

ENVIRONMENT IMPACT ASSESSMENT

FOR THE PROPOSED

GEOTECHNICAL STUDIES AT THILAFUSHI LAGOON, KAAFU ATOLL

August 2017

Prepared for

China Harbour Engineering Company Limited, China

Consultant

CDE Consulting, Maldives



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List of Abbreviations

COADS	Comprehensive Ocean-Atmosphere Data Set
CHEC	China Harbour Engineering Company Limited
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
GPS	Global Positioning System
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
IUCN	International Union for Conservation of Nature
MEE	Ministry of Environment and Energy
MED	Ministry of Economic Development
MSL	Mean Sea Level
NAPA	National Adaptation Programme of Action
NE	North East
NEAP II	National Environmental Action Plan II
NW	North West
SE	South East
SW	South West
TCL	Thilafushi Corporation Limited
TDS	Total Suspended Solids
ToR	Term of Reference
UNFCCC	United Nations Framework Convention on Climate Change and the Kyoto Protocol

Acknowledgement

The lead author of this report is Dr. Ahmed Shaig

Additional assessments and field assistance were provided by the following team members.

Mr. Mohamed Faizan (Marine environment assessment)

Mr. Ali Moosa Didi (Surveying)

Mr. Mohamed Ali (Marine Environment Specialist)

Mr. Ahmed Haiman Rasheed (Field Assistant)

The curriculum vitae's of the EIA consultants are attached in Appendix G 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

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(See Appendix H)

Executive Summary

This document is submitted by China Harbour Engineering Company Limited to fulfil the requirements for an EIA under Environment Protection and Preservation Act and EIA Regulations to undertake the proposed geotechnical investigations on Thilafushi Lagoon.

The proposed activity requires drilling nine boreholes to depth of 30-40 m and extracting sediment samples for laboratory assessments. The project site is the presently undeveloped shallow northwest corner of Thilafushi Lagoon. This site has been designated as a zone for port development in the previous Thilafushi Master Plans. The proposed drill size is 6” and will be undertaken using a drill rig mounted on a small floating platform. Platform will be anchored using weights. Drilled holes will be filled with Bentonite up to the top 1 m. The remaining areas will be filled with sand.

This activity is part of the Thilafushi Container Port Study. The Proponent and Ministry of Economic Development has signed an MoU for an exclusive negotiation towards entering into an investment agreement for the construction, operation, management and financing of a seaport and free trade zone at Thilafushi Island, Male’ Atoll. The project is at its initial phase where its technical and financial feasibility is assessed. The project will only go into a design and construction phase only depending on the outcome of the assessment and the negotiations between the two parties. For the moment, the project requires surveying the project site to determine the technical feasibility. These include bathymetry surveys, geotechnical surveys and hydrodynamic studies.

The project site comprise of shallow reef flat and deep lagoon. The surroundings are in poor condition. The coral reef is largely dead with limited new recruits. The proposed impact foot print is covered with coral rubble and sand. Thilafushi lagoon has undergone years of modification and the marine water quality around it is known to be in the worst conditions of any lagoon in the Maldives.

The proposed activities 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 and Environmental Impact Assessment Regulation 2012.

This assessment shows that there are no significant impacts from the proposed activity. This is due to the limited the number of drill sites, the diameter of the drilling pipe, shallow depth at most sites, short drilling period, small impact foot print and absence of live coral cover or suitable substrate at the proposed drilling locations. Thus, no major mitigations measures are

recommended. However, best environmental practices when working coral reef environments have been recommended.

Consultations were held with Ministry of Economic Development and Thilafushi Corporation (TCL). Both parties consulted have no reservations on proceeding with the project. TCL has raised the concern that the overall port project MoU has been agreed with China Harbour Engineering without their input and asks MED to consult in the matter in the future. However, they have no issue in proceeding with the study. TCL have placed some conditions before the work can be carried out. These include regulatory clearances from EPA and to inform TCL one week prior to the start of work on site.

The alternatives evaluated for the project were the no project option, reduced number of boreholes and alternative options do deal with the abandoned drill holes. No alternative option was necessary as the activities as currently designed do not have significant impacts.

Monitoring programme proposed has focussed on water quality, noise and reef health.

It is recommended to proceed with the project using the mitigation measures and management plan presented in this EIA.

1 INTRODUCTION

1.1 Purpose of the EIA

This Environment Impact Assessment (EIA) report is an evaluation of the potential environmental impacts of the proposed geotechnical studies in Thilafushi Lagoon, Male' Atoll.

This document is submitted to fulfil the requirements of Environmental Protection and Preservation Act (EPPA) of the Maldives (4/93), more specifically the clause 5 of the Act which states that a report should be submitted before implementation of any project that may have a potential impact on the environment.

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.

The project was submitted for screening to EPA and a decision note was issued to prepare an Initial Environmental Examination (IEE). However, the EIA regulation requires either an Environmental Management Plan (EMP) or and EIA after the IEE process. This would increase the processing time and cost of evaluation compared to an EIA. This the proponent has decided to proceed with an EIA to speed up the process.

1.2 Project Title

The overall project title is Thilafushi International Container Port Study. This component of the study is called the Geotechnical Study of Thilafushi Lagoon.

1.3 Project Proponent

The proponent of this project is China Harbour Engineering Company (CHEC) Limited, China. Proponent details are as follows:

China Harbour Engineering Company Limited

NO. 9 Chun Xiu Road, Dong Zhi Men Wai

Beijing, China

1.4 Legal status of the Lagoon

Thilafushi lagoon is owned by Thilafushi Corporation. The Ministry of Economic Development (MED) is seeking to find an international developer for the port in coordination with Thilafushi

Corporation. MED has an MoU signed with CHEC to undertake the port study. MED has provided authorization for CHEC to undertake the study within the designated project boundary.

1.5 Project Background and Scope Summary

As noted above, CHEC and MED has signed an MoU for an exclusive negotiation towards entering into an investment agreement for the construction, operation, management and financing of a seaport and free trade zone at Thilafushi Island, Male' Atoll.

The project is at its initial phase where its technical and financial feasibility is assessed. The project involves international container berth and domestic container berths, container yards, container freight stations approach channels and harbour basins, and auxiliary building area. The project will only go into a design and construction phase only depending on the outcome of the assessment and the negotiations between the two parties.

For the moment, the project requires surveying the project site to determine the technical feasibility. These include bathymetry surveys, geotechnical surveys and hydrodynamic studies.

The scope of this specific activity is to undertake geotechnical assessments at 9 points along the proposed project site in Thilafushi Lagoon. This requires drilling within Thilafushi Lagoon using a 4" diameter drill and removing the core for analysis.

A separate EIA will be submitted to the overall Port project at a later stage, if the project is feasible.

1.6 Project Location and Boundary

The proposed project site is located on the western end of Thilafushi Reef. Site location map and satellite image showing the project boundary is presented in Figure 1.1. Figure 1.2 shows the sensitive environments with in the vicinity.

1.7 Project Objectives and Rationale

The objective of this activity is to determine the soil characteristics at the site to determine the design criteria for piling and other engineering works. The survey is necessary to understand the substrata at the site cost the project adequately. It is also necessary to determine the technical feasibility of the piling works.



Figure 1.1: Location Map and Project Boundary

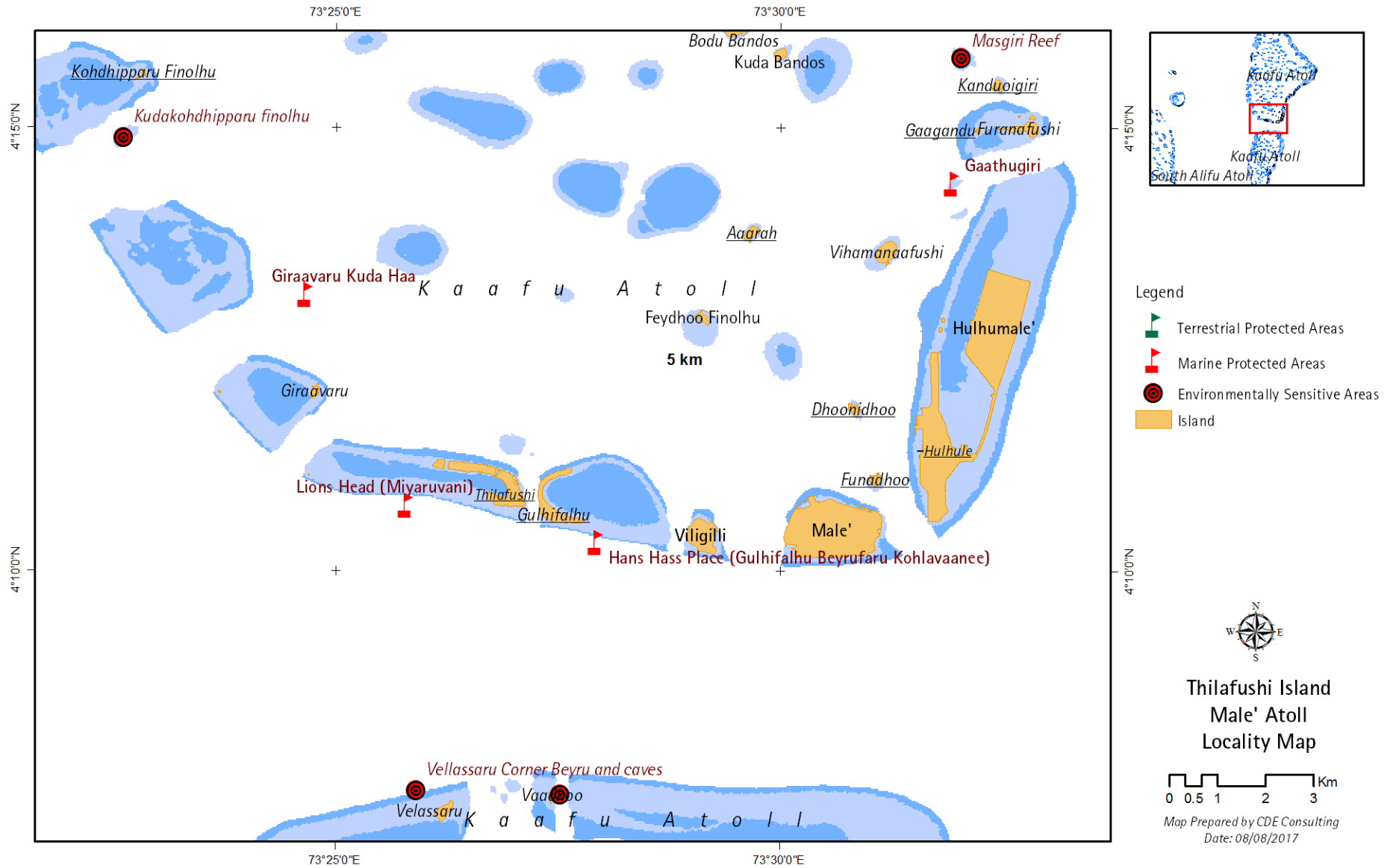


Figure 1.2: Locality map showing nearby islands and declared environmentally sensitive areas

1.8 Consultants, Contractors and Government Institutions

All the EIA related work was undertaken by consultants from CDE Consulting. Geotechnical contractor is also CDE Consulting.

The Government agency relevant to this development is Ministry of Economic Development.

1.9 Project Financing

The activity is financed by China Harbour Engineering Company (CHEC) Limited

1.10 EIA Scope and Terms of Reference

The scope of this EIA is broadly based on the Environmental Impact Assessment Regulations 2012. The assessment more specifically adheres to the Terms of Reference (ToR) issued by the Environmental Protection Agency on 17th August 2016. The ToR is based on scoping meetings held at EPA on the same day. A copy of the ToR is attached in Appendix A.

1.11 Assessment Methodology

1.11.1 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.

1.11.2 Field Observations

Field assessments were undertaken on the site on 8 August 2017. Field visits mainly covered reef system, lagoon physiography, wave conditions assessment, and water quality. In addition, public and stakeholder consultations were carried out.

Coastal Processes

A cursory assessment of surface currents on the lagoon surface was undertaken using drogue method on 8 August 2017. The water was shallow on the reef flat to deploy conventional current meters on the reef flat. About three measurements were taken and the average is presented. Measurements were taken at flood tide.

Tidal data from Hulhule Tide Gauge was used. No In situ wave measurements were undertaken. Studies undertaken for Thilafushi waste management project was used.

All measurements were taken during SW monsoon and no measurements have been undertaken in NE monsoon.

Marine Assessments

Marine assessments were undertaken on the northern side and project site on 8 August 2017. The sea was moderately rough during the surveys. The main objectives of this assessment were:

1. to determine the general status of the reef associated to the study site
2. to assess the condition of the marine environment which will be directly impacted by the project
3. to determine the fish species abundance and composition of the reef system

Fish census

Fish and invertebrates species assemblages and abundance was surveyed using 50 m line transects, whereby the monitor swam along transect and recorded the number and the different species of fish and invertebrates observed within 2.5 m either side of the transect line. A category-based methodology was adopted to estimate fish abundance and the mean number of fish per category and observation was extracted to estimate species and family abundance. The categories used to estimate abundance is displayed in Table 1.1.

Table 1.1: Fish abundance category

Category	Number of fish
1	1
2	2 - 4
3	5 - 16
4	17 - 64
5	65 – 256
6	256 – 1024
7	1025 – 4096
8	4097 – 16384

Photo Quadrat survey

Benthic composition was assessed by taking ten high-resolution images every 5 m (pictures covering 0.5 m², of the seabed) on the side of the 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).

Visual Survey

Visual surveys were carried out at select locations of the lagoon, and reef. General status of these sites were recorded, special attention was given to types of corals and fishes present at these sites and the environmental conditions that could affect growth such as suspended solids, depth, and other threats to coral life.

Water Quality

Water quality was assessed from MWSC laboratory. Water quality samples were taken at two sites within the project boundary.

Parameters measured include pH, temperature, turbidity, Total Suspended Solids (TSS). Water samples were collected at mid depth.

1.11.3 Key Stakeholder Consultation

Stakeholder consultations were undertaken with the following stakeholders:

- Thilafushi Corporation
- Ministry of Economic Development

1.11.4 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

1.11.5 Report Format

The report format and structure presented here follows the report formatting guidelines issued by Environmental Protection Agency (EPA).

1.12 Potential Data Gaps and Limitations of the study

The main limitation of this study is the absence of long term hydrodynamic data. Published data was used to compensate this limitation.

2 PROJECT DESCRIPTION

2.1 Project Outline and Key Features

2.1.1 Project Features

The general scope of the detailed geotechnical work includes:

1. Mobilization/demobilization of all necessary equipment, technical personnel, skilled and unskilled labour on site;
2. Performing a geotechnical investigation at 9 sites including geological investigation, borehole drilling, in-situ testing and sampling at the approved locations;
3. Logging of soil/rock samples;
4. Submission of sufficient and representative soil/rock samples to the laboratory;
5. Performing necessary laboratory tests to determine soil/rock geotechnical properties for the design and construction of quay structures, dredging, reclamation, revetment and link road.
6. Preparation of a geotechnical investigation report summarizing the results from the site investigations and laboratory testing and presenting the associated geotechnical interpretation analysis.

2.1.2 Site Plan

The project site plan is presented in Appendix B. A reduced version is presented in Figure 2.1.

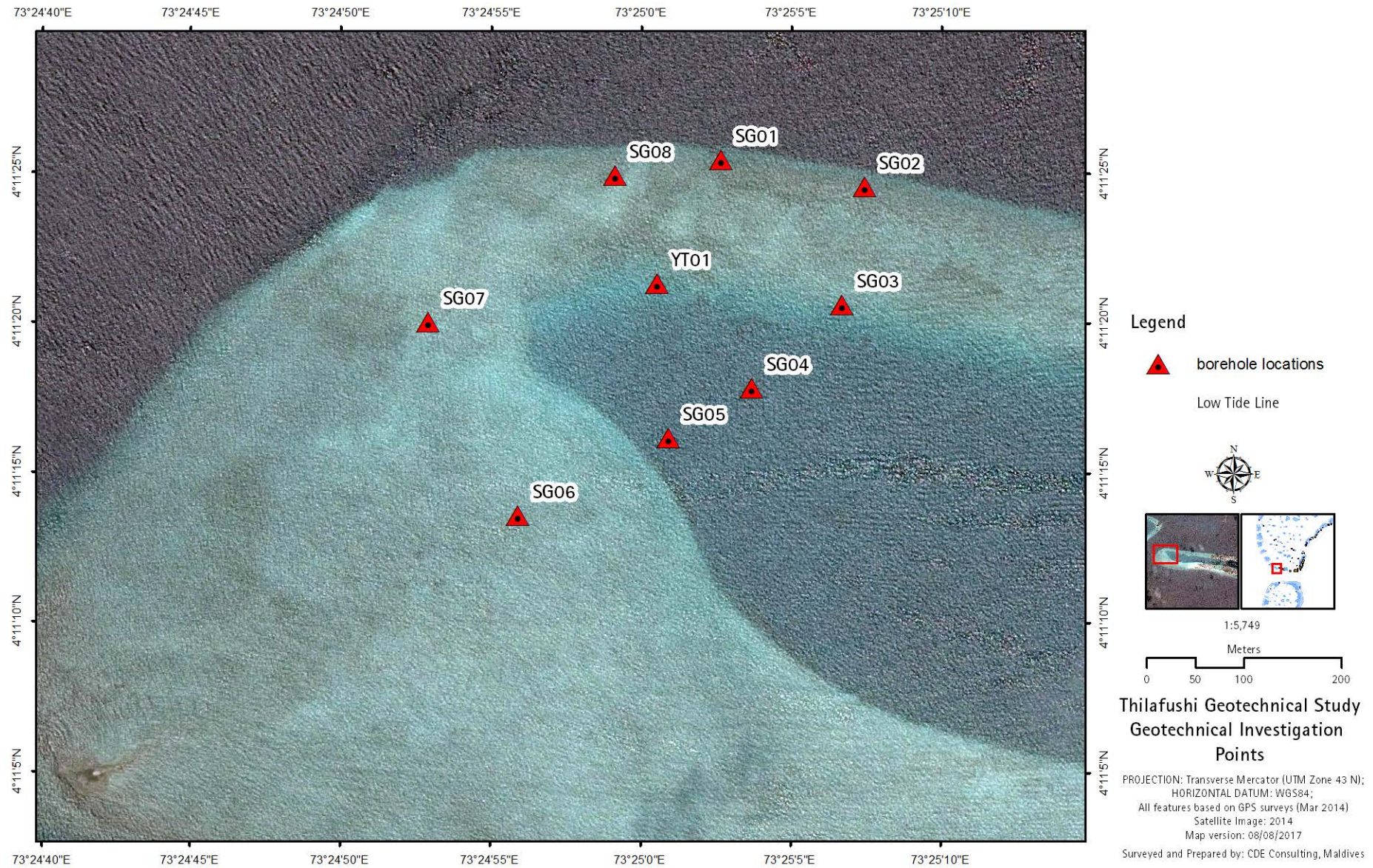


Figure 2.1: Proposed geotechnical investigation layout

2.2 Detailed Description of Project Components

2.2.1 Technical Requirements

A total of 9 boreholes will be investigated for the project. A total of 8 boreholes (SG01~SG08) are to be investigated for the maritime structures and one borehole (YT01) will be investigated for land reclamation area (See Appendix B).

All boreholes are SPT boreholes. And there are 4 sampling boreholes (sampling, field test, and laboratory test should be done), which number is SG01, SG02, SG04 and SG05. . The borehole YT01 is SPT borehole.

