2ND ADDENDUM TO THE EIA REPORT RESORT DEVELOPMENT, MAAGAU, DHAALU ATOLL MALDIVES

Prepared for
New Mood Resorts Pvt. Ltd

Prepared by:
Dr. Mahmood Riyaz (EIA P03/2007)

September 2020

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Declaration of the Consultant:

I certify that the statements made in this 2nd Addendum to the Environmental Impact Assessment Report on resort development project, Dhaalu Maagau, Maldives are true, complete and correct to the best of my knowledge and available information at the time of writing this report.

Dr. Mahmood Riyaz (EIA P03/2007)
7th September 2020

Declaration of the Proponent

As the proponent of the proposed Resort Development Project Dhaalu Atoll, Maagau Island guarantee that We have read the 2nd addendum to the EIA report for resort development project in Dhaalu Maagau Island and to the best of our knowledge all non-technical information provided here are accurate and complete.

Gianandrea Tosi

2nd September 2020

1 ސާދާ ޚުލާސާ

މިރިޕޯޓަކީ ދ.އަތޮޅު މާގައު ގައި ޓޫރިސްޓް ރިޒޯޓެއް ތަރައްޤީ ކުރުމަށް ހިންގާ މަޝްރޫޢުގެ މަސައްކަތް ކުރުމުގެ ކުރިން ހަދަން ޖެހޭ އީއައިއޭ ރިޕޯޓް ނިމި މިނިސްޓްރީއޮފް ޓޫރިޒަމުން ހުށަހަޅާފައިވާ ރިޕޯޓަށް ހުށަހެޅުއްވުމަށްފަހު އިތުރުކުރެވޭ ދެވަނަ ބައެވެ. އިތުރުކުރެވުނު ފުރަތަމަ ބައިގައި މިނިސްޓްރީ އޮފް ޓޫރިޒަމުން ހުށަހެޅުއްވި 19 ޑިސެމްބަރު 2019 (Ref: 88-DS/PRIV /2018 / 2648) ގައެވެ. މިރިޕޯޓް (އިތުރުކުރެވޭ ދެވަނަ ބައި) ހުށަހަޅަން ޖެހުނީ މާގަވަރު ތަރައްޤީކުރުމުގެ މަސައްކަތު ކުރިޔަށްދިޔަ ޤާއިމުވި ދުރިން އަކަރު ތަރަހު ބޮޑުކޮށް ގެރެއިގެންގޮސް ބިސްދޮރު ކުރިއަށްގެންދާ ޓޫރިސްޓް ފެސިލިޓީތަކަށް ގެއްލުންވުމުގެ ސަބަބުންނެވެ. މިގޮތުން ތަރަހު ބިންހިއްސާކުރުން ގެނެވުނު މަސައްކަތް ކުރިމަތިވެފައެވެ. އެއީ ރަސްމީ ޔާހާ ވޯޓަރވިލާ ޔާހާ ދުގުދު އޯވަރ ސަރަހައްދު ގެދޮރުއި، ވީޖަރ މިރާ ސަރަހައްދު ބަދަލުކޮށް ބޭރުވާ ދަތުރުގެ ސުދާ ފެންގިއްސޭ ކަނޑޭއިރުގައި، ތަރަހު އިމާރާތް ވެސް ހަމަ ސަރަހައްދު ބަދަލުކުރުމާއި ބެލުމާއި ބަދަލުގެ މަސައްކަތެވެ. ތަރައްޤީގެ މަސައްކަތް ކުރިޔަށްގެންދިޔައިރު ގެސްޓްހައުސް އިތުރުކޮށް ބިމާއި ބަދަލުކުރުމަށް ގޮސްފައި އޯޝަން ބޭރުވާ ފެންސްގެ އެހެން ޓޫރިޒަމް މިނިސްޓްރީ އެއް ހުރަހަށް، އެބަދަލަކީ ވިޔަވާރި ގޮތުގައި ބިދޭސީ ގެސްޓްހައުސް ބަދަލުގައި ބައިވެރިވުން ފައިދާ ކުރާނެ ފެހިމަތީގެ ކާރިޓްރާ ޤާނޫނީ ގޮތުން ދަތުރުތަކާއި ބެދުމުގެ އެއްޗެއް ތަރައްޤީކުރުމުގެ ހުއްދަ ދީފައިވާ 15 ޖޫން 2020 (88-ES/PRIV/2020/909) ގައެވެ. މިގޮތުން ގެސްޓްހައުސް ހިމާޔަތް ކުރުމުގެ ގޮތުން އެދިފައި ހުށަހަޅާފައިވާ މައިގަނޑު ކަންތައް ތަކަކީ:

ހ. ތަރަހު އިތުރުކުރީ ފެހިމަތީ ހުރިގޮތުގައި ގެސްޓްހައުސް ހިމާޔަތް ކުރުމުގެ ގޮތުން ތަރަހު ގެސްޓްހައުސް ބަދަލުކުރުން ބޭރު އަދި ހިސާބުގައި ޖީއޯޓިއުބް ވަށްފައި އެސަރަހައްދު ވެލިން މެއިންޓަނަންސްކުރުމައި

ށ. ތަރަހު އިތުރުކުރީ ފެހިމަތީ ގައި ބޭރުގަނޑަ ބޭސްބޯޑުގެއްލުން ބޭރު ތަރަހުއްލުމައި

ނ. ގެސްޓްހައުސް ވެލިން މެއިންޓަނަންސްކުރުން ބޭނުންވާ ވެލި ޑްރެޖިންގއާ ދިމާލު ފެހިމަތީއިން ޚަރަދުކުރުމެވެ.

ހުށަހަޅާފައިވާ ބަދަލުތަކާއި ގެސްޓްހައުސް ސަރަހައްދު ރިޕޯޓުގެ ބިލޮކް އަތް އެރީއާ ބަދަލުތައް ނުކެރޭނެއެވެ.

މިހެންކަމުން މިރިޕޯޓުގައި މައިގަނޑު ގޮތެއްގައި ބެލުނު ދެވަނަ ހުށަހަޅާ ބަދަލުތަކާއި ގެސްޓްހައުސް ބޭރުކުރަން ގެސްޓްހައުސް މައްސަލައެވެ.

މިރިޕޯޓް ތަރައްޤީކުރުމުން ބޭރުން ކުރެވިފައިވާ މިސަރަހައްދު އީއައިއޭ ގެޓުމަށްކަމުގެ ފުރަތަމަ އެހެރާ ބޭރުން ކުރެ މަސައްކަތުގެ އިތުރުން ކުރުވޭ ހަމަ ސައިޓް އަދި އެންވަޔަރަންމަންޓަށް ބެދެލޭނެ ތަރުކީބު ކުރެވުނު ފުރިހަމަ ކުރިން ކަނޑާވަރު ހަމަޔަކަ ދިރާސާ ކުރުމުގެ ބަދަލުގައި ފުރަތަމަ ދިރާސާ ކުރެވުނު ސަރަހައްދު ބަދަލުތަކެވެ، މިރިޕޯޓް ތަރައްޤީކުރުމުގެ ޒަރޫރީ ތަރަހު ކުރެވިފައި ދިރާސާގައި އެއްކުރެވިފައި މައްޗާއި ތަފާތެވެ. މިގޮތުން ފާހަގަކުރެ މިއަދަދުގައި ތަރައްޤީ ކުރިމަތިވާ ކަމެއް ނެތް މަޝްރޫޢު ތަފާތު ދިރާސާތައް ރިޕޯޓަކެވެ.

ދ. މާގައުގެ ގެސްޓްހައުސް ހިމާޔަތް ކުރުމަށް ހުށަހެޅިފައި މިވާ މަޝްރޫޢުގެ މަސައްކަތްތަކުގެ ތަރުތީބު ކުރެވޭ ކަންތައްތަކަން ތިމާވެއްޓަށް އެންމެ ބޮޑު އަސަރުކޮށް ކުރާނެ ކަމަކަށް ފާހަގަ ކުރެވޭ ގެސްޓްހައުސް ވެލިން މެއިންޓަނަންސްކުރުމާއި ޖީއޯޓިއުބް އަޅައި ވެލިގެ މަސައްކަތްތަކުގެ ސަބަބުން އެސަރަހައްދުގައި ކަނޑުގެ ދިރުންތަކުގެ ސަބަބުން ނެތެވެ. މިއީ ކުރުމުއްދަތެއްގެ

ދެމިގެންދާނެ ދިގު މިންވަރުގެ އަސަރުތަކެއް ކުރާނެ ކަމެކެވެ. މިމަސައްކަތުގެ ތެރޭގެ ސަބަބުން ފަރުތަކަށް ހާނިކާރަކަށް އުފެދި ފަރުގެ މުރަކަތައް ދިރުމަށް އަސަރުފޯރާ ވިލުތަކުގެ ގޮތަށް ބަދަލުވުމަށް އެކަމުގެ ސަބަބުން ރަށްދިރުންތަކަށް ތިމާވެށީގެ އިތުރު މަސައްކަތްތަކުގެ ކުރިމަތި ވުމަކީ އެކަށީގެންވާކަމެކެވެ. ނަމަވެސް ހުރަހެޅުމާ މަސައްކަތުގެ ބޮޑު ކޮށް މިނަން ބަލާ އަދި އެކަން ކުރެވޭ ސަރަހައްދުގައި އެތެރެވާގެ ފެން ވިލާ ކައިރިވުމުގެ ސަބަބުން މުދުގައި އުފެދޭ ކިލަބުކަން ފެން ސަރަހައްދުގައި އަޅަން ފެށިގެން ދާނެކަމަށް ލަފާކުރެވެއެވެ.

ރަށުގައި ކުރުމަށް ހުރަހެޅުމާ މަސައްކަތްތަކަށް ބަދަލު ގެނެވިދާނެ ބައެއް ކަންތައްތައް ވެސް މިދިރުމުގައި ފާހަގަ ކުރެވިފައިވާ ނެތެވެ. އެގޮތުން ބޭރުގެ ތަރުކީ ގޮސްދިޔަ ހިމާޔަތްކުރުމުގެ ބޭނުންކުރުމަށް މިޔާދު ހުރަހެޅުމާ ޖެއްޓީއާއި އާއި ބޭރު ހިލާގެ ބަދަލުގައި ބޮރުލުމުގެ ބޭނުން ކުރެވިދާނެ އިތުރުގޮތް ބަލާއި ވާނީ ފަޅުން ކުރެވިފައެވެ. މިގޮ އިތުރުން ރަށުގެ ހެލިކުގެ ފަރާތް ހިމާޔަތް ކުރުމުގެ ގޮތުން ބޭރުބައްޓަން ބެލުމަށް ވާނީ ލަފާދީފައެވެ. ހުރަހެޅުމާ މަސައްކަތްތަކުގެ ސަބަބުން ތިމާވެށިގެ ބޮޑު ދެވޭބަދަލުތައް ނައިސްކުރުމަށް ވިޔަސް ފްރޮޖެކްޓް ލޯކަލް އޮފީސަރއާ ގުޅިގެން މައިސާ ކުރުމުން ލަފާ ދީފައިވާ ގޮތުން އެކަން ކަނޑައަޅާ ގޮތަށް ކަމުގެ ފަރާތް ޢަމަލުކުރާނެއެވެ.

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2 EXECUTIVE SUMMARY

This is the 2nd addendum to the EIA report on resort development project in Maagau, Dhaalu Atoll. The first Addendum covered the revisions submitted to the master plan on 13th December 2018 and conditional approval granted by MoT on 19th December 2018 (Ref: 88-DS/PRIV /2018 / 2648). This addendum (second addendum) is prepared to address severe erosion that has been going on for over three years in three different areas of the island; western side between the main jetty and the water villas; coastal erosion and scouring on the base of Water Villa Jetty; the eastern tip of the island which get very severe exposing beach villas near the service jetty area for direct structural impacts, causing damages and making uninhabitable. Proposed coastal modification concept plan was approved in by MoT on 15th June 2020 (88-ES/PRIV/2020/909) on the condition that the proponent should submit an addendum to the EIA incorporating proposed coastal developments. Main activities in the proposed coastal modification include the following:

- Installation of Geotubes for shore protection and backfilling of the area on the eastern and western side of the island
- Construction of breakwater on Eastern side of the island
- Sand sourcing area for backfill and beach nourishment is suggested from the sand accumulating areas on near the Water Villa Jetty.

With these changes total built up area of the island will not be changed. Therefore the main focus of this addendum would be to address the coastal modification that has been proposed in the approved coastal modification concept plan.

Baseline data from the initial EIA report was used and additional site specific data on marine and coastal environment was collected for the report from the field and data from the relevant documents and reports on similar development projects in the Maldives were reviewed.

The most significant activity that has the potential to cause negative environmental impact from the proposed project is the sedimentation impacts associated with pumping of sand from the lagoon to fill Geotubes, backfill and beach nourishment. Pumping sand from the lagoon will have a direct irreversible negative impact to the ecological habitat in the area and lethal impact on sessile benthic organisms on in the area. The direct impact of this activity is very local and limited to lagoon area in the vicinity of water villa proposed for sourcing sand for coastal modifications and areas proposed for the installation of the Geotubes. The proposed work can be considered as a negative environmental impact that will cause sedimentation and coral smothering and changes in the hydrodynamics of the island and changes in seabed elevation. Given the size of the proposed activities, proximity of the work sites to open ocean, the impacts associated due to sediment re-suspension will be of short duration and minor.

The Report has evaluated alternative material for the construction of shore protection structures also recommended extra offshore areas for protection on the western side of the island. Negative and positive environmental impacts associated with the implementation of the proposed coastal modification is recommended to be monitored through the monitoring programme presented in the report.

With proper implementation of the mitigation measures, anticipated direct irreversible negative impact to the ecological habitat in the area from the proposed could be limited and contained in the work area without widespread dispersion of suspended sediment associated with this development. Therefore the proposed coastal modifications will not alter the over-all aspect of the project and recommended to go ahead as proposed.

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3 INTRODUCTION

This is the second addendum to the EIA report on resort development project, Maagau, Dhaalu Atoll. The initial Resort development concept was approved by the MoT on 24 December 2014 and the EIA for the proposed development was approved in June 2015. The initial Master plan was revised and changes for the initial resort development concept was made and submitted to MoT for their approval on 13th December 2018. The first Addendum covered the revisions submitted to the master plan on 13th December 2018 and conditional approval was granted by MoT on 19th December 2018 (Ref: 88-DS/PRIV /2018 / 2648). This addendum (second addendum) is prepared to address severe erosion that has been going on for over three years in three different areas of the island; western side between the main jetty and the water villas; coastal erosion and scouring on the base of Water Villa Jetty; the eastern tip of the island which get very severe exposing beach villas near the service jetty area for direct structural impacts, causing damages and making uninhabitable. Due to this permission to undertake emergency protection measure was obtained from on 6th February 2020 (Ref 203-ECA/PRIV/2020/114). This report is prepared to cover the coastal modification that has been proposed to address the severe erosion problem in the island. Proposed coastal modification concept plan was approved in by MoT on 15th June 2020 (88-ES/PRIV/2020/909) on the condition that the proponent should submit an addendum to the EIA incorporating proposed coastal developments. Main activities in the proposed coastal modification include the following:

- Installation of Geotubes and backfilling of the area on the eastern and western side of the island
- Construction of breakwater on Eastern side of the island
- Burrow sand for backfill and beach nourishment from the sand accumulating areas on near the water Villa Jetty.

With these changes total built up area of the island will not be changed. Therefore the main focus of this addendum would be to address the coastal modification that has been proposed in the in the approved coastal development.

3.1 RATIONAL FOR COASTAL MODIFICATION

Maagau is an operational resort with ongoing construction activities to complete water Villas. Resort development project in Maagau will add 202 beds with direct employment of around 348 jobs and indirect employment contribution of around 150 jobs. Maagau when in full operation is expected to contribute over 30,000-40,000 annual tourist arrivals to the country, hence it is also expected to directly and indirectly contribute US$ 1 - 3 Million annually to the national economy. With the positive outlook of the project, it is regarded as an important for the country. The main rationale for making the proposed coastal modification is to improve and sustain the quality of services provided by the resort for the guest and to undertake tourism activities as specified in the contract between the Government and the Proponent.

Having a beach around island is considered as a necessity for the resort, as most of the tourism visit Maldives for sand and sea related activities. The ongoing erosion if continued will affect the properties and tourist related infra structures on the island. Therefore to sustain and compete as a luxury tourist resort maintaining a beach is considered to be a necessity.

Apart from this, Dh. Maagau would add to the state revenue generated from tourism (through BPT, land rent and green tax recently introduced and further increased goods and services tax) and subsequently help to improve public services and living standards. It also provides direct and indirect employment and other income generating opportunities and help to address several social issues by making the revenue available for improvement of public services.

3.2 PROJECT OBJECTIVES

The main rationale for the proposed changes in the proposed coastal modification plan is

- To manage and prevent ongoing erosion on the island
- To maintain a reasonable beach around the island
- To protect island infrastructure from the impact of coastal erosion

3.3 ASSESSMENT METHODOLOGY

3.3.1 General Approach

This EIA addendum is broadly guided by the EIA regulation May 2012 and EPA data collection guidelines published in www.epa.gov.mv.

This report has been prepared to ensure that the significant environmental and social impacts of the proposed project at various development stages have been considered and assessed at the project planning phase.

The report has been prepared by following five major steps. They are; literature review; field surveys; stakeholder consultations; analysis of results; and report EIA compilation.

Field assessments covering marine, terrestrial and coastal environment surrounding the project area of the proposed project site was undertaken for the initial EIA and relevant assessment were undertaken for this assessment. Methodology used in the assessments is further detailed in the relevant sections of the report.

Extensive stakeholder relevant for this development was consulted during the initial EIA development process.

3.3.2 Literature Review

Following documents which include the initial EIA report and other relevant reports mainly similar undertakings by the consultant in the past are reviewed.

