ENVIRONMENTAL IMPACT ASSESSMENT

For the Proposed Development of Heavy Load Site in Thilafushi

Thilafushi, Kaafu Atoll, Maldives

Proponent: Heavy Load Private Limited

Consultant: Ahmed Zahid (EIA08/07)

September 2010

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Summary

This report addresses the environmental concerns of the proposed reclamation of an area of about 25,300m^2 (2.53hectares) to a height of about 1.3m above MSL by dredging a harbour inside the area that is reclaimed. The total volume of sand required for the reclamation is estimated to be about 56,000 cubic metres. In order to get this volume of sand using the proposed borrow area (harbour), it is estimated that the borrow area has to be dredged to about 5m. Otherwise, an additional volume of about 18,000m^3 of sand would be required to reclaim the given area.

The primary objective of the project is to create a harbour for the several barges, landing crafts and other vessels owned and operated by Heavy Load, to provide safe and adequate access to the facility and to provide space for the different activities carried out on the site as well as to improve the services provided by the facility. The proposed project area is on the southeast corner of Thilafushi, which is the official landfill island for the entire Maldives. Currently, the site has two sand beds on the west and eastern sides, which mark the eastern and western edges of the proposed reclamation area. The exact area is being currently finalised by Thilafushi Corporation Limited (TCL). Once TCL finalises the exact dimensions of Heavy Load Site, dredging and reclamation works will begin. The entire external periphery of the dredge area would be sheet piled prior to dredging and filling works so as to minimize sedimentation. The southern periphery, which faces the sea, would have further protection using rock boulders, which would be installed as a final step. The project is, therefore, expected to take about eight to twelve months.

A large proportion of the reef flat on the southeast end of Thilafushi has been dredged to provide access to the different industrial plots of land in the area by large vessels with an entrance channel at the southeast corner of Thilafushi reef. The proposed dredging is similar in size, however, would have less impact on the marine environment in the area. The reef flat in this area is almost completely dead with a few live porites. The reef slope is also mainly dead. Given the currents in the proposed dredge area is slow and generally in a westerly direction, the potential for the sediments to move to the reef flat would be small. However, it should be noted that there is a lack of long term data to support this observation. Therefore, sediment settlement on the reef has to be minimized and the most practicable means to achieve this would be to sheet pile the reclamation area prior to dredging. This would minimize sedimentation while further mitigation measures including silt curtains at the discharge points of the silt passages may be used. However, this would only be necessary if the silt levels reach very high levels.

The proposed project takes place in an industrial area located on the part of Thilafushi that was reclaimed using garbage and continuous deposition and open burning of waste continuing in the vicinity of the site, the environment in the proposed area has already been subjected to large scale environmental impacts from dredging, reclamation, waste disposal and burning resulting in water and air quality deterioration. Therefore, the

proposed project will have cumulative impacts of very small magnitude. The overall negative environmental impacts of the project are, therefore, considered to be insignificant. However, the project has several socio-economic benefits including industrial development for which Thilafushi was built, improved protection to the coastline. Therefore, it is recommended to allow the project to proceed as proposed. Environmental monitoring has been recommended only for the construction phase and three months thereafter with water quality as the main parameter. A monitoring report shall be submitted to the Environmental Protection Agency within six months upon completion of the project.

Although it was considered that this EIA report would cover other elements of the project such as fuel tanks and other landuse and industrial activities, this EIA report has been prepared only for the dredging, reclamation and reclaimed area coastal protection, as detailed plans have not been prepared at this stage. Therefore, it is envisaged that an Addendum to this EIA would be prepared at a later stage that would cover the other project components and operational impacts of the proposed project.

1 Introduction

1.1 Introduction

This Environmental Impact Assessment (EIA) report has been prepared in accordance with the EIA Regulations 2007 to meet the requirements of Clause 5 of the Environmental Protection and Preservation Act of the Maldives to assess the impacts of the proposed reclamation of about 25,300m^2 by creating a harbour from the proposed borrow area within the industrial land plot allocated in Thilafushi for Heavy Load Private Limited. This report will identify the potential impacts (both positive and negative) of the proposed project. The report will look at the justifications for undertaking the proposed project components. Measures to mitigate any negative impact on the environment would be suggested including environmental monitoring that would help to measure the actual impacts of the proposed project in realistic terms.

The major findings of this report are based on qualitative and quantitative assessments undertaken during site investigations on 14 September 2010 as well as consultations, experience and professional judgment. Available long term data were collected from available sources, such as long term data on meteorology and climate from local and global databases. It may be necessary to note that consistent, regular coastal data for the project area is lacking.

1.2 Aims and Objectives of the EIA

Thilafushi has several environmental issues starting with the atmospheric pollution caused due to the opening burning of massive quantities waste on a daily and continuous basis. The development has not been subject to any environmental scrutiny until recently. Consequently, this is one of the few EIA report done for developments in Thilafushi. The report helps to achieve the following objectives.

- Allow better project planning and implementation
- Assist in mitigating impacts caused due to the project
- Promote informed and environmentally sound decision making
- Demonstrate the commitment by the Proponent to protect and preserve the environment.

1.3 Methodologies

Internationally recognized and accepted methods have been used in this environmental evaluation and assessment. This EIA is based mainly on data collected during a field investigation mission on 14 September 2010 by a team from Sandcays Pvt. Ltd., Maldives. The data collection methods would be described in detail under Section 4.

1.4 EIA Implementation

This EIA has been prepared by Ahmed Zahid, a registered EIA consultant with over 13 of years of experience in Environmental Impact Assessment in the Maldives and has been involved in several reclamation and coastal protection project EIAs undertaken in the Maldives. He was assisted by the following team members:

- Ibrahim Mizal Mohamed
- Abdulla Niyaz
- Mohamed Shifaf
- Hassan Jameel

The different steps involved in the implementation of the EIA and the time frame for those steps/activities are given below.

- EIA application submission 6 September 2010
- Scoping meeting 9 September 2010
- Submission of draft TOR 10 September 2010
- Approval of TOR 16 September 2010
- Field mission 14 September 2010
- Submission of EIA report 22 September 2010

Once the EIA has been submitted it is expected that the review process will not take more than 4 weeks. The review process may result in the requisition of additional information. However, all efforts have been made to ensure that adequate information has been provided with specific attention paid to meet all requirements of the Terms of Reference (TOR). The TOR for this EIA is given in Appendix 1.

