1 Contents

2 Figures

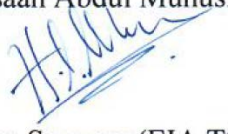
3 Tables

4 Declaration of the consultants

This EIA has been prepared in accordance with the EIA regulation 2012. We certify that the statements made in this EIA are true, complete and correct to the best of our knowledge and abilities.

Mahfooz Abdul Wahhab (EIA P22/2016)

Hassaan Abdul Muhusin (EIA.T03/2019)



Adam Saaneez (EIA.T06/2019)

بسم الله الرحمن الرحيم

ދިވެހިރާއްޖޭ ފުވާމުލަކު ރަށްރަށުގެ ކައުންސިލްތަކުގެ ލިޔުންތަކުގެ ދާއިރާ

Secretariat of the Mulah Council Mulakatholhu,
M· Mulah Republic of Maldives·

ފުވާމުލަކު ރަށްރަށުގެ ކައުންސިލް ލިޔުންތަކުގެ ދާއިރާ،
ދ.ފުވާމުލަ، ދިވެހިރާއްޖެ.

NO: 364-B/203/2019/2

Environmental Protection Agency,
Ministry of Environment and Energy,
Green Building, Male',
Maldives

RE: PROPONENT DECLARATION AND COMMITMENT FOR EIA FOR MEEM. MULAH

Dear Sir

As the proponent of the proposed project we guarantee that we have read the report and to the best of our knowledge, all information relevant to this project in terms of project description, project development works and operational aspects provided here are accurate and complete.

As the proponent of the project; we assure you our commitment to undertake the proposed mitigation measures and monitoring programme given in the report.

Thanking you

Sincerely,

Mohamed Ibrahim

President of Mulak council

بسم الله الرحمن الرحيم

SAS e CONSTRUCTION PVT LTD

Ref: 1276/2019

29/08/2019

Declaration and Commitment of the Contractor

I, Saudulla Ahmed the Managing Director on behalf of SAS E Construction Pvt Ltd am responsible for the actions of our company during the proposed harbour re development project at Sh. Noomaraa and take the full responsibility of the project as agreed with the proponent.

As the contractor I understand that I am accountable for confining the activities of the company to the prescribed project sites. I hereby declare that all mitigation prescribed in the EIA will be followed to the best of our abilities.

Thank You.

Best Regards,

SAS E CONSTRUCTION PRIVATE LIMITED
C-0249/2013

Saudulla Ahmed
Managing Director

SAS e CONSTRUCTION PVT LTD
M.Ebage | 1st Floor | Iramaa Magu | Male' | Maldives
T: +960 333 1682 | F: +960 330 1682
No: C-0249/2013 | TIN:1020282GST501

7 ސާރާ ޚުލާސާ

މި ދިރާސާ ރިޕޯޓަކީ މ. މުލަކު ގައި ފުޓްބޯޅަ ދަނޑަކާއި ރަށުގެ ރައްޔިތުން ދަތުރު ގޮސް އުޅުން ސަރަހައްދެއް ގާއިމުކުރުމަށް ހުށަހަޅާފައިވާ މަޝްރޫޢާއި ގުޅިގެން ތިމާވެއްޓަށް ކުރާނެ އަސަރު ވަޒަންކުރުމުގެ ގޮތުން ކުރެވިފައިވާ ދިރާސާއެކެވެ. މި މަޝްރޫޢުގެ ޕްރޮޕޯނަންޓަކީ މ. މުލަކު ކައުންސިލް އެވެ. މި މަޝްރޫޢުގެ ކޮންސަލްޓަންޓަކީ ސާސީ ޕްރައިވެޓް ލިމިޓެޑްއެވެ. މި ރިޕޯޓުގެ މައިގަނޑު ބޭނުމަކީ މަޝްރޫޢު ހިންގުމަށްޓަކައި ތިމާވެށީގެ ހުއްދަ ހޯދުމަށް ބޭނުންވާ މައުލޫމާތު ހުށަހަޅާ އެންވަޔަރަމަންޓް ޕްރޮޓެކްޝަން އެޖެންސީއަށް ހުށަހެޅުމެވެ.

1. މި މަޝްރޫޢުގެ ތެރޭގައި 112 މީޓަރު ދިގު، 64 މީޓަރު ފުޅާ ފުޓްބޯޅަ ދަނޑެއް ގާއިމުކުރުމާއި، 55 މީޓަރު ދިގު، 50 މީޓަރު ފުޅާ ސަރަހައްދެއްގައި ރައްޔިތުން ދަތުރުކުރުމަށް އުޅޭން ބަނދަރު ގާއިމުކުރުން، އެކަމާ ގުޅުންހުރި ވަސީލަތްތައް ގާއިމުކުރުން ހިމެނެއެވެ. މި މަސައްކަތްތަކަށް ބޭނުންވާ ރަހުބާއި އެންމެ ރައްޓެހި ގޮތަކަށް ކުރިއަށް ގެންދިއުން ގޮތްތައް އަލަށް ރާވާ، އެންމެ ރަނގަޅު ގޮތް ކަނޑައަޅައި ތަރައްޤީކުރެވޭނެ މާ މަސައްކަތްތަކުގެ ތެރޭގައި ހިމެނެއެވެ. އަދި މަޝްރޫޢަށް މި މަޝްރޫޢުގެ ސަބަބުން ކުރާނެ ނޭދެވޭ އަސަރުތައް ކުޑަކުރުމަށް އަޅަންޖެހޭ ފިޔަވަޅުތައް ބަޔާންކުރެވިފައި ހިމެނެއެވެ.

2. މާލެއިން ދިހަ 10 ހަތަރު ދުވަހުގެ ތެރޭގައި ރަށުގެ ޢާބާދީ އިތުރުވެ، 1951 ވަނަ މީލާދީ ދުވަހު ދިރިއުޅުން އެބަޖެހޭނެއެވެ. ރަށުގައި ކުޑަ މައިގަނޑު އިޤްތިޞާދީ މަސައްކަތަކީ މަސްވެރިކަމެވެ. އަދި ރަށުގެ ބިމަ އަދަދުއްގެ ޖާގަހުން މުމަސައްކަތްގައި ސާމިލުވެއެވެ. ރަށުގެ ބިމަ ޖާގަހުންނަކީ ފުޓްބޯޅަ ކުޅޭ ޖާގަހުންނެވެ. އެހެންކަމުން މިފަދަ ރަށުގެ އެއް ފުޓްބޯޅަ ދަނޑުގައި ހުރިހާ ޖާގަހުންނަކީ ފުޓްބޯޅަ ކުޅުމުގެ ފުރުޞަތު ނުލިބުން ވަނީ އިޖުތިމާޢީ މައްސަލައަކަށް ވެގެން ގޮސްފައެވެ. އެހެންކަމުން، ރަށުގެ އިތުރުމި އަލަށްގައި އައު ފުޓްބޯޅަ ދަނޑެއް އެޅުން ވަނީ މުހިއްމުކަމަކަށް ވެފައެވެ. ރަށުގެ ރައްޔިތުން ދަތުރު ގޮސް އުޅުން ސަރަހައްދު ފުރިހަމަ ފަސޭހަތަކާއެކު ގާއިމުކަން ދިނުމަށް ސަރުކާރުގެ ވައުދުކާލެވެ. މި ދެ މަސައްކަތަށް ރަށުގެ ރައްޔިތުންނަށް އިޤްތިޞާދީ އަދި އިޖުތިމާޢީ އެތަކެއް ފައިދާތަކެއް ކުރާނެ މަސައްކަތްތަކެވެ. އަދި މިކަމާ ގުޅޭގޮތުން ރައްޔިތުންގެ ހިއްސާ ހޯދުމަށް ބާއްވާ މަޝްވަރާ ބައްދަލުވުން ތަކުގައި މި ދެ މަޝްރޫޢު އަށް މިވަގުތު ރަނގަޅު ތާއީދު ލިބިފައިވާ ދެ މަޝްރޫޢު ކަމަށް ހުރި ބައިވެރިންގެ ވަނީ އިއްތިފާޤުވެފައެވެ.

3. މި މަޝްރޫޢު ހިންގުމަށް ހުށަހަޅާފައިވާ މާހައުލުގެ ދިރުންތަކާ ގުޅޭ ދިރާސާތައް ކުރުމުގެ، މި މަސައްކަތުގެ ސަބަބުން މާހައުލުގެ ދިރުންތަކަށް ކުރާނެ ނޭދެވޭ އަސަރުތަކުގެ މައްޗަށް ވެސް މި ރިޕޯޓުގައި އަލިއަޅުވާލާފައިވެއެވެ. ގަސްގަހާގެހި ބާރުގަދަ ކުރުމަށް ދިރާސާއިން ހޯދުނު ގަސްތުވެރިން ވިސަރަހައްދުގައި ހުރި އާންމު ރަށްޖަހާގެ ވަތަކަށްގައި ހުރި ގަސްތަކުގެ ބާވަތްތައް ކަނޑައެޅި. އަދި ވަކިން ހާއްސަ ، ދުވަސްވީ އެއްވެސް ގަހެއް ނެތްކަމެވެ. ފުޓްބޯޅަ ދަނޑު އެޅުމަށް ހުށަހަޅާފައިވާ ސަރަހައްދު ކަނޑައެޅުމަށް 52،573.48 އަކަ މީޓަރުގެ ޖާގަ ބޭނުން ވެއެވެ. މި ގަސްބިމުގެ ދިރާސާ ކުރުމުގެ، އޭގެ ތަފްސީލު މި ރިޕޯޓުގައި ހިމެނިފައި ވާނެއެވެ.

4. މި ރިޕޯޓުގައި މި މަޝްރޫޢު ކުރިއަށް ގެންދިއުމަށް އިތުރު ގޮތްތައް އަޅާލައި، އެންމެ ރައްކާތެރި ފޮނުވާލެވޭ ގޮތްތައް ހުށަހަޅާފައިވެއެވެ. އެގޮތުގައި މި މަޝްރޫޢު ކުރިއަށް ނުގެންދިއުމުގެ ފައިދާ އާއި ގެއްލުން އަޅާކިޔާލާފައި ވާނެއެވެ. އަދި މި މަޝްރޫޢު ރަށުގެ އެހެން ސަރަހައްދެއްގައި ކުރިއަށް ގެންދިއުމުގެ ފައިދާ އާއި ގެއްލުމުގެ މައްޗަށްވެސް އަލިއަޅުވާލާފައި ވާނެއެވެ. އެގޮތުން އެހެން ސަރަހައްދެއްގައި މަޝްރޫޢު ކުރިއަށް ގެންދާނަމަ، ރަށުގެ ތަރައްޤީއަށް ރާވާފައިވާ އެހެނިހެން މަޝްރޫޢުތަކަށް ބުރަޔަށްބާރު ވެސް ފޯރާނެކަމަށް ފާހަގަކޮށްފައެވެ.

5. މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެއްޓަށް އެންމެ ބޮޑު ނޭދެވޭ އަސަރެއް ކުރާނީ ފުޓްބޯޅަ ދަނޑު ގާއިމުކުރުމަށް ބިން ސާފުކުރުމުގެ ސަބަބުންނެވެ. މިކަމުގެ ސަބަބުން އެ ސަރަހައްދުގެ ދިރުންތަކަށް ނޭދެވޭ އަސަރު ކުރާނެއެވެ. ތިމާވެއްޓަށް ކުރާ ނޭދެވޭ އަސަރުތައް ކުޑަކުރުމަށް މި ރިޕޯޓުގައި ފާހަގަކޮށްފައިވާ ފިޔަވަޅުތައް އަޅައިގެން މަސައްކަތް ކުރިއަށް

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8 Non-technical Summery

The project is proposed by the council of *M. Mulaku*. Acting on behalf of the government of Maldives. The contractor assigned for the project is SASe. Prv. Ltd

1. The purpose of this EIA is to critically analyse and assess the potential environmental impacts associated with the proposed development of a water sports area (approximately 50m X 55m.) and football ground (approximately 64 X 112 m) in the island of *M.Mulah* and expose the solutions and preferred alternatives as well as mitigation measures to minimize any negative impacts whilst trying to derive the maximum positive impacts from the project;

2. The community has had a steady growth in population in the past decades and has a resident population of 1951 individuals. The island's main economic activity is fishing and sustains a fair portion of the youth base in the island. The demand for a football ground is proposed to accommodate the youth base that shares the existing sports arenas in the island. it was specifically proposed to set up a football ground on the eastern side of the island so as to bring a development to the side that lacked any. The water sports area was a governmental promise and the council as the proponent wishes to implement this as this is beneficial for the locals; socially and economically. During the stakeholder's consultation it was noted that the locals were in need of the developments identified.

3. A baseline of existing environment was studied which falls under the proposed development area as it is anticipated to impact negatively on the direct footprint. The terrestrial survey shows that the plants in the area are typical of most of the tropical low laying islands with five distinct levels of vegetation starting from the forest juveniles on the forest floor, to the forest shrubbery, followed by the under story, the majority reaching the canopy, and few reaching the emergent layer. The majority of the plots were dominated by *Cocos nucifera I* of varying sizes with other species of plants.

   The wetland area close to the developed football area was also studied and a baseline recorded. The area too was typical of a tropical wetland with wet footprint of approximately 52,573.48m^2.

4. Additionally, this study also involved identification of alternative options in place of the proposed development. The considered option was no project scenario which was less feasible. Also an alternative location was not recommended as it may disrupt the approved developments of the island.

5. Land clearance is the proposed action of the project that will have the most significant negative impact. However, in case of an accidental spillage and waste generation both actions can have a similar impact on the environment. Hence, strict mitigation must be followed throughout the development. Almost all positive impacts area socio-economic and that will benefit the locals for a long term.

9 Introduction

9.1 Background and context

This Environmental Impact Assessment (EIA) addresses the proposed development of a senior football ground, and water sports area at *M.Mulah*. The consultant on behalf of INSA PVT LTD had prepared this document in accordance with the EIA regulations (2012) and regulation on felling, uprooting and relocation of trees and palm trees of the Environment Protection Agency (EPA). The scope of the EIA is limited to infrastructure development, and land clearance provides a focused assessment of the proposed work on the existing environment of the area.

Studies conducted for the project include, on site surveys such as assessment of terrestrial habitat, terrestrial environmental conditions, ATS surveys and stakeholder consultation.

9.2 Purpose of the EIA

Given the potential environmental impacts associated with infrastructure development, and land clearance at terrestrial environments, the contractor on behalf of the proponent wishes the consultant to prepare and submit an EIA to the concerned government authorities to comply with the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012.
The objectives of the EIA is;

- To provide an assessment of the potential environmental effects of the proposed development and determine, the activities that are likely to have a significant effect on the environment and to propose ways and means of avoiding, mitigating, or compensating the predicted negative effects of the project,
- To provide the necessary information about the site of development and other factors surrounding the development to EPA,
- To assess the proposal and how it has been developed to achieve a satisfactory level of environmental performance in line with the EIA regulation.

9.3 Project Setting

The island of *M.Mulah.* an island located on the western ridge of *Mulaku atoll* is one of the inhibited islands near the capital *M.Mulhi* . The council of *M. Mulah* requested for public tenders for numerous developments on the island;

a) the development of a senior football ground (location 2.944796°, 73.587817°),
b) the development of a water sports area (location 2.949953°, 73.580913°).

Development ‘a’; proposed to accommodate for the increasing population of the island, to mitigate civil unrest and reduce disputes as currently the majority youth population of the island is to use one playground (location 2.947421°, 73.581986°).

Development ‘b’; proposed in accordance to the current government manifesto 2018 where, all islands shall have an area where the locals can exercise.

The council acting as the proponent proposes to complete the above stated components (a, and b), the consultant is working on behalf of the contractor.

9.4 Scope of the EIA

The scope of the EIA is based on the consultation held during the scoping meeting at EPA on 31st July 2019. After the meeting the drafted ToR was endorsed by the EPA which defined the scope of the EIA under the following;

i. Description of the project
ii. Description of the existing environment

iii. Study of applicable laws and regulations
iv. Potential impacts of the project
v. Alternatives of the project
vi. Mitigation and management
vii. Monitoring plan development
viii. Stakeholder's consultation.

A copy of the TOR and the attendance sheet is attached in Annex 1

The meeting was attended by

i. *Mulaku* atoll council
ii. *M.Mulah* council
iii. The contractor
iv. Environment ministry (MOE)
v. Environment protection agency (EPA)
vi. Maldives land survey authority (MLSA)
vii. Maldives national planning and infrastructure (MNPI)

9.5 Project Justification

The island is one of the most densely populated in the area. With a large population and a considerable youth base, the resident population faces social, health and economical challenges. The proposed works and the need for the development are stated above in heading Project Setting. The island has a main football field that is open for all and is often full hosting numerous teams almost daily. For the semiprofessional teams, a turf ground is present and is used. Hence, this would be the second senior football field developed in the island. The development of the second senior football ground was requested for the island council on numerous occasions and will bring in a relief to the demand on the current mini plot that has been the cause of numerous negative encounters and social unrest. The addition of a senior football ground will mitigate any negative clashes within the immensely competitive population with numerous semiprofessional teams. The senior football ground can be booked in advance and used accordingly. The development of the water sports area was a governmental promise, this is likely to provide the resident youth base an area to socialize, develop new skillsets and potentially expand into the tourism market. This is in line with the self-sufficiency policy of the current government.

9.6 Project boundary

The project boundary is limited to the area demarked on the map in *Figure 1* and *Figure 2*

9.7 Methodology of research.

The field studies have been undertaken using methods employed in EIA studies. The sites of terrestrial assessment are provided in the chart Figure 3.

Environmental impacts are predicted by using checklists and its significances are evaluated by the use of matrices. Expert judgment and professional opinion as well as review of relevant EIA studies have also been widely used throughout the impact assessment and evaluation process. These methods are described in detail at the relevant section of this EIA Report.

9.8 Study Methodology

The field studies have been undertaken using methods employed in EIA studies. The sites of marine assessment and water samples areas area provided in the chart Figure 3.

9.8.1 Existing conditions

The existing conditions were described initially by reviewing relevant available literature about the project, next the material was cross checked on site images using google Earth. This was followed by setting up a plan for consultation of the locals. The local consultation was executed

on site, during the consultation interested locals were invited for a survey field visit to further aid in identifying the problems and sharing the local hindrances; in this methodology the interested parties will point out on site, the significant points of interest for them. On site, every local hindrance relevant to the project was recorded and photographed and if relevant used in the report.

9.8.2 Description of the environment

The physical environment and the climate conditions were described using onsite data, and available data in literature. The climatic conditions were described by using data from the nearest weather stations. The natural and biological environment was surveyed, data collected, analyzed and reported. The socioeconomic data was collected and analyzed with the help of the council and reported. The following are the details of the methodology used.

9.8.2.1 Ecology

9.8.2.1.1 Terrestrial Survey

9.8.2.1.1.1 Footprint analysis

Vegetation survey was carried out on site and using ATS initially. Using Surfer, on the georeferenced ATS image, the coordinates of the footprint border were placed and the images was used to identify the type, number and general size of the trees in the plot.

9.8.2.1.1.1.1 Tree survey

After determining the border, an individual tree count of the plot was carried out. During the survey marks were noted to identify the owner of the plants During the survey girth of random plants were taken

9.8.2.1.1.2 Mangrove area analysis

9.8.2.1.1.2.1 Boundary classification

The boundary was marked using a hand held GPS tracking the path of the surveyor. To ensure the validity of the path the surveyor employed local guides to take them on three desired paths; the mangrove open area, mangrove wet zone, and possible footpath.

9.8.2.1.1.3 Tree Survey

Line transects which falls in the wet zone were taken throughout the footprint and georeferenced. The transects were recorded at every meter for a length of 20m. The transects recorded the type of tree that was encountered in the area. This was taken as a percentage to provide an overall image of the area.

9.8.2.1.1.4 Bird Survey

Bird Survey was carried out at three sites. Employing a point survey method, all birds encountered within a duration of 1 hour was verified and noted..

9.8.2.1.1.5 Kick sampling

Kick samples were taken from numerous water bodies to identify the general aquatic lifeforms in the water samples. Since there was no current or stream movement, the strainer was inserted a kick was generated to mimic a current and the kick up sediment captured and cleaned into a container. This process was repeated to collect the sample data. The samples were sealed to be analyzed.

9.8.2.1.1.6 Tally point count.

On site, whatever insect encountered was noted down and reported to the level of its order

9.8.2.1.2 Noise levels

To determine the general noise levels measurements were taken at set locations in replicates where work was going to be conducted and at locations where no work will be conducted and at residential areas.

9.8.2.1.2.1 Fresh water sampling

Fresh water samples were recorded at different locations and sent to MWSC for testing.

9.8.3 Stakeholder's consultation

All stakeholder consultation was conducted after an official request for the meeting. The consultation with the council was followed by the consultation with the locals. The stakeholder's consultation for the locals was sent to online platforms for those who could not attend the meeting. It was also requested for the stakeholder's to come forward after the meeting to point out the issues at hand.

The local consultation was also extended where the stakeholders could join the team in a field survey showing the different issues relevant to the project.

9.8.4 Impact prediction

Environmental impacts are predicted by using checklists and its significances are evaluated by the use of matrices. Expert judgment and professional opinion as well as review of relevant EIA studies have also been widely used throughout the impact assessment and evaluation process. These methods are described in detail at the relevant section of this EIA Report.

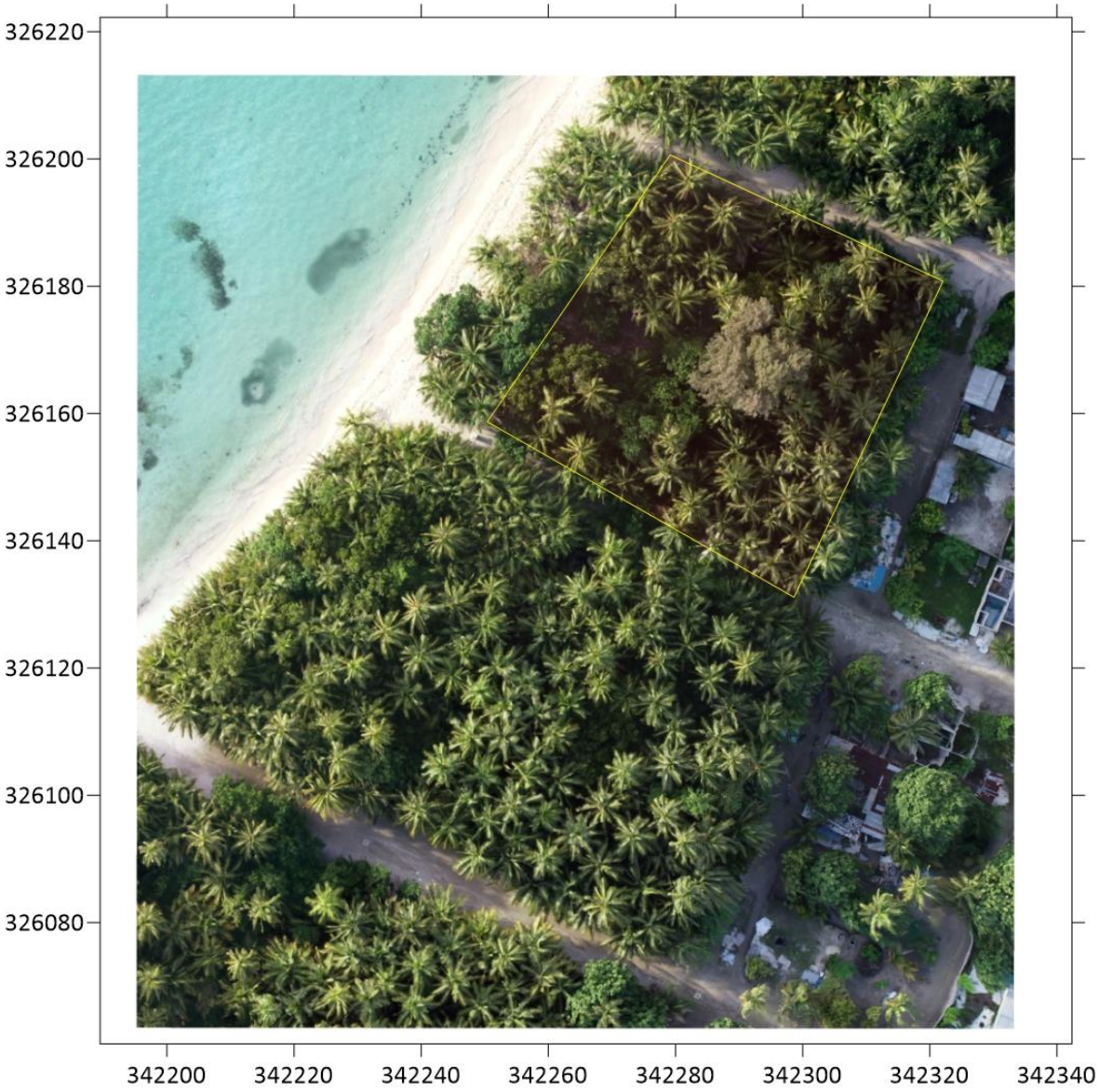
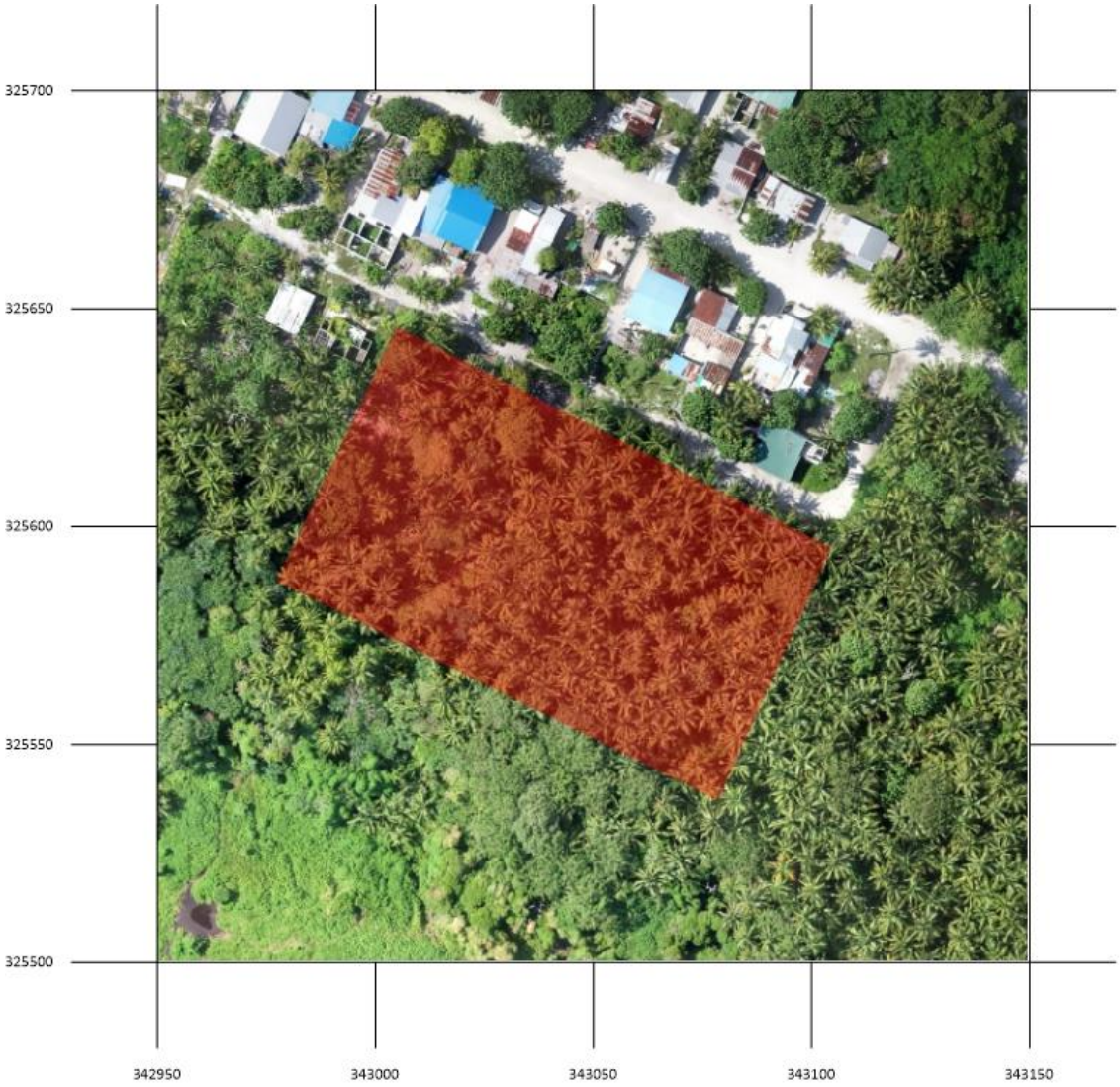


Figure 1 Project boundary and site water sports (reduced version)



Football area map

INSA Pvt Ltd.
Real World Solutions

INSA PVT LTD
H.Dhooriha,
5th FLoor,
Kalaafaanu Hingun,
Male', 20076, Maldives.

