ENVIRONMENTAL IMPACT ASSESSMENT

Coastal Protection Works, Ihuru, Kaafu Atoll, Maldives

Proponent: Angsana Hotels and Resorts

Consultants:

Ahmed Zahid (EIA08/07)

Amir Musthafa (T10/11)

September 2012

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Consultants Declaration

This EIA has been prepared according to the EIA Regulations 2012. We certify that the statements in this Environmental Impact Assessment study are true, complete and correct to the best of our knowledge and abilities

Ahmed Zahid (EIA 08/07)

5th September 2012

Amir Musthafa (T10/11)

5th September 2012

Proponents Declaration

(attached in the following page)

ANGSANA
IHURU

Mr. Ibrahim Naeem
Director General
Environmental Protection Agency
Ministry of Environment and Energy
Male', Maldives

2nd September 2012

Dear Mr. Ibrahim Naeem,

Project: Coastal Protection Works at Ihuru Island Resort

Sub: Proponents Declaration and Commitment for Monitoring and Mitigation

As the proponent of the project, we guarantee that we have read the report and to the best of our knowledge, all non-technical information provided here are accurate and complete. We are aware that this EIA report has been prepared in accordance with the EIA regulations 2012. We confirm our commitment to undertake all mitigation measures and carry out the monitoring program as specified in the report.

Thanking you

Yours Sincerely

Mohamed Jihad
Rooms Division Manager
Angsana Maldives, Ihuru

Non Technical Summary

This report is based on the on-going and proposed coastal protection works in Angasana Ihuru Island Resort. Ihuru island is located in Kaafu atoll, 17 km and 20 minutes speed boat ride away from the Ibrahim Nasir International Airport in Hulhule'. The operations of the island are under Angsana Hotels and Resorts, which is managed by the renowned Banyan Tree group.

An Environmental Impact Assessment was necessary for the works outlined in this report as they fall under the Schedule D of the Environmental Impact Assessment Regulations 2012 of the Maldives. In addition to meeting the regulatory requirements, the report would further assist the proponent and important stakeholders to make decisions based on favourable environmental conditions with the main focus on sustainability.

The coastal management project is divided into three main components including; Pumping sand from the beach, importing sand to the island bought from local suppliers, construction of temporary groynes.

In order to ensure a uniform volume of beach is available all around the island for its guests throughout the year, the operators have been undertaking an occasional sand pumping operation in the island. Sand had been pumped from the area, which undergoes the maximum accretion on a particular season, to where the maximum erosion had occurred. However, this method is only used when they are not able to maintain the beach using temporary groynes field alone. Sand pumping is a last resort occasional action taken in order to maintain the beach.

Sand filled nylon bags are laid side by side perpendicular to the shoreline in the form of groynes. As such, a groyne field is made around the island in an arc facing SW during the SW monsoon and NE during the NE monsoon. The groynes are relocated depending on the seasonal variation to the long shore sediment transport. Sand used for the sand bags are bought from local contractors who mine sand from designated lagoons without the use of any machinery. However, a small volume of sand is bought annually and there have been occasions where sand has been obtained from the beach to fill the bags.

Under the Ministry of Fisheries, and Agriculture's Regulation on Coral, Sand and Aggregate Mining, sand mining from the beaches have been banned irrespective of the activities the sand is used for. Therefore, in the process of undertaking this Environmental Impact Assessment, the operator has decided to stop the sand pumping operation all together and depend entirely on temporary groynes for beach nourishment and on importing sand to the island in severe cases of erosion.

The overall environmental impacts of the project have been assessed using frameworks found on literature and the results indicate that the proposed project has a net positive impact. However, there are some significant impacts on the environment during the construction phase of the project and these needs to be mitigated to avoid any significant damage to the environment. Significance of the impacts and mitigation measures have been provided based on previous similar projects undertaken in the Maldivian environment and based on literature. Apart from the sand pumping operation, the project does not have any significant impact on the environment. In general, soft engineering techniques as used for this project are favourable to the environment and it is the wish of the operators that such techniques be employed as much as possible without resorting to hard engineering solutions.

Alternatives, including the no project option and alternatives for each project component have been given. The most significant alternative is to entertain the no project option for the sand pumping operation, as it leads to significant detrimental effects. Alternative designs have been given special emphasis in the report. As such, the possibility of utilising hard engineering solutions are discussed including, creations of near shore breakwaters, rock revetments and creating feeder headlands. Eventually, the original project methodologies for the temporary groyne construction are recommended, however with a change in design. Additionally a new component to the project has been recommended in the form of closing 2 existing channels previously made in the islands reef.

It is recommended to continue to monitor the impacts of the proposed project by regular monitoring of shorelines and near shore currents and the changing marine environment. A two stage monitoring plan is given, which recommends monthly monitoring during the 1st year and less frequent monitoring for the next 5 years. Undertaking the monitoring, along with the mitigation measures is necessary to ensure the sustainable development of the project with minimum harm to the environment.

It is thus recommended that given the positive socio economic and environmental impacts from the project far outweighs the negative impacts, and since the project has major socio-economic benefits and environmental benefits, it is advisable to allow the project to proceed as proposed.

ސާދާ ޚުލާސާ

މި ރިޕޯޓަކީ ކ. އިހުރުގައި ތަރައްޤީކޮށްފައިވާ ރިސޯޓުގެ ގޯނޑުދޮށް ހިމާޔަތް ކޮށް ދެމެހެއްޓުމުގެ ގޮތުން ތަރައްޤީކުރުމަށްޓަކައި މިހާރު ކުރިއަށްދާ އަދި ކުރިއަށް އޮތްތާގައި ކުރުމަށް ހަމަޖެހިފައިވާ މަސައްކަތަށް ބިނާކޮށް ތައްޔާރު ކޮށްފައިވާ ރިޕޯޓެކެވެ. އިހުރުއަކީ ކާފު އަތޮޅުގައި ހުޅުލެއާއި 17 ކިލޯ މީޓަރު ދުރުގައި އޮންނަ ރަށެކެވެ. މިރަށުގެ އޮޕަރޭޝަންސްއާއި ހަވާލުވެފައިވަނީ 'އަންގްސާނާ ހޮޓެލްސް އެންޑް ރިސޯޓްސް'އިންނެވެ. އަންގްސާނާއަކީ، ފަސްތަރިފެންވަރުގެ ދާއިރާގައި ދުނިޔޭގައި މަޝްހޫރުކަން ހޯދާފައިވާ ބަންޔަން ޓްރީ ގުރޫޕަށް ނިސްބަތްވާ ކުންފުންޏެކެވެ.

ތިމާވެށްޓަށް އަސަރު ފޯރާ މިންވަރު ބަޔާންކުރާ ރިޕޯޓު ހެދުމާއި ބެހޭ ގަވާއިދު 2012 ގެ ޖަދުވަލު (ރ) ގެ ދަށުން މިރިޕޯޓުގައި ތަފްސީލުކޮށްފައިވާ ގޯނޑުދޮށް ހިމާޔަތް ކުރުމުގެ މަސައްކަތްތަކަށް ތިމާވެށްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބަޔާންކުރާ ރިޕޯޓް ނުވަތަ އީ.އައި.އޭ ރިޕޯޓް ތައްޔާރު ކުރަންޖެހޭތީއެވެ. މިގަވާއިދާއި ދިމާ ރާއްޖޭގެ އެކިއެކި ތިމާވެށްޓާއި ބެހޭ ޤާނޫނު ތަކާއި އުސޫލުތައް މަސްއޫލިއްޔަތު ކުރިއަށް ގެންދިއުމުގެ އިތުރުން، މިރިޕޯޓުގެ ސަބަބުން މަޝްރޫއާއި ބެހޭ ފަރާތްތަކަށް ދެނެގަނެވޭނެ ގޮތަކަށް، އަދި ތިމާވެށްޓާއި ރައްކާތެރި ގޮތަކަށް މަސައްކަތްތައް ކުރިއަށް ގެންދިއުމަށް އެހީތެރި ވެދެއެވެ.

އިހުރުގައި ކުރިއަށްދާ އަދި ކުރިއަށް އޮތްތާގައި ކުރުމަށް ހަމަޖެހިފައިވާ މަސައްކަތްތައް ބެހިގެންވެ މައިގަނޑު ގޮތެއްގައި 3 ބައިކަށެވެ. މިގޮތުން އެކުލެވިގެންވަނީ؛ ގޯނޑުދޮށުގެ ވަށާ ސަރަޙައްދުތަކުން ފެނަކާ ދިމާ ސަރަޙައްދުތަކުން ފެށި ހޮޑުހޮޑުކުރުން، ފިޝަރީޒް މިނިސްޓްރީން ހުއްދަދީފައިވާ ސަރަޙައްދުތަކުން ފެށި ފަރާތްތަކުން ފެށި ގޮތުން، އެކި މޫސުމަށް ބަދަލުކުރާކަށް ފެތިބަސްތާގެ ވަގުތީ ހަރަކާތެއް ނެރެވިދާނެ ތަރައްޤީ ކުރުން، މިކަންކަމެވެ.

އިހުރަކީ ކުޑަރަށަކަށް ވުމާއި އެކު، އަދި ރަށު ގިރުމުގެ އަސަރު އާންމުގޮތެއްގައި ތަޢައްލުޤު ކުރަންޖެހިފައިވާ ރަށަކަށް ވުމުން، ރަށުގެ ގޯނޑުދޮށް ހިމާޔަތް ކުރުމަށްޓަކައި ގިނަގިނައިން ކަނޑައަޅަ ކުރަންޖެހިފައެވެ. މިގޮތުން ރަށް ވަށައިގެންވާ ގޯނޑުދޮށް ހުރިހާ ދޫކުރުމަށް ޖިއޮ ޓިއުބް އާއި ތެރޭގައި ހިލަމުށާއި، މާހަނބަދި ގޯނޑުދޮށް ގަލުގަޑު ފަދަ ހުރަސް ތަކި ބޭނުންކުރަށް އެކުލެވިގެން ދަނީ ކުރަންޖެހިފައެވެ. ނަމަވެސް މިމަސައްކަތް ކުރިއަށް ގެންދަނީ ވަގުތީ ގޮތުންނެވެ.

ވަގުތީ ހުރަސް ބޭރި ގެހުގެ މަސައްކަތް ކުރިއަށްދިޔަ ނަމަވެސް ވެލި ބަޔަކުން ބޭނުން ރަށް ބަދަލު ސިފައިގައި ޖެހިފައެވެ. މިބަދަލުތަކަށް ވެލި އަރާފައި ކާރިސާތަކުން އަޅުވާ ވެލިނަގާފައެވެ. ނަމަވެސް ބައެއް ހާލަތްތަކުގައި ރަށުގެ

ގޮނޑުދޮށުންވެސް ވެލި ނަގާ މިބަސްޓޭޝަންތަކަށް އެޅުމަށް ބޭނުންކުރެއެވެ. މޫސުމަށް އަންނަ ބަދަލުތަކާއި ގުޅިގެން، ރަށުގެ ވަށައިގެންވާ ވެލިގަނޑު ދަތުރުކުރާ މިންވަރަށް އަދި ދަތުރުކުރާ ފަރާތަށް ބަދަލު އާދެއެވެ. މިގޮތުން މިއަންނަ ބަދަލުތަކަށް ބަލާ ހުރަސްތަކީ ޖެހިފައިވާ ސަރަހައްދު ތަން ކޮންމެ މޫސުމަކަށްވެސް ދަނީ ބަދަލު ކުރުވަމުންނެވެ. މިމަސައްކަތަކީ ރަށް ވަށައި ގާތްގަނޑަކަށް 11 ތޮރި އަންދާޒާކޮށްދޭގައި ޖެހިފައިވެއެވެ.

ދިރުރެގައި ކުރެވުމުންދާ މަސައްކަތްތަކަށް ބަލާއިރު، ޕްރޮޖެކްޓް މިނިސްޓްރީއިން ސާއިޓް ކްލިއަރެންސް ފައިސާ އެއްވެއި އަދި ނިމުމާއި ބޯނުން ކުރިމާބޯ ގަވާއިދު ދަށުން، ރަށުގެ ގޮނޑުދޮށުން އެއްވެސް މަސައްކަތްތަކަށް ވެލި ނިމުމަށް މަނާ ކަމުކަމުގައި ބާރުންވާގޮތުގައެވެ. އެގޮތުން ކަމުން މި އިއައި.އޭ ރިޕޯޓު ކުރުމުގެ މަސައްކަތުގައި ރިސޯޓުގެ އޮޕަރޭޝަން މިކަން އަންނަމުގެ ސަބަބުން މިމަސައްކަތް އެއްކަލާ ހުއްޓާމޮޑިއުލެއް ހަމަޖެހިފައެވެ. އަދި ކުރިއަށް އޮތުމުގައި ގޮނޑުދޮށް ހިމާޔަތް ކުރުމަށް ހަމައެކަނި ކުރުވުން މަސައްކަތުކަމަ މިހާރު އެއްގޮތަށް ހުރަސްތައް ޖެހުމައި، އަދި ގެނުން ނުހިފެހެއްޓި ކަމުގައިވާ ނަމަ ކަނޑުބޯސްކާސްކުރުގެ އަޑުން ފެލިގޮތުގެ ގޮނޑުދޮށަށް ފެލި އެޅުމެވެ.