2 Project Description

2.1 General context of the study

The proposed project involves the construction of sheetpile quaywall and immediate reclamation of the proposed area of 25,300m^2 of land at the coastline of the existing plot of land owned by Heavy Load Private Limited located on the southeast side of Thilafushi island. The reclamation would be done by dredging an area of about 16,000m^2 at the southeast corner of the Heavy Load site. This area would be required to be dredged to a depth of about 5m below MSL in order to reclaim the proposed area. The primary objective of this dredging, reclamation and sheet piling is to provide space for Heavy Load's operations in Thilafushi, provide mooring area for the landing crafts, barges and other vessels operated by Heavy Load and to protect the coastline of the site so as to provide improved access to and services at site. This section will provide the details of the project including detailed methodologies using maps and other illustrations.

2.2 The Proponent

This project is proposed by Heavy Load Private Limited. Heavy Load is a 100% Maldivian-owned company regarded as one of the pioneers and leaders in the marine construction industry in the Maldives. Heavy Load has been involved in several project involving dredging, reclamation and sheet piling including government and private projects. Other areas of expertise include harbours and water fronts, resort development, coastal engineering, building construction, repair and maintenance of vessels, heavy machinery rentals and marine transport. For the provision of these services and the safety of the different vessels operated by the company, Heavy Load needs to develop its site in Thilafushi.

2.3 Project Location and Study Area

The project takes place at the southeastern side of Thilafushi, quite close to the waste burning area. Thilafushi is the national landfill and primary industrial island. Thilafushi is located in the Greater Malé Region, the primary development hub of the Maldives with Thilafushi being the industrial hub and neighbouring Gulhi Falhu designated as the principal business hub. The reef flat on the southeast corner of Thilafushi reef system, the lagoon immediately behind the project site and the immediate vicinity of the site would be the primary study areas. As such, the shoreline of the project site, levels, bathymetry of the lagoon and longshore currents at the project area would be studied. Water quality in the project site would also be assessed in order to understand baseline conditions.

Figure 2-1: Thilafushi is the industrial hub located in the Greater Malé Region

Figure 2-2: Satellite image showing project location in Thilafushi (source: Google Earth)

2.4 The Project

The proposed project covers three civil components, namely:

1. Sheetpiling at the periphery of Heavy Load site
2. Dredging from proposed harbour and reclamation of the proposed 23,300m^2 of land
3. Rock revetment or similar at the seaward phase of the reclaimed area

The following subsections discuss the details of these three components and an illustrated summary of the project concepts is given in Figure 2-3.

2.4.1 Sheet piling

It is proposed to construct a concrete or steel sheetpile quaywall around the entire periphery of the harbour basin and outside on the seaward side of the reclaimed area. The quaywall will be further reinforced with a precast reinforced concrete panels with concerete capping during the second stage of works. The quaywall would be constructed using steel sheetpile tied using several tie rods. The piling works would be done using excavator or crane lorry available at Heavy Load site.

2.4.2 Dredging and Reclamation

The project involves dredging from the proposed harbour and reclamation of the proposed 25,300m^2 area surrounding the harbour basin. Material would be dredged from an area of about 16,000m^2 in the reef flat area, which is almost entirely dead. There would be some dredging to provide access to the harbour by dredging an access channel that connects to the existing reef entrance. The borrow area is assumed to have average depths of about 1.5m and the reclamation area about 1.3m depths. The following table provides a summary estimation of dredge and fill volumes.

Table 2-1: Dredge and reclamation volume estimates

	Dredge Area (m^2)	Current depth (m)	Dredge depth or fill height (m)	Volume (m^3)
Reclamation Area	22,000	1.2	1.3	55,000
Dredge Area	16,000	1.5	5	56,000

2.4.3 Rock revetment

During the scoping meeting, MHE represented by the Technical Advisor to the Minister stated the importance of having a rock revetment on the seaward side of the reclaimed area. This would help absorb the wave energy rather than a reflective surface such as sheet pile which would reflect the wave leading to severe impacts of the reflected energy elsewhere. Therefore, the Proponent has agreed to consider a rock revetment for the area.

2.5 Project Schedule

The project is expected to start soon after the approval of this EIA report, which is expected to take less than 4 weeks from submission. The civil works are expected to take about eight to twelve months. It is important to ensure that the works are started within the normal duration of one year from the date of the EIA Decision Statement in order to avoid further environmental clearance. In case of any delays in the implementation of any of the components described in this report, it would be necessary to write to the Environmental Protection Agency for an extension of the approval (Decision Statement). A detailed schedule will be provided to the EPA upon completion of detailed design.

2.6 Project Inputs and Outputs

The project has inputs in terms of human resources and natural resources such as water and fuel. The main output of the project is the operational ease and socio-economic and environmental benefits associated with the different components. These inputs and outputs are summarised in Table 2-2 and Table 2-3.

Table 2-2: Main inputs of the proposed project

Input resource(s)	How to obtain resources
Workers	Heavy Load workforce
About 25,300m^3 of dredged sand	Excavated with excavator
Metal sheet pile and precast concrete blocks	Purchased from suppliers (foreign/local)
Cement and aggregate	From suppliers in Thilafushi
Food, water and other resources	Provided on site for workforce
Machinery	Heavy Load
Energy for machinery operation	Diesel fuel

Table 2-3: Matrix of major outputs

Products and waste materials	Anticipated quantities	Method of disposal
Wastewater from workers	No. of workers x 95l/c/d	Through existing island sewerage system
Waste lube oil/spills from excavator, etc	Trace amount	Disposed to waste disposal site nearby
Sediment plumes (during sand pumping)	Moderate	Natural dispersion over a short period
Cement spillage	Trace	To landfill site nearby

2.7 Need and Justification

The primary objective of the project is to provide space for Heavy Load's operations in Thilafushi, provide mooring area for the landing crafts, barges and other vessels operated by Heavy Load and to protect the coastline of the site so as to provide improved access to and services at site. At present it is also difficult to access the site using the reef entrance and dredged area in the vicinity of the site resulting in operational difficulties. Therefore, the project would ease access using existing provisions for access to site and improve the overall efficiency.

The need for the rock revetment proposed as an additional protection measure has been discussed earlier. The structure helps to absorb wave energy thereby minimizing the effect of any reflected wave energy on other coastal areas. Although this has not been done in Thilafushi earlier, this is necessary due to the closeness of the site periphery to the wave breaking zone. In the absence of such structures, the sheetpile or dredged area would be easily damaged and the sand will be severely scoured behind sheet pile structure during stormy conditions resulting in significant spending on repair works.

Figure 2_3: Proposed project components

Total Reclamation= 25333 m²
Entire periphery will be Sheetpiled
Dredged depth of harbour= -5m from MSL

3 The 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. It is important to note that the project is of a local scale but it also has some bearing at a national context.

