

INITIAL ENVIRONMENTAL EXAMINATION

for the proposed construction of a jetty joining Thulusdhoo
and Thulusdhoo - Huraagandu, Kaafu Atoll, Maldives

Proposed by:

Thulusdhoo Island Development Committee

Signature:

Designation:

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EXECUTIVE SUMMARY

This report discusses the findings of a socio-cultural and environmental impact study undertaken by Water Solutions Private Limited, Maldives, up on invitation from the Maldives Thulusdhoo Island Development Committee, the project Proponent. Thulusdhoo Island Development Committee is proposing to build a jetty between Thulusdhoo and Thulusdhoo Huraagandu, which is located on south eastern side of Thulusdhoo.

The primary justification to undertake this project is to provide easy access to Huraagandu from Thulusdhoo main Island. Huraagandu and its beaches are widely used by the residents of Thulusdhoo as a favourite picnic spot. The proposed jetty would be 40 meters long. The jetty would have 11 columns. The design for the jetty has a single 'T' type column.

The proposed project has three main components. They are casting of the columns on land, placement of the columns at appropriate location and placement of the tie beams and jetty planks.

The project is not expected to cause major environmental impact to the terrestrial, coastal and marine environment on eastern side of Thulusdhoo.

Therefore, it appears justified from a technical and from an environmental point of view to carry out the proposed development project if the Thulusdhoo is to absorb the economic gains achieved by the project.

1 INTRODUCTION

This Initial Environmental Examination (IEE) has been prepared to fulfil the requirements of the Environmental Protection and Preservation Act, law no. 4/93 for the proposed construction of a jetty joining Thulusdhoo and Thulusdhoo-Huraagandu in Kaafu Atoll. The proponent of the project is Thulusdhoo Island Development Committee.

Thulusdhoo-Huraagandu is a small islet lying to the south of Thulusdhoo, directly facing the 'Colas'/'Cokes'- a famous surf break among the local and international surfing community for surfing and photography. This project is a community initiative by Thulusdhoo Island Development Committee aimed at providing a recreation place to the island community. To this end, the proposed project involves construction of a jetty to join the small islet of Thulusdhoo-Huraagandu to the main island, Thulusdhoo. This would provide safe and convenient access between Thulusdhoo and Thulusdhoo-Huraagandu.

This report will identify the potential impacts (both positive and negative) of the proposed construction of the jetty. The report will also provide a detailed description of the proposed work, existing environmental conditions, and justifications given by the proponent for undertaking the proposed project activities. A mitigation plan to alleviate negative impacts during and after the construction is also included. This will ensure that the proposed activities are undertaken with caution and proper care so as to protect and preserve the natural environment of the island.

1.1 Structure of the report

The report will provide a detailed description of the proposed project, justifications given by the proponent for undertaking the proposed project activities and description of the existing environment. This IEE report will also identify the potential impacts (both positive and negative) of the proposed development project and suggest measures to mitigate and manage the negative impacts.

1.2 Aims and Objectives of the IEE

This IEE is intended to prevent or minimize potentially adverse environmental impacts and enhance the overall quality of a project

1.3 Methodologies

This environmental evaluation and assessment report is prepared based on common and internationally recognized methods not entailing excessive costs. In general, this IEE is based on data collected during a field investigation mission carried out by the consultants from Water Solutions Pvt. Ltd. In addition, consultative meetings were held between the client, contractor and the consultants as well as key informants of the island community on various occasions during the preparation of the report.

1.4 IEE Implementation

This IEE has been prepared by a team from Water Solutions consisting of Abdul Aleem and Ahmed Jameel as lead environment consultant. Aminath Afrah, Mohamed Riyaz and Hamdulla Shakeeb assisted in the survey and technical work for development of this EIA report.

1.5 Terms of Reference

The terms of reference for this IEE have been attached as Appendix 1. This IEE has been prepared based on this term of reference.

2 PROJECT DESCRIPTION

2.1 General Overview of the Project

The island of Thulusdhoo in Kaafu atoll lies 28.6 km to the north of Male'. It is famous among the local and international surfing community for the surf break on its eastern ridge called the 'Colas' / 'Cokes'. A small islet, Thulusdhoo-Huraagandu, lies to the south of Thulusdhoo, directly facing the famous surf break.

The 'Colas' / 'Cokes' is a well-known surf break recognised for its intense ride, big wave tube and scenic view from the wave zone and is therefore frequented by local and international surfers and surf photographers who visit Male' atoll. However, the full economic and social benefit of the popular surf break is not realised by the local community in Thulusdhoo, as visitors currently visit the site via local tour operators or safari boat operators. The only ways the residents of Thulusdhoo can access the lucrative tourist market is through island hopping, souvenir trade and trade of supplies to safari boats. Furthermore, no well-defined government policy regarding preservation and promotion of the Maldives as a surfing destination is in place as of yet.

In an effort to provide easy access to the place for the islanders, the Island Development Committee of Thulusdhoo has proposed to develop a jetty which joins the island with the Huraagandu. This IEE report is for the proposed construction of the jetty between Thulusdhoo and Thulusdhoo-Huraagandu which will facilitate the development of Thulusdhoo-Huraagandu by providing safe and convenient access to the Huraagandu from Thulusdhoo.

