ENVIRONMENTAL IMPACT ASSESSMENT

For the Proposed Channel Deepening Works in Taj Exotica Resort (Emboodhoofinolhu), Maldives

Proposed by

Taj Exotica Resort

Signature:

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for

Water Solutions Pvt. Ltd., Maldives

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Non technical Summary

The Project

Taj Exotica Resort (Emboodhoofinolhu) island proposes to create an entrance channel, so as to provide safer maneuvering of boats and to allow access to the island's service jetty even during low tide. To do so, the proponent proposes to carry out the minimal amount of excavation required to create the entrance channel in order to improve navigational safety. Hence, the project requires creation of an entrance channel of length 336.7 m, width 22.8 m and to a depth of 2.5 m (from MSL). The works will be undertaken using an excavator placed on a floating barge. Material removed from the site will be placed on the barge and periodically transported to the island where a designated site has been identified for disposal. Details of how the proponent would use the excavated sediments are given in the EIA report. The proposed project is expected to begin in July 2007 and take not more than 2 months.

Environmental Impacts

Impacts on the marine environment of the island system from the proposed deepening activities have been predicted and identified through analysis of the proposed project, field surveys, observations and assessment as well as based on field experience of similar other work in the country. Quantitative and qualitative data were analyzed to predict significance and extent of impacts that may arise from the proposed project activities.

This EIA has identified various impacts. One of the major impacts and perhaps the most significant impacts of the proposed project has been identified as the sedimentation from excavation. Other impacts identified include, changes to the bathymetry and slight changes to current and wave patterns within the project site. A comprehensive mitigation plan has also been outlined indicating the magnitude and the nature of impacts, i.e., whether the impacts are significant, long or short term and whether

mitigation measures are available. Some of the activities do not have mitigation measures while some do. Activities that do not require any mitigation measures are those identified as having positive impacts. A summary of potential impacts relevant to the proposed project are outlined below:

Positive

1. Improved flexibility of the island's operation by allowing access to boats during low tide and at night.
2. Significant cost reduction in daily operations.
3. Improved navigational safety.
4. Greater flexibility for staffs going in and out of the island
5. Better scheduling of logistics

Negative

1. Loss of benthos from the project area
2. Sedimentation and turbidity in the project site due to suspension and dispersal of fine sediments.
3. Slight alteration of the current regime.
4. Alteration of the bathymetry

Project alternatives

Alternatives to the proposed project and methodologies have also been carefully identified and discussed. These alternatives have been evaluated based on their environmental impacts, values, costs and benefits. They were also considered from a management and long term perspective. Alternatives were identified for the project location, method of excavation, alternatives to the project and alternative ways of disposing the sediment. The alternatives considered for the project include extending the existing service jetty. This alternative has been rejected due to its long term management, capital costs and other issues. One of the alternatives proposed for disposal of excavated sediments have been to transport them to Thilafushi island.

All these alternatives have been considered during the planning stage but not considered as practicable due to various reasons, details of which are discussed in relevant sections.

Environmental Monitoring

An environmental monitoring plan has been identified. This monitoring is important to assess the long term changes to the environment and ensure that environmental sustainability is achieved. The monitoring programme includes water quality, sedimentation rates, and reef survey using permanent photo quadrates, manta tows and other methods. The monitoring programme will be undertaken during the 2 months of construction stage and another 12 months after the completion of the works.

1 Introduction

Taj Exotica resort (Emboodhoofinolhu) in South Male' atoll is located roughly 4.5 miles south of Male' in south Male' atoll. The island is enclosed in one of the largest reef system in the Maldives stretching several kilometers to the north and south of the island. The reef system of Emboodhoofinolhu is shaped like an inverted "L" and forms the north-eastern corner of the south-Male' atoll (see Figure 1). From the eastern reef edge, the island is 0.6km inside the lagoon. The island is 0.5 km from the western side deep lagoon. The resort is managed by the Taj group of Hotels, an Indian hotel chain. The resort has very limited land space and to maximize the services, a significant number of guest rooms are built over water (Figure 2). The service and back house areas are concentrated on the northern part of the island.

At present, there are two jetties to access the island. The guest arrival jetty is located on the western side of the island while the service jetty is located on the north-east side (see Figure 2). The existing arrival jetty is at least 0.3 km from the deep lagoon. Access to the island at present is achieved by a narrow stretch of deepened channel on the northern reef rim about 1800 m north of the island. The service jetty is located on the northern side of the island and there is a limited mooring area to the service jetty. This is the access point for all the supplies that are brought in to the island including food, fuel, gas, spares and others. It is also the exit point for the resort's wastes that is taken regularly to Thilafushi and also for staff movement in and out of the island. The resort caters for the high end market meaning that beds are relatively expensive and the level of service is extremely high. This requires a separate jetty for guests and other operational services. The resort is currently faced with the issue of safe maneuvering of boats (mainly mechanized dhonis) to the service jetty and access is possible only during the high tide. Boats sometimes spend hours in the deeper part of lagoon until high tide in order to access the service jetty and vice-versa. This practice is economically and

practically proving to be costly and a difficult procedure. Due to this reason, the management of the resort seeks to create an entrance channel on the northern side.

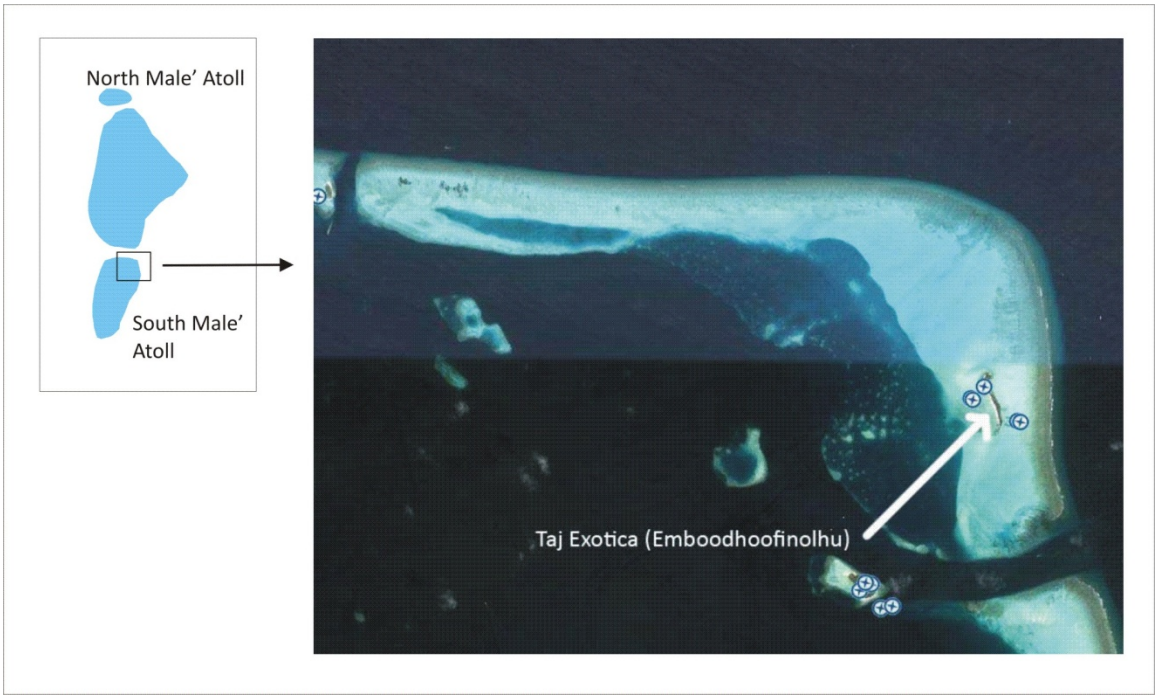


Figure 1: Location map of Taj Exotica Resort (Emboodhoofinolhu).

Figure 2: Aerial view of Emboodhoofinolhu showing the narrow and long shape of the island.

1.1 Excavating entrance channels and EIA

The management of Taj Exotica resort (Emboodhoofinolhu) intends to create an entrance channel from the north side lagoon of the island so as to allow for safer maneuvering of boats and provide unlimited access to the islands service area. To do so, the resort management proposes to carry out the minimal amount of excavation along the proposed entrance channel within the lagoon to improve navigational safety and provide flexibility for access to boats at all times. Excavation of the entrance channel would seek to achieve depths of up to 2.5m (from MSL) in the channel. At present the depths in the area vary from 0.5 to 1m at MSL. Excavation will involve the removal of material from the seabed by using an excavator.

1.2 Project Rationale

Tourism in the Maldives is currently at a high and growing rapidly. This is stretching the limits of the resorts in the Maldives and demands an increase in bed capacity. The demand for resorts in Male' atoll is particularly high due to proximity to the international airport. Due to this context, and the inherent natural beauty and strategic geographic location, Taj Exotica is favoured by many tourists, creating an all year around market. However in order to provide quality and adequate service all year round, the island has to have a continuous and smooth operation of its supplies in and out of the island, that includes staff movements and waste among others. Without this, it would be very difficult and costly to manage the operations. Presently, the island cannot be accessed by supply boats during low tide and maneuvering in the shallow lagoon is a difficult procedure, which is also economically and practically not feasible. At present, the number and frequency of supply boats and vessels in and out of the island depends on tidal changes.

For these reasons, the management of the resort wishes to create an entrance channel from the northern lagoon which will not only be safe for boats, but can be accessed regardless of the tide. This will allow unlimited flexibility in the movement of supply vessels and boats both in and out of the island. It is also very important to have this flexibility in an emergency. Therefore, the resort management is seeking to have the limited amount of excavation that is required to create an entrance channel, which is environmentally and economically justifiable.

1.3 Execution of the EIA

This EIA was carried out by Water Solutions Pvt Ltd on behalf of Taj Exotica Resort. The multidisciplinary team engaged to carry out the assessment included local expertise in environmental impact assessment, coastal management and marine biology. The CV's of the team members are attached as annex. The team members were:

- Mr. Ahmed Zahid, B.Sc; PG Diploma - EIA Specialist

- Mr. Abdul Aleem, B.Sc, MPH – Project Manager
- Mr. Hussen Naeem, B.Sc. – Marine Biologist
- Mr. Mohamed Riyaz, – Assistant Surveyor

1.4 Terms of Reference

The terms of reference for this EIA have been attached as an annex. This EIA has been prepared based on this terms of reference.

1.5 Study Area

The area encompassed by this study is shown in Figure 3. It primarily focuses on the coastal marine area that could potentially be directly affected by the dispersal of suspended sediments generated by the excavation works. This includes the northern side lagoon. The study also considers the implications of entrance channel deepening on activities currently taking place within the island's economic, terrestrial and coastal environments.

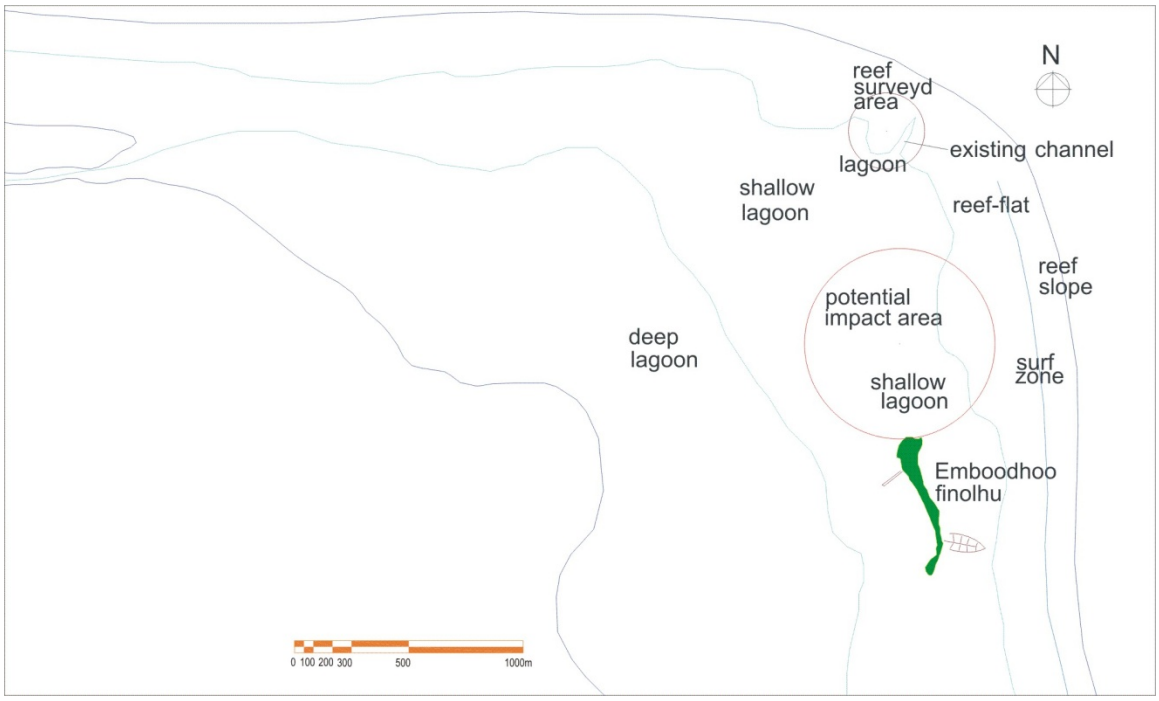


Figure 3: Proposed project site showing the study area

1.6 Methodology

Various methodologies were used to study the project site and gather as much information as possible on the affected environment. In doing so, five (5) types of surveys were undertaken namely, marine surveys, water currents, bathymetry, water quality and interviews with key stakeholders. A brief outline of these surveys are given below.

1.6.1 Marine survey

Status of the existing marine environment was assessed principally by conducting field surveys. Methodologies of field surveys included, standard semi-quantitative and qualitative survey protocols designed for marine environmental surveys and assessment. These were Reef Fish Visual Census methods, Time-Swim coral reef survey, Reef aesthetic survey and Visual observations. Details of these survey methods are given in the following section. Field surveys were supplemented by aerial photographs, recent satellite pictures and discussion with people who are familiar with Emboodhoofinolhu island local environment.

In addition to standard methodologies, aerial photos taken in 1969 and recent satellite pictures and observations in the field were used to assess long-term changes and physical processes in the marine environment i.e. seasonal and tidal current patterns, sediment dynamics, physical aspects of reef and lagoon such as reef extent, orientation and setting of the lagoon and the reef system and with respect to other nearby reefs and islands as these attributes have significant role in magnitude of impacts that may arise from the proposed development.

1.6.1.1 Semi-quantitative assessment

1.6.1.1.1 Reef fish Visual Census

Underwater counts of reef fishes, often referred to as underwater visual census (UVC), have now become widely used for ecological and fisheries work. Visual counts appear to

give reasonably reliable results provided that they are applied to fish that are non-cryptic and either diurnally active or at least evident by day.

In this method, the surveyor swam along paths above the reef counting fish that were observed within 5m either side of the transect. The fish were censused within what is known as a band transects (i.e. one that has a measurable width as opposed to more usual line transect). To improve the accuracy only the fishes from two families were counted at any one time. Other families were counted on repeat swims.

Counting Fish

- To count the fish, the surveyor swam slowly along, counting individual that was seen within 5m to either side of him, that is within a band transect 50m long by 10m wide (i.e. one with a total area of 500m^2). Each individual fish or group of fish was noted on the underwater slate immediately after it was seen, and the totals obtained by adding up these figures following the end of the swim.

- Counting any fish more than once was avoided by training and experience.

- Only the families belonging to one or two closely similar families and groups were counted at any one time. This improved accuracy, because on most reefs there were far too many for all to be counted at the same time.
- The principle different groups of fish for which counts were undertaken included fishes that are common and that indicate the status of the reef in terms of coral cover, algal cover and other benthos within both the reef bottom and lagoon bottom

These fishes are also commercially and ecologically important groups and some of these are indicator species of reef.

The Speed of Swimming and Counting

- Measures were taken to improve the accuracy. Speed at which the path was swum was controlled so as to standardize the efficiency of search. If the observer swims too fast, it is easy to miss fish, especially of smaller species, that may be temporarily obscured by corals or rock or be taking shelter. Experience shows that the slower the diver swims the more fish he records, up to a point. However, the highest number recorded by moving along very slowly may actually be an over estimate of fish density. Hence it is necessary to standardize swimming speed to a slow but not too slow pace.

- The standard speed of swimming practiced was at a mean rate of 10m a minute.

1.6.1.1.2 Time-Swim reef survey

Time-Swim surveying technique was used to assess the benthic communities of coral reefs and lagoon covering broad area. It enabled visual assessment of large areas of reef. Time-Swim survey was used to select sites that were representative of the reef for quantitative assessment of the status of the reef.

Time-Swim reef survey technique involved a series of snorkeling events performed over the reef edge/reef slope at a constant speed of approximately 5m/minute. Each snorkeling event was broken into 5 minutes. At the end of each snorkeling event records of selected set of variables were made on pre-prepared water-proof sheet clipped on a slate. The total survey took 40 minute and covered a distance of 200m. Observations of reef bottom were made 2m either side of the observer. The Time-Swim survey covered approximately 800m^2

Following variables were recorded during each event of time-swim.

- Percentage live corals
- Percentage dead corals
- Percentage sand

- Percentage Rubble
- Other benthos
- No. of endangered or rare species
- Crown-of-thorn starfish
- Visibility

1.6.1.2 Qualitative assessment

1.6.1.2.1 Visual observation survey

Qualitative visual survey was conducted to assess status of reef and lagoon covering a broad area where the proposed deepening may impact these attributes of marine environment. Visual observation survey was used to assess various attributes of the reef bottom including type of habitats, benthic and pelagic species, their diversity and abundance in addition to types of reef substrate, amount of live coral, rubble and sand in the area.

1.6.1.3 Reef aesthetic survey

Reef aesthetic assessment was conducted using Time-Swim reef survey technique. Reef aesthetic is a subjective attribute based on the observer's judgment and experience of the relative merits of a reef. This value judgment incorporated live coral cover, diversity of life forms, fish life, reef structure, habitat diversity and general appeal. Observers took care not to allow the present weather conditions to bias the judgment when assigning these categories as poor visibility will impair the judgment. The following categories were used to determine reef aesthetic.

1. Very poor (= 0)
2. Poor (= 1)
3. Average (= 2)
4. Good (= 3)
5. Very good (= 4)
6. Excellent (= 5)

Each category was given a value to determine the present level of reef aesthetic of Emboodhoofinolhu island coral reef system. Sum of the values gives the present aesthetic level of the reef.

1.6.2 Water Currents

Currents from different locations within the proposed project location and surrounding areas were measured using drogues. Current measurement was conducted in Emboodhoofinolhu on April 4, 2007. Drogues were deployed and their movement tracked with a differential GPS instrument. The location of and the direction of currents are shown in Figure 10.

1.6.3 Water quality

Water quality within the project site was undertaken to provide a baseline set of values on water quality. The parameters measured were turbidity and dissolved oxygen (DO). Samples were collected at a depth of 0.5m from a small boat. All samples were collected in pre-cleaned 1 litre polyethylene sample bottles. Samples were tested using YSI model water quality meter. Figure 5 shows the marine water quality sampling points.

1.6.4 Interviews with key stakeholders

Interviews were conducted with key stakeholders namely, Ministry of Tourism and Civil Aviation, Ministry of Environment, Energy and Water, MTCC and the resort management. In addition, interviews were conducted with members of the resort staff. Details of these are discussed under stakeholder consultations.

2 Project Description

2.1 Project Proponent

The project is proposed by Taj Exotica Resort (Emboodhoofinolhu). Taj exotica is managed by the Tata group of hotels, which is an Indian based company. Taj group has been operating Taj Exotica since 1993. The group also operates Taj Coral in North Male Atoll.