3.1 Applicable Policies, Laws and Regulations

There are few environmental policies, regulations and standards of specific relevance to dredging, reclamation and coastal protection or environmental protection related to those activities. The main legal instrument pertaining to environmental protection is the Environmental Protection and Preservation Act (Law No. 4/93) of the Maldives passed by the Citizen's Majlis in April 1993. This Act provides the Ministry of Environment with wide statutory powers of environmental regulation and enforcement. This umbrella law covers issues such as environmental impact assessment, protected areas management and pollution prevention. The following clauses of the Environmental Protection and Preservation Act (Law No. 4/93) are relevant to the project:

> Clause 5a: An impact assessment study shall be submitted to the Environment Ministry before implementing any development project that may have a potentially detrimental impact on the environment.
>
> Clause 5b: The Environment Ministry shall formulate the guidelines for EIA and shall determine the projects that need such assessment as mentioned in paragraph (a) of this clause.
>
> Clause 6: The Environment Ministry has the authority to terminate any project that has an undesirable impact on the environment. A project so terminated shall not receive any compensation.
>
> Clause 9a: The penalty for minor offences in breach of this law or any regulations made under this law, shall be a fine ranging between Rf5.00 (five Rufiyaa) and Rf500.00 (five hundred Rufiyaa), depending on the actual gravity of the offence. The fine shall be levied by the Environment Ministry or by any other government authority designated by that Ministry.
>
> Clause 9b: Except for those offences that are stated in (a) of this clause, all major offences under this law shall carry a fine of not more than Rf100,000,000.00 (one hundred million Rufiyaa), depending on the seriousness of the offence. The fine shall be levied by the Environment Ministry.

Clause 10: 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. This includes all activities mentioned in Clause No. 7 of this law as well as those activities that take place outside the projects that are identified here as environmentally damaging.

3.2 EIA Regulations

The EIA Regulations, which came into force in May 2007 has been developed by the powers vested by the above umbrella law. The EIA Regulations have been the basis for Environmental Impact Assessment in the Maldives and since its advent it had helped to improve the quality of EIAs undertaken in the country. Today, registered consultants are required to sign EIAs, the EIAs are reviewed by two independent reviewers and final decision is based on the reviews. This EIA would also be subject to these requirements and review criteria.

Schedule D of the EIA Regulations lists the different environmental projects that require an Environmental Impact Assessment study and dredging and reclamation has been included in the list. The EIA Regulations sets out the requirements for the contents of Environmental Impact Assessment reports in Schedule E and format for monitoring reports have been given in Schedule M. Therefore, these requirements have been taken into consideration in preparing this EIA report.

3.3 Environmental Permits required for the Project

3.3.1 EIA Decision Statement

The only environmental permit to initiate proposed works would be a decision regarding this EIA from the Environmental Protection Agency (EPA). The EIA Decision Statement, 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 Statement may only be given to the Proponent after a review of this document following which the 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, the EPA may provide the Decision Statement while at the same time requesting for further information.

4 Existing Environment

This section covers the existing environmental conditions of the project site. The key environmental, social and economic components of the project under consideration are described below.

Vital Environmental, Social and Economic Components

- Topography
- Marine water quality
- Existing coastal defences
- Coastal resources
- Marine resources and protected marine areas
- Health and safety
- Employment and other economic benefits

Data was collected using internationally recognized methodologies discussed below.

4.1 Methods of data collection

Conditions of the existing environment of the study area were analysed by using appropriate scientific methods. Field surveys were undertaken to get further understanding of the existing environment of the island. Field surveys were carried out during field visit to the island in September 2010 to collect baseline data. Before the trip was undertaken all existing information regarding the project and site was gathered.

The following components of the existing environment were assessed.

- Longshore and offshore currents
- Marine water quality
- House reef at the proposed locations
- Stakeholder views and grievances

4.1.1 Marine water quality

Marine water quality around the proposed dredging area was tested on site by using YSI water quality logger which can measure pH, electrical conductivity (salinity and TDS) and dissolved oxygen (DO). These measurements were done for the proposed harbour location so as to assign baseline values.

4.1.2 Bathymetry and Ocean Currents

Bathymetry of the project site could not be done due to field constraints on the day of the survey. However, spot depths were taken at some areas for the purpose of understanding average depths in the area. These spot depths were used for calculations given in the EIA report.

4.1.3 Condition of the housereef

Methodologies adopted for these surveys are internationally accepted and widely used to assess the status of coral reefs in the Maldives as well. Line intercept transect and visual observations of the reef and lagoon of the proposed development areas were carried out according to the methods described in English *et al* (1997). A Line Intercept Transect (LIT) was done at the reef flat area on the southeast of the project site.

4.1.4 Stakeholder consultations

In the Terms of Reference for this EIA, stakeholder consultation is limited to the discussions held during the scoping meeting as well as discussions with those operating neighbouring sites. However, in terms of discussions with neighbouring sites, it was considered more appropriate to get a letter of consent from them.

4.2 Existing Coastal and Marine Environment

This section will describe the topography, marine water quality, existing coastal defences, seabed, beach and other coastal resources as well as marine resources and protected marine areas in the vicinity, especially potential impact zones of the project.

Thilafushi Island has undergone several coastal changes over the past including reclamation of the original island up to the reef flat at the project location and up to the edge of the reef in some other locations. In addition, almost the entire coastline is constructed of concrete quaywalls and seawalls. As a result, the coral reef in the proposed project area and possibly all around the island is literally dead. The coastal and marine environmental components in the project area are separately looked at in the following subsections.

4.2.1 Coastal Elements

The project site is situated on the southern coastline of Thilafushi towards the southeast corner. The coastline at the project site has a small beach but mainly garbage-filled shoreline as the area was reclaimed by dumping waste. There are two reclaimed beds on the east and west of the proposed project area with approximately 250m-wide lagoon area in between the beds. Reclaimed bed located on the eastern side is protected from erosion by few rock boulders and rubble. Some parts of the reclaimed bed located on the western side are protected by placing concrete blocks. The eastern bed is used for loading and unloading vehicles and materials from the site.

The beach area has fine sand with some amount of rubble and garbage washed ashore. The beach gently slopes into the lagoon, which extends to about 10m and then suddenly drops into the dredged area, where there is about 3m depth on average. The dredged area has a width of about 50m, beyond which is the reef flat of about 80m up to the wave break zone which is about 20m wide and slightly raised than the rest of the reef flat. Beyond the breakzone, the reef flat rapidly slopes forming the reef slope, which is about 45m on all areas of the reef on the southeast of Thilafalhu. The reef slope on the south drops to the channel named Vaadhoo Kandu between North Malé Atoll and South Malé Atoll which has average depths of about 400 to 500m.

The lagoon consists of medium-fine silt like sandy floor with rocks and rubble. There is also a lot of fines and low level growth of algae on the bottom of the dredged area. The reef flat is mainly dead with few live porites. The water quality is considered to be good with low levels of contamination. Basic water quality results are discussed separately in this section but detailed water quality investigation is not required under this project.