> EIA for the proposed resort development in Maagau, Dhaalu Atoll, Maldives, Prepared by SandCays for New moods Pvt. Ltd (March 2015)

1st Addendum to EIA Report on Resort Development in Maagauʻ Dhaalu Atoll, Prepared by Dr. Mahmmod Riyaz (February 2019).
2nd Addendum to the EIA Report Uthurumaafaru, Raa, Atoll, Maldives, Prepared by Mahmood Riyaz for Uthurumaafaru Holding Pvt. Ltd (Sept 2018)
Environmental Management Plan for Access channel maintenance dredging and beach nourishment, Cocoon Maldives at Ookolhu Finolhu, Lh, Atoll, Maldives. Prepared for Cocoon Maldives, by Mahmood Riyaz (November 2017)

3.4 STUDY AREA

The proposed project activity will take place on Dhaalu Atoll, Maagau Island and Falhu. Maagau is located at 2°56'51.69"N, 72°54'53.77"E in Dhaalu Atoll. Maagau Island is located on the north western side of Dhaalu atoll in an isolated house reef inside the atoll. The island and the reef are E-W oriented. The island has a registered land area of about 6.9 hectares. The reef surrounding Maagau has an area of about 36 hectares around the reef line. The island is low lying at about 1.2m above mean sea level. The closest inhabited islands are, Dh. Ribudhoo, lies 3 km away on the south western side of island, Dh. Bandidhoo, lies 8km south east of Maagau and Dh Meedhoo located 11km NE of Maagau. **Error! Reference source not found.**. The boundary of the proposed project is the whole house reed of Maagau Island. *Figure **2*** shows approved Coastal Modification concept plan.

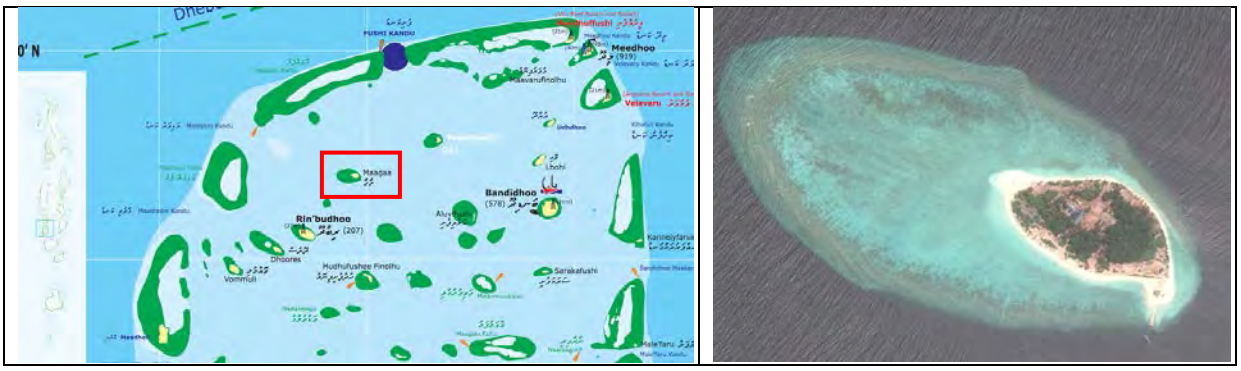


Figure 1: Location of map of Maagau Island in Dhaalu Atoll.

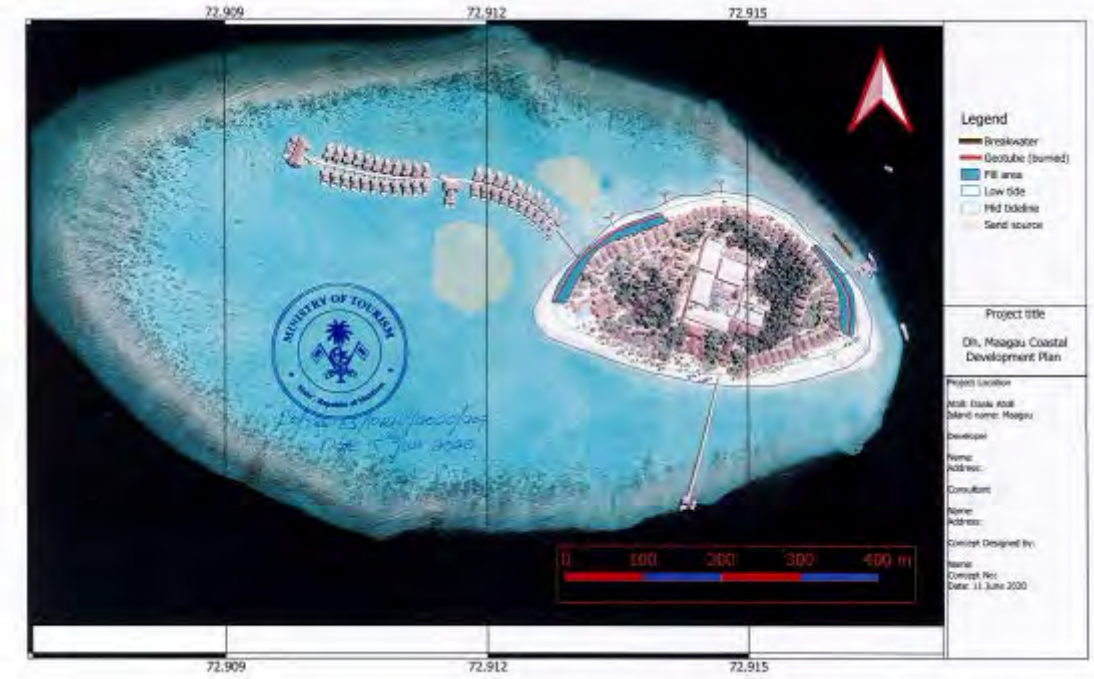


Figure 2: Maagau resort approved coastal modification concept plan

4 DESCRIPTION OF THE PROPOSED CHANGES

This addendum to the EIA report resort development in Dh. Maagau Island is prepared to address the ongoing beach erosion problem on the island. Following the approval of the resort Coastal Modification concept plan by the Ministry of Tourism, ToR for the EIA addendum was finalized and approved by EPA on 6th July 2020 (Annex -1).This addendum to the EIA is prepared in accordance with the Environmental Impact Assessment Regulations of the Ministry of Environment and Energy May 2012 and recently gazetted 5th Amendment to the regulation which came to effect on 27 December 2018. From the date of the 5th Amendment to the EIA regulation 2012 (27th December 2018), all activities undertaken in tourist resorts, and hotels that require an EIA, shall be submitted to and approved by the Environmental Protection Agency (EPA).

4.1 PROJECT PROPONENT

Maagau Was developed as a tourist resort by New Mood Resorts Pvt. Ltd. New Mood Resorts have been incorporated in the Maldives for the purpose of developing and operating resorts in the Maldives. Maagau would be first of its resorts. Maagau Resort has been operation since early 2019. The resort is now managed by the Baglioni Resort which is an Italian Luxury Hotels and Resort chain.

4.2 OUTLINE OF PROPOSED CHANGES

The proposed coastal modification includes shore adjacent Geotubes on the eastern and western side of the island and beach replenishment and backfilling of area. The project also involves construction of an offshore breakwater on the eastern of the island near the supply jetty. The aim of these modification are to protect the erosion areas of the island protect the guest rooms and other infrastructure on the island while causing minimum disruption to the natural sand movement process around the island.

The project components are divided into the following activities:

4.2.1 Preliminary Works

1. Mobilization
2. Environmental mitigation measures set up and site set out

4.2.2 Installation of geotubes, back filling and beach nourishment

1. Import Geotubes (import and bring to the site)
2. lay the Geotubes to the tranche after excavation by using a small excavator
3. Sand pump, pipe system and a barge for pumping sand from the lagoon from the burrow area
4. Backfill the area behind the Geotubes
5. Nourishment of beach in front of the Geotubes

4.2.3 Construction of offshore breakwater

1. Bringing rock boulder to the site (import and bring to the site)
2. Bringing the equipment, barge and Excavator to the site
3. Placement of rock boulders as per the design

4.3 PROJECT LOCATION AND JUSTIFICATION

The proposed Geotube coastal protection, backfill and beach nourishment is on the eastern and western side of the island and the breakwater is located on the eastern side near the supply jetty (*Figure **3** - Figure **5***). Average depth of the area is 1-1.5m *Figure 12*. location of the breakwater and the specifications are shown in *Table **1*** .

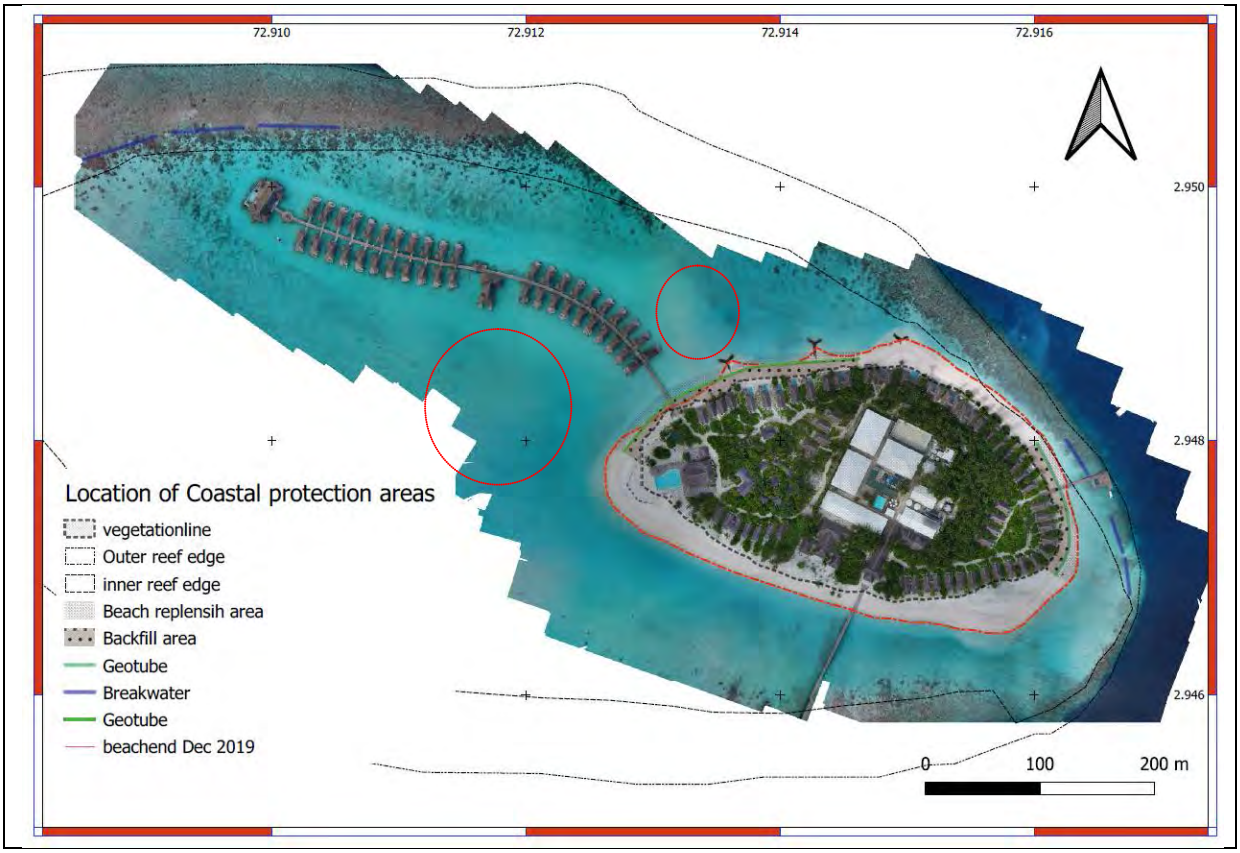


Figure 3. Proposed location for coastal protection and type of structures proposed and sand burrow areas

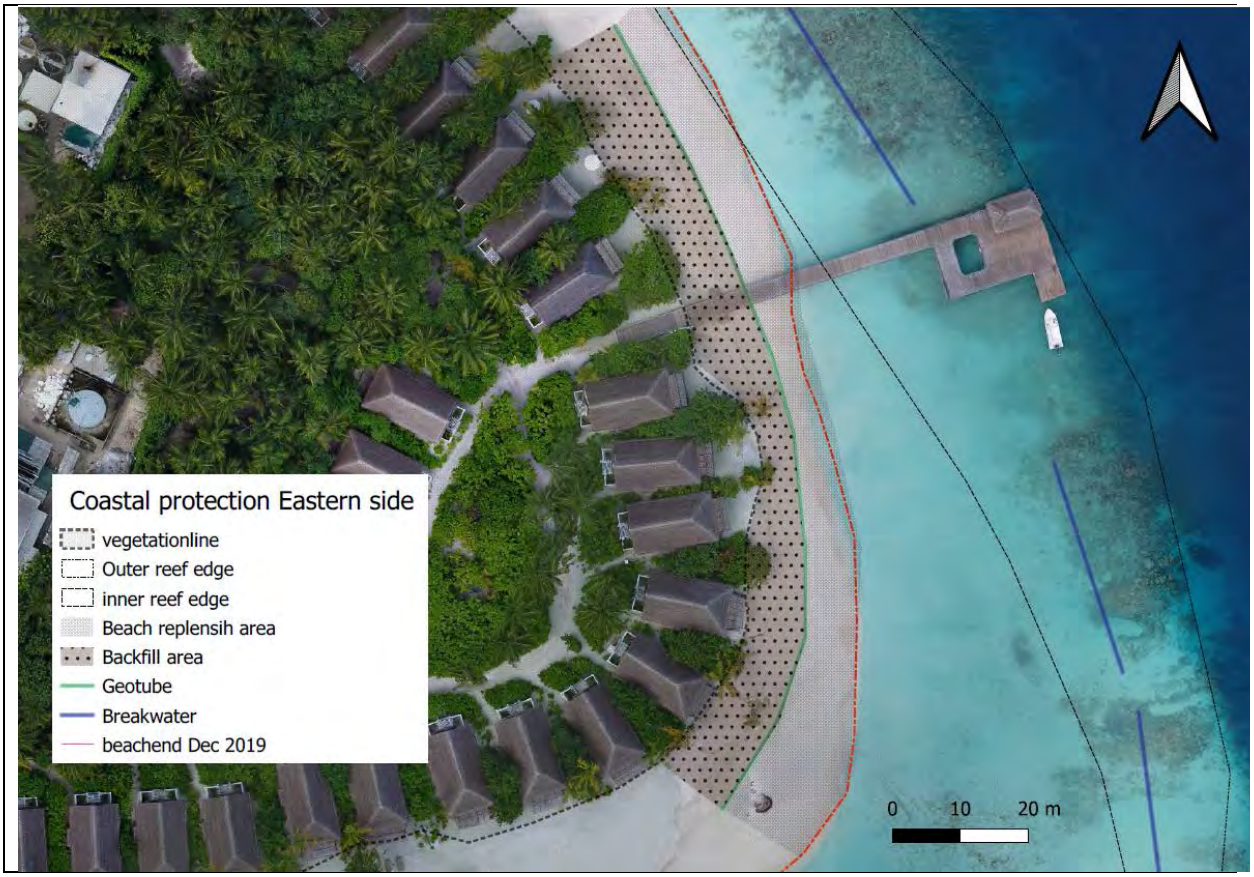


Figure 4. Magnified view of the shore protection area on the eastern side, Geotubes and off shore breakwaters proposed

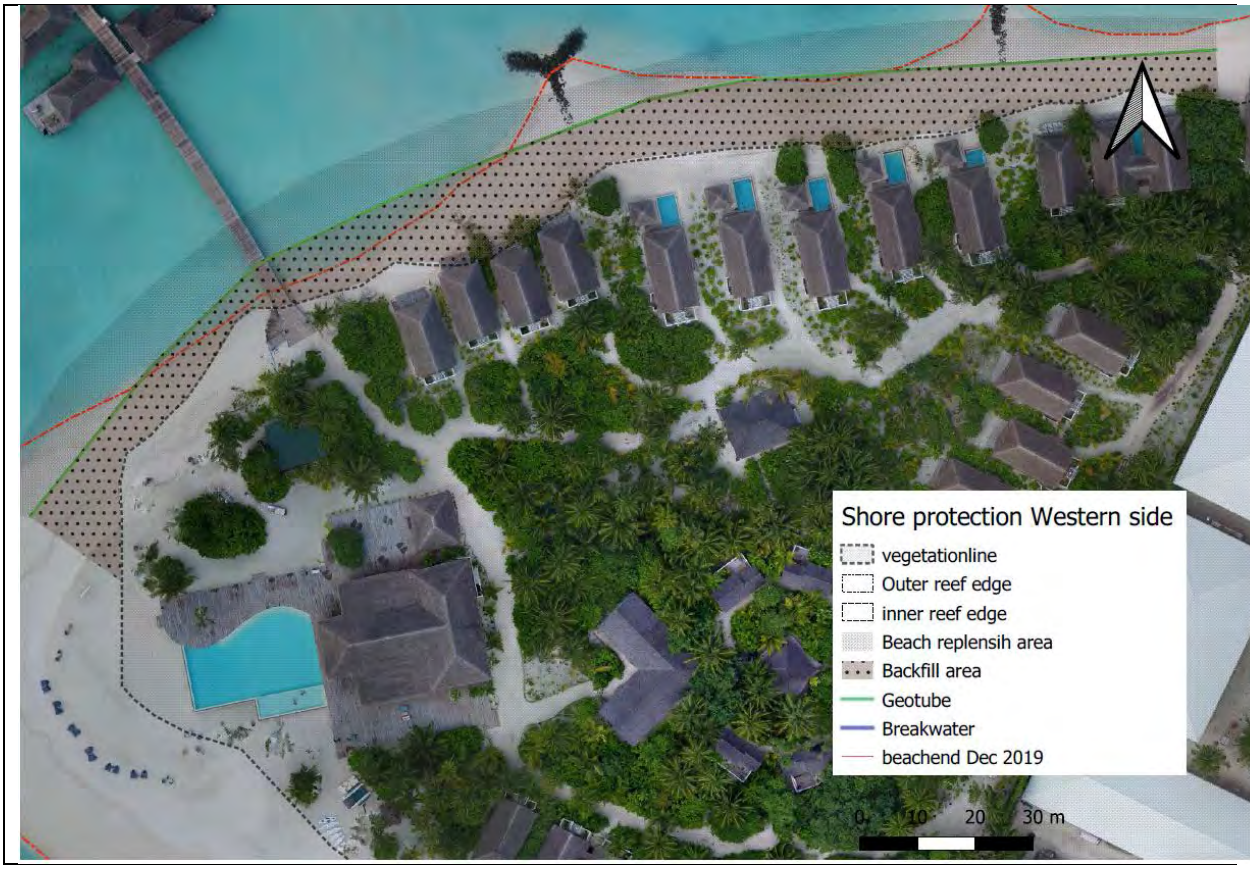


Figure 5. Magnified view of the shore protection area on the Western side

4.4 RATIONAL FOR THE PROPOSED COASTAL MODIFICATIONS

The island has been under severe erosion for over three years in three different areas of the island; western side between the main jetty and the water villas; coastal erosion and scouring on the base of Water Villa Jetty; the eastern tip of the island which get very severe exposing beach villas near the service jetty area for direct impacts to structures causing uninhabitable damages *Figure **6**-Figure **8***. Based on the several assessments in the past it was found that:

- Maagau island has a seasonally shifting sand spits (Sand banks, Thundi) at both eastern and western ends of the island.
- With the commencement of resort development these two sand spits (sand banks, Thundi) were disturbed by the development activities, such as permanent and temporary structures.
- The natural movement of the sand spit on the eastern side was disturbed by the construction of a temporary solid structure perpendicular to the shore to bring construction material into the island.
- Movement of the sand spit on the western end of the island was disturbed by the construction of water villa jetty and shore perpendicular Y-shaped groynes constructed in response to seasonal erosion on the north western side of the island.
- Removal of the temporary shore perpendicular solid jetty on the eastern end at the end of construction period is causing beach adjustments to adapt to the new conditions.

