Environmental Impact Assessment for Coastal Works at Reethi Beach Resort

Proposed By:

Magic Kingdom Resorts Pvt. Ltd.

Signature:

July 2010

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1. INTRODUCTION

1.1. *Object of EIA*

Reethi Beach Resort has experienced erosion since year 2000, and several dispositions have been taken over the year to maintain the beach and the threatened structures. Erosion is significant on the southern tip of the island, even though it was noticed that different places are subject to erosion during the year. A number of reports have already been submitted over the years describing the situation. This report mainly assesses the potential environmental impacts associated with the new coastal developments of the resort on the island of B. Fonimagoodhoo (Reethi Beach Resort).

1.2. *Project location*

Reethi Beach Resort is located on the island of Fonimagoodhoo, on the north-western part of Baa atoll. Hence**,** the house reef of Reethi Beach is quite extensive, especially on the western side with patchy reefs on the eastern side of the island.

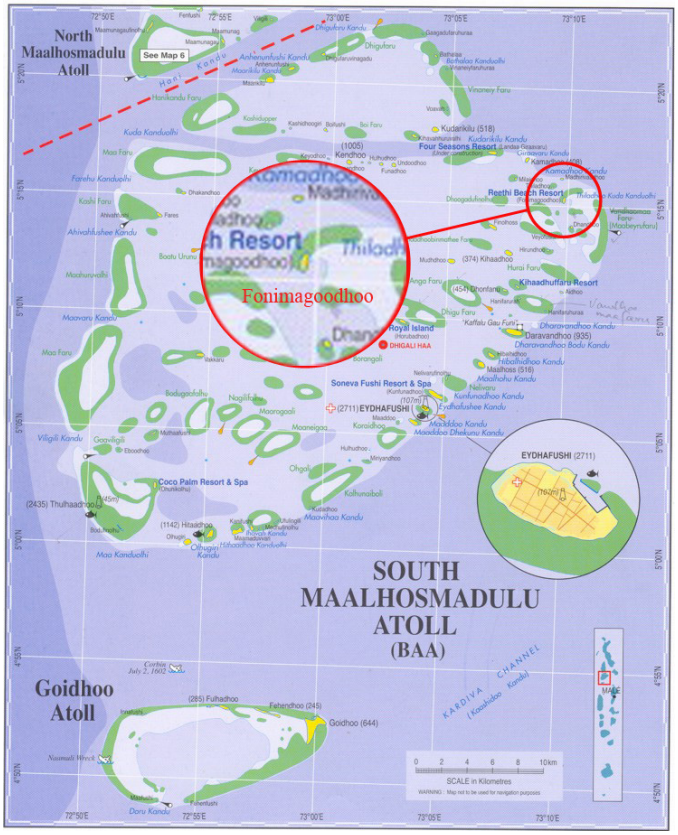

Figure 1: Baa Atoll , Fonimagoodhoo (Reethi Beach Resort)

1.3. *Purpose and objectives of the project*

The assessment of the impacts to the environment investigates the activities proposed as part of the project and analyses the environmental conditions at the site in order to forecast the impacts. The Environmental Impact Assessment then proposes alternatives and mitigation measures to minimize the negative impacts while trying to derive the maximum positive impacts from the project. It is a requirement to submit an EIA report under the Environmental Protection and Preservation Act (EPPA; Law no. 4/ 93) for any development in the tourism industry

1.4. *The proponent and consultants*

Magic Kingdom Resorts Pvt. Ltd. has its head office at G. Rosary View, 6th floor, Husnuheena Magu, Male' 20-03, Rep. of Maldives. The company has been in operation since May 2000 and has been operating Reethi Beach Resort as their only resort in the country ever since. The extended main lease agreement to operate Reethi Beach Resort effective 1st June is under Mahogany Pvt. Ltd., which is an associated company of Magic Kingdom Resorts.

Seamarc Pvt. Ltd. is a company registered at the Ministry of Trade and Industries of the Government of the Republic of Maldives, under the act no. 10/96, since June 2000. The aim of the company is to provide quality advice on dealing with environmental problems arising from the rapid developments in infrastructure taking place in the Maldives. Seamarc Pvt. Ltd has been appointed as the consultant for this project by the proponent.

1.5. *Study area*

The whole island is under consideration as sediment transport cannot be treated partially, but the focus is on the southern tip where most of the erosion was previously noticed and where most of the proposed coastal works will be happening. The island being alone on its reef system and at downstream end, on a sediment transport point of view, it is ruled out that the coastal works on Fonimagoodhoo will

affect negatively other reefs or islands outside the reef system. The boundaries of the survey area are shown in the figure below (Fig. 2)

Figure 2: Survey Boundary Area

2. THE PROJECT

2.1. *Site plan*

Following is a site plan of the island with the proposed coastal protection envisaged to secure the southern part of the island (Fig. 3)

Figure 3: coastal structure designs at B. Fonimagoodhoo, the proposed structures are in black

2.2. *Processes and methods used*

Previously a number of different options have been adopted, which have proved not very long lasting, these included sand bags on the shoreline, cement bag revetments, groynes of various shapes and designs, coir mesh to retain bags, etc... The present project is looking at more permanent solutions to ensure the aesthetics of the beach and the satisfaction of the guests. Based on previous observations, a combination of shore perpendicular and off shore parallel structures has been opted for drawn in black (Fig. 3).

The new structures will be made of Elcorock Beach Protection systems (Fig 4). These consist of containers made of perforated geotextile allowing the sediment to stay inside the container, while the water is drained through the small openings. Once filled, the smaller bags (5 tons) will be placed using excavator. Geotubes, made with of the same fabric are placed in situ and sand pumped from the sandbarge directly. These are very durable and will be installed to create the different groynes and breakwater as highlighted in the drawing. The northern groyne will be built out of jute bags containing a mix of cement and sand as is done in many islands around the Maldives.

Figure 4: A beach protection revetment installed in R. Maduvvari using Elcorock containers

On the site plan, the structures drawn in red already exist, which were implemented after the Tsunami, and will be maintained as last resort coastal protections.
Some beach replenishment will also be carried out once the coastal structures are built to ensure the aesthetics of the island.

2.3. *Duration*

It is expected the project will be finished one month after the approval of the EIA.

2.4. *Machinery*

The project will make use of an excavator SK200, Elcorock 5tn Filling Plant, Sand Barge System, and Flat-top Sand Barge, as well as different utensils used to fill the Elcorock bags. Approximately 10 skilled persons will be required and 1500 litres of fuel will be used consumed during the duration of the project.

3. LEGISLATIVE AND REGULATORY CONSIDERATIONS

This section outlines the relevant environmental legislation, existing plans, policies and guidelines and international conventions pertaining to the development under study.

3.1. *Environment Protection and Preservation Act of Maldives (Law no. 4/ 93)*

The Environment Protection and Preservation Act of the Maldives (EPPA; Law no. 4/ 93) provide the legal basis for environmental protection, preservation and conservation in the country. Being an umbrella law, it gives extensive power to Ministry of Environment, Energy and Water (MHTE) in matters concerning the environment.

The following articles are addressed in the EPPA:

- The guidelines and advice on environmental protection in accordance with the prevailing needs and conditions of the country shall be provided by the concerned government authorities.
- In areas of environmental protection and preservation that do not already have a designated government authority, MHTE shall be the responsible authority to formulate policies, rules and regulations.
- MHTE shall be responsible for identifying and drawing up legislation for conservation of protected areas and natural reserves.
- An environmental impact assessment has to be submitted to MHTE before implementation of any project that may have an impact on the environment. MHTE shall formulate the guidelines and determine the projects that require such an assessment.
- MHTE has the authority to terminate any project that has an unfavourable impact on the environment without compensation.
- Disposal of waste, oil, poisonous gases or other substances harmful to the environment is prohibited within the territory of the Maldives. In the event that disposal of such substances become necessary, they shall be disposed of within the area designated for the purpose by the government.
- Disposal of hazardous, toxic or nuclear waste is prohibited within the territory of Maldives and a permit shall be obtained before any transboundary movement through the Maldivian territory.
- The penalty for defying the law is stated in the Law.
- The government of Maldives has the right to claim compensation for any damages caused by activities that are detrimental to the environment.

3.2. *The EIA Process*

Under Article 5 (a) of the EPPA, an Environmental Impact Assessment has to be submitted by the developer of a project which may have potential impacts on the environment, to MHTE for approval before commencement of the project.

The EIA process is coordinated by the Environment Protection Agency of the MHTE with consultation from other relevant government agencies and the National Commission for the Protection of the Environment (NCPE). The EIA process is initiated when the proponent submits a Screening Form to the Ministry. This stage identifies if the project requires an Initial Environmental Examination (IEE) or a full Environmental Impact Assessment. Subsequently, the scope of the EIA will be discussed in a Scoping Meeting attended by representatives from the Ministry and the proponent. Once the scope is identified, baseline surveys will be carried out and a report submitted to the Ministry according to the guidelines provided in the EIA Regulation. The main components of the report are project description, existing environment, public consultation, impact assessment, alternatives, mitigation and monitoring. A decision statement is then issued by the Ministry stating whether the project is approved, needs further information or is rejected. The EIA process is schematically shown on Figure 2.1. The development of all new resorts is included in the list of activities requiring an EIA (Schedule D) of the EIA Regulations. Thus, this project need not go through the screening process but can go directly to the scoping stage.

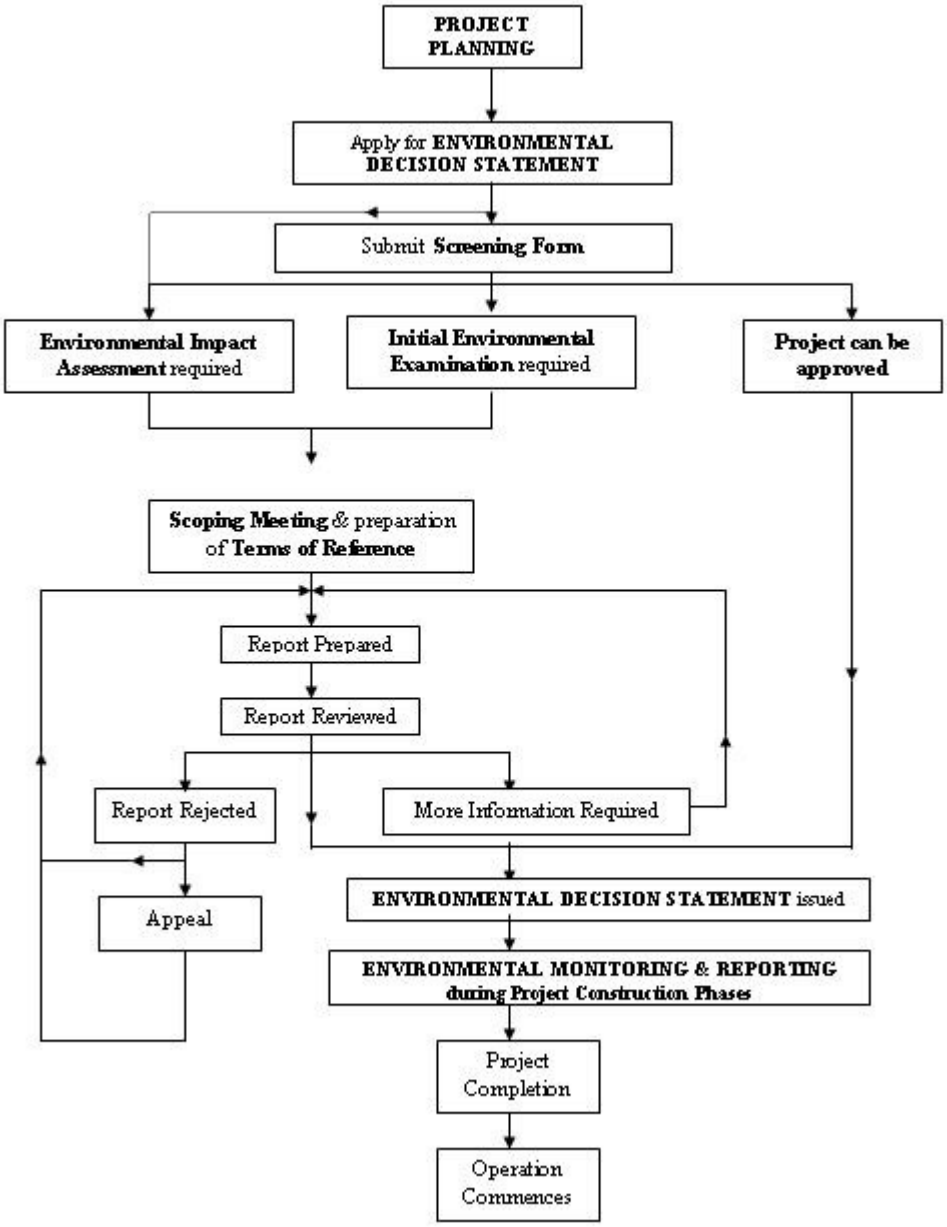

Figure 5: he EIA process in the Maldives

3.3. *Maldives Tourism Act (Law no. 2/99)*

This act encompasses the issues related to the development of tourism in the Maldives. It came into effect on the November, 1999, repealing the Law on Tourism in the Maldives (Act No. 15/79) and the Law on Leasing of Uninhabited Islands for the Development of Tourist Resorts (Act No. 3/94). Act No. 15/79 was the primary legislation that was passed by the Citizen's Majlis in November of 1979 and the main aim was to provide for the collection of a bed tax from the visiting tourists and to control their movement in the Maldives. While this Act only dealt with tourist

resorts, hotels and guest houses, the amended act (Act No. 2/99) incorporates the determination of zones where tourism development can occur, as well as the development and management of marinas and the operation of tourist vessels, diving centres and travel agencies. This is evidence that the tourism industry has expanded since the enactment of the initial laws, both in magnitude and in the diversity of facilities that are provided for the visiting tourists.

The environmental legislation that directly applies to the development is outlined under article 15 (a) and (b). Article 15 (a) provides for the felling of *Ruh'*s and trees, dredging of lagoons, reclamation of land or any other activity that may cause permanent change to the natural environment of an island leased as a tourist resort. It states that the activities mentioned above can only be carried out after obtaining written permission from the Ministry of Tourism, Culture and Arts and in accordance with the relevant regulations.

Under Article 15 (b), a justification has to be provided for such an activity, as well as an environmental impact assessment, which has to be submitted to and approved by the Ministry of Environment, Energy and Water.

There are several regulations under the Maldives Tourism Act (Law No. 2/99) and those pertaining to the environment are presented below.

3.4. *Regulations under Maldives Tourism Act*

3.4.1. Development of Tourist Resorts

Under article 4 of this regulation, permission is required from the Ministry of Tourism, Culture and Arts before felling of trees.

3.4.2. Carrying Capacity for Islands to be Developed as Tourist Resorts

A set of standards has been imposed under this regulation to ensure preservation of the natural beauty and the environment of the islands as well as the consumer's image of the islands. As such, the following guidelines are provided:

- The felling of trees has to be carried out evenly through out the island with the intention of conserving the natural façade and the beauty of the island.
- Sufficient trees have to be left untouched when clearing trees for construction in order that they block the view of the buildings. All buildings, including two storey buildings are to be constructed below the highest canopy level so that they are not visible above the treetops.
- The maximum number of buildings to be constructed on the island should be dependent on how much space can be cleared of vegetation, with consideration of the above factors.
- The maximum area utilized for the construction of buildings should not exceed 20% of the total land area.
- All buildings should be located at least 5m landwards from the vegetation line of the island. In the event that over water bungalows are built on the reef flat or lagoon, an equal area has to be left free on the island.
- To provide the visiting guests with sufficient beach area, the guest rooms should face the beach with a minimum of 5m of beach allocated for each room.