Figure 2 Project boundary and site football ground (reduced version)

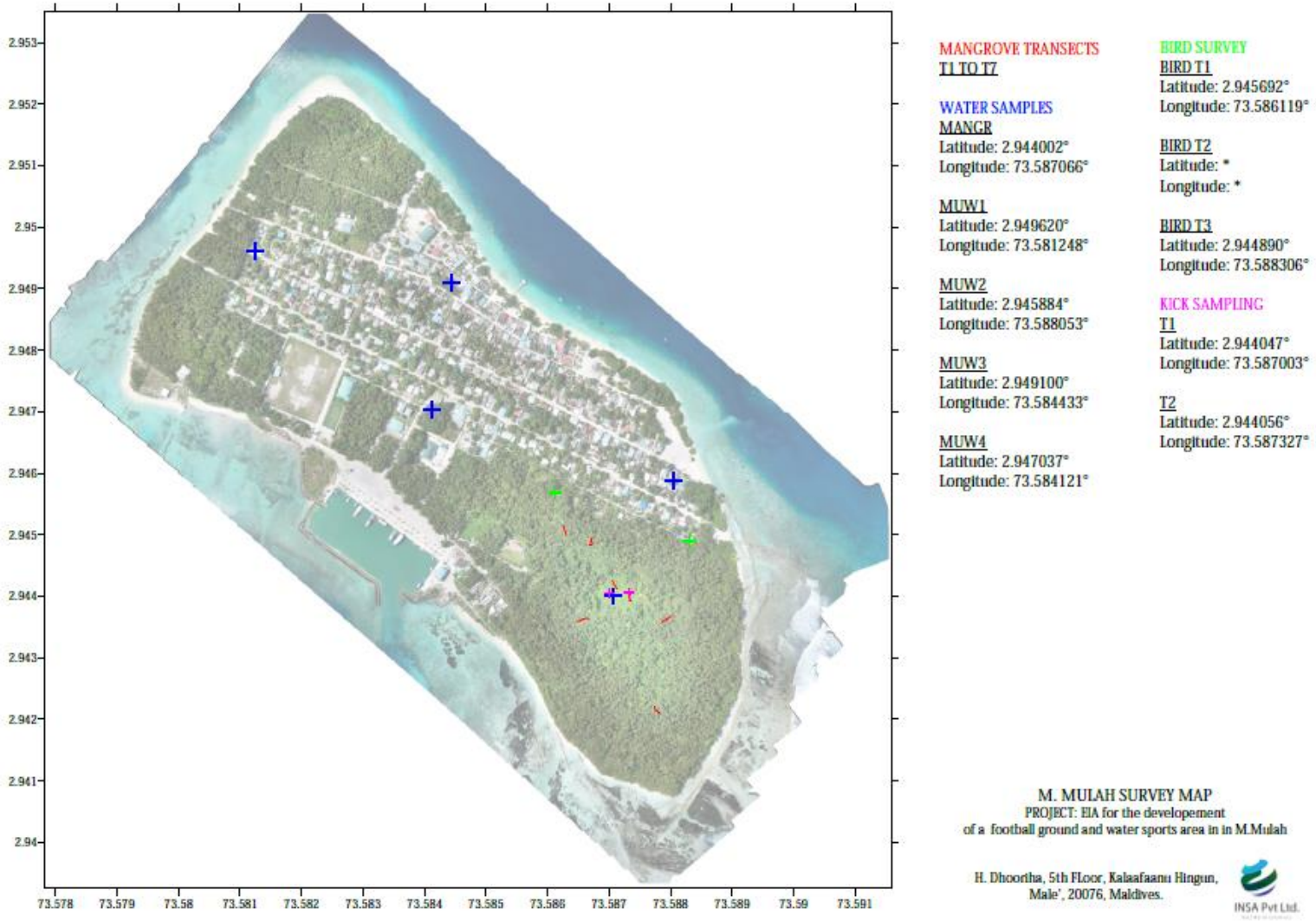


Figure 3 Survey sites at M. Mulak

10 Description of the proposed project

This section details the description of the proponent, project locations and boundary project outline and site plan, main developments of the project and the various engineering aspects of the project.

10.1 The proponent

The proponent for the development of a senior football ground, and water sports area is the council of *M. Mulaku*. Acting on behalf of the government of Maldives the proponent is the responsible body for the proposed works carried out in the island.

10.2 Project location and boundary

The island of *M.Mulah,* an island located on the western ridge of *Mulaku atoll* is one of the inhibited islands near the capital *M.Mulhi* . The project location is the island. The project is terrestrial and will not venture into the marine environment. The specific sites and coordinates of the proposed developments covered in this EIA are, the development of a senior football ground (location 2.944796°, 73.587817°), and the development of a water sports area (location 2.949953°, 73.580913°).

10.3 The main developments of the project

10.3.1 Football ground (location 2.944796°, 73.587817°)

The following specific details are the minimum specifications deemed mandatory as per the specifications of the proposed project. It must be noted that the specifications does not define any international standard. The minimum specifications does not define or mandate the contractor to comply, the specifications are a note to describe the project.

10.3.1.1 Field size and border limits

Approximately 64 X 112 m the senior football ground proposed is a typical grass turf that can hold two teams; 11 a side. The proposed play turf dimensions of the field defines the border limits. All the components of the field must fit into the specified dimensions. The touchline or sideline area must not exceed 64 X 112m. The center mark should be at 20m form either of the shorter sidelines.

10.3.1.2 Façade and demarcation

The proposed façade is a hollow-brick wall around the compound within the border limits. The wall should not exceed 1m above the ground. A 3m wire fencing mounted to the 1m wall can be added if the budget allows.

10.3.1.3 Goals and other stations.

The goal stand should be erect on the sideline of standard size and dimensions. No other stations or utilities are mandated on the ground.

10.3.1.4 Levelling

The entire 2100m^2 of the playground should be leveled to the island ground level and should not have depressions within. any pit holes in the area should be backfilled.

The FA Recommended Pitch Sizes													
		Recommended size without runoff (safety area around pitch)				Recommended size including runoff (safety area around pitch)				Recommended size of goal posts			
Age grouping	Type	Length x width (metres)		Length x width (yards)		Length x width (metres)		Length x width (yards)		Height x width (metres)		Height x width (ft)	
Mini-Soccer U7/U8	5 v 5	37	27	40	30	43	33	46	36	1.83	3.66	6	12
Mini-Soccer U9/U10	7 v 7	55	37	60	40	61	43	66	46	1.83	3.66	6	12
Youth U11/U12	9 v 9	73	46	80	50	79	52	86	56	2.13	4.88	7	16
Youth U13/U14	11 v 11	82	50	90	55	88	56	96	61	2.13	6.40	7	21
Youth U15/U16	11 v 11	91	55	100	60	97	61	106	66	2.44	7.32	8	24
Youth U17/U18	11 v 11	100	64	110	70	106	70	116	76	2.44	7.32	8	24
Over 18 (senior ages)	11 v 11	100	64	110	70	106	70	116	76	2.44	7.32	8	24

Figure 4 the dimensions of a senior football ground data (SAPCA, 2018)

10.3.2 Water sports area (location 2.949953°, 73.580913°).

The proposed water sports area will be developed behind the vegetation buffer zone. The zone will not be cleared or altered in any form. For further details of the vegetation, please refer to existing environment, ecology. The dimensions of the area are approximately 50m to 55m. The area of the footprint is approximately 2707m^2.

10.3.2.1 Beach hut

The proposed project develops beach benches that can hold water sports equipment for the area. The benches will also act as a front office that will act as the official's counter. Figure 7 shows a concept developed for the proponent. However, final drawing will be authorized prior to construction.

The beach huts will be prefabricated and put together on site. The site will have a minimum excavation as it is just in the periphery of the buffer zone. A pad footing foundation may be included if in the design.

Figure 5 Prefabricated hut (source: https://logcabins.co.uk/products/mr-hancocks-workshop/)

10.3.2.2 Sunbeds

The sunbeds will be released from the official's bench. The sunbeds can be moved out to the beach front.

10.3.2.3 Wash rooms and utilities.

The beach hut will be behind the riparian vegetation. The beach hut will be of dimensions. The 3 shower areas will be placed behind the beach hut covered by a fencing.

Figure 6 utility hu prefab (source: https://www.indiamart.com/proddetail/prefabricated-toilet-block-12599495112.html)

The utility services will be borrowed from the service provider accordingly. No excavation for foundation will take place unless for the pad footing.

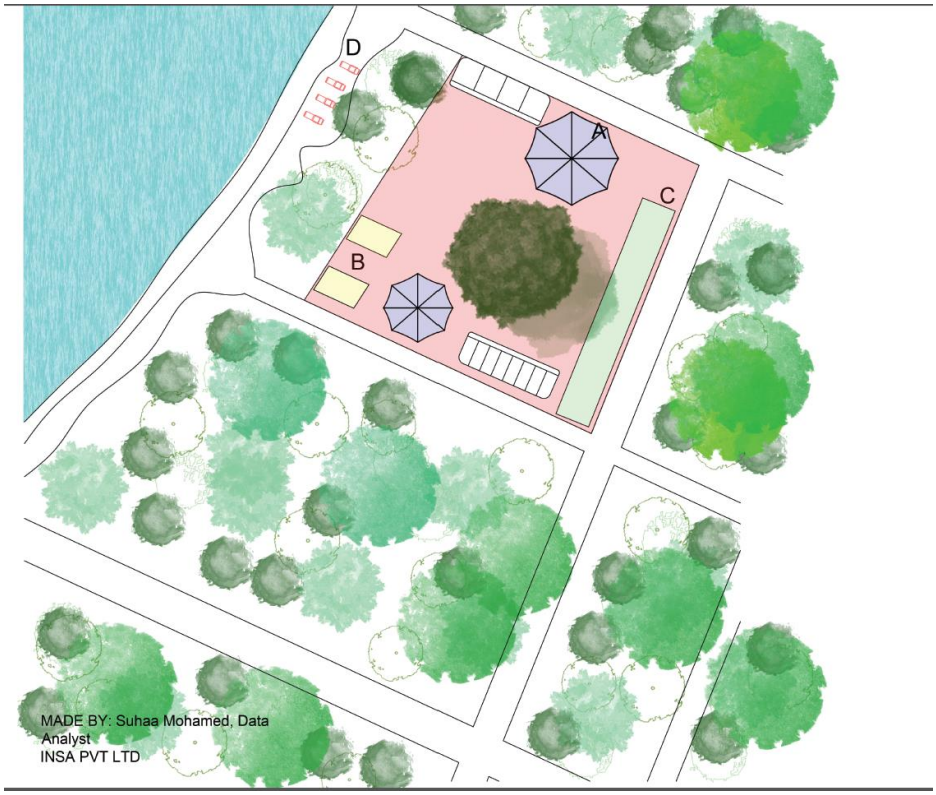


Figure 7 proposed tentative layout for the water sports area. a) beach hut (counter, storage unit, office etc), b) wash room changing room, c) commercial space(shops) and , d) sun beds etc.

10.4 Methodology and equipment

10.4.1 Machinery

The following equipment will be mobilized specifically for the project.

a. 20t hydraulic excavator for land clearance
b. Lorry and crane for removal of material
c. Truck for transport of material
d. Plate compactor
e. Concrete mixer and supply pump
f. Water pumps

10.4.2 Methodology

10.4.2.1 Land clearance.

All sites require land clearance as all the sites have dominant vegetation. The proposed land clearance will employ uprooting, and not felling. Hence the uprooting will be performed to relocate.

10.4.2.1.1 Preliminary setup.

The area necessary for clearance will be marked using GPS systems. The sites will be demarked and double checked using ATS imagery and compared with the masterplan.

10.4.2.1.2 Uprooting trees.

The undergrowth will be cleared primarily using a machete or a chainsaw. The juveniles that can be moved from hand will be relocated to desired sites. This will increase the visibility and allow easy access to the work site.

Pruning of the roots is requires prior to digging. Sufficient time should be given between preparation and final lifting for development of new roots capable of sustaining and continuing the growth of the transplanted tree. For mature trees, root pruning is usually required to be carried out at different stages with a minimum of 1 month allowed for root regeneration between cuts. The root system of a forest, woodland and open area differ greatly but is in all cases wide spread an attempt to lift such a tree without initial preparation of a root ball will result in much of the root system being left in the soil. After transplanting, the tree crown may then die back, or the tree may not be able to recover and will die eventually. In general, the root ball diameter to tree diameter ranges from 8:1 to 10:1 according to international standards, except for a palm which may require a smaller root ball. The root ball sizes should be of a diameter and depth to encompass enough of the root system as necessary for establishment. Normally the diameter of a root ball is larger than its depth which seldom exceeds 1m. There may be practical difficulties in forming a root ball of regular shape or recommended size due to site specific conditions. Consultation is required in such cases (The Government of the Hong Kong Special Administrative Region, 2014)

Crown pruning is limited to minimize the risk of hazard of falling objects. And transportation of diseases and pests. In case of palm trees removal of the coconuts and clearing of pests are required.

As per the guidelines on tree transplantation (2014), the preparation of the plant in the pruning stage goes together wilt trenching of the tree. A properly trenched tree requires sufficient time to adjust. Root cuts must be clean to avoid tearing or breaking the roots. All cut roots shall be trimmed cleanly back to the healthy tissues to reduce the split and torn roots. Sharp cut ends can

promote a flush of new fibrous roots, helping the trees recover faster from injuries. After setting up the root ball, it is necessary for the contractor to wrap the root ball using material such as *Hessian* or *Gunny* to remove keep the moisture inside and prevent damages and loss of sand during transportation. Once the root ball is wrapped, and chain locked, the trees are ready to be lifted and moved to the transportation vehicle. Lifting must be carried out at the base of the tree.

The hydraulic excavators will be used to lift out the tress. The excavator will be directly behind the trees to apply most leverage. Dead trees and stumps can be pulled out after clearing the stump. Care must be taken to limit the exercise to the desired work footprint. Only the marked trees and stumps will be cleared. If a private tree is harmed at any point of the time, they must be reported to the council and compensated.

10.4.2.1.3 Transportation of trees

Transportation of trees across the sea is with the risk of saltwater intrusion. Care must be taken to elevate the trees from the very base of the barges to ensure a buffer zone between the tree and the hull of the barge. Similar to the source site the recipient site must be well equipped for accepting the trees.

10.4.2.1.4 Planting of trees

The receptor site must not be highly compacted; as a mode of site preparation, the receptor site must be broken over and loosened for a sufficient radius past the planting pit. The planting pit must be provided with drainage to allow percolation of water. During pit preparation, the existing topsoil ploughed from digging should be stripped and put aside for reuse as much as possible and to avoid a distinct interface between the planting pit and the surrounding soil. The width and the final depth of a planting hole are determined by the depth and firmness of the root ball and other characteristics of the site. The soil directly beneath the root ball should be undistributed or prepared to prevent settling. In general, the depth of the planting hole shall not exceed the depth of the root ball and the sides of the planting hole should be scarified. In general, the planting hole width should follow international practice at a minimum of 1.5 times the diameter of the rootball to suit the location. After placing of the tree, preferably in the same orientation as the source site, backfill soil should be tamped firmly around the base to stabilize a tree, but the rest of the soil should be tamped only lightly, or left to settle on its own. Water should be added to the root ball and the backfill to bring the root ball to field capacity. Soaking will assist in settling the soil naturally (The Government of the Hong Kong Special Administrative Region, 2014).

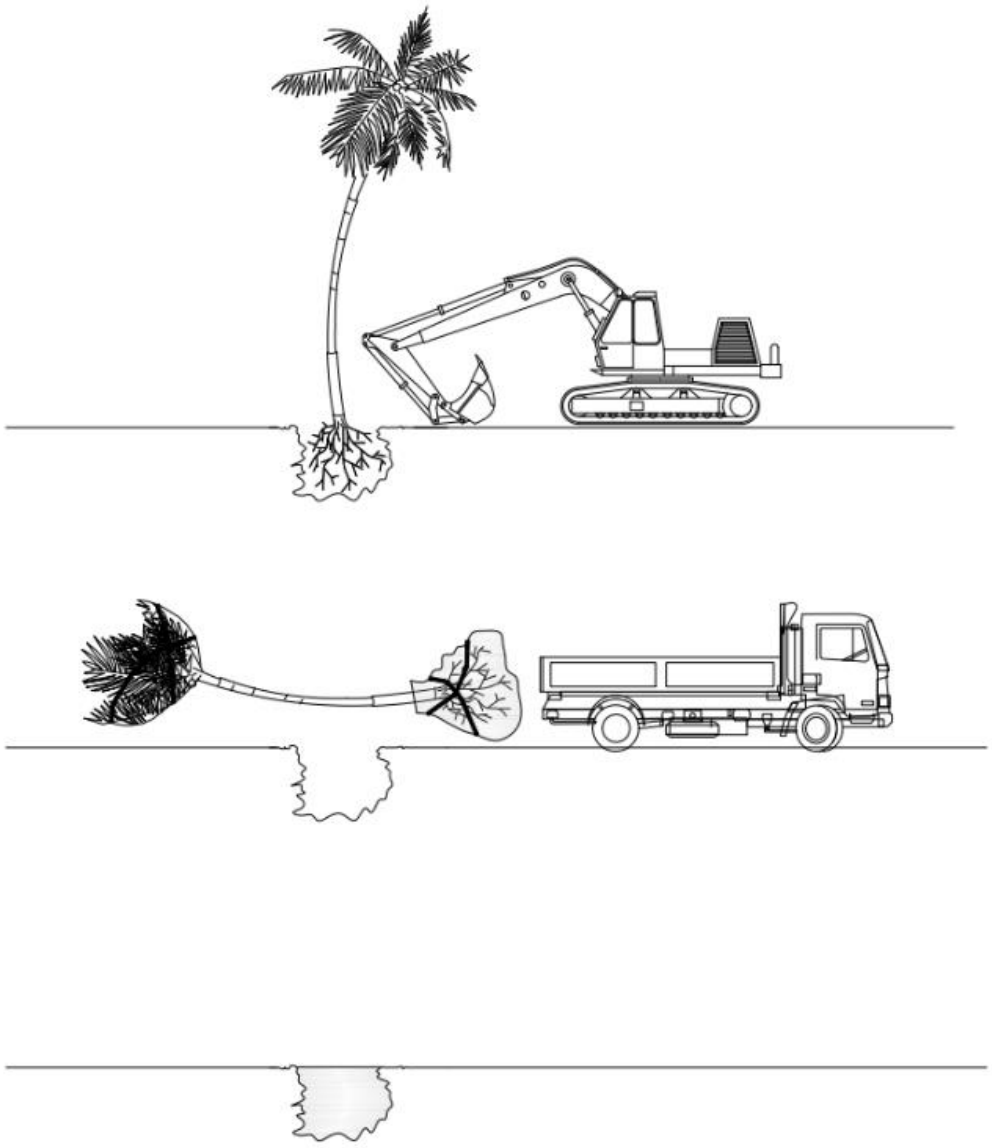


Figure 8 simplified diagrammatic representation of the procedure

10.4.2.1.5 The receptor sites

There are three receptor sites that the contractor proposes and is prepping for transplantation; Kunaaveshi (3.620309°, 73.369052°), Rah galhu huraa (4.611792°, 73.574699°), and islands at Finolhu falhu (4.121957°, 73.499523°). All sites are reclaimed islands which are now being developed as tourist resorts. The reclaimed islands are ideal for transplantation due to lack of vegetation on site. The transplantation will ensure the survival of the plants that in other circumstances be sold as local timber or burned on site.