As part of the Tata Group of companies, Taj Hotels Resorts and Palaces comprises 57 hotels in 40 locations across India with an additional 18 international hotels in the Maldives, Mauritius, Malaysia, Australia, UK, USA, Bhutan, Sri Lanka, Africa, and the Middle East. Over the years, Taj has won international acclaim for its quality hotels and its excellence in dining, business facilities, interiors, and world-class, personalized service. In India, Taj is recognized as the premier hospitality provider, spanning the length and breadth of the country, and gracing important industrial towns and cities, beautiful beaches, historical and pilgrim centres, and wildlife destinations. An innovator in dining, Taj was the first to introduce Sichuan, Thai, Italian, Mexican, and Californian cuisine into the country. In 1972, it was the first to open a 24-hour coffee shop in India at Taj Mahal Palace & Tower, Mumbai. Today, each restaurant is reflective of that tradition, setting benchmarks for an outstanding culinary experience.

Both Taj Exotica and Taj Coral resort adhere to strict environmental standards set by the Maldivian authorities and also incorporates even higher standards that are set by the group themselves. The Proponent has never been fined or penalized in any form whatsoever for environmental damage or liability in the Maldives.

2.2 The project

The proposed project involves excavation from the northern side lagoon to a depth of 2.5 m (from MSL). The deepening channel has a length of approximately 336.73 m and a width of 22.86 m. The length includes the entire entrance. At present, the eastern side of the island is exposed to strong currents and waves. Due to this reason, several shore protection measures such as groynes and sea walls have been constructed to combat erosion. The management intends to dispose the excavated material (mainly sediments) in three methods described below.

1- Use the sediments as fill material to compact the staff soccer field, which is located on the north side of the island. At present, this site has loose sand which does not provide ideal conditions for soccer. Hence, some of the sediments will be disposed off at this location and compacted to create a hard surface. Refer to Figure 4.

2- Use the excavated materials to create a beach on the northern side. Currently, this side has several groyns (Refer to Figure 4). Groynes are structures which run perpendicular to the shoreline. The groyns will help trap the filled sediments thereby trapping sediments to create a beach.

3- Stockpile the dredged spoil at the open space on the northern side to be sieved and utilized later (Refer to Figure 4). The island is a narrow sand cay and requires periodical supply of fine sand to different parts of the island, including the pathway, back house area and guest areas in order to replenish and maintain the look of white sand. It is anticipated that excess dredged spoil from the above two activities will be stockpiled and used in different parts of the island after sieving.

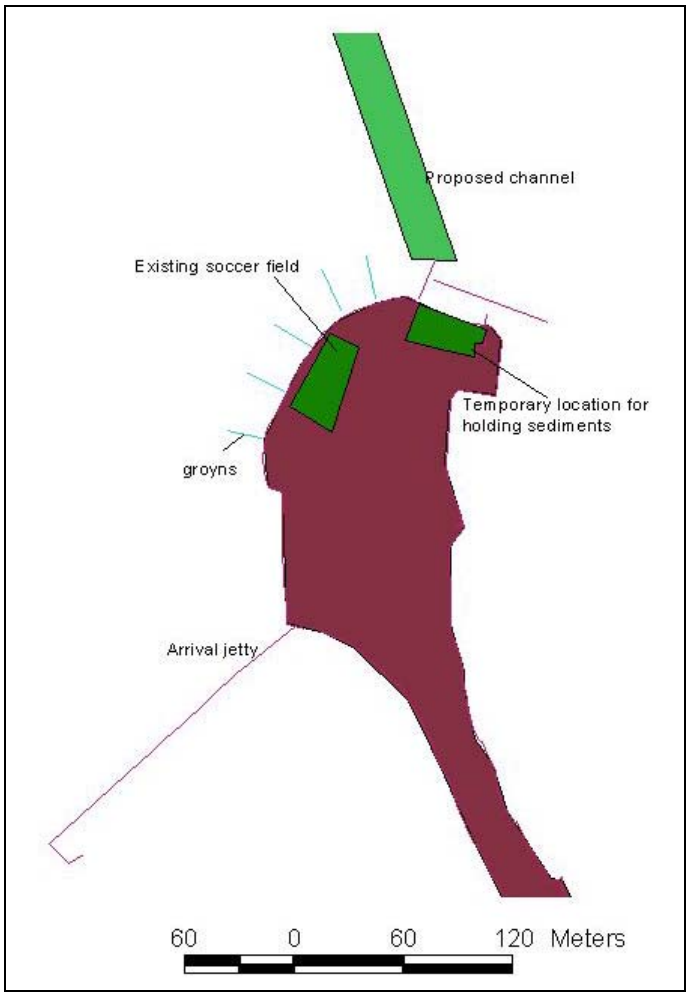


Figure 4: Northern side of Emboodhoofinolhu showing the existing soccer field, location for temporary stockpiling of sediments and groyns.

This EIA report has been prepared in order to carry out the proposed channel excavation works and to assure compliance with the National Environmental Policies and regulations on carrying such works. Therefore, the scope of this EIA covers the excavation of the entrance channel alone and no other activities of the resort. This is also reflected in the Terms of reference approved by the Environment Ministry.

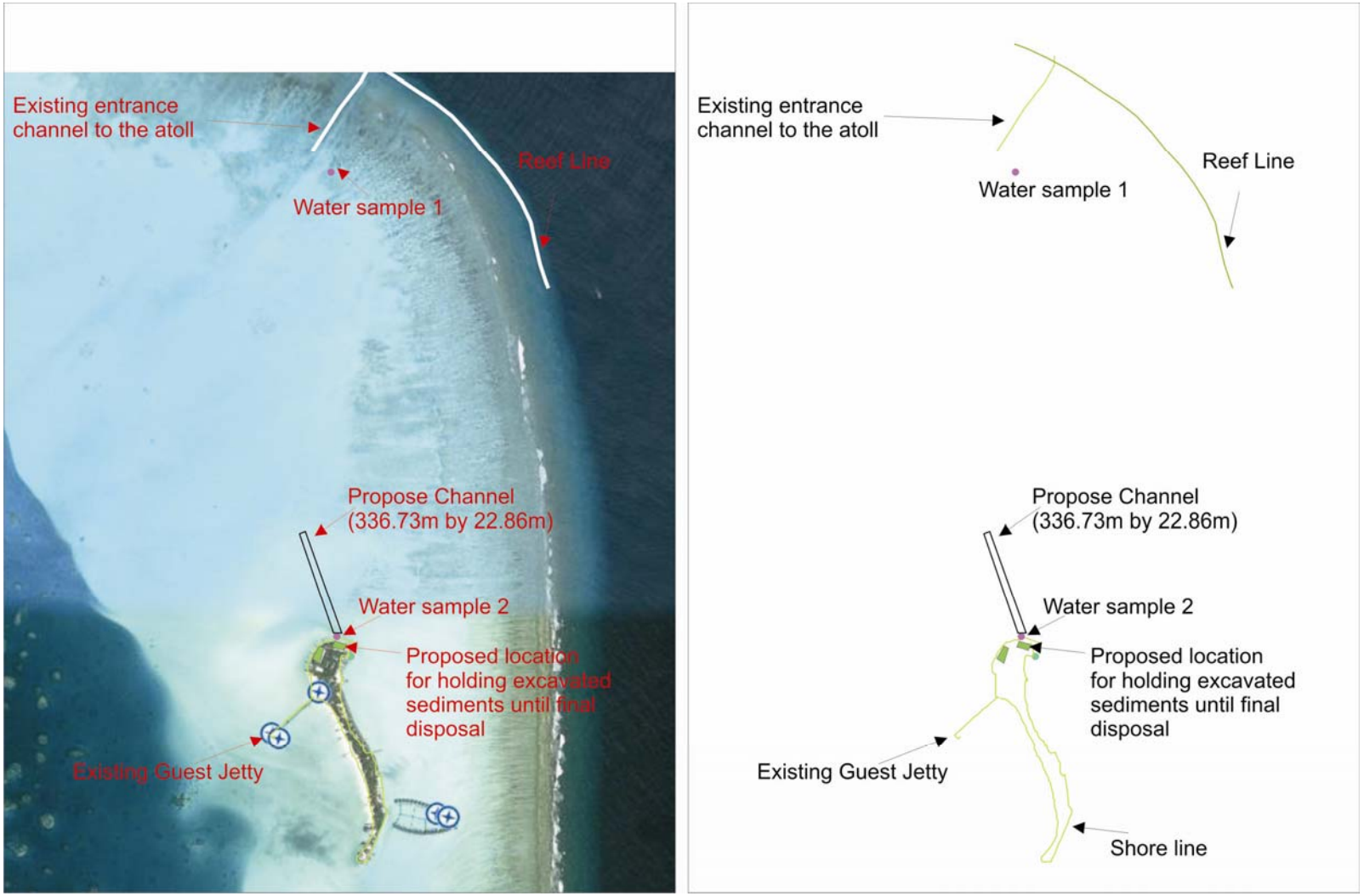


Figure 5: Project location showing the location of the channel and water sampling locations.

2.3 Project Location

Taj Exotica resort (Emboodhoofinolhu) in South Male' atoll is located roughly 4.5 miles south of Male' in south Male' atoll. The island is enclosed in one of the largest reef system in the Maldives stretching several kilometers to the north and south of the island. From the eastern reef edge, the island is 0.6km inside the lagoon. The island is 0.5 km from the western side deep lagoon. Access to the island at present is achieved by a narrow stretch of deepened channel on the northern reef rim about 1,800m from the island (see Figure 5).

The island is very narrow and due to this it has been protected at several locations by sea walls and groynes. The island has an area of 3.70 Hectares (37035.184 m^2 from the shore line), with a length of 720 m. The widest point measures 99 m and the narrowest point measures 26 m. The proposed project is located at the northern side of the island from the existing jetty and stretching to a distance of 336.73 m.

2.4 Rationale and Justification of the project.

At present, the northern side lagoon has an average depth of 1.18 m at mean tide. This depth is not adequate for safe maneuvering of boats, which is only possible at high tide. Presently, the resort cannot be accessed by supply boats during low to medium tide and maneuvering in the shallow lagoon is a difficult procedure, which is economically and practically not feasible. Currently the number and frequency of supply boats and vessels coming in and out depends on tide. Access to the atoll is achieved through a narrow channel from the northern rim of the atoll which is 1800 m from the service jetty (See Figure 5). The entrance channel is roughly 330 m long with an average depth of 3.25 m. Although this channel allows boats to access the deepwater inside the lagoon, boats have to wait in the deep waters until high tide to access the islands service jetty. This process is illustrated in Figure 6.

For these reasons the, management of the resort wishes to create an entrance channel which will not only be safe for boats, but can be accessed regardless of the tide. This will

allow unlimited flexibility in the movement of supply vessels and boats both in and out of the island. It is also very important to have this flexibility in an emergency. Therefore, the resort management is seeking to have the limited amount of excavation that is required to create an entrance channel, which is environmentally and economically justifiable.

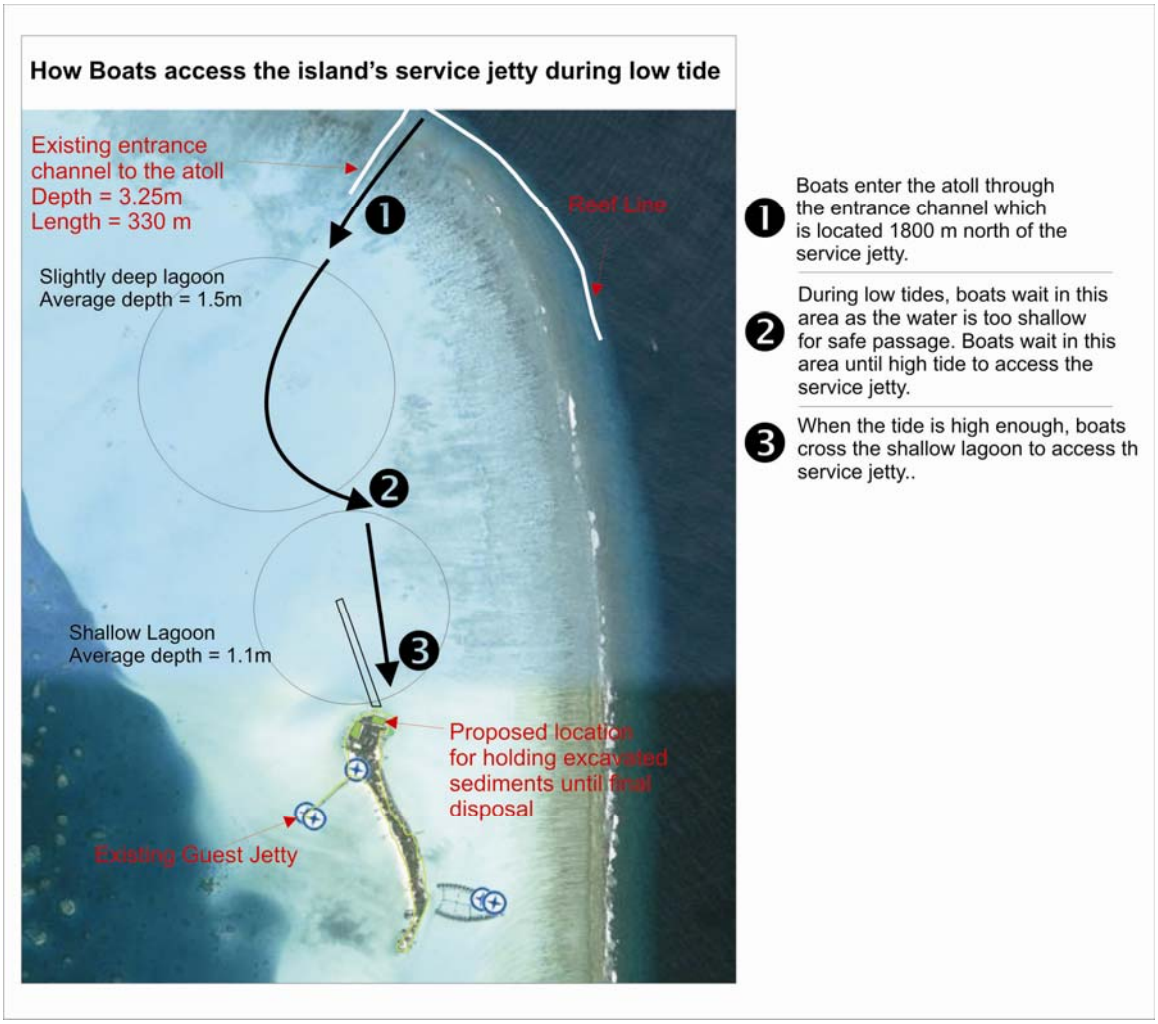


Figure 6: Existing method of accessing the service jetty

2.5 Location and extent of Site Boundaries

The proposed entrance is located on the north side of the island (see Figure 3) which will be deepened to a depth of 2.5 meters (from MSL). At present this area is very

shallow with average depths of 1.18m. The sea bed within this area is mainly sand consisting of small quantities of coral rubble. Data obtained from the aerial photos, bathymetric and marine survey confirms this. Based on the currents, sediment movement and water flow, only a limited area within the project site is expected to be affected by the sediment plume. The anticipated project locations are defined by the deep lagoon, shallow lagoon, patch reefs and reef slopes (see Figure 12). The marine environmental survey undertaken indicates that only 10% of the shallow lagoon will be indirectly affected due to excavation of the entrance channel. It was also estimated that approximately 5% of the reef-flat area will be impacted indirectly due to the deepening of the proposed navigation channel.

2.6 Excavation plan

The project will be implemented through a carefully managed plan. Construction will be initiated as soon as this EIA is approved. It is expected that the work will begin in early August 2007. The project will not extend beyond two months and the proponent wishes to complete within one month. A tentative work plan has been provided in Table 1. Once the EIA is approved, all the machinery and equipment will be mobilized to the site. The project will begin once the barges and excavators are brought in to the site. Barges and excavators will be brought in during the high tide and work will begin from the deep end of the lagoon and move towards the island. All dredged materials will be loaded on to the barge. The barge will be adequately bunded in order to prevent sediment spilling in to the lagoon during the excavation and loading process. After the works, all the excavated materials removed will be transported to the islands north side where they will be disposed in between the groyns.

Table 1: Proposed construction plan for the excavation works (August to September 2007)

Description	July	August				September			
EIA submission	X								
EIA Approval	X								
Bidding		X							
Mobilization			X						
Inspection and assessment by the EIA consultant			X						
Excavation works				X	X	X	X		
Disposal of excavated materials						X	X	X	
Post-excavation hydrographic survey to confirm whether depths meet the plans.									X

2.7 Volumes and types of sediments to be dredged

It has been estimated that a approximately 19,191.00 cubic meters of excavated material will be generated by the proposed works. Excavation will be done by loading an excavator on to a barge. Since this is not a very large project, only one excavator and barge will be used to undertake the proposed works. The proposed area for the entrance channel mainly consists of sand which accounts to 80%. This means, that the majority of the excavated materials will be sand. Apart from sand, the area constrains coral heads (3%), rubble (15%) and algae (2%). The project will not require any blasting of the reef nor any other environment and therefore blasting will not be undertaken.

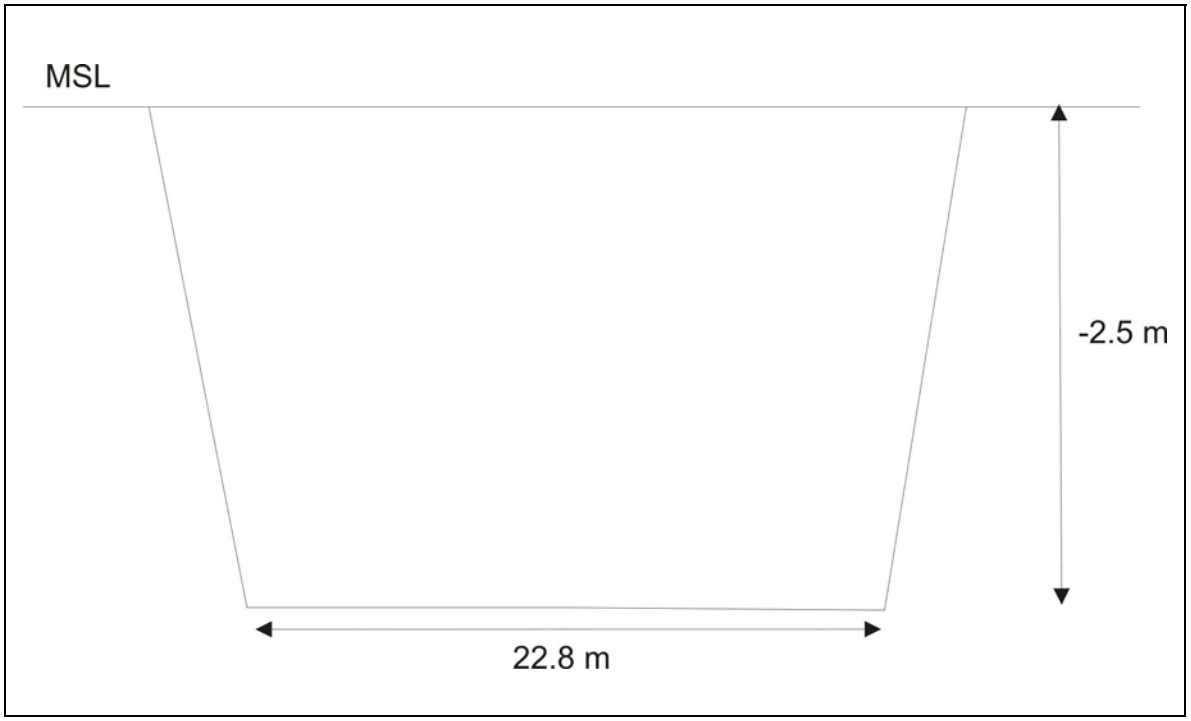


Figure 7: Cross section of the channel showing the cut.