3.4.3. Disposal of Garbage

- Garbage from the resorts should be disposed of appropriately to avoid impacts on the environment. Waste disposed of at sea should be thrown away far out to sea, ensuring that it does not get washed back on the beach of any islands.
- All resorts are required to have incinerators and compactors to be utilized for burning all flammable material and compact the cans respectively. Glass is to be broken into small pieces and plastic and polythene bags burnt.
- A fine between Rf100 and Rf2000 is to be charged if the regulation is breached, and the sum doubled for those who violate it a second time.

In addition to the Maldives Tourism Act and the relevant Regulations, there are Circulars issued by the Ministry of Tourism, Culture and Arts, advising the Tourism industry of their new policies or strengthening the existing ones.

- Circular no. 21/90 (21.04.1990) advices all resorts having filled jetties to be modified so that they allow free flow of currents through them or new jetties composed of reinforced concerted stilts to be built in their place by the end of June 1991.
- Circular no. CIR-ES/98/07 issued on the 27th of January 1998 states that all resorts have to obtain permission from the Ministry of Tourism, Culture and Arts before commencing any coastal modifications. Hard engineering solutions are discouraged while environmentally friendly structures are supported.
- Circular no. 88-ES/CIR/2002/12 (05.05.2002) deals with the proper disposal of garbage from the resorts in response to concerns that floating garbage from resort islands were washing up on beaches of nearby islands.

3.4.4. Maldives Third Tourism Master Plan

The Maldives Third Tourism Master Plan (TTMP) was launched in August 2007. The planning horizon is from 2006 to 2010. The strategies recommended will integrate with the policies and strategies for tourism, air and sea transport proposed in the 7th National Development Plan which is also being developed.

The TTMP will focus on the following areas:

- Identification of potential product expansion and diversification and Maldives tourism product review.
- Increasing the share of Maldivians working in the tourism industry.
- Greater community involvement in the tourism sector.
- Improvements in the retention of economic benefits of tourism within the Maldives economy.
- Improvements to the tourism related infrastructure and support services.

- Protecting, preserving and promoting the natural resource base, heritage and culture in relation to tourism development.
- Strengthening the institutional capacity of Ministry for Tourism and Civil Aviation.
- Developing domestic tourism.
- Improving the legislative framework in relation to the tourism industry.

3.4.5. Fisheries Regulation of the Maldives

Under Article 1 (d) of this regulation, it is an offence to carry out any fishing activity on the house reef or the lagoon of a tourist resort without prior approval from the management of that resort.

3.4.6. Regulation on Sand and Coral Mining

Under Article 7 (c) of the Regulation on Sand and Coral Mining issued by the Ministry of Fisheries and Agriculture (MOFA) on the 13th of March 2000, it is an offence to mine sand or coral from the beach, lagoon or reef of any island leased for the purpose of building a tourist resort. Mining of coral or sand for the construction of resorts and associated facilities is discouraged under the policy of the Ministry of Tourism, Culture and Arts, and utilization of alternative construction material is encouraged. As an incentive, import duty is exempted under Sub clause 3, Article 9 of Law No. 31/79 for the import of cement, iron, steel, roofing sheets and timber for the construction of tourist resorts. However, sand mining is allowed for beach replenishment projects, predominantly from the immediate lagoon of the resort and in the case of a lack of sand on the island, from an area that is decided by MOFAMR.

3.5. *International Conventions*

3.5.1. United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol

UNFCCC is the first binding international legal instrument that deals directly with the threat of climate change. It was enacted at the 1992 Earth Summit in Rio de Janeiro and came into force on the 21st of March 1994.

Signatory countries have agreed to take action to achieve the goal outlined in Article 2 of the Convention which addresses the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous Anthropogenic interference with the climate system," Thus all Parties to the Convention are committed under Article 4 to adopt national programs for mitigating climate change, promote sustainable management and conservation of green house gas (GHG) sinks such as coral reefs, to develop adaptation strategies, to address climate change in relevant social, economic and environmental policies, to cooperate in technical, scientific and educational matters and to promote scientific research and exchange of information.

The Kyoto Protocol entered into force on the 16th of February 2005 and is an international and legally binding agreement to reduce GHG emissions globally. It strengthens the Convention by committing Annex I Parties to individual, legally-binding targets to achieve limitations or reductions in their GHG emissions.

Maldives has signed and ratified both the Convention and the Protocol.

3.5.2. United Nations Convention on Biological Diversity (UNCBD)

The objectives of the UNCBD are "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources." The Convention entered into force on the 29th of December 1993. Maldives has ratified the Convention and has prepared the National Biodiversity Strategy and Action Plan in 2002.

3.5.3. United Nations Convention to Combat Desertification (UNCCD)

The objective of the UNCCD is to "combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa, through effective action at all levels, supported by international cooperation and partnership arrangements, in the framework of an integrated

approach, which is consistent with Agenda 21, with a view to contributing to the achievement of sustainable development in affected areas (article 2)." To achieve this goal the Convention focuses on improving land productivity, rehabilitation of land, conservation and sustainable management of land and water resources.

The Convention was adopted in Paris on 17th June 1994 entered into force on 26th December 1996. Maldives has acceded to the Convention in 2002.

3.5.4. United Nations Convention on the Law of the Sea (UNCLOS)

UNCLOS refers to several United Nations events and one treaty. This treaty provided new universal legal controls for the management of marine natural resources and the control of pollution. UNCLOS provides a legal order for the seas and oceans which will facilitate international communication, and will promote the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment

3.6. *Role of Stakeholders*

There are many parties that can affect or can be affected by development projects. Various national agencies are responsible for environmental management and protection. At the same time, the project proponent has a duty to do their share of conserving the environment by minimising and mitigating impacts arising from the project. The environmental consultants also play a major role in informed decision making by providing the proponent with the information required for this purpose.

3.7. *Government Agencies*

Ministry of Housing, Transport and Environment (MHTE) and Environment Protection Agency (EPA) are the lead government agency that has the responsibility to implement the Environmental Impact Assessment process. It has the task of ensuring all development projects anticipated to have impacts on the environment undergo the process before implementation. This involves screening the projects

and providing approvals and recommendations related to the EIA. MHTE is also responsible for ensuring proper implementation of the environmental measures proposed in the EIA including the Environmental Monitoring Plan.

The EIAs and any related documents for resort development are required to be submitted to the MHTE through the Ministry of Tourism, Culture and Arts (MTCA). MTCA is the authority that determines the zones where tourism development can occur, as well as the development and management of marinas and the operation of tourist vessels, diving centres and travel agencies. It has the mandate to develop tourism in the Maldives in a sustainable manner and is responsible for ensuring that resort construction and operation abide by the Maldives Tourism Act of Maldives and the associated regulations. MTCA also has the responsibility to provide authorisation for operation of aerodromes.

Other government agencies having a role in the project include:

- Ministry of Housing and Urban Development has the authority to allocate the land on inhabited islands, including area approval and implementing “no development” buffer zones as well as enforcing planning regulations. The Ministry provides a planning permit to Ministry of Tourism, Culture and Arts which then allows the development of a resort on the island.
- Pertinent legislation, regulations and standards and responsible authority jurisdiction

4. PROJECT ENVIRONMENT

4.1. *Coastal configuration of the project location*

4.1.1. General description

Reethi Beach Resort is located on the island of Fonimagoodhoo at the eastern tip of Baa Atoll. However, the island does not sit right on the edge of the atoll, and is located at the west of a large reef system, which has quite a lot of sand banks on its outer periphery. In particular a sand bank, visible at times, is present just north of the island. The Northern and Southern tip of the island is facing severe erosion and this is affecting the shore line of the island. The new developments are in fact physical structures that will in time reduce the erosion problem and become a permanent solution.

This reef system is not closed and a pass is located just south of the island, in which the current can be important. The main cause for this current is that the water brought in by the swell from the South-East, which passes between Male' Atoll and Lhaviyani Atoll is somewhat retained inside the reef system and is mostly drained through this channel.

There is for that same reason quite an important outgoing current on the reef flat at the northern tip of the island. It would therefore flow towards the outside of the reef system as long as an oceanic swell is present. This current might only be located in between the island and the sand bank as the predominent current regime on the reef flat dominated by the swell occurs to the north of this sand bank. A channel to the outside of the atoll is located on the north-eastern side of the island, and the direction of the current in this area changes with the tide, at least on calm days like the one when the inspection was carried out.

Compared to many islands in the Maldives, Fonimagoodhoo is sitting quite high and the water table is found at about 2m depth in the middle of the island. Relatively little waves are crashing on the island as it is protected by the reef system, but some

smaller waves, remains of the swell being diffracted or diminished by the friction on the reef flat are present at the northern tip and on the western side of the island. Some of the swell is also passing over the eastern crest of the reef system and hitting the island on the east.

4.2. Wave regime

4.2.1. Tide gauge deployment

Seamarc has conducted an exclusive research on erosion problems faced by RBR taking in to consideration wave and wind impacts, on two locations (Western Side and Northern Side) for a period of 10 days. This research was done from 19/08/2009 to 28/08/2009.

Wave data were measured by deploying two pressure sensors and temperature sensors RBR TWR-2050 were deployed, one on the eastern side, south of the service jetty, and one on the western side, on some rocky outcrops on the edge of the reef slope, near the southern buoy marker.

The pressure sensors continuously measure the height of water above them as well as record wave burst every half hour for 17 min.

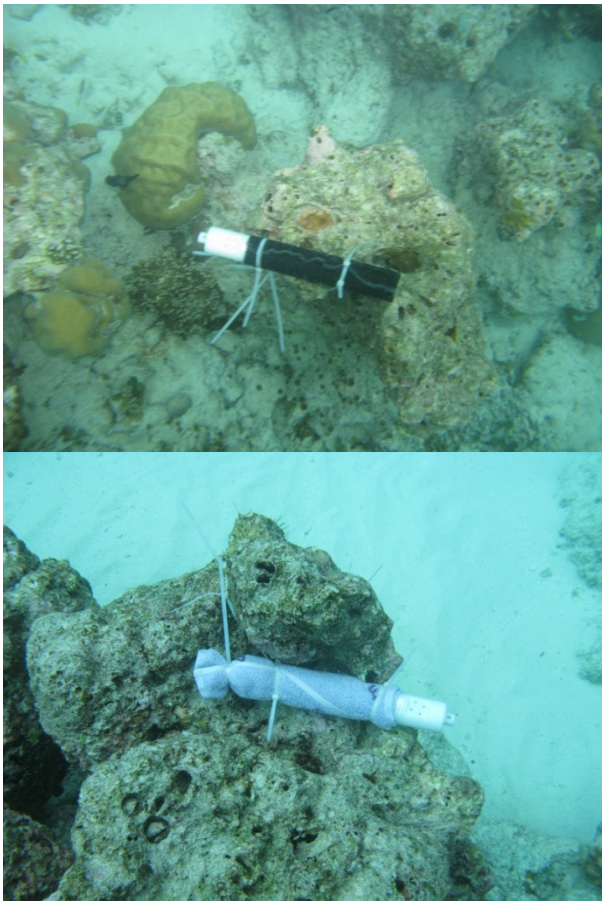

Figure 6: Pressure sensors deployed on the eastern and western side of the island

The eastern sensor remained well attached during the 10 day period whereas the western sensor fell on 23/08/2009 at 11:42 AM. Given the calm conditions that day as well as the deep ridge found on the plastic cover and the rock not being broken, it is thought that a turtle could have shown some interest for the device. The sensor subsequently remained in the sand in the vicinity and the data collected is usable for our purpose.

4.2.2. Wind conditions

During the deployment period, the weather has been variable with windy days and calm days. The wind data from the satellite Quickscat are given below (Figure 5) for the point 5.25^0 N, 73.25^0 S.

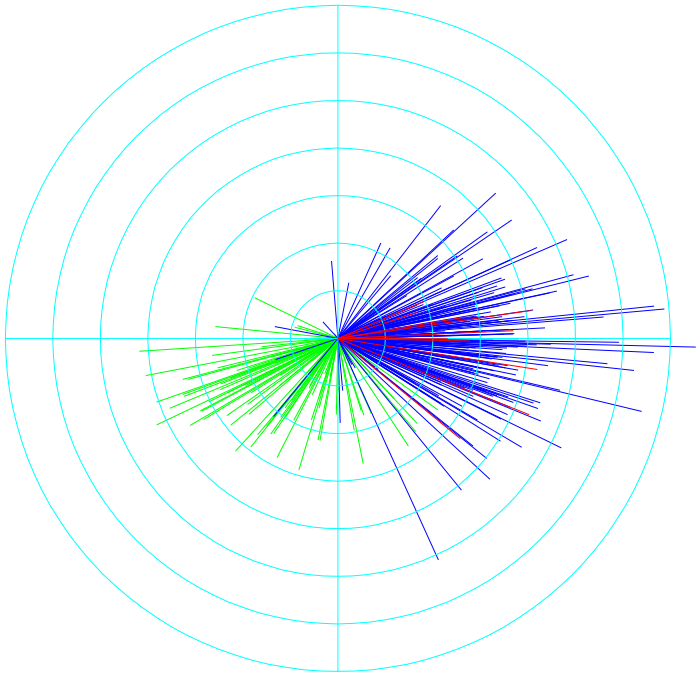

Figure 7: Available wind vector data for the year 2009 from Quickscat, the days where the survey was conducted are dawn in red. The concentric circles are 2 knots apart.

4.3. Results

The outputs from the sensors and the significant wave heights are provided below for both sensors.

4.3.1. Eastern side

4.3.1.1. All sensors

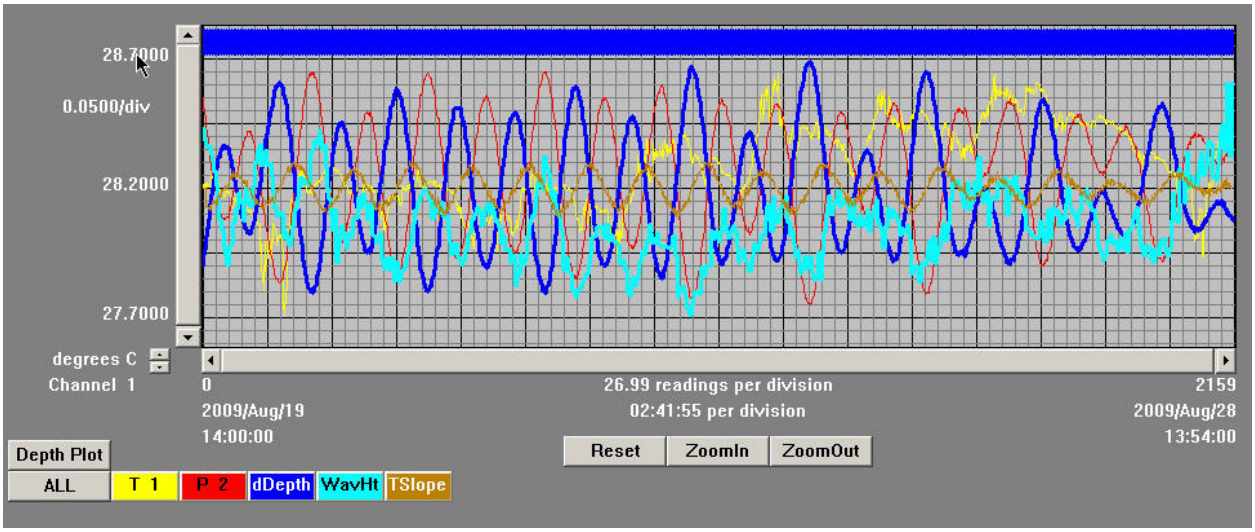

Figure 8: sensor outputs with temperature (yellow), pressure (red), depth (blue), wave height (cyan) and tidal slope (brown).