Drilling Depth

The following criteria should be adopted for bore hole drilling:

Table 2.1: Criteria for drilling works

Site	Criteria
SG01 and SG02	<p>Criterion 1: Drilled minimum -40m CD and ensure no soft soil layer below.</p> <p>Criterion 2: At least 8 m thick soil with SPT-N value greater than 50 or 5m thick coral rock is encountered.</p> <p>Criterion 1 and criterion 2 shall be satisfied</p>
SG04 and SG05	<p>Criterion 1: Drilled minimum -30m CD and ensure no soft soil layer below.</p> <p>Criterion 2: At least 8 m thick soil with SPT-N value greater than 50 or 5m thick coral rock is encountered.</p> <p>Criterion 1 and criterion 2 shall be satisfied.</p>
SG03, SG06, SG07 and SG08	<p>Criterion 1: The depth of all boreholes is greater than 10m;</p> <p>Criterion 2: At least 10m thick soil with SPT-N value greater than 35 or 5m thick coral rock is encountered</p> <p>Criterion 1 and criterion 2 shall be satisfied</p>
YT01	Drilled minimum -30m CD at least and N>30 for SPT

General requirements

Soil sampling is to be carried out at a vertical interval of 1.5 m. And at least two soil samples should be taken for each soil layers.

Standard Penetration Test (SPT) is to be carried out at an interval of 1.5m in every borehole until the bottom elevation.

If necessary, Vane Shear Test (VST) is to be carried out for all clays at the same interval with SPT.

Other Considerations

- If soft soil layers still exist until drill to the required bottom, please contact the designer in time or drill deeper.
- Do best to minimize soil disturbance during sampling and sample preparation period.
- All tests should be carried out in accordance with British Standard.
- To increase the organic content test for the present preserved and future soil samples.
- To increase the number of consolidation and secondary consolidation experiments for the soils with high organic content and take close attention to consolidation and secondary consolidation properties of the soils with high organic content and the containing rotten wood.
- Take attention to the wave affections. Don't work and take samples if there are waves.

Laboratory Testing

Table below lists the laboratory analysis requirements for marine structure areas and land reclamation area.

Table 2.2: Laboratory analysis requirements

Test Type	
COHESIVE SOIL	SILT
moisture content ;	Ultimate uniaxial compressive strength(nature, saturated, dry)
unit weight ;	softening coefficient
relatively density ;	WATER
void ratio ;	Simple analysis
degree of saturation ;	SPECIAL TESTS
liquid limit ;	Coefficient of permeability (vertical, horizontal);
plastic limit ;	Consolidated coefficient (vertical, horizontal);
plasticity index ;	Pre-consolidation pressure;
liquidity index ;	Appendiculate pressure;
direct quick shear test ;	Sensitivity ;
consolidated quick shear test;	Organic fraction[√];
unconfined compressive strength test ;	UU triaxial compression test ;
cone penetration ;	CU triaxial compression test (total stress) ;
consolidated-undrained triaxial test(total stress, effectives stress) ;	CU triaxial compression test(effectives stress) ;
poisson's ratio μ ;	Compressive index, swelling index, and consolidation ratio should also be provided for soft soil layer.
module of groundsill reaction (lateral, vertical) $k (KN/m^3)$ or module of compression E_s (lateral and vertical)	Secondary compression index(C_α) should also be provided for cohesive soil layer below sand layers if cohesive soil are found in maritime structures area.
OCR (over consolidation ratio)	Coefficient of compactness
Organic Content	

2.2.2 Justification for the location and number of boreholes

The proposed locations for the boreholes have been determined as the proposed site for the Port project More specifically it aligns with sheet piling sites and land reclamation sites. The proposed number of boreholes is the minimum requirement to understand the geological condition of the site. There are no other similar assessments done in the site, except for sporadic borehole surveys on Thilafushi Island.

2.2.3 Drilling Equipment and Method

Borehole investigation is carried out using a floating barge custom manufactured for this purpose only (See Figure 2.2). The floating barge has a capacity of around 12 MT. It needed to be anchored rigidly at the location of drilling in order to proceed with investigation. Anchoring is usually done using weights with a standard anchor. The depth of water of the site is between 1.0 m to -8.0 m in offshore investigations.



Figure 2.2: Image showing borehole drilling plat form and equipment

A drill rig which can penetrate around 50 m is used for drilling purpose. The diameter of drilled hole is 150 mm and required length of casing (See Figure 2.3) is driven down for the purpose of extraction of samples. The drill rig is pre-fixed with a test hammer weighing 63.5 kgs as per BSEN-22476-3 standards. The hammer is used in the Standard Penetration Test (SPT) conducted for assessing N values of soil at various predetermined depths.

The Standard Penetration Test is conducted using the split barrel sampler at various depths to determine the 'N' value of the soil. SPT is conducted at prescribed intervals in each borehole to determine penetration resistance as per BS 1377-9:1990 and BSEN 22476-3. Number of blows is recorded for every 15 cm penetration up to 45 cm penetration. The number of blows required to drive the sampler for 30 cm beyond seating drive is termed as penetration resistance 'N'. Refusal is said to have been reached when the sampler penetrates less than 15 cm under 50 blows. The SPT value in each borehole at different depths has been recorded.



Figure 2.3: A view of Split barrel sampler with coral sand collected

Temporary Works

The floating barge will be mobilized to the site and anchored. A boat will be hired to stay close to the site as the main office. The boat will have facilities for food and manager's post.

Surveying & positioning system

Horizontal coordinate and height systems both adopt the systems in accordance with local regulations.

Surveying & positioning method

RTK surveying and R7 or 5700 GPS produced by Trimble (the US) are adopted, with the addition of a GPRS/CDMA data chain so as to increase the length of the RTK data chain and to meet the requirement for long-distance hole release.

Drilling works

For all drill holes, rotary drilling, full-hole section coring casing pipes or slurry wall protection may be adopted. For the upper covering layer, core barrels with a diameter of 150 mm are used to obtain the soil core. For the bed rock section, core barrels with a diameter of 91~118 mm are used to obtain the soil core. Based on drilling workload, 2 drilling rigs and matching drilling tools thereof are equipped in this drilling work, and special windlasses are provided on the platform for 24 h operation. Before drilling is completed, the drilling cannot be stopped normally.

Wall protection method

For the unconsolidated surface layer, borehole wall protection by casing pipe is adopted until the hard soil layer. For the lower soil layer, the high-quality slurry made of bentonite is utilized as circulating fluid for slurry wall protection. To ensure the viscosity and sand ratio of slurry, new slurry is supplemented in a timely manner. In the drilling process, it's required to pay attention to the observation and recording of shrinkage cavities of soft soil or sand layer, borehole wall sloughing as well as sand gushing.

Soil, sand and coral sand sampling

For clay soil (if any), generally one undisturbed sample at a sampling interval of 1.5 m-2.0 m shall be collected. If there's any change in the soil layer, samples shall be taken immediately. In the sandy soil and coral sand layers, in addition to collecting disturbed sand samples through core barrels and standard penetrometers, it's also required to collect some undisturbed sand samples through undisturbed sand samplers at a maximum sampling interval of not more than 3.0 m.

For the coral reef layer, large-sized core barrels shall be used as far as possible to collect the rock core samples maintaining a natural structure.

Rock sampling

For the intensive weathered layer, 1 representative sample at a sampling interval of 2~3 m may be adopted; for the medium and weak weathered layers, 1 representative sample at a sampling interval of 3~5 m may be adopted. If there's no representatively complete rock core, point load test samples may be selected. In case that the thickness of a single layer is not less than 5 m, 1 representative sample may be selected at the upper, middle and lower parts respectively, with an emphasis on the bearing stratum within 10 m above and below. 3~5 groups of rock samples may be adopted in the test. The quantity of rock samples in each layer shall meet specifications and technical requirements. Rock samples shall be packaged and labelled in a timely manner.

For the coral reef layer, large-sized core barrels shall be used as far as possible to collect the rock core samples maintaining a natural structure.

Drill hole management

The drilled holes will be filled with Bentonite until the top 1.5 m. The top 1.5 m will be filled with sand.

2.3 Construction process and program

The proposed study is expected to be completed in 3 weeks. Drilling works are expected to be undertaken within 2 weeks using two rigs.

Project work plan is presented in Figure 2.4.

2.4 Work Force and Services

Workforce

It is projected that the total number of employees during the peak drilling stage is expected to be around 10. Each unit will have a supervisor and 4 workers.

Accommodation

During the construction stage workers will be accommodated at Male' or in Thilafushi. A boat will take them to the site regularly.

Services

The contractor will be responsible for providing meals and services for the workers and it will be provided on site. The details of this component are unclear at this stage.

Hours of Operation

Drilling will only be undertaken during day time unless the schedule is severely affected by bad weather.

Geotechnical investigation for the proposed Thilafushi International Container Port Project, MALDIVES																																								
WORK PROGRAMME			Mobilisation										Drilling							Drilling & report							Report													
Sl.No.	Description	Days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31							
1	Mobilisation	10 days	[Bar]																																					
2	Drilling 4 No. of boreholes	7 days											[Bar]																											
3	Testing samples and obtaining lab reports of 4 No. of bores tested in 2 above	7 days																			[Bar]																			
4	Drilling 5 No. of boreholes																					[Bar]																		
5	Testing samples and obtaining lab reports of 5 No. of bores tested in 4 above with final report	7 days																										[Bar]												

Note - A:

The present schedule has been worked out for ideal conditions which may not be the so, while drilling the bores and it depends on :-

1. Soil strata at the bore site.
2. Weather conditions at site.
3. Unforeseen circumstances not visualised.

Figure 2.4: Project overall work plan

2.5 Waste Management, Logistics and Safety Measures

Site Office

Site office will be on a boat moored in Thilafushi lagoon. The boat is to have a toilet.

Construction Waste Management and Disposal

Waste would be general domestic waste arising from material consumption by construction workforce. These will be disposed in Thilafushi.

All material drilled are stored for analysis purposes.

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 (one barrel) will be on Thilafushi Island
- Fueling the generator will only be done in small ‘empty cooking oil’ containers.

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

2.6 Summary of Project Inputs and Outputs

The types of materials that will go into the survey and from where and how this will be obtained are given in Table 2.3 and the type of outputs (products and waste streams) and what is expected to happen to the outputs are given in Table 2.4. The tables show the inputs and out puts required for one island. Since the scope of works are the same in both islands the inputs and outputs will be similar as well.

Table 2.3: Major Project Inputs

Input resource(s)	Source/Type	How to obtain resources
Machine operators	Local and foreign, mainly foreign	Contractor staff
Operational Staff	Mainly Maldivians	Contractor staff
Material used	Bentonite, drilling heads and pipes	Contractor equipment and imported.
Water supply	Bottled water; pumped sea water	Purchase locally, on site pumping
Electricity/Energy	Petrol	10 kVa Generator
Firefighting equipment	Fire Pumps, Fire Protection System, Smoke Detectors, Carbon Dioxide and Foam Fire Extinguishers, etc.	Local suppliers

Table 2.4: Major Project Outputs

Output Source/Type	Quantity	How it will be dealt with
Potable water bottles	> 9 1.5 litre bottles per day	Disposed at thilafushi
General/domestic waste	< 1 kg	Disposed at thilafushi
Drilled material	As required	Taken out for testing

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 Environment 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 proposed drilling activity.

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.

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.

3.2.2 Regulation on Environmental Damage Liabilities (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.

3.2.3 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 in compliance with the EPA standards for waste management. Waste produced during the project will be taken to the designated waste management centre in Thilafushi.

3.2.4 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.

3.1 Environmental Permits Required for the Project

3.1.1 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 EPA 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, EPA may provide the Decision Note while at the same time requesting for further information.

3.2 Other Permits Required for the Project

3.2.1 Work Permit and Security Clearance

Project requires approval from Thilafushi Corporation to start drilling.

3.3 Responsible Institutions

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

3.3.1 Ministry of Economic Development

The Ministry of Economic development has an MoU with the developer and is the Agency responsible for authorizing the activities for the project and coordinating with other Government Agencies.

3.3.2 Thilafushi Corporation Limited

Since the proposed project location is managed by a government corporation, namely the Thilafushi Corporation Limited, a copy of this EIA report will need to be submitted to them and an acknowledgement letter of their receipt will need to be submitted along with the EIA report to EPA. Similar procedures has been applied for EIAs conducted in Hulhumale, where Hulhumale Development Corporation (HDC) is in charge of the island.

A copy of this EIA will have to be submitted to Thilafushi Corporation Limited.

3.4 Guiding Policies and Documents

3.4.1 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.

3.4.2 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.

3.5 International Conventions

3.5.1 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.

3.5.2 Convention on the Law of the Sea

UNCLOS provides a legal order for the seas and oceans to facilitate international communication, promote the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment.

3.5.3 International Convention for the Prevention of Pollution from Ships (MARPOL)

MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties

adopted in 1973 and 1978 and includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes Prevention of Pollution by Oil; Control of Pollution by Noxious Liquid Substances in Bulk; Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form; Prevention of Pollution by Sewage from Ships; Prevention of Pollution by Garbage from Ships; and Prevention of Air Pollution from Ships.

4 EXISTING ENVIRONMENT

4.1 Physical Environment

4.1.1 Meteorology

4.1.1.1 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

Source: Department of Meteorology

4.1.1.2 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.

4.1.1.3 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.

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 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 met data from Hulhule' (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.
	June	High Speeds from W.
	July	
	August	
	September	
Transition Period 2	October	Mainly from W.
	November	High Speeds from W

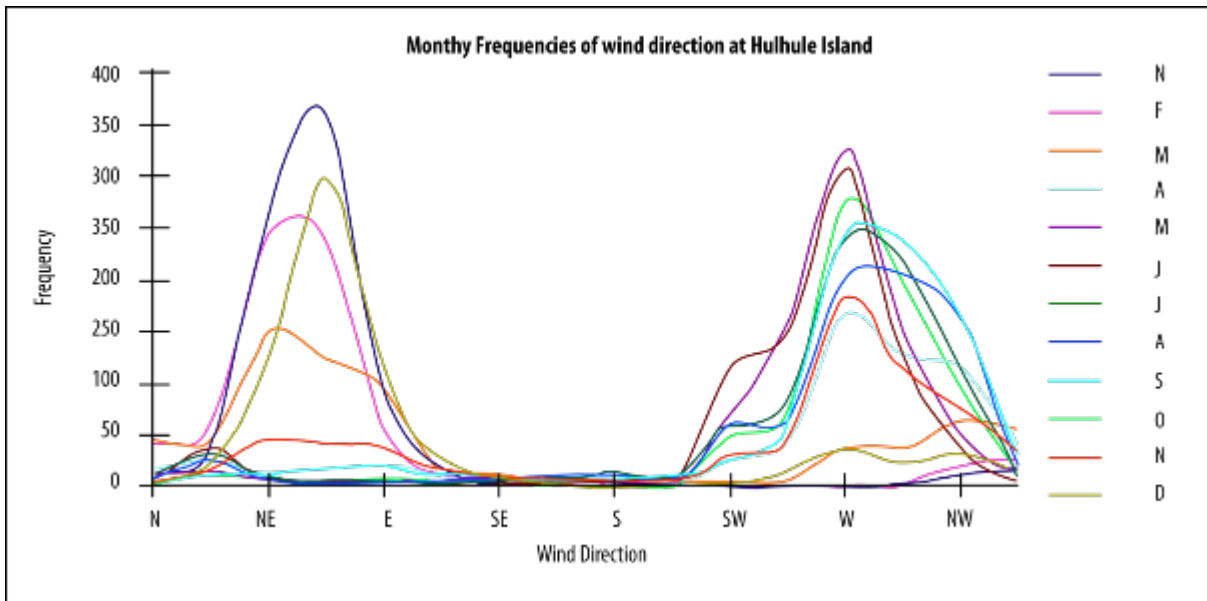


Figure 4.1: Monthly Frequencies of Wind Direction in Central Maldives based on National Meteorological Center 10 year Data (adapted from Naseer, 2003).

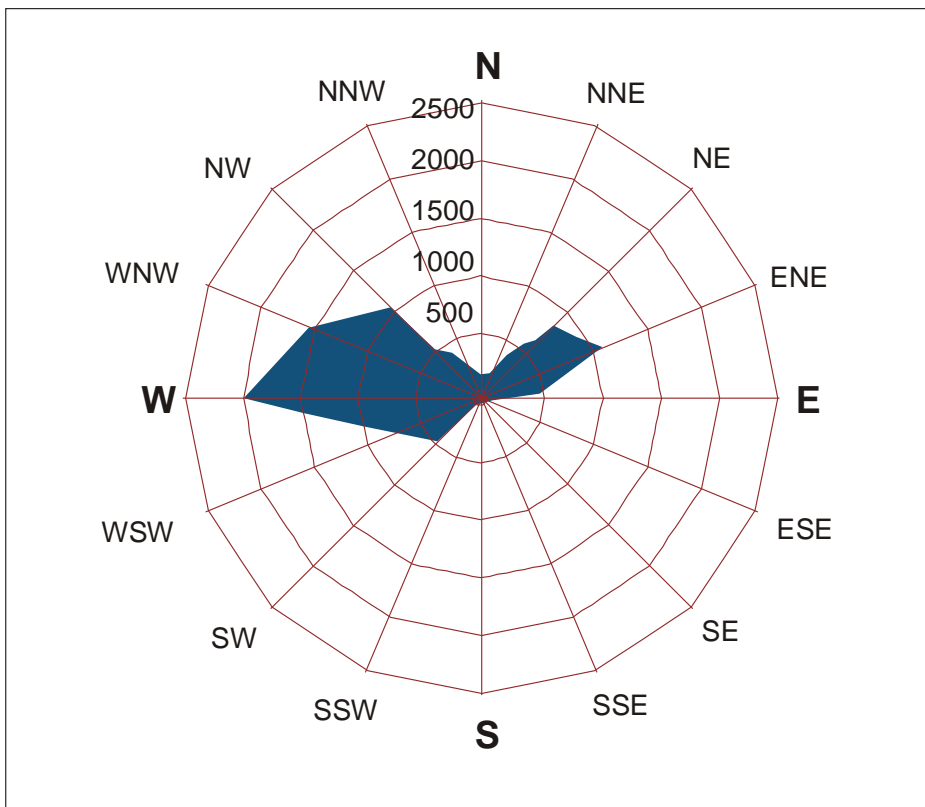


Figure 4.2: 24 Year Wind Frequency Recorded at National Meteorological Center.