2.8 Excavation equipment and methodology

The proposed works do not require sophisticated equipment since the lagoon bottom is mainly sand. Therefore floating barges and excavators will be used for the deepening works. Barges will be towed to the project location during high tide. Excavators will be placed on barges brought in from outside. Therefore there will not be any potential impact on the terrestrial environments, such as need to clear the pathway for its transport and the compacting affect on soil in the island. Workers will be briefed about the environmentally safe methods of working before beginning the works. Regular inspections will be done on the excavator to ensure that no oil and other hazardous fuels leak in to lagoon. All the workers involved in the project will be based in the island to avoid potential delays. Once the work begins, the excavator will excavate the channel to the required depth. The cross section of the cut is shown in Figure 7. Measurement of

the excavated depth will be checked using a handheld echosounder. All the excavated materials will be loaded on the barge. When the barge is full it will be towed to the island and the excavated materials will be transferred to the north side where it will be disposed. All excess dredged material will be stockpiled on land for future use. How they will be used has been discussed earlier in the report. Table 2 provides a the project inputs and outputs during construction and operational stage.

Input / resource	Type	How to obtain
Major inputs during construction stage		
5 to 7 Construction workers	Either local or foreign (this will mainly depend on the contractor selected).	Project will be open tender. It is expected that all major contractors working in this field will bid for the project.
One Barge	Floating type.	Contractor
One Excavator	General excavator used in the construction industry.	Contractor
Fuel	Diesel for excavator.	Contractor
Major outputs during construction stage		
Output	**Description**	**Disposal/management**
Excavated materials	Mainly sand and some coral rubble including coral heads, algae. The total volume is expected to be 19,191.00 m^3.	Excavated materials will be disposed off to create a beach, some used to compact the staff soccer field and the rest stockpiled on land to be utilized later.
Gaseous emissions	Gaseous emissions from the excavator engines during the construction period. Not expected to be of any significance since the quantity will be very minute in comparison to the environment.	No disposal but few mitigation measures to minimize emissions.
Noise	Noise generated form excavation process, engine noise form the excavators.	Noise mitigation measures will be implemented.

Table 2: Major inputs and outputs during the construction stage

2.9 Environmental factors related to the project

Since the project takes place in the marine environment, the greatest threat is on the marine environment. Sedimentation caused by the excavation will increase turbidity and may disperse sediments in a plume to a greater area. However, the reef flat and reef slope is a considerable distance from the proposed channel, it is not likely to be a major threatening factor if the mitigation measures are in place. Furthermore, the impacts of sedimentation are short term and will not last long. However, long term impacts such as alteration of currents may induce sedimentation within the lagoon. These sediments are likely to settle within the lagoon and are not expected to reach the reef areas. During the excavation process, mitigation measures such as using bundwalls and undertaking the works at low tide will be used in order to minimize the environmental impacts.

There will also be minor impacts as a result of stockpiling the excavated materials and disposing them to create a beach. To minimize the impacts, excavated materials will be bunded and protected from run off in case of rain once they are stockpiled on land. Furthermore, the sediment movement along the disposed location will be monitored periodically.

2.10 Disposal of excavated material

2.10.1 Disposal of the fine sediments

The excavated materials will be disposed on the northern side to create a beach. The creation of a beach will be assisted by the presence of groyns on the north side. Some of the excavated materials will also be disposed to the staff soccer field and compacted in order to create a suitable surface for soccer games. Lastly, all excess materials will be disposed off to the designated site on the northern side of the island (Figure 5). This location has an area of 724 m^2. Here the sediments will be held, protected by a bund wall possibly made from wood. The management proposes to utilize the fine sediment

in the island for periodical renewing of sand in different locations such as walkways, guest areas and other locations.

2.10.2 Disposal of the coarse materials

Since the coarse materials will arise from the sieving process, there are three options for the disposal of the coarse materials. Option one is to dispose them in the deep sea, away from the island. This material would not be re-suspended by wave action, given the depth at which the material will be disposed off and considering the effect of abnormal stormy conditions in the Maldives in the past. This will also eliminate any potential damage to the coral reef system around the island. Option two is the use of this material for construction purpose. The coarse material will be mixed with aggregate, sand and cement and can be used in plastering walls, sea walls etc. The third option is to transport the materials to Thilafushi disposal site.

Considering the cost and environmental concerns, it is proposed to use option two, which is their use in construction. Coarse materials will only arise after sieving. Until then, there will not be any coarse materials, since it will only result after sieving.

2.11 Duration of excavation

The amount of excavation to be carried at Emboodhoofinolhu is considered to be a very minor operation. In terms of the work, it is not expected to take more than two months to accomplish the task. This includes the period of bidding and mobilizing the contractors and undertaking a final assessment. Completion of the deepening works would be signaled by conducting a post-excavation hydrographic survey to confirm conformance to the proposed excavation design. This will not be a detailed survey, but a basic survey to check the depths in the channel. Therefore, the proposed project is expected to be completed within a period of two months. However, it is the wish of the proponent to complete the works within one month form starting the works.

3 Policy and Legal Aspects

This chapter describes the legal instruments that shape the project design and implementation. This section will therefore identify the extent to which the project conforms to existing plans, policies, guidelines and laws. These mainly include the National Environment Protection and Preservation Act, and different action plans and policies of the government relating to environmental protection. Since this project involves only the deepening of the lagoon to create an entrance channel, there are very few laws and regulations relevant to this project.

3.1 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 relevant to the proposed development:

- Clause 5: An EIA shall be submitted to MEEW before implementing any developing project that may have a potential impact on the environment.
- Clause 6: Project that has any undesirable impact on the environment can be terminated without compensation.
- Clause 7: 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.
- Clause 9: The Penalty for Breaking the Law and Damaging the Environment are specified indicating a maximum of one hundred million Rufiyaa fine.
- 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.

The project conforms to the requirements of the Environmental Protection and Preservation Act of the Maldives, Law no. 4/93. The EIA has been undertaken in accordance with the EIA Regulation 2007 of the Maldives by registered consultants

3.2 Regulation on Coral, 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.

3.2.1 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. Under Article 7 (c) of the Regulation on Sand and Coral Mining issued by the Ministry of Fisheries, Agriculture and Marine Resources (MOFAMR) on the 13th of March 2000, it is an offence to mine sand or coral from the beach, lagoon or reef of any inhabited island and islands leased for the purpose of building a tourist resort. Coral would not be mined and used in the excavation and channel deepening works in Emboodhoofinolhu.

3.3 The National Biodiversity Strategy and Action Plan

This is also basically an environmental protection and preservation strategy in many ways. This strategy also establishes several guiding principles and a wide ranging policies and targets.

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 been given to ensure that the national biodiversity strategies is adhered to. The proponent has committed fully on conservation and protection of the environment while undertaking this proposed project. More specifically, the coral reef and generally the marine environment have been assessed in detail in order to assess baseline values. Quantitative and qualitative

surveys were undertaken to assess the biological diversity of the coral reef, especially in close proximity to the proposed project area. Practical mitigation measures and solutions have been identified to conserve and protect the biodiversity.

3.3.1 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.

There are no such protected or sensitive areas in the project site.

3.4 Ministry of Tourism Regulations and Circulars

The Tourism Regulations in the Maldives ensure that carrying capacity of the island and atoll ecosystems are well within limits and the negative effects of the development are minimal. The Ministry also issues circulars on several occasions and when necessary to discourage activities such as sand and coral mining, developing on the coastal environment and waste disposal which may cause harm or damage to the natural environment, which is the main tourism product.

Tourism regulations strictly discourage modifications to the natural movement of sand around the islands. Therefore, Tourism Regulations require that special permission from the Ministry of Tourism and Civil Aviation be sought before commencing any coastal modification works on any tourist resort. It is also stated that hard engineering solutions are not encouraged and construction of solid jetties and groynes be controlled and shall only be undertaken after conducting an Environment Impact Assessment study. Similarly, design of boat piers, jetties and other such structures are required to be in such a way that these shall not obstruct current and sediment circulation patterns of the island.

The Ministry also issues circulars on several occasions and when necessary to discourage activities such as sand and coral mining, developing on the coastal environment and waste disposal which may cause harm or damage to the natural environment, which is the main tourism product.

This project fully compiles with the Tourism regulations and circulars and all prior approval has been sort from the Tourism Ministry.

3.5 Environmental Impact Assessment Regulation 2007

The Ministry of Environment, Energy and Water has issued a new EIA regulation on May 2007, which guides the process of undertaking the Environmental Impact Assessment in the Republic of Maldives – This guideline also provides a comprehensive outline of the EIA process, including the roles and responsibilities of the consultants and the proponents. This regulation outlines every step of the IEE/EIA process beginning from application to undertake an EIA, details on the contents, minimum requirements for consultants undertaking the EIA, format of the EIA/IEE report and many more .

The guidance provided in this Regulation was followed in the preparation of this EIA report. The EIA has also been prepared by registered consultants.

4 Existing Environment

This section describes the existing environment of the project site. Since this project is associated with the marine environment, no attempt has been made to describe the terrestrial environment. Instead, the coastal and the marine environment will be described. Climatic data on wind, tides and waves are not specifically available for the island. Instead data gathered from Male' International Airport has been used to describe the prevailing conditions. However, specific data on currents and the bathymetry are described for the island.

4.1 General Meteorology

Maldives is in the Monsoonal Belt in the North Indian Ocean, therefore climate in the Maldives is dominated by two monsoons, the Southwest monsoon (SW) from May to September and the Northeast monsoon (NE) from December to February. These monsoons are relatively mild due to the country's location on the equator. The North-East monsoon is characterised by gentle and dry winds while in the south-west monsoon heavier rains and showers occur. The winds usually get stronger in the south west monsoon especially during June and July. The period between March to April is the transition period from the NE monsoon to SW monsoon known locally as the *Hulhangu Halha*, while the transition period from SW monsoon to NE monsoon known as *Iruvai Halha* is from October to November.

Storms and gales are infrequent in the Maldives and cyclones do not reach as far south as the Maldivian archipelago. Storms and line swells can occur, typically in the period May to July; gusts up to 50 – 60kts have been recorded during these storms (Binnie Black & Veatch (sea) 2000). Generally the northern atolls of Maldives feel the effects of the storms much strongly than the southern atolls of the country.

The relative humidity generally ranges between 75 to 80%. Maldives experiences a tropical climate with mean annual temperature of 30.8°C, daytime highest reach 32 °C

but night time lows rarely drop below 25.5°C (SoE 2004). In contrast to the effects of storms the annual rainfall increases from north to the south of the archipelago (Figure 4-1). This indicates that the south is wetter than the north. The wettest months are May, August, September and December and the driest are January to April. Open water evaporation rates are in the range of 6mm per day and transpiration from plants is also high (SoE 2004).

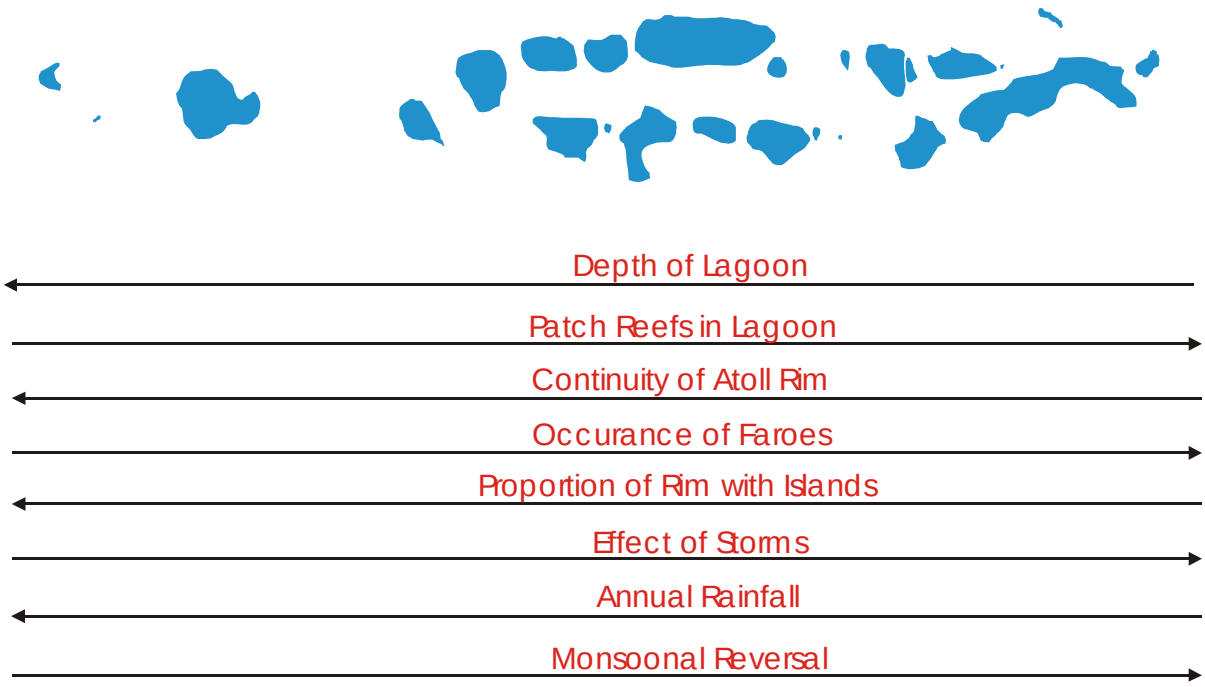


Figure 8: General trends in climatic variations and geomorphologic features across the Maldivian archipelago

4.2 Currents

Currents which affect the sea areas around and within reef systems can be expected to be one or more of tidal currents, wind-induced currents, wave-induced currents and oceanic currents. 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 respectively. In April the westward currents are weak and eastward currents flow will slowly take place. Similarly in December eastward currents 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/sec) 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 (<5sec.) 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/sec) are systematically located around islands.

Due to limited tidal range, tidal currents generally have very weak influence on the overall current patterns within reefs and around islands. Generally, tidal component of the current is eastward during the flood tide and westward during ebb tide (Binnie Black and Veatch 1999). Since many factors affect the strength and speed of currents within a reef system, it has been observed in many places that currents can be highly variable but would be in accordance with general longshore current patterns. Furthermore, given the net effect of frictional forces along the shore, sediments may be expected to move around the island seasonally whilst maintaining the net sediment/sand budget of the island.

Currents around Emboodhoofinolhu are mainly wind driven. The tidal component is expected to be small given the large span of the shallow reef flat and lagoon. There is very strong longshore current around the island. The strongest currents are found around the north and south corners of the long stretch of island, especially on the north due to its proximity to reef. The northern end is, therefore, protected with seawalls.

There is also a strong onshore current on the eastern side, as a result of which groyne structures on this side are not effective in keeping the sand in place. Currents in the project location are further discussed in Section 4.7.

4.3 Waves

Studies by Lanka Hydraulics on Malé reef indicated that there are two major types of waves on the coasts of the Maldives: wave generated by local wind with a period of 3-8 seconds and swells generated by distance storms with a period of 14-20 seconds. Wave energy is important for sediment movement and settlement, and it is also a crucial factor controlling coral growth and reef development. The diversity and the abundance of coral and algal species have been attributed to waves. These aspects have implications for the type and perhaps the supply of sediments into the island.

Wave action around Emboodhoofinolhu is strongest on the northern end where the existing service jetty is located. This area gets rough during harsh weather conditions and with high tide. There is abnormal wave activity at the existing service jetty area which results from short wind-generated waves within the lagoon combining with swell-generated waves from the rim reef on the east.

4.4 Tides

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 significant influence on the formation, development and sediment processes 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 dependent on tidal fluctuations.

4.5 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 have a dominant influence on the sediment transportation process (waves and currents). With the reversal of winds in the Maldives, NE monsoon period form December to March and a SW monsoon from April to November, over the year, the accompanying wave and current processes respond accordingly too. These aspects have ramification on the seasonal sediment movement pattern on the islands and also the delivery/removal of sediments from the reef platform/island.

Analysis of past wind data for Malé region indicated that the highest frequency of wind occurs from the west followed by WNW, NW and WSW during the southwestern monsoon and from ENE and NE during the northeastern monsoon (Figure 5). Results also show that the westerly component dominates over the easterly. Comparison of wind frequency of the transition period between the easterly monsoon and the westerly shows that the transition takes over between March and April and the Western monsoon reaches its peak by June.

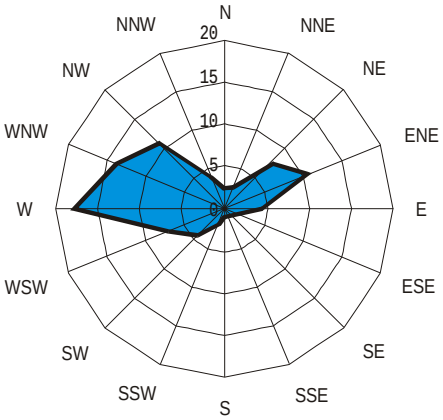


Figure 9: Wind rose diagram for Malé International Airport (1980-1999)

4.6 Island Environment

Emboodhoofinolhu lies in one of the largest reef systems in the Maldives. The reef system is the beginning of the south-Male' atoll and the island lie on the eastern rim of the atoll. The reef itself has several characteristics consisting of a deep lagoon, a shallow lagoon, reef slope and patch reefs (see Figure 12). Marine life in these different areas varies and is described under the section Marine Environment. The proposed project of creating an entrance channel occurs on the shallow lagoon, where average depths are 1.1 m (from MSL). Average depth of the deeper lagoon is 1.5 m from MSL). The nearest island is Emboodhoo which is found on the west of the island. Total area of Emboodhoofinolhu island system, including coral reef, lagoon, beach and vegetation is approximately 1,650 hectares. Approximately 659 hectares (40%) of the island system is covered by shallow lagoon surrounding the island. The coral reef of the island system covers approximately 400 hectares (24%). Out of this 134 hectares (8%) covers reef slope and 264 hectares (16%) covers reef-flat area. The island has an area of 37035.184 m^2 (from the shore line), with a length of 720 m and width at the widest point of 99 m (see Figure 2).

4.7 Bathymetry and currents at the project area

A bathymetric survey was undertaken at the project location to estimate the average depth at mean sea level and also to estimate the volume of sediment required to be excavated along the proposed pathway of the channel. This survey indicated varying depths on the northern side lagoon. First, the lagoon immediately on the northern side of the island is considered very shallow during low tide and average depths are 1.1m. This area also contains an evolving sand bank which makes it very shallow during low tide. Further north, about 600 meters, the lagoon is slightly deep with average depths of 1.5 m (see Figure 10 for details). This is the area where boats wait until high tide in order before accessing the service jetty. Further north of the island, roughly 1,800 m is the entrance channel to the atoll. The average depths in this channel is 3.25 m. Currents

were measured using drogue and during the survey, the direction of the currents were mainly towards south-easterly direction.