4.2.2 Coastal Defences

Since the site is under construction there are no permanent coastal structures other than the concrete blocks placed on the west reclaimed bed and the tin sheets placed along the coastline. Dumped concrete structures on the beach and some rock boulders placed on the edge of the eastern reclaimed bed.

Figure 4-1: Existing coastal protection works in the project area

4.2.3 Marine Resources

Marine resources are confined to the approximately 100m reef substrate found on the southeast reef of Thilafushi. This area has an 80m reef flat, which is almost completely dead followed by a 30m wave break zone which is dead and partly exposed during low tide followed by a reef slope which has some amount of live reef material consisting primarily of small porites of approximately 1 to 2% of the coral cover in the area. The reef slope is generally steep dropping off with groups of reef fishes including parrot fish and pomacentrids. A 30m transect was done in this area, the results of which are given below. Photos of the area are shown in Figure 4-4.

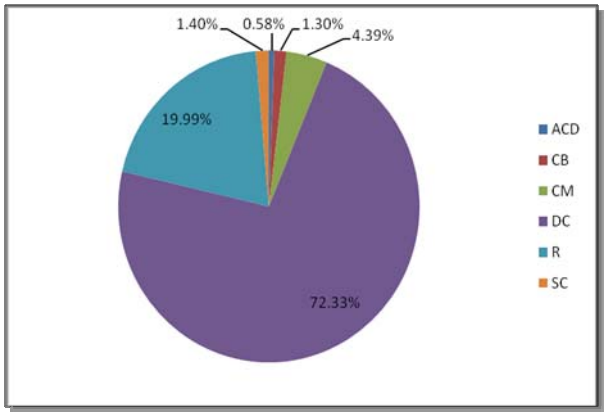

Figure 4-2: Results of the transect carried out at the project site

There are no dive sites or marine protected areas in the vicinity that may be affected by the proposed project. The closest one is Hans Hass Place (*Thilafalhu Medhugaa*), a popular dive site at about 2km from the proposed project site. This spot provides some interesting reef formations with a number of caves. This is the only reef slope area exposed to Vaadhoo Kandu that provides such interesting reef formations. Another popular dive site known as Lions Head (*Dhekunu Thilafalhuge Miyaruvani*), which is one of the best spots for sharks, is located towards the middle of Thilafalhu at about 1 to 2km from the project site. No direct impacts from the proposed project are envisaged for any of these protected marine areas or dive sites.

4.3 Climate and Coastal Dynamics

The climate of the Maldives varies slightly from North to South of the country. Long term meteorological data for Hulhulé is available and has been used in this study.

The Maldives, in general, has a warm and humid tropical climate with average temperatures ranging between 25°C to 30°C and relative humidity ranging from 73 per cent to 85 per cent. The country receives an annual average rainfall of 1,948.4mm. Table 4-1 provides a summary of key meteorological findings for Hulhulé, which is also generally representative of the Maldives.

Table 4-1: Key meteorological information

Parameter	Data
Average Rainfall	9.1mm/day in May, November 1.1mm/day in February 1900mm annual average
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 (115km/h) in November 1978
Average air pressure	1012 mb in December 1010 mb in April

Monsoons of Indian Ocean govern the climatology of the Maldives. Monsoon wind reversal plays a significant role in weather patterns. Two monsoon seasons are observed: the Northeast (*Iruvai*) and the Southwest (*Hulhangu*) monsoon. Monsoons can be best characterized by wind and rainfall patterns. These are discussed in more detail in the following subsections. The southwest monsoon is the rainy season which lasts from May to September and the northeast monsoon is the dry season that occurs 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.

4.3.1 Wind

Wind has been shown to be an important indirect process affecting formation, development and seasonal dynamics of the islands in the Maldives. Winds often help to regenerate waves that have been weakened by travelling across the reef and they also cause locally generated waves in lagoons. Therefore winds are important here, as being the dominant influence on the hydrodynamics in the project area (waves and currents). With the reversal of winds in the Maldives, NE monsoon period from December to March and a SW monsoon from April to November, over the year, the accompanying wave and current processes respond accordingly too.

The two monsoon seasons have a dominant influence on winds experienced across Maldives. These monsoons are relatively mild due to the country's location close to the equator and strong winds and gales are infrequent. However, storms and line squalls can occur, usually in the period May to July; gusts of up to 60 knots have been recorded at Hulhulé during such storms.

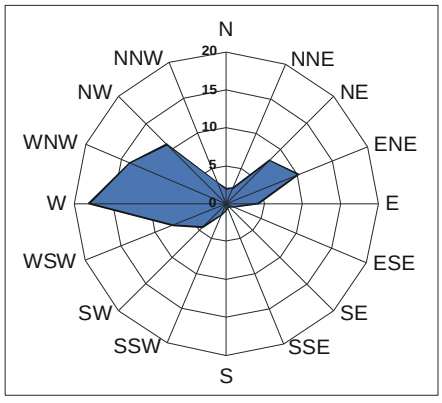

Figure 4-3: General wind rose diagram for the Maldives (source MEEW 2005).

The Maldives experience strong ocean winds at speed of 6m/s to 7.5m/s at a height of 10m during June, July and August (Elliott *et al*, 2003). The southwest monsoon has the greatest impact on the project area on the southeast. However, this side is generally protected during both monsoons. Therefore, the dredging can be carried out during both monsoons.

4.3.2 Waves

Wave energy is also important for the movement and settlement of sediments and suspended solids and is also a crucial factor controlling coral growth and reef development.

Studies by Lanka Hydraulic Institute (1988 & 1998) on Malé reef indicated that two major types of waves on Maldives coasts: wave generated by local monsoon wind and swells generated by distance storms. The local monsoon predominantly generates wind waves which are typically strongest during May-July in the south-west monsoon period. During this season, swells generated north of the equator with heights of 2-3 m with periods of 18-20 seconds have been reported in the region. Local wave periods are generally in the range 2-4 seconds and are easily distinguished from the swell waves. Swell waves have little influence in general on the shoreline at the proposed site while wind waves during the southwest monsoon would be the dominant force on the project site.

4.3.3 Tides

Tidal influence on net longshore current is expected to be low due to the superficial nature of the lagoon. However, tides may be important given the existing low elevation of the site with respect to mean sea level. A tidal surge could flood the area easily.

Tides affect wave conditions and wave-generated and other reef-top currents. Tide levels are believed to be significant in controlling amount of wave energy reaching an island, as no wave energy crosses the edge of the reef at low tide under normal conditions. In the Maldives, where the tidal range is small (1m), tides may have significantly important influence on the formation, development, and sediment movement around the island. Tides also may play an important role in lagoon flushing, water circulation within the reef and water residence time within an enclosed reef highly depends on tidal fluctuations.