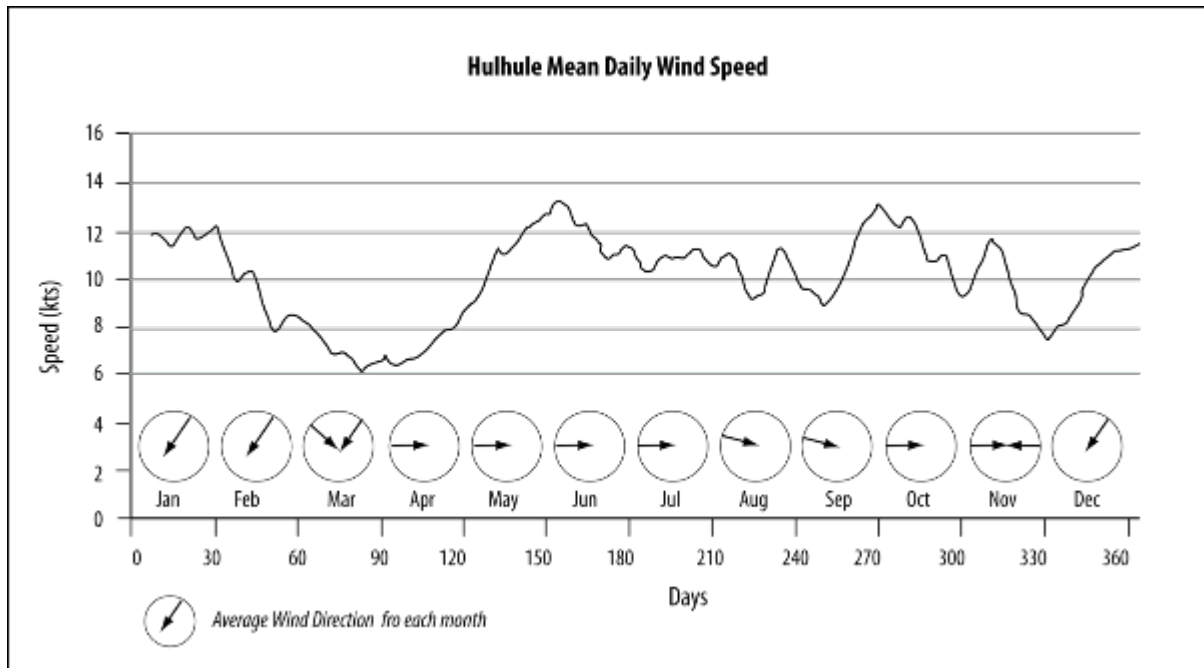


Figure 4.3: Mean Daily Wind Speed and Direction Recorded at National Meteorological Centre (1978 – 2004)

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.

Thilafushi is located in a moderate risk cyclonic hazard zones (UNDP, 2006). The project site is expected to receive regular annual strong winds during the peak SW monsoon.

4.1.1.4 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 Thilafushi 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).

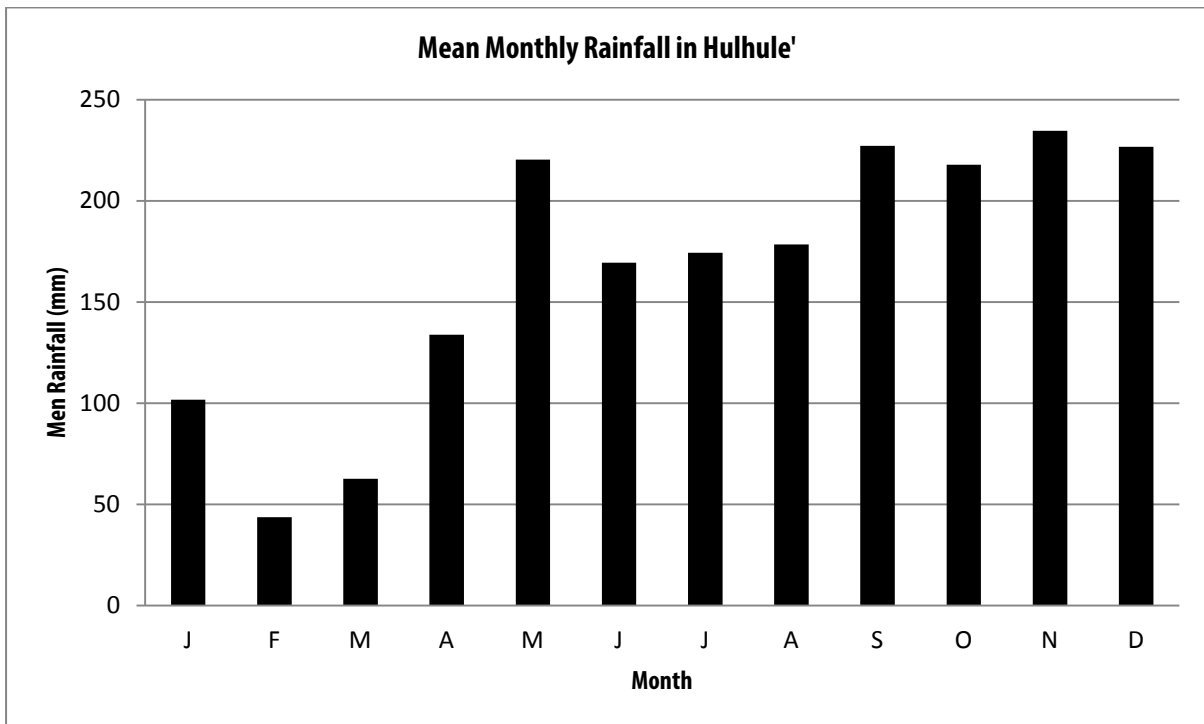


Figure 4.4: Mean Monthly Rainfall in Hulhule' (1975-2004)

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.

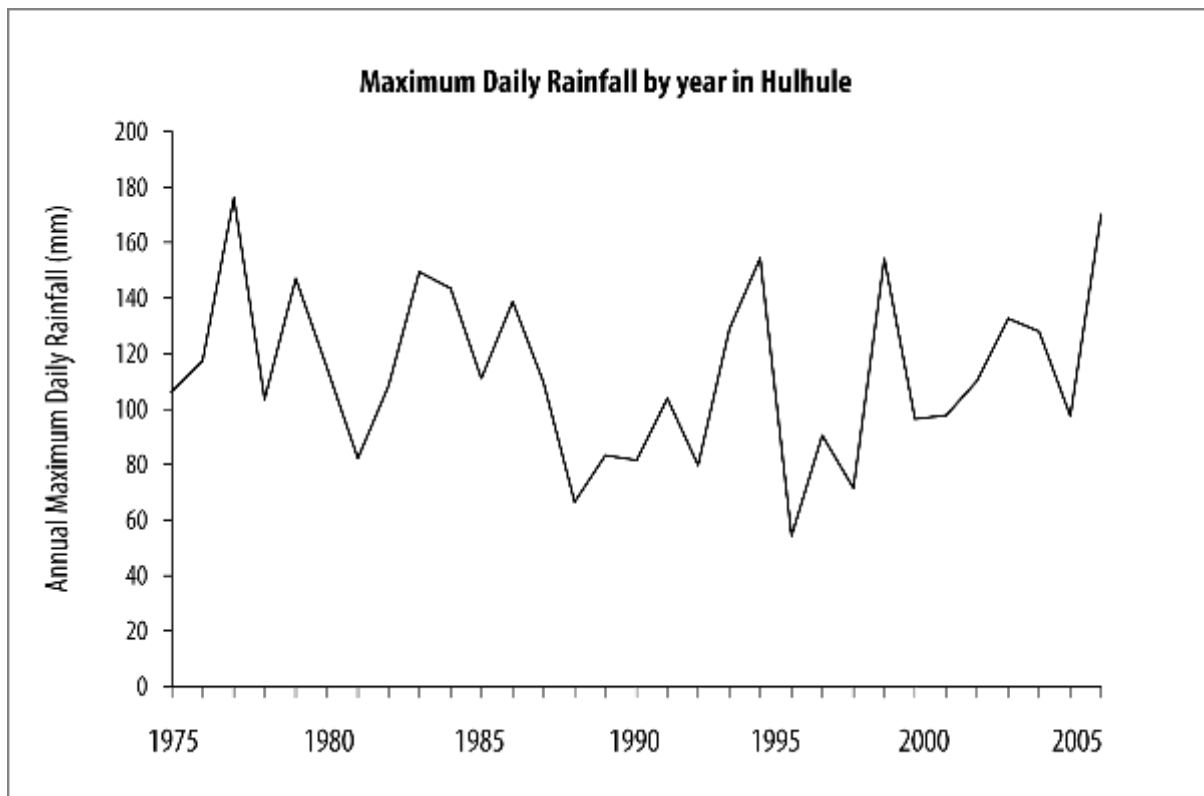


Figure 4.5: Maximum daily rainfall by year in Hulhule' (1975-2005) - (Source: Hay, 2006)

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)

4.1.1.5 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).

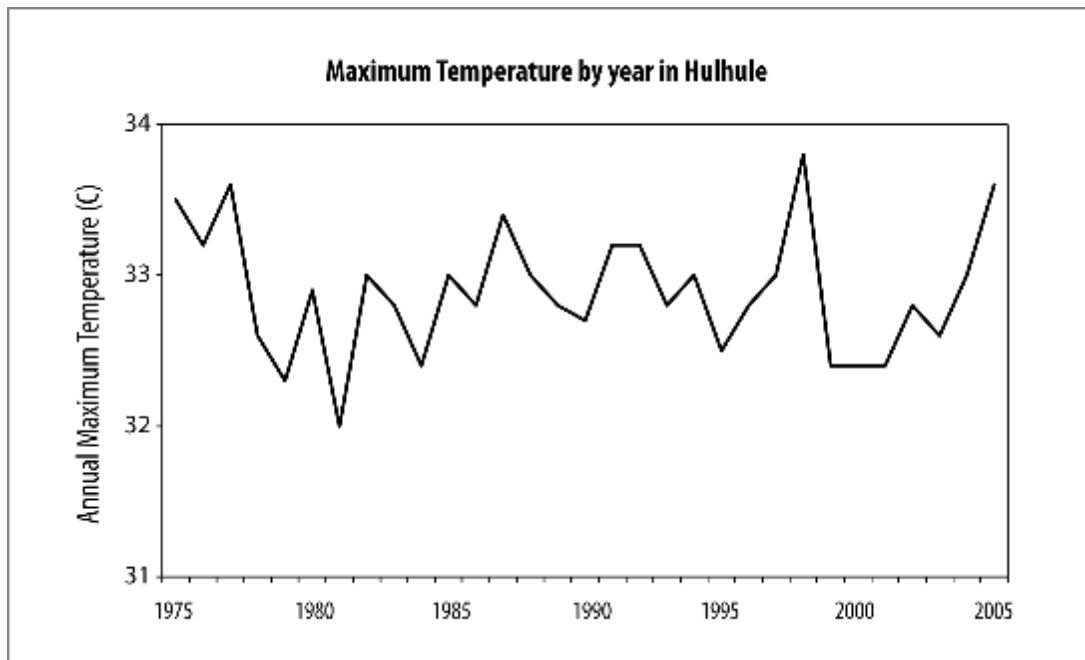


Figure 4.6: Maximum Temperature by year in Hulhule'- 1975-2005 (Source: Hay, 2006)

4.1.2 Hydrology

4.1.2.1 Tidal Pattern

Tides in the Maldives are mixed and semi-diurnal/diurnal. Water levels at the site vary mainly in response to tides, storm surge or tsunamis. Tidal variations are referred to the standard station at Hulhulé Island. Typical spring and neap tidal ranges are approximately 1.0 m and 0.3 m, respectively (MEC, 2004). Maximum spring tidal range in Hulhulé is approximately 1.1 m. There is also a 0.2 m seasonal fluctuation in regional mean sea level, with an increase of about 0.1 m during February to April and a decrease of 0.1 m 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

No tidal measurements were undertaken on site and the Hulhule Tide gauge data was used due to proximity.

4.1.2.2 Wave Conditions

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.

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). The proposed site is exposed to swell

waves approaching from the SW. These waves are partially blocked due to the presence of Ari Atoll on the western half of the Maldives. Nonetheless, waves refracting through open channels on the western half of Maldives can still reach the Southern rim of Thilafushi. The timings of these waves usually coincide with Southwest monsoon and occur between May and November with peak periods between June to October.

Based on existing wave and wind data, the predicted wave patterns around the island are summarized in Figure 4.7.

The proposed reef is exposed to wind generated waves during both monsoons and during transition periods. The Southern side receives the strongest waves during both season and is considered the ocean side. The northern side is exposed to moderate NE monsoon and SW monsoon wind waves. The presence of reefs within the atoll minimises the wave activity.

The project site is located on the northwest corner of the reef. The site is generally protected from swells and wind waves. However, swells approaching from Giraavaru Kandu will diffract through the channel and may affect the site, particularly during June to November. Nonetheless, the shallow reef flat is expected to dissipate energy before it reaches the drilling points.

4.1.2.1 Currents

Currents that affect the site 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.

Strong currents are expected through Giraavaru Kandu and in the deep water off the northwest corner of the reef.

Tidal currents are dominant at the site and wave driven currents are generally minimal but increases during peak SW monsoon.

Current measurements

Drogue tracking undertaken to establish flow speed on shallow reef flat and around the lagoon. The results showed a generally west flowing currents and the speeds were relatively minimal (See Figure 4.8). Tidal flow was strongest towards the reef pass as the time of measurement was ebb tide. Flow in the lagoon was generally in a westerly direction.

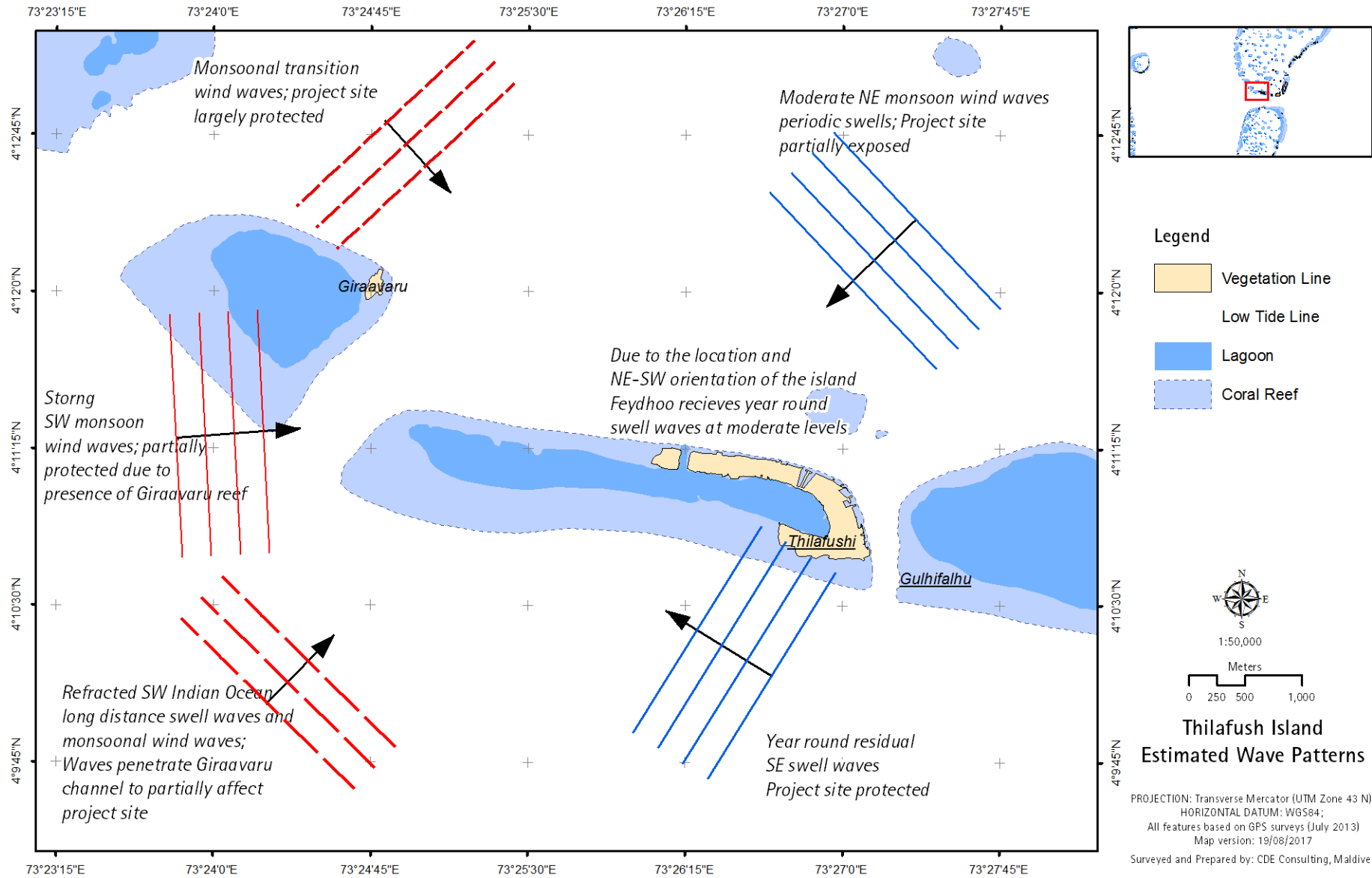


Figure 4.7: Estimated wave patterns of the site

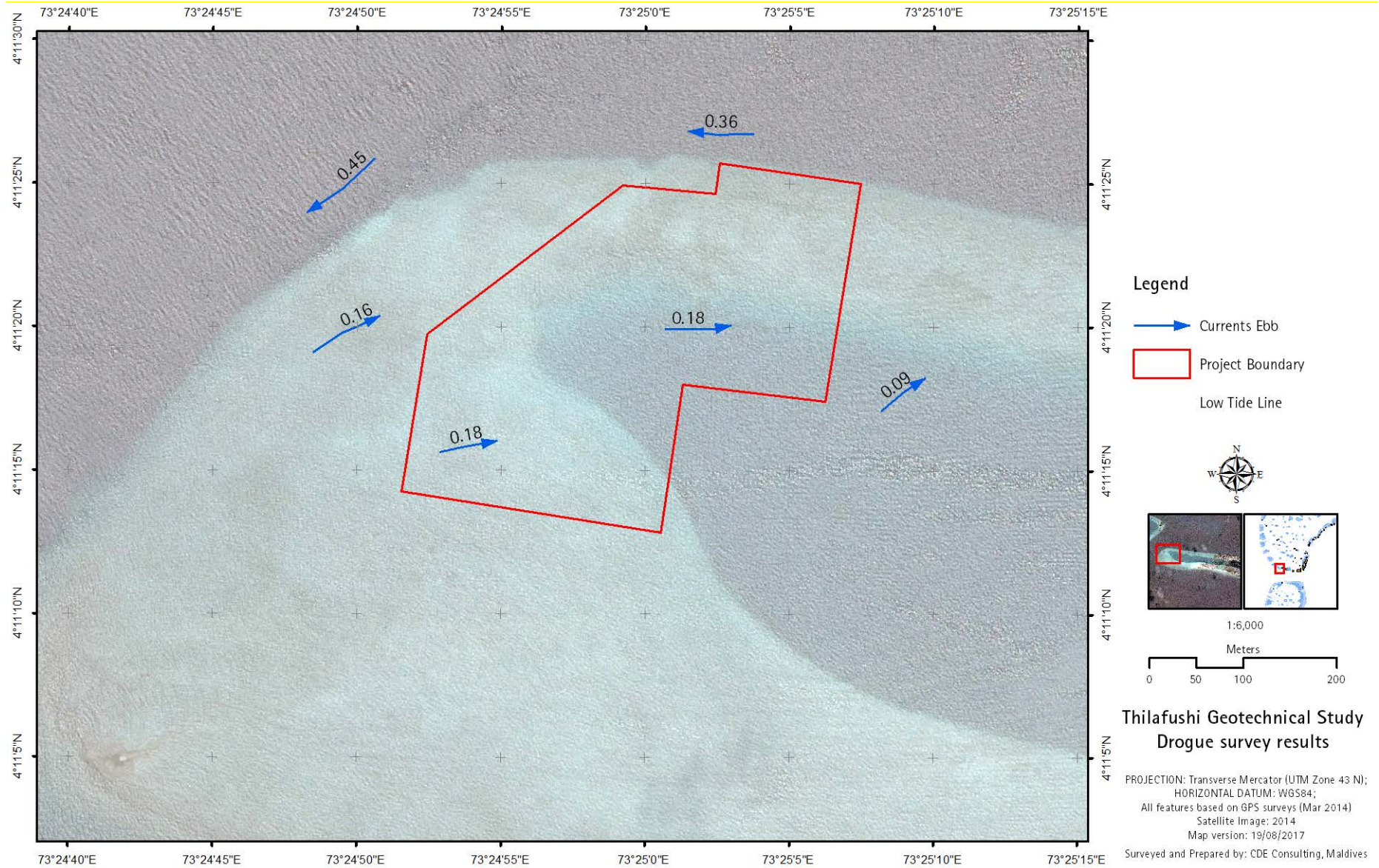


Figure 4.8: Measured currents around the site

4.1.3 Bathymetry

A bathymetry assessment was undertaken for the site and is presented in Appendix D. The results show that the reef system contains three major zones: a reef slope, reef flat and a deep lagoon. The reef has a wider reef flat on the southern side compared to the north. The depths within the shallow reef flat ranges between -1.0 to -1.6 m. Depth within the deep lagoon is between -6.0 to -8.0 m. Two of the drill sites fall in depths over 6 m but the rest were within -2 m MSL.