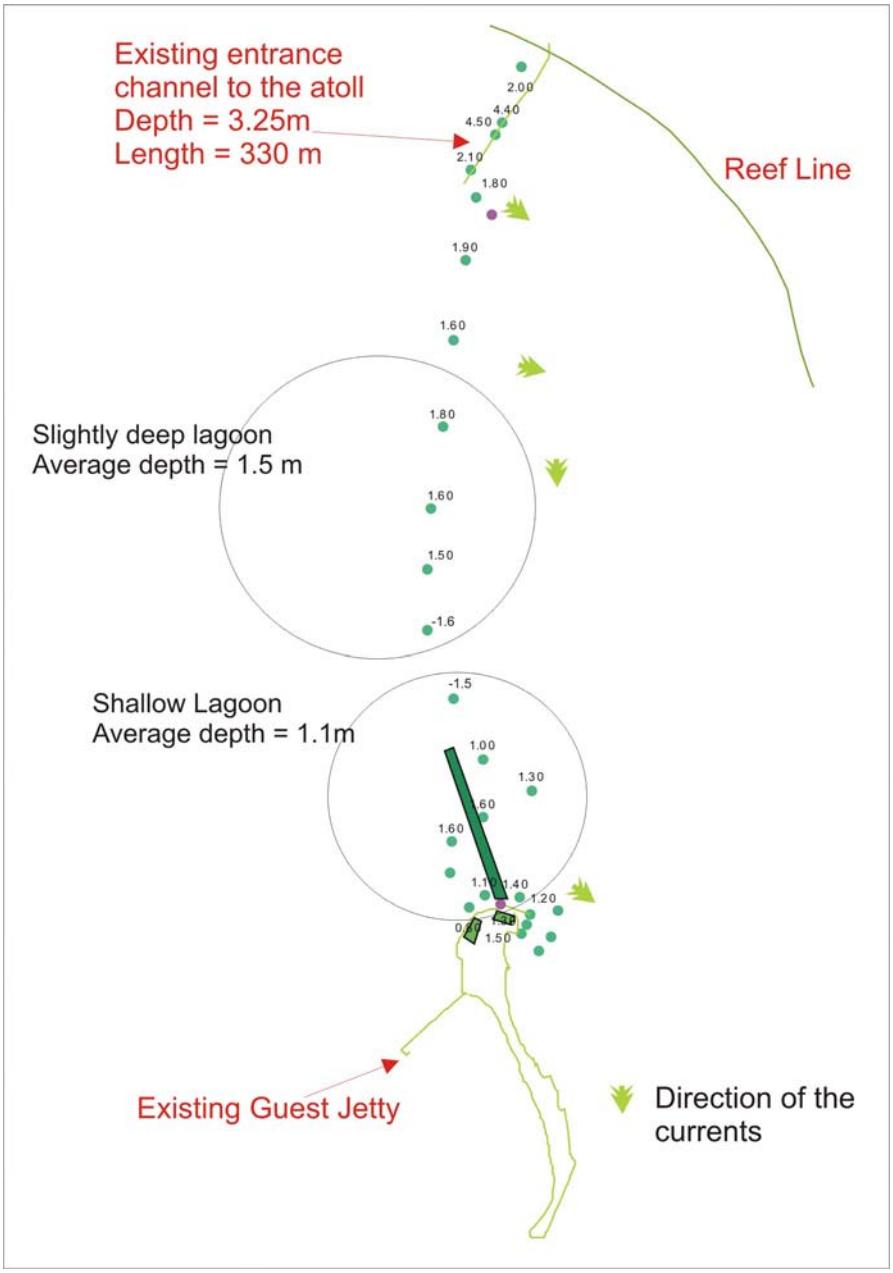


Figure 10: Bathymetric and current survey undertaken in Emboodhoofinolhu

4.8 Coastal Environment

Emboodhoofinolhu has a well formed beach mainly on the western side. Majority of the shoreline on the eastern side has been modified and protected by sea walls and groynes

due to erosion. Several groynes are placed at different points along the shore line. The shoreline on the northern side is completely protected using sea walls and several groyns emanate perpendicular to the shore line. The existence of seawalls renders these groynes useless as far as shore protection is concerned. The scope of work for this study does not cover detail assessment of the coastal environment; hence it was not studied in detail (Refer to Figure 4).

4.9 Existing Marine Environment

Emboodhoofinolhu island reef system is a relatively large separate system forming northeastern rim of South Male' Atoll. This reef system is L-shape and forms the northeastern corner of the atoll as shown in figure 2. It is separated from other reef by Emboodhoo Knadu (deep channel) in south and Velassaru Kandu in north. The coral reef system of Emboodhoofinolhu measures approximately 8km from east to west and 4km from north to south. The entire reef system is approximately 1,650 hectares.

Emboodhoofinolhu is the only island formed within the Emboodhoofinolhu reef system. The closest islands to Emboodhoofinolhu are Emboodhoo approximately 2.5km southwest and Vaadhoo approximately 8km northwest of Emboodhoofinolhu within separate reef systems. Linera distance between Male' the capital city and Emboodhoo island is approximately 8km.

Emboodhoofinolhu reef system is exposed greater to northeast monsoon wind-generated waves than south west monsoon wind-generated waves as this reef system is in northeastern corner of the atoll. Especially eastern side of the reef system is more exposed to northeast monsoon. Strong surf zones is found in eastern side of the reef system. Northern side of the reef system is sheltered to some extent by North Male' Atoll as the two atolls are relatively close.

Two major geomorphologic components of marine environment of Emboodhoofinolhu island system comprises; the coral reef system and the lagoon system. Various features and habitats are contained within these two components of the marine environment.

For instance within the coral reef system, the fore reef slope, reef crest, reef-flat and back reef are different geomorphologic characteristics where different biological habitats are found. The lagoon system consisted of patch reefs in the deep lagoon area. The lagoon system around Emboodhoofinolhu is a very different environment from the coral reef system. The lagoon bottom mainly consisted of sand and rubble.

The following figure shows the different environmental attributes of Emboodhoofinolhu island system in terms of area. These were estimated based on scaled aerial photographs and field surveys.

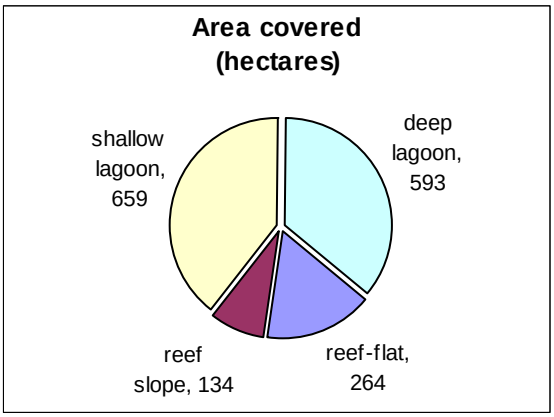


Figure 11 Major marine environmental components of Emboodhoofinolhu island system

Total area of Emboodhoofinolhu island system, including coral reef, lagoon, beach and vegetation is approximately 1.650 hectares. Approximately 659 hectares (40%) of the island system is covered by shallow lagoon surrounding the island. The coral reef of the island system covers approximately 400 hectares (24%). Out of this 134 hectares (8%) covers reef slope and 264 hectares (16%) covers reef-flat area.

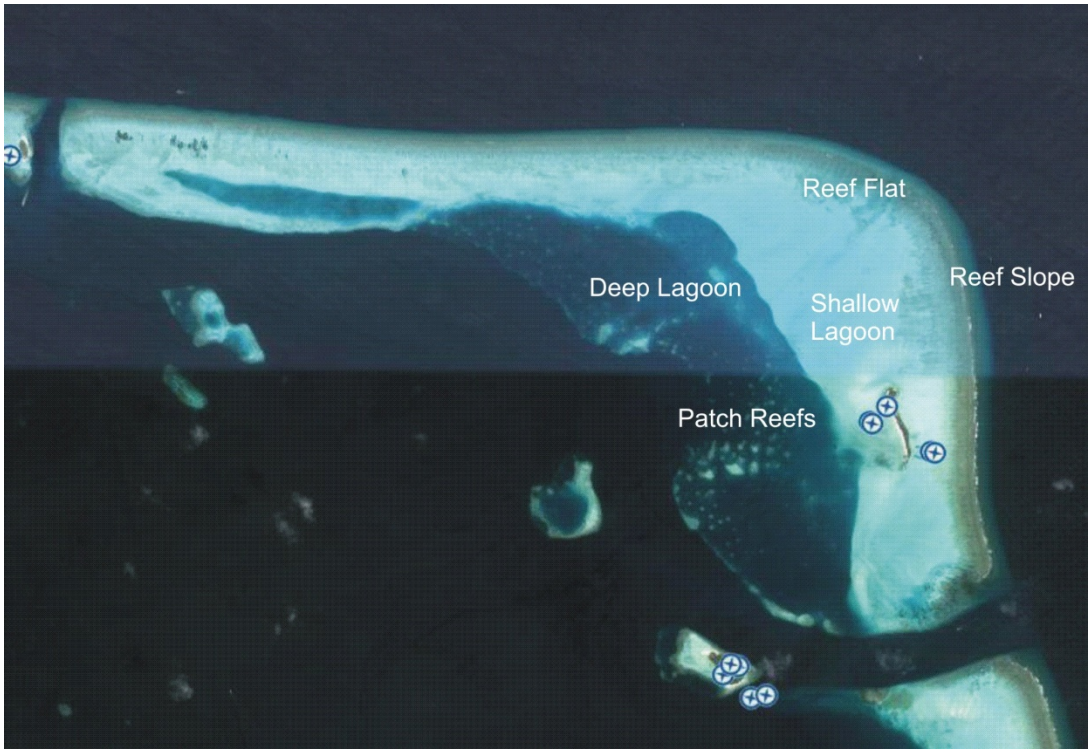


Figure 12: Aerial photo of Emboodhoofinolhu coral reef system showing different environmental

Figure 13: Map of Emboodhoofinolhu island system depicting marine environmental attributes, surveyed sites and potential impact area

4.9.1 Abiotic marine environment

4.9.1.1 Lagoon system

Emboodhoofinolhu is surrounded by a shallow lagoon system covering approximately 659 hectares. Deep lagoon area is found on western side of the island approximately 600m away from the island. The lagoon system has leeward lagoon in western side and windward lagoon in eastern side of the island. Geomorphology and oceanographic condition of leeward and windward lagoon is very different. The windward lagoon is shallower than the leeward lagoon and consisted of more rubble on lagoon bottom. Stronger waves are felt on windward lagoon.

4.9.1.2 Coral reef system

Emboodhoofinolhu is located within a relatively large coral reef system which is approximately 8km east to west and 4km from north to south. The reef slope area is approximately 134 hectares and the reef-flat area is approximately 264 hectares. Geomorphology of this reef system is relatively complex as it the atoll rim reef. Eastern and northern side of the reef is very well formed. The reef slope is wider in northern side especially on eastern side. Wider reef slope on eastern side forms strong surf zone in eastern side. Reef-flat is also wider in eastern side compared to western side. Almost no reef-flat is found on western side of the reef system.

The coral reef system of Emboodhoofinolhu can be categorised into two major components. They are; the reef slope and reef-flat. In addition to this poorly formed patch reef are found in the deep lagoon.

Monsoon current directions around the reef system are southerly during northeast monsoon and northerly during southwest monsoon.

4.9.2 Biotic marine environment

Biotic marine environment of Emboodhoo island system can be categorised into two significant components. They are; the lagoon system surrounding the island and the coral reef system surrounding the lagoon. Biotic marine environment was assessed by adopting semi-quantitative

and qualitative visual observation methods. Semi-quantitative method of Time-Swim and qualitative method of visual observations were used to assess status of coral reef and the lagoon.

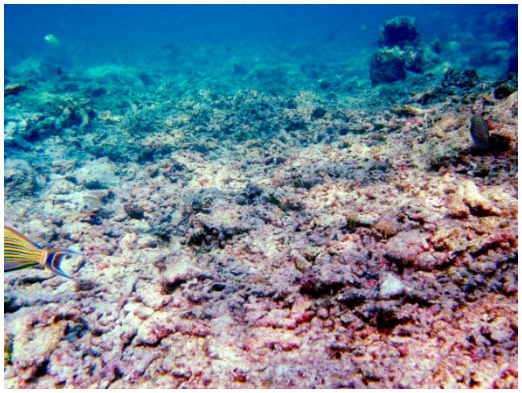


Figure 14: The reef edge area on northern side. (left) Reef-flat area in northern side in the surveyed area (right)

The coral reef system covering 1,650 hectares is the most diverse and significant marine environment of Emboodhoofinolhu island system.

The lagoon system consisted of few colonies of live corals. Dominant bottom substrate is sand and unconsolidated rubble. The shallow lagoon covers approximately 659 hectares.

4.9.2.1 Amount of live corals

Amount of different categories of live corals in the reef slope/reef edge area was semi-quantitatively estimated by Time swim reef survey and assessment method. See figure 2 for the location of reef survey site.

The following figure shows the results of the reef survey at northern side of the island

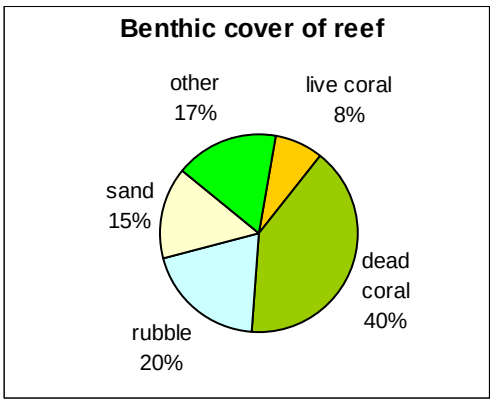


Figure 15: Benthic cover of the reef

The semi-quantitative reef survey and assessment showed that the reef consisted of 8% live corals belonging to different categories. These categories included massive corals, sub-massive corals, branching coral, encrusting corals and digitate corals, Other benthos of the reef mostly included calcareous and encrusting algae covering approximately 17%. Dead area of the reef at this site was approximately 40%. Significant amount of rubble were also found in the reef-flat area covering approximately 20%. Sandy area estimated was 15% of the reef-flat area. Standard error for these estimates is within ±10%. This was estimated based on several other similar studies.

4.9.2.2 Fish population structure

Fish population structure can be used as in indicator of status of the marine environment. Increased grazers is generally a sign of increased nutrients in the area thus decreased coral and other increased algae.

The following figure shows results of the underwater fish census conducted in northern side of the island in the reef survey area.

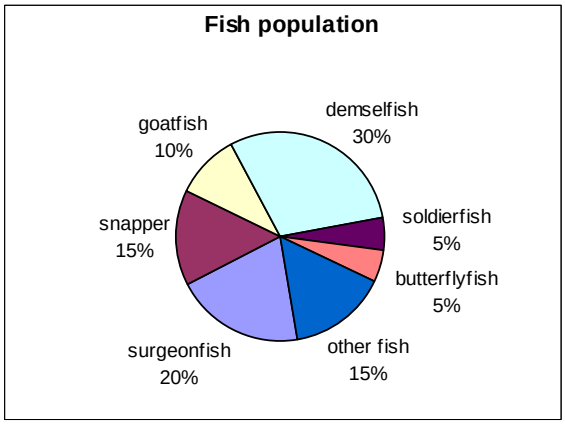


Figure 16: Fish population structure at site 1

Underwater visual census of fish, conducted in northern side of the island showed that fish population was dominated by damselfishes accounting approximately 30% followed by surgeonfishes accounting 20% of all the fishes counted. Other families of fishes counted were snappers accounting 15% goatfishes accounting 10% and butterflyfishes accounting 5%. Fishes belonging to other families accounted 15%.

Figure 17:Fiseshes were dominated by damselfishes, snappers and surgeonfishes.

4.9.2.3 Reef aesthetic

Reef aesthetic was determined by Time-swim surveys conducted in northern side of the island reef system. Reef aesthetic is a subjective attribute based on the observer's judgment and experience of the relative merits of a reef. This value judgment incorporated live coral cover, diversity of life forms, fish life, reef structure, habitat diversity and general appeal.

The following table shows the results of the reef aesthetic surveys.

Category	**Reef attributes**						
	Live corals	Biodiversity	Fish life	Reef structure	Habitat diversity	General appeal	
Very poor (=0)							
Poor (=1)	x	x			x		3
Average (=2)			x	x		x	6
Good (=3)							
Very good (=4)							
Excellent (=5)							
Total							9

Table 3: Reef aesthetic survey results

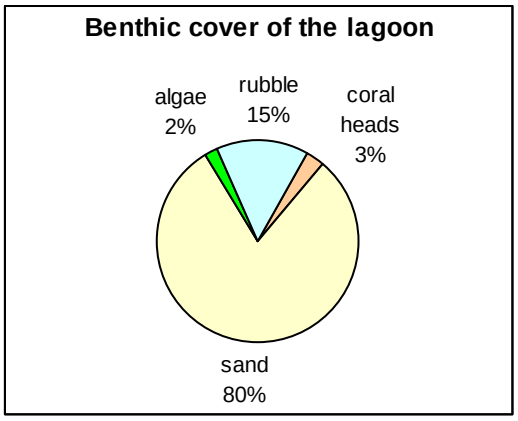
The reef aesthetic survey revealed that Emboodhoofinolhu reef system had poor live corals, biodiversity, average fish life, average reef structure and poor habitat diversity and average general appeal. Reef aesthetic survey scored a total of 9 according to the values given to the categories to determine the aesthetic of the reef system. Reef aesthetic of Emboodhoofinolhu was found to be in poor status compared to most reef system.

Figure 18: Large areas of the reef-flat area were cover by calcareous algae (left) Large Porites heads and fishes were found in few areas of the reef-flat. Reef aesthetic of Emboodhoofinolhu was poor.

4.9.2.4 Lagoon benthos

Lagoon bottom was surveyed by using visual observation covering approximately 3.5 hectares. Figure 2 shows the locations of lagoon survey sites. Visual observation surveys revealed that lagoon bottom is very homogeneous in terms of biotic and abiotic aspects and consisted of mainly fine sand, unconsolidated rubble and few live coral heads. Large areas of calcareous algae were also found in some areas.

The following figure shows the benthic cover of the lagoon in southwestern side as indicated by visual observations.



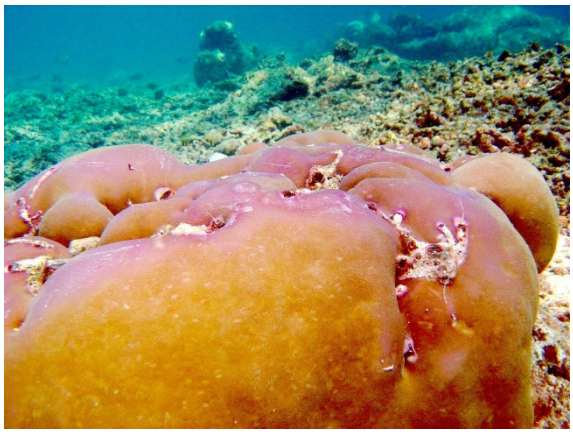


Figure 19: Benthic cover in southwestern side lagoon

Lagoon bottom in northern areas were found to be mainly sandy with sparse colonies of live coral colonies and algae. Approximately 80% of the lagoon bottom consisted of fine sand, 15% consisted of unconsolidated rubble and 3% consisted of coral heads and few digitate coral colonies belonging to Porites and Acropora species. Approximately 2%consisted of calcareous algae belonging to Halimeda specie.

4.9.3 Marine Water Quality

Marine water quality samples were taken from two locations within the lagoon on the northern side (see Figure 5). One sample was taken near the shore line towards the mouth of the proposed entrance channel and one sample further away from the shore towards the exit point of the proposed channel. The aim of testing the water quality was to assess the baseline condition of the water quality in the project area. The water quality data will be used to set up benchmark values for future monitoring. The proposed project is expected to increase the turbidity of the water, especially during the construction stage and hence this data will help to identify and monitor the impacts on the marine life. It will also alter the nutrient dynamics in the project area. The results of the water quality tests are illustrated in Table 4.