4.3.1.2. Wave height

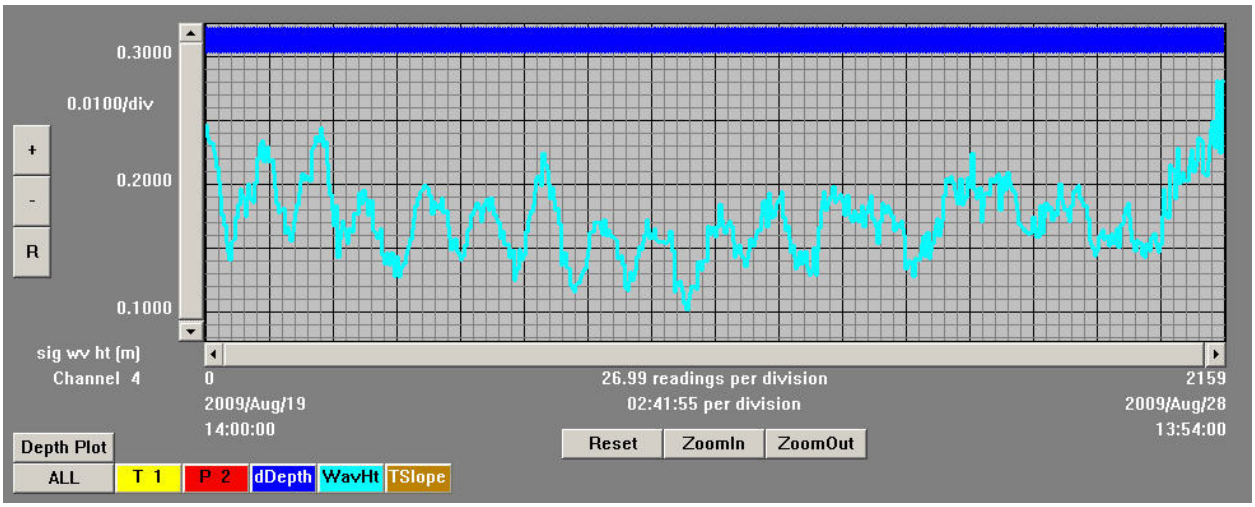

Figure 9: Significant wave heights on the eastern side

A number of wave burst have been analysed using a Fourier transform, which enables the different wave components to be analysed from the sensors wave bursts outputs.

During this monsoon, the eastern side is dominated by the swell and the significant wave height is low, but with a long period. A general observation is that the wave energy reaching the island is very dependent on the tide. At high tide, more energy passes over the outer reef and reaches the island from the east. It has to be noted that the break in the reef north of the island could be a channel where the swell enters almost unhindered in the lagoon area.

4.3.1.2.1. High tide – moderate winds

This condition was encountered on 20th august at 14h00. The Fourier transform gives the following periodogram (Figure 9)

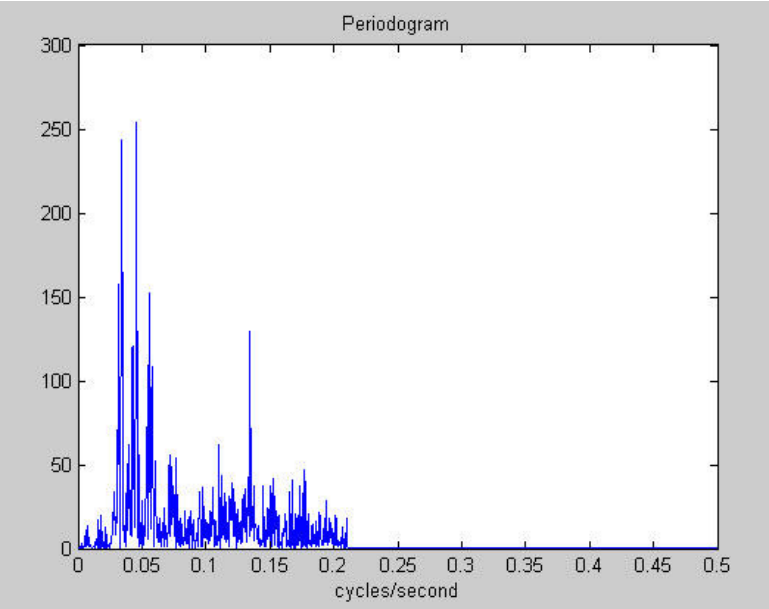

Figure 10: Periodogram during high tide and moderate winds.

There is a strong swell component with periods of 20 – 25 s (the period is inverse to the cycles/second or frequency in our case 0.04-0.05 cycles/second), which could be the swell passing through the northern pass. Another peak with a frequency of 0.13 Hz, or period of 7.7 s is a little low to be corresponding to wind waves but is the major difference with the lower wind conditions presented next.

4.3.1.2.2. High tide-low wind

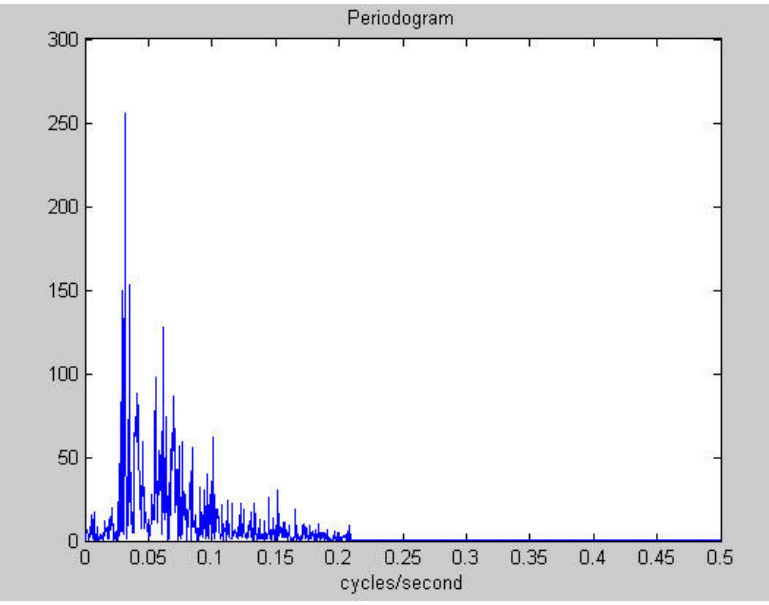

Figure 11: Periodogram during high tide and low winds.

The swell seems to have an even longer period on this occasion but seems to be formed of two components, one with a period of 33 s, and another of 16 s, which is more in keeping with usual swell periods.

4.3.1.2.3. Low tide - low tide

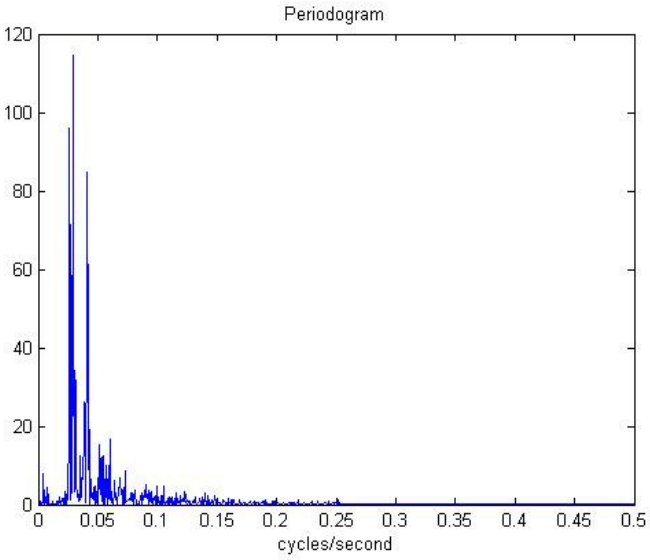

Figure 12: Periodogram of wave burst during low tide under low wind conditions

At low tide, a longer period component is still present, even though with a lesser amplitude. This confirms that this component would be passing through the

northern pass, as it the tide would have a lesser influence in that area. It is of lesser amplitude than on the eastern side by half, but this is less tangible at low tide.

4.3.1.2.4. Mid tide – high wind

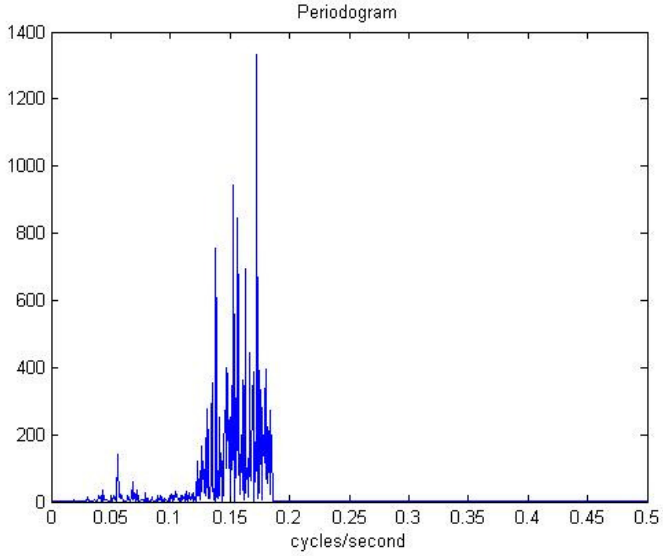

Figure 13: Periodogram during mid time and high wind event

The wind waves with period of 5.5 to 7 s are largely dominating the area with very little swell waves present on that occasion.

4.3.1.2.5. High swell

During the high swell event noted above, these also reach the western shore to some extent.

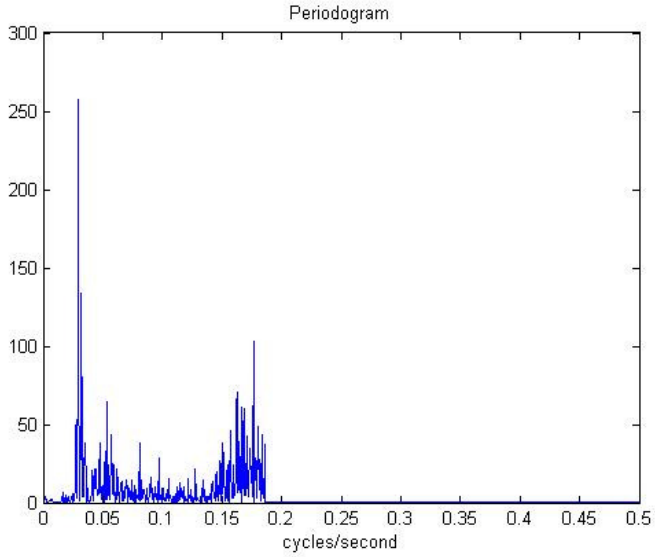

Figure 14: during a high swell event

Most of the energy is carried by the same long wave component with a period of 33 s. Wind conditions are moderate.

4.3.1.2.6. Mid tide – high winds

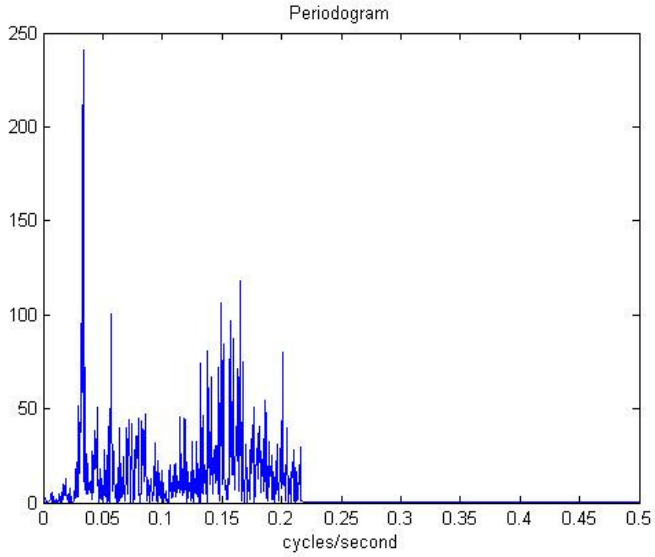

Figure 15: at mid tide under windy conditions from the west

The swell component remains but a wind component appears. It remains of relatively small amplitude on this protected side of the island.

4.3.1.2.7. High swells

An episode of relatively high swell happened on the 28th of august. Even though not happening during the high tide, this shows a more energetic wave associated with a very long period of 33 s.

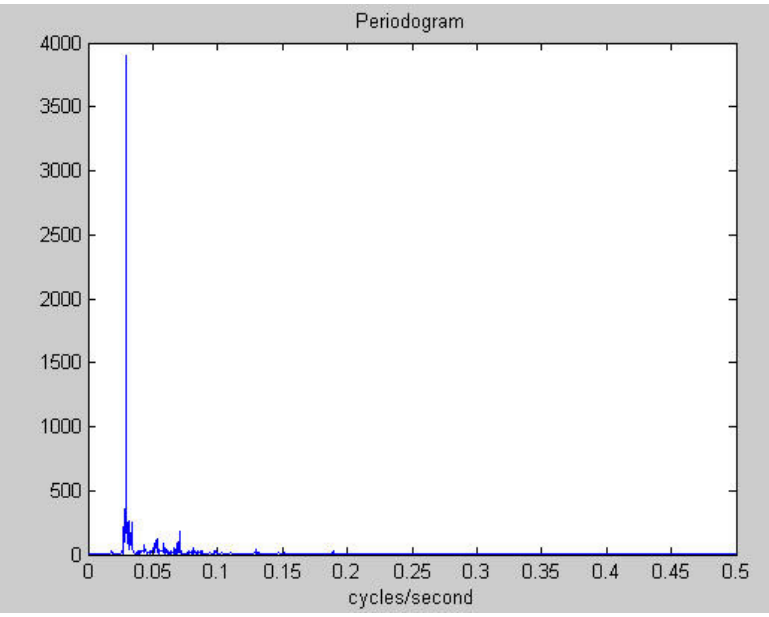

Figure 16: Periodogram druing the high swell event on 28th august

4.3.2. Western side

4.3.2.1. All sensors

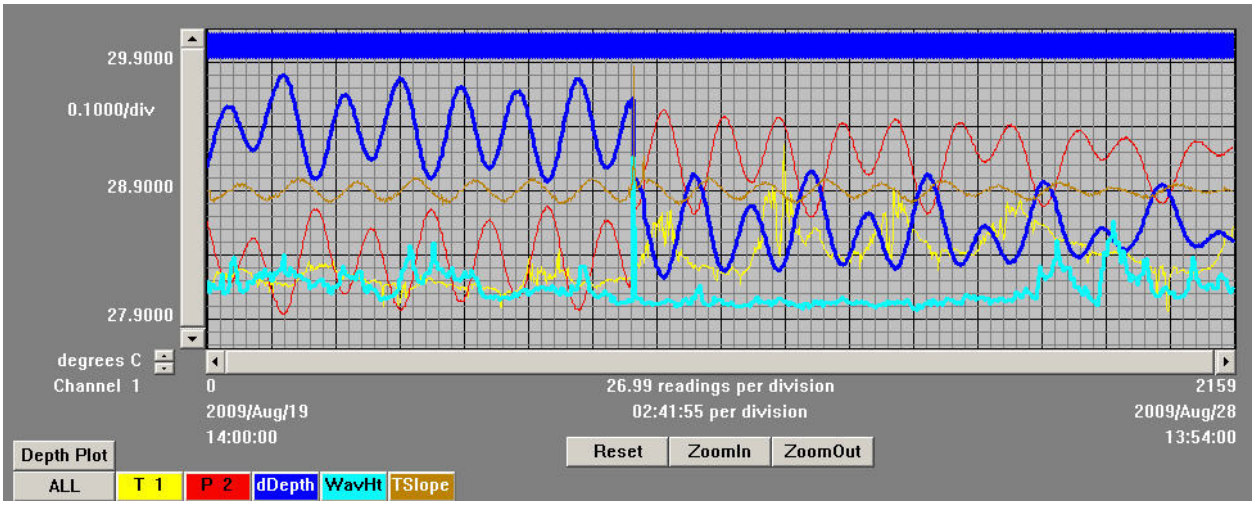

Figure 17: Sensor outputs with temperature (yellow), pressure (red), depth (blue), wave height (cyan) and tidal slope (brown).