މިމަޝްރޫޢުން ތިމާވެއްޓަށް ކުރާނެ އަސަރު ބަޔާންކުރުމަށްޓަކައި މިކަމާއިބެހޭ ޖިއޮލޮޖިކަލް ސާރވޭތަކާއި ދިރާސާ ކުރެވިފައެވެ. އަދި މިޖިއޮލޮޖީއާ ގުޅޭ މަޢުލޫމާތު ހިޔާލު ތިމާވެއްޓަށް ކުރާ އަސަރުގެ މިންވަރު ދެނެގަނެވުނުކަމުގައި 'ޖީ ސިސްޓަމް ޓެކްނޮލޮޖީ' ގެ ބޭނުން ކުރެވިފައެވެ. ގޮނޑުދޮށް ވެލި ޕްރޮފައިލް ކުރުމުގެ މަސައްކަތާއި ހުރިހާ ޓެކްނިކަލް، ދެން ހުރި މަސައްކަތްތަކުގެ ޖޯގްރަފީ ބަލައިލުމުގެ މިޝަނަރީ މަޢުލޫމާތު އަދި އިންޖިނިއަރިންގ ފައިދާކުރުމުގައި ވެސް ކަނޑައެޅިފައެވެ. ނަމަވެސް މަސައްކަތް ކުރުމުގެ ޖާގަ ބައެއް ނުދެވޭ އަސަރު ތިމާވެއްޓަށް ކުރާނެކަމަށް އެކަށީގެންވެއެވެ. މިކަންކަމުގެ ހުރިހާ ހައްލުތަކެއް މިރިޕޯޓުގައި ބަޔާންވެގެންވެއެވެ.

މިރިޕޯޓުގައި މިމަޝްރޫއުގައި ހިމެނޭ މަސައްކަތްތަކާއި 'އަލްޓަނޭޓިވްސް' ގޮތުގައި މަސައްކަތް ކުރިއަށް ގެންދެވޭނެ ތަފާތު ގޮތްތައް ބަލައިލެވިފައެވެ. މިގޮތުން ވެލި ޕަމްޕުކުރުމުގެ ބަދަލުގައި ރަށުން ބޭރުން ގެންނަވެލި ގެނައުން، ވަގުތީ ހުރަސްތައް ޖެހުމުގެ ބަދަލުގައި، ދާއިމީ ހުރަސް ޖެހުމާ އަދި ބޭރު ޖެހުމުގެ ފައިދާ އަދި ގެއްލުންތަކާ ވަޒަން ކޮށްލައިފައިވެއެވެ. މިގޮތުން، ޖެހިޖެހުމަށް ބަލާއިރު މިހާރު މިރަށުގައި މަސައްކަތް ކުރަމުން އައިގޮތަށް ބަދަލުތަކާއި ނަގާނެ، ކުރިއަށް ގެނދަން ވަނީ ފަހަރުވެވިފައެވެ. ސަބަބަކީ މިހާރު ޖެހިގެ ސަރަހައްދު ތިމާވެއްޓަށް ކުރާ އަސަރު ކުޑަވެގެން، ނަގާވާ އަސަރުތަކާއި ކޮންމެހެން މަދުކުރަމުން ވެފައިވާ ބޭރު ޖެހުން ކުޑަ ފެނުމެވެ. ހަމަގޮތް ހުރަސްޖެހުމުގެ ޖިސްމުގެ ބަދަލުތަކާއި ގެންދަން ވަނީ ވަރަށް ދެރަވެއެވެ. އަދި ހަމައެކަނި ރަށުގެ ވާޔާލާގެ ދިމާގައި ފޮނުވަން ޖެހޭ ވަޒީފާ ހުރަސްޖެހުމުގެ 2 ވަނަ ނަމަ ބައްޓަންކޮށްވެސް ވަނީ ރަނގަ ދެވިފައެވެ.

މިމަޝްރޫޢުން ތިމާވެއްޓަށް ކުރާނެ ނޭދެވޭ އަސަރު ރަނގަޅުކުރުމަށް އަދި ފަރުބަދު އަންނަމުނަށް ބަދަލުތަކާ ދެކޮށްދިނުމަށް 'މޮނިޓަރިންގ ޕްލޭން' ހުށަހަޅައިދެވޭ ރިޕޯޓަކީ ބޭނުމެއް އަރައިގަނެފައެވެ.

މިޕްރޮޖެކްޓްގައި 2 ފިޔަވަޅަކަށް ބަހާލެވިފައެވެ. މިގޮތުން ފުރަތަމަ އަހަރު 3 މަހުން ތެރޭގެ ގްރޮއިންތައް އަޅަން ބަދަލުތަކާއި ތެރޭގެ ފެންފަރާތަށް، އަދި ގްރޮއިން ސަރަޙައްދުގައި މަސައްކަތުގެ ސަޕޯޓް އެޅުން ކުރީގެ މިންވަރު ކަނޑައަޅަން ސާރވޭކުރަން ވަނީ ހުށަހަޅާފައެވެ. އަދި ދެވަނަ ފިޔަވަޅުގައި އަހަރަކު އެއްފަހަރު 5 އަހަރު ވަންދެން މިސާރވޭތައް ކުރިޔަށްގެންދަނީ ހުށަހަޅާފައެވެ. ވަރަށް އަންނަމުންދާ ބަދަލުތައް ދެނެގަތުމަށް އަހަރަކު އެއްފަހަރު ރިޕޯޓެއް ތައްޔާރުކުރެވޭ ގޮތަށް އެންވަޔަރަމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ (އީ.ޕީ.އޭ) އަށް ހުށަހަޅަން ޖެހޭނެއެވެ.

މިމަޝްރޫޢުގެ ދަށުން ހުށަހަޅާފައިވާ މަސައްކަތްތަކުގެ ސަރަޙައްދަށް ތިމާވެށްޓަށް އަސަރުކޮށްފާނެ ކަމަށް ބެލެވޭ ކަންކަމާއި އެ ކަންކަމުން ކުރާނެ އަސަރު ކުޑަކުރުމަށް ކުރެވޭނެ ކަންތައްތަކާއި ހުށަހަޅާފައިވާ ކަންކަމާއި ރިޕޯޓްގެ ނިޔަލަށް ކުރެވުނު މިމަޝްރޫޢުގެ ސަރަޙައްދު ކުރާނެ އަސަރުތައް ކުރާނެ ބަދަލުގެ މިންވަރު ހުށަހަޅާފައިވާ ތަފާސް އިން ކުރަވާލުމަށް ފަރާތެއް ހުށަހަޅާފައެވެ. އަދި އެހެންކަމުން މިމަޝްރޫޢުގައި ހިމެނޭ ތަރުގެ ގޮސްޖެހުން ވެސް ޕްރޮޖެކްޓުގެ މަސައްކަތާ އެކު ކުރެވޭ އެހެނިހެން މަސައްކަތްތައް މި މަޝްރޫޢުގައި ހުށަހަޅާފައިވާ ގޮތަށް ކުރިއަށް ގެންދިއުން އެންމެ ރަނގަޅުކަމުގައި ފެނިއެވެ.

1. Introduction

1.1 Background

This Environmental Impact Assessment (EIA) report has been prepared in order to meet the requirements of Clause 5 of the Environmental Protection and Preservation Act of the Maldives to assess the impacts of the proposed coastal related works in K. Ihuru. This report will follow the guidelines given in the Environmental Impact Assessment Regulation 2012. This EIA is based on the following soft engineering measures undertaken for beach maintenance at Ihuru:

- Beach nourishment
- Construction of temporary groynes

The report will look at the justifications for undertaking the proposed project components and it will identify and determine the significance of the potential impacts of the proposed works. Alternatives to proposed components or activities in terms of location, design and environmental considerations would be suggested along with measures to mitigate any negative impact on the environment. Environmental monitoring programme is vital in order to demonstrate the long-term sustainability of the proposed project as well as to undertake mitigation measures before any impact leads to long-term significant effects. Long term monitoring helps to understand uncertainties in impact analysis improving future impact predictions and project implementation. Therefore, a coastal monitoring and management plan would be suggested.

The major findings of this report are based on qualitative and quantitative assessments undertaken during a site visit on February 2012 and survey on June 2012. Available long-term data were collected from available sources, such as long-term data on meteorology and climate from local and global databases. It may be necessary to note that consistent, regular coastal data for Ihuru is lacking, as is the case for most of the islands in the Maldives. However, to compensate for this, qualitative historical observations shared by the management and other relevant stakeholders have been used throughout the report.

The beach maintenance works in Ihuru has been an on-going work. However, to continue with the works, it was required by the Ministry of Tourism, Arts and Culture and the Environmental Protection Agency, that an Environmental Impact Assessment be carried out to identify the major environmental impacts of the practice and to provide mitigation measures.

1.2 Aims and Objectives of the EIA

This report addresses the environmental concerns of the on-going coastal undertaken in Ihuru Island Resort. The report attempts to achieve the following objectives.

- Describe the project components to the relevant authorities
- Allow better project planning and decision-making based on the sustainable development of the island.
- Mitigating impacts caused due to the works outlined in the project
- Promote informed and environmentally sound decision making
- To demonstrate the commitment by the proponent on the importance of environmental protection and preservation.

1.3 Methodologies

This EIA has been prepared by Amir Musthafa, a registered temporary environmental consultant under the guidance of Ahmed Zahid, a registered permanent EIA consultant with a number of years of experience in Environmental Impact Assessment in the Maldives and has been involved in several coastal protection projects undertaken in the country.

The surveying component of the project was undertaken by a registered surveyor in the Maldives with plenty of years of experience.

Internationally recognized and accepted methods have been used in this environmental evaluation and assessment. This EIA is based mainly on data collected during a field investigation mission on June 2012. The data collection methods are described in detail under the following Section.

1.4 Methods of data collection

Conditions of the existing environment of the study area were analysed by using various surveying techniques and scientific methods. Field surveys were carried out to get a further understanding of the existing environment of the island, and were undertaken in June 2012 to collect baseline data.

The following investigations were carried out on site.

- Surveys of the coastal environment including coastal protection structures, long-shore and offshore currents.
- Marine water quality
- Existing shoreline
- Beach profiles
- Qualitative survey of the marine environment

1.2.1 Marine Water Quality

Marine water quality around the proposed dredging area and proposed project site was tested in the National Health Laboratory. Water samples were collected using 500 ml plastic bottles from the locations highlighted in the Annex 5. Water quality was tested for the following parameters; Temperature, Turbidity, Electrical Conductivity, pH, Total Dissolved Solids, and Suspended Solids

1.2.2 Land and Hydrographic Surveys

The existing shoreline of the island, and beach profiles around the island, especially project specific areas were undertaken using a staff, prism and Total Station setup. The result of the survey is given in the Annex 4 with the drogue lines. A purpose built drogue with a GPS was made measure ocean currents. Several drogues were done at different locations of concern. The beach profiles and current shoreline around the island where beach nourishment takes place, is given in Annex 3 and Annex 4 respectively.

1.2.3 Reef health

Reef health was determined qualitatively by extensive snorkelling within the house reef. As this project does not concern the marine environment, detailed quantitative marine assessment was not carried out.

Additional photographic surveys were carried out to give a general outlook on the changes to the environment due to the project.

1.2.4 Stakeholder consultations

Stakeholder consultations were mainly carried out in the EIA scoping meeting held on 13th May 2012. The EIA scoping meeting gave the opportunity to consult with the Environmental Protection Agency, and the proponent, in one sitting. Additionally meetings

with the resort management were carried out throughout this study, both via mail and in person. Further consultations were carried out with the Tourism Ministry discuss their concerns and opinions with regards to the project.

1.5 Institutional Arrangements

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

- Scoping meeting — 13th May 2012
- Submission of draft TOR — 25th May 2012
- Approval of TOR — 05th June 2012
- Field mission — 19th June 2012
- Submission of EIA report to Kaafu Atoll Council — 4th September 2012
- Submission of final EIA report — 5th September 2012

Once the EIA has been submitted it is expected that the review process will not take more than 2 weeks. The review process may result in the request for additional information before issuing a decision statement. However, all efforts have been made to ensure that adequate information has been provided with specific attention paid to meet all requirements of the Terms of Reference (TOR). The TOR for this EIA is given in Annex 1.

1.6 The Proponent

The project is being proposed by Angsana Hotels and Resorts. The company is part of the Banyan Tree Holdings group based in Singapore. The group is directly involved with 4 resort islands in the Maldives. It is therefore one of the major developers in the country's tourism sector.

Banyan Tree Holdings currently operates two resorts in the Maldives under the Banyan Tree brand, which includes Madivaru and Vabbinfaru Islands. These are designated to be higher class resorts compared to the ones under the brand of Angsana. Under the Angsana brand, they operate two islands including Velavaru and Ihuru Islands. Internationally, the group operates several more resorts in Thailand, Macau, UAE, Seychelles, etc.