4.1.4 Marine water quality assessment

The primary objective of the marine water quality sampling was to determine the baseline condition of the marine water near the project site. Water sample was collected in clean 500 ml PET bottle.

Seawater samples collected were clear with particles, and the pH of the samples was slightly basic (8.12 – 8.18). Total Suspended Solids of the samples were below the limit of quantification (<5mg/L) for both samples. Turbidity ranged between 0.504 NTU to 1.11 NTU.

Table 4.5: Seawater sample results (Thilafushi Project Site, 8 August 2017)

Parameter (unit)	SW1 (Sampling date: 8 August 2017)	SW2 (Sampling date: 8 August 2017)
Physical Appearance	Clear with Particles	Clear with particles
pH	8.12	8.18
Temperature (° C)*	20.2	20.0
Total Suspended Solids (mg/L)	<5	<5
Turbidity (NTU)	0.504	1.11

*Ex-situ reading of temperature at laboratory

4.2 Biological Environment

4.2.1 Marine Environment

4.2.1.1 Lagoon Environment

Thilafushi Reef is a moderately sized reef system with a surface area of about 400 Ha. The physiographic features of the lagoon system at the project site is mainly sand and rubble with no live coral cover.

4.2.1.2 Photo Quadrat Survey and Fish Census

Transect 1

This transect was deployed at 2 m depth, along the reef edge on the north western side of Thilafushi lagoon. Visibility was very poor, less 10 m during the surveys.

Predominant benthic substrate at this site was rocky pavement ($58.5\% \pm 6.99$ SE), followed by sand ($23.5\% \pm 7.78$ SE), and turf algae ($12\% \pm 4.67$ SE). Overall live coral coverage was very low ($5\% \pm 2.24$ SE). Live coral cover was dominated by massive type coral family Poritidae.

A total of 24 fish species 11 fish families were recorded during the fish census. Highest number of fishes were recorded from families Pomacentridae (5 species) and Acanthuridae (5 species).

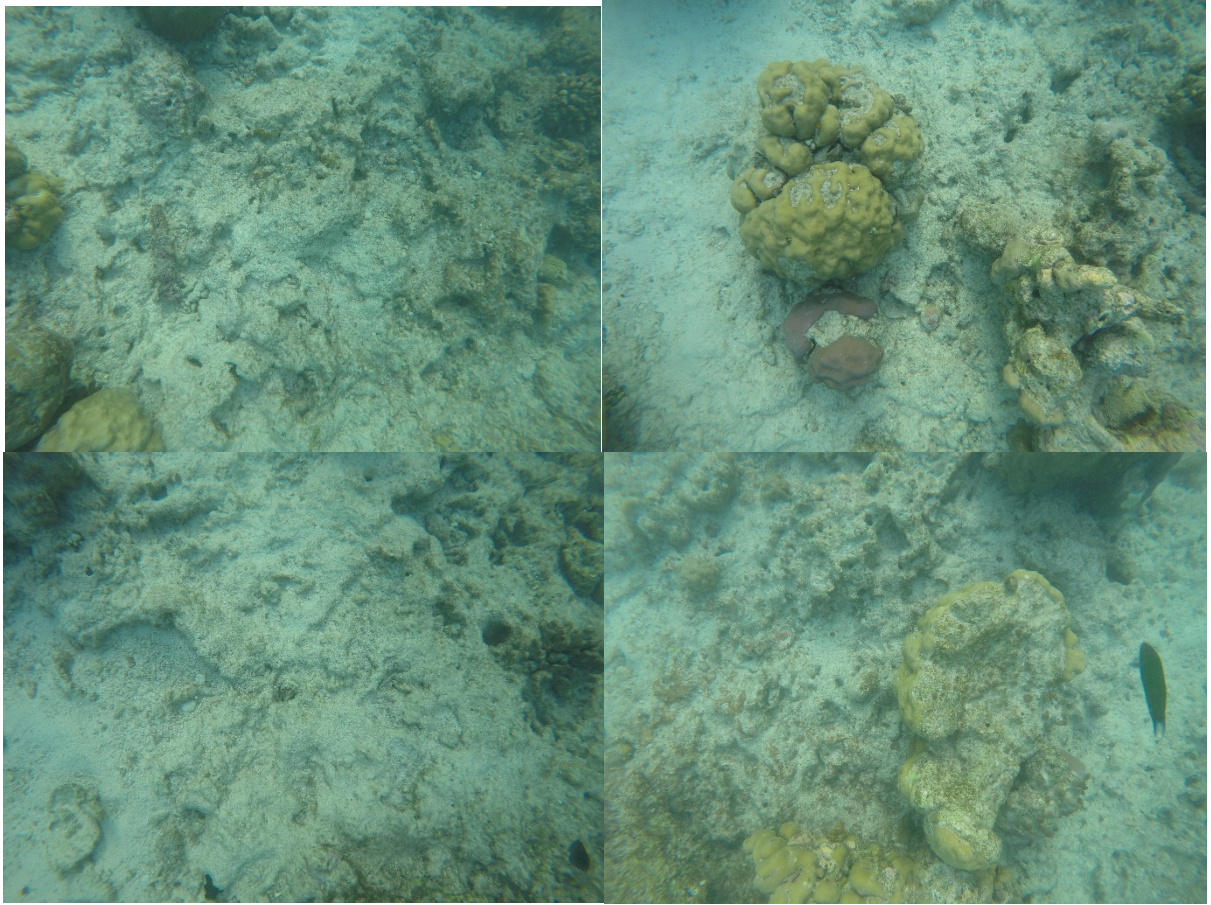


Figure 4.9: Selected images showing variety of coral species along transect 1

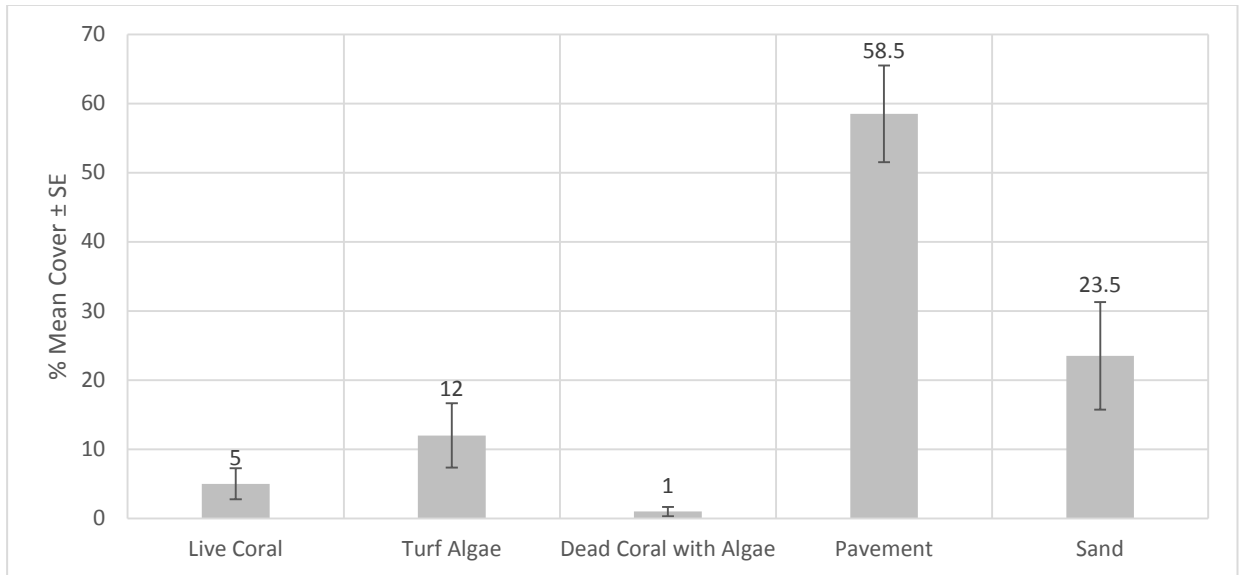


Figure 4.10: Mean benthic substrate composition along transect 1

4.2.1.1 Visual Snorkelling Survey

Visual snorkelling surveys were carried out at selected locations of the lagoon.

Site 1

This site is located on the reef flat on the north western side of the Thilafushi lagoon. The water level at the time was shallow (between 1.5 m – 2 m). This site is mainly made up of coral rubble and sand. Live coral cover at this site is very low with only a few isolated patches of massive corals (Porites) distributed through the area in few numbers.



Figure 4.11: Selected images showing few isolated massive corals (Porites) on the sandy bottom

Site 2

Survey was carried out on the south western side of Thilafushi lagoon. The depth was shallow at 1.5 to 2m m during the surveys. Predominant benthic substrate observed was loose coral rubble and sand. No significant live coral cover was observed at this area



Figure 4.12: Selected images showing benthic cover at Site 2

Table 4.6: Fish census survey along T1 - Thilafushi Lagoon, 8 August 2017

Family	Species	Common Name	Diet	Abundance
Serranidae (Groupers)	<i>Aethaloperca rogaa</i>	Red-flushed grouper	Small fishes; small crustaceans	2
Haemulidae	<i>Plectorhinchus vittatus</i>	Oriental Sweetlips	Benthic invertebrates	2
Caesionidae	<i>Caesio lunaris</i>	Moon Fusilier	Zooplankton	2
Chaetodontidae	<i>Hemitaenichthys zoster</i>	Black Pyramid Butterflyfish	Plankton	2
Chaetodontidae	<i>Chaetodon kleinii</i>	Brown Butterflyfish	Coral polyps; worms; algae; crustaceans	2
Chaetodontidae	<i>Chaetodon falcula</i>	Double-saddle Butterflyfish	Coral polyps; worms; algae; anemones; crustaceans	2
Pomacanthidae	<i>Centropyge multispinis</i>	Many-spined angelfish	Coral polyps, tentacles of feather dusters; Christmas-tree worms	2
Pomacentridae	<i>Amphiprion clarkii</i>	Clark's Anemonefish	Algae; zooplankton	2
Pomacentridae	<i>Pomacentrus caeruleus</i>	Blue-yellow Damselfish	Algae; zooplankton	2
Pomacentridae	<i>Pomacentrus nagasakiensis</i>	Scribbled Damselfish	Algae; zooplankton	2
Pomacentridae	<i>Pomacentrus chrysurus</i>	White-tail Damselfish	Algae; zooplankton	2
Pomacentridae	<i>Plectroglyphidodon lacrymatus</i>	Jewel Damselfish	Benthic invertebrates; algae	2
Labridae	<i>Thalassoma amblycephalum</i>	Two-tone Wrasse	Benthic invertebrates; zooplankton	2
Labridae	<i>Thalassoma hardwicke</i>	Six-bar Wrasse	Benthic invertebrates; zooplankton	2
Labridae	<i>Thalassoma janseni</i>	Jansen's Wrasse	Benthic invertebrates; zooplankton	2
Labridae	<i>Stethojulis strigiventer</i>	Silver-streaked Wrasse	Benthic invertebrates	2
Scaridae	<i>Scarus sordidus</i>	Shabby Parrotfish	-	2
Zanclidae	<i>Zanclus cornutus</i>	Moorish Idol	-	2
Acanthuridae	<i>Acanthurus leucosternon</i>	Powder-blue Surgeonfish	Algae	2
Acanthuridae	<i>Acanthurus nigricauda</i>	Eye-line Surgeonfish	Zooplankton	4
Acanthuridae	<i>Ctenochaetus striatus</i>	Fine-lined Bristletooth	Film algae; detritus	2
Acanthuridae	<i>Zebrasoma scopas</i>	Brown Tang	Filamentous/macroalgae	2
Acanthuridae	<i>Naso lituratus</i>	Orange-spine Unicornfish	Brown kelp	2
Tetraodontidae	<i>Canthigaster valentini</i>	Saddled Pufferfish	Algae; benthic invertebrate	2
Asteroidea	<i>Culcita schmedeliana</i>	Schmedelian pin-cushion sea star	Slow moving invertebrates	2
Tridacnidae	<i>Tridacna maxima</i>	Large Giant Clam	Phytoplankton; relies on zooxanthellae	1

4.3 Project site land use

Thilafushi Island has been developed as a solid waste land fill since December 1992. The island was initially developed as a sand bank using dredged material from the Thilafushi Reef. Since then, land has been reclaimed by placing solid waste in dredged holes on the reef flat and later topping it up with fresh lagoon sand. The island referred to as Thilafushi-1 was and is being reclaimed using this method (Figure 4.13).

The shortage of land in the Male' Urban Region created a demand for the new land being created on Thilafushi Island. Hence, plots of land were leased to individuals and businesses to carry out industrial activities, manufacturing activities, metal and wood workshops and warehousing. Residential development was not allowed. The rudimentary nature of waste dumping and backfilling raised serious concerns about the land use activities on the island but demand for land continued to soar.

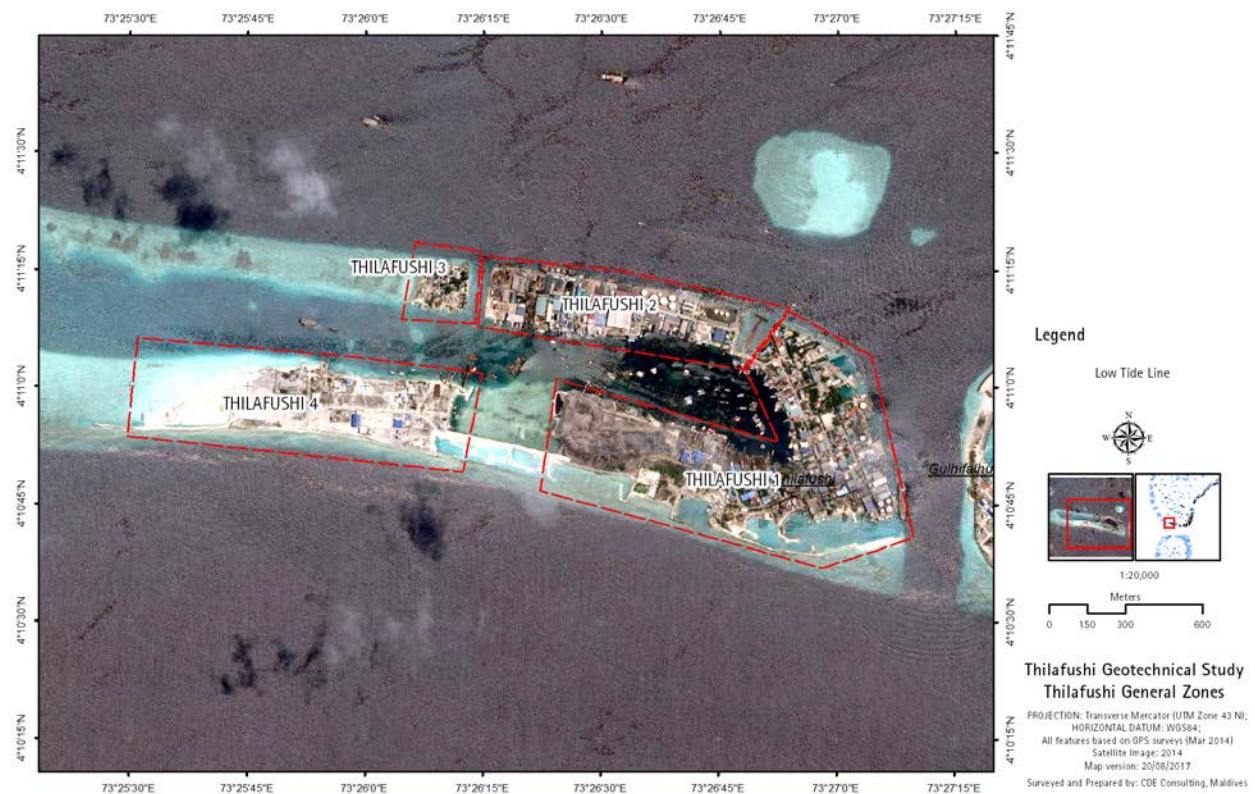


Figure 4.13: Thilafushi Island generalized zones

A second island, zoned as Thilafushi-2, was reclaimed from lagoon sand to meet the demand. Subsequently a third island, Thilafushi-3, was initiated but never reclaimed further than a few hundred square meters. A new project to reclaim a massive 167 Ha of land from the remaining reef areas of Thilafushi was started in 2010 but was abandoned in 2011 with part of the project completed (See Thilafushi 4 in Figure 4.13).

The land use system of Thilafushi was developed in an *ad hoc* manner without a master plan. Hence, the present land use patterns show a mixed approach to development with variety of industrial, manufacturing and warehousing activities being undertaken on the island.

The predominant land use on Thilafushi was in “manufacturing and industrial” developments, followed by waste management. Manufacturing activities comprised of activities like aluminum product assembly, construction prefabrication, boat building and workshops, among others. Waste management activities have always been carried out on a designated piece of land which is leased for development once the filling activities have been completed. Other major activities included processing facilities like gas and cement factories, storage and warehousing activities like oil storage and godowns, and boat repair.

Since January 2009, Thilafushi Island has been managed by the Thilafushi Corporation (TCL). The new land use master plan of the island developed for the remaining areas of the reef as of 2014 are presented in Appendix C. Changes are required to the master plan to shift the port area.

The new plan has allocated a large section of the new reclamation to the proposed Male’ Port. The port is expected to replace the activities being undertaken in Male’ Island and contains a large container terminal. Other development plans include designated areas for warehousing and manufacturing activities. The remaining areas have been designated as administrative facilities, utilities and recreational zones.

The proposed Port Project is being undertaken in a small section of the planned port site. The plan is to develop the initial port area and to expand further in the future.

The proposed geotechnical assessment wall within the designated port site and at present the area is barren with no ongoing activities.

5 IMPACT IDENTIFICATION

Potential adverse and beneficial impacts of construction and operation stage of the geotechnical investigations 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..

5.1 Boundaries of Affected Areas

The estimated boundaries of affected areas are summarised in Figure 5.1 below. These boundaries are based on physical conditions and work methods proposed in the project without any mitigation measures. The extents shown are not absolute and should be treated as the best-guess scenario based on past projects.

It has to be noted that these extents do not represent figures derived from sediment dispersal modelling. It is based purely on past experience from similar project including a number of geotechnical investigations lagoon reclamation projects (for tourist resort development).

5.2 Impact Identification and Evaluation

Environmental and socio-economic aspects that may be impacted by the project are identified in the impact matrices in Table 5.1. Assessments of the impacts are conducted based on the following criteria.