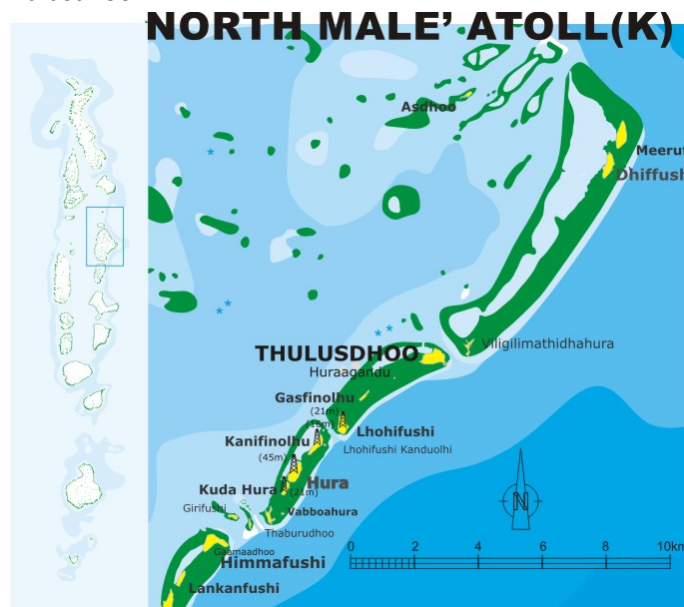


Figure 1: Location of the Project Site

2.2 Description of Project Proponent

The proponent of this project is Thulusdhoo Island Development Committee. The committee, run by the Island Office under the guidance of the Atoll Office, is responsible for organising and carrying out various development projects for the socio-economic benefit of the island community.

2.3 Project Location and Study Area

The project is proposed to take place in Thulusdhoo and Thulusdhoo-Huraagandu of Kaafu atoll. Thulusdhoo is the capital of Male' atoll, located 28.6 km north of Male'. The geographical co-ordinates of the island are 73° 38' 56" E 04° 23' 25" N. As of September 2008, the population of Thulusdhoo is 897. In addition to residential purposes, land on the island is being used for various commercial and municipal purposes. These include bottling facilities for the Coca Cola Company, Precision Marine boat yard etc which provide employment for many. The total land area of the island is 33.50 hectares, making it the second largest island in Kaafu atoll. Thulusdhoo-Huraagandu is a small uninhabited islet located to the south of Thulusdhoo. It faces a locally and internationally famous surf break- the 'Colas' / 'Cokes'. Figure 2- Location of Thulusdhoo and Thulusdhoo-Huraagandu shows the location of Thulusdhoo and Thulusdhoo-Huraagandu in North Male' Atoll.

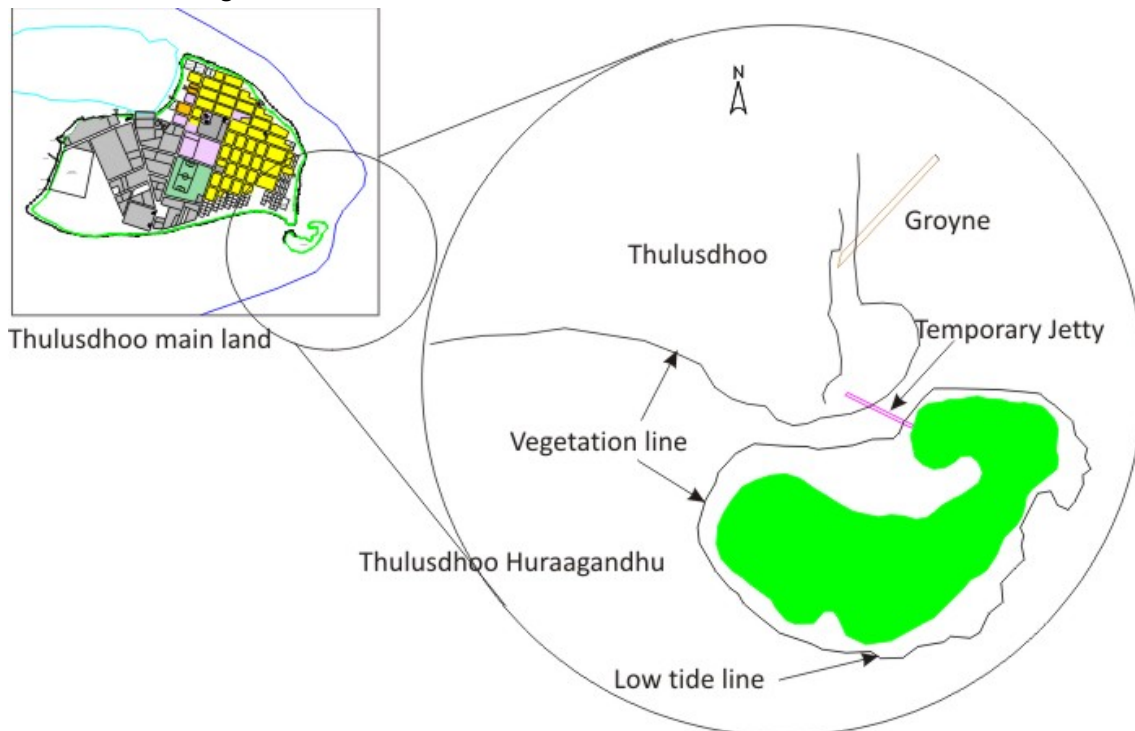


Figure 2- Location of Thulusdhoo and Thulusdhoo-Huraagandu in North Male' Atoll

2.4 Project Boundary

This project is limited to the construction of a timber jetty between Thulusdhoo and Thulusdhoo-Huraagandu. Figure 3 below shows the boundaries of the project site.