1.7 The Project Location

The project is based on the coastal works in Ihuru Island, Kaafu Atoll as indicated in Figure 1. The island is located at coordinates 4°18'24" N and 73°24'571" S and is about 17km away from the capital Male'. There is a neighboring resort island, K. Vabbinfaru, which is approximately 800m away, and is managed by the same parent company. The study area encompasses the whole island of Ihuru, and mainly includes the beach area. There is no marine component of the project and therefore the study area is mostly land based. The general study area includes the whole island along with the lagoon. Therefore an A3 satellite image of the island from Google Earth is illustrated in detail in Annex 2.

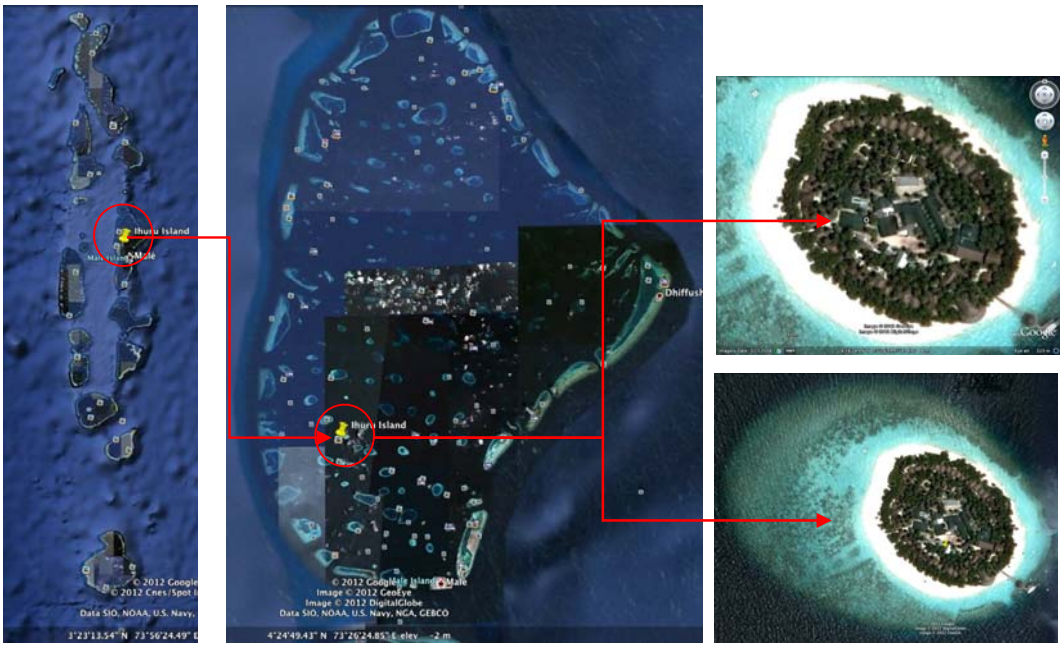


Figure 1 Location of Ihuru (right) in Kaafu Atoll (middle) in the Maldives (left)

1.8 Need and Justification

The need to continue undertaking the project is both environmental and economical. From an environmental point of view, it was imperative that the beach is properly maintained such that the vegetation and other coastal habitats do not get disrupted due to the intense seasonal erosion the beach has had to withstand throughout the years.

Moreover, maintaining regular beach is of upmost importance from an economical view point. Since Ihuru is a small island, it does not offer many recreational facilities for its guests. In addition to the beautiful house reef, the only features offered by the island are the typical sea, sand and sun for which Maldivian tourism is famous for. Therefore, an integral part of this package is a well maintained beach. The operators could not afford to have a significant portion of the beach eroded at any side of the island, as guest rooms occupy every corner of the small island. Therefore, in order to maintain a steady appeal to its guests and thereby a consistent income, an equally stable beach is of upmost importance.

Beach nourishment has been an on-going process in the island. During seasonal fluctuation, the sediment transport around the island leads to accretion and erosion at different areas of the beach, as in the normal occurrence for most of Maldivian islands. Shoreline erosion is perceived as one of the most extensive environmental problems in small island nations and is considered to be aggravated with the impeding phenomenon of sea-level rise (Leatherman, 1997)

Consistent area of beach around the island throughout the year is important to maintain guest satisfaction, and this is sought after by most resort operators. Therefore, although there is no critical threat to any infrastructure, beach nourishment has been undertaken. In addition to the long-shore transport, it was observed that significant amount of sand was being lost from the system due to the cross-shore transport. Therefore, there were times when sand had to be imported into the island from other designated areas for sand collection. Since the island is not blessed with an extensive lagoon, and since high importance had been given for the natural well being of the reef system, pumping sand from within the lagoon was not an option.

Construction and placement of groynes has also been an on-going process in the island. Groynes are made by filling nylon sand bags and placing them perpendicular to the shoreline in order to disrupt the natural long shore transport of sediments around the island. This is necessary to decrease the frequency of pumping and importing sand to the island's beach. Proper groyne placement in this manner ensures that the beach is well maintained without implementing any hard engineering structures, which may have a significant impact on the natural aesthetics of the island.

Soft engineering techniques were chosen for the beach maintenance works in order to find environmentally friendly solutions. In contrast to hard engineering measures, soft engineering methods are methods that are employed in order to enhance the natural features or processes of an island and are regarded more as adaptation measures. It is mostly prevalent in resort island which are conscious about the aesthetic impacts of hard engineered structures (MHE, 2011). Beach replenishment have been considered to be one of the most effective soft engineering measures based on similar projects in Shangrila at Villigili, Irufushi and Sun Island Resort (MHE, 2011)

2. Project Description

The coastal maintenance works in Ihuru is divided into 2 major components including:

- Beach nourishment
- Construction and placement of temporary groynes

The major components of the project are shown in Figure 2

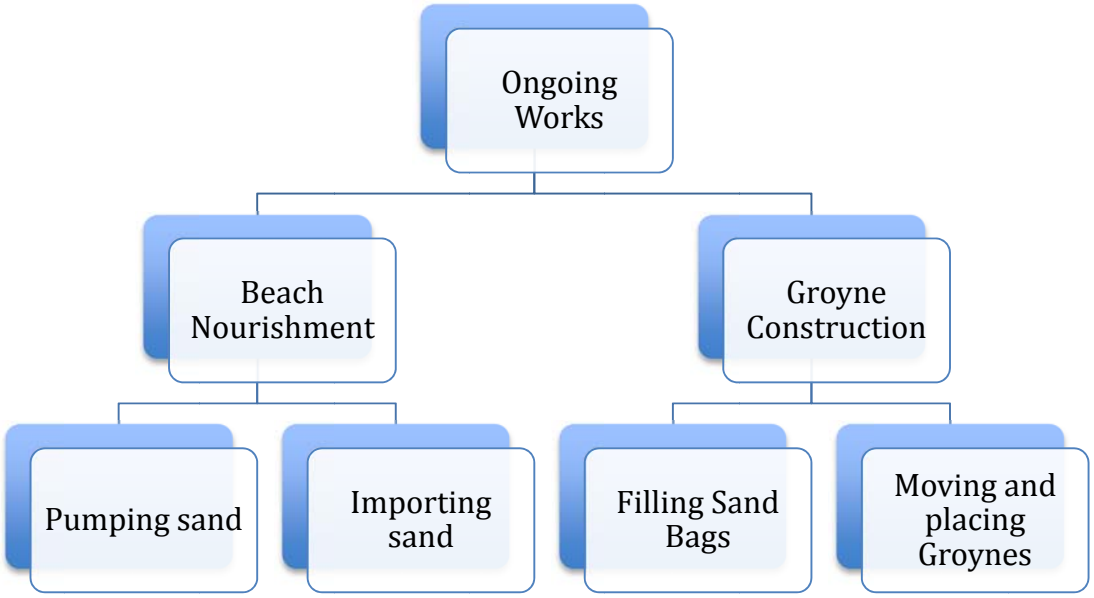


Figure 2 Breakdown of the major project components

2.1 Beach Nourishment

The Beach Nourishment works at Ihuru is undertaken by both pumping sand from inland and also by importing sand into the island from other locations. Beach nourishment is a continuous process for Ihuru, in order to maintain beach area available throughout the year for its guests. The process is integral in maintaining guest satisfaction and the overall quality of the resort.

A 6 inch pump is used for the sand pumping operation. Since Ihuru is not blessed with an extensive lagoon and therefore areas to potentially pump sand, the management is restricted to pump sand from inland from areas of great accretion to areas of excessive erosion.

During the South West Monsoon, sediments are generally transported to the north east side of the island and subsequent accretion and erosion takes place. Depending on how much sand has been eroded from the South West side, sand is pumped back from the North East side to compensate for this loss. Eventually, the volume of sand around the island is forcefully maintained throughout the year by this practice.

Figure 3 Sand bags bought from local suppliers

The beach nourishment program is a continues process. However, there is no set schedule to undertake the nourishment. It is based on daily visual inspections and is undertaken occasionally. Based on previous records, it is expected sand will have to be pumped approximately once an year. Once sand pumping begins, it will continue for approximately 1 – 3 weeks. However, the exact duration depends on when the desired beach width is attained. Approximately 10 – 15 m of beach width is retained with each nourishment cycle.

There is no set location for sand to be pumped to as well. However, usually the location is interchanged between the north east side and the south west side of the island. This schedule is the same for both methods of nourishing the beach. Figure 3 shows sand that had been brought for beach maintenance purposes.

2.2 Groyne Construction

The other practice for beach maintenance is groyne construction. Temporary groynes are constructed using sand bags laid perpendicular to the shoreline to an average 13 m in length. Sand bags are made from white nylon material that is not very durable. The white colour gives an aesthetic look to the groynes, and the material has to be replaced frequently to

preserve this appeal. A longer lasting material was not chosen, as the operators preferred to have a material that has to be renewed frequently. About 11 groynes are present around the island at any given time as shown in Figure 5. The distance between the groynes are not uniform and ranges from 20 – 30m.

Figure 4 Sand Bag Groyne constructed in the island

Sand used to fill the bags is usually taken from the beach, and therefore the sediment budget of the island. However, there have been occasions where imported sand had been used to fill the bags. The bags are placed in areas which undergo significant erosion and accretion, based on visual observation. As the long shore drift around the island changes, the groynes are displaced and again constructed based on areas that are undergoing accretion at the stage. By this continuous method the operators are able to nullify the effects of long shore transport and reasonably maintain the beach area at consistent levels around the island. The groyne field at Ihuru during the time of surveying (during SW monsoon) is shown in Figure 5.

However, there are instances where cross shore transport of sediments takes place, which results in the loss of sediments from the islands sediment budget. In these instances, sand would need to be imported into the island. There are also occurrences where the groynes are not able to function perfectly thus allowing some amount of sand to pass through. In these occasions, excessive erosion and accretion does take place, and therefore the operators have been forced to resort to pump sand from locations of accretion to locations of erosion.

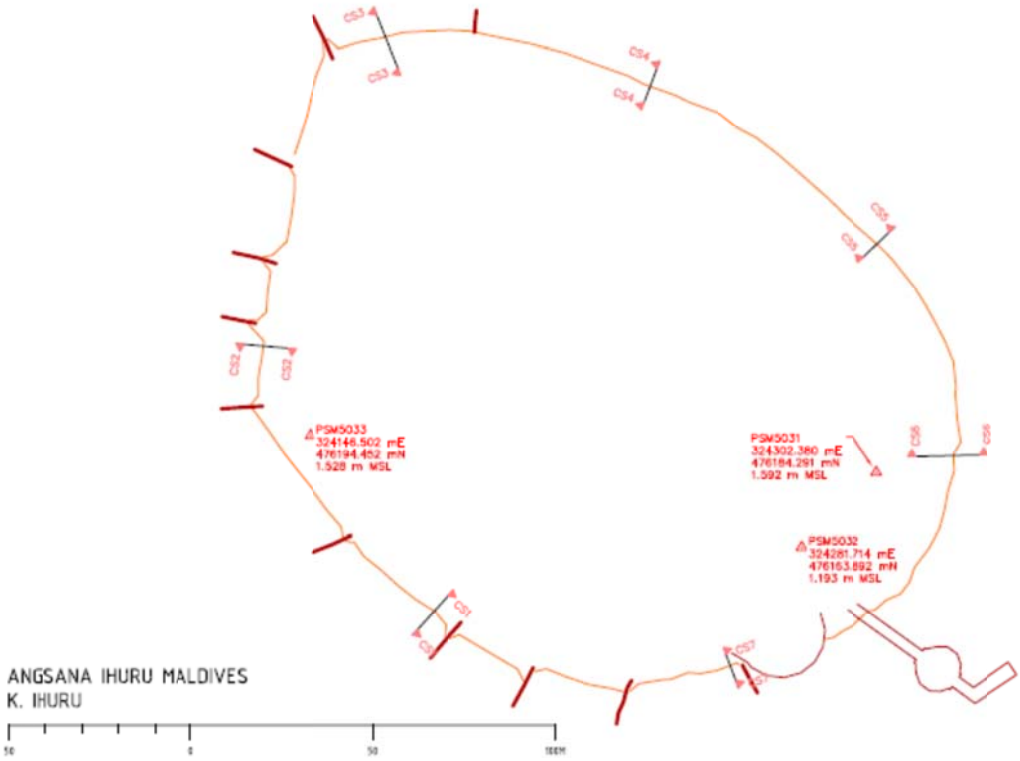


Figure 5 Groyne Field at Ihuru Island during June 2012

2.3 Project Management

The project is managed by the operator, Angsana Hotels and Resorts. Construction works for groyne construction and beach nourishment is r run entirely in house, utilizing existing resort staff from the engineering division with the help of a sand pump and 6-inch diameter pipes already put in place.