Parameter tested	Sample 1	Sample 2
Physical Appearance	Clear	Clear
Color	Clear	Clear
Smell	Nil	Nil
pH	7.5	7.9
Turbidity	1	1
Salinty (ppt)	35000	35000
GPS coordinates	336264 x 455439y	336283 x 453980y

Table 4: Results of the water quality tests

5 Environmental Impacts and Mitigation Measures

The proposed project will entail excavation of the lagoon bed from the north side lagoon in order to create an entrance channel. The impacts of the project are expected to occur both during the construction stage and operational stage. This section of the report identifies the potential environmental impacts and possible issues that could arise from implementation of these works.

5.1 Prediction of impacts

Impacts on the marine environment from the proposed lagoon deepening activities have been predicted and identified through analysis of the proposed project, field surveys, observations and assessment as well as based on field experience of similar other work undertaken in the country. Semi-quantitative and qualitative data collected was analyzed to predict significance and extent of impacts that may arise from the proposed project activities.

5.1.1 Impact Identification

Emboodhoofinolhu is currently a fully operational resort. The proposed redevelopment is not expected to bring any significant negative impact on the island, but will bring about changes to the marine environment. These impacts have been identified both during the construction stage and operational stage.

5.1.2 Assessing Impacts

Environmental impacts of the proposed work have been examined through a number of processes. These include consultations with the stakeholders, field surveys, observations and assessment, and field experience gained from similar development projects implemented throughout the country. Potential positive and negative impacts on the environment have been considered.

The most significant impacts have been examined and is considered to be only short term during the construction period. However, long term impacts are difficult to quantify due to lack

of long term site specific data. A detail monitoring has been proposed in order to collect long term data.

The impacts are categorized into short-term and long-term. Most of the short-term impacts are related to constructional phase, while the long-term impacts are associated with the operational phase.

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 both constructional and operational phases.

This EIA 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 according to the following categories:

Negligible – the impact is too small to be of any significance;

Minor adverse – the impact is undesirable but accepted;

Moderate adverse – the impact give rise to some concern but is likely to be tolerable in short-term (e.g. construction phase) or will require a value judgement 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.

5.1.3 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, geomorpholical or social conditions in a particular place. There is also limited data and information regarding the particular site under consideration, which makes it difficult to predict impacts. However, the level of uncertainty, in the case of Taj exotica is expected to be moderate due to the limited boundary and experience of channel excavation is other resort

islands. The data collected on the marine environment such as currents were also spot readings, meaning that in the absence of long term data, it would be difficult to predict the impacts. Hence there is a moderate amount of uncertainty attributed with the project. sredevelopment in similar settings in the Maldives. Nevertheless, it is important to consider that there will be uncertainties and to undertake voluntary monitoring of natural processes as described in the monitoring programme given in this report.

5.2 Impacts during construction phase

5.2.1 Impacts during Excavation

5.2.1.1 Impacts due to excavation methods

In this project, excavators will be used to create a navigational or an entrance channel and therefore sedimentation will be an ultimate outcome which will be unavoidable. Despite this, it has to be noted that this is only a short term effect and will only last during the excavation period. The entrance channel will be excavated to a depth of 2.5m. The predominant currents during SW monsoon, mainly wind generated from south-west will ensure that sediment dispersion take place within the entire lagoon, thus minimizing the impacts on a specific area. Live coral cover is very low (8%) in the shallow lagoon, and the impactable area for the reef flat has been estimated as 5%, while reef slope is not expected to have any impact (0%) (see Figure 20).

5.2.1.2 Negative impacts on the marine environment

Negative impacts on the marine environment arising from the proposed project will be from excavation of the lagoon area.

Both work phase and operation phase will have direct and indirect negative impacts. Direct impacts will be resulting from removal of lagoon bottom areas to deepen the lagoon and make the navigation channel in the work phase. This impact will include loss of lagoon bottom benthos namely burrowing worms and crustaceans. Indirect impacts will result from release of

sediment to the water column and increase in turbidity during the work phase. Operation phase will have some but not significant direct negative impacts to the marine environment.

Direct impacts arising from work phase will be short-term and to lesser extents however, irreversible. Indirect impacts arising from construction activities will be on a larger scale however, many of these will be reversible over time.

Indirect impacts arising from operation activities will be long-term and on larger scale. Indirect impacts from operation may be even to a greater extent involving the whole island ecosystem. Many of these impacts may also be reversible once operation activities are halted. It is more difficult to predict and identify operation impacts because of lack of long-term data on environmental variability. Therefore, operational impacts will be identified through impact monitoring programme given in this report.

5.2.1.3 Work phase impacts

Work phase impacts were identified through evaluation of the project, field surveys and assessment of existing environment and based on similar projects and experience.

The following figure shows the area of the reef and the lagoon that will be impacted due to the proposed navigation channel deepening in the lagoon.

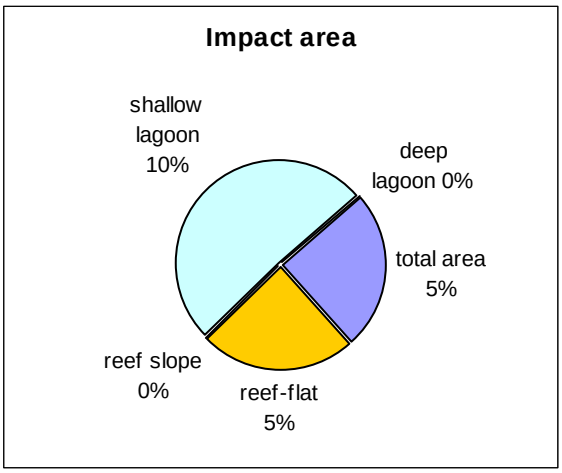


Figure 20: Attributes and their area as percentage that will be impacted

It is estimated that approximately 10% of the shallow lagoon will be indirectly impacted due to deepening of the proposed navigation channel. This impact is related to release of sediment into the lagoon water column and increase of turbidity.

It was also estimated that approximately 5% of the reef-flat area will be impacted indirectly due to the deepening of the proposed navigation channel. This impact is related to excessive sedimentation and siltation on the reef-flat during the excavation of the work.

The reef slope is further away from the possible impact area and therefore the reef slope will not be impacted. Similarly the deep lagoon area is also further way and will not be impacted.

The total area of the marine environment that may be impacted arising from the deepening of the proposed navigation channel was estimated as 5% of the total area of the Emboodhoofinolhu coral reef and the lagoon system.

The negative impact on marine environment of the island lagoon and the coral reef system is considered not adverse and extensive therefore justified based on the need and necessity.

5.2.1.4 Work phase impact mitigation

Early planning is one of the most important steps in reducing and eliminating any adverse impact from the proposed project. Environmental and socio-economic concerns should be considered concurrently with technical planning of the project and precautions will be applied from the outset of the planning process through all phases of the work and operation of the channel. Environmental surveys were conducted to identify these and other means of impact mitigations.

Supervision and inspection of the project activities is imperative to minimize adverse impacts. Competent environmental consultants with experience in same or similar work in the local environment will be consulted and allowed to inspect and monitor the work activities of the project life-cycle. Coordination and communication among the environmental consultants, contractors and the proponent is vital to minimize adverse impacts on the environment and enhance the positive impacts. Hence this process should be followed. Following are the specific

mitigation measures that will be taken to mitigate predicted impacts on the marine environment arising from the project activities.

Following are the specific mitigation measures that will be taken to mitigate negative impacts on the environment that are likely to arise from the proposed project activities.

- Minimum channel through the lagoon bottom will be deepened to minimum depth. Reef-flat or slope will not be touched for access navigation channel development.
- Harbour dredging is avoided by appropriately designing the concept, so that a channel through the lagoon to the service jetty will be sufficient for the resort operation.
- Sedimentation and siltation resulting from the proposed work activity will be minimised and contained within the area by using appropriate techniques such as undertaking the works during low tide and other appropriate retention method to reduce spreading of sediment and silt plumes to the lagoon floor, lagoon water and the coral reef. More specifically bundwalls will be used along the channel length in order to contain the sediment plume form spreading.
- Machinery, equipment and vessels used in the project activities will be maintained in good condition and operated in a manner that they do not pose a risk of the environmental degradation.
- All work activities will be kept to the minimum period of time to reduce impacts on the environment.
- Work will be inspected and supervised in whole lifecycle of the proposed project. Supervision of work will be carried out by a competent and independent party with experience of similar work. Water Solutions have been assigned as the projects environmental consultants to monitor the project and hence will ensure that mitigation measures are taken. The consultants will undertake compliance monitoring and reporting to ensure that the predicted impacts are not exceeded. If predicted impacts were exceeded, the work will be halted and impacts re-assessed and reported.
- All the project activities will be completed within the shortest possible time to minimise negative impacts on the environment.
- The monitoring programme specified in this report will be followed and reported in order to take necessary mitigation measures.

5.2.2 Dispersal of sediments

During the excavation, sediment dispersal will be the most significant impact resulting from the excavation work. Sediment dispersal will be affected by tide, wind and current movement on the day of excavation.

5.2.3 Mitigating the impacts of Sediment dispersion

During the excavation process, bund walls (sand) will be placed along the excavated channel to contain sediments. Once the excavation is completed, the bund walls will be removed. This is the most common method of containing sediment dispersion in channel excavation and dredging projects. Consultations were held with MTCC to verify this. Details of the consultations with MTCC are discussed under public consultations.

5.2.4 Mitigation of impacts during Operation stage

Marine environmental monitoring programme given in the monitoring section will be conducted for the whole operation phase.

5.2.5 Sediment dispersal

The excavation of the seabed will disturb the substrate and place sediments into suspension. These suspended sediments may then smother nearby bottom-living flora and fauna as and when they settle. The effect will be greatest in those areas with fine sediments, which are more easily placed into suspension. The potential impacts of sediment dispersal are considered to be of moderately high significance as the suspended sediments may get caught up in the water. It should however be noted that the live coral percentages in the northern side are only 8% and consists mainly of dead coral, sand and rubble.

Therefore, the direct impacts of sedimentation, although limited in duration could be moderate to severe during the construction period. It is very unlikely that the coarse sediments brought into suspension in the channel would be carried across to the eastern side, towards the coral reef. Furthermore, the excavation activities will only be limited to two months, thus limiting the amount of material placed in suspension.

5.2.6 Water turbidity

The suspension of fine sediments in the water column creates turbidity, which scatters and attenuates light levels and potentially affects the growth of plants and corals indirectly by reducing the availability of light and consequently the photosynthetic process in plants and coral symbionts. High levels of localized turbidity can be expected during excavation. Due to the

weak water currents, the turbidity is not expected to move very far. There is only very limited sensitive biota (8% live coral) in the vicinity of the project area affected by light attenuation.

5.2.7 Impact from Spillages

Spillages can be an issue in this project if adequate measures are not taken. In order to maximize the amount of excavated material on hold in the barge and to save time, excavated materials will be held on the barge before disposing them on to land. As excavated materials increase in volume, the chances of spillage will increase. This can lead to over flow of excavated material from the barge in to the lagoon. In such instances, fine sediments will enter the lagoon resulting in high turbidity of the surrounding water, which could then be transported by surface water currents over a larger area and ultimately to the sensitive areas such as coral reef. However, the potential for this to happen is very low, since the barge will have bund walls to prevent sediment spillage.

5.2.8 Mitigating the impacts from spillages

In order to mitigate the spillage, appropriate controls and disposal site records will be in place. Thus, this practice can shorten the turn-around period for the trip with obvious financial benefits. In addition, the contractors selected for the project will be required to keep careful logs of excavated material, disposal trips and therefore, this potential impact is not expected to be significant.

5.2.9 Noise and air pollution

The project site is not in close proximity to residential areas or populations. It is also isolated from the guest areas, meaning that there will be little or no impact of noise on the guests. The noise generated during the excavation process will therefore be only limited to the project site. Excavation will only occur during the day which means that the most sensitive period, which is the night, will not have any noise impacts. Given the very short-term nature of the works, it is not expected that noise would be a problem.

Operation of the excavators and other equipment and marine machinery such as small tug boats will also create air pollution mainly as exhaust gases. These exhaust gases will be very limited in quantity in comparison to the surrounding environment. The gaseous emissions will

directly be released in to the atmosphere where there will not be any opportunities for them being trapped. Instead the plume of gas will instantly be diluted.

5.2.10 Visual Impacts

To some guests, the presence of the barge, excavator and the whole project could appear as a visual intrusion on the normal seascape at Emboodhoofinolhu. However, given the isolated nature of the project site from the guest areas and the short-term nature of the proposed project, this potential impact is considered to be insignificant.

5.2.11 Impacts from using the material to compact the soccer field

At present, the existing soccer field on the north side of the island contains loose sand which does not create favourable conditions for soccer. Hence some excavated materials will be used to compact the soccer field. It is not expected to have any negative impact as a result of this activity.

5.2.12 Mitigating the Impacts from using the material to compact the soccer field

No mitigation required.

5.2.13 Impacts from stockpiling of excavated materials

All excavated materials will be loaded on the barge during excavation. Once the barge is full, it will be towed by a boat or a tug boat to the shore. Excavated materials will then be disposed of on the northern side to create a beach. All excess will be stockpiled on land (see fig 5) where it will be held until further sieved and utilized. During the storage process, some impacts are likely to occur. Firstly, there could be accidental spillage of sediment during transport and during unloading to the shore. Small quantities of sediment will enter the water along with water, which will be excavated along with sediments.

5.2.14 Mitigating the Impacts from stockpiling of excavated materials

Once the excavated material is stockpiled, there would be potential for contamination of the near shore lagoon if they enter the marine water through run off. Therefore, the stock piled material will be bunded by appropriate measures, such as a wooden fence. This will re prevent spillage especially during rain.

5.2.15 Impacts from disposing the excavated material on the northern side to create a beach

The proposed disposal location on the northern side has several groyns in place. Excavated materials will be disposed in between these groyns to create a beach. Average depth of at this location is less than 1 meters at mean sea level. Groyns will help to trap the sediments from dispersing. The area is also lined with a sea wall, meaning that there will not be any impact on the shore line as a result of disposal at this site. However, there is the possibility of sediment movement in the medium to long term. Due to the lack of long term current data, it is not possible to determine the exact fate of sediment in this area, therefore long term monitoring has been proposed.

5.2.16 Mitigating the impacts from disposing along the northern side beach.

Undertake long term monitoring to assess how sediment moves in the proposed disposal location.

5.2.17 Modification of wave and current pattern

The limited and minor modification of the bathymetry of the lagoon as a result of the channel is not likely to significantly change the existing pattern of currents and waves in the lagoon significantly, but it is going to be altered slightly. At present, the current flowing in the lagoon is generally weak to moderate, but may change with the creation of the channel. This may lead to increase in sediment flow through the channel. During the field visit and from the marine water quality tests undertaken, the water was not turbid at this location and readings were as low as 1 NTU. This can be attributed to the large lagoon which is mostly stable with weak to moderate currents, at least during the data collection period. This indicates that water does not have any turbidity or it's very low. Since the northern side of the island is most vulnerable to the changes in current and sediment pattern, the coastal zone in this area can be expected to have some impacts. The shoreline on the northern part of the island is protected by sea wall and groyns, thus any sediment that end up in this area may be trapped by these groyns, resulting in minor alteration of the bathymetry in this area. The excavation is not expected to have much impact on the shoreline, however the impact would be mainly on the dredged channel which may fill up. Therefore this is to be determined by monitoring.

5.2.18 Social Impacts

No negative social impacts are anticipated from this project. The closes inhabited island is Male' which is at least 4.5 km north. There are no dive or fishing sites in close proximity. The nearest dive site is also more than 2 km south of the project. Positive social impacts are going to be felt through financial gains to the contractor who will be selected through public bidding.

5.3 Impacts during the operation stage

The negative environmental impacts associated with the operation stage of this project are expected to be very minimal and can range from short to long term. Impacts include the deterioration of the water quality from alteration of the sea bed and excavation that can suspend sediments. Impacts also can result from slight changes on current and wave pattern. In the absence of long term data, operational stage impacts are very difficult to assess and hence the monitoring programme will be referred in order to assess the impacts during this stage. Even if there are negative impacts of the channel dredging, these would be insignificant except for impacts on the sediment regime, which includes (1) the excavated channel filling up in time requiring maintenance excavation (2) the fill up of channel causing loss of sediments from lagoon floor as well as island shores and (3) deterioration of quality of beach material as a result of fines and rubble from the excavation process getting washed ashore. These impacts need to be monitored long term to undertake further mitigation measures to minimize frequency of maintenance dredging and long term impact on island shorelines.

5.3.1 Changes to current patterns

During the operational stage, there will be minor changes to current regime in the region, especially in the vicinity of the channel.

5.3.2 Mitigation measures

Long term monitoring will be undertaken to assess the changes in current regime that will allow better decision making.

5.3.3 Sediment filling the excavated channel

In time, sediments may fill the excavated channel. Sediment movement will depend on the current and winds and hence it is difficult to predict or estimate when this would occur. Hence, there is a greater degree of uncertainty in predicting the impact.

5.3.4 Mitigating the impacts

Undertake long term monitoring.

5.3.5 Economic impacts

The creation of an entrance channel will allow safe maneuvering of boats at all time, especially during low tide. It will also allow boats to access the island at night without the risk of damaging the boat. This is going to be a significant economic advantage as the resort operations will become more flexible allowing better scheduling of logistics. Therefore, the proposed project will have positive economic benefits for the resort management, suppliers and others who access the island by ensuring that boats are not damaged during the process.

5.4 Mitigation Plan

In order to undertake the project with the least environmental impact, a mitigation plan has been outlined. Mitigation measures and plans aim to minimize the damage on the environment. It is certainly not a plan to avoid total damage. Adequate mitigation plans will ensure that the proposed works and the resulting environmental damage anticipated are kept to a minimum. In summary the impact mitigation measures proposed will entail:

Mitigation measures	Cost of mitigation
Good excavation practice to minimize sediment suspension and dispersal at the project site. Contractor will be required to have adequate bund walls on the barge to avoid sediment spill during their temporary storage on the barge.	Approximately Maldivian Ruffiyya 5 to 10 thousand to for the protective wall around the barge to prevent sediment spill. This requirement will be made compulsory with the contractor.

Mitigation measures	Cost of mitigation
Bund wall along the excavation channel to contain the sediment plume.	No cost incurred. Contractor will be required to do this during excavation.
Independent environmental monitoring of the project to ensure disposal of excavated material only at approved sites, and compare with baseline turbidity standards.	Monitoring cost is included. See monitoring costs.
Regular consultation with the manager of the resort so as to avoid or minimize disruption of regular resort operations and also ensure that the least disruptions are caused to the guests.	No cost incurred.
Advise the staff prior to commencement, of the intended project, regarding the operations, associated noises, and the short duration of nuisances.	No cost incurred.

Table 5 summarizes a mitigation plan outlining the potential impacts and mitigation measures for the proposed project. In some instances, measures can be taken to avoid or reduce the severity of the impact, and the appropriate mitigation measures are identified. In other instances, the impacts cannot be avoided or successfully mitigated if the project is implemented and these represent irreversible impacts. In each instance, an impact type and mitigation measure is described. A summary of potential impacts relevant to the proposed project are outlined below:

Positive

1. Improved capacity of the island by allowing access to boats during low tide and at night.
2. Improved navigational safety.
3. Greater flexibility for staffs going in and out of the island

4. Better scheduling of logistics
5. Cost savings

Negative

1. Loss of benthos from the project area (insignificant)
2. Sedimentation and turbidity in the project site due to suspension and dispersal of fine sediments (moderate negative and short term)
3. Slight alteration of the current regime (minor negative but long term).
4. Alteration of the bathymetry (minor negative, long term)

Activity	Potential Impacts	Impact Mitigation measures
Excavation		
Removal of sediment and bottom substrate.	• loss of lagoon bottom benthos namely burrowing worms and crustaceans. • Modification of wave and currents. • Release of sediment in to the water column resulting in increase in turbidity. • Dispersion of sediments to the lagoon. • Attenuation of light in water column.	• Restricting the excavated area according to the proposed plan. Minimum channel will be excavated with only the required depth. Reef flat and reef slope will not be touched. • Bund walls will be placed along the channel where excavation will be undertaken to contain sediment plume. • Supervision and inspection of the project activities are imperative to minimize adverse impacts • Coordination and communication among the environmental consultants, contractors and the proponent is vital. • Sedimentation and siltation resulting from the proposed work activity will be minimized and contained within the area by using appropriate techniques such as undertaking the works at low tide and other appropriate retention method, such as bund walls to reduce spreading of sediment and silt plumes to the lagoon floor, lagoon water and the coral reef.

