. The most direct physical impact will be on-site in the area of the actual physical interventions, particularly the vegetation removals areas, over water construction and the suggested alternative reef entrance. To ensure the impacts are fully covered the entire island environment system is studied.
- During operation of the resort most impacts will be confined to the area that will be affected by construction impacts.

– There will also be induced development impacts due to the project, mainly in the form of positive socio-economic benefits to the nearby islands, atoll and region.

Study area boundary is presented in Figure 1.1 and survey locations map for the project is attached in Appendix F.

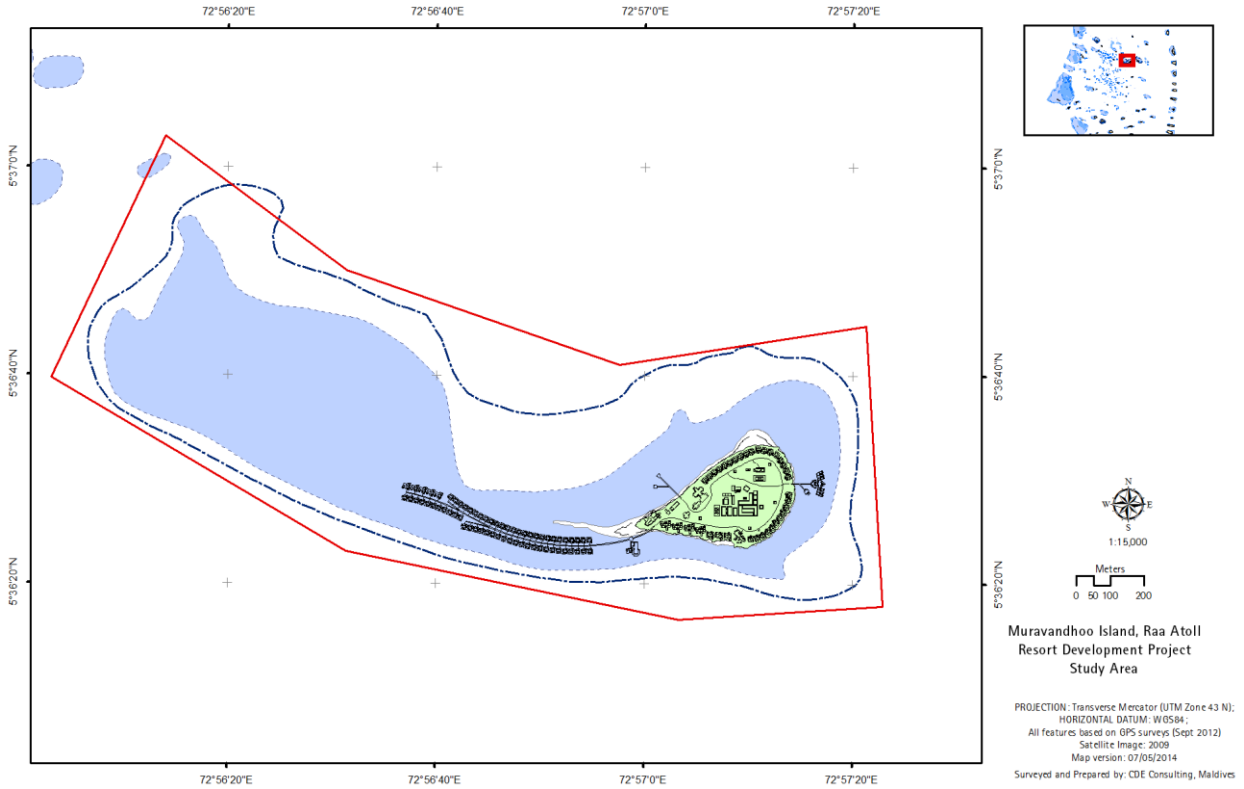


Figure 1.1: Study Area boundary

1.8.3 Field Observations

Field assessments were undertaken in Muravandhoo Island between 10 and 15 March 2014. Field visits mainly covered vegetation, water quality, fauna and soil assessment of the proposed project sites. In addition, public and stakeholder consultations were carried out in nearby islands, specifically for this EIA.

Coastal Processes

Beach profiles were taken from designated locations around the island using standard levelling techniques. These profile locations are marked in Appendix F. The measurement of beach profiles involves standard practice of surveying with a staff and a dumpy level. Measurements were taken along the beach profile line at different intervals, wherever there occurred a distinctive morphological feature, such as beach ridge, high water mark, an erosion scarp, dip, rise, or other significant break in the beach slope up to a minimum distance of 30 m from the Benchmark. Other beach attributes such as beach rock were marked using handheld GPS.

Lagoon currents were measures using drogue method. About 3 measurements were undertaken from every site and an average value is determined.

Tide data has been taken from Male' International Airport Tide Gauge.

Wave patterns have been estimated using secondary studies and visual field assessments.

Terrestrial Flora and Fauna

Terrestrial fauna was not surveyed in detail as the occurrence fauna was found to be minimal during the brief survey period.

The main methodology used for vegetation assessment was vegetation transect method and remote sensing. The vegetation transect method involves recording the species and their abundance along specific lines across the island. There were a number of footpaths across the island, which made the assessment relatively easy. Transects are used mainly to record species abundance and occurrence.

The second method used was remote sensing technology. A high resolution satellite image was used to classify the island vegetation. An extensive grid of ground truthing data (see Figure 1.2) were established and manual classification was carried out based variations in colour band combinations. The classification system used was devised for small coral islands by CDE Consulting and has been tested in other similar assessment.

The initial imagery used was Landsat 7 ETM + dated 21 June 2001 and Quickbird Imagery Standard dated 14 February 2014. Image accuracy for Landsat 7 was 30 m and Quick bird was 6.5 m and is delivered radio-metrically and sensor corrected. Landsat 7 ETM+ images are have quite a low resolution were found to be inadequate when dealing with small coral islands. It is also outdated considering the changes on the island. However, it does have an Infra-red layer which is very efficient in detecting variations in vegetation cover. Quickbird images on the other hand have much higher resolution suitable even for manual classification in a small land area. Hence, Landsat Image was used for preliminary classification and as a cross check for visual classification using Quickbird images. Although the Landsat 7 image is out-dated, it is still valuable is determining the forestry areas due to relatively minimal changes on the island during this period. New vegetation growth was mapped using GPS and ground truthing.

The band combinations used for Quickbird is 4-3-2 which provides good contrast to vegetation colour.

The images itself has an error of 2.4 m. Manual measurements can reduce the accuracy significantly depending on the vegetation classes used. The specified classes for this assessment (see the following sections) ensured that these errors were kept to a minimum by using

identifiable classes. Error levels for coconut groves and coastal vegetation particularly strand vegetation are very low with a confidence level of over 90%. Error Levels for mixed vegetation are high with confidence level around 70%. The ground truthing grid data is used partly as manual training data. The team which undertook this assessment has experience in mapping other coral islands which also reduces the interpretation errors significantly. The goal for this assessment is not to give an exact classification but to provide a crude estimate of the entire vegetation system. This method is to some extent better than the limited transect data method currently used in the EIAs of Maldives. The error levels for this exercise are well within acceptable range for the objectives at hand.

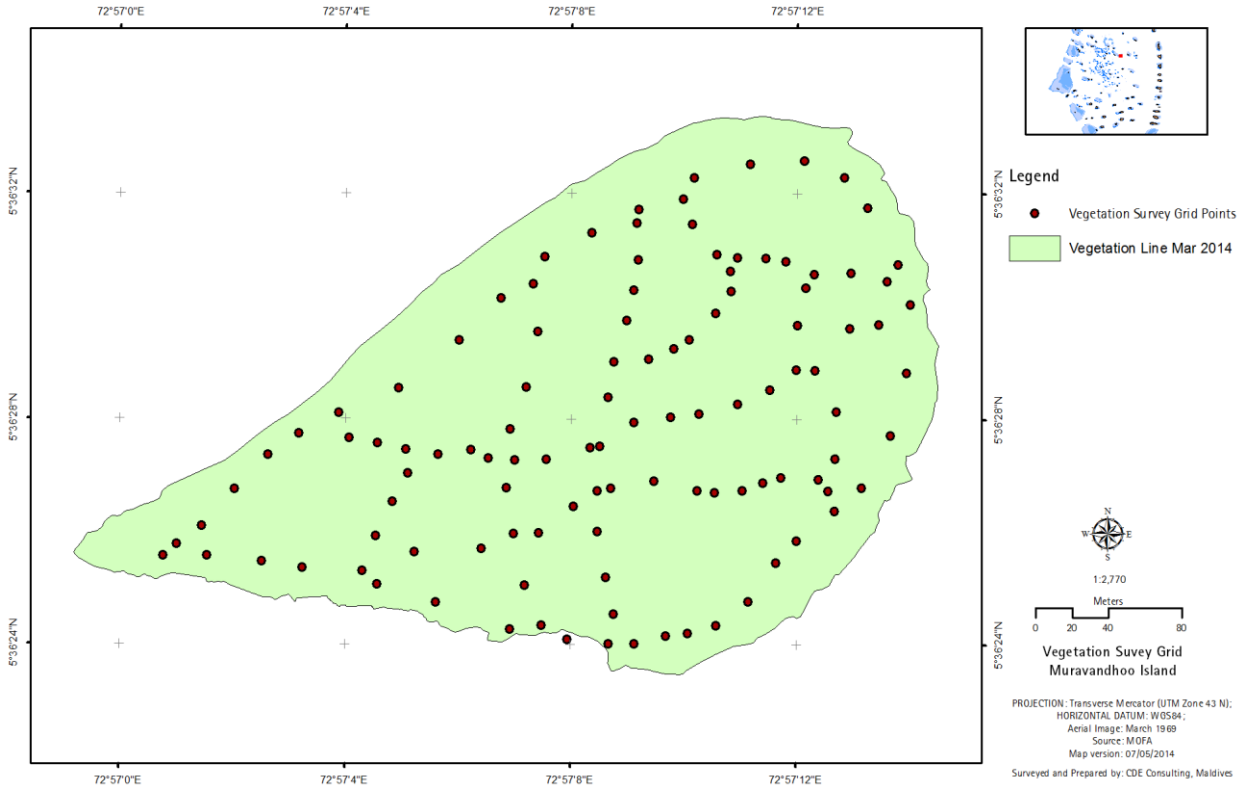


Figure 1.2: Ground truthing data grid

Marine Assessments

Manta tow survey

Manta tow survey was conducted to determine the general benthic cover and reef condition along the study area. A snorkeler (observer) was towed behind a slow moving boat, along the reef edge for a series of set periods of 2 minutes. At each stop the observed noted down the estimate percentage coverage of live corals, dead corals, dead corals, sand/silt and rubble along the tow area. The GPS coordinates were recorded at the start and end of each new tow.

Line Transect Survey

A 50m transect line was deployed at four sites as shown in Appendix F. The observer swam across this line noting down the percentage cover of benthic substrates hard coral (Scleractinia), soft corals (Alcyonacea), rock, rubble, sand and algae at 5 m intervals of the line including 2.5 m area on either side of the centre line. Mean percentage cover for each benthic substrate was then calculated for the transect line. Two replicates were done at each survey location.

The aim was to conduct a fish census and determine the benthic composition at these sites.

The benthic composition of the substrate was assessed by taking ten high-resolution images every 5 m (pictures covering 0.5m2 of the seabed) along the same transect line used for the fish surveys. These were later analysed using CPCe. CPCe, or Coral Point Count with excel extension, developed by the National Coral Reef Institute, is software designed to determine coral community coverage and diversity using transect photographs. Underwater photographic frames are overlaid by a matrix of randomly generated points, and the fauna/flora of species or substrate type lying beneath each point is identified. 20 random points per picture were analysed to characterize the substrate composition (sample size: 200 points per transect).

Fish census

Fish census was carried at each line transect survey location. All fishes observed along 50 m belt transect at each site was recorded and their abundance recorded as follows: Single (1), Few (2-10), Many (11-100) and Abundant (>100).

Timed swim

Timed swim carried out at three locations, to qualitatively determine the benthic substrate composition at these locations. Swims were timed at 5 minutes, during which two observed swam across the site noting down the main benthic substrates, seagrass and coral species observed. Three replicate swims were made at each site.

Water Quality

Water quality was assessed from MWSC laboratory. Water quality samples were taken at different locations selected based on proposed developments. Parameters measured include electrical conductivity, total dissolved solids (TDS), salinity, pH, temperature, and dissolved oxygen (DO). Nitrates, nitrites and phosphates were analysed at the Public Health Laboratory which uses methods prescribed in “Standard Methods for Examining Water and Wastewater”. Samples were collected in clean 1.5L PET bottles after washing them with the water to be sampled. Water samples were collected at mid depth. Biological samples were collected in sterilized 100 ml glass bottles provided by the Public Health Laboratory.

Flora

Vegetation cover around the project sites were assessed using the Transect Method, where an observer documents the number, species and approximate height of the trees on the left and right of a transect line. Two transects surveys were conducted: one on each of the roads that run through the wetland basin.

Fauna

Faunal species were observed and recorded as specific types with the observations spanning for a 12 hour period during the surveys.

Soil Condition

Soil conditions at the sites proposed for excavation were assessed by manually excavating the hole and analyzing the profile. No chemical analysis was undertaken.

1.8.4 Desk Study Review

A literature review was conducted to acquire background information on the site and its environment as well as to identify possible environmental impacts of similar developments in island settings. In this context, the EIA Regulations 2012, best practices from similar development activities, scientific studies undertaken in similar settings around Maldives and previous documents/historical publications was considered.

The literature review comprised of, but is not limited to, the following:

- The detailed studies undertaken of Madivaafaru and Muravandhoo Island during island scoping study for resort development conducted by CDE Consulting for GMR Airports Limited.
- Terrestrial Ecosystem monitoring Study for North Province
- EIA for airport development in R. Ifuru
- EIA for resort development in R. Maamgili
- Island development plans of Ugoofaaru and Dhuvaafau.
- Master plan concept submitted by the proponent to Ministry of Tourism.
- Relevant regulations, including Tourism regulations, dredging and reclamation regulation, Dewatering Regulation and Regulation on cutting down and uprooting trees.

1.8.5 Public Consultation

Public consultations were carried out in Ugoofaaru, Dhuvaafaru and Maakurathu.

1.8.6 Key Stakeholder Consultation

Stakeholder consultations were undertaken with the following stakeholders:

- EPA
- Island Council of Dhuvaafaru
- Island Council of Ugoofaaru
- Island Council of Maakurathu
- Ministry of Tourism
- The proponent

1.8.7 Data Analysis

The EIA experts used their experience and knowledge in their respective fields to analyse the data from the previous studies and field visits in order to determine the potential impacts of the proposed projects, the severity of effects arising from these impacts and how any adverse impacts can be best mitigated and positive impacts enhanced. This analysis provides the framework for the recommendations on corrective actions and remedial measures and provides the basis for the formulation of the environmental management plan which forms part of this repo EIA

1.8.8 Report Format

The report format and structure presented here follows the report formatting guidelines issued by EPA.

1.9 Study Team Members

The team members of this EIA are:
Dr. Ahmed Shaig (EIA and coastal environment Specialist)
Mr. Mohamed Faizan (Marine Environment Specialist)
Mr. Mohamed Ali (Marine Environment Specialist)
Mr. Ali Moosa Didi (Terrestrial surveying and bathymetry)
Mr. Ali Nishaman (Terrestrial environment specialist)
The curriculum vitae's of the EIA consultants are attached in Appendix J of this report.

2 PROJECT DESCRIPTION

2.1 Project Location

Muravandhoo Island is located within the atoll lagoon of Raa Atoll at approximately 72°58'10"E and 5°36'36"N (see Figure 2.1). It is a small island approximately 485 m long and 300 m wide (at its widest point), and has a land area of approximately 9.9 Ha within low tide line and 8.3 Ha within vegetation line in March 2014 (see Appendix G). The island is about 172 km from the Male'. It's nearest inhabited islands are Ugoofaaru (10.4 km), Dhuvaafaru (9.7 km) and Maakurathu (9.5 km). The nearest resort in operation is Meedhupparu Island (17 km). The nearest airport is Ifuru Island about 13.2 km north east of the island, which is scheduled to open in 2014.

The nearest sensitive environment is 5 km south in Gemanaa (See Figure 2.2).

2.2 Project Outline and Project Site Plan

The proposed project involves the development and operation of a resort island in Muravandhoo Island. The resort is expected to be developed as an all-inclusive development where all the infrastructure and guest services are provided on the island. The guest rooms will be developed both on land and over water on stilts. All guest facilities, services and back-of-the-house areas will be constructed on land. The proposed concept plan is presented in Appendix B. A Reduced version of the concept plan is provided in Figure 2.4 below.

The proposed project covers ten main components:

1. Construction of island transport infrastructure
2. Construction of the back-of-the-house and administrative infrastructure
3. Construction of overwater and land based guest rooms
4. Construction of guest facilities
5. Construction of utilities – sewerage, power and water infrastructure
6. Landscaping
7. Resort operations

Details of the proposed project components are outlined in the next section. The project boundary and estimated impact zones are identified in Figure 2.5 below.

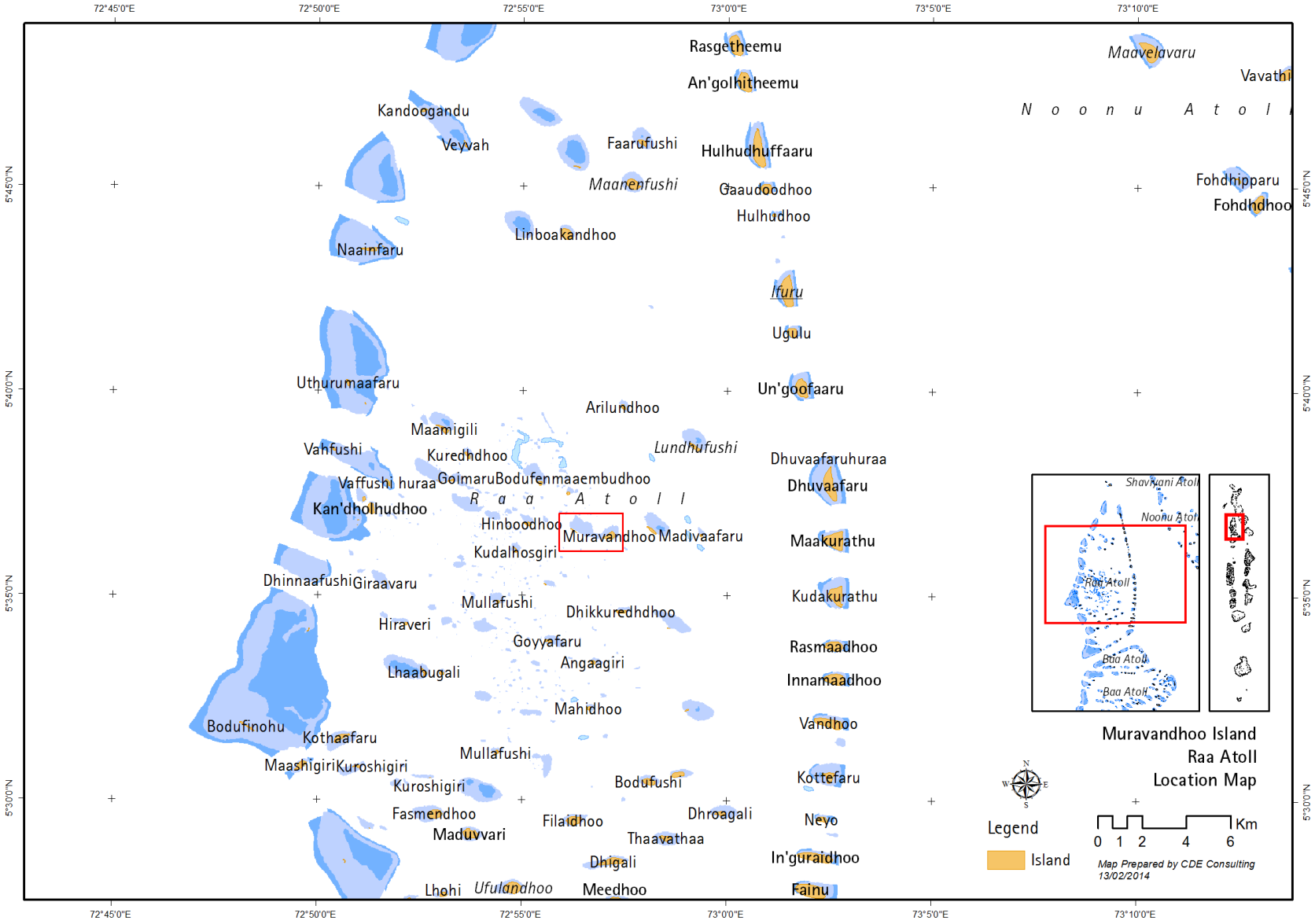


Figure 2.1: Location of proposed project site

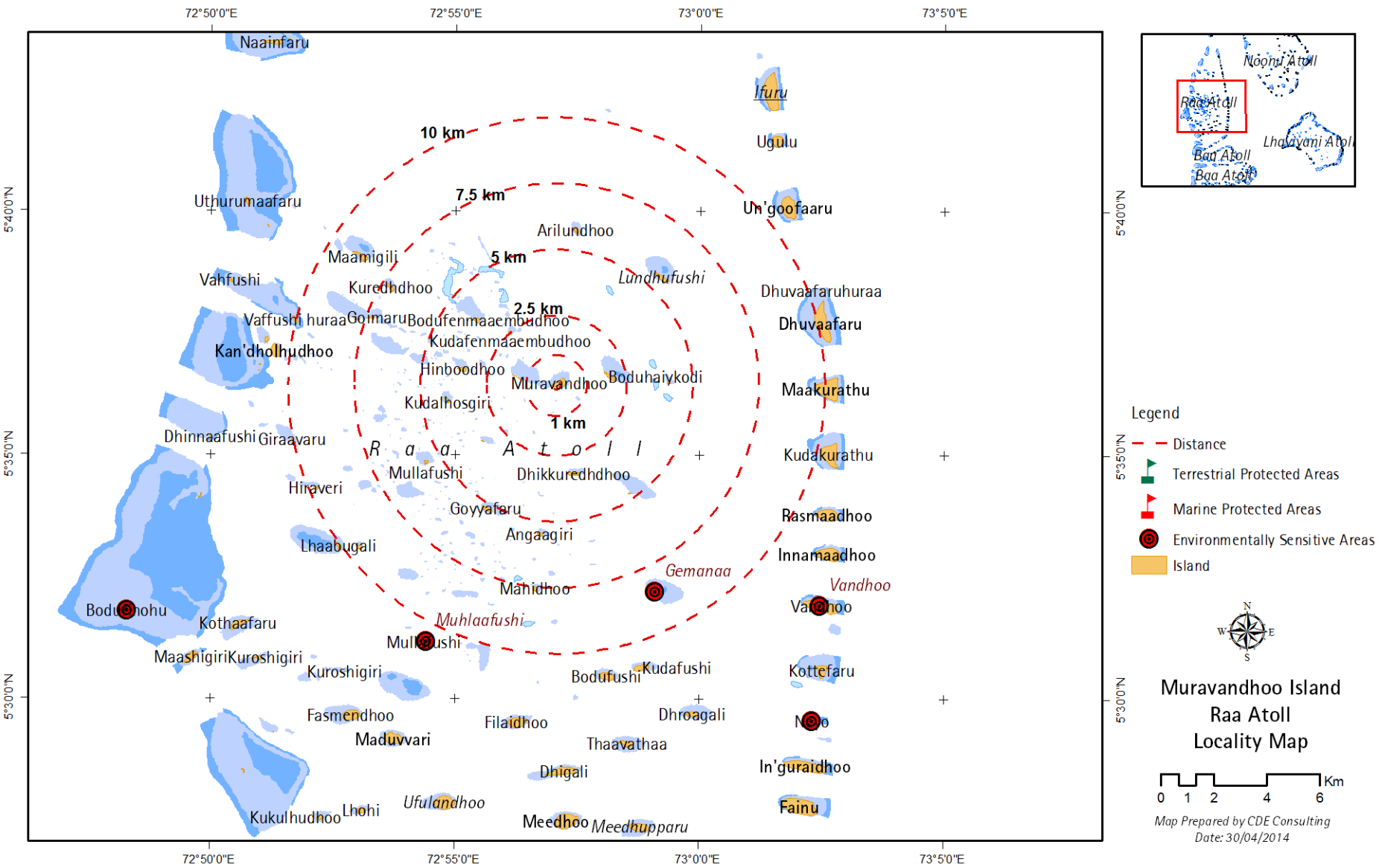


Figure 2.2: Nearby sensitive areas of the proposed project site

Figure 2.3: Satellite Image

Figure 2.4: Site Plan Summary

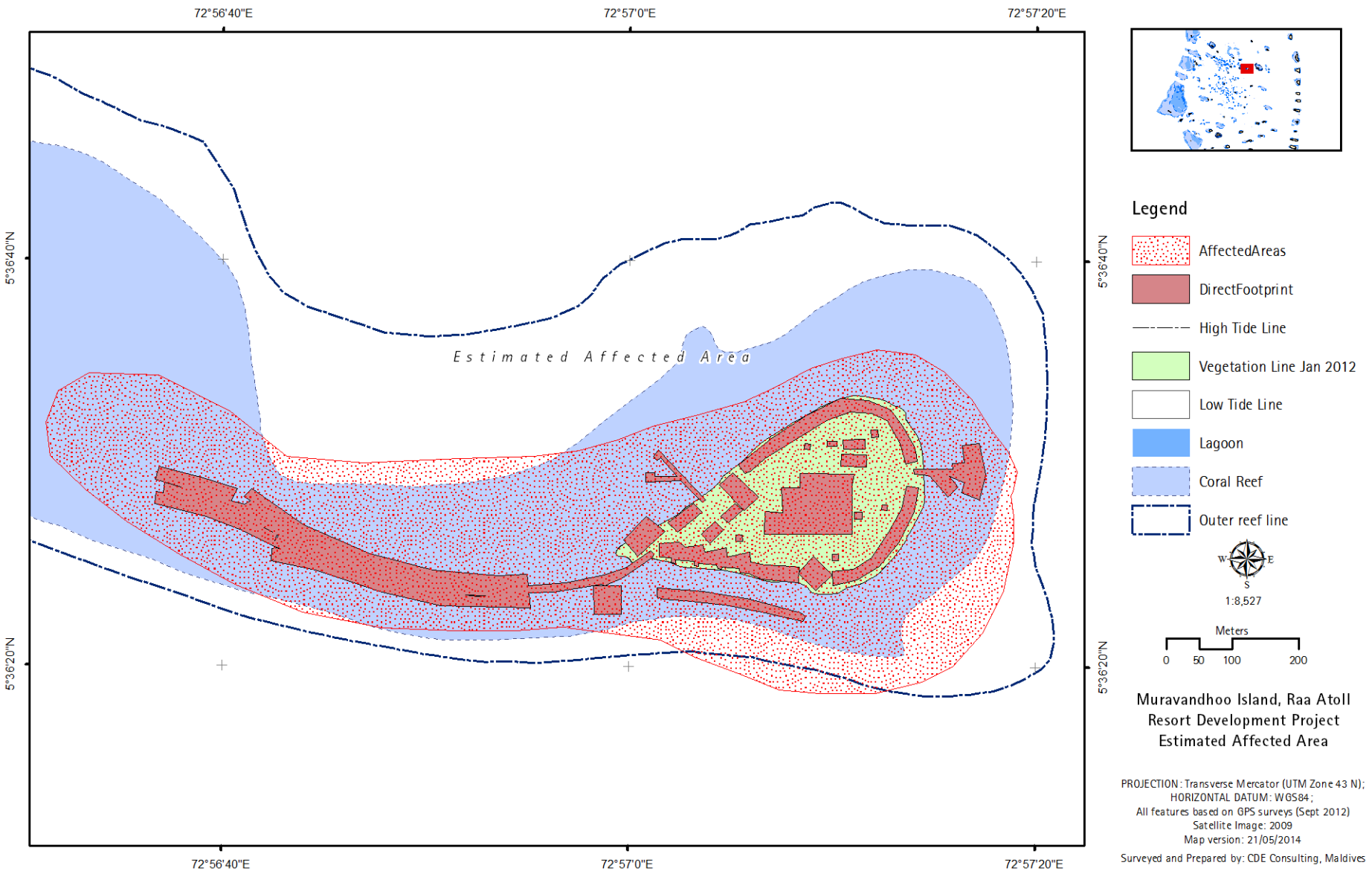


Figure 2.5: Project Boundary and Estimated Affected Zone

2.3 Detailed Project Outline

2.3.1 Island Transport Infrastructure

2.3.1.1 *Main Access Jetty*

The main access jetty will be located on the northern side. The jetty will have two arms, one for passenger use and one for service jetty. The passenger arm will be about 100 m long and the service arm will be 50 m long. Both will be located in the deep water area and will be constructed on stilts.

2.3.1.2 *Sea plane landing area*

The primary method of transporting guests to Muravandhoo is expected to be by air transfer, particularly through the Ifuru domestic airport.

However, on certain occasions, direct sea plane transfers may also be undertaken. There are two options available for creating a sea plane transfer platform: (i) a standalone floating pontoon in the deep lagoon or; (ii) a pontoon attached to the island access jetty. No decision has been reached on the option yet as it depends on the approval from Department Civil Aviation to install and operate a floating pontoon, and the specific sea plane operator. At present it is assumed that a standalone floating pontoon will be used and that Trans-Maldivian/Maldivian Air Taxi will be used as an operator.

Construction of the standalone platform mainly involves placing a 14 x 32ft floating pontoon anchored to the lagoon bottom. Details of the platform and anchoring details are provided in Figure 2.6.

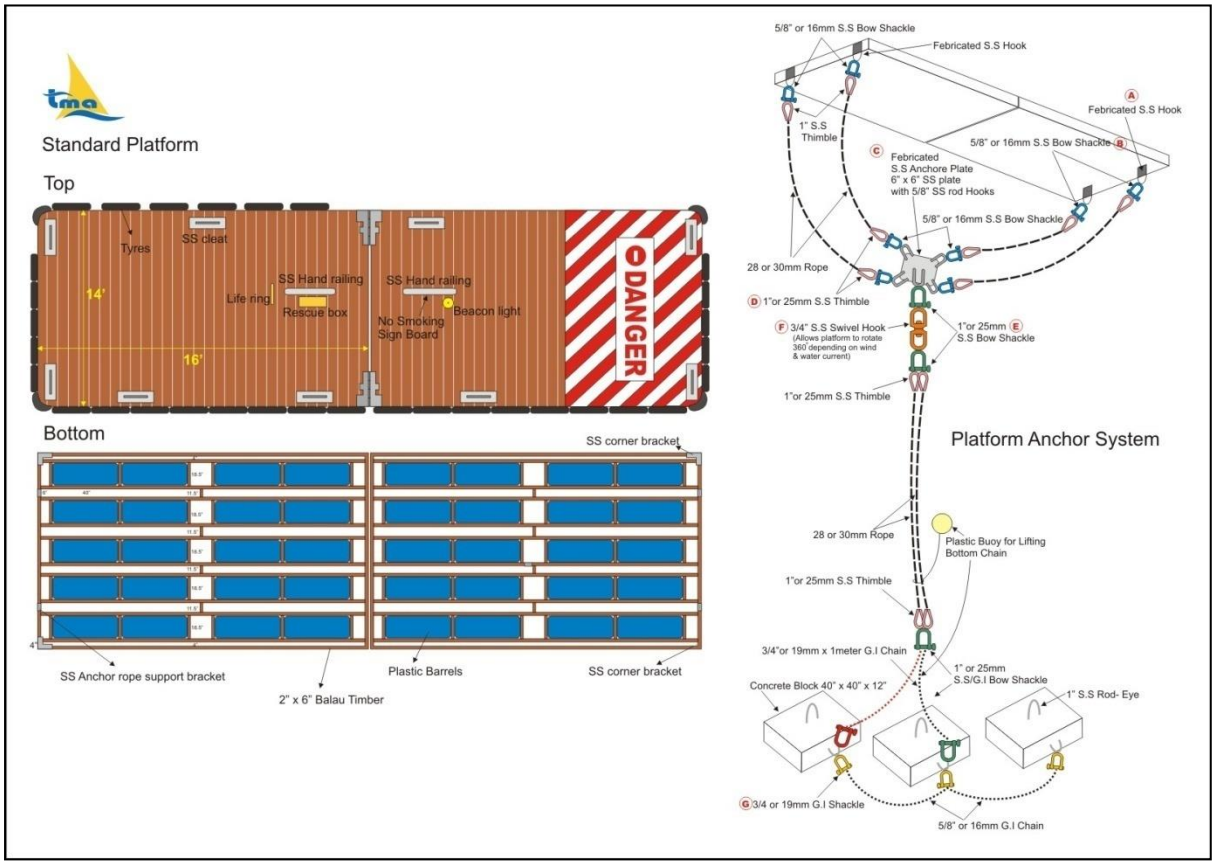


Figure 2.6: Seaplane platform design

2.3.1.3 *Footpaths*

Footpaths will be developed across the island. Approximately 1.8 km of footpaths will be developed. The main footpath will be about 4 m wide and will be developed as a ring road on the land side of the beach villas and around reception area. Smaller paths approximately 2 m wide will be developed for access to the rooms. Trees will be removed to create the footpaths but new trees will be transplanted on the sides of the footpath during landscaping.

2.3.1.4 *Water Villa Access Jetty*

A 800 m access jetty will be developed to access the Water Villas. The jetty will be 2.4 m wide to facilitate one-way golf buggy movements. Construction will involve concrete piles on foundations. The top structure will be constructed using treated wood. Empty service areas have been left every 200 m for housekeeping purposes.

2.3.1.5 *Access to the island*

It is planned to use the existing deep areas on the northern side of the island for access. This area has depth ranging between -2.5 to -3.0 m MSL. It is not proposed to undertake any dredging at this stage. However, some corals may have to be removed manually for safety reasons.

2.3.2 Back-Of The-House and Administrative Infrastructure

2.3.2.1 *Staff Accomodation ans Servics*

The staff complex and the back-of-the-house area are located around the centre of the island. The general staff complex comprises of a two-storey building with 30 rooms in each floor. Each room will have accommodation for up to 3-4 persons with an attached toilet.

There will be two two-storey buildings for the senior staff. The first floor will contain 14 rooms, each with two beds. The ground floor of these buildings will contain the stores.

There will also be three two-storey buildings for the executive staff, each with three rooms.

There will be a separate building for the general manager.

The mosque is located to the next to the staff blocks and includes ablution areas.

The staff services building will house the staff restaurant, kitchen, laundry, TV room, gym, library and poolroom.

2.3.2.2 *Administrative Building*

The administrative building is a separate L-shaped two-storey building located within the back-of-the-house area. It will house all the administrative facilities on the first floor and the laundry, dry stores, F&B and housekeeping offices.

2.3.2.3 *Service Centre*

The service center will house the desalination plants and power plants.

The engineering building will house the engineering office, relevant stores and workshops.

2.3.2.4 *Reception*

The reception building will be a single storey building located on the eastern side of the island near the arrival jetty. The portico at the entrance leads to the reception area with reception desks and lobby. Boutiques and a library will also be located in the building, in addition to the front office facilities and luggage storage area.

2.3.3 Guest Accommodation

2.3.3.1 *Beach Villas*

The Beach Villas are located along the northern (17 units) and southern (13 units) shoreline. They are constructed as two-storey units covering 76.25 sq m. Each unit includes one bedroom, attached bathrooms with bathtub, living areas, open sun deck, dining areas, entry courtyards and an open balcony (See figure 2.7). Each unit also has an attached swimming pool.

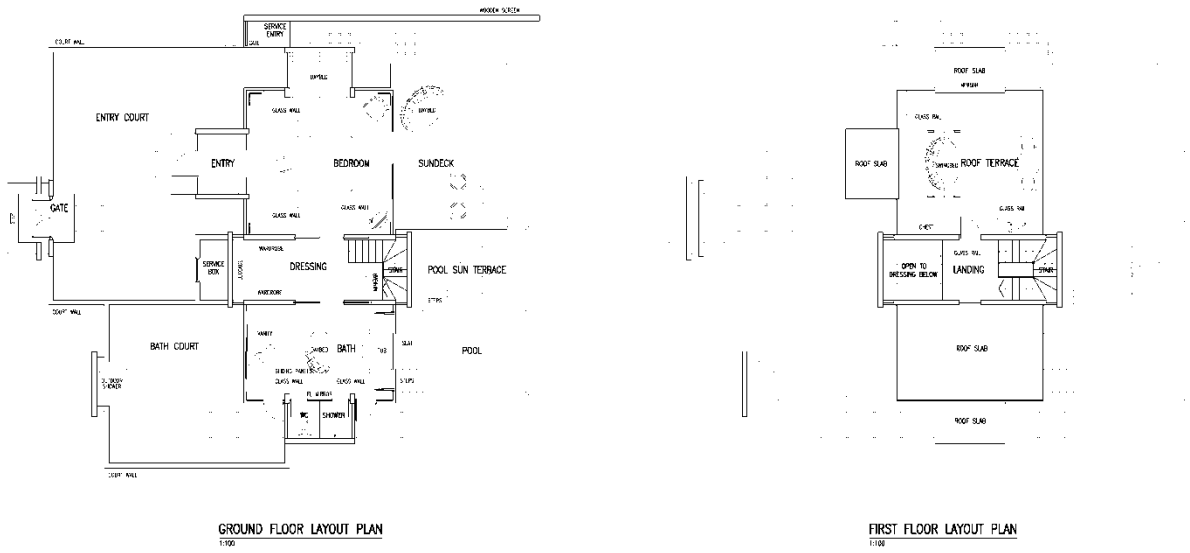


Figure 2.7: Layout of the proposed beach villa

2.3.3.2 *Beach Suite*

The Beach suites are located along the southern shoreline and will have 5 units. They are constructed as two-storey units covering 109.68 sq m. Each unit includes one bedroom, attached bathrooms with bathtub, living areas, open sun deck, dining areas, entry courtyards and an open roo terrace (See figure 2.8). Each unit also has an attached swimming pool.

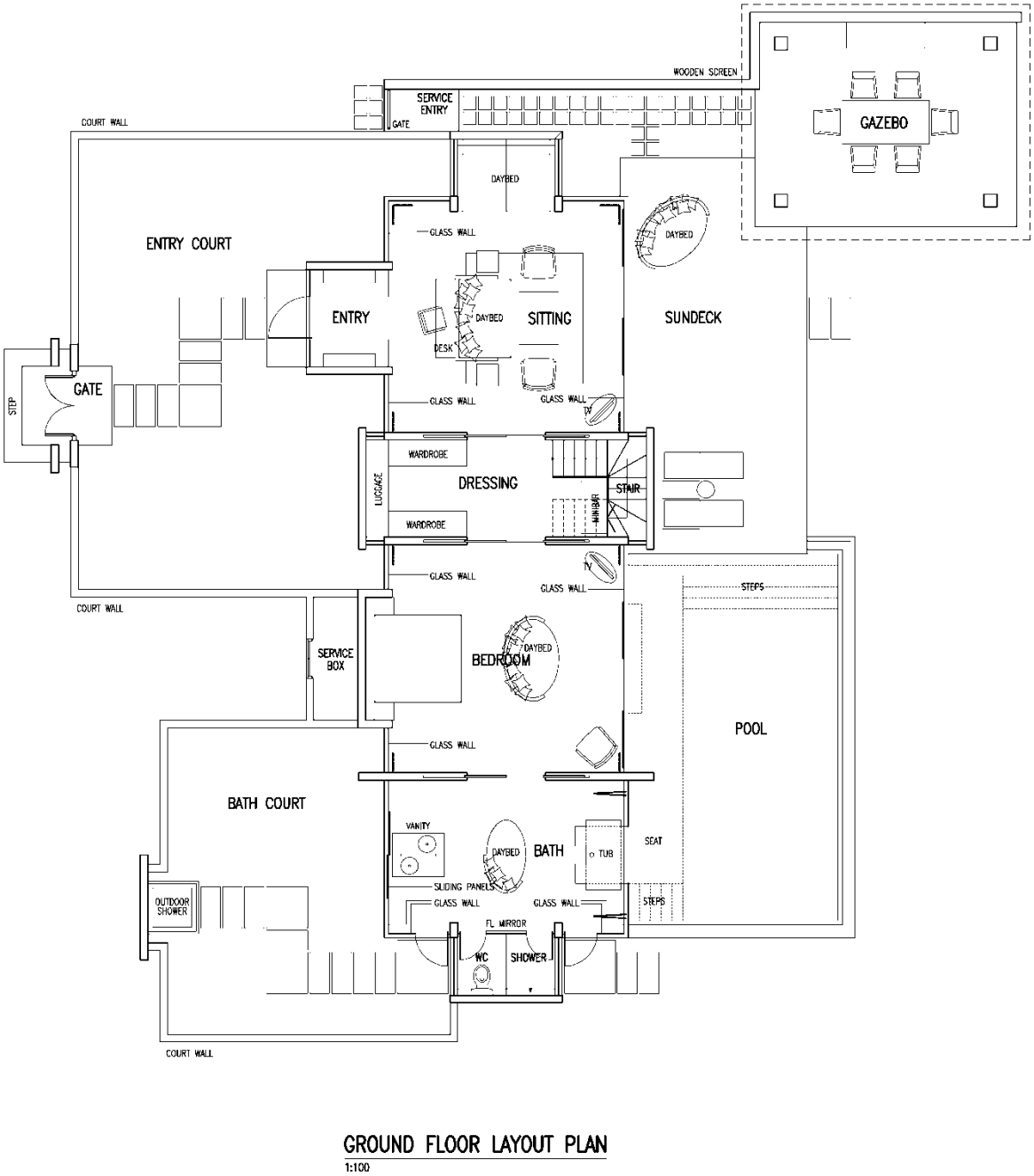


Figure 2.8: Layout of the proposed beach suite

2.3.3.3 *Beach Residence*

The Beach Residence is a single story unit covering 182 sq m. It includes two bedroom bedrooms, attached bathrooms with bathtub, living areas, an open sun deck, dining areas, entry courtyards, an open balcony and attached swimming pool (See figure 2.9).

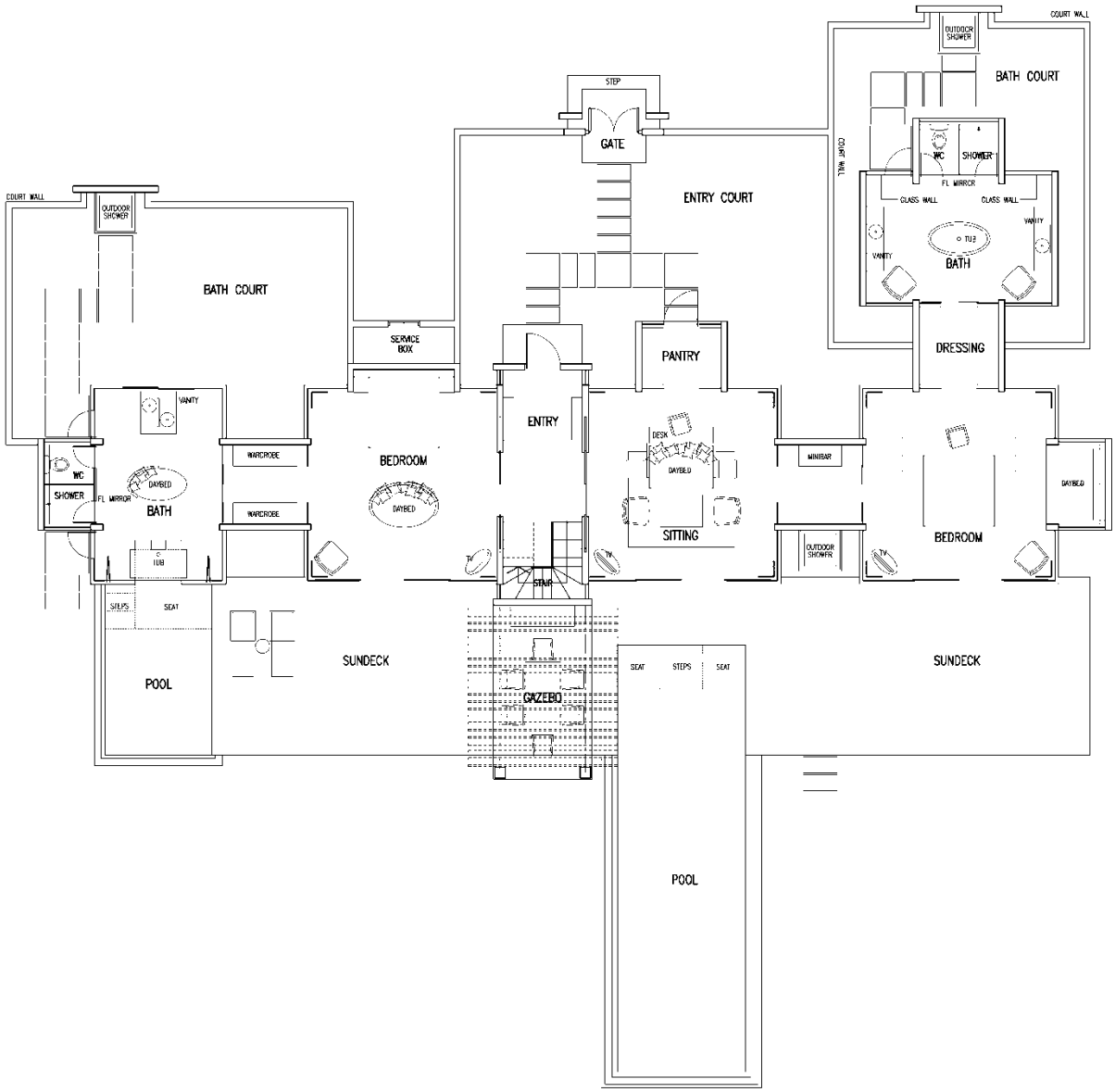


Figure 2.9: Layout of the proposed beach residence

2.3.3.4 *Water Villas and Water suite*

Water villas are over water rooms constructed on concrete piles. Each unit has a footprint of 77 m^2 and there are 59 units in total. Each unit has one bedroom, attached bathroom and bath sundeck, swimming pool and living area (See Figure 2.10). There is a private sundeck and each room has an access staircase to the shallow lagoon.

There is also one water suite with a single bedroom but facilities similar to the beach suite.

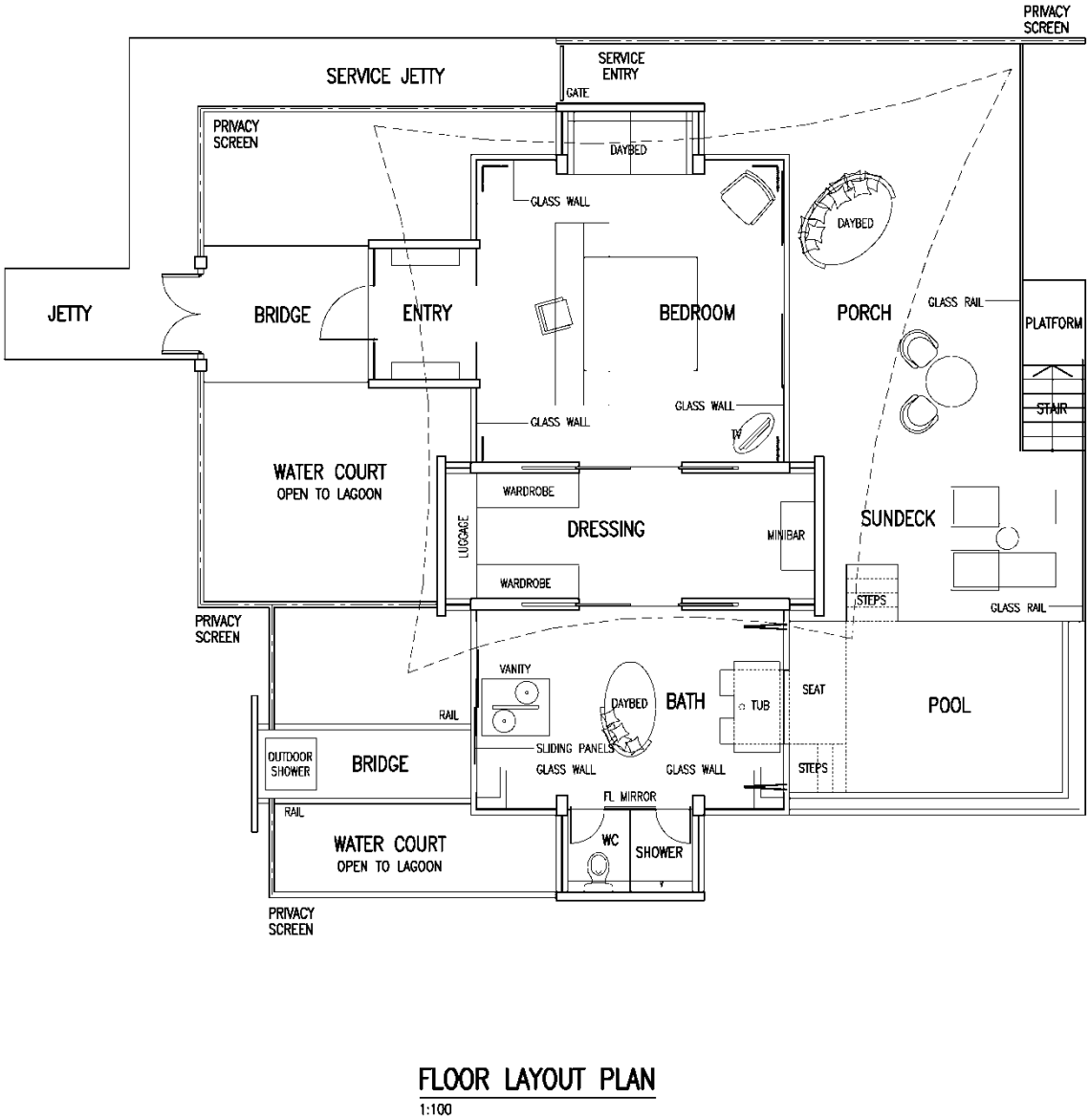


Figure 2.10: Layout of the proposed water villa

2.3.4 Guest Facilities

2.3.4.1 *Restaurants*

The concept behind this island partly focuses on providing in-villa dining. All units have attached dining areas for the purpose. There will be a main restaurant, a speciality restaurant and a signature restaurant and pool bar on the island. The main restaurant is capable of serving all guests at once, and includes buffet counters and both indoor and outdoor seating. The restaurant will be developed with the required kitchen facilities. Additional seating can be made available outdoors.

The signature restaurant is constructed on stilts on the lagoon.

2.3.4.2 *Bars*

The Pool Bar will be located on the main island near the main restaurant with a lap swimming pool. The bar facilities contains bar building, the main swimming pool and an open air deck.

The Lagoon Bar will be located on stilts as described in the previous subsection.

2.3.4.3 *Spa and Recreation Centre*

The one-storey spa building contains six treatment rooms, a relaxation pavilion, and two sun decks, one yoga pavilion and a gymnasium. It is located on the eastern end of the island.

Both buildings are located over water and constructed on stilts.

2.3.4.4 *Dive and Water Sports Centres*

The dive centre and water sports centre will be located near the arrival jetty. The dive centre building contains the wet room for equipment cleaning, workshop, equipment rental and storage area, and classrooms. A main jetty will provide access to dive boats.

2.3.5 Utilities – Sewerage, power and water infrastructure

2.3.5.1 *Power*

Construction stage power sourcing

Power for the construction stage will be provided using a 450 kVA diesel generator installed during mobilization. This unit will be housed in a temporary powerhouse until the main generators could be installed. Power will be switched to the main generators and to the new power grids two-thirds of the way into construction stage.

Operations stage power sourcing

Power for the operations stage will be provided mainly using two 1000 kVA synchronised prime fuel oil generator sets. Back-up generators will include one 1000 kVA and one 450 kVA diesel generator. The resort is designed to be self-sufficient in terms of power generation, and would have 100% back-up capacity as well.

The emission rating for power generation engines will be at US EPA/CARB Tier of 2. The specifications of the generators will be decided based on the quotations and technology assessments. Under the new Guideline for Power System Approval of the Maldives Energy

Authority, power generation plants have to be registered. The environmental considerations and compliance will be addressed later in this report but the technical specifications of the generators will be provided during the application for registration.

Power house

The power house is located next to the STP and the recycle area, which are considered to be high noise zones on the island. The building will house the desalination plants, in addition to the generator sets. The structure is specially designed to be noise and vibration proof as much as possible with floor padding and wall insulations, among other measures.

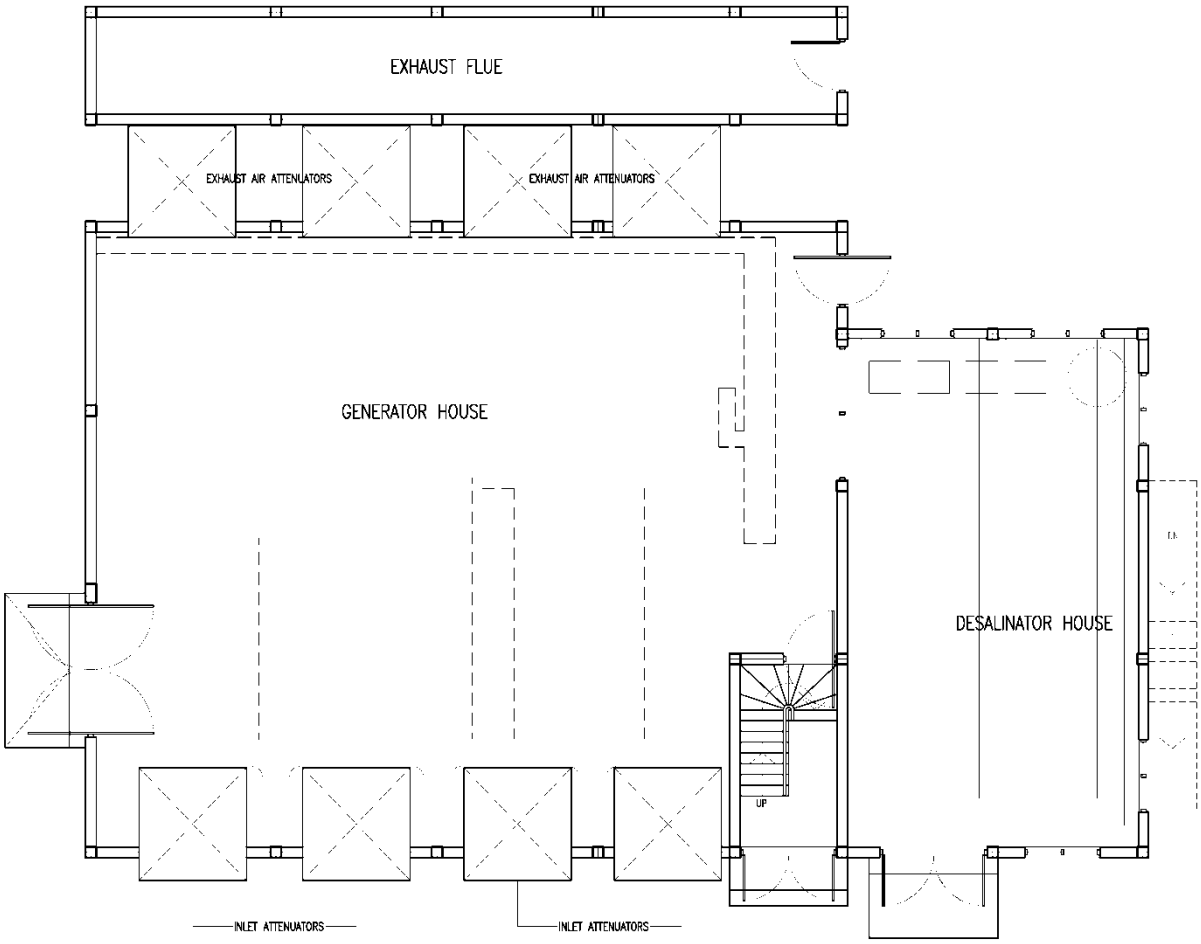


Figure 2.11: Site plan of the power house and desalination plant house

Power Distribution

The planned power distribution network was not finalised at the time of this report submission. However the following information can be derived from the existing concept drawings.

Power supplies to the beach villas and guest facilities will follow the main footpaths and supply to the water villas will follow the water villa access jetty. The land areas will require excavation up to 600 mm. All cabling and connections will conform to the Maldives Electricity Regulation.

The power to the marine will be provided through cables attached to the underside of the jetty.

Fuel storage

Fuel storage requirements of the resort include diesel, petrol and aviation fuel. Diesel fuel will be stored in three 170 m^3 steel tank, about 6 m high and 6 m in diameter. A separate 15 m^2 purified fuel storage tanks will also be constructed. In addition, the facility will have separate pump stations for each fuel type and diesel oil purifier room.

The fuel tank will be bunded by solid concrete walls and will rise to at least 1600 mm above ground level. All underground tanks will also be bunded by concrete structures before placing the steel tanks.

Fuel transportation

Fuel transportation from the service jetty to the fuel tanks will be using appropriately sealed piping. Pipes will be placed 600 mm below ground level and will have safely valves and pipe line condition monitoring setups at designated locations around the island.

Low Energy Consumption Ventures and Awareness

All lighting in the resort is planned to use energy saving light bulbs. Electrical machinery considered for purchase is also expected to meet energy efficiency standards which will be setup in due process.

Air conditioning is provided as standalone units for most guest rooms and facilities. All air conditioning ducts, refrigerants and condensation pipes will be insulated to the highest standard. Air-condition units will use environmental friendly HFC or HCFC (RC134a). All refrigerants used in the resort will comply with Montreal protocol standards.

2.3.5.2 *Energy Efficiency, Air conditioning and Hot water*

As noted above, all lighting in the resort is planned to use energy saving light bulbs. Electrical machinery considered for purchase is also expected to meet energy efficiency standards which will be setup in due process.

The resort has been planned as an energy efficient resort and therefore an energy recovery system will be used. A combined system of hot water and air conditioning will be used which is expected to save 30-35% of energy compared to a conventional system.

Air conditioning is provided as standalone units for most guest rooms and facilities. All air conditioning ducts, refrigerants and condensation pipes will be insulated to the highest standard. Air-condition units will use environmental friendly HFC or HCFC (RC134a). All refrigerants used in the resort will comply with Montreal protocol standards.

Solar water heaters complete with storage will be installed in guest villas to preheat the incoming cold water to approximately 40 ^{0}C.

2.3.5.3 *Water*

Construction stage water sourcing

Water for the construction stage will be provided using a200 m^3/day reverse osmosis desalination plant and rain water. It is proposed to install two 200 m^3/day reverse osmosis plants on the resort with one of them acting as a backup. One of these units will be installed as early as possible to serve the construction water demand. It may require sometime before the 200m^3 plant can be installed. Hence, for the interim period, a temporary 50 m^3 /day plant will be installed.

Ground water will not be extracted for consumption or otherwise, except while dewatering for construction.

Operation Stage Desalination Plant Design

Desalination plant will consist of one building that houses the pumping station, the pre-treatment and post-treatment line and desalination units. Additional facilities include product water tanks, elevated tanks and workshop. The desalination plant will be with energy recovery system.

Desalination Plant House

The desalination plant house is located within the power plant. A separate and partitioned section of the powerhouse is allocated for the desalination plants. The building can house two desalination plants with space for an additional unit if required. The structure is specially designed to be noise and vibration proof as much as possible with floor padding and wall insulations, among other measures.

Water Demand

The total water demand, operating at full capacity of the resort (420) people including guests and staff, has been estimated at 166 m^3/day. Some of these staff will not be resident on the island so the actual demand will be about 20% less.

Desalination Plants

It is proposed to install one 100 m^3 per/day and one 200 m^3 per/day reverse osmosis plant on the resort with one acting as a backup. One of these units will be installed as early as possible to serve the construction water demand. Both units will come with energy recovery system.

Water intake

Water intake will be boreholes located near the desalination plant house (see figure 2-13). A borehole is preferred over a direct pipeline to the lagoon, since water obtained from the borehole has better water quality (lower TDS and temperature), and is completely free of clogging. This allows a much longer lifetime for membranes and other equipment that use the feed water, and produces better quality product water.

The borehole will be drilled up to a depth of 30 metres with an internal diameter of approximately 20 centimetres. The screen pipes will be located along the length of the borehole. The sides will be protected using reinforced concrete, gravel packing and Betonite clay seal. The gravel packing will start from 10 m and the pump will be located at a depth of 10 m. However, the PVC strainer top will be located at 20 m. The essential pumping zone will be between 20 and 30 m. The typical borehole design established by Maldives Water and Sewerage Company, the most likely contractors for the job, is presented in Figure 2.12.

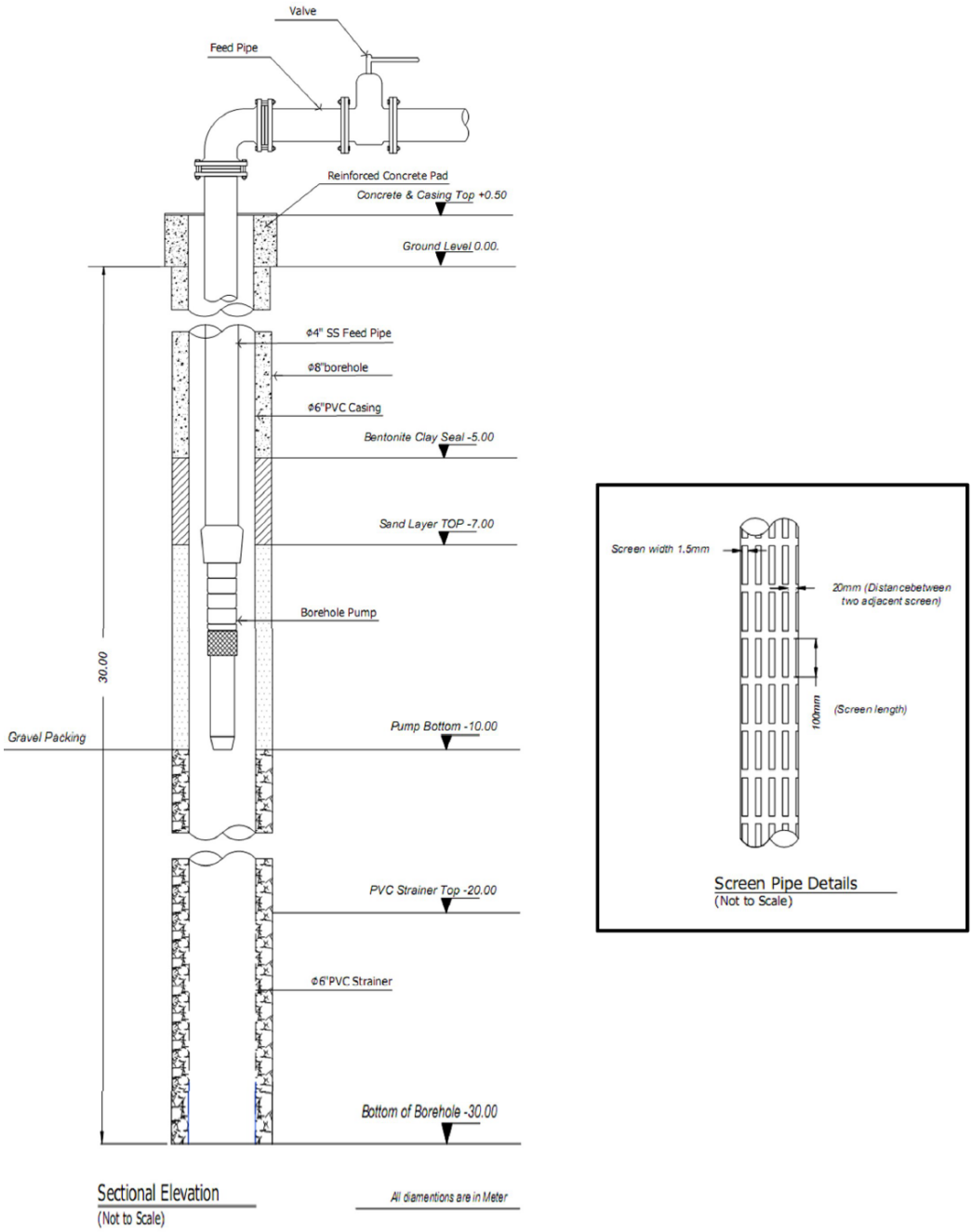


Figure 2.12 Typical borehole design

Brine outfall

The plants will operate on an estimated 45% product water recovery, hence, with 55% brine output. The brine outfall is proposed to be located on the eastern side of the island, about 100 m from the shore, as shown in Figure 2-13. The pipeline will be made of uPVC.

The current flow around the proposed area is eastward during SW monsoon is westward during NE monsoon. The proposed outfall site provides the best flushing and mixing throughout the year.

Water distribution

There will be three distribution pipe systems. The first will transfer the water from the boreholes to the RO unit using a 100 Ø UPVC pipes. The second will be the main distribution line for the treated water using 80 Ø UPVC pipes. Distribution to individual rooms and facilities will be using 40 Ø UPVC pipes. The third pipe system will transfer the recycled water around the island for irrigation usage.

Link to the overwater residences will be via the service jetty, along with the power and sewerage network.

Quality control and water quality standards

The product water will be according to standards defined by EPA Maldives. Where standards are not defined for specific parameters the product water will meet EU standards applicable to water intended for human consumption.

The proposed desalination plants can produce fresh water from sea water pumped at 16 m^3 per hour with TDS of 45,000 ppm at 25°C. The water produced from the plants will have a quality TDS <500 ppm at a pressure of less than 2 Bar. The system efficiency is rated at 45%. The brine outfall can handle a TDS of 60,000 at 9 m^3 per hour.

Water security logistics will be elaborated during detailed designing.

Hot water supply

Hot water will be produced from solar water heaters. All guest rooms, staff accommodation, kitchens and other required areas will be supplied with hot water. Groups of 5-6 units each will be connected to 600 ton capacity units, with all hot water piping made from PP-R piping.

Other water sources

Rainwater will be collected from the back-of-house-area roofing and conveyed to be mixed with the first stage reverse osmosis treated water. The mixed water will then pass the second stage of the reverse osmosis for potable water production.

Water storage

Desalinated water will be stored in three storage tanks, with a total capacity of 200 m^3, thereby providing 24-hour storage for the treated water supply. The storage tanks will be located next to the desalination plant building.

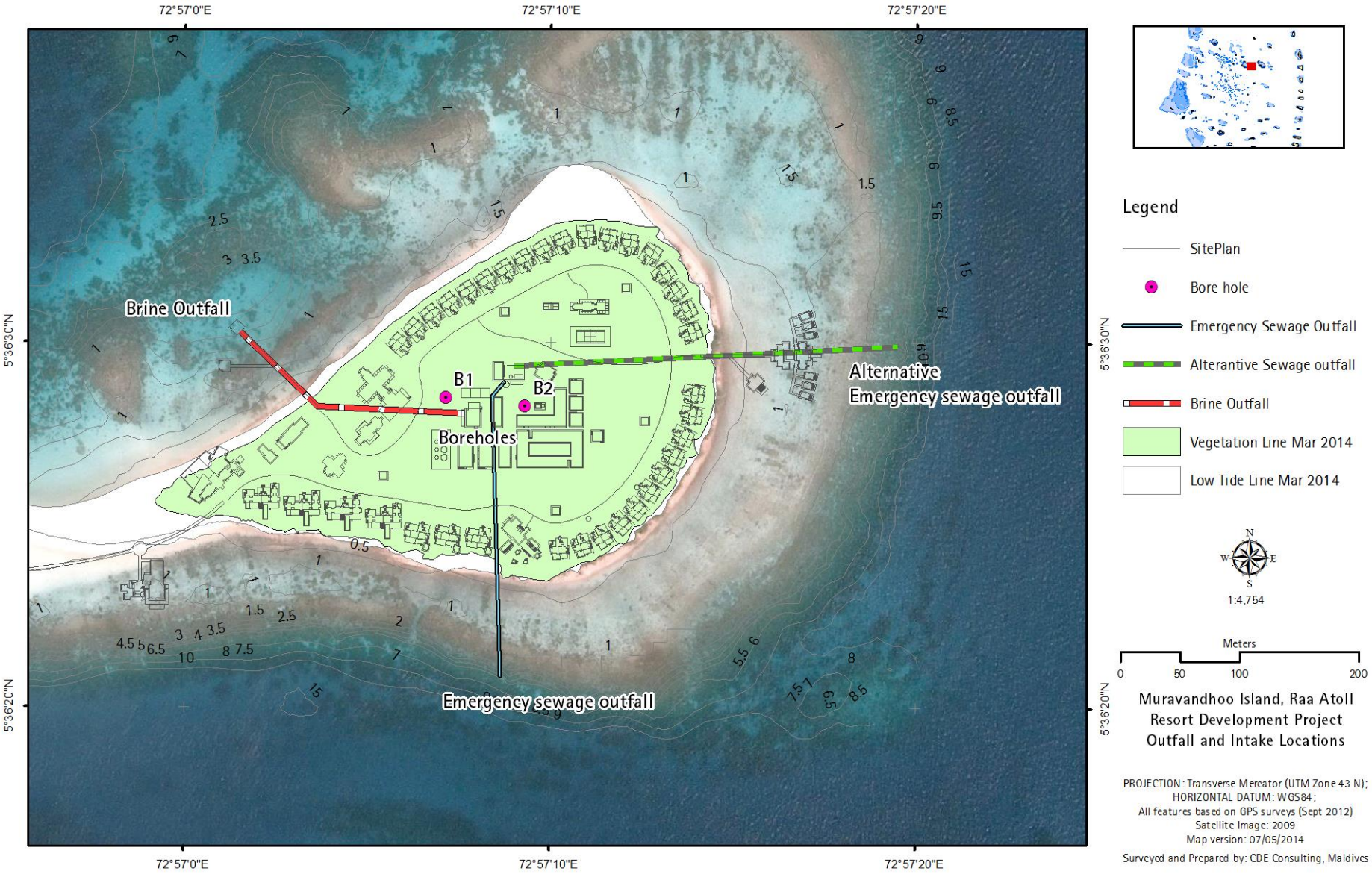


Figure 2.13: Water intake, brine outfall and sewage outfall locations

2.3.5.4 *Sewerage Management System*

Construction stage sewage management

Construction stage sewage will be managed by pumping directly to the sea beyond 5 m from the reef edge on the southern side.

Operations Stage Sewerage System Design

The proposed sewerage system for the island is the conventional gravity system. It is based on constructing a system of sewers, which allows the sewage to flow downhill under gravity to a central point which are pump stations. The proposed sewerage system consists of the following main components:

- Pipelines
- Manholes
- Pump stations
- Building connections
- Sewerage Treatment Plant
- Emergency outfall

The details of the sewerage network were not completed at the time of the survey. The conceptual plan of the network comprises of pressure pipes about 800Ø mm in diameter collecting material from the ocean villas and private residences and gravity pipes for beach villas and lines connecting to pressure pipes. Pump stations will transfer material for the over water structures. There will be 4-6 pump stations located across the island.

The sewage will be collected via pipe work into a tank – the raw effluent collection sump. All the wastewater will be treated and recycled. The resort will not discharge directly to the sea as this has the potential of damaging the reef ecosystem as well as degrade aesthetics.

Sewerage Treatment Plant Design and System Processes

The resort plans to use a 300 m^3/day Sequential Batch Reactor (SBR) System for sewage management. The sequencing batch reactor (SBR) is a fill-and draw activated sludge system for wastewater treatment. In this system, wastewater is added to a single "batch" reactor, treated to remove undesirable components, and then discharged. The system works by oxidization and mixing active biomass, thereby creating a condition for bacteria to flourish and breakdown organic matter. This system may be operated to achieve denitrification as well as BOD reduction. The system is controlled by sensors connected to timers and clocks that control the

aeration. Treated effluent or recycled water will be reused for irrigation. The sludge can be reused after disinfection and drying. This system has been successfully used in the small resorts of Maldives where space is limited.

The proposed plant designed for a peak flow of 30m^3/day and will operate at a normal flow rate of 1.5m^3/hour.

The systems have five steps that are carried out in a timed sequence: (1) fill, (2) react (aeration), (3) sedimentation, (4) decant the supernatant, and (5) idle.

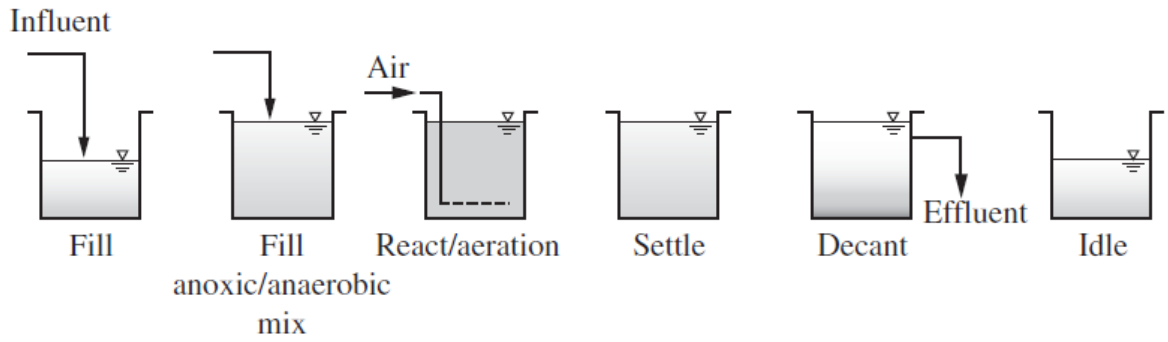


Figure 2.14 The process of denitrification in the SBR system

The process flow diagram of the proposed system is unavailable at the time of this report preparation as the contractor and model for SBR system had not been decided. Under the EIA processes for tourism development projects, detailed designs are only required after the EIA has been approved. It is assumed that Muravandhoo will have a system similar to other resort islands in Maldives. Hence, the process flows in similar units are as follows:

First the screening of incoming sewage is under taken at the receiving tank, after which the storage and initial lifting will take place. A fine screening process follows before biological and denitrification and nitrification occurs in the main reactor. A stage of reaction follows before the purified water is drained with pumps. Post-disinfection treatment will be given by dosing sodium hypochlorite or peracetic acid as the effluent is going to be used for watering plants. Periodic discharge of excess surface sludge is undertaken automatically but seasonal disposal of excess sludge, preferably with dehydration plastic bags is required. The system is also connected to the emergency outfall (see following sections).

Sewerage Treatment Plant (STP) House

A purpose built building will house the STP system and will be constructed next to the powerhouse.

Emergency Sewage outfall

The emergency sewage outfall is proposed to be located outside the reef, at a depth of 5 m on the southern side of the island, and at a distance of about 150 m from the shore (see Figure 2-13 above). The piping will be buried 0.6 m below the seabed and anchored using concrete weights on the reef slope.

Wastewater Influent

No historical data is available for the nature of sewage likely to be available at the proposed wastewater treatment plants. Treatment will, therefore, be based on assumptions, international standards and referenced Maldives information as in Table 2.1.

Table 2.1: Characterization of wastewater influent

Parameter	**Design Value/Units**	**Reference/Notes**
Flows		
Average Daily Flow (ADF)	100 l/person/day	Based on resorts with similar facilities
Peak flow to treatment (PFT)	~ 300 l/person/day (i.e. 3.0 x ADF)	Assumed for up to 5 hrs per day
Concentration/loads		
BOD	220 mg/l	
COD	580 mg/l	Refer footnote [1]
TSS	240 mg/l	Refer footnote
NH_4-N	14 mg/l	Refer footnote
TKN	50.5 mg/l	Refer footnote
Total Phosphorous	9 mg/l	Refer footnote
Fats Oils & Grease	87.5 mg/l	Refer footnote
Total coliforms	5.5×10^8 / 100 ml	Refer footnote
Faecal coliforms	5.0×10^8 / 100 ml	Refer footnote
Other parameters		
pH	6.5 – 7.5	Assumed
Wastewater temperature	20 – 30 ℃	Assumed

Based on the above calculations, the maximum flow is expected to be 150-160 m^3 per day, which can be handled with the proposed system.

[1] National Wastewater Quality Guidelines, Maldives, MWSA-NWWQG 2006, 1st Ed

Treated Wastewater Quality

The treated water quality at the outlet of the tertiary treatment plant after treatment will have the following quality.

pH	6.0 – 8.0
BOD	< 20 ppm
COD	< 50 ppm
Total Suspended Solids	< 30 ppm
Oil and Grease	< 5 ppm

The treated water will be disinfected to eliminate the bacterial load and will be reused for watering plants. This will assist in recharging the aquifer and in the conservation of freshwater in the island.

2.3.5.5 *Waste Management Infrastructure*

A separate building will be constructed for waste management next to the Sewerage Treatment Plant.

The following equipment for treatment and disposal will be installed on the resort:

- Waste incinerator
- Metal can compactor
- Glass and bottle crusher
- Plastic waste shredder
- Green waste shredder/wood chipper
- Earth tub for composting kitchen waste

Waste incinerator will meet the Ministry of Tourism and Ministry of Housing and Environment specifications. The aim will be to meet the following emission limits:

- Particulate matter 197 mg/dscm
- Carbon monoxide 40 ppmv
- Sulphur dioxide 55 ppmv
- Nitrogen oxides 250 ppmv

Details of the waste management system are presented under the Environmental Management Plan, later in this report.

2.3.6 Landscaping

Landscaping and revegetation will be undertaken on the island during construction. There are three sources for vegetation: (i) large trees within the building footprints on the island; (ii) smaller trees from the nursery to be developed on the island; and (iii) imported varieties.

The number of trees and varieties for landscaping are not known at the time of this report, as the landscaping consultant has not been contracted. It is anticipated that the island will adopt local and native vegetation species for 90% of landscaping needs.

2.3.7 Erosion Mitigation

It has been identified in the Alternatives Chapter that shore protection is a preferred option for the island if the island is to be developed as a resort island. Thus, the following shore protection measures are proposed for the island.

2.3.7.1 *Scope of Works*

Shore protection works are required for the southern side of the reef and possibly on the eastern side.

The suggested shore protection areas are presented in Figure 7.1 and Appendix K.

Options for shore protection have not been determined yet as it will depend on the final designs. The two options currently proposed are the sued of armour rock and sand cement bags.

2.3.7.2 *Design Criteria*

Component	Feature	Specification
Submerged Breakwater	Length West Side	200
	Height of structure	+0.2 m MSL
	Width of the structure	5 m

A typical cross section of the breakwater structure is provided in the figure 7.2.

The structure will be placed on the reef flat.

2.3.7.3 *Quantity and volume of material*

Armour rock

If armour rock is used, the volume of armour rock required for all sites is estimated at 3,000 - 5000 cbm. Weight of the rock will be between 400 - 600 kg and will be imported from a neighbouring country.

2.3.8 Resort operations

2.3.8.1 *Transportation*

Transport of tourists will be mainly by air transfer to Ifuru Domestic Airport and then via sea to Muravandhoo. Occasionally, guests may be transferred in seaplanes. Cargo to and waste from the island will be transported using boats that will use the service jetty for unloading and transport manually via non-mechanised vehicles. Regular ferry transfers are expected to transfer staff to nearby islands, reducing the need for onsite accommodation.

2.3.8.2 *Guest and staff activities*

Snorkelling, diving, water sports activities and recreational fishing will be the main tourist activities. These will be carried out with extreme care for the environment. Guests will also be made aware of areas of high currents, eddies and rips for their personal safety. Other recreation and sports facilities on-site will include billiard and darts, library, swimming pool and spa.

Staff will be provided with their own recreation areas for volleyball, futsal etc. and will be provided with a library as well as TV and Internet facilities for their entertainment and education.

Trips to nearby uninhabited islands for picnics and visits to inhabited islands are considered as a service.

Guest activities will be carried out with emphasis on guest education and awareness on the fragile nature of the Maldives ecosystems. Staff awareness programmes will also be conducted and good environmental practice established.

2.3.8.3 *Waste management*

The resort will have a Solid Waste Management Plan. Combustible matter will be incinerated on site and the rest of non-combustible matter taken away from the island to designated disposal grounds, to Vandhoo waste site, once it's operational. Spillage during transportation will be minimized by using appropriate technology and handling of wastes.

The following waste management procedures are proposed to ensure minimum environmental impact from solid waste in the resort.

Incinerator, bottle crusher, compactor and other appropriate machinery used shall be fuel-efficient.

Packaging of all imported supplies and materials will be controlled to ensure that the majority of items will be either organically degradable or recycled.

Other materials would be incinerated or shipped to a waste management site designated by the Government.

Organic waste from kitchen and toilets will be processed by means of anaerobic digestion, which will ensure that the process is odourless and that the resultant sludge can be used (odourless) for improving the quality of the soil on the island.

2.3.8.4 *Landscaping*

There will be an ongoing land scaping programme on the island, which may require replanting of new trees. The vegetation source for this programme will be a small nursery built on the island. Some overseas varieties may be imported to develop the nursery and will be done according to the floral and faunal import regulations of Maldives.

Additional replanting of trees may be required from other islands but at this stage it is unclear how many trees will be required and from where it will be sourced. All approvals required under the tree felling regulations will be obtained before proceeding.

2.4 Work Methodology

2.4.1 Site Clearance

Site clearance will be one of the first activities during the construction stage of the resort. Clearance will be mainly in the form of clearance of vegetation on the island. A total area of 3 Ha of vegetation may be affected and about 1.5 Ha of vegetation may need to be permanently cleared. The numbers of large trees to be relocated or cut down are between approximately 400 to 600 trees. Most of these are coconut palms will be relocated where possible. Vegetation removal is addressed in more detail in the impacts section.

Marine areas to be cleared include the proposed stilt and marine piping footprints and entrance channel.

2.4.2 Mobilisation of equipment and materials

Site mobilisation involves the mobilisation of construction equipment, materials and workforce to the island and providing necessary storage for materials and site access and services for the workforce. This activity has its environmental consequences including transport-related impacts, site-access related impacts and workforce related impacts. These will be considered in detail in Chapter 5 of this report. All site mobilisation and construction related activities would be undertaken in a planned manner in order to avoid excessive cost and environmental implications.

Potential sites proposed as landing area and storage areas are presented in Figure 2.15.

2.4.3 Construction System and Concrete Batching Plant

All land based buildings will be constructed using traditional block and steel placed on concrete platforms supported by concrete piles where required. There is no information available currently on the requirements for space and equipment for the proposed manufacture of piles on the site.

Consideration is being given to having a small concrete batching plant located on the site to produce the volume of concrete that will be required during construction.

2.4.4 Dewatering, Excavation and Pipeline Installation

Pipeline for the proposed water, power and sewage network is proposed to be installed at a depth of 0.6 m to 0.8 m on the sides of the footpaths. Excavation to a maximum depth of 1.0 m may be required. A mini excavator will be used to trenching works. Where instability of the sand/soil conditions is experienced, trench shoring is to be used to maintain the vertical integrity of the sidewalls.

It is expected that only minor dewatering will be required in low areas during construction and installation of pipe networks. The water tables lie on average between 0.8 m below ground level in low areas and 1.2 m in other areas.

All water removed during dewatering will be discharged onto the ground for re-percolation back into the water table as outlined in the EPA guidelines.

Piping required for the over water private residences will be placed first by excavating up to 600 mm and then by placing concrete weights. Only 25 m sections will be excavated at a time and the width of excavation is 0.5 m.

2.4.5 Construction Overwater

All overwater structures will be constructed on concrete stilts with the appropriately sized footings. The stilts or piles will be pre-casted on land to designated lengths and will be placed in the water using excavators or cranes. The foundations of the stilts will be placed on the seabed after manual excavation up to 0.5 m.

2.4.6 Shore Protection

2.4.6.1 *Equipment requirement*

The proposed equipment will consist of the following:

- Excavator/crane
- Truck

2.4.6.2 *Construction Method*

Breakwater will be constructed manually if the preferred the design for the contractor is sand-cement bag breakwater. This will be decided after cost calculations.

If rock boulders are used, beakwater will be constructed using a crane or two excavators. Cranes will be placed on a temporary sand bed created parallel to the structure. The excavators will be used profile the structure and make finer adjustments.

Boulders will be transported to Muravandhoo on barges. Transportation to the sites will be undertaken on trucks.

Construction using sand-cement bags will require manual construction on the site using sand-cement filled bags. No equipment will be deployed in the reef for this purpose.