The project will not use any heavy machinery. Only sewing equipments and nylon bags are used to fill the bags with sand for the groyne construction. For nourishment, after sand is pumped using a 6-inch sand pump, sand is leveled manually on the beach without the use of any heavy machinery.

2.4 Work Schedule

The project is expected to restart soon after the approval of this EIA report, which should take approximately 2-3 weeks from submission. However, since the works are continuous and undertaken on a as-needed basis, a time based schedule has not been formulated.

Beach nourishment, using imported sand will take place approximately once annually or biannually depending on the rate of loss of sediments from the island's sediment budget. Use of groynes will be favoured for beach maintenance works and groyne displacements will be undertaken approximately once every 3 months when seasonal variations occur. However, the frequency is more dependent upon visual observation and how much the beach line has receded after a season.

Physical works will commence once the EPA has approved the EIA and issued the decision statement. Works will need to commence within one year from when the EIA Decision Statement has been issued, in order to avoid further environmental clearance. If project commencement is delayed, it would be necessary to request to the Environmental Protection Agency for an extension of the approval and Decision Statement. Since this is a continuous process, this will not be an issue in this case.

2.5 Project Inputs and Outputs

Each component of the project has inputs and outputs based on human resources, economics, and the environment. However, since the operation is carried out in house, project inputs and outputs are greatly conserved and limited. Furthermore, heavy machinery & equipment is not used in any component of the works. The major inputs and outputs associated with the project as a whole, encompassing all the components, are tabulated below. Table 1 highlights the main inputs, while Table 2 highlights the major outputs.

Table 1 Main inputs from the proposed project

Input resource(s)	Main sources of resource
Workers	In house staff from the engineering department
Sand Bags & sewing equipment	Procured from dealers in Male'. The bags are imported from abroad.

About 4,500m^3 of sand for beach nourishment	Procured from local contractors/suppliers who collect sand from designated sites.
Food, water and other resources	Provided on site for workforce

Table 2 Major outputs from the proposed project

Products and waste materials	**Anticipated quantities**	**Method of disposal**
Waste generated during construction	Variable	Collected and sorted at the waste management site in the island
Sediment plumes (during sand pumping)	Minor	Natural dispersion over a short period

3. Description of the Existing Environment

This section covers the existing environmental conditions of the project site. Since this is a coastal project, the key components with respect to the project under consideration are described below.

- Climate
- Geology and Geomorphology
- Hydrography and hydrodynamics
- Ecology
- Hazard vulnerability

Data was collected using methods discussed in Section 1.4.

3.1 Climate

This section deals with the regional and local climate of the study area. Since the Maldives does not experience relatively highly varying climate patterns throughout the country, utilising the climate conditions on a regional scale provides good indicator for the local environment, albeit with some errors.

Therefore data has been taken from the weather station at Hulhule', the island which accommodates the International Airport. Long-term meteorological data for Hulhulé is available and being only 17 km away from Ihuru, the station is at an ideal location.

The Maldives, appropriately labelled as the 'sunny side of life', in general, has a warm and humid tropical climate with average temperatures ranging between 25°C to 30°C and relative humidity ranging from 73 per cent to 85 per cent. The country receives an annual average rainfall of 1,924.7mm in the central parts of Maldives, where Ihuru is located. (Department of Meteorology, 2012).

The climate of the Maldives is dependent upon the Indian Ocean Monsoons. Monsoon wind reversal plays a significant role in weather patterns. It is also highly significant and is the key factor for coastal projects such as these.

The two monsoon seasons observed in the Maldives include the Northeast (Iruvai) and the Southwest (Hulhangu) monsoon. The northeast monsoon is the dry season that occurs from

December to February and the southwest monsoon is the rainy season, which lasts from May to September. The transition period of northeast monsoon occurs from October to November while that of southwest monsoon occurs between March and April. The 'four seasons' of the Maldives is highlighted in the following Table 3.

Table 3 The 'four seasons' of the Maldives

Seasons	Duration
South West Transition	March to April
South West	May to September
North East Transition	October to November
South West Transition	December to February

3.1.1 Wind

Wind is an important indirect process affecting formation, development and seasonal dynamics of the islands in the Maldives. Winds often help to regenerate waves that have been weakened by travelling across the reef and they also cause locally generated waves in lagoons. Therefore winds are an important factor, as being the dominant influence on the hydrodynamics in the project area. With the reversal of winds in the Maldives over the year, as shown in Table 3, the accompanying wave and current processes respond accordingly.

The two monsoon seasons have a dominant influence on winds experienced across Maldives. These monsoons are relatively mild due to the country's location close to the equator and strong winds and gales are infrequent. However, storms and line squalls can occur, usually in the period May to July; gusts of up to 60 knots have been recorded at Hulhulé during such storms (Department of Meteorology, 2012).

The Maldives experience strong ocean winds at speed of 6m/s to 7.5m/s at a height of 10m during June, July and August (Elliott *et al*, 2003). The southwest monsoon has the greatest impact on the project area. The beach nourishment works will be difficult to be undertaken during this time period of the southwest monsoon. However, it is the most ideal period from a socio-economic point of view. The period is considered the off-peak season for tourism

and is ideal for renovation works. Therefore, it may be best if any nourishment can be undertaken during early May or during the calmer days of southwest monsoon each year.

3.1.2 Waves

Wave energy is an important factor to determine the movement and settlement of sediments and suspended solids and is also a crucial factor controlling coral growth and reef development. Furthermore, understanding the wave climate is critical for coastal structures. For the purpose of the EIA, there were no measurements carried out for the wave generation on a local scale. However, regional data has been studied and visual observation on site was used to analyse the environment.

Two major types of waves are formed on the Maldives coasts: wave generated by local monsoon wind and swells generated by distance storms. The local monsoon predominantly generates wind waves, which are typically strongest during May-July in the aforementioned southwest monsoon period. During this period, swells generated north of the equator with heights of 2-3 m with periods of 18-20 seconds have been reported in the region. Local wave periods are generally in the range 2-4 seconds and are easily distinguished from the swell waves.

Swell waves have the greatest impact on beach nourishment area on the eastern side. Moreover, there is only approximately 30-40m reef flat which usually functions in dissipating the wave energy. The reef is therefore unable to provide adequate protection to the island from incoming waves, and the beaches at Ihuru has to endure the full force of waves. However, the island is located away from the rim of the atoll, and is therefore situated in such a location where it is able to utilise the other island masses for protection from oceanic swells. Wind-generated waves during the southwest monsoon would have the greatest impact on the project area on the west. While this side has a larger reef flat, it is still not sufficient to aptly reduce the wave impact on the beaches.

3.1.3 Tides

In the Maldives, the tidal fluctuations are relatively small, with typically a 1m range. Tides have a significant influence on the formation, development, and sediment movement around the island. Due to the small range, and since coastal works have already been taking place in the island, tides will not be a significant contributor to the project components of this project and is therefore not studied in intense detail.

Tidal influence on net long-shore current is also expected to be low due to the nature of the lagoon. Tides affect wave conditions and wave-generated and other reef-top currents. Tide levels are believed to be significant in controlling amount of wave energy reaching an

island, as minimum wave energy crosses the edge of the reef at low tide under normal conditions. Tides may also play an important role in lagoon flushing and water circulation within the reef.

3.2 Geology and geomorphology

3.2.1 Formation and Topography

Ihuru is a sand cay formed almost at the centre of the reef with a land area of about 3 hectares. Ihuru is isolated within a small lagoon as a single island. The shape of the island is dictated by the wave energy and currents generated from the eastern and western sides, which are stronger and have more influence in bringing sediments to the island than that generated on the north and southern sides. The island is about 1 m above mean sea level as is the case for other similar islands in the Maldives. This is based on the beach profiles taken during June 2012.

The island is in a reef located on North West of Male' about 17km away. Due to the small reef flat, the island is prone to wave action from all directions. However the eastern side of the reef is more prone to swells from the Indian Ocean and the south west side is vulnerable to the strong winds and waves during the south west monsoon.

In addition to the main entrance channel to the island, there are two other entrances formed, mainly as a convenience for snorkelers. This however leads to enhanced cross shore transport from these areas leading to significant erosion of the beach. The lagoon has a width of approximate 160m on the western side of the island. However, rich marine life is found in this area and in any case the area is not suitable for any sand pumping operation.

3.3 Hydrography And Hydrodynamics

3.3.1 Currents

Bathymetry was not required to be undertaken as part of this study. Since there were no developments being undertaken in the lagoon, and sand was not being pumped from any locations in the lagoon, a detail bathymetric survey was not done.

Generally current flow through the Maldives is driven by the dominating two-monsoon season winds. West wardly flowing currents are dominated from January to March and eastwardly from May to November. The change in currents flow pattern occurs in April and

December. In April the westward currents flow are weak and eastward currents flow will slowly take place. Similarly in December eastward currents flows are weak and westward currents will take over slowly.

Drogue tests were done at different locations around the island in order to assess the movement of the water body around the island and to determine seasonal current movement and sediment transport patterns. The results of the drogue tests done as included in the island map shown in Annex 5.

The drogues indicated that at the time of survey, the main component of long-shore current around Ihuru is due to wave-generated currents from the west. On the day of the field visit in June 2012, the wind was in an easterly direction, i.e. from the west. Furthermore, due to wave propagation onto the southwest portion of the reef, it drives the current flow northwards along the western shoreline and eastward along the southern and northern shorelines as shown in Figure 6. Additionally, due to swells from the southeast, it has been observed that the current in a westerly direction is dominant during certain occasions. However, in general the sediment transport and the subsequent erosion and accretion pattern follow the general pattern for similar islands in the Maldives as had been researched in numerous studies including studies by Kench et al. 2003.

Figure 6 General current flow direction (June 2012)

3.3.2 Marine Water Quality

Marine water quality was tested on 5 locations within the lagoon system. One sample was taken from each location and the results are given in Table 4. The parameters remain quite consistent and no significant variations are found with respect to locations.

However, it was observed that the water quality was poorer in the lagoon on the western side of the island. With a larger span of lagoon on the western side, this may be due to relatively lower rate of flushing experienced here compared to the eastern side. There is high turbidity found at this location, while other parameters are quite consistent. Since there had not been any sand pumping carried out recently and since sand had never been pumped from the lagoon, there is no project component that would directly lead to a permanent increase in turbidity.

While these values do not indicate and provide much for analysis, they will be essential to be used as a baseline data for comparative purposes with future environmental studies and environmental monitoring exercises. The test results are shown in Annex 6. The figure showing the locations from which the samples are taken is shown in Annex 5.

Furthermore, some amount of waste material was observed in the lagoon including building construction wastes, and plastic bags and bottles. Although these were very small in number, due to the small size of the island and lagoon, it is imperative that such non-biodegradable waste be removed and prevented from occurring further.

Table 4 Marine water quality test results

	Unit	**W1**	**W2**	**W3**	**W4**	**W5**
GPS Location	-	4o18’23.62” N 73o24’53.21” E	4o18’21.55” N 73o25’00.46” E	4o18’24.19” N 73o24’59.63” E	4o18’22.22” N 73o24’59.63” E	4o18’27.74” N 73o24’55.95” E
Temperature	^{o}C	26.3	26.1	26.3	25.9	26.0
pH	-	8.2	8.2	8.2	8.2	8.3
Total Dissolved Solids	mg/l	28000	28000	28200	28000	27800

Electrical Conductivity	µs/cm	55900	56500	56200	56600	55300
Suspended Solids	mg/l	3	4	4	4	7
Turbidity	NTU	4	1	0	0	2

3.4 Ecology

3.4.1 Coastal Resources

There is only a very small lagoon around the island of Ihuru with an average depth of 1.5 – 2m. Relatively few patches of sea grass communities were present and the area was mostly sandy within 5m from the shoreline.

The lagoon consists of medium-fine sandy floor, with some rocks and rubble at the area observed for this project. The water quality is considered to be good with no sign of faecal contamination and there is no chemical contamination of the water, although intense laboratory tests were not carried out microbial contamination as part of this EIA. However in general visibility of the water was quite good and a thriving marine eco-system could be observed indicating good water quality.

Coastal protection structures are at a minimum at Ihuru mainly for aesthetic reasons. There are no hard engineering structures, which means there is no rock or concrete revetment or breakwater or groyne to be found anywhere in the island. However temporary groynes made from sand bags can be found with significant distances between them, all around the island. They had lengths of approximately 15m. Image of groynes along the shore is shown in Figure 7.