Activity	Potential Impacts	Impact Mitigation measures
Noise and air pollution	• Generation of noise during work periods • Air pollution from the machinery	• Resort staff and guests will be informed about the work. Furthermore, the project site is isolated from the guest areas; therefore it is not expected to cause any serious impacts. • Work will be completed in the shortest possible time • Work will be restricted to day time only. • Machinery will be checked regularly to identify any unsusual amounts of soot or black thick smoke released in to the atmosphere.
Visual Impacts	• Visual intrusion of the beautiful environment due to the presence of barge and excavator.	• This is totally unavoidable, but will be only limited to the project site, which is away from the guest areas. • Work will be finished in the least possible time to avoid long term visual impacts.
Disposal of excavated materials		
Leakage of sediment during transport to	• Increase in turbidity within the	• Monitoring of excavation logs and

Activity	Potential Impacts	Impact Mitigation measures
disposal site.	shallow lagoon.	records for each disposal trip. • Ensure that site supervisors regularly undertake visual monitoring for signs of spillages. • The barge itself will have a containment wall to prevent sediment spillage as they remain on the barge until disposal.
Stockpiling of sediment on land	• Possible dispersion of sediment in to the lagoon from run off, especially during rain.	• Containing the stockpile of sediment within a bund wall to prevent run off and their loss during rain.
Disposal of sediment on the north side shore line to create a beach	• Dispersion of sediment to the region	• Dispose the sand during low tide and under calm conditions. • Regular monitoring to assess how sediments move.
Disposal of sediment on the soccer field.	• Alteration of the soil in this area	• Compacting the sand properly to create hard surface. • Remove the top surface before dumping sediments to create the required hard surface.
Operational stage		
Creation of an entrance channel	• Safe maneuvering of boats even during low tide	No mitigation needed.

Activity	Potential Impacts	Impact Mitigation measures
	• Increase safety for boats • Better scheduling of logistics • Greater flexibility of island operations	
Creation of an entrance channel	• Slight alteration of current and sediment regime.	See monitoring programme outlined.
Creation of the entrance channel	• Positive economic benefits to the resort operations	No mitigation required.

Table 5: Summary of potential environmental impacts and mitigation measures

Table 6: Summary of Impacts and their magnitude

Activity	Impact Type	Duration	Mitigation Possible	Magnitude		
				Low	**Medium**	**High**
EXCAVATION						
Removal of sediment and bottom substrate	Negative	Short to long term	No	X		
Sediment dispersion	Negative	Short to medium term	Yes		X	X
Noise and Air Pollution	Negative	Short term	Yes	X		
Visual Impact	Negative	Short term	No	X		
Disposal of excavated materials						
Temporary stockpiling of sediment on the barge.	Negative	Short term	Yes	X		
Leakage of sediment during transport to disposal site.	Negative	Short term	Yes	X		
Stockpiling of sediment on land	Negative / Positive	Medium to long term	Yes	X		
Disposal of sediment on land	Positive	Long term	Yes			X
Disposal of sediment on coastline to create beach	Negative / Positive	Short to long term	Yes		X	
Operational Stage						
Creation of the entrance channel	Positive	Long term	-			X

6 Public Consultations

For the purpose of this project, public consultations were limited to relevant government agencies, the proponent and a contractor with experience of similar projects. As the project is not a new development, these key stake holders were identified relevant to undertake public consultations. Methodology for undertaking these discussions was through interviews and discussions.

6.1 Consultation with the developer / staff

- In general, discussions were held with the proponent to obtain information about the need for this redevelopment and to justify the project. Consultations were also held with boat crews and staff members to obtain their views on the project. The major outcome of these consultations is outlined below.

- The proponent wishes to create an entrance channel form the northern side due to difficulties in boat access. The need for the project is greatly felt as resort operations are affected due to the lack of a safe passageway for boats. The urgent need to undertake this project has also been described in detailed under, "The rationale for "undertaking the project".

- At present, boats have to depend on tide before accessing the service jetty. This is very difficult and very often the waiting period could be up to 4 hours and more.

- Various other options were explored before finalizing on the channel excavation option. Other options discussed include utilizing the arrival jetty and also extending the service jetty.

6.2 Consultations with the Ministry of Tourism and Civil Aviation.

Consultations were held with Ms. Aishath Ali, Assistant Director-General of Ministry of Tourism and Civil Aviation on 26 June 2007. Following are the main outcomes.

- Tourism Ministry's policy is very clear on such projects and all such projects are required to undertake an EIA prior to commencement. Before undertaking and EIA, the proponent also have to obtain the approval from Tourism Ministry.

- Tourism ministry will also verify all such requests and reference will be made to the lease agreements, bidding documents and other relevant documents.

- If the proposed project is required, then an EIA will have to be undertaken However, even if an EIA is approved, Tourism Ministry may not approve the project. There are also resorts that have agreed upon not to take dredging or undertaking similar works. However, if requests are made, the Ministry will verify them and consider deviations on case by case basis.

- All such projects are to be coordinated through Tourism Ministry, including EIA's.

- There is no criteria for approving such projects since each island is different and unique. Every island has to be considered on a case by case basis.

- From time to time, Ministry of Tourism does get complains from tourists and tour operators on such projects being undertaken in resort islands.

- From the discussion, it was also clear that channel excavation is a significant requirement and the need is felt by lots of resorts. According to Tourism Ministry, annually there are 5 to 10 request for channel excavation. Therefore, it is clear that this is a problem in most resorts and not only in Emboodhoofinolhu.

- Tourism also plays an important role in monitoring such reports. All monitoring reports have to go through Tourism Ministry. Regular inspections are undertaken at least every year.

- Tourism Ministry also highlighted the issue of double standards for resorts and other inhabited islands. At present it seems that environmental protection is only the responsibility of resorts and does not apply for other islands in Maldives.

6.3 Consulations with Minsitry of Environment, Energy and Water.

Consultations were held with Mr. Mohamed Zuhair, Assistant- Director-General of Ministry of Environment, Energy and Water. Following are the main outcome.

- Environment Ministry strongly believes that such projects should only be allowed after conducting proper assessment, such as EIA.
- Only EIAs will allow decision makers to make sound decisions.
- Environment Ministry's interest lies in protection of the environment at the same time allowing development to take place.

6.4 Consultations with the MTCC

Consultations were held with Mr. Hussen Shaheed /Civil Engineer, MTCC. MTCC is a public company with many years of experience in dredging and coastal projects among others. They have undertaken several similar projects for government and the private sector. Discussions were held on normal methods of construction in such projects especially focusing on sediment control methods. Following are the main outcome.

- MTCC also undertakes similar projects using floating barge and excavators.
- Usually, bund walls are places around the excavation pathway to control sedimentation and this is the normal practice in such projects.
- Although bundwalls are in place, there would still be some degree of sedimentation. .

6.5 List of persons consulted

Following are the names and designation of persons consulted.

NAME	DESIGNATION	OFFICE
Ms. Aishath Ali	Assistant Director-General	Ministry of Tourism and Civil Aviation
Mr. Mohamed Zuhair	Assistant Director-General	Ministry of Environment, Energy and Water
Mr. Lallan Singh	Chief Engineer	Taj Exotica
Mr. Hussen Shaheed	Civil engineer	MTCC.

7 Project Alternatives

7.1 No Excavation scenario

The decision to create an entrance channel has been considered due to the difficulties faced by the shallow lagoon, preventing access to the service jetty by boats during low tide. Hence water depths at the northern side (immediately adjacent to the islands northern side) of the lagoon are too shallow to allow safe entry and maneuvering of boats coming in and out of the island. Not implementing this project means that it will not be able to access the island during low tide and this opportunity for increasing the flexibility of accessing the island at all times is economically important for the resort. Therefore it is important to implement this project. Hence, the no project option cannot be considered in this case.

7.2 Project Location

An alternative to the proposed entrance channel is to use the western side of the island. However, this location will require a longer channel to be excavated as the service area and the service jetty exists on the north-east side. This side is also exposed to the island's western side meaning that the guest areas on the north-west side of the island will be in the direct vision line. It will not be an acceptable location for guests as there will be continuous movement of boats in and out of the island, meaning visually this location will not be very suitable.

7.3 Alternative options

One alternative option for excavation that has been considered is to extend the service jetty. This will allow access to the deep areas of the northern side without the need for excavation. Boats can then access the jetty end. A jetty at least with a minimum length of 300 meters will be required. However, extending the jetty this much will be a costly construction and will require much more maintenance. Such a jetty will also require construction of piled structures as support columns for the jetty. Hence, many piled structures will have a more profound effect on the local hydrodynamics than creating and entrance channel. A longer jetty also means that

the supporting columns have to be constructed and placed in the lagoon, which will have to be structurally strong to withstand the weather during the north-east and south-west monsoons. It is also not visually very appealing as the extended jetty will be visible from the water bungalows on the south-east side of the island. A channel entrance with a depth of 2.5 meters will not have much visual contrast to the surrounding lagoon and hence will be visually more appealing. It will also require less and cheaper maintenance than a longer jetty.

Similarly, the service jetty can be developed attaching the existing arrival jetty, but halfway from the arrival jetty. From here, the service jetty could be deviated towards north where the backhouse facilities are located.

7.4 Excavation Type and Method

The current project proposes to excavate the channel using an excavator placed on a barge. This method will have significant environmental impacts during the construction stage. One alternative to minimize this impact is to employ a cutter-suction dredge which will reduce the amount of silt suspended in the water column. It will also eliminate the need for blasting, in case if there is hard substrate on the sea bed. However, this project does not require any blasting since the project area only has sediment and coral rubble to some extent. Use of cutter-suction dredges are not very suitable for such a small scale project, and therefore is not economically justifiable due to high cost of mobilization and operation.

The other option would be to use a sand pump. Sand pumps are less costly and causes less sedimentation. Even if sand pumps were to be used, the sand shall be pumped onto barge and transported to land as the distance to cover if the pump were to pump directly to land would reduce the efficiency of the pump. Also, similar to the dredger the pumped sand would be more compact than excavated sand. Therefore, excavator is preferred over the sand pump to minimize compaction and ensure that the sand can be easily sorted or sieved and used for future beach replenishment, etc.

7.5 Disposal Options

7.5.1 On land Disposal

No appropriate sites for on-land disposal were found in the island due to its small size, which can take up the entire excavated material, except the existing football field on the northern side of the island. However, the island's eastern side is heavily impacted by erosion and requires modification of the shore line and creation of beach by eliminating some of the shore protection structures. This can only be achieved through a detail shore protection studies, which has to be undertaken before it can be implemented. Hence, the excavated sediments will be a valuable raw material, which would otherwise require importing them. Therefore the only cost effective option available for disposal of excavated material is to dispose them in to the coastal area to create a beach on the northern side.

7.5.2 Deep Sea disposal

Deep sea disposal is one option available, but because there are other more useful options to use the excavated sediments in the island environment, this may be less preferable. Disposal in to deep sea will be more expensive as a considerable amount of distance has to be overcome. Therefore for these reasons, deep sea disposal will not be practical for the island.

7.5.3 Disposal to Thilafushi

Thilafushi is a potential disposal site for excavated sediment, but similar to disposal to the open sea, it is not a practical option as there are other more useful options for the excavated sediment.

7.6 Preferred alternative

Several alternatives have been preferred including alternative locations, alternative methods for excavation and disposal. The location has been selected as there are very limited options for an alternative location. Therefore, the selected location is the preferred.

The preferred alternative for excavation is to use the arrival jetty as service jetty. This will eliminate the need for excavation of a channel. However, although this is the preferred

alternative, there are several draw backs to this option. A more preferred alternative is to create an extension from the arrival jetty, halfway towards the island that will be connected to another jetty, which will have to be constructed. This extension, will therefore allow equipments, and supplies to be delivered at the arrival jetty, but will be deviated towards north.

7.7 Mitigation measures for the proposed alternative

Following mitigation measures are proposed for this alternative.

- Construct the minimum required length of the jetty that will extend half way towards the north form the existing service jetty.
- Construct the jetty on the minimum number of piled structures.
- Provide a barrier between this jetty extension and the island through a fence.

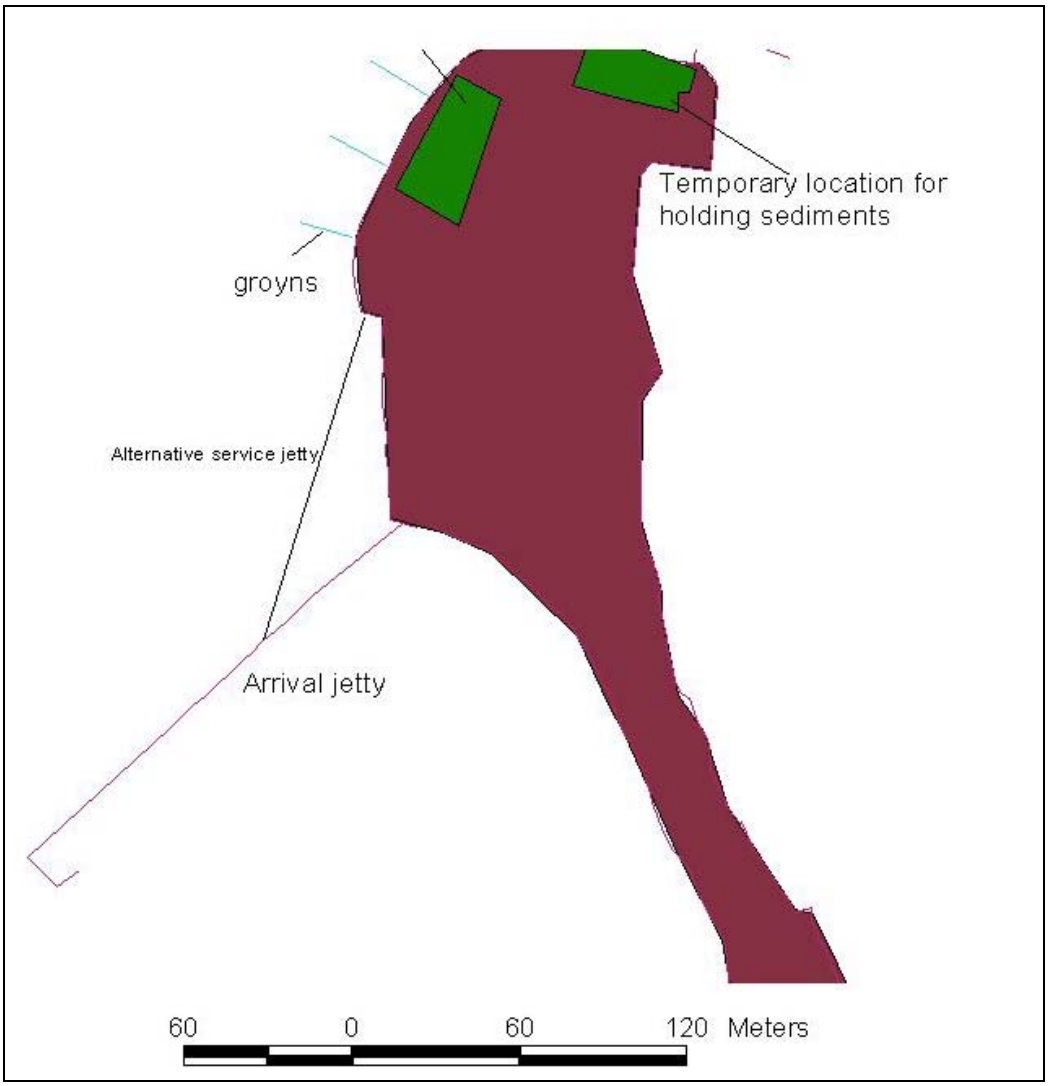


Figure 21: Preferred alternative for creating the channel

7.8 Alternative evaluation matrix

An alternative evaluation matrix is outline in Table 7.

Creation of the channel		
	Alternatives /options	Reasons for not selecting
Preferred option	Excavate a channel	Most feasible and economical
Alternative option	Extend the service jetty	High capital cost, maintenance
Alternative option 2	Construct a service jetty extending halfway from the guest jetty	Interference with guest activity, Aesthetically not suitable, may damage the reputation
Excavation type and method		
	Alternatives /options	Reasons for not selecting
Prefered option	Excavator	More economical and suitable for this project
Alternative option	Cutter-suction dredge	Economically not viable
Alternative option 2	Sand pump	Less efficiency
Disposal of excavated sediments		
	Alternatives /options	Reasons for not selecting
Prefered option	Disposal to create a beach, On land disposal to compact soccer field and stockpiling the excess for future use	More economical, practical, greater need.
Alternative option	Deep sea disposal	Expensive
Alternative option 2	Disposal to Thilafushi	Expensive

Table 7: Alternative evaluation matrix

8 Environmental Monitoring

The impacts predicted above and the effectiveness of the control and the mitigation measures proposed will be evaluated during both work phase and operation of the proposed channel. The proposed monitoring programme when followed would allow doing so, and in evaluating the impacts on the marine environment.

Ecological change often occurs gradually over time. Therefore, long term monitoring programs are necessary to reliably assess environmental change. This is particularly true when the change is due to small but chronic perturbations to the environment which have a cumulative effect. It should be kept in mind that (1) many ecological processes are slow occurring over a number of years, (2) inter-annual variability is often high, (3) short term studies miss rare but important events, and (4) monitoring only reveals recent historical events.

Environmental change can occur in two directions: (1) from a healthy, pristine ecosystem to a degraded one, or (2) in the opposite direction of making a degraded environment to a healthier one. The latter would be the case for the monitoring programme given which should be followed in order to ensure best management of the existing marine environment of coral reef and lagoon system during the construction and operational phase.

The objectives of this monitoring program is to detect and document the changes occurring to the reef system due to the proposed project. The purpose will be to 1) assess the magnitude of the impacts resulting from the various activities of the resort 2) evaluate the success of a particular management action, 3) to quantify the change in abundances of certain marine organisms, e.g. indicator species.

Early warning indicators of community stress and impending change would be valuable. For this reason long term monitoring is needed. The level of change that must be detected to meet monitoring objectives will partially determine the approach which must be taken, in particular the precision that is required. Selection of methods will depend not only on what should be measured but on the intended use of the data and the available logistics.

As changes in marine environment especially in a coral reef ecosystem may be almost imperceptible over the short term or highly variable from one year to the next, looking at the long-term trends in the conditions of reefs is vitally important.

Given the incredible variety in the elements of the coral reef system, it is difficult (and risky) to depend on a single set of observations or on "indicators" when trying to evaluate reef conditions and assess any impact. For example, high coral species richness is not necessarily a sign of optimal reef conditions because many of the stresses which affect reefs result in decreases in abundances of organisms rather than loss of species. High densities of juvenile corals probably are one of the better indicators of the status of a reef. In general, the best approach is to look for relative changes in a particular habitat over time when trying to elucidate trends. The following methods were selected to monitor the reef system considering all these aspects. The data will be used for regulatory and management purposes to minimize any adverse affect resulting from the proposed work and operations of the resort.