4.3.4 Currents

Studies on current flow within a reef flat in Male' Atoll suggests that wave over wash and tides generate currents across the reef platforms, which are also capable of transporting sediments (Binnie Black & Veatch, 2000). However, available information suggests that tidal currents are not strong due to small tidal range.

Generally current flow through the Maldives is driven by the dominating two-monsoon season winds. Westwardly flowing currents are dominated from January to March and eastwardly from May to November. The change in currents flow pattern occurs in April and December. In April the westward currents flow are weak and eastward currents flow will slowly take place. Similarly in December eastward currents flows are weak and westward currents will take over slowly.

Studies on current flow process within a coral atoll have shown that waves and tides generate currents across the reef platforms, which are capable of transporting sediments on them. Currents, like waves are also modified by reef morphology. Under low-input wave conditions (0.5m heights) strong lagoonward surge currents (>60cm/s) are created by waves breaking at the crest. Studies on current flow across reef platforms have shown that long-period oscillations in water level cause transportation of fine-grained sediments out of the reef-lagoon system, while strong, short duration surge currents (<5s) transport coarse sediments from the breaker zone to seaward margin of the backreef lagoon. Always sediment accumulates at the lee of high-speed current zones. Generally, zones of high current speed (jets or rips, 50-80cm/s) are systematically located around islands.

Drogues were done at the project location and in the vicinity including the entrance channel as shown in Figure 4-4 in order to determine seasonal current movement and sediment transport patterns in the area. The drogues indicated that the currents in the project site are expected to be generally weak. On the day of the field visit, the wind was in an easterly direction, i.e. from the west. However, it has been observed that the westerly current is dominant with about 0.17m/s out of the entrance channel decreasing to 0.13 at the entrance channel. Further inside closer to the project site, the current dies out with hardly any movement. This observation is most probably due to the easterly current that dominates on the western side of Thilafushi, which pushes the water on the eastern side towards the western end of Thilafushi. If currents were observed at the western end of the southern arm of Thilafushi, this phenomenon could have been clearer. However, it is beyond the scope of the EIA.

As has been observed in past studies, sediment generally accumulates at the lee of high-speed current zones. So, it is unlikely that sediment plume from dredging the area would move towards the reef areas in the vicinity. In fact, it is expected to slowly settle at the project site or more towards the west and east of the project site.

4.3.5 Marine Water Quality

The marine water quality tested at the project location is given in Table 4-2. The water quality results given in this table does not show signs of water quality degradation at the given location. Since BOD and COD could not be tested from the lab at the time, it shall be tested prior to start of works.

Table 4-2: Water quality results (7 July 2010)

Parameter	Unit	Measurements
GPS Location (WGS1984, Zone43)	UTM	327679.3524E 461975.3243N
Temperature	^{o}C	29.7
Salinity	mg/l	34,800
DO	mg/l	6.20
pH		7.34
BOD	mg/l	CNBT
COD	mg/l	CNBT
Turbidity	NTU	0.7


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5 Stakeholder Consultations

Stakeholder consultations are limited to the discussions held during the scoping meeting.

5.1 Scoping Meeting

The project details were provided by Heavy Load who pointed out that Heavy Load vehicles are kept in the neighbouring plot on the east of the proposed site under contractual terms. However, that site does not belong to Heavy Load. It was pointed out that this EIA will cover proposed dredging, reclamation and sheet piling. Other infrastructure that will be built on site may also be included within the scope of this EIA if such details can be made available prior to submission of this EIA. EPA noted that it is important to include all project components within the EIA report so that the project can be dealt with in a holistic manner.

Thilafushi Corporation Limited, TCL highlighted that the project is good to go ahead except for the Environmental Impact Assessment report and that there are no further issues with the project. However, the exact boundaries of the project would be decided within a week. In principle, TCL accepted the site layout shown by the Proponent but indicated that the zone between reefline and site would be increased as shown by Proponent instead of previous plan given prior to TCL's involvement.

Based on the information provided, EPA decided that the main environmental parameters that need to be considered in the scope of the EIA are project details including methods of dredging and coastal protection and facilities provided on site, marine water quality to include basic parameters, marine environment at the project site, bathymetry of the site, development plans by Thilafushi Corporation as well as neighbouring sites (if available) and their opinions of the project. The EIA should also consider the different alternative dredge methods and coastal protection measures. Ministry of Housing and Environment specifically required that a revetment with rock boulders or similar would be worth considering at the seaward face of the proposed development.

Following are the names and designation of persons who participated in the scoping meeting.

1.	Mohamed Zuhair	EPA	Director General
2.	Fathimath Reema	EPA	Assistant Director
3.	Shifaz Ali	MHE	Technical Advisor
4.	Mohamed Latheef	TCL	Manager
5.	Mohamed Hussain	TCL	Manager
6.	Abdulla Rashid	Heavy Load	Manager
7.	Ahmed Zahid	Sandcays	Project Consultant

6 Impacts and Mitigation Measures

This section covers potential environmental impacts of the proposed dredging and reclamation of an area of about 25,300m^2 of land at the proposed Heavy Load site located on the southeast side of Thilafushi. The section also describes the mitigation measures for each identified impact. Methods of identification of potential impacts and possible mitigation measures have been described. Before proceeding on to the potential impacts from the project, it is considered worthwhile looking at the existing environmental concerns so that cumulative and residual impacts of the proposed project are better understood.

6.1 Impact Identification

Impacts on the environment from various activities of the proposed project have been identified through:

- Purpose-built checklists
- Existing literature and reports on similar developments in small island environments and other research data specific to the context of the Maldives
- Baseline environmental conditions described in Chapter 4
- Consultant's experience of projects of similar nature

Possible negative impacts on the environment have been considered in worst-case scenario to recommend mitigation measures in the best possible ways so that these impacts would be minimized and perhaps eliminated in the implementation phase. Potential positive impacts of the project have been considered on a moderate note so that the negative impacts are not ignored, especially during planning as well as implementation of the project.

6.2 Identifying Mitigation Measures

Where an impact identified can be mitigated, mitigation measures are identified and discussed along with the identification of the impact. The mitigation measures proposed will help to alleviate or eliminate environmental problems before they occur. Mitigation measures are important because if identified impacts are significant and/or important, it would be necessary to identify and implement mitigation measures. Mitigation measures are selected to reduce or eliminate the severity of any predicted adverse environmental effects and improve the overall environmental performance and acceptability of the project. Where mitigation is deemed appropriate, the proponent should strive to act upon effects, in the following order of priority, to:

1. Eliminate or avoid adverse effects, where reasonably achievable.
2. Reduce adverse effects to the lowest reasonably achievable level.
3. Regulate adverse effects to an acceptable level, or to an acceptable time period.
4. Create other beneficial effects to partially or fully substitute for, or counter-balance, adverse effects.