The moment when the sensor fell is readily identifiable.

4.3.2.2. Wave height

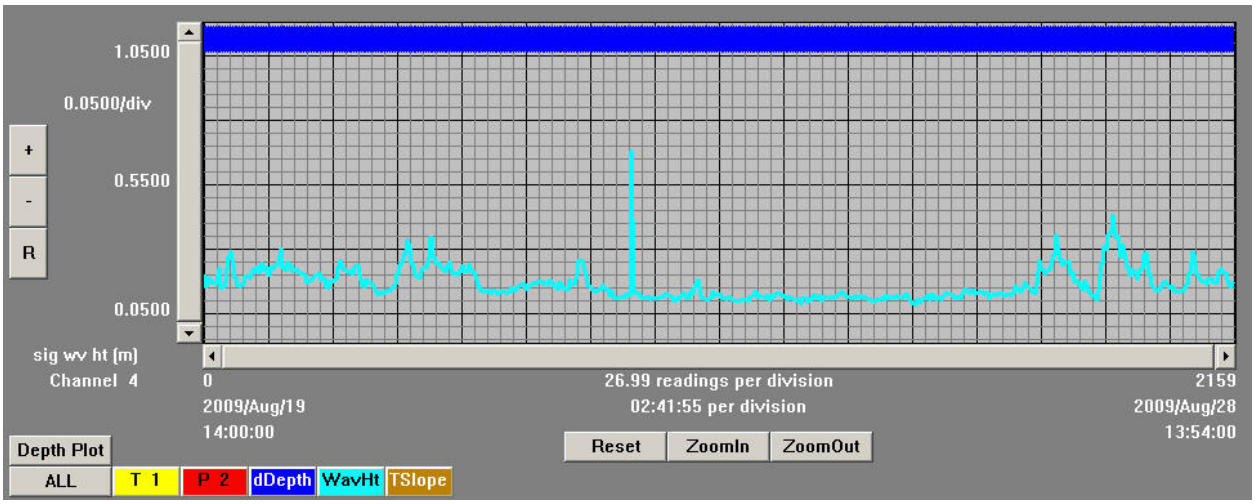

Figure 18: Significant wave heights on the western side

On the eastern side, the presence of waves is not related to the tide and is dominated by the wind waves.

4.3.2.2.1. High wind - high tide

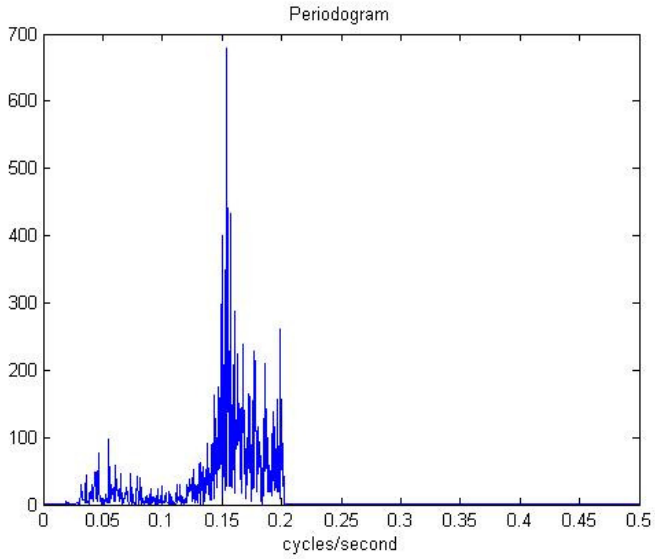

Figure 19: Periodogram during high wind and high tide

Under these conditions, the bulk of the energy is carried by wind waves of a period of 7 s. Shorter period wind waves are also present. A small swell component with a period of 20 s is noticeable.

4.3.2.2.2. High tide – low wind

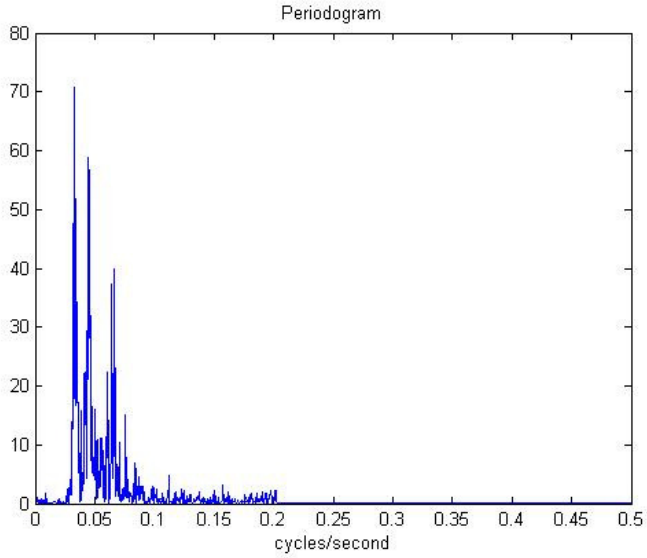

Figure 20: Periodogram under high tide and low wind conditions

The wave heights are usually low on this side, and little small period waves are present. The low energy is carried by long period swell of small amplitude.

4.4. Conclusion

Given the erosion pattern on the island, which is dependent on the monsoon, it is assumed that the wind wave components of the wave spectrum are responsible for most of the sediment transport. This survey tend to prove that the wind waves have a slightly longer period than initially expected, often reaching 7 s. This has consequences in terms of design of a floating filter for the waves. The efficiency of such a device would of course be dependent on the wave length, which for such waves in a depth of 2 to 3 meters would be around 35 m.

4.5. Beach profiles

All the beach profiles were taken from the areas, where the current project is predicted to have most effect.

Figure 21: Beach Profiles

4.5.1. Beach profiles taken on the south eastern side.

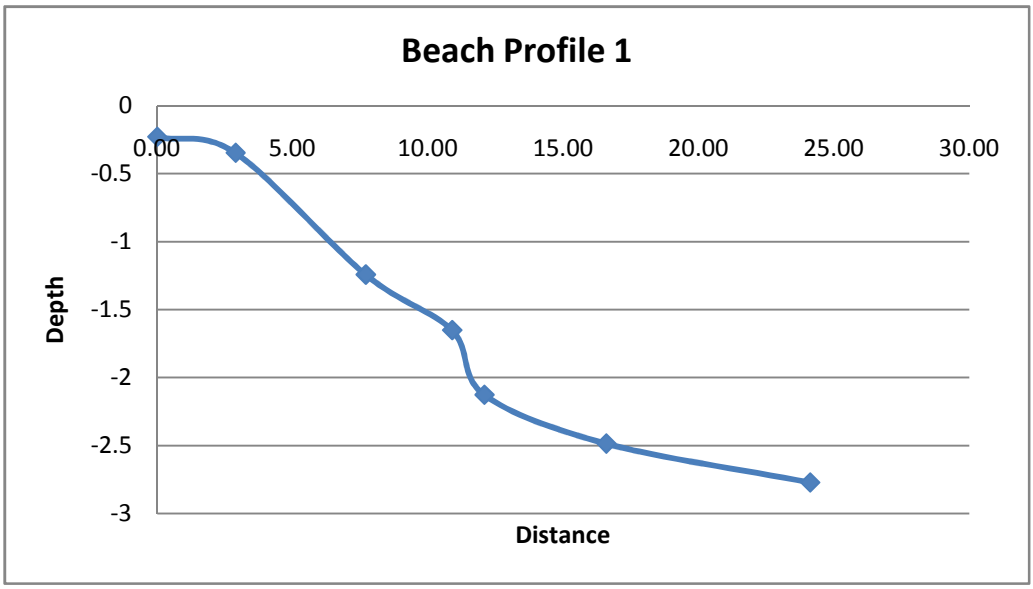

Figure 22: Infront of the restaurant

Profile 1 (Fig. 22) had nothing but sand at the time of the visit and it can be seen that the lagoon gets rapidly deeper from the beach trough, located 12 m from the start of the profile.

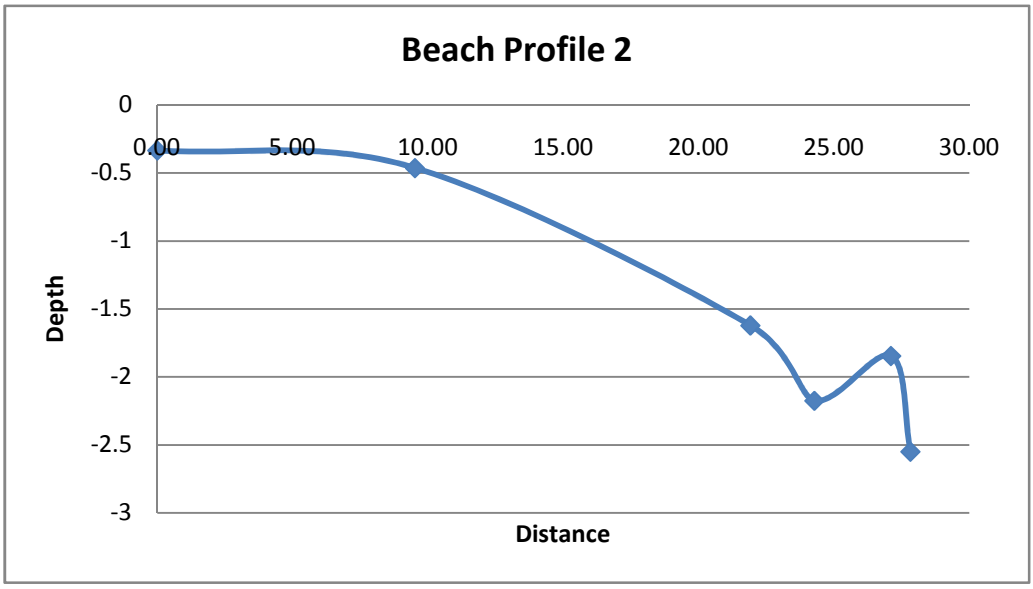

Figure 23: Near the main jetty

The beach is quite high in the area and the rise in the graph is where there was beach rock and concrete blocks.

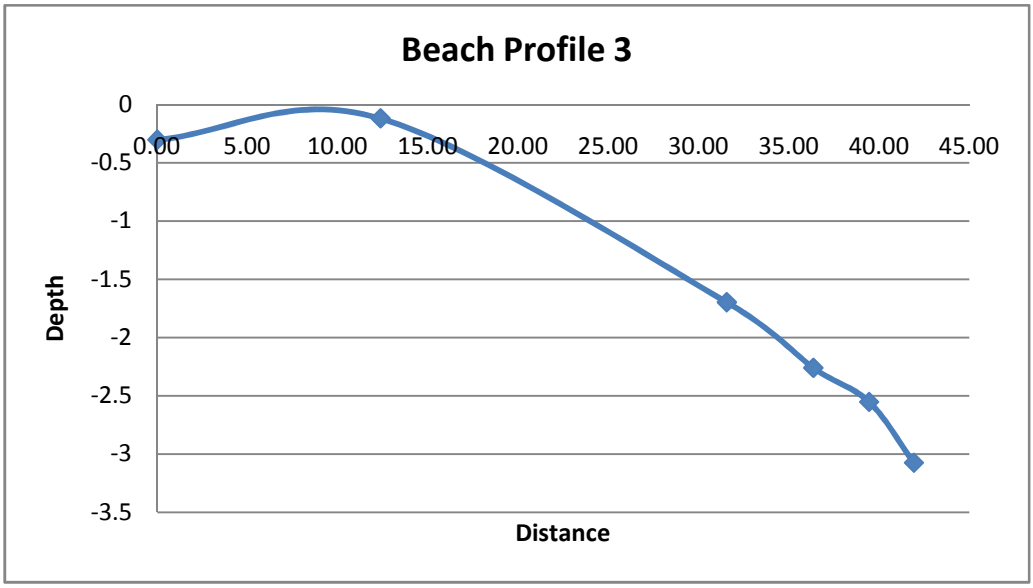

Figure 24: In front of the water sports centre

In front of the water sports centre (Profile 3, Fig. 24); higher waves are reaching the shore. The sand is fine and the profile is that of a nice beach during the southwest monsoon. The water is deep not very far from the shoreline.

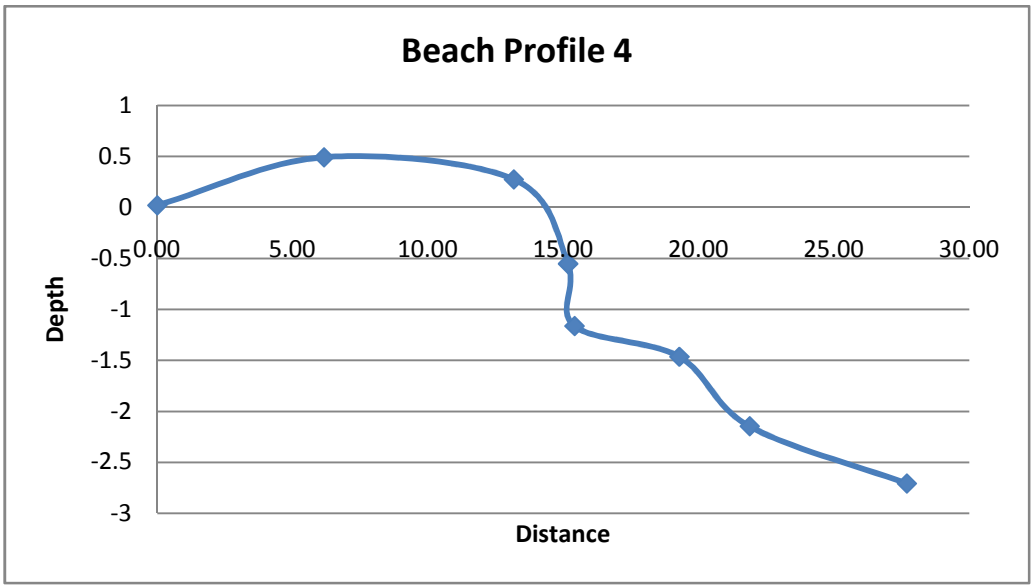

Figure 25: Southern tip of the island

Sand has been pumped inside some geo-textile pockets to retain the sand. The swells coming and pounding on the beach are very strong since this area is exposed to the ocean side. The sudden dip in the graph is where the containers end, also we can see from the graph that it gets deeper just after 5 meters from the containers. This area is the most affected area from the waves.