- In this process beach sand is sifting various parts of the island seasonally causing sediment accumulation and erosion in alternative parts of the island.
- During this process sediment deficit is in some areas are exposing the structure, particularly those near the beach due to direct impact and exposure to waves and causing damage to resort infrastructure.
- Unusually strong bad weather condition in the Maldives from November 2019 to February 2020 has caused complete shifting of sand spit on the eastern side of Maagau (near the service jetty) westwardly exposing the rooms 141 - 146 for direct hit from waves and un usable.

The following is a pictorial representation of erosion in Maagau 2018-2020

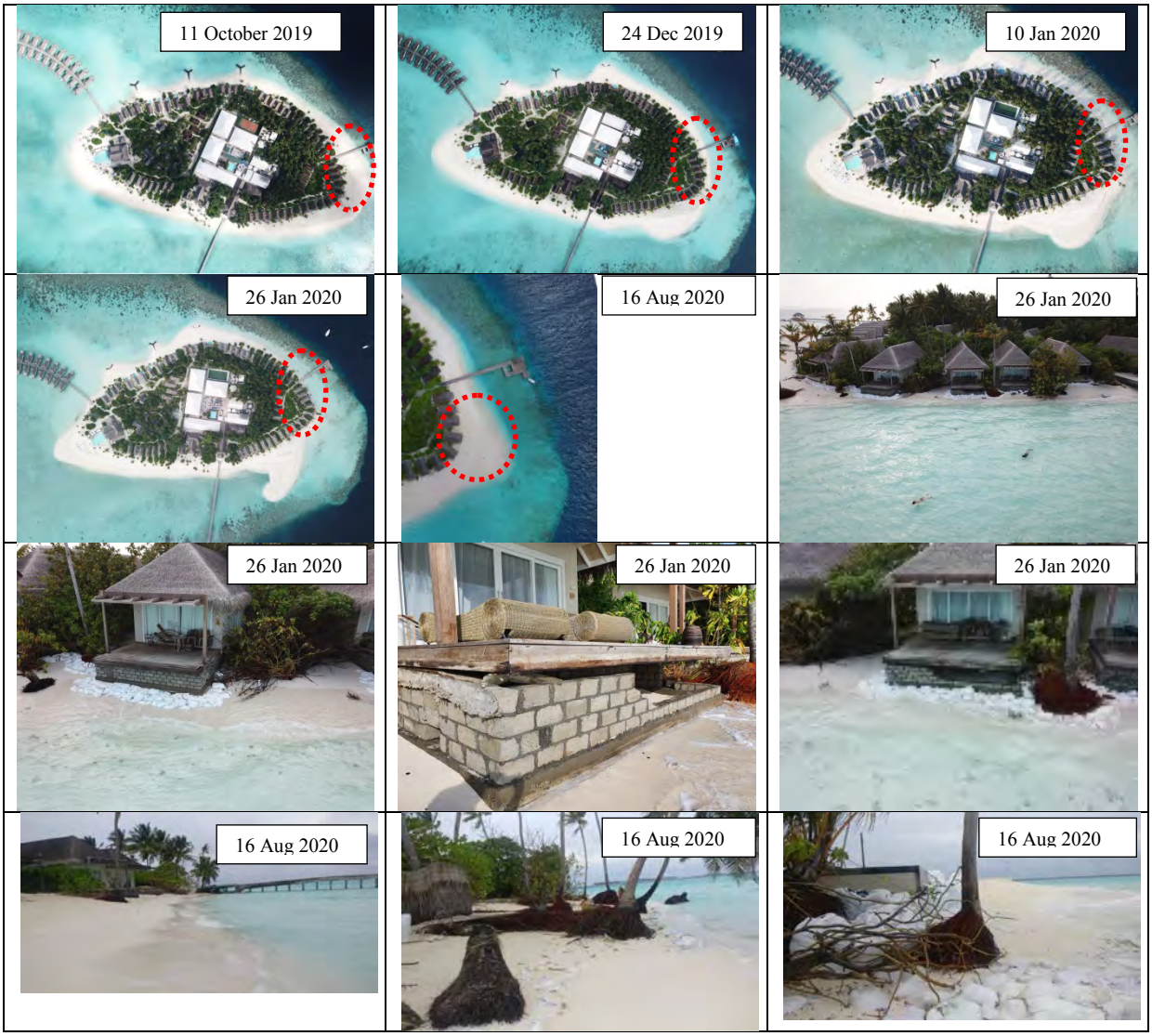
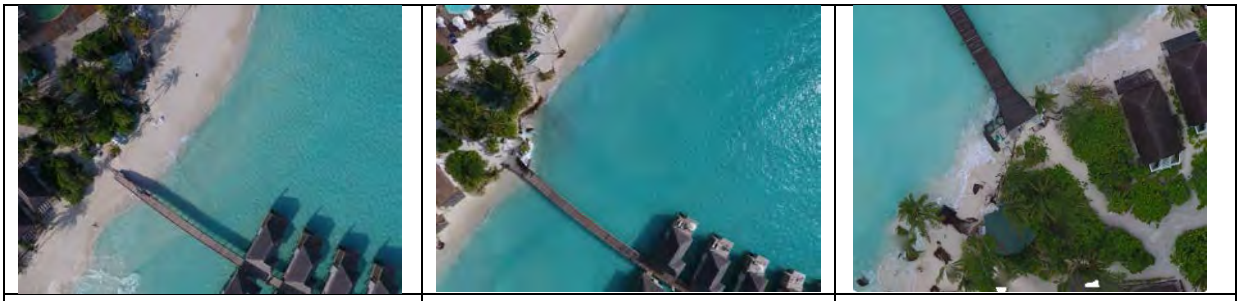


Figure 6. Most recent erosion Magau: time laps photos showing the eastern end beach sand movement and the structural damages near the service jetty area



June 2019	August 2019	August 2020

Figure 7. Erosion water villa jetty area in August 2019

Figure 8. Erosion on the South western side (between the Main Jetty and Water Villa Jetty) July 2018

As can been from the above the eastern and western sides of the island has been going through severe erosion at different periods of the year based on the prevailing climatic conditions. The eastern and western sand spits are extremely dynamics therefore any hard coastal protection measure might exacerbate the problem and alternative areas in the island may be exposed to counter erosion elsewhere. Therefore the proposed soft protection measures will cause less disruption to the sand movement and protection reasonable protection to the island infrastructure. During the construction period of the resort a channel has been cut through the reef on the eastern side to bring in construction material through the temporary jetty.

The reef opening is causing movement of sand into the atoll lagoon through this channel. This can be considered as sand loss from the reef system which may cause net deficit in sediment available for shifting around the island. Therefore the main rationale for the proposed offshore breakwater on the eastern side is to prevent sand movement into the atoll lagoon and protect the island from the prevailing waves during the eastern monsoon. Therefore the proposed coastal protection on the western and eastern side is necessary to maintain a wide sand beach for the tourist on the island and to protect resort infrastructures from erosion caused by the seasonal climatic changes to the island.

4.5 COASTAL PROTECTION METHODS

Based on number of assessments and continued monitoring of the island for over 3 years, observation of sand movement pattern waves and current the most suitable method for coastal protection of the island has been identified are:

4.5.1 Beach anchoring

This is a shore adjacent shore parallel structure an unseen Geotube filled with sand and the geotube will be limit for erosion. The idea behind this method of protection is to allow erosion /sand shifting to take place up until the protection (Geotube) so the property and structure behind the seawall made of Geotube can be protected and give time to react to the erosion. Once the erosion reaches the seawall the beach is again replenished. Therefore the hidden seawall can be considered as a buffer for coastal protection *Figure **9***. There will be no aesthetic or visual intrusion after the construction. Steps for Geotube installation:

1. Burry a seawall made of sand filled geo-tube
2. Backfill/replenish the area (at island level) between seawall and the island and cover the seawall with sand to make it as a buried new beach berm
3. Extend extra 10-15m wide gently sloping beach
4. Extend gently sloping 10-15m wide beach from the seawall. With this fill profile the beach end (toe of beach) will be in the same level as the toe of the sand spit, therefore it is anticipated that the sediment movement around the island will be reactivated.

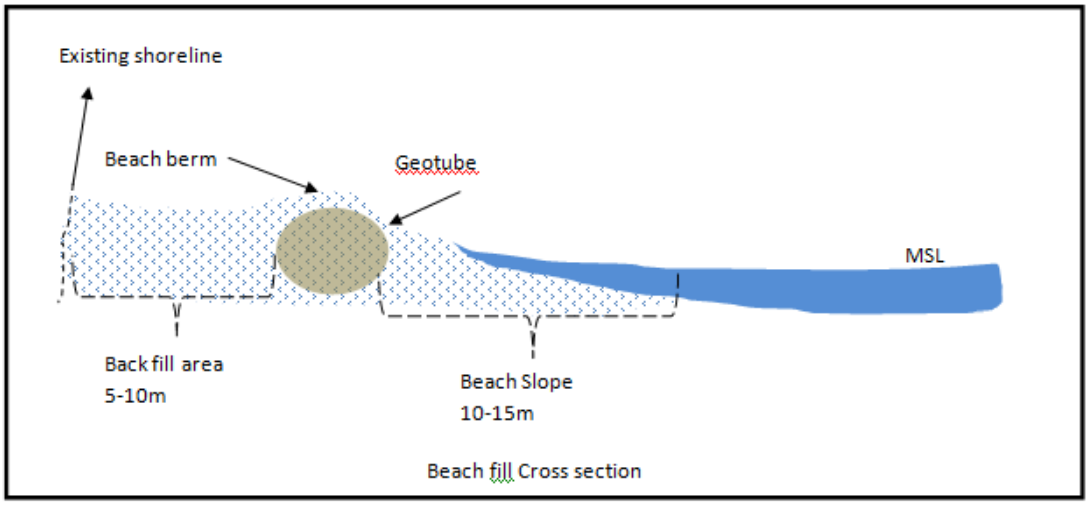


Figure 9. Beach anchoring beach fill profiles

Geotubes and beach replenishment will be used on the eastern end and western end of the island (See *Figure **9***). Dimensions of Geotube installation are shown in table below:

Table 1: Details of the proposed Geotube

Description	E- side	W-side	Approximate fill material cbm
Geo tube length (m) Height 1.5-1.8m and width 2-2.5m Each tube piece 20-25m	96	100	500 60-80% fill

Backfill area (sqm) Height and beach slope 1.5m above MSL	1558	2259	5624

The eastern side beach is about 61m from the reef flat. This gives fairly short distance for the breaking wave to properly disperse in the lagoon. Although beach on this area will be anchored with Geotubes construction of an offshore breakwater will reduce wave energy and wave exposure in the areas. This will result in maintaining beach sand without much erosion during the NE monsoon period. This would be a thirty meter long rubble mound breakwater that will allow overtopping at high tide.

Specification of proposed breakwaters on eastern shown in *Table **2*** and location is shown in *Figure **4***. Breakwater design has considered the prevailing wave condition and significant wave height hence the seaward slope of the breakwater has a 1:3 ratio *Figure **10***. Suggested boulder size for the breakwater on the eastern side is 100-300kg boulders.

Table 2. Breakwater design details

Feature 1m	Details
Breakwater length	three segments 30m each
Elevation	0.5m above the MSL
Slope (seaward side)	1:3m
Slope (landward side)	1:1m
Cross section area	8.75 sqm
Armour rock Average weight	100-300kg

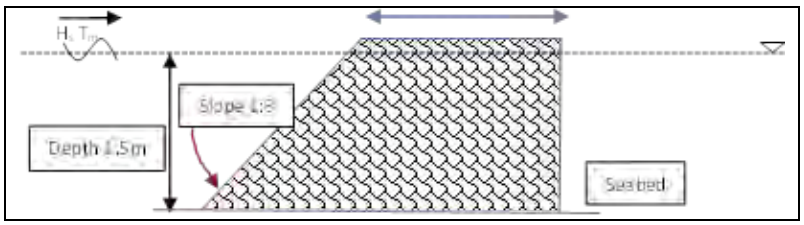


Figure 10: Breakwater cross section showing design details

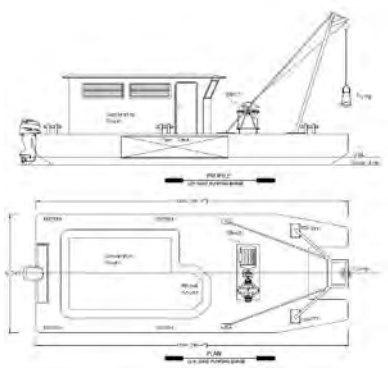
4.5.2 Backfill and beach nourishment

Sand required for backfill and replenishment can be sourced from the lagoon. Due to the dynamic nature of the sand movement around the island seems that large amount of sand is accumulated in the lagoon on the western side offshore near Water Villa area. The accumulated sand in the lagoon is making the areas shallow and causing local magnification of wave's amplitude. Therefore the area can be deepened to source sand for the proposed backfilling and nourishment. This will yield the required sand for the replenishment also the deep area will dampen the water movement and reduce regenerating waves near-shore. Also the natural filling of the deepened area can be used to source sand required for maintenance in the future.

A sand pump mounted on a barge with the necessary diesel power generators will be used for pumping sand via pipes to the replenishment site. This is a commonly practised beach

replenishment method in the Maldives. Specification of the barge and sand pump are given below *Table 3*.

Table 3: Barge and pump specifications

Specification	Photo
12 M Steel Barge (Length Over All) LOA: 12 m (Breadth Over All) BOA: 4.5 m (Depth Over All) DOA: 1.2 m Draft: 0.4 m Water storage capacity: 1 T Fuel storage capacity: 4000 L	
Sand Pump Toyo Submersible Agitator Sand Pump (Chinese Brand) Model: DP-100B-1, Bore (mm): 200, Head (m): 30, capacity (m^3/min): 6.0, Solid size (mm): 60, Output (kW): 75, Voltage (V): 200, Pole (P): 8, Weight (kg):2300, Cabaltyre cable 10m(symbol x mm2 x core) :3PNCT×100#×3C·14#×1C Sand Discharge Dredging Pipe Pipe floater Generator set 150KvA	

4.6 CONSTRUCTION REQUIREMENTS AND TEMPORARY FACILITIES

4.6.1 Workforce

This is an operating resort; therefore, there is no need for a temporary facility. The work force can be accommodated in the existing staff accommodation facilities on the resort. Also all the required logistical support can be provided without any additional effort.

The proposed coastal modification work is not expected to affect the number of workers that will be employed. The Contractor is expected to provide workers with meals and appropriate entertainment facilities including radio and television and fully follow the HPA guidelines since this work will be conducted during the Covid1- 19 Pandemic period.

4.6.2 Work Methodology

4.6.2.1 Geotube installation

Ground Preparation

Excavate and make a tranche that fits the Geotube according to the Engineer's design and drawings. Trim or remove any large roots, or sharp objects that might puncture or tear the Geotubes, refilling any voids created if necessary.

Installation

Before unrolling the Geotube , verify the roll identification, length, and installation location, inspect it for damage or defects. Discard or repair any damage that occurred during storage, handling or installation. The Geotube is filled hydraulically by pumping sand from the lagoon through the filling ports. To allow flow of fill material, the fill is in the form of sand/water mixture until the design height is reached. Lagoon water can be used for this purpose. The Geotube, being permeable, allows the excess water to pass through the geotextile skin while sand is retained within the Geotube. The installed Geotube will acts as gravity massed building blocks for erosion protection along the shoreline.

Equipment required for installation of Geotubes

1. Geotubes
2. Sand pump, pipe system and a barge for pumping sand from the lagoon
3. Small excavator to excavate tranche to lay the Geotubes.

4.6.2.2 Breakwater construction

Rocks are delivered to the site from India via big barges and unloaded to a small barge using excavators. It is transferred to breakwater construction sites on a barge and place the rocks to construct breakwater using an excavator mounted on the barge.

4.6.3 Health and Safety

The following health and safety measures will be implemented in execution of the project.

- Every site worker would be provided with work appropriate Personal Protective Gear (PPE) such as safety shoes, hardhats, gloves overalls etc. Safety gear would be worn at all times during work.
- Fire extinguishers would be readily available in site, at known locations.
- First aid kits would be readily available in site, at known locations.
- Utilize experienced and qualified workers.
- Only certified operators would be allowed to operate vehicles and machine .
- Proper Standard Operation Procedures would in use in site to improve coordination.
- Construction site would be closed for unauthorized personnel.
- Proper vehicle maintenance would be undertaken.
- Proper communication flow would be maintained within the project team including stakeholders of different levels.
- Workers would be made aware of emergency evacuation plans.
- Regularly monitor and clean construction site for water accumulation to reduce potential risks of mosquito breeding.
- All underwater works will be carried out by suitably trained, and certified scuba diver with all necessary safety precautions

4.6.4 Emergency plan during spillages

Since the proposed work site is in a remote area where there is no availability of health facilities, an emergency response mechanism would be in place during the construction period to avoid any possible immediate risk.

- Fire extinguishers and first aid kits would be readily available.
- Formulated an emergency response and evacuation plane in the site.
- The plan would clearly identify the steps to be taken and an assembly point in the site in case of any emergency.
- The plan would include the emergency contact numbers and responsible contact personals of the site.
- A speed boat would be on short call to mobilize to the site for emergency evacuation of any person if required.
- Only certified operators would be allowed to operate machines.
- Proper Standard Operation Procedures would in use in the site to improve coordination.
- Proper communication flow would be maintained within the project team including stakeholders of different levels.

4.6.5 Waste Management, Logistics and Safety Measures

Major categories of waste that is anticipated to be generated during proposed breakwater construction include, waste oil, packaging waste and waste arising from material consumption by construction workers.

It is the responsibility of the contractor to dispose all construction-related waste during demobilization, along with any other waste. The contractor will be required to clear all areas of work.

All construction waste that can be reused will be disposed at a site agreed between the resort and Contractor. If no agreement can be reached due to cost reasons, all remaining waste will be transported to Thilafushi.