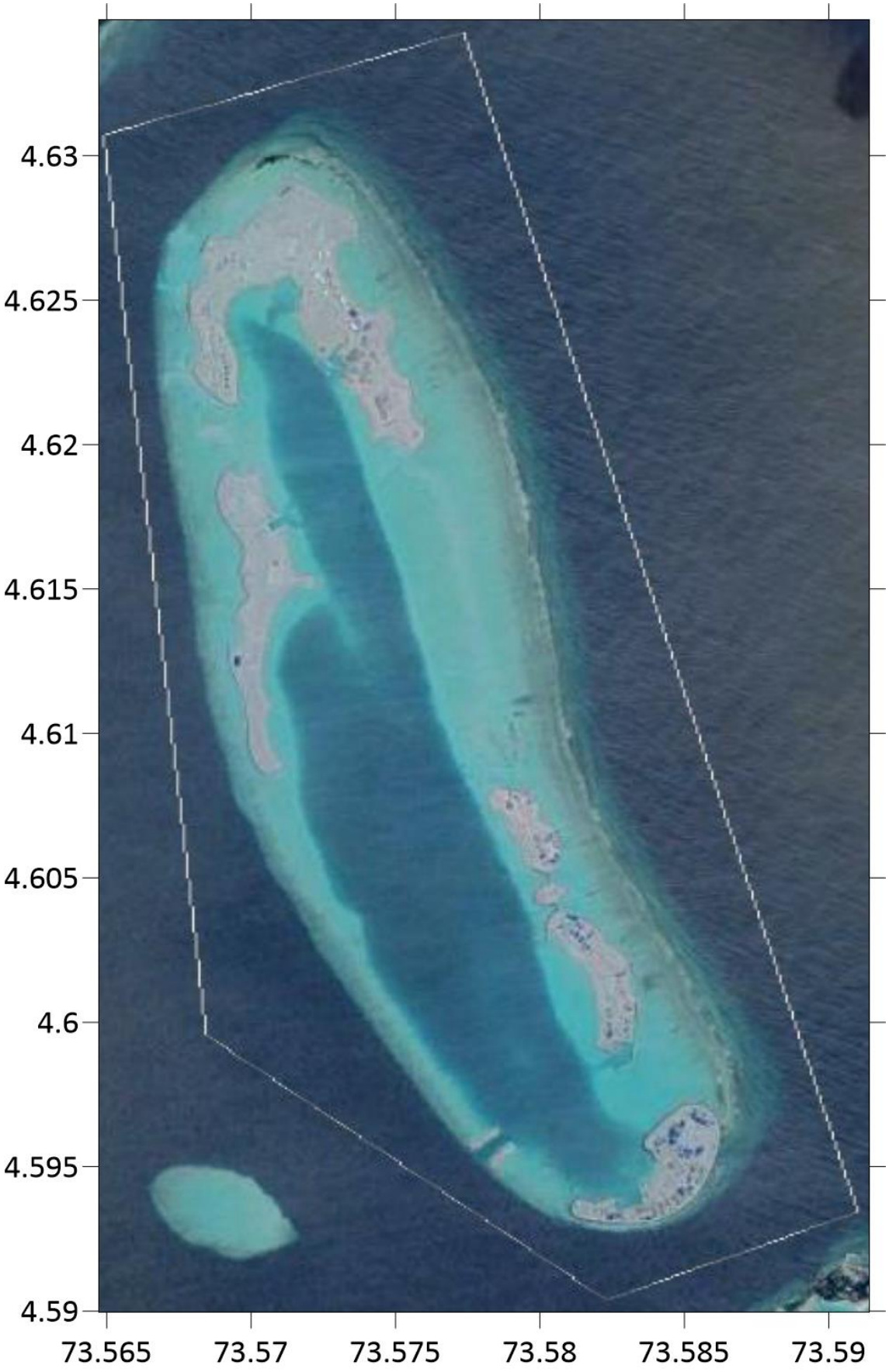


Figure 9 location of transplantation Rah falhu huraa

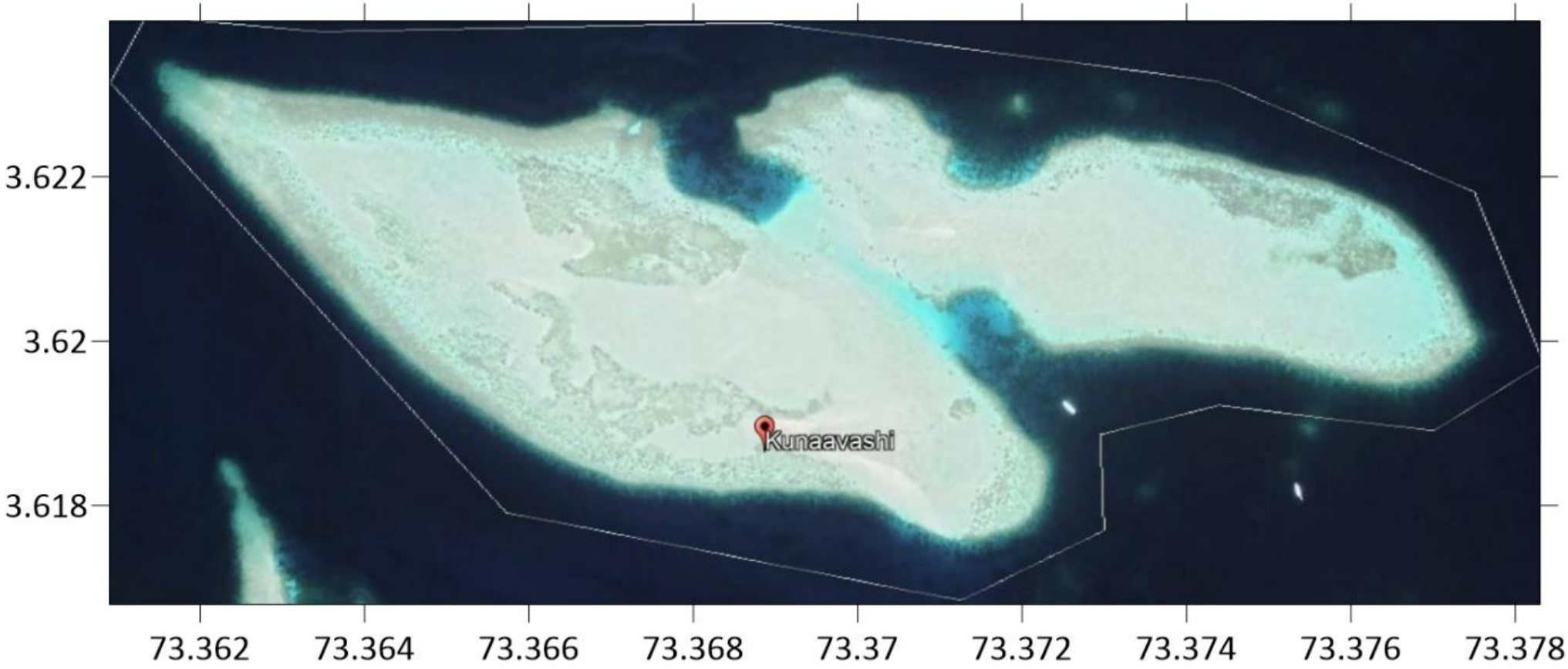


Figure 10 location of transplantation Kunaaveshi

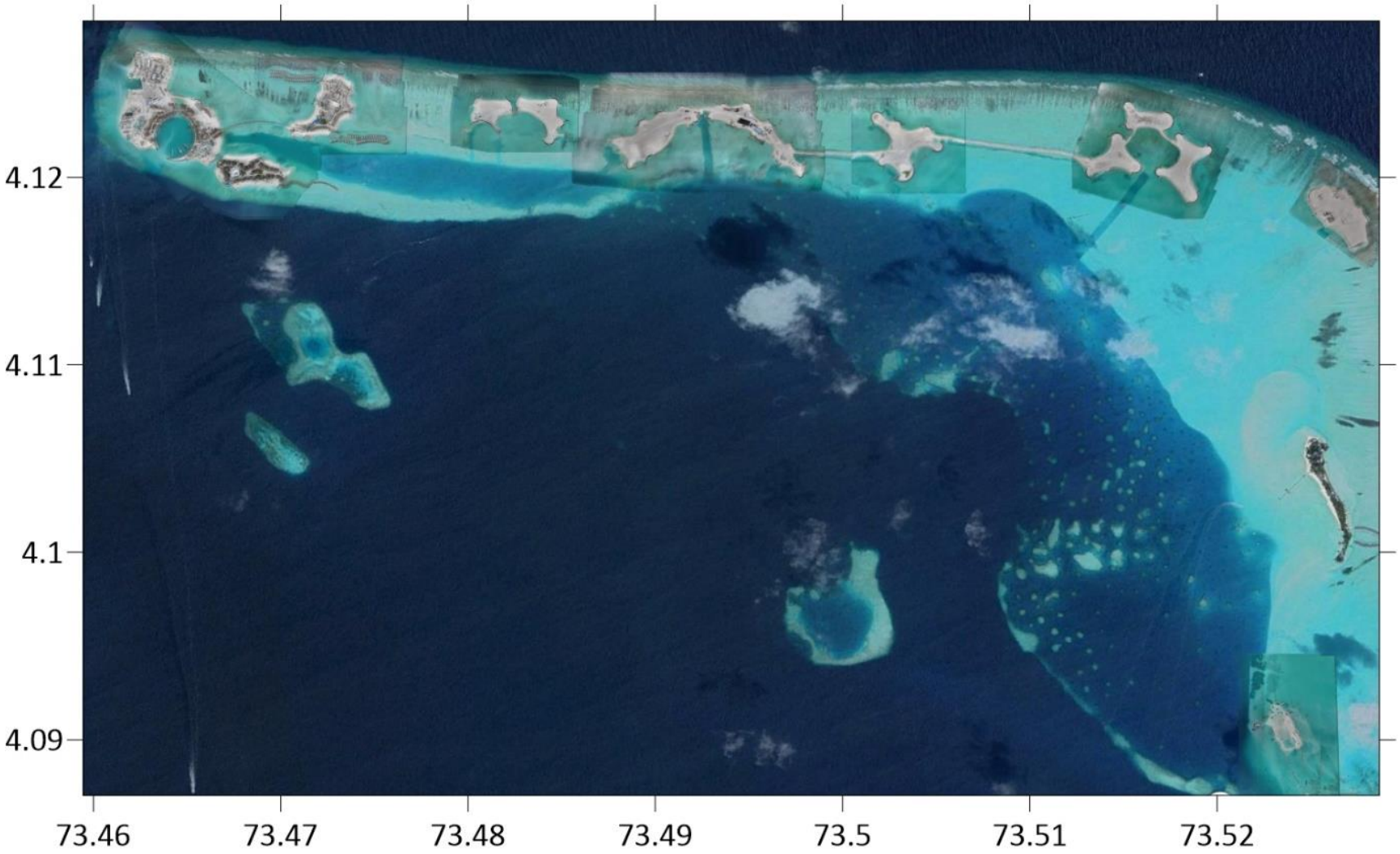


Figure 11 location of transplantation Finolhu falh

10.4.2.1.6 Procedural literature on uprooting and transplanting trees

Not a major bulk of literature is available on the mode of tree uprooting and clearing. The only specific study carried out for Maldives that can be accessed is by Ahmed Saleem (2018). Apart from the mentioned project most of the literature is either made for or describes the procedure in managed forests where the trees are far apart and wide with minimum undergrowth due to canopy cover and anthropological interference or for relocation and removal of trees in managed urban/ sub- urban and rural setups. The existing environment for the current project predominantly holds palm trees.

As per the Guidelines on Tree Transplanting (2014), there is no alternative to digging and uprooting if one is to consider transplantation. This procedure can remove as much as 90 percent of the absorbing roots which causes transplant shock to the tree. A transplanted tree should be able to re-establish sufficient roots to sustain itself. If the tree has poor health, the rates of survival and recovery will be low. To ensure reestablishment, trees need bigger root ball to encompass more roots to ensure adequate re-growth, as well as anchorage and stability. Transplanting may not be recommendable for situation where a reasonable root ball size cannot be achieved. Species that are normally difficult to transplant may benefit from larger root balls more than those of species that are easily moved (Watson & Himelick, 1997)

The purpose of the procedure is to minimise the loss of the trees. For the procedure to be effective, a translocation site must be available and ready. As per the works of Tomlinson (1990), juveniles and younger palms are easier to remove and transport as they have require a relatively small root ball during translocation due to their adventitious root system composed of numerous, simple, fibrous primary roots that arise independently and periodically from the root initiation zone (RIZ). It must also be noted that although it is easy to transport, many large palms do not survive transplanting or they require an inordinate length of time to reestablish. Bringing up the transplanting failure up to 30% of the bulk (Meerow, 1997). Quick transplantation and rapid regeneration of roots, minimum injury and desiccation of the trees during transit and handling, and maintaining sufficient soil moisture around the root balls after transplanting ensures successful reestablishment (Pittenger, Downer, & Hodel, 2005)

10.4.2.2 Fencing and façades

The football ground and the water sports area require fencing as per the proposal. As per general practice, the fencing and façade required for the football ground is a concrete wall around the parameter and a façade of reasonable size around it. As for the water sports area the fencing will be wooden; the liking of the council will be preferred.

10.5 Location and size of the area

The proposed work areas and locations are shown in the maps on *Figure 1* and Figure 2.The dimensions are provided under the main developments of the project.

10.6 Justification of the sites.

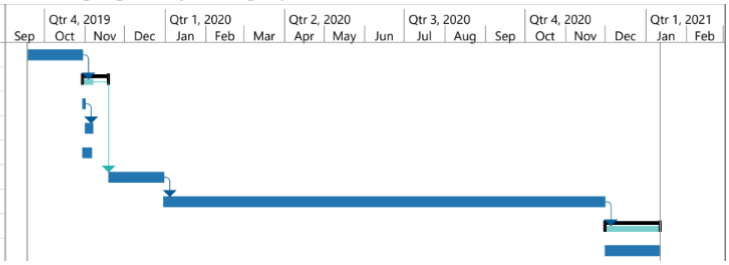
The sites of work are as per the Land Use Plan (LUP) used in the island. The LUP defines the sites and numerous proposed developments of the island. The waste management area is set by the ministry of environment; the resultant path is the path proposed. The for the newly proposed and existing residential area the proposed football field is in the most ideal location for easy access. Its location is ideal in this regard. The water sports area is the optimal location due to its proximity to the residential area. Located in the north western direction, it is preferred over the south western zone due to the presence of a beach area, and the existence of a main road to the area.

10.7 Duration of work

The proponent proposes the completion of the project within 8 months after approval of the EIA. One week is assigned for demarcation and 8 months are proposed for the development work. Demobilization is assumed to take 12 days.

Table 1 Duration proposed for the project activities

ID	Task Mode	Task Name	Duration
1		Approval of EIA	30 days
2		**Mobilization**	**14 days**
3		Accomodation	2 days
4		Logistics	4 days
5		Work camp setup	5 days
6		Demarcation	30 days
7		Development	240 days
8		**Demobalization**	**30 days**
9		Clearance	30 days



The schedule proposed in Table 1 is an optimistic proposal. If the development prolongs due to unforeseen hindrances the proponent should inform the required authorities.

10.8 Labor requirements and local labor availability

The labor requirements and the activities are largely dependent on the contractor and site availability. Typical development activity requires surveyors to set out and demark the limits of the project, specialist operators, for the excavators and cranes, and barges and dump lorries. With a team of 3 laborers for each of the equipment. Additional, 12 general laborers are required for the activities with an overall manager and 3 work supervisor.

10.9 Site demarcation and mobilization

The project site is in an inhibited island in a residential area. For the safety of the locals the sites should be demarked to maintain a safe distance from the work area. Similarly the island should contain the heavy machinery and temporary housing for the proposed project.

- it is the proponent's responsibility to inform the residents of the dangers of unauthorized access into the construction site during the project duration
- it is the contractor's responsibility to demark the area warning the residents of the informed danger and risks of unauthorized access to the project site.
- It is the contractor's responsibility to put up temporary boundary fences or facades to prevent unauthorized access to the project site.
- It is the contractor's responsibility to monitor the temporary boundary fences or facades for breaches.
- It is the proponents' responsibility to ensure the removal of the temporary boundary fences or facades before accepting the completion of the project from the contractor.

10.10 Housing of temporary labor

Temporary housing will be created in the work camp. The proponent is required to request for the work camp area prior to mobilization. The most optimal work camp area is on the harbor in the coordinates 2.945907° 73.582883 °.

Figure 12 The location of the work camp on the harbor

This location is ideal as it provides easy access to all the work locations of the island. The tentative components of the work camp are as given below;

A. Accommodation block
B. Accommodation block
C. General Block (dine, storage and entertainment)
D. Utility hut (wash and restrooms with laundry)
E. Water and electricity
F. Emergency assembly
G. Workshop
H. Parking area
I. Oil storage
J. Waste management area
K. Exit

Figure 13 Tentative components of the work area

10.11 Path of heavy machinery

Since the island is a residential island with roads typical of Maldivian islands, it is important for the contractor to set out the paths of machinery motion and movement to reduce the risk of hazard and unnecessary destruction and involuntary compaction of the roads. Figure 14 shows the best drive path for the heavy machinery. The roads are not the best for the desired work, since the south eastern side of the island floods. While moving material up and down extra care has to be taken to ensure the safety of the locals, their properties and the staff.

The path that leads to the senior football ground area is a packed residential zone, and the road floods during rainy season. although not ideal, the football ground is proposed at the current location and access is necessary. The road to the waste management area is direct hence is the least problematic path in the process. the water sports are is the most difficult area to reach with heavy machinery. The beach path should be avoided and saved as the last option.

Figure 14 Optimal drive path advised

10.12 Emergency plan in case of spills

The proponent must ensure that the contractor has an emergency plan, an emergency coordinator and the alternative emergency coordinator.

10.12.1 Overall emergency plan

The overall emergency plan must be site specific and drafted upon by the contractor and the proponent taking into account the features of the island. The emergency plan must be understood and followed by all staff. A typical emergency plan must include the following.

- The emergency plan should be followed and executed without delay in case of an emergency
- All staff must learn the basis of the emergency plan.
- Assembly points must be decided prior to mobilization
- Points of relief must be equipped with medical kits and fire safety kits
- Spill kits must be installed near the storage sites and in easily accessible areas.
- Alarms must be installed and tested
- Informed drills must be carried out at a schedule.
- All staff must be informed that they could call in an alarm.

- All emergency coordinators should be trained well with the alternative.
- In case of an emergency the point of reference must be the coordinator or the alternative.
- In case of an emergency, the emergency coordinator or the alternative must be informed primarily
- All staff must strictly follow the instructions of the emergency coordinator.
- Authorities must be informed by the coordinator or the alternative

The contractor is required to take the following measures in order to ensure minimal pollution in case of a spill.

- Use serviced machinery to reduce toxic emissions
- Service the machines in use during the work process.
- Keep spill kits on the island and portable spill kits on the machines
- Bund all necessary lubricants and oils stored on site.

10.13 Backfill material and source

The land clearance component of the activity will require backfill due to the scale of the project, the backfill material can be sourced from the numerous developments proposed for the island.

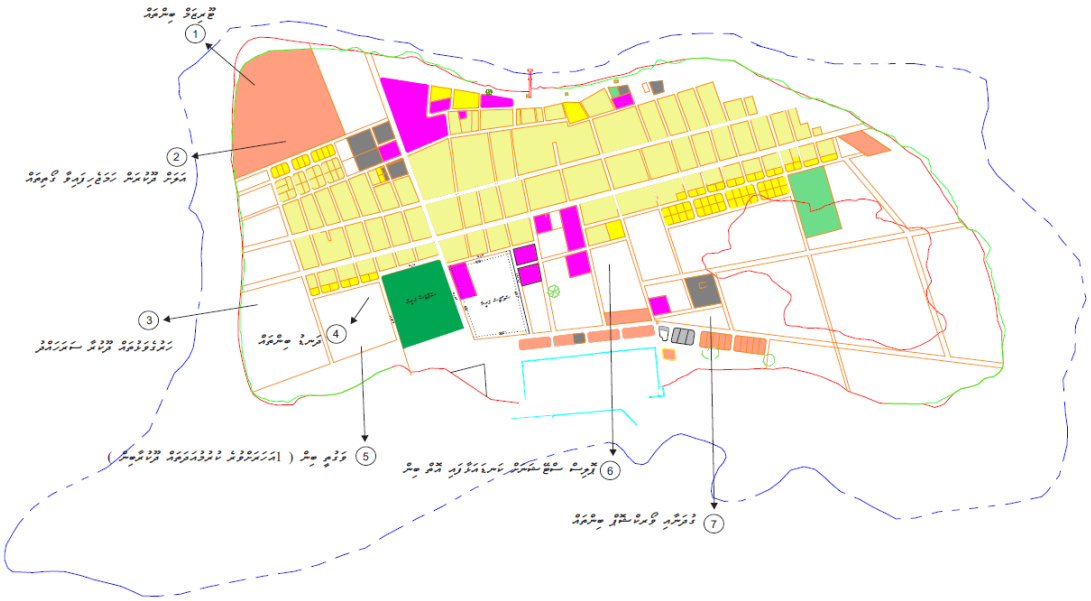


Figure 15 a section of the proposed developments for the island.

Land clearance will be carried out taking into account backfilling. Hence, only the root ball soli will be moved from the donor site. Therefore, backfilling can be sourced locally from the proposed developments.

10.14 Description of safety measures during construction.

The proposed project site is on an inhibited island. The proponent and the contractor are responsible for the safety of the locals, the staff, and visitors; health and safety rules must be followed strictly.

- The project site and the work area must be fenced.
- The proponent and the contractor will ensure that all the supervisors are trained and qualified to identify, report, response to, and mitigate any health code violation on site.

- The proponent, contractor and other supervisory bodies will ensure all the health and safety procedures are followed while in the project site.
- All the precautions and steps will be taken to ensure the safety of the employees. Safety gear will be worn all the time.
- The proponent must ensure that the contractor provides numerous first aid kits on site. This is of the uttermost importance as the island has a health center and the closet hospital is at best 5 minutes away in the atoll capital.
- The proponent must ensure that the contractor trains sufficient number of staffs in basic first aid drills both terrestrial and marine. Hence making these staff available throughout the project work hours while setting the duty roster.
- The proponent must ensure that the contractor reports all medical emergencies to the hospital.
- If the use of the equipment requires licenses or special permits, the contractor should ensure the staff are licensed.
- All tools and equipment will be handled by competent staff.
- All staff must be trained to follow the emergency plan
- Health checks and safety checks will be administered before commencement of work.
- All project activities will be carried out in the presence of a qualified supervisor.
- The staff will be trained in fire extinguishing drills and appropriate fire extinguishing equipment will be placed at easily accessible points.
- Flammable material if stored on site, will be stored at site appropriately.
- Any tools stored on site will be stored appropriately.
- Oils, grease and lubricants will be stored as specified above

10.15 Utilities

Due to the location of the project site and the scale of the project all utilities will be requested from the service provider.

10.16 Summary of Project Inputs and Outputs

The overall material inputs and the overall material outputs of the development are given in the Table 2 and Table 3 respectively.

Table 2: Major Project Inputs

Input resources	Source/ Type	Obtained by
Construction worker	A mix of local and foreign	Contractor's staff and procured through announcements, etc
Water supply during construction	A mix of bottled and filtered tap water (FENAKA outlet)	Purchased form local shops and by registering for a water line form the local utilities provider
Machinery	• 20t hydraulic excavator for land clearance • Lorry and crane for removal of material • Truck for transport of material • Plate compactor • Concrete mixer and supply pump • Water pumps	Contractor's machinery or locally available machinery for hire

Maintenance material	Various maintenance material and tools required for the project activities.	Contractor's own, purchased locally or imported.
Food and accommodation	Accommodation in the workers camp, and food through contractor's staff	Procured through announcements, etc
Firefighting gear	Fire extinguishers	Contractor's equipment
Fuel	All forms of fuel	Local suppliers
Telecommunication	Mobile phones, hand held radio and internet facilities	Contractor's equipment, personal, etc.
Food and beverage bottles	PET bottles, glass bottles, packaging, waste, plastic bags, and various frozen, packaged, and fresh food.	Contractor's equipment

Table 3: Major Project Outputs

Products and waste materials	**Anticipated quantities**	**Method of disposal**
Bio waste	Large quantities	Sent to use as agricultural fertilizers.
Construction waster	Small quantities	If plastic, fibre and metal collected and sent to the waste collection site.
Waste oil	Small quantities	Barrelled and sent to the waste collection site.
Hazardous waste material	Small quantities	Barrelled and sent to the waste collection site.
Noise	Only localised	Inevitable noise pollution of the use of heavy missionary
Food waste	Small quantities	Collected and sent to the waste collection site.
Plastic and packaging wastes	Small quantities	Collected and sent to the waste collection site.

10.17 Demobilisation

The actual demobilisation will be negotiated between the contractor and proponent. The consultant advises a phased-out demobilisation during the last phase of the project.

11 Description of the environment

11.1 Introduction

This section assembles, evaluates, and presents the environmental baseline relevant to the project. The section includes, detailed methodologies of the study with the findings. To describe the existing environment, the report sub divides environment to physical, biological, and social. Wherein, the existing physical environment geology and geomorphology, hydrography/hydrodynamics, ecology, socio-economic environment, and hazard vulnerability is further described.

11.2 Study area and Survey Locations

Details of the study area and survey locations are given in Project location and boundary. After analyzing the project area, some survey sites were pre-selected while others were selected upon site visit after consulting with the stakeholders and locals.

11.3 Methodology

The components of the existing environment were divided to climate, ecology and socio-economic environment. The baseline study was carried out as per the standard scientific methods. special attention was given to the marine and terrestrial environment of the project area, as these components are likely to have the most significant environmental impacts. The different methodologies used in assessing the existing environment are given below.

11.3.1 Physical Environment

The physical environment data was collected using the available literature, secondary data and information available and onsite recordings. As for the historical data, as Meemu atoll does not have a weather station on site or in atoll, the report depended largely on available secondary data.

11.3.2 Natural and Biological Environment

The geological data and the seasonal geological patterns were collected on site, and using secondary data available.

11.3.3 Socio-economic environment

The socioeconomic environment of the island and the nearby islands were collected using the available literature, secondary information and interviews.

11.4 Physical Environment

11.4.1 Climate

11.4.1.1 General Climate

A typical tropical monsoon climate is enjoyed throughout the year in Maldives. The south-west monsoon occurs between mid-May to November and the north-east occurs between January to March. The North-East monsoon is dryer than the South West Monsoon. The transition period of southwest monsoon occurs between March and April while that of northeast monsoon occurs from October to November (Table 4). The temperature ranges from 27 till 31°C daily, where the maximum mean dry temperature is 30.4°C and minimum mean dry temperature is 25.7°C. (Meteorology, 2006). Rainfall patterns in the Maldives is dictated by the Indian ocean Monsoons. The rainfall averages at 2,124 mm annually where the south receives more rain than the north.

Table 4 months and the seasons associated with them

Season	**Dhivehi name**	**Month**
NE-Monsoon	*Iruvai*	December
NE-Monsoon	*Iruvai*	January
NE-Monsoon	*Iruvai*	February
Transition period 1	*Hulhangu Halha*	March
Transition period 1	*Hulhangu Halha*	April
SW-Monsoon	*Hulhangu*	May

SW-Monsoon	*Hulhangu*	June
SW-Monsoon	*Hulhangu*	July
SW-Monsoon	*Hulhangu*	August
SW-Monsoon	*Hulhangu*	September
Transition period 2	*Iruvai Halha*	October
Transition period 2	*Iruvai Halha*	November

The project area *M.Mulah*, falls in the general climate as the rest of the Maldives with minute differences which will be discussed in this section.

11.4.1.2 Temperature

The general temperature of Maldives does not show large fluctuation when it come to the difference between day, night and seasons; due to the abovementioned monsoon climate and the tropical position of the chain of islands. Furthermore, the flat topography and a lack of high risen earth ensures a consistent temperature throughout.

The average maximum temperature from 1992 till 2017 ranged between 30.54 till 31.94°C. The average minimum temperature from the same timeline ranged from 24.86 till 26.08°C(*Figure 16*, *Figure 17*). The general annual temperature ranges approximately around 31°C during daytime to 26.4°C during night time in Maldives. The average maximum recorded temperature for the Maldives on 2018 is 31.2°C. and the average minimum recorded temperature for the Maldives on 2018 was 25.5°C. As always, average maximum and minimum temperature of 2018 shows an increase during the transition period to south west monsoon (Figure 18 and Figure 19). The daily mean temperature 2018 shown in Figure 20 shows the same rise in temperature while ranging between 28.13 and 29.69°C. The daily mean temperature form January 2019 till may shows the same general pattern with a slight increase ranging between 28.43 till 30.34°C During the sit visit, the temperature on site were between 30.0 to 30.8°C

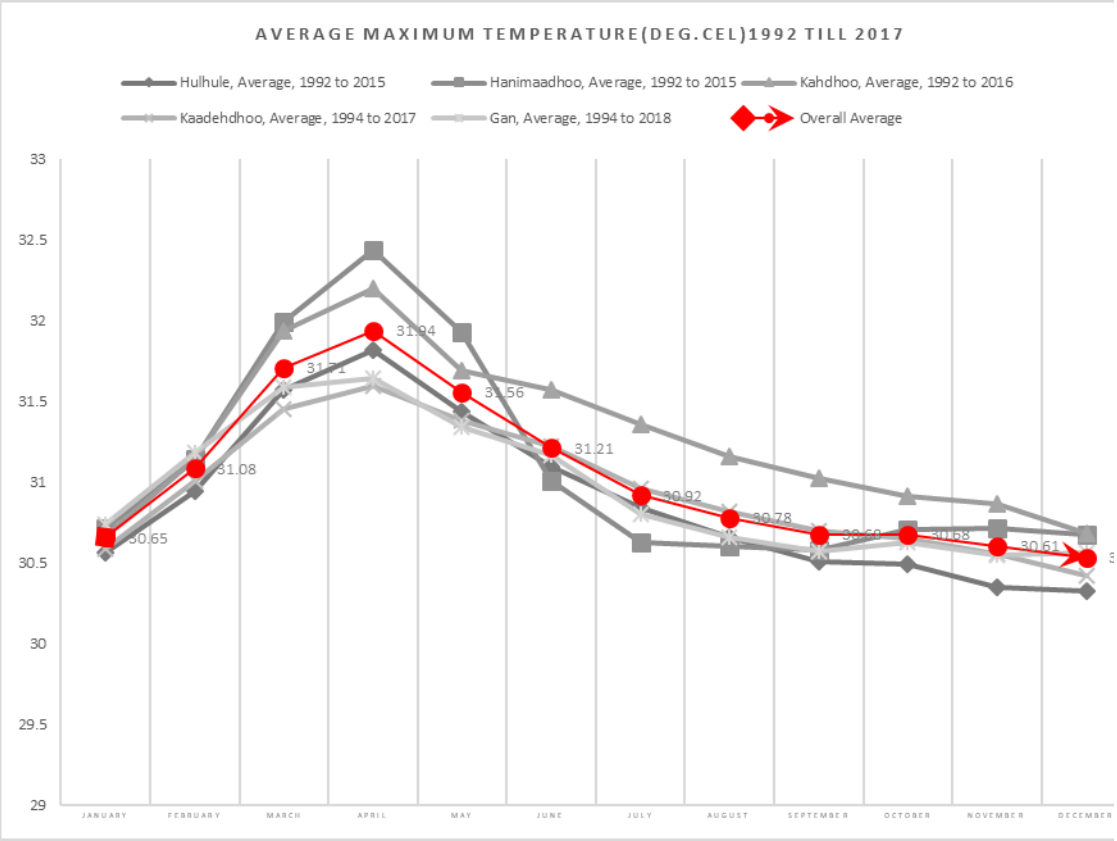


Figure 16 Average Max Temperature 2018 ((Maldives Meteorological Service, 2019)*)*