8.1 Environmental monitoring programme

Parameter/Methods	Frequency of Monitoring	Purpose
Ambient Environmental Parameters,Temperature,Salinity,Turbidity/light penetration, Currents	Twice every month during work phase; once every month thereafter for 1 year	Important to the 'health' of living marine resources, reefs and fish populations and other benthos
Manta Tow Technique	Once every year or following a significant natural event e.g. coral bleaching, COT infestation, storm damage etc.	Broad scale qualitative and Semi-quantitative assessment of general status of the reef system / coral and other benthic recruitment
Marine Environmental Aesthetic Survey using Time Swim and Manta Tow Technique	Once every month during work phase /once every 6 months thereafter for 1 year.	Broad scale semi quantitative assessment of anthropogenic activities e.g. wastes disposal, amount of rubbish on the reef and general appeal of the reef system
Reef benthos/Line Intercept Transect	Once every 6 months after the construction period for one year.	Quantitative assessment of spatial patterns of coral and other benthic cover
Indicator/Underwater Fish Census & indicator fish species census	Once every 6 months in conjunction with Line Intercept Transects after the construction period for one year.	Quantitative assessment of fish population of selected species
Permanent Photo quadrates	Once every month during work phase/once every 6 months thereafter for 1 year.	Quantitative assessment of temporal changes in the reef system e.g. coral growth rates

Parameter/Methods	Frequency of Monitoring	Purpose
		and coral recruitment
Sedimentation/Sediment traps deployment/collection	Twice every month during work phase/once every month thereafter	Quantitative assessment of sediment loading on the reef benthos.
Water column/Water quality test	Once every month during operation phase. After completion, every 3 months for 1 year.	Quantitative assessment of Nitrogen and Phosphorous contents and other parameters: Total and faecal coliform and streptococci counts
Changes to the deepened channel	Every 6 months for the first year after completion.	To understand the sedimentation and filling rates of the channel in one complete cycle, that is two seasons.
Changes to the sediment movement along the north side where beach will be created	Every 3 months for the first year after the completion of the project.	To assess the stability of the sediment along this location.
Current	Every 2 months for the first year after completion of the project.	To assess the current movement within the lagoon.

Table 8: Impact monitoring programme

This monitoring programme is recommended for short and long-term evaluation of Emboodhoofinolhu coral reef and lagoon system and ambient marine environment.

It is strongly recommended that all of the methods are included in the long term monitoring programme. This monitoring programme should be started before start of the proposed work

and continued in order to identify impacts and take necessary mitigation measures based on analysis of data collected.

8.2 Monitoring duration

It is proposed that monitoring should be done during the construction period and also for one year after completion of the work.

8.3 Monitoring responsibility

Monitoring programme will be undertaken by subcontracting the work to the project's environmental consultants, Water Solutions Pvt. Ltd. The proponent has fully committed to the monitoring programme outlined in the report and a commitment letter has been attached as an annex.

8.4 Monitoring report

A detail monitoring report will be compiled after the completion of the construction works based on the data collected for monitoring the parameters included in the monitoring plan. This report will be submitted to the relevant Government agencies for compliance. The report will include details of the site, data collection and analysis, quality control measures, sampling frequency and monitoring analysis and details of methodologies and protocols followed. These reports will also be submitted to the relevant Government authorities.

8.5 Cost of monitoring

The management will be fully committed for the monitoring programme outline in section 7.1 in the interest of environment and to follow the EIA regulations. Table 9 outlines the cost of undertaking the monitoring in Emboodhoofinolhu (Taj Exotica).

Details	**Date for monitoring**	**Unit cost (MRF)**	**Total (MRF)**
Construction period (2 months)	**July to Sep 2007**		
Sea transport to Emboodhoofinolhu		Client to provide	Client to provide
Consultants Fee (MRF 10,000 per month)		10,000.00	20,000.00
Accommodation and Food		Client to provide	Client to provide
Monitoring report writing		Included in the fee	Included in the fee
Operational period (12 months only)	**October 2007 to September 2008**		
Sea transport to Emboodhoofinolhu		Client to provide	Client to provide
Consultants Fee (MRF 10,000 per month. Monitoring every two months)		10,000.00	60,000.00
Accommodation and Food		Client to provide	Client to provide
Monitoring report writing		Included in the fee	Included in the fee
Total (Eighty thousand rufiyya only)			**80,000.00**

Table 9: Cost of undertaking the monitoring programme (2 months during construction stage and 12 months after construction stage).

9 Conclusion

This EIA report has identified the major impacts of the proposed project. The project will only have its environmental impact on the project boundaries which is confined mainly to the northern side marine marine and coastal environment of Emboodhoofinolhu. Mitigation measures have been proposed to these anticipated impacts including a detailed environmental monitoring programme. It has been assessed that the most significant negative impacts from the proposed development will be caused during the construction period as a result of sedimentation and siltation. Mitigation measures to reduce the impact on the marine environment have been proposed. They include measures such as use of bund walls. In addition, several other mitigation measures including limiting the time frame of construction, proper supervision and other measures are also proposed. Although the social impacts of the project were not assessed in detail, public consultations were undertaken with key stakeholders. From these consultations, it was clear that channel excavation is a typical requirement in most resorts and annually between 5 to 10 applications are lodged with Ministry of Tourism and Civil Aviation. The most significant positive impact of the project was identified as the benefits derived from a safe entrance channel for boats. This has several economic advantages .

Although several alternatives to the proposed project were considered, these alternatives cannot be implemented for various reasons. Alternatives were considered to avoid excavation and opt for an extended services jetty, but it was considered un economical and hence have not been considered. Alternatives were also considered for disposal of excavated sediments such as transporting them to Thilafushi island, but again were rejected as there were more better options.

The monitoring programme for this project will mainly focus on aspects of marine water such as sedimentation levels on the reef, water quality and visibility, and the sediment fill rate of the excavated channel. The monitoring programme has been developed to begin soon before beginning the excavation works and further one year after completion. Hence, the monitoring programme will be to a duration of 14 months.

10 Declaration

This EIA has been prepared according to the EIA Regulations 2007, issued by the Ministry of Environment, Energy and Water. The EIA was carried out by a multidisciplinary consulting team representing Water Solutions Private Ltd. In preparing this report, no data has been manipulated. All data has been collected by field visits.

I certify that the statements in this Environmental Impact Assessment study are true, complete and correct.

Name: Abdul Aleem

Signature:

Date:

11 References

1. Binnie Black and Veatch (1999), *Environmental/Technical Study for Dredging/Reclamation Works under the Hulhumalé Project*, Maldives
2. English, S., Wilkinson, C. and Baker, V. (1997). *Survey Manual for Tropical Marine Resources. Australian Institute of Marine Science*, Townsville, Australia. 390pp.
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4. Haveeru (7 December 2003), *Overbooking result in tourists diverted away from the Maldives*
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11. Viles, H. and Spencer, T. (1995). *Coastal Problems: Geomorphology, Ecology and Society at the Coast*, Coral Reefs pp. 206-252, Edward Arnold, a division of Hodder Headline PLC, 338 Euston Road, London.
12. Westmacott, S. (1996), *Cost effectiveness analysis of coral reef management and protection:* A case study of the Republic of Maldives. Phase 2 report – Model definition and data collection. Prepared for the Latin America and Carribean and Urban Development Division of the World Bank

12 Annex: Terms of reference

Terms of Reference for the EIA for excavation of an entrance channel in

Taj Exotica (Emboodhoofinolhu)

The EIA report for the above proposed project will be carried in accordance with the following TOR.

The EIA will be undertaken according to the instructions provided in the EIA regulations, 2007. The format and structure of the report will adhere to the format given in Schedule E of the EIA Regulation. As such a title page, non-technical summary and this TOR (as agreed by the Ministry of Environment) will be included in addition to the following project specific considerations.

1. **Project Setting**

The project takes place in the Maldives Environment and therefore, the extent to which the project conforms to existing plans, policies, guidelines, regulations and laws of the Maldives will be considered. The EIA will specifically consider the national Environmental Protection and Preservation Act, the EIA Regulations, 2007, regulations on coral and sand mining. The report also will look at the Tourism Regulations, circulars of the Tourism Ministry regarding works in the coastal zone of resorts.

2. **Project Description**

The EIA should properly describe the proposed excavation work including, duration of the project, equipment and machinery to be used, quantitative analysis of project inputs and outputs including those during construction stage and the project area including project boundaries.

The consultant should provide aerial maps and photos of the project site, clearly marking the area of the proposed channel and, the island boundaries. The maps should also outline and indicate any existing channels within the project site that are currently used.

The consultant should also provide a detailed description of the dredging methodology and what methods will be used to dispose or utilize the dredged spoils and how and where the contractors will be obtained.

The consultant should also provide sketches or illustrations of the cross section of the excavated channel with dimensions and depths at mean sea level.

The report shall indicate clear, practical means and ways to manage dredge spoil.

The report should also provide a rationale for undertaking the project and justification taking into consideration but not limited to environmental constraints and Socio-economic benefits arising from the project.

3. **Existing Environment**

The EIA report should properly describe the project site environment. Since the project takes place in the marine environment, the emphasis should be on describing the marine environment in detail. Particular reference needs to be made to describe the various marine environments such as coral reefs, deep lagoon, and shallow lagoon. The area(s) designated for dredge spoil disposal should also be studied.

A proper assessment of the bathymetric conditions of the project site should be undertaken, including local hydrodynamics.

A proper quantitative assessment on the quality of the marine water should be undertaken. This should include reef surveys and water quality assessments.

The report should also outline the detail methodology of data collection utilized to describe the existing environment.

4. **Stake Holder Consultation**

Consultation shall be carried out with the relevant ministries, Ministry of Tourism and Civil Aviation and Ministry of Environment Energy and Water.

5. **Impacts**

The EIA report should provide a full and proper assessment of the impacts with particular reference to the proposed development. In particular, the impacts should be described for both during the construction stage and also during the operational stage.

The report should outline the impacts of the proposed excavation and also the impacts resulting from the disposal of the excavated materials.

The consultant should provide an impact matrix for all the impacts identified and quantify the impacts, by providing appropriate weighing scale for impact identification.

The report should outline the uncertainties in impact prediction and also outline all the positive and negative impacts.

6. **Alternatives**

The EIA report should outline at least three alternatives for the proposed project, one of which will be the no project option. These alternatives should be discussed in detail providing reasons and justifications as why they have not been considered. The consultant should also provide a comparison matrix for the alternatives proposed.

In undertaking alternatives analysis particular attention shall be given to dredging techniques management of dredge spoil, and mitigation measures.

7. **Mitigation**

The EIA report should provide detailed mitigation measures that are proposed to minimize the impact. All the impacts identified in the report should be practical, backed by proper mitigation methods including sediment control measures.

The report should also outline the cost of mitigation measures and the commitment of the proponent to undertake the mitigation measures.

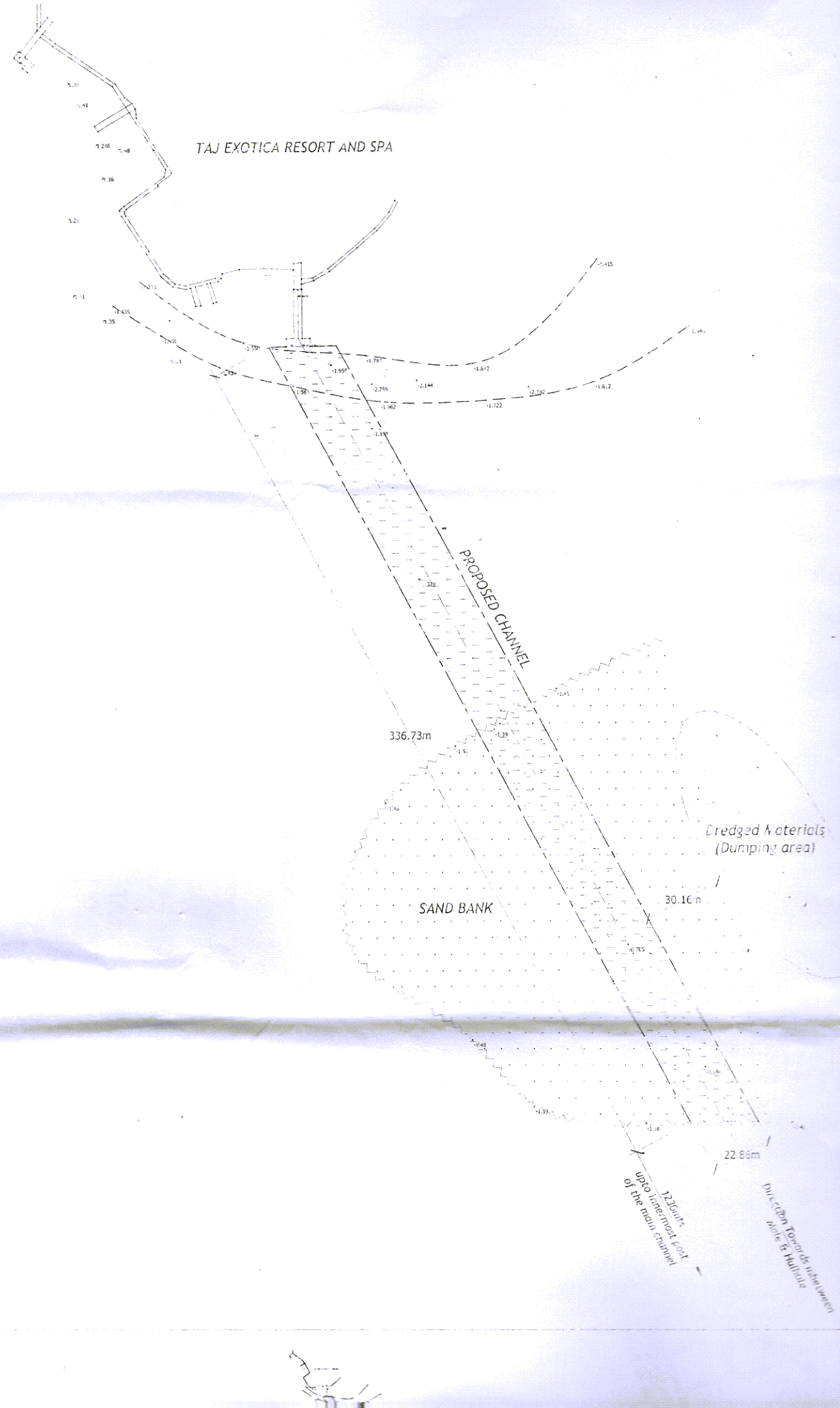
8. **Monitoring**

Monitoring should focus during construction stage and operational stage. Therefore a detailed monitoring plan needs to be outlined in this section which should outline the parameters for monitoring, frequency, duration and the responsible person.

The report should also provide a detail cost breakdown for implementing the monitoring plan.

The report should also provide the full commitment of the proponent for monitoring.

13 Appendix: Detail drawings of the entrance channel

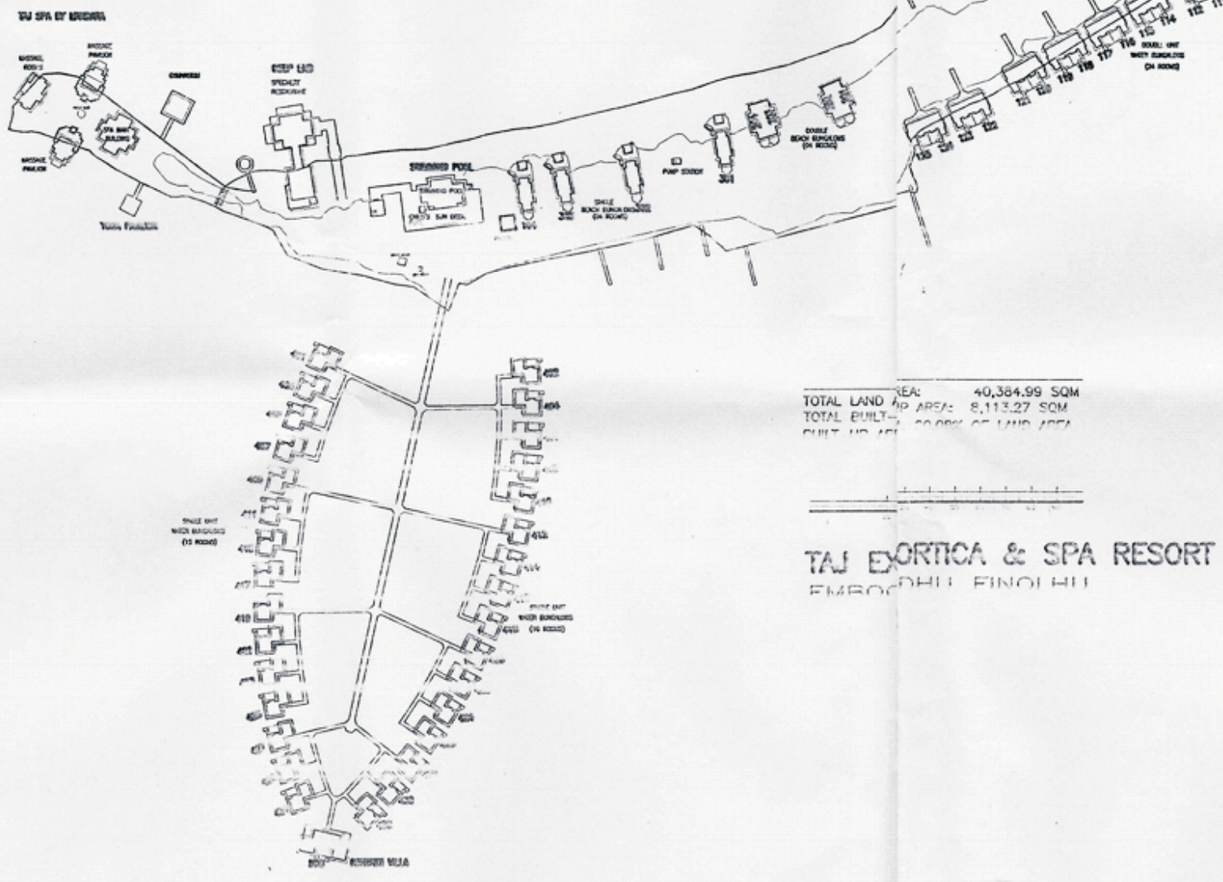

TAJ EXOTICA RESORT AND SPA
PROPOSED CHANNEL
336.73m
SAND BANK
30.16m
Dredged Materials
(Dumping area)
22.86m
1230mts
upto innermost part
of the main channel
Direction Towards Interview
Point & Hutments

14 Appendix: Existing site plan of Emboodhoofinolhu

SPACE / UNIT	NOS.	UNIT AREA	TOTAL AREA
SINGLE UNIT WATER BUNGALOWS (31 ROOMS)	31	51.68	1602.08
SINGLE UNIT WATER SUITE (01 ROOM)	01	114.48	114.48
DOUBLE UNIT WATER BUNGALOWS (34 ROOMS)	17	100.01	1270.17
DOUBLE UNIT BEACH BUNGALOWS (04 ROOMS)	02	156.77	313.54
SINGLE UNIT BEACH BUNGALOWS (04 ROOMS)	04	76.23	304.92
RECEPTION LOBBY	01	158.03	159.03
LIBRARY, SHOP, LOUNGE, GAMES LOUNGE	01	227.44	227.44
BEACH BAR	01	203.35	203.35
RESTAURANT AND MAIN KITCHEN (WITH EXTENSION)	01	537.54	537.54
SPECIALTY RESTAURANT AND KITCHEN	01	335.78	335.78
GYMNASIUM	01	64.80	64.80
SPA MAIN BUILDING	01	159.03	159.03
MASSAGE PAVILIONS	02	58.52	117.04
MASSAGE ROOMS	01	91.79	91.79
YOGA PAVILION	01	91.79	91.79
ARRIVAL PAVILION	01	43.36	43.36
DIVE SCHOOL	01	70.66	70.66
ADMIN CUM BUNGALOW	01	106.90	106.90

SPACE / UNIT	NOS.	UNIT AREA	TOTAL AREA
JETTYHEAD PAVILION	01	12.00	12.00
STAFF COMPLEX	01	909.78	909.78
SENIOR STAFF ROOMS TYPE 1	01	41.88	41.88
SENIOR STAFF ROOMS TYPE 2	01	137.89	137.89
SENIOR STAFF ROOMS TYPE 3	01	123.86	123.86
SENIOR STAFF ROOMS TYPE 4	01	89.46	89.46
SENIOR STAFF ROOMS TYPE 5	01	40.22	40.22
SENIOR STAFF ROOMS TYPE 6	01	77.31	77.31
EXECUTIVE BUNGALOW	01	73.10	73.10
MOSQUE	01	73.36	73.36
SERVICE COMPLEX	01	315.28	315.28
COMPACTOR/INCINERATOR	01	60.60	60.60
SEWAGE TREATMENT PLANT	01	76.00	76.00
FUEL TANKS	02	7.35	14.70
MDR STAFF CENTRE	01	64.00	64.00
WATER TANK	01	63.00	63.00
PANTRY	01	49.19	49.19
GARAGE	01	18.81	18.81
FIRE STORE	01	9.73	9.73
MISC	01	27.45	27.45

TOTAL BUILT-UP AREA 8113.27



TOTAL LAND AREA: 40,384.99 SQM
TOTAL BUILT-UP AREA: 8,113.27 SQM
TOTAL BUILT-UP AREA 20.09% OF LAND AREA

TAJ EXOTICA & SPA RESORT
EMBOGOHILI, FINOLHU

15 Annex: Committment Letter from the proponent to undertake the monitoring programe.

TAJ
Hotels Resorts
and Palaces
Taj Maldives Private Limited
G. Rosary, Husnuheena Magu, Male', Republic of Maldives
Telephone : + (960) 3317530, Facsimile : + (960) 3314059
Email : tajmale@dhivehinet.net.mv

Mohamed Slaeem
Assistant Director General,
Environmental Research Center
Male', Maldives

9 May 2007

Dear Mr. Saleem,

Sub: Commitment letter for monitoring programme proposed for Taj Exotica Resort / Emboodhoofinolhu

Taj Exotica Resort in South Male' Atoll has been facing difficulties accessing the service jetty due to the shallow lagoon on the northern side of the island.