Figure 7 Groyne Field along the shoreline

Based on the resort operator's experience of some years of continuous sand pumping to preserve natural beach conditions all around the island, the resort operators are of the opinion that sand pumping is the most practicable method to maintain the beach. With

diligent supervision and a strict sand-pumping schedule based on daily observations, beautiful white sandy beach are found throughout the year at Ihuru all around the island.

3.4.2 Marine Resources

An intense marine survey was not undertaken as part of this study as the project is by nature a land based project with no component directly involved with the marine environment. However since there may be indirect impacts, a qualitative assessment was undertaken.

The survey assessed live coral cover, coral recruitment, fish population, littering, at the project location. These were mainly subjective attribute based on the observer's judgment and experience. Observations from the survey are given in Table 5.

Table 5 Results of qualitative marine survey carried out

Survey Attribute	Status	Management Options
Live coral cover	Very High	Intense natural coral growth and Artificial coral growth in the lagoon. Ensure no further pollution of the lagoon
Aesthetics	Good	Minimize waste material being deposited into the lagoon.
Coral recruitment	High	Minimize any possible dredging activities, and excess nutrient input
Sea Grass	Moderate	Sea grass communities should be left undisturbed, however should be managed such that it wont compete with any potential coral growth in the area
Fish population	Good	Minimize nutrient input and activities that alter the nutrient availability in reefs. Minimize waste being deposited into the lagoon.
Littering	Moderate	Some nylon bag material and construction waste was observed in the lagoon. The resort staff is to be made more aware while undertaking construction to prevent any waste seeping into the lagoon and enforce a waste deposit area on the island to which

		waste can be collected.

The visual observations showed that the live coral cover high and was mainly comprising of massive type coral heads. finger corals, and table corals. Coral recruits were found to be high in number. While the area close to the beach was predominantly characteristic of sandy bottom, further away from the beach a vibrant garden of marine life is observed.

Observation of fish population showed the presence of significant amounts of a variety of fish populations at the surveyed areas. The fish population structures observed was indicative of a healthy reef system. The qualitative surveys conducted at the project areas, and considering previous recent surveys done for the reef, it suggests that this reef is at a good quality status compared to most of the reef systems around in the country at present time. Some photographic evidence of the lagoon are shown in Figure 8.

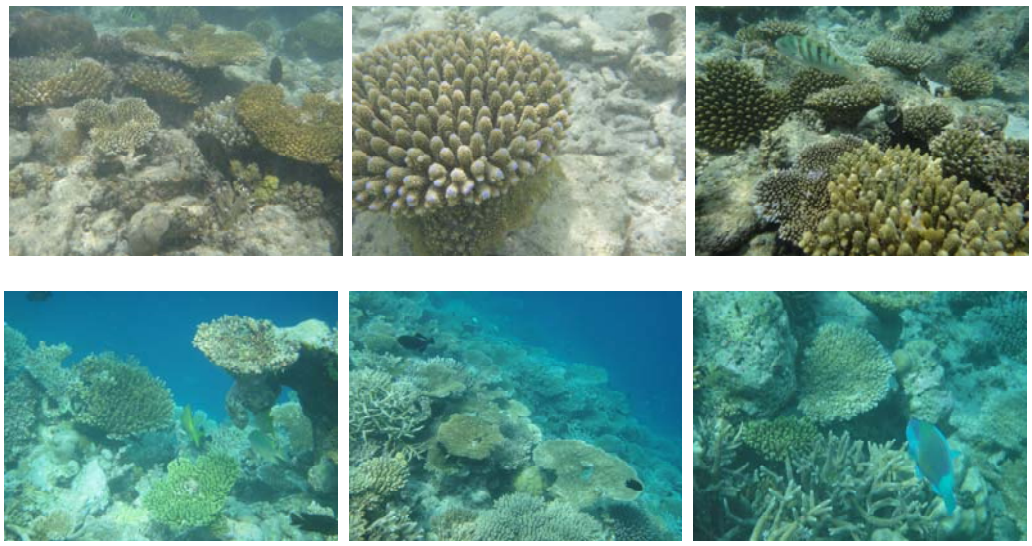


Figure 8 Photographs of the Ihuru lagoon

3.5 Hazard Vulnerability

Maldives in general does not experience natural disasters and hazards on a frequent basis. However, the Indian Ocean Tsunami in 2004 was a momentous reminder on potential hazardous threats the country faces. The islands across Maldives face similar type of threats and hazards to varying degrees and magnitude depending on several factors.

The vulnerability of islands to natural hazards depend on geological and more importantly geographic aspects of the island. As such, the location of the island, with respect to the

country and atoll is quite important. Likewise, the level of protection the island is offered from neighbouring islands, and the house reef, shape and orientation of the island are also important factors.

Based on the UNDP Disaster Risk Assessment Report of Maldives in 2006, Ihuru is located in an area that has been designated as a low-risk hazard zone. However, as stated in the report, sea level rise due to climate change is a uniform hazard throughout the country, and will have high impact on Ihuru as well. Figure profiling the Maldives based on the hazard zones are given in Figure 9.

Local data on the hazard vulnerability of Ihuru cannot be taken within such a short period as has been for this EIA report. Long-term data on a local and regional scale is required to deduce such probabilities.

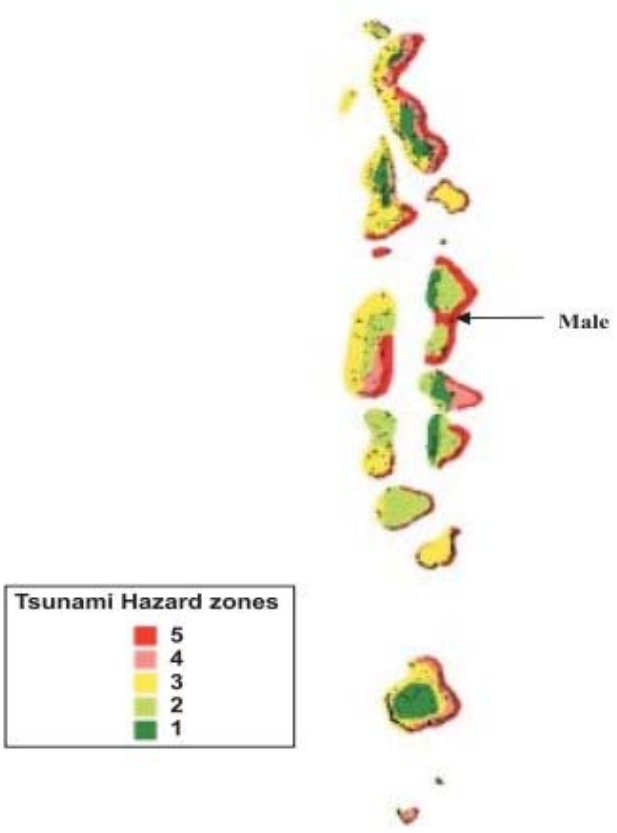


Figure 1: Tsunami Hazard Zones

Figure 9 Disaster risk profile of the Maldives (UNDP, 2006)

4. Legislative and Regulatory Considerations

The legislative and regulatory consideration the project adheres to is mostly at a national level, since it takes place on a local scale within the Maldivian environment. The extent to which the project conforms to existing plans, policies, guidelines, regulations and laws of the Maldives are considered in this Section. Some of the more important regulations are stated within the context of this project scope. The regulatory context in which the project activities take place and the legal and policy aspects relevant to those activities will be discussed in the Section.

4.1 Applicable Policies, Laws and Regulations

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

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

Clause 9b: Except for those offences that are stated in (a) of this clause, all major offences under this law shall carry a fine of not more than Rf100,000,000.00 (one hundred million Rufiyaa), depending on the seriousness of the offence. The fine shall be levied by the Ministry of Environment, Energy and Water.

Clause 10: The government of the Maldives reserves the right to claim compensation for all damages that are caused by activities that are detrimental to the environment. This includes all activities mentioned in Clause No. 7 of this law as well as those activities that take place outside the projects that are identified here as environmentally damaging.

4.2 EIA Regulations

The EIA Regulations, which initially came into force in May 2007 has been amended and published in May 2012 by the powers vested by the Environmental Protection and Preservation Act. The EIA Regulations have been the basis for Environmental Impact Assessment in the Maldives and since its inception, it had helped to improve the quality of EIAs undertaken in the country. Today, registered consultants are required to sign EIAs and the reports are subsequently reviewed by two independent reviewers and a final decision is made by EPA based on the reviews. Likewise, this EIA report would also be subject to these requirements and review criteria.

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

4.3 Maldives Tourism Act

The Maldives Tourism Act identifies the issues related to the development of tourism in the Maldives. It came into effect on the November, 1999, revoking 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. 13/79 was the primary legislation that was passed by the Citizens Majlis in November 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 guesthouses, 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 passing 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 in under article 15 (a) and (b). Article 15 (a) provides for the felling of Ruh (Coconut Palms) 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, Arts and Culture in accordance with the relevant regulations.

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

4.4 Regulation on Protection and Conservation of Environment in the Tourism Industry

The Regulation on the Protection and Conservation of the Environment in the Tourism Industry came into effect on 20 July 2006. Clause 2.1 of the regulation requires that any coastal work in a resort including beach enhancement by pumping sand, construction of breakwater, seawall, revetment or groyne and dredging of channel should be undertaken by obtaining permission from the Ministry of Tourism. Clause 2.4 requires that an EIA report be submitted to the Ministry in order to carry out the works. As part of submission for coastal modifications under clause 2.3, the Ministry of Tourism has also prepared an Application Form for Coastal Modifications.

The tourism regulation in general strictly discourage modifications to the natural movement of sand around the islands. More significantly, hard engineering solutions are not encouraged. Similarly sand mining or pumping from the beach is not allowed.

Since this is not a major construction project, there are no detailed design drawings that need to be approved from the Tourism Ministry before proceeding with the EIA procedure. However, once the EIA is complete and the Decision statement is subsequently obtained, the Tourism Ministry has to be notified before undertaking the coastal management works.

4.5 Regulation on Coral, Sand and Aggregate Mining

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

Coral mining from the house reef and the atoll rim has been banned through a directive from the President's Office dated 26th September 1990. Under Article 7 (c) of the Regulation on Sand and Coral Mining issued by the Ministry of Fisheries, Agriculture and Marine Resources (MOFAMR) on the 13th of March 2000, **it is an offence to mine sand or coral from the beach, lagoon or reef of any inhabited island and islands leased for the purpose of building a tourist resort.**

Sand mining is allowed for beach nourishment projects, provided that an EIA is carried out. However, sand mining has to be predominantly from the immediate lagoon of the resort, as is not the case in this project. Therefore under this regulation, sand pumping from the beach at Ihuru needs to be stopped and alternatives found for the process.

4.6 Permits required for the Project

4.6.1 EIA Decision Statement

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

5. Impacts and Mitigation Measures

This section is based on the potential environmental impacts due to the project components including, the beach nourishment, and construction and seasonal displacement of groynes. The section describes the mitigation measures for each identified impact. Since the components are all coastal related some impacts are general to all the components of the project, and some are specific. Likewise, the same applies for the mitigation measures. Methods of identification of potential impacts and assessing the significance of the impacts are described in the following sections.

5.1 Identification of Impacts and their Significance

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

- Public consultation with important stakeholders. Including the Terms of Reference for the EIA.
- Using decision frameworks for assigning significance to impacts
- Existing environmental studies carried out similar developments in other similar environments
- Research data that has been accumulated specific to the Maldivian context.
- Baseline environmental conditions collected.
- Past experience of the consultants with similar projects.

Possible negative impacts on the environment have been considered in worst-case scenario to recommend mitigation measures in the best possible ways so that these impacts would be minimized and perhaps eliminated in the implementation phase.

The impacts highlighted in the TOR for this EIA has been used as a guideline in identifying important impacts. However, this was not used as a strict instruction for the identification. Once new impacts not highlighted in the TOR were foreseen, they were given equal importance. Likewise, eventually it was observed that some of the highlighted impacts on the TOR were not very applicable to this project.

5.2 Identifying Mitigation Measures

Mitigation measures are proposed where significant impacts are expected. Once an impact is identified to have 'moderate' or 'major' impact, appropriate mitigation measures are given for the project. Successful implementation of the measures given would lead to a major reduction and/or nullification of the impacts on the environment and thereby ensuring that the project is environmentally sustainable.

5.3 Environmental Impacts And Mitigation Measures

Groyne construction and the continuous sand pumping operation to replenish eroding beach areas are the most environmentally sensitive components of the proposed project. The degree of adverse environmental impacts caused by these components depends on the location, methodologies, and distance of ecologically sensitive areas or species and economically important areas. The impacts of the different project components are considered in the following subsections and mitigation measures are provided for those impacts that can be mitigated.

5.3.1 Construction of the Groynes

Construction of temporary groynes as practiced in Ihuru is a soft engineering technique and is in general more environmentally friendly compared to other hard engineering efforts. A great number of islands in the Maldives have had endured hard engineering structures incorporated into their environments and there have been mixed results. Such permanent alteration of the natural environment in favour of achieving engineering solutions, have more often than not lead to irreversible disruption in other natural processes in islands, most notable the long shore sediment transport, leading to escalation of erosion in some cases.