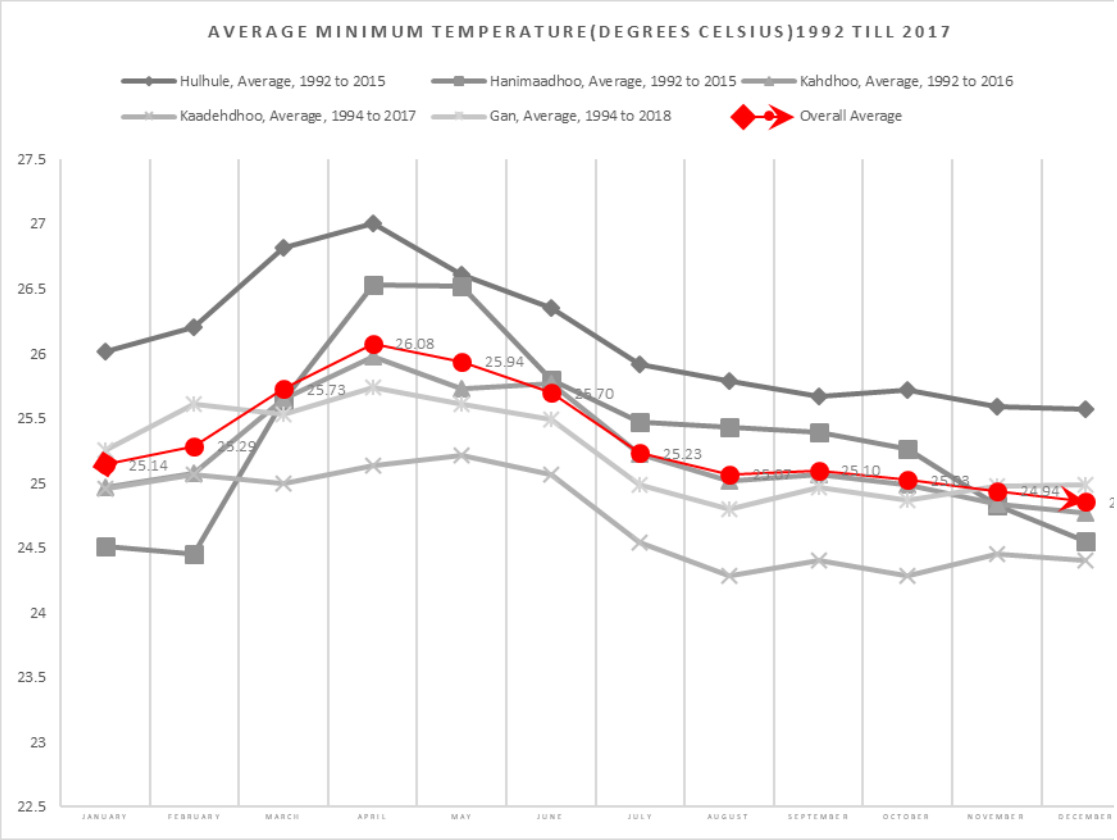
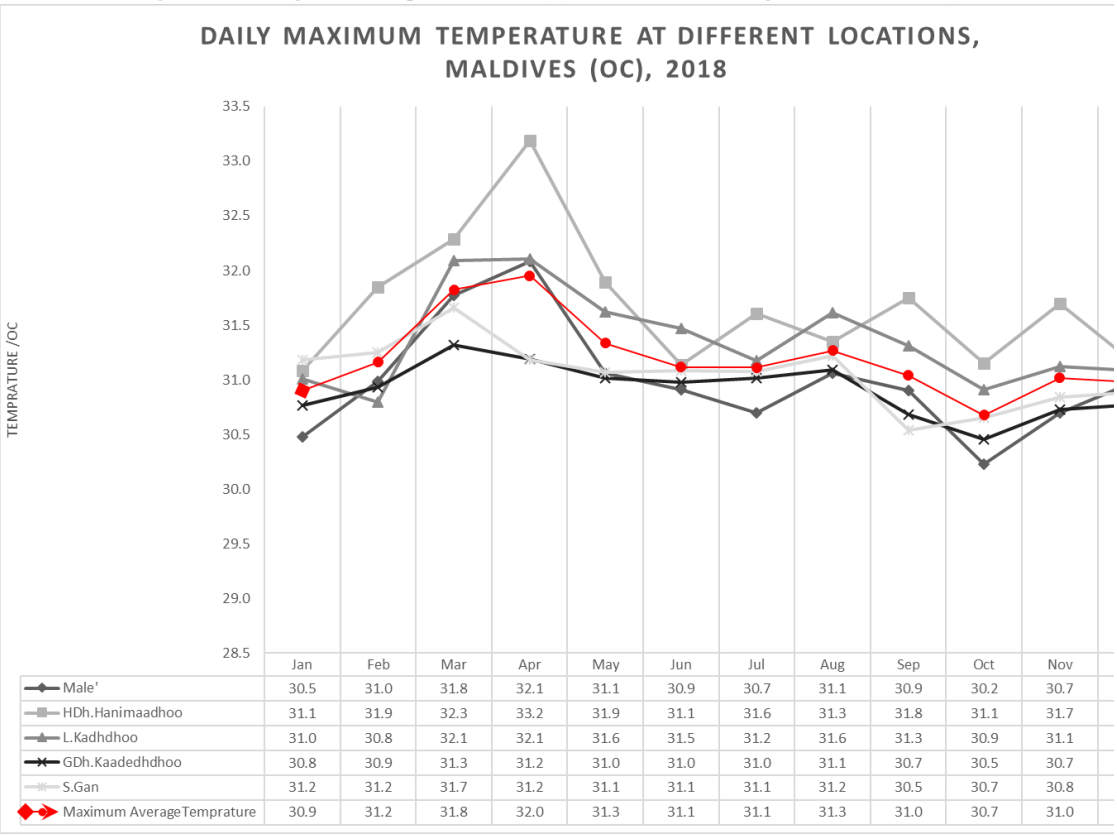
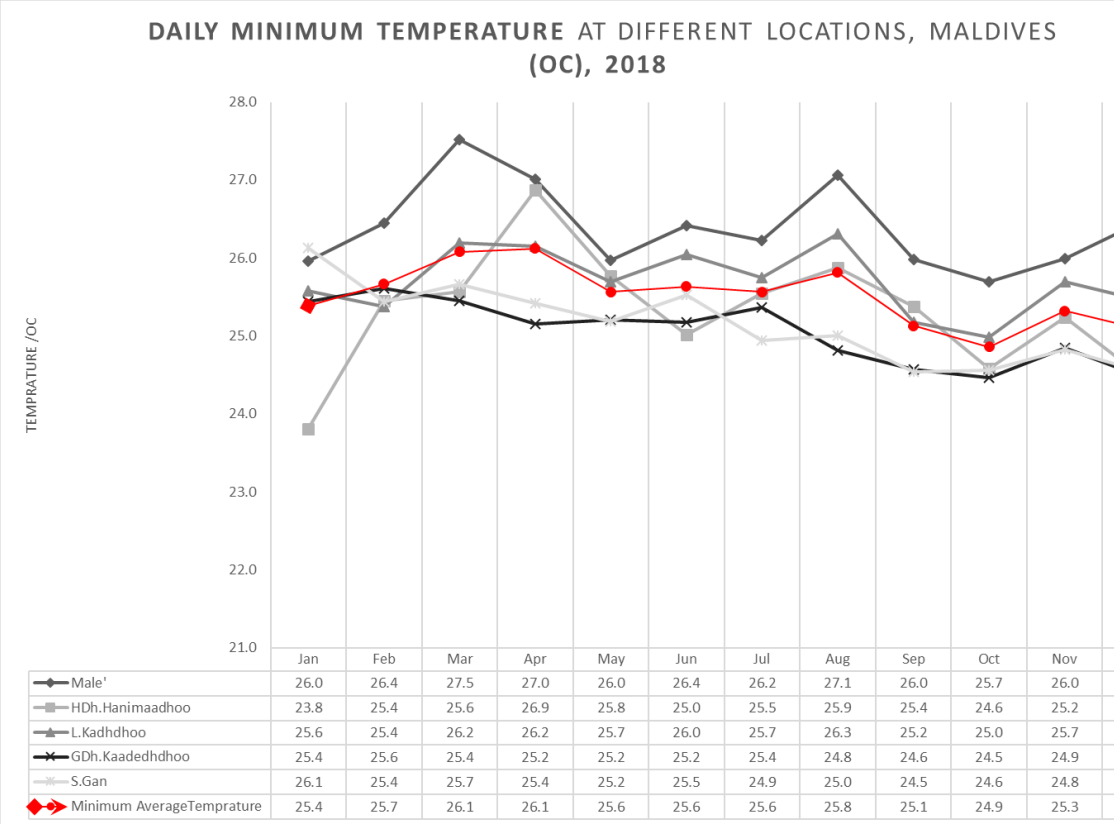


Figure 17 Average Min Temperature 2018((Maldives Meteorological Service, 2019)*)*



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Male'	30.5	31.0	31.8	32.1	31.1	30.9	30.7	31.1	30.9	30.2	30.7
HDh.Hanimaadhoo	31.1	31.9	32.3	33.2	31.9	31.1	31.6	31.3	31.8	31.1	31.7
L.Kadhdhoo	31.0	30.8	32.1	32.1	31.6	31.5	31.2	31.6	31.3	30.9	31.1
GDh.Kaadedhdhoo	30.8	30.9	31.3	31.2	31.0	31.0	31.0	31.1	30.7	30.5	30.7
S.Gan	31.2	31.2	31.7	31.2	31.1	31.1	31.1	31.2	30.5	30.7	30.8
Maximum AverageTemprature	30.9	31.2	31.8	32.0	31.3	31.1	31.1	31.3	31.0	30.7	31.0

Figure 18 Average Max Temperature 2018((National Bureau of Statitics , 2019)*)*



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Male'	26.0	26.4	27.5	27.0	26.0	26.4	26.2	27.1	26.0	25.7	26.0
HDh.Hanimaadhoo	23.8	25.4	25.6	26.9	25.8	25.0	25.5	25.9	25.4	24.6	25.2
L.Kadhdhoo	25.6	25.4	26.2	26.2	25.7	26.0	25.7	26.3	25.2	25.0	25.7
GDh.Kaadedhdhoo	25.4	25.6	25.4	25.2	25.2	25.2	25.4	24.8	24.6	24.5	24.9
S.Gan	26.1	25.4	25.7	25.4	25.2	25.5	24.9	25.0	24.5	24.6	24.8
Minimum AverageTemprature	25.4	25.7	26.1	26.1	25.6	25.6	25.6	25.8	25.1	24.9	25.3

Figure 19 Average Min Temperature 2018 ((National Bureau of Statitics , 2019))

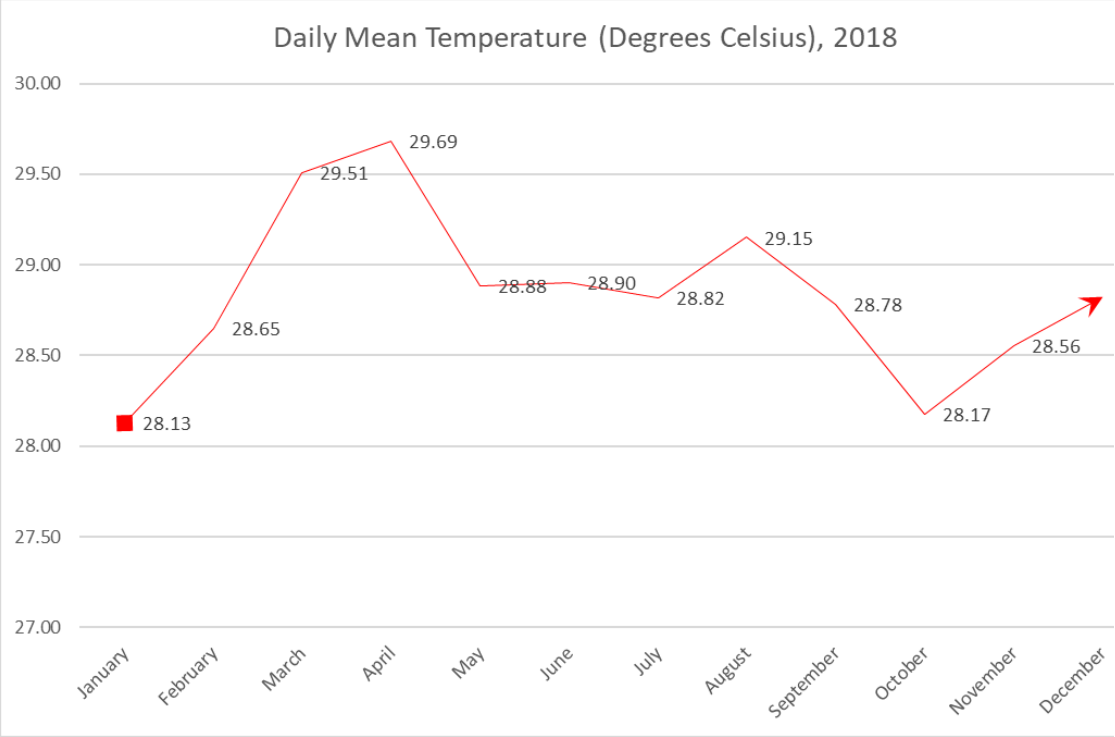


Figure 20 Daily mean temperature 2018 (Maldives Meteorological Service, 2019))

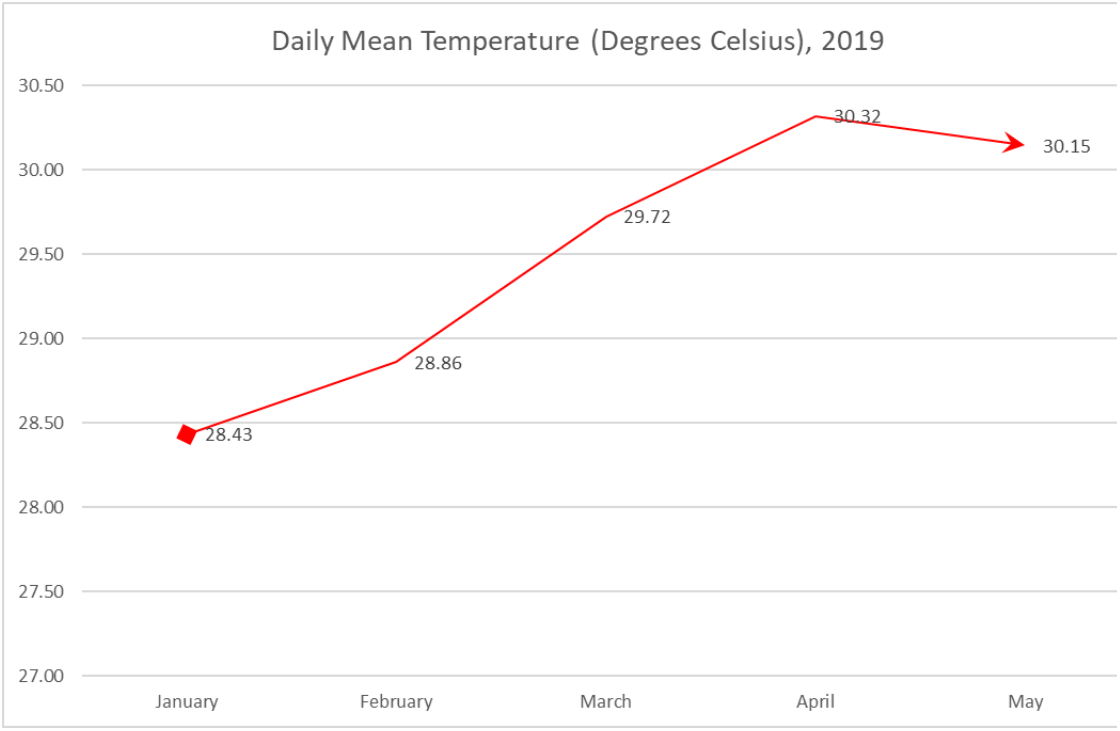


Figure 21Daily mean temperature 2019, Jan till May (Maldives Meteorological Service, 2019))

11.4.1.3 Rainfall

The rain ranges in different parts of the Maldives depending on the monsoonal cycles. The south west monsoon; wet season is from mid-May to November where rapid rain in large quantities are expected.

As per the National Bureau of Statitics, (Figure 22) on 2018, Laamu, Gaafu and Seenu had the more rain in comparison to the north. The average total rainfall throughout all the collection points in 2018 ranged between 38.1 to 367.9 mm. On 2019, the total rainfall in Male' ranged between 6.8mm to 171.8mm (*Figure 23*).

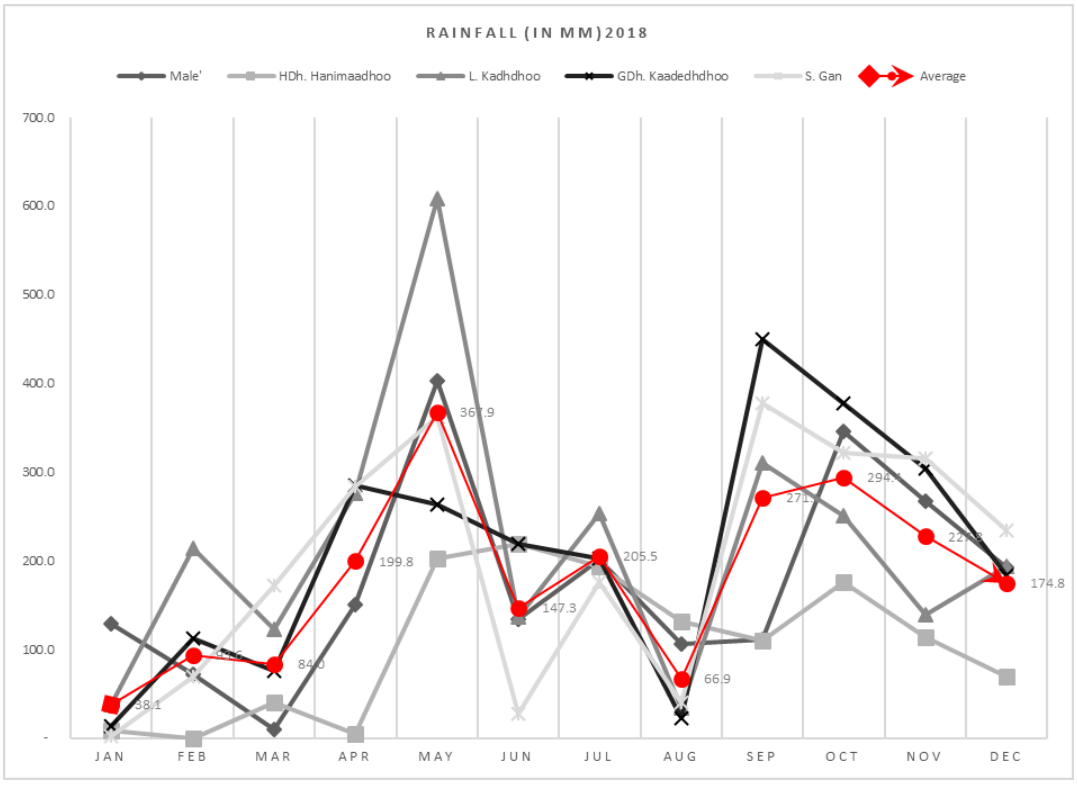


Figure 22 Average rainfall throughout 2018 from Hanimaadhoo till Gan, with overall average (National Bureau of Statitics , 2019))

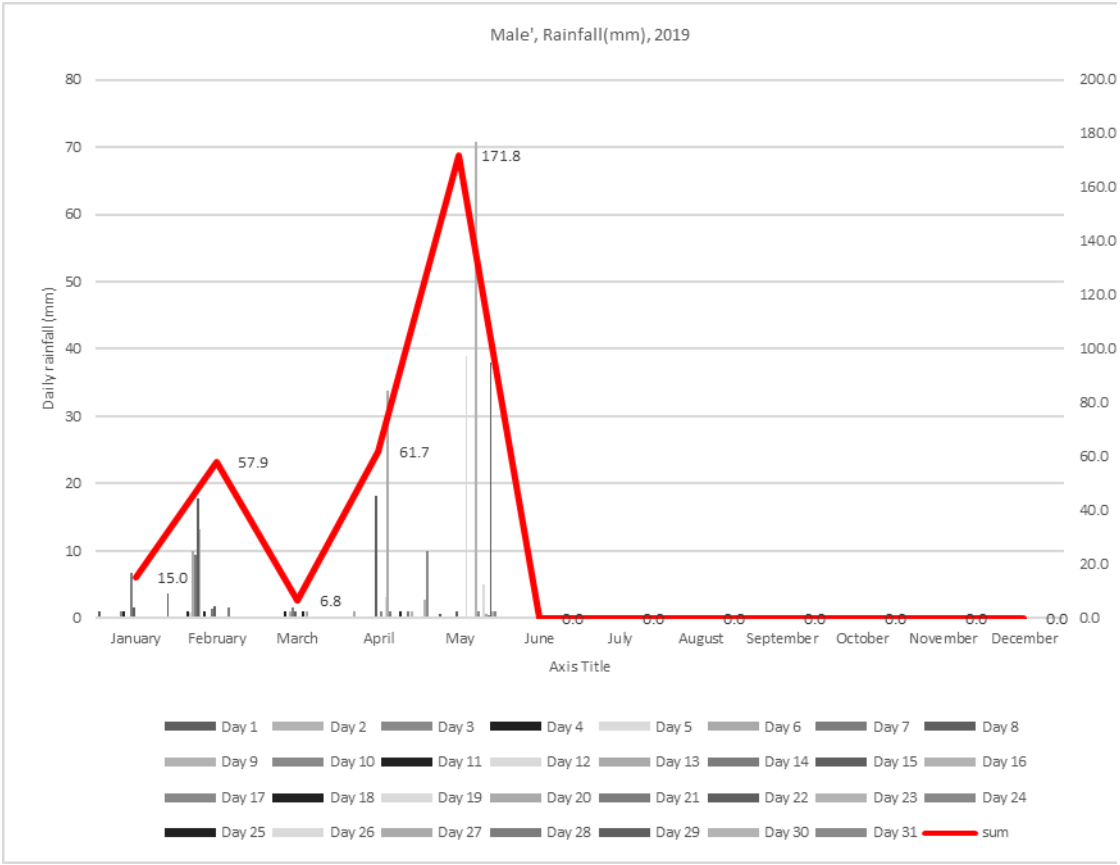


Figure 23 Average rainfall in Male' 2019 till May (Maldives Meteorological Service, 2019)

11.4.1.4 Wind

Located in the equatorial region of the Indian Ocean, Maldives enjoys a generally mild monsoon. However, winds do pick up to storms and line squalls, but the area is generally a cyclone fee area. The monsoon climate is driven by the atmospheric pressure differences that arise as a result of rapid warming or cooling of the Tibetan Plateau relative to the Indian Ocean (Hastenrath, 1991; Fein & P, 1987). As per the observations of NASEER, 2003, the Maldivians monsoon patterns show consistency for the past two decades. His analysis shows that the wind speed is usually higher on the months May till October in central Maldives while the monsoon is significantly stronger in the central and the northern region in comparison to the south.

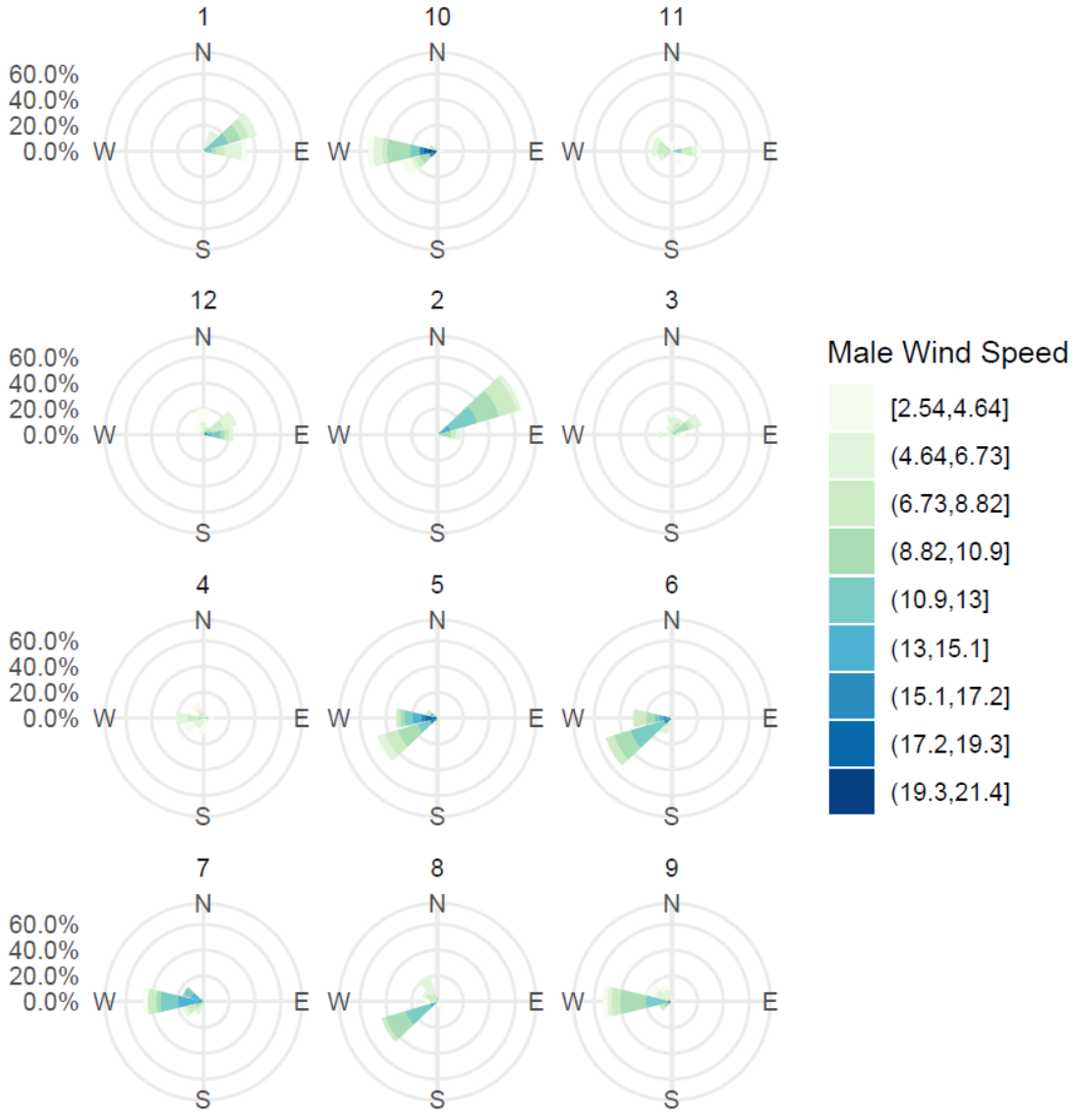


Figure 24 Average wind speed and direction 2018 (Maldives Meteorological Service, 2019)

The wind data for Male' from January 1985 till March 2019 are shown in *Figure 24* and *Figure 25* respectively.