We would like to confirm our commitment to the proposed monitoring programme outline in the EIA report.

Thank you,

Yours Sincerely,

MUSTHAFA ALI
COMMERCIAL MANAGER
TAJ MALDIVES PRIVATE LIMITED

16 Annex: Names and Registration Certificate numbers of the EIA consultants

1. Abdul Aleem – EIA Registration no: EIA09/07
2. Ahmed Zahid – EIA Registration no: EIA08/07

17 Annex:CV's of unregistered consultants

HUSSAIN NAEEM

Environment Analyst

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Ministry of Environment, Energy and Water
Environment Department
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HOME
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Male' 2006 Republic of Maldives
Mobile Phone No. 960 7777178
E-mail: husennaim@hotmail.com

ACADEMIC QUALIFICATION

July 1998 **Bachelor of Science with Honours Degree in Coastal Marine Biology**
(Upper second / 2(i))
University of York/University Collage Scarborough, England, UK (1995 - July 1998)

OTHER QUALIFICATIONS

June 1996 **First Aid Certificate**
Wearside College, Sunderland, England, UK (June 1996)

August 1994 **PADI Open Water Diver**
Sea Explorers Maldives, Male'/ PADI Willoughby, N.S.W. Australia (August 1994)

EMPLOYMENT AND WORK EXPERIENCE

May 2006 **Environment Analyst**

Ministry of Environment, Energy and Water. Work include surveying of islands with severe beach erosion, harbour construction, dredging and reclamation islands and consultations and attending other environmental issues in the islands.

May 2006 **Environmental Consultant** (February 2002 to present)

Working for private organisations in the Maldives. Organized and conducted extensive field studies and consultations in major development projects including tourist resort establishments, commercial fisheries development projects and commercial agriculture development projects, airport development projects and conducted environmental impact assessments for over 40 development projects in the Maldives. Designed, developed and conducted marine environmental monitoring programmes for tourist resort establishments.

Dec. 2004 **Environment Analyst**

Ministry of Environment and Construction**.** Worked at National Disaster Management Centre established in Maldives following the Asian Tsunami in 2004. Carried out rapid assessment of Tsunami impacts to the islands in Northern and central atolls. The assessments were focused on overall environmental impacts to the islands including beach, coastal damage, impacts on the vegetations, groundwater, coastal structures and facilities such as harbours, seawalls and beach retention structures. Carried out consultancy work with UNEP and World Bank consultants in identifying tsunami related and other environmental issues in the country. Prepared environmental needs assessments for the country with respect to coastal and marine environment including coral reefs.

Aug. 2003 **Environment Analyst**

Environment Section, (Ministry of Home Affairs, Housing and Environment), now Ministry of Environment, Energy and Water, Republic of Maldives.

Coordinated and conducted Coastal Zone Management Training Course for participants from all inhabited islands in Ha. Ha. Dh. and Shaviyani Atolls. Preparation of Coastal Zone Management Training Course syllabus and Course Handbook for the trainers and the participants. Carrying out technical and field work related to harbour, jetty and land reclamation.

Apr. 2002 **Technical Staff**

Worked for Maldives Protected Areas System Project (funded jointly by GoM and AusAid) aimed at biodiversity conservation by establishing PAs in the country.

Extensive work conducted to identify potential sites to declare as national Protected Areas. Conducted a long process of consultations with international experts, locals and government authorities and other stakeholders to establish pilot protected areas in south and north of the country. Organized and participated in stakeholder workshops. Conducted extensive marine and coastal surveys in northern and southern atolls of Maldives

May 2001 **Local Counterpart** (May to June 2001)

Worked for the (Global Environment Facility funded Project) Conservation and Sustainable Use of Biodiversity Associated with Coral Reefs of the Maldives. Worked with overseas consultants and experts. Conducted extensive marine and coastal surveys and stakeholder consultations in Baa Atoll and Vaavu Atoll as part of the project preparation.

Aug. 1998 **Assistant Environment Analyst**

Environment Research Centre, Ministry of Home Affairs, Housing and Environment

Travelled to all the atolls and most islands in the country to carry out various environment related work such as inspection of harbour construction, reclamation, coastal development sites and organized and conducted various stakeholder consultation. Visited most of the tourist resort islands on assignments related to environmental issues in tourism establishments.

Sep. 1993 **Research Assistant**

Environment Research Unit, Ministry of Planning and Environment

Worked with overseas consultants and experts in marine environmental and coastal aspects related to tourist resorts, inhabited and uninhabited islands in the country. Worked on identification of coral and sand mining areas for regulation.

Feb. 1992 **Research Assistant (Trainee)**

Environment Research Unit, Ministry of Planning and Environment

Work included administrative and technical work related to environmental issues in outer atolls and islands

Jan. 1990 **Technician**

Dhiraagu Telecommunication Pvt. Ltd. Maldives

Responsibilities were installation of telephone radios in outer atoll / islands and customer services of telephones.

Jan. 1987 **Technician**

Modern Techniques Pvt. Ltd. (Maldives)

Work included repair of electronic equipment and mechanisms of electronic systems

CONFERENCES, SEMINARS AND WORKSHOPS ATTENDED

Dec. 2005 **11th Conference of Parties to the United Nations Framework Convention on Climate Change**
28 November – 9 December 2005 Montreal, Canada

Dec. 2005 **European Capacity Building Initiative pre-COP Workshop to strengthen the capacity of Least Developed Countries to negotiate and implement the UNFCCC and the Kyoto Protocol** 24 - 25 November 2005 Montreal, Canada

Jan. 2005 **7th Conference of Parties to the United Nations Convention to Combat Desertification**
17 – 28 October 2005 Nairobi, Kenya

Jan. 2005 **United Nations World Conference on Disaster Reduction**
18 – 22 January 2005, Kobe, Hyogo, Japan

Nov. 2004 **Concluding Regional Workshop on Strategic Planning and Management of Natural Resources** 24 – 26 November 2004 Bangkok, Thailand

Nov. 2004 **Capacity Development Forum for Millennium Development Goals 7 (Environment in Asia)**
Role of National Capacity Self Assessment and Public Private Partnership.
1 – 5 November 2004. Kuala Lumpur, Malaysia

Oct. 2004 **South Asian Association for Regional Cooperation – Meeting of Experts to Strengthen Environment Management Infrastructure**
14 – 15 October 2004. New Delhi, India

Oct. 2004 **Global Climate Observing Systems - Regional Workshop for South and South-West Asia**
11 – 13 October 2004. Held in New Delhi, India

Jul. 2004 **Renewable Energy Workshop**
Introduction of technical aspects and policy issues related to using renewable energy in rural and urban areas. Solar, Wind, Hydro, Biomass and Hybrid systems. 19 – 20 July 2004. Male', Maldives

Jun. 2004 **Dive Seminar 2004**
Diving safety and amendment of diving regulation in the Maldives
29 June, 2004, Male' Maldives. Organised by Ministry of Tourism

Jan. 2004 **National Workshop to Review Draft Fisheries Law**
Maldives Fisheries and Marine Resources Management Policy and Legislation Project
21 – 22 January 2004 Male', Maldives. Organised by Ministry of Fisheries, Agriculture and Marine Resources

Dec. 2003 **National Workshop on the Code of Conduct for Responsible Fisheries**
Implementation of FAO code of conduct for responsible fisheries
18 – 19 December 2003 Male', Maldives. Organised by MRC, (under BOBP) Ministry of Fisheries, Agriculture and Marine Resources.

Dec. 2003 **National Workshop on Bay of Bagal Large Marine Ecosystem Management**
Focusing on a wide range of issues relating to sustainable fisheries development in the country
29 – 30 December. 2003 Male' Maldives. Organized by Marine Research Center,

Nov. 2003 **Strategic Approach to International Chemical Management Preparatory Committee 1**
9 – 13 November 2003 in Bangkok, Thailand

Nov. 2003 **Fourth session of Intergovernmental Forum on Chemical Safety**
Chemical management with regard to environmental and health safety.
1 – 7 November 2003 Bangkok, Thailand

Nov. 2003 **Project Proposal Writing Skills Training Workshop**
Focused on project design, project management tools and project proposal development.
February 2003 Male', Maldives Organized with the assistance of DFID United Kingdom and the British Council – Ministry of Planning and National Development

Feb. 2003 **Dive Seminar 2003**
Introduction and discussion of diving regulation in the Maldives,
25 February 2003 Male', Maldives Organised by Ministry of Tourism

Jun. 2002 **GCRMN (South Asia) Maldives Coral Reef Workshop**
Inauguration of Coral Reef Forum IOC-UNESCO / UNEP / IUCN June 2002 Hulhule Island Hotel, Maldives

Nov. 2001 **Workshop on Concepts and Application of IUCN Categories to Protected Areas**
November 2001 Male', Maldives

Jul. 2001 **GCRMN South Asia Coral Reef Database, Data entry and management Workshop**
July 2001Male', Maldives (UNDP)

May 2001 **Seminar on Population and Development for Policy Makers**
May 2001 Male', Maldives Ministry of Planning and National Development

May 2000 **GCRMN South Asia Training Workshop in Coral Reef Survey Design and Data Analysis**
May 2000 Chennai, India

Oct. 1992 **Workshop on Coral Reef Ecology, Monitoring and Training**
October 1992 Male' Maldives Organized by Dr. Gudrun Gaudian/Hunting Aquatic Resource, York, England and John Willamere/Hatfield Consultants, Vancouver, Canada

REPORTS AND DOCUMENTS WRITTEN

Apr. 2005 **Business Proposal for Water-sports Center at island hideaway at Dhonakulhi Maldives Spa Resort and Marina**

Oct. 2004 **Country paper to South Asian Association for Regional Cooperation Meeting of Experts to Strengthen Environmental Management Infrastructure**

Jun. 2004 **Environmental Aspects of Resort Development Proposal at Olhuveli**, Laamu Atoll

Jun. 2004 **Environmental Aspects of Resort Development Proposal at Kalhufahalafushi**, Thaa Atoll

Jun. 2004 **Environmental Aspects of Resort Development Proposal at Dholhiyadhoo**, Shaviyani Atoll

Jun. 2004 **Environmental Aspects of Resort Development Proposal at Hondaafushi**, Haa Dhaalu Atoll

Jun. 2004 **Environmental Aspects of Resort Development Proposal at Konotta**, Gaafu Alifu Atoll

Jun. 2004 **Environmental Aspects of Resort Development Proposal at Hadaha**, Gaafu Alifu Atoll

Jun. 2004 **Environmental Aspects of Resort Development Proposal at Funamauddoo**, Gaafu Alifu Atoll

Mar. 2004 **Environmental Aspects of Anbaraa Picnic Island Development Proposal**, Vaavu Atoll

Sep. 2003 **Velidhoo Inspection Survey Beach replenishment Consultation and Report** N. Ari Atoll

Sep. 2003 **Earthquake Damage Assessment Report 2003** Report submitted to the Presidents Office

Aug. 2003 **Coastal Zone Management Course Syllabus and Hand Book**

Aug. 2002 Contributed a project to **National Biodiversity Strategy and Action Plan of the Maldives**
Published by Ministry of Home Affairs, Housing and Environment

Aug. 2002 **Sun Island Resort Environmental Monitoring Report**
Submitted to International Finance Cooperation

May 2002 **Royal Island Resort & Spa Environmental Monitoring Report**
Submitted to International Finance Cooperation

Jan. 2002 **Marine Environmental Survey and Monitoring Programme**
(A Compilation of relevant Protocols for Coral Reef Ecosystem Monitoring) – A document written for Maldives Protected Areas System Project funded by AusAid

Oct. 2001 **Proposed Protected Area (Addu Atoll, Hithadhoo) Habited Exploration Report**
prepared for Maldives Protected Areas System Project

Jul. 2001 **Survey Report on Olhuveli Resort Re-Development Site Visit**

Jun. 2001 **Report on Vaavu Atoll Field Trip** *(for Conservation and Sustainable Use of Biodiversity Associated with Coral Reefs of the Maldives Project – GEF Project)* (June 2001)

May 2001 **Report on Baa Atoll Field Trip** *(for Conservation and Sustainable Use of Biodiversity Associated with Coral Reefs of the Maldives Project – GEF Project)* (May 2001)

May 1999 **Environmental Issues in Huvadu Atoll** Produced by Hussain Naeem & Williams

Feb. 1999 **The Status of Coral Reef Communities in North Male' Atoll: Recovery Following a Severe Bleaching Event in 1998** Produced by Dr. Susan Clark, Stephen Akester and Hussain Naeem

Oct. 1998 **Field Survey Report on Proposed SCUBA diving Wreck at *Machchafushi Island Resort***

Oct. 1998 **Field Survey Report on Proposed SCUBA diving Wreck at *Ellaidhoo Island Resort***

Sep. 1998 **Moofushi Island - Field Visit Report** Produced by Ahamed Ali Maniku & Hussain Naeem

Sep. 1998 **Environmental Survey Report *on Developing Lh. Landaa Giraavaru as a Tourist Resort***

Apr. 1998 **Coralivor Butterflyfishes as Indicators of Health of Coral Reef Systems in the Maldives** Dissertation/thesis submitted for Honours Degree in Coastal Marine Biology at University of York

Jun. 1996 **Grazing, Mucus production and energetics involved in *Littorinid*** with Dr. Mark Davis at University of Sunderland, Sunderland, UK

ENVIRONMENT IMPACT ASSESSMENT WORK

Surveys and report writing for Marine/Coastal environmental component of the following EIA reports

Mar. 2006 **Vilingili existing structure demolition and seagrass removal EIA,** Seenu Atoll

Feb. 2006 **Hankede resort/hotel development EIA,** Seenu Atoll

Jan. 2006 **Hoadedhdhoo fishery cold storage plant EIA,** Gaafu Dhaalu Atoll

2005 **Olhuveli resort redevelopment EIA,** South Male' Atoll

Oct. 2005 **Machchafushi resort redevelopment EIA,** South Ari Atoll

Aug. 2005 **Kudahithi Hithi resort redevelopment EIA** (North Male' Atoll)

Aug. 2005 **Kalhufahalafushi resort development EIA** (North Male' Atoll

Jul. 2005 **Lonudhuhutta resort development EIA** (Gaafu Dhaalu Atoll)

Jul. 2005 **Dholhiyadhoo resort development EIA** (Shaviyani Atoll)

Jul. 2005 **Konotta resort development EIA** (Gaafu Dhaalu Atoll)

Jul. 2005 **Olhuveli resort development EIA** (Laamu Atoll)

Feb. 2005 **Bodu Hithi resort redevelopment EIA,** North Male' Atoll

Dec. 2005 **Baarah channel excavation and harbour development EIA,** Haa Alifu Atoll

Dec. 2004 **Maayaafushi resort water bungalow development EIA,** North Ari Atoll

Dec. 2004 **Alimatha Aquatic Resort water bungalow development EIA,** Vaavu Atoll

Nov. 2004 **Fesdu Sun Island redevelopment North Ari Atoll EIA**

2004 **Sun Island resort channel deepening EIA,** South Ari Atoll

Oct. 2003 **Fonadhoo fish processing complex, ice plant and cold storage EIA,** Fonadoo, Thaa Atoll

Aug. 2003 **Traditional Agriculture Development in Udhdhoo Island EIA**, Dhaalu Atoll

Jul. 2003 **Dhiggiri resort beach modification and nourishment EIA,** Vaavu Atoll

Jun. ***2003*** **Club Kudarah resort beach nourishment EIA,** S. Ari Atoll

May ***2003*** **Club Boduhithi resort beach nourishment EIA,** N. Male' Atoll

May ***2003*** **Alimathaa resort beach replenishment EIA,** Vaavu Atoll

May ***2003*** **Soneva Gili channel dredging EIA,** Lankanfushi, N. Male' Atoll

Apr. ***2003*** **Landagiraavaru resort development EIA** Baa Atoll

Feb. ***2003*** **Rehiveli resort beach replenishment EIA,** S. Male' Atoll

2002 **Island resort coastal modification and renovation EIA,** S. Male Atoll

Jul. ***2002*** **Maamigili airport development**, **EIA** South Ari Atoll

May ***2002*** **Mayafushi resort entrance channel dredging EIA,** North Ari Atoll

Apr. ***2002*** **Etheremadivaru picnic island development EIA,** North Ari Atoll

Apr. ***2001*** **Villigili resort development EIA,** Addu Atoll

Dec. ***2000*** **Hudhufushi resort development proposal and EIA**, Lahviyani Atoll

Nov. ***2000*** **Mushimasmigili picnic island development EIA,** North Ari Atoll

Aug. ***2000*** **Hudhuveli resort seagrass removal and redevelopment EIA,** (Lankanfushi) N. Male' Atoll

Jul. ***2000*** **Kandoomaa resort redevelopment EIA,** South Male' Atoll

Apr. ***2000*** **Maadhoo picnic island development EIA,** South Male' Atoll

REFEREEES

Graham Scott Lecturer in Coastal Marine Biology, University College Scarborough, England, UK	grahams@ucscarb.ac.uk +44 (0) 1723 362392
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Stephen R. Lindsay Director, Marine Consultant Services, Kolonia, Pohnpei	slindsay@mail.fm (691) 320 7257