6.3 Existing Concerns

There are some existing environmental concerns in addition to the erosion of the shoreline especially on the western half of the coastal periphery of the site. They include dumping and burning of solid waste in the vicinity of the site which adds severely to the contamination of the surrounding marine environment, lack of a breakwater in the area, the existing sand bed on the west of the area and existence of several other industries in the area. Some of these are looked at in more detail in the following subsections.

6.3.1 Lack of coastal protection and waste leachate

The site has been allocated for a long time but has not been reclaimed so far. The proposed site is just off the proposed main road running along the coast. Since the area up to the existing shoreline just off the road has been reclaimed using partially segregated waste, there is leachate into the surrounding marine waters. Since there is no protection at the shore periphery, there is the potential for the waste to get washed out and also for wave to run up to the waste-filled land increasing leachate. The proposed reclamation of Heavy Load site is expected to minimize such leachate and wave runup.

6.3.2 Sandbeds on either side of the site

The sand bed placed on the west and east of the project site is of concern only in terms of sediment settling at the project site. It is possible that the low magnitude of the currents in the area is due to the presence of these sand beds which helps to minimize longshore currents at the project site. Given that the sediment plume would generally move westwards, sedimentation from the proposed dredging may take longer to settle due to the presence of these beds which causes stagnant conditions in the project area and vicinity of the bed. On the other hand, the bed would help minimize leachate from the landfill area on its north from reaching the project site, thereby minimizing the net cumulative effects of the landfill site on the project site and deterioration of water quality in the proposed harbour.

6.3.3 Dumping and burning of waste in the vicinity

General waste except some plastic, rubber and other non-combustible items are dumped and burnt on site in Thilafushi in the vicinity of the proposed project site. Although this has no relevance to the proposed project, it is important to mention here the magnitude of the environmental concern from such dumping and open burning of waste. The effects of such burning on the workers at the project site, especially during the southwest monsoon would be considerable. The cumulative net effects of leachate in the absence of proper lining of the landfill site would also be of concern in the long term. The proposed project will minimize leachate at that location.

6.4 Project Impacts and Mitigation Measures

6.4.1 Site mobilisation and demobilisation

Site mobilisation will involve the mobilisation of excavators, lorries or dump truck, and workforce to site. In addition, the delivery of materials to site would also be part of mobilisation. The most significant of this would be the delivery of steel sheets for the piling, which would involve several trips by lorries or excavators. Since the material is available from Thilafushi itself and Thilafushi being the industrial island, the movement of the machinery and several trips would have a net cumulative impact in terms of disruption to other vehicular movements and dust and air pollution. This impact is considered to be minor negative and short-term. The noise and site illumination from the proposed works would also be considered to be minor negative, cumulative and short term.

The mitigation measures to be adopted include appropriate planning and liaison with Thilafushi Corporation and neighbouring industries to ensure disturbances or nuisances are minimized and dealt with.

6.4.2 Sedimentation

The main impact of any dredging and reclamation project is the siltation or sedimentation and sediment movement and settlement on the reefs killing live coral reefs in project areas. Sediment resuspension over the long term is also of concern. For the proposed project, the reef flat in the area is completely dead due to cumulative impacts of past reclamation, dredging, waste disposal and possibly other anthropogenic and natural events. The proposed project is very local and small to medium a scale compared to other dredging projects in the Greater Malé Region including neighbouring Bolifushi to impact negatively on the reef and marine environment of the project site. The immediate vicinity of the project site has been dredged to the same depths as the proposed dredging depth starting from the reef entrance on the southeast corner. Also, based on the current movement in the area observed during the recent field visit under this EIA study, the sediment is not expected to move towards the reef areas on the south. Sediment movement is expected to the east and west depending on monsoon and this movement would be restricted due to the existence of sand bed barriers on the west and east of the site. Such stagnation would cause deterioration of water quality (discolouration) in the immediate vicinity depending on the direction and magnitude of the currents in the area. This is a short term impact given that the silt would slowly settle on the excavated seabed. The significance of the impact would also be small or negligible given that the area is industrial in nature. There are no recreational uses of the affected marine areas.

Sedimentation is inevitable and there are measures that can be taken to minimize sedimentation including the use of sand bunds or geotextile bunds or silt curtains. However, given that the impacts from the proposed project are minor and of low significance, sediment control measures would be cost prohibitive.

6.4.3 Operational improvements

The main impacts of the proposed project are beneficial to all stakeholders. These include provision of space for industrial development, improvements to existing operations of Heavy Load, direct and indirect revenue to the Government and direct revenue to the Proponent or operator of the site. Ease of access to site and improved efficiency of operations will be achieved. The concerns over damage to existing and proposed or future infrastructure would be eased.

As a means to assessing project benefits, long term monitoring of such positive impacts of the project is recommended.

6.5 Overall Impact Evaluation

This section provides a summation of the impacts of the project components discussed above. The impacts of the project have been evaluated according to the following criteria:

1. Magnitude (or severity): the amount or scale of change that will result from the impact
2. Significance: importance of the impact. Reversibility is considered part of its significance
3. Duration: the time over which the impact would be felt
4. Extent/spatial distribution: the spatial extent over which the impact would be felt

The scales associated with the above criteria are given in the table below.

Table 6-1: Impact evaluation scale

Criteria	Scale	Attribute
Magnitude *Change caused by impact*	-3	Major adverse
	-2	Moderate adverse
	-1	Minor adverse
	0	Negligible
	1	Minor positive
	2	Moderate positive
	3	Major positive
Significance/Reversibility *Impact implications / Reversibility of impact's effects*	0	Insignificant
	1	Limited implications / easily reversible
	2	Broad implications / reversible with costly intervention
	3	Nationwide or global implications / irreversible
Duration *Duration / Frequency of Impact*	0	Immediate
	1	Short term/construction period only
	2	Medium term (five years of operation)
	3	Longterm/continuous
Extent/Spatial Distribution *Distribution of impact*	0	None/within 1m from point of discharge/no affected party
	1	Immediate vicinity/household level/developer/consumer
	2	Specific areas within the island/atoll/specific parties
	3	Entire island/atoll/nation/all stakeholders

Based on the above scale, an impact matrix was developed for the proposed or recommended option to determine that overall impact of the proposed project. This matrix is given in the table below.