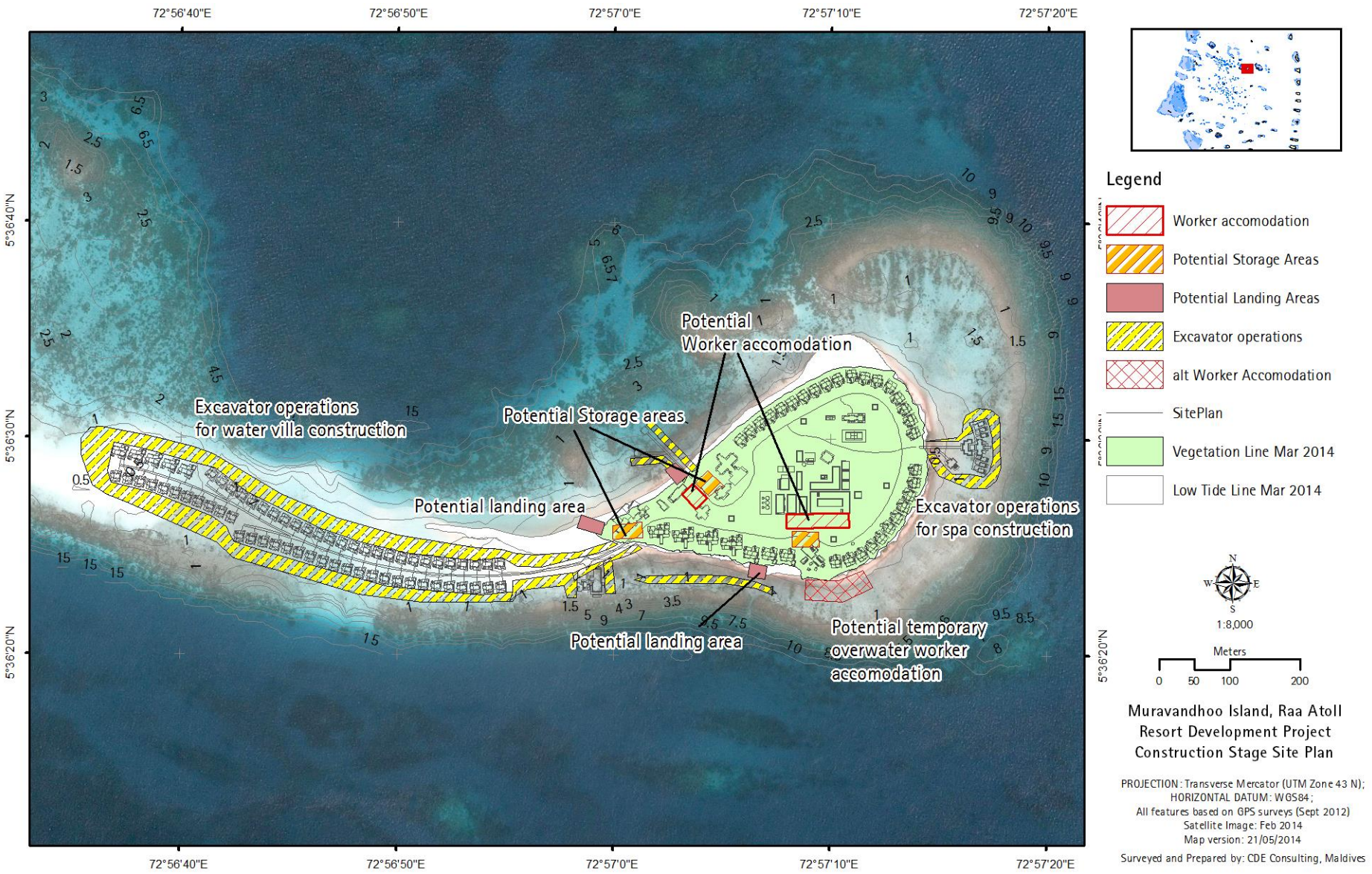


Figure 2.15: Constrcution stage activties site plan

2.5 Project Schedule and Life Span

Mobilisation for the project will begin after the EIA is approved. It is anticipated that the completion of the whole project will take approximately 24-36 months. The preliminary work plan is provided in Appendix E. The actual details may be dependent on the final contractor.

2.5.1 Work Sequence

During the initial stage of resort infrastructure construction, temporary facilities will be set up. This includes temporary accommodation and temporary service facilities. At this stage some source of temporary services for power, water, sewerage and telecommunications will need to be established before the actual equipment arrives. These will be on a very temporary basis for a period of about three months.

The first activities relating to permanent construction include the desalination plant/power house and staff accommodation. Construction of some of the staff facilities and building works for some services would commence prior to the guest villas and the public areas. This will ensure that some of the services could be used during the construction stage as well.

The construction of the guest villas and public areas are expected to take the longest duration of the construction program. Of these the majority of time will be spent on finishing details of the built structures. Mock-up guest villas would be made at an early stage to use it for marketing as well as to refine the design.

Simultaneously, work on completing the final aspects of the services will be carried out. The timing for completion of this activity will be such that individual connection to the bungalows can be made without disrupting the services to the staff facilities that will be used to some extent by the construction workers. Once the service connections are made, testing and commissioning of the completed services lines will be carried out.

Aspects of landscaping would be an important consideration. A nursery would be set up at an early stage to prepare plants and planting material,

During the final stages, in addition to completing the guest villas and public areas, refurbishment of the jetty, service facilities and staff facilities will be carried out. This will be done at the same time as the final landscaping is done.

Demobilisation and site clearance will be the final activity of the construction program.

2.6 Labour Requirements and Services

2.6.1 Workforce

It is projected that the total number of employees during the construction stage will be around 1200. Workers will mainly be accommodated on the island. However, it is not expected that all the 1200 workers will be present on the island at once in any given time.

During operation stage of the resort about 4 staff per bed will be employed.

2.6.2 Services

The Contractor is expected to provide workers with meals and appropriate entertainment facilities including radio and television. The Proponent would not be responsible for any of the services to be provided to the Contractor's staff or workers.

2.7 Waste Management, Logistics and Safety Measures

2.7.1 Site Office and Temporary Accommodation

A site office and temporary accommodation blocks will be constructed at the initial phase. In locating temporary accommodation as well as material storage and other construction-related infrastructure and services on the island, special attention would be given to ensure there is minimal impact on the environment. See Figure 2.15 for more details.

2.7.2 Procurement

Procurement of materials will take place in three stages. An initial shipment of materials comprising of basic building materials would be ordered soon after a preliminary agreement has been reached with the contractor. The first procurement and delivery is expected be completed within seven weeks from order confirmation. The remaining building materials along with the basic finishing material will be ordered to time their arrival within three months after construction starts.

All imported furniture, cutlery, crockery and bed linen will be ordered to time their arrival one month before completion of construction. This will enable storage cost to be reduced.

2.7.3 Utilities

See Section 2.3.8.

2.7.4 Construction Waste Management and Disposal

Construction waste that will be created will mainly be green waste from clearing of areas for resort buildings. These will be chipped and burnt on site. Other wastes would be general domestic waste arising from material consumption by construction workforce. These will be managed according to Waste Management Plan and it would be the Contractor's responsibility to dispose of all construction-related waste during demobilisation along with any other waste. The Contractor will be required to clear all areas of work.

The designated regional waste site for this project is Vandhoo Waste Management Centre, once it becomes operational.

2.7.5 Pollution Control Measures

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

- Machinery will be properly tuned and maintained to reduce emissions and minimize risk of spills/leaks.
- Fuel storage will be bunded
- Spill kits will be maintained around island to handle any liquid spills
- Septic tanks will be utilized for sewage and wastewater disposal during construction period
- All paints, lubricants, and other chemicals used on site will be stored in secure and bunded location to minimize risk of spill

2.7.6 Health and Safety Measures

The following health and safety measures will be implemented during the construction stage.

- Contractor would ensure that Health and Safety procedures are complied.
- Construction activities would be carried out under the supervision of a suitably experienced person.
- All reasonable precautions will be taken for the safety of employees, and equipment will be operated by competent persons.
- Health checks will be administered before work commences
- Warning signs, barricades or warning devices will be provided and used.
- Necessary safety gear will be worn at all times.

- Fire extinguishing equipment would be readily available and employees will be trained in its use.
- Oxygen, acetylene or LPG bottles will not be left free-standing.
- First aid kits will be made available on site
- The construction site will be properly closed to unauthorised personnel

2.7.7 Fire Prevention

Fire extinguishing equipment would be readily available and employees will be trained in its use. In general, water-based fire extinguishers would be used.

Oxygen, acetylene or LPG bottles will not be left freestanding. All welding and cutting will be done in accordance to high safety regulations by experienced personnel.

2.8 Summary of Project Inputs and Outputs

The types of materials that will go into the development and from where and how this will be obtained are given in Table 2.2 and the type of outputs (products and waste streams) and what is expected to happen to the outputs are given in Table 2.3.

Table 2.2: Major Project Inputs

Input resource(s)	Source/Type	How to obtain resources
Construction workers	Local and foreign, mainly foreign	Recruiting agencies, etc.
Operational Staff	Mainly Maldivians	Advertise in local papers, social networks, etc.
Construction material	Timber; Thatch for roof, electrical cables and wires, DBs and MCBs, PVC pipes, light weight concrete blocks, reinforcement steel bars, sand, cement, aggregates, telephone cable CAT 5, PVC conduits, floor and wall tiles, gypsum boards, calcium silicate boards, zinc coated corrugated metal roof, paint, varnish, lacquer, thinner, armour rock etc.	Import and purchase where locally available at competitive prices – Main Contractor's responsibility.
Maintenance material	Similar to above	Import or purchase locally where available
Water supply (during construction)	Desalinated water	50-200 m^3/day desalination plant
Electricity/Energy	Diesel	450 kVA generator

Input resource(s)	Source/Type	How to obtain resources
(during construction)		
Water supply (during operation)	Desalinated water	2x200 m^3/day RO plant
Electricity/Energy (during operation)	Diesel Solar	2x1000 kVA generator
Diving and sports gear	Air Compressor Nitrox Enabled Air Compressor Nitrox Membrane System High Pressured Air bank (for Nitrox Membrane System)	Import
Electrical appliances/machinery	Energy efficient machinery and lighting; ozone-friendly refrigerators	Local suppliers
Telecommunications	Hotel Phone Systems, Fax Machines, E-mail and internet facilities	Local telecom company to provide telecom service
Transport (air and sea)	International air travel, domestic air and sea transport	
Food and Beverage	Mainly imported sources except a few locally available products. Preference will be given to locally produced food items	Import and purchase locally
Laundry chemicals	Detergent, All Purpose Cleaners, Glass Cleaners, Bathroom Cleaners, Destainer Bleach, Oxygen Bleach, Softener, Alkali Neutraliser, Builder C Detergent, Detergent Plus, Starch, Stain Spots Remover, etc. NOTE: All Chemicals are Bio-degradable compounds	Local resort suppliers
Paper Products	Tissue Roll, Tissue Boxes, Hand Tissues, Guest In-room Paper Amenities/ Brochures Office Use Paper Products	Local suppliers
Insecticides, pesticides, etc.	Imported pesticides	Local suppliers
Fire fighting equipment	Fire Pumps, Fire Protection System, Smoke Detectors, Carbon Dioxide and Foam Fire Extinguishers, etc.	Local suppliers
Fuel, Kerosene and LPG	Light Diesel, LPG Gas, Petrol, Lubricants	Local suppliers

Table 2.3: Major Project Outputs

Output Source/Type	Quantity	How it will be dealt with
Outputs during construction stage		
Green waste from site clearance	Large quantity	Burnt or mulched on site and used for nursery and landscaping needs.
Construction waste (general)	Small quantities	Combustibles: Burnt/incinerated Others: Sent to designated landfill
Outputs during operational stage		
Potable water bottles	>6,000 Plastic bottles per month and >300 Glass bottles per month	Plastic Bottles – designated landfill; Glass – Reused or Returned to manufacturer
Non-potable water (plantation, gardening, landscaping, etc.)	50 litres per day	Recharge the aquifer
Sewage and wastewater **Grey water/laundry wastewater**	About 200 litres/person/day	Treated wastewater reuse and excess pumped to sea, bio-degradable chemicals
General/domestic waste	>300x60L rubbish bags per month	Combustibles: incinerated Others: Sent to designated landfill
Food and kitchen waste	>550 kg per day	Bio-degradable: deep sea disposal, non-biodegradable: incinerated
Waste oil and grease	1000 litres per month	Incinerated Made available for locals to reuse
Scrap metal/cans/plastics	>50 kg per day	Made available for locals to reuse
Paper and cardboard	>50 boxes per day	Sent to designated area
Glass and glass bottles	>50 bottles per day	Sent to designated area
Hazardous waste	>100 litres of diesel and oils per month	Barrelled and sent to designated landfill (Vandhoo)
Garden wastes	Minute quantities	Composted on site and used as fertilizer

3 POLICY AND LEGAL FRAMEWORK

These legal and policy provisions have to be fully respected in carrying out the proposed development. All contractors and sub-contractors will be informed of these requirements. This project conforms to all relevant laws and regulations of the Maldives.

3.1 Relevant Legislation

3.1.1 Environment Protection and Preservation Act (Act no. 4/93)

The Environmental Protection and Preservation Act (*4/93*) enacted on 19 March 1993 is the framework law related to environment protection in the Maldives. The authority responsible for the Environment Act is the Ministry of Environment and Energy.

Articles 2, 4, 5, 6, 7, and 8 of the law are relevant to the Muravandhoo resort development Project.

Article 2 states that the concerned government authorities shall provide the necessary guidelines and advise on environmental protection in accordance with the prevailing conditions and needs of the country. All concerned parties shall take due considerations of the guidelines provided by the government authorities.

The project developers and contractors shall abide by any guidelines or advice given by the concerned Government authorities for the project.

Article 4 states that the Ministry of Environment shall be responsible for identifying protected areas and natural reserves and for drawing up the necessary rules and regulations for their protections and preservation.

The project developers and contractors shall ensure that there is no negative impact from the proposed project on sensitive environments in the vicinity or protected species.

According to Article 5 (a) of the Act, an Environmental Impact Assessment study shall be submitted to the Ministry of Environment before implementing any development project that may have a potential impact on the environment.

According to Article 5 (b), The Ministry of Environment shall formulate the guidelines for EIA and shall determine the projects that need such assessment as mentioned in paragraph (a) of this clause.

This report is prepared to fulfil this clause.

According to Article 6, the Ministry of Environment has the authority to terminate any project that has any undesirable impact on the environment. A project so terminated shall not receive any compensation.

All project developer and contractors shall be aware of this provision and contractors shall take all practical measures to ensure there is no irreversible and significant negative impact of the projects on the environment

Article 7 of the EPPA (4/93) states that any type of waste, oil, poisonous gases or any substances that may have harmful effects on the environment shall not be disposed within the territory of the Maldives. In cases where the disposal of the substances becomes absolutely necessary, they shall be disposed only within the areas designated for the purpose by the government. If such waste is to be incinerated, appropriate precaution should be taken to avoid any harm to the health of the population.

All project contractors shall comply with the Environmental Management Plan presented in this report, which specifies how the wastes, oil and gases generated by the project will be disposed.

Article 8 of the EPPA (4/93) states that Hazardous/ Toxic or Nuclear Wastes that is harmful to human health and the environment shall not be disposed anywhere within the territory of the country.

Any hazardous wastes that may be generated from this project shall be transferred to the designated waste site in Thilafushi or Vandhoo for disposal according to Government regulations and standards. It should not be disposed on the Island, as it does not have the necessary facility.

3.1.2 Relevant Tourism Legislation

The main law on tourism in the Maldives (Act no. 15/79) was passed by the Citizen's Majlis in November 1979, outlining the basic regulations for the resorts on registration and operation, and tax policies. The original law had seven clauses in it and amendments were made to the original law through law no: 11/80, 14/80, 4/82, 6/83 and 2/87. The present law (2/99) came into force on the first of November 1999.

The project shall comply with the Tourism Act in terms of its title to build and operate a resort on the island, development concept and operational standards.

With the Tourism Law as the basis, a number of regulations, standards and controls have been specified by the Ministry of Tourism, Arts and Culture for operations within the tourism sector.

The book of tourism regulations comprises of important regulatory measures including the Building Standards, Sanitation Standards, Disposal of Garbage, Carrying Capacity, Electricity Code and Tourist Behaviour.

The project shall comply with all the relevant Tourism Regulations with regard to its concept designs, construction and operation.

A tourism planning permission has to be obtained from the Ministry of Tourism, Arts and Culture before undertaking any tourism related project. Such permission often requires a study of the environment and the likely impacts.

Accordingly, the concept design of the proposed tourist resort development in Muravandhoo has been approved by the Ministry of Tourism.

3.2 Relevant Regulations and Guidelines

3.2.1 Environmental Impact Assessment Regulations 2012

Environmental Impact Assessment regulations were issued by Environment Ministry on 8 May 2012. The first step in environmental assessment process involves screening of the project to be classified as one that requires an EIA or not. Based on this decision, the Ministry then decides the scope of the EIA, which is discussed with the proponent and the EIA consultants in a "scoping meeting". The consultants then undertake the EIA starting with baseline studies, impact prediction and finally reporting the findings with impact mitigation and monitoring programme. This report follows the principles and procedures for EIA outlined in the EIA regulations.

The EIA report is reviewed by MEE following which an EIA Decision Note is given to the proponent who will have to implement the Decision Note accordingly. As a condition of approval, appropriate environmental monitoring may be required and the proponent shall have to report monitoring data at required intervals to the Ministry. The project proponent is committed to implement all impact mitigation measures that are specified in this EIA report. Furthermore, the proponent is committed to environmental monitoring and shall fulfil environmental monitoring requirements that may be specified in the EIA decision note as a condition for project approval.

This report complies with the EIA regulations.

3.2.1 Regulation on the Protection and Conservation of the Environment in the Tourism Industry

With the Tourism Law as the basis, the Ministry of Tourism has released environmental regulations for tourist resort development and operation in 2006.

In the design, construction, and development of the resort, the environmental regulations issued by the Tourism Ministry will be adhered to.

3.2.2 Regulation on Sand and Coral Mining

Regulation on sand mining covers sand mining from uninhabited islands that have been leased; sand mining from the coastal zone of other uninhabited islands; and aggregate mining from uninhabited islands that have been leased and from the coastal zone of other uninhabited islands.

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 Muravandhoo island beach or any beach. Sand should also not be mined from within 100 ft. of the shoreline. Please see regulation on dredging and reclamation for further controls.

3.2.3 Regulation on Cutting Down, Uprooting, Digging Out and Export of Trees and Palms from One Island to Another

Pursuant to the Environment Protection and Preservation Act of Maldives 1993, the Environment Ministry made a bylaw with the purpose of educating developers about the importance of trees including best management practices for maintaining trees and provide standards for preservation of trees in the Maldives and set down rules and regulations to be adhered to prior to commencing felling, uprooting, digging out and exporting of trees and palms from one island to another in Maldives.

The by law states that the cutting down, uprooting, digging out and export of trees and palms from one island to another can only be done if it is absolutely necessary and there is no other alternative. It further states that for every tree or palm removed in the Maldives two more should be planted and grown in the island.

The by law prohibits the removal of the following tree types;

- The coastal vegetation growing around the islands extending to about 15 meters into the island
- All the trees and palms growing in mangrove and wetlands spreading to 15 meters of land area;
- All the trees that are in a Government protected areas;
- Trees that are being protected by the Government in order to protect species of animal/organisms that live in such trees; and

- Trees/palms that is abnormal in structure.

This project will not require removal of prohibited vegetation except for clearing some coastal vegetation. There is an overlap between the Tourism Regulation which requires retention of 5 m coastal vegetation belt and this regulation which requires a 15 m belt. Given that the tourism developments have specific requirements, the Tourism Regulations are used here. The clearings required are mainly for construction of footpaths, beach villas and the main swimming pool.

3.2.4 Regulation on Dredging and Land Reclamation

The regulation of Dredging and Land Reclamation was published on 2 April 2013 with the aim of minimising environmental impacts associated with dredging activities in islands and reefs across Maldives.

- The regulation defines the rationales acceptable for dredging as those related to approved development activities on inhabited islands and economic islands. It defines that those activities should be if utmost necessity for dredging to be considered.
- All dredging and reclamation activities must be approved by EPA in writing. The process includes the submission of project information to EPA along with a scaled before and after map.
- The regulation defines rationales for reclamation as those absolutely necessary for social, economic or safety purposes.
- Beach replenishment is restricted from 10 m of the registered shoreline in resort islands
- Dredging is restricted in the following areas:
    - 500 m from the ocean side reef edge
    - 50 m from any island vegetation line
    - An environmentally sensitive site
- Land reclamation is restricted within 200 m of a sensitive area.
- Land reclamation cannot exceed 30% of the house reef area

The construction of the temporary sand bed for breakwater construction will require dredging and refilling of the dredged areas. The regulation does not explicitly state the use of temporary sand beds as requiring approval.

3.2.5 Regulation on Conservation of Old Trees

This regulation aims at identifying ways to manage protected trees in the Maldives. The reason for the formulation of the law is due to the increased cutting down of trees resulting in the loss of the islands natural, biological wellness and greenness. And due to the extinction of some types of trees at island level and rapid reduction in the amount of certain types of trees at national level and also to comply with the convention on biological diversity

There are no old trees on the island that fits within this regulation.

3.2.6 Dewatering Regulation (Regulation No. 2013/R-1697)

This regulation is drafted under the Act number 4/93 (Maldives Environment Protection and Preservation Act) and issued on 31st December 2013. The main purpose of the regulation is to minimize the impact of dewatering activities on ground water table and also to decrease the impacts on the receiving environment of the disposed water. The regulation encourages prevention of contamination and damage to ground water table, protect the living organisms as well as the environment from the negative impacts due to dewatering activities.

This regulation is to be enforced by EPA of the Maldives.

If dewatering is to be carried out for any development purposes in any of the islands in Maldives, it shall be done by gaining a written approval from the enforcing agency or an agency assigned by the enforcing body. However, dewatering done at individual level i.e., from a bore well or for the purpose of installing a bore well and water drawn for agricultural purposes are considered exceptions from the regulation.

Dewatering can only be to be carried out, after gaining approval by submitting “the dewatering approval form” in the annex 1 to the enforcing body for approval with all the required documents expressed and with an administrative fee of Rf500. Water quality tests results also have to be submitted as one of the required component.

The regulation also guides on where and how the extracted water shall be disposed of, and how it has to be handled. According to the regulation, permission can be granted for dewatering at a stretch for a maximum of 28 days, for which a sum of Rf500 should be paid per day. This amount is liable to be increased with the number of days increased.

A fine not exceeding Rf100 million may be charged for violation.

This project may require pumping water during exaction works. The proponent will be required to get an approval from EPA before commencing excavation.

3.2.7 Waste Management Regulation 2013

Waste Management Regulation (WMR) was published on August 2013 and came into effect in February 2014. It will be implemented by EPA. The aim of WMR is to implement the national waste policy, which contains specific provisions to:

- Implement measures to minimize impacts on human health
- Formulate and implement waste management standards
- Implement an integrated framework for sustainable waste management
- Encourage waste minimisation, reuse and recycling
- Implement Polluter-Pays Principle
- Introduce Extended Producer Responsibility

WMR contains four main sections:

- Waste management standards: Defines standards for waste collection, transfer, treatment, storage, waste site management, landfills and managing hazardous waste.
- Waste management Permits: Defines approval procedures for waste sites
- Waster transfer: Standards and permits required for waste transport on land and sea, including trans-boundary movements.
- Reporting requirements: Defines reporting and monitoring requirements and procedures.
- Enforcement: Defines procedures to implement WRM and penalties for non-compliance.

This project is compliance with the Ministry of Tourism standards for waste management, which requires the island to manage most of its waste. Any waste taken out of the island and the receiving waste management site shall be in compliance with this regulation. A regional waste site is to become operational in Vandhoo Island about 12 km from Muravandhoo, which is likely to have better waste management capabilities compared to Thilafushi Island.

3.2.8 The Environmental Liability Regulation (Regulation 2011/R-9)

This law is pursuant to Article 22 of national constitution that states that protection, preservation and maintenance of the Maldivian natural environment, the richness of the living species, the natural resources and the beauty of the Maldives for the present generations as well as for the future generations is a basic obligation of the Maldivian government. The government shall enforce that the activities conducted in order to gain economic and social development should be of sustainable nature that protect the environment and such activities shall not deteriorate the

environment, endanger any species, damage the environment, and shall not waste any natural resources.

This regulation is also pursuant to Environment Protection and Preservation Act of Maldives (4/93). The regulation is aimed at maintaining equal standards for reprimanding and enforcing environmental liabilities, fines for those who violate the rules and regulations and give guidance to those who are involved in the implementation process of the regulations pursuant to Preservation Act of Maldives (4/93).

One of the key objectives of the environmental liability regulation is also to practice polluter-pay-principles in the Maldives.

All project developer and contractors shall be aware of this provision and contractors shall take all practical measures to ensure that all relevant laws and regulations, and the EMP proposed in this EIA is followed.

3.2.9 Compliance

In general, the proposed developments are in compliance with the laws and regulations described above. Where there is a special requirement to comply, the EMP identifies measures and mechanisms required to comply.

3.3 Environmental Permits Required for the Project

3.3.1 Approval of the concept and site plan

The Ministry of Tourism will have to approve the concept plan and site plan for the proposed project before the EIA could be approved. This project has approval from Ministry of Tourism (See Appendix D).

3.3.2 Environmental Impact Assessment (EIA) Decision Note

The most important environmental permit to initiate project work would be a decision regarding this EIA. The EIA Decision Note, as it is referred to, shall govern the manner in which the project activities must be undertaken. This EIA report assists decision makers in understanding the existing environment and potential impacts of the project. Therefore, the Decision Note may only be given to the Proponent after a review of this document following which the Ministry may request for further information or provide a decision if further information is not required. In some cases, where there are no major environmental impacts associated with the project, the Ministry may provide the Decision Note while at the same time requesting for further information.

3.3.3 Registration of Desalination Plants

According to Desalination Regulation of the Maldives, all desalination plants operating in the Maldives catering for public water supplies and commercial purposes would have to be registered with Environmental Protection Agency (EPA), the former Maldives Water and Sanitation Authority (MWSA). Therefore, the desalination plants to be installed in Muravandhoo will have to be registered with EPA. For this, the Proponent will be required to submit the EIA Decision Note for this EIA report, completed application forms with all details of the plant to be registered. A copy of the relevant section of this EIA may be appended to the forms as justification for the desalination plants.

3.3.4 Domestic Wastewater Disposal Consent

The General Guidelines for Domestic Wastewater Disposal issued by the EPA former MWSA in 2006 requires wastewater disposal to be undertaken with written consent of the Agency. A copy of the guidelines can be obtained from the EPA.

3.3.5 Dewatering Permit

A dewatering permit is required for the project during excavation works. A separate application will have to be made to the EPA to get the permit. Permission can be granted for dewatering at a stretch for a maximum of 28 days, for which a sum of Rf500 should be paid per day. This amount is liable to be increased with the number of days increased.

3.4 Responsible Institutions

The main government institutions that have roles and responsibilities relevant to this project are summarised below.

3.4.1 Ministry of Tourism, Arts and Culture

The Ministry of Tourism is main agency responsible for approving and overseeing the development of a resort island in Muravandhoo Island. The concept for the resort development has been approved by the ministry. Detailed drawings for the resort need to be submitted to the ministry once the EIA has been approved by the Environment Ministry and the project is initiated.

3.4.2 Ministry of Environment and Energy

The Ministry of Environment is mandated for the effective implementation of the Environmental Protection Act of the country and has the statutory power over issues related to the environment. It has the central control over the environment protection, management, conservation and

environmental emergencies. The Ministry operates mainly at a policy level and the more regulatory and technical assessment activities are mandated to the Environmental Protection Agency (EPA). In this respect EPA has now been mandated to manage all issues relating to Environmental Impact Assessment of individual projects.

The Ministry of Environment also seeks the advice of National Commission for the Protection of Environment (NCPE) on all significant environmental matters. The commission is appointed by the president and is mandated to advice the Minister of Environment on environmental matters such as environment assessment, planning and management, and political decisions with regard to the protection of environment.

3.4.3 City Council

Under the Decentralization Act, Raa Atoll has elected Atoll Council comprising representatives from the islands within the atoll and elected Island Council in each inhabited island. Raa Atoll Council is located in Ugoofaaru Island. The Council Office is the main focal point of Government Ministries in Raa Atoll and they co-ordinate and liaises with Government Ministries and elected island councils on all issues relating to the Atoll.

A copy of this EIA will have to be submitted to the City Council.

3.5 Guiding Policies and Documents

3.5.1 National Environmental Action Plan II (NEAP II)

The aim of NEAP II is to protect and preserve the environment of the Maldives and to sustainably manage the country's natural resources for the collective benefit and enjoyment of present and future generations.

Accordingly, the key strategies of the NEAP II are:

- Continuous assessment of the state of the environment in the Maldives, including impacts of human activities on land, atmosphere, freshwater, lagoons, reefs and the ocean; and the effects of these activities on human well-being
- Development and implementation of management methods suitable for the natural and social environment of the Maldives and maintain or enhance environmental quality and protect human health, while at the same time using resources on a sustainable basis
- Ensure stakeholder participation in the decision making process by consultation and collaboration with all relevant sectors of society

- Preparation and implementation of comprehensive national environmental legislation in order to provide for responsible and effective management of the environment
- Adhering to international and regional environmental conventions and agreements and implementation of commitments embodied in such conventions.

Furthermore, NEAP II specifies priority actions in the following areas:

- Climate change and sea level rise; coastal zone management;
- Biological diversity conservation; integrated reef resources management;
- Integrated water resources management;
- Management of solid waste and sewerage;
- Pollution control and management of hazardous waste;
- Sustainable tourism development;
- Land resources management and sustainable agriculture
- Human settlement and urbanization.

3.5.2 Waste Management Policy

The aim of the waste management policy is to formulate and implement guidelines and means for solid waste management in order to maintain a healthy environment. Accordingly, the key elements of the policy include:

- Ensure safe disposal of solid waste and encourage recycling and reduction of waste generated;
- Develop guidelines on waste management and disposal and advocate to enforce such guidelines through inter-sectoral collaboration;
- Ensure safe disposal of chemical, hazardous and industrial waste.

The proponents of this project must be aware of the policy and all solid and hazardous waste produced in this project should be disposed according to the Environmental Management Plan for the project, which reflects the principles of the Waste Management Policy.

3.6 International Conventions

3.6.1 Convention on Biological Diversity

The Maldives is a party to the United Nations Convention on Biological Diversity. The objective of the convention is "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding". The proposed development activities outlined in this project does not fall on any area recognised for its ecological value. Therefore it is unlikely there will be a major loss of biodiversity. The loss is not going to be significant at atoll or national level. Yet, it is recommended that the developer ensure that silt screens are used during dredging works, construction of the jetty and breakwaters to minimise any impact on the marine biodiversity.

3.6.2 International Plant Protection Convention

The Maldives has become a party to the International Plant Protection Convention (IPPC) as a step to protecting native plant species in the Maldives from the risk of diseases introduced by imported plant varieties. The Maldives adhered to the IPPC on 3 October 2006 and the Convention requires that certificates of phytosanitary condition and origin of consignments of plants and plant products be used for import and export of plants and plant materials. Contracting parties have the full authority to regulate entry of plants and plant products and may prescribe restrictions on imports or prohibit importation of particular plants or plant products. Thus it is advisable that the proponent be aware of the requirements of IPPC and obtains the necessary phytosanitary certificates if any plants are to be imported to stabilise the beach or for landscaping.

3.6.3 UNFCCC and Kyoto Protocol

The Maldives is a party to the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the UNFCCC. The objective of the Convention is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

The IPCC defines mitigation "as an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases." The greenhouse gas inventory of the Maldives forms an integral part of the First National Communication of the Maldives to the UNFCCC. In March 2009, the President of the Maldives has announced the target to make Maldives carbon neutral by 2020. Hence, in the implementation of the project, careful attention needs to be given to ensure energy efficiency and reduce transport related fuel consumption. Furthermore, planting of beach vegetation would help in mitigation of greenhouse gas emissions from the project.

The IPCC defines adaptation "as an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects." Various type of adaptation include anticipatory and reactive adaptation; private and public adaptation; and autonomous and planned adaptation. The adaptation policies and strategies of the Maldives are given in the Maldives National Adaptation Programme of Action (NAPA). The replenishment of the beach can be considered as a long-term adaptation measure against beach erosion caused by rising sea levels.

4 EXISTING ENVIRONMENT

4.1 Physical Environment

4.1.1 Geological Setting

Muravandoo Island is a small reef island rising to no more than 1.6 m above MSL. The island is approximately 485 m long and 300 m wide (at tis widest point), and has a land area of approximately 8.2 Ha within vegetation and 8.7 Ha within high tide line in March 2014. The highest part as on other islands is a peripheral storm berm on the north-eastern side. The island shows little relief even as displayed by vegetation patterns in the oldest (1969) air photography available. Heights on the island vary between 0.8 m and 1.8 m MSL.

Compared to other islands within the atoll lagoon of Raa Atoll, the island appears to be relatively stable geologically. Over the last 40-50 with much of its northern shoreline has remained intact but shoreline on the eastern side had retreated 40 m and southern side had retreated 15 m in 45 years. See Section on beach for more details. These conditions have been less pronounced over the last 10 years. The causes of this movement are part of the natural coastal process that operates in the islands of Maldives, including natural changes to hydrodynamics, storm impacts, and changes to sediment production and supply.

The reef system of Muravandhoo is moderate, covering over 140 Ha. The length of the reef system is 2,200 m and width at its width point is 650 m. The reef system is oriented in a WNW-ESE direction and the island is oriented in an E-W direction. The average depth of the reef flat is around -1.5 m MSL. There is only one island on the reef system and land comprises of about 7% of the reef area. There is a narrow seasonal sand bank on the western half of the reef with an area of 0.8 Ha at low tide. The reef is characterised by gently sloping reef on the northern side with good coral cover and a steep sloping reef on the southern side with high sedimentation.

Island sediments are mostly fine to medium sands with a moderate percent of coarse material and very uniform around the entire island. Because of their fineness, identification of constituents is difficult but a cursory examination suggested dominance by coral and algal fragments with some contribution from molluscs. Foraminifera and Halimeda common on other coral island beaches were evident on the northern side. Reef flat sediments appeared to be similar indicating the fragmentation of biogenic fragments across the reef flat from the carbonate productive reef margins.

The island coastal environment has not been physically modified. The terrestrial environment, however, has been modified by vegetation clearings, agriculture, some construction works and forestry.

The active beach varies from <5m to about 20 m in width. The toe of the beach overlies the reef flat with a sharp break in slope. The beach is widest, with an accompanying unvegetated berm on the northern side of the island. There is a long sand pit on the western end extending to 250 m form the vegetation line. A sand pit also forms on the NE corner of the island extending to 50 m during NE monsoon.

Beach rocks occur on the northern and southern side of the island.

The NE and SE rim of the reef also has a well-developed algal and rubble ridge suggesting string wave activity during the peak swell periods and SW monsoon.

4.1.2 Meteorology

4.1.2.1 *Climate*

The climate in Maldives is warm and humid, typical of the tropics. The average temperature ranges between 25°C to 30°C and relative humidity varies from 73 percent to 85 percent. The annual average rainfall is approximately 1,948 mm. As Maldives lies on the equator, Maldives receives plenty of sunshine throughout the year. Significant variation is observed in the climate between the northern and the southern atolls. The annual average rainfall in the southern atolls is higher than the northern atolls. In addition, greater extremes of temperature are also recorded in the southern atolls. On average southern atolls receive 2704 hours of sunshine each year. Table 4.1 provides a summary of key meteorological findings for Maldives.

Table 4.1: Key Meteorological Information of the Maldives

Parameter	**Data**
Average Rainfall	9.1mm/day in May, November; 1.1mm/day in February
Maximum Rainfall	184.5 mm/day in October 1994
Average air temperature	30.0 C in November 1973; 31.7 C in April
Extreme Air Temperature	34.1 C in April 1973;17.2 C in April 1978
Average wind speed	3.7 m/s in March; 5.7 m/s in January, June
Maximum wind speed	W 31.9 m/s in November 1978
Average air pressure	1012 mb in December; 1010 mb in April

4.1.2.2 *Monsoons*

The climate of Maldives is characterised by the monsoons of the Indian Ocean. Monsoon wind reversal significantly affects weather patterns. Two monsoon seasons are observed in Maldives:

the Northeast (Iruvai) and the Southwest (Hulhangu) monsoon. The parameters that best distinguish the two monsoons are wind and rainfall patterns. The southwest monsoon is the rainy season while the northeast monsoon is the dry season. The southwest monsoon occurs from May to September and the northeast monsoon is from December to February. The transition period of southwest monsoon occurs between March and April while that of northeast monsoon occurs from October to November.

4.1.2.3 *Winds*

The winds that occur across Maldives are mostly determined by the monsoon seasons. The two monsoons are considered mild given that Maldives is located close to the equator. As a result, strong winds and gales are infrequent although storms and line squalls can occur, usually in the period May to July. During stormy conditions gusts of up to 60 knots have been recorded at Male'.

Wind has been uniform in speed and direction over the past twenty-plus monsoon seasons in the Maldives (Naseer, 2003). Wind speed is usually higher in central region of Maldives during both monsoons, with a maximum wind speed recorded at 18 ms-1 for the period 1975 to 2001. Mean wind speed as highest during the months May and October in the central region. Wind analysis indicates that the monsoon is considerably stronger in central and northern region of Maldives compared to the south (Naseer, 2003).

Besides the annual monsoonal wind variations there are occasional tropical climatic disturbances (tropical storms or low intensity tropical cyclones) in the central region which increases wind speeds up to 110 km/h, precipitation to 30 to 40 cm over a 24 hour period and storm surges up to 3 m in open ocean (UNDP, 2006).

Table 4.2 summarises the wind conditions in central Maldives throughout a year. Medium term meteorological data from Hulhule meteorological centre (see Figure 4.1, Figure 4.2 and Figure 4.3) and findings from long-term Comprehensive Ocean-Atmosphere Data Set (COADS) are used in this analysis.

Table 4.2: Summary of General Wind Conditions from National Meteorological Centre

Season	**Month**	**Wind**
NE - Monsoon	December	Predominantly from NW-NE.
	January	High Speeds from W
	February	
Transition Period 1	March	From all directions. Mainly W. High Speeds from W.
	April	
SW - Monsoon	May	Mainly from W. High Speeds from W.
	June	
	July	
	August	
	September	
Transition Period 2	October	Mainly from W.
	November	High Speeds from W

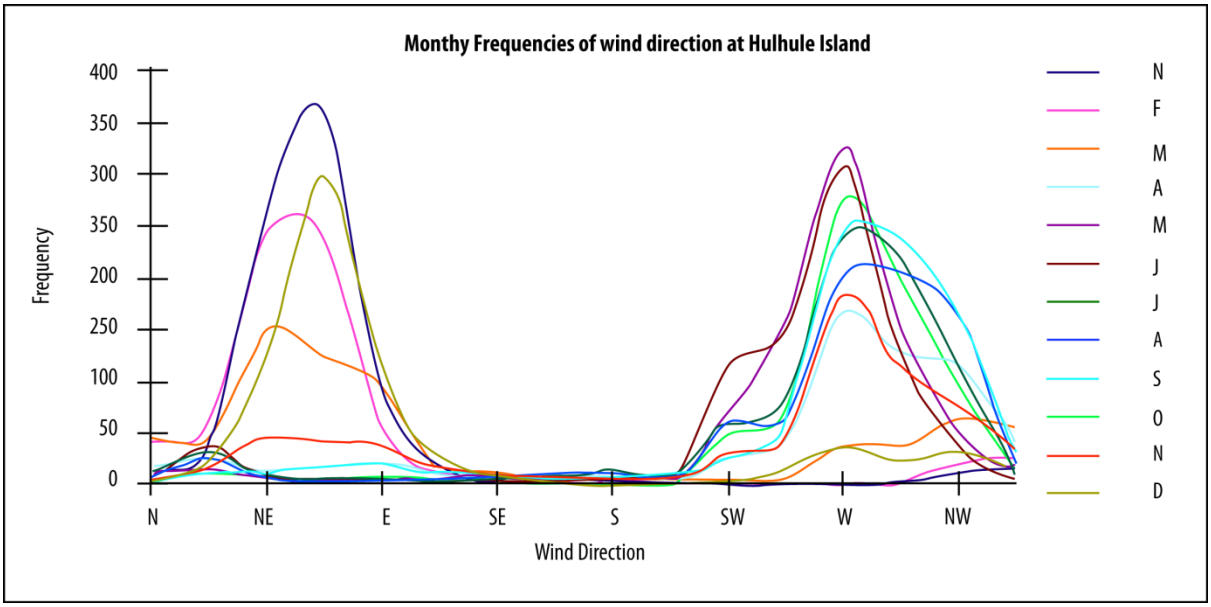


Figure 4.1: Monthly Frequencies of Wind Direction in Central Maldives based on National Meteorological Center 10 year Data (adapted from Naseer, 2003).

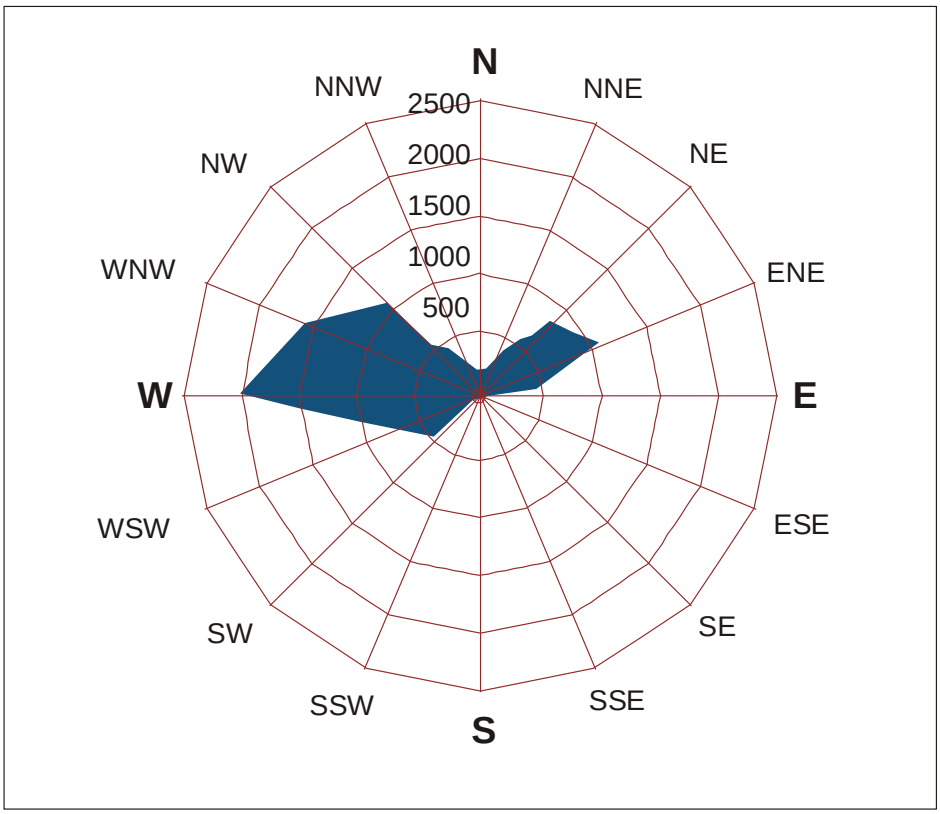


Figure 4.2: 24 Year Wind Frequency Recorded at National Meteorological Center.

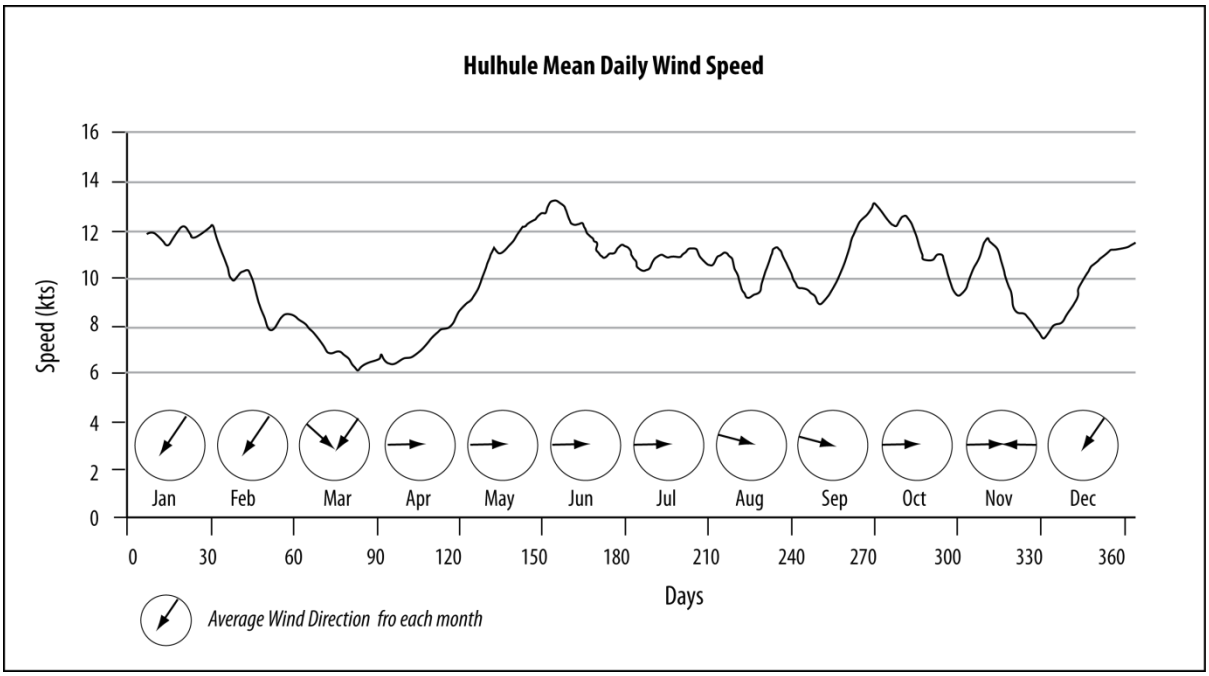


Figure 4.3: Mean Daily Wind Speed and Direction Recorded at National Meteorological Centre (1978 – 2004)

The Disaster Risk Profile of Maldives (UNDP, 1006) reports 11 cyclonic events over the Maldives in the last 128 years and only one event over the central Maldives. All of these events were of category 1 cyclones. There have been no cyclonic events since 1993.

Muravandhoo Island is located in a high risk cyclonic hazard zone which has the potential for a maximum probable cyclonic wind speed of 84.2 kts (UNDP, 2006).

The project site is expected to receive regular annual strong winds during the peak SW monsoon.

4.1.2.4 *Rainfall*

The average annual rainfall for the archipelago is 2,124 mm. There are regional variations in average annual rainfall: southern atolls receive approximately 2,280 mm, and northern atolls receive approximately 1,790 mm annually (MEC, 2004). Mean monthly rainfall also varies substantially throughout the year with the dry season getting considerably less rainfall. This pattern is less prominent in the southern half, however. The proportions of flood and drought years are relatively small throughout the archipelago, and the southern half is less prone to drought (UNDP, 2006).

The nearest meteorological station to Muravandhoo is the National Meteorological Centre in Hulhule' Island. The mean annual rainfall in Hulhule' is 1991.5 mm with a Standard Deviation of 316.4 mm and the mean monthly rainfall is 191.6 mm. Rainfall varies throughout the year with mean highest rainfall during October, December and May and lowest between February and April (See Figure 4.4).

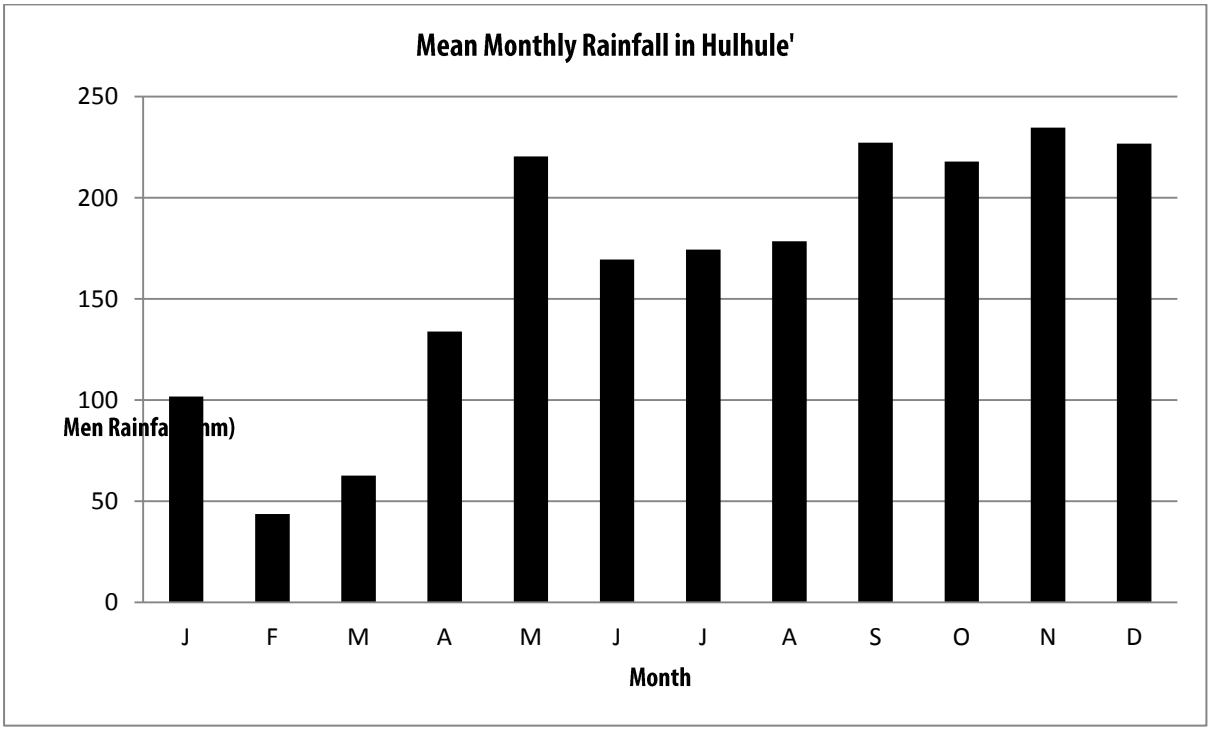


Figure 4.4: Mean Monthly Rainfall in Hulhule' (1975-2004)

Analysis of daily maximum annual rainfall data shows high variability, including extremes (see Figure 4.5 below). However, no significant long term trends are evident in the Hulhule data.

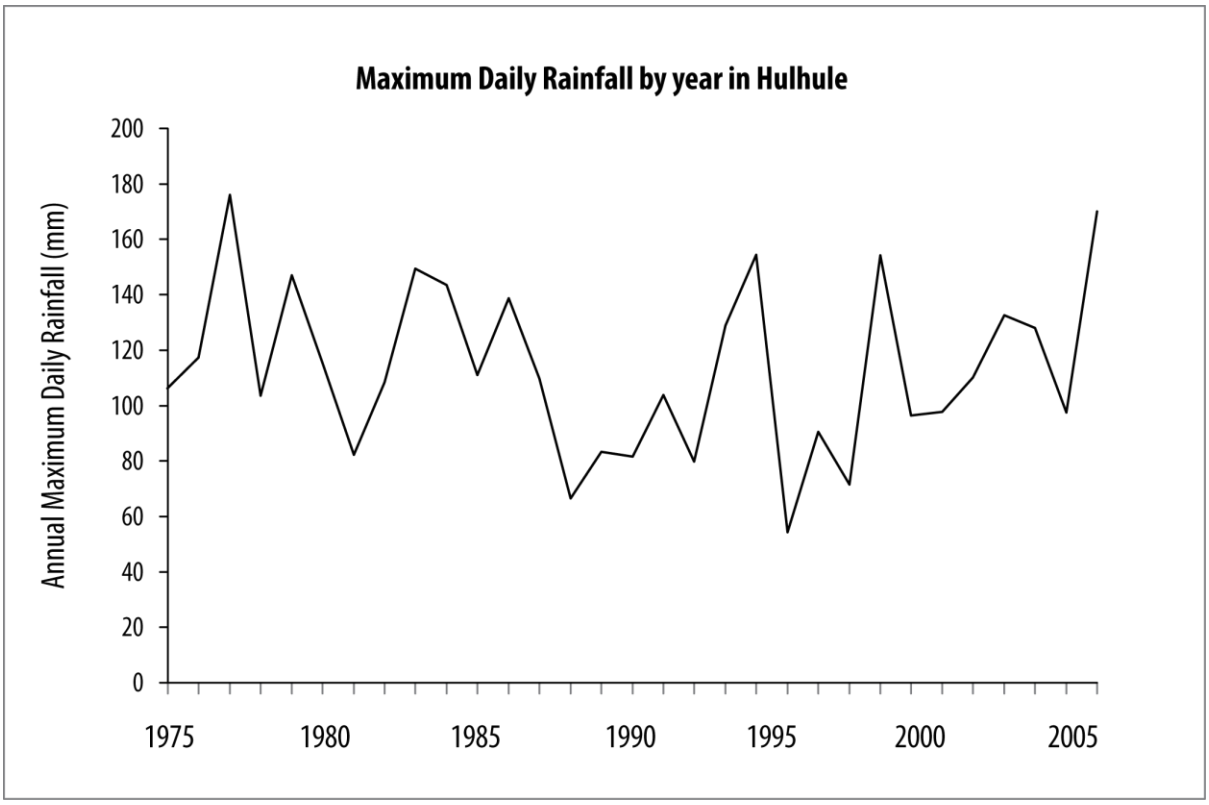


Figure 4.5: Maximum daily rainfall by year in Hulhule' (1975-2005) - (Source: Hay, 2006)

The probable maximum precipitations predicted for Hulhule' by UNDP (2006) are shown in Table 4.3.

Table 4.3 Probable Maximum Precipitation for various Return periods in Hulhule'

Station	Return Period			
	50 year	100 year	200 year	500 year
Hulhule'	187.4	203.6	219.8	241.1

Source (UNDP, 2006)

It would be possible to identify threshold levels for heavy rainfall for a 24 hour period in Muravandhoo, which could cause flooding or disruptions to operations. However, it does require observation of historic, daily rainfall data, which at present is unavailable.

4.1.2.5 *Temperature*

Daily temperatures of Maldives vary little throughout the year with a mean annual temperature of 28°C. The annual mean maximum temperature recorded for Male' during the period 1967-1995 was 30.4°C and the annual mean minimum temperature for the same period was 25.7°C. The highest recorded temperature for Male' was 34.1°C on 16th and 28th of April 1973. The

hottest month recorded was April 1975 with a maximum monthly average temperature of 32.7°C, the next highest being 32.6°C in April 1998. The lowest minimum average temperature of 23.7°C was recorded in July 1992.

There is considerable inter annual variability in extreme temperatures for Hulhule as shown in Figure 4.6. A maximum temperature of at least 33.5°C is rare at Hulhule and has a return period of 20 years (Hay, 2006).

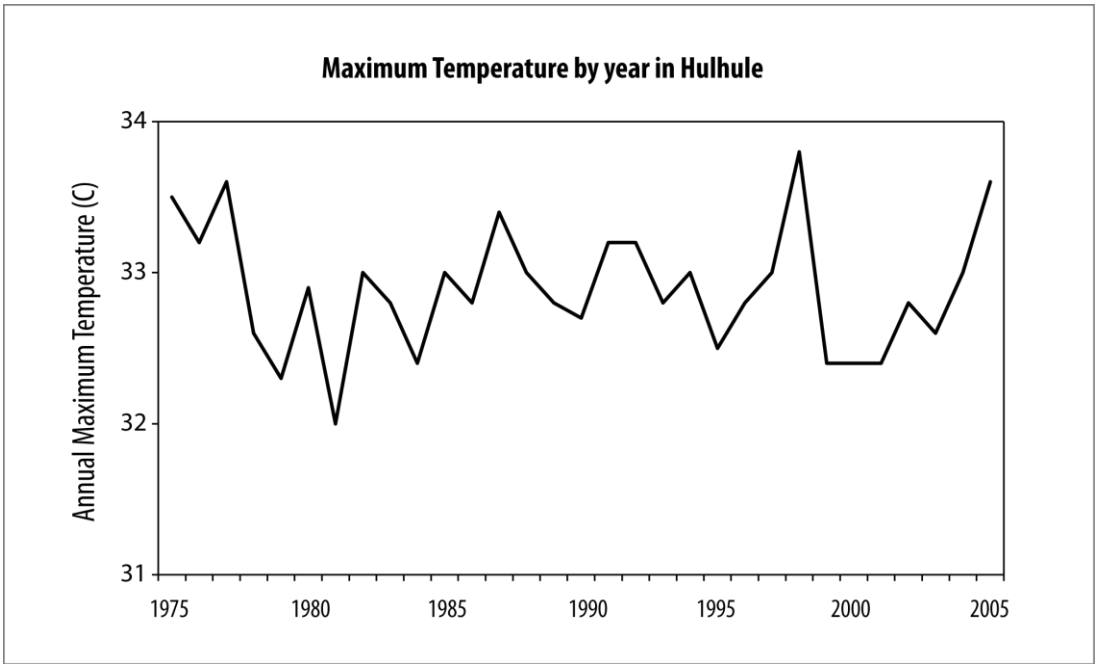


Figure 4.6: Maximum Temperature by year in Hulhule'- 1975-2005 (Source: Hay, 2006)

4.1.3 Hydrology

4.1.3.1 *Tidal Pattern*

Water levels at the site vary mainly in response to tides, storm surge or tsunamis. Tides in the Maldives are mixed and semi-diurnal/diurnal.

Tidal variations are referred to the standard station in at Hulhulé Island located approximately 160 km from the Muravandhoo Island. Typical spring and neap tidal ranges are approximately 1.0m and 0.3m, respectively (MEC, 2004). Maximum spring tidal range in Hulhulé is approximately 1.1m. There is also a 0.2m seasonal fluctuation in regional mean sea level, with an increase of about 0.1m during February to April and a decrease of 0.1m during September to November. Table 4.4 summarizes the tidal elevations reported at Hulhulé, which is representative of tidal conditions at the project site.

Table 4.4: Tidal Variations at Hulhule International Airport

Tide Level	Referred to Mean Sea level
Highest Astronomical Tide (HAT)	+0.64
Mean Higher High Water (MHHW)	+0.34
Mean Lower High Water (MLHW)	+0.14
Mean Sea Level (MSL)	0.00
Mean Higher Low Water (MHLW)	-0.16
Mean Lower Low Water (MHLW)	-0.36
Lowest Astronomical Tide (LAT)	-0.56

The predicted tide curve for the period between 02 March and 1st May 2011 is presented in Figure 4.7 below. Details of the two months are presented in Figure 4.8 and the details for the month of April are presented in Figure 4.9. The largest measured tide during the short monitoring period had a range of about 1.05 m.

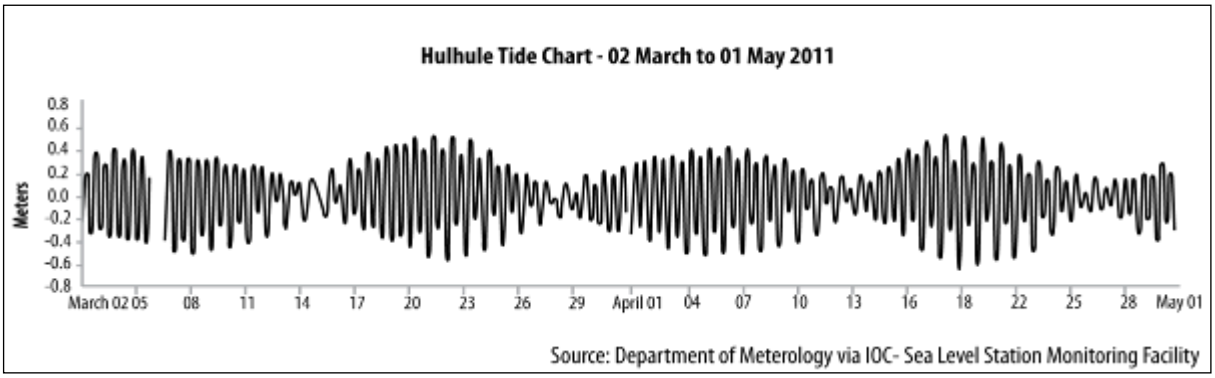


Figure 4.7: Predicted tides for March and April 2011, based on data supplied by Department of Meteorology, Maldives

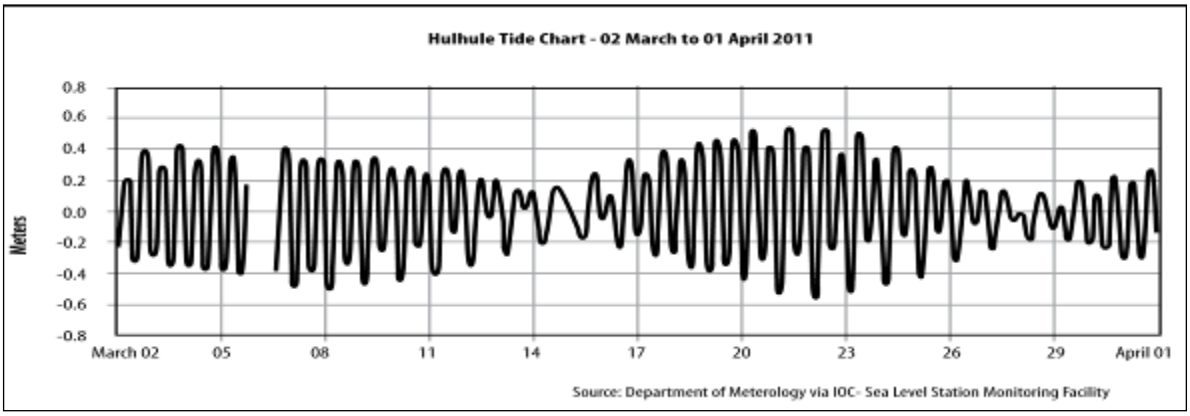


Figure 4.8: Predicted tides for March 2011, based on data supplied by Department of Meteorology, Maldives

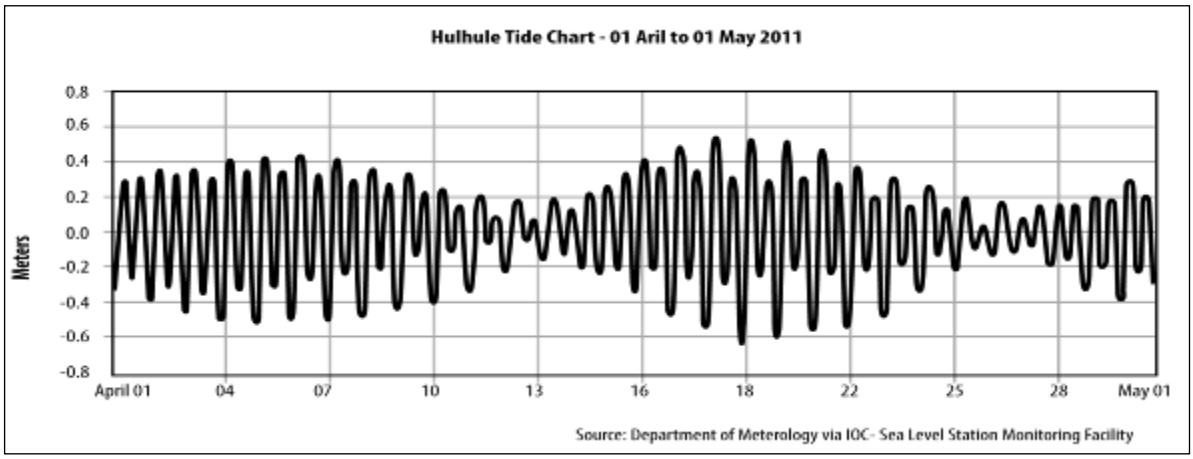


Figure 4.9: Predicted tides for April 2011, based on data supplied by Department of Meteorology, Maldives

4.1.3.2 *Waves*

There are two major types of waves observed along the islands of Maldives. The first type is wave generated by local monsoon wind with a period of 3-8 seconds and the second type is swells generated by distance storms with a period of 14-20 seconds [Kench et. al (2006), DHI (1999), Binnie Black & Veatch (2000), Lanka Hydraulics (1988a & 1998b)]. The local monsoon predominantly generates wind waves, which are typically strongest during April-July in the southwest monsoon period. Wave data for Male and Hulhulé' between June 1988 and January 1990 (Lanka Hydraulics 1988a & 1998b) shows that the maximum significant wave height (Hs) recorded for June was 1.23 m with a mean period (Tm) of 7.53s. The maximum recorded Hs for July was 1.51 m with a Tm of 7.74s. The mean wave periods were 5.0 – 9.0s and the peak wave periods were within 8.0 – 13.0s.

Maldives experiences occasional flooding caused by long distance swell waves that are generated by South Indian Ocean storms (Goda 1988). The swell waves of height 3 meters that flooded Male' and Hulhulé' in 1987 are said to have originated from a low pressure system off west coast of Australia (refer the next section for more detail). In addition, Maldives has recently been subject to an earthquake-generated tsunami reaching heights of 4.0m on land (UNEP, 2005). Historical wave data from Indian Ocean countries show that tsunamis have occurred in more than 1 occasion, most notable has been the 1883 tsunami resulting from the volcanic explosion of Karakatoa (Choi et al., 2003).

Muravandhoo Island is exposed to wind generated waves during both monsoons and during transition periods. The northern side receives the strongest waves during the peak NE and SW monsoon (see figure 4.10) and during transition periods when wind blow from a northerly direction. The stronger waves are mostly likely due to the relatively unobstructed fetch within the northern half of Raa Atoll (see figure 2.1).

The southern side receives the strongest waves during the NE monsoon.

Wave refraction around the small patch reefs on the southwest plays an important role in the wave setup outside the Muravandhoo reef (See figure 4.10). The presence of patch reef to the west is primarily responsible for reduced exposure to SW monsoon wind waves approaching directly from the west. The presence of Madivaafaru to the east somewhat reduces wave activity from the east.

4.1.3.3 *Swell Waves and Storm Surges*

Waves studies around Maldives have identified the presence of swell waves approaching predominantly from a southwest to a southerly direction Kench et. al (2006), Young (1999), DHI(1999), Binnie Black & Veatch (2000) and Naseer (2003).

Being located inside the atoll lagoon, the island is generally protected from the predominant Indian Ocean swells approaching from the SW during the SW monsoon. However, some residual waves are expected as they refract through the western rim of Raa Atoll.

The strongest swell wave activity occurs when winds blow directly from the N or NW. The northern reef line, particularly the NE corner is exposed to these waves and is evident from the algal rim and the presence of old rubble.

Waves generated from abnormal events could also travel against the predominant swell propagation patterns (Goda, 1998), causing flooding on the eastern and southern islands of Maldives (UNDP, 2009).

As noted in the previous section, Muravandhoo Island is located in a high risk cyclonic hazard zone. It has the potential for a 2.30 m storm tide in a 500 year return period (UNDP, 2006, p45).

4.1.3.4 *Currents*

Currents that affect the reef system of Muravandhoo Island can be caused by tidal currents, wind-induced currents and wave-induced currents. It is presumed that generally current flow through the country is defined by the two-monsoon season winds. Westward flowing currents are dominant from January to March with the change in current flow pattern taking place in April and December (Kench et. al, 2006). In April the westward currents become weak while the eastward currents start to take over. In December the eastward currents are weak with the westward currents becoming more prominent. Hence, currents within the site are very likely to be heavily influenced by the monsoons.

Current measurements were undertaken on the island during field visits (NE monsoon) during day time high tide. Generally, long term studies are required to establish the prevailing site

specific current patterns. However, due to time limitations of the present study a snapshot assessment was undertaken using drogue technique. The findings of the tide measurements are presented in Figure 4.12.

Current measurements varied based on location. Current flow was generally in a W direction on the reef flat and in a NW direction in the deep atoll lagoon. Flow rate was higher in the deep lagoon and on the ends of the island at over 0.2 m/s.

4.1.3.5 *Bathymetry*

A detailed bathymetric survey of the proposed borrow sites was undertaken during November 2011. Survey results have been summarised in bathy charts Appendix G. The depth figures presented are in meters below MSL.

The reef flat areas have a fairly flat depth ranging from -1.0 to -1.5 m MSL. On the south side, the reef slopes steeply from -1.0 m to -15 m within a space of 30 m.

The northern side generally has a gently sloping reef with numerous small submerged patch reefs. There is an embayment towards the centre of the northern side where the reef is narrowest with just 200 m. The depths in this area slope moderately gently from -1 to -8 within a space of 90 m. On the western half of the reef system, the reef slopes gently from -1 to -15 m within a space of 350 m. The eastern half of the reef system where the island is located has more pronounced reef edges reaching a about -0.6 m on the rim.

The proposed jetty extends up to deep water (between -2.5 to 3.5) and therefore, no dredging is required. Boats may be able to access the site without further dredging. The proposed water villa, alternative breakwater and spa locations have depths ranging between -0.8 m to -1.0 m.

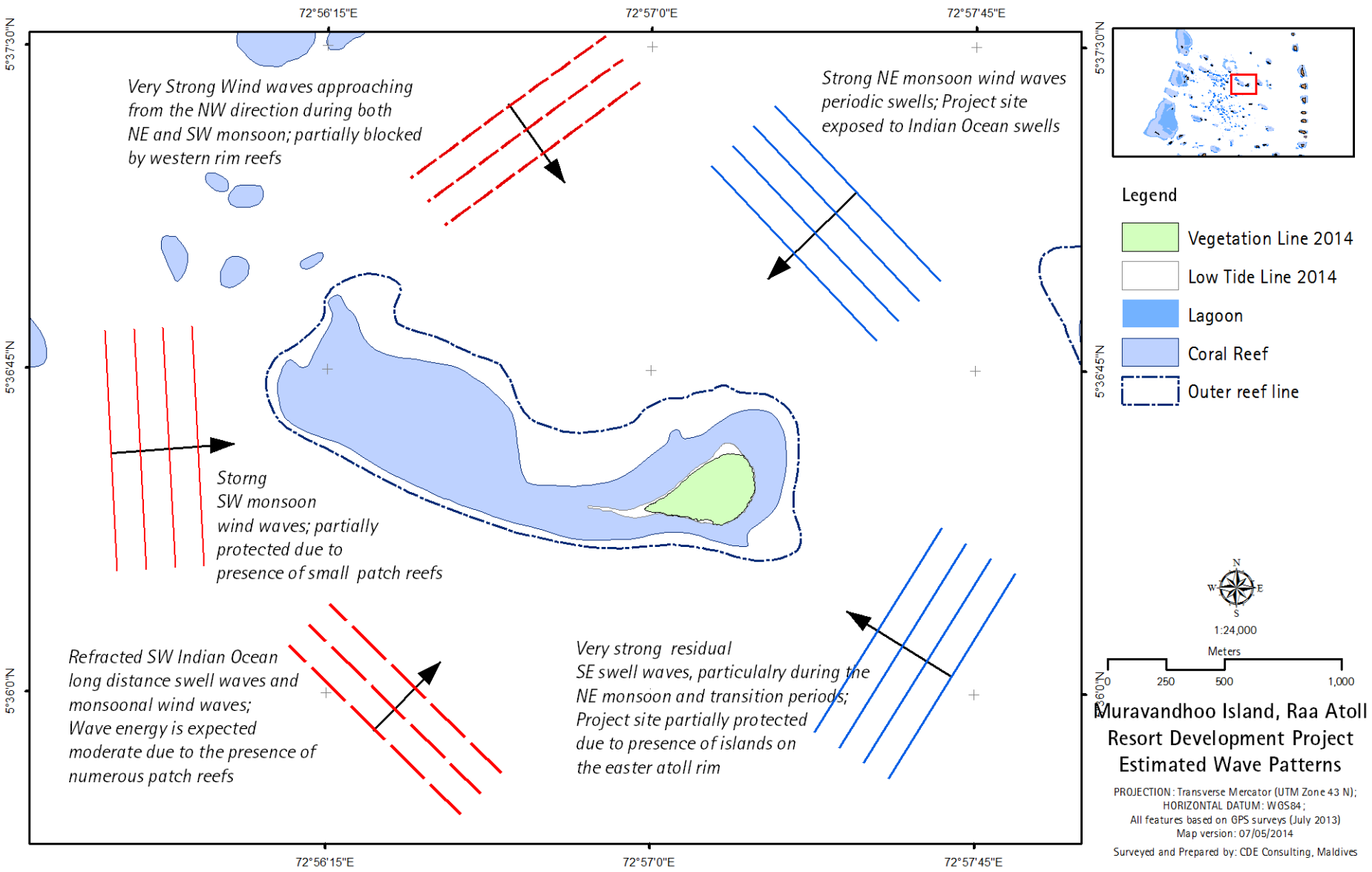


Figure 4.10 Estimated wave patterns aorund Muravandhoo Island

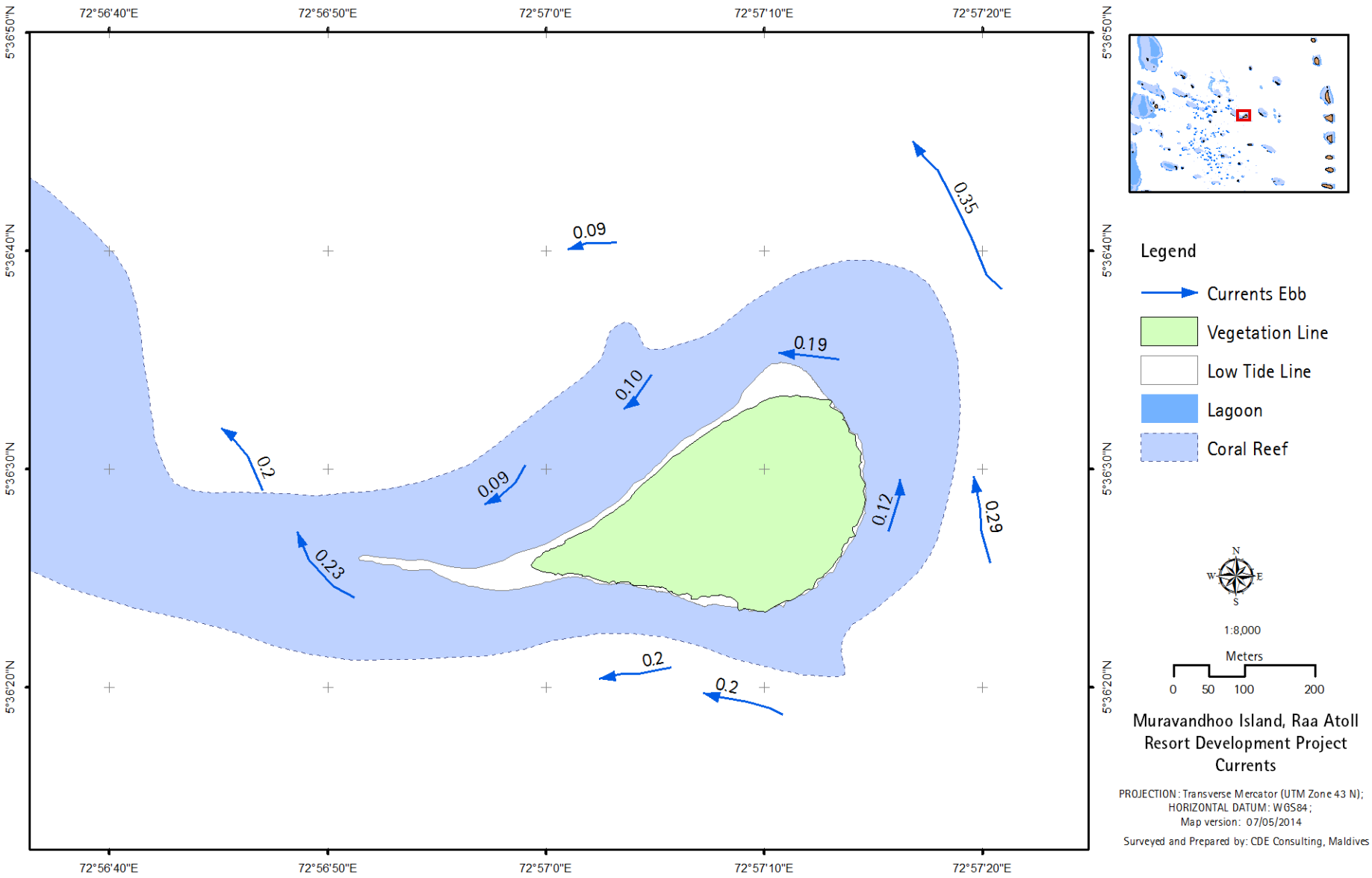


Figure 4.11 Results of current study – March 2014

4.1.4 Beach

4.1.4.1 *Beach erosion and coastal changes*

Historical changes and long-term erosion

Analysis of historical changes to beach was undertaken using remote sensing technology by comparing aerial photographs from 1969 (see figure 4.12) against shoreline data from 1996, 2004, satellite imagery from 2008, 2012 and GPS surveys from 2013.

The results show that the island has undergone shoreline changes over the last 45 years. Comparison of data between 1969 and 2014 shows that, overall the island has slightly reduced in size from 9.5 Ha to 8.2 Ha (Figure 4.13). Overall approximately 1.4 ha has eroded and 0.3 Ha have been gained, with a net 1.1 ha loss. Most of the beach retreat has been on the eastern side where a retreat of 45 m was recorded. These trends can be verified on the ground form the vegetation in the area, which now lacks any coastal vegetation strands, which are found on stable areas like the northern shoreline of the island. The area now comprises of mixed woody trees, which would have been the second layer of vegetation on the island. The southern shoreline has retreated less dramatically but had still lost, on average, 15 m of vegetation land. The lost material has been found on the island beach system, which now has a 250 m long sand spit. The sand bank on the western half of the reef system has also grown in size, presumably from the material lost from the main island.

This assessment shows the long-term trend based on two points in temporal scale, but it discounts the periodic shifts that may have occurred in between. Comparison of multi-decadal data shows that the shoreline had been comparatively stable except for a small area on the NEside and some sections of the southern shoreline (see Figure 4.14). The western end is particularly mobile with periodic swings in the vegetation line. This pattern was also observed in Maamgili Island (CDE 2011).

The recent change on the southern shoreline appears to have been triggered during the late 2000s. Comparison of short-term data from 2008 to 2014 (See Figure 4.14) shows that most significant changes occurred over the last 5 years. The vegetation line had retreated 30 m on the SW end and accreted about 10 m towards north. This pattern is evident in the young shrub vegetation in the area. The change son the eastern end has been more modest in the last 5 years with erosion of 7-10 m.

The observed volatility on the NE corner and western end, and the gradual erosion on the southern side is expected to continue in the near future. Some coastal protection measures may be required to prevent erosion on the southern side and NE side of the island.

Predicted short-term beach changes

The recent trend in beach growth on the W side indicates that there may be continued accretion in this zone. There is also a high risk of the over water structures being engulfed by the beach particularly due to the energy reduction potential of the concrete stilts.

There is a strong likelihood of moderate erosion continuing around the eastern and southern shoreline, making it difficult to retain a dry beach in these areas.

The northern beach is expected to remain fairly stable.

4.1.4.2 *Beach Characteristics*

Beach characteristics could be usefully determined by two main features: i) beach composition; ii) beach profiles.

Beach composition and sediment characteristics

The beach material right around the island comprise mainly of fine sediments, except of the eastern side which contains coarse material. The size of the island sediment footprint marked by a sandy outline around the island shows that there is no substantial sediment movement around the island, given the minimal footprint of the *moat* around the island.

Beach Profiles

Beach profiles provide invaluable information about the sediment volume, beach slope and changes to volume and slope over time. In addition the slope, height and width are good indicators of wave and wind conditions, and erosion dominant areas. In general, gentler slopes and wider widths indicate an accreting area with generally lower wave energy and erosion at the time of the survey. Steeper slopes indicate stronger wave energy particularly if the beach material is composed of coarser material. Steeper slopes are also associated with severe erosion, in other areas.

Beach profiles for the island are presented in Appendix I.