All hazardous and waste oil generated by the project will be disposed as per the standards specified in the waste management regulation.

4.7 PROJECT SCHEDULE

For the proposed Coastal protection work in Maagau the following durations and work programme can be considered:

- Obtaining approvals to commence and execute the works ~1 month
- Import Geotubes and deliver to the sites ~1 month
- Import Rock boulders ~1 month
- Mobilization of all resources required to execute the works ~2 week
- Breakwater construction work ~1 weeks
- Post Construction survey ~1 week

Total project is expected to take 4 months for completion Breakwater construction work is expected to finish by Mid October 2020.

4.8 INPUTS AND OUTPUTS

Table 4: Matrix of major inputs to the proposed activities during construction phase

Input resource(s)	Source/type	How to obtain resources
Construction phase		
Geotubes	Imported	Imported and
Heavy machinery (mini excavator Barge sand pump and Genset)	Contractor's machinery	Hire locally/ contractors machinery
Rock Boulder	Imported	Import or purchase locally where available
Maintenance tool and equipment	Maintenance parts and fluids required for the machinery	Import or purchase locally where available
Fuel and lubricant for machinery	Diesel, Petrol, Lubricants	local suppliers/ contractor
Fresh water	Desalinated water	From existing desalination plants.
Electricity/ energy during construction	Diesel generator	From existing diesel generator

Table 5: Matrix of major outputs Construction Phase

Outputs (s)	Anticipated quantities	How to deal with it
Construction Phase		
Protected beach	Western and eastern coastline protect	Coastal protection
Lagoon Sand	Minor quantity 6000 m^3 approximately	Back filling and beach nourishment
Construction Waste	Small quantities	combustibles burnt/ incinerated others sent to Thilafushi
Fuel and lubricant for machinery	Minor quantities	Gathered in a barrel properly sealed with appropriate signage and sent to Thilafushi

5 REGULATORY CONSIDERATIONS

The proposed changes to the master plan in Maagau Island will be subject to the laws in particular Environmental Impact Assessment Regulations of the Ministry of Environment and Energy, May 2012 and recently gazetted 5th Amendment to the regulation which came to effect on 27 December 2018. The amendment has reversed the 7th Amendment to the Maldives Tourism Act (Law No. 2/99), and Regulation to Prepare EIA Report for Tourist Resort, Guest House, Tourist Hotel and Yacht Marina Development (2015/R-157) which came to effect on 27 April 2015 . From the date of the 5th Amendment to the EIA regulation 2012 (27th December 2018), all activities undertaken in tourist resorts, and hotels that require an EIA, shall be submitted to and approved by the Environmental Protection Agency (EPA). With this change the EIA process in the tourism sector will be administered and implemented by EPA. Thus, it must satisfy the EIA process and get approval before the project starts implementation. This section (relevant laws, regulations, government policies and permissions required for the project etc.,) has already been addressed in the approved EIA report in detail. Therefore it is not necessary to repeat them in this report only the most relevant and recent regulations are addressed here.

5.1 REGULATION ON TOURIST HOTEL DEVELOPMENT (REGULATION NO: 2013/R-1652)

The most relevant regulation for the proposed project is the regulation on tourist hotel development (Regulation no 2013/R-1652) particularly the chapter 2 of the regulation on concept approval and construction permits is directly relevant to the proposed project.

Chapter two of the regulation starts with (Article 13) which is related with the construction permits and describes details of documents required to obtain the permits. According to this article any type of new construction or demolition in an island or land designated for tourism development should obtain permission from MoT prior to undertaking the activity.

Prior to any development, erecting a a new structure or demolition of any existing structure, should be undertaken after submission of the concept plan and detail drawing specified in Articles 14 -15 to the MoT. Construction work should not be undertaken only after obtaining necessary permissions and clearances from the relevant authorities specified by the MoT.

As per this regulation the proposed project has already been granted conditional approval for the proposed coastal modification (Appendix 2) and the conditional approval from MoT requests the proponent to submit environmental clearance from EPA prior to undertaking proposed coastal modification project.

This document is prepared to obtain the necessary environmental clearance and to obtain environmental decision note for the project from EPA, which is prerequisite for the conditional approval.

5.2 CONSTRUCTION SITE HEALTH AND SAFETY REGULATIONS AND STANDARDS (R-156/2019) JANUARY 2019.

Recently after Maagau became operation many regulations mostly related health and status of health emergency came into force. Since the COVID -19 lockdown condition is still effective and slowly those temporary regulations are reverting to the normal conditions. One of the main regulation that came into force recently which is very relevant to the project is Construction Site Health and Safety Regulation. Health and safety regulation that needs to be adhered by all contractors is briefly described below and the actions taken by the contractor to implement the regulation in AB lagoon construction site is explained.

The purpose of this act is to establish the necessary health and safety measures and standard required in construction sites. This regulation also defines the penalties for those who contravene implementation of the provisions of the regulation in construction sites in general. Second Chapter of the regulation defines the contractors based on the size of the project to projects that are below or above 1.5 million MRV. According to the regulation it is the responsibility of the contractor for the project above 1.5 million to have provided a written document eg booklet on health and safety guidelines that will be implemented at the construction site to all the construction workers at the site. The booklet must have provisions for safe guarding the safety and health of the General public and employees at the site. The contractor must provide an emergency response plan that should be followed and maintained at the site. Also the site should have a trained first aid person at all times and first aid kit should be easily accessible and maintain a health and safety signboards. According to the article 7 of the regulation all sites must have a site safety health and safety supervisor and the responsibilities of health and safety supervisor is clearly outlined in the regulation Article 8.
Article 9 is has provision for insurance of project over 5. Million MVR. And Article 10 is on ensuring public safety .Article 11 is provision of Personnel Protective Gears that has to be provided to the worker and employees at the site. Article 12 is on hording and goes on describing the standards for hoarding. Articles 13-39 has provision standards and guidelines on; avoiding exposure when working with hazardous substances, working height over 3m, Guardrails, safety nets, roofs, ladders, scaffolding and suspended scaffolding, electrical supply, Temporary switchboards, inspection of electrical equipment and clearance from power lines, safe use of chemicals, Asbestos, flame cutting welding with compressed gas hazards, fumes and vapour, storage, fire fighting and protective equipment, use of mechanical and electrical power tools, cranes and lifting appliances working in confined spaces, demolition and housekeeping, loading unloading and keeping signboards evacuation paths and emergency exits and response to accidents during construction. The provisions have provided necessary details, guidelines and standards.

Third chapter provides provisions for penalties for offender and breaches of the regulations. Fines for offenders are within the range of 5000-500,000MVR with provision to implement corrective measures within 3-30 days depending on magnitude and severity of the breach. The 4th Chapter of the regulation provides the responsibilities of the owner of the construction site.

5.3 SPECIAL CIRCUMSTANCES FOR COVID-19 PANDEMIC

Since the proposed work will be undertaken during the Period of COVID-19 Pandemic special restriction period. The resort management and the project contractor must follow the guidelines issued by the HPA. Some of the relevant guidelines with regard to COVID-19 Special circumstances that are relevant to the project are :

a) SOP on Environmental Management and Infection Control in a tourist resort establishment
b) Guideline on movement of service providers during COVID-19 pandemic
c) Procedure to follow for travel between islands to provide essential services during COVID-19

As per the new guidelines workers such as engineers electricians etc eg; who are engaged in coastal protection work should quarantine in the resorts if they are staying more than 5 days on the island. Such guidelines should be strictly followed during the proposed project work in Maagau.

6 EXISTING ENVIRONMENT

6.1 METHODOLOGIES

A very comprehensive and exhaustive description of the environmental conditions was presented in the EIA report for the proposed resort development project in Maagau Island prepared by Sandcays Pvt. Ltd in March 2015 and approved on June 2015. Therefore, fairly good environmental baseline is already established from the initial EIA report as well as from the 1st addendum submitted as well as the various monitoring conducted to assess the coastal erosion problem in the island. Therefore relevant data from those assessments were used in this study. Also a field visit to collect specific data for the project was conducted from 7-9August 2020. Thus, assessments of both baseline marine and terrestrial assessments are covered in the original EIA report. Additional coastal and marine environmental data were collected and evaluated for the report from the field and the revision of the following documents which mainly similar undertakings by the consultant in the past.

- EIA for the proposed resort development in Maagau, Dhaalu Atoll, Maldives, Prepared by SandCays for New moods Pvt. Ltd (March 2015)
- 1st Addendum to the to the EIA Report, Maagau, Dhaalu, Atoll, Maldives, Prepared by Mahmood Riyaz, for New Moods Pvt.Ltd (February 2019)
- 2nd Addendum to the EIA Report Uthurumaafaru, Raa, Atoll, Maldives, Prepared by Mahmood Riyaz for Uthurumaafaru Holding Pvt. Ltd (Sept 2018)
- Environmental Management Plan for Access channel maintenance dredging and beach nourishment, Cocoon Maldives at Ookolhu Finolhu, Lh, Atoll, Maldives. Prepared for Cocoon Maldives, by Mahmood Riyaz (November 2017)

Major activities of the proposed project on coastal modification that will have a noticeable negative impact on the environment in Maagau resort is activities related to the pumping of sand required for backfill , installation of Geotubes and beach nourishment. Therefore the relevant baseline marine and coastal environmental conditions in Maagau are presented below.

6.1.1 Constrains for the field study and data gaps

The field study for this addendum was conducted right after the initial main lockdown period due to community spread of Covid-19 pandemic in Greater Male region. Sea water samples were taken and tested in the MWSC laboratory, a bathymetry study, wave measurements and drone photos are taken for the purpose of this study. Also data collected for the environmental monitoring in various field observation trips to the site was used in this report reef survey and wave measurements and beach monitoring.

6.1.2 Water Sampling

The following map shows the water sampling locations and reef survey areas in the Lagoon plot. Result of the seawater analysis was compared with the results of initial EIA 1st addendum and the monitoring report.

Figure 11. Map showing, wave gauge, reef transact and sea water sampling location

6.1.3 Wave Measurements

Site specific wave measurement was conducted in two locations in Maagau island during July 2018 and August 2020. In each location the wave gauge (RBR Solo wave gauge) was deployed for 2-3 days in the locations shown in Maagau Falhu, (*Figure 11* **Error! Reference source not found.**). Over 300 samples with a burst rate of 2Hz at 0.05 minutes interval were taken from each location. General specification and wave statistics and wave height in each location is shown in (*Figure 11*).

6.1.4 Reef monitoring surveys

Baseline for reef monitoring was established and results of the surveys are presented here. Reef monitoring has been conducted over a year now. Permanent monitoring stations have been established. Regular reef surveys using Line Intercept Transact (LIT) are conducted from the established benchmarks. Initial surveys were used to establish the baseline condition of the reef.

6.1.5 Bathymetry

A bathymetry survey of Maagau was conducted using a handheld depth gauge and DGPS. The data is reduced to mean sealevel and GPS data are corrected during the post processing. Bathymetry map produced from the survey is shown is in *Figure 12*. Lagoon depth of the area is within the range of -0.7 to -2.5m. The area proposed for breakwater construction and burrow sand on the on the western and eastern side has an average depth of 1-1.5m.

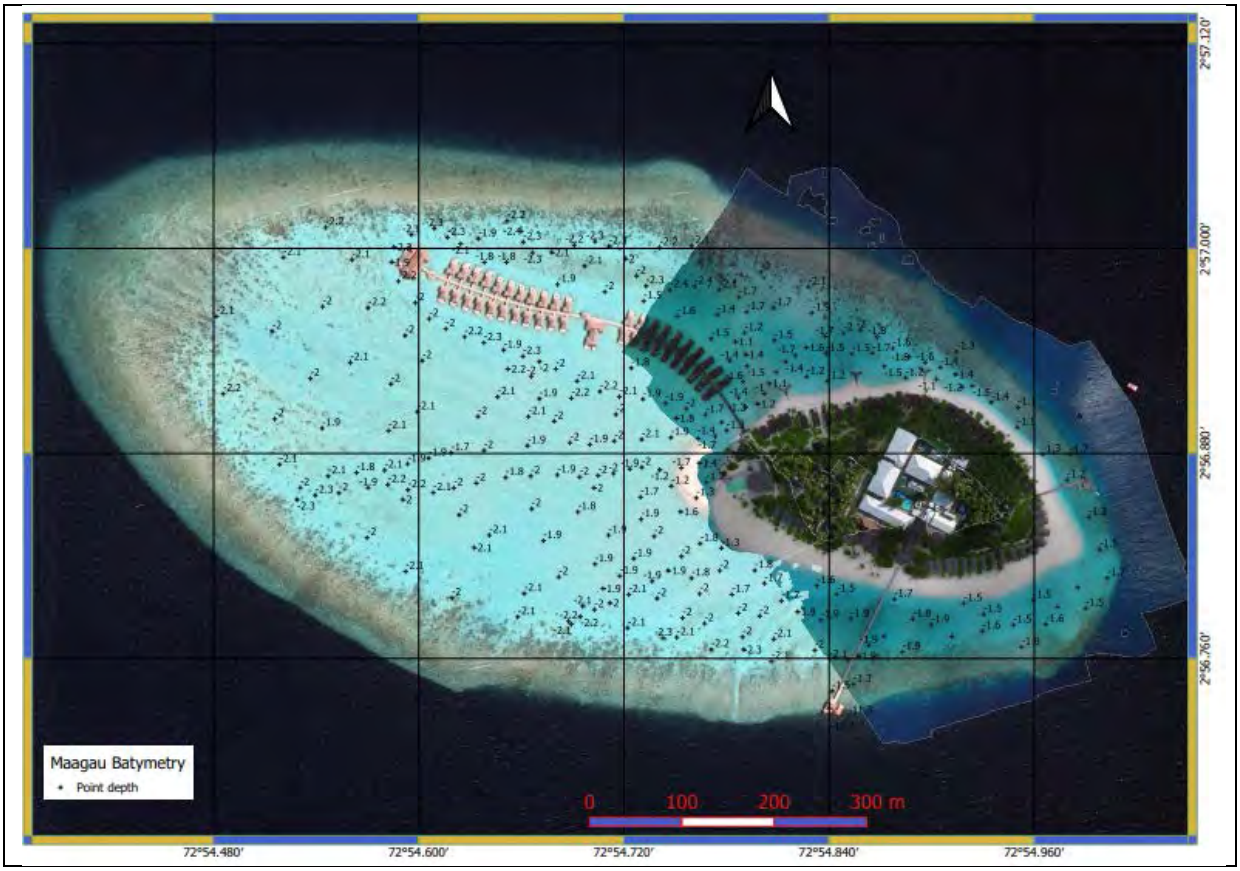


Figure 12: Near shore bathymetry, Maagau

6.2 GENERAL SETTING AND WAVE CHARACTERISTIC

6.2.1 Offshore wave conditions

Maagau resort is fairly well sheltered against W and NE swells within Dhaalu Atoll. However the western part of the island is exposed to Westerly and North Westerly swells that pass between the two reefs, on the NW and SW of Maagau, at the rim through the channel into the atoll lagoon. Wind waves can also be generated inside the atoll, mainly waves due to NE and SW winds which will affect the Island. This is visualized in Figure 13 below Swell waves are generated in storms far away and travelled large distances over the ocean, have long wave periods (> 12s.) and are unidirectional. Swell wave directions and wave heights are independent from local wind conditions. Wind waves are generated more locally and therefore have shorter wave periods (steeper waves), are more irregular and directional and they have a direct relation to the local wind speed and direction.

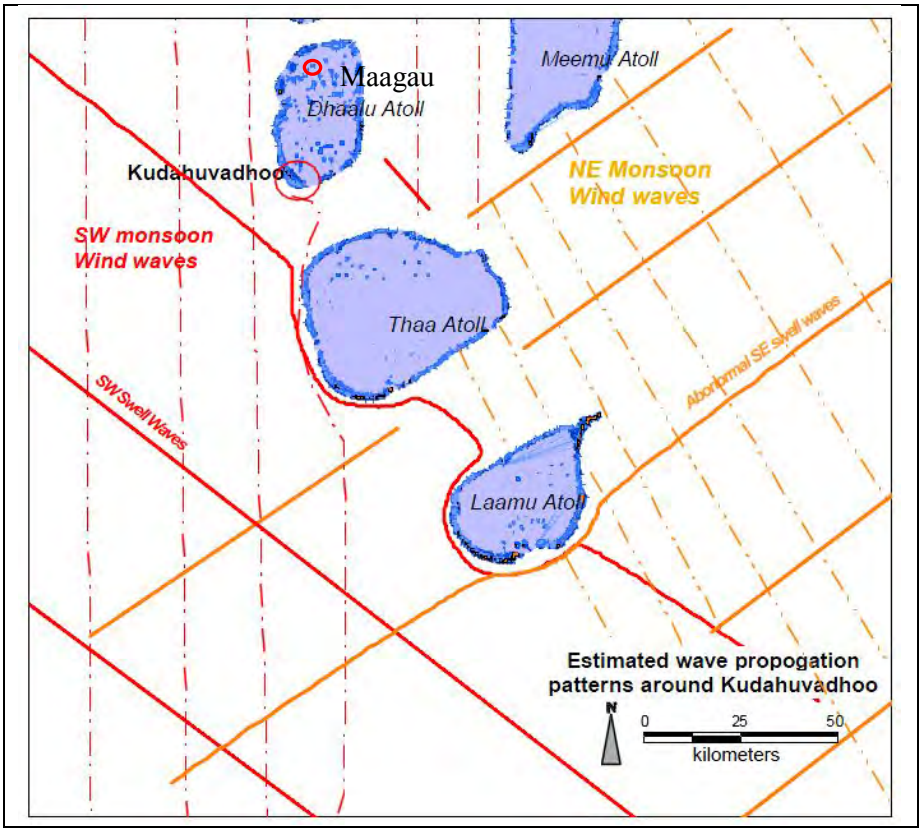


Figure 13: Wave condition Dhaalu Atoll

The wind waves experienced by the Dhaalu Atoll are conditioned by the prevailing bi-annual monsoon wind directions and typically strongest during April – July in the SW monsoon period, giving wind waves coming from the West. In the (weaker) NE monsoon local wind waves can be generated within the atoll. Small islands within the atoll prevent the growth of waves to their full potential, considering the local wind conditions and fetch lengths. Swell waves always come from SW directions and are present all-year round at the atoll rim.