Table 6-2: Impact matrix for the proposed project

	KEY COMPONENTS									
	Environment					Socio-Economic				
PROJECT ACTIVITIES	Reefs	Live Bait	Lagoon/seawater	Land/seascape	Air/Noise	Services and Infrastructure	Health and Safety	Employment	Property Value	Costs to consumer/tax payer
Construction										
Dredging	-1 0 1 1	-1 0 1 1	-1 0 1 1	-1 0 1 1	-1 1 1 1	0	0	1 1 1 2	0	-2 1 2 1
Reclamation	-1 0 1 1	-1 0 2 1	-1 0 1 1	-1 0 1 1	-1 1 1 1	0	0	1 1 1 2	0	-2 1 2 1
Quaywall/sheet piling	-1 0 1 1	-1 0 1 1	-1 0 2 1	0	-1 1 1 1	0	0	1 1 1 2	0	-1 1 1 1
Machinery and construction equipment	0	0	0	-1 0 1 1	-1 1 1 1	0	-1 0 1 1	1 1 1 2	3 2 1 1	-1 1 1 1
Workforce	0	0	0	0	0	0	-1 0 1 1	1 1 1 1	3 2 1 1	-1 1 1 1
Operation										
Harbour and reclaimed land	0	0	1 1 3 1	2 2 3 2	0	3 2 3 2	1 1 3 2	1 1 3 3	3 3 3 3	-2 1 2 2
Quaywall/seawall defence	0	0	2 1 3 1	2 2 3 2	0	3 2 3 2	1 1 3 2	1 1 3 3	3 3 3 3	-2 2 2 2
Proposed other developments	0	0	0	0	0	3 2 2 2	1 2 1 2	1 1 3 3	3 2 3 3	-1 2 3 2

An impact potential index was then developed from the above table. The impact potential index table below represents a product of the magnitude (M), significance (S), duration (D) and extent/spatial distribution (E) given in the above table. The sum of all key component specific indices for one activity (i.e. sum by rows) provides the Activity Potential Impact Index (API) and the sum of all activity specific indices for one key component (i.e. sum by column) provides the Component Potential Vulnerability Index (CPVI) which gives an indication of the vulnerability of each key component to activity related impacts. The table below represent the impact potential indices for the proposed project.

Table 6-3: Impact potential indices for the proposed project

	KEY COMPONENTS										
	Environment					Socio-economic					
PROJECT ACTIVITIES	Reefs	Live Bait	Lagoon/seawater	Land/seascape	Air/Noise	Services and Infrastructure	Health and Safety	Employment	Property Value	Costs to consumer/tax payer	TOTAL API
Construction											
Breakwater on the west	0	0	0	0	-0.01	0	0	0.02	0	-0.05	-0.04
Breakwater on the east	0	0	0	0	-0.01	0	0	0.02	0	-0.05	-0.04
Sand pumping and beach replenishment	0	0	0	0	-0.01	0	0	0.02	0	-0.01	0
Machinery and construction equipment	0	0	0	0	-0.01	0	0	0.02	0.07	-0.01	0.07
Workforce management	0	0	0	0	0	0	0	0.01	0.07	-0.01	0.07
Operation											
Breakwater on the west	0	0	0.04	0.3	0	0.44	0.07	0.11	1	-0.1	1.86
Breakwater on the east	0	0	0.07	0.3	0	0.44	0.07	0.11	1	-0.2	1.79
Periodic sand pumping and beach replenishment	0	0	0	0	0	0.3	0.05	0.11	0.67	-0.15	0.98
TOTAL CPVI	0	0	0.11	0.6	-0.04	1.18	0.19	0.42	2.81	-0.58	4.69

API = Activity Potential Impact Index
CPVI = Component Potential Vulnerability Index

The table above indicates that the project has few and insignificant negative environmental impacts during the construction phase which are not as strong as the positive outcomes of the project, as a result of which the total potential impact index for the project is highly positive and the project is desirable.

6.6 Uncertainties in Impact Prediction

The level of uncertainty, in the case of the proposed project may be expected to be low due to the experience of similar projects in similar settings in the Maldives. Nevertheless, it is important to consider that there will be uncertainties and to undertake voluntary monitoring during and after project implementation as recommended in the monitoring programme given in this report.

7 Alternatives

There are few alternatives that may be considered for the project. These include alternative location of the entrance channel and harbour (dredge area), alternative coastal protection options and alternative sites. These are considered in a bit more detail in the following sub-sections.

7.1 Alternative design

There are two alternative design concepts that may be considered. One is the option of a weir or channel on the other end of the harbour to improve circulation within the harbour. This is important given the leachate issues and stagnation issues under consideration. However, this may also be done at a later stage if problems persist. However, this shall be given due consideration in the design.

The other option is the relocation of the entrance channel so that the site can be accessed from Vaadhoo Kandu. This does not cause additional impacts apart from the removal of existing reef barrier to some extent. It can be seen from the Google photo that the reef barrier at the proposed location already has been dredged to form a narrow channel. It is also observed that the existing reef entrance at the southeast corner gets congested at times due to current operations to access the sites. With the proposed access to MPL Repair Yard from the same reef entrance and potential future expansion of other sites, there may be a need to consider other access points from the reef. Therefore, this alternative would provide such ease of access to proposed site and minimize impacts on access from existing channel and hindrance to future development as a result of that. This option is illustrated in

7.2 Alternative Coastal Protection

The alternative to the proposed sheet pile is concrete piles. This involves the placing of concrete L-shaped piles and building capping beams on top of the piles to create the quaywall.

As has been proposed by MHE in the Scoping Meeting, it would be necessary to consider a rock revetment at the seaward side. This is not considered as an alternative but will form part of the project, possibly in this phase or later. The option of offshore breakwater cannot be considered for this site given the depths beyond the seaward periphery of the proposed development.

7.3 Alternative Site(s)

Thilafushi Corporation has proposed to undertake large scale reclamation of the entire Thilafalhu and alternative site for Heavy Load can be considered in the proposed reclaimed areas. However, this is a project at the planning stage and may take longer than Heavy Load could afford to wait.

Figure 7_1: Alternative Project Design

8 Environmental Monitoring

Environmental monitoring is essential to ensure that potential impacts are minimized and to mitigate unanticipated impacts. The purpose of the monitoring is to provide information that will aid impact management, and secondarily to achieve a better understanding of cause-effect relationship and to improve impact prediction and mitigation methods. The proposed monitoring programme will yield beneficial results if it is undertaken for a longer period. Therefore, the proposed monitoring programme is recommended for the construction period and three months thereafter. Longer term monitoring would also be useful.

The parameters that are most relevant for monitoring the impacts that may arise from the proposed project are included in the monitoring plan. Therefore, the monitoring programme will cover the following aspects of the proposed project:

- marine water quality
- Currents in the area
- Incidents/accidents
- Fuel consumption during construction

8.1 Recommended Monitoring Programme

Outlined here are minimum project specific monitoring requirements that can be considered. This monitoring programme for the proposed project covers the three stages of the project implementation.