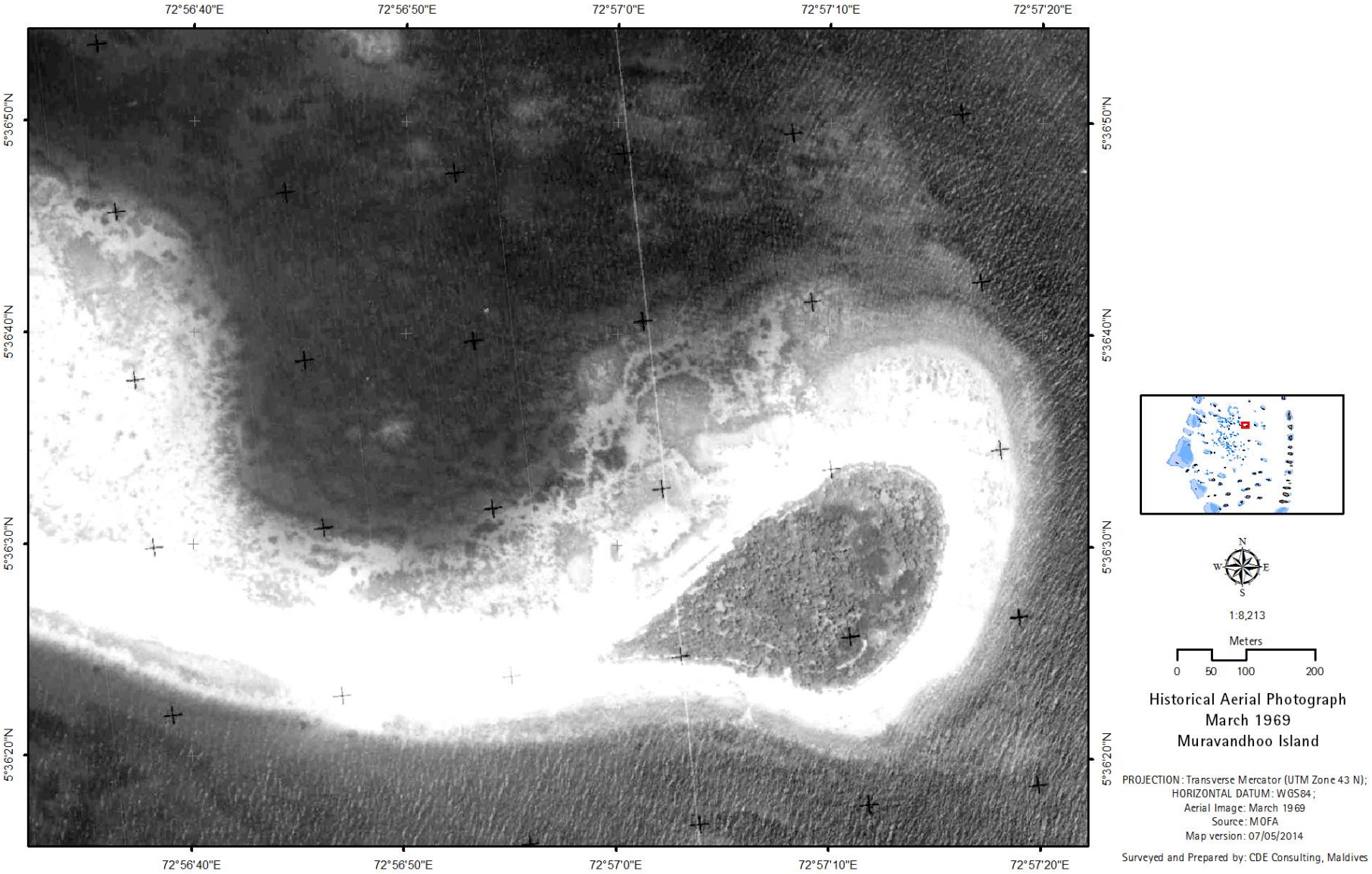


Figure 4.12: Historical photograph of Muravandhoo - 1969

Figure 4.13: Historical changes to shoreline – 1969 and 2014

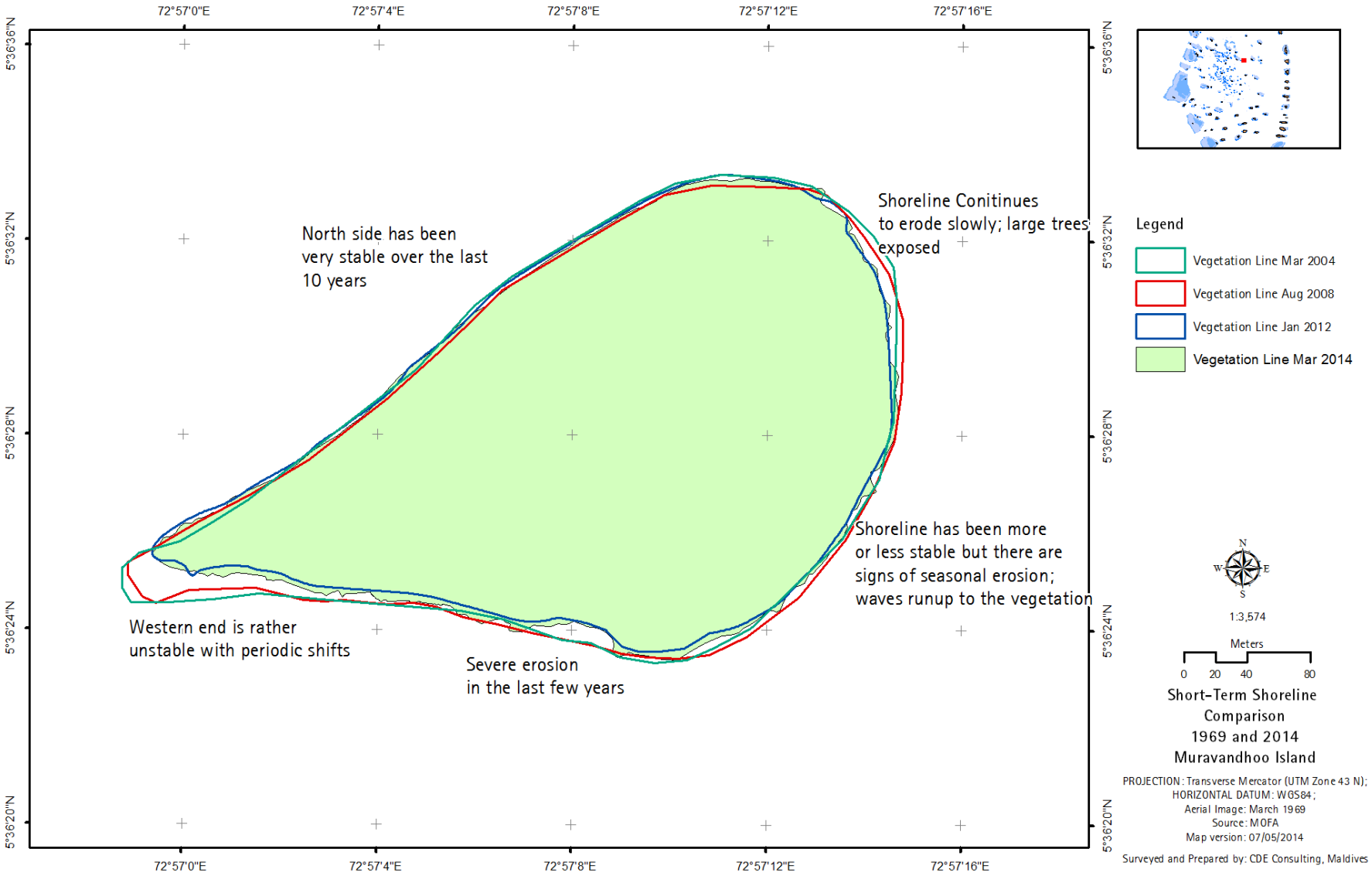


Figure 4.14: Historical changes to shoreline – short-term

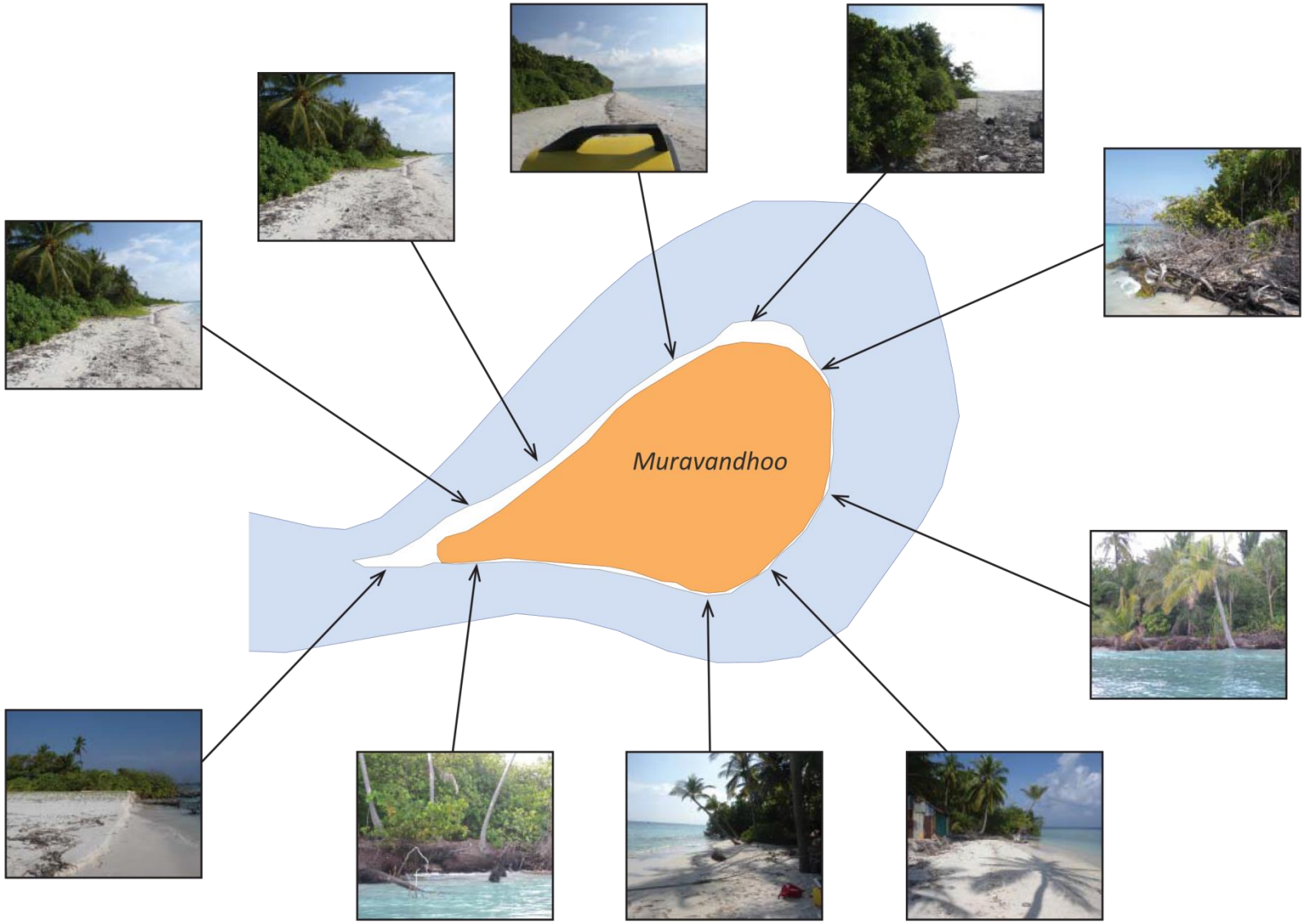


Figure 4.15: Pictorial summary of coastal conditions on Muravandhoo Island

4.1.4.3 *Pitorical description of Coastal Conditions*

A pictorial summary of the coastal conditions on the eastern and western side of the island is provided in Figure 4.15.

Northern Side

The northern end of the island is characterised by a narrow beach. During spring tides, waves may reach up to the vegetation line. There was a lot of debris observed on the island, which are believed to be flotsam and green waste from the severe erosion that has occurred on the eastern side.

Eastern side

The eastern side is characterised by severe erosion (See Figure 4.15).

Southern side

Southern side have sections of eroding areas as well seasonally accreting areas.

4.1.4.4 *Causes of Beach Erosion in Muravandhoo*

Much of the major recent erosion and depositional changes that have occurred on Muravandhoo Island is the result of natural causes. Some of the possible reasons are:

- Changes to wind/wave dynamics – There are known changes to monsoonal intensity and oceanographic conditions, which may be responsible for periodic shifts in the erosion and accretion patterns. Usually such changes affect an entire region and will be visible from the neighbouring islands. Findings from the nearby Maamigili Island show a similar pattern in the long-term erosion trends. Such changes may be associated with periodic or yearly variations in wind speeds, direction, angle of wave approach and the intensity of storm events.
- An aging reef flat – the reef flat is clearly not as productive of carbonate sediments as it was >3000 years ago. Any sand loss from the island is not likely to be balanced by influx of new sediment. The island mass is thus a finite reserve of sand, that needs careful management. The quality of reef has observably declined even over last 40 years based on the old aerial photographs. Number of coral colonies has disappeared, particularly from the southern and south eastern side either through natural causes or mining.

– Recent perturbations – The northern Maldives is known to experience strong storm events, which could change the coastal conditions abruptly.

4.1.5 Marine water quality assessment

The primary objective of the lagoon water quality sampling was to determine the baseline conditions of the marine water in around Muravandhoo. Water samples were collected from three locations. All water quality tests were done at the MWSC laboratory.

The following table shows (see Table 4.5) the test results of the marine water samples collected on 17 March 2014. Laboratory results are attached in Appendix H.

Table 4.5 Marine water quality assessment results from MWSC laboratory

Parameter	Optimal Range (EPA)	Results					
		SW1	SW2	SW3	SW4	SW5	SW6
pH	8.0 – 8.3	8.16	8.16	8.18	8.17	8.20	8.17
Temperature (^{o}C)	18 - 32	24.4	24.9	25.0	25.1	25.0	24.8
Salinity ($^{o}/_{oo}$)		32.29	31.98	32.09	31.92	32.09	31.67
Turbidity (NTU)	3-5	0.173	0.174	0.171	0.233	0.381	0.190
Nitrate (mg/L)	<5	0.4	0.4	0.4	0.4	0.4	0.5
Phosphate (mg/L)	0.005 – 0.020	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate (mg/L)	2 – 80	2500	2600	2600	2550	2550	2600
Nitrogen Ammonia (mg/L)	2-3	0.19	0.04	<0.02	0.03	0.02	<0.02
Total Suspended Solids (mg/l)	-	<5	<5	<5	<5	<5	<5
Biological Oxygen Demand (BOD)- (mg/l)	<2	5	6	5	6	4	6

Marine water qualities for most parameters appear to be within acceptable ranges at all sites. A pH range of 8.16 to 8.20 was observed in all the samples tested and the pH level is within the recommended optimal range by EPA. The average Sulphate level ranges between 2500 mg/L – 2600 mg/L which is within the normal limits for seawater. On average, around the world seawater usually contains about 2700 mg of sulphate per litre. Though nitrate levels fall within the acceptable level, phosphate levels appear to be slightly higher than the acceptable levels and Biological Oxygen Demand of all the water samples varies between 4 to 6 mg/l which is slightly higher than acceptable levels in proposed by EPA (<2 mg/L). As BOD is a measure of the amount of oxygen that bacteria will consume while decomposing organic matter under aerobic conditions, it denotes that decomposable organic matter is relatively high in the sampling sites.

4.1.6 Topography

Muravandhoo Island is generally low lying with an average elevation of +1.1 m MSL. Topographic surveys for the island covering vegetation lines, shoreline and key coastal features are presented in Appendix G.

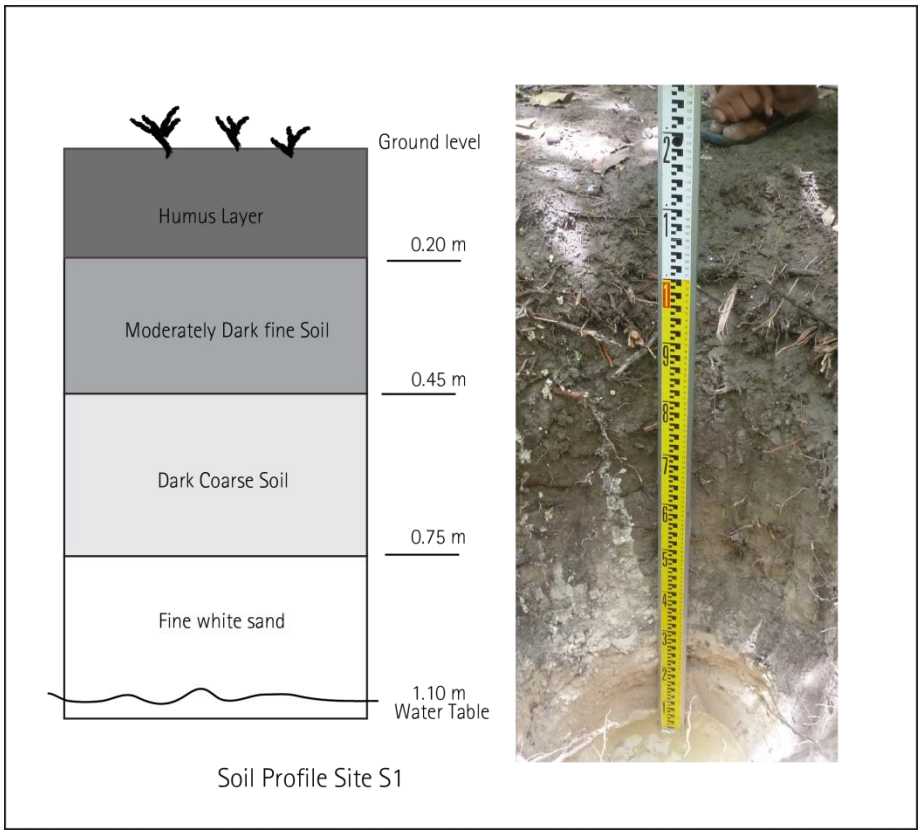
4.1.7 Soil

The soil conditions of the site were similar to soil conditions across the Maldives, consisting considerable quantities of un-weathered corals as parent materials, coral rocks and sand. Since the island is an uninhabited island with very minimal human presence, a thick layer of dried leaves and humus/peat (up to 10 cm) is observed on the top. A large number of roots can be found with in this layer due to the excessive vegetation growth on the island.

The soil found underneath the humus layer are coarse in texture with a top layer of dark soil (up to 19 cm) followed by a transition zone of soil to coarse rocks (up to 11 cm) down to the underlying bedrock. The bedrock is a thick hard-pan layer of cemented calcium carbonate (up to 14 cm). A deep layer of white and (up to 61 cm) is found underneath the bedrock before, the water table is reached at a depth of 1.10 meters.

A good layer of topsoil has allowed vegetation to develop in the area extensively, but the shallow bed rock prevents the penetration of the roots of most plants except for the larger tree species. The soil also exhibits elements of high porosity and high infiltration, indicating the site to have a generally poor water holding capacity.

Normally, areas with high levels of humus and organic matter has a rather acidic soil, however this site has a PH value of 7.79 indicative of slightly alkaline soils. This is mainly due to the presence of excess calcium in the soil (at the depth of the water level).



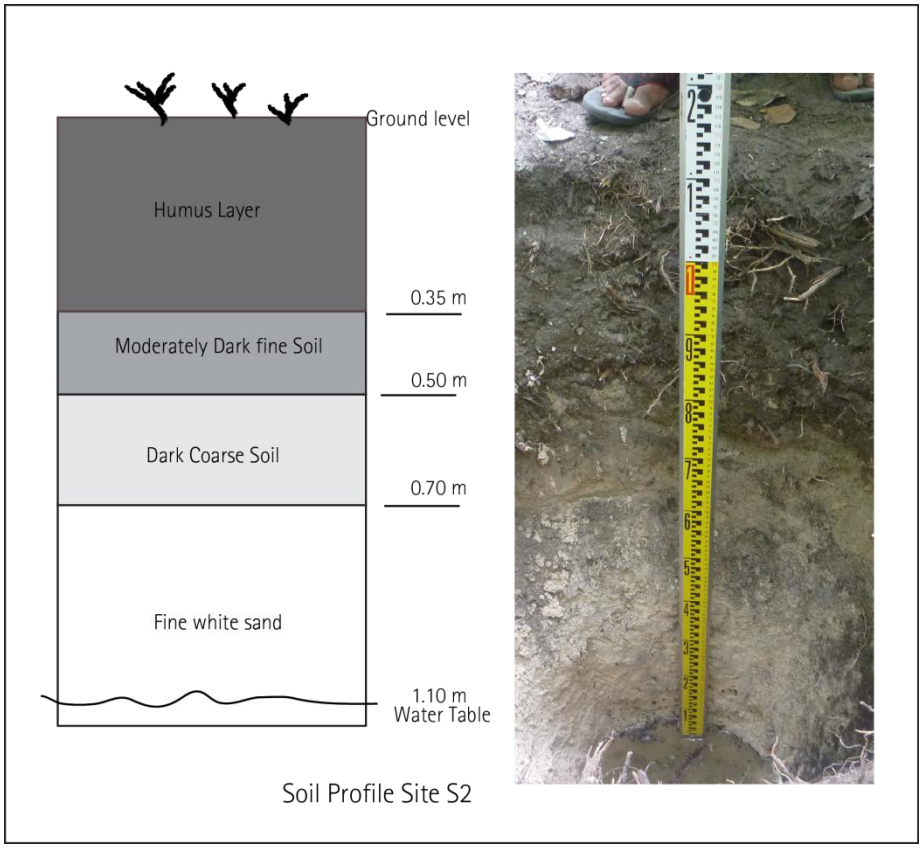


Figure 4.16: Soil profiles of Muravandhoo Site 1 AND Site 2

4.1.8 Ground water

Ground water quality was assessed by taking samples from three locations during the field visit. Samples were collected in a 100 ml sterilized glass bottle to test for biological content and in three 500 ml clean PET bottles to test for all other parameters. Samples in the PET bottles were collected after washing the bottle with the sample to be collected. Geographical coordinates of all locations were recorded using a differential GPS. Time and date of sampling was also recorded. All samples were kept at 4 degree Celsius and sent to MWSC laboratory for analysis.

Groundwater assessment was conducted to assess the ambient conditions of groundwater. The water table stands approximately 1.3 m below ground level at MSL. As illustrated from Table 4.6, the investigations of groundwater revealed that the groundwater in site is in good condition. Laboratory results are attached in Appendix H.

Table 4.6: Results for water quality testing for ground water

Parameter	Results		
	G1	G2	G3
pH	7.79	7.02	7.16
Temperature	24.4	24.3	24.5
Salinity (ppt)	22.39	11.60	12.07
Phosphate (mg/l)	0.36	0.15	0.38
Turbidity (NTU)	0.518	8005	15625
Nitrate (mg/l)	0.4	0.6	0.7
Nitrogen Ammonia (mg/l)	0.19	0.60	1.79
Sulphate (mg/l)	1650	825	800
Biological Oxygen Demand (mg/l)	25	26	42
Total Suspended Solids (mg/l)	<5	7463	15150
Coliform, Total (CFU/100mL)	137	TNTC	CGW/WC
Coliform, Faecal	132	TNTC	CGW/WC

The quality of ground water appears to be poor and indicates high levels of contamination. The concentration of nitrates, nitrogen ammonia, phosphates and sulphates are at elevated levels. The exceeded levels of turbidity, BOD and the total and faecal coliforms show that the ground water is contaminated by microorganisms. All these results signifies the increased levels of organic nutrients in the water tested, indicating that the organic load of the water is high and there is need to minimise the organic components.

4.1.9 Air and Noise

General local air quality in Muravandhoo was observed to be in pristine condition.

Noise levels were observed to be insignificant in its natural state especially with dense coconut areas trees of the island. Noise levels at various locations along the line transect (for the vegetation survey) were recorded using a handheld sound level meter of 0.1dB resolution. The average noise level inside the islands was on average 49.6 dB (A). In areas close to the beach sound of waves crashing on the beach was generally heard and ranged between 0.60 dB(A) and 0.70 dB(A). Other sounds heard were from birds such as Crows.

Air quality of the Maldives is generally considered to be good and in pristine state. As the islands of the Maldives are small, sea breezes flush the air masses over the islands and refresh air over the islands.

Recently it has been observed that trans-boundary air pollution is affecting the air quality of the Maldives. Trans-boundary air pollution in the Maldives became first known in 1997, when large parts of the country were affected by haze caused by forest fires in Indonesia. The haze layer blanketed the country between October 1997 and December 1997 and significantly affected the routine lives of the Maldivians. The actual state of the trans-boundary movement of air pollutants over the Maldives was measured in the Indian Ocean Experiment (INDOEX). INDOEX results showed widespread pollution over large sections of the Indian Ocean. In March and April 1999, the scientists were surprised to find a dense brownish pollution haze layer stretching an area of more than 10 million square kilometres over the Indian Ocean tropical region. Because of the pollution, visibility over the open ocean dropped below 10 km, a visibility which is typically found near polluted regions in the eastern United States and Europe.

4.1.10 Land use

Muravandhoo Island was used by the locals of for various activities including agriculture, recreation, collecting firewood, forestry and sand mining. Hence, the island has undergone both visible and potentially unknown changes in the past. Existing developments on the island include remnants of a building (mainly outer walls), evidence of agriculture and poultry.

4.1.11 Marine resource use

Muravandhoo north side is regarded as one good harbour area for travelling vessels to moor. Occasional bait fishing and recreational reef fishing is prevalent on the outer reef. However, it is not regarded as a major bait fishing area.

4.2 Natural and Biological Environment

4.2.1 Terrestrial ecology

4.2.1.1 *Flora*

General characteristics

Muravandhoo Island is a medium sized island with a moderately well-established vegetation system. There is a well-established coconut dominated forest on the western side and a sub littoral thicket on the eastern side. The coconut-dominated forest has a moderately high canopy and healthy palms, and the bottom layer is dominated by indigenous mixed species. The top layer of the forest is dominated by Coconut trees *(Cocos nucifera).*

Much of its coastal vegetation on the eastern and southern side has been lost to erosion. At present much of the vegetation along the shoreline represent vegetation of sub littoral thicket rather than coastal strand or shrubs.

There is a distinct area on the western end of the island which is growing and young, comprising to some extent coastal strand as well as pioneer vegetation.

Much of the island is strongly affected by human activities and most of the larger varieties including Coconut and Funa were planted. Numerous areas have been cleared, particularly the undergrowth, and new species have been introduced.

There are well-established footpaths on the island with coconut palms planted on the sides.

Unique trees, very old trees or vegetation was observed on Muravandhoo Island.

An inventory of plants observed during the field visits along the transects are presented in Table 4.8

Vegetation Types

For the purposes of this assessment, the major groups of vegetation can be classed into the following categories of vegetation and land use. The main reason for this adoption is the specific nature of vegetation in small coral islands. Vegetation classification was undertaken using remote sensing and GIS software based on the methodology outlined at the start of this section. The results of the vegetation classification are presented is Figure 4.18.

1. Coconut Dominated Forest: The top layer of the forest is dominated by Coconut trees *(Cocos nucifera).* The central layers comprise of Boa-kashikeyo (Pandanus tectorus),

Midhili (Terminalia catappa), Funa (Calophyllum inophyllum), Dhun'buri (Ochrosia borbonica), Dhiggaa (Hibiscus tiliaceus) and less frequent occurrence of Maakashikeyo (Pandanus odoratissimus), Nika/Kiri gas (Ficus benghalensis), Ethumadhu (Similax china).

2. Sub littoral Thicket: Dominated by Dhiggaa (Hibiscus tiliaceus), Ethumadhu (Similax china), Midhili (Terminalia catappa), Kaani *(Cordia subcordata)*, Hirundhu *(Thespesia populnea)*, Uni (Guettarda speciosa) and Funa (Calophyllum inophyllum). The bottom layer is dominated by Magoo (*Scaevola taccada)* and Kuredhi *(Pemphis Acidula)* Binhima gas (Desmodium triflorum), Ahi (Morinda citrifolia).
3. Funa Grove: Dominated by Funa (Calophyllum inophyllum) with sparsely distributed Ethumadhu (Similax china) and Dhiggaa (Hibiscus tiliaceus)
4. Littoral Shrub vegetation: Vegetation is mainly dominated by Magoo (*Scaevola taccada) and Kuredhi (Pemphis Acidula).* Pioneer vegetation, namely, *Cyperus conglomeratus*, *Lupturus repens*, *Launaea pinnatifida* and *Thuarea involute* was also observed.
5. Coastal Bush Vegetation: Vegetation is mainly dominated by Dhiggaa (Hibiscus tiliaceus), Uni (Guettarda speciosa), Magoo (*Scaevola taccada) and Kuredhi (Pemphis Acidula).*
6. Coastal strand vegetation: A narrow stretch of strand vegetation dominated by Magoo (*Scaevola taccada).*

Figure 4.17: Images of the coconut dominated forest

Figure 4.18: Images of the sublittoral thicket

Figure 4.19: Images of the Funa Grove

Figure 4.20: Images of the Coastal Vegetation

4.2.1.2 *Fauna*

Birds

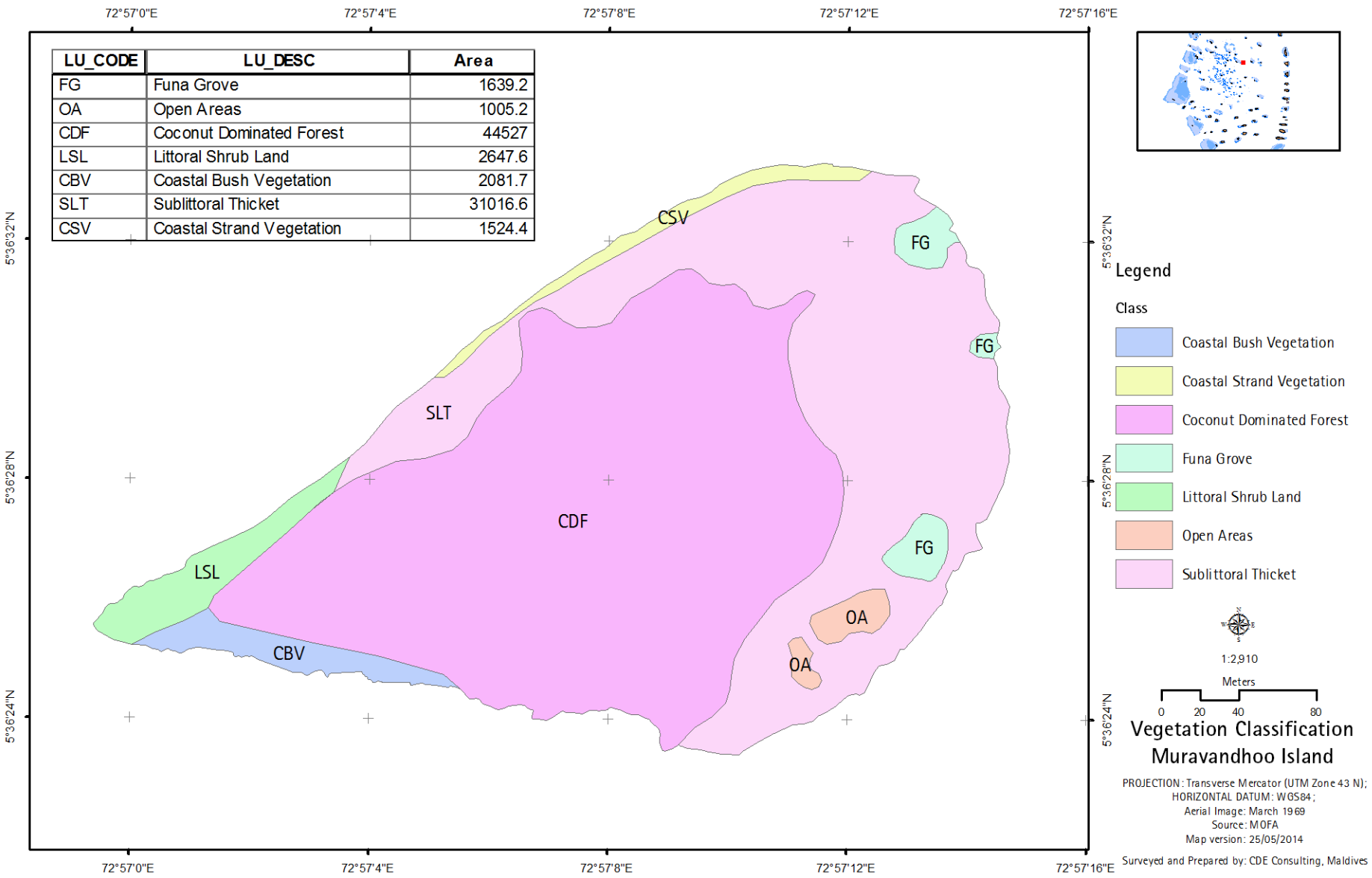
Birds observed during field visits were mainly Black-naped Tern *(Sterna sunmatrana)*.

A large number of free-range chicken were observed on the island, which are maintained by the current caretakers of the island.

Reptiles and Mammals

Records of reptiles and mammals are minimal. Two species were identified: namely one gecko (*Hemidactylus frenatus)* and the Common garden lizard (*Calotes versicolor)*.

Amongst pests, rats were observed in moderate numbers on the island.



LU_CODE	LU_DESC	Area
FG	Funa Grove	1639.2
OA	Open Areas	1005.2
CDF	Coconut Dominated Forest	44527
LSL	Littoral Shrub Land	2647.6
CBV	Coastal Bush Vegetation	2081.7
SLT	Sublittoral Thicket	31016.6
CSV	Coastal Strand Vegetation	1524.4

Figure 4.21: Vegetation classification results for Muravanadhoo Island

Table 4.8: Vegetation inventory of Muravandhoo Island

Category	Name				Distribution (ACFOR[1])	Additional Info
	Family	**Scientific**	**English**	**Dhivehi**		
Trees	Arecaceae	*Cocos nucifera*	Coconut palm	Dhivehi ruh	A	
	Combretaceae	*Terminalia catappa*	Country almond	Midhili	C	
	Malvaceae	*Hibiscus tilaceus*	Sea hibiscus	Dhiggaa	F	
	Pandanaceae	*Pandanus tectorus*	Screw pine	Boa kashikeyo	F	Very few
	Rubiaceae	*Guettarda speciosa*	Nit pitcha	Uni	C	
	Malvaceae	*Thespesia populnea*	Tulip tree	Hirun'dhu	F	
	Ehretiaceae	*Cordia subcordata*	Sea trumpet	Kaani/Kauni	F	
	Guttiferae	*Calophyllum inophyllum*	Alexander Laurelwood tree	Funa	F	Also occurs in small groves
	Apocynaceae	*Ochrosia borbonica*	Corkwood	Dhun'buri	O	
	Pandanaceae	*Pandanus odoratissimus*	Panadanus	Maakashikeyo	R	
	Moraceae	*Ficus benghalensis*	Banyan tree	Nika/Kiri	R	
	Liliaceae	*Similax china*	China root	Ethumadhu	O	
Shrubs	Goodeniaceae	*Scaevola taccada*	Sea Lettuce	Magoo	C	
	Lythraceae	*Pemphis acidula*	Iron wood	Kuredhi/Keredhi	F	
	Fabaceae/Papilionaceae	*Desmodium triflorum*		Binhima gas	O	
Others (ground cover/ vines)	Cyperaceae	*Cyperus conglomeratus*	-	Mirihi	O	
	Poaceae	*Lupturus repens*			O	Only in pioneer vegetation zones
	Asteraceae	*Launaea pinnatifida*			O	Only in pioneer vegetation zones
	Poaceae	*Thuarea involuta*			O	Only in pioneer vegetation zones
	Cuscuta sp.	*Convolvulaceae*	Lone Vine	Velanbuli	O	

[1]*NOTE: ACFOR scale: A: Abundant; C: Common; F: Frequent; O: Occasional; R: Rare*

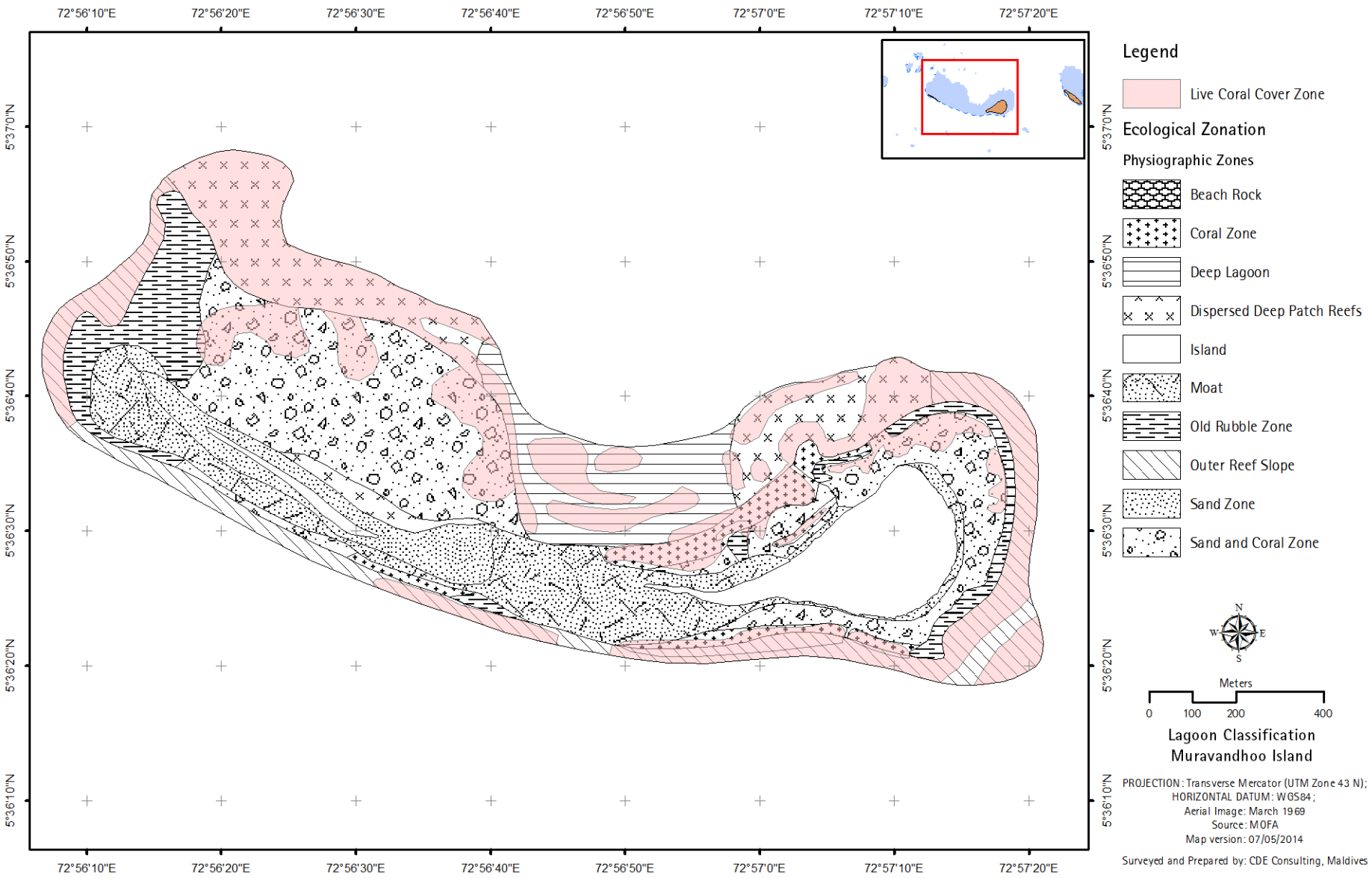


Figure 4.22: Ecological zonation map of reef areas around Muravandhoo Island

4.2.2 Marine environment

4.2.2.1 *Lagoon Environment*

The reef system of Muravandhoo is moderate, covering over 140 Ha. The length of the reef system is 2,200 m and width at its width point is 650 m. The reef system is oriented in a WNW-ESE direction and the island is oriented in an E-W direction. The average depth of the reef flat is around -1.5 m MSL. There is only one island on the reef system and land comprises of about 7% of the reef area. There is a narrow seasonal sand bank on the western half of the reef with an area of 0.8 Ha at low tide.

Figure 4.22 above provides a summary of the ecological zonation of reef system around Muravandhoo Island, based on remote sensing classification and ground truthing.

The lagoon system comprises various zones of differing characteristics. The shallow reef area is the most prominent zone on the reef system with areas of coral and sand zones. The moat or the sediment movement footprint of the island occupies a significant chunk of the reef flat and may continue to expand in the future.

The northern side comprises of deeper and gently sloping reef with areas of coral and sand, dispersed coral heads and a deep lagoon.

There are partially developed old coral rubble zones on the western and eastern end of the reef system, suggesting the presence of strong wave activity. This ridge is absent on the north, which is slightly deeper.

Live coral over areas are quite substantial but mostly on the northern side. The deep lagoon, reef flat as well as the reef slope contains live coral cover zones (See Figure 4.22).

There is also a prominent live coral cover zone on the southern side, except around the sand banks..

4.2.2.2 *Line Transect Surveys*

Site 1

Transect was laid at 3m depth. Dominant benthic cover substrate along this transect was live coral. Main coral families observed in this area belonged to Acroporidae (branching 56% and table 14%) and Poritidae (branching 3% and massive 1%).

Loose rubble coverage was high making up 17% of the transect area. Rocky pavement and sand coverage was low making up 6.5% of the transect area. Summary of benthic cover along transect 1 is presented in Figure 4.23 below.

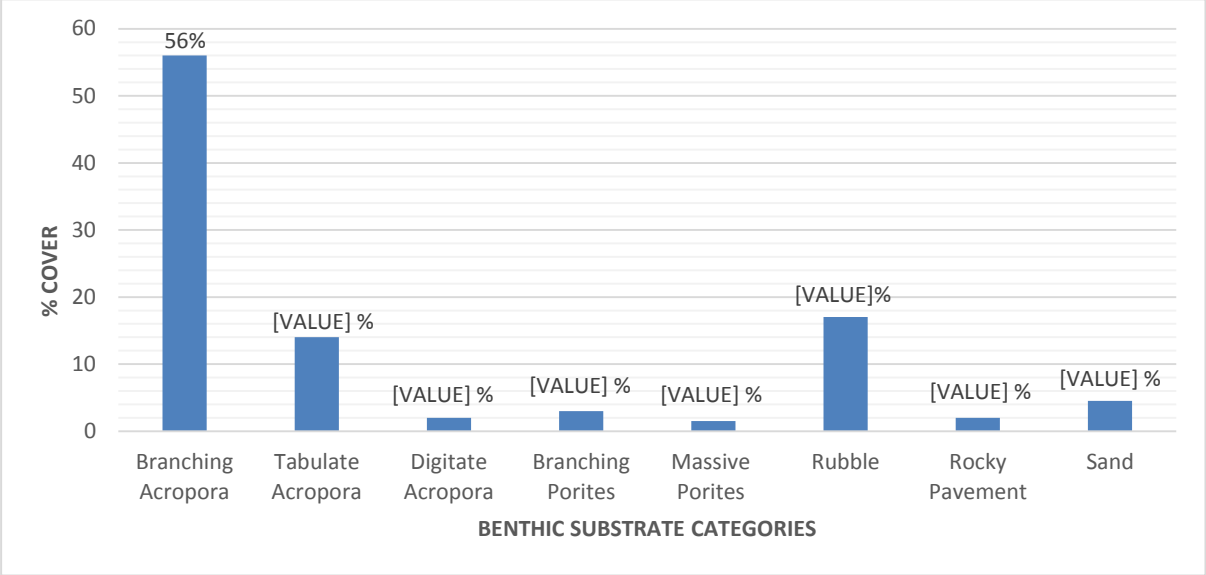
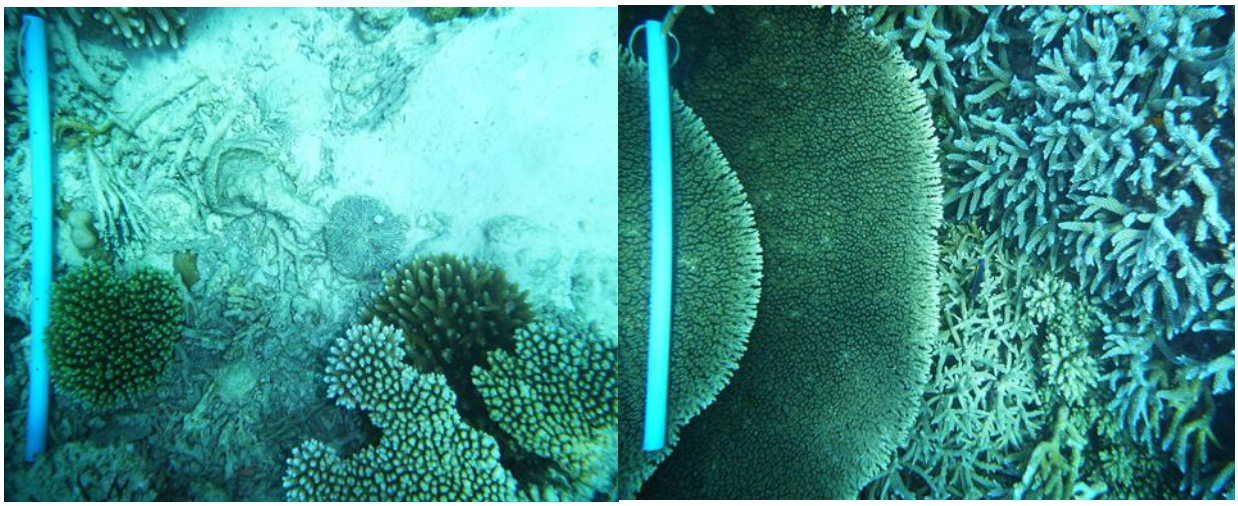


Figure 4.23: Mean benthic substrate composition at Transect Site 1



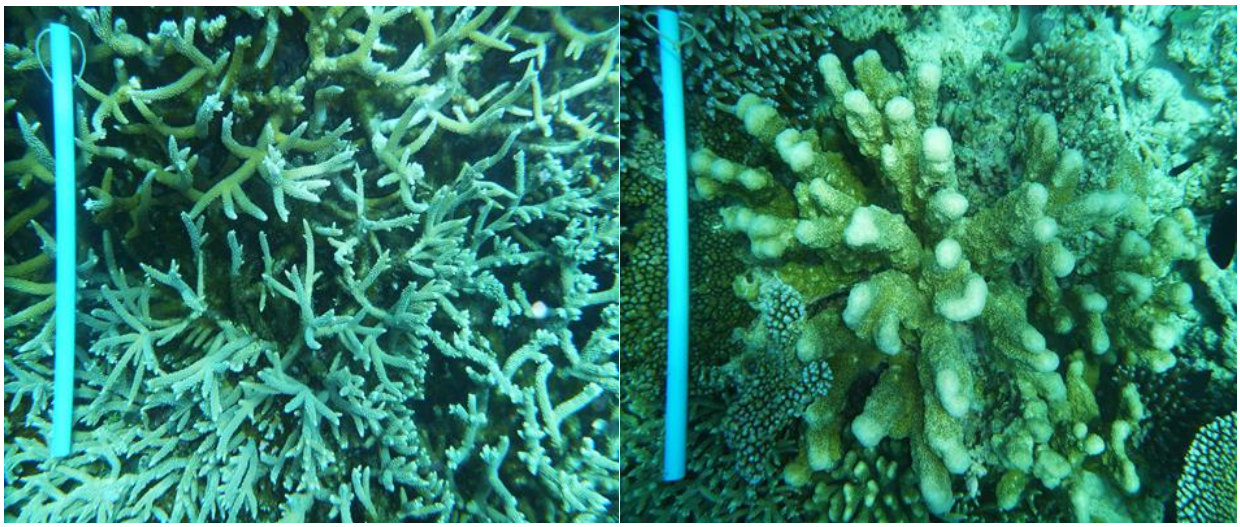


Figure 4.24: Photos showing the benthic cover at Transect Site 1

A total of 35 species belonging to 9 families was recorded in the fish census of the transect 1. The dominant fish species along this transect were Pomacentridae (11 species) and Labridae (6 species). Table below displays the results of fish census along transect 1.

Table 4.10: Fish Census along transect 1

family	**genus**	**Species**	**Number of fishes**
Serranidae	Cephalopholis	Cephalopholis argus	2
Lutjanidae	Lutjanus	Lutjanus bohar	2
Chaetodontidae	Chaetodon	Chaetodon trsifasciatus	2
Chaetodontidae	Chaetodon	Chaetodon trifascialis	4
Chaetodontidae	Chaetodon	Chaetodon auriga	2
Pomacanthidae	Pygoplites	Pygoplites diacanthus	2
Pomacanthidae	Centropyge	Centropyge multispinis	2
Pomacentridae	Dascyllus	Dascyllus aruanus	4
Pomacentridae	Chromis	Chromis virdis	6
Pomacentridae	Pomacentrus	Pomacentrus nagasakiensis	3
Pomacentridae	Pomacentrus	Pomacentrus indicus	3
Pomacentridae	Pomacentrus	Pomacentrus philippinus	3
Pomacentridae	Abudefduf	Abudefduf vaigiensis	3
Pomacentridae	Amblyglyphlyphidon	Amblyglyphlyphidon batunai	3
Pomacentridae	Plectroglyphidodon	Plectroglyphidodon lacrymatus	2
Pomacentridae	Plectroglyphidodon	Plectroglyphidodon dickii	2
Pomacentridae	Pomacentrus	Pomacentrus pavo	4

family	genus	Species	Number of fishes
Pomacentridae	Stegastes	Stegastes lividus	3
Labridae	Halichoeres	Halichoeres hortulanus	2
Labridae	Labrichthys	Labrichthys unilineatus	2
Labridae	Thalassoma	Thalassoma hardwicke	3
Labridae	Hemigymnus	Hemigymnus fasciatus	2
Labridae	Oxycheilinus	Oxycheilinus digrammus	2
Labridae	Halichoeres	Halichoeres vrolikii	2
Scaridae	Cetoscarus	Cetoscarus bicolor	2
Scaridae	Scarus	Scarus strongylocephalus	2
Scaridae	Scarus	Scarus sordidus	2
Scaridae	Scarus	Scarus scaber	2
Scaridae	Scarus	Scarus ghobban	2
Acanthuridae	Ctenchaetus	Ctenchaetus striatus	3
Acanthuridae	Zebrasoma	Zebrasoma scopas	2
Acanthuridae	Naso	Naso lituratus	2
Acanthuridae	Acanthurus	Acanthurus nigrofuscus	2
Balistidae	Balistapus	Balistapus undulatus	2
Balistidae	Melichthys	Melichthys indicus	2

Site 2

Transect was laid at 2.5m depth. Rocky pavements (16.5%) and rubbles (9%) were observed throughout the area. Live coral coverage along this transect was very high. Main families observed were categorized into:

- Acroporidae branching (43.5%)
- Acroporidae tabulate (6.5%)
- Poritidae branching (18%)
- Montipora foliose (6.5%)

Summary of benthic cover along transect 1 is presented in Figure 4.25 below.

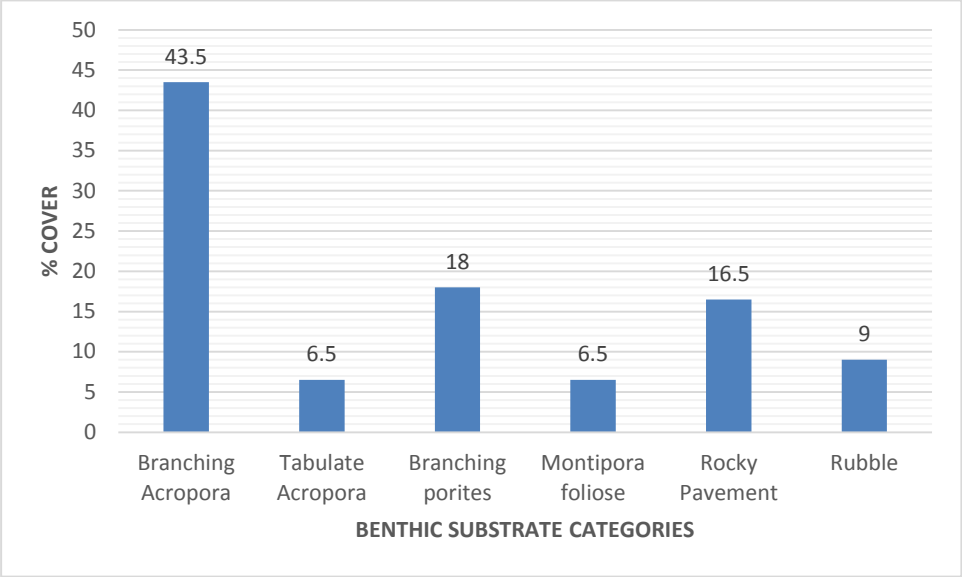


Figure 4.25: Mean benthic substrate composition at Transect Site 2

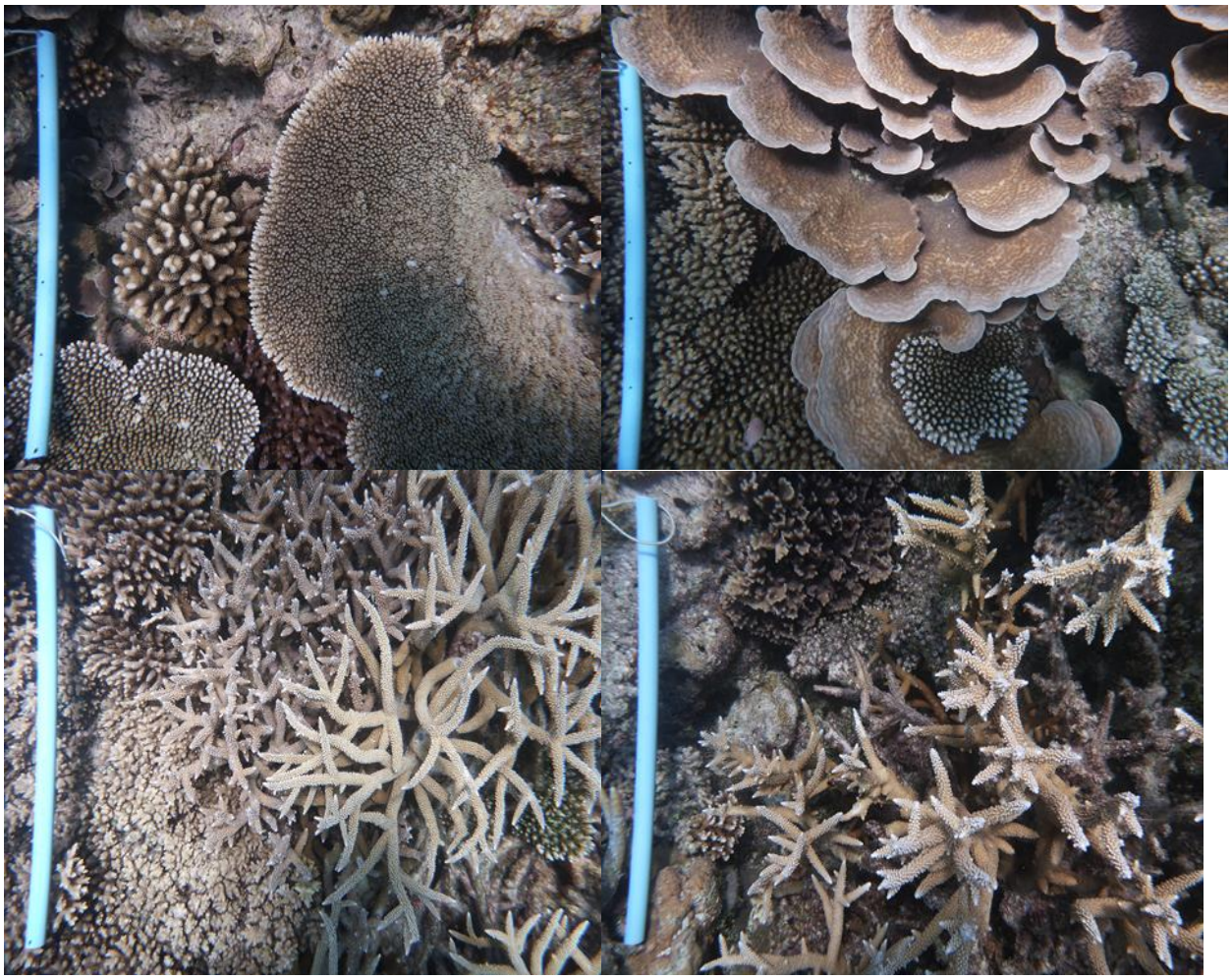


Figure 4.26: Photos showing the benthic cover at Transect Site 2

A total of 39 species belonging to 16 families was recorded in the fish census of the transect 2. The dominant fish species along this transect belonged to the families Pomacentridae (8 species) and Chaetodontidae (7 species). Table below displays the results of fish census along transect 2.

Table 4.11: Fish Census along transect 1

family	genus	species	Number of fishes
Synodontidae	Synodus	Synodus binotatus	2
Serranidae	Aethaloperca	Aethaloperca rogaa	2
Lethrinidae	Lethrinus	Lethrinus erythracanthus	1
Lutjanidae	Lutjanus	Lutjanus Kasmira	3
Lutjanidae	Aphareus	Aphareus furca	2
Caesionidae	Pterocaesio	Pterocaesio trilineata	5
Caesionidae	Caesio	Caesio caerulaurea	4
Chaetodontidae	Hemitaurichthys	Hemitaurichthys zoster	2
Chaetodontidae	Chaetodon	Chaetodon trsifasciatus	2
Chaetodontidae	Chaetodon	Chaetodon trifascialis	2
Chaetodontidae	Chaetodon	Chaetodon guttatissimus	2
Chaetodontidae	Chaetodon	Chaetodon meyeri	2
Chaetodontidae	Chaetodon	Chaetodon triangulum	2
Chaetodontidae	Forcipiger	Forcipiger flavissimus	2
Pomacanthidae	Pygoplites	Pygoplites diacanthus	2
Pomacanthidae	Centropyge	Centropyge multispinis	2
Pomacentridae	Dascyllus	Dascyllus aruanus	3
Pomacentridae	Chromis	Chromis virdis	6
Pomacentridae	Pomacentrus	Pomacentrus nagasakiensis	2
Pomacentridae	Pomacentrus	Pomacentrus indicus	2
Pomacentridae	Pomacentrus	Pomacentrus philippinus	3
Pomacentridae	Amblyglyphlyphidon	Amblyglyphlyphidon batunai	4
Pomacentridae	Plectroglyphidodon	Plectroglyphidodon lacrymatus	2
Pomacentridae	Pomacentrus	Pomacentrus pavo	4
Labridae	Halichoeres	Halichoeres hortulanus	2
Labridae	Gomphosus	Gomphosus caeruleus	2
Scaridae	Scarus	Scarus strongylocephalus	2
Scaridae	Scarus	Scarus sordidus	2

family	genus	species	Number of fishes
Scaridae	Scarus	Scarus nigger	2
Zanclidae	Zanclus	Zanclus cornutus	2
Acanthuridae	Acanthurus	Acanthurus leucosternin	2
Acanthuridae	Ctenchaetus	Ctenchaetus striatus	2
Acanthuridae	Ctenchaetus	Ctenchaetus truncatus	2
Siganidae	Siganus	Siganus argenteus	3
Balistidae	Balistapus	Balistapus undulatus	2
Balistidae	Melichthys	Melichthys indicus	2
Holothuriidae	Pearsonothuria	Pearsonothuria graeffei	2
Tridacnidae	Tridacna	Tridacna maxima	2

Site 3

Transect 3 was laid at 3m depth. Live coral coverage in this area was very high. The major coral family in this area was Acroporidae (branching 52%, table 22% and digitate 6%). Patches of corals which belonged to the family Poritidae (branching 4% and massive 1.5%) were observed. Rocky pavements, sand and rubble made up a combined total of 14.5%.

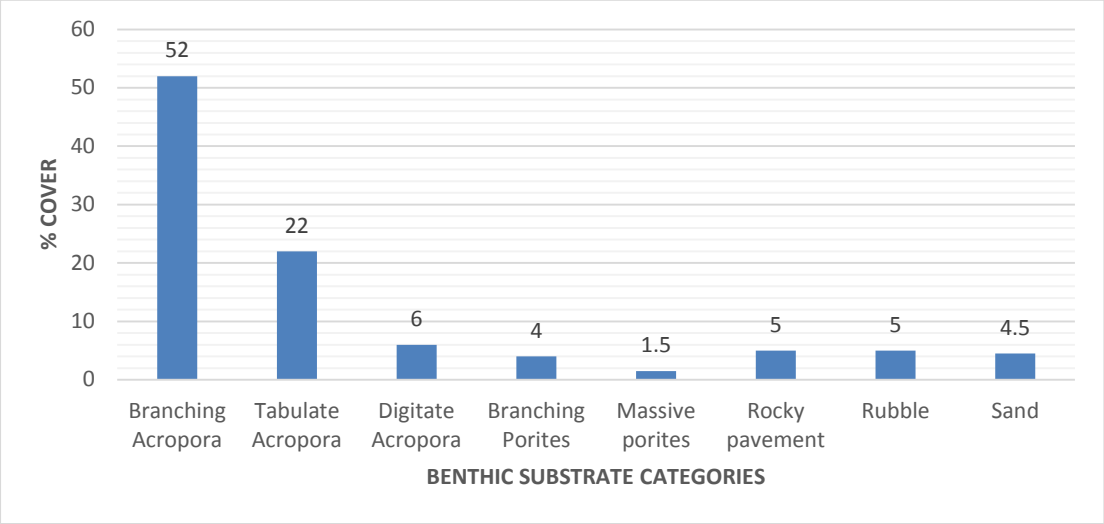


Figure 4.27: Mean benthic substrate composition at Transect Site 3

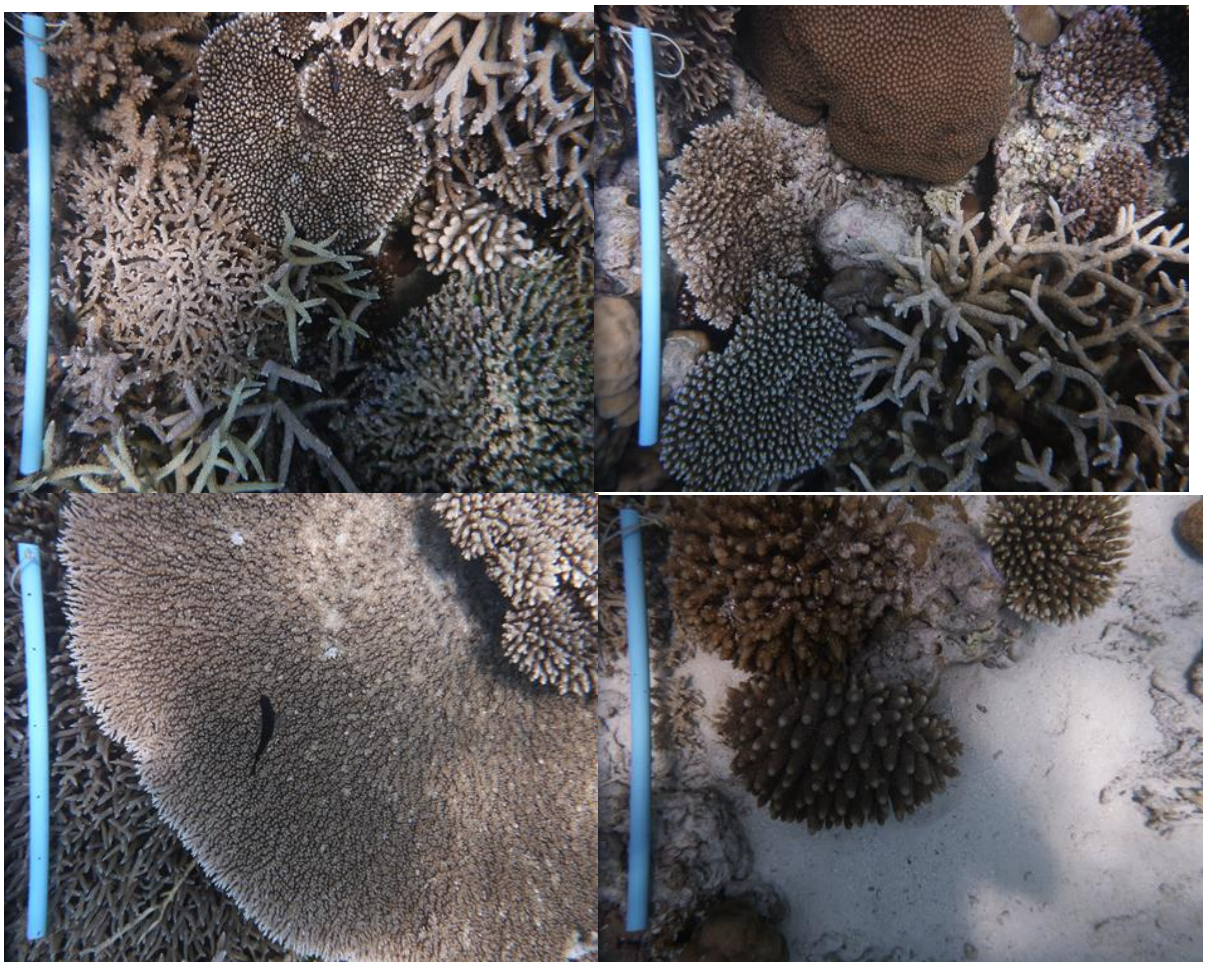


Figure 4.28: Photos showing the benthic cover at Transect Site 3

A total of 36 species belonging to 10 families was recorded in the fish census of the transect 3. The dominant fish species along this transect belonged to the families Pomacentridae (7 species) and Labridae (7 species). Table below displays the results of fish census along transect 3.

Table 4.12: Fish Census along transect 1

Family	**Genus**	**Species**	**Number of fishes**
Serranidae	Cephalopholis	Cephalopholis argus	2
Lutjanidae	Lutjanus	Lutjanus bohar	2
Lutjanidae	Aphareus	Aphareus furca	2
Caesionidae	Pterocaesio	Pterocaesio trilineata	6
Chaetodontidae	Chaetodon	Chaetodon trsifasciatus	2
Chaetodontidae	Chaetodon	Chaetodon trifascialis	2
Chaetodontidae	Chaetodon	Chaetodon guttatissimus	2
Chaetodontidae	Chaetodon	Chaetodon meyeri	2
Chaetodontidae	Chaetodon	Chaetodon auriga	2

Chaetodontidae	Chaetodon	Chaetodon triangulum	2
Chaetodontidae	Forcipiger	Forcipiger flavissimus	2
Pomacentridae	Amphiprion	Amphiprion nigripes	3
Pomacentridae	Dascyllus	Dascyllus aruanus	3
Pomacentridae	Pomacentrus	Pomacentrus nagasakiensis	4
Pomacentridae	Pomacentrus	Pomacentrus indicus	2
Pomacentridae	Amblyglyphlyphidon	Amblyglyphlyphidon batunai	3
Pomacentridae	Plectroglyphidodon	Plectroglyphidodon dickii	2
Pomacentridae	Pomacentrus	Pomacentrus pavo	3
Labridae	Labroides	Labroides dimidiatus	2
Labridae	Labrichthys	Labrichthys unilineatus	2
Labridae	Gomphosus	Gomphosus caeruleus	2
Labridae	Thalassoma	Thalassoma hardwicke	3
Labridae	Epibulus	Epibulus insidiator	2
Labridae	Hemigymnus	Hemigymnus fasciatus	2
Labridae	Halichoeres	Halichoeres vrolikii	2
Scaridae	Scarus	Scarus strongylocephalus	2
Scaridae	Scarus	Scarus sordidus	3
Scaridae	Scarus	Scarus scaber	2
Scaridae	Scarus	Scarus nigger	2
Microdesmidae	Ptereleotris	Ptereleotris evides	2
Acanthuridae	Acanthurus	Acanthurus leucosternin	2
Acanthuridae	Ctenchaetus	Ctenchaetus striatus	3
Acanthuridae	Naso	Naso lituratus	2
Acanthuridae	Naso	Naso hexacanthus	2
Acanthuridae	Acanthurus	Acanthurus nigrofuscus	2
Balistidae	Balistapus	Balistapus undulatus	2

Site 4

Transect four was laid at 4.8m depth. The dominant benthic substrate along this transect were Acroporidae corals(branching 41.5% and table 26.5). The combined total of rocky pavements and rubble (25.5%) in this transectwas higher than the 3 previous transects . A Juvenile Poritidae coral (massive 1%) was found along the transect.

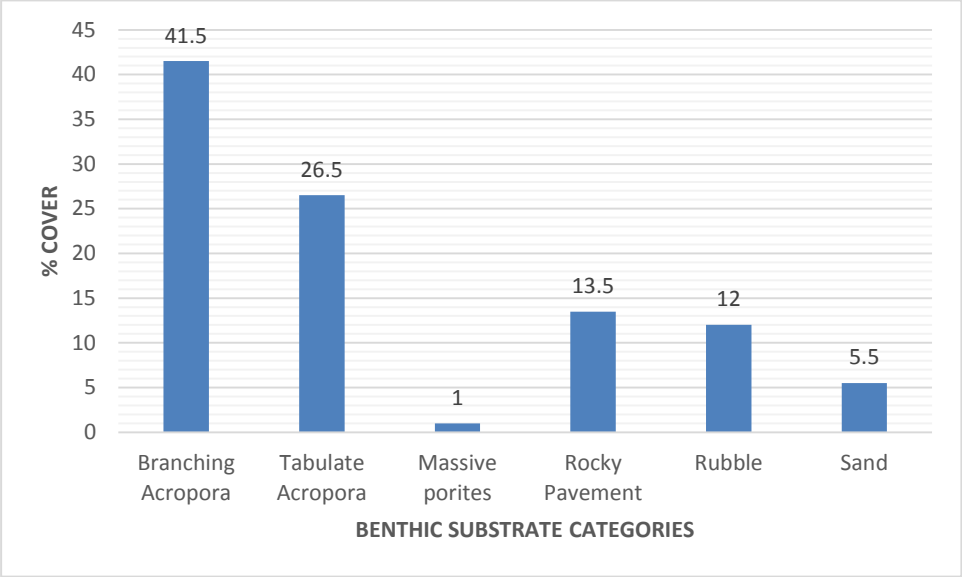


Figure 4.29: Mean benthic substrate composition at Transect Site 4

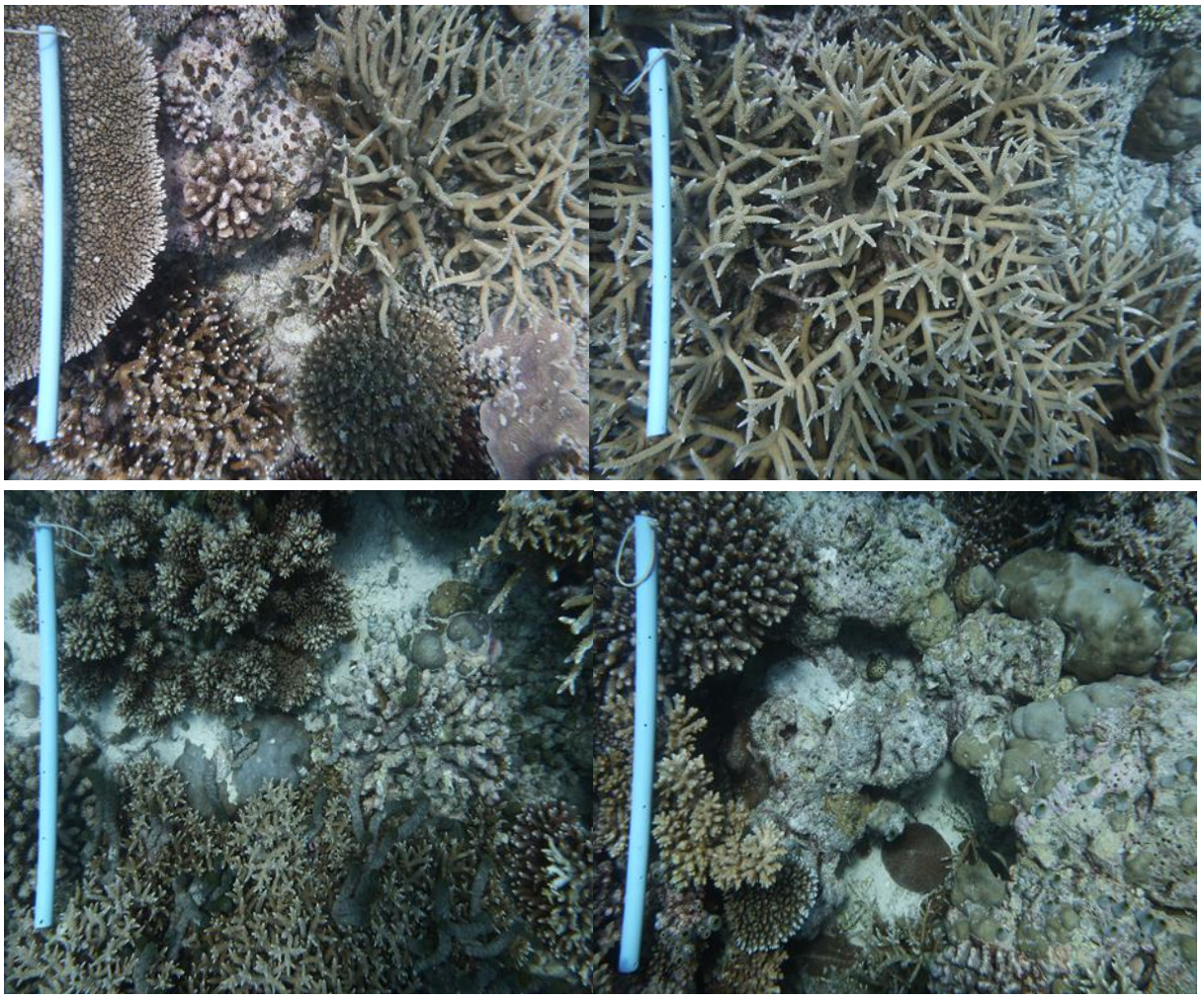


Figure 4.30: Photos showing the benthic cover at Transect Site 4

A total of 26 species belonging to 10 families was recorded in the fish census of the transect 4. The dominant fish species along this transect belonged to the families Pomacentridae (6 species) and Acanthuridae (5 species).

Table 4.13: Fish Census along transect 1

Family	Genus	Species	Number of fishes
Serranidae	Aethaloperca	Aethaloperca rogaa	2
Serranidae	Pseudanthias	Pseudanthias evansi	3
Lutjanidae	Aphareus	Aphareus furca	2
Caesionidae	Pterocaesio	Pterocaesio tile	4
Caesionidae	Pterocaesio	Pterocaesio trilineata	3
Chaetodontidae	Chaetodon	Chaetodon auriga	2
Chaetodontidae	Chaetodon	Chaetodon triangulum	2
Chaetodontidae	Heniochus	Heniochus pleurataenia	2
Chaetodontidae	Heniochus	Heniochus singularius	2
Pomacentridae	Dascyllus	Dascyllus aruanus	3
Pomacentridae	Chromis	Chromis virdis	3
Pomacentridae	Chromis	Chromis ternatensis	3
Pomacentridae	Pomacentrus	Pomacentrus nagasakiensis	3
Pomacentridae	Pomacentrus	Pomacentrus indicus	2
Pomacentridae	Amblyglyphlyphidon	Amblyglyphlyphidon batunai	3
Labridae	Gomphosus	Gomphosus caeruleus	2
Labridae	Epibulus	Epibulus insidiator	2
Scaridae	Scarus	Scarus nigger	2
Acanthuridae	Ctenchaetus	Ctenchaetus striatus	2
Acanthuridae	Zebrasoma	Zebrasoma scopas	2
Acanthuridae	Naso	Naso lituratus	2
Acanthuridae	Naso	Naso brevirostris	2
Acanthuridae	Naso	Naso hexacanthus	2
Balistidae	Balistapus	Balistapus undulatus	2
Balistidae	Melichthys	Melichthys indicus	2
Monacanthidae	Cantherhinus	Cantherhinus pardalis	2

4.2.2.3 *Timed swims*

Timed Swim 1 – Northwest side

The area was mostly covered with sand and the coral coverage was less in this area. Few patches of Acroporidae corals were found in this area. Visibility was very low in this area (5m) due to sedimentation. The average depth of the area was 2m. Fish species belonging to the family Pomacentridae were recorded throughout the area.

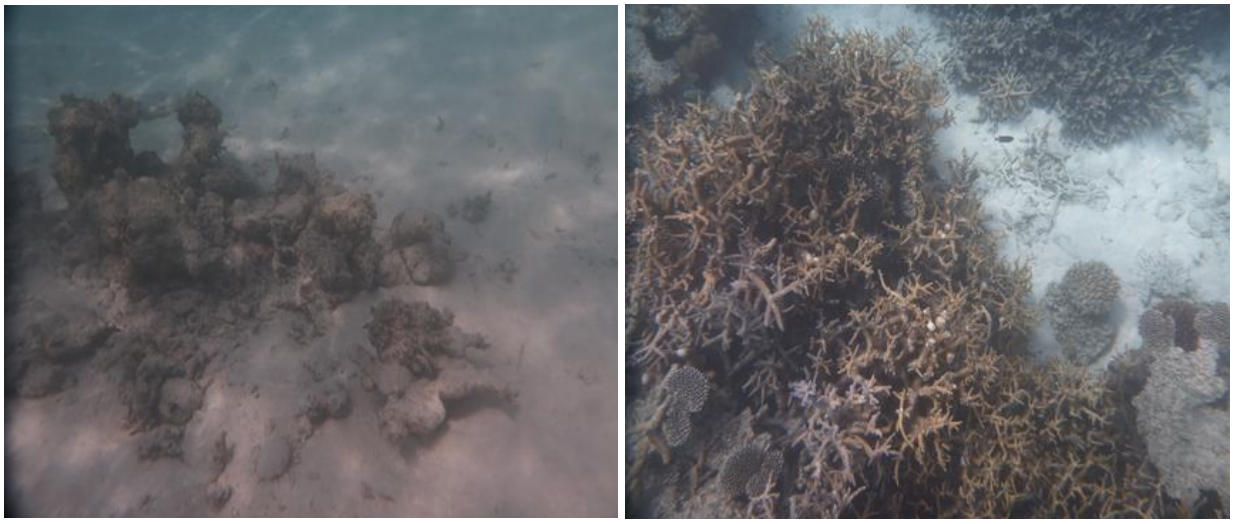


Figure 4.31: Photos showing the benthic cover on the north west side

Time Swim 2 – Proposed breakwater site

Almost 70% of the area was covered with sand and dead coral rubble. However few patches of Acroporidae corals were found in this area. Average depth of the area was 2m. Visibility was low in this area (5m). Fish species belonging to the family Pomacentridae were recorded throughout the area. Few dead corals were observed in this area.

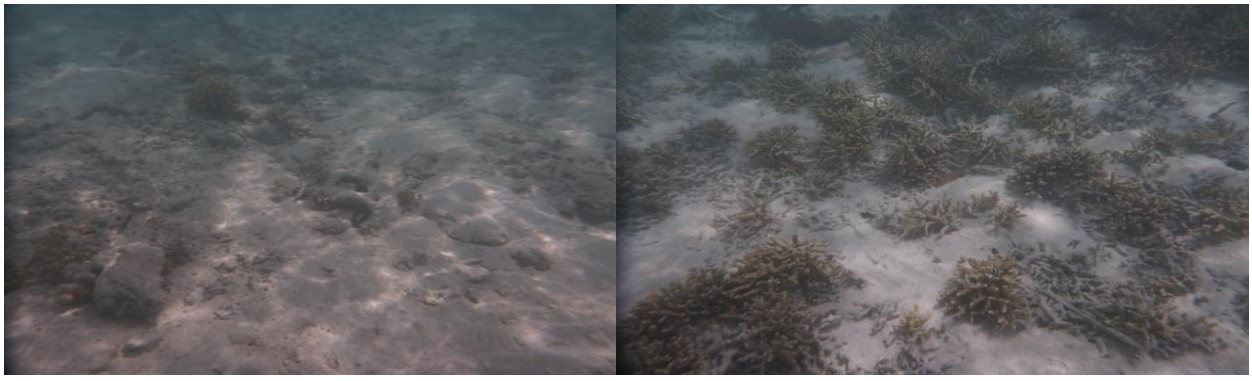


Figure 4.32: Photos showing the benthic cover at the proposed breakwater site

Time Swim 3 – Proposed Overwater villa area

The area was mostly covered with sand and the coral coverage was very less in this area. Very few Acroporidae corals were found in this area. Visibility was high in this area (15m). The average depth of the area was 1m. Coralline algae was found in this area. Fish species belonging to the family Pomacentridae were recorded throughout the area.

Figure 4.33: Photos showing the benthic cover at theproposed Overwater villa area

Time Swim 4 – Eastern side

Live coral coverage in this area was generally good, making up almost 50% of the survey area. Coral species belonging to the family Acroporidae were abundant in this area. Few dead corals were observed in this area. The average depth of the area was 2m. Damsel fishes (pomacentridae) were the most common fish species found in this area.

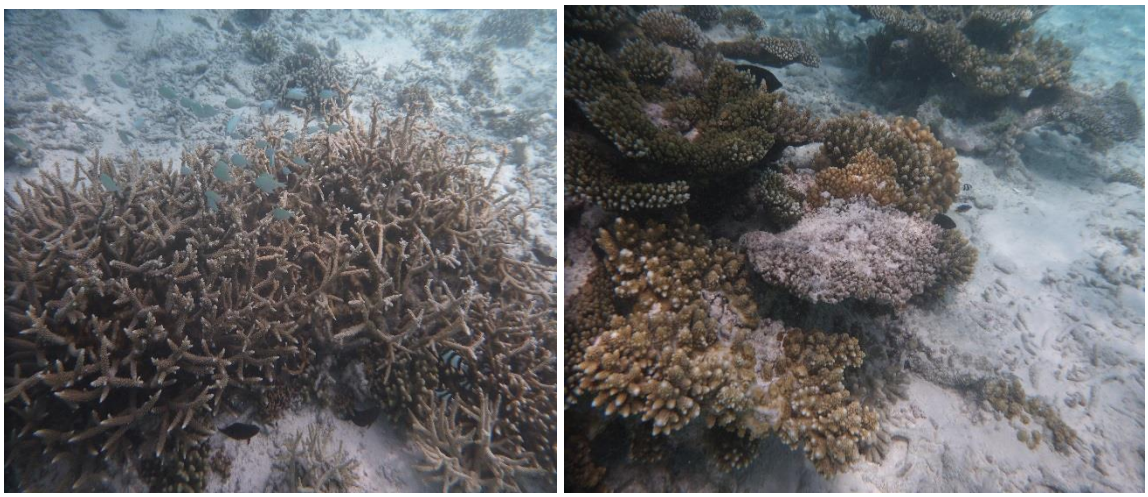


Figure 4.34: Photos showing the benthic cover on the eastern side reef flat

Timed swim 5 – Southern side

Live coral coverage in this area was very high making up almost 70% of the surveyed area. Coral species of Poritidae and Acroporidae (table) were abundant in this area. Average depth of this area was 1m. Visibility was generally good in this area (10m). Fish species of Acanthuridae and Pomacentridae were recorded in this area.

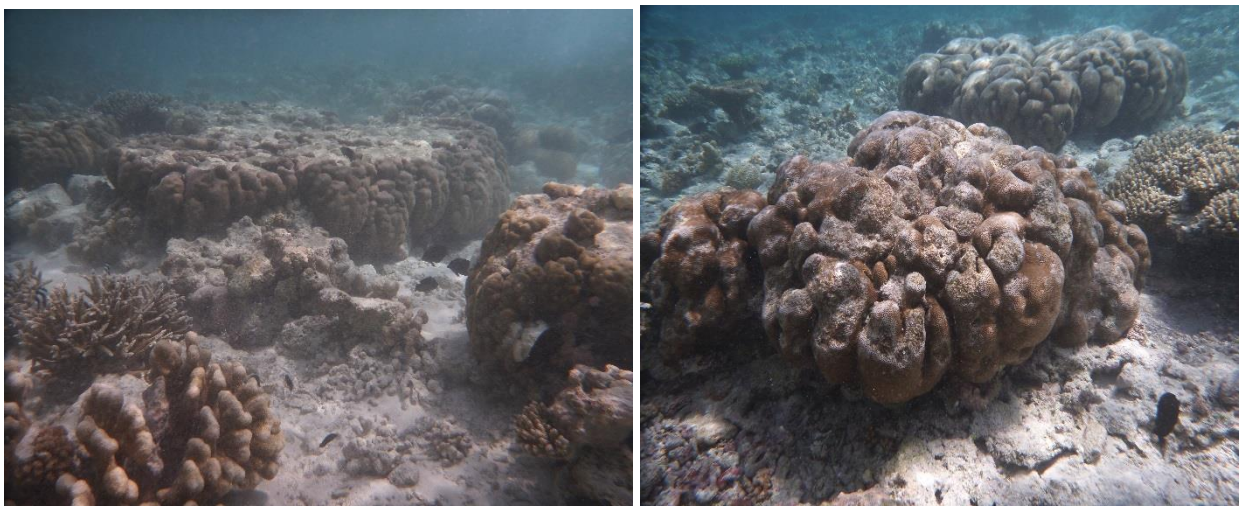


Figure 4.35: Photos showing the benthic cover on the southern side reef flat

Timed swim 6 – Northern side

Live coral coverage in this area was very high, making up almost 80% of the survey area. Coral species belonging to the family Acroporidae were abundant in this area. Few dead corals were observed in this area. The average depth of the area was 2m. Surgeon fishes (Acanthuridae) were the most common fish species found in this area. Visibility was generally good in this area (10m).

Figure 4.36: Photos showing the benthic cover on the northern side

4.2.3 Marine protected areas and sensitive sites

Although five Environmentally Sensitive Areas (ESA) are located in the atoll, the nearest sensitive environment is 5 km south in Gemanaa (See Figure 2.2). This site is not expected to be affected by the project.

4.2.4 Breeding or nursery grounds for protected or endangered species

All coral reef areas have the potential to be used as breeding/nurseries for reef fishes. No literature is available to indicate that reef system of Muravandhoo is used as breeding/nursery for fishes, crustaceans, marine mammals, sharks or turtles. Further studies are required to determine the specificity of the sites.

4.3 Hazard Vulnerability of the Site

According to the UNDP Disaster Risk Assessment Report of Maldives in 2006, Muravandhoo Island is located in an area exposed windstorms, storm surges, swell waves and to tsunamis. It does not identify the island as being exposed to heavy rainfall flooding. The following parameters can be deduced for the Muravandhoo region based on Disaster Assessment Report and the Detailed Island Risk Assessment Reports (UNDP, 2009).

Tsunami: Maximum probable wave height range 0.8-2.50

Cyclone or storm (wind): Probable maximum wind speed 84.2 knots (category 2 cyclone).

Storm surge: predicted storm surge height – 0.45; predicted storm tide height 1.38.

Rainfall: probable maximum daily rainfall for Hanimaadhoo for a 500 year return period 175.6 mm

Based on these parameters and field surveys (primarily reef depths and topography), the methodology for risk assessment identified in the Detailed Island Risk Assessment Reports (UNDP, 2009) was used to assess the hazard risks on the site. However, the results should be treated with caution as this is a preliminary risk assessment. A more comprehensive assessment will require a longer time frame and a lot of data, which is beyond the scope of this EIA.

In general, due to its low elevation, Muravandhoo is exposed to the predicted severe intensity flooding events, particularly storm surges, swell waves and tsunami. The probability swell waves are high as the island is located close to the western rim. Impacts on storm surges are expected to moderate at most. Risks from earthquake damages are very low. The proposed replenishment site is exposed to flooding.

Table 4.14 Predicted disaster risks in Muravandhoo

Hazard	**Max Prediction** (based on UNDP 2006)	**Impact thresholds** (based on UNDP 2009)			**Probability of Occurrence** (based on UNDP 2006)		
		Low	**Moderate**	**Severe**	**Low Impact**	**Moderate Impact**	**Severe Impact**
Swell Waves/storm surges *(wave heights on reef flat – Average Island ridge height +1.4 m above reef flat)*	1.4m	< 1.2 m	> 1.2 m	> 2.0m	High	Moderate	Low
Tsunami *(wave heights on reef flat)*	2.5m	<1.5m	> 1.5 m	> 2.0m	Moderate	Low	Very low
SW monsoon high seas	0.5m	<1.2m	> 1.2 m	> 2.0m	High	Very low	Unlikely
Heavy Rainfall *(For a 24 hour period)*	175mm	<60mm	> 60mm	>175mm	High	Moderate	Low
Wind storm	84.2 knots	<30 knts	> 30 knts	> 45Knts	Very High	High	Moderate
Earthquake (MMI value – see table 4.11)	I	< IV	> IV	> VI	Very Low	Unlikely	none

4.4 Socio-economic Environment

4.4.1 Raa Atoll socio-economic setup

Raa Atoll consists of 15 inhabited islands distributed over approximately 28 km by 78 km area (See Figure 4.34). Population of the Atoll stands at around 14,756 (MPND 2006a). There are 4 major population centres in the Atoll; Dhuvaafaru, Ugoofaaru the Capital Island and Alifushi. Together they account for more than 40% of the atoll population (see Figure 4.37 below). Seven of the inhabited islands have a population below 600, often an indicator of poor economic conditions in these islands. The majority of the population of the atoll was below 15 years of age in 2000 and is expected to remain so today.