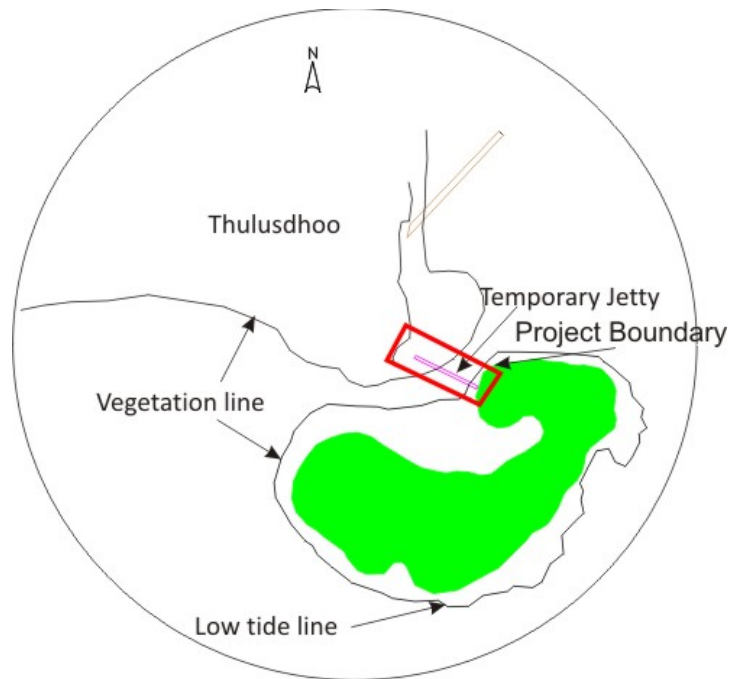


Figure 3- Project Boundary

The dimensions of the proposed bridge are provided in Figure 4. The length of jetty is estimated to be 40 meters. The jetty would have 9 columns. The space between the columns would be 5 meters

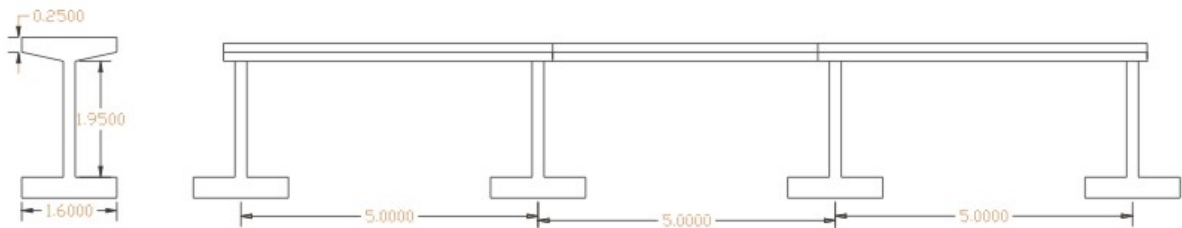


Figure 4- Proposed jetty

2.5 Need and Justification for the Project

2.5.1 Need for the Project

Presently Huraagandu is used by the island community as a picnic spot. The place is heavily used on weekends, when the island receives a large number of weekend holiday makers from Male. The islanders have made a temporarily jetty out of used crater boxes to access to the Thulusdhoo-Huraagandu from the island. Since this jetty is not properly done, it is highly prone to a disaster which is waiting to happen.

The proposed project of building a jetty between Thulusdhoo and Thulusdhoo-Huraagandu will provide safe and convenient access to the Huraagandu, enabling the island community to reap the full benefits of the place as a picnic spot.

2.5.2 Justification for Location

The jetty is proposed in the location, where a temporarily jetty has been presently constructed. The location has proven to be a good location, as the temporary jetty build by used cargo crate boxes has remain for a number of season, despite it faced a number of severe weather events.

2.5.3 Justification for Design

The design adopted for the jetty is widely used in the Maldives, especially in tourism sector. This particular design adopted for this project has one column. This is to reduce the impact of development on the hydrodynamic environment of the site.

2.6 Project Duration and Scheduling

Figure 5 gives the tentative schedule of the proposed project. The main activity of the project is the casting of the columns. There is no preferred monsoon to carry out the work as the area is not properly sheltered in either monsoon. However, it would be easier to carry out the project, if it could be phased as such that the majority of the civil works can be carried out in the south west monsoon.

Activities	M1	M2	M3	M4	M5
Mobilisation of the equipments					
casting of the Coloumns					
Placement of the coloumns					
construction of the deck					
demobilisation					
enviornmental monitoring					

Figure 5- Project Schedule

2.7 Proposed Project Activities and Construction Methodology

The main project activities of the proposed project would be the casting of the concrete columns and placement in the lagoon.

Casting of the columns will be carried out at the island on southern side. After casting, the columns will be placed in sea for curing for 14 days. Then columns will be placed where it would be located in the jetty. The lifting and moving the columns will be carried out using a small excavator.

2.8 Project Inputs and Outputs

2.8.1 Project Inputs

The types of resources that will be used during the proposed project work and from where and how these will be obtained are given below

Input Resource(s)	Source/Type	Method of Obtaining Resource
Work Force	Locals	Local hiring
Machinery and Equipment	Concrete mixer, excavator	Machine available on the island
Fuel for machinery/vehicles	Diesel/ petrol	From island
Water supply (construction period)	Well water from the island	From well
Electricity (construction period)	Diesel-based electricity from island mains	
Transport (sea)	Materials to be transported in carrier vessels	Cement, iron bars, aggregate, timber will be sourced from island
Construction Materials	cement, sand, metal rods etc.	From island

Table 1: Matrix of major inputs of environmental significance during construction activities

2.8.2 Project Outputs

The type of outputs (products and waste streams) and what is expected to happen to the outputs are given below.