1. **Magnitude:** Refers to the quantum of change that will be experienced as a consequence of the impact. It is defined by the severity of each potential impact based on impact reversibility, irreversibility and potential rate of recovery. Impacts of high magnitude are those that cannot be mitigated substantially or involve substantial residual impacts.
2. **Nature:** Where the activity or component has direct, indirect or cumulative impacts from multiple projects or activities.
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. An impact can be site specific or limited to the project area; locally occurring within the immediate vicinity of the project locality; atoll level; or at a national level. The four criteria are detailed using the following scale and attributes given in table 5.2.
5. **Significance:** Refers to the importance of the impact's consequence or implications (ecological social, economic). An impact of small magnitude could have a very high

significance and vice-versa (e.g. siltation of a small reef area with rare coral species has low magnitude but very high significance). Once an impact has been identified it needs to be evaluated using set of criteria. The key criterion considered in this study are:

- a. The degree of reversibility of an impact (i.e. duration of its effects) is considered part of its significance.
- b. Threats to sensitive eco-systems. For example, those leading to loss of key habitats and extinction of species, or those affecting Protected Areas.
- c. Threats to key resources leading to depletion of resources or loss of livelihood associated with those resources.
- d. Geographic extent of impact. For example, national or trans-boundary impacts
- e. Duration and timing of the impact
- f. Likelihood or probability of the impact occurrence
- g. Reversibility
- h. Resource use conflicts
- i. Public views and complaints
- j. Cumulative impacts on an area due to multiple projects
- k. Uncertainty in impact predictions
- l. Cost of mitigation

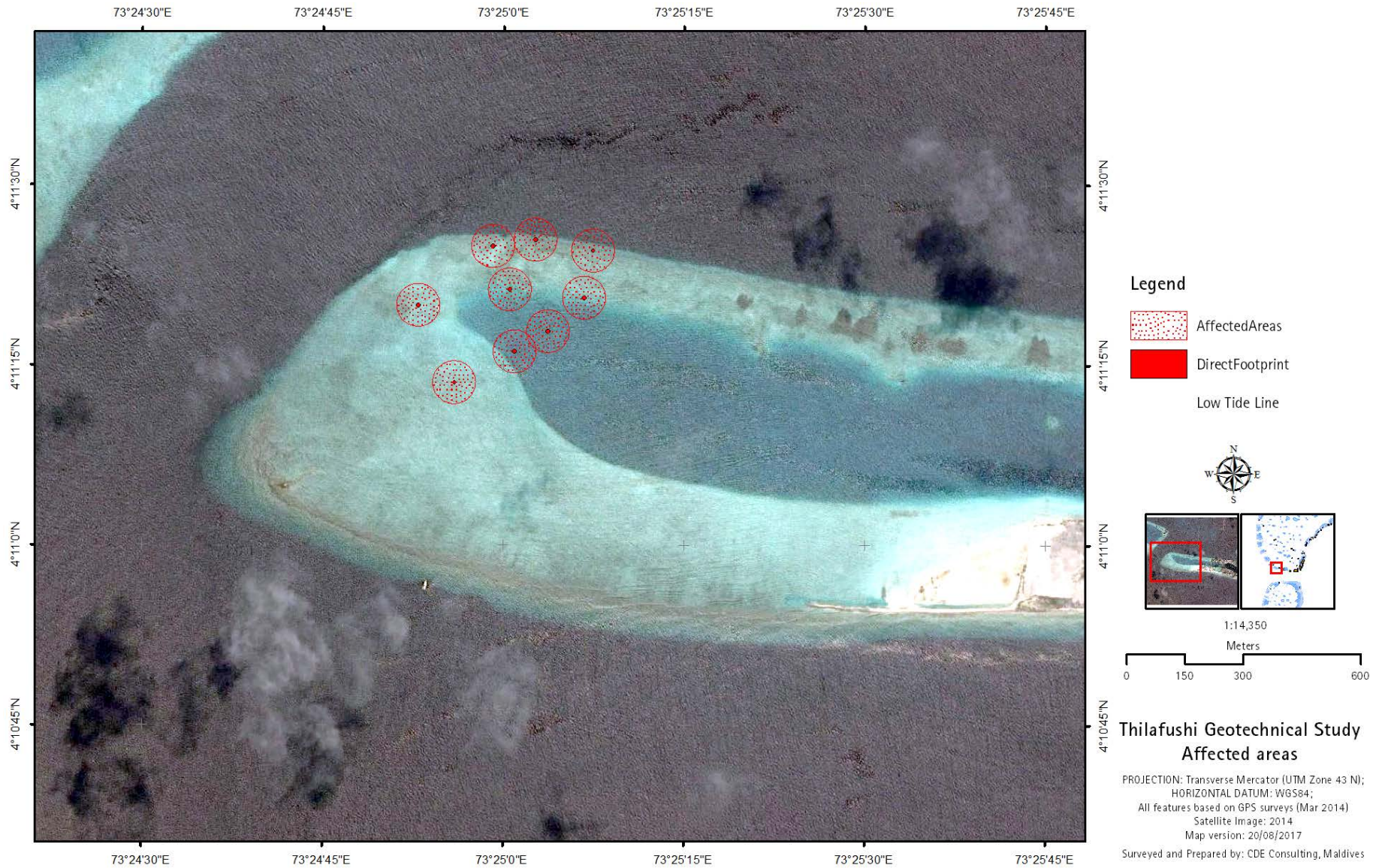


Figure 5.1: Estimated Affected Area – Combined for both seasons

Table 5.1: Impact Identification Matrix for Geotechnical Investigations

Activity / Potential Impact	Direction		Nature			Duration		Distribution			Magnitude			Significance		
	Pos	Neg	Dir	In Dir	Cumu	Long	Short	Site	Local	Nat	High	Mod	Low	High	Mod	Low
1. Mobilization and site preparation																
Physical Impacts																
Visual aesthetics		X		X			X	X					X			X
Air Quality		X		X			X	X					X			X
Noise levels		X	X		X		X	X					X			X
Marine water turbidity		X	X				X	X					X			X
Marine water pollution		X		X	X		X	X					X			X
Sedimentation		X		X			X	X					X			X
Biological Impacts																
Impacts on coral communities																
<i>Direct removal and burial (Anchoring)</i>		X	X				X	X					X			X
<i>Indirect (smothering from sedimentation, turbidity)</i>		X		X	X		X	X					X			X
Fish and invertebrate displacement		X		X	X		X	X					X			X
2. Drilling																
Physical Impacts																
Visual aesthetics		X		X			X	X					X			X
Air Quality		X		X			X	X					X			X
Noise levels (drilling)		X	X				X	X					X			X
Vibration (drilling)		X	X				X	X					X			X
Marine water turbidity		X	X				X	X					X			X
Marine water pollution		X	X				X	X					X			X
Sedimentation		X		X			X	X					X			X
Biological Impacts																
Impacts on coral communities																
<i>Direct removal and burial (Drilling,</i>		X	X			X		X					X			X

Activity / Potential Impact	Direction		Nature			Duration		Distribution			Magnitude			Significance		
	Pos	Neg	Dir	In Dir	Cumu	Long	Short	Site	Local	Nat	High	Mod	Low	High	Mod	Low
<i>anchoring</i>																
<i>Indirect (smothering from sedimentation, turbidity)</i>		X		X			X	X					X			X
Fish and invertebrate displacement		X	X				X	X					X			X
Other marine life (e.g. turtles) displacement		X	X				X	X					X			X
Impact of avian fauna (noise levels and worker actions)		X		X			X	X					X			X
3. Transport																
Marine traffic hazards due to drilling works		X		X			X	X					X			X
4. Construction workers																
Waste management		X	X				X		X				X			X
Waste water management		X	X				X	X					X			X
Worker safety		X	X		X		X	X					X			X
5. Socio-economic impacts																
Employment	X		X		X		X		X				X			X
Demand on resources and services (e.g Thilafushi, boats)	X	X	X	X			X		X				X			X
Giraavaru resort operations		X		X	X		X	X					X			X

6 SIGNIFICANT IMPACTS AND MITIGATION MEASURES

There are no significant impacts from this project.

6.1 General Impacts on Natural Environment during Construction Phase

6.1.1 Noise Pollution and Vibration Impacts

Operation of drilling rig involves noise and vibration. The nearest sensitive receptor is Centara Rasfushi Resort and Spa Maldives (Giraavaru Resort). The expected 55 LEQ dBA within a 500 m radius is unlikely to affect any sensitive receptor, including the sensitive areas. The work is also to be undertaken during the SW monsoon which will carry noise away from Giraavaru Resort.

Vibration will also be localized.

Mitigation Measures

All workers must wear ear mufflers if the dBA is above 80 during drilling works and if work sessions exceed one hour.

6.1.2 Air Quality and Greenhouse Gas Emissions

While emitted greenhouse gases can persist in the atmosphere in the long term, the level of emission from the activity is expected to be negligible.

No mitigation measures required.

6.1.3 Marine Water Quality

The following activities will involve sea bed disturbances.

- a. Anchoring drilling platform: Platforms will be anchored using concrete weights or ship anchors. While the anchor works is being undertaken there will be temporary turbidity and sedimentation.
- b. Drilling: When drilling the seabed will be disturbed when the initial penetration takes place. Following that, each lifting action to collect samples will involve temporary turbidity within a 10 m diameter but is expected to last a few minutes.

The extent of turbidity dispersion and the time the turbid water takes to clear makes the impact on water quality negligible.

The only potential significant impact on the water quality is from an oil spill. However, oil is carried in small containers (reused empty cooking oil containers) making any spill negligible and allowing it to be contained immediately.

Mitigation Measures

All fuel on the platform must be properly sealed and contained

Refuelling must be undertaken carefully to prevent spills and during calm sea conditions.

6.1.4 Marine Biodiversity

There are no live coral colonies within the project foot print. However, lagoon bed dwelling organisms exist within the footprint. Given that the diameter of the drill is 6”, these impacts are negligible.

Drilling noise and vibration may affect the fish behaviour but is considered temporary.

No mitigation measures required.

6.1.5 Impact on Unique Habitats

Miyaruvani is a marine protected area, located about 1.5 km southeast of the project site on the outer slope of Thilafushi Reef. Given the limited impacts from turbidity, noise and vibration, it is unlikely that this site will be affected.

No mitigation measures required.

6.1.6 Impact on visual amenity

As noted above, the nearest sensitive receptor is Giraavaru Resort. The distance between the proposed drill site and the nearest facility or room on the resort is 950 m. Given that the platform is small and that the resort is designed to avoid views towards Thilafushi Island, the drilling works is unlikely to have an aesthetic impact on Giraavaru Resort operations.

No mitigation measures required.

6.2 Impacts on the Socio-economic Environment during construction

6.2.1 Business and Employment Opportunities

The proposed activity is too small to have significant benefit on employment. However, demand for resources such as food and accommodation for construction workers, equipment, machinery, vehicles and vessels hire will also likely benefit the local suppliers and businesses.

6.2.2 Health and Safety

Health and safety risks arising from drilling work is moderate, especially due to the use of specialised equipment and machinery. Accidents related to equipment use can lead to injury, and fatalities. Accidental spills/ leakage of hazardous substances can contaminate the site and pose risks to human health. The project activities include measures to minimize risks to health and safety of workers.

Mitigation Measures

All health and safety precautions described in Chapter 2 will be implemented. They include the following:

- a. Workers operating equipment that generates noise should be equipped with noise protection. As a guide, workers operating equipment generating noise of > 80 dBA should wear ear muffers and workers experiencing prolonged noise levels > 70 dBA must wear ear plugs.
- b. Health checks will be administered before work commences.
- c. Warning signs, barricades or warning devices will be provided and used.
- d. Necessary safety gear will be worn at all times. These include safety gloves, construction boots, facemasks, earmuffs, etc.
- e. Fire extinguishing equipment would be readily available and employees will be trained in its use.
- f. First aid kits will be made available on site.
- g. The drilling site will be properly closed to unauthorised personnel.

The costs of most activities identified above are included in the contractor price as part of general site management and practices.

7 ALTERNATIVES

7.1 “No-Project” Alternative

The No Project option takes the following into account that drilling will not be undertaken. Drilling is being undertaken to determine the site’s suitability and engineering parameters to build a port. This is an essential component in due diligence when designing structures at the site. If drilling is not undertaken, the conditions will have to be guessed based on other studies. Given that the bulk of the impacts on the site will be from port construction itself, it is crucial that geotechnical studies be used to determine the broader impacts on the environment before a decision is taken to proceed with the port project designing.

Thus, in the absence of significant impacts, and presence of numerous environmental and technical benefits of understanding the site conditions, the no project alternative has not been considered.

7.2 Reduced number of boreholes

One option to reduce the overall impact is to reduce the number of boreholes. This will reduce the overall foot print and time required to complete the works. However, the proposed boreholes are located in exact locations where piling may be considered, the number of boreholes currently used are a bare minimum, as required by engineers. The proposed nine boreholes will be used in the study.

7.3 Alternatives to deal with the drilled holes

This project considers the filling the drilling holes with Bentonite up to 1 m from the surface and filling the remaining part with sand. The alternative option is to leave the holes unfilled. There are significant environmental impacts anticipated in leaving the holes as they are and is likely to be occupied by lagoon bottom dwelling organisms. Furthermore, given that the site will be reclaimed in the future, these holes are likely to be covered naturally. Nonetheless, the proponent has asked the contractor fill the holes before completing works.

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 applicable 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.

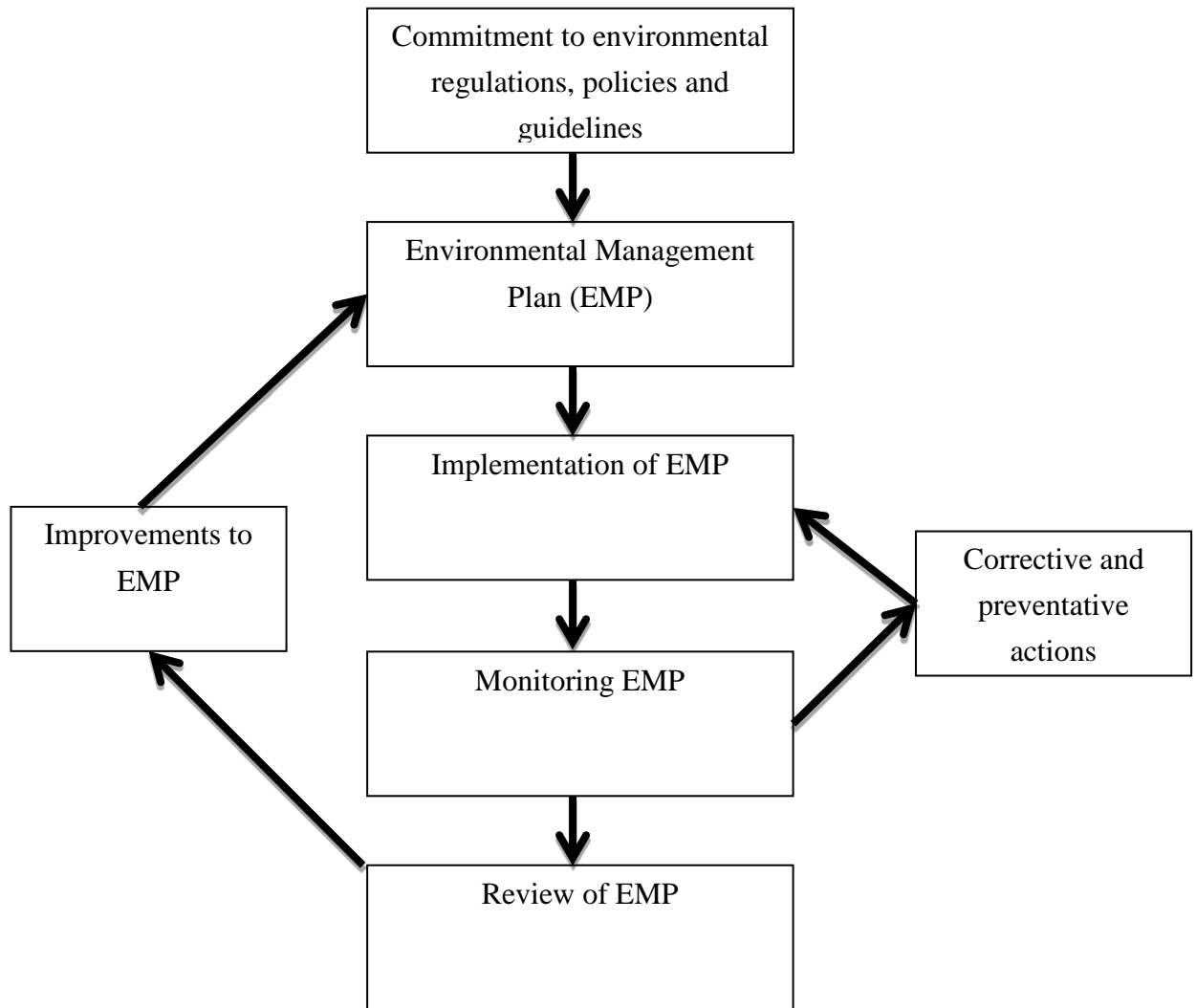


Figure 8.1: Environmental Management Strategy flow diagram

8.2 Management Structure and Responsibilities

The following parties are involved in the EMP of this project:

- Project proponent
- Contractor
- Environmental consultant
- EPA
- Thilafushi Corporation

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 geotechnical requirements
- Monitoring of the project activities
- Submission of annual environmental monitoring reports as required by the EPA

8.2.2 Contractor

- Execution of all project activities
- Implement mitigation measures
- Report to environmental consultant and proponent
- Carryout all work as specified in the EIA and according regulations

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 EPA

- Approval of EIA
- Review environmental monitoring reports
- Intervention in the event of a breach in environmental permit conditions
- Site visit if required

8.2.5 Thilafushi Corporation

- Grant permission to drill on Thilafushi

Figure 8.2: Environmental Management Plan for construction and operation phase

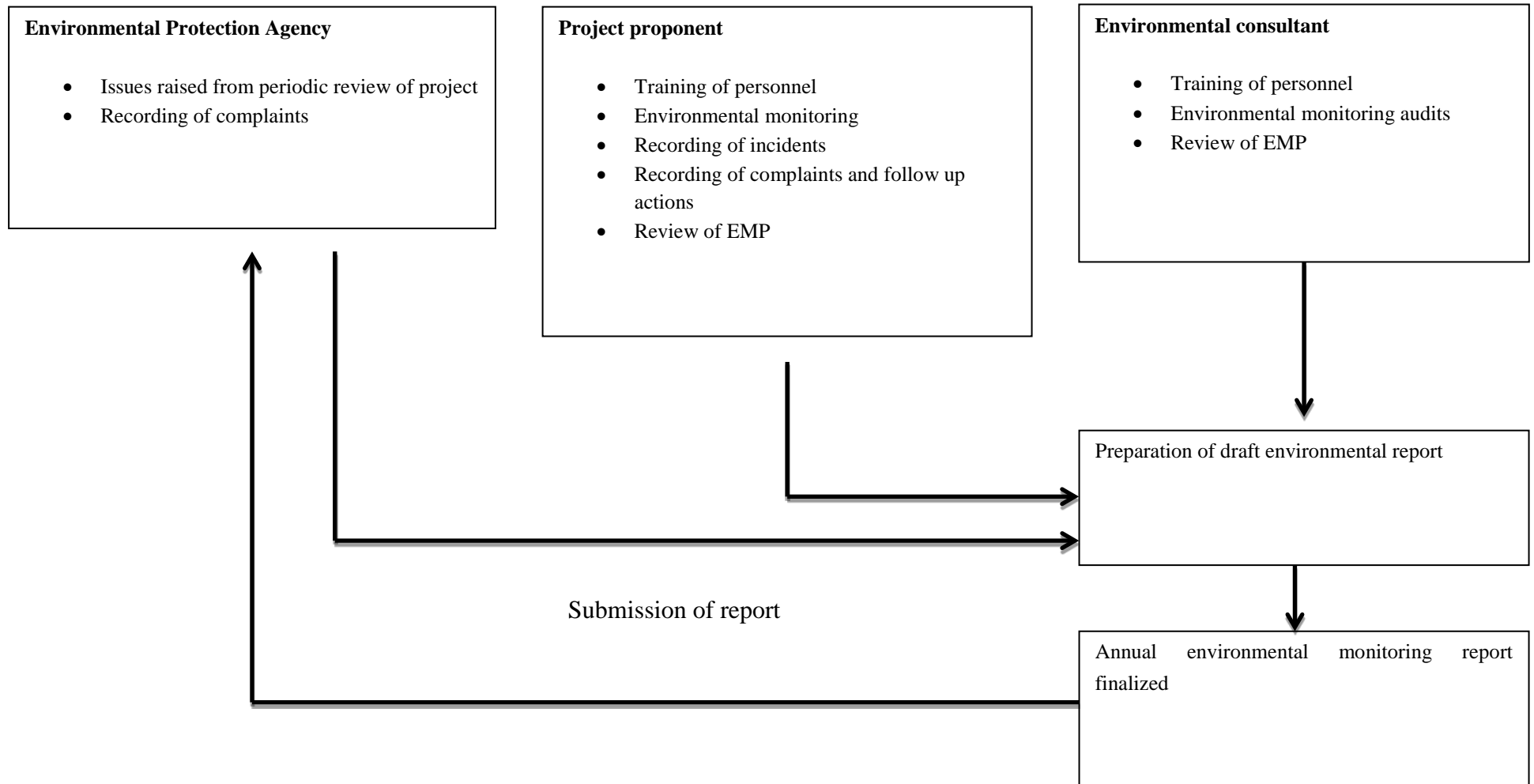


Table 8.1: Environmental Management Plan for construction and operation phase

Activity	Management measures	Responsible party	Timing
Training of staff and contractors	All construction workers and project management staff will be provided information on general environmental issues, compliance with environmental permits and EMP. All staff involved with environmental monitoring will be provided training in environmental monitoring procedures.	Project proponent & Environmental Consultant	Before commencement of construction activities
Documenting non-conformances and corrective actions	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	Project proponent & Environmental consultant	Continuous during construction phase
Implement mitigation measures specified in Chapter 6	See relevant sections of Chapter 6	Contractor	Continuous during construction phase
Supervision of project activities	Assign suitably experienced and qualified personnel to supervise the entire project and ensure that all activities are carried out with minimal adverse impact on the environment	Project proponent	Before commencement of the project

8.3 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.