Stage 1: Immediately before starting works

Stage 2: During construction

Stage 3: Operational phase

The monitoring needs of each stage are discussed in detail below:

Stage 1 (before construction)

- Marine water quality for pH, Conductivity(mg/l), dissolved oxygen(mg/l), turbidity (NTU) and Salinity
- Currents using drogues at the baseline locations given in the EIA and preferably more

Stage 2 (during construction)

- Marine water quality for pH, DO, EC, salinity, turbidity at possible impact areas
- Currents using drogues at the baseline locations given in the EIA and preferably more
- Accidents and incidents

- Fuel consumption by the different machinery used in the construction

Stage 3 (operational phase)

Upon completion and three months after completion of proposed works, the following shall be undertaken.

- Marine water quality – pH, DO, salinity and turbidity

8.2 Cost of monitoring

The following table outlines a cost estimate for annual monitoring assuming the monitoring will be undertaken by environmental consultants and most of the parameters would be tested in-situ.

Table 8-1: Costs of the annual monitoring programme

Item No.	Details	Unit cost (Rf)	Total (Rf)
1	Field allowance for 2 consultants for 1 day	500.00	2,000.00
2	Monitoring equipment depreciation and other charges	200.00	800.00
3	Laboratory charges	50.00	200.00
4	Compliance reporting	2,500.00	2,500.00
	Total		**5,500.00**

8.3 Monitoring Report

A detailed environmental monitoring report is required to be compiled and submitted to the Environment Protection Agency of the Ministry of Housing and Environment. The report must be based on the data collected for monitoring the parameters included in the monitoring programme given in this report.

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. The Proponent's commitment to undertake monitoring and to report annually is attached with this report.

9 Declaration of the consultant

This EIA has been prepared according to the EIA Regulations 2007. I certify that the statements in this Environmental Impact Assessment study are true, complete and correct to the best of my knowledge and abilities.

Name: Ahmed Zahid (EIA 08/07)

Signature:

Date:

10 Sources of Information

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Appendix 1: Terms of Reference

Appendix 2: Commitment letter from the proponent

بسم الله الرحمن الرحيم

Environmental Protection Agency

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Environmental Protection Agency
Ministry of Housing and Environment
Male', Republic of Maldives

Terms of Reference for the Environmental Impact Assessment on the proposed development of Heavy Load Site in Thilafushi, Kaafu Atoll, Maldives.

The following is the TOR for undertaking the EIA of **the proposed development of Heavy Load Site in Thilafushi, Kaafu Atoll, Maldives.** This TOR is based on the issues raised in the scoping meeting held on Thursday, 9 September 2010 at Environmental Protection Agency.

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

1. Introduction – This TOR has been prepared for the Environmental Impact Assessment of the proposed dredging, reclamation, sheet piling, coastal protection and site facilities involved in the development of Heavy Load's site in Thilafushi, Kaafu Atoll. The project is proposed by Heavy Load Private Limited. The reclaimed area would be used for the development of site facilities and the dredged area as the harbour. Existing reef entrance on the southeast corner of Thilafushi would be used; therefore, no reef entrance channel would be dredged.

2. Study Area – The study area is slightly to the west of the southeast corner of Thilafushi, which has been reclaimed by landfill of un-segregated waste. This is an industrial area with several semi-industrial activities such as boat yards and fibre-glass works.

3. Scope of Work - The following tasks will be performed:

Task 1. Description of the Proposed Project – Provide a full description of the relevant components and nature of the project, using maps at appropriate scales where necessary. This is to include: brief description of the proponent, justification of the proposed project, a clearly labelled site plan and drawings, a detailed description of how the project activities will be undertaken including work method for dredging, reclamation and sheet piling and a project schedule. The boundaries of the study area for the EIA shall be provided. The details of the operations of the project site should also be included. This should include details of the activities that would be carried out on the site as well as details of power and water generation including intake/discharge locations if any.

Task 2. Description of the Environment – Include a description of the existing environmental conditions of the project site with photos of the site where relevant. 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 may be usefully applied to future monitoring.

Specific emphasis should be placed on the following activities of the project or related to the project:

- *Site Mobilisation, machinery and construction equipment*
- *Sheet piling/coastal protection*
- *Dredging*
- *Reclamation of the proposed area*
- *Workforce management*

As such the following field investigations must be considered for baseline data collection:

- *Longshore/offshore currents around the site*
- *General climatic and oceanographic conditions in the project area*
- *Bathymetry of the proposed borrow and fill locations*
- *Sea water quality parameters shall specifically include dissolved oxygen, salinity, pH, temperature, BOD, COD and turbidity*
- *Condition of the reef areas that may have any potential impacts from the proposed development*

All survey locations shall be referenced with Geographic Positioning System (GPS). All water samples shall be taken at a depth of 1m from mean sea level or mid water depth for shallow areas. The report should outline the detailed methodology of data collection utilized to describe the existing environment.

Task 3. Legislative and Regulatory Considerations - Describe the pertinent national 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. Impacts – provide an assessment of the impacts including the constructional and operational impacts. During the constructional phase impacts of dredging, reclamation and sheet piling needs to be considered. Operational phase impacts shall consider the future development activities and how they may hinder or alter the use of proposed Heavy Load site and impacts of on-site facilities and services.

Task 5. Mitigation measures - Identify possible measures to prevent or reduce significant negative impacts to acceptable levels with particular attention paid to sediment control and construction methods. Discuss the feasibility and cost effectiveness of each mitigation measure and provide the costs of mitigation and the commitment to it.

Task 6. Alternatives - This section must include the proposed development scenario evaluated against the no-project option and other alternatives. These include alternative coastal protection measures, alternative development concepts or layout of the harbour, alternative methods such as use of dredger instead of excavator, and alternative sediment control measures. The report should discuss how the recommended alternative was selected.

Task 7. Environmental Monitoring Plan – Environmental monitoring shall focus mainly on the construction phase of the proposed project. Constructional monitoring shall cover sea water quality to understand sedimentation by including monitoring of pH, DO and turbidity at regular intervals before, during and sometime after the construction phase. The report should also provide a detailed cost breakdown for implementing the monitoring plan. The monitoring programme shall identify the different parties involved in the monitoring and their commitment, especially the commitment of the Proponent to carryout critical monitoring tasks associated with the project.

Task 8. Stakeholder Consultation – Stakeholder consultation shall consider discussions during the EIA Scoping Meeting. Issues raised or identified in the Scoping meeting with a list of participants of the meeting shall be provided. In addition, consultations with the neighbouring sites in Thilafushi shall be considered.

Presentation - The environmental impact assessment report, to be presented in print and digital format, shall be concise and focus on significant environmental issues. It shall 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 EIA report shall be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Regulations 2007.

Timeframe for submitting the EIA report - The developer must submit the completed EIA report within 3 months from the date of this Term of Reference.

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16 September 2010