6.2.2 Locally generated wind waves from NE directions

Normal wind conditions during the NE monsoon period vary between 2 to 8 m/s winds. More extreme wind conditions are in the order of 11 m/s. considering fetch lengths of 25 to 30km within the atoll, local wave conditions can simply be estimated. However, several small islands are located within the atoll which limits the full growth of the wind waves. For this reason it is assumed wind waves will only grow up to 75% of the theoretical, full fetch length. This gives normal wave heights in the order of 0.2m to 0.45m. In more extreme situations wave heights of 0.8 to 0.9m can occur from the Easterly directions. Characteristics of the measured wave are shown in *Figure 16*

6.2.3 Wave conditions around Maagau

A typical feature of the atoll is that the island is surrounded by coral reefs. Usually the island is formed at the calmest area that has been created by interaction of various geomorphological features and hydrodynamic forces surrounding the condition. In the case of

Maagau the reef- island distance is smallest on the eastern side and gradually increases westwards. The reef-island distance on western side is measured to be 712m on the western tip 41m on the eastern tip and 150-61m on the northern side and 250-90 on the southern side of the island (Figure 14).

Figure 14: Reef-island distance (reef width) important for wave energy dissipation

The Waves approaching Maagau islands actually break on the reef during which much of the energy will be absorbed by the reef flat. During high water levels, increasing wave energy is able to penetrate towards the islands. As the waves approach the reef flat, depth limited wave breaking will occur. The breaking criterion due to water depth is normally given by the non-dimensional breaker index parameter (γ_{br}), defined as the maximum wave height-to-depth ratio (H/h) through:

$H/h = \gamma_{br}$

For irregular waves, typical values are found to be 0.5-0.8. For a steep bathymetry / foreshore the breaking criterion goes to 0.8, for normal sand coasts the value is close to 0.7. For a horizontal / very gentle and shallow bed level the criterion goes towards 0.5.

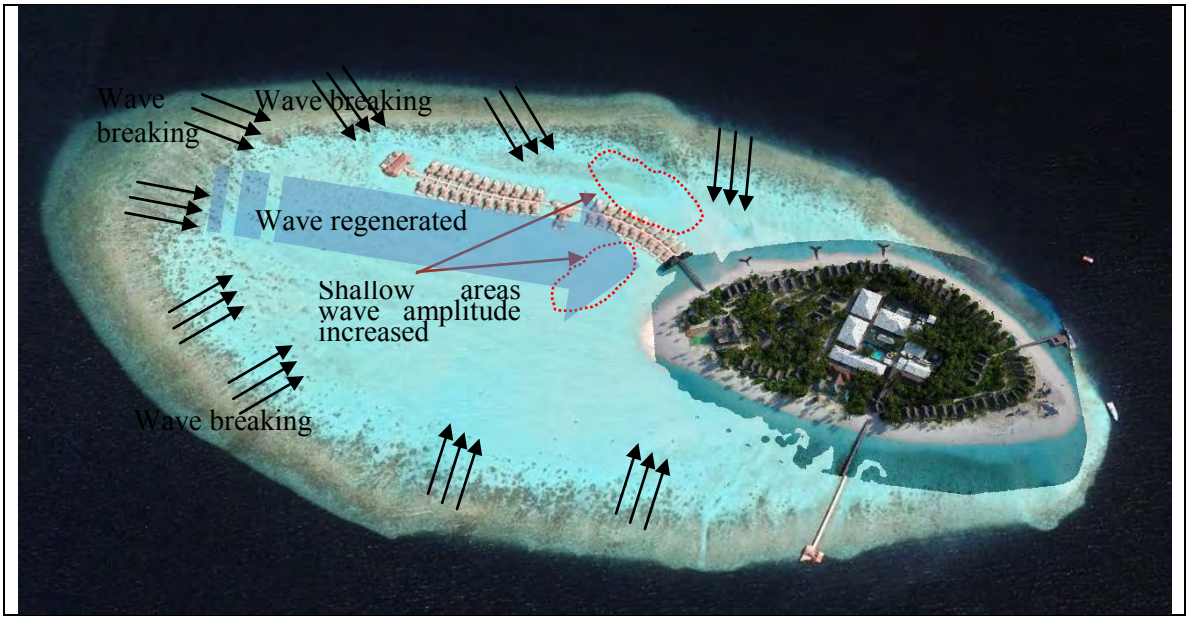


Figure 15: Wave condition around Maagau

In this case of Maagau, is a relatively horizontal, shallow seabed behind the reef within the lagoon midway between water villas and the shoreline is causing further regeneration and magnification of the shoaling wave. Result of this process is exposure of the island shoreline on the north westerly part of the island for higher energy strong waves (*Figure 15-Figure 16*). Subsequently the sandy beach on western side of the island gets eroded.

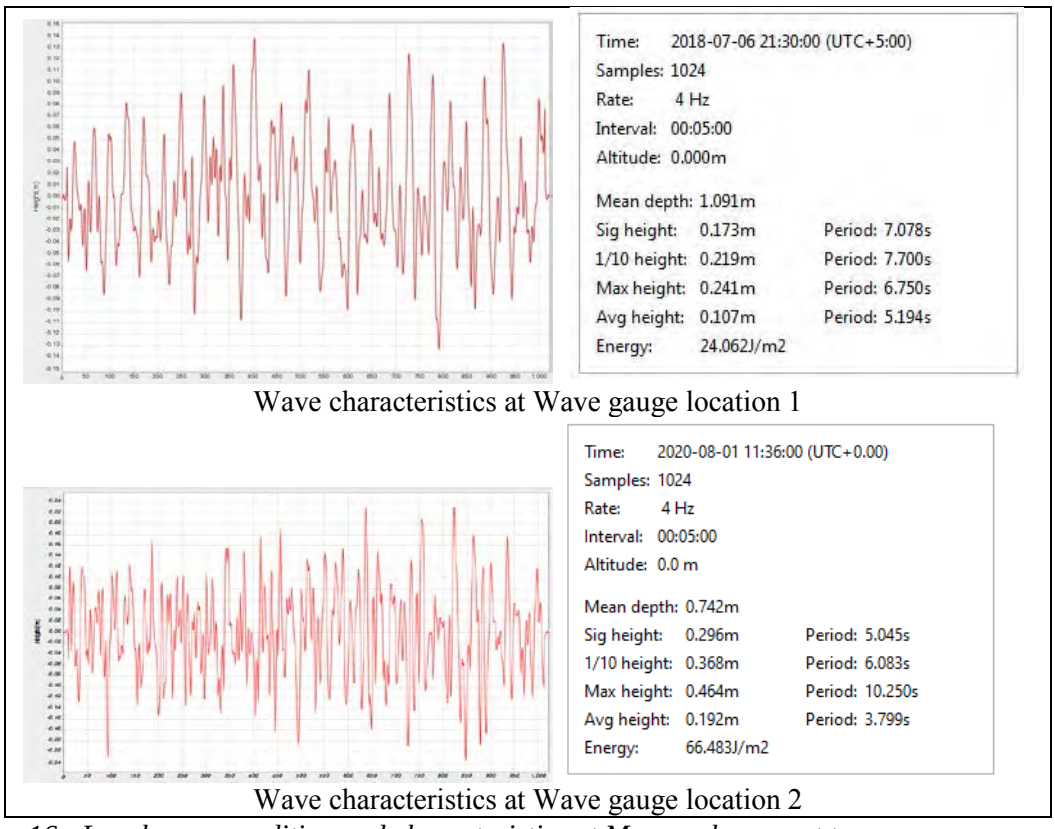


Figure 16: Local wave condition and characteristics at Maagau lagoon at two wave gauge records

6.3 COASTAL DYNAMICS

Current flow through the country is defined by the two-monsoon season winds. Westward flowing currents are dominant from January to March with the change in current flow pattern taking place in April and December. In April the westward currents become weak while the eastward currents start to take over. In December the eastward currents are weak with the westward currents becoming more prominent.

Dhaalu Maagau island is located on the north western side of Dhaalu atoll located in an isolated house reef inside the atoll. The island and the reef are E-W oriented. The island is located at the eastern half of the reef *Figure **1***.

Historical photographs show that naturally the island has seasonally shifting sand spits (Sand banks Thundi) at both eastern and western ends of the island *Figure **17***.

Figure 17: Drone photo taken in 2016 December showing seasonally shifting natural sand spits on the eastern and western end of Maagau and the temporary jetty constructed for loading and unloading material for construction.

With the commencement of resort development these two sand spits (sand banks, Thundi) were disturbed by the development.

The natural movement of the sand spit on the eastern side was disturbed by the construction of a temporary shore perpendicular solid structure to bring construction material into the island (***Figure 18***). Movement of the sand spit on the western end of the island was disturbed by the construction of water villa jetty and shore perpendicular Y-shaped groyne constructed in response to seasonal erosion on the north western side of the island.

Figure 18: Time-lapse drone photographs showing beach changes and impact of groynes and other coastal structures on sediment movement around the island

Analysis of time-lapse drone photographs show that construction of Y-shaped groynes helped to accumulate sand in the area between the groynes but exacerbated the disturbance created by the structure to the movement of the sand pit and confined its extent up to the Y-groynes. As a consequence an extra sand spit was formed south (in front of swimming pool)of the main sand spit in 4th April 2018 (see ***Figure 18***) however with the change in monsoon from Easterly to westerly, sand accumulated in front of the swimming pool was transported east and West and vice versa based. Similarly the sand spit that is formed on the eastern side is shifted back-and-forth with the change in season.

The sand spit on the north western part is exposed strong wave action from the north westerly direction which is in an angle /oblique to the shore line. Whereas southern part of the sand spit is exposed to wave action perpendicular to the shore therefore the sand is moved away from the shoreline. When the wave action is oblique to the shoreline sand movement is littoral (more or less parallel to the shoreline) see dominant wave direction and measured wave characteristics in the area (*Figure 16*).

Figure 19: Coastal dynamics and changes in shoreline over laid on Google earth photo July 2019, Maagau

Coastal erosion observed on the western and eastern end of the island is largely seasonal. Construction of resort infrastructures in these dynamic locations are subjected to damage if left unprotected. This is because; a) the structures are constructed very close to the shoreline, without due consideration to the seasonal movement, b) W and E ends of the islands are the most dynamic areas of the island. Erosion and accretion (sand movement) pattern around the is shown in (*Figure **19** -Figure **21***)

Figure 20: Coastal erosion and accretion pattern around Maagau Jul-Dec 2019

Figure 21: Coastal erosion and accretion Aug 2019- Aug 2020

6.4 CORAL REEF AND BENTHIC COVER

State of coral reef was re-assessed using photo-imagery. A total of the 2 sites were chosen to assess the reef (*Figure 11*). The transact 1 of the monitoring covers the same area the transact 2 in the 1st Addendum to the EIA report and the eastern part of the transact 1 in this monitoring covers the transact 1 in the 1st Addendum. Over all the reef depth was fairly uniform ranging between 1-2.5m were chosen to assess the benthic cover to provide a total of 2 LIT surveys. At each site, series of high density photographic images were taken in sequence by keeping the camera at horizontal plan. An image was taken at each two-fin kicks until about 100-150 m (linear distance) was covered in the transect.

Data analysis was done using Coral Point Count with Excel Extension Software[1](CPCe). Roughly 100-150 meters were covered in each transect. On average roughly 40-50 photo images were available for analysis in each transect. A total of 2 transects from representative areas of were conducted. Photos have been automatically numbered in sequence by the camera. Using Excel function RANDBETWEEN(min, max) where minimum and maximum are first and last sequence number of the transect, 20 numbers were chosen and number representing the image was chosen for analysis.

[1] http://www.nova.edu/ocean/cpce/; Kohler, K.E. and S.M. Gill, 2006. Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Computers and Geosciences, Vol. 32, No. 9, pp. 1259-1269, DOI:10.1016/j.cageo.2005.11.009

Using CPCe (Coral Point Count with Excel Extension) relative cover of the following categories was estimated.

1. Hard Coral (HC)
2. Soft Coral (SC)
3. Recently killed coral (RKC)
4. Nutrient indicator algae (NIA)
5. Sponge (SP)
6. Rock (RK)
7. Rubble (RB)
8. Silt (SI)
9. Other (OTH)

6.4.1 Results:

The summary results of substrate cover for the 2 transects are given in *Figure 22*. Substrate cover in both transects appear to be highly variable as indicated by large standard deviations. Relative cover of hard coral for transect one was much higher than transect 2. There were large patches of brain coral which represented the dominant form of cover. It was noticed most of them had large white patch which exposed rock showing the dead zone. Most of them were 'clean' without algal growth – thanks to healthy population of herbivores fishes.

Transect two was much more variable and liver coral cover was relatively much lower. Most the images were dominated by rock and rubble and few images large area of the sand/silt. Soft coral recently killed coral, nutrient indicator algae and sponges were minimal on both transects. Despite the large coverage of rock and rubble there were hardly algae on them - thank to the fish herbivore in the Maldivian reefs, which is almost unique compared in the Caribbean (reference for herbivore)

The hard-coral component was dominated by massive corals. There were very few otherwise branching corals.

Rock hard coral and rubble dominated in transact one representing 37%, 28 and 15% cover respectively. In transact 2 rock and rubble is dominated covering close to 80% of the transact, roughly 39 rock and 40% rubble. Siltation and sedimentation is higher in transact two then transact one See (*Figure 23* & *Figure 24*).

Fairly large number COTs were observed during the survey (*Figure 25*). 4 COTs were recorded along the transact 1 and 3 in transact 2.

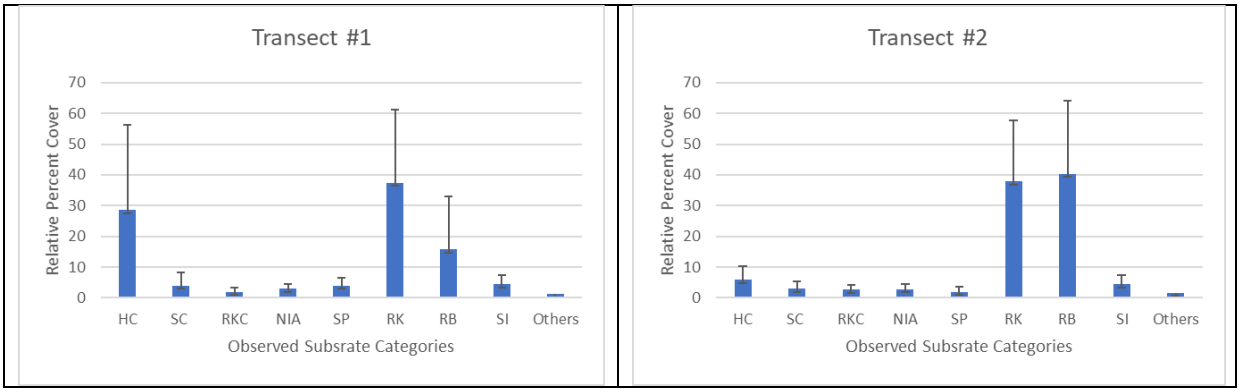


Figure 22: Summary results of the transect cover of the 2 transects sampled on Maagau Reef – Error-bars a 1 standard deviation from the mean; n= 10 images randomly selected from series of 40-50 images from each transect.

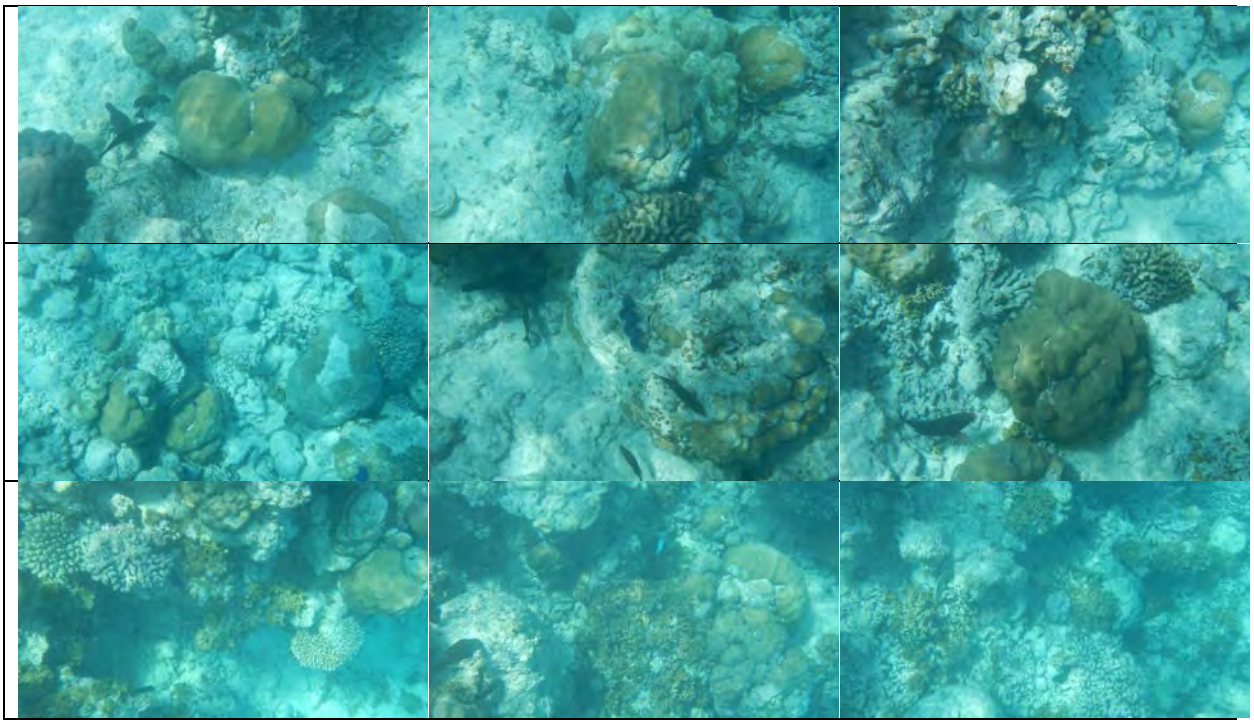


Figure 23: Photos from Transact #1

Figure 24: Photos from Transact #2

Figure 25: COTs recorded from the reef survey, the reef is infested with a large population of COTs

6.5 WATER QUALITY

Water quality was tested at two locations one on the southern end of the island and another on the northern end of the island. These can be used as reference during the project monitoring period. The locations are shown in *Figure 11* **Error! Reference source not found.** and the results in ***Table 6*** Water sample analysis for the baseline assessment and the results of sample taken in July 2020. Comparison of the results of the laboratory analysis of water sample show minor changes in various parameters, which means there is no significant changes or alteration in the sea water quality around Maagau Island

Table 6: Compassion of water seawater quality test results with the baseline data

Parameter	**EPA Optimal range**	**Baseline EIA Report**		**Sampling date**			
		23rd October 2014		**24th June 2019**		**28th August 2020**	
Sampling date and location		(Site 2 (supply jetty)	Site 3 (Main jetty)	(Supply jetty)	(Main jetty)	Supply Jetty	Main Jetty
Conductivity (µS/cm)		54320	54130	51000	51300		
pH	8-8.03	8.11	8.47	8.05	8.03	8.21	8.16
Salinity (‰)	32-42	34.87	34.11	33.43	33.65	34.4	34.5
Temperature ^{o}C	18-32	29.04	29.37	23.7	24.0	25	25
Total Dissolved solid (mg/L)		34060	34180			26200	26200

Total Suspended Solids(mg/L)		0	<5(LoQ 5mg/L)		0	<5(LoQ 5mg/L)	<5(LoQ 5mg/L)
Turbidity (NTU)	Less than 3-5	0.11	0.126		0.26	0.186	0.912

7 STAKEHOLDER CONSULTATION

Extensive consultation has been conducted with the stakeholders during the EIA preparation process including the people directly involved with the project such as the MoT, the proponent engineers etc *Table 7*. The ToR has identified stakeholder to consult during the preparation of this and it includes

(a) Ministry of Tourism
(b) MMRI
(c) Resort management

Since the preparation of this addendum took place during the lockdown period, physical meeting with anyone was not possible. Therefore all the contact were made through telephone

7.1 MINISTRY OF TOURISM

Date: 22 August 2020
Time: 11:35AM
Location: Phone interview
Participants:
• Ibrahim Fikry, Assistant Director, MoT
Proceeding:
The details regarding the project components were sent to MoT via email.
MoT was asked about their views, concerns and suggestions regarding the project.