8.4 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 9.2. All non-compliances and complaints during the execution of the project are to be reported to 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:

- To identify whether the predicted impacts are accurate and mitigation measures taken are effective.
- To identify any unforeseen impacts so that appropriate mitigation measures can be taken at the earliest.
- To identify and resolve any issues of social unrest at the earliest.
- To eliminate or reduce environmental costs.

9.3 Monitoring during Construction Phase

Table 10.1 shows the details of the different monitoring attributes and parameters must be monitored during drilling.

Additionally, the following aspects will be monitored during this phase to ensure that environmental impacts are minimized.

- 1) Daily monitoring to ensure that the 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.

9.4 Monitoring Report

A detailed environmental monitoring report is required to be compiled and submitted to 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. 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.

9.5 Cost of Monitoring

The cost of monitoring is estimated to be approximately US\$ 750-1000. Professional consultants will be hired to undertake the monitoring and the necessary equipment for monitoring will be procured.

For construction stage monitoring, individual parameter costs are provided in the relevant tables above.

Monitoring cost is calculated excluding logistics and contingency costs.

Table 9.1: Monitoring Schedule for Drilling Works

Monitoring Attribute	Objective	Indicator	Methodology	Locations & samples	Frequency	Reference Guideline / Standard	Est. Total Costs / USD
Marine Water Quality	To monitor the basic condition of marine water at drilling site including control points	Temperature, pH, TSS, Turbidity	Portable Multi parameter water testing equipment Refer to procedures as specified in EPA guidelines See Annex	SW1, SW2	Once during drilling	Great Barrier Reef Marine Park, 2009 (GBRMP 2009) UNESCO/WHO/UNEP 1996	1000 per year
Noise	To determine the impact of noise on resorts and on site	Noise complaints received outside the project site	Logs	Project vicinity	Daily logs	-	Included in contractor fees
Marine Water Contamination	To assess the marine water contamination due to oil spills and leakage	Oil spills Oil leakage from machinery or vessels	Visual observation Maintenance and tuning of all machinery & vessels	All area where oil is handled	Daily	NA	Included in contractor fees
Coral reef health	To determine the general status of the reef and to determine the species abundance and composition of the reef system	Percent of live coral cover, and fish species abundance and composition	Photo Quadrat survey; Fish census Visual observation	All coral reef monitoring sites (T1)	Once after project completion	Maldives EPA standards	2,000

10 STAKEHOLDER CONSULTATIONS

10.1 Summary

Stakeholder consultations for this EIA were conducted between 25 July 2017 and 5 August 2017. Consultations were done via face-to-face meetings and emails. During each consultation stakeholders were briefed about the proposed project and asked about their views and concerns about the project activities, and to give recommendations. Stakeholders consulted were:

- Ministry of Economic Development
- Thilafushi Corporation

Both parties consulted have no reservations on proceeding with the project. TCL have placed some conditions before the work can be carried out.

10.2 Ministry of Economic Development

Contact person: Ms Nuha Riza, Phone 3333187

MED has no reservations to carry out the work provided that Thilafushi Corporation is informed. MED will assist in getting approvals from the required Government Agencies for any assessments required.

10.3 Thilafushi Corporation Limited (TCL)

Contact Person: Mr. Mohamed Waseem, Manager Project Implementation (phone: 330-7513)

TCL has raised the concern that the overall port project MoU has been agreed with China Harbour Engineering without their input and asks MED to consult in the matter in the future. However, they have no issue in proceeding with the study. TCL will facilitate to carry out the project provided the following are submitted prior to commencement of work.

1. The type of soil investigation to be carried out.
2. Locations for sampling
3. Method of sampling and amount of sand involved.
4. Who would be carrying out the sampling work, Details including copies of relevant permits or licenses from relevant government authorities. Copies of permits by EPA for the work either in the form of approved EIA decisions statements for any drilling or sand borrowing for sampling purposes.
5. Duration and time schedule for the work
6. A formal request from the party seeking the approval

11 Conclusions

This EIA has proposed to undertake geotechnical investigations on Thilafushi reef. This assessment is part of the Thilafushi International Container Port Study which is being undertaken under an MoU between the Government of Maldives and China Harbour Engineering Company Limited. The purpose of this assessment is to understand the geophysical conditions of site so that the technical feasibility for the port can be established before the project can be undertaken. Nine bore holes to are to be drilled to depths between 30 and 40 m. Results from the assessment will be used to determine the practicality of sheet piling and land reclamation and potential costs associated with it.

Thilafushi Reef is a heavily developed reef with reclamation works dating back to 1990. The existing development is on the eastern half the island and proposed study areas represent a small percent of the undeveloped area on the northwestern corner of the reef. The existing condition on the site is poor. The coral reef is virtually dead around the area with limited new coral recruits. The proposed drilling site contains coral and rubble.

This assessment finds that the proposed geotechnical drilling works is unlikely to cause any significant damage to the environment around Thilafushi. This is because of the limited the number of drill sites, the diameter of the drilling pipe, shallow depth at most sites, short drilling period, small impact foot print and absence of live coral cover or suitable substrate at the proposed drilling locations. Thus, no major mitigations measures are recommended. However, best environmental practices when working coral reef environments have been recommended.

There is no benefit to consider alternatives as the project does not significant impacts.

Monitoring programme proposed has focussed on water quality, noise and reef health.

It is recommended to proceed with the project using the mitigation measures and management plan presented in this EIA.

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APPENDIX A – Terms of Reference



No: 203-EIARES/PRIV/2017/713

Terms of Reference for Environmental Impact Assessment for the proposed Geotechnical Investigation on Thilafushi Reef

The following is the Terms of Reference (ToR) following the scoping meeting held on 17/08/2016 for undertaking the EIA for geotechnical investigations on Thilafushi Reef. The investigation forms part of the initial study for the proposed Container Port Project on Thilafushi. The proposed activity is to undertake geotechnical assessments at nine points along the proposed project site in Thilafushi Lagoon. This requires drilling within Thilafushi Lagoon using a 4-6" diameter drill and removing the core for analysis. The proponent of the project is China Harbour Engineering Company Ltd.

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 study and, if applicable, the background information of the study and the tasks already completed. Objectives of the geotechnical investigations should be specific and if possible quantified. Define the arrangements required for the environmental assessment including how work carried out under this contract is link other activities that are carried out or that is being carried out within the project boundary. Identify the institutional arrangements relevant to this project.
- 2. Study area** – Submit a minimum A3 size scaled plan with indications of all the proposed drilling sites. 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, marine protected areas, sensitive species nursery and feeding grounds). Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites.
- 3. Scope of work** – Identify and number tasks of the project including preparation, drilling and demobilizing phases.
 - **Task 1. Description of the proposed activities** – Provide a full description and justification of the relevant parts of the drilling works, using maps at appropriate scales where necessary. It should define the type of equipment used and the work methodology.
 - Project management (include scheduling and duration of the activity; communication of drilling details, progress, target dates, labour requirement, local labour availability, housing of temporary labour, , Emergency plan in case of spills (petrol) access to site, safety, equipment and material storage, fuel management and emergency plan in case of spills).

Details required

- Technical requirements from engineers





- Laboratory assessment requirements
- Justification for number and location of boreholes
- Equipment and method used for drilling

Task 2. Description of the environment – Assemble, evaluate and present the environmental baseline study/data regarding the study area and timing of the study (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 sampling/survey locations shall be geo referenced including but not limited to water sampling points, reef transects/photo quadrats for monitoring data comparison. Information may be divided into the categories shown below:

Climate

- General description of climate in the area

Geology and geomorphology

- Bathymetry of the required sites (use maps);
- 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 currents;
- Sea water quality measuring these parameters: temperature, pH, Suspended Solids and turbidity.

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 site (see appendix for monitoring guidelines);

Socio-economic environment

- Planned land use for the site

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 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. Legal requirements:

- Approval from the MED in the form of stamped site plan and approval to drill;

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 drilling, and evaluate the



magnitude and significance of each. Particular attention shall be given to impacts associated with the following:

Impacts on the natural environment

- Loss of marine bottom habitat in the drill sites
- Sediment dispersal in water column (turbidity at the drilling site), possibly resulting in changes in visibility, smothering of coral reefs and benthic communities and affecting fish and shellfish etc.;
- Impacts of noise, vibration and disturbance;
- Impacts on marine water quality in terms of turbidity and potential spills
- Impacts on unique or threatened habitats or species (coral reefs, sea turtles etc.),

Impacts on the socio-economic environment

- Impacts on nearby resort
- Land use conflicts

Construction related hazards and risks

- Risk of accidents and pollution.

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”. This should include reduced number of boreholes and option to fill the drilled holes. Environmental, social and economic factors should be taken into consideration. The report should highlight how the location was 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 must be considered. 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 – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan. Ecological monitoring will be submitted to the EPA to evaluate the damages during construction, after project completion and three months thereafter. 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

4



commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided. Monitoring is required in:

- Marine water quality assessments;
- Marine ecosystems monitoring, if required (coral reef and fish and invertebrates communities).


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. The following parties must be consulted:

- a. Thilafushi Cooperation
- b. Ministry of Economic Development

The EIA report should include a list of people/groups consulted, their contact details and summary of the major outcomes.

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 of 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 and subsequent amendments.

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.

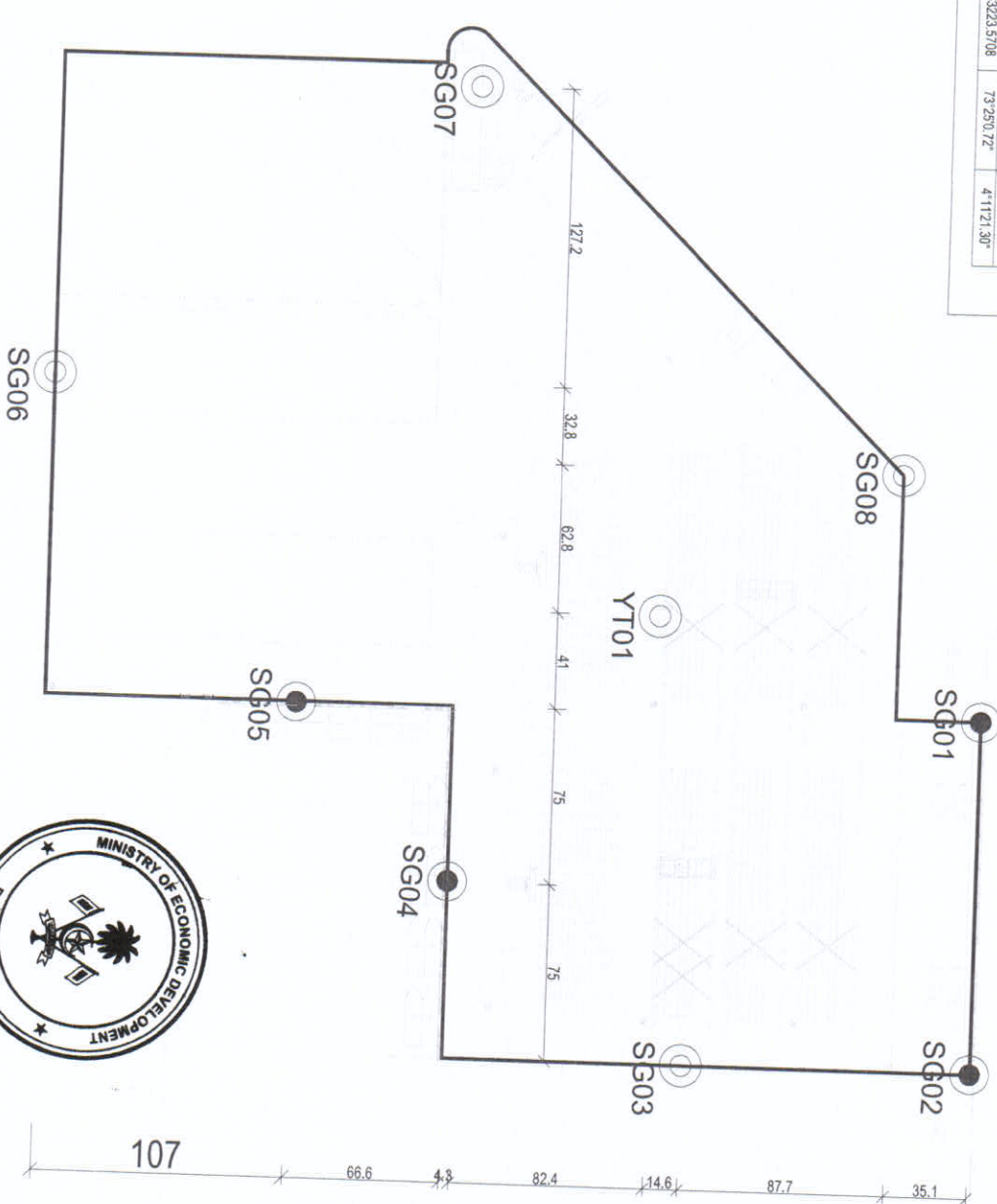

17th August 2017



APPENDIX B – Approved site plans

COORDINATES OF BOREHOLES

No.	EASTING(X)	NORTHING(Y)	LONGITUDE(E)	LATITUDE(N)
SG01	324347.9870	463351.0699	73°25'2.85"	4°11'25.45"
SG02	324495.2463	463322.9088	73°25'7.62"	4°11'24.55"
SG03	324472.3649	463302.3175	73°25'6.89"	4°11'20.62"
SG04	324379.6223	463116.7103	73°25'3.89"	4°11'17.83"
SG05	324294.0256	463065.2264	73°25'1.12"	4°11'16.14"
SG06	324139.4355	462986.1060	73°24'56.11"	4°11'13.56"
SG07	324047.6394	463184.1977	73°24'53.12"	4°11'20.00"
SG08	324239.2944	463335.0750	73°24'59.32"	4°11'24.93"
YT01	324282.0749	463223.5708	73°25'0.72"	4°11'21.30"



NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED
2. DEPTHS AND HEIGHTS ARE METERS AND THEY ARE REFERRED TO MEAN SEA LEVEL (MSL).
3. ALL DIMENSIONS AND COORDINATES SHOULD BE CHECKED BY THE CONTRACTOR BEFORE WORKS IN THE LOCATION AND THE COORDINATES OF BOREHOLES IS BASED ON DRAWING 'Thilafushi, Coasta' Final 2010/04/04' OFFERED BY MALDIVES GOVERNMENT. THE COORDINATES AND BOREHOLE LATITUDE KNOWLEDGE INFORMATION ONLY IS INTENDED FOR GUIDANCE ONLY. THE CONTRACTOR SHOULD CARRY OUT Ongoing WORKS ON THE BASIS OF SITE SITUATION. IF THE SITE SITUATIONS INCONSISTENT WITH THE COORDINATES, THE CONTRACTOR SHOULD REPORT TO CHIEF.
4. LEGEND:
 - SAMPLING AND SPT TEST BOREHOLE
 - SPT TEST BOREHOLE

REFERENCE DRAWINGS

DRW. NO.	DRW. TITLE

THILAFUSHI INTERNATIONAL CONTAINER PORT

DESIGNER: CHINA HARBOR ENGINEERING CO., LTD.

CONTRACTOR: CCCP-FIND ENGINEERING CO., LTD.