Products and Waste Materials	Anticipated Quantities	Method of Disposal / Control
Noise	Only localised to the island environment, and mainly to project site.	Unavoidable, but impact can be minimised by limiting construction to daytime hours and weekdays. Project will be completed at the earliest possible date.
Air pollution	Limited quantities of dust in designated areas only	Mainly arising as a result of dust emission from moving machinery and vehicles. Only localised to project boundary. See mitigation measures for details.
Construction Waste		Stockpiled and transferred to island waste management site constructed by the Ministry

Table 2: Matrix of major outputs of environmental significance during construction activities

3 PROJECT SETTING

The project takes place in the Maldives Environment. Therefore, the extent to which the project conforms to existing plans, policies, guidelines, regulations and laws of the Maldives needs to be considered. Hence, this section will look at the context in which the project activities take place and the legal and policy aspects relevant to those activities.

3.1 Applicable Policies, Laws and Regulations

3.1.1 Environmental Protection and Preservation Act

The Articles of the Environmental Protection and Preservation Act (Law No. 4/93) addresses the following aspects of environmental management:

- Guidelines and advice on environmental protection shall be provided by the concerned government authorities.
- Formulating policies, rules and regulations for protection and conservation of the environment in areas that do not already have a designated government authority already carrying out such functions shall be carried out by Ministry of Housing, Transport and Environment (MHTE).
- Identifying and registering protected areas and natural reserves and drawing up of rules and regulations for their protection and preservation.
- An EIA shall be submitted to MHTE before implementing any development project that may have a potential impact on the environment.
- Project that has any undesirable impact on the environment can be terminated without compensation.
- Disposal of waste, oil, poisonous substances and other harmful substances within the territory of the Maldives is prohibited. Waste shall be disposed only in the areas designated for the purpose by the government.
- Hazardous / Toxic or Nuclear Wastes shall not be disposed anywhere within the territory of the country. Permission should be obtained for any transboundary movement of such wastes through the territory of Maldives.
- The Penalty for Breaking the Law and Damaging the Environment are specified.
- The government of the Maldives reserves the right to claim compensation for all damages that are caused by activities that are detrimental to the environment.

3.2 Second National Environment Action Plan (1999)

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

Main 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
 - Consultation and collaboration with all relevant sectors of society to ensure stakeholder participation in the decision making process
 - 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.

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 urbanisation

NEAP II contains environmental policies and guidelines that should be adhered to in the implementation of the proposed project activities, especially impact assessment, stakeholder consultation, biodiversity conservation and human settlement and urbanisation.

3.2.1 National Biodiversity Strategy and Action Plan

The goals of the National Biodiversity Strategy and Action Plan are:

- Conserve biological diversity and sustainably utilize biological resources.
- Build capacity for biodiversity conservation through a strong governance framework, and improved knowledge and understanding.
- Foster community participation, ownership and support for biodiversity conservation.

In implementing the proposed project activities due care has to be taken to ensure that the national biodiversity strategies are adhered to. In fact, surveys were undertaken at the design stage to find out if

biological resources of value and protected nature are affected by the proposed project. The proponent has committed fully to conservation and protection of the environment while undertaking this proposed project. More specifically, the marine environment has been assessed in detail in order to assess baseline values. Practical mitigation measures and solutions have been identified to conserve and protect the biodiversity.

3.2.2 Protected Areas and Sensitive Areas

Under Article 4 of the Environment Protection and Preservation Act, the Ministry of Environment is vested with the responsibility of identifying and registering protected areas and natural reserves and drawing up of rules and regulations for their protection and preservation. At present there are no rules and regulations made available to the public on designation and protection of habitats and heritage areas.

No protected/ sensitive areas exist within the project site or its vicinity.

3.2.3 Regulation on sand and aggregate mining

This regulation addresses sand mining from uninhabited islands that have been leased; sand mining from the coastal zone of other uninhabited islands; and aggregate mining from uninhabited islands that have been leased and from the coastal zone of other uninhabited islands.

This regulation will be strictly respected and there would not be any sand and aggregate mining except that which is required and approved under the terms of this Environmental Impact Assessment.

3.2.3.1 Ban on coral mining

Coral mining from the house reef and the atoll rim has been banned through a directive from the President's Office dated 26th September 1990. According to these policies,

- Coral mining is not to be carried out on island house reefs;
- Coral mining cannot be carried out on atoll rim reefs and common bait fishing reefs;
- Coral or sand mining is only allowed from designated sites, and approval from the concerned Atoll Office is required prior to the commencement of any mining operation.
- Requests for coral or sand mining from residents of inhabited islands are required to be submitted to the Atoll Office through their respective island office
- The island office is required to estimate the quantity of corals required for the applied construction work and hence this ensures that permission is granted to mine just the required amount;
- Every island is required to keep a log book of the amount of corals mined.
- Sand mining is not allowed on the beaches of inhabited islands, islands leased for industrial developments and tourist resorts and within the lagoons adjoining these islands.

This project does not involve sand or coral mining.

3.2.4 Consultation and public participation laws

In the Maldives public participation has been limited to the review stages of the EIS until recently with the EIA Regulation, which considers public consultation as an important and integral part of the EIA process. Hence, this IEE has also taken public views into consideration. In fact, public consultation was conducted in order to take public opinion, views, suggestions and expectations into consideration in the design of the project and not simply to fulfil the obligations under the EIA Regulation.

3.2.5 Population Policy

The objective of the Population Policy of Maldives is to contribute to improve standard of living and quality of life of the Maldivian people through socio-economic development with a sustainable balance between population and development. One important aspect of the Population Policy is the strategy of population and development consolidation, which focuses on organising human settlements in such a way that sustainable development is fostered and economies of scale are met. The proposed project in Thulusdhoo is expected to improve the standard of living and quality of life of the population of Thulusdhoo via its anticipated socio-economic benefits.