The potential for instant reversibility is one of the most favourable factors of implementing temporary or seasonal groynes. These structures are easy to remove and can be displaced at any given time. Groyne placement would lead to erosion and accretion at the structure as illustrated in Figure 10 and if poorly designed, may lead to excessive erosion. There are also no major impacts faced with the transportation of materials to the island unlike for hard engineering structures, which more often than not require rock boulders to be transported in large barges. During temporary groyne construction and maintenance, there is the possibility of waste material being deposited to the lagoon. The poor quality of bags used in some resort islands in general have had resulted in damaged empty bags being littered on to the reef (MHE, 2011)

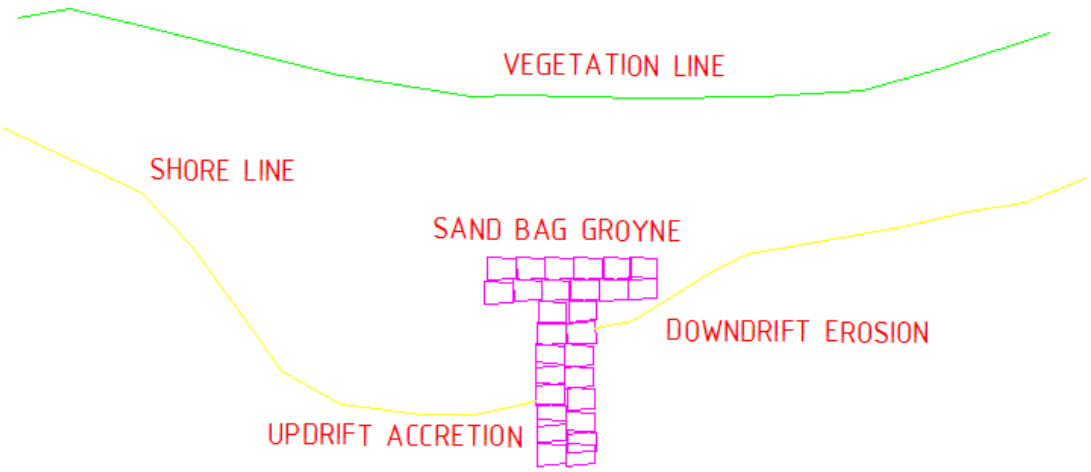


Figure 10 Construction of Groyne leading to accretion and erosion

Since sand used to fill in the bags used for groyne construction is imported, there is the potential impact of introducing foreign species to the environment. Although since the biotic environment is very similar from island to island, this can not be a significant impact. Additionally, due to the lightweight work involved, complacent or casual workmanship may lead to mismanagement of waste. It was observed even during the field trip that there were some nylon materials dispersed to the lagoon. Since the quantity was relatively very small, at the moment there was no significant impact on the marine life. However, this is a problem that could escalate if it is not given sufficient attention.

A more significant impact is an unforeseen increase in erosion due to the disruption of the natural sediment transport. However, as described previously, this is easily reversible and can be instantly mitigated.

5.3.2 Machinery and Aesthetics

Physical works of this development occurs in a tourist island, with no other islands in close proximity. The project does not include the use of heavy machinery and therefore regular construction impacts from such machinery would not exist for this project.

In terms of aesthetic impacts during construction of groynes, there will be significant such impacts as tourists will not be able to enjoy the beach while workers continue the process of constructing and displacing groynes around the island. The beach as a tourism product is highly based on aesthetics, and therefore the operators should ensure that these works will only be undertaken during off peak times.

A similar notion is applied to the sand pumping operation. However, this is a muss less frequent operation and the operators will be more able to avoid tourist interaction with the process. However, excessive pumping will lead to potholes in the beach and potentially other significant aesthetic impacts. Where ever sand is being pumped to, it is best to keep tourist contact with the process at a minimum by ensuring the work is being carried out during the off peak seasons and times.

5.3.3 Sand pumping and beach nourishment

The beach nourishment programme is a continuous process. The proposed pumping of sand to the western side of the island and subsequent filling on the eastern and western shoreline areas would cause deterioration of water quality in the immediate vicinity and to some extent nearby areas depending on the direction and magnitude of the currents in the area. The impact of the sand pumping on the environment would be mainly that of fine silt spreading around the fill area and areas onto which the fines have been spread. The fines could accumulate in more stagnant areas in the vicinity and this could have some problems due to re-suspension associated with it especially during the operational phase.

This is a short-term impact given that the silt would be moved by the long-shore and offshore currents around the island. Since the island is open on all sides sediment dispersal is quite rapid and low-level siltation from sand pumping operations would not cause significant deterioration of water quality even in the short term or immediately following the sand pumping operation.

Since sand is not pumped from the lagoon in this project, there will not be significant impacts on the marine environment. However, due to sourcing sand from the existing beach, the negative impacts on the sediment budget may be substantial and may exacerbate erosion elsewhere (MHE, 2011).

Regular beach nourishment in general would lead to degradation of the quality of coastal waters. Although this has not been the case for Ihuru at the moment, with a healthy lagoon rich with marine life, the potential for escalation of the issue exists. While this impact can be considered to be minor, keeping a sand pump for regular beach nourishment in a location considered to be one of the primary attraction of the island would lead to negative aesthetic impacts.

While importing sand from other environments are allowed, care should be taken to ensure that living organisms are not transported in this process. The material should also not be coarser than the existing sand material in the island and should be compatible.

The process of pumping sand from the beach should be halted with immediate effect to remove the continuous changes to the hydrodynamics of the island by anthropogenic means. Reducing the frequency importing sand into the system is also favourable, and different options for protection of the beaches including feeder headlands, modifying the groyne field, offshore breakwater, near shore breakwaters and others have to be evaluated.

5.4 Impacts During Operation And Mitigation Measures

Since the construction stage of the project is an on going process, impacts during operational stage are similar to that of the construction stage. The project can not really be phased into a construction and operation phase as these two phases will proceed hand in hand. However, in general waste management can be regarded as a major concern for the operation phase, during brief periods in which none of the construction works are on going.

Furthermore, the changes to sediment transport should be continuously monitored even during times of no construction such that it can be ensured that undesirable impacts or erosion are not occurring at any region of the beach. The resort operators are quite diligent in this operation as currently they continuously visually observe the changes daily, although hard statistical data is not collected.

5.5 Impact Evaluation

This section provides a summation of the impacts of the project components discussed above. The impacts of the project have been evaluated according to the criteria proposed by Posford Haskoning (2004). The decision framework is given in Figure 11.

In order to make the evaluation quantitative, the framework proposed by Haskoning has been modified. Spatial distribution of impact is also added in order to make the significance of the impacts more realistic. Scores are given for each impact once it is identified that the resource is vulnerable to the impact. Scores are based on the following factors.

- Sensitivity of Receptor
- Recoverability of Receptor
- Importance of Receptor
- Spatial Distribution of impact

The scales associated with the above criteria are given in the Table 6.

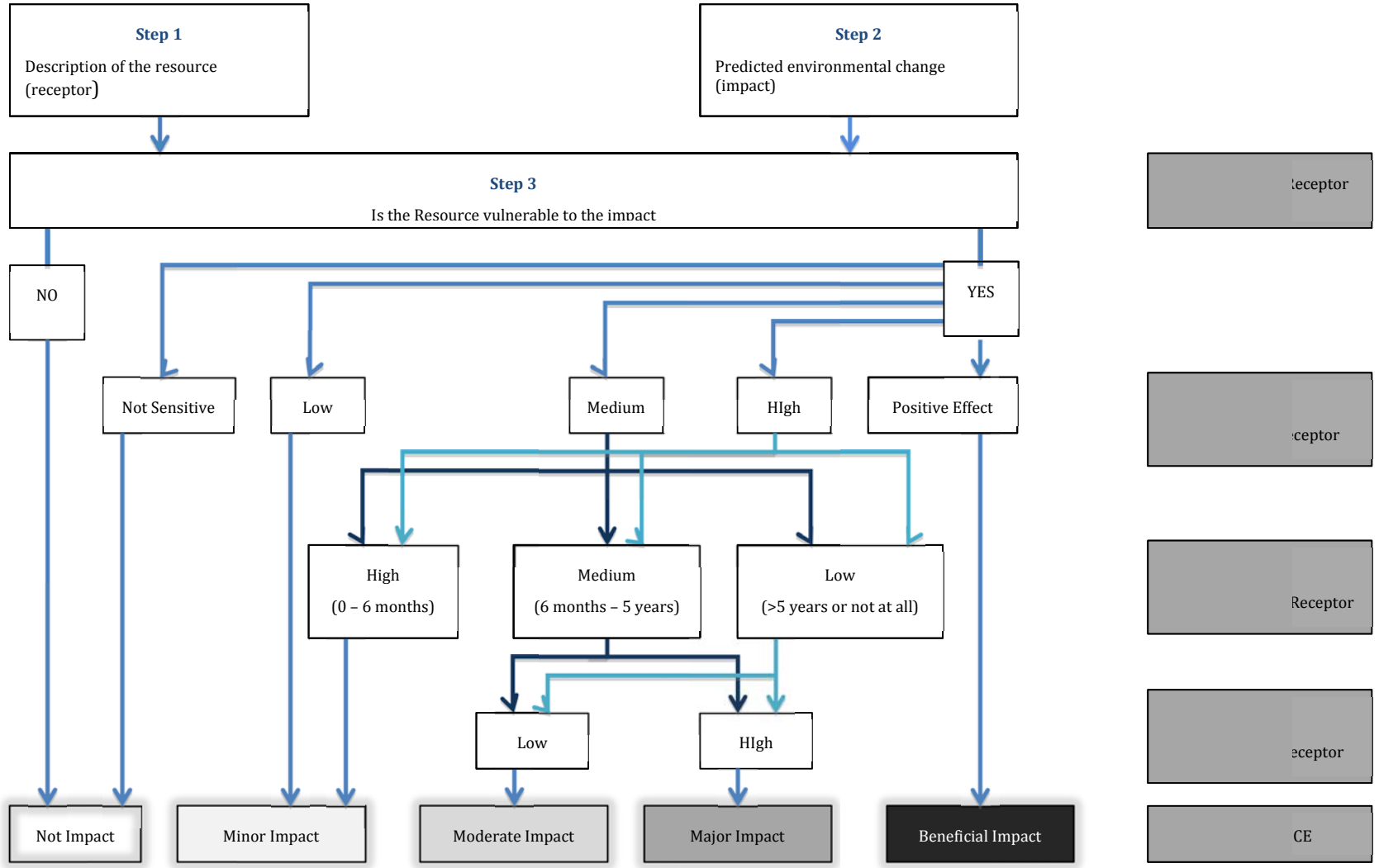

Step 1
Description of the resource (receptor)
Step 2
Predicted environmental change (impact)
Step 3
Is the Resource vulnerable to the impact
NO
YES
Not Sensitive
Low
Medium
HIgh
Positive Effect
High (0 – 6 months)
Medium (6 months – 5 years)
Low (>5 years or not at all)
Low
HIgh
Not Impact
Minor Impact
Moderate Impact
Major Impact
Beneficial Impact

Table 6 Impact Evaluation Criteria

Criteria	Scale	Attribute
Sensitivity *How sensitive the receptor is to the impact*	-1	Positive Effect
	0	Not sensitive
	1	Low
	2	Medium
	3	High
Recoverability *How long it would take for the receptor to recover from the impact*	1	Short
	2	Medium
	3	Non-recoverable
Importance *The importance of the receptor to the environment*	1	Low
	2	Medium
	3	High
Spatial Distribution *Distribution of impact*	1	local scale
	2	regional scale
	3	global scale

If the impact receives a -1, it deems the impact to have a positive effect on the receptor and the other criteria is then not applied. The impact is referred to as a Beneficial impact as is done by the Haskoning framework.