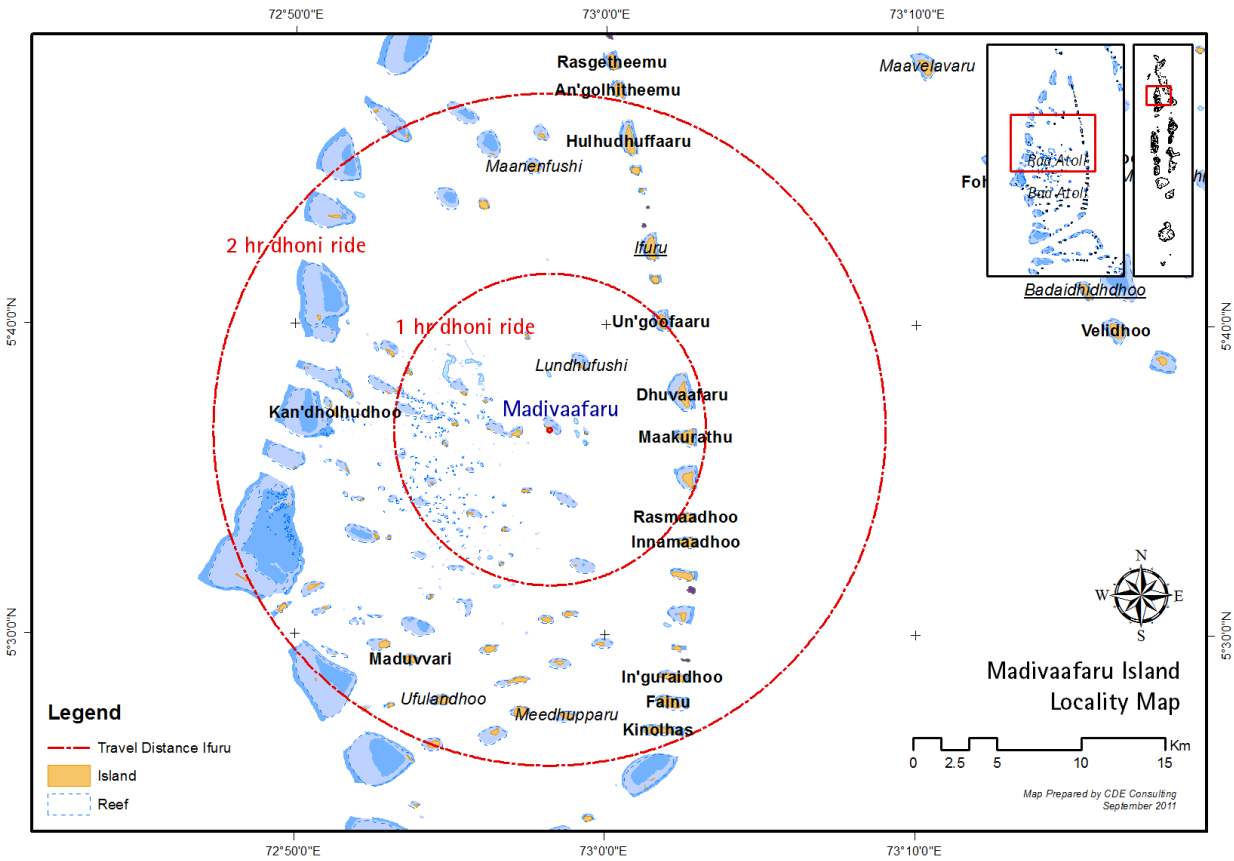


Figure 4.37: Locality Map of Muravandhoo

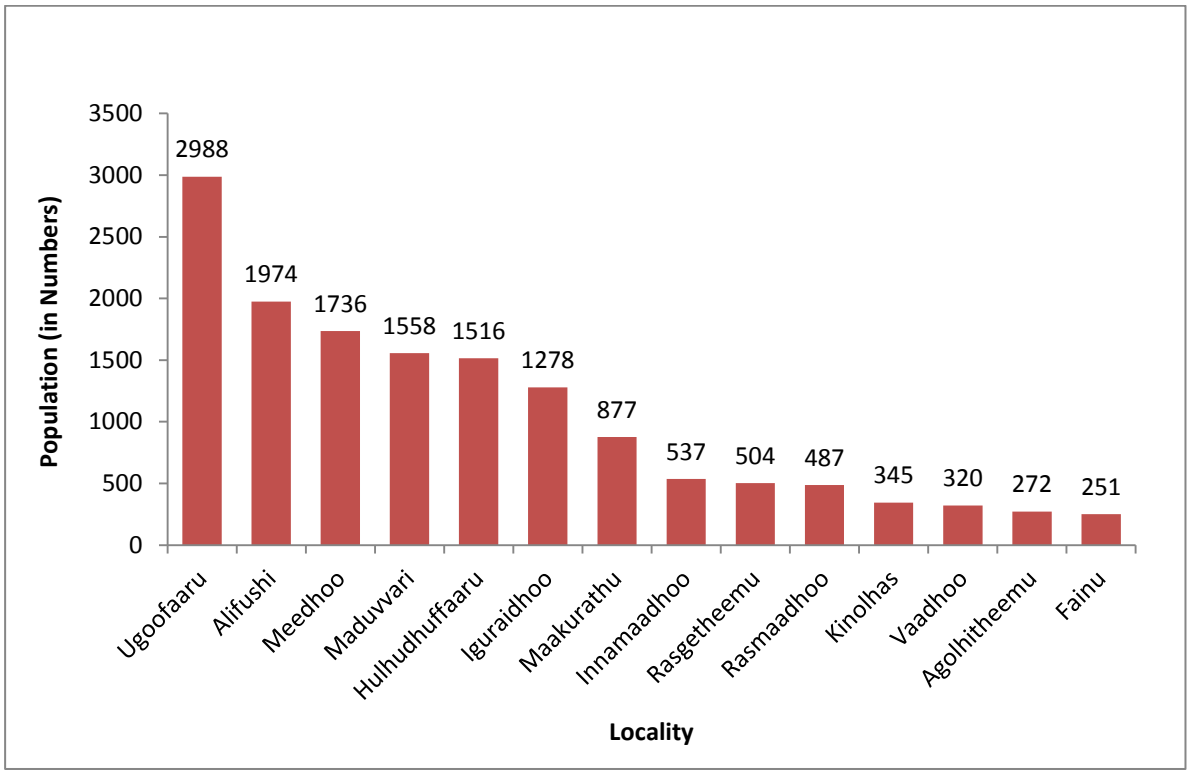
4.4.1.1 *Population Structure and Migration Characteristics*

Population

According to census 2006, the total population residing in Raa atoll was 14,756 people with 7,136 males and 7,620 females. It contributes to 4.94% of the total population of Maldives.

Figure 4.38 below presents the population sizes for all administered islands of Raa atoll based on census 2006.

Figure 4.38 Islands by Population Sizes, R. Atoll, Census 2006



Source: Ministry of Planning and National Development, 2008

Among all the administered islands in Raa atoll, Ugoofaaru has the biggest population with a total of 2,988 people contributing 20.25% of the total Raa atoll population. Fainu has the smallest population in the atoll with only 251 people contributing to 1.7% of the atoll population.

Annual Population Growth Rate

During the last few years, the population of Raa atoll has continued with a positive annual growth. According to census 2006, the average annual growth rate for the atoll is 0.31. Ungoofaaru shows the highest positive annual growth rate in the atoll with 16.77 reflecting the increase in Ungoofaaru population due to the in-migration of tsunami victims from the nearby islands of the atoll. Hulhudhuffaaru shows the second highest annual growth rate with 7.96. A few islands including Rasgetheemu, Agolhitheemu, Rasmaadhoo, and Kinolhas show a negative average annual growth rate. Table 4.15 below represents the average annual growth rate for all administered islands of Raa atoll.

Table 4.15 Average Annual Growth Rate, R. Atoll, Census 2006

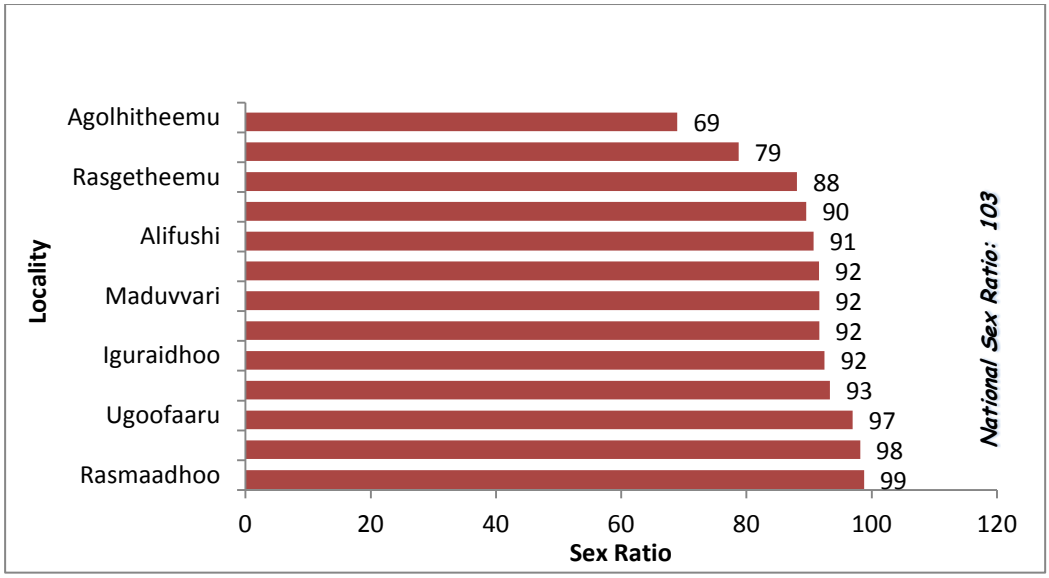
Locality	Average Annual Growth Rate
North Maalhosmadulu (R)	0.31
Alifushi	2.12
Vaadhoo	0.05
Rasgetheemu	-2.53
Agolhitheemu	-3.95
Ugoofaaru	16.77
Maakurathu	1.32
Rasmaadhoo	-1.84
Innamaadhoo	1.45
Maduvvari	0.30
Iguraidhoo	0.05
Fainu	0.13
Meedhoo	3.22
Kinolhas	-0.80
Hulhudhuffaaru	7.96

SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Sex Ratio

According to census 2006, the National Sex Ratio for the country shows that there are more males than females in Maldives with a sex ratio of 103 (103 males per 100 females). However, in Raa atoll, the population of females out numbers that of males. This is also the case for the all administered islands in the atoll. According to census 2006, the sex ratio of Raa atoll population is 92 males per 100 females. The island with the biggest difference in sex ratio is Angolhitheemu with a sex ratio of 69 Males per 100 females. The island with the smallest difference in sex ratio is Rasmaadhoo with 99 males per 100 females. Figure 4.39 below show sex ratios for all administered islands of Raa atoll based on census 2006.

Figure 4.39 Sex Ratio by Locality, R. Atoll, Census 2006

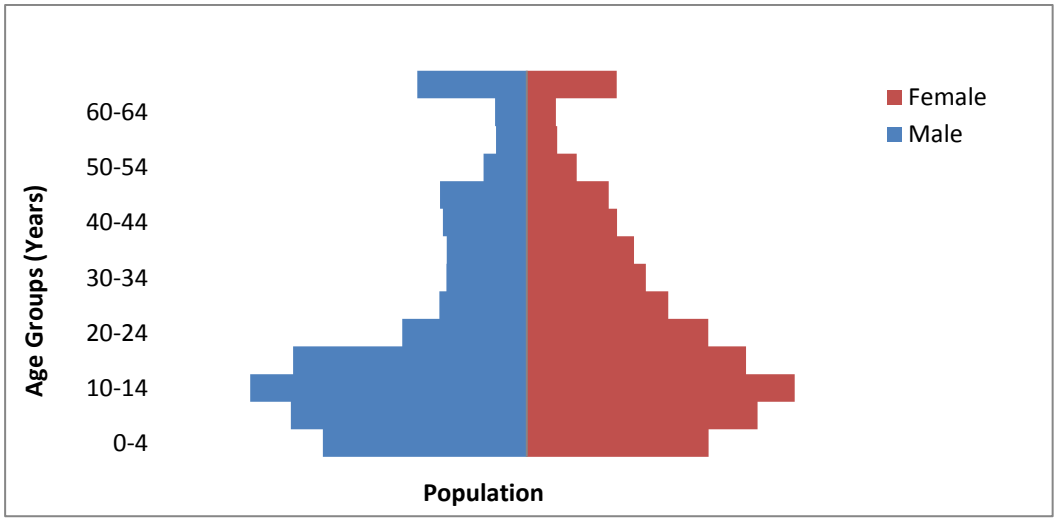


SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Population Structure

Figure 4.40 below shows the population pyramid of Raa atoll population based on census 2006.

Figure 4.40: Population Pyramid for R. Atoll, Census 2006



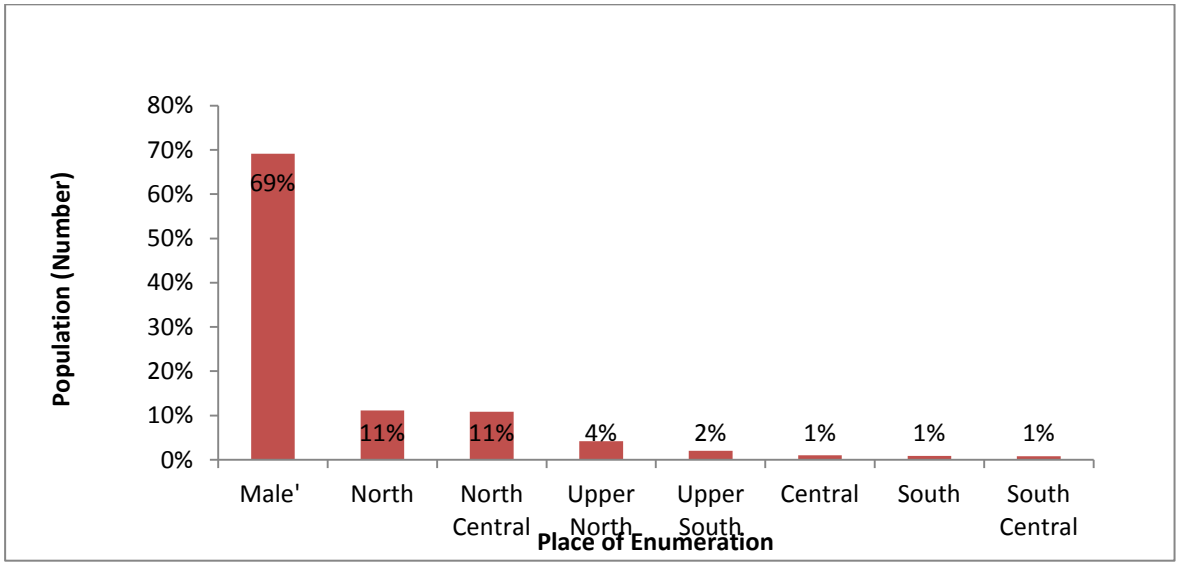
SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

According to the figure, the most dominant age group for the atoll is between 10-14 years for both males and females. The dependent population is at 45.2% comprising 39.5% children and 5.6% elderly. The working age population comprises of more than half of the population with 55%.

Migration

According to census 2006, the registered population of Raa atoll was 18,357 people, however, only 77.5% of this population resides in the atoll. Majority of the Raa atoll registered in the atoll, but did not reside there, were enumerated in Male' (69%). Figure 4.41 below shows the out-migration of Raa atoll population by place of enumeration.

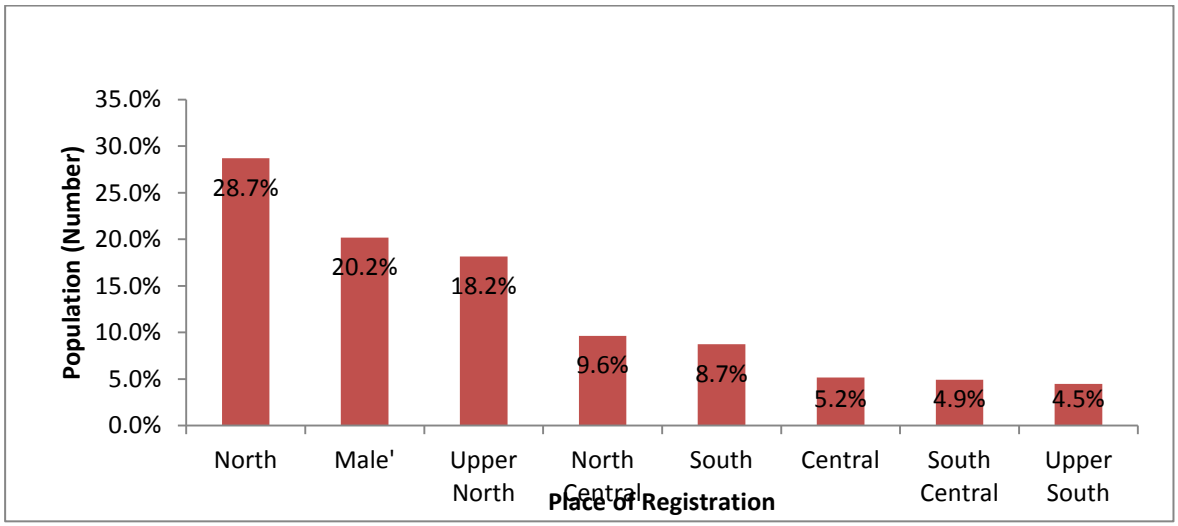
Figure 4.41: Out-Migration from R. Atoll by place of Enumeration, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

At the time of census 2006, majority of people residing in Raa atoll were registered in the atoll, however 4% of the total population living in Raa atoll were from other areas. The majority of people who have moved to Raa atoll are from North province, which includes Noonu, Raa, Baa and Lhaviyani atoll. Figure 4.42 below represents in-migration to Raa atoll from other parts of the country by place of registration.

Figure 4.42: In-Migration to R. Atoll by place of Registration, Census 2006



4.4.1.2 *Education*

Currently there are 16 schools in Raa atoll and the highest level of education provided is Higher Secondary education with GCE A'level standard. According to the Ministry of Education a total of 4,300 students are currently enrolled in Raa atoll schools.

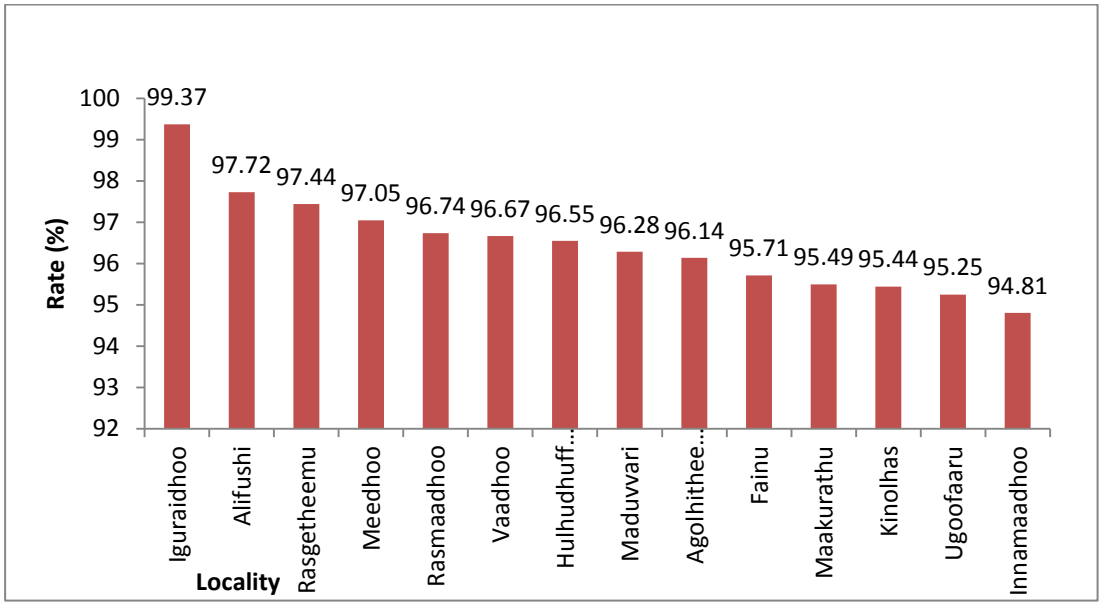
Currently there are plans to construct a campus building and a hostel of Maldives National University in Alifushi. There are also plans to construct a pre-school in Alifushi under Japanese Food Aid and Counterpart Fund.

Literacy Rate

Literacy rate for Raa atoll population is 96.62% and women have a higher literacy rate (97.19%) than that of men (96%). Figure 4.43 below shows the literacy rates for all administered islands in Raa atoll based on census 2006.

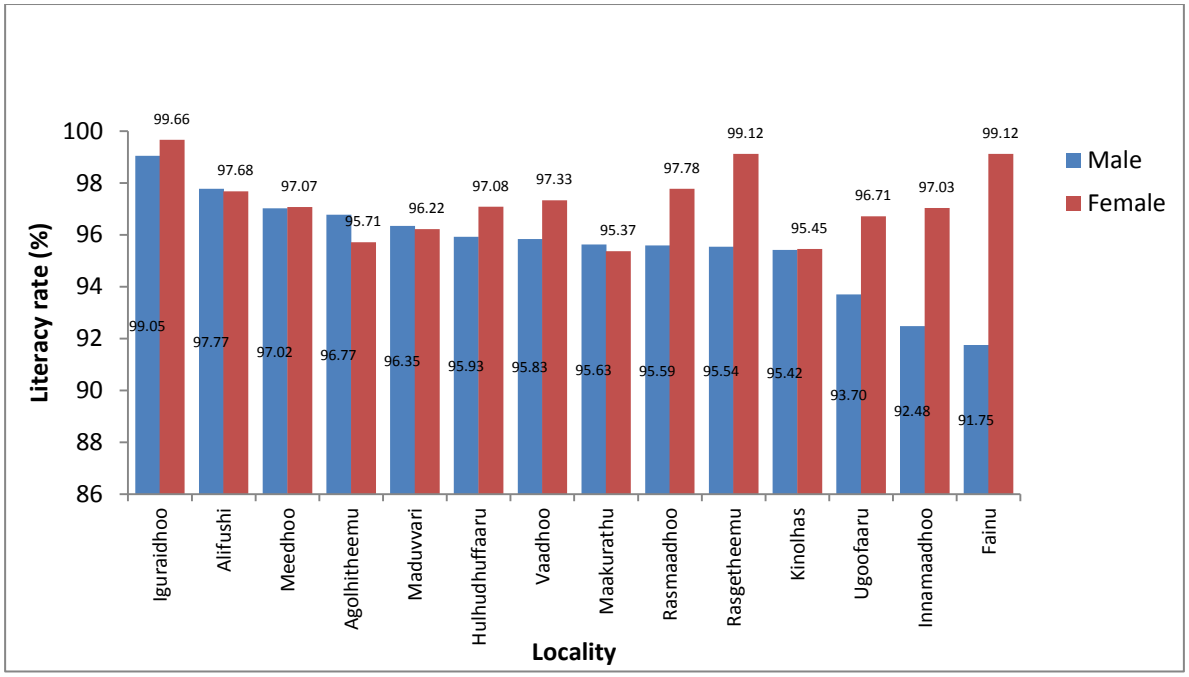
Among all administered islands in Raa atoll, literacy rate is highest in Inguraidhoo with 99.37% and lowest in Innamaadhoo with 94.81%. Inguraidhoo also has the highest male and female literacy rates in the atoll (99.05% and 99.66% respectively). Female literacy rate is lowest in Maakurathu with 95.37% and male literacy rate is lowest in Fainu (91.75%). The biggest gender difference in literacy rate is also seen in Fainu with 99.12% of females literate compare to 91.75% of males. Figure 4.44 below shows percentage literate by sex and locality for Raa atoll based on census 2006.

Figure 4.43: Percentage Literate by Locality, R Atoll, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Figure 4.44: Percentage literate by Sex and Locality, R Atoll, Census 2006



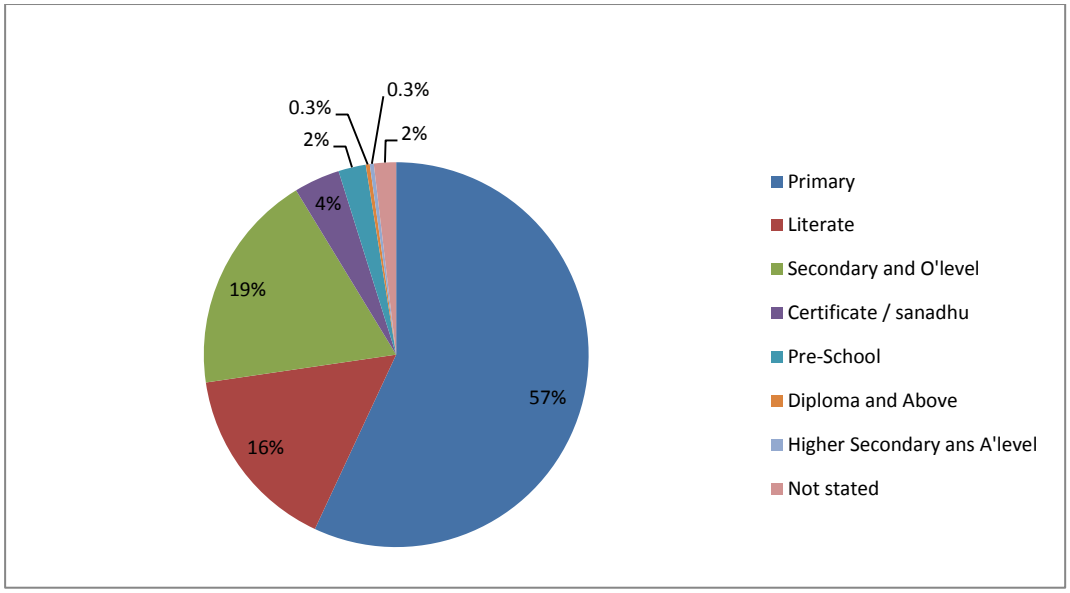
Source: Ministry of Planning and National Development, 2008

Education Attainment Levels

In education attainment, majority of people over the age of 6 years have received primary level education (57%). However, there is a huge drop in the percentage of people attaining secondary level education as only 19% reported to have attended secondary education and completed GCE O'level. A further 4% reported to have completed certificate or sanadhu level qualification. There is also a huge drop in the percent of people attaining higher secondary education and beyond as only 0.6% reported to have received higher secondary education and above qualifications.

Additionally, 16% of people over the age of 6 years reported to have achieved literacy level education and 2% reported to have received pre-school education. Figure 4.45 below shows education attainment rates for Raa atoll based on census 2006.

Figure 4.45 Education Attainment Rates for R. Atoll, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

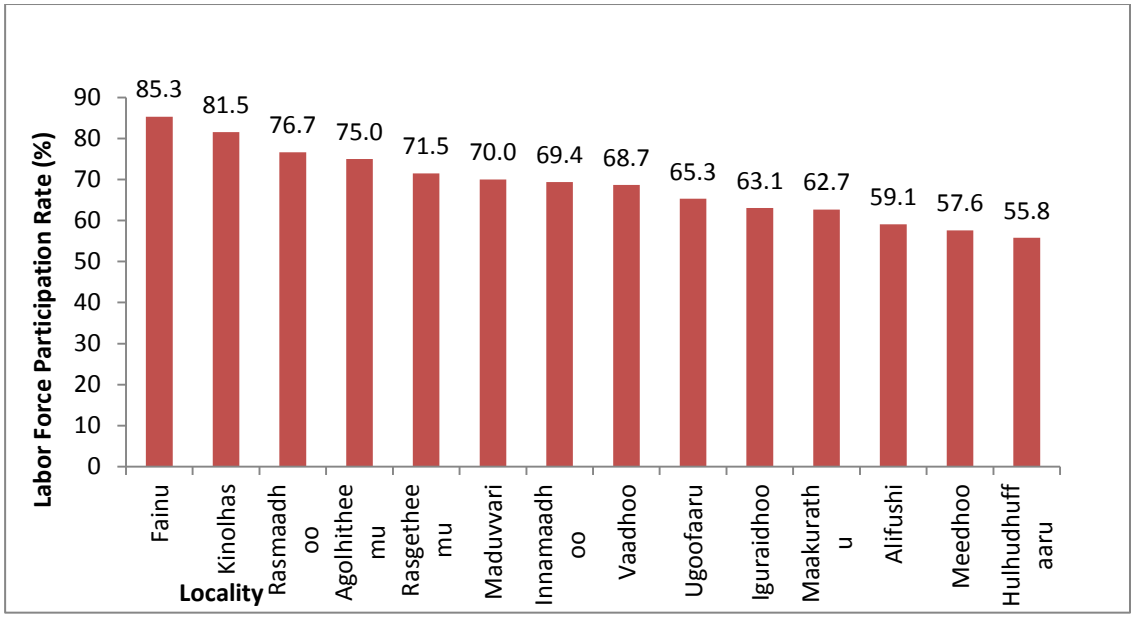
4.4.1.3 *Employment and Economic Industries*

Labor Force Participation

According to census 2006, labor force participation rate for Raa atoll population over the age of 15 years is 64.8% and labor force participation is higher among male population (73.3%) compare to that of female population (57.4%). Figure 4.46 below shows labor force participation rates for all administered islands of Raa atoll based on census 2006.

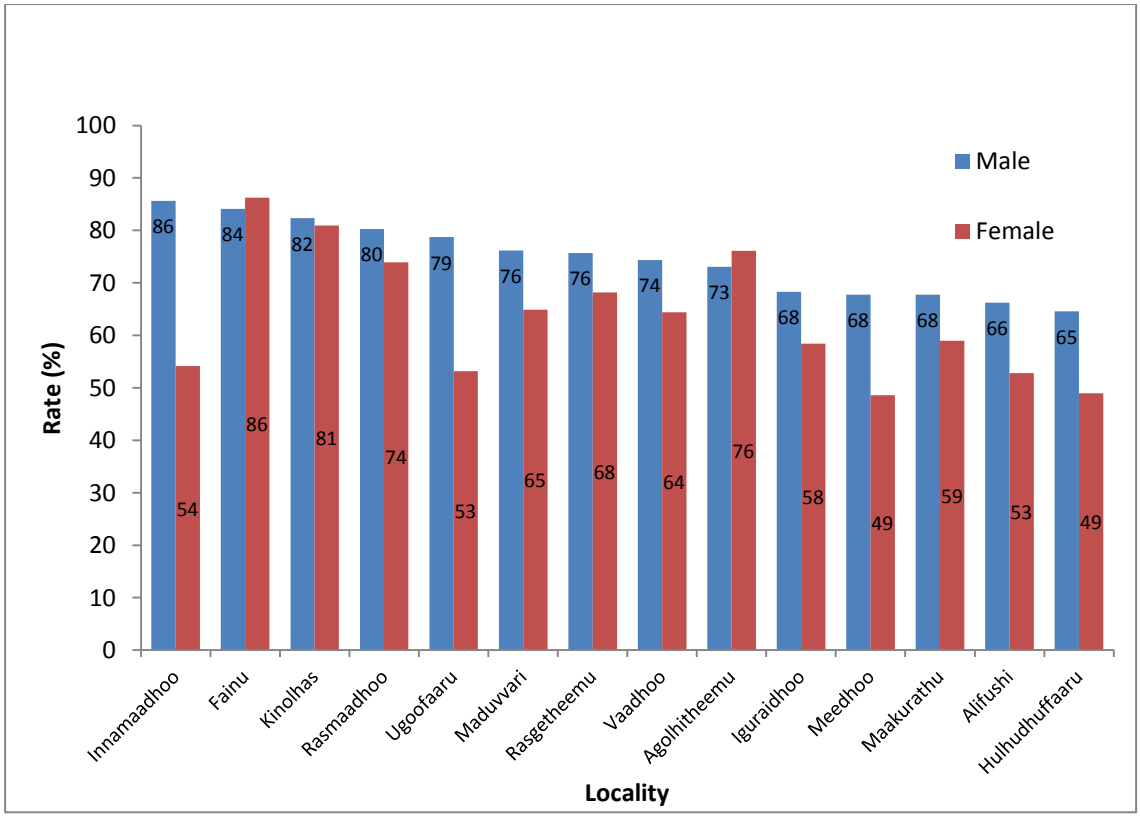
Among all administered islands of Raa atoll, labor force participation rate is highest in Fainu with 85.3% of population over the age of 15 years engaged in the work force. Fainu also have the highest percentage of females employed with 86% of females over the age of 15 years active in the work force. Male labor force participation is highest in Innamaadhoo with 86% of males over the age of 15 years employed. Labor force participation is lowest in Hulhudhuffaaru with 55.8%. Hulhudhuffaaru also have the lowest labor force participation by both male (65%) and female population (49%). Female labor force participation for Meedhoo population is also at 49%. The island with the biggest gender difference in the labor force participation is Innamaadhoo with 86% of males and only 54% of females engaged in work force. Figure 4.47 below shows labor force participation rates by sex and locality for Raa atoll based on census 2006.

Figure 4.46: Labour Force Participation Rate by Locality, R. Atoll Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Figure 4.47: Labor force Participation by Locality and Sex, R. Atoll, Census 2006

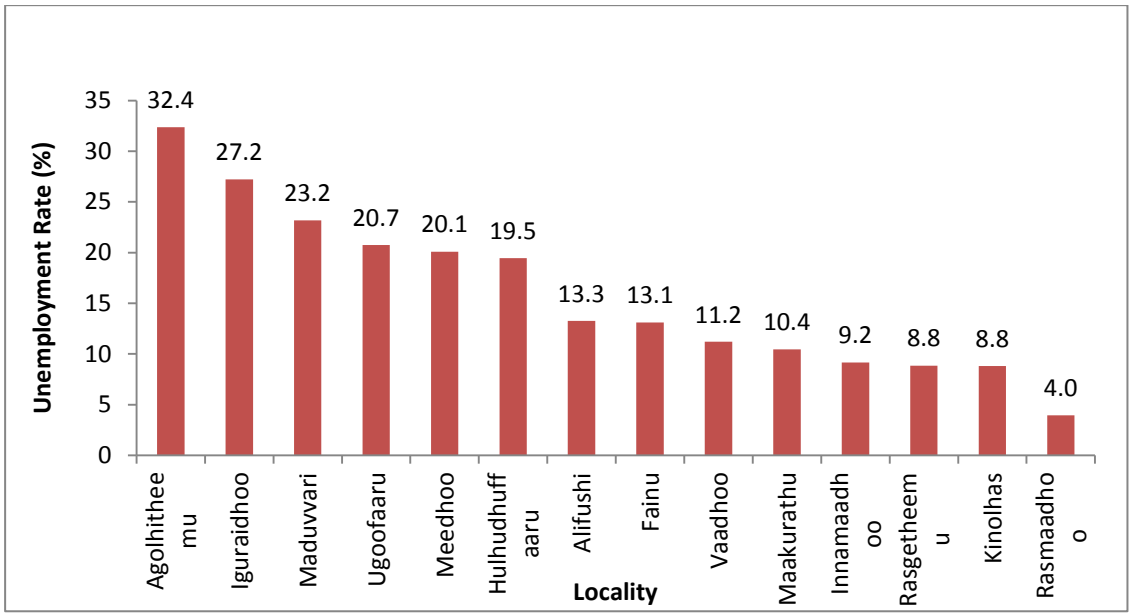


SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Unemployment Rate

Unemployment rate for the population of Maldives over the age of 15 years is 16.2%, and unemployment rate for Raa atoll is a little higher at 17.4%. Much of the unemployment is among female population as 27.5% of females unemployed compare to only 8.3% of males. Figure 4.48 below shows unemployment rates by locality for all administered islands of Raa atoll based on census 2006.

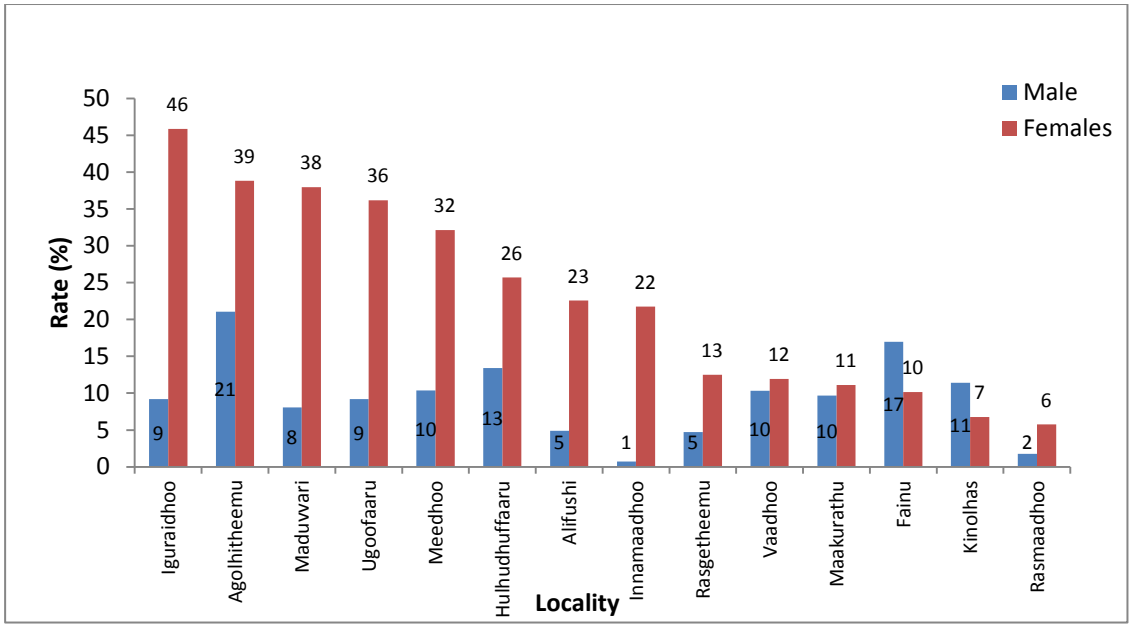
Figure 4.48 Unemployment Rate by Locality, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Among all administered islands of Raa atoll, unemployment rate is highest in Agolhitheemu with 32% and lowest in Rasmaadhoo with 4%. Rasmaadhoo also have the lowest female unemployment rate with 6% while Inguraidhoo has the highest female unemployment rate (46%). Among male populations, unemployment is highest in Agolhitheemu with 21% and lowest in Innamaadhoo with 1%. Figure 4.49 below shows unemployment rates by gender and locality for Raa atoll based on census 2006.

Figure 4.49 Unemployment Rates by Locality and Sex, R. Atoll, Census 2006

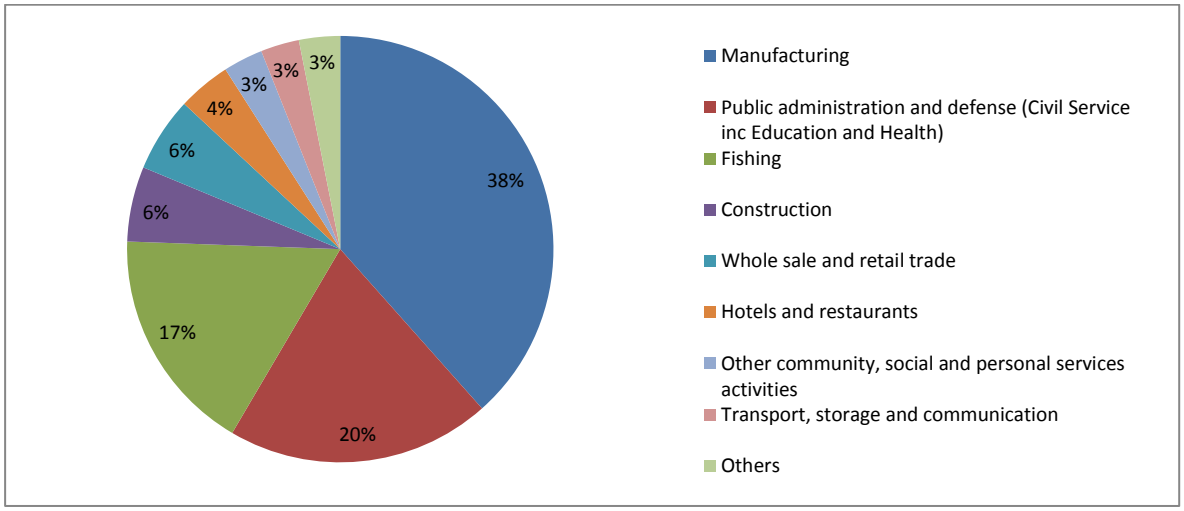


SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Employment by Industry

The three most common economic sectors in Raa atoll include manufacturing (38%), Public administration and defense (20%) and fishing (17%). Other economic activities practiced in Raa atoll include construction (6%), wholesale and retail trade (6%), hotels and restaurants (4%), other community, social and personal services (3%) and transport, storage and communication (3%). Figure 4.50 below shows the main employment sectors in Raa atoll based on census 2006.

Figure 4.50 Employment by Industry, R. Atoll. Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

4.4.1.4 *Fisheries, Agriculture and Tourism*

Fisheries

Fishing is the third most common economic activity practiced in Raa atoll. According to the Ministry of Fisheries and Agriculture, there were 837 fishermen in Raa atoll in 2006. A total of 219 fishing vessels were engaged in fishing including 101 Mechanized Masdhoani, 4 Mechanized Rowboat, 17 Mechanized Vadhu dhoani, 33 Row Boat, 6 Sailing Masdhoani, and 58 Sailing vadhu dhoani.

Tourism

According to the Ministry of Tourism, Arts and Culture, the first tourist resort in Raa atoll started operating in 2000 with a bed capacity of 466. No new resorts have opened since then, however the bed capacity of the resort has increased to 470 by 2009. At the end of 2009, Raa atoll contributed to 2% of the total resort bed capacity in Maldives. There are 4 upcoming resorts/hotels in the atoll with a total bed capacity of 440.

Agriculture

According to the Ministry of Fisheries and Agriculture there are a total of 176 registered farmers in Raa atoll, including 77 females and 99 males. Table 4.16 below shows the number of farmers registered in each island of Raa atoll as of August 2011.

Table 4.16: Number of Registered farmers in Raa atoll by Locality

Locality	**Number of Registered farmers**		
	Female	**Male**	**Total**
Inguraidhoo	32	13	45
Fainu	7	33	40
Ungoofaaru	13	11	24
Kinolhas	12	10	22
Vaadhoo	3	13	16
Alifushi	7	8	15
Hulhudhuffaaru	1	6	7
Rasgetheemu	1	5	6
Innamaadhoo	1	0	1
TOTAL	77	99	176

SOURCE: MINISTRY OF FISHERIES AND AGRICULTURE, 2011

Income Poverty

According to the Maldives Vulnerability and Poverty Assessment, the human vulnerability index for Raa atoll is a little higher than the vulnerability index for the country (0.32 for Raa atoll compare to 0.25 for Maldives). Similarly, income poverty index for Raa atoll is also a little higher than that of the country average (0.20 in Raa atoll compare to 0.1 for Maldives). See table 4.17 below for information on income poverty for Maldives and Raa atoll.

Table 4.17 Income Poverty by Locality, R. Atoll

Locality	2004	2004	2004	2004	1997	2004
	Headcount ratio, percentage of the population with less than RF. 15 per person per day	**Average income of the population with less than Rf.15 per person per day (RF)**	**Income Shortfall of the population with less than Rf.15 per person per day (%)**	**Poverty gap index of the population with less than Rf. 15 per person per day**	**Human vulnerability Index**	**Income Poverty Index**
Maldives	21	10.6	29	0.06	0.25	0.10
Raa Atoll	41	10.4	31	0.13	0.32	0.20
Alifushi	80	9.1	39	0.31	0.14	0.51
Vaadhoo	18	14.4	4	0.01	0.08	0.01
Rasgatheemu	36	11.5	24	0.08	0	0.14
Angolhitheemu	50	8.8	41	0.21	0.14	0.33
Ugufaaru	34	12.6	16	0.05	0.33	0.09
Kandhalhudhoo	33	12.3	18	0.06	0.16	0.1
Maakurathu	51	8.1	46	0.23	0.23	0.38
Rasmaadhoo	57	7.2	52	0.3	0.15	0.48
Innamaadhoo	17	12.3	18	0.03	0.14	0.05
Maduvvari	68	10.8	28	0.19	0.81	0.3
Iguraidhoo	29	9.8	35	0.1	0.44	0.16
Fainu	36	11.3	25	0.09	0.88	0.14
Meedhoo	22	9.2	39	0.08	0.21	0.14
Kinolhas	65	11.8	21	0.14	0.44	0.22

Source: Vulnerability and Poverty Assessment, Ministry of Planning and National Development, 2004

4.4.1.5 *Health Services*

According to census 2006, there are a total of 17 health facilities in Raa atoll including 1 regional hospital, 6 health centers, 1 health posts and 9 pharmacies. A total of 58 health professionals were employed in these health facilities in 2006.

Currently there are plans to build a new regional hospital and a Family and Children Service Center in Ungoofaaru.

Table 4.18 below shows the number of available health facilities with the distribution of doctors and nurses in each health service center in Raa atoll based on census 2006.

Table 4.18: Medical facilities and distribution of doctors and nurses, Raa atoll, 2006

MEDICAL FACILITIES	NUMBER AVAILABLE	DOCTORS	STAFF NURSES	NURSES
Regional Hospitals	1	8	16	11
Atoll Hospitals	0	0	0	0
Health Centers	6	5	9	8
Health posts	1	1	-	-
Pharmacies	9	-	-	-

SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

4.4.1.6 *Infrastructure and accessibility to services*

Households

Total number of households in Raa atoll, according to census 2006 is 2,538. 83% of these households were used as living quarters and 16% were used as temporary shelter for the victims of tsunami. Temporary shelters are located in 5 islands of the atoll including Alifushi, Ungoofaaru, Maduvvari, Meedhoo and Hulhudhuffaaru.

Majority of the households in Raa atoll were occupied by the owner of the house (81.5%). 53.6% of households in the atoll were owned by males and the percentage of households owned by females is 25.9%. A further 2.2% of the households are owned by the both male and female.

Currently there are plans to construct a total of 240 housing units in 6 islands of Raa atoll including 20 housing units in Angolhitheemu, 50 units in Alifushi, 30 units in Inguraidhoo, 30 units in Rasgetheemu, 40 units in Maakurathu and 70 units in Ungoofaaru.

Access to Household Goods and Services

According to census 2006, majority of the households in Raa atoll have washing machines and refrigerators (84% and 64%). However, only 0.5% of the total households in the atoll have air-conditioning.

Most of the households have bicycles (54.3%), however only 7.1% of the households have motor cycles and 0.5% of the households have car/jeep.

Telephones and television services are easily available in Raa atoll as 80% of the households have mobile phones and 94.3% have Televisions.

Satellite services are also commonly used in Raa atoll. 60.2% of the households have access to cable TV connection. A further 12% of the households have access to computer, however, only

0.3% of households have access to Internet and 0.4% has access to newspaper. Table 4.19 below shows ownership of selected household goods and services in Raa atoll based on census 2006.

Table 4.19: Ownership of selected household goods and Services R. Atoll, Census 2006

	Household Goods	**Percentage**
Household Appliances	Washing Machine	84.4%
	Refrigerators	46.5%
	Air conditioning	0.5%
Transport and Communication	Bicycle	54.3%
	Motor Cycle	7.1%
	Car/Jeep	0.5%
	Mobile Phone	80.0%
	Fixed Line	0.4%
	TV	94.3%
Satellite services	Cable TV Connection	60.2%
	Computer	12.0%
	Newspaper	0.4%
	Internet	0.3%

SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, CENSUS 2006

Transport and Communication

The main transportation system in the atoll is the inter atoll ferry system which travels between the islands twice a day for 6 days a week.

Current developments in this are in the atoll include construction and re-construction of harbors in the islands. For instance, harbor construction in Angolhitheemu, Kinolhas, Alifushi and Maakurathu have recently being completed and is also planned for Vaadhoo. Reconstructions of harbors in Meedhoo and Rasmaadhoo have also being completed recently. Reconstruction of harbor is currently on-going in Fainu. Additionally, harbor rehabilitation project under Maldives Tsunami Reconstruction Project is planned for Ungoofaaru.

The three main communication facilities in the atoll are Dhiraagu and Wataniya service centers and post office established in R. Ungoofaaru. According to census 2006, 80% of households in Raa atoll have access mobile phones.

4.4.2 Ugoofaaru Island Socio-economic setup

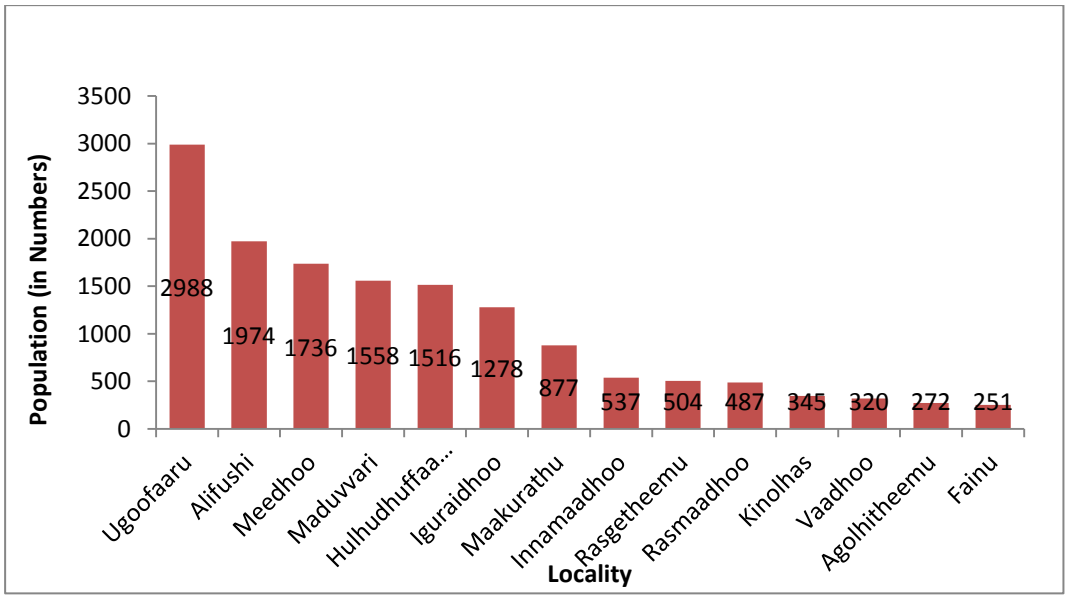
4.4.2.1 *Population Structure*

Total Population

The total registered population of Ungoofaaru as of April 2011 is 1,457 people with 730 males and 727 females.

The total enumerated population from Maldives Population and Housing Census of 2006 is reported as 2,988 people with 1,471 males and 1,517 females. Ungoofaaru has the biggest population in the atoll and shares 20.25% of the total population of Raa atoll. Figure 4.51 below represents population sizes for the all administered islands in the atoll.

Figure 4.51: Population sizes by Locality, R. Atoll, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Sex Ratio

According to census 2006, there were more females than males in Ungoofaaru with a sex ratio of 94 males per 100 females. However, the current population of Ungoofaaru as of April 2011 shows that there are almost equal number of males and females in the population.

Annual Growth Rate

According to census 2000 and 2006, the population of Raa atoll had a positive annual growth with a rate of 0.25. The average annual growth rate of Ungoofaaru was very high at 16.77 reflecting the in-migration of tsunami victims to Ungoofaaru. The current decrease in the

population of Ungoofaaru is due to the out-migration of tsunami victims to Dhuvaafaru. Table 4.20 below shows the population figures for census 2000 and 2006 of Ungoofaaru.

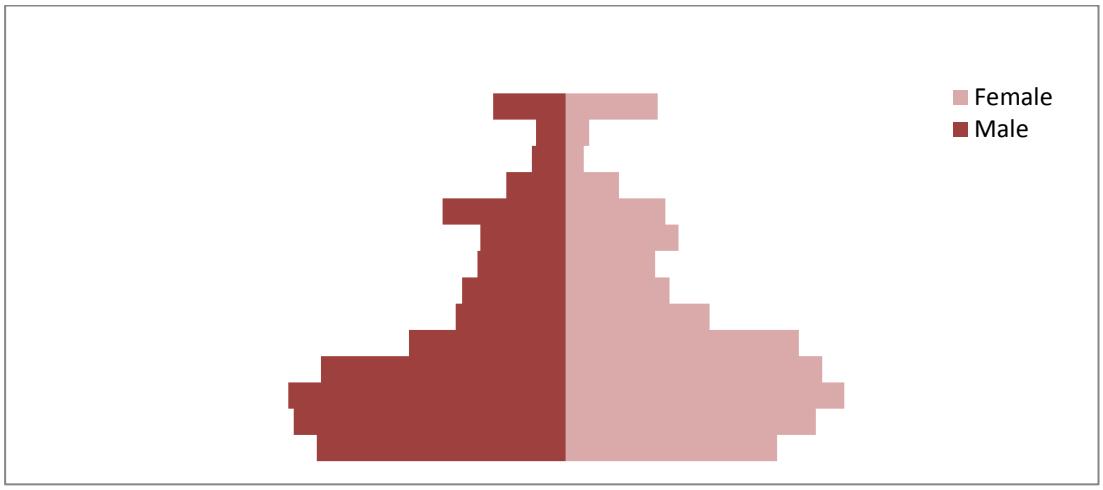
Table 4.20: Ungoofaaru population census figures of for 2000 and 2006

	Census 2006	Census 2000
Total Population	2,988	1,089
Male	1471	548
Female	1517	541

Dependency Ratio

The general structure of Ungoofaaru population is shown in Figure 4.52 below. The dependent population is at 45.2%, which comprises of 39.5% children and 5.6% elderly. The working age population comprises of more than half of the population with 55%.

Figure 4.52: Population Pyramid of R. Ungoofaaru, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Population Density

Ungoofaaru is the third smallest administered island in Raa atoll with 28 hectares in area. It is also the most populous island in the atoll with a population density of 106 persons per hectare. Administrative and Institutional Capacity

Education Sector

There are a 2 education institutes established in Ungoofaaru including one island level school and one pre-school. The Highest level of education qualification provided in the island is up to GCE O'level standard. Currently 293 students are enrolled in school including 127 females and 166 males.

Heath Sector

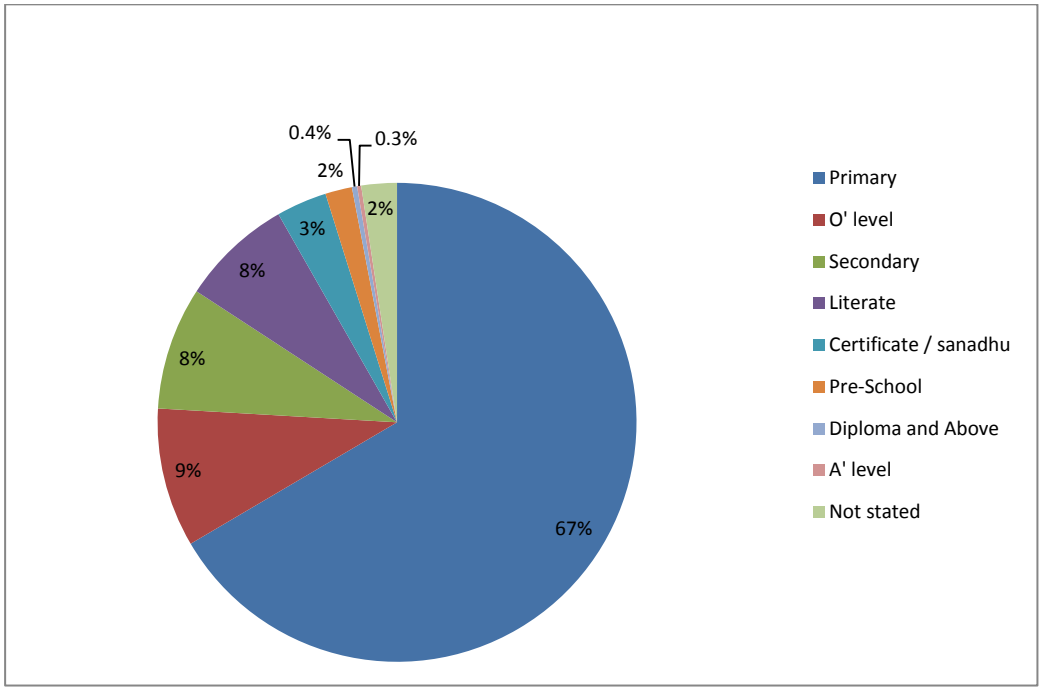
The main health service facility in Ungoofaaru is the regional hospital in the island. There are also 2 pharmacies owned and administered by the local population.

Education Attainment

According to census 2006, literacy rate for Ungoofaaru is 95.25%. The literacy rate for female population is higher than that of males (96.71% females compare to 93.70% males).

In education attainment, majority of the population over the age of 6 has received primary education with 67%. However, there is a huge drop in the percent of people attaining secondary education as only 8% reported as having secondary level education and 9% having GCE O'level qualification. A further 3% have achieved certificate or Sanadhu level qualification and only 0.7% have attained GCE A'level and above qualification. Figure 4.53 below shows education attainment rates for Ungoofaaru population based on census 2006.

Figure 4.53: Education Attainment Rates, R. Ungoofaaru, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

4.4.2.2 *Employment*

Employment and Unemployment Rates

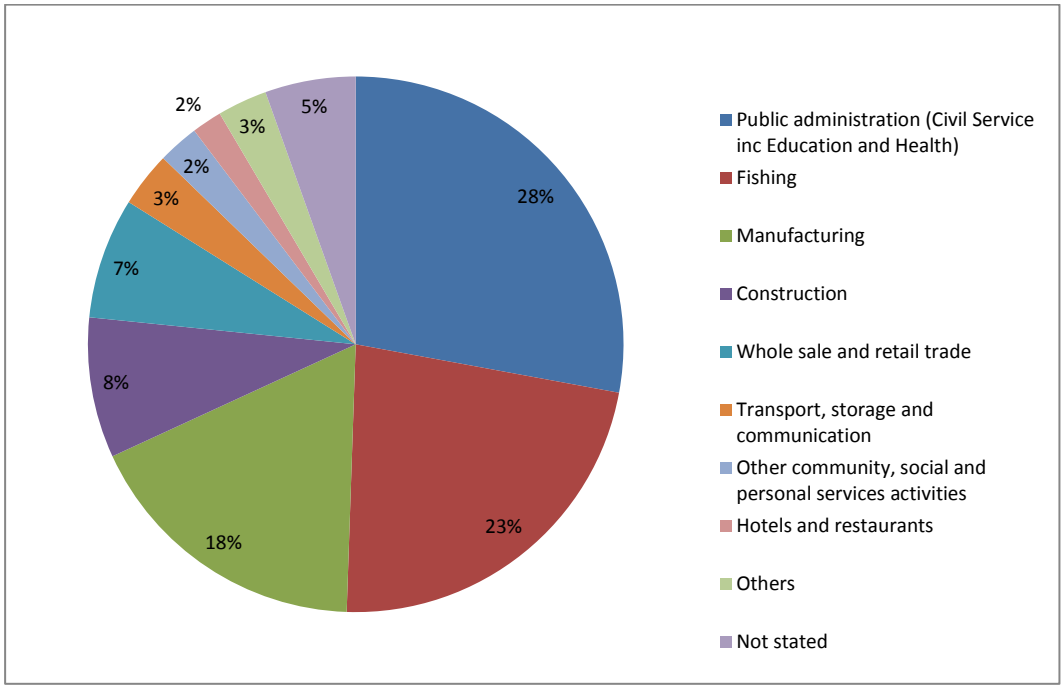
According to census 2006, the total number of economically active population in Ungoofaaru is 1,176. Among these 932 are employed and 244 are unemployed. The economically not active

population is reported as 591 people. Labor force participation rate is 65.3% and the unemployment rate is reported as 20.7%. Among all administered islands in the atoll, Ungoofaaru has the fourth highest unemployment rate. Much of the unemployment is among the female population with 36.2.2% of females unemployed compare to 9.2% males.

Main Employment Sectors

The three main employment sectors in Ungoofaaru according to census 2006 are public administration and defense (28%), fishing (23%) and manufacturing (18%). Other main economic sectors include construction, wholesale and retail trade, transport, storage and communication and hotels and restaurants. Figure 4.54 below shows the main employment sectors in Ungoofaaru based on census 2006.

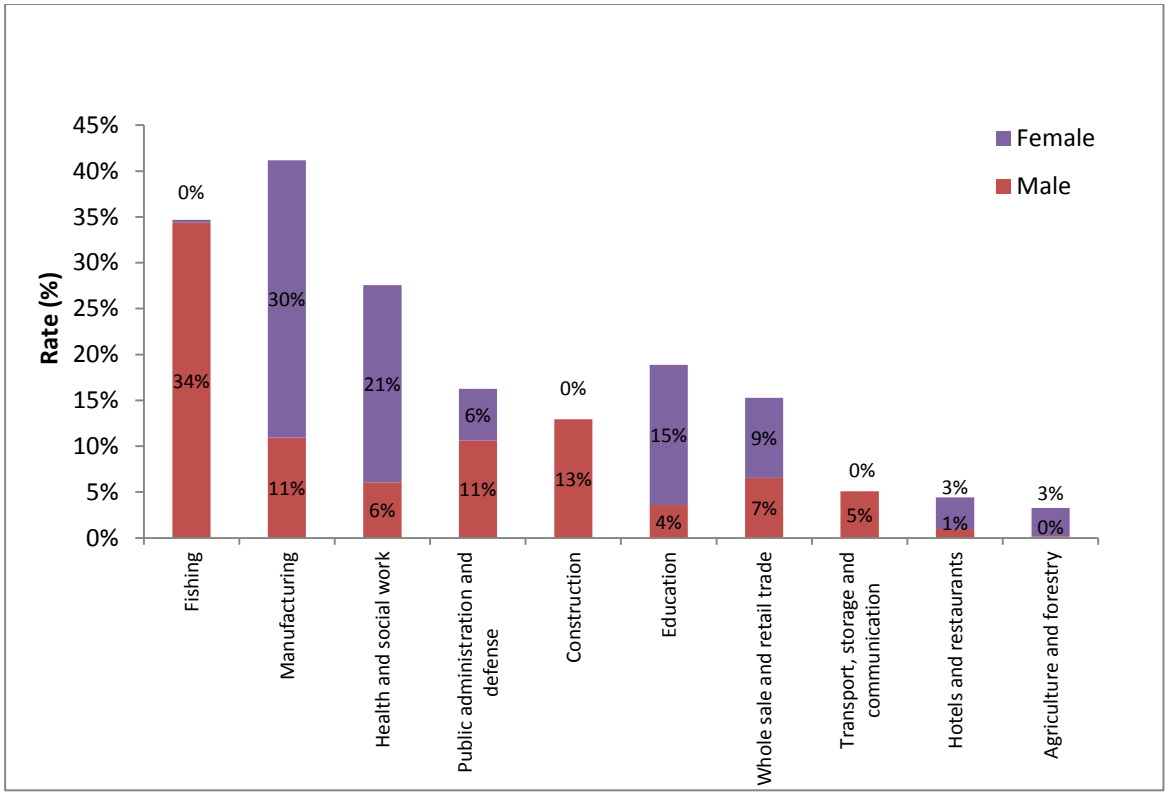
Figure 4.54: Employment by Industry, R. Ungoofaaru, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

There are noticeable differences in employment with regard to gender. The total employed male population is 611 and that of female population is 321. There are also gender variations in employment based on the type of economic activity. Industries such as fishing, construction transport, storage and communication are completely dominated by the working male population. Additionally, public administration sector is also dominated by the male work force. On the other hand, education, manufacturing, health and social work, wholesale and retail trade, hotels and restaurants and agriculture and forestry are dominated by the female work force. Figure 4.55 below shows the gender variations in employment in Ungoofaaru based on census 2006.

Figure 4.55: Employment by Gender, R. Ungoofaaru, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

4.4.2.3 *Infra-Structure and Services*

Households: The total number of households in Ungoofaaru at the time of census 2006 is 472 including 203 living quarters and 267 temporary shelters provided due to tsunami. The total number of households as of April 2011 is 297.

Power: Electricity is currently generated using 1 engine and provides electricity for all households in the island for 24 hours a day.

Toilet Facility: According to census 2006, majority of the households in Ungoofaaru have toilets connected to sea (59%). A further 38% of the households also have toilets connected to septic tank. However, the current sewerage system established in the island covers 95% of the households. Currently, there is also a water plant system installed in the island.

Water Supply: At the time of census 2006 the majority of households in Ungoofaaru used rainwater as the main source of drinking water (97%). However, 1% of the households also used well water and a further 1% used desalinated water for drinking. However, only 6% of the households used treated water for drinking while 92% used untreated water. As of April 2011, clean drinking water has been provided to 85% of the households in the island

Waste Management: According to census 2006, majority of the households in Ungoofaaru use safe way of garbage disposal (99.6% of the households).

Cooking: At the time of census 2006, 90% of the households in Ungoofaaru use gas for cooking while 6% of households use firewood and 3% use oil as the main source of fuel for cooking.

Transport and Communication: Ungoofaaru is connected to rest of the islands in the atoll through the atoll ferry system, which travels within the atoll twice a day. There are a total of 173 registered vehicles in the island including 6 speed launch, 2 boats, 5 pickups and 160 other vehicles. Sea transport to and from the island is facilitated by the island harbor and jetty.

The three main communication service providers in Ungoofaaru are Dhiraj and Wataniya service centers and the post office in the island.

Business Services and facilities: As of April 2011, there are a total of 56 business facilities in Ungoofaaru including 33 shops, 5 café's, 3 workshops, 3 carpentries and 2 tailors shop.

Sports and Recreation: Sports and recreational facilities in Ungoofaaru include a football ground, a children's park, a social center, a youth center, and an indoor sports hall.

4.4.3 Hulhudhuffaaru Island Socio-economic setup

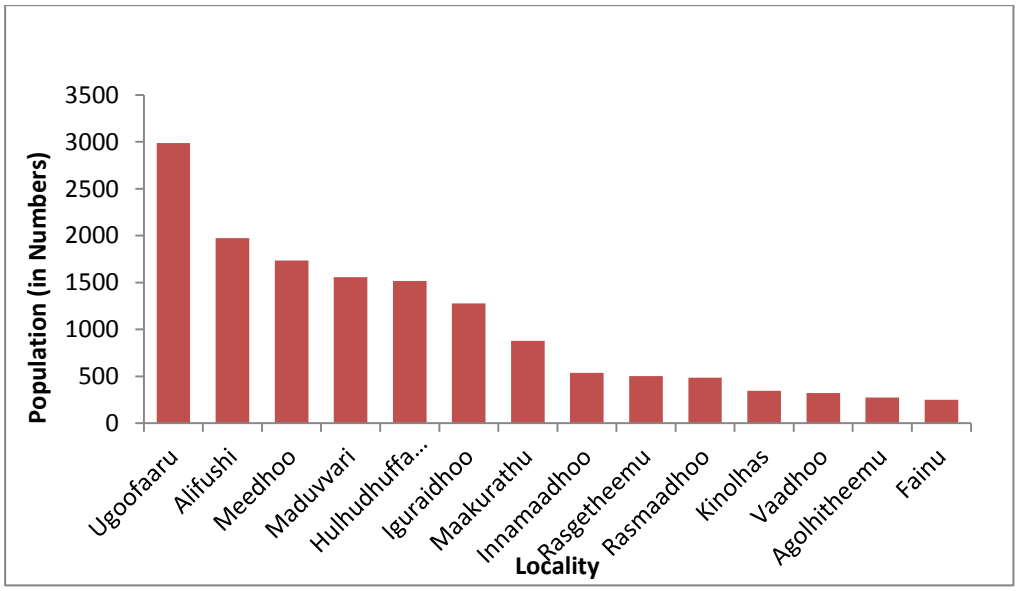
4.4.3.1 *Population Structure*

Total Population

The total registered population of Hulhudhuffaaru as of April 2011 is 1,338 people with 680 males and 658 females.

The total enumerated population of Hulhudhuffaaru from Maldives Population and Housing Census of 2006 is reported as 1,516 people with 725 males and 791 females. Hulhudhuffaaru shares 10.27% of the total population of Raa atoll. Figure 4.56 below represents population sizes for all administered islands in the atoll.

Figure 4.56: Population by Island Size, R. Atoll, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Sex Ratio

According to census 2006, there are more females than males in Hulhudhuffaaru with a sex ratio of 92 males per 100 females. However, the current population of Hulhudhuffaaru as of April 2011 shows that there are more males than females with a sex ratio of 103 males per 100 females.

Annual Growth Rate

According to census 2000 and 2006, the population of Raa atoll had a positive population growth with a rate of 0.25. The average annual growth rate of Hulhudhuffaaru was very high at 7.96 reflecting the in-migration of victims of tsunami. The current decrease in the population

Hulhudhuffaaru may be due to the out-migration of tsunami victims to Dhuvaafaru. Table 4.21 below shows the population figures for census 2000 and 2006 of Hulhudhuffaaru.

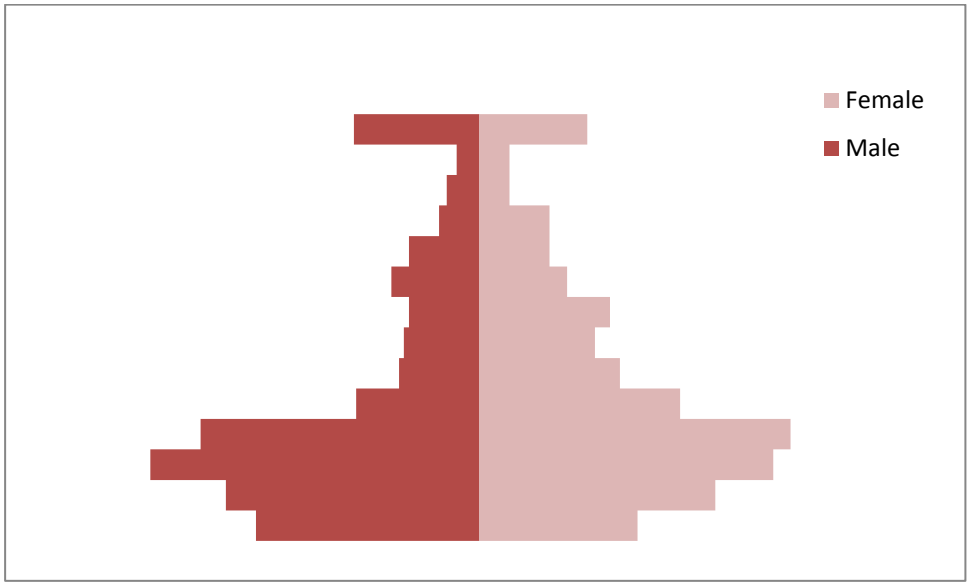
Table 4.21: Hulhudhufaaru population census figures of for 2000 and 2006

	Census 2006	Census 2000
Total Population	1,516	939
Male	725	453
Female	791	486

Dependency Ratio

The general structure of Hulhudhuffaaru population is shown in figure 4.57 below. The dependent population is at 45%, which comprises of 39% children and 6% elderly. The working age population comprises of more than half of the population with 54%.

Figure 4.57: Population Structure of R. Hulhuduffaaru, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

Population Density

Hulhudhuffaaru is the second largest administered island in Raa atoll with 49 hectares in area. According to census 2006, it has a population density of 31 persons per hectare.

4.4.3.2 *Administrative and Institutional Capacity*

Education Sector

As of April 2011 there are a 2 education institutes established in Hulhudhuffaaru including one island level school and one pre-school. The highest level of education qualification provided in the island is up to grade 11 standard. Currently 312 students are enrolled in the school including 143 females and 169 males. This also includes 63 students who are studying in Hulhudhuffaaru but are from other island. A total of 70 students from Hulhudhuffaaru, are currently studying out of the island including 57 in Male', 7 in other islands and 6 in abroad.

Health Sector

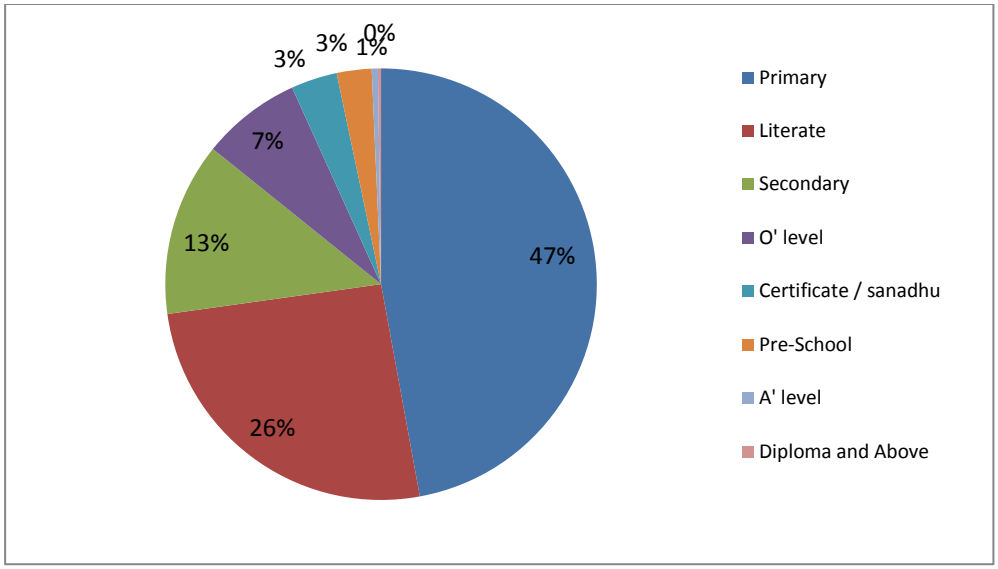
The main health service facilities in Hulhudhuffaaru are the health center and the pharmacy in the island. There are a total of 15 health professionals employed in the island including 1 doctor, 6 nurses, 3 health workers, 1 midwife, 1 pharmacist and 3 traditional medical practitioners.

4.4.3.3 *Education Attainment*

According to census 2006, literacy rate for Hulhudhuffaaru is 96.55%. The literacy rate for female population is higher than that of males (97.08% females compare to 95.93% males).

In education attainment, majority of the population over the age of 6 have received primary education. However, there is a huge drop in the percent of people attaining secondary education as only 13% reported as having secondary level education and 7.5% having GCE O'level qualification. A further 3.5% have received certificate or Sanadhu level qualification and only 0.7% attained GCE A'level and above qualifications. Figure 4.58 below shows education attainment rates for Hulhudhuffaaru population based on census 2006.

Figure 4.58: Education Attainment Rates, R. Hulhudhuffaaru, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

4.4.3.4 *Employment*

Employment and Unemployment Rates

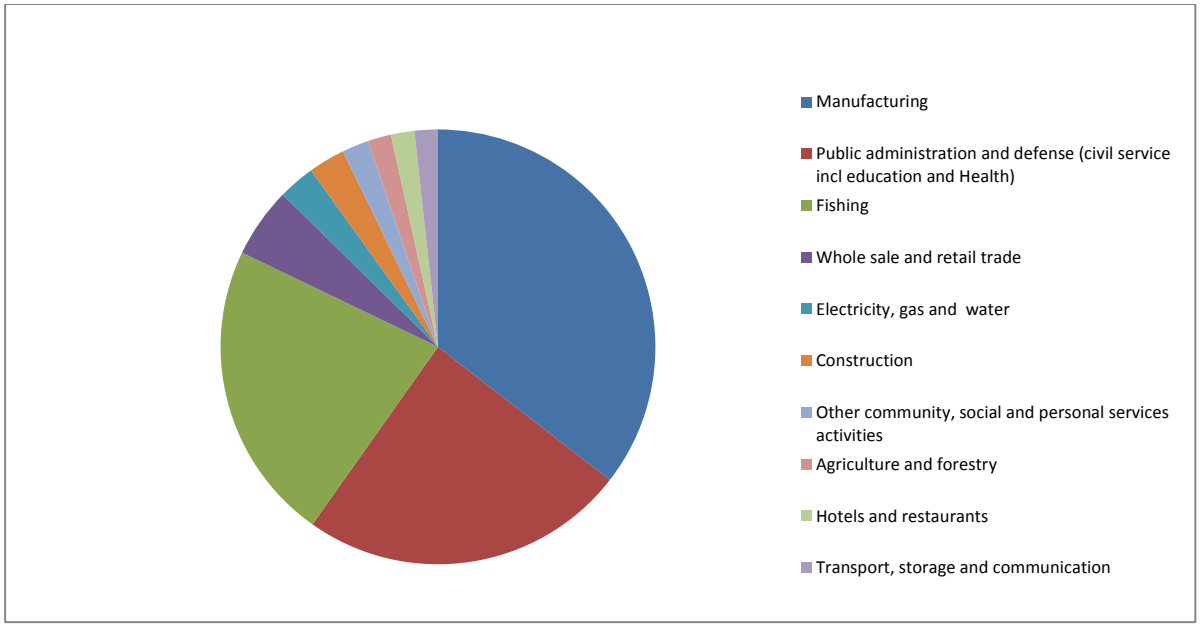
According to census 2006, the total number of economically active population in Hulhudhuffaaru is 514. Among these 414 are employed and 100 are unemployed. The economically not active population is reported as 377 people. Among all administered islands in the atoll, labour force participation rate is the lowest in Hulhudhuffaaru (55.8%) Unemployment rate in Hulhudhuffaaru is reported as 19.5% and much of the unemployment is among the female population with 25.7% of females unemployed compare to 13.4% males.

As of April 2011 a total of 152 people including 120 males and 32 males from Hulhudhuffaaru are currently working outside the island. On the other hand, there are a total of 33 foreigners working in the islands including 21 males and 12 females

Main Employment Sectors

The three main employment sectors in Hulhudhuffaaru according to census 2006 are manufacturing (35%), public administration (24%) and fishing (22%). Other economic sectors include wholesale and retail trade, electricity, gas and water, construction, agriculture and forestry and hotels and restaurants. . Figure 4.59 below shows the main employment sectors in Hulhudhuffaaru based on census 2006.

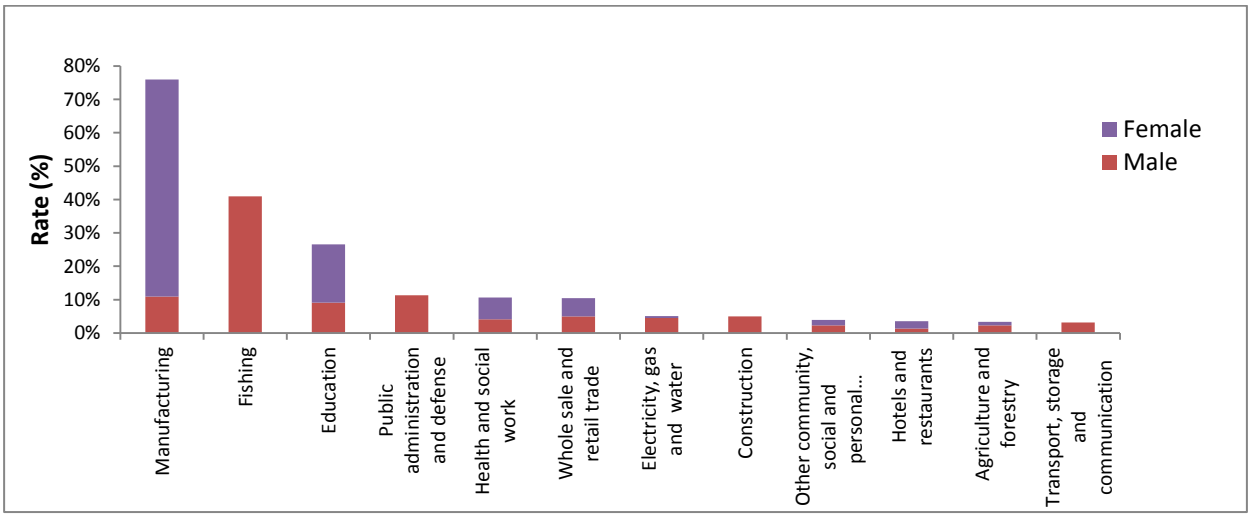
Figure 4.59: Employment By Sector, R. Hulhudhuffaru, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

There are noticeable differences in employment with regard to gender. The total employed male population is 226 and that of female population is 188. There are also gender variations in employment based on the type of economic activity. Industries such as fishing, public administration, construction and transport, storage and communication are completely dominated by the working male population. On the other hand, manufacturing, education and health and social work, are mainly dominated by the female work force. Figure 4.60 below shows the gender variations in employment in Hulhudhuffaaru based on census 2006.

Figure 4.60: Employment Industry by Gender, R. Hulhudhuffaaru, Census 2006



SOURCE: MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT, 2008

4.4.3.5 *Infra-Structure and Services*

Households: The total number of houses in Hulhudhuffaaru at the time of census 2006 was 285 including 204 living quarters and 79 temporary shelters provided due to tsunami. The total number of households as of April 2011 is 362.

Power: Electricity is currently generated using 3 engines and provides electricity for all households in the island for 24 hours a day.

Toilet Facility: According to census 2006, majority of the households in Hulhudhuffaaru have toilets connected to septic tank (69%). A further 28% of the households also use toilets connected to sea and 1% use reserved compound of the house (gifili).

Water Supply: At the time of census 2006 almost all households in Hulhudhuffaaru used rainwater as the main source of drinking water (97%). However, only 4% of the households used treated water for drinking while 95% used untreated water.

Waste Management: According to census 2006, almost all households in Hulhudhuffaaru use safe way of garbage disposal (98.9% of the households).

Cooking: At the time of census 2006, 67% of the households in Hulhudhuffaaru use gas for cooking while 27% of households use firewood and 4% use oil as the main source of fuel for cooking.

Transport and Communication: Hulhudhuffaaru is connected to rest of the islands in the atoll through the atoll ferry system, which travels within the atoll twice a day. There are a total of 352 registered vehicles in the island including 43 vehicles used for sea transportations and 309 vehicles used for land transportation. Sea transport to and from the island is currently facilitated by the harbour and jetty.

The main communication services used in Hulhudhuffaaru are Dhiraagu and Wataniya telephone service. There is also an agency post office established in the island.

Business Services and facilities: As of April 2011, there are a total of 16 business facilities in Hulhudhuffaaru including 13 shops, 1 café and 3 workshops.

5 IMPACT IDENTIFICATION

5.1 Introduction

Potential adverse and beneficial impacts of construction and operation stage of the resort development are identified and evaluated in this section. Significant impacts are identified and evaluated in two stages. The first stage identifies the environmental and socio-economic components that may be impacted from key project activities. The second stage determines the significance of impacts of each component. The following sections provide details of the evaluation of impacts.

Nature of potential impacts is defined here as No Impact, Adverse Impact or Beneficial Impact. Table 5.1 below provides the nature of potential impacts from the proposed project on environmental and socio-economic aspects by the project components. Where impacts are not applicable to different components, this is indicated as 'X'. Some aspects may be affected both adversely (indicated as [-]) and beneficially (indicated as [+]) from the project.

5.2 Impact Identification and Evaluation

Environmental and socio-economic aspects that may be impacted by the project as identified in Table 5.1 are further evaluated to identify significant impacts. Assessments of the impacts are conducted using the four criteria of Magnitude, Reversibility, Duration and Distribution as described below. Evaluation of key impacts is provided in Table 5.2.

1. **Magnitude**: Refers to the quantum of change that will be experienced as a consequence of the impact.
2. **Reversibility:** Refers to the degree of reversibility of an impact (i.e. ease of reversing the conditions).
3. **Duration:** Refers to the temporal scale (i.e. duration, frequency) of the impact. It does not take into account the duration of the impact's effects.
4. **Distribution:** Refers to the spatial scale of the area impacted (e.g. a small portion of a reef or an entire lagoon)

Estimates for negative impacts represent a 'worst case scenario' based on the assumption that the project will undergo full-scale development with no consideration for its environmental and social consequences, i.e. significance is assessed prior to implementation of mitigation measures. Values are attributed by the EIA team on the basis of direct observation of surveyed sites, professional judgment and pre-existing experience in development projects of similar nature.

5.3 Evaluation of Cumulative Impacts

While direct primary impacts are relatively easy to identify and evaluate, special consideration needs to be afforded to evaluating cumulative impacts. While it is relatively simple to identify and evaluate direct primary impacts, the complex nature of natural systems makes it difficult to accurately predict synergistic and interactive impacts of a particular development project. On the other hand, it is relatively simple to identify potential additive impacts.

The following sources of cumulative impacts were considered in evaluating the potential impacts of the resort development project.

- Time crowding: overall impacts of many similar concurrent developments. E.g. While many marine species and birds are relatively versatile and can relocate to other similar habitats following disturbances, concurrent developments in nearby habitats will reduce their chances of relocation and survival.
- Space crowding: high density of impacts on a single environmental medium. E.g. release of effluent from different sources into the same area.
- Indirect impacts: secondary and tertiary impacts resulting from an activity. E.g. groundwater contamination can affect the growth of terrestrial plants, which result in loss of habitat for terrestrial fauna.
- Triggers and thresholds: ecological systems can undergo fundamental changes beyond certain thresholds. Standards and guidelines have been developed based on anticipated threshold levels, for instance, in determining water quality. Such standards have been considered, where available.