3.3 International conventions, treaties and protocols

Some of the international conventions, treaties and protocols of relevance to the proposed project may be identified as follows:

3.3.1 United Nations Convention on Biological Diversity (UNCBD)

The proposed project involves activities which may have impacts on some biological resources. The construction of the jetty may specifically impact marine resources. These impacts and mitigation measures have been dealt with in this report.

3.4 Environmental Permit Required for the Project

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

4 EXISTING ENVIRONMENT

The project is proposed to take place in Thulusdhoo and Thulusdhoo-Huraagandu of Kaafu atoll. This section of the report focuses only on the bathymetry, local hydrodynamics and sediment transport around the project area. This has been identified in the TOR.

4.1 Methodology

In addition to the compilation of secondary information, field surveys were undertaken to get further understanding of existing conditions in January 2009. Before this trip all available information, including the location of jetty, coastal and marine areas around the project site were considered. At site discussions were held with Island Development Committee regarding project details and Huraagandu uses regarding the Huraagandu and its surrounding coastal environment. The following components were then assessed in the field: Marine Environment around the project site, Coastal Environment including the beaches, the lagoon, long shore sediment transport processes and currents and Bathymetry of the site up

Data collection locations were referenced using handheld differential GPS (sub meter accuracy).

A hydrographic survey was undertaken using an echosounder connected to a differential GPS unit. Currents in the channel were studied using a buoy. The marine environment around the site was assessed using qualitative methods.

4.2 Coastal Environment

4.2.1 General Climatic Condition

Site specific data on climate were not taken, but nationwide climatic conditions were taken into consideration. There is very little variation in the climate from one part of the country to another.

The Maldives are located in the Monsoon Belt in the North Indian Ocean. The climate is divided into two distinct periods. The North-East monsoon lasts from December to April while the South-West monsoon lasts from May to October. These monsoons are relatively mild because of the country's location on the equator. The North-East monsoon is characterised by gentle and dry winds while the south-west monsoon brings with it heavier rains. The winds are usually stronger during the south west monsoon especially during June and July. The relative humidity generally ranges between 75 to 80%.

The Maldives experience a tropical climate with a mean annual temperature of 30.8°C with a day time high of 32 °C, night time lows rarely drop below 25.5°C. The average annual rainfall amounts to 1900mm, and there is an increase in the rainfall from north to south. The average annual rainfall in the north is 1977mm; in the south, it is 2470mm. This indicates that the south is wetter than the north; the wettest months are May, August, September and December. The driest are January to April. Open water evaporation rates are in the range of 6mm per day; transpiration from plants is also high.

4.2.2 Currents

The currents which affect Thulusdhoo and Thulusdhoo Huraagandu can be expected to be tidal currents, wind-induced currents, wave-induced currents and/or oceanic currents. Available data indicates that wind driven currents are the dominant form of currents around the project site as is the case for the other islands of the Maldives. Wave induced currents in the form of over washing, and in some locations long shore currents due to waves breaking on the reefs obliquely to the line of the reef, also affect the current regime.

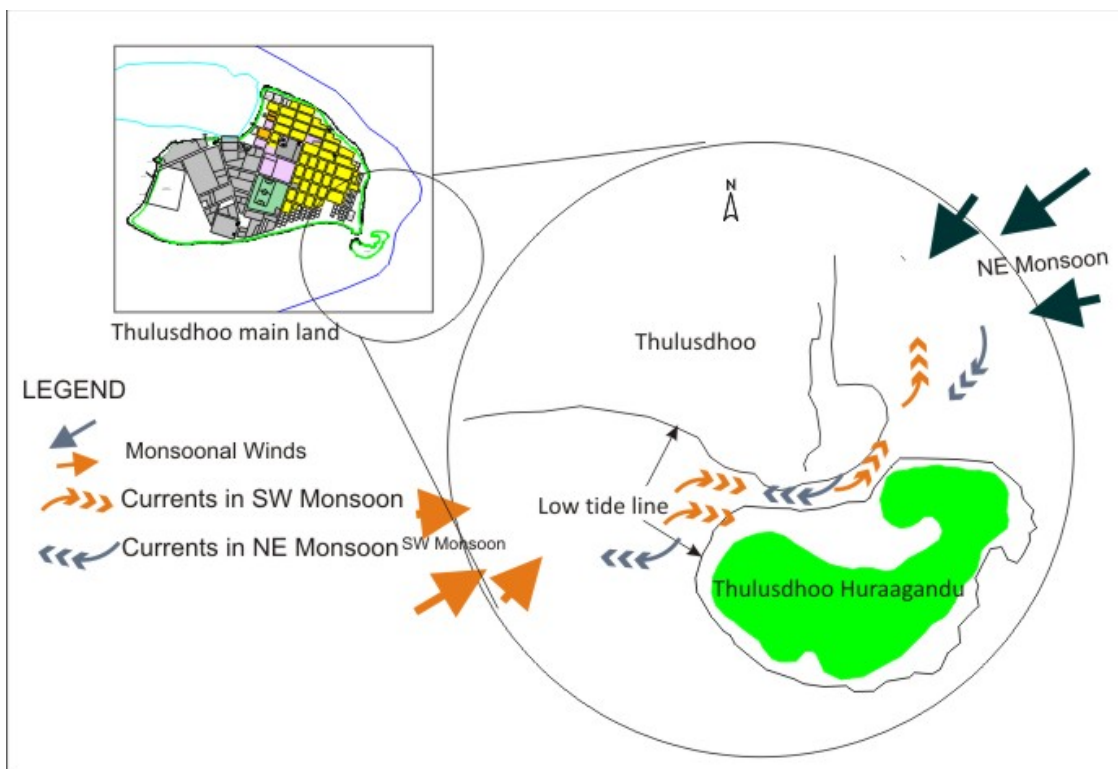


Figure 6- currents around Thulusdhoo and Thulusdhoo-Huraagandu in North Male' Atoll

Due to the limited tidal range, tidal currents tend to have a very weak influence on the overall current patterns within the reefs and around the islands. However, in the channel between Thulusdhoo and Kuda Villingili current direction and strength is mainly determined by tidal influence. Currents were observed to be in a net westerly direction on the day of the field trip with the winds coming from the east. Further studies need to be done to understand how currents vary.