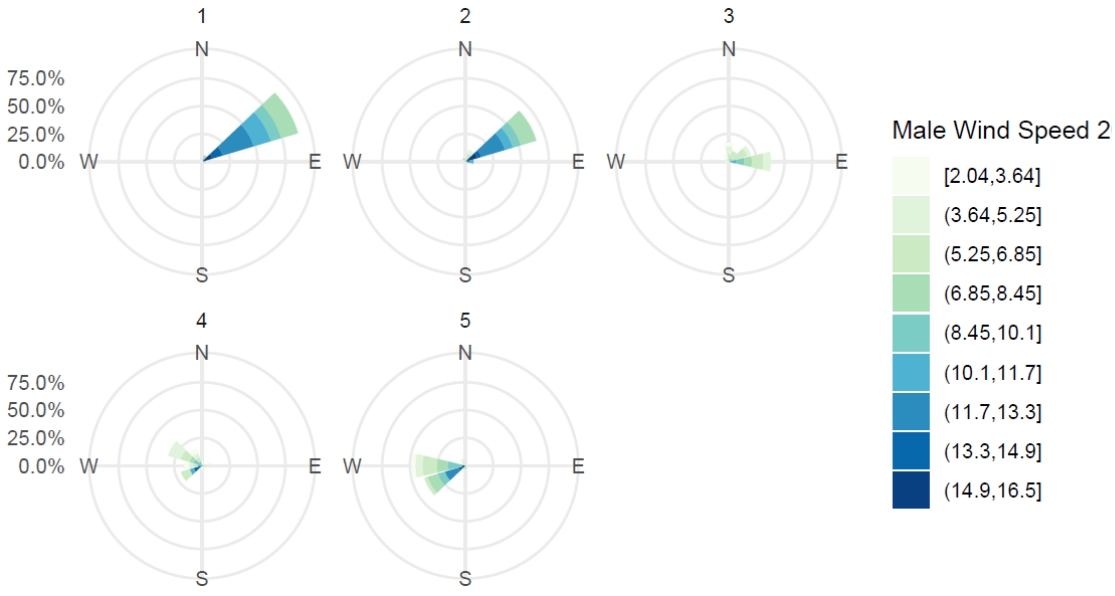


Figure 25 Average wind speed and direction 2019 (Maldives Meteorological Service, 2019)

11.4.1.5 Risk of hurricanes and storm surges

Like most islands in Maldives, *M.Mulah* is a low lying island. As recorded in the past, the island is vulnerable to storm surges or flooding. The risk is higher during the south western monsoon as weather conditions can get rough at the south eastern and western side of the island.

11.4.2 Geology and geomorphology

There are 1200 naturally formed coralline low laying islands in Maldives and cays where in except for the island of *Fuvahmulah* is a part of a larger atoll. The islands are classified into 25 atolls. The islands are elevated steeply from the surrounding sea floor of 2500-3000m deep to the east and 2800 – 4200m deep to the west. The sea in between the atolls are around 200m deep (Naseer & Hatcher, 2000).

It is hypothesised that Maldives lies on a volcanic basement of depth 2000 m that pore out between Laccadives and Chagos Band and during Cretaceous and early Cenozoic times moved northward to form a submarine ridge. It is believed the islands have been exposed to 27 glacial sea level cycles with eustatic sea level fluctuating by more than 120 m at various times resulting in many "karst-induced" coral reef formations and geomorphological structures. (Rudie & Tim, 2014). Hydrography/hydrodynamics of the project site

11.4.2.1 Tides

The tides of the Maldives (Table 5) are generally mixed and semi-diurnal. Neap and spring tides are approximately 0.3m and 1.0m respectively. In the central Atolls, maximum spring tide range is 1.1m. A seasonal mean sea level fluctuation in reginal mean sea level with an increase of about 0.1m during February to April and a decrease of 0.1m during September to November can be

seen. Like in many Atolls semidiurnal tides are experienced in the proposed project site. The tides are largely based on the shape, depth and location of the site.

Table 5 Tide levels, Maldives

Tide level (Referred to MSL)
Highest Astronomical Tide (HAT) +0.64
Mean Higher High Water (MHHW) +0.34
Mean Lower High Water (MLHW) +0.14
Mean Sea Level (MSL) 0.00
Mean Higher Low Water (MHLW) -0.16
Mean Lower Low Water (MHLW) -0.36
Lowest Astronomical Tide (LAT) -0.56
Highest Astronomical Tide (HAT) +0.64
Mean Higher High Water (MHHW) +0.34
Mean Lower High Water (MLHW) +0.14

The motion of the moon and the sun is reflected in the astronomical tides with a range of periodicities. 0.64m is the highest astronomical tide recorded above the MSL and -0.56m was the lowest astronomical tide recorded below MSL. Maldives has a general variation of 1.2m from the lowest to the highest tide. At low tide the movement of water is very low and is an ideal time to conduct marine development works in general.

11.4.2.2 Currents

The systems that affect the sea around the Maldives are, oceanic currents, tidal currents, wind induced, and wave induced currents. the geography, and geology of the Maldives in the Indian ocean ensures a strong constant flow of water through the atolls. Towards the equator in the Arabian sea, the winds become indicative of the ocean surface currents. Thus, during monsoon the wind become a major factor affecting current velocity and direction. Hence, wind induced currents can dominate. From January to March, the westerly flowing currents tend to dominate and from May to November easterly currents tend to dominate. In April and December, the changes in the current flow of patterns occur.

The tidal currents are the horizontal water movement associated with the vertical movements of the rise and fall of the tide. The tidal currents are westward in ebb and eastward in flood.

Localised to the project site, the wave induced currents form an important factor effecting the current.

11.4.2.3 Waves

Two monsoon periods govern the swell and wind waves experienced in the Maldives. The swells and wind waves experienced by the Maldives are conditioned by the prevailing biannual monsoon wind directions, and are typically strongest during April – July in the southwest monsoon period. During this season, swells generated north of the equator with heights of 2- 3m with periods of 18-20 seconds have been reported in the region. The proposed project site shows minimum wave action as the project site faces the west which is the inner atoll.

11.4.2.4 Ground water quality

Ground water quality checks were performed checking the temperature, pH, conductivity, TDS, and TPH of the water.

The water was analyzed using probes on site and were tested in the lab at Male' Water and Sewerage Company (MWSC). The sites of ground water analysis are presented in Figure 3. The overall conditions are presented in Table 6

Table 6 Ground water quality of the sites as per the MWSC tests

Sample number	Physical appearance	Conductivity (µS/cm)	pH	TDS (mg/L)	TPH (mg/L)

MUW 3 Control	Clear with particles	544	7.52	272	0.05
MUW 1	Clear with particles	1274	7.66	637	0.42
MUW 2	Clear with particles	907	7.31	454	0.06
MUW 4	Yellow with particles	24100	7.10	12070	0.16
Wet land S1	Pale yellow with particles	793	7.95	397	0.54

Table 7Probe readings on site

SITE	Temp (°F)
muw3	86.42563
muw1	88.95641
muw2	87.38617
muw4	80.17037
Wet land S1	84.36849

11.5 Ecology

To provide a better description of the environment, as a part of the literature review governmental databases and local knowledge was reviewed and described. The detail study of the site that followed focused on gathering site specific data and the data for the areas that fall under the footprint of the proposed project location, proposed alternative sites, and surrounding impact zone for both the sites.

11.5.1 Wetland area of the island.

The island is a large island with one major depression on the island which consequently holds the wetland area. The protected area has an approximate area of 48749.37m^2. The exact boundary of the mangrove area was demarked using a GARMIN 78s GPS system. The surveyor walked through the area to mark the boundary of the wetland area. The wetland area and layers can be seen in Figure 26.

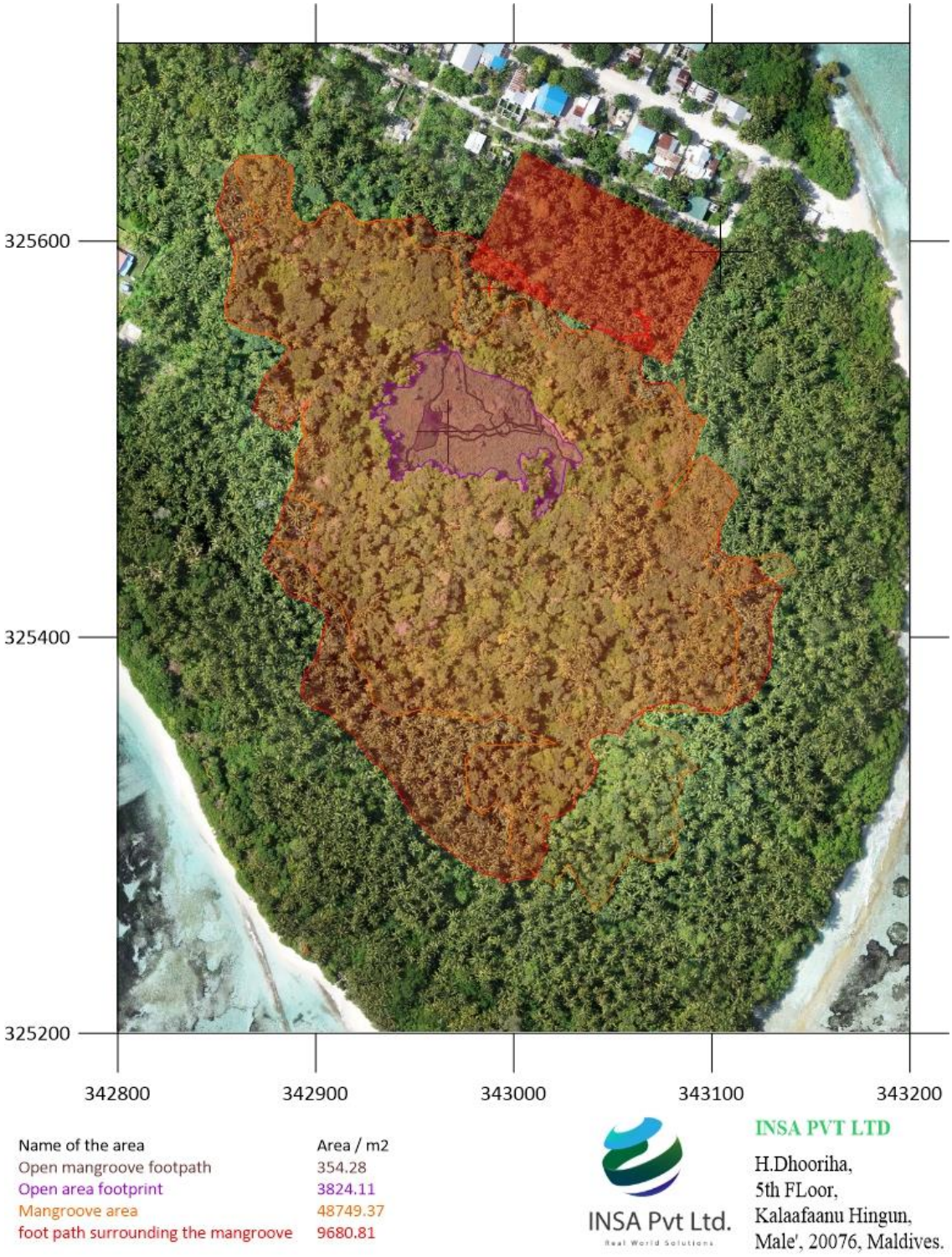


Figure 26 The mangrove area with the layers marked separately. The area provided in the chart shows the subtracted mangrove footprint area and the subtracted foot path surrounding the mangrove footprint area. (Reduced map)

11.5.1.1 Features of the wetland area

The wetland area is surrounded by the island and does not have a salt inlet point. The area which has an overall footprint area of 58430.18m^2 has a strong vegetation line surrounding the mangrove. On the inner riparian under the canopy pools can be seen isolated with water. Similarly, the areas show numerous mud depressions throughout. The map on Figure 26 shows the different sections of the mangrove area surveyed. The line in red colour demarks the footpath

surrounding the mangrove area. For the most part, the footpath shows signs of farming attempts of the locals to harvest banana and yam. At points of access at the southern tip of the island, the footpath has little to no buffer zone before the wet zone and cuts across the wet zone. It must also be noted that the lack of a buffer in some cases is due to the foot path being an old road which predates protection of the mangrove areas. The footpath seems to be elevated form the mangrove area, according to the accompanying guides, the footpath does not flood during rainy season. However, it is our assumption that in the south of the island, the footpath will flood but may drain faster than the mud path.

Figure 27 A photo from the foot path on the northern side of the mangrove footprint.

The inner section marked in orange is the mangrove area. The footprint of the section is approximately 52573.48m^2 . The area does not have a definite access road, and is distinguished by large vegetation and a waterbody that is mostly filled with leaf matter, and topsoil or sediment that sinks to about 0.5m deep. The vegetation of the area is mostly mixed dominated by screw pines and coconut palms.

Figure 28 inside the mangrove area; the wet path.

Figure 29 inside the mangrove area wet path

Through the mangrove area road leads to the open area. The open area is a unique feature of the island. Mostly consisting of low levels of water covered with vines that spread across the entire area the footprint of the area is approximately 3824.11m^2. The rare path taken while traversing through the mangrove is seen exposed as a footpath of approximately 354.28m^2. . The inner area is elevated due to the abovementioned woody vines.

Figure 30 Inner mangrove area opening

According to the locals the area is known for its mud baths. However, in the recent years the usage of the area has declined and as a result has led to an overgrowth of the vines on location. During the visit, the council staff guiding the team commented that the existing gap is smaller in comparison to the recent past.

Figure 31 Known for its mud baths, the area has shrunk is size due to the spread of vines

The plant cover of the open area was calculated using the data and ATS images which comes up to approximately 91.5% of the entire area.

11.5.1.2 Tree survey

On location, numerous mangrove plants[1], coconut palms, screw pines, hard wood trees, ferns and vines were seen. Vines and ferns dominated the centre area smothering any woody plants. As a result the periphery contains a mix of coconut palms, screw pines and woody trees.

7 transects 2Om long were taken at the GPS coordinates provided in Table 8. Using a hand held GPS, the transect paths were georeferenced.

Table 8 GPS coordinates of the tree transects

Site	Start point	End Point
T1	43 N, 342902.81 m E, 325457.43 m N	43 N, 342921.44 m E, 325462.58 m N
T2	43 N, 342964.78 m E, 325531.08 m N	43 N, 342973.25 m E, 325516.12 m N
T3	43 N, 342928.58 m E, 325608.36 m N	43 N, 342922.21 m E, 325596.52 m N

[1] Form the initial interview with the locals it we were informed that at least two types of mangroves would be spotted *Bruguiera cylindrica* and *Ceriops tagal*. However, after the survey we report that our transects did not report *Ceriops tagal*.or anyother form of mangrove apart form *Bruguiera cylindrica.* This mention here is not to challenge the claim of the locals; just a clarification for interested parties.

T4	43 N, 343040.41 m E, 325304.65 m N	43 N, 343050.46 m E, 325292.28 m N
T5	43 N,343054.83 m E, 325455.89 m N	43 N, 343071.25 m E, 325466.98 m N
T6	43 N, 342964.78 m E, 325531.08 m N	43 N, 342973.25 m E, 325516.12 m N
T7	43 N, 342997.84 m E, 325507.55 m N	43 N, 343001.09 m E, 325495.23 m N

Transect 1 to 5 were taken in the forest area surrounding the mangrove opening. Except for transect 1 and 5, other were muddy and shows no signs of recent anthropological influence. At 1 and 5 trash either washed down from the nearby roads opening or from the locals who frequent the area can be seen. Transect 6 and seven were open spaces with smothered woody trees and a platform of vines elevating the team from the muddy ground. The area had little to no signs of trash except for the exposed waterbodies that had different types of plastic wrappers disposed.

Table 9 Overall tally of the transects and composition of the area

Tree	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**
Bruguiera cylindrica	3	2	2	2	1	0	0
Cocos nucifera I	1	5	5	2	5	0	0
Pandanus odorifer (Forssk.) Kuntze	4	0	5	7	0	0	0
Bruguiera cylindrica ju	7	7	2	3	1	0	0
Taliparitiliaceum	0	0	0	0	0	7	6
Tropical vine 1	0	0	0	0	0	4	9
NONE	5	6	6	4	7	0	0
Nephrolepis *hirsutula* (G.Frost.) C. Presl	0	0	0	0	6	0	0
Tropical vine 2	0	0	0	0	0	6	2
	%						
Bruguiera cylindrica	15.0	10.0	10.0	11.1	5.0	0.0	0.0
Cocos nucifera I	5.0	25.0	25.0	11.1	25.0	0.0	0.0
Pandanus odorifer (Forssk.) Kuntze	20.0	0.0	25.0	38.9	0.0	0.0	0.0
Bruguiera cylindrica ju	35.0	35.0	10.0	16.7	5.0	0.0	0.0
Taliparitiliaceum	0.0	0.0	0.0	0.0	0.0	41.2	35.3
Tropical vine 1	0.0	0.0	0.0	0.0	0.0	23.5	52.9
NONE	25.0	30.0	30.0	22.2	35.0	0.0	0.0
Nephrolepis *hirsutula* (G.Frost.) C. Presl	0.0	0.0	0.0	0.0	30.0	0.0	0.0
Tropical vine 2	0.0	0.0	0.0	0.0	0.0	35.3	11.8

Transect one was a closed canopy area with *Pandanus odorifer* (Forssk.) Kuntze and *Bruguiera cylindrica,* dominating at 20%, and 15% respectively followed by *Cocos nucifera I at 5%* as the main plant form. Consequently the under cover ensured the suppression of numerous juveniles the majority. *Bruguiera cylindrica,* and *Pandanus odorifer* (Forssk.) Kuntze younglings unable to qualify for the 0.5m height line which is marked as NONE. The qualifying juvenile *Bruguiera cylindrica* juveniles for the transect covered 35% of the area. Although not on the transect, the site had clusters of ferns scattered throughout the area.

Similar to transect one, transect two was muddy and silty, the section was dominated by *Cocos nucifera and Bruguiera cylindrica* at 25% and 10% respectively. The NONE category was dominated by *Bruguiera cylindrica and Adenanthera pavonina I juveniles below the 0.5m height line. The qualified juveniles were Bruguiera cylindrica ju at 35%.* It must be noted that the site had both *Adenanthera pavonina I and Pandanus odorifer* (Forssk.) Kuntze on site, but not on the transect.

Transect three was less muddy consequently with *Cocos nucifera I and Pandanus odorifer* (Forssk.) Kuntze dominating at 25%. This was followed by 2 large . *Bruguiera cylindrica* trees which as a percentage comes up to 10% of the transect and from the undergrowth, only 10% of the juvenile *Bruguiera cylindrica* qualified to be represented on the transect belt. The rest covered 30% of the transect does not qualify to be recorded.

Transect four is predominantly *Pandanus odorifer* (Forssk.) Kuntze covering 38.9% of the transect, followed by 11% of *Bruguiera cylindrica* and 11% of *Cocos nucifera I. Combination of Pandanus odorifer (Forssk.) Kuntze and Bruguiera cylindrica ensured a closed canopy cover. This also ensured 16% of juvenile Bruguiera cylindrica and 35% of juveniles that did not qualify the tally.*

Transect five was taken near a road path. 25% of the section was *Cocos nucifera I* followed by 5% of *Bruguiera cylindrica and 5% of Bruguiera cylindrica juveniles. Unqualifies juveniles covered 35%* of the transect and interestingly on this transect 30% of the ground cover that did not qualify was *Nephrolepis hirsutula (G.Frost.) C. Presl.*

Another interesting feature of this section was the distribution of *Terminalia catappa.l* juveniles after the end of the transect which we noticed carpeting the rest of the *Cocos nucifera I. cluster.* There was no adult *Terminalia catappa.l* in the area of the cluster. However, up the road at a slight elevation was one that could have been one.

Site T6 and T7 was a mix of *Talipariti tiliaceum*, and two types of vines labelled Tropical vine 1and Tropical vine 2. As for clarifications of the vines, we have requested the concerned authorities for identification (Appendix 32 Email proof 1 Runner clarification).

11.5.2 Football area

11.5.2.1 General description

This piece of community forest best described as a section of a climax community dominated by *Cocos nucifera I.* with full canopy cover seen throughout the section had not gone through any development in the past. The area has seedlings and shrubs carpeting the bottom layer together with ferns (*Nephrolepis hirsutula* (G.Frost.) C. Presl).

Two roads pass through either ends of the plot. One leads to the mangrove area and the other leads to a path around the mangrove area. On both roads, signs of management can be seen which extends into the core of the plot. The plot therefore, can be identified as a managed piece of forest plot.

There are no signs of recent trash in the plot. However, aged plastic debris can be spotted rarely even at the core of the plot.

11.5.2.2 Tree survey

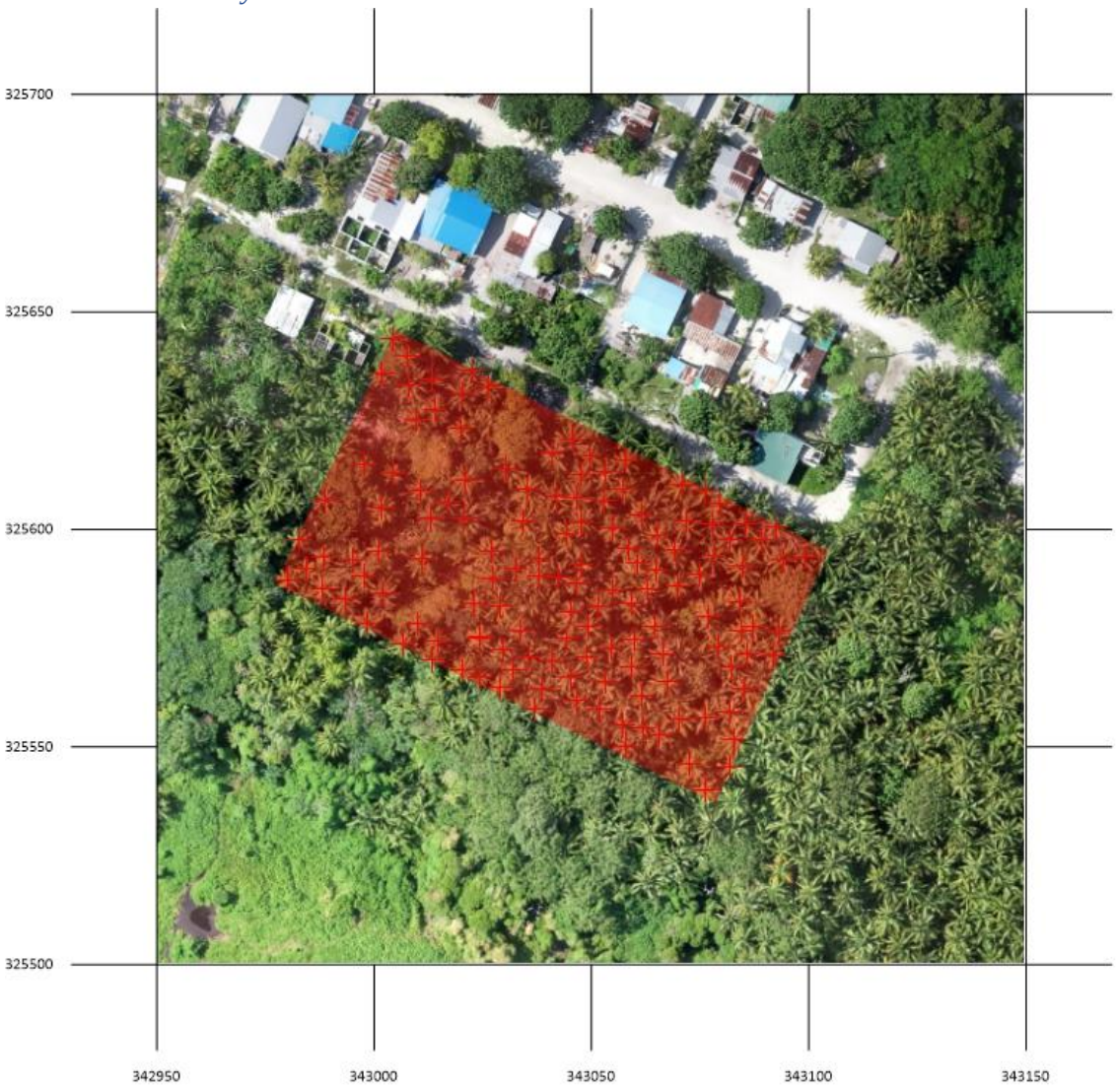


Figure 32 Ats Image for tree count (reduced)

Using the ATS imagery we were able to detect and count 139 trees. This comes with the limitation of canopy cover.

On site tree survey shows that the work footprint area has a total of 150 significant trees of which 146 are *Cocos nucifera I* and 3 are *Artocarpus altilis* and one *Adenanthera pavonia L* tree. The section of interest is a canopy covered, semi managed,

Table 10 General description and count

Tree Categories		**Number of trees**
Coconut palms	*Cocos nucifera I*	146
Breadfruit	*Artocarpus altilis*	3
Circassian	*Adenanthera pavonia L*	1

Table 11 Status of the plants in the plot

Category	**No of trees**

Local	0
Government	150
Unidentified	0

The labels and records in the island show that the plot belongs to the council.

Table 12 Girth and species of plant (random sampling)

Random sample	Girth/ m	Type of plant
1	1.38	*Cocos nucifera I*
2	1.35	*Cocos nucifera I*
3	1.3	*Cocos nucifera I*
4	1.45	*Cocos nucifera I*
5	1.5	*Cocos nucifera I*
6	1.3	*Cocos nucifera I*
7	1.6	*Cocos nucifera I*
8	1.63	*Cocos nucifera I*
9	1.2	*Cocos nucifera I*
10	1.75	*Cocos nucifera I*

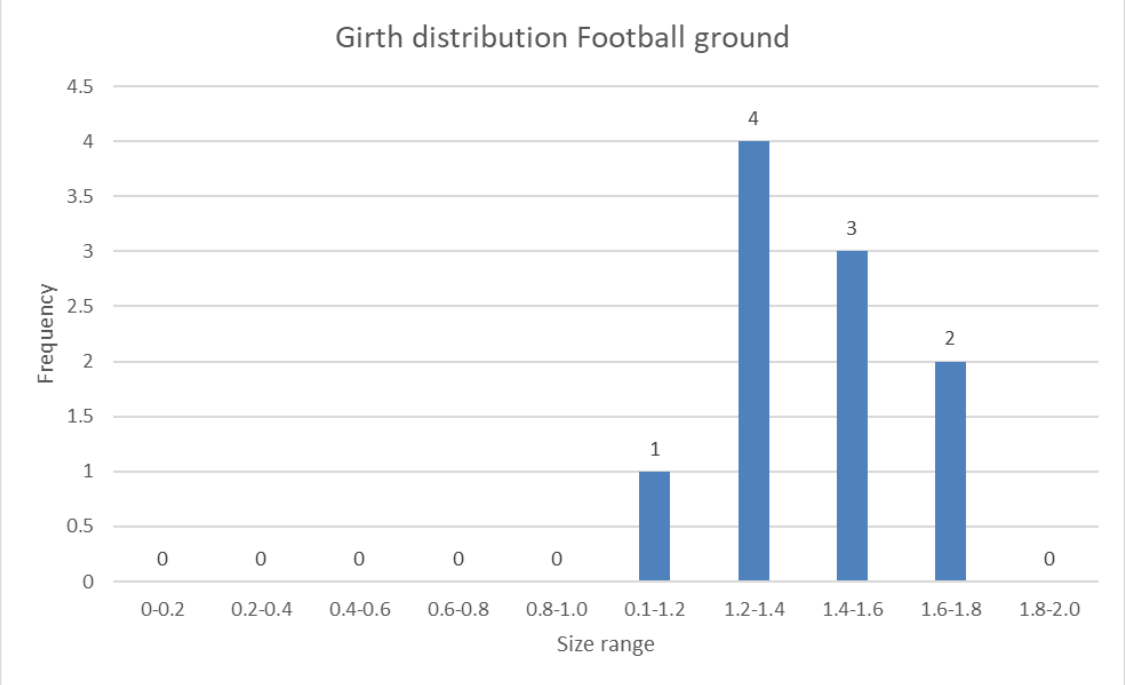


Figure 33 Distribution of plants according to the size range

Table 13 Size range distribution data

Size range	**0-0.2**	**0.2-0.4**	**0.4-0.6**	**0.6-0.8**	**0.8-1.0**	**0.1-1.2**	**1.2-1.4**	**1.4-1.6**	**1.6-1.8**	**1.8-2.0**
Frequency	0	0	0	0	0	1	4	3	2	0

The size among the random samples did not vary as much as expected due to one species being sampled throughout. Only sample number 10 at a girth of 1.75m stood out. The girth distribution shows 4 samples occupies the girth range of 1.2 to 1.4m, followed by 3 samples the girth range of 1.4 to 1.6m, followed by 2 samples 1.6 to 1.8m and finally 1 sample at the girth range of 0.1 to 1.2m

This is expected in a canopy covered tropical semi managed woodland where the dominating old plants are of generally the same size with just slight variations.