Summary of key discussions:
The following concerns and recommendations were made by MoT
• No specific comments regarding the project
• Must comply with the rules and regulations

7.2 MMRI

Since this the preparation of this addendum was during the Covid-19 lock-down period it was difficult consult with MMRI officially, they usually don't respond to email. Unofficially have discussed with the Mr, Nizam Ibrahim Senior Research Officer at MMRI said that according to NOAA sea surface temperature is decreasing and they are expecting reduction of heat stress on corals during the period August –September. If the SST is increasing MMRI will issue an advisory to not to undertake any activity (dredging and reclamation). The general recommendation from the MMRI is post September August therefore it will be fairly safe to go on with the project.

7.3 MAIN OUTCOMES OF THE STAKEHOLDER CONSULTATION

Main conclusions from the stakeholder discussions is that the proposed project must go ahead in order to protect the infrastructures of the island and to crate reasonable beach area and it is

considered economically important as it adds values to the tourism product offered by the resort.

Table 7: List of stakeholders consulted

Name	Designation	Contact number
Mr. Ibrahim Fikry	Assistant Director (MoT)	9997816
Mr. Toshi	Contractor	
Mr. Emillio	Engineer at the Site	
Dr. Mahmood Riyaz	Consultant	7890307
Ahmed Thahuseen	Architect of the island	7773846

8 POTENTIAL IMPACTS AND MITIGATION MEASURES

Coastal modifications involved in this project include, installation of Geotubes on the eastern and western side of the island, construction of breakwater on the eastern side of the island, and burrow sand for backfill and nourishment of the beach protected by the Geotubes. This section will identify the Environmental impacts arising from the proposed changes and revisions have not been identified and mitigation measures are not proposed in the EIA report. Table 8 is an impact identification matrix for the proposed development project in Maagau Island.

Table 8: Impact Identification matrix

	Construction phase Activities						Operational phase Activities			
Impact	Site setup and mobilization	Work force	Geotube installation	Sand Pumping	Breakwater construction	Backfill & beach nourishment	Geotubes	Breakwater	Sedimentation	Scouring and erosion
Coastal process	-	X	-	-	-	X	-	-	-	-
Lagoon Substrate	-	X	-	-	-	-	X	X	-	-
Marine water	-	-	-	-	-	-	X	X	-	-
Hydrodynamics	X	X	-	-	-	X	-	-	X	-
Marine habitat flora & Fauna	X	X	-	-	-	X	X	-	-	-
Vegetation and soil	-	-	X	X	X	-	X	X	X	X
Natural hazard risk and safety	X	X	+	-	+	+	+	+	X	X
Visual impact	X	X	-	-	-	-	X	-	-	X
Employment	+	+	+	+	+	+	X	X	X	+

(-) Negative impact (+) Positive impact (X) no impact

8.1 IMPACTS AND MITIGATION MEASURES

8.1.1 Impacts from Mobilization of Equipment and Labour

Mobilization and operation of sand pump, excavator on barge to unload the armour blocks from the big barge and placing them on the seabed for breakwater construction will have minor impact on the marine and coastal environment. The construction work will create short-term negative impact on the marine environment.

Mitigation measures:

- A specific area should be designated in the coastal area for landing and material loading/unloading.
- Creation of temporary area for landing and material loading/unloading could be avoided if the unloaded material is placed directly on the breakwater construction site
- Signs should guide workers to proper environmental care.
- Avoid creation of temporary structures, such as bunds, pathways etc

8.1.2 Installation of Geotube

Installation of Geotubes at the hightide level at the island beach will require trenching and filling the tube by pumping sand into the tube. The process will cause temporary impact and increase the sedimentation in the area. The placement of the Geotube will increase the surface available for other life forms such as algae growth by time. This may have positive or negative impact which has to be monitored and attended in a timely manner. Visual impact of the algal growth on the Geotube may not be very attractive. Therefore it is important to ensure that the Geotube is buried below the ground at all times.

Mitigation Measures: The most important mitigation measure is to monitor the area and respond to the changes. Geotube installation work should be undertaken during low tide or slack tide period, and the area should be sealed with silt curtains during the filling process.

8.1.3 Breakwater Construction

Placing the rock boulders on the seabed to construct the breakwater will have a direct irreversible negative impact to the ecological habitat in the area and lethal impact on sessile benthic organisms on the direct path of the breakwater. The direct impact of this activity is very local and limited to the reef area of in the vicinity of proposed breakwater structure *Figure 26*.

Given below are relevant impacts that should be considered:

1. Direct damage on substrate organisms directly below and within 0.5-2m radius from the breakwater construction area. The total area that will have direct irreversible impact on the living organisms is approximately 300m^2 in the lagoon on the eastern side. Short-term indirect impact from sedimentation may be felt larger area. Figure 26 shows the area that will have direct irreversible impact due to proposed developments.
2. Physical damage on live coral and other organisms on the substrate: The effect of this would be in the immediate to medium term with the loss of substrate and its fauna.
3. Disturbance to the area during placement of rock boulders on the seabed: Release of sediments and potential loss of the faunal composition underneath sediment material will undoubtedly occur causing sedimentation and subsequent smothering of coral nearby.
4. Construction of breakwater structure will change in the flow patterns. Tidal flows can be quite significant on the shallow reef flats and the placement rock boulders will change flow across the lagoon. The unexpected impact may be erosion or accretion of the sediment within the lagoon and overall change in the hydrodynamic regime of the lagoon.

5. Blocking of sediment moving and diversion of sediment due to the construction of breakwater may result in filling of the lagoon area or change in the sediment movement pattern around the island.

Mitigation Measures: A range of possible outcomes is expected as have been mentioned. The most important mitigation measure is to monitor the area and respond to the changes in the sedimentation pattern within the lagoon. The management should be aware of this and should be prepared to for potential actions in the future.

In order to minimize the impact from sedimentation, construction work should be completed in shortest time possible. Placement of rock boulders on the seafloor ought to take place during low tides or slack tides to minimize the release of sediment to the area.

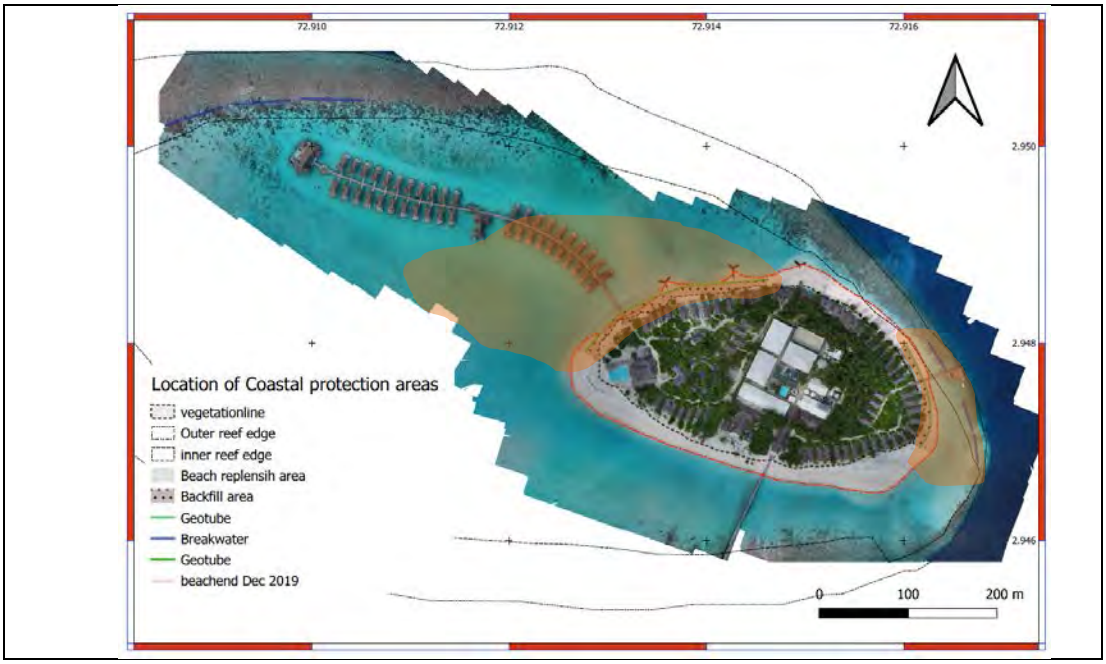


Figure 26: Maagau island area that will be subjected to direct damage from the proposed coastal modification project.

8.1.4 Hydrodynamic regime

Development of breakwaters and beach replenishment will influence current and water flow pattern through the lagoon. Wave energy environment within the lagoon will also be influenced because of refraction and redirection of the incident waves by the development of the breakwater structure. Change in the water flow pattern and subsequent change in sedimentation and water depth is likely to bring minor changes to the overall hydrodynamic regime within the lagoon and beach dynamics. Therefore the lagoon conditions may take a number of years to adjust against the prevailing conditions.

8.1.5 Sedimentation

Corals on the reef flat and reef slope on the eastern and western side will be impacted mainly from sand, pumping, backfill beach replenishment and Geotube installation. Direct impacts related to sedimentation will be limited to Maagau reef. Impacts of excessive sedimentation on corals include:

- Direct Physical smothering of corals and benthic organisms
- Reduced light penetration and subsequent reduction in photosynthesis productivity of coral reef growth, calcification and reproduction
- Shifting unstable sediments will form a false bottom
- Increased amount of sediment will cause eutrophication which will increase the amount of nutrients and lead to algal blooms
- Formation of anoxic black bottom beneath the fine sediment
- Suspended sediment in the sediment plume may trap pollutants which are absorbed into the sediments.
- Short term turbidity increase in lagoon water column during excavation to lay the foundation of pad-column will result in decrease in fish and other pelagic populations.

Mitigation measures: To reduce the impact of sedimentation sea bed excavation work will be carried during low tide and calm water condition to minimize effects on the reef. Installation of turbidity screen at the outer boundary of the sand pumping, Geotube installation and breakwater areas construction site will reduce the sedimentation.

8.1.6 Impact on ground water table and Vegetation

Size of the ground water aquifer is very limited in the islands. Development of ground water reservoir is dependent on the length and width of the island. Given the size of the island it is expected that the island aquifer will be very small and usage could be minimal. Groundwater also plays an important role in sustaining the ecological system of the island. Extraction of groundwater for construction purposes eg: trenching to lay the Geotube may prolong the water lens recovery process and increase the potential for saltwater intrusion into the groundwater aquifer. Increased salinity will generate some environmental consequences such as vegetation that are dependent on freshwater for survival will be deteriorated. As a consequence, more salt tolerant plant species will have the potential to dominate the island environment. Although ground water will not be used for human consumption in the island, it is important for the trees and shrubs in the island. Therefore, special care should be taken when handling oil, solid waste and hazardous waste to entirely avoid any accidental spills and leakage.

Since All the activities of the project are in the coastal areas and marine environment, it is very unlikely that the project will have a significant impact on the water table and vegetation. However the following precautionary mitigation measures are necessary

Mitigation measures:

- All paints, lubricants, and other chemicals used on site should be stored in secure and bunded location;
- Oil, solid waste and hazardous waste should be handled carefully and transported in sealed containers in properly bunded vehicles/vessels;
- Vessels, equipment and machinery used for the work should be properly maintained at all times during the operation;

- Littering and accidental disposal of any construction wastes can be avoided by pre-planning modalities for waste disposal or re-use wherever possible. Careful planning of the work activities can also reduce the amount of waste generated.

8.2 OPERATIONAL PHASE IMPACTS

Long term operation of the breakwater and change in the coastline will bring considerable changes to hydrodynamics regime of the lagoon. Major impact of the construction will be scouring and erosion associated with the breakwater. This may result in aggradations and degradation, increase and decrease in sea floor elevation over a long reach through sediment deposition or erosion which has to be closely monitored.

Mitigation Measures:

- Change in hydrodynamic condition of the lagoon and the beach
- Continuous monitoring to identify abnormal activity and implement mitigation measures when needed.

Table 9: Summary of Major impacts their reversibility and significance.

Impact	Reversibility	Significance	Mitigation cost (MRV)
Contamination of marine environment; sediment plumes are anticipated to be generated during site setup, installation of Geotube, breakwater and sand pumping process for backfill and replenishment. This will degrade the overall quality of marine water. In addition, there is possibility of accidental spillage of fuel to the sea. Increased turbidity and sedimentation-caused by excavation to place the pad-columns will result in smothering of coral harm substrate habitat infauna and other fish species and corals	Reversible over short-medium time frame Reversible over short-medium timeframe	low-medium sedimentation level could cause moderate stress on the marine environment and may impair the aesthetic quality of the surroundings Significant particularly for habitats in the vicinity	Installation of Silt screen Approximately 50,000, Estimated cost is based on similar experiences in other project.
Coastal process: The lagoon will undergo significant change and coastal adjustment process before it stabilizes due to the beach nourishment and breakwater construction. Continued erosion can cause long term sedimentation issues for the coral reef	Reversible though proper maintenance and monitoring	Low -Moderately significant, change in hydro dynamic regime.	

Major costs associated with mitigation measures are as follows;

- Control of suspended sediment dispersal by installing silt screens
- Turbidity barrier purchase and repairs
- Employment of environmental persons to monitor excavation construction work

9 ALTERNATIVES

9.1 NO DEVELOPMENT OPTION

The proposed coastal modification project is necessary to protect the existing infrastructures of the island and to provide reasonable beach for the tourists. The island has gone through under severe erosion. Although no impacts on the environment will be associated if the proposed development does not go ahead, it will be a huge economic loss for the proponent and loss of revenue for the government and other numerous financial and socio-economic loss for the country and the people. Therefore the proposed project coastal modifications are vital for the island to operate as a resort in the country.

Given the range of benefits that the proposed development will bring to the country, the proposed work in Maagau Island has been considered important. Development can take place only within the limits of the environment and the society. Hence, the aim is to ensure that all project activities are undertaken without any adverse long term irreversible environmental damages that cannot be mitigated. Preferred alternatives discussed below has been selected based on the above broad development concept.

9.2 DEVELOPMENT OPTION

Having decided and followed the development option of the proposed project one has to consider the alternative options for some of the activities that has been included in the revised concept plan that would have least environment impact. Following have been considered for the alternatives.

9.3 ALTERNATIVE MATERIAL FOR COASTAL PROTECTION

The proposed breakwater to protect the eastern side is designed to be constructed by using rock boulders. An alternative and cheaper option would be to use sand & cement bags to construct the structure. This would be relatively a cheaper option but the construction period will be longer and the durability would be generally shorter than the rock boulders. Therefore it would more favorable to use rock boulders rather than sand cement bags.

Rock boulders or sand/cement bags can be used instead of Geotubes, and could be cheaper, but it would considered as a hard structure burring them and maintain them would be difficult. Also the is the rock boulders will be visually unattractive. Therefore the proposed Geotube will be a very appropriate and the cost will also be reasonable and cheaper than rock boulders but more expensive than the Sand/cement bags.

9.4 EXTRA COASTAL PROTECTION MEASURES

The western side of the island has fairly long, over 700m long, reef flat between the beach and the wave breaking reef. However the commence of resort development, the most expensive water villa (presidential suite) is located only few meters from swell breaking area. At present during high tide area experiences strong wave action. If not properly protected the

area might not last for long. Providing offshore protection in this area will overall reduce the wave action inside the lagoon. Subsequently provide shoreline protection for the beach. Construction of such an offshore breakwater will be the only plausible long term potential solution for the coastal erosion problem in the island. Even though the proposed coastal modification does not include offshore breakwaters on the western side, construction of offshore breakwater along with the proposed shore protection measures, through installation of Geotubes, it is recommend constructing an offshore breakwaters on the western side.

10 DEVELOPMENT OF A MONITORING PLAN

Environmental monitoring and auditing is an essential component of any project. Under the EIA regulation, a detailed monitoring plan is a mandatory component of any EIA report. The initial EIA has developed a fairly comprehensive monitoring plan; however, monitoring programme was not implemented at any stage during the construction period. Therefore it is recommended to start environmental monitoring programme and document the baseline conditions associated with construction stage at the end of construction work and prior to the resort opening. Bi annual monitoring is recommended to be conducted for minimum of 3 years during the operational stage of the resort.

The following baseline parameters are recommended to be documented in the monitoring report at the end of the construction period prior to the opening:

- Marine water quality for pH, EC/salinity, and turbidity
- Shorelines and beach profiles around the impact areas
- Temporal Sedimentation
- Observation and monitoring waste generation and oil spillage.
- Observation of maintenance and management of health and safety hazards
- Noise measurement
- Marine environment survey of the house reef

In the operational phase also, bi annual monitoring of the following parameters are recommended to be covered.

- Shoreline mapping (beach toe, high tide vegetation line).
- Near shore current measurement
- Sediment settlement and transport
- Marine water quality – pH, E-conductivity/salinity, and turbidity.
- Marine environment survey of the house reef
- Investigations to identify recolonization of the benthic organisms in the borrow area
- Observation and monitoring waste generation and oil spillage.

Table 10, - Table 13 shows the details of the proposed monitoring plan including the monitoring parameters, indicators, baseline, proposed methods, frequency and estimated costs.