The significance of the negative impacts will be given based on the following range:

- 1 – 5 : Minor Impact
- 6 – 9 : Moderate Impact
- 10 – 12: Major Impact

Table 7 Analysis of potential impacts and associated mitigation measures for the impacts

CONSTRUCTION PHASE		**Criteria**					
Project Activities	**Potential Impact**	Sensitivity	Recoverability	Importance	Spatial Distribution	**Significance**	**Mitigation**
Pumping Sand	Sedimentation, siltation and sediment re-suspension, increasing turbidity of water	3	2	3	2	10 (Major)	Pumping sand from the beach needs to be stopped and removed from the project components.
Pumping Sand	Altering the natural deposition of sand leading to further change in the hydrodynamics of the coastal environment	3	2	3	2	10 (Major)	Pumping sand from the beach needs to be stopped and removed from the project components.
Importing Sand	Loosing sand materials to the marine environment while transporting	1	1	2	2	6 (Moderate)	Mitigation responsibility not on the proponent. However, the suppliers should be made to

							ensure that all steps have been taken to prevent any sediment leaks during transportation.
Importing Sand	Introducing foreign organisms to the environment	1	2	1	2	6 (Moderate)	Check content of imported sand at a designated site with concrete flooring before utilising the material.
Importing Sand	Impact on an unknown area from which sand is borrowed from.	1	1	2	1	5 (Minor)	Obtain written assurance from dealers that sand is being taken without using any machinery and from designated areas.
Beach Replenishment	• Sedimentation on sediment re-suspension on land	1	1	3	1	6 (Minor)	
Beach Replenishment	Temporary aesthetic impact during operation.	2	1	2	1	6 (Minor)	Ensure nourishment works are carried out during guest absent hours. Can be undertaken during night as operation

							produces low noise
Beach Replenishment	Tourist satisfaction from consistent beach area, leading to greater market potential	-1	-	-	-	Greater Beneficial Impact	Implement alternatives given in this report to decrease the frequency of sand pumping operation.
Filling Sand bags	Sand removed from the beach, altering the natural environment and possibly temporarily destroying habitats	2	2	2	1	7 (Moderate)	Only use sand imported into the island to fill the sand bags.
Construction of Groyne	Impact on aesthetic quality of the beach	2	3	2	1	8 (Moderate)	Ensure the bags materials are consistently renewed (at least biannually), so that the aesthetic quality of the groynes are maintained
Construction of Groyne	Alter the natural environment, leading to further disruption of sediment transport	2	1	3	1	7 (Moderate)	Ensure that the groyne design including gap between groynes and length of each groyne comply with the natural environment. If severe erosion

							is observed, change groyne location or design immediately.
Construction of Groyne	Provide protection to significant coastal infrastructure and assist in beach maintenance.	-1	-	-	-	Greater beneficial impact compared to negative impacts	
Labour management	Generation of waste.	2	1	3	2	8 (Moderate)	Increase awareness among construction staff. Designate specific personal to handle and transport waste.
Labour Management	Possible lack of safety features leading to work hazards.	1	1	2	1	5 (Minor)	Ensure all work safety measures are taken. Run awareness programs and regular training sessions focusing on worker safety.

The potential impacts, their significance and mitigation measures to be undertaken are given in Table 7 for the construction and operation phase together since the components of the project are all continuous processes.

In conclusion, the construction of the temporary groynes is the component with the minimum environmental impacts, while pumping sand from the beach is the component with the greatest environmental impact. Moreover, there are several general impacts during the on going continuous maintenance program.

Overall, Table 7 indicate that the project has few negative environmental impacts, which are not as strong as the positive outcomes of the project. However, pumping sand from the beach is regarded as a component with major environmental impacts. Upon evaluating the impacts and consultation with the Environment Protection Agency, and the Tourism Ministry, it has been notified to the proponent, that this component needs to be removed from the beach maintenance project in Ihuru. The other negative impacts are the ones that can be properly mitigated. On the long term, the resort operators may have to consider implementing some hard engineering structure to reduce the frequency of the beach nourishment activities.

5.6 Uncertainties in Impact Prediction

The impact prediction has been carried out based on literature and tested methods. However, the prediction relies heavily on the judgement of the consultant, and would therefore lead to uncertainties. Alternatively, such coastal projects as has been described in this report has been carried out in many islands in the Maldives and therefore observing past literature on a local context, the uncertainty would be severely reduced. Based on this, the level of uncertainty, in the case of the proposed project in Ihuru may be expected to be low as similar projects in similar settings has been carried out in the Maldives.

Uncertainties will be further reduced by undertaking the monitoring program and re-analysing impacts, after comparing the monitoring data with the baseline data provided in this report and previous recent environmental studies done for Ihuru.

6. Alternatives

This section looks at different alternatives for the proposed project. The main alternative is the no project option. After extensive discussion of this alternative, then alternatives for the project components are investigated. Alternatives are given for each component based on location and design. Each alternative is discussed based on economic, social, and environmental factors. Finally the recommended alternatives are suggested to assist in the project decision-making process.

These alternatives are not as intensively investigated as the original scope of the project. However, investigating and discussing alternatives is important so that it is ensured that the best available option(s) is/are chosen to solve the issues/problems of the project.

6.1 No project option

Initially the no project option is discussed in order to hypothesise whether the project should be taking place first of all. Sometimes, projects are proposed at a whim without much thought given to the socio-economic motivation of such development and the unnecessary impacts it may have on the environment, especially those that are long term. Therefore carrying out this practice is important to avoid such a scenario and to ensure that undertaking this project at this stage makes good socio-economic sense without much impact on the environment.

In the case of Ihuru, the project has been an on going process of construction and operation and this has already been taking place for a considerable amount of time. However, upon extensive evaluation, consultation and research it is recommended that the no project option be taken for one component of the project.

It is rare to give the no project option precedence over undertaking a project. Often times, despite having considerable detrimental environmental impacts, the long term beneficial socio economics take precedence, and projects are given the go ahead to commence and complete. However, in the case of Ihuru, pumping sand from the beach has been deemed unacceptable to the authorities based on current regulations and it has been notified to the proponent that this component need to be removed from the beach maintenance works in Ihuru.

Upon observation of the natural environment of the island, and especially from historical accounts of high levels of erosion, it cannot be justified that beach maintenance need not take place in Ihuru. If fact, beach maintenance is an absolute necessity to protect the natural environment of the island in addition to providing protection to the coastal structures. Therefore for basic protection and safety reasons alone, Ihuru can not entertain the no project option completely.

The advantages and disadvantages of not undertaking each project component is given below.

Table 8: Advantages and disadvantages of the no project option

Component	Advantages	Disadvantages
Pumping Sand	It will stop the forced continual changes to the coastal environment. Nullify any impact on the ground water system. Avoid aesthetic impacts.	There will be situations during which extreme erosion and accretion may occur. Unable to maintain the beach to the satisfaction of the resort's guests.
Importing sand	Do not have to endure such an expensive process, thereby saving costs. Do not have to disrupt the natural environment of the island by introducing new materials.	Will have to resort to pumping sand for beach maintenance.
Groyne construction	Natural beach will be preserved, although in a poor condition. Constructions waste will not be produced	Seasonal erosion of areas of beach will continue May lead to impact on coastal infrastructure Major guest dissatisfaction due to receding beach line depending on seasons.

A comparison of the no project option with the recommended and other evaluated options indicate that the no-project option is practicable but involves long-term costs, and a significant degree of tourist dissatisfaction. The major disadvantage of the no project option is that the resort may lose significant volumes of sand material from the beach if action is not continuously taken for prevention. However, the no project option has to be adapted for the pumping sand component. This can be replaced by taking other actions to maintain the beach as described in subsequent sections.

The island requires alternative means of beach maintenance rather then pumping sand from the beach. The current groyne field construction program is one such alternative that has been on going simultaneously with occasional sand pumping. The practice can perhaps be modified so that beach sand pumping will not be necessary at all. Alternatively, other practices can also be implemented in place for sand pumping. These would be looked into in the following sub sections.

6.2 Project Alternatives

The Proponent initially decided that the best option not encompassing excessive costs would be adopted after evaluating different options. Therefore, the different alternatives for the project components were considered and discussed in order for the proponent to finalise a particular option. Alternative options; mainly based on location and design for the beach nourishment, and groyne construction area are given below.

6.2.1 Beach nourishment

The major alternative for pumping sand is to engage more in importing sand instead. Although even currently sand is being imported for some civil works in the island, this component needs to fully replace the pumping sand component, which means a considerably larger amount of sand needs to be bought and deposited into the system.

Locations for beach nourishment are set depending on the level of erosion the areas have been undergoing. Therefore, there is no alternative location for the beach nourishment, as there is no need for other locations to be nourished. However, alternative methods exist for to undertake the continuous nourishment process. Currently the nourishment is to maintain the natural shoreline of the island at all seasons.

However, an alternative to the current method would be to undertake beach nourishment in such a way that feeder headlands are created using imported sand. This, however, requires additional fill material than shore parallel nourishment. The effectiveness of this has to be monitored over the long term to ensure that beach nourishment in this manner provides an adequate stable beach.

6.2.1 Hard Engineering solutions

The main alternative to temporary groyne field construction is to implement some hard engineering structure to reduce erosion. As such the following can be implemented

1. Groyne field
2. Offshore breakwater
3. Near-shore breakwater

A potential design for a permanent groyne field would be to construct 15m groynes spaced at 45 to 50m on both sides. However such a groyne field may have major aesthetic impacts. Currently there are some existing groynes built at the resort, and the proponent wishes to maintain the natural beach aesthetics in the nourished areas.

For all three options, gunny bags (nylon), geotextile bags, or granite rocks can be used. Gunny bags was a popular choice for hard engineered coastal protection structures previously, but due to its short life and difficulty in maintenance, it is currently not a preferable option. Geotextile bags provide a much more attractive, although expensive, alternative to gunny bags. However, due to anthropogenic activities and mismanagement, the bags lives are cut short from the promised 25 year guarantee usually given. They also tend to accumulate algae much more easily creating a negative aesthetic impact. Therefore granite or rock boulders are recommended.

From the three options given above, the offshore breakwater option is recommended. In this option the crest of the breakwater will be at about the mean tide line such that the average height of waves will be broken at the breakwater. Also, solid breakwaters have to be avoided. The impact of solid breakwaters can be easily seen in other islands such as Paradise Island Resort. Such breakwaters does not disintegrate the force of the incoming waves, therefore, does not reduce wave induced currents in the lagoon. Geotextile bags have a similar effect as they would also be reflective structures unless some gaps have been provided in the structure, which is difficult to achieve and does not provide the same level of porosity as with rock boulders.

6.2.1 Alternative design for existing groyne set up

Instead of implementing hard engineered structures as discussed, another alternative is to vary the design of the current temporary groyne field set up. Currently the groynes are laid without any proper engineering design and are mostly based on visual observation and on hand experience. While the groynes have been functioning reasonably well, it still allows for significant sediment transport, due to which occasional sand pumping have had to take place.

An ideal scenario will be when the groynes alone are able to maintain consistent beach area around the island. However, with drastic changes in weather patterns and due to hydrodynamic changes this may not be entirely possible. Nevertheless, the design can be improved such that the frequency of beach nourishment can be reduced only to rare occasions of extreme weather.

Properly designed groynes have to consider the following parameters:

- Length and height of groyne
- Location and orientation
- Ability to withstand bed scour adjacent to structure
- Sufficient structural strength to withstand incoming waves and high current

Considering the guidelines given in the United States Army of Corps Engineers Shore Protection manual, several important basic guidelines can be taken. As such, the groynes shoud have spacing equal two to three times the groyne length and to avoid] abrupt changes in the shore alignment that may result in erosion of the downdrift beach, the use of groynes gradually reducing lengths is recommended. (USACE, 1984).

An alternative design has been formulated based on these guidelines and is shown in the Figure 12. In this design configuration, the length of the groynes periodically changes from 14m to 9m down drift on both sides, along with the spacing between the groynes from 35m to 22.5m.

Figure 12 An alternative design configuration for the groyne field (for SW monsoon)

6.2.2 Closing Channels

This is not a component of the project. However some measures are recommended to be taken for the existing entrance channel openings in the reef as well.

There are two channels dredged in the reef of width approximately 6m. These channels have been made to make it convenient for snorkelers to move around in the area during low tides. Due to the dense coral and rock materials in the area, guests are not able to pass the reef edge without causing harm to the reef system in the area and/or to themselves. Therefore a pathway had been made at these two locations as shown in Figure 13.

However, in addition to making it convenient for snorkelers and divers, it also makes it convenient for waves to enter the lagoon without any obstructions. Subsequently, it encourages cross shore transport of sand out of the lagoon. Therefore as a permanent but minor civil works, concrete blocks are recommended to be laid in these two locations. Sulphate resistant cement is recommended to be used to cast these blocks and the surface of the blocks should be smooth so that the channels original purpose can still be fulfilled i.e. guests should still be able to use the pathway. A concrete pyramid shaped block can be made such that there would be steps on both sides and guests would find it easy to climb up and down pass the reef edge. Also these steps

would also allow for better absorption of incoming wave energy. Details of the design are to be investigated with the assistance of a civil or coastal engineer. Locations in which the channels are to be closed are shown in Figure 13.

Figure 13 Two entrance channels that need to be closed

6.3 Recommended Alternatives

The recommended alternative for beach nourishment is to first of all, use only imported sand. As stated before, it is of upmost importance that all sand pumping operations in the island needs to be stopped. Using the imported sand, it is recommended that the beaches are nourished in such a way that feeder headlands can be created thereby minimizing the frequency of beach nourishment. Continuing with the beach nourishment program is essential both from an environmental and economical point of view.

For groyne construction, it is recommended that the resort follows its current practice. Implementing hard engineering structures in the island, which has done well to avoid them, should be discouraged. Soft engineering techniques seem to have served the island well so far and thus continuing with current method is recommended. Changes to the shoreline needs to be monitored as per the monitoring program given in this report. Based on the findings, the design of the groyne field might need to be altered. It was observed on site that even now, there were some groynes in the field which was

rendered useless due to the changes in current pattern. The bags themselves can be changed to more durable geo-synthetic bags, which has greater UV stability.

7. Stakeholder Consultations

Stakeholder consultations were carried out with the management and staff of Ihuru Island Resort from Angsana, Banyan Tree, and the Dhirham Travels and Chandling Co. Officials from the Environmental Protection Agency were also met for consultation. The EIA scoping meeting held at the Ministry of Housing and Environment provided a good opportunity to discuss issues with all the major stakeholders present and thus a significant portion of the consultation were carried out at the meeting. Additionally, meetings were held with the developers and operators in Male', as well as at the island during the field visits.