11.5.3 Water sports area

11.5.3.1 General description

This plot can be described as a small section of the shoreline forest vegetation that mixes with the island vegetation. The lack of typical shoreline vegetation line or defence such as *Scaevola taccada* (Gaertn.) Roxb or *Pemphis acidula* J.R.Forst. & G. Forst is noteworthy. Road are on both sides of the plot. Hence, the site is infiltrated on all the sides. The section has *Casuarina equisetifolia.I* in the core of the plot which are signs of anthropological infiltration and use in the past. Trash both oceanic and local can be seen throughout the plot.

11.5.3.2 Tree survey

Figure 34 ATS Tree count Sports area (reduced)

ATS images of the tree count in the sports are shows that the area has a total of 74 trees. As this method proves impossible to count the canopy cover, on site survey was carried out.

On site tree survey shows that there are 6 different confirmed species in the area among which; 177 are of the species *Cocos nucifera I*, 10 *Taliparitі tiliaceum T*, 5 *Calophyllum inophyllum*, 2 *Terminalia catappa.l*, and 3 *Casuarina equisetifolia.I*

Table 14 General description and count

Tree Categories	Type of plant	Number of trees
Coconut palms	*Cocos nucifera I*	177
Indian Almond	*Terminalia catappa.l*	2
Oil nut tree	*Calophyllum inophyllum*	5
Sea hibiscus	*Taliparitі tiliaceum T*	10
Beefwood Tree	*Casuarina equisetifolia.I*	3
Total		197

Table 15 Status of the plants in the plot

Category	No of trees
Local	28
Government	1
Unidentified	97

The labels and records show that the 28 plants are local one is the councils and 97 plants have yet to be claimed.

Table 16 Girth and Species of plants (random sampling)

Random sample	Girth/m	Type of plant
1	1.36	*Cocos nucifera I*
2	1.85	*Cocos nucifera I*
3	1.55	*Cocos nucifera I*
4	1.67	*Cocos nucifera I*
5	1.2	*Cocos nucifera I*
6	1.5	*Taliparitі tiliaceum T*
7	1.3	*Taliparitі tiliaceum T*
8	1.3	*Taliparitі tiliaceum T*
9	1.3	*Taliparitі tiliaceum T*
10	1.3	*Taliparitі tiliaceum T*
11	1.3	*Taliparitі tiliaceum T*
12	0.4	*Taliparitі tiliaceum T*
13	0.4	*Taliparitі tiliaceum T*
14	0.4	*Taliparitі tiliaceum T*
15	1.77	*Taliparitі tiliaceum T*
16	0.8	*Calophyllum inophyllum*
17	1.1	*Calophyllum inophyllum*
18	1.1	*Calophyllum inophyllum*
19	1.1	*Calophyllum inophyllum*

20	1.7	*Calophyllum inophyllum*
21	0.5	*Terminalia catappa.l*
22	0.7	*Terminalia catappa.l*
23	1.9	*Casuarina equisetifolia.I*
24	2.1	*Casuarina equisetifolia.I*
25	0.56	*Casuarina equisetifolia.I*
26	1.63	*Cocos nucifera I*
27	1.65	*Cocos nucifera I*
28	1.2	*Cocos nucifera I*
29	1.23	*Cocos nucifera I*

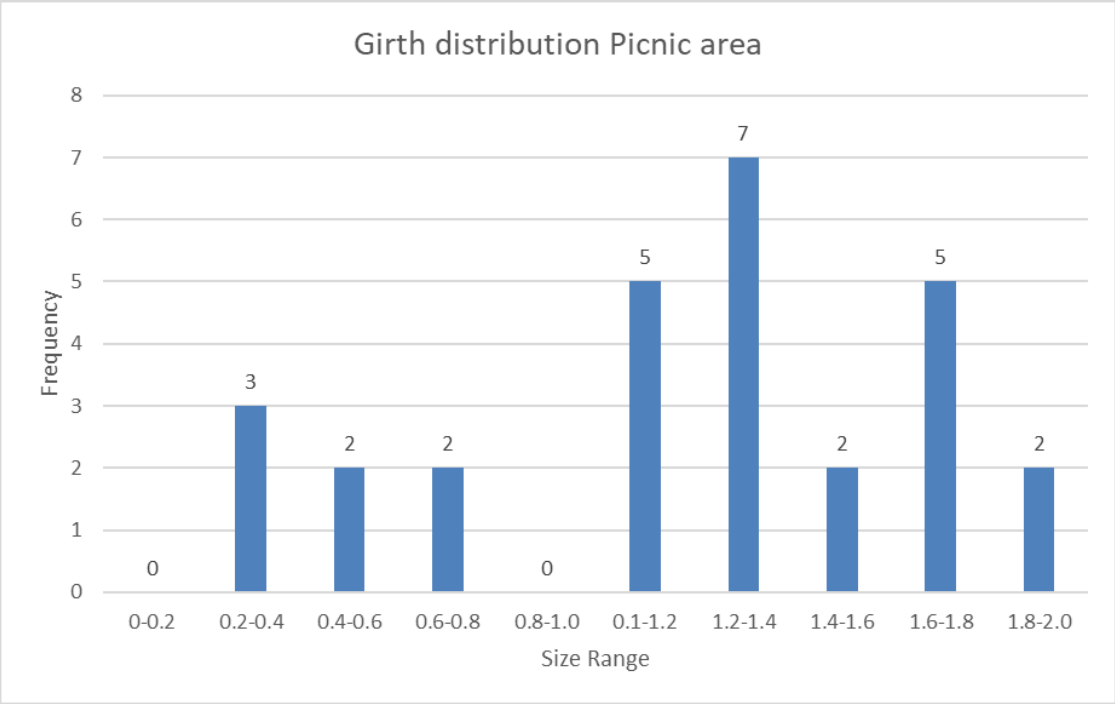


Figure 35 Distribution of plants according to size range

Table 17 Size range distribution data

Size range	**0-0.2**	**0.2-0.4**	**0.4-0.6**	**0.6-0.8**	**0.8-1.0**	**0.1-1.2**	**1.2-1.4**	**1.4-1.6**	**1.6-1.8**	**1.8-2.0**	**2.0-more**
Frequency	0	3	2	2	0	5	7	2	5	2	1

With the variation of the species in the plot, the size varied drastically. The highest occupied girth range was 7 plants at 1.2 to 1.6m. Uniform distribution of sizes can be seen as expected in such an infiltrated plot.

11.5.4 Mega Fauna analysis

11.5.4.1 Bird Survey

Table 18 Bird Survey locations

Site	**GPS point**
Bird T1	43 N, 342861.87 m E, 325690.14 m N

Bird T2	*Lost coordinates during data transfer
Bird T3	43 N, 343104.70 m E, 325601.11 m N

Table 19 Summary data for bird survey

Bird Survey	Common name	T1	T2	T3
Corvus splendens	House Crow	12	15	9
Eydynamys scolopacea	Asian Koel	2	2	1
Amaurornis phoenicurus	Maldivian Water Hen	0	0	1

Table 20 Raw data for bird survey with time of siting

	Bird Survey	T1	T2	T3
1	*Corvus splendens*	15:30		
2	*Corvus splendens*	15:31		
3	*Corvus splendens*	15:34		
4	*Corvus splendens*	15:35		
5	*Corvus splendens*	15:36		
6	*Corvus splendens*	15:37		
7	*Corvus splendens*	15:41		
8	*Corvus splendens*	15:48		
9	*Corvus splendens*	15:49		
10	*Corvus splendens*	15:50		
11	*Eydynamys scolopacea*	15:54		
12	*Corvus splendens*	15:55		
13	*Corvus splendens*	15:56		
14	*Eydynamys scolopacea*	15:57		
1	*Eydynamys scolopacea*		16:30	
2	*Corvus splendens*		16:33	
3	*Corvus splendens*		16:36	
4	*Corvus splendens*		16:36	
5	*Corvus splendens*		16:36	
6	*Corvus splendens*		16:36	
7	*Corvus splendens*		16:48	
8	*Corvus splendens*		16:51	
9	*Corvus splendens*		16:54	
10	*Corvus splendens*		16:57	
11	*Corvus splendens*		17:00	
12	*Corvus splendens*		17:03	
13	*Corvus splendens*		17:06	
14	*Corvus splendens*		17:19	
15	*Corvus splendens*		17:22	
16	*Eydynamys scolopacea*		17:23	
17	*Corvus splendens*		17:28	
1	*Corvus splendens*			13:00

2	*Corvus splendens*			13:30
3	*Corvus splendens*			13.31
4	*Corvus splendens*			13:32
5	*Corvus splendens*			13:45
6	*Corvus splendens*			13.31
7	*Eydynamys scolopacea*			13:32
8	*Corvus splendens*			13:38
9	*Corvus splendens*			13:44
10	*Corvus splendens*			13:50
11	*Amaurornis phoenicurus*			13:57

Bird survey data shows that during the time of survey site 1 had a total of 14 sightings where, 12 were *Corvus splendens* and 2 were *Eydynamys scolopacea.* Similarly, on site 2 out of 17 sightings, 15 are *Corvus splendens* and 2 are *Eydynamys scolopacea.* On site 3 out of 11 birds 9 are *Corvus splendens* and 1 was a *Eydynamys scolopacea* and 1 was *Amaurornis phoenicurus*

To determine the diversity of the bird population more data is required. The survey carried out just shows the interaction of the avian lifeforms to that of the habitat. The local guides also informed that during seasons, the island gets numerous sea birds that frequent the shoreline and the wetland area.

11.5.5 Hexapod analysis

A hexapod analysis was to determine the dominant order represented in the sample. Kick samples and a simple tally point count was taken in order to determine the representation at the time.

11.5.5.1 Kick sampling

Samples were taken at 3 different locations. Analysis of the samples show that in the water body 1 and 2 same order was represented[2]. Insects of the order diptera specifically the lave of culex dominated all samples.

Table 21 Kick sample analysis

	T1	T2	T3
GPS coordinates	43 N, 342959.71 m E, 325508.72 m N	43 N,342995.75 m E,325509.14 m N	
Type of sample	Kick	Kick	Kick
Culex,spp	3	12	15
Unidentified arthropod	1		1

11.5.5.2 Tally point count

A tally point count showed that the dominant form of hexapod in the wetland area during the time of the survey is Hymenoptera with 2 types of different ants and 2 types of wasps. The ant population was noted in clusters where every spotting was noted as +100. The next dominant order found mostly at the periphery of the entrance roads and rarely in the study area were the order Orthoptera with two major types. A total of 34 individuals were counted. The order that dominated next was lepidoptera with 1 type of butterfly and 2 types of moths. These were

[2] 3 insect orders Diptera, Coleoptera and Hemiiptera were identified at the edge and within the waterbody. Hoervey the kick sampling only had two different orders represented in it.

followed by the order Mantodea with 2 observations. Followed by Odonata and coleoptera both identified once.

Table 22 Results for tally point count analysis

Order	Family	Count
Hymenoptera	Formicidae (type 1)	+100
	Formicidae (type 2)	+100
clade	Anthophila (type 1)	1
	Anthophila (type 2)	2
Lepidoptera	Danaidae[3]	1
	Arctiidae	3
	Noctuidae	1
Orthoptera	Unspecified	19
	Unspecified	15
Mantodea	Unspecified	2
Odonata	Unspecified	1
Coleoptera	Unspecified	1

11.5.6 Noise levels

Noise levels were taken at day time, to assess the baseline of ambient noise.

location	Point 1	Point 2	Point 3
Work area Football ground	63	72	85
Work area Water sports area	52	85	87
Wetland area	53	63	72
Control area village	88	85	83
Control area village	80	82	86

The proposed project areas and the wetland area is relatively silent as they are far from the residential areas. The residential areas of *M. Mulah* is quite loud as houses are close together and urban noise (television, entertainment, chatter, motorised vehicles, construction, kids playing and craws) is heard throughout.

11.6 Socio-economic environment

The island of *Mulak* is located at *Meemu* atoll or Mulaku atoll. The atoll consists of 8 inhibited islands where *M.Muli* is the administrative capital of the atoll.

11.6.1 History

The island, like most Maldivian islands with a long history of inhabitants stretching back further than the great famine. There are few historical landmarks on the island, where the current generation inhibited are not aware of the actual age of. This includes two mosques on the old

[3] Representing family Danaidae, hence reported as such.

town area and a cemetery attached to them. There is no history of an exodus and according to the locals there has been a noticeable immigration to the island since the 80s.

According to the locals old enough to remember the famine, much like other islands, the locals of *M.Mulah* did not go out to sea for fishing as they were aware of looting and the harsh treatment of any captive ship/boat out at sea. However, fishing was enough to sustain as the island was on the channel and agro-food was in abundance as the island of was a hub for trade and had wetland area that could provide enough for the island and trade.

Throughout the 60s, 70s, 80s and well into the 90s the island had a strong sense of community involvement and responsibility as the law of the island where in establishing forest harvest twice a week through community support was practiced[4]. The harvest was distributed through the island for those in need.

During the 2004 Tsunami, The island suffered little to no destruction. Therefore, *M.Mulah* was a hub for relief work where the islanders form different parts of the atoll were brought in given shelter, and food; acting as the temporary administrative head[5] of the atoll.

11.6.2 Economy and population.

As per the council of *M.Mulah.* The resident population of the island is 1951 individuals. The main line of work on the island is fishing. With 7 boats in the category of size 80 to 100ft and numerous small boats. The island has a major section in the industrial zone set for fish processing.

The island has 2 guest houses and the island hopes to expand the guesthouse components of the island further to a specialised section of the island. The island also wishes to expand into the tourism sector by allocating a tourism area in the island.

The island also makes and exports ‘fangi’; traditional tach roofing. Which according to the locals can be sold for a price of 30 to 50 MVR.

11.6.3 Education

The council also reports that the island has schooling from kindergarten to the 10th grade. With BTECs.

11.6.4 Health

The island has a health centre, and for major operations require assistance from the atoll capital or the capital. However, it was reported that most of the islands opt for services abroad for health care.

11.6.5 Electricity, sewerage, and water.

All utilities are provided by FENAKA since 2016.

11.6.6 Transportation

Transportation to M. Atoll is easy with government and local transportation in place. Using speed boat the maximum time taken to reach the island is approximately 2 hours 30 minutes. The speed

[4]According to the locals who participated and benefited from the practice,” *twice a week early morning we would line up outside our house doors to the sound of the conch. We would go into the forest area with sacks and vessels. Every able-bodied woman, man, and child would go and collect all the forest harvest that is not claimed. Then they will be brought back by late evening where every home will take a fair share of the collected or pay and the rest will be distributed among the poor. if there was excess, they will be stored for addition to a later harvest*.”

[5] The existing admirative head was devastated during the 2004 Tsunami and had to be moved.

ferries make stops at different island along the way in *M.atoll* during the trip making the last stop the capital of the atoll.

11.6.7 Socio Economic benefits

The developments proposed are predicated to bring an overall contentment to the islanders who need and proposed for the development. The use of the facilities will ensure the development of skillset of the locals who use the football area and the water sports activities.

The football area will most likely be released on a booking basis for the locals but will be leased for an acceptable amount for the professional teams. This income will be incorporated into the council's budget. Similarly, the water sports area will bring an income for the island as further development and maintenance will be leased to the lowest bidder and will have to pay rent to the council. This will bring in additional income to the island and will overall provide economic benefits.

11.7 Hazard vulnerability

The hazard risk assessment of the area was derived from the hazard profile published in the Base Line Study Report, Shaviyani Atoll, Maldives (UNISDR-ADRRN, 2005).

11.7.1 Tsunamis.

Tsunami hazard is mostly from the south. Understandably this is due to the active state of the tectonic plates at the east.

Historically, Maldives has been affected by three earthquake sources in the Indian Ocean. Of the total 85 tsunamis generated since 1816, 67 originated from the Sumatra subduction zone in east and the remaining 13 from the Makran coast zone in north and Carlsburg Transform fault zone in south. Hence, islands along the eastern fringe of the atolls are at a greater hazard than the western. *M. Mulak* along with the other islands on the eastern fringe, are in the highest hazard zones (*Figure 36*). This is evident form the distruction the islands were subjected to in the eastern 2004 tsunami. However, the location of the island in the channel and the high ridge of the island mitigated most damages.

The island is in hazard zone 5, where the probable wave height is 320-450cm (Table 23)

Table 23 Tsunami hazard zone and wave height (UNISDR-ADRRN, 2005)

Hazard Zone	**Range of probable maximum wave height**
1	<30 cm
2	30-80 cm
3	80-250 cm
4	250-320 cm
5	320-450 cm

Figure 36 Tsunami hazard zones, (UNISDR-ADRRN, 2005)

11.7.2 Storms.

The cyclone hazard zone for Maldives is highest in the north. Historical records indicate that during 1877 to 2004, eleven cyclones crossed Maldives. Where the frequency reduces as we move towards the south. Hence, the northern atolls are at a higher hazard from cyclonic winds and storm surge (UNISDR-ADRRN, 2005)

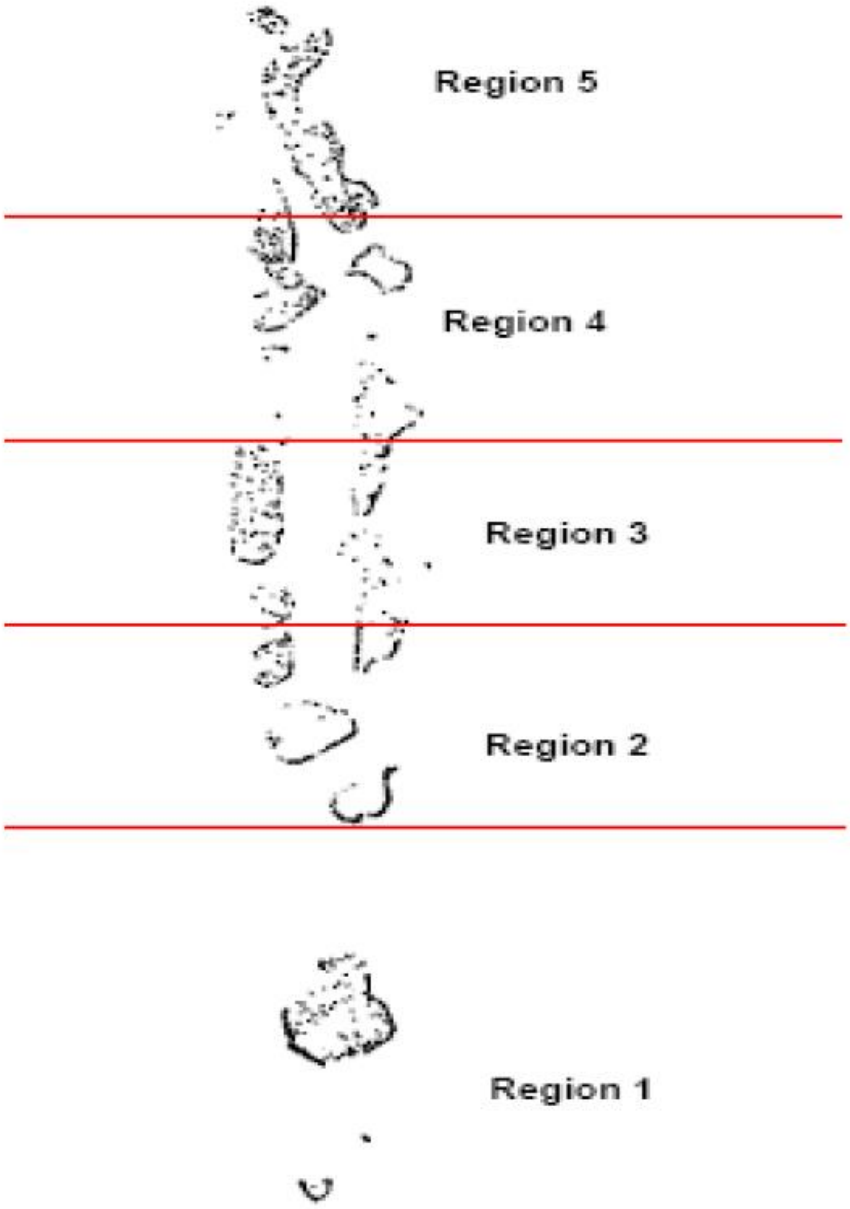


Figure 37 Cyclone hazard zones, (UNISDR-ADRRN, 2005)

Table 24 Cyclone hazard zone in Maldives and the probable maximum wind speed (UNISDR-ADRRN, 2005)

Hazard Zone	Probable Maximum Wind Speed	Saffir Simpson Scale
1	0.0	0
2	55.9	0
3	69.6	1
4	84.2	2
5	96.8	3

The island of *M.Mulah* is in region 2 of the hazard zone (*Figure 37* and *Table 24*) where the maximum probable wind speed reaches 55.9 knots.

11.7.3 Storm tide hazard

Local storms are high in the Maldives. Usually accompanied by rainfall and high waves. In general, he southern parts of the islands are mostly affected during April and December, which is the interim period between northeast and southwest monsoon season. (*Figure 38*), (UNISDR-ADRRN, 2005).

Figure 38 Surge hazard zones, (UNISDR-ADRRN, 2005)

Table 25 Hazard zones and specific conditional data (UNISDR-ADRRN, 2005).

Hazard Zone	Pressure drop hPa	Storm Surge Height	Average Tide height (m)	Storm tide (M)
1	-	-	-	-
2	15	0.45	0.93	1.38
3	15	0.60	0.93	1.53
4	30	0.99	0.98	1.97
5	30	1.32	0.98	2.30

The island of *M.Mulah* is on the eastern fringe, hence is exposed to the conditions from the east at surge hazard zone 3. The island is exposed to a general storm surge height of 0.60 and an average tide height of 0.93m and storm tide of 1.53m (Table 25).

11.7.4 Earth quake Hazard

The islands in Seenu, Gavini, and Gaafu are at the hazard zone of a seismic activity. Otherwise the entire country is in the low seismic hazard zones. (UNISDR-ADRRN, 2005)

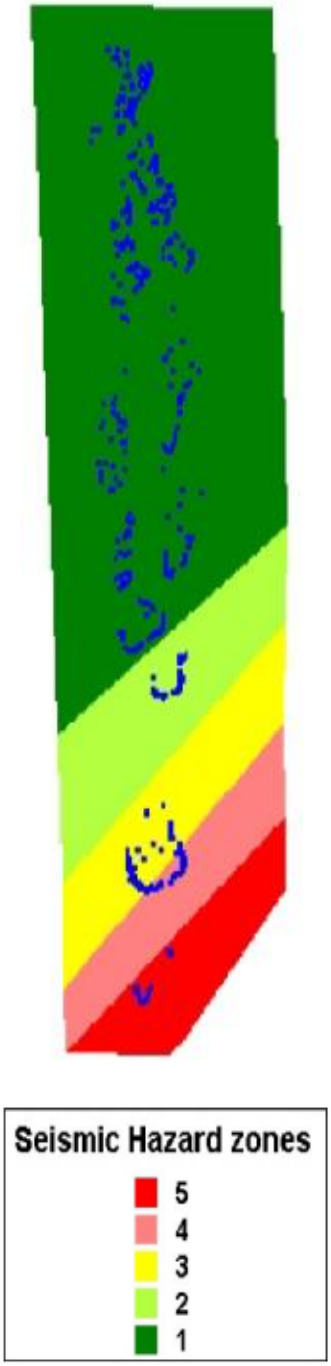


Figure 39 the seismic hazard zones for Maldives (UNISDR-ADRRN, 2005).

The island of *M.Mulah* falls under the seismic hazard zone 1 hence has a MMI value range for 475 year return period of less than 4.5. (Figure 39, Table 26)

Table 26 the seismic hazard zones for Maldives (UNISDR-ADRRN, 2005)

Seismic hazard zones	MMI value range for 475 years return period
1	Less than 4.5
2	4.5 to 5
3	5.0 to 5.5
4	5.5 to 7.0
5	7.0 to 8.0

12 Stakeholder's consultation

Stakeholder's consultation was held in two settings. On site and in offsite All the stakeholder meetings were casual interviews where the consultant allowed the stakeholder to express their views regarding the proposed project

The details of the meetings follows;

12.1 Scoping meeting

The scoping meeting was granted on 31st July 2019. In the meeting the proponent presented his proposal to an audience of *Mulaku* atoll council, Environment protection agency (EPA), and Ministry of environment (MRC), Ministry of planning and infrastructure (MNPI), The contractor and Land survey authority (MLSA).

In the meeting, the proponent (*Mulaku Council*) briefed the audience on the need for the project. The proponent highlighted the need for a new professional football ground and the difficulties / challenges the locals face due to lack it. He also added that the locals are fiercely competitive and takes practicing very seriously. The lack of practice space often leads to negative clashes within the island that is bad for the social wellbeing of the island.

The proponent also added that the island was in need of a waste management system. They added that currently the locals have an artisanal waste management practice of 'stack and burn' in different locations of the island. The proponent also highlighted that this practice is impractical and has more negative impact on the island and overall general environment. Therefore, a waste management area is necessary. The introduction of the waste management area will allow the council to sort the trash, process the trash and reduce the refuse through recycling and decomposing. Hence, to achieve this the road to the waste area is necessary. The next component introduced was the water sports area. the proponent proposes to implement the presidential promise of sports areas in all islands through the development of the water sports area.

Upon introduction of the project the floor was opened for discussions. The government representatives raised the concern of proper fulfillment of the initial procedures and achieving the necessary permits before proceeding with the projects. There was also concern of the location of the football ground as it was in the vicinity of the wetland area To this the proponent ensured that the paperwork is in order.and further clarification on the locations will be provided. Hence, the government representatives requested for the inclusion the approval from of requested for the approval of the football ground from MLSA and the approval of the football ground from MNPI in the EIA. They also requested for the consultation from Marine research center (MRC), Ministry of national planning and infrastructure, ministry of youth, sports and community empowerment for the EIA.

After the meeting the TOR was approved and sent to the supervising consultant the next day.