Table 5.1: Impact Identification Matrix

Project Activity	Ambient noise level	Ambient air quality	GHG emissions	Groundwater	Coastal Processes	Marine water	Terrestrial Flora and Fauna	Soil Condition	Marine Flora and Fauna	Landscape Integrity/ Scenery	Natural Hazard Risk	Health and Safety	Demand for Resources and Services	Local Economy	Social Cohesion
Mobilization	-	X	-	X	-	-	-	-	-	-	X	X	X	+	+
Worker accommodation and activities	-	-	X	-	X	-	-	X	-	-	X	X	-	+	+/-
Equipment and material storage	X	X	X	-	-	X	-	-	X	-	X	+/-	X	X	X
Site clearance	-	-	-	-	X	X	-	-	X	-	-	X	X	X	X
Excavation and dewatering	-	X	X	-	X	X	X	-	X	-	X	-	X	X	X
Construction of land rooms & guest facilities	-	-	-	-	-	X	-	-	X	-	X	X	-	+	+
Construction back-of-the-house facilities	-	-	-	-	-	-	-	-	-	-	X	X	-	+	+
Construction of over water facilities	-	-	-	X	-	-	X	X	-	-	X	-	X	X	X
Construction of jetties	X	X	X	X	+/-	-	X	X	-	-	X	+	X	+	X
Landscaping	X	X	X	-	X	-	+/-	+/-	X	+	+	X	-	+	X
Construction stage waste	X	-	-	-	-	-	-	-	-	-	X	-	X	X	X
Demobilization	-	X	X	X	X	X	X	X	X	X	X	-	X	+/-	+/-
Operation stage guest and staff activities	X	X	-	X	X	-	-	X	-	X	X	-	X	+	X
Solid waste	X	X	X	-	X	X	X	-	X	X	X	X	X	X	X
Power generation and Water production	-	-	-	X	X	-	X	X	-	X	+	+/-	X	X	X
Waste water	X	X	X	X	x	-	X	X	-	X	X	+	X	X	X
Beach management	X	X	X	X	-	-	x	x	-	-	+	+	X	+	X

X (no impact), - (negative impact), + (positive impact)

Table 5.2: Evaluation of key impacts on the natural and socio-economic environment

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
Ambient noise level	**Noise pollution:** Operation of vehicles, machineries during site preparation, demolition and construction. However these will not be operated continuously for a long period of time.	Reduced or complete absence of birds by the time operations begin Impacts cumulative overtime	Moderate negative	Easily reversible	Short and long term	Vicinity of project site	Minor
Ambient air quality	Dust and air emissions from equipment and machinery during construction	Cumulative from different project activities	Minor negative	Reversible once project is completed	Long term	Island level	Insignificant
GHG emissions	**Increase in GHG in atmosphere** due to construction equipment, power generation for equipment and during resort operation.	Emissions from flights taken by guests arriving at the resort. Cumulative from different project activities and over time	Minor negative	Reversible in the long term	Short term	Regional level	Minor
Groundwater	Accidental spillage of fuel, lubricants, etc. Leakage from construction	Cumulative from different project activities	Moderate negative	Irreversible	Short term	Island level	Major

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
	stage sewerage. Depletion due to dewatering Seepage of sea water into the groundwater	Indirect impact on terrestrial flora and soil fauna Excavation can expose deeper soil layer and groundwater to increased risk of contamination by accidental spillages					
Coastal Processes	**Effects of existing erosion;** any structure constructed close to shoreline on the eastern and southern and western end is at risk of being affected by erosion. **Changes to the flow velocity** and direction due coastal structures, potentially leading changes to island movement patterns. If shore protection measures are deployed, island coastal processes may cease to	Indirect impact on product quality offered on the island and high cost of erosion mitigation. Cumulative from different project components	Major negative	Reversible in the long term with costly implications	Medium to long term	Island level	Major

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
	exist. The proposed overwater villas is within the footprint of a mobile sandpit, which may make the rooms 'beach villas' for some periods of the year.						
Marine water	Accidental spillage of waste, fuel and lubricants into the marine environment Increased turbidity and sedimentation due to coastal construction activities and reef entrance clearing Disposal of sewage water may degrade the water quality at the affected locations.	Cumulative from different project activities and over time; Indirect impact on physiological fitness of marine organisms, and community composition of the marine ecosystem.	Moderate negative	Reversible in the long term	Long term	Island level	Major
Terrestrial Flora and Fauna	Loss of terrestrial flora and fauna due to vegetation clearance and worker actions Workers may catch disturb	Cumulative from different project activities and over time	Minor negative	Reversible in the long run	Short term	Site level	Minor

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
	birds arriving to the sand pit. Introduction of diseases and pests due to new species introduction.						
Soil Condition	Accidental spillage/ leakage of fuel, lubricants, etc. during construction	Cumulative from different project activities and over time	Minor negative	Reversible in the long term	Short term	Site level	Minor
Marine Flora and Fauna	The benthic organisms and habitat of marine organisms in the direct footprint of the area to be cleared for overwater room construction will be lost.	Cumulative from different project activities	Moderate negative	Reversible in the long term and with coral colony relocation.	Long term	Site level	Major
Landscape Integrity/ Scenery	Loss of visual amenity due to built structures and vegetation removal	Cumulative from different project activities	Minor	Practically irreversible	Short term	Site level	Moderate
Natural Hazard Risk	Erosion around the island due to the natural forces will affect the structures.	-	Minor positive	Reversible	Long term	Island level	Minor

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
Health and Safety	Accidents related to equipment handling and pollution	Indirect impacts from contamination of water, air and soil	Moderate	Possibly irreversible	Long term	Island level	Moderate
Demand for Resources and Services	Demand for freshwater, energy and waste disposal will increase during construction and operation	Cumulative impact on waste management facilities at Thilafushi or Vandhoo	Negligible	Reversible	Short term	Island level	Insignificant. Resort will be mostly self-sufficient
Local Economy	Temporary employment opportunities for construction related activities. Trade of food and beverages, and other daily necessities would also temporarily improve, with the influx of external construction workers.	-	Minor positive	Reversible	Short term	Atoll level	Minor
	Business opportunities for local fishermen, farmers, artisans, etc. due to demand from resort. Employment opportunities in resort operations.		Moderate positive	Reversible	Long term	Atoll level	Moderate

Impact area	Direct Impacts	Indirect/ Cumulative Impacts and Impact Interactions	Magnitude	Reversibility	Duration	Distribution	Significance
Social Cohesion	The choice of construction workers or contractors for the project, particularly if chosen from outside the atoll, may lead to dissatisfaction amongst Raa Atoll population and neighbouring islands.	Cumulative from different project activities	Minor negative	Reversible	Short term	Island level	Minor

6 SIGNIFICANT IMPACTS AND MITIGATION MEASURES

6.1 Impacts on Natural Environment during Construction

6.1.1 Ambient Noise Level, Air Quality and Greenhouse Gas Emissions

During the mobilisation of equipment and operation of heavy machinery, it is anticipated that significant noise will be generated. Noise vibrations may alter species behaviour. In addition, dust and emissions, including greenhouse gases, from vehicle and machinery exhausts will degrade the air quality. However, these adverse impacts will be short term and can be mitigated to avoid nuisance to the resident worker community. With proper mitigation measures, it is unlikely that noise and air pollution impacts will cause long term effects such as human health risks leading to increased public and private health costs. While emitted greenhouse gases can persist in the atmosphere in the long term, the level of emission from this project is expected to be negligible.

There no inhabited settlement in close vicinity to Muravandhoo and therefore impacts on other islands are expected to be minimal.

6.1.2 Groundwater and Soil Condition

The construction and development of the island is expected to have impacts on the quality and quantity groundwater and soil condition. Impacts are expected to be severe in the event of accidental spills.

The relatively small size of the island and the ground water lens is of particularly concern in terms of vulnerability to negative impacts.

During the constructional phase oil, paint or other chemicals will need to be handled properly. Mishandling of fuel has led to serious pollution of soil and groundwater aquifer in some of the other resort construction projects. There have also been reports of spilled oil near temporary generator sets and around fuel transport lines in other similar resort construction projects. This sort of pollution may sometimes have long-term irreversible effects, extending through the operations stage, since such contamination does not degrade itself and is expensive to clean up. The clean-up itself may require extensive ground water extraction, which will impacts such as salt-water intrusion.

During the construction stage, civil works including excavation will be undertaken to make way for foundations for major infrastructure of the resort such as beach villas, swimming pools, restaurants, kitchen and other amenities. Erection of these structures will require removal of sand and possibly dewatering of groundwater for concrete foundations. Therefore, this stage of

construction will affect the soil and groundwater and may potentially cause saline intrusion. The extent and level of salinization will depend on the location of the structure being built. In general, excavation and dewatering in areas close to the *Vadose zone* or areas close to the beach makes the groundwater vulnerable to salinization.

Removal of vegetation for construction will expose the soil to wind erosion.

Excavation for building foundations and utility pipelines can also expose groundwater and the deeper sections of the soil to more harmful contaminants such as oils and hydrocarbons from vehicles and other machineries used during the construction.

Solid waste and wastewater generation during the construction stage can also affect the groundwater, if they are mishandled and mismanaged during the construction stage. The risk is moderate as construction will be well supervised and managed by project staff to ensure that waste is handled and disposed properly.

Groundwater pollution can also occur as a result of poorly designed and poorly addressed wastewater treatment systems. Leaking sewerage systems such as septic tanks may pollute the soil. This in turn will lead to the formation and accumulation in the aquifer of hazardous gases such as hydrogen sulphide. Eventually, the immediate vicinity of the ground water aquifer may become polluted and cause hazards to human health in medium to long-term. Therefore, even temporary sewage and wastewater systems during the construction stage have to be designed and constructed properly so as to avoid leakages into the ground.

Although Tourism regulations in Maldives prohibit the use of groundwater for any activities during the construction stage, it is unlikely that the project will be managed without having to use some water from the ground.

6.1.3 Terrestrial Flora and Fauna

Development of the resort at Muravandhoo would inevitably involve changes to the terrestrial environment, including flora and fauna. About 10-15 % of the total land area of Muravandhoo will contain built structures. All of the vegetation falling within the footprint will need to be removed. The impact or affected area footprint is summarised in Figure 2.5 and Figure 6.1. Additional areas are also expected to be cleared during construction for temporary storage of construction material, equipment and machinery and waste, and for construction-related activities, such as construction of pre-fabricated columns for overwater structures.

The existing pioneer vegetation zone on the northwest side may be severely affected. It is likely to be used a storage area. Vegetation growth in this area will be impeded and natural ecological succession will be largely altered.

Construction of tourist facilities on the island will require trees and shrubs to be cut down. In the process, some of the peripheral vegetation is removed or the natural ecological succession of the vegetation is altered. With the removal or change to coastal vegetation, the habitat for many coastal dwelling species is lost. In the absence of an environmental management plan, removal of or damage to coastal vegetation is particularly likely during construction, as the coastal areas are convenient for temporary storage of construction materials that are offloaded onto the island and waste that need to be removed from the island, via marine transport.

Influx of workers to the island would inevitably have negative impacts on the terrestrial environment. Lack of awareness or concern to preserve the environment may lead to deliberate or inadvertent damages to the trees in order to speed up their work. Disposal of hazardous waste and sewage may be a concern if not appropriately dealt with. If proper attention is not paid, such a large number of workers on the island could easily disturb the island fauna.

The image of a palm fringed sandy beach and lush tropical vegetation is integral to the perception of, and satisfaction, with Maldives as a tourist destination. To replace the trees and shrubs cut down in the construction process alien species are often imported. Exotic ornamental and fast growing species are now commonly imported to replace the vegetation removed and for resort landscaping. The introduction of exotic species not only reduces the ability of the island vegetation to recover to its natural state but also the exotic species may outgrow local species or introduce new pests. There is also the issue of maintaining the natural perception of the island for marketing purposes. Whilst the palm is the most important vegetation feature on an island there are local plants that have historic and cultural importance and so have marketing value which imported exotics do not have.

Soil and fertiliser have largely been imported to improve the growth prospects of exotic imports. These imports are very much on a trial and error basis and there is little doubt that many soils and a variety of fertilisers have been tried. This process detracts from efforts to use local vegetation, which is already adapted to local conditions, and so should not have to be sustained artificially. Imports may also introduce soil-associated pests and diseases for which local plants have limited resistance. Since the proposed development on Muravandhoo is not expected to import exotic plants in bulk, such environmental impacts would be low but not negligible.

In the absence of adequate data on the faunal species of Muravandhoo it would not be appropriate to draw conclusions on detailed impacts on the fauna. However, general impacts could be identified through experience in such activities. Generally, any clearing of vegetation will either displace or eliminate certain animals since their habitats are destroyed. The clearings combined with heavy machinery operation may temporarily force them to look for alternate sites. In addition, exotic plant species introduced into the island may not provide suitable alternative habitats for native plants that are removed during land clearing.

Wastes and residue arising from construction activities such as oil spills and other wastes may also affect the terrestrial environment. Dumping of construction debris or remains of earth works or temporary waste mounds on or near scrubby vegetation could destroy them easily. Hence, strict measures need to be considered on deposition and monitoring of the refuse as well as other materials produced during the construction phase. Haphazard deposition of waste could destroy several habitats and microhabitats that are crucial for the dynamic island environment.

6.1.1 Marine Water Quality

Construction activities will involve significant adverse impacts on the marine water quality. Construction activities require the use of chemical substances such as fuel, oil and paints. Accidental spillage of such substances, particularly during transportation or offloading, and the construction of overwater structures, can lead to marine water contamination. The spillage of construction material during construction of the overwater villas is a particular concern, given the probable longer length of construction period.

The prefabrication onshore would reduce any possibility of spilling of cement and concrete into the water column during construction of overwater structures. However, there would be some degree of disturbance to the water column due to equipment mobilization and placement of prefabricated columns, particularly due to excavator operations. Sediment dispersal will occur at a moderate scale.

Clearing the entrance channels will also involve disturbance to bottom sediments, generating suspended sediments.

Suspended sediments are carried by water and/or accumulate in a loose unconsolidated form on the reef bottom. While large particles settle on the bottom of the water body, sediment particles less than 0.063 mm in size (mostly clay and silt) will remain suspended in the water column. Suspended sediment will be easily dispersed thereby causing sedimentation on the reef.

Furthermore, significant quantities of waste will be generated from all construction related activities where any mishandling of solid (non-biodegradable) waste and hazardous waste will also contaminate the marine water. Therefore, special care should be taken when handling oil, solid waste and hazardous waste to entirely avoid any accidental spills and leakage.

Sometimes chemicals are used to clear and control vegetation, and these contaminants may also reach the marine environment leading to eutrophication affecting biological life.

Figure 6.1: Vegetation clearing impact footprint

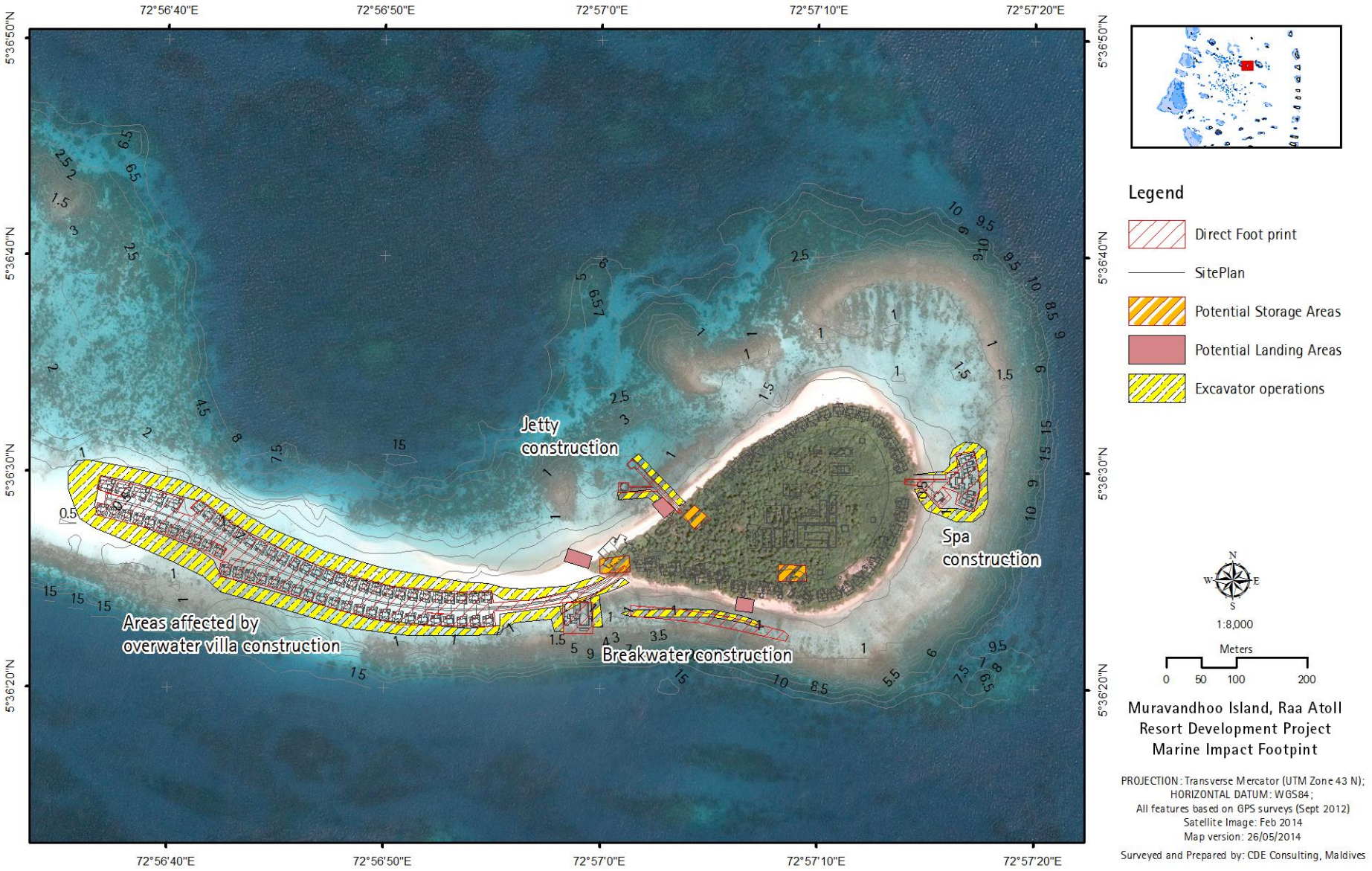


Figure 6.2: Marine impact foot print

Figure 6.3: Coastal impact foot print

6.1.2 Coastal Processes

The following activities and structures are located along the coastline and lagoon, and are likely to have impacts on the coastal environment.

- Construction of overwater villas and access jetty
- Construction of overwater spa and gym
- Construction of the speciality restaurant
- Construction of breakwater (explored in more detail in the alternatives chapter)

The overwater structures will be developed on concrete piles. The piles will be extended inland in order to accommodate potential future erosion in the areas. The piles will be prefabricated on shore and placed in the water using machinery. The structural design has considered the wave activity, and is designed to facilitate and withstand them.

The columns may cause wave scour at the bottom thereby affecting longshore movement of sand to some degree. The impact would be small and is likely to stabilise over time and is unlikely to affect the geomorphology of the island beaches in the long-term.

With construction of any coastal protection structure there is a high likelihood of abrupt changes to coastal hydrodynamics. This may lead to temporary erosion on the island and changes to coral growth. Of particular concern is the immediate severe erosion that may follow these activities as the coastal process tries to adjust to the changes.

The coastal processes currently present on the island the subsequent erosion and accretion process will have an impact on the proposed infrastructure and operations on the island. The eastern and southern side of the island, at present, does not contain a beach (See Figure 6.3). The proposed beach villas may not be classifiable as beach villas in these areas due to the lack of beach. Moreover, the continued erosion may retreat the beach and affect the proposed beach villas on the eastern and southwestern side. Shore protection and beach replenishment may be required to makes these beaches useable. This aspect is explored in more detail in the alternatives chapter.

The construction of breakwater on the southern side will affect the accretion patterns. It is expected that the beach will accrete along the shoreline behind the breakwater. Unprotected areas may continue to erode. Too much accretion, if it happens, will occur at the expense of other beach areas of the island, leading to net erosion in some areas.

The construction of the overwater structures close to the sand pit and the sand bank may also result in some villas to be over land periodically (see operations phase impacts).

6.1.1 Marine Biodiversity

Construction stage of the project is expected to have direct and indirect adverse impacts on the flora and fauna of the marine environment.

The benthic organisms and biological structures in the footprint of the area where the coastal structures are to be constructed and the excavator operations zone will be completely removed (See Figure 6.2). According to the field survey, live coral colonies are rare in the footprint of the proposed structure.

Sewage outfall will require seabed excavation up to a depth of 0.6 m along the placement line. In addition to excavation prefabricated concrete weights will placed to hold the pipe network in place. Lagoon benthos along the excavation line will be directly impacted.

Apart from the live corals, lagoon bottom is a habitat for certain organisms such as worms, molluscs, amphipod etc. which are important food sources for bottom feeders such as certain species of fishes. Lagoon bottom at the proposed project sites will be affected by reef clearing through direct removal of benthic communities and habitats and disturbing habitats of lagoon bottom organisms. However, it has been found elsewhere that lagoon bottom dwelling organisms re-establish within few months after such disturbances.

Degradation of the water quality due to spillage of substance used in construction and construction waste, and sedimentation due to disturbance of bottom sediments and generation of sediment plumes would degrade the habitat of marine organisms. In particular, significant increases in the level of suspended and bedded sediment within the water column for a prolonged period will alter the habitat and adversely affect the living organisms at the site.

A moderately significant amount of siltation and sedimentation of the lagoon waters is anticipated. Similarly, increased turbidity of the lagoon water is expected. These factors will cause adverse impacts such as smothering of corals and reduced light penetration to the coral and benthic communities. Under normal circumstances, corals have a self-cleansing mechanism and can withstand a certain rate of sedimentation. Hence, detrimental impacts such as reduced coral growth and recruitment rate and decreased visibility can be short term effects. However, if the sedimentation exceeds the rate at which corals can self-clean then it may lead to serious detrimental impacts such as coral mortality and alteration of habitat and species composition within the lagoon.

Frequent short-term exposures or chronic long-term exposure to sedimentation and turbidity will result in mortality for many coral species. If moderate levels of impacts on a coral reef persist for particularly long periods of time, the coral reef may undergo changes in diversity, with more sensitive coral species gradually being replaced by more tolerant ones. This may result in an overall reduction in the biodiversity of the coral reef. The risk and severity of impacts from

dredging activities on coral reefs are directly related to both the intensity and duration of impacts causing stress.

Foraging behaviour of fishes may be impeded by turbid conditions as well; gills maybe clogged by sediment particles and sediment deposition may cover and suffocate eggs and larvae of benthic spawning fishes. Prolonged exposure to high sediment levels can lead to a decrease in fish immunity against parasites and diseases. As fishes can readily disperse they are likely to relocate to nearby reefs if high sediment conditions persist.

In addition, sedimentation is likely to cause major shifts in invertebrate populations as sediment is deposited at the crevices/crannies blocking their habitat. This favours domination of invertebrate populations that are more tolerant of the condition. The overall population diversity, size and quality of reef ecosystem are likely to decline due to increased and prolonged sedimentation arising from the proposed activities.

6.2 Impacts on the Natural Environment during Operational Phase

6.2.1 Coastal Processes

As in the construction stage, it is highly likely that there will be considerable changes to beach conditions during the operation stage. Based on the predicted trend of island erosion, all coastal structures on the western side and southwestern side will be at risk from erosion. In the long-term, the currently accreting northwest may also be at risk if treated as permanent land.

As noted before, the west side is expected to experience significant sand pit movement seasonally, making the over water villas unclassifiable as overwater rooms. All privacy related to these rooms may be lost if the beach extends under them.

The spa area is likely to erode as well. The jetty will be particularly at risk if the shoreline retreats.

During the operation phase, access jetty will be heavily used. The increased approach of mechanised vessels to the jetty will cause some disturbance to the currents and waves in the area speeding up sediment transport on the northern side. This has been experienced in a number of resort islands.

Shore protection will be required on the SW side and possibly on the NE corner of the island. Soft adaptation measures such as beach replenishment may not be practical due to the absence of substantial beach quality sand in the reef system within a reasonable distance.

The absence of a beach on the western and southern shoreline will severely restrict the operations on the island, particularly for those villas classified as beach villas. Artificial renourishment may be required (See Alternatives section).

6.2.2 Marine Water Quality

Operational stage activities that can potentially lead to degradation of the marine water quality include improper disposal of solid waste into the marine environment (including waste generated on land and littering from boats), in adequate mixing and dilution of brine from the desalination plant and effluent from the sewage treatment plant.

The Environmental Management Plan presented in Chapter 8 of the report includes methods for proper disposal of solid waste, thereby mitigating the risk of marine environment degradation due to solid waste.

Adverse impacts due to sewage/ wastewater disposal are not expected during the daily operation of the resort, unless the system fails or due to a major natural hazard. If the system fails, wastewater will be pumped out directly into deep water via the emergency outfall location. The system will be repaired as soon as possible. Although temporary impacts on the reef are expected, they are likely to be minimal, given the location of the emergency outfall (ensuring thorough mixing). The locations of the wastewater effluent and brine outfalls are also proposed with consideration of the wave and current conditions in the area, in order to ensure good mixing and thorough dilution.

6.2.3 Marine Biodiversity

Guest recreational activities and operational activities of the resort can have adverse impacts on the marine biodiversity, through physical damage and habitat degradation.

Intensity of boating activities would be relatively high when the resort is in full operation. Intense boating activities have proven chronically detrimental to marine environment especially coral reefs both resulting from direct and indirect impacts such as physical damage to the benthos especially to corals through anchor damage and littering by boat crew and indirectly through disturbances to the lagoon bottoms especially in shallow areas. Boat grounding and anchor damage to the reef are potential risks especially during bad weather conditions and boat operations after dark.

Recreational diving and snorkelling are increasingly becoming a potential damaging activity for the coral reefs due to the increase in sheer frequency of the activity. No detailed studies have been undertaken in the Maldives, but dive operators are increasingly reporting declining quality due to unusually high number of dives.

Given that most reefs are being shared by many resorts for diving, damage to corals should be considered significant in term of direct physical damage and indirect ecological deterioration by divers such as alteration of natural behaviour of reef organisms and boat activities such as wastes and oil spills from boat operation. Anchor damage from dive boats at dive sites are minimal as they do not anchor when the divers are under water and most dives are drifting dives.

Snorkelling is considered less damaging to coral reefs as it mostly involves floating on the surface. However, in many instances the reef flats are too shallow to swim and snorkeler-*trampling* damage may occur while they try to access the reef slope. Damage to reefs occurs when snorkelers kick or stand on coral colonies.

Recreational fishing is a very popular activity carried out in nearly all the resorts in the Maldives. Direct impacts of recreational fishing include, anchor damage and declining fish abundance in extensively fished reefs. The high demand from the resorts for reef fish species also lead to local fishermen to extensively fish known areas until the location's reputation as 'good fishing spot' declines.

Degradation of the marine environment due to solid waste, sewage/ wastewater and brine discharge can affect the marine biodiversity in the area as well. However, as discussed above, these impacts are highly unlikely, given the measures taken to mitigate the risk of such impacts.

6.2.4 Ground Water Quality and Quantity

Usage of groundwater during operation of the resort may have dramatic impacts on the scarce ground water lens. Similarly groundwater can easily be contaminated due to any hazardous chemicals handled on the island.

Fuel tanks within the island will have bund walls to contain at least 110 % of the tank capacity, in case of an accident. Other hazardous materials will have proper labels and material safety datasheets (MSDS) clearly labelled. Access and use of these substances will also be strictly controlled and monitored by specially trained personnel. Therefore, with these mitigation measures, the likelihood of any groundwater contamination is not expected.

Once the resort is in operation, no groundwater will be used for any resort activity other than gardening. Desalination plants will provide fresh water for most of the resorts activity including guest toilets, showers, cooking, cleaning etc. Therefore groundwater will be positively impacted in that the overall quantity will be maintained by not using it.

Furthermore, environmental technologies will be incorporated in Muravandhoo, so as to conserve water during operation. Water efficient taps will be installed at bathrooms and toilets and all operational areas such as kitchen and laundry. High quality water efficient showerheads

will be installed in all guest showers. Low-flush and dual-flushing toilets will be used at bathrooms. Treated water from the wastewater treatment plant will be used for flushing toilets.

6.2.5 Terrestrial Environment

The main operational activities of the resort that are expected to have potential adverse impacts on the terrestrial environment are solid waste and waste oil generation, and gardening/ landscaping/ pest control.

Operational stage of the resort will generate large quantities of solid waste as almost all supplies will be imported. Likely types of waste generated include kitchen waste, packaging, green waste, cans, bottles, hazardous waste (chemicals used in laundry, used fuels etc.). The Environmental Management Plan includes measures to effectively manage solid waste and waste oil in a manner that is least harmful to the environment. Hence, major adverse impacts on the terrestrial environment due to solid waste and waste oils are not expected.

Waste oil from the generators will be collected and will be incinerated. It is estimated that 600 litres of waste oil will be generated per month. Storage and transport of waste oil involves of groundwater leakage or spill if mishandled.

Use of chemical fertilizers, pesticides and insecticides for gardening/ landscaping purposes may also be of concern. The resort would require the use of pesticides and insecticides for rodent and vector control, especially mosquitoes. Introduction of such measures should consider its potential positive and negative impacts on the terrestrial flora and fauna. Environmentally safe products shall be used.

6.2.6 Ambient Noise Level and Air Quality

The resort is designed to provide a peaceful environment will low ambient noise for guests. Hence, guest accommodation and recreation facilities are located separate from the back-of-the-house infrastructure. Back-of-the-house activities that are expected to generate high noise levels are power generation; water desalination; carpentry and mechanical workshops, and, to a lesser extent, laundry.

Emissions from the power generation are expected to be the only significant source of air quality degradation, as motorised vehicles will not be used within the resort boundary. Electric buggy carts will be used for resort operations, and non-motorised vehicles will be available to guests for sightseeing excursions.

The powerhouse will be designed with appropriate insulation to minimise the radiation of heat, soot filters at the chimneys and chimneys height appropriately to minimise the soot emission and effective dispersion outside the boundaries of the island environment. The powerhouse and

desalination plant are proposed to be adequately sound proofed to achieve the allowable limits of 70 -75 dB(A) at 3 meters radius.

Hence, significantly excessive levels of noise and air pollution are not anticipated during operation of the resort.

6.3 Impacts on the Socio-economic Environment

6.3.1 Health and Safety

Health and safety risks arising from construction work is high, especially due to the use of specialised equipment and machinery. Accidents related to equipment use can lead to injury, and fatalities. Materials used in construction, in addition to the equipment and machinery, also involve risks to health and safety. Accidental spills/ leakage of hazardous substances can contaminate the site and pose risks to human health, including workers on the site and the local population. The project activities include measures to minimise risks to health and safety of workers.

6.3.2 Business and Employment Opportunities

The potential beneficial impacts of the proposed development are mainly socio-economic impacts.

Socioeconomic benefits of the construction stage include:

- Employment opportunities during construction works
- Business opportunity for local suppliers
- Opportunity for local contract workers
- Opportunity for locals to rent out property, equipment, machinery, vehicles and vessels.

The development of the resort is likely to have positive impacts on the atoll community. Economic benefits anticipated from resort operation include,

- Agriculture: opportunity to grow fruits and vegetables and sell to the resort
- Fisheries: Opportunity to sell fish catch (both pelagic and reef fish)
- Employment: Many young people as well as women will be employed by the resort
- Trade: excursions, souvenir shops
- Manufacturing: Sataa, fangi, handicrafts

Out of these benefits, employing the poor is the highest priority for the people of the atoll. Tourism is a labour-intensive industry and offers opportunity for private sector to provide additional paid employment to the poor. In order to successfully implement such a programme, attention needs to be given to proper awareness-raising as well as reliable and sustainable employment, and involvement of the people hired as much as possible.

Good examples of this kind of employment are found in other resorts of Maldives, where the women from neighbouring islands clean the beach and gardens of the resort. One other area that could be developed in this fashion is to involve the fishermen from the neighbouring islands to organise "traditional" fishing trips for the tourists. In order to successfully employ the poor for day-jobs it would be critical to have a daily bus/ ferry service between population centres in the atoll and the resort.

The second most important impact area identified by the public is the impact on trade of local goods. Reef fish, agricultural produce and handicraft items are potential products for trade. It would be important for the resort management to determine in advance the policies for purchase of agricultural products and reef fish from islands and free and fair trade should always be encouraged.

6.3.3 Development of Other Economic Sectors

Introduction of tourism often brings structural changes to the nearby island economies that benefit from the resort. Since small outer islands contain only a small number of working age population, engagement in new industry by most working age persons will lead to corresponding decline in another sector. The most effected industries in other islands are Fishing and Agriculture, where the youth usually opts for the tourism sector leaving the fishing industry without any new developments or employment. Sometime the boats used in other industries are converted to serve the tourism industry, further leading to the decline of other industries.

Fishing provides a higher level of income in comparison to tourism. However, fishing is seasonal and involves greater risk in contrast to permanent jobs in tourism. Hence, school leavers may prefer jobs in the resort leaving the mature men to fishing.

Growth of reef fishing and potential over fishing of reefs to meet tourism demands may have detrimental effects on the atoll in the long-term. The management should encourage and conduct awareness programmes for the local fisherman not to overfish reefs. There is also possibility of resource use conflicts with those who export reef fish. The management of the resort would have to strategically assess their market to buy reef fish and establish good working relationships with the fishermen in the atoll.

6.3.4 Local Culture and Values

Some of the islands in the atoll are conservative by Maldivian standards. Guided tours to nearby islands will have to be well regulated and moral standards in dressing by guests and accompanying staff shall be maintained. The resort would also have to avoid bias in selection of islands for excursions and have a policy of equity, in order to avoid conflict among the local population. On the other hand, tourism can increase socio-cultural tolerance within the community, from increased exposure to people from other cultures, and promote better understanding and acceptance of other cultures.

Drug abuse is an emerging concern in the atoll at the moment and every effort has to be made to ensure that this problem does not reach the staff of the resort. It also has to be ensured that there is no contribution by the staff of the resort to the increase in use of drugs in the atoll. The management must ensure a zero tolerance policy for sale or use of drugs by staff of the resort.

Influx of a large construction workforce, presumably with a high proportion of expatriates, can lead to conflicts between the local population and the workers.

6.3.5 Demand for Resources and Services

Once the resort is operational, there will be additional burden on the landfill site in Vandhoo or Thilafushi. Most of the waste generated will be handled on site, but certain materials like non-combustible and hazardous waste will need to be handled at the waste management site at Vandhoo or Thilafushi. There will be an overall long term moderate impact as a result.

There will not be any additional burden on other utilities, since the resort will be developed as a self-sufficient entity with its own power supply, water desalination plant and sewage system with treatment plant.

The transport infrastructure at Ifuru Airport will be used by the resort. The volume of passengers using the airport is expected to increase, but it is not expected that the demand will exceed the capacity of the airport and airlines.

6.3.6 Improved Environmental Protection

Employing the poor can be a means of reaching the dual goal of poverty reduction and environmental conservation. Direct full time employment in the tourism industry has shifted many people from environmentally damaging occupations such as coral and sand mining and destructive commercial reef fisheries.

Long term livelihood opportunities for the poor may be integrated into plans for environmental management in the resort. Such opportunities would enhance appreciation of environmental resources by the poor and meet income poverty reduction goals as well.

Tourism industry in the Maldives is completely reliant on the natural environment of the islands, especially the marine and coastal environment. Likewise, the economic sustainability of the tourism industry depends on the sustainability of the natural ecosystems. This inevitably leads to greater consideration for the natural environment, and recognition of the need for improved environmental protection and conservation.

Since conservation of the environment requires large-scale measures, environmental conservation efforts cannot be limited to resort boundaries, and must include regional-scale programmes. Hence, resorts often conduct environmental conservation and awareness programmes with nearby local communities, leading to increased awareness on environmental issues among the public.

Recognition of the need to ensure the sustainability of natural ecosystems for the sustainable development of the tourism industry (and the country's economy) can also lead to improved legislative and institutional frameworks for environmental management.

6.4 Mitigation Measures for Significant Adverse Impacts

6.4.1 Air and Noise Pollution

Project activities that can lead to air and noise pollution are operation of equipment and machinery, including electricity generators and desalination plants, both during construction and operations.

Mitigation Measures

- Properly tune and maintain all vehicles and machinery
- Keep ground/ soil damp to minimize dust/ topsoil erosion by wind
- Conduct construction activities during daytime to minimize nuisance to humans and fauna
- Insulate power generator and desalination plant house with appropriate material
- Monitor all occupational areas to ensure noise levels do not exceed WHO standards

The main cost would be for insulation of the power house and desalination plant house. This would cost about USD 10,000.

6.4.2 Contamination of Marine Water, Groundwater and Land

Contamination of marine water, groundwater and land can occur both during construction and operation. Construction activities have a particularly high potential for pollution. Contaminants can include construction materials, fuel, chemicals used for different purposes (including land clearing) and construction waste. Exposure of groundwater and deeper soil sections by excavation for construction increases the risk of groundwater contamination. Improper disposal of wastewater and solid waste can also result in contamination during operations.

6.4.2.1 *Construction Activities*

Construction activities that can lead to contamination of groundwater, soil and marine waters include:

- Accidental spillage of construction materials
- Improper storage of chemicals and raw materials used for construction
- Improper stockpiling and disposal of construction stage waste

Mitigation Measures

- Oil, solid waste & hazardous waste handled carefully & transported in sealed containers.

- All paints, lubricants, and other chemicals used on site stored in a secure and bunded location
- All raw materials stored away from the vicinity of the coastal areas
- General refuse stockpiled in one central area
- Keep spill cleanup materials readily available
- Train workers in spill prevention and cleanup, and designate responsible individuals
- Properly tune and maintain all machinery
- Carry out construction activities user the supervision of a suitably experienced person
- Pre-fabricate columns and footings away from shore

Costs are to be included in the contract value and are mainly the responsibility of the contractor.

6.4.2.2 *Wastewater*

Wastewater contamination of the marine water, groundwater and soil can occur due to:

- Leakage from temporary septic tanks used by construction workforce
- Leakage of untreated wastewater from the operation stage sewerage system into the island
- Disposal of untreated wastewater from the operation stage sewerage system into the island/ sea (likely only if sewage treatment plant breaks down or during natural hazard occurrences)
- Disposal of wastewater effluent from vessels within the island reef system

Mitigation Measures

- If required, maintain temporary septic tanks and avoid seepage of untreated wastewater into soil and groundwater
- Undertake regular inspection of operation stage sewerage system for timely detection and repair of any leakages
- All the wastewater will be treated and recycled. The resort will not discharge directly to the sea as this has the potential of damaging the reef ecosystem as well as degrade aesthetics.
- Effluent from toilets should not be discharged while boats are moored, anchored or close to the island

Mitigation measures mainly involve routine maintenance activities, and do not include additional costs. The STP, power and water is designed to meet the needs of the island.

6.4.2.3 *Solid Waste*

Improper disposal of solid waste during construction and operation, including from vessels used by the resort, can contaminate the receiving environment. Strategic measures and actions proposed for effective solid waste management are included in the Environmental Management Plan (Section 8).

Mitigation Measures

- All supply boats, dive boats and transfer vessels should be equipped with trash bins within easy reach and sign should be displayed to encourage use of trash bins

6.4.2.4 *Fuel*

Fuel spillage/ leakage during handling and storage can also contaminate the receiving environment.

Mitigation Measures

- Diesel fuel will be stored in a steel fuel storage tank located near the generators
- LPG and kerosene barrels will be stored in an appropriate building
- All areas on the island where diesel or other fuels are stored and handled (fuel tank, generator service tanks, filling station for canisters (boats), kerosene store and tanks) will be sealed with a fuel-resistant impervious lining to avoid any percolation of hazardous liquids into the ground.
- Fuel will be handled at sealed areas only
- In transportation, the danger of spilling diesel fuel into the sea or the coral environment as well as on the island will be reduced by tight fittings and appropriate material.
- Precautions to avoid spilling of diesel fuel (filling up of tanks and canisters, refuelling of boats) will also be given by instructions to the staff ("handle fuel carefully, avoid spilling")
- Appropriate execution of construction and sealing of the main fuel tank

- Regular inspections of the welded seams of fuel tanks will be carried out
- Care should be taken in the refuelling process of boats to avoid any spillage of fuel

These mitigation measures mainly involve routine maintenance activities, and do not include additional costs.

6.4.2.5 *Resort Operations*

Project activities specific to the operational stage of the resort that can lead to contamination of the receiving environment include improper storage and handling of chemicals used for cleaning, landscaping and pest control during operation.

Mitigation Measures

- Cleaning and disinfecting of the desalination plant will be done according to the suppliers recommendations for service and maintenance
- Biodegradable cleaning and disinfecting agents will be used for service and maintenance of the desalination system
- Biodegradable detergents and agents will be used for all cleaning purposes (sanitary installations, bungalows, kitchen, laundry etc.) in order to facilitate wastewater treatment and minimise the impact of such agents on environment.
- Use of artificial fertilizers will be minimised, in favour of compost
- Natural faunal diversity of the island will be conserved to serve as biological control for pests, thereby reducing need for artificial pesticides

These mitigation measures involve procurement policy decisions, and do not include significant additional costs, as all materials would be purchased for resort operations in any case.

6.4.3 Groundwater Depletion

Groundwater depletion can occur due to dewatering for construction of building foundations and excavation for laying utility pipelines. Groundwater is not planned to be used for any resort operations.

Mitigation Measures

- Discharge extracted water within the island to assist aquifer recharge

6.4.4 Existing and Predicted Changes to Coastal Processes

As noted before, at present, the island is undergoing erosion in eastern and southern shoreline and is predicted persist in the short-term. Moreover, the western and southern side does not have a beach suitable for tourism, which may hamper the operations and the tourism product offered on the island.

Mitigation Measures

- Undertake erosion mitigation measures to control erosion in the most vulnerable zones. The south side has been suggested as an immediate protection zone with the option to consider other areas based on monitoring (See Alternative shore protection measures).
- The island may also require beach rejuvenation to create the necessary beaches to operate a beach resort (See Alternative beach rejuvenation options).

Due to the serious nature of these impacts, these aspects have been looked into detail in the alternatives chapter.

6.4.5 Increased Turbidity and Sedimentation

Construction activities near the coastline and within the island lagoon can disturb the bottom sediment, leading to turbidity of the water column and sedimentation in nearby lagoon and reef habitats. Activities that can lead to turbidity and sedimentation include:

Mitigation Measures

- Complete works in shortest time period possible
- Carry out work in low tide hours and in calm condition
- Excavator movement should stick to predefined routes for travel along the reef.

6.4.6 Loss of Terrestrial Vegetation and Fauna

Activities that can lead to loss of terrestrial vegetation and fauna are:

- Vegetation removal for construction
- Inadvertent and deliberate damage by construction workers
- Exclusion of native species by imported plants used for landscaping
- Introduction of pests/ disease via imported plants and soil
- Pest infestation due to green waste accumulation

Mitigation Measures

- Where possible, leave mature trees intact during construction.
- Clearly mark vegetation to be retained and communicate to workers
- Only the sites of building and footpaths will be cleared for construction purposes and removal of scrubs and shrubs will be limited to the minimum extent required
- Plants and trees that have to be removed from construction sites will be used for landscaping
- Signs to guide workers to proper environmental care
- Designate working areas and labor quarters to construction staff
- Use native species for landscaping as far as possible
- Manage and monitor effects of any introduced species on local biodiversity
- Carefully monitor incoming shipments and vegetation for pests
- Monitor pest sightings and take action to control infestations
- Obtain plants for landscaping from authorized dealers with health clearance certification
- Clear green waste to prevent pest infestations
- Maintain natural biodiversity of the island to reduce pest problems

6.4.7 Removal of Marine Organisms / Marine Habitat Destruction

Coastal activities such as construction of coastal structures can lead to direct removal of benthic organisms and destruction of marine habitat.

Mitigation Measures

- Relocate live coral in footprint of coastal structures
- Minimize affected area and preserve areas not in direct footprint for relocation of fauna

The main cost would be for relocation of live coral, which is estimated to be about USD 15,000.

6.4.8 Occupational Health Impacts

Occupational health impacts may occur due to:

- Accidents during machine and equipment operation
- Exposure to chemical contamination in water/ air
- Respiratory health impacts due to air pollution during construction
- High noise level during construction
- High noise level in powerhouse and desalination plant house during construction and operation

Mitigation Measures

- All health and safety precautions described in Chapter 2 will be implemented. They include the following.
    - Health checks will be administered before work commences
    - Warning signs, barricades or warning devices will be provided and used.
    - Necessary safety gear will be worn at all times. These include safety gloves, construction boots, facemasks, earmuffs, etc.
    - Fire extinguishing equipment would be readily available and employees will be trained in its use.
    - Oxygen, acetylene or LPG bottles will not be left freestanding.
    - First aid kits will be made available on site
    - The construction site will be properly closed to unauthorised personnel
- The building housing electricity generators and desalination plant will be properly insulated to mitigate noise pollution in the vicinity

Cost of insulating the service building is estimated at USD 10,000.

6.4.9 Increased Demand on Waste Disposal Facilities

Solid waste generation during construction and operation will put extra burden on the existing waste management facilities in Thilafushi or soon-to-be-opened Vandhoo Island.

Mitigation Measures

- Waste minimization and recycling ventures included in Environmental Management Plan (Chapter 8)

6.4.10 Guest Activities and Services

Guest recreational activities fishing, snorkelling and diving, as well as the use of boats for these activities and other resort operations can have adverse impacts on the marine ecosystems.

6.4.10.1 *Boating*

Mitigation Measures

- Provide mooring facilities at jetties and mooring buoys near reefs used for recreational fishing to avoid anchor damage to corals and benthic organisms
- Formulate and implement Codes-of-practice for boating to avoid littering, oil spillage and any physical/ecological damage to coral reef systems

6.4.10.2 *Recreational fishing*

Mitigation Measures

- Ban recreational fishing from the reef areas for all construction workers and resort staff
- Maintain logs of fish caught. These logs should include species, size/weight, amount caught and location to avoid population collapse.
- Regularly clean reefs used for fishing of broken fishing lines and any litter

6.4.10.3 *Diving and Snorkelling*

Mitigation Measures

- Dive boats should abide by the dive regulations "Maldives Recreational Diving Regulation" Section 14: set out by the Ministry of Tourism

- Provide environmental briefing all snorkelers and divers before and after each session. These briefings should include aspects of coral biology, damage to coral reefs caused by divers and environmental conservation, as well as importance of controlling

buoyancy, fins, weight, eye and equipment control while diving.

- Maintain detailed logs of all the dives. These logs should include; reef/location, number of divers in each group, number of dives each day, average depths, and overall status of the reef, signs of coral bleaching, crown-of-thorn starfish infestation if any, and sighting of endangered and protected species and any other important attribute

The main cost would be for providing mooring facilities for boats, in order to avoid anchor damage to corals and benthic organisms. The estimated cost in USD 25,000.

6.4.11 Resource Conflicts

Conflicts over resources can occur due to:

- Loss of talent from other economic sectors to tourism
- Demand for reef fish by resort for consumption
- Requirement to preserve reef ecosystem as a tourism product

Mitigation Measures

- Establish links with other economic sectors, especially fisheries, agriculture and artisanal crafts
- Establish sustainable procurement practices, especially for reef fish
- Promote awareness on non-extractive value of ecosystems, and long-term benefits of ecosystem conservation and sustainable use

6.4.12 Social Conflicts

Social conflicts may arise due to the:

- Influx of largely expatriate workforce
- Loss of job opportunity for locals in construction stage
- Disagreement regarding project components and their effects on locals

Mitigation Measures

- Employ local residents as far as possible
- Provide proper orientation to all workers regarding local values and customs
- Inform and consult all stakeholders at all stages of the project

7 ALTERNATIVES

7.1 "No-Project" Alternative

The No Project option takes the following into account.

- A resort will not be developed under this project
- No resort infrastructure is developed on Muravandhoo Island and there is no change to the existing environment of the island

The comparison of benefits of each alternative is provided in Table below.

Table 7.1: Summary of no project alternative

Advantages	**Disadvantages**
Environmental impacts related to resort development can be avoided. No development costs to the Proponent	Loss of business to the proponent Investment in Ifuru is tied with the resort in Muravandhoo Loss of government revenue Loss of additional employment opportunities Compensation payments by the Government Public dissent

Given the high opportunity cost of the No Project option to the proponent, the Maldivian government and the local community, the preferred option is to go ahead with the proposed components of project.

7.2 Alternative Options for Erosion Mitigation

The rationale for suggesting alternative options for erosion mitigation has been explored in Chapters 4, 5 and 6. These include the high volatility of beach environment and the predicted volatility for the short-term.

The following options can be considered to resolve the erosion issues:

1. **Hard engineering options:** A series of raised near shore breakwaters on the southwestern side to control wave energy. The design layout and details of the breakwater are presented in Figure 7.1. Conceptual designs for the breakwater are presented in Figure 7.2.
2. **Soft engineering options:** Ongoing beach replenishment combined with setbacks and construction on stilts to accommodate erosion.
3. **Setbacks only:** Design setbacks of about 20 m from shoreline to allow for erosion and accretion.

The comparison of costs and benefits are summarised below.

Table 7.2: Summary of reducing impacts of erosion

Option/aspect	Advantages	Disadvantages
Hard engineering option	1. Future erosion mitigation is guaranteed 2. Solid structures that will require less maintenance costs 3. Effective against monsoonal and storm erosion 4. Construction impacts limited to initial installation period.	1. High impacts on the coral reef during construction (reef damage, sedimentation and water quality impacts) 2. Significant changes to coastal conditions – may require completely blocking the coastal processes. 3. Aesthetic issues and reduction in tourism product quality 4. Very high initial investment: Approximately US$0.5-1.0 million
Soft engineering option	1. Will better facilitate the coastal processes to operate. 2. Initial environment impact is limited 3. Better aesthetics	1. High maintenance costs spread over operation stage 2. Periods of severe erosion may affect resort operations and lead losses. 3. Highly exposed to storm damage and potential damage to existing near shore infrastructure 4. High impacts on reef and water quality as mitigation measures

Option/aspect	Advantages	Disadvantages
		like beach replenishment implement frequently. 5. Enough sand is not guaranteed from the deep lagoon as has been experienced in Maamigili Island (another resort under construction) in Raa Atoll; Costs may increase for beach replenishment. 6. Sand pit may continue to extend given the additional sand in the system.
Setback only	1. Lowest cost option 2. Minimal interference with the environmental processes	1. Highest impact on operations and sections of the island may have to be closed due to severe erosion activities. 2. Not enough space to setback on the island as the island is very narrow. 3. Large areas of newly vegetation land will have to be left undeveloped. 4. The overwater bungalows will still be affected by the movement of the sandpit. 5. Impractical to operate beach villas.

Based on the above evaluation, it is the opinion of the authors of this report, that a combination of hard and soft engineering options be pursued. In this regard a submerged breakwater is recommended to be placed on the SW corner of the island. The prosed site plan is presented in Figure 7.1 and proposed shore protection design is presented in Figure 7.2. A further breakwater

of the same design is to be considered on the NE side based on monitoring data during the construction stage. This is to determine if the shoreline is retreating in the NE corner.

Proposed soft adaptation measure is beach replenishment. The proposed area for replenishment is presented in Figure 7.3. At present, sourcing sand will be difficult for this island as the reef system does not appear to have sufficient beach quality sand. A detailed project will need to be compiled to undertake beach replenishment, including methods of replenishment, sand sourcing locations and transportation options. It may also require consultations, negotiations and approvals from the Ministry of Tourism and Atoll Council to sand source form outside Muravandhoo Reef. At the time of this EIA these details were not available. Therefore, it is recommended to pursue this aspect further and request for additional approvals, including coastal modification approval from Ministry of Tourism, Dredging and Reclamation Approval from EPA and a spate EIA addendum approval from EPA, before commencing beach replenishment works.

7.3 Alternative Access Jetty

Given that the northern side may receive strong wave activity when the wind blows from NE to NW quadrant, an additional jetty may need to be considered for the island. The options considered are summarised in Table 7.3. The locations of the proposed jetty alternatives are presented in Figure 7.4.

Table 7.3: Summary of alternative locations for resort development

Location	Jetty Length	Advantages	Disadvantages
1. South Side	85 m	- Lowest wave energy when the wind blows from the NE to NW quadrant - Easier access to most areas of the island - Least disruption to guest activities areas	- Aesthetic issues for the beach villas - Strong wave activity during SW monsoon and due to SE swells
2. East Side	105 m	- Can be combined with the spa jetty - Least visual impacts on beach villas	- Strong wave activity - Disruption to spa activities - Too far from guest services area
3. SW corner	85 m	- Can be linked to other overwater structures - Least visual impacts on beach villas	- Visual impacts on guest facilities such as the restaurant. -

The best option in terms of practicality and least wave activity is the proposed South Side jetty.

Figure 7.1: Alternative shore protection site plan

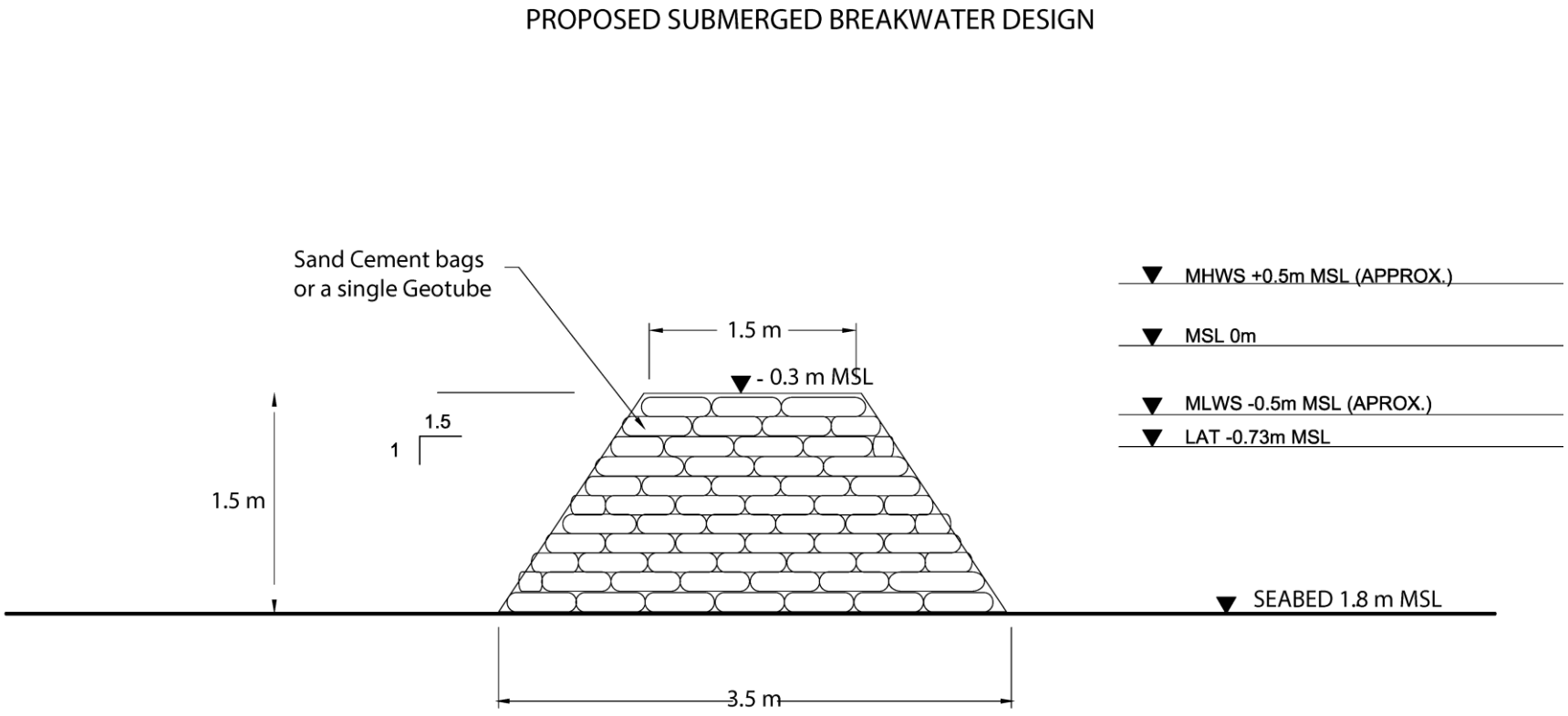


Figure 7.2: Alternative shore protection design

Figure 7.3: Suggested beach replenishment areas

Figure 7.4: Suggested alternative locations for additional jetty

7.4 Alternative Outfall Locations

The proposed location for the emergency sewage outfall is outside the reef on the south side of the island. This location has the best flushing, moderate wave activity and comparatively lower coral cover than the north side.

The alternative location is to locate an outfall on the eastern side of the reef (see Figure 2.13). The distance to the eastern reef edge in this method is the longest. The wave condition on the areas is also expected to be stronger than the south side. Therefore the preferred option is the proposed south side option.

The proposed option for brine outfall is the northern side jetty. Alternative locations include using the same pipe as emergency outfall for brine discharge, a separate pipe along with the emergency outfall pipe is also an option. In addition, locating it under the proposed alternative jetty location, described above is an option. All these options have equal weight and therefore the final option will be left the water systems engineer to place them in any of the locations described above.

7.5 Shore Protection Alternatives

The material proposed for shore protection is sand-cement bags. A number of alternatives could be used for coastal protection both to improve the effectiveness and reduce the costs of development. Other key alternatives are geobag revetments, armour rock revetments, concrete s-block revetments and concrete tetrapods. Comparison of these alternatives is provided below.

Table 7.4: Comparison of coastal protection options

	Armour Rock	**Concrete Tetrapods**	**Sand-Cement Bag Revetment**	**Concrete S-Block Revetment**	**Geobags**
Strength against strong waves	Very High	Very High	Moderate	Moderate	High
Construction material	Rock	Concrete and aggregate	Sand and cement	Concrete and aggregate	Sand, geo textile
Maintenance requirement	Low	Very Low	High	Moderate	Moderate

Durability	Very High	Very High	Moderate	Moderate	High
Environmental Impacts during construction	Moderate	Moderate	High	Moderate	High
Aesthetic Impacts	High	High	Moderate	High	Low
Cost	High	Very High	Low	Moderate	High

The preferred option of using sand cement bags based on the lower wave activity and costs.

8 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) is an important component of the EIA process, needed to determine the accuracy of impact prediction, the adequacy of mitigation measures, and level of compliance with commitments regarding implementation of mitigation measures and monitoring of relevant environmental aspects.

The main objectives of the environmental management plan are to:

- Produce a framework for managing anticipated impacts, including practicable and achievable performance requirements and systems for monitoring, reporting and implementing corrective actions.
- Provide evidence of compliance to legislation, policies, guidelines and requirements of relevant authorities.

8.1 Environmental Management System

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

- **Environmental Management Planning and establishment of key performance indicators:** The EMP specifies environmental management measures and required performance standards
- **Monitoring and corrective action**: The implementation of EMP measures will be monitored. Any inconsistencies between the EMP and its on-site implementation will be identified and addressed through corrective actions
- **Auditing, reviews and improvement**: The EMP will be reviewed. Improvements to the EMP will be made as necessary to achieve desired environmental outcomes.

The environmental management strategy is demonstrated in the following figure.

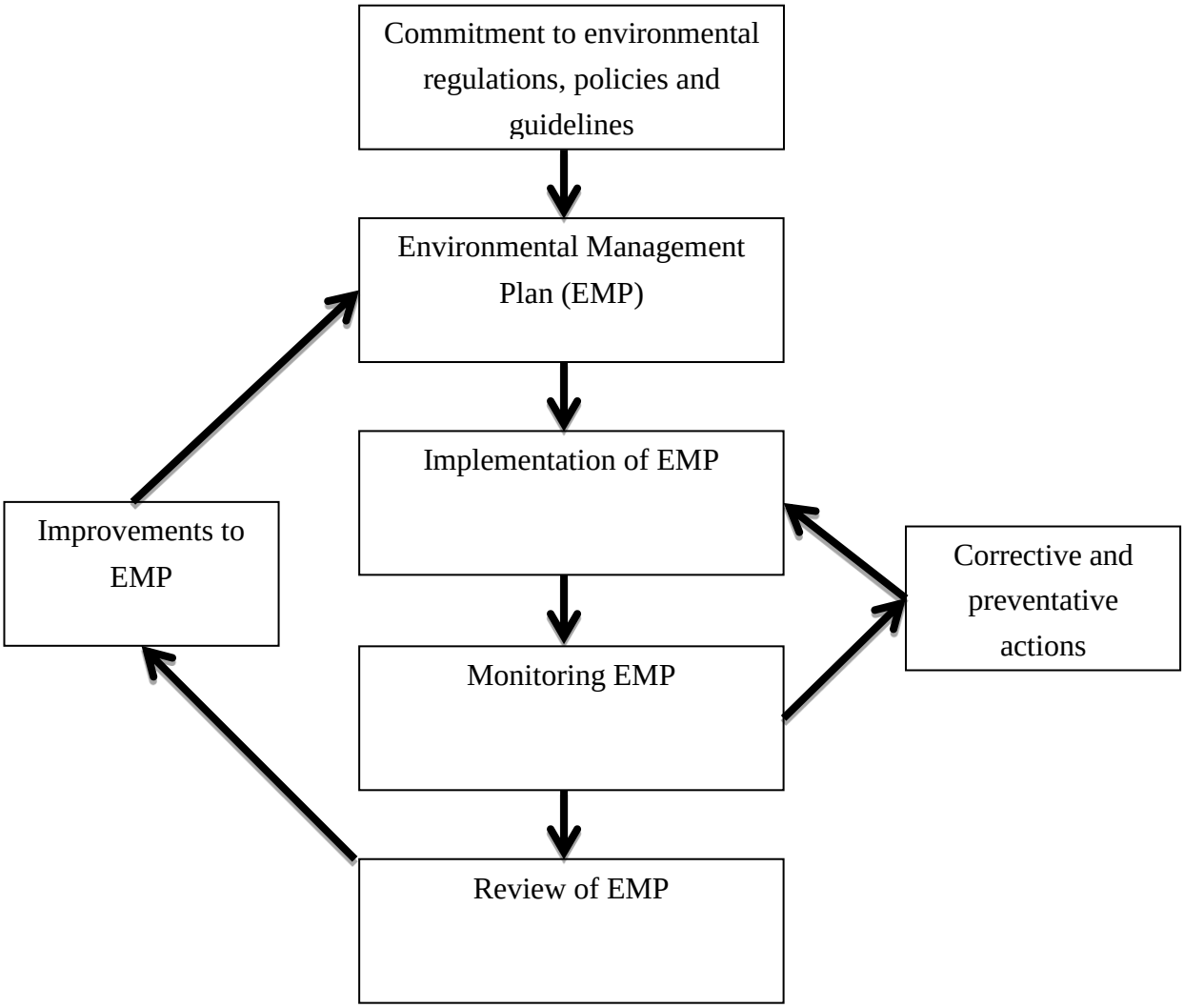


Figure 8.1: Environmental Management Strategy flow diagram

8.2 Management Structure and Responsibilities

The following parties are involved in the EMP of this project:

- Project proponent
- Environmental consultant
- Environmental Protection Agency (EPA)

The roles and responsibilities of the parties involved are as follows.

8.2.1 Project proponent

- Execution of all project activities
- Preparation of EMP

- Detailed designs of resort
- Monitoring of the project activities
- Submission of annual environmental monitoring reports as required by the EPA

8.2.2 Ministry of Tourism

- Approval of detailed drawings
- Approval for construction

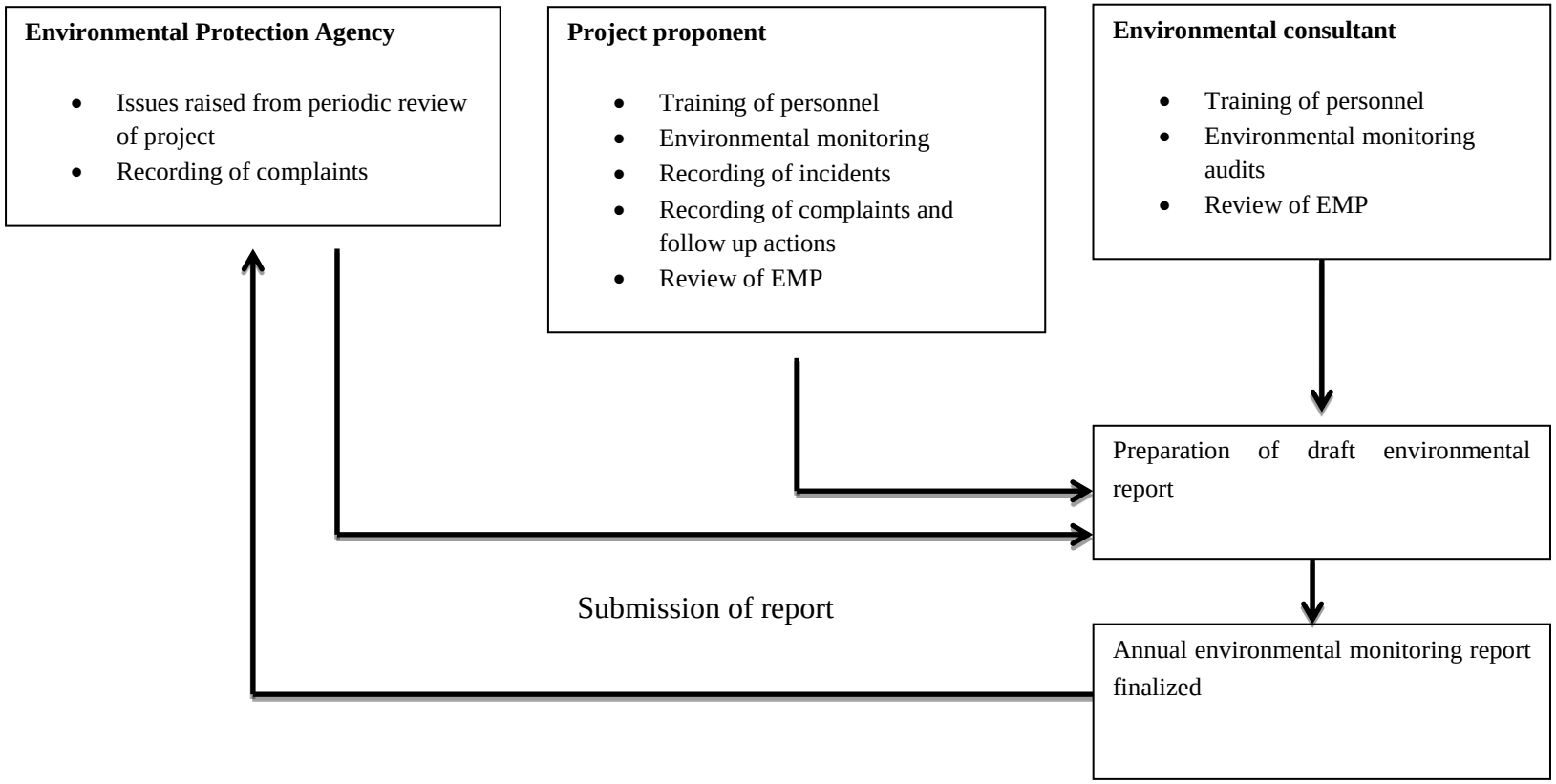
8.2.3 Environmental Consultant

- Preparation of EMP
- Monitoring of performance of project activities according to the EMP
- Auditing the EMP to ensure desired outcomes are achieved
- Making amendments to the EMP according to the results of the audits
- Preparation of environmental monitoring report as required by the EPA (detailed in Chapter 9 of this report)

8.2.4 Environmental Protection Agency

- Review environmental monitoring report
- Intervention in the event of a breach in environmental permit conditions
- Site visit and inspection before resort opening

Figure 8.2: Environmental Management Plan for construction and operation phase



8.3 Management Strategies and Actions

8.3.1 Planning and Design Phase

8.3.1.1 *Environmentally sound design*

The first step to sustainable tourist resort development in the Maldives is to understand and appreciate the island's fragile ecosystem and to design the resort to fully utilise the aspects of a tropical island environment and construct the resort to mitigate adverse environmental impacts.

Among the most important considerations for an environmentally sound resort is the need to protect the unique and key natural systems found in the site. Based on the findings of the initial assessment of environmental conditions, the best coral reef areas have been identified in the resort design for protection.

The resort development in Muravandhoo has been planned to have the least intrusive human impact, to pass over the existing natural systems without destroying them.

All the buildings in the resort have been designed to harmonise with the existing small tropical island environment. Primary materials from the environment such as coconut thatch and un-processed timber are used for roofing. Colours reflect the surrounding environmental features such as vegetation and marine life.

History and culture is incorporated in the interior design of the restaurant, bar and guestrooms through the use of local artefacts. Crafts and artwork would be used as architectural elements and as artistic pieces by themselves.

Location and grouping of buildings has been carefully considered in order to limit the environmental impact. Larger trees will be grown to further develop the canopy of the island and conceal the buildings as well as to attract birds. Materials that exist together in nature have patterns, textures, and colours that are in harmony with one another. This harmony can be maintained through using native species and local vegetation in landscaping.

All buildings blend in with the natural environment and are in harmony with the island vegetation and landscape. None of the big trees in the island will be felled and all large mature trees will be conserved. No roads will be constructed in the island. Where necessary only narrow footpaths will be developed and buildings and pathways have been planned around the major trees.

The design concept provides human comfort through the use of natural energy and climate resources. From the outset, every effort has been made to save energy. The buildings have been

designed with windows and vents for natural convection currents and cooling. In the design, cross ventilation has been taken care of to make good use of the tropical climate. Trees and roof over hangs are screening techniques used to protect and shade the buildings from the sun. The islands of Maldives are blessed with daylight from dawn at six in the morning till dusk at six in the evening. During daytime all public areas and guestrooms will receive enough daylight and there will be no need for artificial lighting on fine days.

Efficient use of resources and waste minimisation has been key principles in the design and location of buildings.

Imported blocks will be used in the construction of the resort. There will be strict controls to make sure that coral or coral sand is not used in the construction of this resort. All construction materials will be imported.

8.3.1.2 *Strategic Environmental Assessment*

All the business strategies and decisions will be examined in light of their probable impact on the environment together with their possible effect on the resort's business performance, competitive position and employment situation. Should it become clear that a decision would result in environmental degradation or result in higher levels of pollution, the proponent is committed to search for ways to reduce this burden to the environment.

8.3.2 Construction and Development Phase

8.3.2.1 *Construction Impact Management Plan and Awarding of Contracts*

The most severe environmental impacts of resort development occur during the construction stage. Thus the proponent is committed to develop a Construction Environmental Impact Management Plan. The Construction Environmental Impact Management Plan will contain on-site guidelines for contractors specifying appropriate construction practices. The results of the existing environmental conditions assessment would be used in the Construction Impact Management Plan to clearly identify the areas that needs protecting and help mark the reef access, construction routes and work areas. The Construction Impact Management Plan and the results of the existing environmental conditions assessment would be used to educate the contractor and labourers on the value of each part of the island and to inform of their duty of care. The following are some of the other measures that would be implemented to ensure that construction practices have minimal site disruption.

- In the construction, preference would be given to hire local labour from Raa Atoll. The use of local labour encourages community participation in resort

development, provides opportunities for local artists and crafts people to exhibit their work and skills, and provides employment.

- Technically competent personnel would be employed to supervise the activities of the workforce throughout the construction phase. Briefing or training sessions for all contractors and their employees, specifying the desired practices and consequences of non-compliance will be held.
- Contractors would be asked to provide a performance bond or deposit which can be used to repair any environmental damage inconsistent with the Construction Environmental Impact Management Plan.
- All construction workers and project management staff provided with information on general environmental issues, compliance with environmental permits and EMP.

8.3.2.2 *Raw Materials, Energy and Residues*

The main raw materials used for guestrooms, guest service areas and staff areas would include building construction materials (sand, gravel, concrete etc). The construction materials would not cause any negative impacts on extraction sites in the Maldives as all of the construction material will be imported.

The construction of the guestrooms and service buildings will generate substantial increase in water consumption for mixing of concrete and watering. The water required for construction will be provided through desalination. Desalination plants will be installed prior to construction and groundwater will not be utilized for construction purposes.

The energy required for construction process would be provided through a temporary generator set to be installed for construction purposes only.

Solid waste is expected to be a significant residue from the development in construction phase. Waste will principally come from the building sites, and staff kitchen. Domestic waste such as food items and leaf litter would be composted in designated areas to enhance future gardening and landscaping. All the waste from construction will be separated categorically and stored for future waste management practices.

8.3.2.3 *State of the Art Environmental Infrastructure*

During the construction and development phase the proponent is committed to invest in the following state of the art cutting-edge environmental infrastructure:

- Sewage and wastewater treatment
- Heat recovery from power plant
- Reverse osmosis desalination plant
- Fuel efficient low emission generator sets as backups
- LPG fired incinerator for waste burning
- Bottle and glass crusher
- Plastic Waste shredder
- Green waste shredder/wood chipper
- Can compactor
- Earth tub for composting
- Solar water heaters

The best available technology will be used to continuously reduce the negative impact of resort activities on the environment. The infrastructure development will particularly focus on solid waste disposal, sewage treatment and disposal, water production and conservation, energy generation and conservation.

8.3.3 Operational Phase

8.3.3.1 *Environment Department with Full Staff Complement*

Without adequate human resources it will not be possible to achieve the goals and aims of environmental management. Therefore a team of environment staff who will be led by a highly qualified and experienced manager with the designation of Environment and Safety Manager will be recruited. An Environment, Safety and Maintenance Department headed by an Environment and Safety Manager with adequate staff complement will be established. The Chief Engineer and his support staff will also work with the Environment and Safety Manager. It will be the responsibility of the Environment and Safety Manager and his staff to implement the environmental management system.

8.3.3.2 *Environmental Education*

Environmental education and awareness is the key to the success of an environmental management system and thus will be an integral part of the total environmental management system. The education and awareness programme will be addressed to both staff and tourists.

8.3.3.3 *Environmental Monitoring, Reporting and Audit*

A regular environment monitoring programme will be conducted to observe any changes taking place in the resort environment and this programme would be mainly directed at continuously understanding and reporting the reef health, the beach line, lagoon water quality, ground water quality and terrestrial biodiversity.

An independent environmental audit will be conducted every year. The purpose of this audit is to check whether all the operations of the resort conform to the standards set by the government authorities and to evaluate the success of the policies and programmes implemented by the resort and identify where improvements can be made.

8.3.3.4 *Solid Waste Management and Disposal Plan*

The Solid Waste Management programme will consist of the following activities:

- Prevention and minimisation of waste generated
- Collection and separation of solid waste
- Intermediary storage
- Treatment/recycling inside the resort area
- Treatment/recycling outside the resort area
- Final disposal

Prevention and Minimisation

Within the integrated waste management plan importance will be given to the prevention and minimisation of waste. The first component of waste prevention and minimization is the green procurement policy. This policy will ensure to obtain goods and services that lessen the burden on the environment in their production, use and final disposition, wherever possible and economical. In this regard the proponent shall:

- Buy only what is required
- Buy quality
- Buy locally
- Buy in bulk
- Buy for simplicity
- Buy for energy efficiency

- Buy recycled or recyclable products
- Avoid disposable products
- Minimise packaging
- Favour products that are gentle on the environment

The following specific priority measures for prevention and minimisation of waste are planned on the resort:

- Instead of canned soft drinks returnable bottles and tetra-packed drinks will be used (e.g. soft-drinks from Maldives Coca Cola Company)
- Draught beer will be served in the public area and mini-bars will be replenished with bottled beer, where possible.
- Special soft drink dispensing systems will also be installed in the bars and restaurant. Maldives Coca Cola Company supplies soft drinks in bulk containers and provides technical services in installation of fountain systems.
- Liquid soap, shampoo and conditioner will be supplied for guest rooms in specially designed ceramic containers to minimize domestic waste from guest rooms.

Waste Management Infrastructure

As outlined in the project description, the following equipment for treatment and disposal will be installed on the resort:

- Waste incinerator
- Metal can compactor
- Glass and bottle crusher
- Plastic waste shredder
- Green waste shredder/wood chipper
- Earth tub for composting kitchen waste

Domestic Wastes (excluding kitchen waste)

The following measures will be undertaken to manage domestic wastes:

- In order to achieve a maximum level of separation, separate waste bins for plastic, paper, glass, metal and residual waste will be placed in all areas of the resort, where applicable.
- For collection of the respective types appropriate appliances will be provided.
- Waste from the guest rooms will be separated by the room boys into corresponding waste bins or bags
- For the collection of waste and valuable material in the bungalow area, waste bins will be used. For intermediary storage, containers will be used.
- Special comfort and safety requirements of the resort (aesthetics, odour, fire protection) will be observed.
- Waste bins inside the buildings will be easily accessible.
- The cleaning personnel will sort out potential foreign matter when emptying the valuable material bins.
- A high level of public relations and staff training will be necessary to reach a good system of waste separation at the resort.
- Total amount of solid waste will be measured and composition will be determined on a regular basis.
- Glass bottles from the Coca-Cola Company will be returned
- Crushing of non-returnable glass and reusing for construction purposes
- Cans (e.g. from canned peeled tomatoes etc.) will be compacted and transported to the designated site by the government. Recycling possibilities will be investigated.
- Combustible residual waste will be incinerated on the island according to the legal requirements and permissions.
- The selection of valuable materials to be collected depends on the treatment and recycling facilities currently existing and planned for the future.

Kitchen Waste

Organic waste materials will be collected in special wet waste collection facilities or in separate bins. This waste stream must not be contaminated with packaging or other contaminating material. The pure organic waste will be picked up daily and used to make compost. Compost will be made in a state of the art composting earth tub. The homemade compost from all organic

wastes will be used in the resort and the surplus will be disposed. Non-organic material will be separated and treated as domestic waste.

Hazardous Waste

A number of different types of hazardous wastes are generated at resorts, especially in technical areas. In the field of hazardous waste management high priority will also be given to prevention and re-utilisation. Measures to be taken are:

- Rechargeable batteries will be used
- Biodegradable cleaning agents will be used
- Further possibilities of prevention and reusing will be investigated
- A suitable area for the intermediary storage of hazardous waste will be provided. Dimension and location will be fixed after assessing amount of hazardous waste
- Disposal of the hazardous waste material will not take place on the resort area or at sea.
- All hazardous waste will be deposed at a designated waste site by the government.

Green Wastes

Green wastes are generated during site clearing and from green area maintenance during operation. Surplus wood will be shredded and used to cover the ground as part of gardening. Other green waste (e.g. leaves) from clearing will be composted in compost heaps and later used as fertiliser.

Sewage Sludge

The non-odorous and anti-septic sludge resulting from the wastewater treatment process will be used as a fertiliser after appropriate treatment (dewatering, drying). Surplus sludge may be donated to the nearby local communities for the use as a fertiliser. Sludge will be periodically analysed according to international requirements.

8.3.3.5 *Measures to Conserve Energy*

Action Plan for Energy Efficiency

An action plan for energy efficiency will be implemented with the following priority activities:

- Carry out annual energy audit for the resort to assess performance.

- Compare the total and individual consumption figures with Maldivian benchmarks of resorts with same standard and bed capacity.
- Prepare a summary of opportunities for energy conservation.
- Seek the advice of experts for analysis, evaluation and recommendations
- Using the energy audit results, establish realistic goals for each department and the entire resort.
- Communicate management's commitment to employees and explain objectives and goals clearly.
- Appoint the Chief-Engineer as the energy co-coordinator and define departmental responsibilities.
- Involve the entire staff.
- Establish a monitoring and targeting system.
- Provide training in efficient utility use.
- Provide continued motivation.
- Review current supply arrangements frequently.

Energy Conservation Measures

It is possible to organize an energy conservation programme in order of expenditure and urgency, and to start with action that will reap the greatest savings at the least cost. Guestrooms consume a major proportion of the resort's energy, on average about 30 percent of the total. Consumption for air-conditioning changes with weather conditions, while lighting is directly proportional to occupancy. The architects have incorporated the following design features to reduce energy consumption:

- The proper orientation of the rooms to reduce the penetration of solar gains. This has been achieved by aligning most of the guestrooms to reduce exposure to the western sun as far as possible
- Reduction of solar exposure is further enhanced by utilising the shade provided by the existing natural vegetation and will be complemented by selective landscaping
- Providing ample sun shading for all guestrooms to reduce direct solar penetration into the interior of these buildings.

- Providing ample cross ventilation in the design to minimise the need to use mechanical cooling and to enable rooms to cool rapidly during the night and passive cooling
- Air-conditioning would be a major consumer of energy and thus the roof, ceiling and walls will be insulated and for construction special insulate materials will be procured.
- Installation of solar water heaters for warm water production instead of electrical boilers

Based on the energy use information and the lighting and amenities concept proposed by the architects, the following are specific energy conservation measures proposed:

- Installation of key switches in guest rooms
- Installation of energy saving light bulbs
- Using sun screen film on windows
- Using 24 V "Casablanca" type ceiling fans with a spring wound timer controller. These fans are 75% more efficient than conventional fans.

The bathroom fixtures present significant opportunity for energy saving as they are switched on for nearly eight hours a day. It is proposed to install wall-pack occupancy sensors with an additional night light feature. The occupancy sensor will detect the presence of a guest and to reduce any inconvenience by such a detector, it will be set on a one-hour timeout so that it would not turn the light off in a short time. Bathroom lights are on for a 1-2 minute interval or around 16-32 minute intervals.

A special night light feature would enable the bathroom light to be operated at 10% of normal light output. This is designed as an energy efficient option for people who may want a low-level night light in their bathroom during the night. The light would stay in the 'night light' mode for ten hours or until the on/off switch was pressed again.

The following are the specific measures that will be used to conserve energy in the kitchen and restaurant:

- Installation of energy-efficient appliances in kitchens
- Reduce peak loading by scheduling equipment run times
- Stagger turn-on times for heavy duty electrical equipment

- Schedule food preparation wisely including cooking some items during resort electricity off peak times
- Use microwave ovens where possible, microwave ovens use significantly less energy than other cooking equipment and can be used for thawing, partially cooking and reheating food
- Energy saving light bulbs will be used in the kitchen and restaurants
- Infrared remote control present dimming system will be used in restaurant

8.3.3.6 *Measures to Conserve Water*

Since seawater desalination is an expensive operation and to protect the ground water in the island a special water management programme will be implemented. Reducing water consumption will significantly lessen operational costs and to take advantage of saving the management will be investing in water saving devices.

Rainwater tanks will be installed and rainwater will be collected to supplement the desalinated water.

To ensure that the groundwater is conserved and in good quality to maintain the natural island vegetation, groundwater will not be extracted at all. Even for watering plants the treated effluent from the sewage treatment plant will be used.

Specific water conservation measures include the following.

- All kitchen and bathroom taps as well as showers will be equipped with percolators (spray taps) and flow restrictors, which reduce the amount of used water up to 50 % compared to conventional taps.
- Dual-flush toilets will be used
- For toilet flushing treated wastewater will be used.
- Freshwater in the swimming pool will be automatically filtered to reduce refilling intervals.
- For gardening purposes and irrigation, treated wastewater will be used.
- Towels will be changed every second day and on request.
- Bed linen will be changed twice a week and on request.

- Special staff training programmes will be run to educate them on water conservation measures and this programme will pay special attention to laundry, restaurant and kitchen staff.
- Guests will be given information about the resorts water conservation programme through leaflets and cards to be placed in guestrooms.

8.3.3.7 *Fuel Storage and Handling*

Diesel fuel will be delivered through an oil tanker (on a need basis) and pumped through a pipeline into the main diesel tank. The fuels used on the resort represent hazardous liquids, which may damage the environment in case of inappropriate handling and storage. The specific measures to avoid any pollution or contamination of the natural resources are provided in Section 6.4.

8.3.3.8 *Management of Guest and Staff Activities*

Codes-of-practice for boating should be formulated and implemented. Environmental awareness of boat crew and passengers should be raised on environment friendly practices.

Dive boats should abide by the dive regulations "Maldives Recreational Diving Regulation" Section 14: set out by the Ministry of Tourism

Environmental briefing given to all snorkelers and divers before and after each session should be based on various aspects of coral biology, damages to coral reefs caused by divers and environmental conservation and include importance of controlling buoyancy, fins, weight, eye and equipment control while diving.

Dive logs should include; reef/location, number of divers in each group, number of dives each day, average depths, and overall status of the reef, signs of coral bleaching, crown-of-thorn starfish infestation if any, and sighting of endangered and protected species and any other important attribute.

Logs of fish caught should include species, size/weight, amount caught and location to avoid population collapse.

8.4 Non-Conformances and Corrective Action

All non-conformances to the environmental permit conditions, observed during monitoring will be documented.

Necessary corrective actions and preventative actions will be identified

Corrective actions will be implemented, with systematic follow-ups to ensure effectiveness of these measures.