Figure 26: Geo-textile pockets retaining the sand on the south-western corner of the island

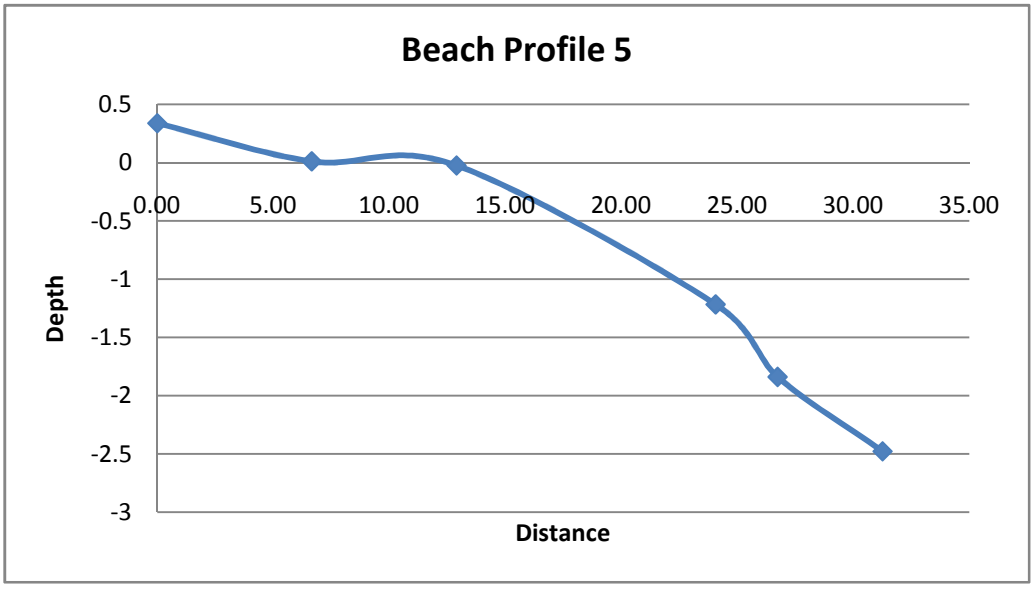

Figure 27: beach profile 5, 30 m north of the reclaimed area

The beach on the south western side of the island looks comparatively good and it seems that the beach was getting bigger which can be due to the change in monsoon. Important sediment movement was observed.

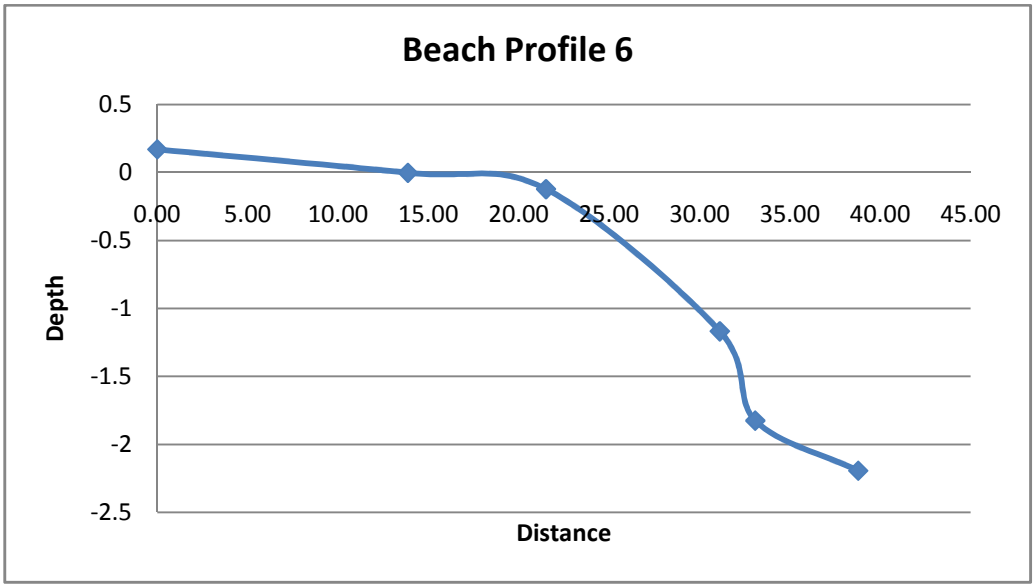

Figure 28: Western side near the refreshment hut

The beach is getting closer to the reef and from the graph we can see the sudden trough in the beach profile where it reaches up to depths 2.5m before reaching the reef flat. In general the beach is in good condition.

4.5.2. Beach profiles taken on the north western tip of the island.

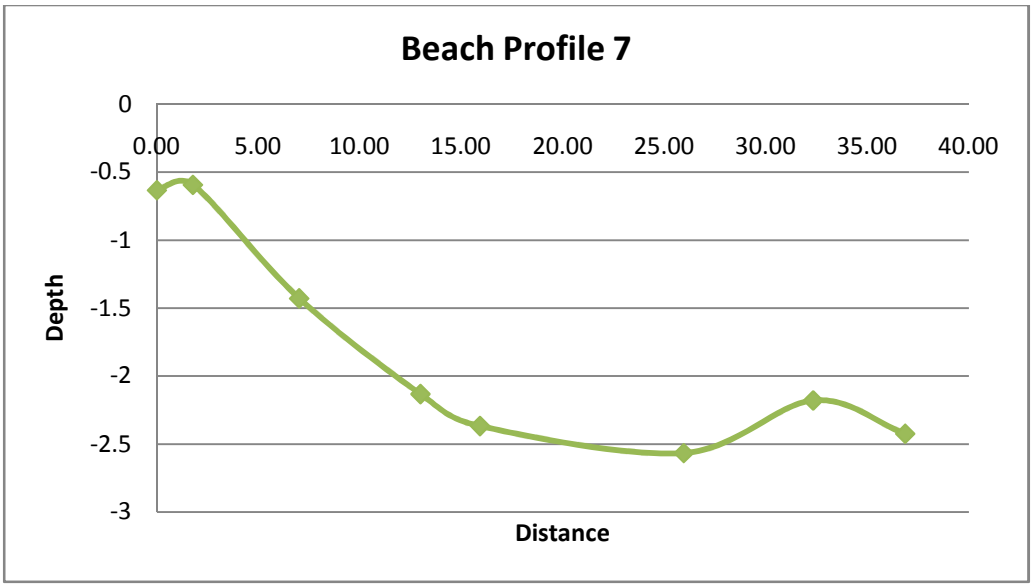

Figure 29: Near to the western end of the water villas

The rise in the graph is at 32m from the start of the profile is due to the presence of beach rock, which probably denotes a larger island in that area. This part of the island is exposed the swell refracted around the Vandhoomaa faru.

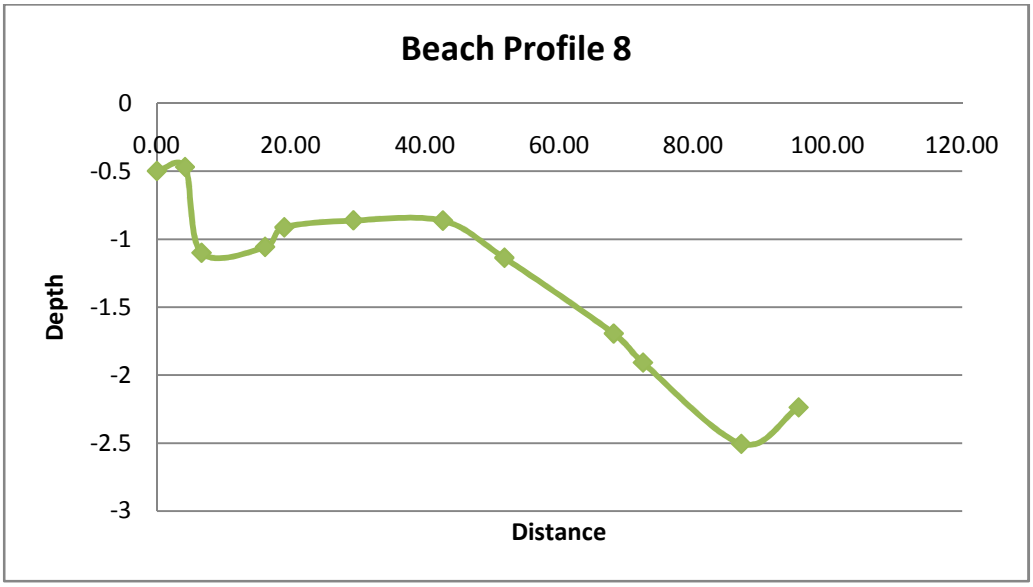

Figure 30: Near the walk way of the water villas

Profile 8 is along the northern sandy tip extending north of the island. The crest consists in a micro cliff at about 4 meters into the profile which marks the maximum of erosion and vegetation loss noticed previously. Further into the profile, the sand level is rising thanks to some structures made of jute bags filled with a cement and sand mix implemented by the management to hold back the sand. At the end of the profile, beach rock is present, denoting a more northward position of the island in the past.

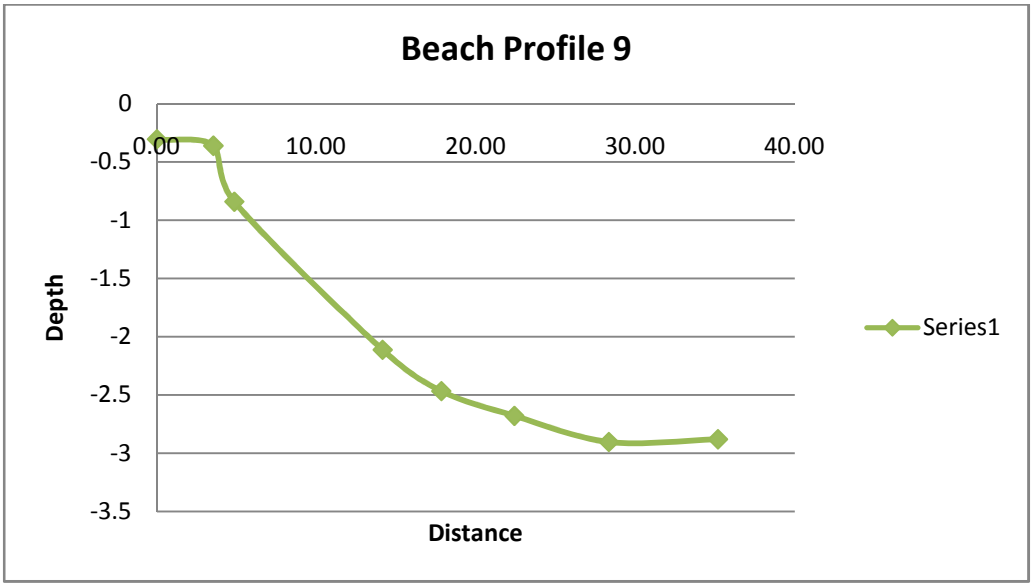

Figure 31: near the end of the water villas to the east

The beach starts to get steadier from this profile onwards towards the south again. Lots of small rocks were observed in this profile. In this part, a micro cliff is still present due to scouring during the northeast monsoon. The beach face is accumulating sediment during the southwest monsoon.

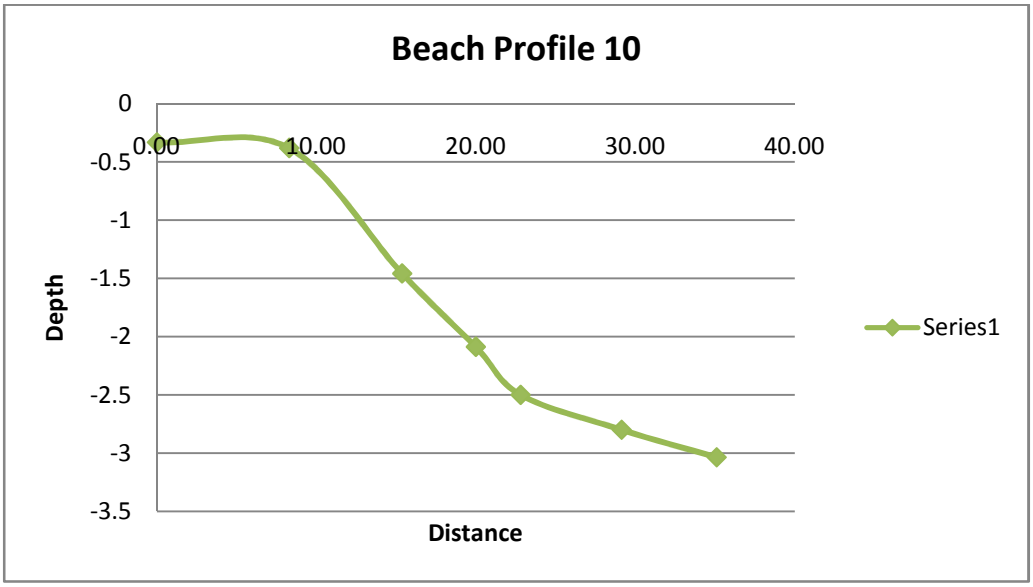

Figure 32: Near the spa area

The beach gets wider from this point on wards. Yet it was observed that the waves were able to reach the vegetation line during the high tide. The weather was windy when the profiles were taken.

4.6. Reef status

4.6.1. Survey plan

The coral reef environment was surveyed on 16th June 2010. To assess the benthic cover 6 photographic transects were carried out on the reef. The areas surveyed have been chosen to serve as a baseline to assess anticipated impacts occurring during the construction and operational stage. The fish life was visually assessed around the island.

Figure 33: survey site plan showing the different transects around the island

The following table (table 1) is giving the geo-coordinates of the different transects.

Table 1: the geo-coordinates of the transect carried out to assess the benthic substrate

Transect	Latitude (^{o} N)	Longitude (^{o} E)
Transect 1	5.2568665	73.1624629
Transect 2	5.2541738	73.1622723
Transect 3	5.2525629	73.1642887
Transect 4	5.2529667	73.1645939
Transect 5	5.2539667	73.1650215
Transect 6	5.2549643	73.1652964

4.6.2. Results

The results obtained on the different transect with the subdivisions of the abiotic substrate is shown in the table below (Table 2) and in graphic form without the separation of the abiotic substrate (Fig 33).