4.2.3 Waves

Thulusdhoo is exposed to short, wind-generated waves from all sides since Thulusdhoo is on the eastern rim of Kaafu Atoll. Therefore, the impact of oceanic swells and surf waves are experienced on the eastern shore during the north east monsoon.

4.2.4 Tides

Tides in the Maldives are a mixed diurnal – semidiurnal type. The maximum tidal range in most locations is about 1m. No measurements of the tidal variation at Thulusdhoo were taken. The Hulhulé station is the closest tidal station. There is very little variation in tidal changes between Hulhulé and Thulusdhoo. Hence, tide records for Hulhulé were used to correct bathymetry data.

The tide height varies between 88 cm and 110 cm during the spring tide, and its range is as small as a few centimetres during the neap tides. The height of the tide is also affected by the weather. Winds influence the water level and high sea levels outside the atolls are caused by storm surges and wave set-up.

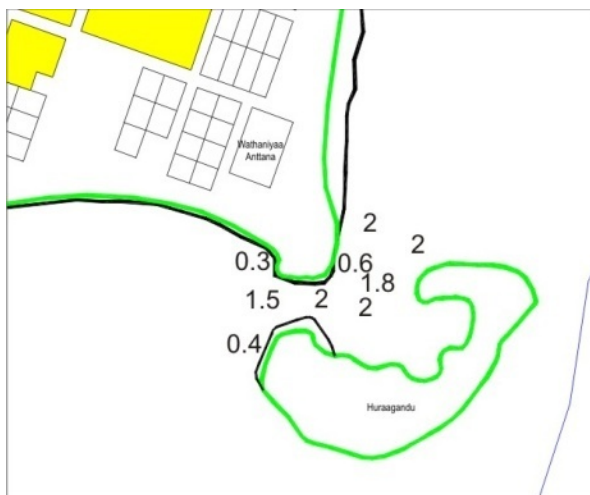
4.2.5 Beach and Lagoon

Thulusdhoo has on beach on different areas around the island. Thulusdhoo Huraagandu has sandy beach on north western side which faces the Thulusdhoo island. The Huraagandu has coral beach on rest of its perimeter. The beaches as well as the lagoon are of original material as there has not been any beach nourishment or coastal protection works undertaken.

The depth of the lagoon in between the island varies depending on the tide. At low tide, the area between the islands does not have any water and high tide, the depth measures at 1.2 meters with strong currents.

4.3 Bathymetry

Bathymetry was done for the area in which the jetty would be build. Bathymetry readings indicate that the average depth in the channel between two islands varies between 1.0 m and 2.0 m. The depth towards the middle is quite uniform with an average of about 2.0 m. The depth then varies gently until 2.9 m is reached near the reef flat on south eastern side of the island. The bathymetry of the area is shown below.



5 POTENTIAL IMPACTS OF THE PROJECT

5.1 Impact Identification

The activities proposed for the project have been considered with regard to the nature and significance of impacts they will have on the environment, in order to identify the impacts of the project. The construction methods, technology and other factors that could have a potential impact were identified and examined in detail to determine the impacts of the different project activities and components.

5.2 Assessing Impacts

Environmental impacts of the proposed project have been examined through a number of processes. Potential positive and negative impacts on the environment have been considered. In general, the impacts of the project have been assessed for coastal, marine and social environment.

Impacts on the marine and coastal environment from the proposed project have been predicted through analysis of the proposed project, discussions with the project proponent, field surveys, observations and assessment as well as based on field experience of similar works in the country. Data collected from field work were analyzed to predict the extent and significance of the impacts that may arise from the proposed project activities. The impacts are considered to be significant and need to be mitigated with proper planning and appropriate mitigation measures.

Impacts on the socio economic environment from the proposed project have been predicted through series of community consultation. Social impacts were assessed based on their positive and negative outcomes. Social impacts usually surface after long term and therefore, experience of similar projects in the Maldives and the outcomes of the stakeholder consultations were used to determine the impacts.

All impacts have been categorized into short-term and long-term. Most of the short-term impacts are related to construction activities, while the long-term impacts are associated with the existence and use of the proposed bridge. Possible negative impacts on the society and environment have been considered in the worst-case scenario to recommend mitigation measures in the best possible ways so that these impacts would be minimized and perhaps eliminated in both constructional and operational phases.

This IEE identifies and quantifies the significance of adverse impacts on the environment from the proposed project. Impacts on the environment were identified and described according to their location/attribute, extent (magnitude) and characteristics (such as short-term or long term, direct or indirect, reversible or irreversible) and assessed in terms of their significance. Negligible – the impact is too small to be of any significance.

5.3 Uncertainties in Impact Prediction

Environmental impact prediction involves a certain degree of uncertainty as the natural and anthropogenic impacts can vary from place to place due to even slight differences in ecological,

geomorphological or social conditions in a particular place. There may also be limited long term data and information regarding the particular site under consideration, which makes it difficult to predict impacts.