The scoping meeting for the coastal development projects for Ihuru was held on 13 May 2012 at Environmental Protection Agency. In the scoping meeting, the need of the project and the different concerns as well as the description of the proposed development was outlined by Mohamed Haleem from Dhirham, who represented the proponent as the manager of the Male' office. The other stakeholders present at the meeting raised their concerns and are described in detail in the subsections.

Following are the names and designation of persons who were consulted during the stakeholder consultation.

Table 9 Important stakeholders met during the consultation process

Name	Office	Designation
Mohamed Musthafa	EPA	Director
Mohamed Hamdhaan Zubair	EPA	Environment Analyst
Mohamed Jihad	Angsana	Room Division Manager
Mohamed Haleem	Dhirham	Male' Office Manager
Mohamed Nahid	Ministry of Tourism Arts	Environmental Officer

	and Culture	

7.1 Consultations with the Management and Staff

From the operator's side, the resort manager Mr. Mohamed Jihad provided invaluable information on the need of the proponent and justification for the project. Other members of the resort staff were also met.

The main concern of the resort management was to continue the beach maintenance works without any disruptions. They highlighted the erosions issues the island had been enduring for years and described the need to continue the project in order to continue functioning as a resort island.

The management were quite flexible and was willing to incorporate any mitigation measures and/or alternatives to the existing works in the island. As such, after intense discussion of the sand pumping operation, the management accepted that they will remove this component and will solely rely on imported sand for beach nourishment works in the future. Also, they were willing to accommodate any new components that could reduce the extent of erosion around the island.

However, the management was quite straightforward and clear on the fact that they do not want to implement any hard engineering structures in the island. The natural look and feel of the island was paramount to their operation and they expressed their desire to maintain the islands natural image.

The operators were advised to follow the mitigation measures outlined in the final report. Furthermore, they were advised to undertake the monitoring program given in the report as well.

7.2 Consultation With the Tourism Ministry

Telephone consultation with the environmental officer at the Ministry of Tourism Arts and Culture was held to discuss the on going works at Ihuru.

The main objective of the consultation was to identify if there were any component of the beach maintenance works in Ihuru that were not in line with the regulations of the Ministry of Tourism. While the ministry commended the project's dedication for soft

engineering techniques, it was notified that pumping sand from the island's beach can not be allowed under the regulations.

They notified to alter this component of the project, and find means to maintain the beach without any sand pumping operation.

7.3 Environmental protection agency

EPA identified the various components of the assessments that need to be conducted and was summarised in the TOR.

EPA informed that all the project components need to be included in this EIA for the proponent to carry out the works, and it was duly obliged. EPA stressed on the issue that sand pumping operation at Ihuru needs to be stopped with immediate effect. Mining sand from the beach could not be allowed at any circumstances, even if the sand is to be deposited into another area of the same beach.

During the discussions, EPA did entertain the idea put forward by the consultant that pumping sand from the beach could be the best solution to an Island such as Ihuru. However, it was informed that under the current regulations as outlined in Section 4, an approval can not be given to any beach sand mining operation and therefore it is best to comply with the existing regulations and stop the procedure of sand pumping from the beach.

EPA emphasised on the need for regular monitoring and the importance of monitoring data in future decision-making regarding coastal protection and beach nourishment.

8. Environmental Monitoring

This section deals with the Environmental Management and Monitoring plan for Ihuru Island with respect to the coastal developments proposed in this EIA. The proposed monitoring plan is for the continuous construction and operation phase of the project components including; beach nourishment and groyne construction. The data collected for this assessment and previous assessments will be used as baseline data while undertaking the monitoring plan. Undertaking environmental monitoring is essential for several reasons including:

- To ensure that potential impacts are minimized and to mitigate unanticipated impacts.
- To aid in impact management,
- To improve impact prediction and mitigation methods.
- To gather long term data to minimise uncertainty
- To ensure sustainable development

Environmental monitoring has traditionally been a component that has been overlooked by most proponents. Proponents claim that this is mainly due to difficulty in making arrangements with the environmental consultants on a long-term basis and making arrangement for each monitoring is difficult since monitoring plans are given for a long term. Currently, environmental monitoring does not appear to be cost effective from the proponent's point of view and is generally viewed as a burden. However in order to make the best use of this report and for the aforementioned reasons, carrying out the monitoring plan as outlined is vital, especially for a continuous project such as this.

The proposed monitoring programme will yield beneficial results if it is undertaken for a long period. As required in the TOR, the monitoring is to take place during the continuous construction and operation phase once every 3 months up to 1 year, and then on an annual basis for as long as the works are being undertaken.

The proponent expressed their full commitment to carry out the monitoring program outlined in this report. The proponent's commitment to undertake the environmental monitoring and mitigation measures is given in the **Proponents Declaration.**

8.1 Monitoring Methodology and Costs

The methodology used for monitoring will be similar if not the same as those used in this environmental assessment. However, field water quality testing equipment can be

employed to decrease the uncertainties of the results as they can be compared to those obtained from the National Health Laboratory. To carry out field water testing, such equipment needs to be procured, which may not be feasible based on this project along. However, considering the many other projects that would be carried out in the resort, and also considering the operation of the obligatory desalination plant facility, procurement of such equipment makes more economic sense. The same may not apply to professional grade surveying equipment, which is also needed for the monitoring works due to their high costs.

Cost estimates for environmental monitoring were usually given in previous EIAs based on the components that require monitoring. However, this was not seen as an efficient method and it tended to give high overall cost estimates to proponents and how much the proponent would need to spend to generate an annual monitoring report was not clear. As a result, more often than not, it discourages the proponent from attending to the monitoring program. Generally the components that require monitoring can be done simultaneously and therefore estimated costs are given based on the activities that need to be carried out to compile an effective monitoring report.

The costs given in Table 8, and Table 9 are calculated for monitoring to be undertaken by hiring environmental consultants for each monitoring program. However, field data collected for the proposed environmental monitoring program can be carried out by an in house team of engineers and/or technical assistants since most of the parameters are to be investigated monthly and quarterly, and therefore hiring a consultant for each occasion may not be feasible. Nevertheless, if the resort does not employ environmental experts among its staff, it is highly recommended that an arrangement is made with an environmental consultant on a long term basis to carry out and supervise the execution of the monitoring program. Additionally, it is an EPA requirement that the annual environmental monitoring report needs to be compiled and formulated by a registered environmental consultant with a **permanent** EIA consultant license.

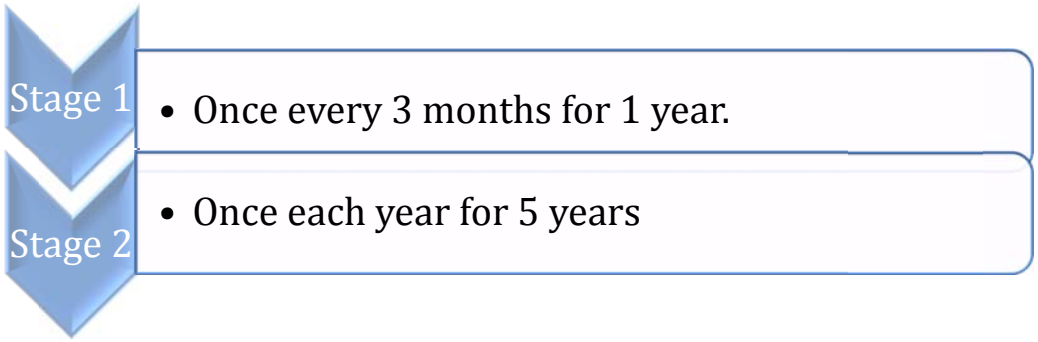
The parameters that are most relevant for monitoring the impacts that may arise from the project are included in the monitoring plan. Therefore, the monitoring programme will cover the following aspects of the project:

- coral cover and marine life
- marine water quality
- changes to shoreline
- condition of coastal structures

- Beach profiles
- Opinions of staff and tourists

8.2 Recommended Monitoring Programme

As instructed in the TOR, the monitoring programme will be divided into 3 stages.



Stage 1

- Marine water quality for pH, DO, EC/salinity, turbidity and nitrates at possible reef areas into which sediment plume is expected to move.
- Shorelines and beach profiles around the impact areas
- Drogues to measure and analyse long shore and cross shore sediment transport
- Observation and monitoring condition of coastal structures
- Observation of maintenance and management of health and safety hazards
- Noise measurement

Stage 2

- Shorelines (low tide, mean tide and high tide) starting immediately after beach enhancement.
- Drogues to measure and analyse long shore and cross shore sediment transport

- Marine water quality – pH, DO, E-conductivity/salinity, nitrate and turbidity.
- Observation and monitoring condition of coastal structures
- Photographic evidence of marine environment

8.3 Cost of monitoring

The following tables outline the cost estimate for each stage of the monitoring plan given. The costs are calculated assuming the monitoring will be undertaken by hiring environmental consultants on a project basis.

Table 8 Estimated costs of Stage 1 of the Monitoring Programme

Item No.	Details	Unit cost (US$)	Frequency	Total (US$)
1	Field allowance for 2 consultants for 1 day	100.00	4	400.00
2	Surveying and monitoring equipment depreciation	800.00	4	3200.00
3	Laboratory charges	50.00	4	200.00
4	Compliance reporting (annual report)	800.00	1	800.00
	Total			**4600.00**

The monitoring is for a period of 1 year, where data is collected quarterly.

Table 9 Estimated costs of Stage 2 of the Monitoring Programme

Item No.	Details	Unit cost (US$)	Frequency	Total (US$)
1	Field allowance for 2 consultants for 1 day	100.00	5	500.00
2	Surveying and monitoring equipment depreciation	800.00	5	4000.00

3	Laboratory charges	50.00	5	250.00
4	Compliance reporting (annual report)	800.00	5	4000.00
	Total for 5 years			**8750.00**

This monitoring is for a period of 5 years, where a data is collected annually. Therefore for each year the cost will be approximately USD 1750.00, not taking into account any effects of inflation and other such economic scenarios. Considering the 3 stages of monitoring, monitoring costs in the first year would be approximately **USD 4600.00**. The proponent has to endure the greatest cost during the first year, as frequency of monitoring is greater. However, in the following years the frequency considerably decreases. In each of the next 5 years, the consultant would need to spend approximately **USD 1750.00** to undertake proper environmental monitoring.

Please note that the costs are subjective. It may vary depending on the consultant and also due to changes in price with time. Also, in the case that a long term arrangement is made with a consultant, the price may considerably decrease and may be more feasible for the proponent.

8.4 Monitoring Report

Monitoring report should be compiled based on the baseline data collected. This report should be submitted to the EPA and any other relevant government agencies for compliance, if requested. The report structure may include but not limited to;

- Introduction
- Details of the site at the time of investigation,
- Data collection and analysis,
- Details of methodologies and protocols followed
- Quality control measures,
- Sampling frequency and monitoring analysis
- Conclusion and recommendations

9. Conclusion

The scope of the project is different from usual coastal modification projects undertaken in the Maldives. The resort operators have thus far been able to maintain the beach without bringing drastic alterations to the natural environment. However, under the current program the works need to be continuous all year round and that may lead to cumulative financial and environmental stress.

The major component of the project from an environmental perspective is the sand pumping operation. After investigating the potential impacts of the project, and more importantly after referring to the relevant laws and regulation it has been notified that this operation has to be stopped with immediate effect as sand mining from Maldivian beaches is not made legal. The operation at Ihuru may have been an exceptional case where sand pumping had not lead to any major environmental impact over the years. This hypothesis can only be verified after longer-term data has been collected from the island. However, in order to comply with the laws and regulation this practice is no longer set to take place in the island. Alternatively, if the beach can not be maintained without any nourishment, it has been advised to undertake this nourishment using sand bought and imported to the island by local suppliers.

In addition to nourishing the beach, the other practice of temporary groyne field construction is in general an environmentally friendly method to deal with erosion. It provides greater reversibility and minimum aesthetic impacts compared to permanent structures. The dynamic nature of the groyne construction program also enables the operators to keep pace with the erosion by changing the location of the groynes periodically. Using such soft engineering techniques should be encouraged. However, changes to the groyne field design have been recommended to comply more with international design guidelines. Additionally it has been recommended to close 2 small entrance channels in the lagoon to prevent cross shore loss of sediments.

In conclusion, the operations in the resort are environmentally friendly except for the occasional sand pumping operation. The socio economic and also environmentally benefits of the project far outweighs the temporary negative impacts of the project. Therefore **it is recommended that this project goes ahead, without the sand pumping operation**. Minor changes to other components have been recommended under the mitigation measures and alternative sections. Incorporating these changes and undertaking the environmental monitoring program diligently will ensure sustainable development and maintenance of the beach at Ihuru Island Resort.

10. References

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Annex 1 – Terms of Reference

Annex 2 – Study Area and Layout

Annex 3 – Beach Profiles

Annex 4 – Shoreline and Ocean Currents

Annex 5 – Water Sampling locations

Annex 6 – Water test results