Table 2: results of the transect with separation of the abiotic substrate into its components

MAJOR CATEGORY (% of transect)	T1	T 2	T 3	T 4	T 5	T 6	Average
CORAL	12.10	11.38	6.40	2.40	8.80	8.20	8.21
OTHERS	0.00	1.63	0.80	0.80	0.00	1.64	0.81
ALGAE	34.68	20.33	19.20	28.00	16.80	66.39	30.90
PAVEMENT	29.84	30.89	8.80	27.20	17.60	16.39	21.79
RUBBLE	18.55	25.20	34.40	21.60	42.40	6.56	24.78
SAND	4.84	8.13	23.20	2.40	14.40	0.00	8.83
SILT	0.00	0.00	1.60	16.80	0.00	0.00	3.07
DEAD CORAL	0.00	2.44	5.60	0.80	0.00	0.82	1.61

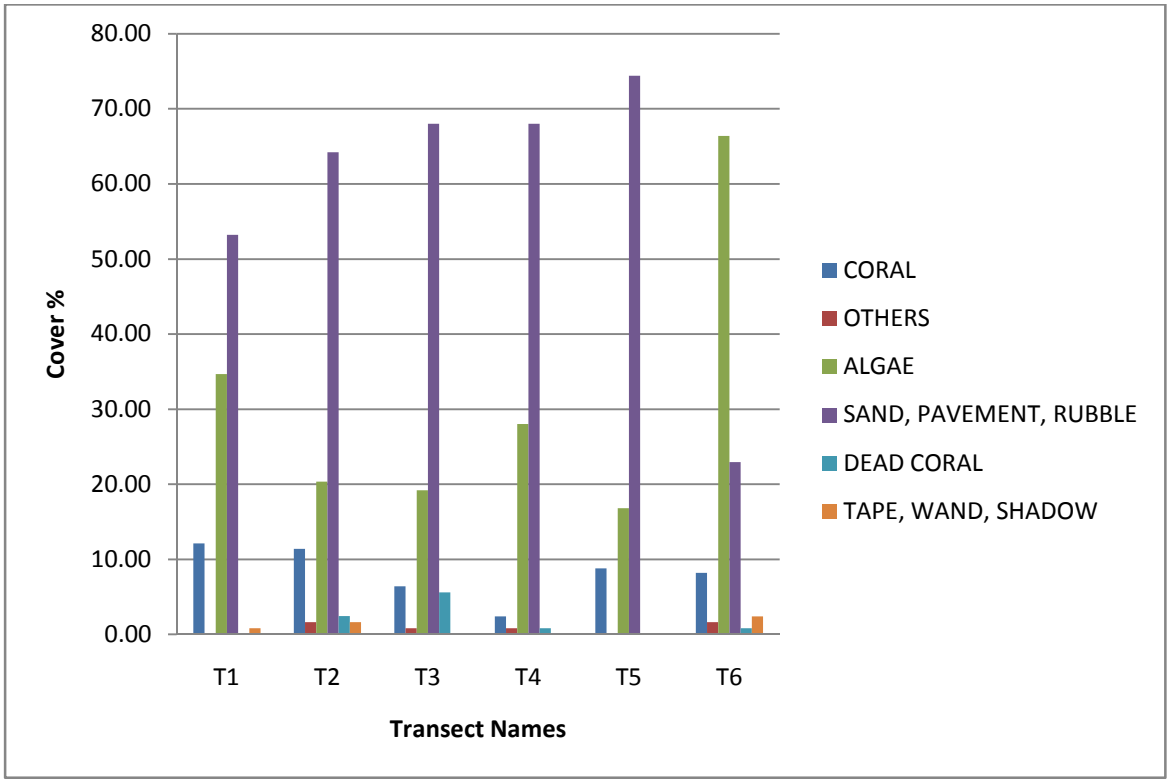

Figure 34: Subdivisions of the abiotic substrate

With an average of 8 %, the reef still does not show much recovery from the 1998 bleaching event. The present survey carried out during the bleaching event of 2010 also shows that close to 25 % of the corals present were bleached (Fig 33).

Figure 35: a large colony of Pavona clavus exhibits bleaching and necrosis on the western side of the island due to the recent high sea surface temperature event.

It is also possible that corals do not grow on the western side due to high turbidity and sedimentation. This is due to the presence of sediment on the western reef flat, in particular on its southern side, which causes the sediment to be resuspended by wave action. Due to the coastal modification brought about to tackle the erosion problem on the southern side, the sandy tip in that area has been moved northwards and westwards to the edge of the reef. The sediment resuspension is illustrated in the following figure (Fig 35) where the sediment plume from the reef flat is highly very visible.

Figure 36: The sediment plume originating from the reef flat contrasts with the deeper less turbid waters.

The pavement is heavily colonized by algae. Coralline algae dominate this category on the western reef flat whereas a turf alga is dominant on the eastern side. This could also be due to the lesser presence of rubble and sand especially on transect 6, which is more like a patch reef above the reef flat, probably the remains of a previous reefal construction which has not been able to form a continuous crest.

The two transects T3 and T 4, which are the most likely to be affected by the coastal works envisaged exhibit very little live corals, respectively 6.4 % and 2.4 %.

4.7. *Methods used for field assessment*

4.7.1. Methodology

4.7.1.1. *Water Quality*

Seawater samples were collected from the areas where the new developments will take place, northern and the southern coasts of the island, at the base and at the tip of the jetties.

For testing of physical and chemical parameters, empty plastic water bottles were flushed with the water and then filled with the same, collected at mid depth. The bottles were then promptly stored in ice boxes. Chemical tests were carried out using the Hach method. We would like to notify the Authorities that Physical or Biological tests cannot be carried out at present in the Maldives.

4.7.1.2. *Climate*

Climate data was collected from Department of Meteorology stations at the regional and international airports. In addition, data from the NASA Scatterometer on board the satellite QuikSCAT was used to construct wind roses.

Satellite and aerial photos as well as field observations were used to assess the wave regime around the island.

4.7.1.3. *Topographic Survey*

A survey of the area concerned was carried out using a total station and a prism. Levels were recorded as well as horizontal positions relative to fixed benchmarks on the island. During the survey, remarks on the substrate types at each point were also taken for further analysis. All the survey data was analyzed using Microsoft Excel and AutoCAD.

4.7.1.4. *Marine Environment*

4.7.1.4.1. Sampling methods

4.7.1.4.1.1. *Photographic transects*

Photographic transects were carried out to assess benthic cover of the six reef slope sites. Map observation prior to field survey enabled to determine the areas to characterise, and emphasis has been given to areas the most likely to be impacted as well as a control site which is situated away from the construction areas. However the exact site locations were chosen only during field observations in order to adapt the survey to the reef patterns.

Observation of the entire area was necessary prior to carrying out transects because the operator had to choose a survey site with a representative pattern in terms of species and homogeneity. Once chosen, the operator randomly took 10 photos in line at a depth between 1 and 3 metres to avoid any bias.

For each site, pictures have been analyzed using CPCe software. It enables to randomize 20 points per picture and attribute benthic data for a quantitative and qualitative survey. Each photo result is automatically grouped in a table presenting the means and standard deviation of each benthic substrate groups.

4.7.1.4.1.2. *Impact Identification Methodology*

Impacts on the environment are divided into two main categories: impacts during construction and impacts during operations.

4.7.1.4.1.3. *Impacts during construction*

The impact prediction methodology for constructional impacts starts with the identification of the potential impact area from the development. There is, in this category a difference made between direct physical damage and indirect impacts, for example, the direct and indirect impact which could arise from turbidity plumes.

Therefore, the extent of the damage area very often follows natural features, such as shoreline and streamline of hydrodynamic patterns.

Once the location was defined, the activities taking place at the site were listed and their impacts on the environment were identified. The impacts were predicted using the following:

- The results of field surveys, along with consultations with project manager and engineers
- Impact prediction was also based on experience from similar projects carried out previously.

Finally, the magnitude of the impact was inferred based on the conditions at the site and experience from previous projects.

4.7.1.4.1.4. *Impacts during operations*

For the operational impacts, the process starts with the identification of the factors, which potentially differ from the existing conditions before the works, and the situation once the works are completed. The impacts are mostly linked to the Shore line and to the coastal dynamics of the island; however the guests' activities can also significantly impact the environment.

4.7.1.4.1.5. *Impacts ratings*

The results from the survey presenting the natural environment in the considered area were then used to assess how the changing conditions will affect the existing environment. The significance of the impacts were predicted based on the experience gathered over years of observations, the magnitude and the duration of the exposure to changing condition as well as the long lasting changes caused to the natural processes. The negative impacts on the environment have been considered in the worst-case scenario in order to emphasize the need for mitigation and try to minimize the impacts. The importance of each impact was rated along a scale from very negative (---) to very positive (+++). When the impact is not very significant, it is stated as negligible.

4.7.1.4.1.6. *Limitations in impact prediction*

Even though a thorough brainstorming occurs when assessing the impacts, there is always a possibility for some of the impacts to have been disregarded, either that they do not have been noticed in the past or that the effects and causes have not been related. Therefore there is an intrinsic limitation due to the limitation of our knowledge itself.

The lack of previous devoted studies or careful monitoring creates a lack of information as to the extent and magnitude of the impacts encountered in other similar, and in many case it is difficult to ascertain the significance of impacts, which remains subjective to the field experience of the consultant and observations of the proponent.

There is often a discrepancy between the understanding of the consultant and the work methods carried on site by the contractor. Even though the environmental follow up of the project is supposed to reduce these discrepancies, it is clear that there is an inherent risk of misunderstanding.
Furthermore, there is always a possibility that uncertainties about related decisions such as planning, negotiation, coordination, etc., affect the accuracy of prediction in EIA process.

5. ASSESSMENT OF THE SIGNIFICANT EFFECTS

5.1. *Description of Impacts on the Natural Environment*

5.1.1. Disturbance of sea bed

The top layers of the sea bed will be disturbed in the project area. It is colonized by an array of living organisms such as worms, shells and echinoderms etc... These will be exposed and suspended into the water column when the excavator and the sand

pump operate. Most of these will be eaten by the fish, in particular wrasses, which are not hindered by the turbid conditions. On the other hand some fish, such as gobies, will lose their habitat and could fall prey to other fish when they move away in search of a new habitat. The concerned species usually have very short life cycles, and colonization of the area after the end of the disturbance will be rapid.

5.1.2. Cement spillage and leachate

When cement is poured into the jute bags, some concrete may spill or leach into the sea, thus some cement is release into the environment. It has to be emphasized that cement is of a very similar composition as the corals themselves. In small quantities, the harm to the environment will be negligible. In addition, the finishing touches of the groyne will be carried out at low tide, and the cement will have already dried before the tide comes up again.

5.1.3. Alteration to water flow and sediment transport

The current sediment transport is not natural to the island as so many coastal structures have been implemented to counter the erosion problems. In particular, the sandy tip on the south-western side has shifted north after the implementation of the southern structures and has been covering the reef partly on the south-western side. In addition to providing direct protection to the affected areas, the project will aim to restore the natural sand processes and prevent the sandy tip from moving too far north. It is therefore expected that the impact from the project will be positive not only for the island stability but also on the coral reef which will become less sedimented.

5.1.4. More durable structures without goni bags

Previously the structures have been made with goni bags maintained in place in some GI pipe maintained nets. The goni bags, whether put in these structures or at the top of the beach face have a tendancy to break apart, especially under the high UV radiation present. The sand then spill and often the empty bags is washed away by the tides and waves. These unfortunately can be later entangled in the corals, eaten by fish, etc...and cause their death.

5.1.5. Noise, smell and other disturbances to habitat

When excavating, some material will have to be carried to the disposal area using different machinery. These will usually emit a fair amount of black smoke which will disturb the habitat. Also the noise pollution from the machinery will scare the wildlife and birds in particular will not be able to roost in these areas during construction. Given the short time scale of the project, and the fact that the area has already been built, this does not represent a significant threat.

5.1.6. Green house gas emissions

The green house gases that are emitted increase the global world emission, which contributes to the increase in the global warming effect. The overall amount, of course, is very limited compared to the general fuel consumption in the world, and even at the scale of the result will only represent a few percent of the resort output. The principal source of fuel consumption during this operation will be the machinery, which will use up to 1500 l of fuel.

5.1.7. Increased aesthetic and structural stability

The area considered is a major recreation area for the guests and the entire work will directly affect the beach in front of the water sports centre and all along the shore of the island. It is expected that the presence of a new sandy area will increase the aesthetics enabling the guests to relax on beach by the sea.

The most south-eastern bungalow was undermined and the passage difficult around the corner of the island. The water world and the bungalows (4 of them) around the area were under threat repeatedly. It is expected that the present work will reliably stabilize the area.

6. PROJECT ALTERNATIVES

6.1. *No-project scenario*

If the project does not take place, the island will continue to lose its shoreline and face operational hindrances, when resorts strive to provide the best possible standards to their guests.

In addition, the management will have to continue with the previous ad hoc methods which have a bad environmental impact as mentioned previously.

The maintenance costs will continue to be high, not allowing for the resort to devote means to other important areas.

6.2. *Alternative solutions*

Another envisaged solution was to reclaim part of the land on the south-eastern corner and secure it with a revetment. This would have securely stabilized the island but divided the sediment transport processes on this part of the island.

The aesthetic improvements were judged less beneficial to the island and the guest experience would have been impaired by the “unnatural feel” of the revetment.

6.3. *Alternative borrow area*

Different sandy areas are present around the island, where sand could be taken to carry out the beach reclamation and filling of elcorock bags. The problem is that they are away from the project area and will therefore more effort and fuel consumption to be transported to the site. In addition, and as mentioned earlier, the southern tip is the natural downstream part of the sediment transport process, ensuring that sand retrieval will not affect any other part of the island. What is more, the sediment plume will drift towards the east and not affect corals as it could happen in other locations.

7. MITIGATION MEASURES

The practical actions to mitigate or compensate for the significant effects are discussed in the following paragraphs.

7.1. Sediment plumes creation and sedimentation

Sand is pumped into the Elcorock, which are extremely robust geotextile containers to be filled with sand, soil, gravel, recycled material, treated materials or a combination of the above such that they form a stable, durable and solid container. Using special machineries they are filled and then compacted using hydraulic gears to stabilize the structure. The Elcorock retains the sand inside and allows the water to pass out of it cutting down the amount of silt passing into the sea. Also these materials can be filled on land itself and then placed in an area that needs protection which can reduce the amount of silt passing into the sea. Elcorock pumped inside means less silt in the water so less silt on the surrounding corals.

In addition, a sediment plume will be created when replenishing the beach on the southern side, the works will be carried out during the southwest monsoon, so that the sediment plume would be transported to the east, where the substrate consists in a sandy slope, which will not be affected by sedimentation.