The level of uncertainty in predicting the impacts of the development works in Thulusdhoo is expected to be low. This is because the necessary data for impact prediction is mostly available. Nevertheless, a certain level of uncertainty is to be expected. Even though most major impacts may be anticipated, the degree of impact may in fact be greater than anticipated, rendering the recommended mitigation measures ineffective. Therefore, regular monitoring of the aspects specified in the monitoring program provided in this report is strongly recommended.

5.4 Impacts on the Marine Environment

The proposed project is not expected to have significant negative impacts on the marine environment. Coastal hydrodynamics in the project site is not considered to be affected.

5.4.1 Impacts of construction activities

Pollution of the lagoon and reef system can be caused by waterborne and windblown debris escaping from the construction site as well as accidental oil/chemical spills. Waste and residue arising from the project activities can also affect the marine environment.

Sedimentation and increased turbidity can also result from the proposed construction activities.

The footings of the over-water structures which will be constructed on the sea bed will have direct impacts on the lagoon floor. The location, where jetty would be built has sandy sand. Hence, this activity is not expected to make an impact on the coastal and marine environment.

5.5 Impacts on the Coastal Environment

5.5.1 Changes to hydrodynamic regime

Changes to the hydrodynamic regime can also cause deterioration of habitat and water quality. Near-shore hydrodynamics including current and wave pattern, as well as bottom hydrodynamics can be affected by anthropogenic coastal infrastructure such as jetties. This can lead to;

- Alteration of bottom substrate topography
- Degradation of sea water quality due to turbidity caused by alteration of littoral sediment transport regime
- Sedimentation and turbidity resulting in poor water quality which will negatively impact the vitality of marine organisms

This project is not expected to bring any significant changes to the hydrodynamic regime around the project site. The design adopted for the jetty has one column. This is to minimise the impact on the natural hydrodynamics around the project site.

5.5.2 Sedimentation

The coral reefs may be impacted indirectly due to spreading of sediment plumes on the coral reef. Corals can tolerate sedimentation to a certain extent. However, coral growth and recruitment will be affected in the moderate term. Prolonged exposure will eventually lead to death of the corals. The impacts of excessive sedimentation on corals include;

- Direct physical impacts like smothering of corals and other benthic organisms,
- Reduced light penetration reducing the productivity and growth, calcification and reproduction rates of corals.
- Formation of false bottoms characterized by shifting of sediments.
- Eutrophication due to increased fine sediments leading to algal blooms.
- Formation of anoxic (black) bottoms under the fine sediments.

Sedimentation is only expected to occur in the short-term during the construction phase. Furthermore, the proposed bridge could potentially limit sedimentation and habitat disturbance in the area over the long run as Thulusdhoo-Huraagandu can then be accessed by a jetty as opposed to people having to walk through the water channel between the islands.

5.6 Socioeconomic Impacts

Noise and air pollution are inevitable consequences of any project involving construction. Operation of heavy machinery can cause noise pollution while windblown debris from the construction site and emissions from machinery can cause air pollution. However, these effects are likely to be minor, especially with implementation of proper mitigation measures.

The positive socioeconomic impacts of the project are likely to outweigh the negative impacts of air and noise pollution. Construction of the jetty will provide opportunities for the local community to gain economic benefits via increased access to the tourist market interested in the island's popular surf zone, providing increased employment opportunities and diversification of the island economy.

5.7 Significance of Impacts

The impacts that may arise from activities of the proposed project were categorized based on their significance. The characteristics used to assess the significance of the impacts are nature, magnitude/geographical range, duration and reversibility of the impacts.

Table 3- shows the main impacts that are expected to arise from the proposed project activities and their significance based on impact characteristics.

- Minor – the impact is very minor and not serious
- Minor adverse – the impact is undesirable but acceptable;
- Moderate adverse – the impact gives rise to some concern but is likely to be tolerable in the short-term (e.g. construction phase) or will require a value judgment as to its acceptability;

- Major adverse – the impact is large-scale, giving rise to great concern; it should be considered unacceptable and requires significant change or halting of the project.
- Positive – the impact is likely to bring a desired or beneficial change

Table 3- Significance analysis of major environmental impacts

Impact Characteristic	Impacts on the marine environment	Impacts on the coastal environment	Socioeconomic impacts
Nature	Cumulative	Cumulative, unpredictable	Cumulative
Duration	Short-term	Short-term	Short term negative Long term positive
Reversibility	Mostly reversible	Reversible	Reversible
Significance	Minor negative	Minor negative	Minor negative Mostly positive

6 MITIGATION AND MANAGEMENT OF NEGATIVE IMPACTS

All components of the proposed project have been examined to determine the environmental impacts of the project. Mitigation measures are suggested to reduce/ avoid the negative environmental impacts. These mitigation measures are aimed at the planning phase, construction phase and operational phase of the proposed project.

Careful planning of all project activities is vital to reduce environmental impacts as well as to save time and costs. Aspects of the project which require careful planning include waste management procedures, equipment transportation and mobilisation and design elements of the jetty such as location, materials and architecture.

Use of environmental best practice is important in all aspects of the construction activities. Project managers must be educated on the best procedures for each project activity. Awareness should also be created among the workforce on measures to avoid damage to the environment and reduce environmental impacts of construction activities.

Vigilant supervision of construction activities and careful, regular monitoring of key environmental indicators is necessary during construction and operation of the proposed project. This will enable timely remedial response in case the project has unforeseen negative environmental impacts of significance.

All project activities must be completed at the earliest possible date to minimise the negative impacts. The boundaries of the project must also be clearly marked so that any potential impacts are confined to the smallest possible area.