DATE:

BY:

SCALE: 1:1000

1:07 SCALE: A (1:1)

ISSUE NO: CHCE-3-2001

REV. NO: 5



REV.	DATE	BY

4°11'15"N

4°11'30"N



SG07

SG06

SG05

SG04

SG03

Y101

SG08

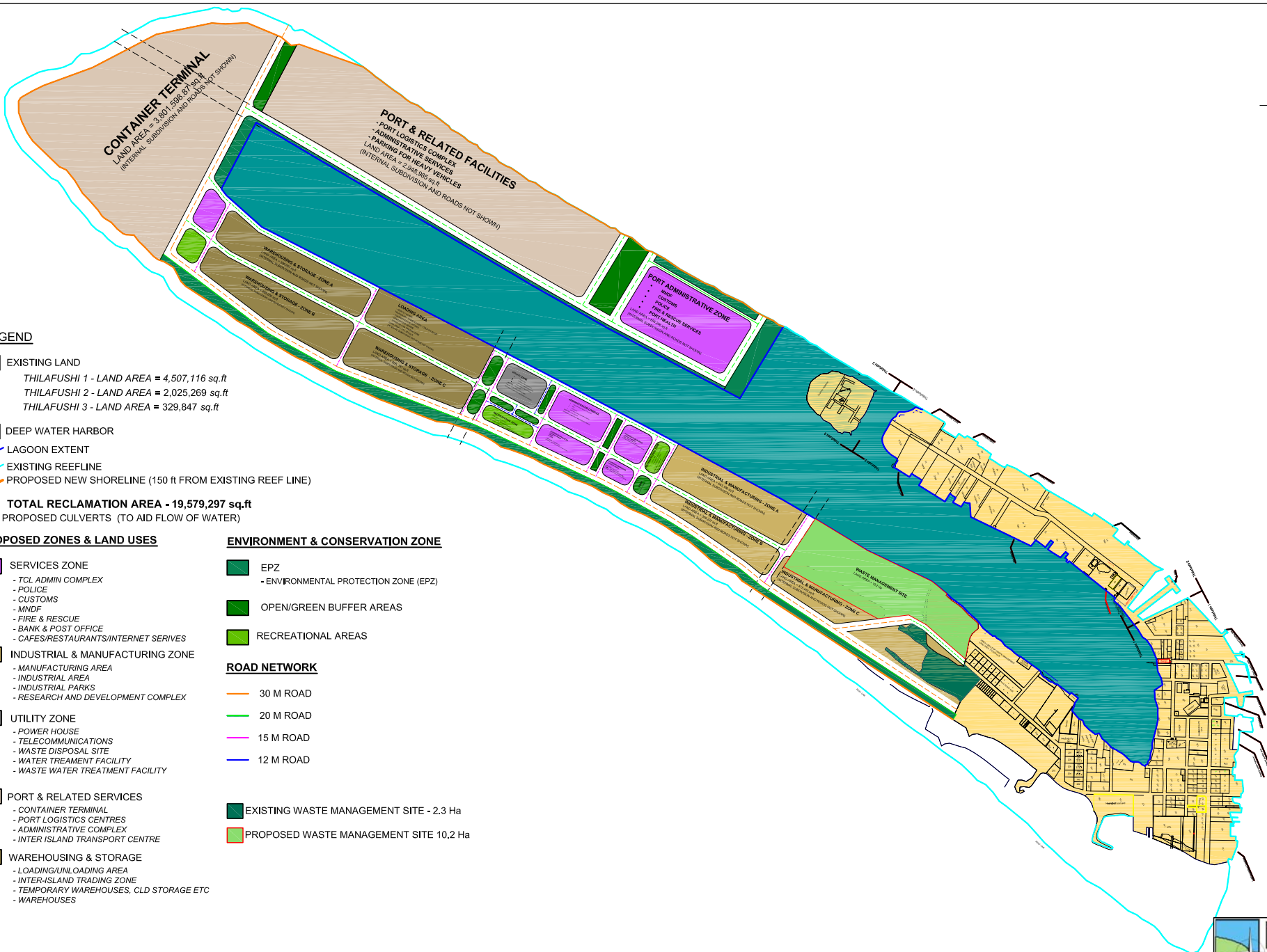
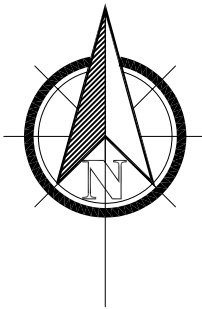
SG01

SG02

73°24'45"E

73°28'0"E

APPENDIX C – Thilafushi Landuse Master Plan



LEGEND

- EXISTING LAND
 THILAFUSHI 1 - LAND AREA = 4,507,116 sq.ft
 THILAFUSHI 2 - LAND AREA = 2,025,269 sq.ft
 THILAFUSHI 3 - LAND AREA = 329,847 sq.ft
- DEEP WATER HARBOR
- LAGOON EXTENT
- EXISTING REEFLINE
- PROPOSED NEW SHORELINE (150 ft FROM EXISTING REEF LINE)

TOTAL RECLAMATION AREA - 19,579,297 sq.ft
 ||| PROPOSED CULVERTS (TO AID FLOW OF WATER)

PROPOSED ZONES & LAND USES

- SERVICES ZONE
 - TCL ADMIN COMPLEX
 - POLICE
 - CUSTOMS
 - MINDF
 - FIRE & RESCUE
 - BANK & POST OFFICE
 - CAFES/RESTAURANTS/INTERNET SERVICES
- INDUSTRIAL & MANUFACTURING ZONE
 - MANUFACTURING AREA
 - INDUSTRIAL AREA
 - INDUSTRIAL PARKS
 - RESEARCH AND DEVELOPMENT COMPLEX
- UTILITY ZONE
 - POWER HOUSE
 - TELECOMMUNICATIONS
 - WASTE DISPOSAL SITE
 - WATER TREATMENT FACILITY
 - WASTE WATER TREATMENT FACILITY
- PORT & RELATED SERVICES
 - CONTAINER TERMINAL
 - PORT LOGISTICS CENTRES
 - ADMINISTRATIVE COMPLEX
 - INTER ISLAND TRANSPORT CENTRE
- WAREHOUSING & STORAGE
 - LOADING/UNLOADING AREA
 - INTER-ISLAND TRADING ZONE
 - TEMPORARY WAREHOUSES, CLD STORAGE ETC
 - WAREHOUSES

ENVIRONMENT & CONSERVATION ZONE

- EPZ
 - ENVIRONMENTAL PROTECTION ZONE (EPZ)
- OPEN/GREEN BUFFER AREAS
- RECREATIONAL AREAS

ROAD NETWORK

- 30 M ROAD
- 20 M ROAD
- 15 M ROAD
- 12 M ROAD

- EXISTING WASTE MANAGEMENT SITE - 2.3 Ha
- PROPOSED WASTE MANAGEMENT SITE 10.2 Ha

TITLE:
DRAFT ZONING PLAN - K. THILAFUSHI

PROJECT:
 PROPOSED RECLAMATION - K.THILAFUSHI

CLIENT:
 THILAFUSHI CORPORATION LIMITED (TCL)

SURVEYED BY: LESA Pvt Ltd

DRAWN BY: MA

CHECKED BY: II, MF

SCALE: AS SHOWN

FILE NO: 1 OF 1

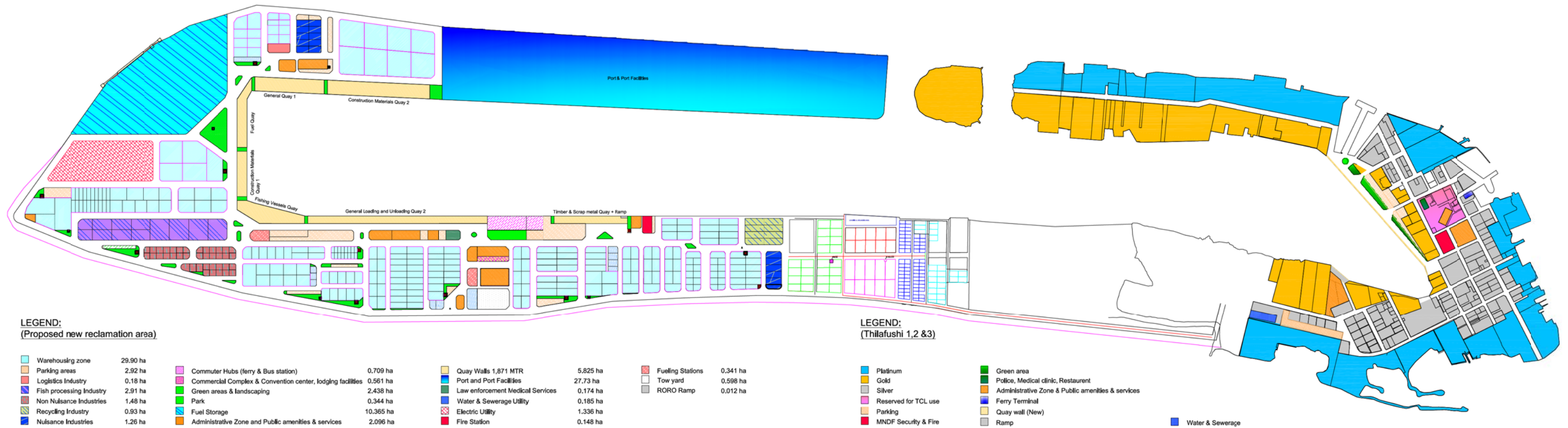
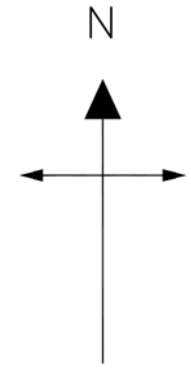
DATE: 17 JUNE 2010



G. Maalhika (Ground Floor),
 Saharaa Magu, Male'
 Maldives

Tel: (960) 331 6037, Fax: (960) 331 6038
 Email: lesa.maldives@gmail.com

Thilafushi Industrial Island Master Zoning 2014



LEGEND:
(Proposed new reclamation area)

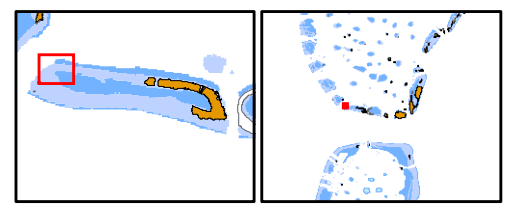
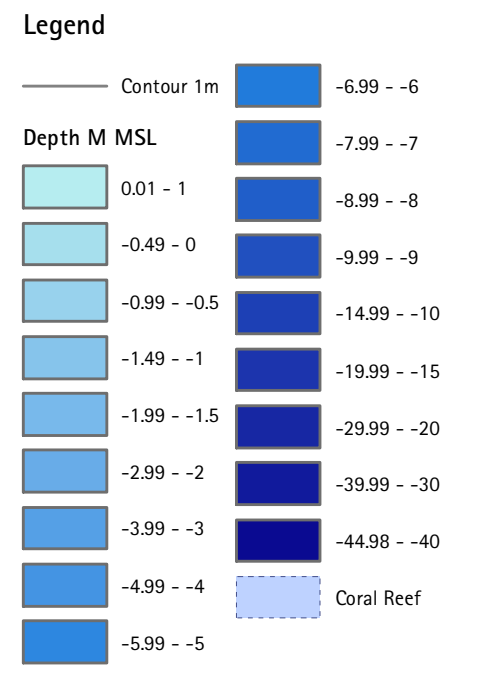
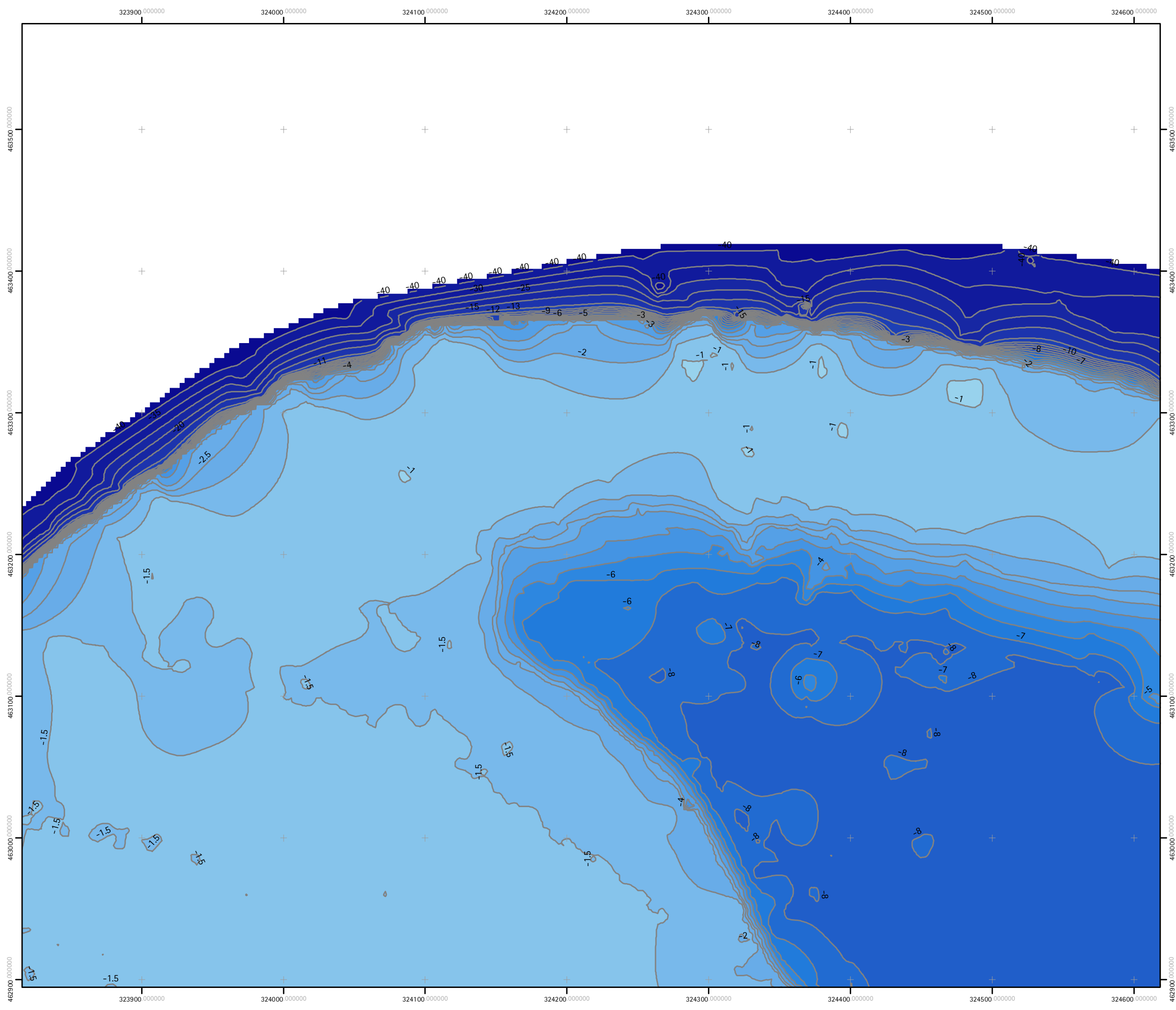
Warehousing zone	29.90 ha	Commuter Hubs (ferry & Bus station)	0.709 ha
Parking areas	2.92 ha	Commercial Complex & Convention center, lodging facilities	0.561 ha
Logistics Industry	0.18 ha	Green areas & landscaping	2.438 ha
Fish processing Industry	2.91 ha	Park	0.344 ha
Non Nuisance Industries	1.48 ha	Fuel Storage	10.365 ha
Recycling Industry	0.93 ha	Administrative Zone and Public amenities & services	2.096 ha
Nuisance Industries	1.26 ha		

Quay Walls 1,871 MTR	5.825 ha	Fueling Stations	0.341 ha
Port and Port Facilities	27.73 ha	Tow yard	0.598 ha
Law enforcement Medical Services	0.174 ha	RORO Ramp	0.012 ha
Water & Sewerage Utility	0.185 ha		
Electric Utility	1.336 ha		
Fire Station	0.148 ha		

LEGEND:
(Thilafushi 1,2 &3)

Platinum	Green area
Gold	Police, Medical clinic, Restaurant
Silver	Administrative Zone & Public amenities & services
Reserved for TCL use	Ferry Terminal
Parking	Quay wall (New)
MNDP Security & Fire	Ramp
	Water & Sewerage

APPENDIX D – Bathymetry Chart



Project
**Thilafushi Port Project,
 Thilafushi Reef, North Male' Atoll**

Map Title
Bathy Chart

Client: China Harbour Engineering Company

Scale and Projection: 1:2,500

Meters
 0 25 50 100

PROJECTION: Transverse Mercator (UTM Zone 43 N);
 HORIZONTAL DATUM: WGS84;
 VERTICAL DATUM: Hulhule Tide Gauge

Map No: **V-BATHY-1-01** Revision **01**
 Map version: 21/08/2017; Prepared By: Shaig

CDE Consulting
 4th Floor, Orchidmaage
 Ameer Ahmed Magu
 Male' Maldives
 (+960)3312514; info@cde.com.mv

APPENDIX E – Water Results

WATER QUALITY TEST REPORT
 Report No: 500175203

Customer Information:
 AURINKO PVT LTD
 ORCHIDMAAGE, 4TH FLOOR
 Ameeru Ahumadhu Magu
 Male'. Maldives 20095

Report date: **09/08/2017**
 Test Requisition Form No: **900178006**
 Sample(s) Received Date: **09/08/2017**
 Date of Analysis: **09/08/2017 - 09/08/2017**

Sample Description	Thilafushi Project - SW 1	Thilafushi Project - SW 2	TEST METHOD	UNIT
Sample Type	Desalinated Water	Desalinated Water		
Sample No	83189809	83189810		
Sampled Date	08/08/2017	08/08/2017		
PARAMETER	ANALYSIS RESULT			
Physical Appearance	Clear with particles	Clear with particles		
pH	8.12	8.18	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	-
Temperature	20.2	20.0	Electrometry	°C
Total Suspended Solids	<5 (LoQ 5 mg/L)	<5 (LoQ 5 mg/L)	Method 8006 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Turbidity	0.504	1.11	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

Keys: °C : Degree Celcius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit

Checked by



Afnan Farooq
 Laboratory Executive Gr.1

Approved by

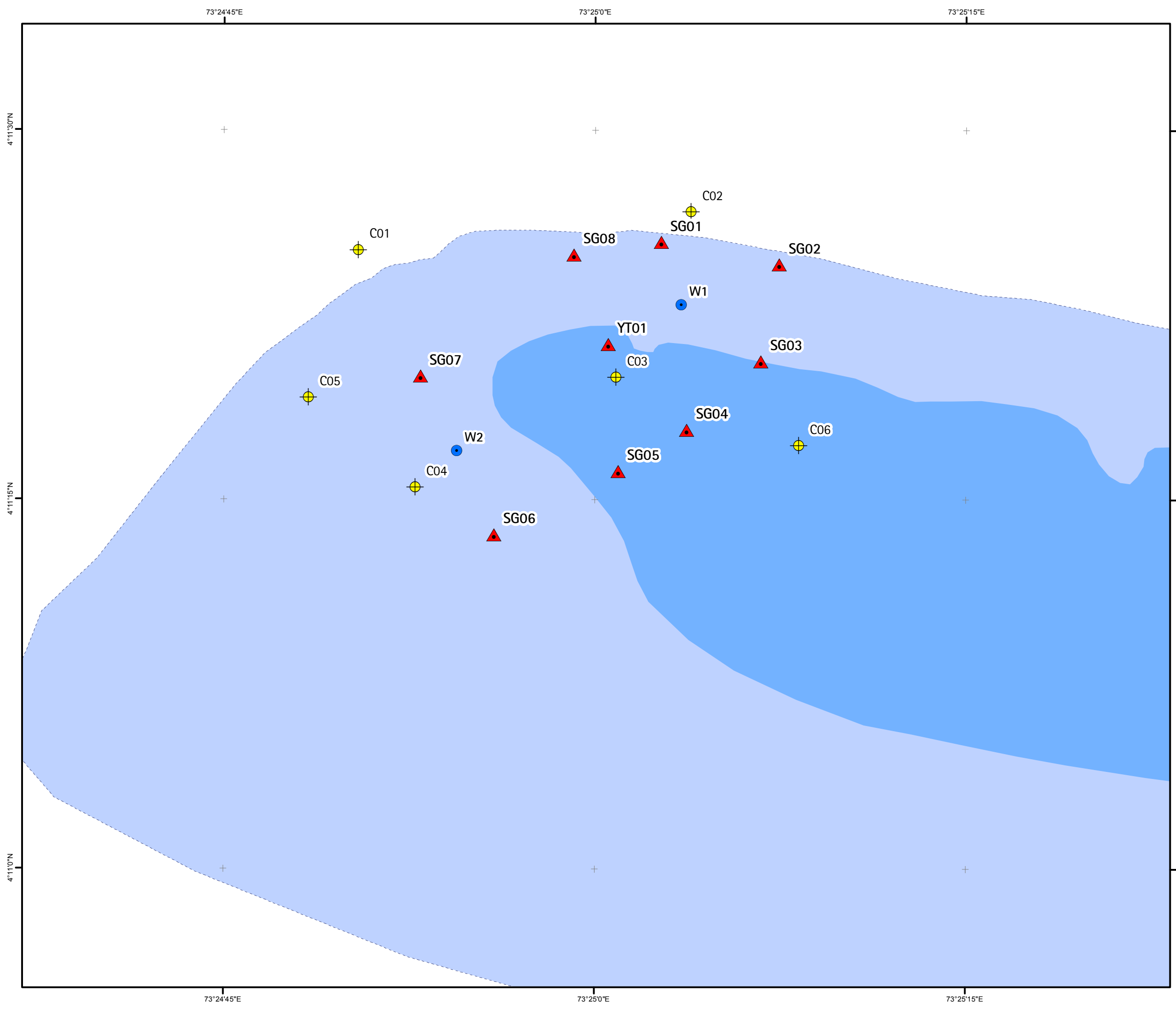


Mohamed Eyman
 Assistant Manager, Quality

Notes: Sampling Authority: Sampling was not done by MWSC Laboratory
 This report shall not be reproduced except in full, without written approval of MWSC
 This test report is ONLY FOR THE SAMPLES TESTED.
 ~ Information provided by the customer