Table 10: Monitoring of the shoreline, beach profiles and coastal environment

Parameter	Indicators	Baseline / Reference Values	Method / Technique	Frequency	Rate USD	Total cost /year (USD)
Shorelines (high / low	Beach morphology	Baseline to be re-established	Differential GPS	Bi-annually	400/ trip	800

tides)		immediately after construction				
Beach profiles	coastal changes	Requires to re-establish the baseline after construction	Beach profile surveys	Bi-annually	200 / trip	400
Currents	Near shore currents	Baseline to be collected after construction	Drogue survey	Bi-annually	200/trip	400
Sedimentation	Near shore sediment settlement/transport	Baseline to be established after construction	Sediment traps	Bi annual	200/trip	400
Total / year						2000

Table 11: Monitoring of the reef environment

Parameter / Method	Frequency of Monitoring	Purpose	Rate (USD)	Total cost /year (USD)
Benthic cover by major life forms (live, dead, rock rubble and sand)	Once six months	Indicative of the changes in the live coral cover	300/trip	600
Fish population / visual census	Once six months	To assess broad scale change in the ecological status of the coral reefs (increase / decrease of herbivores, etc.)		

Table 12: Water quality monitoring

Type	Parameters	Locations	Frequency	Rate (USD)	Total cost/year (USD)
***In situ* monitoring / sampling and testing from a laboratory**	Dissolved oxygen Turbidity (NTU) Nitrates Sulphates TDS, E-conductivity	Locations specified in the EIA report	Bi-annual	350/ set of tests	700

Table 13: Solid waste and oil spill monitoring

Type	Parameters	Locations	Frequency	Rate (USD)	Total cost/year (USD)
Solid waste and oil spill	Type and quantity of waste generated oil handling, storage transport and disposal using resort logs	Loading site and disposal site transportation etc	Bi-annual	200/ set of tests	400

10.1 MONITORING REPORT

Monitoring report should be compiled and submitted to the EPA after each monitoring and any other relevant government agencies for compliance, if requested. The report will include details of the site, strategy of data collection and analysis, quality control measures, sampling frequency and monitoring analysis and details of methodologies and protocols followed. The report structure may include but not limited to;

- Introduction
- Details of existing site condition,
- Data collection and analysis,
- Methodologies and protocols followed
- Quality control measures,
- Sampling frequency and monitoring analysis
- Conclusion and recommendations

10.2 MONITORING COSTS

The estimated total cost per annum for monitoring is estimated to be 3700 US$. It is understood that costs of monitoring be borne by the proponent. It is also understood the mitigation measures would be accommodated in the contract costs. A commitment letter confirming compliance on monitoring and mitigation measures is given in Annex.

10.3 MONITORING SCHEDULE

Table 14: A tentative schedule for submission of monitoring and compliance report to EPA

Year	Construction phase				Operational phase					
	Jan	Feb	Mar	Dec	Apr.	Oct	Apr.	Oct	Apr.	Oct
2020										
2021										
2022										
2023										

11 CONCLUSIONS

This Addendum is required for the proposed coastal modification project in Dh. Maagau. The island has been going through severe erosion over the past 2-3 years. Fairly longterm observation of the beach dynamics the proponent has come-up with the present proposal for coastal modification. The proposal includes shoreline protection by using Geotubes, backfilling and beach nourishment on the western and eastern side of the island and construction of an offshore breakwater on the eastern side of the island. The most significant activity that has the potential to cause negative environmental impact from the proposed project is the sedimentation impacts associated pumping of sand from the lagoon to fill Geotubes, backfill and beach nourishment. Pumping sand from the lagoon will have a direct irreversible negative impact to the ecological habitat in the area and lethal impact on sessile benthic organisms on in the area. The direct impact of this activity is very local and limited to lagoon area in the vicinity of water villa proposed for sourcing sand for coastal modifications and areas proposed for the installation of the Geotubes. Given the size of the proposed activities, proximity of the work sites to open ocean, the impacts associated due to sediment re-suspension will be of short duration and minor. Proposed activities can be considered as a negative environmental impact that will cause sedimentation and coral smothering and changes in the hydrodynamics of the island.

The Addendum has evaluated alternative material for the construction of shore protection measures also recommended extra areas offshore protection on the western side of the island. Negative and positive environmental impacts associated with the implementation of the proposed coastal modification is recommended to be monitored through the monitoring programme presented in the report. The report presents fairly good account of the baseline conditions surrounding the island to make necessary adjustment based on the findings of various measured environmental parameters suggested in the monitoring plan.

With proper implementation of the mitigation measures, anticipated direct irreversible negative impact to the ecological habitat in the area from the proposed could be limited and contained in the work area without widespread dispersion of suspended sediment associated with this development. Therefore the proposed coastal modifications will not alter the over-all aspect of the project and recommended to go ahead as proposed.

12 REFERENCES

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EIA for the proposed resort development in Maagau, Dhaalu Atoll, Maldives, Prepared by SandCays for New moods Pvt. Ltd (March 2015)

1st Addendum to the to the EIA Report, Maagau, Dhaalu, Atoll, Maldives, Prepared by Mahmood Riyaz, for New Moods Pvt.Ltd (February 2019)

2nd Addendum to the EIA Report Uthurumaafaru, Raa, Atoll, Maldives, Prepared by Dr. Mahmood Riyaz for Uthurumaafaru Holding Pvt. Ltd (Sept 2018)

Environmental Management Plan for Access channel maintenance dredging and beach nourishment, Cocoon Maldives at Ookolhu Finolhu, Lh, Atoll, Maldives. Prepared for Cocoon Maldives, by Dr. Mahmood Riyaz (November 2017)

13 ANNEXES

Annex 1: Approved Terms of Reference (ToR) for the addendum

Annex 2: Approved Coastal Modification Project Concept plan Dhaalu Maagau island

Annex 3: Commitment letter from the Proponent

Annex 4: Seawater Laboratory report

Annex 5: Enlarged Maps used in the text

No: 203-ECA/PRIV/2020/328

Terms of Reference for the Second Addendum to the Environmental Impact Assessment for the Proposed Resort Development Project at Maagau, Dhaalu Atoll

The following is the Terms of Reference (ToR) for undertaking the **Second Addendum to the EIA of the Proposed Resort Development Project at Maagau, Dhaalu Atoll.** The proponent of the project is **New Mood Resorts Pvt Ltd**. The EIA consultant of this project is **Dr. Mahmood Riiyaz (License No. EIAP03/2007).**

While every attempt has been made to ensure that this ToR addresses all of the major issues associated with development proposal, they are not necessarily exhaustive. They should not be interpreted as excluding from consideration matters deemed to be significant but not incorporated in them, or matters currently unforeseen, that emerge as important or significant from environmental studies, or otherwise, during the course of preparation of the EIA report.

1. **Introduction and rationale** – Describe the purpose of the project and, if applicable, the background information of the project/activity and the tasks already completed**.** Objectives of the development activities should be specific and if possible quantified. Define the arrangements required for the environmental assessment including how work carried out under this contract is linked to other activities that are carried out or that is being carried out within the project boundary. Identify the donors and the institutional arrangements relevant to this project.

2. **Study area** – Submit a minimumA3 size scaled plan with indications of all the proposed infrastructures. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location and size. The study area should include adjacent or remote areas, such as relevant developments and nearby environmentally sensitive sites (e.g. coral reef, sea grass, mangroves, marine protected areas, special birds site, sensitive species nursery and feeding grounds). Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites.

3. **Scope of work** – The report should be categorised into the following components:

   Task 1. Description of the proposed project – Provide a full description and justification of the relevant parts of the proposed works, using maps at appropriate scales where necessary. The following should be provided (all inputs and outputs related to the proposed activities shall be justified):

   - Project justification;
   - Excavation methods, if required for construction purposes including machinery, man power, expertise and scheduling;
   - Coastal protection methods;
   - Emergency plan during spillages;

- Environmental monitoring during construction activities;
- Measures to protect environmental values during construction and operation phase;
- Project management (include scheduling and duration of the project and life span of facilities; communication of construction details, progress, target dates, construction/operation/closure of labour camps, access to site, safety, equipment and material storage, fuel management and emergency plan in case of spills).

Dredging/Excavation

- Location and size of sand burrow areas (s) on a map;
- Justification for the selection of this location;
- Quantity, quality and characteristics of fill material;
- Indication of guarantees for sufficient availability of fill material;
- Method and equipment used for dredging, including description of positioning system, depth control system and operational control procedures;
- Justification for selecting the methods and equipment;
- Duration of dredging activity;
- Labour requirements and (local) labour availability;
- Housing of temporary labour;
- Emergency plan in case of spills (diesel, grease, oil);
- Plans of translocations/ transplantations of corals (if any).

Coastal Protection

- Design concept of coastal protection measures;
- Coastal protection structures construction and justification;
- Details and justification of location, number, size and materials of coastal protection structures;
- Designs, cross section quantity and characteristics of materials used in coastal protection;
- Method and equipment used;
- Justification for selecting the methods and equipment.

Beach Nourishment

- Beach nourishment locations and size of proposed reclamation areas;
- Planning and timing of sub activities;
- Method and equipment of transport of fill material and hydrauling filling, if any;
- Need for and location of temporary stockpile(s);
- Location and design of the external bunds for the containment of the sand together with a description of their stability against waves and currents.

Task 2. Description of the environment – Assemble, evaluate and present the environmental baseline study/data regarding the study area and timing of the project (e.g. monsoon season). Identify baseline data gaps and identify studies and the level of detail to be carried out by consultant. Consideration of likely monitoring requirements should be borne in mind during survey planning, so that data collected is suitable for use as a baseline. As such all baseline data must be presented in such a way that they will be usefully applied to future monitoring. The report should outline detailed methodology of data collection utilized.

Monitoring data from the last monitoring report needs to be provided in the report. Latest monitoring should be from this year, if assessment needs to be undertaken from the marine sites in which baseline is collected and results presented.

The baseline data will be collected before construction and from at least two benchmarks. All survey locations shall be referenced with Geographic Positioning System (GPS) including water sampling points, reef transects, vegetation transects and manta tows sites for posterior data comparison. Information should be divided into the categories shown below:

Climate

- Seasonal climatic variations;
- Temperature, rainfall, wind, waves, current patterns.

Geology and geomorphology

- Offshore/coastal geology and geomorphology (use maps);
- Bathymetry (bottom morphology) (use maps) of all dredging and reclamation locations;
- (Seasonal) patterns of coastal erosion and accretion (use satellite images for data comparison);
- Shoreline (high tide line, low tide line) and vegetation line;
- Beach profiles from around the island;
- Characteristics of seabed sediments to assess direct habitat destruction and turbidity impacts during construction.

Hydrography/hydrodynamics (use maps)

- Climatic conditions on the day of the field visit;
- Tidal ranges and tidal currents;
- Currents at site;
- Waves at site;
- Erosion patterns around the existing island (using satellite imagery and baseline data);
- Sea water quality measuring these parameters: temperature, pH, salinity, turbidity, electrical conductivity, dissolved oxygen and TSS (from all dredging and reclamation locations and from at least one control site).

Ecology

- Identify marine protected areas (MPAs) and sensitive sites such as breeding or nursery grounds for protected or endangered species (e.g. coral reefs, spawning fish sites, nurseries for crustaceans or specific sites for marine mammals, sharks and turtles). Include description of commercial species, species with potential to become nuisances or vector;
- Quantitative marine assessment (coral cover and fish census survey) at the borrow site and at the reef adjacent to the borrow area and from at least two control sites;
- Coastal environment at the locations where beach nourishment and coastal protection would be undertaken.

Hazard vulnerability

- Risk of hurricanes and storm surges;
- Vulnerability of area to flooding and storm surge.

Absence of the facilities in the country to carry out water quality and air quality tests will not exempt the proponent from the obligation to provide the necessary data. The report should outline the detailed methodology for data collection utilized to describe the existing environment.

Task 3. Legislative and regulatory considerations – Identify the pertinent legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project and identify the appropriate authority jurisdictions that will specifically apply to the project. Include permits and approvals in the EIA document. The follow shall be included:

- Concept approval from the Ministry of Tourism.
- Dredging and coastal modification permit from EPA.

Task 4. Potential impacts (environmental and socio-cultural) of proposed project – The EIA report should identify the impacts, direct and indirect, during and after construction, and evaluate the magnitude and significance of each. Particular attention shall be given to impacts associated with the following:

Impacts on the natural environment

- Changes in flow velocities/directions, resulting in changes in erosion/sedimentation patterns, which may impact shore zone configuration/coastal morphology;
- Loss of marine bottom habitat, both in the borrow area as well as due to enlargement of the islands, resulting in (temporary) loss of bottom life, which may impact fish stocks and species diversity and density of crabs, shellfish etc.;
- Sediment dispersal in water column (turbidity at the dredging site (overflow) and related to shore protection activities), possibly resulting in changes in visibility, smothering of coral reefs and benthic communities and affecting fish and shellfish etc.;
- Seawater quality deterioration;
- Impacts of noise, vibration and disturbance;
- Impacts on unique or threatened habitats or species (coral reefs, sea turtles etc.);
- Impacts on landscape integrity/scenery;
- Impacts as a result of timing of the activities. If the project is planned for coral bleaching period;
- Ecosystem services: loss of corals in the area;
- Waste management during constructional and operational activities;
- Erosion on unprotected reclaimed areas.

Impacts on the socio-economic environment

- Impacts of the dredging and coastal protection works on the public, stakeholders and tourism ventures (nearby resorts and dive sites);
- Impacts on employment and income, potential for local people to have (temporary) job opportunities (and what kind) in the execution of the works;
- Pollution of the natural environment (e.g. oil spills, disposal of construction waste);
- Risk of accidents and pollution on workers and local population;

- Safety- worker and community safety during construction and operation;
- Level of protection against hazards like sea level rise, storm surges, etc.

The methods used to identify the significance of the impacts shall be outlined. One or more of the following methods must be utilized in determining impacts; checklists, matrices, overlays, networks, expert systems and professional judgment. Justification must be provided to the selected methodologies. The report should outline the uncertainties in impact prediction and also outline all positive and negative/short and long-term impacts. Identify impacts that are cumulative and unavoidable.

Task 5. Alternatives to proposed project – Describe alternatives including the *"no action option"* should be presented. Determine the best practical environmental options. Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". This should include but not limited to alternative borrow sites, alternative equipment/machinery for dredging, alternative disposal sites and alternative containment measures. All alternatives must be compared according to international standards and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. Mitigation options should be specified for each component of the proposed project. The comparison should yield the preferred alternative for implementation. The EIA report may focus on alternatives such as:

- Alternative dredging methods;
- Alternative borrow areas: have these been considered and if so, give arguments why these alternative locations were not selected;
- Alternatives for the design of coastal protection structures, including materials used.

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. These will include both environmental and socio-economic mitigation measures with particular attention paid to sedimentation control and future changes in coastal processes. Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources required to implement those measures. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included. An Environmental management plan for the proposed project, identifying responsible persons, their duties and commitments shall also be given. In cases where impacts are unavoidable arrangements to compensate for the environmental effect shall be given.

Task 7. Development of monitoring plan – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan for coastal modification, beach morphology, sediment movement around the island. Monitoring reports will be submitted to the EPA to evaluate the damages during construction, after project completion and every three months thereafter, up to one year and then on a yearly basis for five years after, if necessary or by incorporation within the EIA for the resort development. The baseline study described in task 4 of section 4 of this document is required for data comparison. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided. The following shall be considered in the monitoring programme proposed.

- Water quality, especially turbidity, during dredging and reclamation;
- Current patterns and velocities;
- Erosion and accretion changes;

- Temporal sedimentation rates on nearby coral reefs, benthic system and sea grass beds;
- Condition of the sensitive ecosystems and marine resources;
- Re-colonization of the benthic organisms in the borrow areas;
- Environmentally sound site clearance;
- Environmentally sound removal of construction equipment and materials;
- Employment of available local labour force.

Task 8. Stakeholder consultation, Inter-Agency coordination and public/NGO participation) – Identify appropriate mechanisms for providing information on the development proposal and its progress to all stakeholders. The EIA report should include a list of people/groups consulted, their contact details and summary of the major outcomes. The following stakeholders need to be consulted:

1. Maldives Marine Research Institute, particularly with respect to timing of the project and potential coral bleaching predicted.
2. National Disaster Management Authority (general points highlighted by the authority in the guidance document provided to consultants can be highlighted).
3. Ministry of Tourism.
4. Ministry of Environment (Environment Department).

If consultation is undertaken at a time of public health emergency is declared due to COVID 19, consultation with stakeholders can be undertaken via e-conference calls or telephone. The EIA report needs to be submitted to atoll council and evidence of submission needs to be included in the report. Meeting minutes shall be annexed and the report shall include a list of those who are consulted and their contacts needs to be provided.

Presentation- The environmental impact assessment report, to be presented in digital format, should be concise and focus on significant environmental issues. It should contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations f or any references used in interpreting those data. The environmental assessment report shall be organized according to, but not necessarily limited by, the outline given in the EIA Regulations, 2012 and the subsequent amendments.

Timeframe for submitting the EIA report – The developer must submit the completed EIA report within 6 months from the date of this Term of Reference.

……

06th July 2020

ENVIRONMENTAL PROTECTION AGENCY Male', Rep of Maldives

Annex-2 Approved Concept Plan

بسم الله الرحمن الرحيم

MINISTRY OF TOURISM
REPUBLIC OF MALDIVES

Ref no: 88-ES/PRIV/2020/909

Monday, June 15th, 2020

Mr. Gianandrea Tosi,
Chief Executive Officer,
New Mood Resorts Pvt. Ltd.,
2nd Floor, Unit C,
Faamudheyrige,
Orchid Magu,
Malé,
Republic of Maldives,

Dear Mr. Gianandrea Tosi,

Re: Coastal modification project at Maagau in Dhaalu Atoll.

We refer to your application dated 30th May 2020 (revised on 15th June 2020), requesting to approve the proposed coastal modification project at Maagau in Dhaalu Atoll.

The main activities of the proposed project include:

- Beach nourishment,
- Dredging (Sand borrow sites),
- Construction of breakwater and geotubes.

A conditional approval is hereby granted to the coastal modification plan submitted to the fulfillment of the following requirement and procedure:

- Submission of approved Environment Impact Assessment (EIA) report or an Environmental Clearance from Environmental Protection Agency (EPA).

Kindly note that this conditional approval is based on the rules and regulations and practices of this Ministry and concerned government authorities. In addition, this approval is issued only for the purpose of the aforementioned project.

Thank you.

Yours sincerely,

MINISTRY OF TOURISM
Male', Republic of Maldives

Mohamed Khussan
Senior Policy Director

Copy: Baglioni Maldives Pvt. Ltd.