8.5 Reporting

Reporting shall be undertaken to provide evidence of the ongoing implementation of the EMP and will cover any training activities, site conditions and operations, monitoring data, details of non-conformances, incidents, complaints and follow up action, results of audits and reviews. Reporting shall be undertaken by the project proponent and the Environmental Consultant.

The environmental reporting process is summarized in the figure 8.2. All non-compliances and complaints during the execution of the project are to be reported to the EPA.

9 ENVIRONMENTAL MONITORING PLAN

9.1 Introduction

This chapter will outline the monitoring plan for the proposed project. Environmental monitoring is essential because, although with proper mitigation measures, the overall environmental damage can be significantly minimized, an unforeseen impact may still occur. Furthermore, some of the impacts predicted may turn out to be far greater than predicted, making mitigation measures ineffective. Therefore, in order to avoid or reduce the chances of such events, regular and frequent environmental monitoring is vital.

9.2 Objectives of the Monitoring Plan

The main objectives of the monitoring plan are:

1) To identify whether the predicted impacts are accurate and mitigation measures taken are effective
2) To identify any unforeseen impacts so that appropriate mitigation measures can be taken at the earliest
3) To identify and resolve any issues of social unrest at the earliest
4) To eliminate or reduce environmental costs

9.3 Before Construction

The monitoring assessments prescribed in Table 9.1 are required before construction, if the construction activities begin 12 months after this EIA.

9.4 Monitoring during Construction Phase

Table 9.2 shows the details of the different monitoring attributes and parameters must be monitored during the construction stage.

Additionally, the following aspects will be monitored during the construction stage to ensure that environmental impacts are minimized.

1) Daily monitoring to ensure that the cleared areas and other construction processes are not creating any significant dust nuisance for the local environment.

2) Daily monitoring of vehicle refuelling and repair should be undertaken to ensure that these exercises are carried out on hardstands and to ensure that they are done properly. This is to reduce the potential of soil contamination from spills. Spot checks will be conducted by the site supervisor.

3) Daily inspection of site clearance activities to ensure that the proposed building plans are followed.

4) Weekly assessment to determine that toilets are in proper working order. This will ensure that sewage disposal will be adequately treated.

5) Monitor and ensure that approved suppliers and sources of local materials are used.

Table 9.1: Monitoring Schedule for Pre-construction Stage (if required)

Monitoring Attribute	**Indicator**	**Methodology**	**Locations & samples**	**Frequency**	**Applicable standard**	**Est. Total Costs RF[2]**
Marine Water Quality (Marine)	The following parameters will be tested: Temperature, Salinity, pH, Total Hydrocarbon, Total Suspended Solids, Nitrate, Phosphate, Total Coliform, Faecal coliform	Laboratory analysis	Four Locations (sites W1, W2, W4, W5) One sample for each site	Once prior to commencement of construction activities	WHO marine water quality standards	7,200
Ground Water Quality (ground water)	The following parameters will be tested: Temperature, Salinity, pH, Total Hydrocarbon, Total Suspended Solids	Laboratory analysis	Two Locations (sites G1 and G2)	Once prior to commencement of construction activities	Maldivian (EPA) ground water monitoring standards (See Appendix A, Annex 1, Section 1)	3,200
Erosion and Coastal Changes	Beach profiles	Surveying using level, staff, compass & D-GPS	Profile locations P1-P9	Once prior to commencement of construction activities	Maldives EPA standards (See Appendix A, Annex 1, Section 1.3)	4,000
	Beach line (at high tide & low tide) and Vegetation Line	D-GPS tracks along the beach	Whole island	Once prior to commencement of construction activities	Maldives EPA standards (See Appendix A, Annex 1, Section 1.3)	10,000

[2] *Covering pre-construction, construction and operations stage*

Table 9.2: Monitoring Schedule for Construction Stage

Monitoring Attribute	Indicator	Methodology	Locations & samples	Frequency	Applicable standard	Est. Total Costs RF[3]
Marine Water Quality (Marine)	The following parameters will be tested: Temperature, Salinity, pH, Total Hydrocarbon, Total Suspended Solids, Nitrate, Phosphate, Total Coliform, Faecal coliform	Laboratory analysis	Four Locations (sites W1, W2, W4, W5) One sample for each site	On every four months during construction and once annually during operational phase for 5 years Total of 13 tests	WHO marine water quality standards	93,600
Ground Water Quality (ground water)	The following parameters will be tested: Temperature, Salinity, pH, Total Hydrocarbon, Total Suspended Solids	Laboratory analysis	Two Locations (sites G1 and G2)	On every four months during construction and once annually during operational phase Total of 13 tests	Maldivian (EPA) ground water monitoring standards (See Appendix A, Annex 1, Section 1)	41,600
Marine Water Contamination	Oil spills (Surface layer of groundwater)	Visual observation	All area where oil is handled	Daily for the duration of the project	NA	Included in contractor fees
	Oil leakage from machinery or vessels	Maintenance and tuning of all machinery & vessels	All area where oil is handled Excavated area	Weekly during the construction phase	NA	Included in contractor fees
Solid Waste monitoring	Waste generation levels	Daily assessment of waste quantities and records of ultimate disposal Waste census	Whole island	Monthly during the construction and annually during operation	NA	Costs incl. in contractor and environmental consultant fees

[3] *Covering pre-construction, construction and operations stage*

Monitoring Attribute	**Indicator**	**Methodology**	**Locations & samples**	**Frequency**	**Applicable standard**	**Est. Total Costs RF[3]**
Coral reef health	Percent of live coral cover, and fish species abundance and composition	Line transect survey; Fish census Manta tow	Transect sites T1, T2, T3, T4	Once before initiation of project and completion of project, and thereafter annually for 5 years	Maldives EPA standards (See Appendix A, Annex 2, Section 2.1)	Included in environmental consultant fees
Erosion and Coastal Changes	Beach profiles	Surveying using level, staff, compass & D-GPS	Profile locations P1-P9	Two months after completion of the project and thereafter annually (for 5 years)	Maldives EPA standards (See Appendix A, Annex 1, Section 1.3)	Included in environmental consultant fees
	Beach line (at high tide & low tide) and Vegetation Line	D-GPS tracks along the beach	Whole island	Bi-annually during construction and Quarterly during operations (for 5 years)	Maldives EPA standards (See Appendix A, Annex 1, Section 1.3)	Included in environmental consultant fees
	Longshore currents	Drogue method	Sites C1, C2, C3, C4, C7	Annually during construction and operations stage (for 5 years)	NA	Included in environmental consultant fees
Water Depth	Water Depth	Sonarmite or handheld Echosounder		Two months after completion of the project.	Maldives EPA standards (See Appendix A, Annex 1, Section 1.2)	23,000

9.5 Monitoring during Operational Phase

9.5.1 Terrestrial Environment

With the completion of the construction, monitoring will be undertaken for terrestrial environment in conjunction with a more comprehensive program of monitoring for the whole island. There will be a performance evaluation plan and indicators in place once the resort is operational to evaluate the changes and impacts on the terrestrial environment. Performance indicators that would apply to the terrestrial environment include indicators for:

1) The extent of vegetation cover in the island (which is a fairly good indicator of the state of ecosystem diversity)
2) Evidence of soil contamination
3) Changes in vegetation, bird colony and other animal species such as snails and turtle
4) Land loss due to erosion
5) Groundwater contamination

Table 9.3: Monitoring schedule for operational stage terrestrial environment monitoring

Type	Frequency of monitoring	Main Concerns to address	What to monitor
Flora	Annually	Preservation and retention of existing mature trees of high amenity value in the island.	Presence, loss or damage
Flora	Annually	Vegetation loss or increase indicates either improvement or damage to the flora.	The amounts of vegetation cover in the three zones identified in the terrestrial baseline survey.
Fauna - Birds	Quarterly	Assess whether bird numbers are decreasing or increasing.	Bird species and numbers
Soil	Six monthly	Ensure that resort activities do not contaminate the soil and	Evidence of soil contamination in high risk locations such as outside

		land, especially as a result of fuel and chemical storage, transportation handling and use.	the fuel storage area, near the power house, garages (if any).
Groundwater	Quarterly	Assess the changes to groundwater quality in salinization, nutrient enrichment, sewage contamination and fuel contamination	Laboratory analysis of salinity, total hardness, nitrate concentration, phosphate concentration, total and faecal coliform count and total petroleum hydrocarbons

9.5.1.1 *Desalinated Water Quality Monitoring*

In desalination, quality of both intake water and product water will be monitored as per the requirement of EPA as follows (Table 9.4).

Table 9.4: Water quality monitoring related to desalination process

Type	**Frequency of monitoring**	**Main Concerns to address**	**What to monitor**
Intake water	According to EPA guidelines.	Ensure efficiency of desalination plant through appropriate quality of seawater.	Water quality parameters according to EPA guidelines.
Product water	According to EPA guidelines.	Ensure acceptable quality of water is supplied for residents.	Water quality parameters according to EPA guidelines.

In addition, the following water quality monitoring will be undertaken quarterly and annually (Table 9.5).

Table 9.5: Microbiological parameters for quarterly monitoirng

Parameter	**Parametric value (number/100 ml)**
Escherichia coli (E. coli)	0
Enterococci	0

9.5.1.2 *Wastewater monitoring*

Quality of wastewater discharged in to the environment play a key role in contaminating the receiving water body. Failure of the wastewater treatment system will result in poor effluent quality and hence pollution of the environment Poor water quality of effluent has the potential to contaminate the lagoon and the regional environment. It is also a public health hazard for the guests who use the marine environment for recreational purpose. Therefore the effluent quality of the sewage treatment plant will need to be monitored to determine the efficacy of the treatment system in terms of its claimed standards and to provide a means of accurately monitoring any changes in treated effluent.

Wastewater will need to be regularly monitored for selected parameters. The frequency for wastewater monitoring is once every three months. The parameters to be included in monitoring are BOD_5, COD, Total suspended solids (TSS), E. coli, total nitrogen, total phosphorus, pH and dissolved oxygen. Table 9.6 outlines the required quality standards for wastewater monitoring.

Table 9.6: Recommended effluent quality standards for wastewater monitoring

Parameter	Justification for monitoring	Standard
pH	Range suitable for the existence of most biological life is quite narrow and critical	5-9
BOD_5	Indicates organic pollution	20-60 mg/l
COD	Used to measure the contents of organic matter of both wastewater and industrial water. Also used to measure organic matter in wastewater that contains compounds that are toxic to biological life.	120 mg/l
Total Suspended Solid (TSS)	One of the most important contaminants in wastewater treatment. Suspended solids can lead to the development of sludge deposits and anaerobic conditions when untreated wastewater is discharged	150 mg/l

At present, Maldives does not have a published water quality standard for effluents. Therefore international guidelines should be used. Considering the above monitoring requirements and parameters, the effluent standards outlined in Table 9.6 will be followed as a guideline. These guideline values are adopted from the World Health Organizations (WHO) environmental quality standards.

9.5.2 Monitoring the marine environment

Ecological change often occurs gradually over time. Therefore, long term monitoring and research programs are necessary to accurately assess environmental change. This is particularly

true when the change is due to small but chronic perturbations to the environment which have a cumulative effect. It should be kept in mind that (1) many ecological processes are slow occurring over a number of years, (2) inter-annual variability is often high, (3) short term studies miss rare but important events, and (4) monitoring only reveals recent historical events.

Environmental change can occur in two directions: (1) from a healthy, pristine ecosystem to a degraded one, or (2) in the opposite direction of making a degraded environment to a healthier one. The latter would be the case for the monitoring programme given which should be followed in order to best management of the existing marine environment of reef system during the construction and especially the operational phase.

The objectives of this monitoring programme are to detect and document the changes occurring to the reef system due to the proposed project. The purpose will be to 1) assess the magnitude of the impacts resulting from the various phases of the project activities 2) evaluate the success of a particular management action, 3) to quantify the change in abundances of certain marine organisms, e.g. indicator species near a sewage outfall and elsewhere to compare.

By the time coral abundance for instance, declines, management action may be too late; early warning indicators of community stress and impending change would be valuable. For this reason long-term monitoring is needed. The level of change that must be detected to meet monitoring objectives will partially determine the approach which must be taken, in particular the precision that is required. Selection of methods will depend not only on what should be measured but on the intended use of the data and the available logistics.

Because changes in marine environment especially in a coral reef ecosystem may be almost imperceptible over the short term or highly variable from one year to the next, looking at the long-term trends in the conditions of reefs is vitally important.

Given the incredible variety in the elements of the coral reef system, it is difficult (and risky) to depend on a single set of observations or on "indicators" when trying to evaluate reef conditions and assess any impact. For example, high coral species richness is not necessarily a sign of optimal reef conditions because many of the stresses which affect reefs result in decreases in abundances of organisms rather than loss of species. High densities of juvenile corals probably are one of the better indicators of the status of a reef. In general, the best approach is to look for relative changes in a particular habitat over time when trying to elucidate trends. The following methods were selected to monitor the reef system considering all these aspects. The data should be used for regulatory and management purposes to minimize any adverse effect resulting from the proposed work and operations of the resort.

Table 9.7 gives the coral reef monitoring programme recommended for the long-term evaluation of reef system and ambient marine environment for impact assessment and mitigation of impacts.

Table 9.7: Operational stage marine environment monitoring schedule

Parameter/Method	Method	Frequency of Monitoring	Purpose
Water quality	Measurement/ laboratory analysis of Temperature, pH, Salinity, Turbidity, BOD, DO, Nitrates, Phosphates, Faecal and Total Coliforms	Once every month in operation	Assess changes to water quality due to resort operations, mainly brine discharge and nutrient loading
General status of reef	Manta Tow Technique	Once every year or following a significant natural event e.g. coral bleaching, COT infestation etc.	Broad scale qualitative and Semi-quantitative assessment of general status of the reef system / coral and other benthic recruitment
Marine Environmental Aesthetic Survey using	Time Swim and Manta Tow Technique	Once every 6 months in operation	Broad scale semi quantitative assessment of anthropogenic activities e.g. wastes disposal, amount of rubbish on the reef and general appeal of the reef system
Fish population structure	Underwater Fish Census	Once every 6 months in operation	Quantitative assessment of fish population of selected species
Benthic cover of reef	Permanent Photo quadrats	Once every 6 months in operation	Quantitative assessment of temporal changes in the reef system e.g. coral growth rates

Parameter/Method	Method	Frequency of Monitoring	Purpose
Sedimentation	Sediment traps deployment/collection	Once every 3 months in operation	Quantitative assessment of sediment loading on the reef benthos.
Impacts from Diving and Snorkelling activities /	Comparison with control sites using Visual observation	Once every 3 months in operation	Quantitative assessment of damage from these activities.

9.5.3 Coastal zone monitoring

The coastal environment of the island including beaches and bathymetry of the lagoon may be affected as a result of the proposed development. Therefore it may be necessary to monitor beach profiles at monthly intervals during the proposed construction phase and as specified below in the operational phase.

Table 9.8: Environmental monitoring requirements for the coastal zone

Monitoring Parameter	Indicators	Baseline / Reference values	Technique	Frequency
Sediment distribution	High tide line Low tide line Vegetation line	Baseline given in EIA report	Differential GPS	Quarterly
Rates of accretion and/or erosion	Beach Profiles	Baseline data given in EIA report	Beach profile surveys	Quarterly
Currents	Nearshore currents	Baseline data given in EIA report	Drogue method	Quarterly
Coastal Water Quality	DO, BOD, COD, TDS, Selenium, Total Hardness, Turbidity, Nitrates, Phosphates, Nitrites and Salinity	WHO recreational water guidelines	Laboratory Analysis	Twice a year for standard monitoring.

9.6 Socio-economic Impact Monitoring

Impacts on employment, trade of local goods, crime, and social conflicts are the key impact areas identified for this project. The following indicators are proposed to measure the socio-economic impacts. While some of this data can be obtained from official sources, other data has to be obtained through surveys using pre-designed questionnaires. Since the social and economic impacts of the project are as important as the physical environmental impacts, the project proponent should give due attention to socio-economic impact monitoring.

Table 9.9: Monitoring schedule for socio-economic conditions

Impact Area	Data sought	Min. Frequency	Purpose
Employment	Percentage of employees from the atoll Number of female employees from the atoll Frequency and number of islands to which there is regular ferry from the resort Unemployment rate in the atoll Income poverty in the atoll	Once a year	To understand the impacts on employment and income levels from the project
Trade in local goods	Volume of agricultural products bought by the resort from the atoll Value of agricultural products bought by the resort from the other atolls Volume of fish bought by the resort from the atoll Value of fish bought by the resort from the other atolls	Once a year	To determine the impacts of the resort on trade and economic development in the atoll
Crime	Number of arrests in the atoll Number of sentences for serious crime	Once a year	To evaluate the changes in crime rate in the atoll and ensure that the resort is not impacted
Social conflicts	Reported incidences of social conflicts related to the resort in the media	Six monthly basis	To monitor social conflicts and take appropriate action before it escalates into serious social disorder

9.7 Monitoring report

A detailed environmental monitoring report is required to be compiled and submitted to the EPA annually based on the data collected for monitoring the parameters included in the monitoring plan given in the EIA. This report may be submitted to the relevant Government agencies in order to demonstrate compliance. If required, however, a monitoring report for the proposed work phase may be prepared and submitted to the Ministry of Environment. The report will include details of the site, strategy of data collection and analysis, quality control measures, sampling frequency and monitoring analysis and details of methodologies and protocols followed. In addition to this more frequent reporting of environmental monitoring will be communicated among the environmental consultant, project proponent, the contractors and supervisors to ensure possible negative impacts are mitigated appropriately during and after the project.

9.8 Cost of monitoring

The cost of monitoring is estimated to be US$ 15,000 annually. Professional consultants will be hired to undertake the monitoring and the necessary equipment for monitoring will be procured.

For pre-construction and construction stage monitoring, individual parameter costs are provided in the relevant tables above.

9.9 Commitment to monitoring

The proponent is fully committed to undertake the monitoring programme given in this chapter (see Appendix L).

10 STAKEHOLDER CONSULTATIONS

Stakeholder consultation sessions for resort constructions EIA in R. Madivaafaru and R. Muravandhoo were held with the island council members and the local community of R. Ungoofaaru, R. Dhuvaafaru and R. Maakurathu on 17 March 2014. The council members and the general public of these islands were invited to the public consultation meeting. Representatives from the council and the active associations of the islands took part in the consultation meeting.

In the consultation meetings, the resort development project in R. Madivaafaru and R. Muravandhoo were described to the participants and they were asked about their opinions and concerns with regard to the resort development in these two islands. The participants were also asked about their opinion of positive and negative impacts that may arise from developing resorts in these 2 islands. In general the island council and the public of the 3 islands who took part in the consultation meetings welcome the development of the two resorts in R. Atoll. Their expectations are for more employment opportunities for the youth in their islands, leading to economic progress in their respective islands. There were no negative impacts raised and the consensus is for the resort developments to be completed at speed, hence allowing for the participation of young people in the development of the islands and progress in their economic wellbeing.

Consultation notes are provided in Appendix K.

10.1 R. Ugoofaaru Council

The general findings from the meeting with the council members are as follows:

- The participants from the meeting in R. Ungoofaaru explained the island and economic status of the people. They aspire for the island to continuously progress and people of the island to be employed and earning a high income.
- They pointed out that the main issues of the island are waste, road infrastructure and lack of sports complex for indoor sports.
- The council members explained that most of the women of R. Ungoofaaru are employed in the civil service while the men are employed in construction sector and in tourist resort employment. Furthermore, since 2011 many school leavers on completion of schooling have joined for higher education tertiary level programmes.
- The council explained that the people of Ungoofaaru welcome new resort development in the atoll. The participants believe that it would create more employment for the people;

infrastructure development of the island; and economic progress in the island that would contribute to the island development.

- No other concerns were raised by the participants of the meetings regarding the construction of resorts in R. Muravandhoo and R. Madivaafaru.

Table 10.1: List of council members consulted in R. Ungoofaaru

Name	Position
Mohamed Iqbal	Council Vice President
Ali Aiman	Council member
Thaha Hussain	Council member
Fathimath Shimla	Head of civil service (Temporary)

10.2 Dhuvaafaru Council and Public

The general findings from the meeting with the council members and the general public are as follows:

- The participants from the meeting in R. Dhuvaafaru explained the island and economic status of the people. They aspire for the island to develop and for the youth of the island to have more employment opportunities.
- The participants expressed that employment for the youth of the island, and educational training opportunities are the some of the biggest needs of the people.
- The participants believe that if creating more employment opportunities is well addressed, the island would progress. That would be a positive impact of resort development in the atoll.
- The council also requested for an awareness programme for the people to understand the positive impacts of resort development within the atoll and the contribution to the local community resulting from such development.

Table 10.2: List of council members consulted in R. Dhuvaafaru

Name	Position
Amir Ahmed	Council vice president
Ali Arif	Council member
Ibrahim	Council member

Table 10.3: List of members of the public consulted in Dhuvaafaru

Name	Position
Ibrahim Rasheed	Maathilaage
Aishath Zaahiraa	Gulzaaruge
Ahmed Rasheed	Daylight
Mohamed Ibrahim	Beach rest
Adam Ali	Vaidhashuge
Mohamed Adam	Kausar
Ali Mohamed Nizar	Finifaru
Abdul Maajid	Udha
Ali Rasheed	Alhivilaage
Ali Rasheed	Dhethandimaage

Contact numbers were not provided by the participants as they preferred not give additional personal details.

10.3 Maakurathu Council and Public

The general findings from the meeting with the council members and the general public are as follows:

- The council members from the meeting in R. Maakurathu explained the situation of the island. The total population of the island is 1224 people. Their biggest concern is the lack of employment opportunities for the youth in the island. They expressed hence, due to low employment opportunities, the wellbeing of island is not very good.
- The council members raised concern that upon completion of schools, youth are not clear of the way progress and where to invest in their carrier development.
- At present the main the income generating activity by the youth in the island are extraction of sea cucumber for exporting.
- The participants expect that development of 2 resorts in the atoll would bring a positive impact to the wellbeing of the people.

Table 10.4: List of council members consulted in Maakurathu

Name	Position
Ahmed Shifan	Council President
Saudhullah Mohamed	Council Vice President
Ibrahim Risan	Council member
Ahmed Rasheed	Council Member
Mariyam Saeedha	Council Mmeber

Name	Position
Abdulla Naeem	Director
Badhurunnisa Abdullah	Administrative officer

Contact numbers are provided in the meeting notes

Table 10.5: List of members of the public consulted in Maakurathu

Name	Position
Waheedha Mohamed	Andhaleebuge
Ali Umar	Tharivilaage
Abdulla Mohamed	Bageechaage
Mohamed Rilwan	Moorithi
Dhaood Hassan	Sithaaraa Vaadhee
Aboobakuru Ali	Beach Villa
Mohamed Ali	Dhaarul falah
Aneesa Moosa	Seybooge
Habeeba Mahmood	Dhiraasaage
Ahmed Khaleel	Finifaru
Ahmed Zakariyya	Binmatheege
Mohamed Musthafa	Haki
Zaahidhaa Mahmood	Three flower
Mohamed Ibrahim	Moonlight
Mohamed Rameez	Ocean Villa
Abdulla Rasheed	Magbool
Fathuhiyya Adam	Tharividhaage
Azeema Hussain	Somaa

10.4 Ministry of Tourism

The assistant director of the Ministry Mr Mohamed Adly stated that the ministry approves the concept plan of the resort prior to the initiation of the development works. Therefore all necessary concerns have been raised with the resort management and owners prior to the approval of the resort concept plan. They also welcome upgrading of resort facilities to provide a better product.

Contact Details: Ministry of Tourism (3323224)

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11 POTENTIAL DATA GAPS AND ASSESSMENT LIMITATIONS

11.1 Gaps in Information

The environment of Maldives is generally poorly understood. This may be due to the lack of detailed studies in the Maldives. Much of the literatures on coral islands are derived from studies done in the Pacific which unfortunately has very different climatic and geologic settings.

Detailed environmental analysis for an EIA is often required to be undertaken in a relatively short period of time. Give the seasonal climatic variations in Maldives and the differences in local geomorphologic and climate settings in individual islands such a short time frame is often too little to assess selected aspects of the environment. This problem is compounded by the absence of long-term studies in other parts of Maldives. Hence, most EIA's end up being based on an environmental snapshot of specific point in time. However, experienced EIA specialists can deliver a close match to reality based on a number of similar assessments. In this regard, the following gaps could be identified in information.

- Absence of long-term site specific or even regional data (at least 2 years). Most critical data include current, wave and terrestrial modification history.
- Absence of historical and long-term records on reef and lagoon environment.
- Lack of detailed data on geology and soil due to time limitation in EIA submission.

These gaps are seriously considered in the assessment and care has been taken to address the issue in designing mitigation measures and the monitoring programme.

11.2 Uncertainties in Impact Prediction

Environmental impact prediction involves a certain degree of uncertainty as the natural and anthropogenic impacts can vary from place to place due to even slight differences in ecological, geomorphological or social conditions in a particular place. As note earlier, there is also no long term data and information regarding the particular site under consideration, which makes it difficult to predict impacts. It is important to consider that there will be uncertainties and voluntary monitoring of natural processes as described in the monitoring programme is absolutely essential.

Project information and planning and background data were not fully prepared or decided during the conduct of this study. However, available documents in connection with data provided particularly the concept plan, experiences of the proponent in other islands, particularly in the numerous resorts developed by Universal Enterprises, were used as the basis for preparation of

this document. Therefore, it will be possible to analyse, implement mitigation and suggest monitoring measures to the most relevant negative impacts.

Environmental impact prediction involves a certain degree of uncertainty as the natural and anthropogenic impacts can vary from place to place due to even slight differences in ecological, geomorphological or social conditions in a particular place. As note earlier, there is also no long term data and information regarding the particular site under consideration, which makes it difficult to predict impacts. However, the level of uncertainty is partially minimised due to the experience of resort and operation in similar settings in the Maldives. Nevertheless, it is important to consider that there will be uncertainties and voluntary monitoring of natural processes as described in the monitoring programme is absolutely essential.

Table 11-1 EIA study aspects and their limitations

Issue/Item	**Required Information**	**Current Status / action**
Resort Detailed Master Plan	Final Master Plan, discussed with and approved by Ministry of Tourism	At present, there is a concept plan but the details can be worked out after the EIA approval.
Engineering designs	Detailed engineering designs for the over water structures and land based structures to determine the extent of excavations and root removal.	Details can only be worked out after the EIA approval.
Details of the utility machinery and equipment	Exact model of the desalination plant, power plant and sewerage system (where relevant) is required to determine the process flows and procedures	Use concept plan. Base the assessment on minimal requirement of the EPA for the establishment of these facilities.
Natural Hazard Risks	Detailed modelling of flooding and storm damage risks	Data not available at local level; use broad level studies undertaken for Maldives
Resort Demand	Detailed demand analysis and occupancy forecasts for the next 10 years	Not available for the planned upgrade; Use the occupancy rates of similar resorts in Maldives
Environmental baseline data	Historical and long-term records on reef and lagoon environment.	Baseline snapshots of the site taken to design mitigation measures

Issue/Item	**Required Information**	**Current Status / action**
	Detailed data on geology, hydrogeology and soil. Long-term site specific or even regional data (at least 2 years). Most critical data include current, wave and sediment movement history. Air quality measurements Up-to-date Socio-economic data of Raa Atoll	Estimated based on other similar studies in Maldives Snapshot data for currents taken; wave studies in Baa atoll used Assumed as pristine Primary date collection will be time consuming; Secondary sources will be used
Environmental Standards	Environmental Standards for Air and Noise Quality	USEPA standards followed

12 CONCLUSIONS

The key conclusions of this ESIA are summarized below.

- The proposed developments are generally in conformance to the laws and regulations of the Maldives. Additional approvals are required for the following before commencement of project activities.
    - Detailed drawings approval from the Ministry of Tourism
    - Dewatering application and approval before commencement of any dewatering activities.

    The following approvals will be required before commencement of operations

    - Registration of the power plants with Maldives Energy Authority
    - Registration of Desalination Plants
    - Registration of waste facility
    - Resort operations licence
- The development is designed based on environmental best practices suitable for construction of resort islands in fragile environment of Maldives. The project involves constructing a self-sustaining resort island with transport infrastructure, back-of-the-house facilities, utilities, tourist accommodation, tourist facilities and staff facilities, and operating the new resort.
- The island is generally in natural condition but not in pristine condition. Vegetation has been modified to some extent and the water quality is poor. The lagoon and reef environment is in pristine condition. There are large areas of live coral cover on the reef slopes. There is a seasonal sand bank on the western side of the reef. The island also has a 200 m long sand pit during some seasons.
- The biggest challenge from the natural environment is current erosion and lack of beach on the island, particularly on the eastern and southern side. Alternative solutions have been proposed in this report to address these issues including shore protection and beach replenishment.
- The island has natural access points which will allow to create access jetties without the need to undertake dredging. However the proposed single jetty on the northern side may have access difficulties during some periods of the year. An alternative jetty on the south has been proposed.
- The negative impacts from this project are typical impacts associated with resort development in Maldives. The most significant impact from this project during construction stage would be the loss of live coral colonies due to reef entrance clearance, removal of limited vegetation, excavation and dewatering, changes to coastal

processes due to coastal developments, degradation of the terrestrial and marine environment due to the worker activities, lost marine life due to overwater construction and disposal of waste. Main social impacts include potential conflicts with the atoll public if equal job opportunity is not available for construction stage or operations stage of the resort.

- The main anticipated negative impact during operations stage is the impact on marine flora and fauna due to potentially high number of vessels using the access jetty, impacts on the beach due significant erosion and accretion patterns and social impacts associated with foreign workers or general lack of opportunities.
- The project mainly has positive socio-economic benefits, including increased direct and indirect job opportunities, tourism growth and conservation of the islands iconic environment.
- Key mitigation measures for the construction stage include finding options to mitigate severe erosion on the island. A number of mitigation measures have been proposed in this assessment to mitigate the most significant impacts associated with the development, worker activities, vegetation removal, marine construction, and excavation works and utilities operation.
- Alternatives options were evaluated for the activities that are identified to have significant impacts on or from the project. These include the options for erosion mitigation, access jetty and beach rejuvenation.
- The monitoring plan has been designed with a focus to analyse the significant impacts over time. Cost of monitoring is estimated at US$15,000 per year.
- A management framework has been proposed and it is essential that this framework be used in the construction and operation stage of the project.
- The Island Councils and public of the nearest three islands were consulted on the project and all stakeholders have strong support to implement this project.

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APPENDIX A – Terms of Reference

EPA/TOR/2014/15

Terms of Reference for Environmental Impact Assessment of the Tourist Resort Development Project at Muravandhoo Island, Raa Atoll

The following is the Terms of Reference (ToR) following the scoping meeting held on 19/02/2014 for undertaking the EIA of the proposed tourist resort development at Muravandhoo Island, Raa Atoll.

While every attempt has been made to ensure that this TOR addresses all of the major issues associated with development proposal, they are not necessarily exhaustive. They should not be interpreted as excluding from consideration matters deemed to be significant but not incorporated in them, or matters currently unforeseen, that emerge as important or significant from environmental studies, or otherwise, during the course of preparation of the EIA report.

1. **Introduction and rationale** – Describe the purpose of the project and, if applicable, the background information of the project/activity and the tasks already completed. Objectives of the development activities should be specific and if possible quantified. Define the arrangements required for the environmental assessment including how work carried out under this contract is linked to other activities that are carried out or that is being carried out within the project boundary. Identify the donors and the institutional arrangements relevant to this project.
2. **Study area** – Submit a minimumA3 size scaled plan with indications of all the proposed infrastructures. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location and size. The study area should include adjacent or remote areas, such as relevant developments and nearby environmentally sensitive sites (e.g. coral reef, sea grass, mangroves, marine protected areas, special birds site, sensitive species nursery and feeding grounds). Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites.

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Green Building, 3rd Floor HandhuvareeHingun | ގްރީން ބިލްޑިންގް، 3ވަނަ ފަންގިފިލާ ހަނދުވަރީހިނގުން
Male', Rep. of Maldives, 20392 | މާލެ، ދިވެހިރާއްޖެ، 20392
Tel: [+960] 333 5949 [+960] 333 5951 : ފޯން | Email: secretariat@epa.gov.mv : އީމެއިލް
Fax: [+960] 333 5953 : ފެކްސް | Website: www.epa.gov.mv : ވެބްސައިޓް

3. **Scope of work** – Identify and number tasks of the project including preparation, construction and decommissioning phases.

Task 1. Description of the proposed project – Provide a full description and justification of the relevant parts of the project, using maps at appropriate scales where necessary. The following should be provided (all inputs and outputs related to the proposed activities shall be justified):

The main activities of the resort development are:

- Land clearance (up to 20% of island vegetation);
- Channel dredging and jetty construction;
- Infrastructure construction including power house, water desalination plant, sewerage plant, oil storage tanks, waste management facility and hardware workshop;
- Construction and operation of accommodation, restaurants, spa, sports and marine centre facilities (include an A3 land use map);
- Coastal protection works including groins, breakwaters, sea walls;
- Environmental monitoring during construction activities;
- Measures to protect environmental values during construction and operation phase;
- Project management (include scheduling and duration of the project and life span of facilities; communication of construction details, progress, target dates, construction/operation/closure of labour camps, access to site, safety, equipment and material storage, fuel management and emergency plan in case of spills)

Land clearance:

- Define the total area of cleared vegetation;
- Methods of clearance and vegetation waste disposal.

Water desalination plant:

- Location, desalination capacity, technology and water quality monitoring system;
- Pipeline construction methods, scheduling and drawings;
- Justification for the location of the water intake and brine outfall pipelines;
- Emergency water supply plan.

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Power supply plant and oil storage:

- Location and size of generators and facility;
- Fuel transportation technique and volume required;
- Cooling water system including cooling pipe location (if any) and justification;
- Emergency power supply plan;
- Low energy consumption ventures and awareness.

Sewerage plant:

- Plant location, capacity and justification;
- Water collection points and pipeline drawings;
- Describe operations for dewatering excavations for pump stations and sewer trenches;
- Describe rain water collection and mechanisms used to avoid pipe leakages protecting ground water contamination;
- Discharge water quality testing system, leakage detection system and emergency plan;
- Justify outfall site selection including the distance from the reef and depth of the pipe using oceanographic and ecological information. Currents and waves ought to quickly disperse the discharged water with little to no impacts on marine ecosystems and economic activities. Illustrate the extent of sediment plume. The public and stakeholders should support the location of the outfall site.
- Describe equipment needed and construction methods for laying the offshore pipeline including handling transportation.
- Detail solid waste disposal mechanisms, equipment used and periodicity (how often?).
- Specify materials, equipment, heavy machinery, staff estimate (quantity and period of time), key personnel positions, intermittent technical expertise required;
- Specify an emergency plan if system fails.

Waste management facility:

- Location justification, carrying capacity, materials to be collected and equipment required for waste reduction and recycling;
- Transportation mechanisms and costs;

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- Recycling ventures and awareness activities within the resort.

Marina and jetties:

- Location justification, capacity and design;
- Construction activities, dock protection and periodical dredging requirements, if any.

Shore protection works and beach nourishment activities:

- Protection structure size, location, number and type, including oceanographic justification and map;
- Construction materials and function;
- Longevity of protection structures;
- Beach nourishment technique (sand pumping, excavation, etc), volume and type of sand required, periodicity;

Temporary facilities:

- Construction methods, scheduling and operation of temporary facilities including power generation, oil storage, water supply, waste water treatment, accommodation facilities, waste management and decommissioning.

Absence of facilities in the country to carry out the water quality tests will not exempt the proponent from the obligation to provide necessary data. The report should outline the detailed methodology of data collection utilized to describe the existing environment.

Task 2.Description of the environment – Assemble, evaluate and present the environmental baseline study/data regarding the study area and timing of the project (e.g. monsoon season). Identify baseline data gaps and identify studies and the level of detail to be carried out by consultant. Consideration of likely monitoring requirements should be borne in mind during survey planning, so that data collected is suitable for use as a baseline. As such all baseline data must be presented in such a way that they will be usefully applied to future monitoring. The report should outline detailed methodology of data collection utilized.

The baseline data will be collected before construction and from at least two benchmarks. All survey locations shall be referenced with Geographic Positioning System (GPS) including water sampling points, reef transects, vegetation transects and manta tows

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sites for posterior data comparison. Information should be divided into the categories shown below:

*There is a description of the specific data collection requirements attached in the appendix of this TOR template.

Climate

- Temperature, rainfall, wind and waves (including extreme conditions)
- Risk of severe weather events;

Geology and geomorphology

- Offshore/coastal geology and geomorphology (use maps);
- Bathymetry (bottom morphology) (use maps);
- (Seasonal) patterns of coastal erosion and accretion (see appendix for monitoring details), and
- Characteristics of seabed sediments to assess direct habitat destruction and turbidity impacts during construction;

Hydrography/hydrodynamics (use maps)

- Tidal ranges and tidal currents;
- Wave climate and wave induced currents;
- Wind induced (seasonal) currents;
- Sea water quality measuring these parameters: temperature, pH, salinity, turbidity, phosphate, nitrate, ammonia, sulphate, BOD and COD.

Ecology

- Identify marine protected areas (MPAs) and sensitive sites such as breeding or nursery grounds for protected or endangered species (e.g. coral reefs, spawning fish sites, nurseries for crustaceans or specific sites for marine mammals, sharks and turtles). Include description of commercial species, species with potential to become nuisances or vector.
- Benthic and fish community monitoring around the island (see appendix for monitoring guidelines);

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- Landscape integrity, and
- Include ground water monitoring (See appendix for parameter healthy ranges);

Socio-economic environment of the Atoll and nearby Islands

- Demography: total population, sex ratio, density, growth and pressure on land and marine resources;
- Income situation and distribution
- Economic activities of both men and women (e.g. fisheries, home gardening, fish processing, employment in industry, government);
- Seasonal changes in activities;
- Land use planning, natural resource use and zoning of activities at sea;
- Accessibility and (public) transport to other island;
- Services quality and accessibility (water supply, waste/water disposal, energy supply, social services like health and education);
- Community needs;
- Sites with historical or cultural interest or sacred places (mosques, graveyard).

Hazard vulnerability:

- Vulnerability of area to flooding and storm surge.

Task 3. Legislative and regulatory considerations – Identify the pertinent legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project, and identify the appropriate authority jurisdictions that will specifically apply to the project. Include permits and approvals in the EIA document:

Task 4. Potential impacts (environmental and socio-cultural) of proposed project, incl. all stages – The EIA report should identify all the impacts, direct and indirect, during and after construction, and evaluate the magnitude and significance of each. Particular attention shall be given to impacts associated with the following:

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Impacts on the natural environment

- Loss of terrestrial vegetation and fauna from land preparation works;
- Impacts on marine habitats including damages to coral reefs, fish stocks, protected areas and protected species;
- Changes in erosion/sedimentation patterns, which may impact shore zone configuration/coastal morphology;
- Temporary sediment dispersal in water column (turbidity at the dredging site, reclamation areas and related to shore protection activities), possibly resulting in changes in visibility, smothering of coral reefs and benthic communities and affecting fish and shellfish etc.;
- Impacts on ground water table and quality as a result of construction and operation activities (leaching of salts in the deposited sediments and change in ground water quantity);
- Impacts on landscape integrity/scenery.

Impacts on the socio-economic environment

- Impacts on employment and income, potential for local people to have (temporary or long term) job opportunities (and what kind) in the execution of the works;
- Disturbance to local natural resource users such as fishing areas, other tourism ventures;
- Impacts to nearby resorts and dive sites;
- Level of protection against hazards like sea level rise, storm surges, etc.
- Impact equity (economic activities, employment, income);
- Impacts on accessibility and transportation of goods to island.

Construction related hazards and risks

- Pollution of the natural environment (e.g. oil spills, discharge of untreated waste water and solid waste, including construction waste);

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- Risk of accidents and pollution on workers and local population.

The methods used to identify the significance of the impacts shall be outlined. One or more of the following methods must be utilized in determining impacts; checklists, matrices, overlays, networks, expert systems and professional judgment. Justification must be provided to the selected methodologies. The report should outline the uncertainties in impact prediction and also outline all positive and negative/short and long-term impacts. Identify impacts that are cumulative and unavoidable.

Task 5. Alternatives to proposed project – Describe alternatives including the "no action option" should be presented. Determine the best practical environmental options. Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". The report should highlight how the locations were determined. All alternatives must be compared according to international standards and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. Mitigation options should be specified for each component of the proposed project.

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. These will include both environmental and socio-economic mitigation measures. Mitigation measures to avoid or compensate habitat destruction, e.g. temporal sediment control structures, coastal protection structures to reduce erosion, coral reconstruction and MPA replacement areas. Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources required to implement those measures. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included. An Environmental management plan for the proposed project, identifying responsible persons, their duties and commitments shall also be given. In cases where impacts are unavoidable arrangements to compensate for the environmental effect shall be given.

Task 7. Development of monitoring plan (see appendix)– Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan for coastal modification, beach morphology, sediment movement around the island. Ecological monitoring will be submitted to the EPA to

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evaluate the damages during construction, after project completion and every three months thereafter, up to one year and then on a yearly basis for five years after. The baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided.

- Water quality, especially turbidity;
- Erosion and accretion changes;
- Temporal sedimentation rates on nearby coral reefs, benthic system.
- Condition of the sensitive ecosystems and marine resources;
- Re-colonization of the benthic organisms in the borrow areas;
- Environmentally sound site clearance;
- Environmentally sound removal of dredging and other equipment including construction materials, and
- Employment of available local labour force.

* This TOR contains an outline of the parameters that have to be tested (see appendix). All projects are different, therefore additional or less data will be collected for recovery and impact assessments.

Task 8. Stakeholder consultation, Inter-Agency coordination and public/NGO participation) – Identify appropriate mechanisms for providing information on the development proposal and its progress to all stakeholders, government authorities such as Ministry of Housing, Transport and Environment, Planning Council, Tourism Ministry, Finance Ministry, government agencies, NGOs, engineers/designers, development managers, staff and members of the general public. The EIA report should include a list of people/groups consulted, their contact details and summary of the major outcomes.

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Presentation- The environmental impact assessment report, to be presented in digital format, will be concise and focus on significant environmental issues. It will contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations f or any references used in interpreting those data. The environmental assessment report will be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Regulations, 2012

Timeframe for submitting the EIA report – The developer must submit the completed EIA report within 3 months from the date of this Term of Reference.

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24.02.2014

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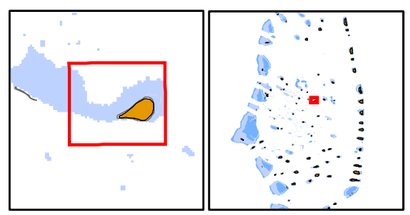
APPENDIX B – Resort Concept Plan

Legend

SitePlan



Meters

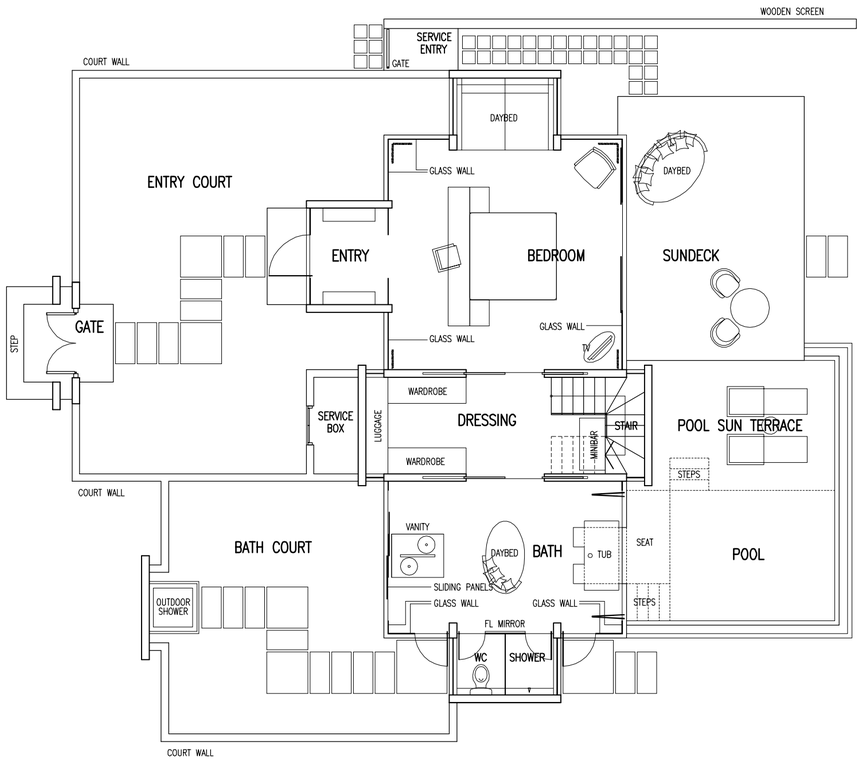
0 50 100 200

Madivaafaru Island, Raa Atoll
Resort Development Project
Site Plan

PROJECTION: Transverse Mercator
(UTM Zone 43 N); HORIZONTAL DATUM: WGS84;
VERTICAL DATUM: Hulhule Tide Gauge
Map version: 07/05/2014
Satellite Image: Digital Globe 04/02/2014

Surveyed and Prepared by: CDE Consulting, Maldives

APPENDIX C - Detailed Designs



GROUND FLOOR LAYOUT PLAN

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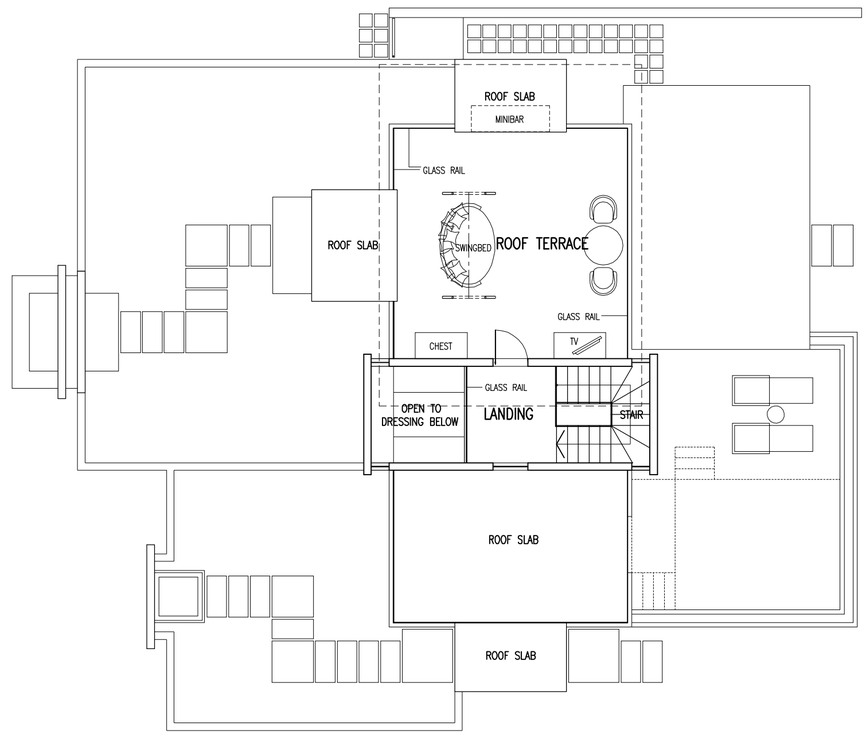

FIRST FLOOR LAYOUT PLAN

1:100

BEACH VILLA

MURAVANDHOO

RAA ATOLL, MALDIVES

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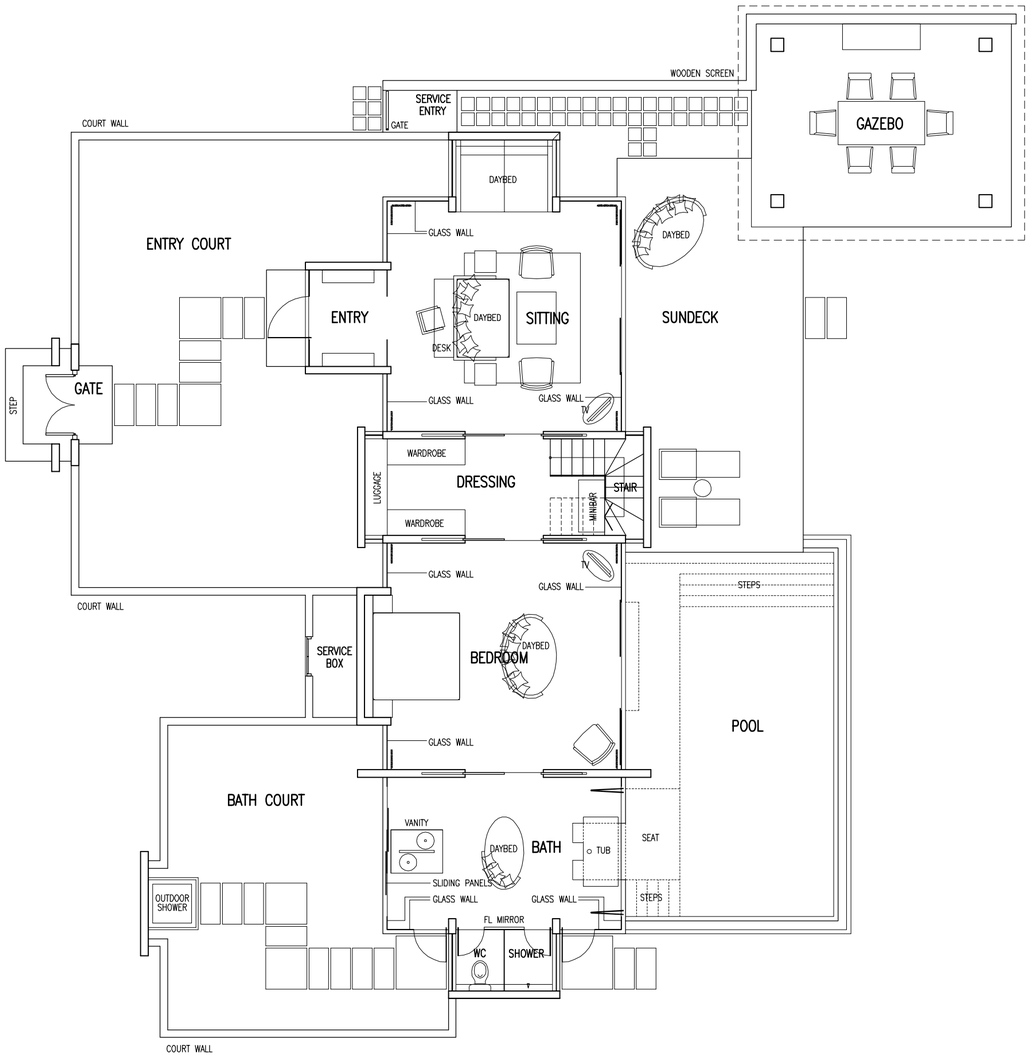

GROUND FLOOR LAYOUT PLAN

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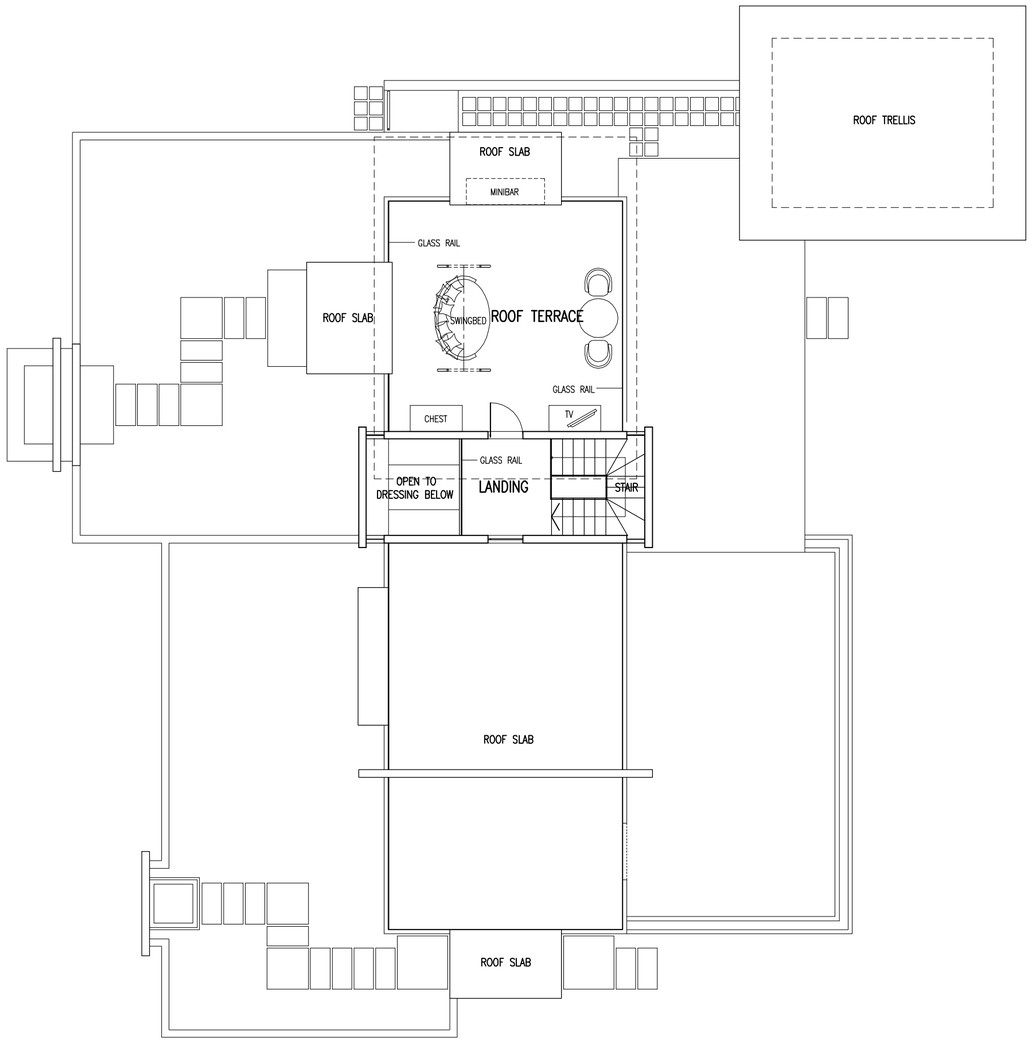

FIRST FLOOR LAYOUT PLAN

1:100

BEACH SUITE

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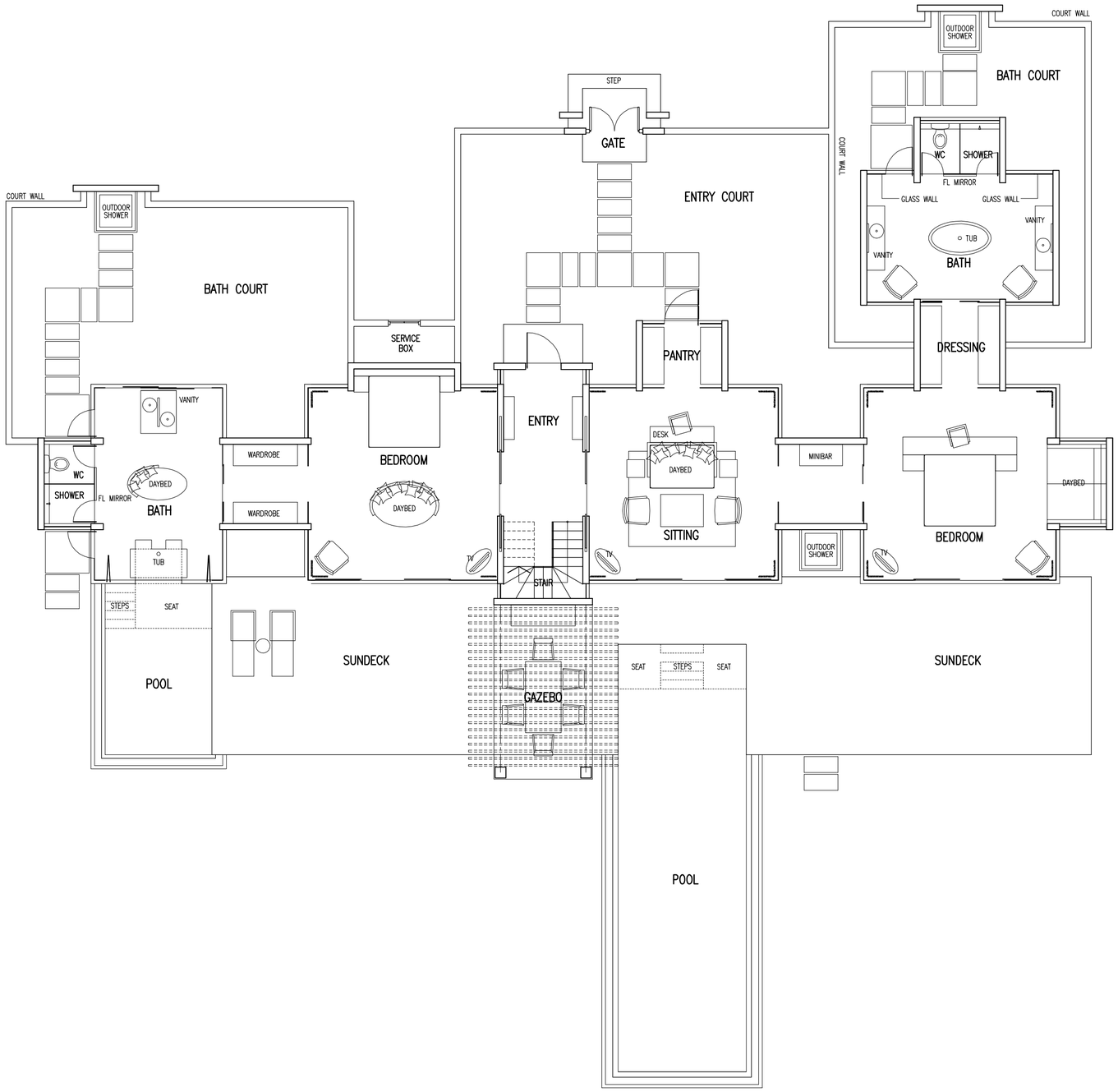

GROUND FLOOR LAYOUT PLAN

1:100

BEACH RESIDENCE

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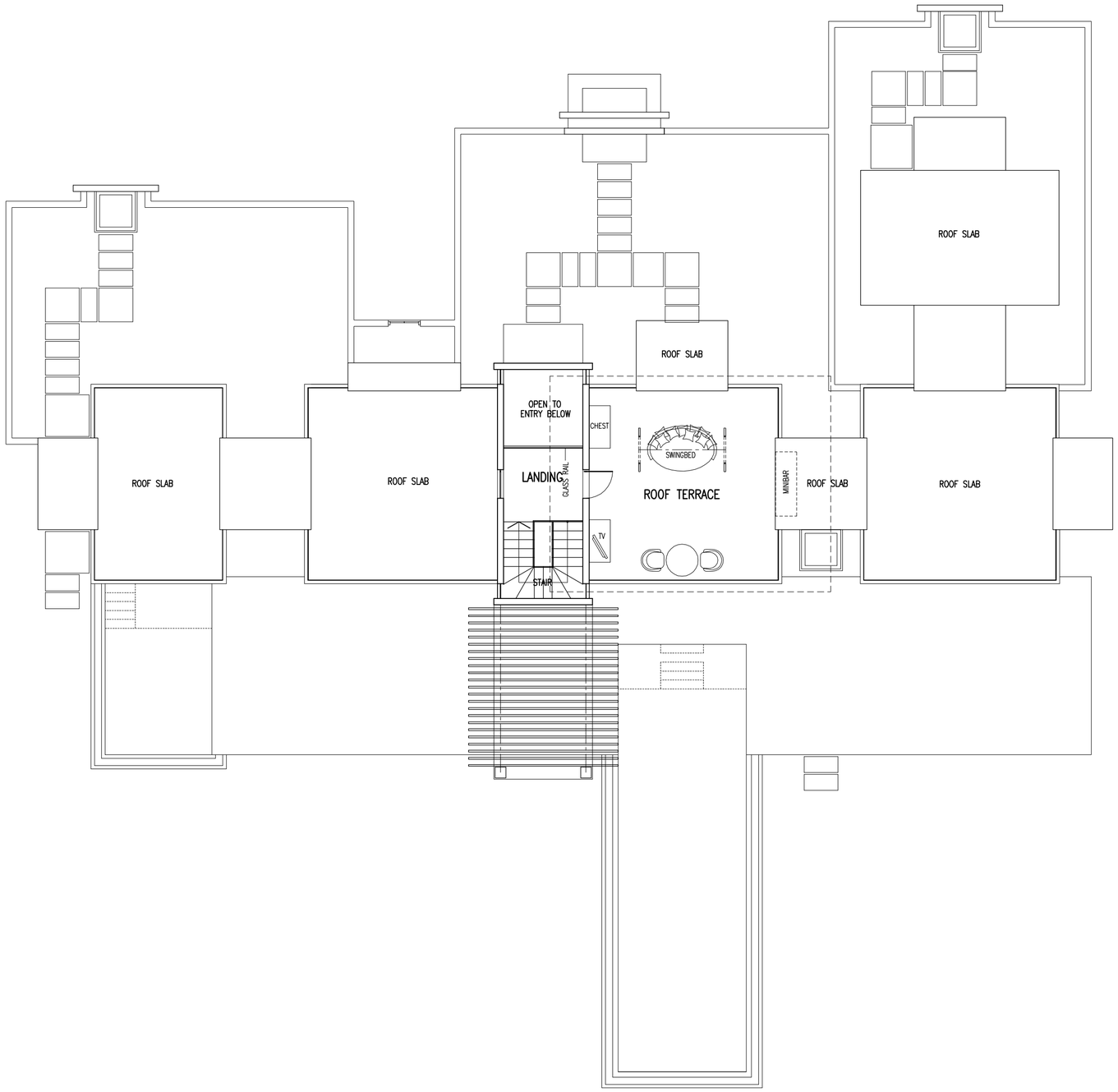

GROUND FLOOR LAYOUT PLAN

1:100

BEACH RESIDENCE

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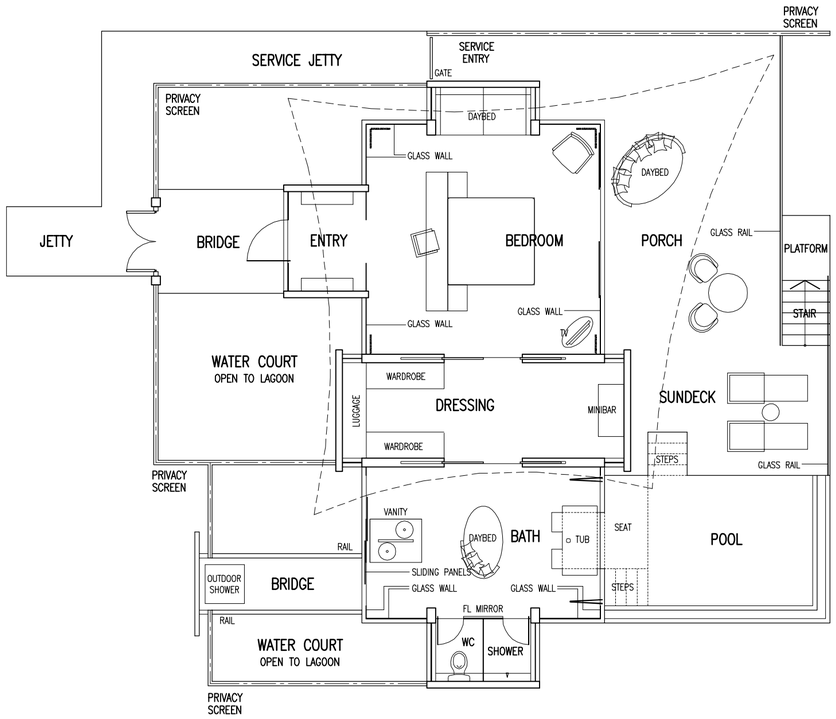

FLOOR LAYOUT PLAN

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WATER VILLA

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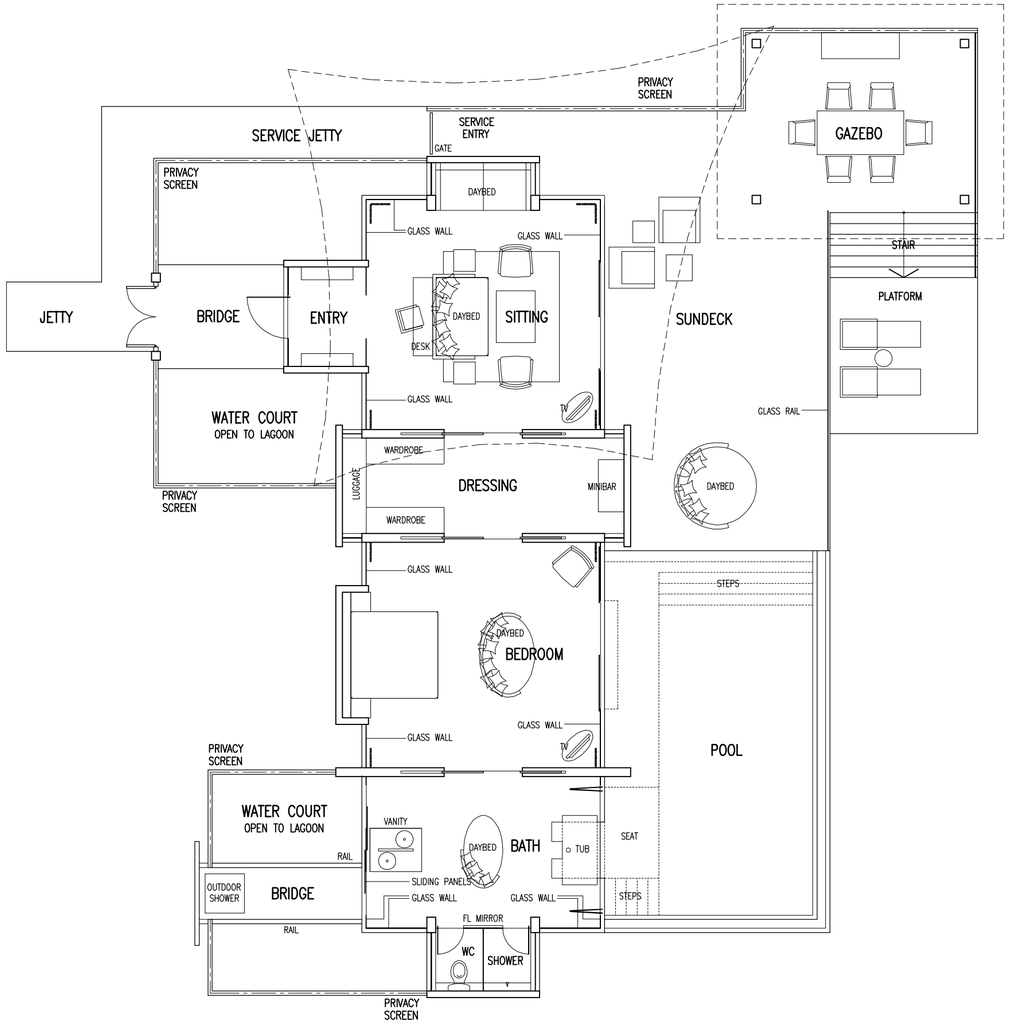

FLOOR LAYOUT PLAN

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WATER SUITE

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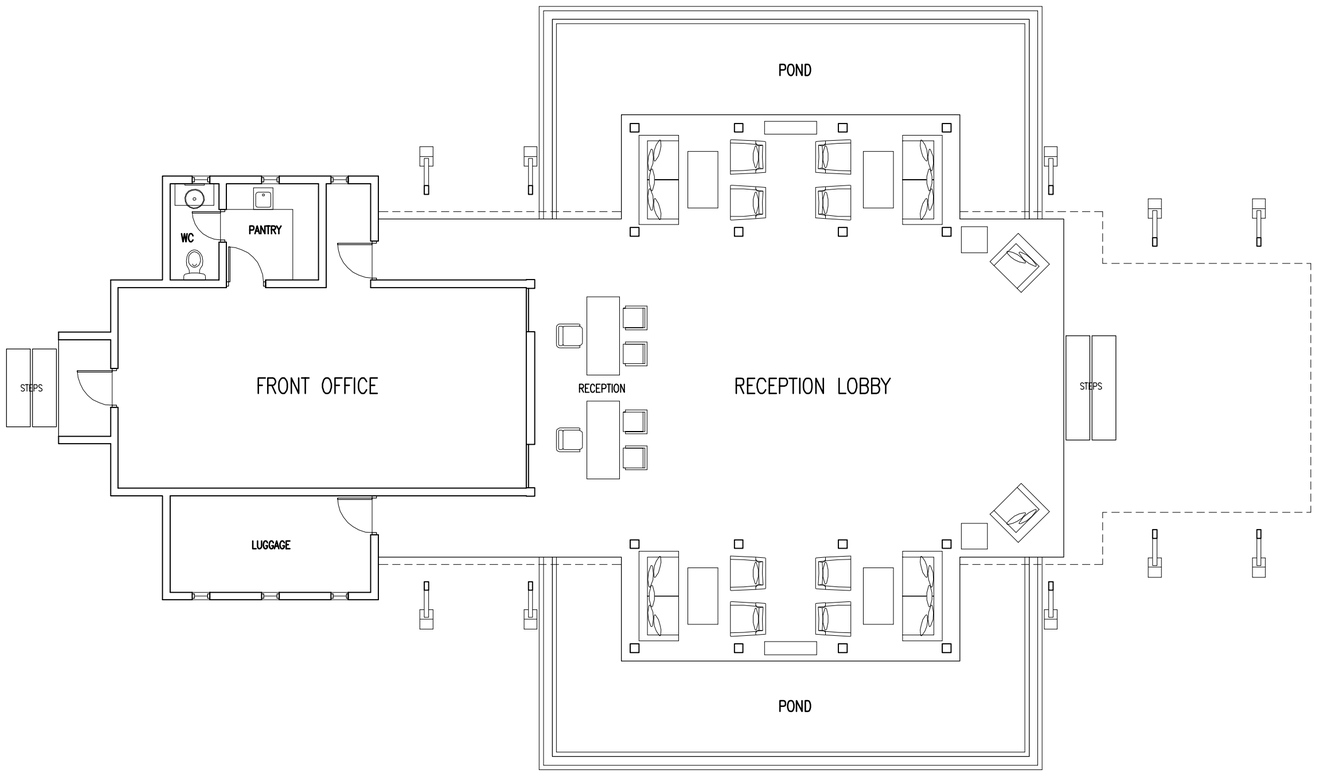

FLOOR LAYOUT PLAN
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RECEPTION LOBBY

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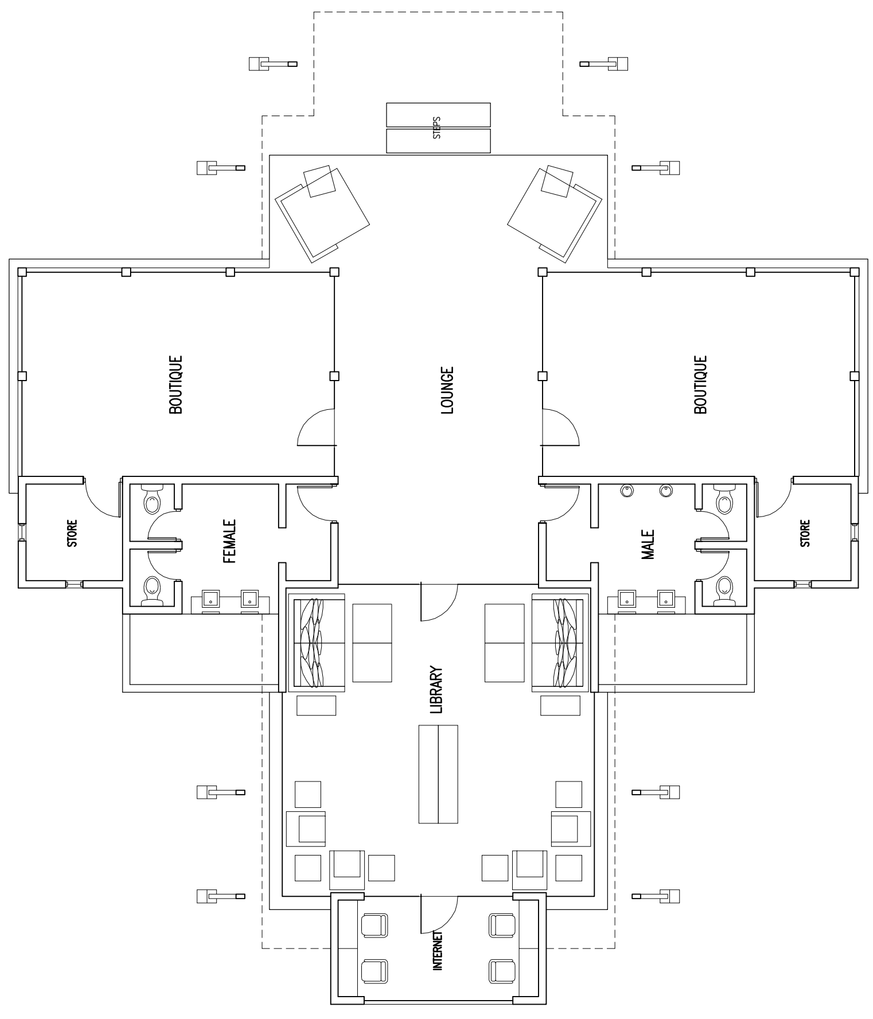
LIBRARY & BOUTIQUES



FLOOR LAYOUT PLAN
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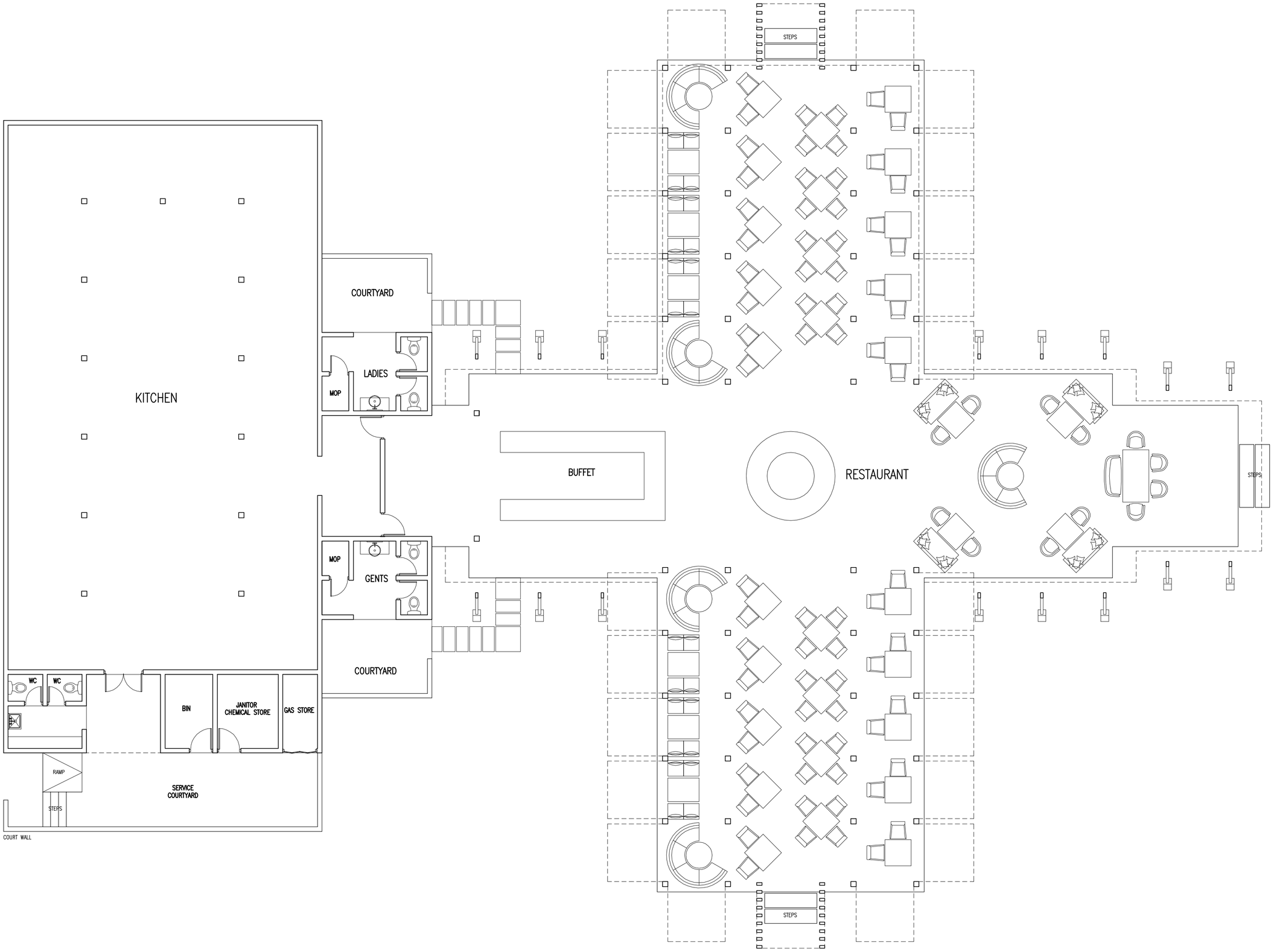

FLOOR LAYOUT PLAN

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MAIN RESTAURANT

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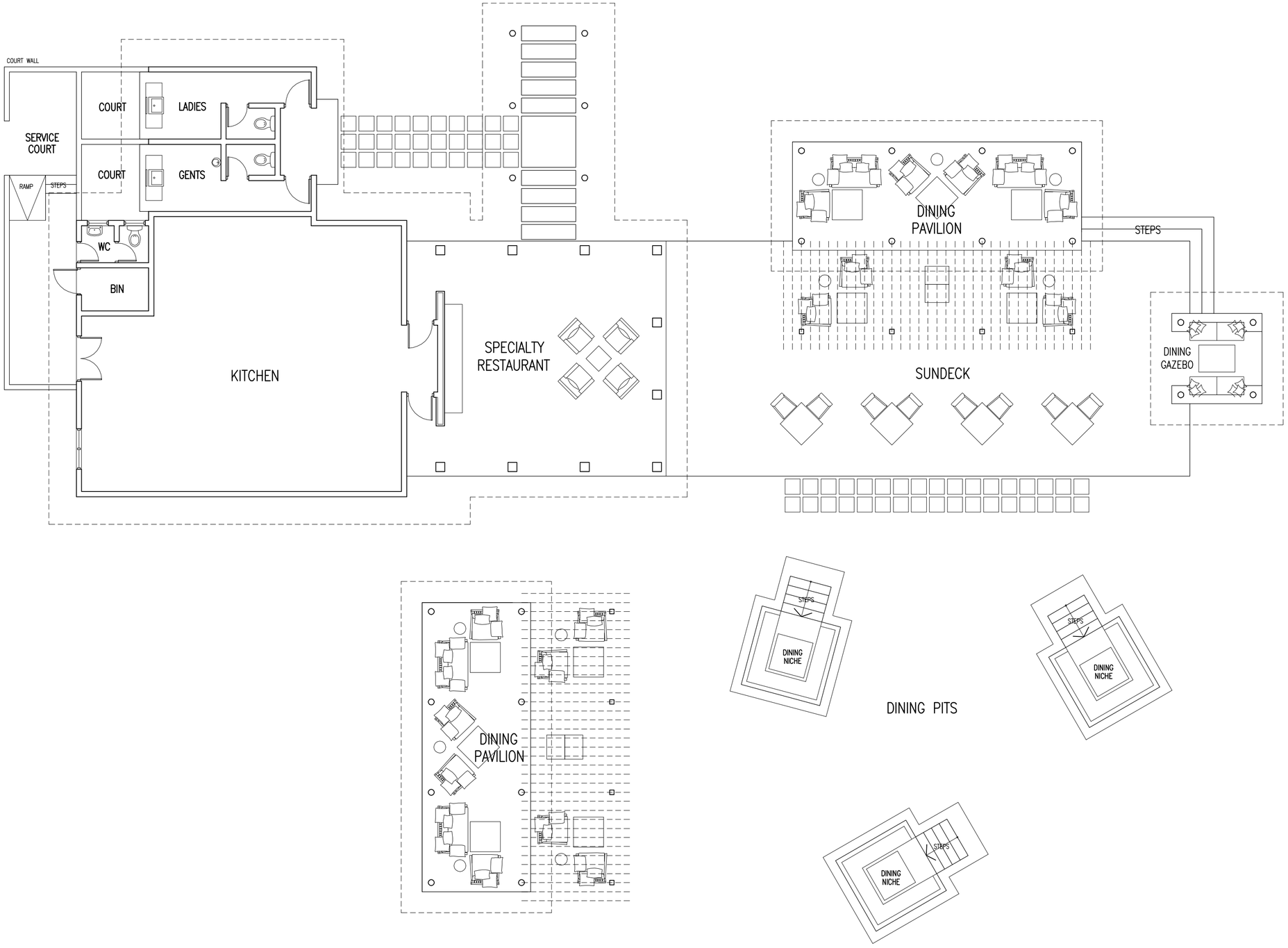

FLOOR LAYOUT PLAN

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SPECIALTY RESTAURANT

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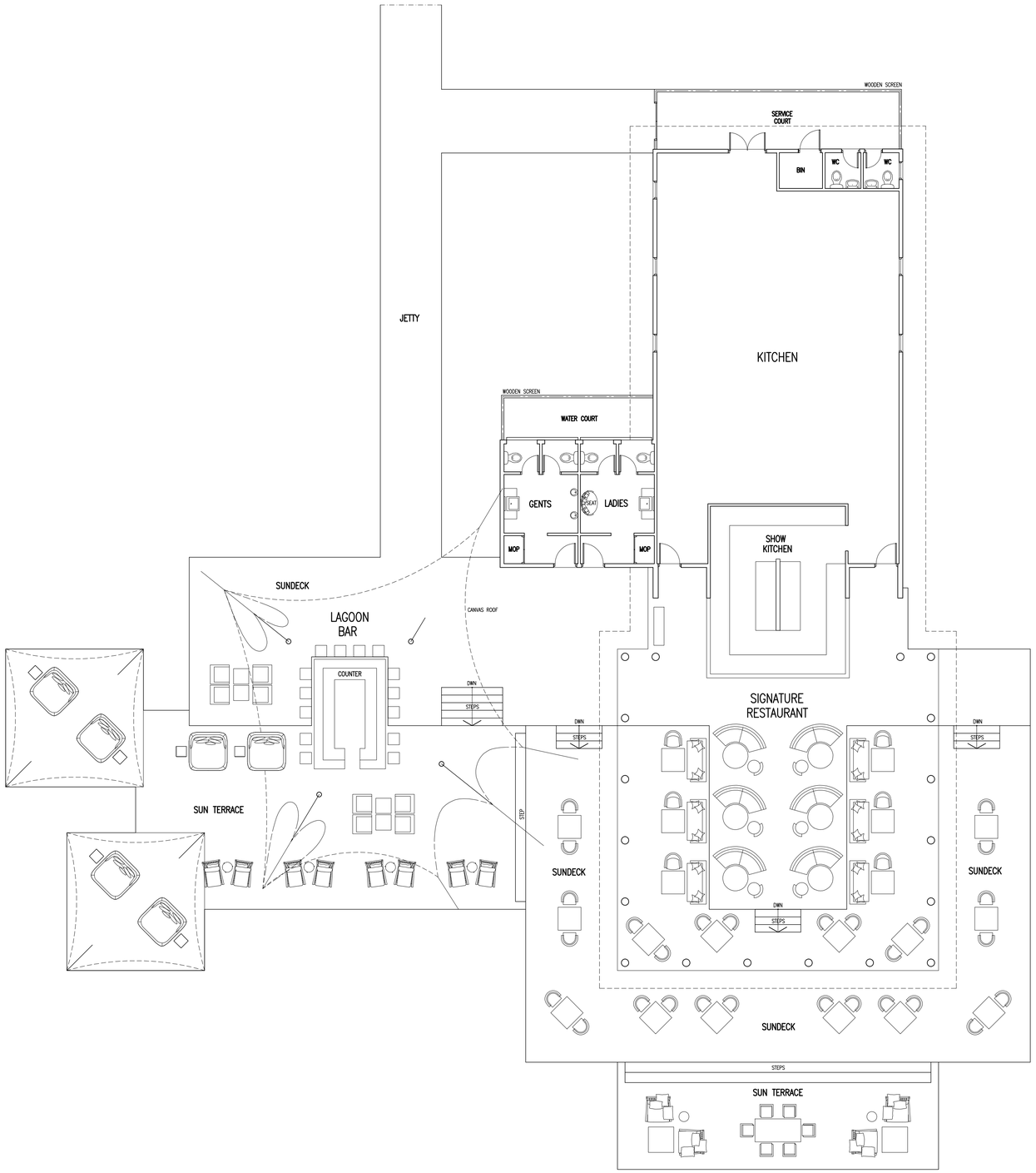