In the scoping meeting it was informed by the council that the go-ahead for the road mentioned in the TOR was given to the council. Hence, it was requested to remove the access road from the scope but it was retained in the final TOR. Therefore, in the EIA presents Appendix 2 Letter to EPA and letter form EPA regarding the TOR.

12.2 Meeting with *M.Mulah* council

The request for the meeting with *M.Mulah* council was requested on 19th August 19 and the meeting was granted on the 20th August 19. The meeting proceeded with the consultant requesting for the population data and other statistics of the island. the meeting initiated with the discussion of the main source of income for the island. To this the representatives of the island stated that the main source of income for the locals is fishing where the island currently has 7 boats in the

range of 80 to 100 ft and numerous smaller boats that are in service and carry out numerous forms of fisheries activities in the island. They further explained that the main source of income for the council currently is rent from the various leased areas of the island. Next the development plan was discussed the council stated that there are numerous development proposed in the island including a tourism zone in which the council proposes to open the development for the highest bidder and also a local tourism area is also planned. However, the current planned developments are the proposed developments. The council also stated that an official LUP for the island is not developed and so far, all developments are proposed to the government and granted the location from the concerned government body. They also further explained that the new housing projects and the access roads to the new housing areas are granted permission form the government and will follow shortly. Further, they explained that the tourism zones are also proposed and discussions will commence soon.

Next the location of the football stadium was discussed. Initially the concern in the scoping meeting was that the football stadium footprint was directly on the mangrove area. to clarify, the council noted that the footprint of the football ground is in the north west to south east direction not the north east to south west direction as shown in the map initially. Therefore, the consultant requested for the revised drawings prior to proceeding with the survey. Further, the council stated that they have left a buffer of around 200-450ft before the wetland area. This was followed by the discussion of development of the football ground in this location while all other sports related developments are on the other side of the island. To this the council commented that the development of the football ground in this location is important due to the lack of development in this area of the island. Next an alternative location for the football ground was discussed. As per the council, the location is set and can not be altered as the new developments are planned elsewhere in the island.

Next the water sports area was discussed. in the kickoff meeting, the council stated that the water sports area was a governmental promise. To clarify, in the stakeholder's meeting this was further discussed and the council stated that this promise is the general promise that all islands will have a sports area and the council wishes to implement this as this is beneficial for the island. next the location of the water sports area and how it was decided was discussed. To this, the council stated that the location was the best location as it was safe for picnics and safe for kids to play in. They also stated that the proximity of the area to the local tourism zone is another advantage of the location as it can promote the proposed businesses and features of the area. The council also added that they plan to develop the entire area as a picnic area with activities such as canoes, wind surf and services such as jet ski rides and various attachment rides at affordable prices for locals and tourists. They also added that they have an upcoming youth base licensed in these sports activities who are eager to come back from their work stations at resorts to the island to their families once the employment opportunity is available. They also highlighted that they plan to open up the opportunity to provide services with their own gear for services at the water sports area for the highest bidder. This they added was to allow, local expansion to tourist services through in house training for the future. The alternatives for the location was discussed further. And as before the council stands firm on the decision of the location and states that that moving the location would interfere with planned developments.

Next the road to the waste management area was discussed. The location of the waste management area was the topic of initial discussion. To this the council stated that the location was set and granted by the government as the area was far from the settlements. To this the

proximity of the area to the tourism zone and the surf area was discussed and the council ensured that the area is far enough from the tourism area. as for the location of the road to the waste management area, the council ensures that there is no alternative.

The next the discussion was on clearing of the land and the options opted for land clearance. On discussion the council stated that they are in need of the developments and they do not, and have not put a price tag on the plants and the work was awarded procured to the most capable bidder. They also stated that any benefit from the development that is gained from the project will be used in developing the island and be used in retributions to the lost trees of the locals. They also noted that the islanders are aware of the agreement price of the work and the majority of the island approves for this development. They also added that the alternative to tree translocation is slash and burn as the island does not have land for bulk translocation.

The final discussion was on the site for the temporary work camp. After discussions a preliminary work camp area was agreed as the north astern side of the harbor as the area had space. However, the council requests the contractor to request for the details and the utilities necessary, and space necessary for the work camp prior to mobilization and docking to the island.

In the meeting the proponent stated that they will further provide the latest statistics of the island, The in use LUP of the island and the proposed LUP of the island. they also ensured that they will provide the approval of the approval of Ministry of Youth and sports, and the approval of Maldives land survey authority

12.3 Meeting with the women volley team of *M.Mulah*

Prior to the arrival at *M.Mulah*, a meeting request was sent to the council to meet with interested parties and stakeholders of the community. Upon arrival it was brought to the teams attention that the women's volleyball team was interested to meet as a stakeholder for the proposed project. Both for the team's and the survey team's convenience, it was agreed to meet at the sports ground after practice. The meeting started at 18:10.

The first topic discussed was the football ground. Upon asking if the island needs another football ground or sports area, the stakeholder's stated that they are in need of a football ground that can reduce the demand of the shared space with the volley area. They also stated that the current football ground cannot accommodate the existing population especially during football season. They also reported that this often leads to teams carrying excess team members to include all who demands and eventually end up with some who cannot participate in the match. They also stated that they have to often give up their turf during football season due to the demand.

Next the specifics of the football ground was discussed. In the discussion, the stakeholder's noted that they are aware of the dimensions of the football ground and they would like to develop a good football ground with the services such as steel goalposts and clearly marked sidelines. They also demanded that they need a good buffer area for the spectators (stand in this case).

The next topic of conversation was an alternative location. As per the stakeholders, there is no alternative for the football location. They stated that the developed area and the planned upcoming developments are set and most of them approved at strategic location. Hence, moving the football ground would disrupt the proposed plan. They also noted that the area demarked for the development is planned as a development for the eastern side of the island aimed for the

locals of the eastern side as they feel that not enough developments exist on the east. Hence, according to the locals, there is no alternative location.

Next the significance and importance of the mangrove area in the vicinity of the development was discussed. All presented acknowledges and understands the importance of the wetland area and noted that although not in use now in the past the area was crucial and fundamental for their survival in the island. The islanders also noted that they understand that the development is close to the wetland area and there can be potential impacts of the development on the wetland. Hence, they would like the contractor to undertake all precautionary measures before the development.

Next the discussion was focused on the waste management areas [6]of the island. It was clear to see that waste management was a huge concern for the locals. They stated that they have been pushed to the limit when it comes to waste management. They also stated that they have approved the new waste management area long back and is waiting on the authorities to allow for the development. They also noted that the current condition of the waste management area next to the sports ground that holds one football ground and two volleyball courts sends nonstop toxic fumes to the sports area and has serious implications on the performance and the health of the individuals. They also noted that they fear that if the waste area is not complete soon they might have a serious waste management issue as the locals are now opting to dispose waste in almost any direction they please including the surf zone area. When asked about the location of the area they all agreed that the location was perfect as it has the minimum impact on the area.

Next the discussion was on the location of the road. When asked if they agreed on the location of the proposed road they stated that they all agree strongly on the location as the next entrance to the area will turn the existing beach area and the local husk fermenting area to the road will be a loss for the island in the long run. They also stated that the next alternative is through the mangrove area which they do not agree to make any changes to.

Next the discussion was on the water sports are. Where the locals stated that the location was best for the water sports area which is in the best picnic location and the safest beach. They also stated that a water sports area will potentially bring more jobs to the island which allowed families to stay together[7].

Next the stakeholders were consulted regarding the historical areas on the island. To this they stated that they have two historical areas on the island which are the old mosque and the shrine in the island.

12.4 Meeting with the men's football team and volleyball team of *M.Mulah*

This meeting followed the women's volleyball team meeting. Here too the same discussions were held with the same response, where both the teams stated the need of a football ground was to foster for the ever-growing population and the need for even distribution of facilities. They further noted that a practice pitch while competitions are held is important and that the new area can be used as either one.

[6] Here the form of waste management in place is the concept of dump and burn. It must be noted that with the new development, the council wishes to propose proper waste management.

[7] The last statement shows a concern of the islanders for having to leave the island and consequently their families for employment, this must be noted as this has a great impact on many Maldivian families.

They also stated that the proximity of the football ground to the waste management area is extremely close where it almost brings the players to the point of dizziness. They also noted that as the youth among the men, they believe that the waste management area should be built first.

They also noted that there is a large concern by the youth over the waste disposal discipline or rather the lack of one that they have noticed recently due to the lack of a waste management area. They stated that the surf area is now being subjected to trash deposition all over the shoreline and as this is the proposed tourism zone they have serious concerns over the cleanliness and present ability of the area.

They also reported that they have serious concerns over erosion[8] at the surf zone, after completion of the harbor.

12.5 Meeting with elders of the island.

The meeting for the elders was requested on 3/9/19 and granted on 4/9/19 at 21:00, at the harbor café. The meeting commenced after a brief introduction from the senior admin officer followed by the ZV of the island. The first topic of discussion was the access road to the waste management area. In the discussion, the elders of the island noted that they were in desperate need of a solution to the waste management of the island. They further noted that they are in need of proper waste management as the current waste management practice is to burn the collected garbage. They also noted that the island has had issues with flues and respiratory problems and allergies due to the unsanitary, and less than ideal waste management practice used.

The next set of discussions were on the water sports are. To this, the elders noted that they have a potentially ideal location for the development of the watersports area and are in need of an expansion to the field of watersports. They also noted that this development is important for the youth and the old alike as this will provide much needed entertainment and inculcate the appreciation of nature and natural resources within the community. They also noted that the overall development would bring the community closer.

Next the topic of discussion was on the football field development. During the discussion, it was noted that the development of the football field will bring a relief to the existing overcrowding of the stadium and the streets during the football season and offseason alike. They also noted that they look forward for the new development in hopes that it will bring a stop to the practice of playing on the streets during football season.

Next the significance of the wetland area to the island was highlighted. They stated that in the past the area was not smothered by vines and access was easy as the area was managed. However, in the past few decades the area was largely ignored due to imports and a lack of need for the islanders to go in search of food in to the forest area. They also noted that the old roads are now inaccessible as new fats growing trees are in the way and reaching the once important source of food is hard. They also cautioned the youth stating that the resource should not be looked over as it is the only mode of sustenance on the island if history is to repeat itself[9]. They also stated that

[8] Placement loss erosion is seen in this island too. The concerned locals stated that they can notice shallowing of the harbor with this erosion. It must be noted that this is common in Maldives some of the examples include Sh. Noomaraa, Sh. Lhaimagu and *M.Mulah*.

[9] Reffering to WW2, and the famine that followed the disruption of the marine and areal supply routes due to war.

the current condition can be reversed to a more ideal, useable condition through management as they used to do in their childhood some sixty to seventy years back.

The last topic of discussion was the ideal work camp location. On the topic, the elders recommended the harbor area as the best for such a workforce. They also noted that accommodation at the local facilities and houses are also welcome as long as the council is informed.

12.6 Meeting with MRC

The. meeting with MRC was requested on the 27th of Aug and granted on the 28th. At MRC, the data from the stakeholder's consultation and the work scope was explained. At MRC they commented that it was out of there scope as sand from the marine environment is not borrowed for any purpose. They further noted that the contractor must ensure that removal of trees from near/on the buffer area of the wetland has minimal chance of causing runoff into the sea as this may impact the marine life.

12.7 Consultation with Mulaku atoll council

After a phone call, an email with the details and the stakeholder's consultation details were sent to the atoll council and the concerned staff for comments (Appendix 31 Email proof 4 Mulak atoll council).

12.8 Meeting with MNPI

Invitations through emails and phone calls were exchanged for consultation, we are yet to be granted a meeting (Appendix 29 Email proof 2 MNPI).

12.9 Meeting with MYSCE

Invitations through emails and phone calls were exchanged for consultation, we are yet to be granted a meeting (Appendix 30 Email proof 3 Youth)

13 Policy and legal framework

13.1 Introduction

The following section addresses the legal, policy , administrative framework for the environmental management and some regulatory guidelines and standards relevant for the proposed project All the activities during both development and implementation stage of the proposed project will be carried out in accordance with existing plans, policies, guidelines, laws and regulations of Maldives in addition to relevant international conventions to which Maldives is a party to.

13.2 Relevant Environment Legislation

13.2.1 Environment Protection and Preservation Act (Act no. 4/93)

Environment Protection and Preservation Act of Maldives (4/93) is the framework law on environmental management in the Maldives. Articles 2, 4,5,6,7, and 8 of the law are relevant to this project.

13.2.1.1 Article 2

states that the concerned government authorities shall provide the necessary guidelines and advise on environmental protection in accordance with the conditions and needs. All concerned parties shall follow the guidelines provided by the government authorities

13.2.1.2 Article 4

states that the Ministry of Housing, Transport and Environment shall be responsible for identifying protected areas and natural reserves and formulating the necessary rules and regulations for their conservation and protection. The proponent shall ensure that there is no negative impact from the proposed project on any protected areas

13.2.1.3 Article 5

(a) states, an Environmental Impact Assessment shall be submitted to the Ministry of Housing and Environment (MHE) if a project is likely to have an impact on the environment, before implementing any activity. This EIA report is prepared and submitted by the project proponent to fulfil the legal requirement specified in Act (4/93)

13.2.1.4 Article 6,

the Ministry of Housing, Transport and Environment has the authority to terminate any project that has any undesirable impact on the environment without any compensation. The project proponent is aware of this condition and will ensure all practical measures to prevent irreversible and significant negative impact of the project.

13.2.1.5 Article 7

of the Environment Protection Act (4/93) prohibits the disposal of wastes, oil and gases in a manner that will damage the environment. Wastes, oil and gases must be disposed in areas designated by the Government. Hence, the project proponent shall use the Environmental Management Plan for this project which specifies how the wastes, oil and gases generated by the project will be disposed.

13.3 Relevant Regulations and Guidelines

13.3.1 Environmental Impact Assessment Regulations 2012

The decision to go forward with an EIA will be decided upon screening process. which dictates a category and the scope of the EIA. The proponent and the proponent's

consultant (who is a registered consultant) will meet the EPA and stakeholders in a scoping meeting which will approve the TOR which will set the limits for the EIA. The EIA will start with the baseline studies, impact prediction and finally reporting the findings with impact mitigation and monitoring program. This report follows the procedures for EIA outlined in the EIA regulations.

The EIA report is reviewed by EPA, where a decision note will be given accordingly. After approval the project proponent will be required to follow the monitoring and implement the mitigation measures prescribed in the EIA.

13.3.1 Regulation on Sand and Coral Mining

This regulation covers sand, coral, and aggregate mining from costal zones, and uninhibited islands that have been leased. This regulation is of direct relevance to the project. A ban on coral mining from house reef and atoll rim exists since 26 September 1990. This project strictly follows the ban.

13.3.2 Regulation on Sand and Coral Mining

Since 2nd April 2013 the regulation of Dredging and Land Reclamation was in effect with the aim of reducing environmental impacts associated with dredging activities in islands, and reefs across Maldives.

It defines the rational acceptable for dredging only in cases necessary, as those approved for developmental activities on inhibited islands and economic islands. All dredging and reclamation activities must be approved by EPA. It defines rational for reclamation as those absolutely necessary for social, economic or safety purpose. Beach replenishment is restricted from 10m of the registered shoreline in resort islands.

- Dreading is restricted in the following areas:
- 500 m form the ocean side of the reef
- 50 m form any island vegetation line
- An environmentally sensitive site.
- Land reclamation is restricted within 200m of a sensitive area
- Land reclamation cannot exceed 30% of the house reef area.

13.3.3 Regulation on cutting down trees

Cutting down trees and relocating trees are regulated in the Maldives by law on cutting down, uprooting, digging out and exporting of trees and palms form one island to another. The law is made in accordance to Law No 4/93. The law states that the law is to educate the citizens and contractors and developers on the importance, and need of management of trees and provide preservation of the existing trees.

The law prohibits the following trees to be removed.

- The riparian vegetation growing around the islands extending to about 15m from the vegetation line inland.
- All trees and palms growing in mangroves and wetlands, and the vegetation surrounding the area spreading 15m from the wetland.
- All trees in Government protected areas
- Trees that are being protected by the Government in order to protect species of animal organisms that use the trees as habitat.
- Trees / palms those are unusual, unique, and special in nature.

In case off removal, the law states

- That prior permission must be obtained for removal or relocation of 10 or more palms.
- Un-specified removal and land clearance requires an EIA.
- The crown spread of the palms should be at +15 ft from the lowest point to qualify for removal.
- The trees to qualify for removal should be more than 8ft from the lowest point of the trunk to the tip of the highest branch.
- It also states that all trees removed shall be removed under the supervision of the government authorities that holds jurisdiction.

13.4 Relevant Regulations and Guidelines Environmental permits required for the project

13.4.1 Environmental impact Assessment (EIA) Decision Note

The decision note is based on the comments of the EIA reviewer. The note may request further information from the proponent or may declare that the EIA provides enough details to proceed with a decision. If the EIA is not rejected, the decision note will administer the scope of the project and strengthens the EIA which binds the proponent, contractor and sub-contractors to the monitoring and implementation of the mitigation measures prescribed in the EIA.

13.4.1 Dredging and Reclamation Permit

If the project requires dredging and reclamation, a permit must be taken from EPA. A specific form published by the EPA must be completed and submitted for the approval. EIA application will not be accepted if the approval is not given.

13.5 Responsible Government Institutions

The main governmental institutes that acta as the main answering bodies are

13.5.1 Ministry of environment and energy

The ministry is responsible for the policies while the EPA manages the technical aspects of various projects. screening, scoping, approval of terms of reference, reviewing and requesting for additional information, issuing decision statement and halting a project falls under the EPA.

13.5.2 *M.Mulah* island council

The island council can act autonomously on developmental activities in coordination with the government to meet the needs of the people.

13.6 Guiding Policies and Documents

13.6.1 Policy of waste management

The policy was framed keeping in mind a healthy environment which is solid waste free. Ensuring safe disposal of Solid waste, chemicals and hazardous industrial waste. Encouraging recycling, and reducing of waste generated. It also allows development of guidelines on waste management and disposal and advocate enforcing such guidelines.

13.1 International Conventions

13.1.1 United Nations Convention on Biological Diversity (CBD)

Maldives is a party to the CBD The objective of the convention is "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding".

Although the project does not fall on any protected area the numerous dive site in the area and the seagrass bed surrounding the island is now recognized for its ecological value. Loss of seagrass habitat for the project is inevitable. However, disturbance and sedimentation must be minimized to allow minimum loss of the coral reefs surrounding the area. Hence, it is recommended for the developer to use all mitigation measures including planning a pathway and maintenance of the vehicles to minimize any incidences of negative impact.

13.1.1 International Plant protection convention (IPPC)

Since 3rd Oct 2006 Maldives follows the IPPC in order to protect the native plant species in the Maldives form the risk of disease from introduced and imported plants. Hence, it is advisable for the proponent to be aware of the requirements of the IPPC and obtain the necessary IPPC certifications if any plant is to be imported later on.

14 Potential Impacts

14.1 Introduction

In this section the objective is to investigate the potential impacts of the proposed project on the existing environment. The identification of an impact does not ensure the occurrence of the impact and it does not mean that it cannot be mitigated. However, it informs the authorities that the proponent is made aware of the impacts and the contractor is informed of the expected mitigation measures for the proposed project prior to awarding of the work.

14.2 Impact predication

Various methods of impact assessment are available. The assessor must understand and consider the proposed method, the baseline natural environment and the socioeconomic environment of the project while assessing the impacts. The proposed work is simple. Possible impacts that can arise from the proposed work on the area are described according to the work location, extent (magnitude) and characteristics. Further the intensity of impacts is classified into; negligible, minor, moderate, and major for identifying the best possible mitigation. The impact categories are classified as follows

Table 27 Intensity of impacts defined

Impact category	Description	Reversible \ irreversible	Cumulative impacts
Negligible	The impact has no significant risk to the environment either short-term or long term.	Reversible	No
Minor	The impact is short-term undesirable but accepted	Reversible	No
Moderate	the impact give rise to some concern but is likely to be tolerable in short-term, or will require value judgment as to its acceptability	Reversible	May or may not
Major	the impact is large scale giving rise to great concern; it should be considered unacceptable and requires significant change or halting of the project	Reversible and irreversible	Yes, mitigation measure has to be addressed

The principle of Leopold matrix (Leopold, Clarke, Hanshaw, & Baisiey, 1971) has been used to classify the magnitude and importance of the possible impacts which may arise during the various stages of the proposed project. The dimensions of the matrix refer to the possible / foreseeable / probable impacts of the proposed work/project/activity) on the existing environmental conditions at the proposed work area. Leopold matrix lists numerous actions which cause impacts and environmental conditions. The current matrix is modified for the specific project.

The actions are evaluated in terms of magnitude of impact on the environment, significance of impact on the environment and the probability of impact as described in the paper by Josimović & Petric, 2014.

Table 28 Evaluation criteria, grading scale

Evaluated criteria	Designation	Scale
Impact probability	M	impact is possible (probability of less than 50%);
	V	impact is probable (probability of over 50%);
	I	impact is certain (100% probability).
Impact magnitude	0	No observable effect
	1	Low effect
	2	Tolerable effect
	3	Medium high effect
	4	High effect
	5	Very high effect
Impact significance	L	Limited impact on location
	O	impact of importance for municipality;
	R	impact of regional character;
	N	impact of national character;
	M	Impact of cross-border character.
Impact duration	P	Occasional/Temporary
	D	Long term/ Permanent

The proposed project is straight forward and has few potential impacts limited terrestrial modification / development. The construction phase contains impacts unique to the development stage while, potential impacts while during operation, is unique as well.

14.2.1 Impact zone analysis

14.2.1.1 Football ground

The impact area during construction of the football ground is marked on the map below (Figure 40). The impact zone demarked is approximately 10m form the border of the work area. The impact zone has borders with the existing buffer of the mangrove area. The buffer being a dry zone, the demarcation of the buffer on the map must be used to identify the buffer limits. The vegetation is thick for the most part of the impact zone towards the mangrove side. However, the impact zone on the road side is open, facing urban areas.

14.2.1.2 Water sports area

The impact area during the construction of the water sports area is marked on Figure 41. The impact zone is approximately 10m form the work footprint. The impact zone goes over the shoreline buffer zone of the section. However, as shown on the map, the area remains as a no development zone.

Football area map

INSA Pvt Ltd.
Real World Solutions

INSA PVT LTD
H.Dhooriha,
5th FLoor,
Kalaafaanu Hingun,
Male', 20076, Maldives.

Figure 40 Impact zone demarked approximately 10 m from the area of impact. (reduced map)

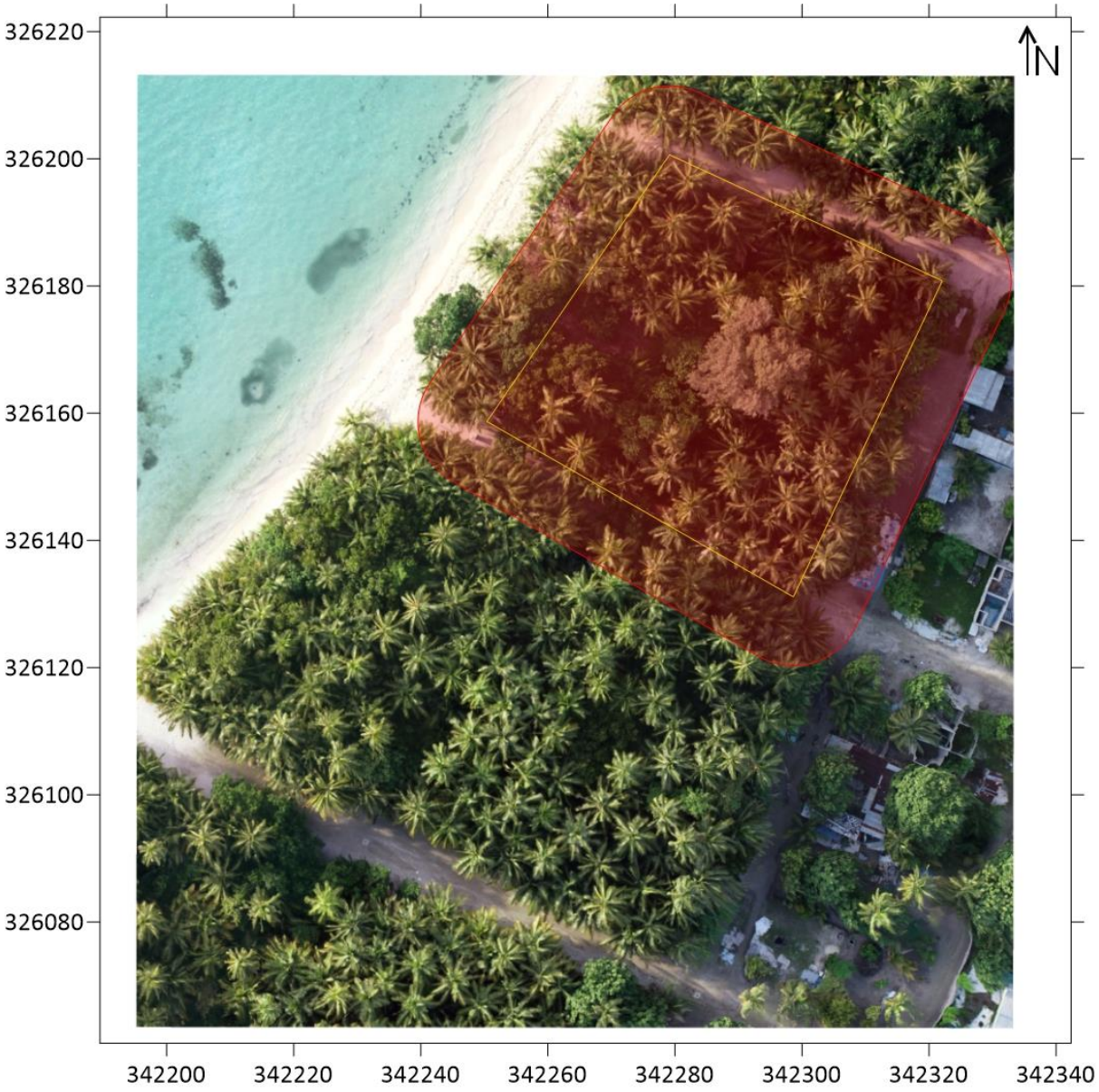


Figure 41 Impact zone predicted for water sports area (Reduced map)

14.2.2 Limitations of impact prediction

The limitations of the impact prediction are. Due to time constrains and scheduling, long term data necessary for impact prediction is unavailable. Thus, acting as a major limitation. Long term data is necessary to understand the complex systems of the project area A limited understanding of these unique features, how these features change over time, impact the local population have on these features due to their activities, and a lack of documented historical data is another limitation.

The possible bias in the available historical data, stakeholder's consultation and the proponent's information is also considered. Impact prediction is carried out using the available data during site visit. Hence, is another major limitation.

14.2.3 Impacts during construction

In any developmental project, direct impacts to the environment occurs during construction phase. The term "construction phase" hear-forth refers to; mobilization, land clearance, Development and demobilization and all activities in between.