72.909
72.912
72.915
Legend
Breakwater
Geotube (burried)
Fill area
Low tide
Mid tideline
Sand source
MINISTRY OF TOURISM
Male', Republic of Maldives
Ref: 85-CS/PRIV/2020/909
Date 15th Jan 2020.
0
100
200
300
400 m
Project title
Dh. Maagau Coastal Development Plan
Project Location
Atoll: Daalu Atoll
Island name: Maagau
Developer
Name:
Address:
Consultant
Name:
Address:
Concept Designed by:
Name:
Concept No:
Date: 11 June 2020

Annex-3 Proponent Commitment Letter

Our Ref: 2nd September, 2020

Mr. Ibrahim Naeem
Director General
Environmental Protection Agency
Green Building, 3rd Floor
Handhuvaree Hingun
Male, Maldives, 20392

Dear Mr. Ibrahim,

Re: 2nd ADDENDUM TO THE EIA REPORT ON RESORT DEVELOPMENT PROJECT, DHAALU MAAGAU, MALDIVES

As the proponent responsible for environmental compliance for the above project, I hereby give our financial commitment to implement the monitoring plan, undertake the mitigation measures recommended and to comply with the issues identified in the Environmental Impact Assessment Report submitted to the Environmental Protection Agency.

Yours sincerely,

Gianandrea Tosi (CEO)

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
Quality Assurance Building, 1st Floor, Male' Hingun, Vilimale', Male' City, Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

090-LB-TEST

MWSC

WATER QUALITY TEST REPORT

Report No: 500184980

Customer Information:
Mahmood Riyaz
H.Hithifaiy

Report date: **02/09/2020**
Test Requisition Form No: **900190360**
Sample(s) Recieved Date: **30/08/2020**
Date of Analysis: **30/08/2020 - 30/08/2020**

Sample Description ~	Jetty 1	Jetty 2	**TEST METHOD**	**UNIT**
Sample Type ~	Sea Water	Sea Water		
Sample No	83213485	83213486		
Sampled Date ~	28/08/2020 11:20	28/08/2020 11:20		
PARAMETER	**ANALYSIS RESULT**			
Physical Appearance	Clear with particles	Clear with particles		
pH *	8.16	8.21	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	34.5	34.4	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Total Dissolved Solids	26200	26200	Electrometry	mg/L
Total Suspended Solids	<5 (LoQ 5 mg/L)	<5 (LoQ 5 mg/L)	HACH Method 8006	mg/L
Turbidity *	0.912	0.186	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

Keys: ‰ : Parts Per Thousand, **mg/L** : Milligram Per Liter, **NTU** : Nephelometric Turbidity Unit

Checked by

Aminath Sofa
Laboratory Executive

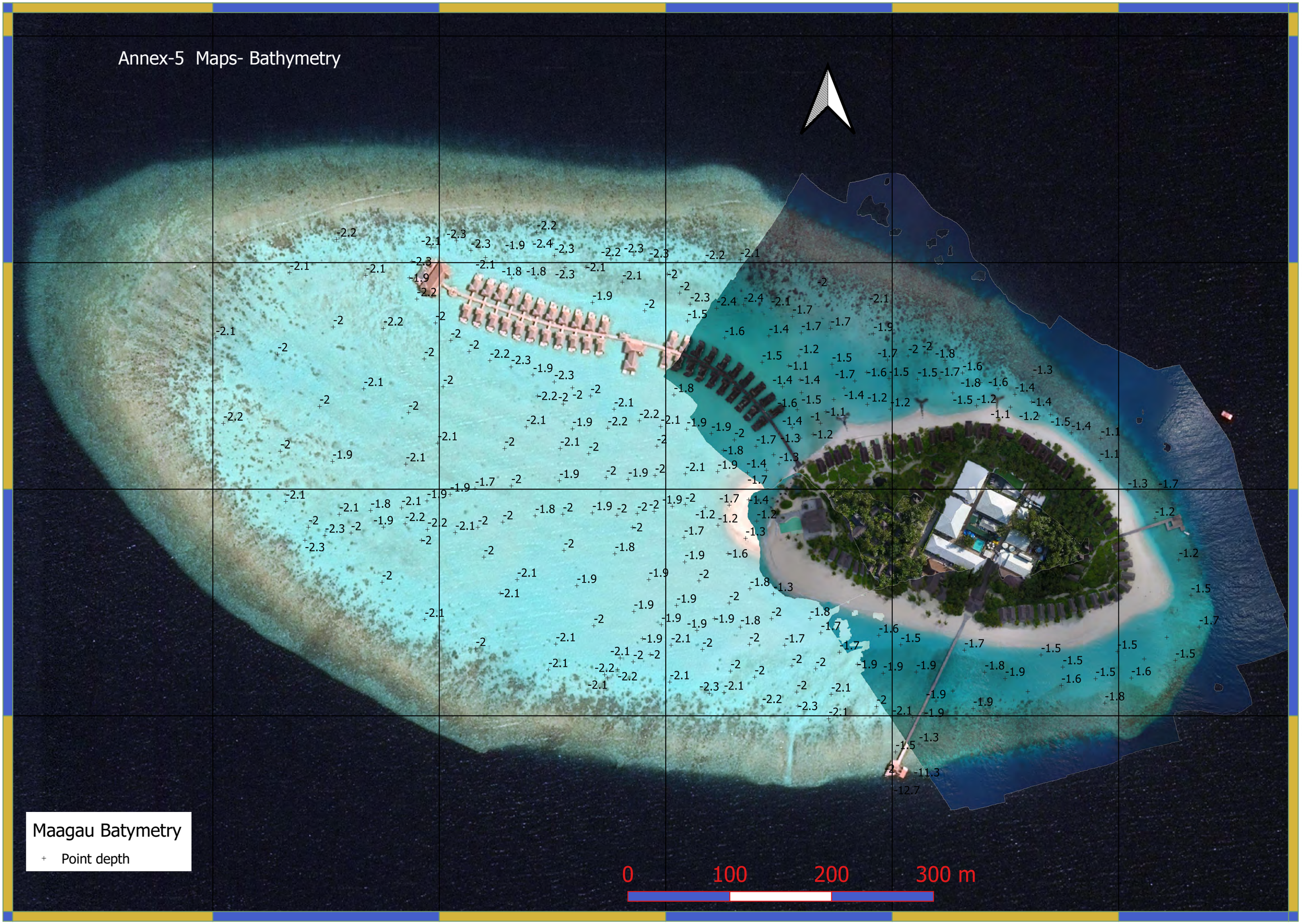
Approved by

Mohamed Eyman
Manager, Quality

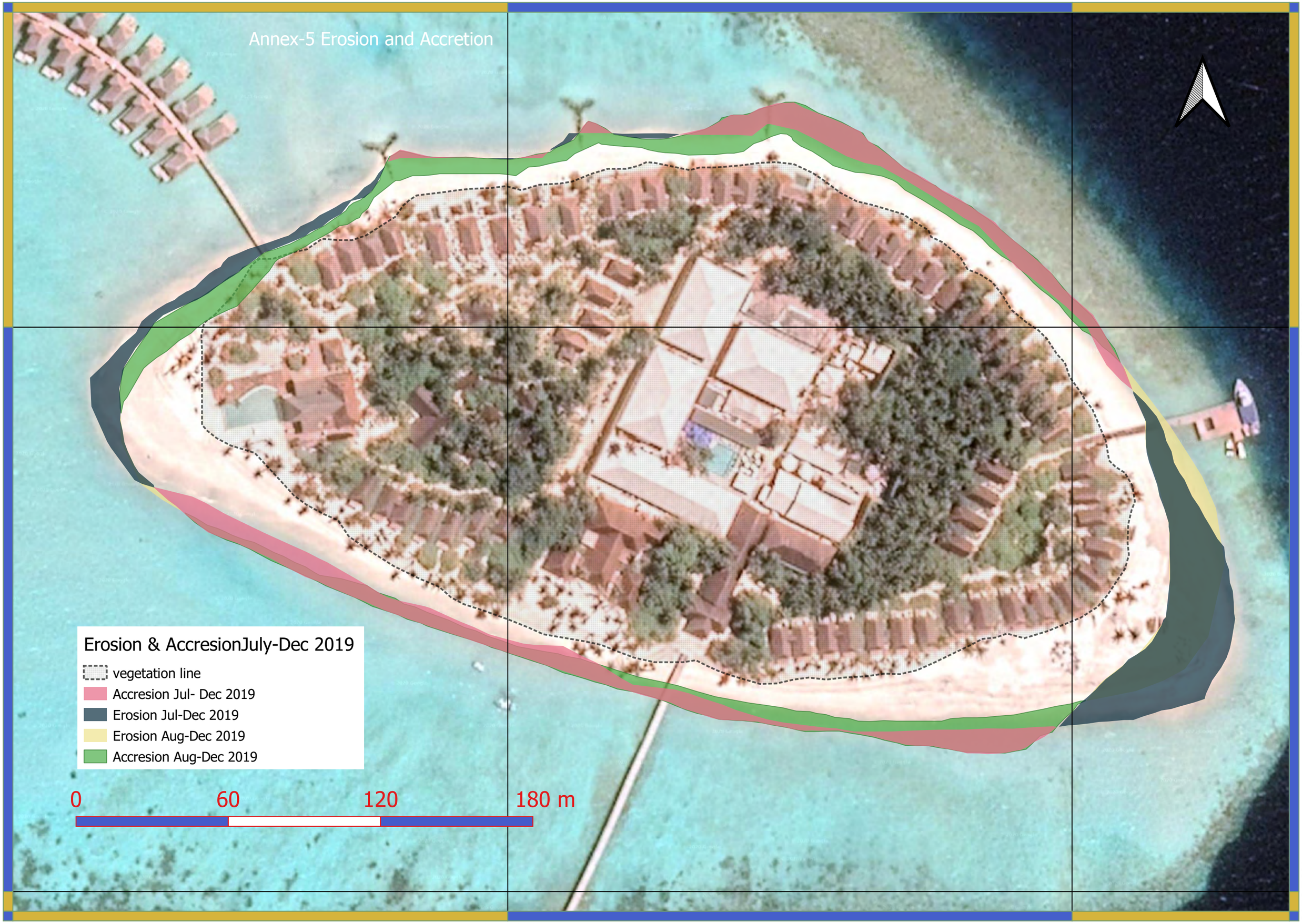
Notes: Sampling Authority: Sampling was not done by MWSC Laboratory
This report shall not be reproduced except in full, without written approval of MWSC
This test report is ONLY FOR THE SAMPLES TESTED.
~ Information provided by the customer
*Parameters accredited by EIAC under ISO/IEC 17025:2017

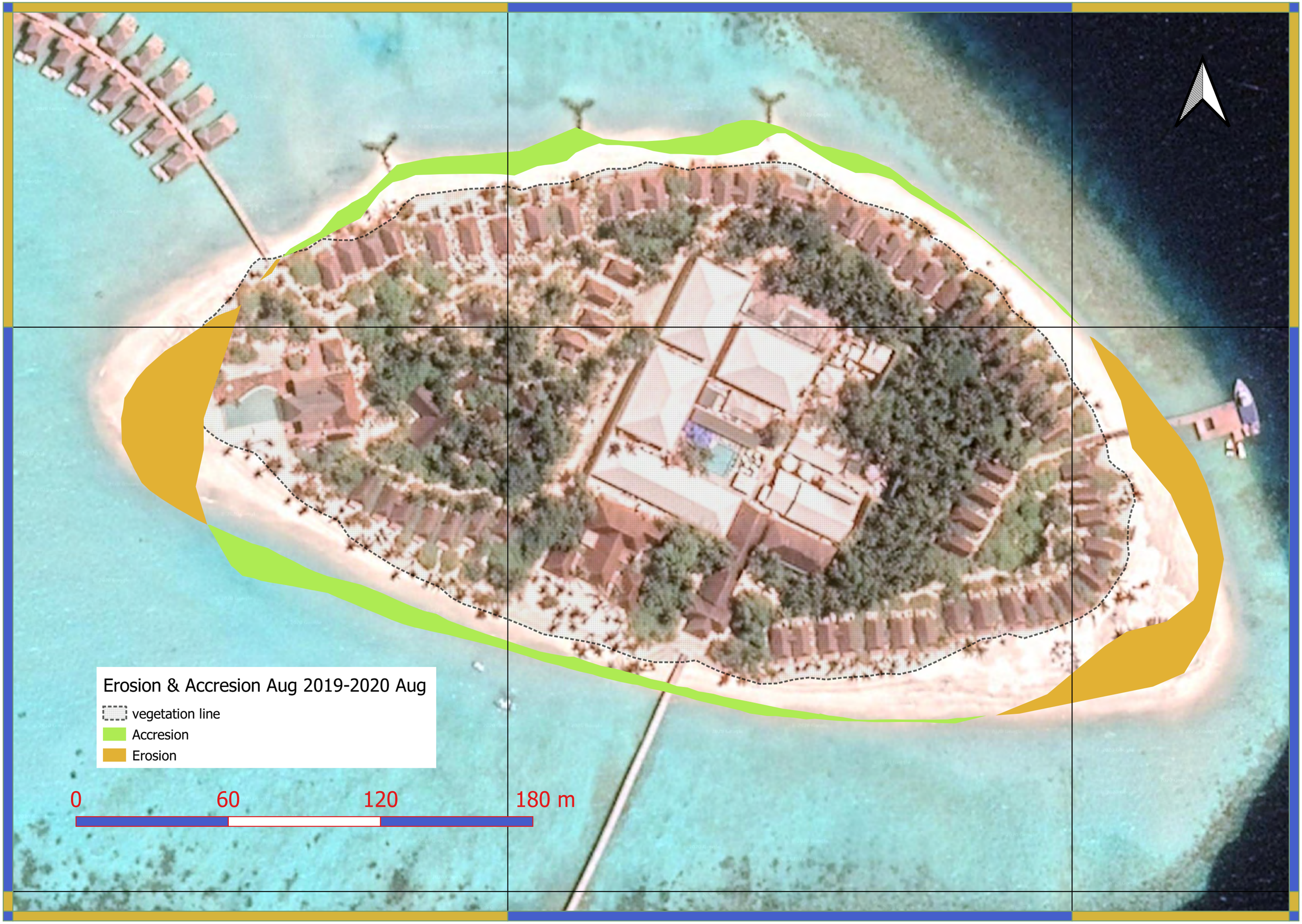
********** END OF REPORT **********

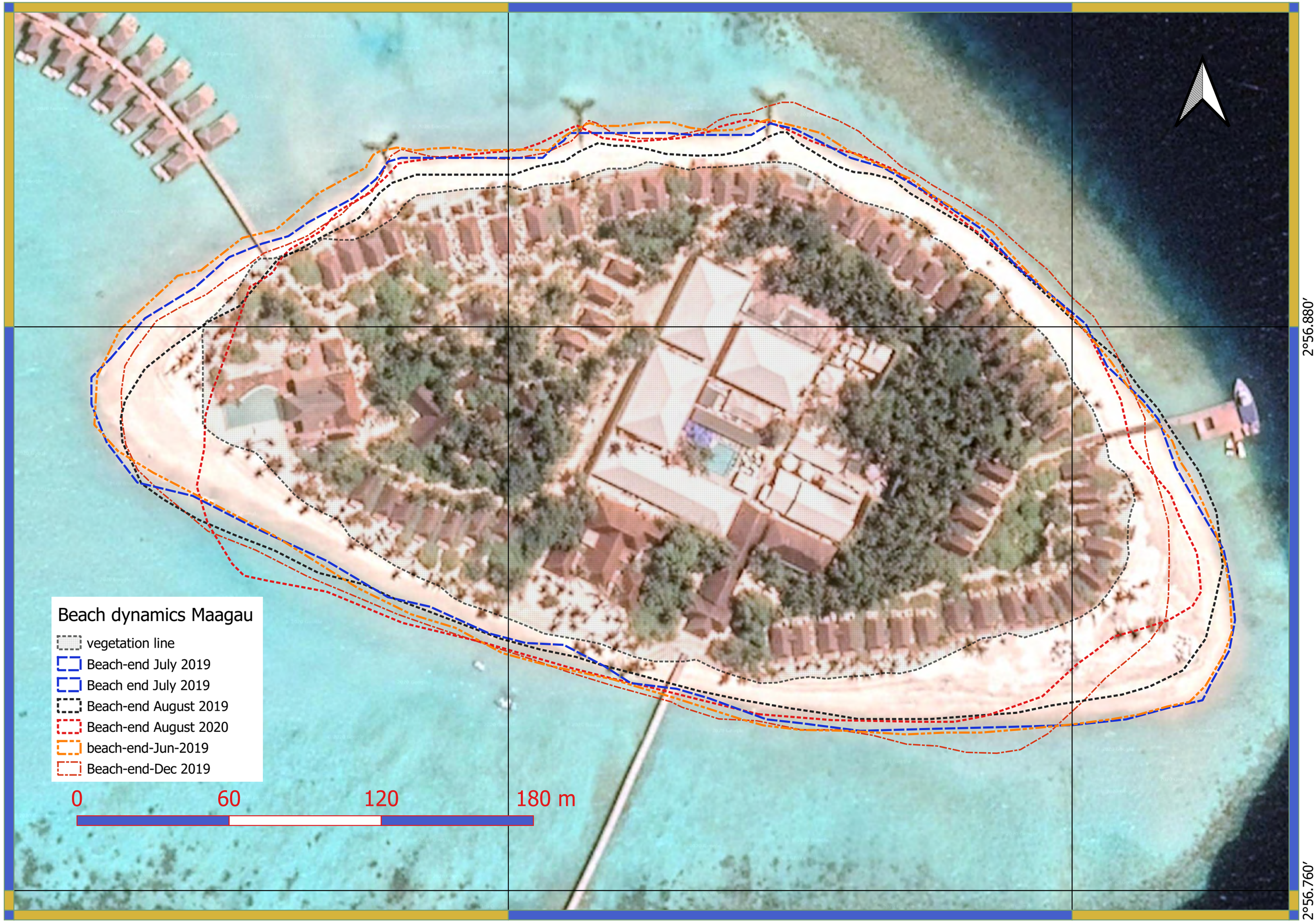
Annex-5 Maps- Bathymetry



Annex-5 Erosion and Accretion




Erosion & Accresion Aug 2019-2020 Aug
vegetation line
Accresion
Erosion
0
60
120
180 m
2°56.880′
2°56.760′
72°54.840′
72°54.960′


Beach dynamics Maagau
vegetation line
Beach-end July 2019
Beach end July 2019
Beach-end August 2019
Beach-end August 2020
beach-end-Jun-2019
Beach-end-Dec 2019
0
60
120
180 m
2°56.880′
2°56.760′
72°54.840′
72°54.960′