FLOOR LAYOUT PLAN
1:100

MURAVANDHOO

RAA ATOLL, MALDIVES

SIGNATURE RESTAURANT & LAGOON BAR

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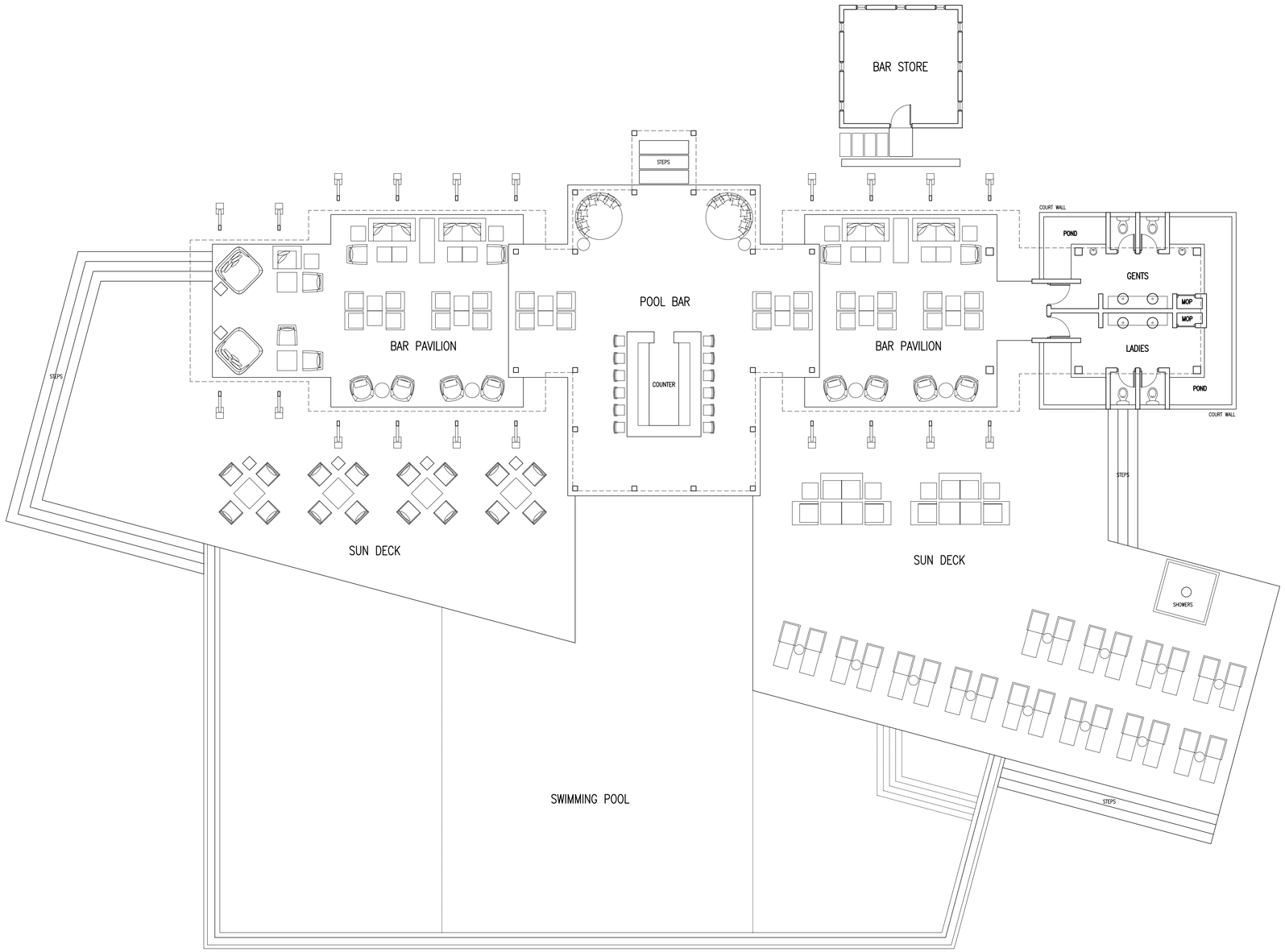

FLOOR LAYOUT PLAN
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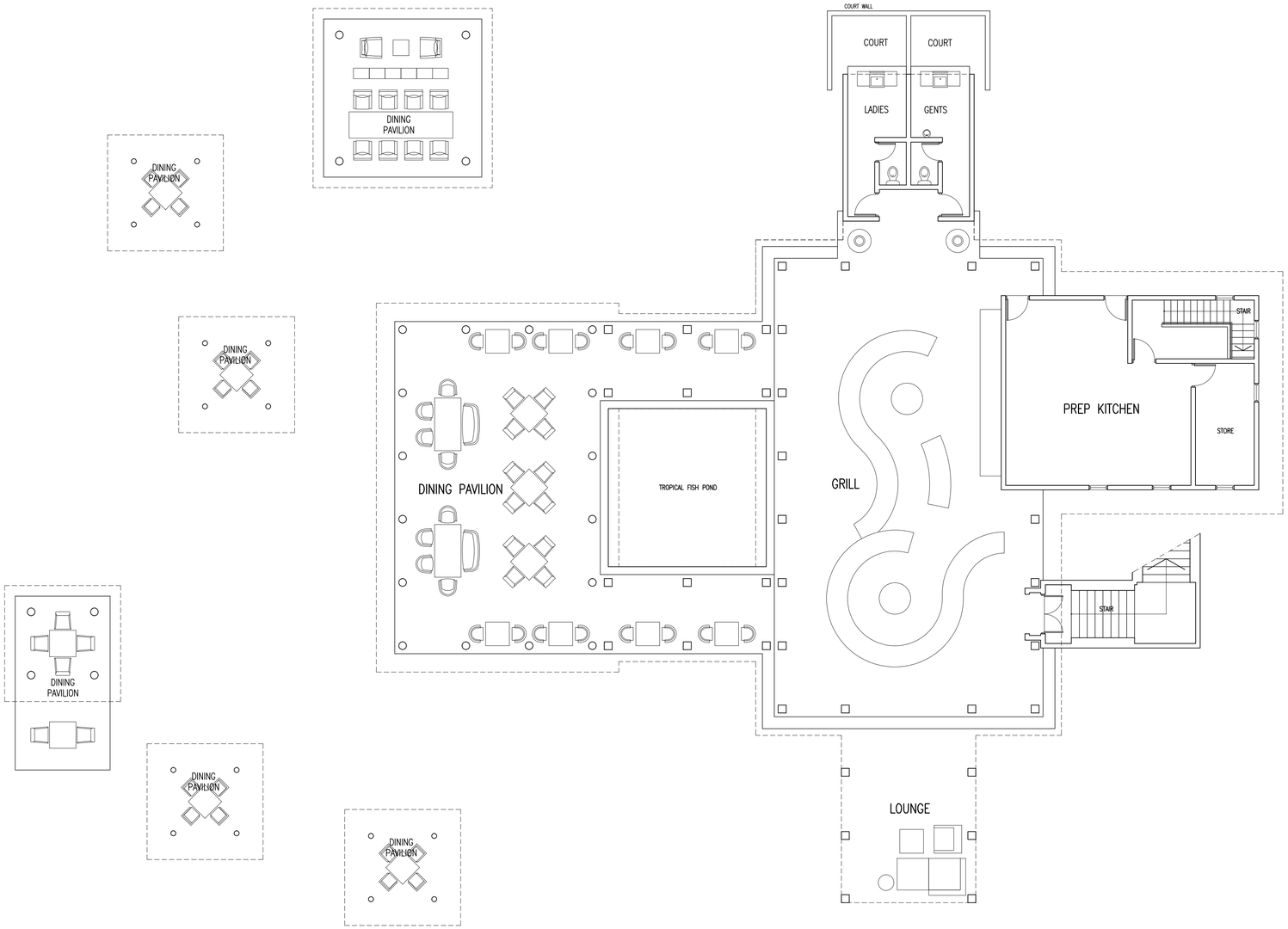
POOL BAR & SWIMMING POOL

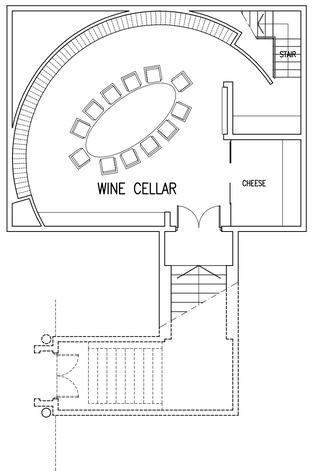
MURAVANDHOO

RAA ATOLL, MALDIVES

GX ASSOCIATES
PRIVATE LIMITED
G. MUANAVIT, MEEDHOO WARD, MALE', MALDIVES
TEL: +960 332 8070, +960 332 8080
FAX: +960 332 4882 EMAIL: info@gxgroup.com
WEBSITE: www.gxassociates.com



FLOOR LAYOUT PLAN
1:100



BELOW GROUND
FLOOR LAYOUT PLAN
1:100

GRILL RESTAURANT & WINE CELLAR

MURAVANDHOO

RAA ATOLL, MALDIVES

GX ASSOCIATES
PRIVATE LIMITED
G. ARMAGHT, HULHUMALE BAND, MALE', MALDIVES
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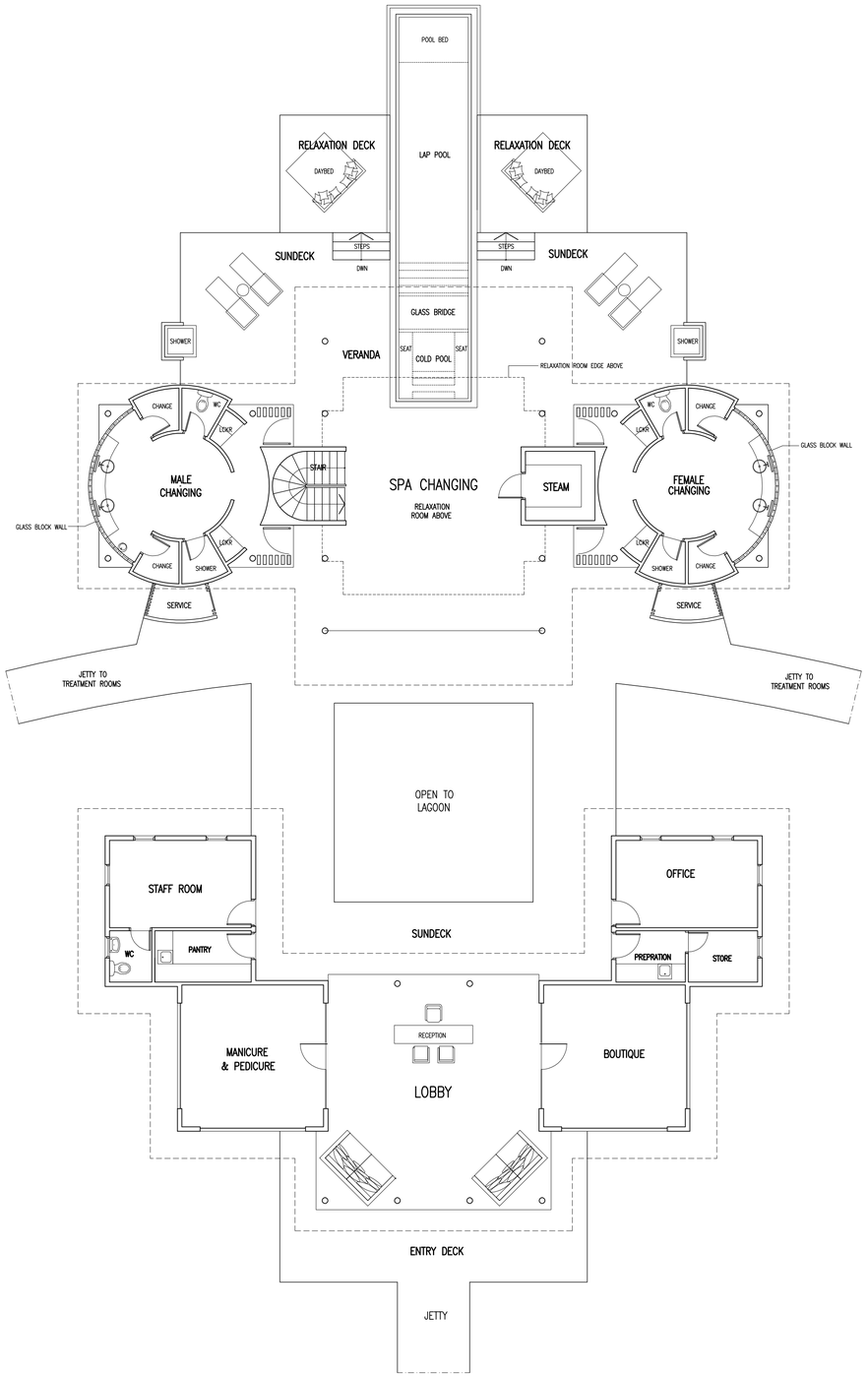
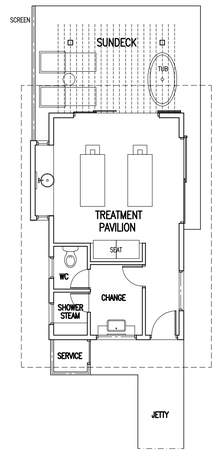
FAX: +960 22 4002 EMAIL: info@gxlimp.com
WEBSITE: www.gxassociates.com



FLOOR LAYOUT PLAN
1:100



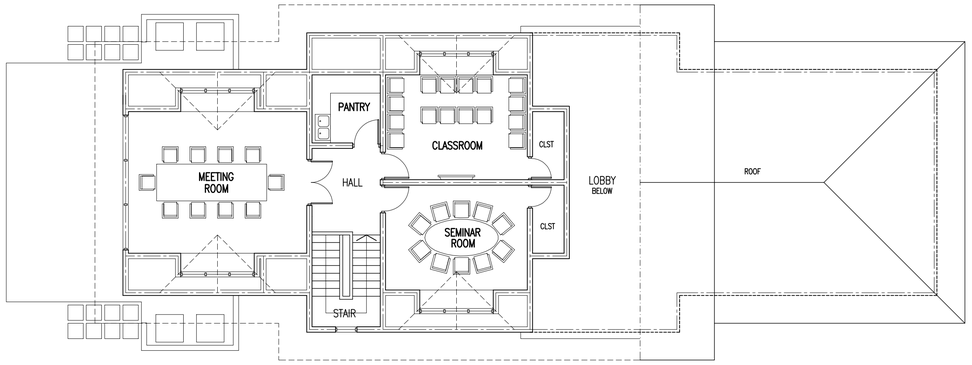
FLOOR LAYOUT PLAN
1:100

SPA MAIN & TREATMENT ROOM

MURAVANDHOO

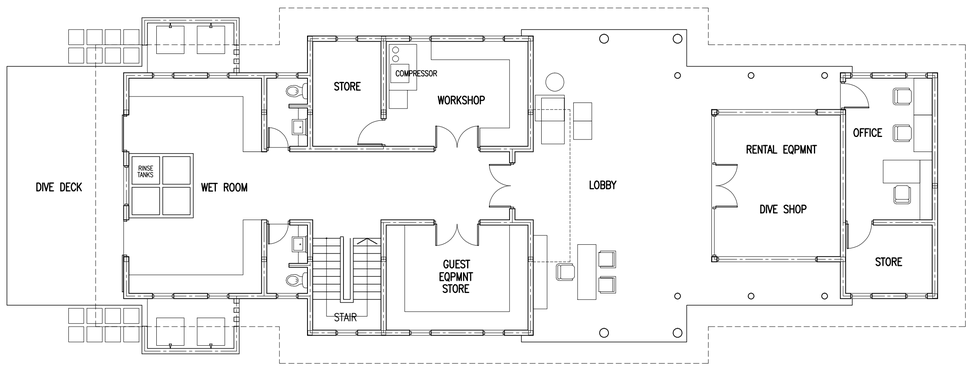
RAA ATOLL, MALDIVES

GX ASSOCIATES
PRIVATE LIMITED
G. MUSAFIRU', BODUMORI MAGU, MALE', MALDIVES
TEL: +960 332 8074, +960 332 8080
FAX: +960 33 4012 (MAL) info@gxlmp.com
WEBSITE: www.gxassociates.com



UPPER LEVEL
FLOOR LAYOUT PLAN
1:100

0 1 5M



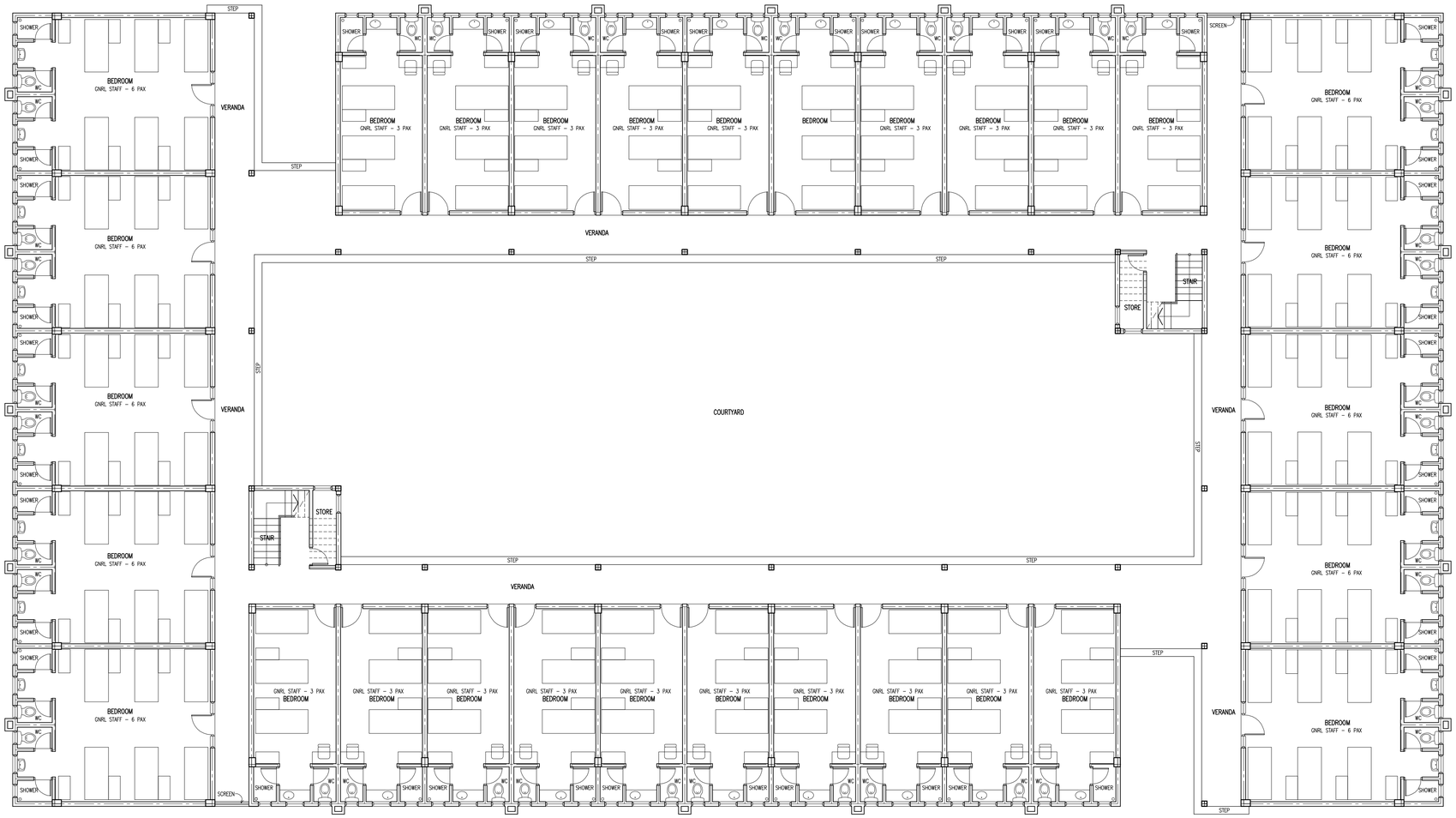
LOWER LEVEL
FLOOR LAYOUT PLAN
1:100

DIVE CENTRE

MURAVANDHOO

RAA ATOLL, MALDIVES

GX ASSOCIATES
PRIVATE LIMITED
G.MAGUDHOOZ, MEDUKKUNDU ARCH, MALE', MALDIVES
TEL: +960 333 8070, +960 332 3000
FAX: +960 332 4802 EMAIL: info@gxgroup.com
WEBSITE: www.gxassociates.com

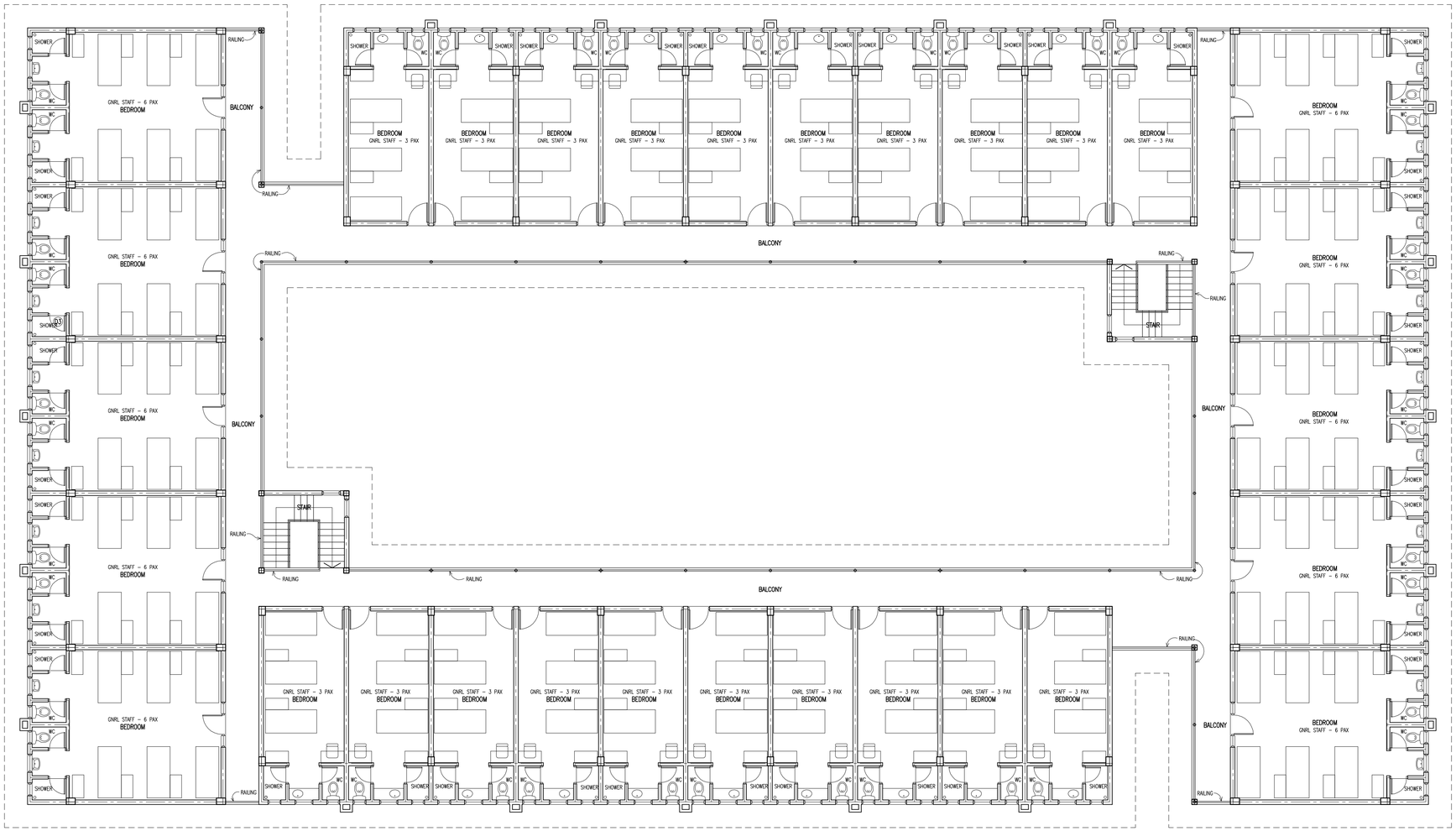


GROUND FLOOR LAYOUT PLAN
1:100

GENERAL STAFF QUARTERS

MURAVANDHOO
RAA ATOLL, MALDIVES

GX ASSOCIATES
PRIVATE LIMITED
4, AMBANAIT, MEDUKURU MAGU, MALE', MALDIVES
TEL: +960 332 8070, +960 332 8065
FAX: +960 332 4002 EMAIL: dev@gx-pvt.com
WEBSITE: www.gxassociates.com

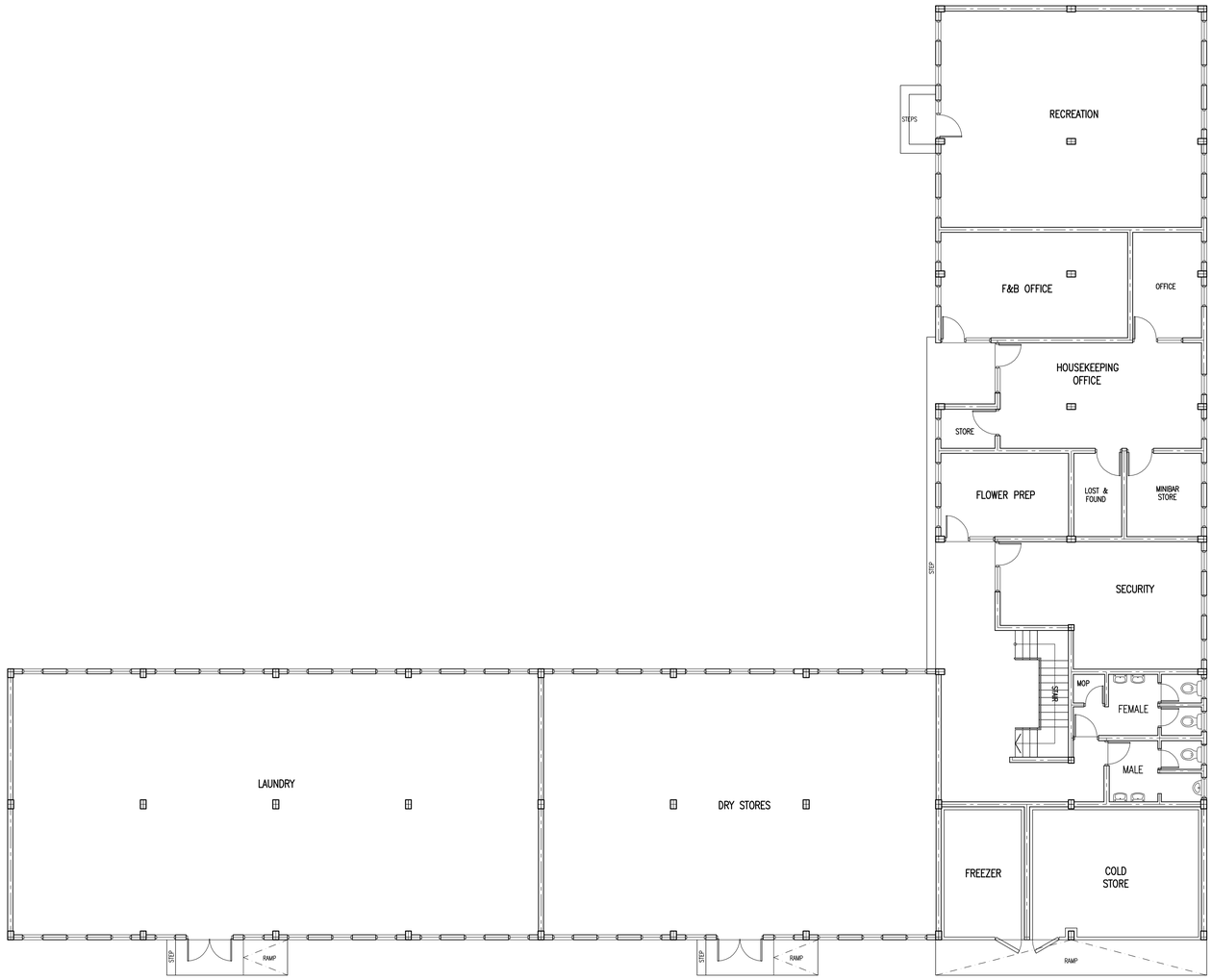


FIRST FLOOR LAYOUT PLAN
1:100

GENERAL STAFF QUARTERS

MURAVANDHOO
RAA ATOLL, MALDIVES

GX ASSOCIATES
PRIVATE LIMITED
4, MAGHAIC, HULHUMALE MALE, MALE' ATOLL
TEL: +960 332 8075, +960 332 8040
FAX: +960 33 402 1390, dsa@gxa.com
WEBSITE: www.gxassociates.com

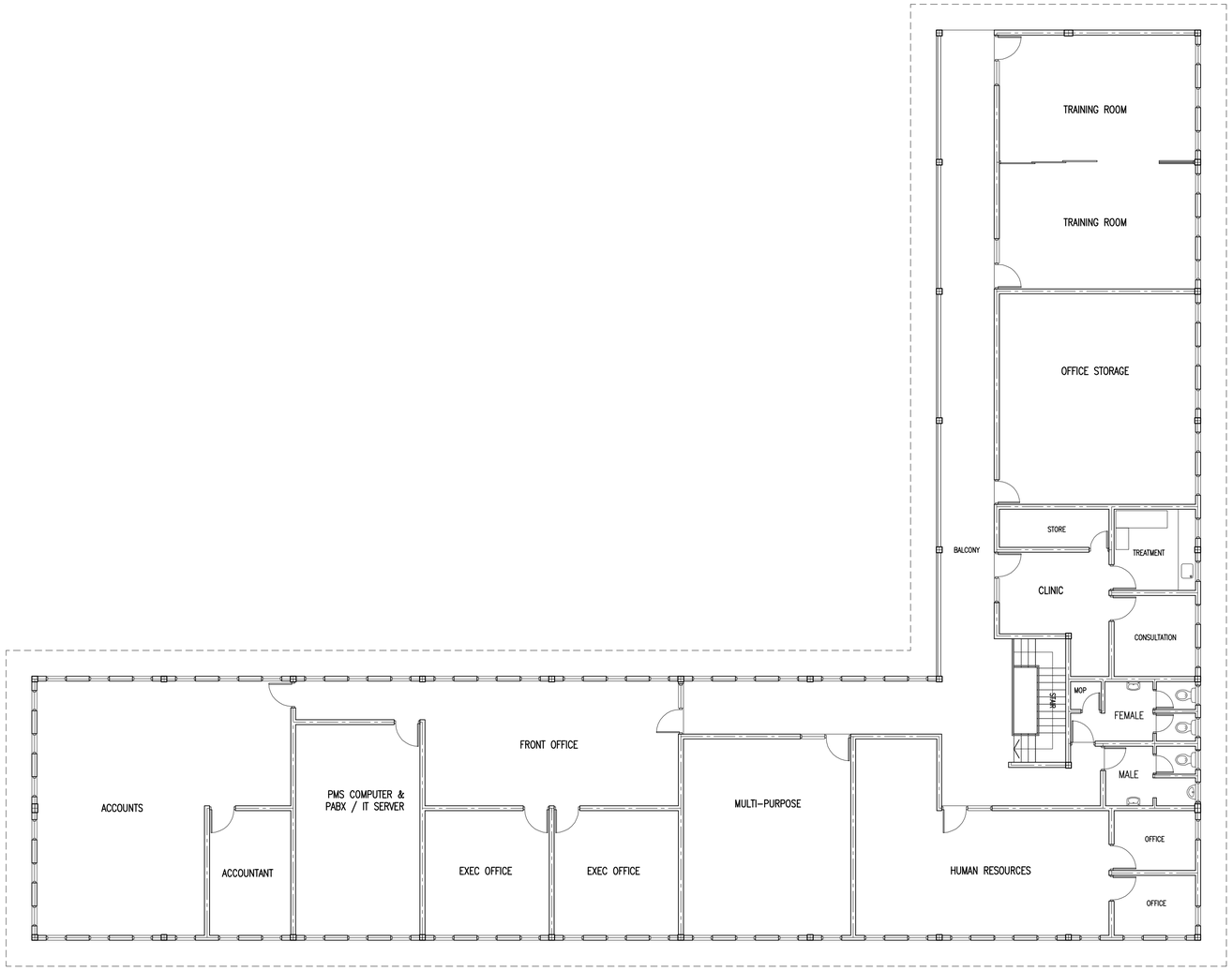


GROUND FLOOR LAYOUT PLAN
1:100

LAUNDRY, STORES
& RESORT ADMINISTRATION

MURAVANDHOO
RAA ATOLL, MALDIVES

GX ASSOCIATES
PRIVATE LIMITED
4, MAHINAC, HULHUMALE MALE, MALDIVES
TEL: +960 332 8075, +960 332 8045
FAX: +960 33 402 1066, dsa@gxa.com
WEBSITE: www.gxaassociates.com



FIRST FLOOR LAYOUT PLAN
1:100

LAUNDRY, STORES
& RESORT ADMINISTRATION

MURAVANDHOO
RAA ATOLL, MALDIVES

GX ASSOCIATES
PRIVATE LIMITED
4, AMIRAHMAT, MEDUHIRIGU MAGU, MALE', MALDIVES
TEL: +960 332 8070, +960 332 8065
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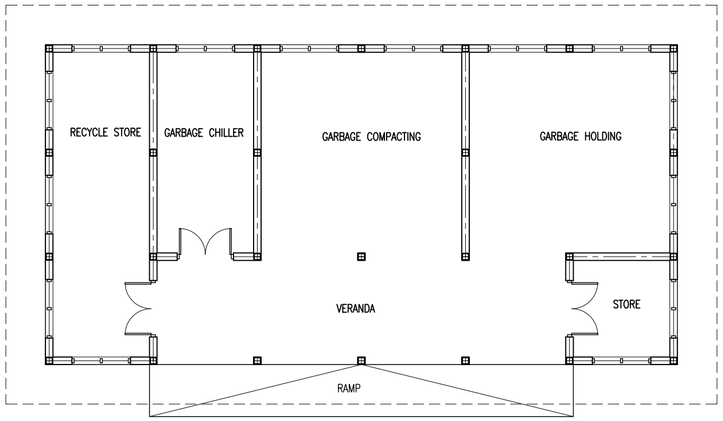
WEBSITE: www.gxassociates.com



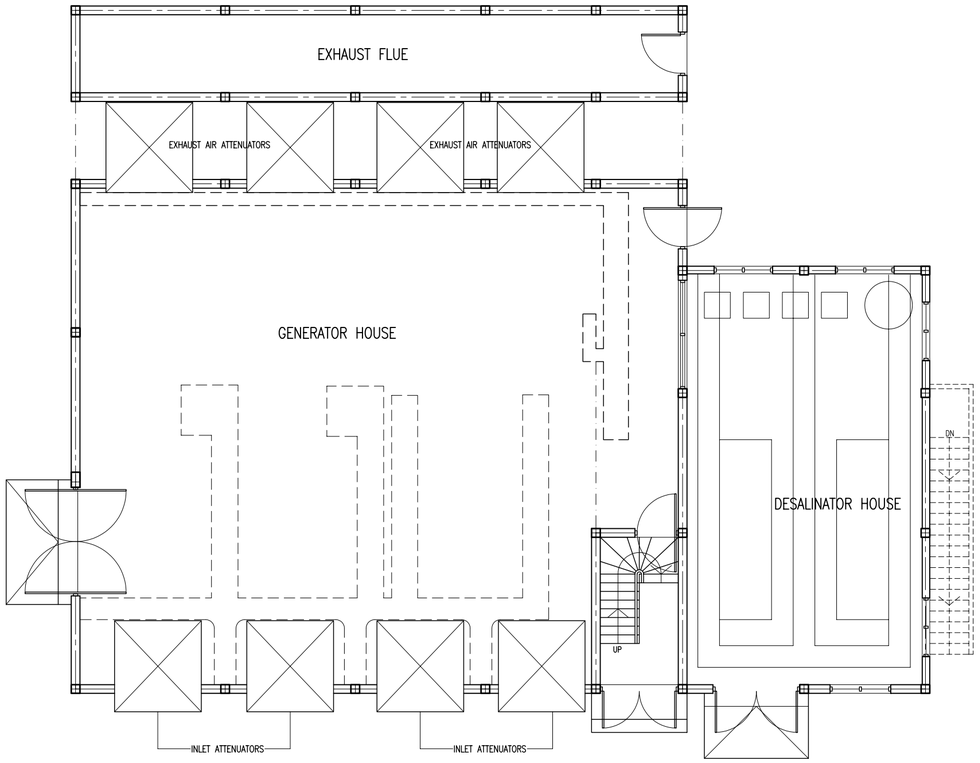
FLOOR LAYOUT PLAN
1:100

RECYCLE HOUSE

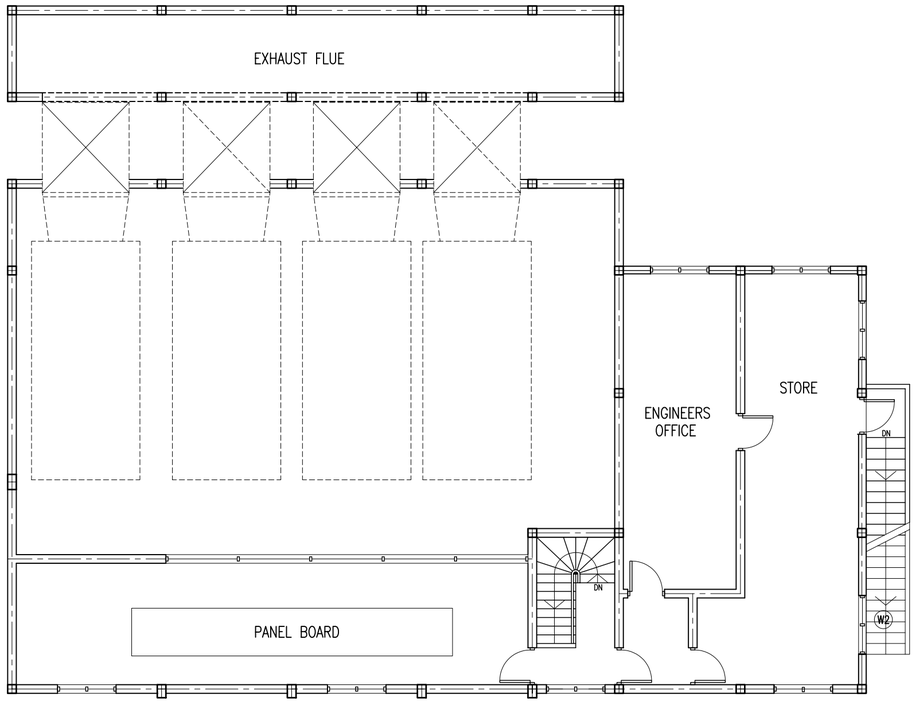
MURAVANDHOO

RAA ATOLL, MALDIVES

GX ASSOCIATES
PRIVATE LIMITED
G. ANKHANAA", HULHUMARU MAGU, MALE', MALDIVES
TEL: +960 332 8075, +960 332 8565
FAX: +960 332 4802 EMAIL: info@gxgroup.com
WEBSITE: www.gxassociates.com



GROUND FLOOR LAYOUT PLAN
1:100



FIRST FLOOR LAYOUT PLAN
1:100

SERVICE CENTRE

MURAVANDHOO

RAA ATOLL, MALDIVES

GX ASSOCIATES
PRIVATE LIMITED
G. AMANAHAE, MELEGHAIRU MAGU, MALE', MALDIVES
TEL: +960 332 8075, +960 332 8565
FAX: +960 332 4802 EMAIL: design@gxa-.com
WEBSITE: www.gxaassociates.com

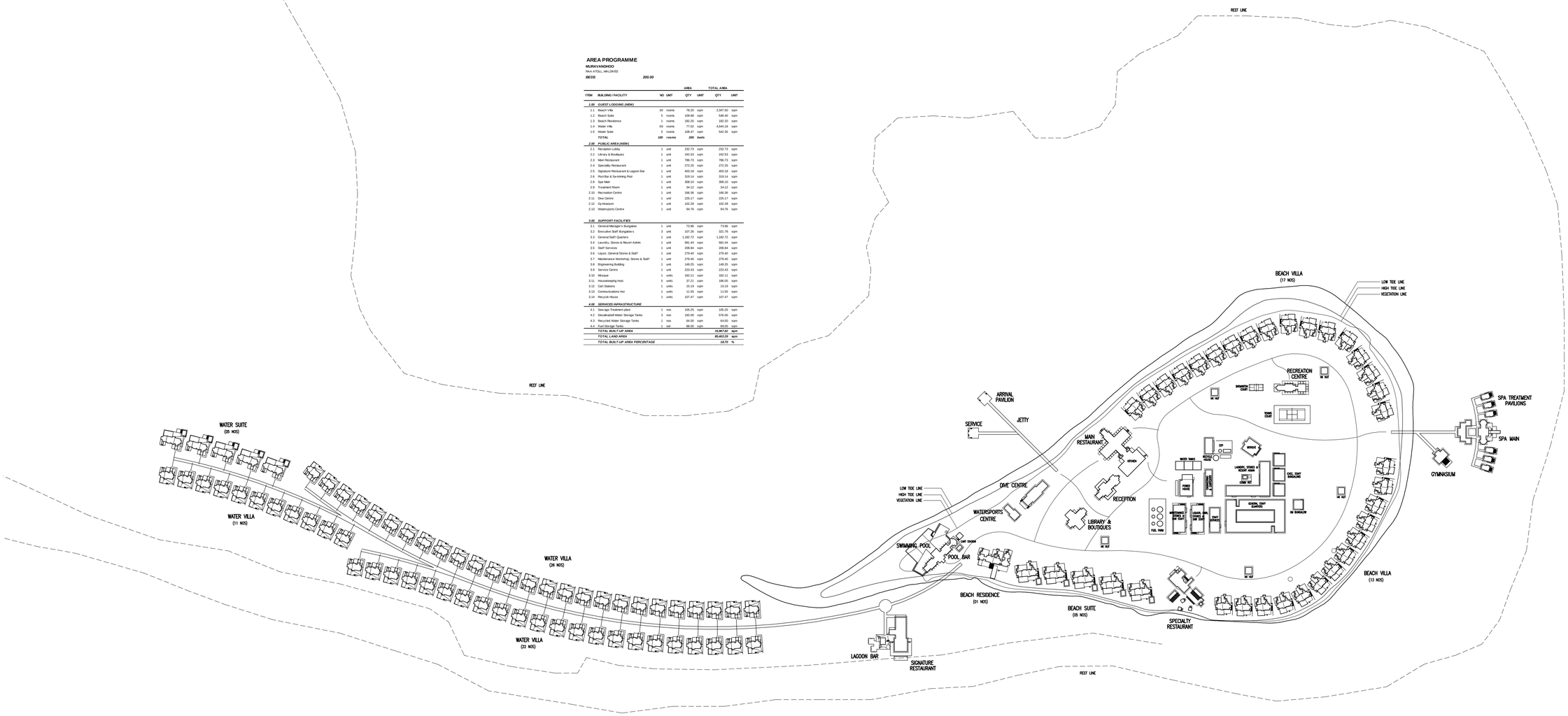
APPENDIX D – Approvals

AREA PROGRAMME

MURAVANDHOO
RAA ATOLL, MALDIVES

BEDS ***200.00***

ITEM	BUILDING / FACILITY	NO	UNIT	AREA Q'TY	UNIT	TOTAL AREA Q'TY	UNIT
1.00	***GUEST LODGING (NEW)***						
1.1.	Beach Villa	30	rooms	78.25	sqm	2,347.50	sqm
1.2	Beach Suite	5	rooms	109.68	sqm	548.40	sqm
1.3	Beach Residence	1	rooms	182.20	sqm	182.20	sqm
1.4	Water Villa	59	rooms	77.02	sqm	4,544.18	sqm
1.5	Water Suite	5	rooms	108.47	sqm	542.35	sqm
	TOTAL	***100***	***rooms***	***200***	***beds***		
2.00	***PUBLIC AREA (NEW)***						
2.1.	Reception Lobby	1	unit	232.73	sqm	232.73	sqm
2.2	Library & Boutiques	1	unit	242.53	sqm	242.53	sqm
2.3	Main Restaurant	1	unit	786.73	sqm	786.73	sqm
2.4.	Speciality Restaurant	1	unit	272.25	sqm	272.25	sqm
2.5.	Signature Restaurant & Lagoon Bar	1	unit	403.18	sqm	403.18	sqm
2.6	Pool Bar & Swimming Pool	1	unit	319.14	sqm	319.14	sqm
2.8.	Spa Main	1	unit	308.10	sqm	308.10	sqm
2.9	Treatment Room	1	unit	34.12	sqm	34.12	sqm
2.10	Recreation Centre	1	unit	186.36	sqm	186.36	sqm
2.11	Dive Centre	1	unit	225.17	sqm	225.17	sqm
2.12	Gymnasium	1	unit	102.28	sqm	102.28	sqm
2.13	Watersports Centre	1	unit	94.76	sqm	94.76	sqm
3.00	***SUPPORT FACILITIES***						
3.1.	General Manager's Bungalow	1	unit	73.96	sqm	73.96	sqm
3.2	Executive Staff Bungalow's	3	unit	107.26	sqm	321.78	sqm
3.3	General Staff Quarters	1	unit	1,182.72	sqm	1,182.72	sqm
3.4	Laundry, Stores & Resort Admin	1	unit	581.44	sqm	581.44	sqm
3.5.	Staff Services	1	unit	208.84	sqm	208.84	sqm
3.6.	Liquor, General Stores & Staff	1	unit	279.40	sqm	279.40	sqm
3.7	Maintenance Workshop, Stores & Staff	1	unit	279.40	sqm	279.40	sqm
3.8	Engineering Building	1	unit	149.25	sqm	149.25	sqm
3.9	Service Centre	1	unit	223.43	sqm	223.43	sqm
3.10	Mosque	1	units	162.11	sqm	162.11	sqm
3.11	Housekeeping Huts	5	units	37.21	sqm	186.05	sqm
3.12	Cart Stations	1	units	15.19	sqm	15.19	sqm
3.13	Communications Hut	1	units	11.55	sqm	11.55	sqm
3.14	Recycle House	1	units	107.47	sqm	107.47	sqm
4.00	***SERVICES INFRASTRUCTURE***						
4.1.	Sewage Treatment plant	1	nos	105.25	sqm	105.25	sqm
4.2	Decalinated/ Water Storage Tanks	3	nos	192.00	sqm	576.00	sqm
4.3	Recycled Water Storage Tanks	1	nos	64.00	sqm	64.00	sqm
4.4	Fuel Storage Tanks	1	set	88.00	sqm	88.00	sqm
	TOTAL BUILT-UP AREA					***15,967.52***	***sqm***
	TOTAL LAND AREA					***85,402.29***	***sqm***
	TOTAL BUILT-UP AREA PERCENTAGE					***18.70***	***%***



MURAVANDHOO

10 0 50 100 M

SCALE: 1:2000

TOTAL HIGH TIDE LINE AREA = 85,402.29 sqm

MURAVANDHOO

RAA ATOLL, MALDIVES

SITE PLAN

WITH SOUTH BACK OF HOUSE

GX ASSOCIATES
PRIVATE LIMITED
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WEBSITE: www.gxassociates.com

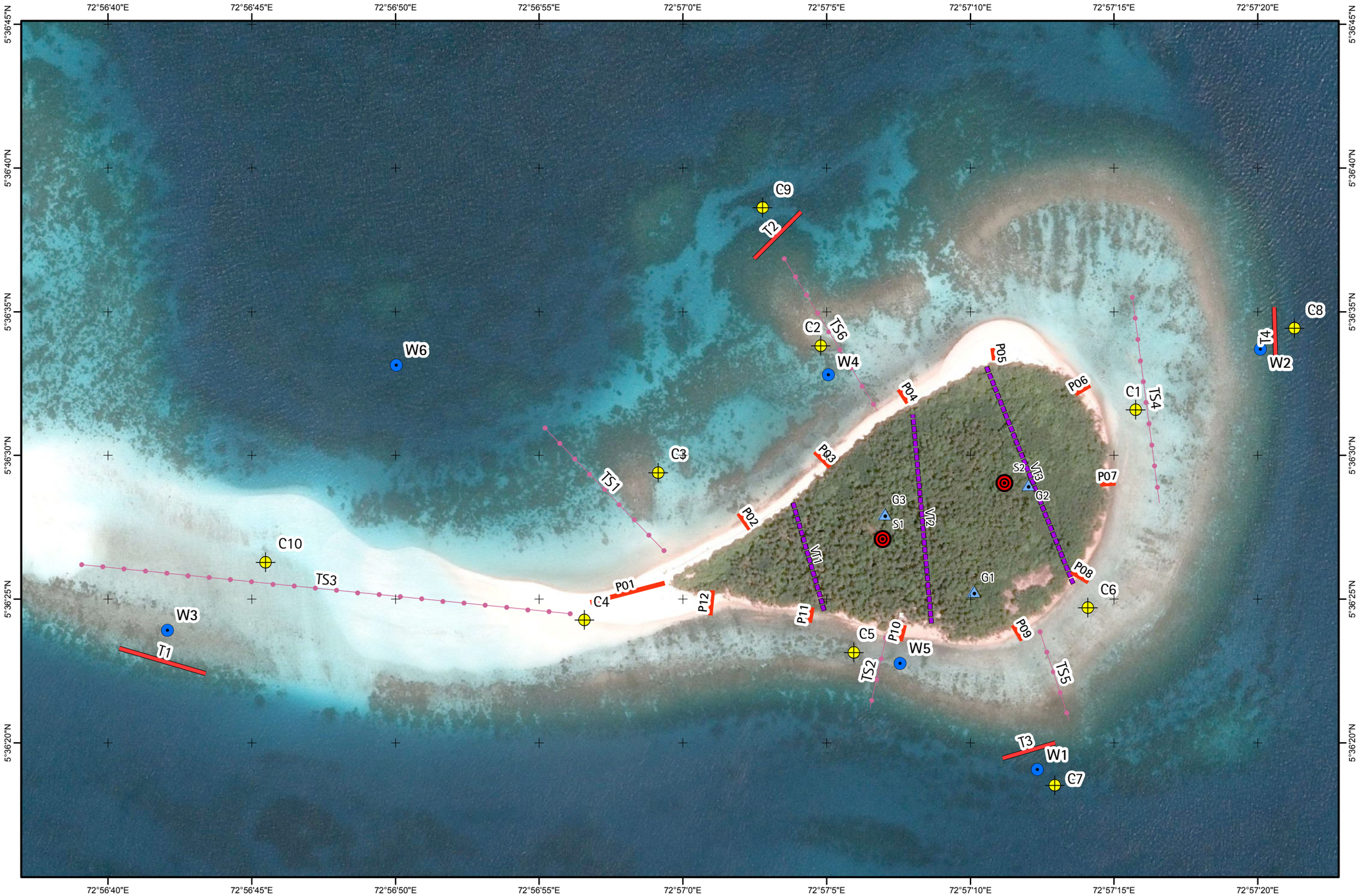
APPENDIX E – Work Plan

R. Muravandhoo Island Preliminary Workplan

Time Frame: months after GRANT OF APPROVAL for construction

Activity	Duration (No. of Days)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Approval for construction	-	◆																	
Setting out and site clearance	45 Days																		
Procurement of Machinery and Equipments	210 Days																		
Procurement of Construction Material	180 Days																		
Commencement of Construction Work	-			◆															
Construction of Temporary Accomodation	60 Days																		
Construction of Jetty Head	60 Days																		
Construction of Power House, Desalination Plant & Workshop	75 Days																		
Construction of Water and Fuel Tanks	60 Days																		
Construction of Mosque	90 Days																		
Construction of Staff Accommodation	210 Days																		
Construction of Main Restaurant, Kitchen & Staff Restaurant	135 Days																		
Construction of Mock-up Guest Villas	90 Days																		
Construction of Guest Rooms (Beach Villas)	210 Days																		
Construction of Guest Rooms (Beach Suites)	120 Days																		
Construction of Guest Rooms (Ocean Villas)	180 Days																		
Construction of Guest Rooms (Ocean Suites)	90 Days																		
Construction of Guest Rooms (Other)	60 Days																		
Construction of Arrival Pavilion & Administrative Complex	210 Days																		
Construction of Spa, Gym & Health Food Restaurant	30 Days																		
Construction of Specialty Restaurant	60 Days																		
Construction of Bar	60 Days																		
Construction of Diving School and Water Sports Center	120 Days																		
Construction of Incinerator, Compactor & Sewage Treatment Plant	60 Days																		
Construction of Laundry, Storage & House Keeping	60 Days																		
Construction of Staff Recreation Center	90 Days																		
Construction of Swimming Pool & Deck	120 Days																		
Install Power Distribution	120 Days																		
Install Sewage Distribution	120 Days																		
Install Water Distribution	120 Days																		
Install Furniture and Fittings	120 Days																		
Completion of construction work	-																◆		
Landscaping	330 Days																		
Interior Furnishing and Fitting	210 Days																		
Testing and Commissioning Machinery, Equipment and Services	75 Days																		
Finishing and Clearing	60 Days																		
Inspection	15 Days																		
Commencement of Operation	-																		◆

APPENDIX F – Survey Locations



Marine Water Samples

code	X	Y
W1	72.9534	5.60529
W2	72.9556	5.60936
W3	72.945	5.60664
W4	72.9514	5.60911
W5	72.9521	5.60632
W6	72.9472	5.60921

Profiles

Profile_ID	X	Y
P01	72.9498	5.6071
P02	72.9506	5.60762
P03	72.9514	5.60822
P04	72.9522	5.60884
P05	72.953	5.60925
P06	72.9538	5.60898
P07	72.954	5.60805
P08	72.9538	5.60721
P09	72.9532	5.60669
P10	72.9521	5.60669
P11	72.9512	5.60686
P12	72.9503	5.60703

Currents

SiteID	X	Y
C1	72.9544	5.60878
C2	72.9513	5.60939
C3	72.9498	5.60817
C4	72.9491	5.60674
C5	72.9517	5.60643
C6	72.9539	5.60686
C7	72.9536	5.60515
C8	72.9559	5.60956
C9	72.9508	5.61073
C10	72.946	5.6073

Ground Water

code	X	Y
G1	72.9528	5.60701
G2	72.9533	5.60804
G3	72.952	5.60776

Marine Transects

Site_ID	X_Start	Y_Start	X_Start	Y_Finish
T1	72.9454	5.60622	72.94455	5.606467
T2	72.9511	5.61069	72.95069	5.610234
T3	72.9531	5.6054	72.9536	5.605554
T4	72.9557	5.60977	72.95573	5.609187

Muravandhoo Island Resort Development Project Survey Locations

PROJECTION: Transverse Mercator
(UTM Zone 43 N); HORIZONTAL DATUM: WGS84;
VERTICAL DATUM: Hulhule Tide Gauge
Map version: 29/05/2014

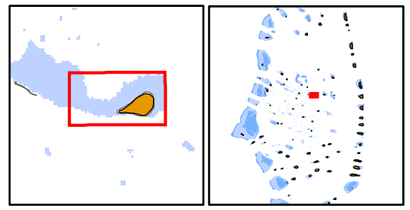
Surveyed and Prepared by: CDE Consulting, Maldives

APPENDIX G – Bathymetry and Topography

Legend

- Beach rock
- Vegetation Line Mar 2014
- High Tide Line Mar 2014
- Low Tide Line Mar 2014
- Coral Reef
- Outer reef line

N
W E
S



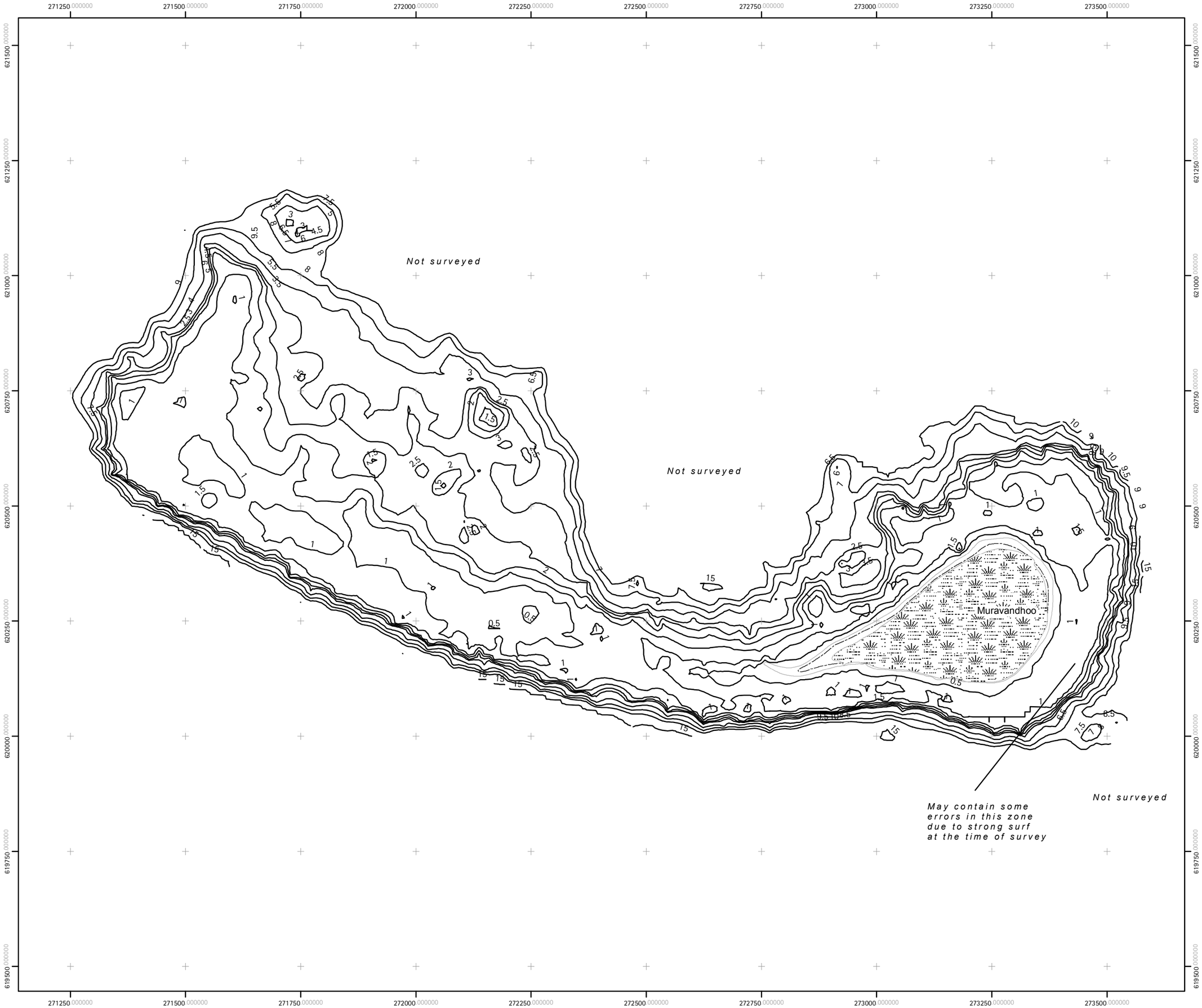
Meters

0 50 100 200

Muravandhoo Island, Raa Atoll
Resort Development Project
Topographic Survey Map

PROJECTION: Transverse Mercator
(UTM Zone 43 N); HORIZONTAL DATUM: WGS84;
VERTICAL DATUM: Hulhule Tide Gauge
Map version: 07/05/2014
Based on GPS data collected on March 2014

Surveyed and Prepared by: CDE Consulting, Maldives



Legend

Contour

Intervals in m MSL

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 5
- 7.5
- 10
- 15

Vegetation Line

High Tide Line

Low Tide Line

N W E S

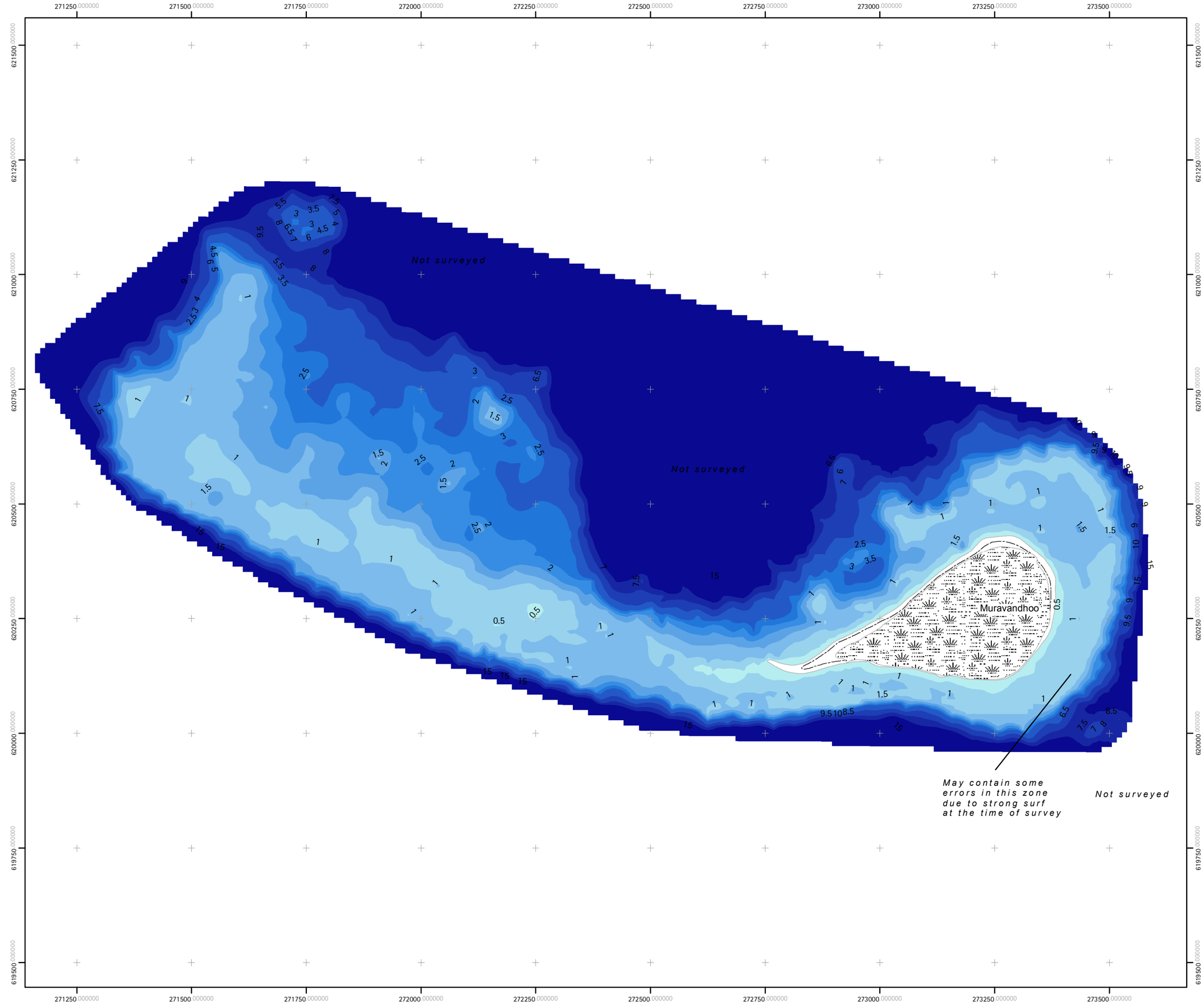
1:7,500

0 50 100 200 300 Meters

Muravandhoo Bathy Chart

PROJECTION: Transverse Mercator (UTM Zone 43 N); HORIZONTAL DATUM: WGS84;
VERTICAL DATUM: Mean Sea Level (2011) - Hulhule Airport Tide Gauge
All features based on GPS surveys (Nov 2011); satellite imagery (2006)
Map version 10-10-2011.

Surveyed and Prepared by: CDE Consulting, Maldives



Legend

- Vegetation Line
- High Tide Line
- Low Tide Line

Depth MSL (m)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 5.0
- 5.0 - 7.5
- 7.5 - 10.0
- 10.0 - 15

N W E S

1:7,500

0 50 100 200 300 Meters

Muravandhoo Bathy Chart

PROJECTION: Transverse Mercator (UTM Zone 43 N); HORIZONTAL DATUM: WGS84;
VERTICAL DATUM: Mean Sea Level (2011) - Hulhule Airport Tide Gauge
All features based on GPS surveys (Nov 2011); satellite imagery (2006)
Map version 10-10-2011.

Surveyed and Prepared by: CDE Consulting, Maldives

APPENDIX H – Water Test Reports

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
FEN Building 5th Floor, Machangoalhi, Ameeneemagu, Male', Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

بسم الله الرحمن الرحيم

MWSC

WATER QUALITY TEST REPORT

Test Report No: 300678/2014/08

Customer Informations : ***CDE Consulting Pvt Ltd***
H.Orchidmaage 4th Floor
Ameeru Ahmed Magu
Male'
Rep.of Maldives

Date: 25/03/2014

Sample Description / Location~	Muravandhoo						TEST METHOD	UNIT
	SW1	SW2	SW3	SW4	SW5	SW6		
Sample Type~	Sea water							
Sampled Date~	17/3/2014							
Sample Received Date	18/3/2014							
Test Requisition Form No.	900156798							
Sample No.	810538	810539	810540	810541	810542	810543		
Date of Analysis	18/3/2014-24/3/2014							
PARAMETER	**ANALYSIS RESULT**							
Physical Appearance	Clear	Clear	Clear	Clear	Clear	Clear	Visual	-
Nitrate	0.4	0.4	0.4	0.4	0.4	0.5	Method 10049 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
pH	8.16	8.16	8.18	8.17	8.20	8.17	Method 4500-H+ B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	-
Nitrogen Ammonia	0.19	0.04	<0.02(LOQ 0.02mg/L)	0.03	0.02	<0.02(LOQ 0.02mg/L)	Method 8038 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Sulphate	2500	2600	2600	2550	2550	2600	Method 8051 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Salinity	32.29	31.98	32.09	31.92	32.09	31.67	Method 2520 B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	‰
Phosphate	<0.05(LOQ 0.05mg/L)	<0.05(LOQ 0.05mg/L)	<0.05(LOQ 0.05mg/L)	<0.05(LOQ 0.05mg/L)	0.05	0.07	Method 8048 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Temperature	24.4	24.9	25.0	25.1	25.0	24.8	Electrometry	°C
Biological Oxygen Demand (BOD)	5	6	5	6	4	6	HACH Method 8043	mg/L
Total Suspended Solids (TSS)	<5 (LOQ 5mg/L)	<5 (LOQ 5mg/L)	<5 (LOQ 5mg/L)	<5 (LOQ 5mg/L)	<5 (LOQ 5mg/L)	<5 (LOQ 5mg/L)	Method 8006 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Turbidity	0.173	0.174	0.171	0.233	0.381	0.190	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

UNITS: mg/L: Milligram Per Liter, **°C:** Degree Celcius, **‰:** Parts per thousand, **NTU:** Nephelometric Turbidity Unit
LOQ: Limit of Quantification

Checked by:	Approved by:
Afnan Farooq WQAO	Adam Rasheed Assistant Manager, WQA

Notes:
Sampling Authority: Sampling was not done by MWSC Laboratory
This report, in full or in part, shall not be published, advertised, used for any legal action, unless prior permission has been secured from MWSC.
This test report is ONLY FOR THE SAMPLES TESTED.
~ Information Supplied by the customer

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

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
FEN Building 5th Floor, Machangoalhi, Ameeneemagu, Male', Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

بسم الله الرحمن الرحيم

MWSC

WATER QUALITY TEST REPORT

Test Report No: 300678/2014/09

Customer Informations : ***CDE Consulting Pvt Ltd***
H.Orchidmaage 4th Floor
Ameeru Ahmed Magu
Male'
Rep.of Maldives

Date: 25/03/2014

Sample Description / Location~	Muravandhoo			TEST METHOD	UNIT
	GW1	GW2	GW3		
Sample Type~	Ground water				
Sampled Date~	17/3/2014				
Sample Received Date	18/3/2014				
Test Requisition Form No.	900156798				
Sample No.	810544	810546	810547		
Date of Analysis	18/3/2014-24/3/2014				
PARAMETER	**ANALYSIS RESULT**				
Physical Appearance	Pale yellow	yellow with particles	yellow with particles	Visual	-
Nitrate	0.4	0.6	0.7	Method 10049 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
pH	7.79	7.02	7.16	Method 4500-H+ B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	-
Nitrogen Ammonia	0.19	0.60	1.79	Method 8038 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Sulphate	1650	825	800	Method 8051 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Salinity	22.39	11.60	12.07	Method 2520 B. (adapted from Standard methods for the examintation of water and waste water, 21st edition)	‰
Phosphate	0.36	0.15	0.38	Method 8048 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Temperature	24.4	24.3	24.5	Electrometry	°C
Biological Oxygen Demand (BOD)	25	26	42	HACH Method 8043	mg/L
Total Suspended Solids (TSS)	<5 (LOQ 5mg/L)	7463	15150	Method 8006 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Turbidity	0.518	8005	15625	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU
Coliform, Total	137	TNTC	CGW/WC	HACH Method10029	CFU/100mL
Coliform, Faecal	132	TNTC	TNTC	HACH Method 8074	CFU/100mL

UNITS: mg/L: Milligram Per Liter, **°C:** Degree Celcius, **‰:** Parts per thousand, **NTU:** Nephelometric Turbidity Unit, **CFU:** Colony Forming Unit

LOQ: Limit of Quantification

TNTC: Too numerous to count

CGW/WC: Confluent growth with or without coliforms

Checked by:	Approved by:
Afnan Farooq WQAO	Adam Rasheed Assistant Manager, WQA

Notes:

Sampling Authority: Sampling was not done by MWSC Laboratory

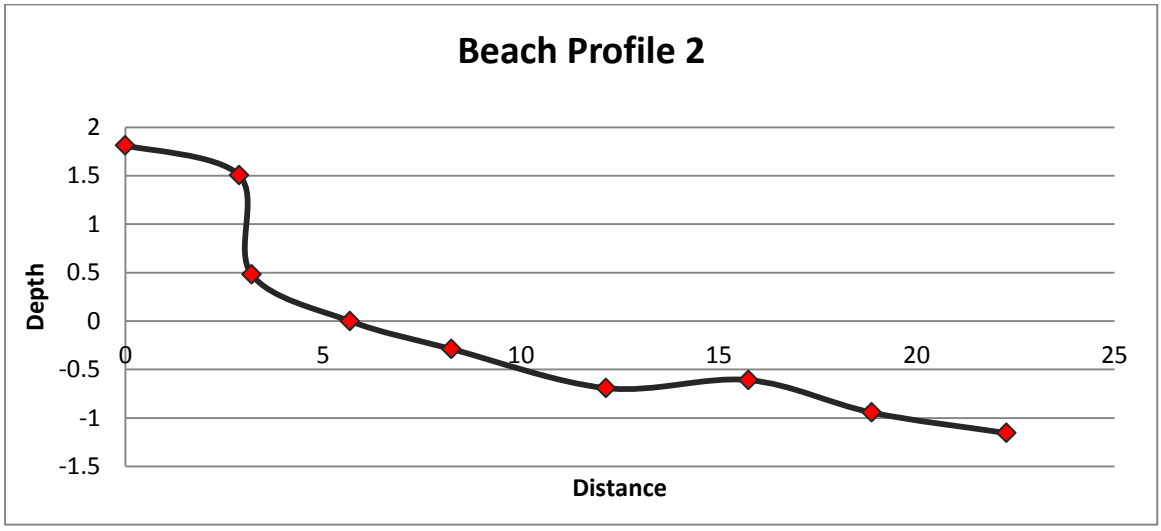
This report, in full or in part, shall not be published, advertised, used for any legal action, unless prior permission has been secured from MWSC.

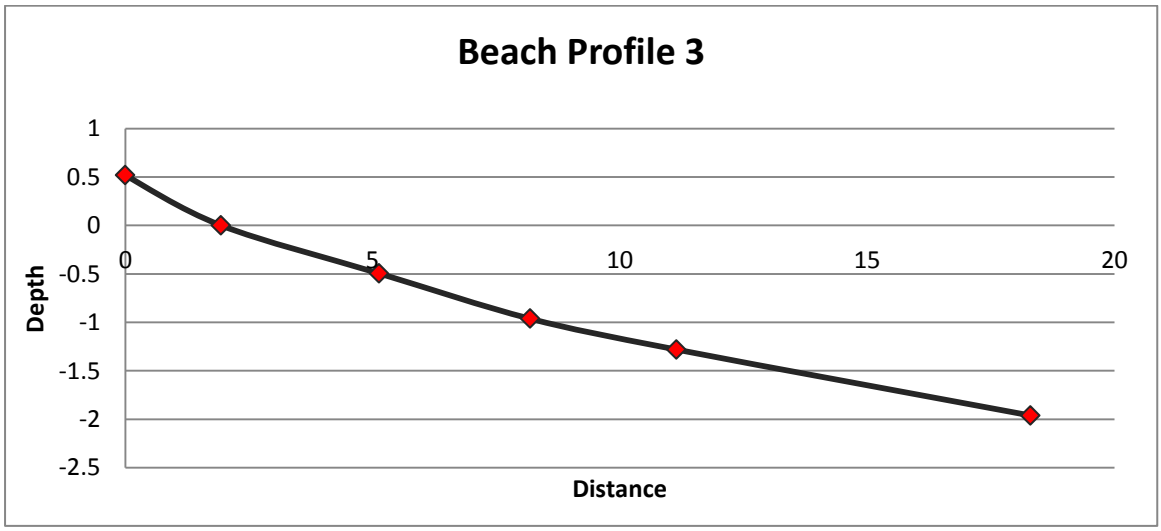
This test report is ONLY FOR THE SAMPLES TESTED.

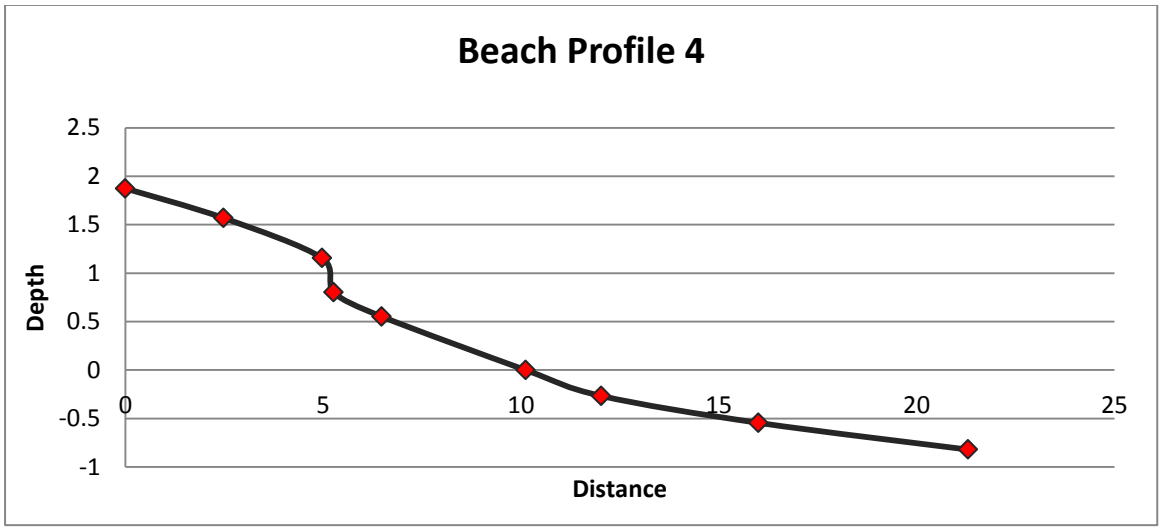
~ Information Supplied by the customer

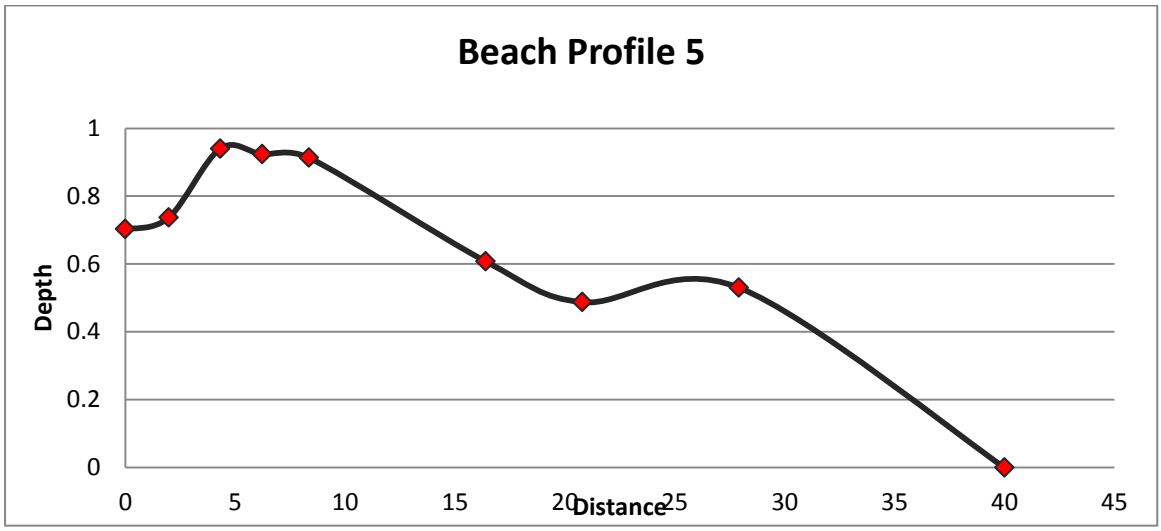
**********END OF THE REPORT**********

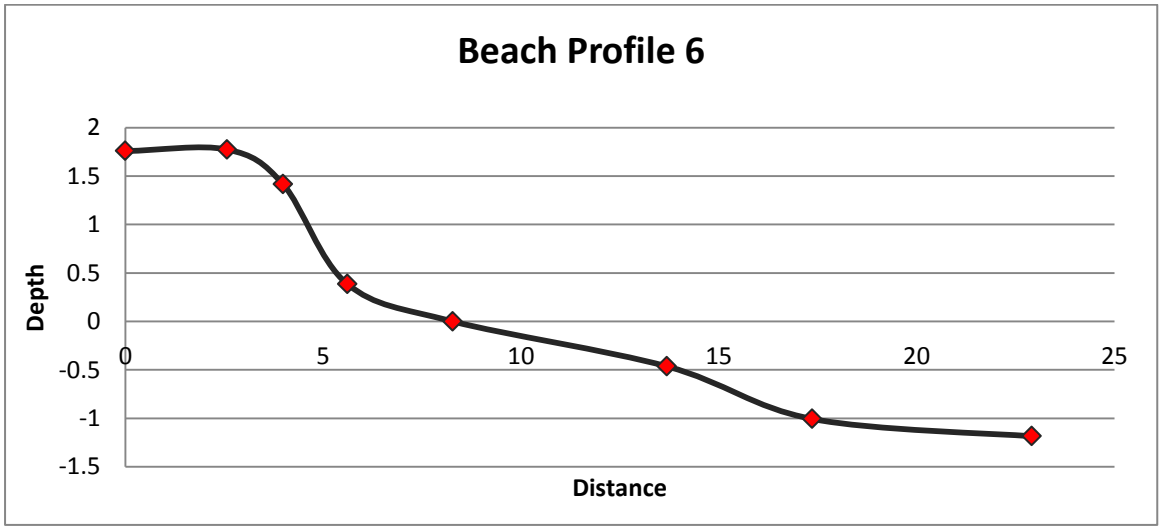
APPENDIX I – Beach Profiles








Beach Profile 5
Depth
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30
35
40
45
Distance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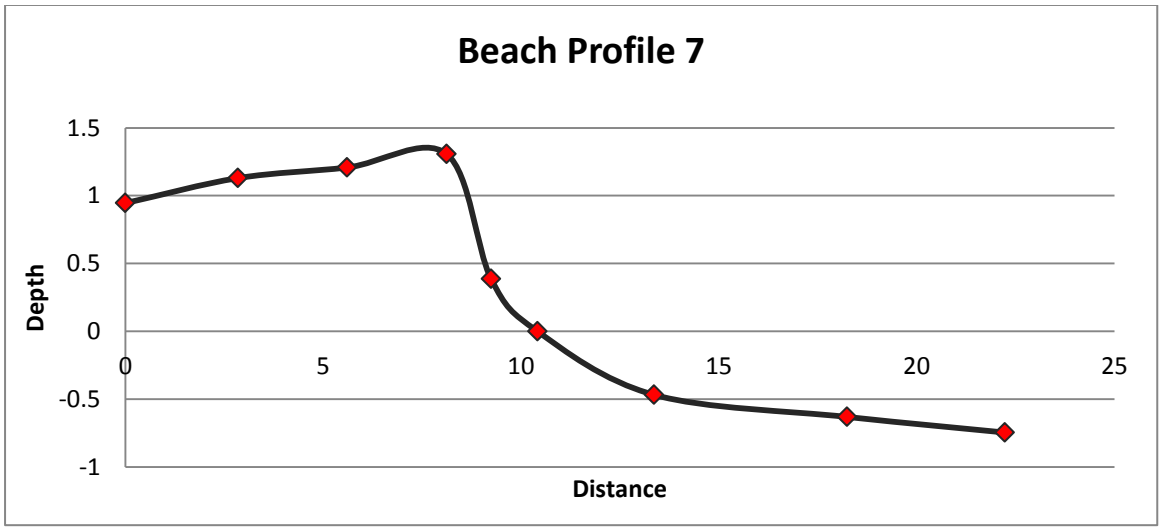
-1
-1.5
0
5
10
15
20
25
Distance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0
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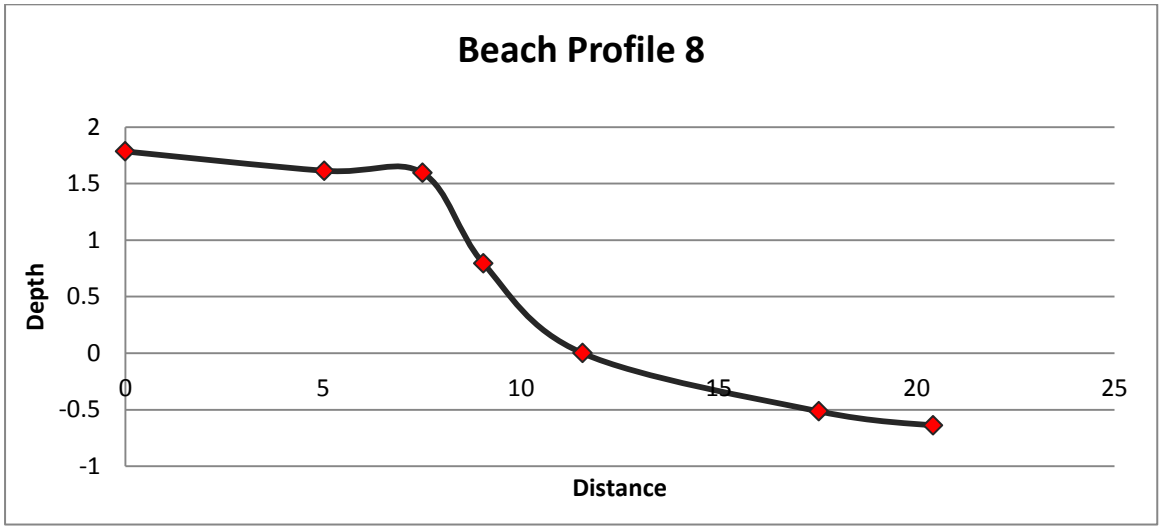
-1
0
5
10
15
20
25
Distance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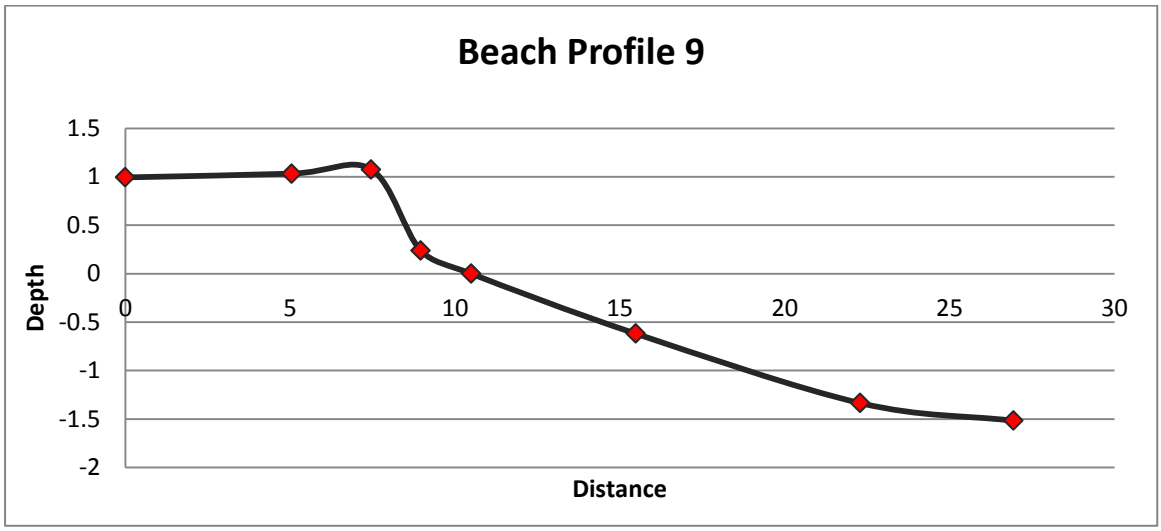
5
10
15
20
25
Distance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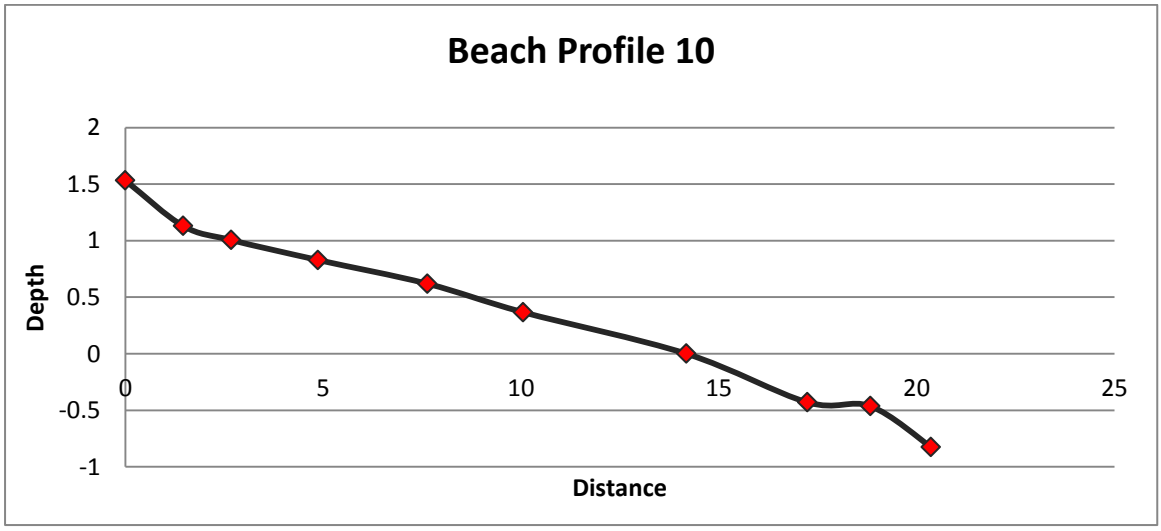
5
10
15
20
25
30
Distance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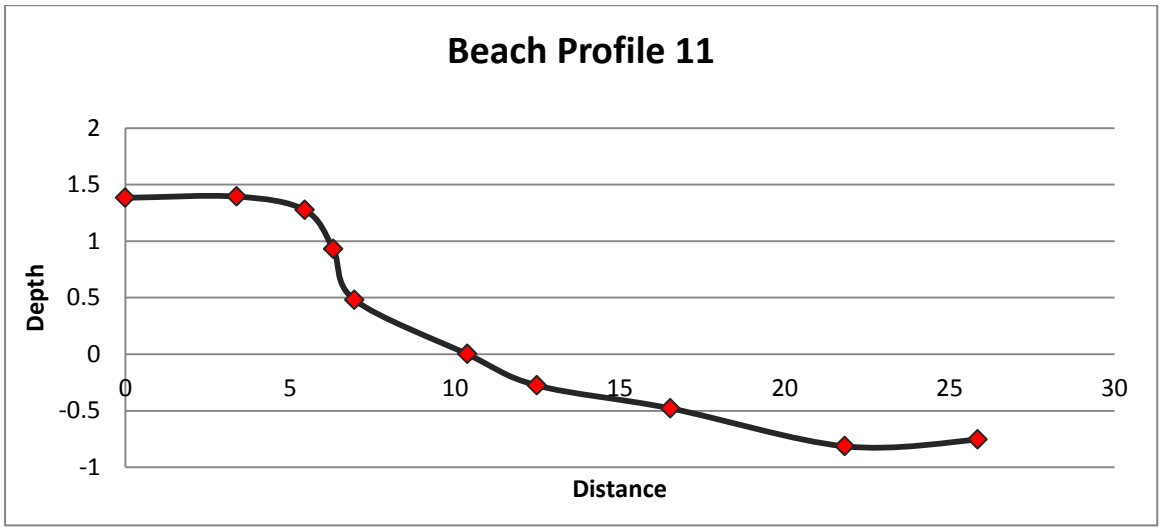
-1
0
5
10
15
20
25
Distance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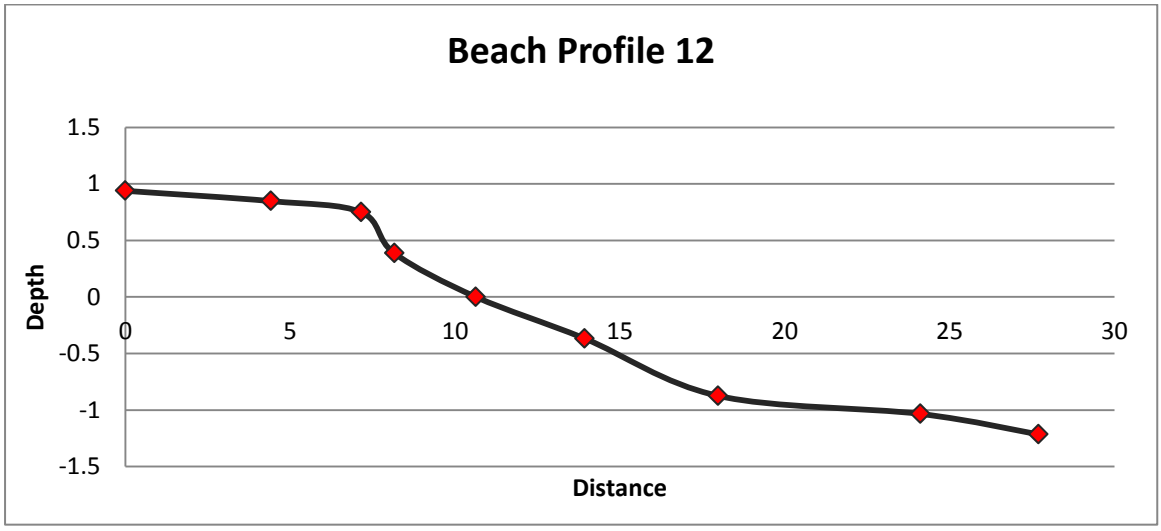
15
20
25
30
Distance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-1
-1.5
0
5
10
15
20
25
30
Distance

APPENDIX J – CV's of Consultants

Ahmed Shaig

Phone: (+960) 77 88 758 shaig@cde.com.mv

Personal Details

Date of Birth: 19/02/1976 **Nationality:** Maldivian **Gender:** Male **Marital Status:** Married

Permanent Address: Maldives **Present Address:** M. Muleege, Orchid Magu, Male', Maldives.