Noise, smel

7.2. Summary table of impacts and ratings

7.2.1. Impact during construction

Table 3: Direct Impacts expected to arise from the project during the construction phase

Activity	Site of Impact	Component	Impacts	Rating	Mitigation	Final rating
Transport of construction material	Southern tip/storage area	Machinery	Green house gas emissions	negligible		negligible
		Unloading and dispatching	Solid waste from the construction material can be released into the environment	-	Waste management practices have to be strictly implemented	negligible
Fill Elcorock bags	Filling area	Storage of solid wastes	Wastes can be dispersed in the environment	-	Waste management practices have to be strictly implemented	negligible
		Transport and disposal	Release of solid wastes in the environment	-		
Sand Pumping	Eastern / Southern tip of the island	Beach replenishment	Sedimentation and silt plumes will be created	--	More environmentally friendly materials used (Elcorock), works done during southwest monsoon	negligible
Machinery Operation	Project site	Machinery Used	Disturbances to the wild life	-	Speed operations	negligible

7.2.2. Impact during operation

Table 4: Indirect Impacts expected to arise from project during the operation phase

Activity	Site of Impact	Component	Impacts	Rating	Mitigation	Final rating
Beach maintenance	Island coastline	Coastal modification	Changes to former water flow and sediment transport. Restoration of a more natural sediment transport and island shape	++		++
	Groyne	Goni bags	Costly and not environment friendly, Can be broken down easily, Aesthetically not appealing	--	Use Elcorock bags	++
		Seawall structure	Sand leaking from the structure can produce some sediment movement	-	A geotextile layer will prevent sand leakage	Negligible

The mitigation measure proposed for the negative impacts arising from the project are summarised in Tables 3 and 4.

8. MONITORING PROGRAM

Monitoring is the systematic collection of information over a long period of time. It involves the measuring and recording of environmental, social and economic variables associated with the development impacts. Monitoring is needed to;

- Compare predicted and actual impacts
- Test the efficiency of mitigation measures
- Obtain information about responses of receptors to impacts
- Enforce conditions and standards associated with approvals
- Prevent environmental problems resulting from inaccurate predictions
- Minimize errors in future assessments and impact predictions
- Make future assessments more efficient
- Provide ongoing management information
- Improve EIA and monitoring process

The before-impact data collection at Fonimagoodhoo was carried out during baseline surveys in June 2010. Baseline survey is carried out to quantify ranges of natural variation and/ or directions and rates of change that are relevant to impact prediction and mitigation. A set of reference data was obtained from these surveys, which can be used during the construction and operation phases to evaluate whether the predicted impacts occurred and to test the efficiency of the mitigation measures that will be implemented.

To compare predicted and actual impacts occurring from project activities and to determine the efficiency of the mitigation measures an environmental impact monitoring and a mitigation monitoring are carried out. This type of monitoring is targeted at assessing human impacts on the natural environment. By monitoring the actual impacts, the environmental risks associated with the project can be reduced. Impact monitoring is supported by an expectation that at some level, anthropogenic

impacts become unacceptable and action will be taken to either prevent further impacts or re-mediate affected systems. Mitigation and monitoring, aims to compare predicted and actual (residual) impacts, and hence to determine the effectiveness of mitigation measures.

In summary, environmental monitoring can:

- Illustrate the extent of environmental effects and resource losses
- Provide scientific information on the response of the environment to human activities and mitigation measures
- Provide data that can be used in the environmental auditing for management purposes.

All monitoring activities will be carried out under the supervision of the environmental consultants. The details of the monitoring program are given in Table 5.

Table 5: Environmental Monitoring Plan for Fonimagoodhoo

Monitoring Parameter	Phase	Methodology	Indicators	Sampling Frequency	Estimated Cost
Coastline	Construction/ Operational	Beach level survey	• Erosion or accretion • Changes to the beach profile • Sand movement around island	Every 6 months	USD 1000/ survey
Coastline	Construction/ Operational	Photography	• Erosion or accretion • Changes to the beach profile • Sand movement around island	Every 6 months	USD 200/ survey
Benthic substrate	Construction/ Operational	Photo transects	• Percentage live coral cover and other benthic substrates	Just after construction and every 6 months following that	USD 1000/ survey
Seawater quality	Operational	Test of the seawater parameters	• Salinity, Turbidity, COD, pH, nitrate, suspended solids	Just after construction and every 6 months following that	USD 500/ survey

Summary reports will be submitted to the Ministry of Tourism and Civil Aviation according to the requirements of the Ministry and the Ministry of Environment, Energy and Water. This report will include the results of the monitoring carried out on Fonimagoodhoo according to the monitoring plan.

9. Declaration of the Consultant

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

Name: Mariyam Rozlyn Saleem

Signature:

Date: 07/07/2010

APPENDICES

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

Terms of Reference for Environmental Impact Assessment

The following is the TOR based on the scoping meeting held on 26th May 2010 for undertaking the EIA for the **proposed Coastal Works at Reethi Beach Resort, Fonimagoodhoo, Baa Atoll, Maldives**

1. Introduction - Identify the development project to be assessed and explain the executing arrangements for the environmental assessment.

2. Study Area - Specify the boundaries of the study area for the assessment as well as any adjacent areas that should be considered with respect to the project.

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

Task 1. Description of the Proposed Project –Following things shall be provided in the project description.

a) *Brief description of the proponent and proposed project components. A full description of how the project activities will be undertaken including work method for constructing structures in the coastal environment, how matured trees will be removed(if it is to be done), project concept, duration and schedule of the project, the relevant parts of the project, need and justification of the proposed changes.*
b) *Clearly labeled site plan of the redevelopment indicating the location of proposed activity and all the changes, site plan indicating all existing structures shall also be included, using maps at appropriate scales where necessary.*
c) *inputs(e.g. manpower, machineries, energy and materials) and outputs(e.g. length of protection, quantity of sediment pumped) related to the proposed activities, project costs, their need and justification*

Task 2. Description of the Environment –a description of the existing environmental conditions of the project site with photos of the site where relevant. Consideration of likely monitoring requirements should be borne in mind during survey planning, so that data collected is suitable for use as a baseline. As such all baseline data must be presented in such a way that they may be usefully applied to future monitoring.

Specific emphasis should be placed on the following environmental aspects of the project:

- *Describe the coastal configuration of the project location and affected areas.*
- *Bathymetry and hydrodynamic regime around the project area*
- *Baseline reef status*
- *Sea water quality parameters shall specifically include; dissolved oxygen, salinity, pH, temperature and turbidity, sulphate, nitrates, COD*
- *Methods used for field assessment*

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

All survey locations shall be referenced with Geographic Positioning System (GPS) including sampling points, reef transects, vegetation transects, manta tows and soil sampling sites. All water samples shall be taken at a depth of 1m from the mean sea level or mid water depth for shallow areas. At least two benchmarks shall be used when undertaking the baseline assessments. The report should outline the detailed methodology of data collection utilized to describe the existing environment.

Task 3. Legislative and Regulatory Considerations - Describe the pertinent legislation, regulations and standards, and environmental policies including carbon neutral policy that are relevant and applicable to the proposed project.

Task 4. Determine the Potential Impacts of the Proposed Project – The EIA report should identify all the impacts and shall determine and analyze all the significant impacts for the proposed redevelopment. Particular attention shall be given to impacts associated with the following:

- *Impacts on coral reef, reef flora and fauna due to turbidity and sedimentation*
- *Changes in hydrodynamics and sediment transport in the area and around the island, with long term forecast outcomes.*

It should also describe the methods used identify the significance of the impacts outlined. In particular, the impacts should be described for both during the construction stage and also during the operational stage. The report should outline the uncertainties in impact prediction and also outline all the positive and negative: short and long-term impacts. Identify impacts that are cumulative and unavoidable.

Task 5. Analysis of Alternatives to the Proposed Project. – Describe the

a) Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". This includes alternative technologies, demolition methods, material, designs, locations of water villas, alternative options for coastal protection etc and mitigation options should be specified for each component of the proposed project. Also alternatives in terms of burrow areas must be included.

b)Atleast three alternatives should be discussed including no development option. Determine the best practical environmental options. And mitigation measures must be described for the alternative.

Task 6. Mitigation and Management of Negative Impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels with particular attention paid to sediment control during dredging and construction of coastal structure. Mitigation measures must also be identified for both construction and operation phase. Discuss the feasibility and cost effectiveness of each mitigation measures and provide cost of the mitigation measures, equipment and resources required to implement those measures. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included. An Environmental management plan for the proposed project, identifying responsible persons, their duties and commitments shall also be given. In cases where impacts are unavoidable arrangements to compensate for the environmental effect shall be given.

Task 7. Environment Management Plan and Monitoring – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan. Detail of the monitoring programme including the physical and biological parameters for monitoring, reasonable time

period and schedule should be outlined for environment monitoring in both construction and operational phase and cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting time table and ways and means of undertaking the monitoring programme must be provided.

Task 8. Stakeholder Consultation – Major stakeholder consultation to include Ministry of Tourism Arts and Culture, Environment Section of Ministry of Housing, Transport and Environment and any other relevant stakeholder including the engineers/designers and management and staffs of the resort. EIA report should include a list of people/groups consulted and the methodology of consultation.

Presentation - The Environmental Impact Assessment Report, to be presented in print and digital format, will be concise and focus on significant environmental issues. It will contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations for any references used in interpreting those data. The environmental assessment report will be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Report, 2007.

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

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27 June 2010

References

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Ministry of Home Affairs and Environment (MHAE). (2004). Identification of Existing Barriers to the Provision of Effective Solid Waste Management Services within the Maldives and Recommendations for their removal. Male': MHAE.

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Hiscock, K. & Breckels, M. 2007. Marine Biodiversity Hotspots in the UK. A report identifying and protecting areas for marine biodiversity. WWF UK.

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Iping Petterson, I. Chemistry and ecology of a coral encrusting marine sponge, *Terpios spp*, from Guam. http://www.nova.edu/ncri/11icrs/abstract_files/icrs2008-002324.pdf

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Stampar, S.N., Da Silva, P.F. and O.J. Luiz Jr (2007) Predation on the zoanthid *Palythoa caribaeorum* (Anthozoa, Cnidaria) by a Hawksbill turtle (*Eretmochelys imbricata*) in Southeastern Brazil. Marine Turtle Newsletter 117 : 3-4.

Langmead, O. and N.E. Chadwick-Furman (1999) Marginal tentacles of the corallimorpharian *Rhodactis rhodostoma*. 1. Role in competition for space. Marine Biology 134 : 479-489

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http://www.seaworld.org/Animal-info/info-books/sea-turtle/diet.htm

http://conservationinstitute.org/anemonebarrens.htm

CRC Reef Research Center Ltd. Crown of thorn starfish. http://www.reef.crc.org.au/discover/plantsanimals/cots/index.html

Ifrecor, Initiative française pour les récifs coralliens. http://www.ifrecor.nc/Acanthaster

Kurugu, B.L., Mgaya, Y.D., Öhman, M.C. and G.M. Wagner (2004) The reef environment and competitive success in the Corallimorpharia. Marine Biology 145 : 875-884

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Richmond, M.D. (ed.), 2002. A field guide to the seashores of Eastern Africa and the western Indian Ocean islands. Sida/SAREC – UDSM. 461 pp.

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Miller, M.W. & Sluka, R. D., 1999. Patterns of seagrass and sediment nutrient distribution suggest anthropogenic enrichment in Laamu Atoll, Republic of Maldives. Marine Pollution Bulletin, 38 (12) : 1152-1156.

Bers,A.V., 2005. Biodiversity assessment for Maldives' Baa Atoll. Baseline information for UNDP's Atoll ecosystem-based conservation programme. UNDP Maldives – Ministry of Environment, Energy and Water Maldives. 47 pp.

Environmental Impact Assessment Team

The EIA for the development of the Resort was carried out by Seamarc Pvt. Ltd. with an experienced professional team lead by Ms Mariyam Saleem (EIA Consultant No. EIA05/07). Following are the Curriculum Vitae of the team members:

CURRICULUM VITAE of MARIYAM SALEEM

PERSONAL DETAILS

Name: Mariyam Rozlyn Saleem

Nationality: Maldivian

Gender: Female

Date of Birth: 1st of September 1974

Marital Status: Married with two children

Languages: Dhivehi, English and French Present address for communication:

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Email: marie@seamarc.com

EDUCATIONAL QUALIFICATION

SECONDARY EDUCATION: 1991-1993 Woodstock School, Mussoorie, U.P, India
High School Diploma

May 1993 - **Advanced Placement**
1981-1991 Aminiya School, Malé
Republic of Maldives
GCE O' level

TERTIARY EDUCATION: **Bachelor of Science** (Marine Biology)
July 1996 - June 1997 - University of the South Pacific, Fiji
July 1997 - July 1999 - James Cook University, Australia
Conferred in August 1999

Master of Applied Science (Protected Area Management)
James Cook University February 2002 – April 2004

Conferred in May 2004

EMPLOYMENT HISTORY

28.06.00 – ongoing	Environmental Manager	Seamarc Pvt. Ltd.
08.05.04 – ongoing	Senior Research Officer	Marine Research Centre Min. of Fish, Agri. & Mar. Res.
28.07.99 – 08.05.04	Research Officer (Grade 3)	Marine Research Centre Min. of Fish, Agri. & Mar. Res.
29.11.94 - 30.06.96	Research Assistant	Marine Research Section Min. of Fish, Agri. & Mar. Res.
23.08.93 - 28.11.94	Marine Biology Trainee	Marine Research Section Min. of Fish, Agri. & Mar. Res.

WORKSHOPS AND SEMINARS ATTENDED

Workshop held on the "Introduction of Reef Resources Management Handbook", Vaavu & Meemu Atoll, 1994

Involved in the International Coral Reef Initiative Workshop 1995, Bandos Island Resort.

Workshop on Integrated Reef Resources Management 1996, MCSE, Malé.

CORDIO Workshop on Survey Design and Data Analysis 23-30 January 2000, MRC, Malé'.

Workshop on Monitoring the Social, Economic and Environmental Impacts of Tourism in the Maldives 27 January 2000, Nasandhura Palace Hotel, Malé.

Introduction and demonstration of Marine GIS to conduct the spatial analysis for fisheries and oceanographic data 27 March 2000, MRC, Malé.

Training Workshop on Climate Change Vulnerability and Adaptation Assessment 17-27 April 2000, Bandos Island Resort, Maldives.