Table 4 below summarises details of mitigation measures that can be implemented to reduce/ avoid major negative environmental impacts anticipated to arise as a result of the proposed project.

Table 4- Mitigation measures for the major negative environmental impacts of the proposed project

Anticipated Impact	Impact Significance	Development Phase	Impact Locality	Mitigation Measures	Responsible Institution	Cost (MRF)
Littering on terrestrial and marine environment	Minor, Short-term, Reversible	Construction	Reef-flat, lagoon and land	<p>Careful planning of waste handling, transportation and disposal</p> <p>Reduction of waste through careful planning of work activities</p> <p>Stockpiling of all construction related waste on site before they are transported to a waste disposal facility</p> <p>Storing hazardous waste safely until they are transported to a proper waste disposal facility</p> <p>Regular transportation of waste materials to island waste management centre</p>	Contractor	5,000
Damage due to loading and unloading activities and mobilisation of construction equipment	Minor, Short term, Reversible	Construction	Reef-flat, reef slope and lagoon	<p>Careful planning to streamline the procedures and save time</p> <p>Educating project managers on environmental best practice</p>	Contractor	2,500
Sedimentation and siltation of the reef and lagoon	Minor, Short term, Reversible	Construction	Reef flat, reef slope and lagoon	<p>Carrying out project activities in low tide during calm weather</p> <p>Clearly marking the project boundaries to limit the working area to within the boundary of the construction zone</p> <p>Creating awareness among work force on how to minimise impacts</p>	Contractor	2,500

				<p>Completion of project activities as soon as possible to minimise impacts</p> <p>Monitoring and supervision of project activities throughout the duration of the project</p>		
Air pollution	Minor, Short term, Reversible	Construction	Air	<p>Completion of the project at earliest possible date</p> <p>Equipment and machinery will be maintained in good working order</p>	Contractor	
Noise pollution	Minor, Short term , Reversible	Construction	Land	<p>Use of safety equipment such as ear muffs for the personal safety of the work force.</p> <p>Completion of project at earliest possible date</p> <p>Avoid working during the night</p>	Contractor	
Alteration of hydrodynamic regime and sand movement patterns	Minor, Long term, reversible over the long run	Construction, Operational	Reef-flat, lagoon, coast	<p>Minimal supporting columns will be used during construction</p> <p>Columns and footings of the jetty will be prefabricated on land</p> <p>Beams will be placed at least 20cm above the HHWL</p> <p>Flow will not be restricted at any part of the jetty</p>	Contractor	
Disturbance to lagoon bottom due to column footings	Minor, Long term, Reversible	Operational	Lagoon	<p>Proper briefing and supervision of work.</p> <p>Clearly marking work areas to limit the disturbances to the project boundary.</p>	Contractor	

7 SOURCES OF INFORMATION

English, S., Wilkinson, C. and Baker, V. (1997). *Survey Manual for Tropical Marine Resources* (2nd edition), Australian Institute of Marine Science

Ministry of Environment and Construction (2004), *State of the Environment 2004*, Maldives

Roe D, Dalal-Clayton & Hughes, R (1995), *A Directory of Impact Assessment Guidelines*, IIED, Russell Press, Nottingham, UK

APPENDIX 1: Terms of Reference

Environment Research Centre
Ministry of Transport, Housing and Environment
Male', Republic of Maldives

Terms of Reference for Environmental Impact Assessment

The following is the TOR is based on the points discussed in the scoping meeting held on the 25th December for undertaking the **IEE for proposed construction of a jetty joining Thulusdhoo and Thulusdhoo-Huraagandu, K. Atoll.**

This document is a legally binding document prepared after consultation with all relevant stakeholders and the IEE report must strictly follow the activities under this ToR.

1. Introduction - Identify the development project to be assessed and explain the executing arrangements for the environmental assessment. Describe the rationale for the development and its objectives
2. Scope of Work - The following tasks will be performed:

Task 1. Description of the Proposed Project –The description of the project should consider the following.

- a) *Details of the proposed project. Provide a brief description of the project and how the project will be undertaken. describe the relevant parts of the projects using clearly labeled maps, scaled site plan architectural drawings or sketches where necessary, sources and quantities of all project inputs; types and quantities of all outputs and how they will be managed.*

Task 2. Description of the Environment - Where baseline data is to be collected, careful consideration must be given to the design of the survey and sampling programme. Data collection must focus on key issues needing to be examined for the IEE. Consideration of likely monitoring requirements should be borne in mind during survey planning, so that the data collected is suitable for use as a baseline to monitoring impacts.

Assemble, evaluate and present baseline data on the relevant environmental characteristics of the study area (and disposal sites), including the changes to the existing environment in light of monitoring conducted after the commencement of the initial project.

- a) *A proper assessment of the bathymetric conditions of the project site should be undertaken, including local hydrodynamics and sediment transport of the reef flat and coastal dynamics around the island*

Task 3. Legislative and Regulatory Considerations - Describe 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.

Task 4. Determine the Potential Impacts of the Proposed Project –identify the impacts for both construction and operational phase. Distinguish between significant impacts that are positive and negative, direct and indirect (= triggering), and short and long term. Identify impacts that are cumulative, unavoidable or irreversible. Identify any information gaps and evaluate their importance for decision-making. Special attention will be paid to:

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- *Impacts on marine environment on the location of the jetty construction*
 - *Impacts on the reef flat due to hydrodynamics and sediment transport.*
 - *Impacts to the coastal dynamics of the island*

Task 6. Mitigation and Management of Negative Impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. Cost the mitigation measures, commitment, equipment and resources required to implement these measures.

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 for 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 Regulation, 2007.

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20 January 2009