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

APPENDIX F – Survey Locations








Geotechnical investigation locations

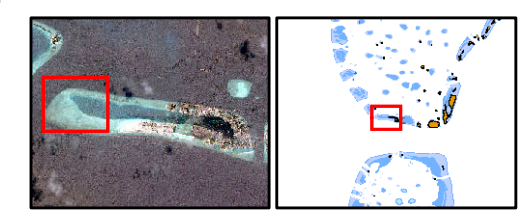
SITE_ID	Longitude	Latitude
SG01	73.4175	4.1904
SG02	73.4188	4.19015
SG03	73.4186	4.18906
SG04	73.4177	4.18828
SG05	73.417	4.18782
SG06	73.4156	4.1871
SG07	73.4148	4.18889
SG08	73.4165	4.19026
YT01	73.4169	4.18925

Water Samples

code	X	Y
W1	73.4177	4.1897
W2	73.4152	4.18805

Legend

-  borehole locations
-  Currents
-  Marine Water Samples
-  Lagoon
-  Coral Reef

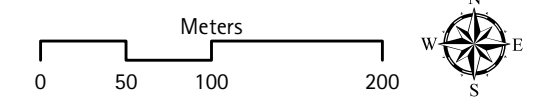


Project
Thilafushi Geotechnical Survey
Locations
North Male' Atoll

Map Title
Survey Locations

Client: CHEC

Scale and Projection: 1:4,418



PROJECTION: Transverse Mercator (UTM Zone 43 N);
 HORIZONTAL DATUM: WGS84;
 VERTICAL DATUM: Hulhule Tide Gauge

Map No: **SURVEYLOC-01** Revision

Map version: 21/08/2017; Prepared By: Shaig

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 4th Floor, Orchidmaage
 Ameer Ahmed Magu
 Male' Maldives
 (+960)3312514; info@cde.com.mv



APPENDIX G – 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.

ALI MOOSA DIDI

4th floor, MA. Rose Villa • Dhevina Magu • Male' • Maldives • 00 960 791-2001 • ali@cde.com.mv

A highly motivated individual with a hardworking attitude and over ten years of experience in the surveying industry of the Maldives.

Personal

Name: Ali Moosa Didi
Date of Birth: 18th June 1985
Gender: Male
Marital Status: Single
NID No: A-154179

Education

**UNIVERSITY OF CAMBRIDGE, GCE ORDINARY LEVEL
(JAN 1997)**
*Madharasthul Islamiya School
Male', Rep of Maldives*

Employment

SURVEYOR (FULL TIME)
(January 2010 – PRESENT)
*CDE Pvt Ltd
Male', Rep of Maldives*

Conducting field based surveying activities; including shoreline mapping exercises, vegetation assessments, topographic surveys and hydrographic surveys. Work duties also include the consequent data processing and mapping activities of all the surveys conducted at the office.

HUMAN RESOURCES OFFICER (FULL TIME)
(January 2010 – PRESENT)
*Ryco Investment Pvt Ltd
Male', Rep of Maldives*

Assisted the Office Manager in handling all the human resources related duties of the Office, including Payroll processing.

ASSISTANT SURVEYOR (FULL TIME)
(January 2010 – PRESENT)
*CDE Pvt Ltd
Male', Rep of Maldives*

Assisting field based surveying activities; including shoreline mapping exercises, vegetation assessments, topographic surveys and hydrographic surveys. Work duties also included the consequent data processing and mapping activities of all the surveys conducted at the office.

Skills

- ✓ Competent in using Surveying Equipment and Accessories
- ✓ Intermediate in Microsoft Applications
- ✓ Intermediate in ArcGIS application

Work Experience

- Travelled to all 20 atolls of the Maldives
- Over 100+ islands in the Maldives; including 20+ Resorts, 50+ Inhabited islands and 30+ Uninhabited islands and their associated reef systems

Some of the EIA's that I have worked on as a member of the team, or contributed to the field surveying work (Past 5 years only);

- Tourism Development Projects:
 - Adh. Bodukaashihuraa Resort Development EIA
 - B. Dhigufaruvinagandu Resort Development EIA
 - K. Madivaru Resort Development EIA
 - Lh. Fushifaru Resort Development EIA
 - N. Thanburudhuffushi Picnic Island Development EIA
 - K. Gasfinolhu Addendum EIA (Palm transplanting)
 - K. Taj Vivanta Resort Shore Protection EIA
 - Lh. Maabinhuraa Resort Development EIA
 - Aa. Maagaa Resort Development EIA
 - Aa. Madivaru Finolhu Resort Development EIA
 - Olhuveli Lagoon Reclamation EIA
 - Dh. Aluvifushi Resort Development EIA
 - Lh. Huruvalhi Resort Development EIA
- Agricultural Development Projects:
 - Sh. Madidhoo Agricultural Development EIA
 - Lh. Maduvarri Agricultural Development EIA
 - N. Minaavaru Agricultural Development EIA
- Airport Development Projects:
 - R. Ifuru Airport Development EIA
 - N. Maafaru Airport Development EIA
- Major public/ private sector Projects:
 - Tree Top Hospital Development EIA
 - Nasandhura Palace Hotel Redevelopment EIA
 - Thilafushi Harbor Development EIA
 - Male-Hulhule Bridge, Borehole Drilling EIA
 - Male-Hulhule Bridge EIA
 - Addu and Fuvahmulah ESIA for Wetland Project

References

Simad Saeed, PhD

Managing Director

CDE Pvt Ltd

4th Floor, Orchidmaage, Ameeruahmed Magu,

Male' Maldives

info@cde.com.mv

Tel: +960 331 2514

Fax: +960 331 5926

Ahmed Shaig, PhD

Director

CDE Pvt Ltd

4th Floor, Orchidmaage, Ameeruahmed Magu,

Male' Maldives

info@cde.com.mv

Tel: +960 331 2514

Fax: +960 331 5926

Mohamed Faizan

Contact Details

Address: H. Pent Land,
Lansimoo Goalhi,
20041 Male',
Maldives

Tel: +960-7501205

E-mail: Faizan@cde.com.mv

Education

August 2012 – October 2014 University of Malaya, (Malaysia)

- Master of Technology (Environmental management)
- Dissertation title "Study on the impact of anthropogenic pressure on coral reefs around Cape Rachado, Malacca and recommendations to improve its management"

July 2006- June 2010 International Islamic University Malaysia, (Malaysia)

- Bachelor of Biotechnology (Honours).
- Final year thesis title "Spatio-temporal study on coastline changes along Tanjung Lumpur – Cherok Paloh Coast".

June 2002 – June 2004 Centre for Higher Secondary School, (Maldives)

- GCE Advanced level.

January 1997 – February 2002 Majeediya School, (Maldives)

- GCE Ordinary level.

Employment History

July 2014 – Present CDE Consulting

- **Environmental Consultant** at CDE Consulting. Roles and responsibilities include preparation of Environmental Impact Assessment reports, undertaking environmental baseline surveys, and conduct environmental monitoring.

June 2010 – July 2012 CDE Consulting

- **Environmental Consultant** at CDE Consulting. Responsibilities included undertaking environmental baseline studies for Environmental Impact Assessments, and environmental monitoring. In addition, co-ordination of field surveys.

February 2005 – April 2006 Integrated Climate Change Strategy

- **Project Assistant** for the Integrated Climate Change Strategy implemented by Ministry of Environment, Energy and Water (Maldives).
- Responsibilities included assisting the project manager, in preparation of financial reports, organizing workshops.
- Helped launch monthly newsletter on climate change "Nakaiy".

EIA experience

Environmental Impact Assessment (EIA)	Proponent	Date
<p>EIA for the proposed Malé-Hulhulé bridge</p> <ul style="list-style-type: none"> - Undertook the marine baseline assessment surveys, and prepared marine assessment report 	Ministry of Housing and Infrastructure	July 2015
<p>EIA for the proposed redevelopment of of Nasandhuraa Palace Hotel</p> <ul style="list-style-type: none"> - Undertook the marine baseline assessment surveys 	Nasandhura Palace Hotel Investments Private Limited	June 2015
<p>EIA for the proposed resort development in Madivaru, Kaafu Atoll</p> <ul style="list-style-type: none"> - Undertook the marine baseline assessment surveys 	Shuaz Investment Private Limited	May 2015
<p>EIA for the proposed Coral Reef rejuvenation project at Velaa Private Island</p> <ul style="list-style-type: none"> - Undertook the baseline assessment surveys, including stakeholder consultations. Complied the EIA report. 	Velaa Private Island	March 2015
<p>EIA for the proposed Coral Gardening at Shangri-La's Villingili Resort & Spa</p> <ul style="list-style-type: none"> - Undertook the baseline assessment surveys, including stakeholder consultations. Complied the EIA report. 	Shangri-La's Villingili Resort & Spa	February 2015
<p>EIA for the proposed sewerage system project at Kanditheem, Shaviyani</p> <ul style="list-style-type: none"> - Marine environment assessment and report for the EIA 	Male' Water and Sewerage Company Pvt Ltd	April 2014
<p>EIA for the proposed beach replenishment project in Holiday Inn Resort Kandooma, Maldives, South Male' Atoll</p> <ul style="list-style-type: none"> - Marine environment assessment and report for the EIA 	Holiday Inn Resort Kandooma Maldives	April 2014
<p>EIA report for the proposed sewerage system at Maduvvari, Raa Atoll</p> <ul style="list-style-type: none"> - Undertook the baseline assessment surveys, including stakeholder consultations. Complied the EIA report. 	Mr. Ibrahim Shazyl, Venture Maldives Pvt Ltd	February 2012
<p>EIA report for the proposed installation and operation of desalination plant at Hithaadhoo, Baa Atoll</p> <ul style="list-style-type: none"> - EIA report compilation. 	Mr. Ismail Shafeeu, Static Company Pvt Ltd	January 2012

AHMED HAIMAN RASHEEDH

PERSONAL DETAILS

Full Name: **Haiman Rasheedh, Ahmed** NIRC: **A297924**
Gender: **Male** Date of birth: **September 24, 1993**
Place of birth: **S.Feydhoo, Republic of Maldives** Nationality: **Maldivian**
Marital Status: **Single**

Permanent Address: **Goal Corner
S.Feydhoo 19040
Republic of Maldives** Current Address: **G. Velagala
Faashanakileygefaanu Magu
Male, Republic of Maldives**

Contact Details: **(Mobile): +960 7684393**

Email for correspondence: **haiman@cde.com.mv**

EDUCATION

Year	Name of Education Institute	Title of Qualification	Status
2007 – 2009	DHARUMAVANTHA SCHOOL	GCE / IGCSE O' Level under the curriculum of University of Cambridge	Graduated

EMPLOYMENT HISTORY

Time Period	Position Held, Employee	Task assigned
February 2014 – present	Associate Consultant, CDE Consulting	<ul style="list-style-type: none">Marine surveying (Conducting inspections, reef transects, manta tows, designing coral reef restoration projects, & examinations of reefs)Coral Point Count with Excel extensions (Software to determine of coral cover using transect photographs)Beach surveyingCompiling Marine reports (Prepare reports on types of surveys conducted)
August 2013 – February 2014	Assistant technician, Ministry of Fisheries and Agriculture	<ul style="list-style-type: none">Designing the structure of FAD (Fish Aggregating Device)Research on the status of pelagic fishes found near FADs
January 2011 – January 2012	Research officer, CDE Consulting	<ul style="list-style-type: none">Marine surveying (Conducting inspections, surveys & examinations of reefs)Beach surveyingCompiling Marine reports (Prepare reports on types of surveys conducted)
December 2009 – June 2010	Research officer, CDE Consulting	<ul style="list-style-type: none">Marine surveying (Conducting inspections, surveys & examinations of reefs)Beach surveyingCompiling Marine reports (Prepare reports on types of surveys conducted)

Field Experience

- Traveled to all 20 atolls of the Maldives
- Over 100+ islands in the Maldives; including 20+ Resorts, 50+ Inhabited islands and 30+ Uninhabited islands and their associated reef systems

Some of the EIA's that I have worked on as a member of the team, or contributed to field work;

- Tourism Development Projects:
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 - B. Dhigufaruvinaandu Resort Development EIA
 - K. Madivaru Resort Development EIA
 - Lh. Fushifaru Resort Development EIA
 - N. Thanburudhuffushi Picnic Island Development EIA
 - K. Gasfinolhu Addendum EIA (Palm transplanting)
 - K. Taj Vivanta Resort Shore Protection EIA
 - Lh. Maabinhuraa Resort Development EIA
 - Aa. Maagaa Resort Development EIA
 - Aa. Madivaru Finolhu Resort Development EIA
 - Olhuveli Lagoon Reclamation EIA
 - Dh. Aluvifushi Resort Development EIA
 - Lh. Huruvalhi Resort Development EIA
- Agricultural Development Projects:
 - Sh. Madidhoo Agricultural Development EIA
 - Lh. Maduvarri Agricultural Development EIA
 - N. Minaavaru Agricultural Development EIA
- Airport Development Projects:
 - R. Ifuru Airport Development EIA
 - N. Maafaru Airport Development EIA
- Major public/ private sector Projects:
 - Tree Top Hospital Development EIA
 - Nasandhura Palace Hotel Redevelopment EIA
 - Thilafushi Harbor Development EIA
 - Male-Hulhule Bridge, Borehole Drilling EIA
 - Male-Hulhule Bridge EIA
 - Addu and Fuvahmulah ESIA for Wetland Project

Dive Qualifications

Date	Qualification	School	Status
May 2014	Open Water Diver, PADI	Maldivers Diving Center, Maldives	Certified
Mar 2016	Advanced Diver, PADI	Dive Desk, Maldives	Completed, Card pending
Mar 2016	Emergency First Response, PADI	Dive Desk, Maldives	Completed, Card pending

REFERENCES

Name	Address, Telephone & Fax	Email, Occupation & Business Title
Ahmed Shaig, PhD	CDE Pvt Ltd 4 th Floor, Orchidmaage Ameer Ahmed Magu, Henveiru Male', Maldives (Telephone): +960 3312514 (Fax): +960 3315926	Director CDE Pvt Ltd info@cde.com.mv
Mohamed Ali	CDE Pvt Ltd 4 th Floor, Orchidmaage Ameer Ahmed Magu, Henveiru Male', Maldives (Telephone): +960 3312514 (Fax): +960 3315926	Marine Specialist/ DiveMaster CDE Pvt Ltd mohamed.ali@cde.com.mv

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

APPENDIX H – Commitment Letter

APPENDIX I – Acknowledgement Letter



中国港湾工程有限责任公司

**CHINA HARBOUR ENGINEERING COMPANY LTD.
REPRESENTATIVE OFFICE IN SRI LANKA.**

01502/2017

Level 32, East Tower, World Trade Centre, Echelon Square, Colombo 01, Sri Lanka.
Tel; 0094-11 -2470998-9, 0094-11-2470800, Fax : 0094-11-2470997, Email: srilanka@chec.lk

Ref. Number: CHEC/MACL/TPDP/O/0012

22nd August 2017

Mr. Ibrahim Naeem,
Director General
Environment Protection Agency
3rd Floor, Green Building
Ameenee Magu,
Male', Maldives

Dear Sir,

**Sub: EIA Report for the proposed Geotechnical Studies at Thilafushi Lagoon, Kaafu Atoll,
Maldives**

As the proponent of the above-mentioned project, we guarantee that we have read the report and to the best of our knowledge all non-technical information provided here are accurate and complete.

We also hereby confirm our commitment to carry out and bear costs of environmental mitigation measures and monitoring as outlined in the EIA report.

Yours faithfully,

For and on behalf of

China Harbour Engineering Company Ltd.



Zhong Di

Representative in Maldives



ਸਰੋਤ: CDE-L/0817/275

www.cde.com.mv

ਮੇਰੀ ਮਾਨਯੋਗਤਾ ਅਤੇ ਸਹਿਯੋਗ ਦੀ ਸ਼ੁਕਰੀਆ ਪ੍ਰਗਟਾਉਣ ਲਈ ਮੈਂ ਆਪਣੇ ਸਰੋਤ ਅਤੇ
 ਫੰਡਾਂ ਨੂੰ ਸਹਿਯੋਗੀ ਢੰਗ ਨਾਲ ਵਰਤਿਆ ਹੈ।

ਮੇਰੀ ਮਾਨਯੋਗਤਾ ਅਤੇ ਸਹਿਯੋਗ ਦੀ ਸ਼ੁਕਰੀਆ ਪ੍ਰਗਟਾਉਣ ਲਈ ਮੈਂ ਆਪਣੇ ਸਰੋਤ ਅਤੇ ਫੰਡਾਂ ਨੂੰ ਸਹਿਯੋਗੀ ਢੰਗ ਨਾਲ ਵਰਤਿਆ ਹੈ।
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 21 ਅਗਸਤ 2017

ਸ਼ਾਇਗ
 ਮੈਨੇਜਿੰਗ ਡਾਇਰੈਕਟਰ
 ਆਪਣੇ ਸਰੋਤ ਅਤੇ ਫੰਡਾਂ ਨੂੰ ਸਹਿਯੋਗੀ ਢੰਗ ਨਾਲ ਵਰਤਿਆ ਹੈ।

THILAFUSHI CORPORATION	
Entry No.:	IN 2618
Received by:	Shima
Date/Time:	2018/17, 12:58
Sign:	[Signature]
FYI	
Received by:	Shima
Sign:	Shima Sharaf
FYA	PROJ
Received by:	Gumna PROJ
Sign:	[Signature] 22/Aug/17 2:25pm

ਮੇਰੀ ਮਾਨਯੋਗਤਾ ਅਤੇ ਸਹਿਯੋਗ ਦੀ ਸ਼ੁਕਰੀਆ ਪ੍ਰਗਟਾਉਣ ਲਈ ਮੈਂ ਆਪਣੇ ਸਰੋਤ ਅਤੇ ਫੰਡਾਂ ਨੂੰ ਸਹਿਯੋਗੀ ਢੰਗ ਨਾਲ ਵਰਤਿਆ ਹੈ।

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[Signature]