GCRMN Training Workshop on Coral Reef Survey Design and Data Analysis 1-8 May 2000, Chennai, India

First Regional Workshop on Conservation of Biodiversity 15-18 July 2000, AA. Mahibadhoo, Maldives

Third Regional Workshop on Conservation of Biodiversity 25-26 August 2000, Seenu Gan, Maldives

Fourth Regional Workshop on Conservation of Biodiversity 15-16 September 2000, Baa Eydhafushi, Maldives

Fifth Regional Workshop on Conservation of Biodiversity 13-14 October 2000, Meemu Muli, Maldives

9th International Coral Reef Symposium 23-27 October 2000. Bali, Indonesia

Sectoral Workshop on Conservation of Biodiversity 6-7 November 2000, Hulhulé, Maldives

GCRMN Evaluation Meeting Phase II March 2001, Male', Maldives

GCRMN Database Evaluation Meeting June 2001, Colombo, Sri Lanka

National Workshop on Conservation of Biodiversity September 2001, Male', Maldives

Workshop on Protected Areas: IUCN categories November 2001, Male', Maldives

Workshop on Code of Conduct for Responsible Fisheries January 2004, Male', Maldives

10th International Coral Reef Symposium 28 June – 2 July 2004, Okinawa, Japan

Technology Needs Assessment for Climate Change: First Workshop on Technology Needs Assessment Methodology 22 – 24 November 2004, Hulhule', Maldives

Inception workshop on the "Preparation of National Adaptation Plan of Action" (NAPA) Project 25 November 2004, Hulhule', Maldives

Inception workshop on AEC – AEC Baa Atoll Project July 2005, Hulhule', Maldives

First Workshop on the Development of a National Waste Management Strategy December 2005, Hulhule' Island Hotel, Maldives

Second Workshop on the Development of a National Waste Management Strategy May 2006, STELCO Seminar Room, Male', Maldives

National Biodiversity Strategy and Action Plan (NBSAP) and National Development Plan 7 Review Retreat – Atoll Ecosystem Conservation Project and National Climate Change Project, July 2006, Paradise Island, Maldives

NAPA Workshop on Identifying and Prioritisation of Adaptation Measures, September 2006, Bandos Island Resort, Maldives

Roundtable on Coastal Erosion and Disaster Risk and Vulnerability, September 21, 2006 - Male, Maldives

Regional Resource Coordination and Mobilisation Workshop for the Long-term Management and Conservation of MCPAs in South Asia, September 2006, Colombo, Sri Lanka

Environment and Disaster Risk Assessment of Islands in the Maldives, December 2006, Hulhule' Island Hotel, Maldives

SAARC Expert Group Consultation on Coastal Zone Management, April 2007, Dharubaaruge, Male', Maldives

Workshop on the Development of a Grouper Management Plan, April 2007, Dharubaaruge, Male', Maldives

National Consultation on the Fisheries Sector Master Plan, May, Islamic Centre Conference Hall, Male', Maldives

WORK EXPERIENCE

Was involved in the Integrated Reef Resources Management Programme, MRS & BOBP. This project was carried out in Vaavu, Meemu, Faafu and Dhaalu atolls and was focused on working with the communities to develop sustainable reef resource management. Importance was given to environmental awareness and community involvement in the process of management.

Was involved in the National Turtle Conservation Program and my main task was to liaise with the researchers at the turtle hatchery at Vaadhoo resort, Male' Atoll.

Was involved in setting up a system for regulating and monitoring coral and sand mining in the Maldives. My task was to give expert advice on the coral reef environment in the development of the Regulations.

Carried out the environmental component of two bids for resort development at Hudhufushi Island, Lhaviyani Atoll. The emphasis of my work was on Ecological values and relationships as well as conservation.

Carried out the environmental component of the Proposed Information Technology Project in the Maldives for ADB. My task was to analyse and discuss the existing

marine environment and the predicted impacts from the proposed development as well as mitigation measures and monitoring.

Annual monitoring for resorts: Velavaru Island and Reethi Beach Resort where my main responsibility is to carry out the monitoring of the marine environment including field work and report writing.

Carried out the Environmental Impact Statement for Thari Village Resort for the Harbour enhancement Project and my area was to assess the marine environment as well as the terrestrial environment and associated impacts.

Project Manager, GCRMN Socio-economic Monitoring Project, MRC, Maldives. My main task was to carry out the field work including interviews with the community and coordinating the project.

GCRMN Coral Reef Database Development Project, Seamarc Pvt. Ltd., Maldives. My main tasks were testing the database, preliminary data entry, developing the help file and the data entry guide.

National Coral Reef Monitoring Program (Global Coral Reef Monitoring Network) team member. My main task within this project was to collect field data which contributes to the National Coral Reef Database.

CORDIO (Coral Reef Degradation in the Indian Ocean) Project team member. My main responsibility was to collect field data on coral reef recovery and compile it. I was also in charge of data collection for the project carried out to assess the impacts of the 1998 Coral Bleaching on Tourism in the Maldives. This involved questionnaire based interviews with departing tourists at the airport.

Maldives Climate Change Vulnerability and Adaptation team member. My area was to give expert advice on coral reef related issues.

Focal point for GEF Conservation of Coral Reefs in the Maldives Project, PDF B. My task was to give expert advice on coral reefs at the community workshops held in the atolls as well as report writing. I was also involved in the field data collection carried out in Baa Atoll.

Focal Point for TNA Climate Change Project. My task was to give expert advice on the marine environment associated with climate change issues.

Worked on the preparation of a report on the Status of the Shark Fishery in Maldives. This involved field trips to the northern and southern atolls of Maldives to collect socio-economic data on the fishery.

Worked on the preparation of a report on the Aquarium Fishery of Maldives. This involved compilation and analysis of export data and interviews with exporters.

Preparation of report on Cost Estimation and Willingness to pay for waste management in Baa Atoll as National Consultant for AEC project.

Presently working on the Management of the Aquarium Fishery of the Maldives.. It involves working closely with the exporters and Maldives Customs Services to develop tools and guidelines for monitoring and management.

ADDITIONAL SKILLS

Computer literate - Fluent in Microsoft Windows
Languages spoken - Fluent in Dhivehi (mother tongue) and English
French (intermediate)

REPORTS & PUBLICATIONS

Anderson, R.C. & M.R. Saleem. (1994). Seasonal and Regional Variation in Livebait Utilization in the Maldives. In: *Rasain,* M. H. Maniku (ed.), Vol 14. Ministry of Fisheries and Agriculture. pp: 162-182.

Anderson, R.C. & M.R. Saleem. (1995). Inter-annual Variations in Livebait Utilization in the Maldives. In: *Rasain*, M. H. Manik (ed.), Vol 15. Ministry of Fisheries & Agriculture. pp: 194-216.

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Ahmed, H. & M.R. Saleem. (1999). *Marine Flora and Fauna of the Maldives*. Biodiversity theme paper prepared for the Ministry of Home Affairs, Housing and Environment. Unpublished manuscript.

Ahmed, H., Le Berre, T. & M.R. Saleem. (2000). Environmental statement for Thari Village Beach reclamation and associated harbour development project. Unpublished report.

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Ahmed, H., Le Berre, T. & M.R. Saleem. (2000). Annual environmental monitoring report – Reethi Beach Resort, Maldives. Unpublished report.

Cesar, H., Waheed, A., Saleem, M. & D. Wilhelmsson. (2000). Assessing the impacts of the 1998 Coral Bleaching on Tourism in the Maldives and Sri Lanka. Report prepared for CORDIO Programme.

Ahmed, H., Le Berre, T. & M.R. Saleem. (2001). Initial Environmental Examination for Proposed Information Technology Project in the Maldives. Report prepared for ADB.

Jameel, A., Hameed, F., Shakeel, H., Ahmed, H., Shareef, H.A., Shareef, M., Saleem, M., Aslam, M., Faiz, M., Zuhair, M., Hassan, M.Z. and S. Saeed. (2002). *National Biodiversity Strategy and Action Plan of the Maldives*. Ministry of Home Affairs, Housing and Environment, Male', Maldives.

Zahir, H., Clark, S., Rasheed, A. and M.R. Saleem. (2002). Spatial and temporal patterns of coral recruitment following a severe bleaching event in the Maldives. In: O. Linden, D. Souter, D. Wilhelmsson and D. Obura (eds.) *Coral Reef Degradation in the Indian Ocean: Status report 2002*. CORDIO, Sweden. 125-134 pp.

Saleem, M.R. (2004). Monitoring management effectiveness of Kuda Huraa Dive Site, North Male' Atoll, Maldives. Report submitted for the degree of Master of Applied Science in TESAG, James Cook University, Australia.

Saleem, M.R. and M.S. Adam. (2004). Review of the Aquarium Fishery of the Maldives. Unpublished report.

Saleem, M.R. and M.S. Adam. (2004). Status of the Shark Fishery of Maldives. Dhivehi report prepared for the Fisheries Advisory Board of Maldives.

Saleem, M. R. and M. Hameed. (2006). Willingness to Pay for Waste Management in Baa Atoll. Report prepared by Seamarc for the AEC Baa Atoll Project.

REFEREES

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CURRICULUM VITAE of THOMAS LE BERRE

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32 y. o

Married

2 children

Main Compétences

- **Trilingual** (french (mother tongue) / english (fluent) / divehi (maldivian)), **bicultural** french-maldivian.
- Environmental consultant, coastal oceanography, Programming (Delphi)
- Worked overseas (Maldives, Australia).

Education

1995 -1998 **Engineering Diploma (ENSTA, Paris),** a 3 year-formation, admission after preparatory classes, ending Baccalaureat + 5 years. Participated in two exchange programs with KTH, Stockholm, Sweden (6 months in second year), studies in groundwater management and fluid mechanics, and JCU, Townsville, Australia (1 year in third year), studies in environmental engineering, coral reef geology and fluid mechanics.

1992 -1995 **Mathematic superior and special : Preparatory classes for selective examination to the french engineering schools (major in Physics and Chemistry)** Lycée Chateaubriant, Rennes. This is to prepare the selective examination to enter the french "Grandes Ecoles".

1992 **Baccalauréat C (Math-Physics, distinctions)**. Lycée Lesage, Vannes. French equivalent to A-levels

Professionnal experience

1999 - 2008 **Setup and run an Environmental Consultancy in the Maldives - Seamarc Pvt. Ltd.** (Systems Engineering and Marine Consulting)

The major contracts in which I was involved were:

- Environmental Impact assessment and design for coastal development of Vabboa Huraa (Four Seasons Resort, HPL)
- Coral Monitoring of T. Vilufushi, which was undergoing major dredging operations, dredging works and consultancy for Boskalis International.

- Environmental Impact Assessment for the development of a fisheries project in Addu Atoll, for MIFCO (Maldives Industrial Fisheries Company)
- Environmental Impact Assessments for the development of Herethere as a tourist resort, for MTDC (Maldives Tourism Development Corporation).
- Work as national consultant for the development of the Integrated Climate Change Strategy. Includes GEF (Global Environmental Facility) NAPA (National Adaptation Plan of Action) project, NCSA (National Capacity Self Assessment) project and TNA (Technology Need Assessment) project. Remains member of the National Climate Change Technical Team.
- Environmental Impact assessment and design for coastal redevelopment of Kuda Huraa (Four Seasons Resort, HPL)
- Environmental Impact Assessment and coastal designs for the redevelopment of K. Kandooma. redevelopment works not yet started (Leisure Hollidays, HPL Maldives)
- Erosion control at Baa Landaa Giraavaru (upcoming Four Seasons resort, LGPL) (on going).
- Coral translocation as a mitigation measures for development impacts at Baa Landaa Giraavaru (upcoming Four Seasons resort) (on going).
- Setting up of a fish laboratory to breed *Amphiprion nigripes* and other ornamental species at Baa Landaa Giraavaru (upcoming Four Seasons resort) (on going).
- Supervising clearing of 45 hectares plot in L. Gan for the French Red Cross utilizing man power from the IDP camps and villages in L. Gan.
- Constructed a 50 feet boat in the Maldives in order to carry out research and tourism activities. Subsequently managed this activity (on going).
- Bid documents for a number of resort islands, regularly obtained among top ranking for environmental concepts.
- Local Environmental counterpart for BCL (Bangladesh Consultant Limited) for a IDB funded project for the government of Maldives about Focus Development Islands.

- Research on *Amphiprion nigripes* (Maldives clownfish for aquarists) and export of 500 individuals maricultured by the Marine Research Center of the Government of Maldives.
- Bid document and Environmental Impact Assessment for the development of a hotel/marina in H.A. Dhonakulhi for Turquoise Pvt. Ltd.
- Environmental and research programs for restoration and rejuvenation of reefs affected by global warming and bleaching using Reef Balls, for Four Seasons Resort (on going).
- Consultancies for the dredging operations and coastal works at Medhufinolhu (One and Only at Reethi Rah).
- Database design and programming for coral reef resources management for the governments of India, Sri Lanka, and the Maldives, for IOC/UNESCO through the GCRMN (Global Coral Reef Monitoring Network)
- Analysis of salinity and temperature profile data at the mouth of the Herbert and Burdekin River in North Queensland, Australia, for James Cook University.
- Environmental auditing of tourist resorts for Velavaru (Turtle Island Resort) and Fonimagoodhoo (Reethi Beach Resort) since 2000.
- Feasibility study for power generation with wind mills in the Maldives.
- Translation into French of books pertaining to the Maldives (Marine Life of the Maldives, by Neville Coleman, Dive Maldives, by Tim Godfrey).

Moosa Athfal (CV).

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Dhilleemagu, Malé, Maldives

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Summary

Able to handle work in a cooperate environment; manage projects with ease, good knowledge of the environment and a friendly attitude.

Experience

2008 – 2010 - TENNSSOR HOLDINGS PVT.LTD

Tennssor Surveying and Design Solutions (Manager)

Tennssor Holdings Pvt. Ltd is a premier company building its reputation of Quality, Trust, Craftsmanship and Expertise throughout Maldives. A team of Motivated Professionals, understanding your development needs requirements to meet and cater to your utmost needs. Tennssor Holdings Pvt. Ltd is in the business of building and realizing your dreams. Always in tune with the latest market trends and supported by our impeccable service and excellent quality of work.

Responsibilities

- Manage a team of 7 staff's developing technical solutions for the clients.
- Manage and worked on a number of RFP's.
- Liaised with the implementation team once RFP won.
- Followed up with client post sales to ensure satisfaction and on-going business.
- Manage Survey trips and coordinate the project whilst handling the finance.
- Supervise the technical drawings and assist in staff development.

Achievements

- Surveyed and Manage the Data for the project of "Establishment of three Airport Islands in Dh. Kudahuvadhoo, Th. Thimarafushi and Sh. Funadhoo".

- Attend COP15 as a member of the youth delegate which represented Maldives at COP15.

Experience

2008- To present – Development Technologies

Architectural Designer & Drafter (Part time)

The Company is a small company mainly specialized in problems related to sewerage and water. Also the company has been expanding their spectrum of work and has been working on small real estate projects.

Responsibilities

- Design and Draft Houses according to government regulations.
- Follow up with client post sales to ensure satisfaction and on-going business.
- Manage all the administrative works regarding the job title.

Experience

2010 – Present - System Engineering and Marine Consultancy (SEAMARC Pvt.Ltd)

Surveyor

The aim of the company is to provide quality advice on dealing with environmental problems arising from the rapid developments in infrastructure taking place in the Maldives.

Responsibilities

- Coastal geomorphology and research consultancy.
- Coastal engineering and hydro graphic analysis and carry out research and feasibility studies in aquaculture.
- Environmental impact assessment.
- Surveying, Beach monitoring as well as creating awareness programs.

Achievements

- Participate in the National Environmental Guidelines convention.
- Analyze 30 yrs of National Meteorological Data and implement it on the EIA's.

Experience

2002-2005 – Environment Research Centre (ERC)

Research Assistant

A Centre Created by the Government to do Research and Find mitigation and sustainable methods to protect the vulnerable environment of the Maldives.

Responsibilities

Area of work included:

- Coastal geomorphology and research.
- Coastal engineering and hydrographic analysis and research.
- Integrated coastal zone management.
- Environmental impact assessment.
- Geophysical information assessment.
- Surveying, Beach monitoring as well as creating awareness programs.

Education

Completed Advanced Certificate in AutoCAD – 2004

Completed A' Levels Jan 2002 – Centre for Higher Secondary Education

Completed O' Levels Jan 1998 – Majeedhiya School

Technical Skills

- Good Knowledge of Microsoft Office Package.
- Excellent Knowledge and Practice of AutoCAD.
- Fairly Good in Written and Spoken English.

Interests

Cooking, Swimming, Music and National Geographic Channel

Referee

Mohamed Zahir, Director General

Ministry of Housing, Transport and Environment

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