Education

PhD, Environmental Science, 2009
James Cook University, Townsville, Australia

Research degree on 'Settlement Planning for Natural Hazard Resilience in Small Island States: The Population and Development Consolidation Approach'

BSc Land and Spatial Information Studies/Information Science. (double major), 1999-2001
University of Otago, Dunedin, New Zealand

Diploma in project planning, implementation, monitoring and evaluation, 1995
ILO training Centre, Turin, Italy

Employment History

Director, Environmental Services 2008 to present
CDE Consulting Supervisor: Dr. Simad Saeed
Republic of Maldives Phone: +(960) 7777445
Head of environmental wing

Assistant Under-secretary, Spatial Planning 2002-2004
Ministry of Planning and National Development Supervisor: Hon. Hamdun Hameed
Republic of Maldives Phone: +(960) 332-3919
Head of Spatial Planning Unit. Relevant Tasks include:

- Oversee environment related projects and application of environmental guidelines for planned projects.
- Plan, implement and oversee the development of a National GIS;
- Aid/facilitate/oversee urban planning, housing, land use planning, natural resource planning and environment related projects; Provide assistance in project planning (includes urban and regional planning, natural resources planning)

Project Manager, National Digital Mapping Project 2005 (8 months)
Ministry of Planning and National Development Supervisor: Hon. Hamdun Hameed
Republic of Maldives Phone: +(960) 332-3919

- Project involved aerial photography and satellite imagery of entire Maldives, ground surveying of key settlements, digital conversion of data and setting up a Mapping Unit.

Assistant Planning Officer/Planning Officer 1994-1999
Ministry of Planning and National Development Supervisor: Mr. Mohamed Hunaif
Republic of Maldives Phone +(960) 331-3040
Relevant tasks involved:

- Assisting in the National GIS Development Programme (Junior GIS developer)
- Facilitate urban planning, housing, land use planning, natural resource planning and environment related projects.

Experience in Consultancy

- *September 2002:* Member of the team appointed for environmental surveying and carrying capacity assessment of islands for tourism development in the southern atolls of Maldives for Ministry of Tourism Maldives.
- *October 2002:* Developed the Census GIS for United National Population Fund
- *December 2002:* Developed the Maldives Protected Areas Systems GIS for Maldives Home Affairs Housing and Environment.
- *February 2003*: Participated in the preparation of Royal Island and Spa Resort Annual Environmental Monitoring Report for Royal Island and Spa.
- *April 2003:* Member of the team selected for developing town plans for urban centres in Northern and Southern Regional Development Zones, looking specifically into environmental control measures, for Ministry of Planning and National Development.
- *April 2003:* Participated in the preparation of Environmental Impact Statement for Coastal Modifications on Rihiveli, South Malé Atoll, Maldives.
- *April 2003:* Participated in the surveying and preparation of Environmental Impact Statement for the proposed coastal improvements to address coastal erosion concerns on Royal Island Spa Resort, Baa Atoll, Maldives.
- *May 2003:* Participated in the bathymetry survey and preparation of Initial Environmental Examination for Deepening of Existing Entrance Channel to Service Jetty, Soneva Gili Resort and Spa, North Malé Atoll, Maldives
- *May 2003:* Participated in the preparation of Initial Environmental Examination for development of an access channel into the natural inner lagoon (*Vilu*) of Mayafushi resort, North Ari Atoll.
- *May 2003:* Participated in the preparation of Environmental Impact Assessment for Landaa Giraavaru Pvt. Ltd. for the development of a Four Season's Tourist Resort on the island of Landaa Giraavaru in Baa Atoll, Maldives.
- *June 2003:* Participated in survey and preparation of Initial Environmental Examination for the Development of a Mooring Area and Associated Beach Replenishment in, Boduhithi Club, North Malé Atoll, Maldives.
- *July 2003:* Participated in the surveying and preparation of Initial Environmental Examination for Short-term and Long-term Shore Protection Measures at Alimatha Tourist Resort, Vaavu Atoll, Maldives.
- *July 2003:* Conducted shoreline and vegetation line of Alimatha Tourist Resort, Vaavu Atoll, Maldives.
- *July 2003:* Participated in the surveying for Initial Environmental Examination for Short-term and Long-term Shore Protection Measures at Dhiggiri Tourist Resort, Vaavu Atoll, Maldives.
- *July 2003:* Participated in conducting and preparation of Fun Island Resort Annual Environmental Monitoring Report.
- *July 2003:* Participated in conducting and preparation of Sun Island Resort Annual Environmental Monitoring Report.
- *July 2003:* Participated in conducting and preparation of Holiday Island Resort Annual Environmental Monitoring Report.
- *August 2003:* Developed the Initial Environmental Examination for the construction of Sun Decks along the southern beach of Kudarah Island Resort.
- *September 2003:* Participated in surveying and preparation of Fonaddoo Environmental Impact Assessment Report for the development of fisheries complex, Fonaddoo, Maldives.
- *October 2003*: Participated in surveying and preparation of Kuda Rah Erosion Study and recommendations for shore protection and erosion prevention
- *November 2003:* Conducted vegetation and shoreline survey of Dhonveli Beach and Spa and Four Seasons Report for the Boundary Delineation between the two islands.
- *December 2003:* Contributed to the Landuse Planning Guidelines of Maldives (environmental aspects) for Ministry of Housing and Urban Development.
- *December 2003*: Contributed to the Development of a Building Code of Maldives for Ministry of Housing and Urban Development.
- *January 2004:* Co-author to the Environmental Guidelines for the Development of Resort Islands in Maldives, Ministry of Tourism.
- *February 2004:* Developed the Baa Atoll Spatial Development Plan for Ministry of Planning and National Development.

- *April-July 2004:* Participated in the preparation of the Environmental aspects of the 8 bid proposals for resort Development for various proponents.
- *November 2005:* Participated in the preparation of EIA for L.Gan Resettlement Project for Ministry of Housing.
- *December 2005:* Participated in the surveying and preparation of EIA for Gn Fuvahmulaku Tourist Hotel Development
- *November 2005:* Developed a GIS for strategic planning to select islands for tourism development for Ministry of Tourism.
- *January 2006:* Local consultant for the Strategic Environmental Assessment (SEA) of Maldives Regional Development Plan, for AGRIFOR Consult Consortium, Belgium.
- *June 2006:* Developed the Baa Atoll Resource Management GIS for Ministry of Environment and Energy.
- *August 2006:* Consultant to the Integrated Climate Change System (ICCS) project – Assessment of vulnerability of Maldives Islands and Beaches to climate change
- *September 2006:* Consultant to the ICCS project – Assessment of vulnerability of Maldives Infrastructure to climate change
- *November 2006:* Consultant to the preparation of National Adaptation Programme of Action in Maldives for Ministry of Environment.
- *December 2006*: Environmental Consultant to the United Nations Development Programme (UNDP) Project: Disaster Risk Assessment of Selected nine Safe Islands in Maldives.
- *April 2007:* Prepared the Coastal Erosion Assessment and Management Report for Ga.Meradhoo Island.
- *May 2007:* Participated in the preparation of EIA for N. Randheli Resort Development Project, I&T Management group.
- *June 2007:* Participated in the preparation of Millennium Development Goals, Maldives Country Report.
- *October 2007*: Natural Hazard Assessment consultant to the UNDP Project: Disaster Risk Assessment of Selected Safe Islands in Maldives.
- *November 2007*: Prepared the EIA for proposed coastal protection, beach replenishment and access improvement of Elaa, Thaa Atoll, for Mr Abbas Mohamed, H. Merry Rose.
- *May 2009*: Participated in the preparation of EIA for sand sourcing and beach replenishment project of Viligilli Island, Addu Atoll, for Shangri-La at Viligilli..
- *April 2009:* Participated in the preparation of EIA for N. Maafaru Airport Development Project for Noonu Hotels Pvt Ltd.
- *May 2009:* Participated in the preparation of EIA for resort development in Huvandhumaavattaru, Noonu Atoll
- *June 2009:* Prepared a status of the environment report Randheli Island, Noonu Atoll.
- *July 2009:* Prepared the Environmental EIA for harbour development in Fiyoari, Gaafu Dhaalu Atoll.
- *July 2009:* Participated in the preparation of EIA for Jetty and arrival lounge development project in Gan, Addu Atoll, for Island Aviation Services Private Limited.
- *July 2009:* Team Leader for the socio-economic risk assessment of Selected Safe Islands in Maldives.
- *August 2009:* Coastal erosion data synthesis for selected islands of Maldives, for World Bank Maldives Environmental Management Project.
- *September 2009:* Prepared the beach management plan and development control measures for Reethibeach Island Resort, Baa Atoll.
- *September 2009:* Participated in the preparation of EIA for agricultural island development in Felivaru, Noonu Atoll, for Fantasy Private Limited.
- *September 2009:* Consultant to review the safer islands programme and cost benefit study of mitigation measures in three islands in the Maldives for UNDP.
- *October 2009:* Consultant to the Maldives Environmental Management Project for waste management technical assistance for World Bank.
- *December 2009:* Environmental consultant for advising on resort development and development control measures in Randheli Island, Noonu Atoll.
- *January 2010:* Prepared the beach management plan and development control measures for Shangri-La Island Resort, Addu Atoll.
- *January 2010:* Consultant to the Atoll Ecosystem Conservation project conservation component defining conservation areas and development controls.
- *February 2010:* Prepared the environmental audit of Thunbafushi Island, Kaafu Atoll, for Champa Brothers Private Limited.

- *March 2010:* Prepared the beach management plan and development control for Herathera Island Resort, Addu Atoll.
- *March 2010:* Lead author in the preparation of EIA for power plant upgrading project in Palm Beach Island in Lhaviyani Atoll.
- *April 2010:* Lead author in the preparation of EIA for Seagrass removal and beach replenishment project in Olhuveli Island Resort and Spa, Kaafu Atoll.
- *April 2010:* Prepared an EIA addendum for resort development in Gaakoshibee Island, Shaviyani Atoll.
- *May 2010:* Consultant to undertake island environmental scoping studies in 30 islands in North Maldives to determine islands with resort development potential for GMR Group of India.
- *May 2010:* Lead author in the preparation of EIA for harbour development project in Madidhoo Island, Shaviyani Atoll.
- *June 2010:* Lead author in the preparation of EIA for deep piling project in Olhuveli Island Resort and Spa, Kaafu Atoll.
- *July 2010:* Lead author in the preparation of EIA for the development of an aquaculture site in Kanduoigiri, Kaafu Atoll.
- *July 2010:* Environmental planning consultant for Shangri-La at Viligilli Maldives, Addu Atoll.
- *July 2010:* Environmental planning consultant to the Addu Land Use Planning project (including defining development controls) in Addu Atoll Maldives for South Province Office.
- *August 2010:* Environmental Consultant for the Atoll Ecosystem Conservation Project to declare Baa Atoll as a UNESCO Biosphere reserve.
- *September 2010:* Lead author in the EIA for Seagrass removal and beach replenishment project in Herathera Island, Addu Atoll.
- *September 2010:* Lead author in the EIA for resort redevelopment in Vilamendhoo Island Resort, Ari Atoll.
- *September 2010:* Lead author in the preparation of EIA for Gulhifalhu land reclamation project in Gulhifalhu, Male' Atoll, for Capital Investment and Finance Limited, UK.
- *September 2010:* Participated in the preparation of EIA for sewerage system development project in Miladhoo, Noonu Atoll.
- *October 2010:* Consultant to undertake the coastal adaptation survey of 40 islands in Maldives for Ministry of Housing and Environment.
- *November 2010:* Environmental consultant for advising on resort development and development control measures in Maamigili Island, Raa Atoll
- *January 2011:* Lead author in the preparation of EIA for sewerage and water system development project in Hithadhoo Island, Addu City for Bi-water International Private Limited.
- *February 2011:* Lead author in the preparation of EIA for sewerage and water system development project in Maradhoo Island, Addu City for Bi-water International Private Limited.
- *March 2011:* Lead author in the preparation of EIA for sewerage and water system development project in Feydhoo Island, Addu City for Bi-water International Private Limited.
- *April 2011:* Lead author in the preparation of EIA for sewerage and water system development project in Maradhoo-Feydhoo Island, Addu City for Bi-water International Private Limited.
- *May 2012:* Coastal erosion mitigation assessment and planning for Six Senses Laamu, Laamu Atoll
- *January 2012:* Lead author in the preparation of EIA for sewerage and water system development project in Fuvahmulah Island, Addu City for Bi-water International Private Limited.
- *February 2012:* Coastal erosion mitigation assessment and planning for Fushivelavaru Island
- *March 2012:* EIA for the proposed resort redevelopment project in Conrad Rangali Island for Champa and Crown Resorts
- *March 2012:* EIA for the proposed resort redevelopment project in Gasfinolhu Island Resort, Champa and Crown Resorts
- *May 2012:* Environmental consultant for advising on resort development and development control measures in Gasfinolhu Island, Male' Atoll
- *June 2012:* Environmental consultant for advising on resort development and development control measures in Nakachchaa Huraa Island, Male' Atoll
- *April 2012:* Member of the consultant team that prepared the Tourism Opinion and Profile Survey 2011, Ministry of Tourism.
- *October 2012:* Environmental consultant to the preparation of 4th Tourism Master plan for Ministry of Tourism, Maldives.
- *November 2013:* Environmental consultant for advising on land reclamation, resort development and development control measures in Dhiffushi Island Reef, Male' Atoll.

- *January 2013:* Environmental consultant for advising on resort development and development control measures in Hankede Island, Addu Atoll
- *January 2013:* Environmental consultant for advising on resort development and development control measures in Hankede Island, Addu Atoll
  June 2013: Local Environment consultant to the WCCM project, HIDRIA and Aquatica, Spain.

Membership of Professional Bodies

- Member of Building Code Committee, Maldives
- Member of Commission on Sustainable development
- Member of the Technical Committee for Developing Spatial Plans for conducting tourism related activities in Ari Atoll.
- Member of Climate Advisory Council to the President of Maldives 2009- to present.
- Registered EIA Consultant in Maldives Environment Protection Agency roster.

Major Publications

SHAIG, A. (2001) "An Overview of Web Based Geographic Information Systems". In Proceedings: Thirteenth Annual Colloquium of the Spatial Information Research Centre. P.A. Whigham (ed). 2 - 5 Dec, Dunedin, New Zealand. University of Otago, pp.255-264.

SHAIG, A. (2006). Climate Change Vulnerability and Adaptation Assessment of the Coastal Infrastructure of Maldives. Technical Paper submitted to Maldives National Adaptation Plan of Action for Climate Change. Ministry of Environment, Energy and Water, Male', Maldives.

SHAIG, A. (2006). Climate Change Vulnerability and Adaptation Assessment of the Land and Beaches of Maldives. Technical Paper submitted to Maldives National Adaptation Plan of Action for Climate Change. Ministry of Environment, Energy and Water, Male', Maldives.

SHAIG, A. (2007) Land Study of Maldives, 2006. Ministry of Planning and National Development, Male' Maldives.

SHAIG, A. and Aslam, M (2007) Detailed Island Risk Assessment Maldives Volume I to Volume IV – Natural Hazard Assessment (Final Draft). UNDP, Male' Maldives

SHAIG, A. (2007) Detailed Island Risk Assessment Maldives Volume I to Volume IV – Environmental Vulnerability Assessment (Final Draft). UNDP, Male' Maldives.

Academic Achievements

2001 Critchlow Associates Prize in Surveying, New Zealand.
Prize awarded annually by University council for the highest standard of Achievement in Spatial Information Studies in University of Otago.
1994 Certificate for best results in General Certificate of Examinations, Advanced Level.
Science Education Centre, Male', Maldives

References

Hamdun Hameed
Member of Parliament
Male', Maldives
Tel: (+960) 3323414
minister@planning.gov.mv

Simad Saeed, Dr
Managing Director,
CDE Consulting
Male', Maldives
Tel: +960 777 7445
Email: simad@cde.com.mv

David King, Dr.
Associate Proffessor
James Cook University
Townsville, QLD,Australia, 4811
Tel: (+61) 747 81 4441 ,Fax: (+61) 747 81 5581
Email: david.king@jcu.edu.au

Peter Valentine
Head of School, TESAG Department
James Cook University
Townsville, QLD,Australia, 4811
Tel: (+61) 747 81 4441 ,Fax: (+61) 747 81 5581
Email: peter.valentine@jcu.edu.au

Clarification

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes myself, my qualifications and my experience. I understand that any willful misstatement described herein may lead to my disqualification or dismissal, if engaged.

Signature Date: 15 July 2013

NASHIYA SAEED
CURRICULUM VITAE

1. **Proposed Position**: **Socio economic Consultant**

2. **Name of Firm**: Commerce, Development and Environment Pvt Ltd, Maldives

3. **Name of Staff**: Nashiya Saeed

4. **Date of Birth**: February 28, 1984 **Nationality**: Maldivian

5. **Education**:

   - Bachelor of Arts: Economic and Political Science, University of Delhi, New Delhi, India – July 2010 to June 2013

6. **Countries of Work Experience:** Maldives

7. **Languages:**

	Speak	**Read**	**Write**
English	Excellent	Excellent	Excellent
Dhivehi	Excellent	Excellent	Excellent

8. **Employment Record:**

May 2009 – Present

Socio-Economic Development **Consultant**

CDE Consulting
Male', Maldives

- Social and economic impact assessment.
- Vulnerability assessment
- Participatory development
- Participatory rural appraisal.
- Key areas of interest: Macroeconomic policy, Education policy, Youth Employment, Health Care policy, Social Justice, Social Protection, Child Rights, Gender

Mar 2008 – May 2009

Executive member and Lead **Co-ordinator**

Rights for All (RFA) Male', Maldives

- Represent RFA at various national level meetings and international missions
- Project and activity planning and executions
- Organizing forums, workshops, events
- Coordinated awareness and public advocacy initiatives within the organization and jointly conducted with Maldivian Civil Society Network
- Media coordination

Sep 2004 – Mar 2008

Clinical Assistant Trainee

Indira Gandhi Memorial Hospital, Male', Maldives

- Assist in Patient – Doctor communications
- Translation from Dhivehi to English
- Assist doctors in cardiovascular, neurology, orthopaedics, paediatrics, obstetrics & gynaecology, dermatology, psychiatry departments.
- Assist doctors, health care professionals in casualty and emergency department.
- Actively participated in helping the Tsunami victims brought from islands and Male' from the time they were brought to hospital till they were discharged or admitted to the wards. This included assisting the patients in the observation room, assisted in getting the prescribed medicines, giving them moral support and tending to their needs - 24th December 2004 – 15th January 2005

9. Detailed Tasks Assigned	**12. Work Undertaken that Best Illustrates Capability To Handle the Tasks Assigned**
Field Research *Community-consultation* *Data Collection* *Data Analysis* *Report Writing*	**Work Undertaken that Best Illustrates Capability to Handle the Tasks Assigned** *{Among the assignments in which the staff has been involved, indicate* *The following information for those assignments that best illustrate staff capability to handle the tasks listed under point 11.}* *Name of assignment or project:* ***Maldives Disaster Risk Reduction Baseline Survey***

	Year: 2014 *Location: Maldives* *Islands Visited: AA. Thoddoo, L. Gan, GDh. Gaddhoo, HDh. Kulhudhuffushi* *Procuring Entity: UNDP* *Main project features: Maldives Disaster Risk Reduction Baseline survey* *Positions held: Socio economic Consultant* *Activities performed: Literature review, methodology design, field research, data analysis and report writing* *Name of assignment or project:* ***Maldives Visitors Survey February 2014*** *Year: 2014* *Location: Maldives* *Procuring Entity: Minisrty of Tourism* *Main project features: Maldives Visitors Survey February 2014* *Positions held: Socio economic Consultant* *Activities performed: Data analysis and report writing* *Name of assignment or project:* ***Assessment of Deprivations amongst Adolescents*** *Year: 2013* *Location: Maldives* *Islands visited: S. Hithadhoo, S. Hulhudhoo, N. Manadhoo, N. Velidhoo, AA. Rashoo, AA. Ukulhas* *Procuring Entity: UNICEF* *Main project features: Assessment of Deprivations amongst Adolescents* *Positions held: Socio economic Consultant* *Activities performed: Literature review, methodology design, field research, comments to report* *Name of assignment or project:*

	Maldives Youth and Gender Study *Year: 2013* *Location: Maldives* *Procuring Entity: World Bank* *Main project features: Maldives Youth and Gender Study* *Positions held: Socio economic Consultant* *Activities performed: Research, data analysis and report writing – Author of chapters on Education, Employment and Civic Engagement* *Name of assignment or project:* ***Maldives Economic Diversification Strategy*** *Year: 2013* *Location: Maldives* *Procuring Entity: Ministry of Economic Development* *Main project features: Maldives Economic Diversification Strategy* *Positions held: Socio economic Consultant* *Activities performed: Research, data analysis and report writing* *Name of assignment or project:* ***An assessment of Economic Activities, Opportunities and Challenges in Shaviyani Atoll*** *Year: 2012* *Location: Maldives* *Islands Visited: All islands of Shaviyani Atoll* *Procuring Entity: Shaviyani Atoll Council* *Main project features: Assessment of Economic Activities, Opportunities and Challenges in Shaviyani Atoll* *Positions held: Socio economic Consultant* *Name of assignment or project:* ***Villingili Island Development Plan*** *Year: 2012*

	Location: Maldives *Islands visited: GA. Villingili, GA. Maamutaa* *Procuring Entity: Shaviyani Atoll Council* *Main project features: Island Development Plan of Villingili island* *Positions held: Socio economic Consultant* *Activities performed: Community consultations, data collection and report writing – (Author of Education, Health and Governance chapters)* *Name of assignment or project:* ***Sustainable Development Strategy – North Province Office*** *Year: 2011* *Location: Maldives* *Islands Visited: Selected islands from N, R, B, Lh atoll* *Procuring Entity: North Province Office* *Main project features:* *Positions held: Socio economic Consultant* *Activities performed: Community consultations, field research and report writing* *Name of assignment or project:* ***Social Assessment of 46 islands*** *Year: 2009* *Location: Maldives* *Islands visited: Selested islands from N, R, B, Lh atoll* *Procuring Entity: World Bank MEMP Project* *Main project features: Social Assessment of 46 islands* *Positions held: Associate Consultant (Socio economic)* *Activities performed: Community consultations, data collection*

	Name of assignment or project: ***Technical and Financial Feasibility of Waste Management in Noon, Raa, Baa and Lhaviyani Atoll*** *Year: 2009* *Location: Maldives* *Islands visited: Selected islands from N, R, B, Lh atoll* *Procuring Entity: World Bank MEMP Project* *Main project features:* *Positions held: Associate Consultant (Socio economic)* *Activities performed: Community consultations, data collection*

Signature Date: 24 March 2014

DR. SIMAD SAEED

CURRICULUM VITAE (CV)

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1. PROPOSED POSITION: Social Consultant

2. FULL NAME: Simad SAEED

3. ADDRESS: G. Chaman/Male'/Maldives

4. E-MAIL: simad.saeed@gmail.com; simad@cde.com.mv

5. Date of Birth: 31/01/1971

6. NATIONALITY: Maldivian

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7. EDUCATION

Doctor of Philosophy – Resource Management and Environmental Science

PhD Thesis Title: Social Capital and Well- Being: Delving into the deep determinants of sustainability

March 2001 to June 2005

Asia Pacific School of Economics and Government

Australian National University, Australia

Master of Science - Environmental Assessment & Management

September 1994- October 1995

Oxford Brookes University, UK

Bachelor of Science (Honours) Environmental Sciences

September 1990- July1993

University of Southampton, UK

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8. MEMBERSHIP OF ASSOCIATIONS AND COMMITTEES:

Member, Advisory Committee to the President of the Maldives on Climate Change

Registered Environmental Impact Assessment Consultant, Environmental Protection Agency, Government of the Maldives.

Review Editor, Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)

Member of the Special Task Force established by the President of the Maldives to develop the Maldives National Vision 2020

Member, Steering Committee of the Tourism Impacts Study of the Maldives, Ministry of Tourism

Member, Selection Committee for the Presidents Green Resort Award, Ministry of Tourism

Member, Technical Committee of the Maldives Housing and Urban Development Board

Member, Sixth National Development Plan of Maldives - Infrastructure Sub-Committee, Ministry of Planning and National Development

Principal author and leader of the team for the drafting of Second National Environment Action Plan, Ministry of Home Affairs, Housing and Environment

Member, Co-ordination Committee on HulhuMale' Reclamation, Ministry of Construction and Public Works

Member, Technical Committee on Ports Development, Ministry of Construction and Public Works

Member, Technical Committee on Solid Waste Management, Ministry of Home Affairs, Housing and Environment

Member, Technical Committee of the Southern Atolls Development Project, Ministry of Atolls Administration

Member, National Accounts Project Technical Committee, Ministry of Planning and National Development

Member, Technical Committee on Dredging and Land Reclamation, Ministry of Planning and National Development

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9. EMPLOYMENT RECORD

Date:	**June 2005 – present**
Location	Maldives
Company	CDE Pvt Ltd
Position	Managing Director
Description	Managing Director of CDE Consulting registered in the Maldives (C-262/2001) since 2001. Responsible for executive direction, corporate governance, strategic planning, consultant services management in the company and team leader of several consultancy projects

Date:	**Dec 2000 – March 2001**
Location	Maldives
Company	Ministry of Home Affairs, Housing and Environment, Government of the Republic of Maldives;
Position	Deputy Director
Description	Formulation of environmental policy issue papers for the National Commission for Protection of Environment Enforcement of National Environment Impact Assessment regulation and procedures in the Maldives Supervision of the work of the Pollution Control division, EIA division, Climate Change division and Environmental Planning division. Implementation of the second National Environment Action Plan of the Maldives Representation of the Maldives at international conferences, seminar and workshops and preparation of briefing papers for Maldives delegations Implementation of the UNDP/GEF Climate Change Enabling Activity Project of Maldives Co-ordination of work of International Advisory Board on Climate Change, Local Consultants & Project Team Development of the first Greenhouse Gas Inventory of the Maldives; Development of the Climate Change Mitigation Plan; Preparation of the National Vulnerability Assessment of the Maldives; Formulation of an Adaptation Plan and Implementation Plan on Climate Change; Formulation of the first National Communication of the Maldives to UNFCCC.

Date:	**May 1997 – Dec 2000**
Location	Maldives
Company	Ministry of Home Affairs, Housing and Environment, Government of the Republic of Maldives
Position	Assistant Director, Programmes
Description	Implementation of the National Environmental Impact Assessment procedures Supervision of the work of the Environmental Assessment Division Supervision of the work of the Climate Change Division Supervision of the work of the Pollution Control Division Formulation of environment and conservation plans Representing the Maldives at the negotiations of UNFCCC on climate change Representing the environmental interests of Maldives at international conferences Work related research and preparation of papers to brief the Minister and executive staff of the Ministry

Date:	**September 1993 – April 1997**
Location	Maldives
Company	Ministry of Planning, Human Resources and Environment, Government of the Republic of Maldives
Position	Assistant Environment Analyst
Description	Drafting of the Environmental Impact Assessment (EIA) Procedures of the Maldives Undertaking consultations on the EIA Guidelines and Procedures Presentation of the EIA Guidelines and Procedures of the Maldives to the National Commission of the Protection of the Environment for endorsement Coordinating the adoption of the EIA guidelines by the Government Implementation of the Environment Impact Assessment Procedures in the Maldives

10. CONSULTANCY ASSIGNMENTS

Date: 2012
Client: Ministry of Economic Development
Position: Team Leader
Description: Preparation of strategy papers on energy, tourism, and fisheries for the Maldives National Economic Diversification Framework Study

Date: 2012
Client: Ministry of Fisheries and Agriculture
Position: Team Leader
Description Agriculture Needs Assessment Tool Kit and Baarah Needs Assessment Report

Date: 2012
Client: Shaviyani Atoll Council
Position: Team Leader and Lead Author
Description An Assessment of Economic Activities, Opportunities and Challenges in Shaviyani Atoll

Date: 2012
Client: UNDP
Position: National Consultant
Description: National Report of the Maldives to the United Conference on Sustainable Development, Rio+20,

Date: 2012
Client: USAID/Chemonics
Position: National Consultant
Description: Training for community leaders on climate change, water resources management and sustainable development

Date: 2012
Client: Biwater International
Position: Team Leader/Environment Impact Assessment Expert
Descripton: Environmental Impact Assessment Study for Water Supply and Sewerage System in Hulhumeedhoo, Addu City

Date: 2012
Client: Food and Agriculture Organization
Position: National Consultant
Description: Trans-boundary Diagnostic Analysis (TDA) National Validation, Bay of Bengal Large Marine Ecosystems Project

Date: 2012
Client: Fuvahmulah Atoll Council
Position: Team Leader and Sustainable Development Consultant
Description: Formulation of Vision Fuvahmulah

Date: 2011
Client: UPL Environmental Engineers Limited, India
Position: Team Leader /Environmental Impact Assessment Expert
Description: Environmental and Social Impact Assessment of Solid Waste Management Project, Thilafushi, Male' City, Maldives

Date: 2011
Client: Biwater International
Position: Team Leader/Environmental Assessment Expert
Description: Environmental Impact Assessment Study for Water Supply and Sewerage System in Hithadhoo, Addu City

Date: 2011
Client: North Province Office
Position: Team Leader
Description: North Province Sustainable Development Strategy

Date: 2011
Client: UNESCO
Position: National Consultant
Description: Survey on the Impact of Global Financial Crisis on Education in the Maldives

Date: 2011
Client: Ministry of Tourism, Arts and Culture
Position Team Leader and Lead Author
Description Maldives Visitor Survey 2010

Date: 2010
Client: European Commission
Position: National Consultant
Description: Evaluation of the European Commission's Cooperation with Maldives

Date: 2010
Client: Ministry of Tourism, Arts and Culture
Position: Consultant
Description: Preparation of the report on Tourist Profile and Opinion Survey 2008

Date: 2010
Client: South Province Office
Position: Team Leader - Social Expert
Description: Preparation of the Land Use Plan for Addu Atoll

Date: 2009
Client: World Bank - MEMP Project
Position: Social Development Expert
Description: Social Assessment of 46 islands in Noonu, Raa, Baa and Lhaviyani Atolls

Date: 2009
Client: World Bank - MEMP Project
Position: Development and Environment Policy Expert
Description: Technical and Financial Feasibility of Waste Management in Noon, Raa, Baa and Lhaviyani

Date: 2008
Client: UNDP
Position: Social Development Expert
Description: Social and Economic Vulnerability Assessment of 9 islands of the Maldives

Date: 2008
Client: Ministry of Environment, Energy and Water
Position: Development and Environment Policy Expert
Description: Preparation of the Maldives National Sustainable Development Strategy (NSDS)

Date: 2008
Client: Ministry of Housing and Urban Development
Position: Development Policy Expert
Description: Development Strategy and Land Use Plan for Gan Airport

Date: 2008
Client: UNDP/GEF
Position: Development and Environment Policy Expert
Description: Preparation of Baa Atoll Development Plan

Date: 2007
Client: Ministry of Environment, Energy and Water
Position: Development and Environment Policy Expert
Description: Maldives National Capacity Self Assessment for Global Environmental Management

Date: 2007
Client: Ministry of Environment, Energy and Water
Position: Development and Environment Policy Expert
Description: Technology Needs Assessment for Climate Change Adaptation and Mitigation

Date: 2007
Location: Randheli, Maldives
Client: Cyprea Pvt Ltd
Position: EIA Lead Consultant
Description Preparation of EIA for tourist resort development in Randheli

Date: 2007
Location: Maldives
Client: Ministry of Environment, Energy and Water
Position: Environment and Development Policy Expert
Description Preparation of the Third National Environment Action Plan

Date: 2007
Location: Addu, Maldives
Client: Addu Atoll Office
Position: Development Policy Expert
Description: Formulation of Vision Addu

Date: 2006
Location: Maldives
Client: Ministry of Planning and National Development
Position: Social Development and Environment Expert
Description Preparation of Second Millennium Development Goals Report of the Maldives

Date: 2006
Location: Maldives
Client: Ministry of Planning and National Development
Position: National Facilitator
Description: Seventh National Development Plan of the Maldives

Date: 2006
Location: Maldives
Client: Ministry of Environment, Energy and Water
Position: Environment Policy Expert
Description Preparation of National Adaptation Programme of Action for Climate Change in the Maldives

Date: 2006
Location: Maldives
Client: UNDP/Ministry of Atolls Development
Position: Development Policy Expert
Description Preparation and presentation of policy research paper on "A new thinking on governance for development and delivery of public services in the Maldives" for the National Seminar on Atoll Councils and Island Councils

Date:	2006
Location	Maldives
Client	European Commission through AGRIFOR Consult – led consortium
Position	Strategic Environmental Assessment Expert
Description	EC Framework Contract for Strategic Environmental Assessment (SEA) for the Maldives Regional Development Plan

Date:	2006
Location	Maldives
Client	Ministry of Atolls Development
Position	Consultant
Description	Preparation of Island Development Plans for Eydhafushi; Dhaalu Kudahuvadhoo and Laamu Gan

Date:	2006
Location:	Gaakoshibee, Shaviyani Atoll, Maldives
Client:	ADK Travels Pvt Ltd
Position	EIA Lead Consultant
Description	Environmental Impact Assessment Study for resort development on Gaakoshibee

Date:	2006
Location:	Meradhoo, Gaafu Alifu Atoll, Maldives
Client:	Xanadu Holdings Pvt Ltd
Position	EIA Lead Consultant
Description	Environmental Impact Assessment Study for resort development on Meradhoo

Date:	2006
Location:	Manafaru, Haa Alifu Atoll, Maldives
Client:	Tropical Maldives Pvt Ltd
Position:	EIA Lead Consultant
Description	Environmental Impact Assessment Study for resort development on Manafaru

Date:	2004
Location	Maldives
Client	Ministry of Tourism, Government of the Maldives
Position	Consultant
Description	Preparation of Environmental Guidelines for Tourist Resort Development and Operation in the Maldives.

Date:	2002
Location	Maldives
Client	United Nations Development Programme, Male'
Position	Consultant/Lead Author
Description	National Assessment Report of the Maldives to the World Summit on Sustainable Development.

Date:	2002
Location	Maldives
Client	South Asia Poverty Alleviation Programme (Kathmandu, Nepal) and United Nations Development Programme, Male'
Position	Consultant
Description	Situation Analysis and Strategy for Change; Poverty and the Environment Maldives National Report Project

Date:	2001
Location	Maldives
Client	Ministry of Home Affairs, Housing and Environment.
Position	Consultant
Description	State of the Environment Report Maldives 2001.

Date:	2000
Location	Maldives
Company	BFS Consulting Group
Position	Local Consultant
Description	Responsible for the Environmental Impact Assessment and environmental monitoring for the Asian Development Bank financed First Regional Development Project.

Date:	2000
Location	Maldives
Company	BFS Consulting Group, for Ministry of Planning and National Development.
Position	Consultant
Description	Prepared report on the indicators for the Environment and Housing Sector to be included in the National Social Development Management Information System (SOMIS).

Date:	1999
Location	Maldives
Client	Institute of Global Environmental Studies, Japan
Position	Consultant
Description	Study report on Environmental Education needs and opportunities in the Maldives.

Date:	1998
Location	Maldives
Client	Cowrie Investments Private Limited
Position	Consultant
Description	Prepared winning bid proposals submitted to Ministry of Tourism for lease, development and operation of Meedhupparu Resort and Kanuhura Sun Resort and Spa by developer.

Date:	1998
Location	Maldives
Client	Vaaly Brothers Private Limited.
Position	Consultant
Description	Prepared the winning bid proposals submitted to the Ministry of Tourism for the lease, development and operation of Medhufushi Resort and Filitheyo Resort by developer.

Date:	1997
Location	Maldives
Client	Sun Travels and Tours Company Private Limited
Position	Consultant
Description	Prepared the winning bid proposals submitted to the Ministry of Tourism for the lease, development and operation of Vilu Reef Resort by developer.

Date:	1996
Location	Maldives
Client	World Health Organisation
Position	Consultant
Description	Health and Environment in the Maldives - A Situation Analysis

11. TRAINING, CONFERENCES AND WORKSHOPS

United Nations Climate Change Conference, COP 18, Doha, Qatar, 26th Nov-08 December 2012.

Rio+20, United Nations Conference on Sustainable Development, Rio de Janeiro, Brazil, 20-22 June 2012.

Trans-boundary Diagnostic Analysis (TDA) Confirmation Meeting, Bay of Bengal Large Marine Ecosystems Project (BOBLME), Phuket, Thailand, 13-14 February 2012.

15th session of the Conference of the Parties to the UNFCCC and the 5th session of the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol, Copenhagen, Denmark, 07-18 December 2009

Protecting human health from climate change: technical discussions, WHO/SEARO, New Delhi, India, 18-21 August 2009

South-South collaborative study tour to 'Explore technology options for Climate Change Mitigation and Adaptation in Maldives', New Delhi, India, 22 – 30 August 2006

Asian Regional Workshop on Capacity Building for Clean Development Mechanism, Bangkok, Thailand, 19-21 October 2005

UNDPCSD Mission to Barbados to formulate Twinning Project on Sustainable Development Indicators for Maldives, Barbados and Costa Rica, Bridgetown, Barbados, May 2001

Sixth Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, The Hague, Netherlands, 13 - 24 November 2000

Third Lead Authors' Meeting of the Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), Lisbon, Portugal, 08-11 August 2000

AOSIS Workshop on Preparations for the Fifth Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, Apia, Samoa, 29July -04 August 2000

Tenth Asia-Pacific Seminar on Climate Change, Penang, Malaysia, 9 - 13 July 2000

Final Workshop on the Implementation of Male' Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia, Kathmandu, Nepal, 1-3 March 2000

Second Lead Authors Meeting of the Third Assessment Report (Working Group II) of the Intergovernmental Panel on Climate Change, Canberra, Australia, 07-10 December 1999

Fifth Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, Bonn, Germany, 25 October - 05 November 1999

Special Session of the UN General Assembly on the Implementation of the Barbados Programme of Action, New York, USA, 28-29 September 1999

Inception Meeting on the Implementation of NORAD/UNEP Project on Strengthening Environment Assessment and Monitoring Capabilities, Bangkok, Thailand, 19-20 April 1999

Inception Workshop on the Implementation of Male' Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia, Kathmandu, Nepal, 22-23 February 1999

Fourth Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, Buenos Aires, Argentina, 02-13 November 1998

Fifth Special Session of the Governing Council of the United Nations Environment Programme, Nairobi, Kenya, 20-22 May 1998

Seventh Meeting of the Governing Council of South Asia Co-operative Environment Programme, Malé, Maldives, 20-22 April 1998

Preparatory Meeting of the Asia Pacific National Councils for Sustainable Development to the 6th Session of the Commission on Sustainable Development, Bangkok, Thailand, 23-25 March 1998

Regional Dialogue on Air Pollution in South Asian Countries, Bangkok, Thailand, 19-20 March 1998

Third Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, Kyoto, Japan, 01-10 December 1997

Meetings of the Subsidiary Bodies of the United Nations Framework Convention on Climate Change, Bonn, Germany, 20-31 October 1997

SAARC Environment Minister's Conference, Bandos, Maldives, 15-16 October 1997

Thirteenth Session of the Intergovernmental Panel on Climate Change, Bandos, Maldives, 22-29 September 1997

Meetings of the Subsidiary Bodies of the United Nations Framework Convention on Climate Change, Bonn, Germany, 28 July – 07 August 1997

Earth Summit + 5, Special Session of the United Nations General Assembly on the Implementation of Agenda 21, New York, USA, 22-27 June 1997

World Bank/SAARC Seminar on Economic Globalization and Sustainable Development in South Asia, Goa, India, 07-11 April 1997

SAARC Environment Minister's Conference – Preparatory Meeting for the UN Special Session on Agenda 21, New Delhi, India, 02-03 April 1997

Meetings of the Subsidiary Bodies of the United Nations Framework Convention on Climate Change, Bonn, Germany, 25 Feb – 07 March 1997

Second Meeting of National Councils for Sustainable Development in Asia and the Pacific, Manila, Philippines, 12 - 14 December 1996

Regional Consultative Meeting on Environmentally Sound and Sustainable Development Indicators, Bangkok, Thailand, 26 - 29 November 1996

Commonwealth Asian Region Workshop on Integrating Economic and Environmental Policies and Using Economic Instruments to Promote Environmentally Sound Development, Colombo, Sri Lanka, 11 - 14 November 1996

SACEP/UNEP/NORAD Environmental Management Seminar for South Asia, Colombo, Sri Lanka, 16 - 27 September 1996

Eleventh Meeting of the Technical Working Group of the Basel Convention, Manchester, United Kingdom, 9 - 13 September 1996

Regional Inter-Governmental Consultations on Global Environment Outlook (GEO), Kathmandu, Nepal, 23 - 24 July 1996

Asian Workshop on Communication and Education Strategies for Ministries of Environment and Potential Partners, Bangkok, Thailand 17 - 19 July 1996

Maldives National Workshop on Integrated Reef Resources Management, Male', Maldives, 16 - 20 March 1996

Final Review and Evaluation Meeting: SACEP/NORAD Co-operation in Environmental Training: Capacity Building in South Asia Region, Ahmedabad, India, 22 - 24 Feb 1996

Intersectoral Consultation on Health and Environment, Malé, Maldives, 17 December 1995

UNEP/SACEP/JNU Workshop on Framework Legislation for Environmental Management in South Asia, New Delhi, India, 11 - 15 Dec 1995

Seventh Meeting of the Conference of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, Vienna, Austria, 5 - 7 Dec 1995

Preparatory Meeting to the Seventh Meeting of the Conference of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer, Vienna, Austria, 28 Nov - 1 Dec 1995

SACEP/NORAD Regional Workshop of National Consultants for Assessment of Environmental Training Needs and Opportunities in the South Asia Region, Bandos, Maldives,16 - 20 July 1995

Inter-Governmental Meeting on Capacity Building for Coastal Environmental Management in the South Asian Seas Region, New Delhi, India, 7 - 9 April 1994

Third Asia Pacific Seminar on Climate Change, Osaka, Japan, 28 - 30 March 1994

UNEP/UNITAR Training Programme on Environmental Law and Policy, Nairobi, Kenya, 29 Nov - 17 Dec 1993

UNDP Workshop on Environmental Management and Sustainable Development, Male', Maldives, Nov 1993

First meeting of the Working Group of Legal and Technical Experts to draft a protocol on liability and compensation under Basel Convention, Geneva, Switzerland, 13 - 17 Sept 1993

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12. COUNTRIES OF WORK EXPERIENCE

Maldives

Australia

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13. LANGUAGES

Language	Reading	Spoken	Written
English	Excellent	Excellent	Excellent
French	Fair	Fair	Fair
Dhivehi	Excellent	Excellent	Excellent

14. REFEREES

Prof Jeff Bennett	Dr. Ahmed Shaig	Mr. Mohamed Khaleel
Professor of Environmental Management	Director	Director, Environmental Affairs
Crawford School of Economics and Government	CDE Pvt Ltd	Ministry of Environment
Australian National University	4F Orchidmaage	Government of the Maldives
Canberra	Male'	Male'
Australia	Maldives	Maldives
+61 2 6125 0154	+ 960 3312514	+960 3004300
Jeff.Bennett@anu.edu.au	shaig@cde.com.mv	secretariat@mhe.gov.mv

Signature: **Date: 23 October 2012**

Mohamed Ali

ID #:	A 094918
Nationality:	Maldivian
Languages:	English, Sinhalese, Dhivehi
Date of Birth:	13/09/1983
Telephone:	960-790-6007
Email:	mohamed.ali@cde.com.mv

Experience

Marine Environmental Specialist — June 2011- Present
CDE Consulting

Marine Environment Officer — July 2008 – May 2011
Banyan Tree Vabbinfaru

Freelance Lobster Hunter, Shark Fisherman — Jan 2007 - July 2008
Laamu Atoll

Dock Assistant — Sep 2006 - Jan 2007
Tourist Submarine Maldives

Education and Certifications

PADI Rescue Diver	June 2011
PADI Enriched Air Diver	June 2011
Emergency First Responder	May 2011

Basic Computer Science — 2001 - 2006
Singapore Informatics, Colombo Sri Lanka

Profile

I am very passionate about protecting the marine environment. After having worked as both a fisherman and a marine environment officer I am aware of the impact that human activity has on our fragile marine environment. My favorite activities are reef monitoring and planting coral gardens. With my undying passion for the underwater world and also with my vast experience diving all over the Maldives, educating people on the marine environment is my greatest mission, to ensure the preservation and protection of our most valuable treasure. Furthermore, I have got the opportunity to work besides the greatest marine experts in the world namely Prof. J.E.N. Veron,Dr. Norman Queen and Dr. Daphne G. Fautin.

References

N.D. Abdul Azeez Abdul Hakeem
Former Director of Conservation
Mobile: + 960 7784263
Banyan Tree Maldives

Dr. Steve Newman
Former Marine Lab Manager at Banyan Tree
steve.newman@ncl.ac.uk

Robert James
Former Marine Lab Manager at Banyan Tree

MOHAMED FAIZAN

PERSONAL DETAILS

Address:	H. Pent Land, Lansimoo Goalhi, 20041 Male', Maldives	Date of Birth:	29th June 1985
		Gender:	Male
Mobile:	+960 7975987	Nationality:	Maldivian
Email:	Faizan@cde.com.mv Mohamed.Faizan@gmail.com		

EDUCATION

International Islamic University Malaysia **2006 – 2010**

Bachelor of Biotechnology (Honours)

Centre for Higher Education Secondary Education, Male' Maldives **2002-2004**

London Examinations GCE Advanced level certificate

Majeedhiyaa School, Male', Maldives **1997-2002**

London Examinations GCE Ordinary level certificate

EMPLOYMENT

CDE Consulting Pvt Ltd, Maldives (June 2010- Present)
Environmental Consultant – Marine environment monitoring and assessments

Ministry of Environment, Energy and Water, Maldives (February 2005- May 2006)
Project Assistant to Integrated Climate Change Strategy

CO-CURRICULAR ACTIVITIES

- Information and multimedia secretariat of Student Representative Council 07/08 - International Islamic University Malaysia (2007 - 2008)

- Head of Research and Education Bureau of Science Students Society – International Islamic University Malaysia (2008)

PROFESSIONAL EXPERIENCE

- Environmental Impact Assessment report for the proposed guest swimming pool at Komandoo Maldives Island Resort (April 2012)

- Marine environmental assessment report for the Environmental Suitability report of Baa Atoll Keyodhoo for resort development (March 2012)

- EIA report for the proposed sewerage system at Maduvvari, Raa Atoll (February 2012)

- EIA report for the proposed installation and operation of desalination plant at Hithaadhoo, Baa Atoll (January 2012)

- EIA report for the proposed installation and operation of desalination plant at Kudarikilu Island, Baa Atoll (January 2012)

- Initial Environmental Examination (IEE) report for the proposed relocation of coconut palms from Laamu Hithadhoo to Six Senses Laamu (December 2011)

- Marine environmental assessment and report for the EIA prepared for the proposed harbour development project in Noomara Island, Shaviyani Atoll (December 2011)

- Initial Environmental Examination (IEE) report for the proposed relocation of coconut palms from Rasgetheem to Fushivelavaru Resort (November 2011)

- Baseline environmental assessments and report for the EIA prepared for the development of domestic airport in Ga. Koodoo (September 2011)

- Baseline environmental assessments and report for the proposed channel deepening, beach replenishment and erosion mitigation project at Maamigili Raa Atoll (August 2011)

- Marine environmental assessments and report for the EIA prepared for the proposed reconstruction of AA. Bodufolhodhoo harbour (August 2011)

- Baseline environmental assessments and report for the EIA prepared for the proposed redevelopment of Gasfinolhu Island Resort, EIA (July 2011)

- Marine assessment report for the baseline environmental study for Thilafushi Solid Waste Management Facility (June 2011)

- Marine environmental assessments and report for the EIA prepared for the proposed resort development at Giraavaru Island, Maldives (June 2011)

- Baseline environmental assessments and report for the EIA prepared for the proposed Harbour reconstruction work in Foakaidhoo Island, Shaviyani Atoll (March 2011)

- Co-ordinated the national Household Income and Expenditure Survey (Foreigners) (February 2011)

- Marine environmental assessments and report for the EIA prepared for the proposed Resort development at Villivaru Island, Maldives (February 2011)

- Carried out assessments to determine the baseline conditions of the reefs around Rahfalhu Huraa, Male' Atoll for the EIA prepared for the proposed development of a picnic island at Rahfalhu Huraa, Male' Atolll, Maldives (January 2011)

- Carried out marine assessments to determine the condition of the marine environment of Herathera Island Resort, Addu Atoll for the EIA prepared for the removal of seagrass and beach replenishment activities in Herathera Island Resort, Addu Atoll, Maldives. (September 2010)

OTHER SKILLS

- Certified PADI open water diver

Ali Nishaman Nizar

G. Dhoores Villa, 20132
06th March 1988
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ali.nishaman@gmail.com

EDUCATION

Cyprus Forestry College (2006 - 2008)

- Adv. Diploma in Forestry

Center for Higher Secondary Education (2004 - 2006)

- Edexcel - G.C.E. A'levels (Statistics, Business, Accounts)
- Cambridge - Certificate in Advanced English

Majeedhiyya School (2001 - 2003)

- Cambridge - O'levels (Mathematics, Economics, Commerce, English, Accounts)

EXPERIENCE

Terrestrial Environment Consultant – CDE Consulting, (July 13 – Present)

- Provides technical assistance to various national and international projects, specifically providing input in areas such as; wetlands, agriculture, forestry, vegetation mapping, mangroves, waste management, composting…etc.
- Working on and contributing to several Environmental Impact Assessment studies.

Local Consultant – Vegetation Expert – Hidria, Spain, (May 13 – Aug 13)

- Worked as a local consultant for Hidria, on developing the Wetland Management Plan for Addu Hithadhoo Eidhigali Kilhli and Gn.Fuvahmulah Bandaara & Dhandimagu Kilhi.

Agriculture Implementation Officer (AIO) – Project Implementation Unit, MOFA (Oct 10 – Jun 13)

- Worked on the "Post-Tsunami Agriculture and Fisheries Rehabilitation Programme" & the "Fisheries and Agriculture Diversification Programme"
- Focal point for forming and mobilizing agriculture cooperatives in island based communities.

Head of Agriculture Research & Extension – Ministry of Fisheries and Agriculture (Jan 10 – Sept 10)

- Lead a team of 5 staff at the Agriculture Research and Extension Section in the Capital city and an additional 15 staff at our regional research centers in the North and South
- Devised agricultural research programs that develop and improve agriculture in a sustainable manner in the country.

Agriculture Officer – Ministry of Fisheries and Agriculture (Aug 08 – Dec 09)

- Handled the "Training & Extension Unit" (Agriculture Division).
- Planned and coordinated all agriculture related training programs in the Maldives on a daily basis according to the staff availability.

National Project Assistant – F.A.O, United Nations (Aug 06 – Oct 06)

- Worked on a Post-Tsunami forest rehabilitation project.
- Worked with international consultants on several aspects of Maldivian forestry, agriculture and especially focusing upon Maldivian Mangrove ecosystems.

WORKSHOPS / SHORT-TERM TRAININGS ATTENDED

- 2009,
  - Workshop on Strengthening Plant Quarantine and Inspection, Male', Maldives, 15-16 July 2009
  - "Awareness of Food Security" Workshop, Male', Maldives, 22nd October 2009
  - Workshop on Updating and Finalization of the Agriculture Development Master Plan (ADMP), Male, Maldives, 21st December 2009

- 2010,
  - Fisheries & Agriculture Diversification Programme, Financial, Procurement & M&E Training, Male', Maldives, 26-28 January 2010
  - Team Leaders Meeting, 8th Virtual University for Small States of the Commonwealth's (VUSSC) International Training and Materials Development Workshop, Singapore, 14-20 April 2010
  - Prevention, Control and Management of Forest Invasive Species in South Asia, (by APFSIN), Male', Maldives, 29th April 2010
  - 8th Virtual University for Small States of the Commonwealth's (VUSSC) International Training and Materials Development Workshop, Male', Maldives, 15-31 March 2011
  - Loan Administration Training, Hdh.Kulhudhuhfushi, Maldives, 3-8 July 2010
  - Workshop to Finalize the Draft Pesticides and Plant Protection Bill, Male', Maldives, 12-13 July 2010
  - International Workshop on Climate Change Extreme Events Adaptation Practices and Technological Solutions, New Delhi, 16-18 August 2010

- 2011,
  - FADIP "Rolling Baseline Survey" Workshop, Male, Maldives, 2-3 March 2011
  - Knowledge Sharing in Asia Workshop #3: Participatory Techniques in the Field, Godavri, Nepal, 30th March 2011 – 2nd April 2011
  - Knowledge Sharing in Asia Workshop #2: Writing to Share Knowledge Effectively, Godavri, Nepal, 3-6 April 2011
  - Consultation Workshop for Facilitators on Cooperatives and Business Development, UNDP Building, Male, Maldives, 21st April 2011
  - AFE's Workshop on "Value Chain Program Design", Chiang Mai, Thailand, 12-16 September 2011
  - Training of Trainers Workshop on Systematization, Nepal, 8-10 December 2011

- 2012,
  - Workshop on Knowledge Management, tools and techniques (as a trainer for the programme), Maldives, 29th November 2012 – 02nd December 2012
  - Partnering 4 Development Forum, UNDP, Paradise Island Resort, 2nd December 2012

- 2013,
  - Consultative Workshop on ICRAF's Capacity Development Strategy & ICRAF's South Asian Partner's Capacity Needs Assessment, BRAC (Bangladesh Rural Advancement Committee) Centre, 30-31 January 2013
  - Certificate in Co-operative Poverty Reduction, Co-operative College of Malaysia, Malaysia, 3-21 March 2013

SKILLS

- ICT Competent (MS Applications, Corel Suite…etc)
- Flexible to travel at any time
- Able to Multi-task and work in stressful conditions
- Able to co-ordinate and work with CBPO's / Co-operatives / NGO's
- Decision Making Skills
- Logistical Planning Skills
- Good Interpersonal Skills
- Training Skills in "Agri-Business", "General Agriculture", "Hydroponics", "Agro-Forestry", "Home-gardening", "Baseline Surveys" and "Co-operatives".

MEMBERSHIPS IN PROFESSIONAL ASSOCIATIONS

- Bluepeace - an Environmental NGO
  - Advisor on environmental and agricultural issues since the year 2009.
  - Participated in several beach and reef cleanup programs.
  - A member since the year 2008.
- United Artists of Maldives - an association focusing on Maldivian Art and Artisans
  - Sits in the Steering committee of UAM as the Media Coordinator, since January 2013
  - Participated in the International Hay Festival Activities held in the Maldives in 2010.
  - A member since the year 2008.
- UN Global Compact Maldives Network - a network of local private sector parties
  - Representative for Addu Meedhoo Cooperative Society
  - Representative for CDE Consulting

REFEREES

- Dr. Ahmed Shaig,
  Director of Environment, CDE Consulting,
  shaig@cde.com.mv
  +9607788758

- Dr. Aminath Shafia,
  Former State Minister, Ministry of Fisheries and Agriculture,
  shafia@fishagri.gov.mv
  +9607792458

LANGUAGE PROFICIENCY

- Fluent in both writing and reading of Dhivehi (mother tongue)
- Fluent in both writing and reading of English

PERSONAL DETAILS

Name in Full : Ali Moosa Didi
Date of Birth : 18.06.1985
Gender : Male
Nationality : Maldivian

Address:

Permanent : Saraasaruge Aage, S.Hithadhoo
Neelonfaru Magu

Present : Ma. Rose Villa SE, 4th Floor
Dhevina Magu
Male'

Telephone : +960 7912001
+960 7703969

EDUCATIONAL QUALIFICATIONS

Madharasthul Islamiya School

- Certification, University of Cambridge General Certification of Education O/L

  Subject
  English
  Mathematics
  Business Account
  Commerce
  Economics

- Secondary School Certificate

  Islamic Studies

  Dhivehi Language

WORK PLACE DETAILS

Commerce Development and Environment Pvt.
Orchid Maage 4th Floor

Ameeru Ahmed Magu
Male',Republic of Maldives
Telephone: + 960 3312514
Fax: + 960 3315926
E-mail: ali@cde.com.mv

EMPLOYMENT RECORD

January 2004 – December 2008	Commerce Development & Environment Pvt Assistant Surveyor
January 2009 – December 2009	Ryco Investment Pvt HR. Officer
January 2010 – To Current Date	Commerce Development & Environment Pvt Surveyor

WORK EXPERIENCE

Assistant Surveying Officer (Sep 2008 – To Current Date)
-Survey proposed areas for the new projects under the instruction of survey officer.

-Determine precise location and measurements of points, elevations, lines, areas, contours for the construction studying the morphology of the seabed mapmaking and for construction staking, defining and managing parcels data, as-built and profiling.

-Utilize recourses to the optimum level.

-Use company civil/ survey software for contouring, setting alignments, setting points construction, land division.

-Edits and troubleshoot incoming data collector files in accordance with company procedures.

- Processing Survey Data's Using Topcon Tools, Surfer, Sonar XP, etc

-Reviews and utilize survey crew field notes. -Imports verified data into the appropriate CAD drawing file, using company standards point layer management and description keys.

-Prepares survey drawings and documents using company standards, prototypes, templates and blocks.

-Operate digital cameras and download photo files into database and/ or CAD drawings.

-Utilize company scanners to transfer reference maps into CAD files to facilitate utility mapping and property line.

- To perform bathymetric and topographical survey before start of the Projects

-Plotting survey data using AutoCAD 2006-2009

- Processing Survey Data's Using Topcon Tools, Surfer, Sonar XP, etc.

-Modeling accurate contours

- Preparation of survey maps

-Make sure all the survey instruments are working in good condition.

APPENDIX K – Consultation notes

މާޅޮސްމަޑުލު އުތުރުބުރީ އުނގޫފާރު ކައުންސިލްގެ އިދާރާ
އުނގޫފާރު
ދިވެހިރާއްޖެ

Secretariat of the Un'goofaaru Council, North Ma
Un'goofaaru, Republic of Maldives

17 މާރިޗު 2014 ވަނަ ދުވަހު ސީ ޓީ ޕީ ގެ ބޯޑުމެންބަރުންނާއެކު މިއާދާކުރި ބޭއްވުނު ބައްދަލުވުމުގެ ޔައުމިއްޔާ

ބައްދަލުވުން ބޭއްވުނު ގަޑި: 11:00

މިޖަލްސާގައި އެޖެންޑާ ކުރެވުނު ތަފްސީލް ތަރައްޤީ ކުރުމުގެ މަސައްކަތުގެ ދަށުން މިއަހަރުގެ 2 ވަނަ ބައި ރ. އުނގޫފާރު، ރ.މަޑުއްވަރީގައި ރިސޯޓް ތަރައްޤީކުރުމުގެ މަސައްކަތް މިހާރުވާނީ އެދެ ބައި ހުރިހާ ކުރެވޭ މަސައްކަތުގެ ތެރެއިން ދެ ބައި ޖެހިއްޖެ ކުރިއަށްދާނެ ގޮތުގެ ކުރުން ދައްކާދެން މި ބައްދަލުވުމުގައި އެދެވޭ.

ރިސޯޓުގެ އަމިލީ މަސައްކަތް ކުރަން ފެށުނީ ޕީ އައި ޓީ ގުދުރަތީގެ ޕީ އައި ޓީ ފެސިލިޓީސް ސީ ޓީ އިން ދުރުވ ބޯޑުން މިއާދުވިއްޖެ. ޕީ އައި ޓީ ފެން ކުރަން އެއްމަސް ދުވަހުގެ މުއްދަތު ވަނަކަން ބޭނުންވާތީ ވަގުތުގައިވެސް މިއާދުވިއްޖެ.

އަ ބޯޑުން އަދި ހަމަޖެހުން މިހާރުވެސް ދެމެހި ދެކޭގޮތް އެދުން ފެށުމަށްޖެހޭ.

އަދި ހަމަޖެހުން ހަރާއިދުމެހި ދެކޭ ގޮތް ދުވަހުން ހަރަން ކުރިއެރުން ލިބި މިހަރުގައި ދިރިއުޅޭ ކާނުގެ ހައްދިނީކުރެވޭ ޖެހޭގޮތް އެއްބާރުލުން ހަމަޖެހި އާރވަނިއްޖެ ލިބޭ ވަޒީފާއެގައި އުޅުއްވާ ބޯޑުގެ ވެއްޖެ. ހައްދިނުމްނަން ލިބޭނެ ހެޔޮ އަސާސީ ހިދުމަތްތައް ހަމަޖެ ފެންވަރުގައި ލިބޭ ހަރަކާތް ވެއްޖެ. އެޖެހޭނެ ގިނަ ރިސޯޓުތަކުން ކުރިއަށް ޖެހޭ ދަތިތަކުގައި ލިބޭނެވެ.

ދެން އެބޯޑުން ސަމާލުކަމަ މިހާރު ދިމާވެފައިވާ ބޭއީ މަސައްކަތުގެ ކާބަލުކަމަށް ދެއްވާ.
ފަހަރު ކުރިއަށްވާ މަސައްކަތު ކުރިނު

1- ކުރީގެ މަސައްކަތް
2- މަޖިލީހުގެ މަސައްކަތް
3- ތަފާތު ގިނަ ފައްތަރުގެ އިންޖީނު ކުރިއަށްދަތުރު ކުރެވޭނެގޮތް ނެތުން

ޖާގަނެ ކިޔަވައި ނިމުމުން އެނގުނު/ ފިހާރުން ބޯޑުން މަސައްކަތް ކުރުމަށް ދާ ދާއިރާތަކާ ގިނަ އަނގުން ބޯޑުން މަސައްކަތް ކުރަނީ ސަރުކާރު ވަޒީފާގައި، މިހަރުގައި މާއިމާނީ ގޮތުގައި ފިހާރުތަކުން މަސައްކަތް ކުރަނީ ކޮންސްޓްރަކްޝަން މަސައްކަތުގައި، ރިސޯޓް ދާއިރާ އަމިއްލަ ވިޔަފާރީގެ މަސައްކަތް. 2011، 2012، 2013 ގައި އެތެރެވެ ނިމޭ ގިނަކުދިން ކޮލެޖަށް ފިހަރަމަކުރުމަށް ޒަރޫރީ ވެއެވެ.

ރިސޯޓު މިއަތޮޅުގައި ހެދުމުގެ މަސައްކަތް ކުރަމުންދާ އަޅެ ދިނަފުހަރަށް އިތުފައި އޮންނަނީ. ވަރަށް އުމާލު ދިނަ ރިސޯޓުތަކުގެ ހެދުމަށް ރަށްތަކުގެ ދުވަފައިވާކަމަށް ޙިޔާތަކުން އަޅެއިފައި ވާތީ. މިގެ ދުރިއްޖެ އަޅެތަކުގެ އިއްތިފާގު ނުވެ. އަދަދު ގޮތުންފަށް މަސައްކަތް ކުރުވުމުންނާއެކު ފެށުނު. އުއްމީދު ކުރަނީ އިސްރާރުކުރުވިއްޔާ މާލަސްތަކުގެ ޖިއަ ދު ރިސޯޓުގެ އަދަދު މަސައްކަތް ވީ އުންސުރުއަރަހަކަން ފެށޭނެ ދުވަހަކަށް.

އަޅުގަނޑުމެން އާއްމުން ދުއްކުރާ ނުކުރެން ރިސޯޓުތަކުގެ ތަރައްޤީ ފުރަގަސް އާއްމުން ނޫރާ އަސަރުތަކުގެ ކުރާނުކަމަށް. އަޅުގަނޑުމެން ދެކޭ ހަވާސާ އަތޮޅުގެ ގިނަބަޔަކަށް ރިސޯޓު ދާއިރާއިން ވަޒީފާ ލިބި އާމްދަނީ ރިސޯޓުތަކުންވެސް ގިނަ އުފެދިގެންދާނެ އަޅުގަނޑުމެން އަތޮޅުގެ ރަށްތަކަށް ލިބިގެން ދިޔުން.

މިއަދު ބާވުން ހެދުމަށް ހަމަޖެހިފައިވާ ވީ ތަން ޑޮ ގައި ހިޔާލުމަށް ވެ ކޮޅުން ބޭނުންވާ ޓޫރިޒަމް ތަރައްޤީ ރިސޯޓު ތަކުން ވިހެވެސް ގިނަ ވަޒީފާ ވެ އަތޮޅުގެ ރައްޔިތުންނަށް ލިބިގެން ރިސޯޓުތަކުގެ ސަރަހައްދު އުމްރާނީ ތަރައްޤީއާއި ވިޔަފާރި ތަރައްޤީގެ ކުރިއެރުންތަކަށް ލިބޭނޭރަތަކަށް މަސައްކަތް ކުރިވެގެން ދިއުމަށް.

ބައްދަލު ފުރުޞަތު ބައިވެރި ފަރާތްތަކަށް

1 ކައުންސިލްގެ ނައިބު ރައީސް މުޙައްމަދު އިލްޔާސް

2 ކައުންސިލް މެމްބަރު އަލީ އައިމަން

3 ކައުންސިލް މެމްބަރު ޙުޒާ ޙުސައިން

4 ކައުންސިލްގެ ވަގުތީ ޖެނެރަލްޑިރެކްޓަރު ޒާހިދާ ސަލީމާ

މުޙައްމަދު އިލްޔާސް

ކައުންސިލްގެ ނައިބު ރައީސް

ޤާޒީމަގު، ރ.އުނގޫފާރު، ދިވެހިރާއްޖެ
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بسم الله الرحمن الرحيم

މާޅޮސްމަޑުލު އުތުރުބުރި ދުވާފަރު ކައުންސިލްގެ އިދާރާ

ރ. ދުވާފަރު، ދިވެހިރާއްޖެ

ސީ ޖީ އީ ގެ ބަޔަކު ބޭފުޅުންނާއި އެކު ބޭއްވި ޖަލްސާގެ ޔައުމިއްޔާ

17 މާރިޗް 2014 (ހޯމަ)

ފެށުން:

މިބައްދަލުވުމަކީ ސީ ޖީ އީ (އިޖުރާ އިންވެސްޓްމަންޓް) ގެ ފަރާތުން މިއާދާގެ ކައުންސިލަރުންނާއި ބައްދަލު ކުރެއްވުމަށް އެދި ލިޔުއްވުމުން މިއާދާގެ ފަރާތުން އިންތިޒާމުކުރި ބައްދަލުވުމެކެވެ. ބައްދަލުވުން ފެށީ 12:30 ގައެވެ.

ބައްދަލުވުމުގައި ބައިވެރިވި ފަރާތް :

ޒަކީ ޝާކިރު (ކައުންސިލަރ) ،އިބްރާހިމް (ކައުންސިލަރ) ، މުޙައްމަދު ޒަކީ (ސީ ޖީ އީ ގެ މެނޭޖަރ އިންވެސްޓްމަންޓް ސްޕެޝަލިސްޓް) މި ބައްދަލުވުމުގެ ރިޔާސަތު ބެލެހެއްޓެވީ ކައުންސިލްގެ ނައިބުރައީސް އަލްފާޟިލް ޒާހިރު އަޙްމަދު އެވެ.

މަޝްވަރާ/ ހުށަހެޅުން ކަންކަން :

ސީ ޖީ އީ އާއި ކައުންސިލާއި ދެމެދު ބައްދަލުވުމުގައި މަޝްވަރާކުރެވުނު ދެކަމަކީ ދެކޮޅުން ވާހަކަ ތަކާ އިޖުރާ އިންވެސްޓްމަންޓްގެ ފަރާތުން ރ.އަތޮޅުގައި ޓޫރިޒަމް ތަރައްޤީކުރުމަށް ރ.އަތޮޅުގެ ދެރަށެއްކަމުގައިވާ މަޑުވާފަރާއި ހުރަވަލްހިއެވެ.

މިދެރަށުގެ ކުރިއުމާއި ރަށުގައި އިމާރާތްކުރުވާނެ އިމާރާތްތަކުގެ މައުލޫމާތު ހިއްސާކުރިއެވެ. އަދި ކައުންސިލުން ރަށުގެ އިޖުތިމާއީ ގޮތުން ދުވާފަރުގައި ކުރުމަށް އެދެނީ ކޮންކޮން ކަންތައްތައްކަމާ މަޝްވަރާކުރުމުން ދިޔައެވެ.

އެފަރާތުން ކައުންސިލުން ވާހަކަދެއްކެވި ޓޫރިޒަމް އިންޑަސްޓްރީއަށް 2 ރަށެއް ތަރައްޤީކުރުމަށް ގެންގުޅެވޭ ކޮންސެޕްޓްގެ ވާހަކަ މަޝްވަރާއެވެ.

އެފަރާތުން އެކޮންސެޕްޓްގެ ސަބަބުން ކައުންސިލުން ރަށަށް ބޭނުންވާނީ ކޮންކަހަލަ ކަންތައްތަކެއްކަން، ކައުންސިލުން އެފަރާތާ މަޝްވަރާ ކުރުމުން އެއީ ޖާގަދިނުން ވަޒީފާއާއި، ޓްރެއިނިންގ ފުރުޞަތު ހޯދުމަކީ ބޭނުންވާ ކަމެއްކަމުގައި އަދި

އެފަރާތުން ކައުންސިލަރުންނާއި ސަވާލުކުރުމުން ދުވާފަރު ރައްޔިތުން އާމްދަނީ ހޯދުމަށް ހިންގޭ ކަންތައްތަކާ މަޝްވަރާ ކުރެވުނެވެ. ކައުންސިލުން އެފަރާތުން ކައުންސިލަރުންނަށް މަޝްވަރާކުރުމުން މިކަމުން ނުކުމެވޭ އަސަރުތަކާއި ޕްރޮޖެކްޓްތައް ހިންގާ ތަރައްޤީކުރުމުގެ ރަށުގެ ތަރައްޤީއަށް ބޭނުންވާ ކަންތައްތަކެއް، މިކަމުން ތަރަށް ދަނީ ބޭނުންވާ އެހީތެރިކަން ނުކުތުން ބެހޭ ކަންތައް ކޮށްދިނުމަށް ހުށަހެޅުން ތަރައްޤީގެ ބައްދަލުވުން ކުރުމަށް ތަރައްޤީގެ ކުރިޔަށް ދިޔުމަށް ހުށަހެޅުމަށް ކައުންސިލުން އެދުނެވެ.

ބައްދަލުވުން ފެށުން/ ނިމުނުގަޑި:

އެފަރާތުން މިމަޝްވަރާގެ ހިމެނޭ ކަންތައްތައް ރިޕޯޓަށް ގެނެސް ބައްދަލުވުމުގެ ހުށަހެޅުން ތަރައްޤީގެ ހުށަހަޅާނަމަކަން ދަނީ ކައުންސިލުން ސްކޫލްރާއި ކުރިމަށް 12:30 ފެށިގެން 13:30 ގައި ނިންމާލެވުނެވެ.

North Maalhosmadulu Dhuvaafaru — މާޅޮސްމަޑުލު އުތުރުބުރި ދުވާފަރު
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بسم الله الرحمن الرحيم

މާޅޮސްމަޑުލު އުތުރުބުރީ މާކުރަތު ކައުންސިލްގެ އިދާރާ
މާކުރަތު، ދިވެހިރާއްޖެ

ބައްދަލުވުމުގެ ޔައުމިއްޔާ

ތާރީޚް: 17 މާރޗް 2014 | ފެށިގަޑި: 15:06 | ނިމުނުގަޑި: 15:19

ބައްދަލުވުމަށް ހާޒިރުވި: ކައުންސިލްގެ ރައީސް އަލްފާޟިލް އަޙްމަދު ޝަފީޤް އާއި ކައުންސިލްގެ ނައިބުރައީސް އަލްފާޟިލް ސަޢުދުﷲ މުޙައްމަދު އާއި ކައުންސިލް މެމްބަރ އަލްފާޟިލް އިބްރާހީމް ރިޟާން އާއި ކައުންސިލް މެމްބަރ އަލްފާޟިލް އަޙްމަދު ރަޝީދު އާއި ކައުންސިލް މެމްބަރ އަލްފާޟިލާ މަރްޔަމް ސަޢީދާ އާއި ޖެނެރަލް އަލްފާޟިލް ޢަބްދުﷲ ނަޢީމް އާއި ބޭރުން އެންވަޔަރަމަންޓަލް ސްޕެޝަލިސްޓް މުޙައްމަދު [illegible] އާއި އެޑްމިނިސްޓްރޭޓިވް އޮފިސަރ އަލްފާޟިލާ ބަދުރުއްނިސާ ޢަބްދުﷲ އެވެ.

ސެކްރެޓޭރިއޭޓް ބެލެހެއްޓީ: އެޑްމިނިސްޓްރޭޓިވް އޮފިސަރ އަލްފާޟިލާ ބަދުރުއްނިސާ ޢަބްދުﷲ

ބައްދަލުވުމުގެ މަޤްޞަދު: ރ. މާކުރަތުގައި އަލަށް ހެދުމަށް ހަމަޖެހިފައިވާ [illegible] ދިރާސާ ހެދުމަށް އީ.އައި.އޭ ރިޕޯޓް ތައްޔާރު ކުރުމަށް ބޭނުންވާ މައުލޫމާތު ހޯދުމާއި، އެކަމުގެ މައުލޫމާތު ކައުންސިލަށް ދިނުމަށް ބާއްވަން ބައްދަލުވުމެކެވެ. ބައްދަލުވުން ފެށުނީ 15:06 ގައެވެ. މިބައްދަލުވުމުގައި ބޭރުން އެންވަޔަރަމަންޓަލް ސްޕެޝަލިސްޓް އަލްފާޟިލް މުޙައްމަދު [illegible] ދެންނެވީ މިބައްދަލުވުމުގެ މައިގަނޑު މަޤްޞަދަކީ [illegible] ކައުންސިލަރުންނާއި ވާހަކަ ދައްކާ [illegible] ކަމަށެވެ. އަދި ބައްދަލުވުމުގައި ބައިވެރިވި [illegible] ފާހަގަކުރެއްވިއެވެ. އެގޮތުން ޖެނެރަލް އަލްފާޟިލް ޢަބްދުﷲ ނަޢީމް [illegible] މިރަށުގެ އާބާދީގައި 1224 މީހުން [illegible] ނޫންކަމަށެވެ. އަދި [illegible] ފާހަގަކުރެއްވިއެވެ. އަދި [illegible] ފާހަގަކުރެއްވިއެވެ. އަދި [illegible] ފާހަގަކުރެއްވިއެވެ. ކައުންސިލް މުޙައްމަދު [illegible] ފާހަގަކުރެއްވިއެވެ. ޖެނެރަލް އަލްފާޟިލް ޢަބްދުﷲ ނަޢީމް [illegible] ކުރެއްވިއެވެ. އަދި [illegible] 2 [illegible] ފާހަގަކުރެއްވިއެވެ. މިބައްދަލުވުން ނިމުނީ 15:19 ގައެވެ.

16 ޖުމާދަލްއޫލާ 1435
17 މާރޗް 2014

އަޙްމަދު ޝަފީޤް
ކައުންސިލްގެ ރައީސް

بسم الله الرحمن الرحيم

ފާސްކުރެއްވުން ބޭނުންކުރާ ކުރެހުން ކަންތައްތަކުގެ ތަފުސީލް

ން. ފުރުވެރިކަން، ދިވެހިރާજ્ય

ސ.ބ.ން ފުރަތަމަ ވިހާގެ ކަންބަންދުން ދުރަހަރުގެ ތެރެއިން ން.ފުރުވެރި ކަންތައްތަކުން ހެދިފައިވާ ބަދަލުތަކާ ބެހިގެން ވަނީން ދަންނަން.

ބަދަލުން ފެންވަރުން: 15:06 ބަދަލުން ނިންމި ތާریخ: 15:19 ތާریخ: 17 ފެब्रުވަری 2014 (ބુધ)

#	ނަން	ބަދަލު	ދަންނަން	ބަދަލު	ފައިސާ ބަދަލުކުރާ	ސޮއި
1	ބަންޑާ ބަންދާ ښوؤން	ބަންދާ ކ. ފުރުވެރި	ކަންތައްތަކުގެ ބަދަލު	ން. ފުރުવેરિ ކަންތައްތަކުގެ ތަފުސީલ્	7,990,353	
2	ބަންؤ ښوؤ ښاهد الله ذبراهدر	ؤؤزروش، ކ. ފު
ેરિ	ކަންތައްތަކުގެ ބަދަલ દ	ން. ફુરુવેરિ ކަންતથ્તથ્તકુગે તફુસીલ	7,608,765	
3	ބَنؤ ښوؤ ببرحدر برښوؤر	�ؤؤ، ક. ફુરુવેરિ	ક્રમાંક	ક્રમાંક	7,699,957	
4	ક્રમાંક	ક્રમાંક	ક્રમાંક	ક્રમાંક	7,503,005	
5	ક્રમાંક	ક્રમાંક	ક્રમાંક	ક્રમાંક	7,767,252	
6	ક્રમાંક	ક્રમાંક	ક્રમાંક	ક્રમાંક	7,794,682	
	ક્રમાંક	ક્રમાંક	ક્રમાંક	ક્રમાંક	9,701,910	
7	ક્રમાંક	–	ક્રમાંક	ક્રમાંક	7,906,007	

APPENDIX L – Letter of Commitment to Monitoring

IFURU INVESTMENT PVT LTD

120, Majeedhee Magu, Male' 20-01, Republic of Maldives

Hon. Thorig Ibrahim
Minister
Ministry of Housing and Environment
Male', Republic of Maldives

31 April 2014

Dear Sir,

EIA for the proposed Resort Development Project at Muravandhoo Island, Raa Atoll

As the proponent of the above mentioned project, I hereby confirm our commitment to carry out and bear costs of environmental mitigation measures and monitoring outlined in the EIA report.

Sincerely,

Ahmed Waheed