14.2.3.1Environmental impact of the construction and operation activities

14.2.3.1.1 Air quality

The air quality in the Maldivian islands depends on the type of settlement, the location of settlement and the work carried out by the locals and the topography of the island. It is rare to see hazardous toxic concentrations of particulate matter within islands due to the open nature of the islands mostly due to a lack of high raising features and low laying basins on the islands. This is not to state that the air quality of the islands are ideal, in most cases due to improper waste disposal methods the areas islands go through periods of bad air quality.

The air quality of the island specifically is unideal as the island has no waste management area and are forced to pile and burn waste all over the island specifically on the south western side of the harbor. The burned waste often is blown across the harbor to the playground and into the houses nearby.

In the construction and operation phase, due to mobilization, site preparation, land clearance, construction and demobilization it is highly unlikely that any impact will be felt on the existing environment due to the intensity of the existing air pollution.

The only construction component that requires the use of cement is in the development of the water sports area. Therefore, any use of cement will cause an increase in the particulate matter (PM) concentration which is a negative impact.

14.2.3.1.2 Terrestrial flora

Terrestrial flora of the island is typical of a low laying coralline island. Here a feature of the island is a higher ridge system; typical of standalone islands which causes a depression in the island. The flora of the island consists of native naturalized and invasive species in a continuum of costal, forest and mangrove ecosystems. During operation phase, mobilization and demobilization, site preparation, and waste collection are set in the work camp area as proposed. Thus, the above mentioned do not require cutting of threes are they are mostly proposed on bare land on the harbor.

Land clearance and construction on the other hand will fall exactly on the forest area and will require removal of the trees which will have a permanent, negative impact on the existing terrestrial environment specifically the existing native trees and the fauna that reside in it. This will also create a large edge effect further exposing the animals that use the area as habitat to

human interaction and other animal interactions such as cats and rats. Minimizing the population due to exposure and loss of habitat.

Land clearance will also cause the loss of native vegetation from the area exposing the under canopy promoting the growth of the vegetation underneath and on the sides, which will require constant monitoring and maintenance. Usually invasive species succeed over the native, smothering the native flora. Thus, negatively impacting the biodiversity of the area.

The operational impacts on the terrestrial flora and fauna of the proposed footprint is not discussed the football ground due to a lack of one. However, on the periphery of the footprint during operation stage the plants that grow will mostly be grass and weeds which depending on the type of weed might impact the existing footprint negatively smothering the existing plants. For the animals that inhibit the area, the exposure will drive them away deeper into the existing wood cover, which will increase competition within the area. These are negative impacts of the proposed work on the fauna and flora. The open space also promotes positive changes. Which includes, creation of new habitat for new life forms. These must be monitored overtime. As for the footprint of the water sports area, the new habitat will promote growth of new plants and will also bring new terrestrial forms of animals to site.

14.2.3.1.3 Ground water

The contractor proposes to use the same water grid as the island locals. Therefore, no impact of the increase in population due to mobilization, site preparation, and demobilization is predicted on the water table.

Impact is likely due to site clearance on the water table as this removes a percentage of the catchment area of the island and compacts the ground to a hardness that makes water impermeable or at least promotes the water to flow off the compacted area.

Impact is also likely due to exposure, post site clearing, the chances of dumping and accumulating trash and biodegrading matter on the cleared area is likely, given that a well-managed and planned waste management system is not in place by the time. The abovementioned impacts in combination with stagnating water on site if not maintained will eventually allow draining of contaminated water to site.

Another impact that should be closely monitored and mitigated, would be the impact of vehicle spillage on site. Often a common occurrence during operation in heavy vegetation, vehicle spillages of hydraulic fluid, gear oil, petrol and grease on site, leaves contractors with a limited option of actions to manage and mitigate. This often leads to the leaching and draining of toxic material to the water table.

These impacts in combination will reduce the quality of the water to a level that can only be determined quantified after construction monitoring or a post completion monitoring and comparison with the baseline data collected.

14.2.3.1.4 Soil

Soil often disregarded as a component of minimum impact, on the contrary, soil as component will go through the most impact as it is inevitably exposed.

Movement of vehicles on dirt roads often result in either compaction of the sand or churning and loosening of the soil. In elevated grounds the loose soil in the absence of trees when mixed with water flow downstream effecting the water quality. On flat surfaces, the soli when loose in the

presence of water mixes, and settles in ponds that eventually drains to the water table or evaporates depending on the soil. Either case has an impact on the environment.

When soil mixed with hazardous substances as a medium with an extremely large surface area, long-term environmental exposure of the substance as removal is extremely difficult. Leaching of the substance to the water table can have negative impacts on the locals.

Similarly when the sand is hardened and compacted, after heavy vehicle movement, the compacted road can also promote flooding resulting in loss of property and damages in a heavy downpour.

During the development of the water sports area, although a minimum, prefab, concept is proposed, the structures will stand on a foundation with the foundation of the wash area and the lavatory. The foundation of the hut might be cast at site or might be brought in pre cast. Therefore, the use of cement on the pad footing will mix the cement to the existing sand composition and will be a negative impact..

14.2.3.1.5 Hazard, risk, and safety

Mobilization, site preparation, land clearance, construction work, and demobilization for the specific project has a set of hazard, risk and safety issues. Which directly puts the locals in risk of hazard.

14.2.3.1.5.1 Movement of heavy vehicles.

On inhibited islands, heavy vehicles use can cause unnecessary disruption. Specially on island that has minimum vehicles. although the movement of vehicles would be on allocated roads, the movement can put the locals and their properties at risk, impacting negatively.

14.2.3.1.5.2 Work camp related accidents.

There is also the risk of having a work camp and equipment on the island. Locals are often made aware and are aware of the all the rules of a work site, and follow the border barriers set, and demarked by the contractor and the council. In rare cases the contractor finds either a deliberate or an uninformed trespasser in the camp who might be in harms way. In case of an accident, this will have a negative impact on the locals.

14.2.3.1.5.3 Accidents during land clearance,

This project specifically requires digging of diches and removal of large plants which are all actions with potential risk of hazard. As stated in the section ‘Site demarcation and mobilization’, all sites should be prepared accordingly. This will ensure that the contractor has done everything possible to prevent the locals form venturing into the work area. However, in the rare case of entry, falling into a root ball dich can seriously injure the individual. Additionally, in case of a fall of the tree or snap of a root tie to the crane, the chances of loss of life is also likely.

14.2.3.1.6 Impact on the wetland

The proximity of the development is very close to the buffer area of the wetland and will impact the wetland and the quality of the water in the wetland. Opening of the plot of land removes much necessary topsoil and leaf litter that filters the water before being absorbed slowly to the wetland. The compacted ground of the football area ensures flow over of the water to the natural depression; wetland. This unfiltered water flow will carry with it surface waste and ions that can decrease the quality of the water in the wetland. Similarly, the use of the area by people of all ages will collect the inevitable human nitrogenous waste can again decrease the quality of the water in the wetland area.

The loss of topsoil and leaf litter from a patch will cause an overall loss in the water retained in the area which will have an impact on the wet barrier surrounding the area. The rescission of the wet barrier/ mangrove footprint translates to ecological change and addition of silt and topsoil to the mix form the development will further promote ecological succession. This can eventually cause the island its food security. Highest mitigation must be practiced for the border within the buffer and the footprint. Monitoring will show if there is a recession of the line.

Using heavy machinery in the area comes with the risk of exposure to vehicle lubricants and other hydrocarbons. If hydrocarbons are released to the area it will have a negative impact on the existing area and water quality. Baseline data shows the tested hydrocarbon content at all sites and should be referred to during monitoring.

Opening up access to the edge of the buffer zone allows easy access to the wetland area. This will allow locals the possibility of entrance to the area and will make the area a frequented area. this will also help the locals manage the area better than now. These are positive impacts of the from management point of view. Consequently, it provides negative impacts if waste management is not implemented.

14.2.3.2 Social impact of the construction and operation activities

14.2.3.2.1 Employment for the contractor

The contractor is likely to bring all the necessary staff for the project however, employment in transport, food, beverage, and hospitality is likely throughout the process. This will be an economic benefit for the island. It must always be made clear to the locals that the employment brought in by the proposed work is temporary.

14.2.3.2.2 Employment in the facilities.

The implementation of the facilities will provide new job opportunities. During the operation phase this will ensure economic benefit through operation and management. This economic increment would be a positive impact to the locals.

14.2.3.2.3 Increase business opportunities

The implementation of a water sports are will promote the affinity for locals and other islanders alike, to visit. Therefore, promoting local tourism. this will further increase the likelihood of development of other guesthouses and accommodating facilities on the island. This will be a positive impact for the island.

14.2.3.2.4 Disease

An influx of new individuals to a different social setting may promote the spread of numerous diseases starting form sexually transmitted diseases to different types of colds. This impact is likely post mobilization and commencement of work. For the construction phase the local trust, the isolated accommodation organized by the contractor and the economic stability of the island may mitigate the spread such infections. For the operation phase, the locals are aware of the consequence of the increase in temporary population to the island and believe that through awareness activities and other social mitigation activities such negative impacts will be mitigated. Although controversial, it is naïve to not consider diseases as a socio economic, negative, impact of the proposed development.

14.2.3.2.5 Social stability

On the site visit, it was noted that the proposed work camp site is an area for the local cafes. The young and the old, men and women, alike, to enjoy the space frequenting throughout the day. Closing of a section of the area might promote social unrest as this may hinder the potential

business of the locals and may make one of the social gathering spots undesirable. Another factor that can cause social unrest the negative mixing / clashing / interactions of the contractor's staff and the locals. Hence, the staff must always be advised to maintain professional behavior during the stay.

Social unrest may also be caused by un-even opportunities from the contractor to the locals. This must be mitigated through careful use of local help.

14.2.3.2.6 Economic benefit for the council

As identified in the stakeholder consultation the only source of income for the island is through the generated rent from different plots of the island. the proposed project promises an increase in the generated income through rent for the football ground and the watersports area. This will ensure an increase in the generated income for the island which will allow the island council to further develop the facilities.

14.3 Impact analysis

The following is the impact analysis according to the probability of impacts, significance of impacts, magnitude of impacts and the duration of impacts For key please refer to Table 27, Table 28. The main environmental impacts during the construction phase are permanent and negative However, the social impacts of the use of the proposed projects are permanent and positive and outweighs the negatives

It must also be noted that one of the highest negative magnitudes of impacts during construction is form the activities of land clearance, accidental spillages, and waste generation. The environmental factor that carries the highest negative impact are ground water, soil, air quality and terrestrial flora. Social aspects such as employment and other economic benefits show a positive impact (Table 29, Table 30, Table 31, Table 32). Probability of impacts

The overall social and economic components reviewed goes through a positive impact as the projects were requested by the locals. The negative impacts can be seen predominantly on the environmental components as the work proposed will cause quiet a lot of environmental change. Specifically on the ground water and footprint of the work area.

The wetland area is in a very delicate region in this project. The slightest breach of the construction silt, waste, etc. into the wetland area will have a everlasting negative impact on the habitat which in the long run will impact the food security of the locals.

Table 29 Assessment of probability of impacts

	Development activities									Operation activities	
Impact factors	**Football / water sports area**									**Football / water sports area**	
	Mobilization	**Site preparation**	**Workforce**	**Land clearance**	**Construction work**	**Accidental spillages**	**Waste generation**	**Operation of heavy machinery**	**Demobilization**	**Use of water sports are**	**Use of football ground**
Air quality	M	M		V	I	I	M	V	M	M	V
Terrestrial flora		I		I	I	I	I	V		M	M
Ground water		V		I	V	I	I	I			M
Soil	I	I	I	I	I	I	I	I	I		M

Hazard, risk, and safety	V	V	V	V	V	V	V	V	V		
Impact on the wetland		I		I	I	I	I	I			
Employment for the contractor	M		M	M	M		M		M		
Employment in the facilities	I		I		I				I		
Increase business opportunities	I		I		I			I	I	I	I
Disease	M		M				M		M		M
Social stability	M								M	V	V
Economic benefit for the council				M						I	I

14.3.1 Significance of impacts

Table 30 Assessment of significance of impacts

	Development activities									Operation activities	
Impact factors	**Football / water sports area**									**Football / water sports area**	
	Mobilization	**Site preparation**	**Workforce**	**Land clearance**	**Construction work**	**Accidental spillages**	**Waste generation**	**Operation of heavy machinery**	**Demobilization**	**Use of water sports are**	**Use of football ground**
Air quality	L	L		L	L	R	L	L	L	L	L
Terrestrial flora		L		L	L	L	L	L		L	L
Ground water		L		L	L	L	L	R			R
Soil	L	L	L	L	L	L	L	L	L		L
Hazard, risk, and safety	L	L	L	L	L	L	L	L	L		
Impact on the wetland		R	L	R	R	R	R	R			
Employment for the contractor	L	L						L	L		
Employment in the facilities	R		R			R	R	R	R		
Increase business opportunities	R			R					R	L	L
Disease	N								N		R
Social stability	L		L						L	L	L
Economic benefit for the council				L						R	R

14.3.2 Duration of impacts

Table 31 Assessment of duration of impacts

	Development activities									Operation activities	
Impact factors	**Football / water sports area**									**Football / water sports area**	
	Mobilization	**Site preparation**	**Workforce**	**Land clearance**	**Construction work**	**Accidental spillages**	**Waste generation**	**Operation of heavy machinery**	**Demobilization**	**Use of water sports are**	**Use of football ground**
Air quality	P	P		D	P	D	P	P	P	P	D
Terrestrial flora		D		D	D	D	D	D		D	D
Ground water		D		D	D	D	D	D			D
Soil	D	D	D	D	D	D	D	D	D		D
Hazard, risk, and safety	D	D	D	D	D	D	D	D	D		
Impact on the wetland		D		D	D	D	D	D			
Employment for the contractor	P		P	P	P		P		P		
Employment in the facilities	P		P		P				P		
Increase business opportunities	D		D		D			D	D	D	D
Disease	D		D				D		D		D
Social stability	P								D	P	P

Economic benefit for the council	D	D	D

14.3.3 Magnitude of impacts

Table 32 Assessment of magnitude of impacts

	Development activities											Operation			
	Football / water sports area											**Football / water sports area**			
Impact factors	**Mobilization**	**Site preparation**	**Workforce**	**Land clearance**	**Construction work**	**Accidental spillages**	**Waste generation**	**Operation of heavy machinery**	**Demobilization**	**Sum**	**Average**	**Use of water sports are**	**Use of football ground**	**Sum**	**Average**
Air quality	-2	-2		-2	-3	-3	-3	-2	-2	-19.0	-2.4	-1	-1	-2.0	-1.0
Terrestrial flora		-2		-2	-2	-2	-2	-2		-12.0	-2.0	-2	-2	-4.0	-2.0
Ground water		-1		-5	-5	-5	-5	-3		-24.0	-4.0		-4	-4.0	-4.0
Soil	-2	-2	-2	-4	-4	-2	-2	-2	-3	-23.0	-2.6		-1	-1.0	-1.0
Hazard, risk, and safety	-1	-1	-1	-1	-1	-1	-1	-1	-1	-9.0	-1.0			0.0	
Impact on the wetland				-3	-3	-2	-3	-3		-14.0	-2.8	2		2.0	2.0
Employment for the contractor	2		2	2	2		2		2	12.0	2.0			0.0	
Employment in the facilities	3		3		3				3	12.0	3.0			0.0	
Increase business opportunities	3		3		3			3	3	15.0	3.0	5	5	10.0	5.0
Disease	-1		-1				-1		-1	-4.0	-1.0		-3	-3.0	-3.0
Social stability	-1								-1	-2.0	-1.0	2	3	5.0	2.5
Economic benefit for the council				5						5.0	5.0	I	I	0.0	
Cumulative values of IF according to the environmental factors	1.0	-8.0	4.0	-15.0	-10.0	-15.0	-15.0	-10.0	0.0			6.0	-3.0		
Average	0.1	-1.6	0.7	-2.1	-1.1	-2.5	-1.9	-1.4	0.0			1.2	-0.4		

15 Alternatives

Prior to suggesting alternatives, the proposed development plan of the island must be referred to (Appendix 7 The proposed developments for the island.). The plan shows;

1. A Guesthouse tourism zone proposed
2. Upcoming housing projects proposed
3. Utility houses and carpentry proposed
4. Farm plots proposed
5. Short term lease plot
6. Proposed police station plot
7. Warehouse and workshop lot

Given the proposed developments, it must be noted that suggestion of the proposed locations becomes extremely sensitive for the council and could not identify an ideal location for the change as the rest of the locations are either developed or falls under a protected / sensitive zone.

15.1 No development options

Not implementing the proposed project implies that the island will not have the proposed developments. Therefore, in the case of the football area, the local's demands will not be met and in case of the water sports are, the governments promise will not be implemented.

Considering the benefits of the project, the "no development" option has been considered not favorable for the proposed project and decided to go ahead with the proposed development.
The developments can take place within the limits of the study, ensuring confinement of the damages due to the development to the studied area and ensuring mitigation of the impacts.

15.2 Development options

After reviewing the proposed project and considering the development plan by the local government, the most ideal locations for the development are the currently proposed options and as detailed in the stakeholder's consultation allocating a new location to the current developments is not ideal as, it will fall into a footprint of a proposed development eventually hindering the development of the already set development.

15.2.1 Alternative locations for the football ground

Moving the football ground north effectively eliminates the possible development of the tourism zone in the proposed location 1. This eventually eliminates the economic benefit from tourism for the island. This will also be a key issue as the area is also proposed for the next housing project.

If the football ground is to be moved the agricultural area it would cause the loss of income for the locals in the area.

Further according to Appendix 27 Letter form land survey authority, the location requested was granted approval for the development. Which is on the eastern side of the island. and considering the eastern side of the island, the only space with a minimum damage to the riparian vegetation and the wetland is the location proposed.

15.2.1 Alternative locations for the Water sports area

If the water sports are is moved to the south, the issue of developing the desired footprint between the riparian vegetation and wetland area becomes a challenge. Further access will be difficult and moves the activities from a relatively safe area to a surf zone.

Due to the current developments in place, moving the developments to the north eastern face of the island is not practical.

Given the conditions at site, the proposed location is ideal for the development.

16 Mitigation and management of the negative impacts

Impact of the environment from various activities have been identified in the respective chapter. The mitigation measures for the possible impacts with the estimated cost of the measure have been suggested in this section.

16.1 Impact mitigation

Table 33 further details the potential impacts identified and details the corresponding mitigation. The mitigation suggested should demand.

16.1.1 Land clearance

- Proper land clearance practice to minimize exposure of water pools, and shallow pits during construction.
- Conducting the land clearance during dry weather conditions.
- Transportation and disposal of excavation waste should be standard practice where accumulation is prevented
- To mitigate the impact of bad weather stalk silt screens must be installed on the barrier of the work are to prevent direct water flow into the wetland area/ inland. The barrier encapsulating the proposed footprint should be appropriate for the existing environment

16.1.2 Tree transplantation

- Cutting down trees and disposing should be avoided.
- While removal / transportation care must be taken to prevent the death of the tree at all cost.

16.2 Mitigation cost

The mitigation measure associated with significant cost for land clearance, excavation, and transplantation is given in the table below.

Table 33 Significant impacts, mitigation measures and associated costs

Activity	Impact	Mitigation	Cost (MVR)
Land clearance	Air quality, and PM concentration due to use of heavy machinery and due to development in the island.	Ensure that the equipment used is maintained to prevent burin Ensure no waste is burned	8,000.00 MVR Maintenance charges.
	Top soil flow, silt and sediment flow out of the work area.	Attachment of silt fence at the football ground that opens up to the wetland area, and the flow off zone on both	Any form of wire back silt fencing with geotextile is recommended. 70,000 .00 MVR

sides of the water sports area towards the beach side and into the island.

Figure 42 Successful establishment of silt fence near the riparian vegetation on a upper water shed (Lakel, et al., 2019)

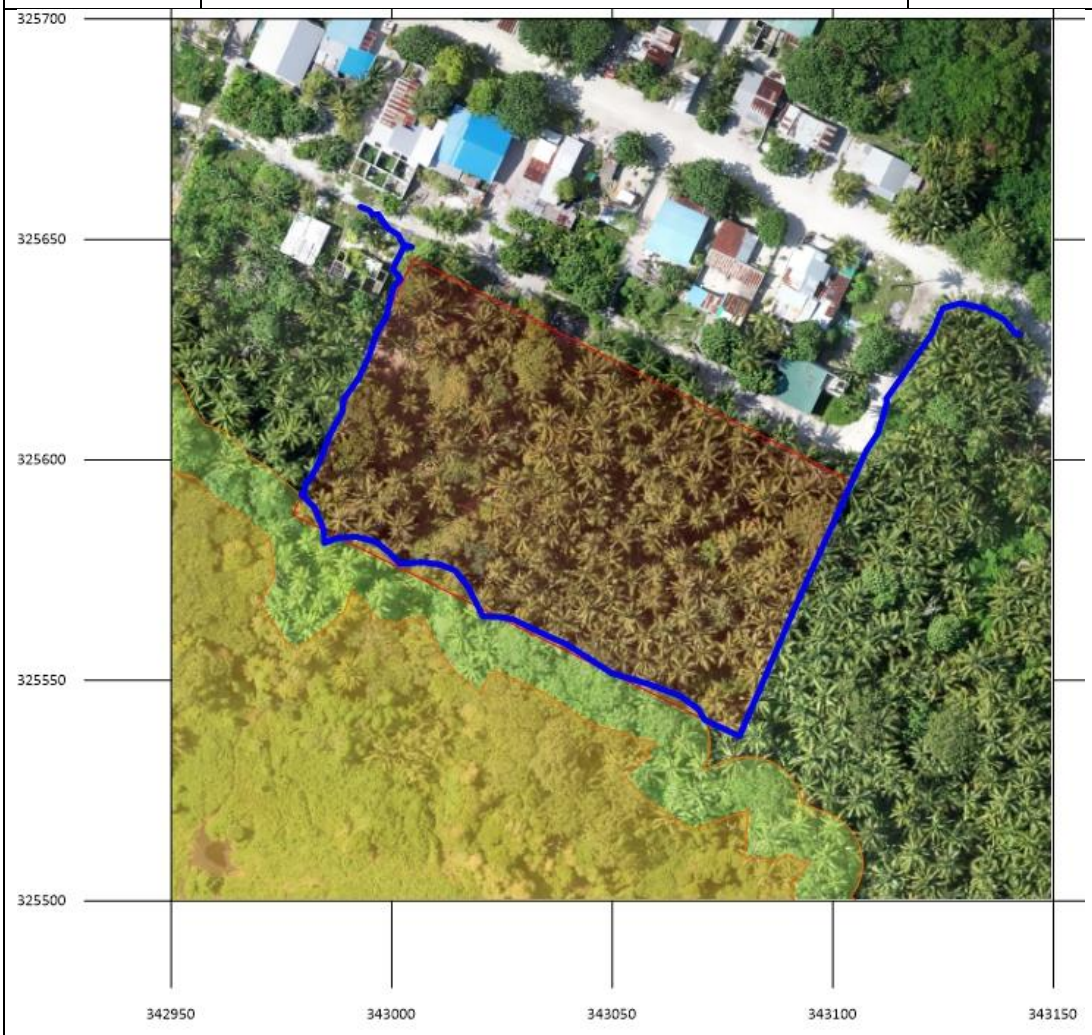


Figure 43 silt fence path proposed wetland area

	 *Figure 44 silt fence sea spots area*		
	Increased ambient noise	All construction should be carried out during daytime to minimise noise pollution. Provide year muffs for construction workers while using machinery	1,000.00 MVR
	Loss of terrestrial flora	All plants will be relocated to desired locations	120,000.00 MVR
Work site related hazards	Movement of vehicles and diching of the roads	Set roads must be planned, and agreed upon prior to movement of vehicles If a road proves too soft for movement of heavy vehicles, alternatives must be found and roads must be repaired.	70,000.00 MVR

		 *Figure 45 Track marks of heavy trucks on dirt roads (source: stock photos)*	
	Hazard safety and risk	All chemicals and oils in storage must be bunded	
	Work camp / site accidents	Work camp and site must be separated using a facade with warning signs.  Figure 46 a Facade at in Male' Maldives (Source: https://www.naheez.com/2016/11/a-huge-tower-crane-in-nasandhura-palace.html)	20,000.00 MVR
Social impact to the people	Short term employment	Inform the employers of the duration of employment.	

17 Environmental Monitoring

The monitoring process is essential to any development project. The monitoring process will determine the level of change during the proposed work, and after the work is done. This also allows the proponent to adjust the methodology depending on the changes observed.

The parameters that are required to be monitored for the project activities are included in the monitoring plan. The objective of the monitoring plan is to monitor and control the environmental effects of the proposed project Therefore, it is highly recommended that the contractor carries out the monitoring plan and present the report to EPA.

The major monitoring requirements are

A monitoring one month after the work commences. Followed by a monitoring every three months throughout the construction phase and a monitoring every 6 months after completion. For one year. The details are in *Figure 36*

Table 34 monitoring requirements and costing

Parameter	Indicator	Baseline/ Reference values	Method technique	Frequency	Estimated cost
Changes in the wet footprint and dry footprint of the mangrove area	Recession of the wet footprint or mud path of the wetland	Baseline in the EIA	GPS tracker	• 3 month after the work commences, • Followed by a a monitoring every 3 months during construction • And monitoring every 6 months after completion till one year.	10000.00 MRF per trip
Changes in vegetation in the wetland	Loss of trees and infiltration of weed	consider the baseline in the existing environment and baseline taken before commencement of work	RTK, and ATS survey Transect survey		15000.00 MRF per trip
Water quality of the island	Changes in the water quality changes of the island .		Probe and laboratory testing NOTE, Salinity, Conductivity, pH, TDS, TPH		4000 MRF per trip

General insect orders in the area	Diversity observed	Take a control plot and make a baseline, compare with the EIA data	Kick sampling Pitfalls Light traps		5000.00 MRF per trip
Waste monitoring	Construction waste and general waste	**	Overall compliance check		500.00 MRF per trip

17.1 Monitoring costs

The proponent shall bear the cost of the monitoring. The proponent is to employ competent monitors, to complete the monitoring procedure as per the schedule. The estimated costs are not a fixed value and should be considered as a reference to the monitoring party.

17.2 Monitoring report format

The following is the monitoring report format expected for this project. The report will include details of the site, data collection and analysis methodologies, sampling frequency, and analysis. All data collected in the monitoring period shall be presented in the monitoring without bias.

Introduction

- Aims and Objectives

Existing conditions

- Terrestrial Environment (vegetation, footprint area, groundwater)

Comparison with EIA Baseline Data

Impact Monitoring

- Ground water quality
- Changes in the wet path footprint
- Habitat change

Compliance Monitoring

- Water Quality monitoring
- Waste monitoring

Conclusion and Recommendations

18 Conclusion

The EIA was carried out as the locals of the island demanded the development of a football ground and was promised a water sports area.

Review of the previous work done on the island shows that the council is undergoing numerous developments approved by the government and wishes to time and complete the proposed development together.

The current EIA focuses on the proposed development of the football area and the watersports are. The impact assessment is limited to the stated developments.

The proposed project has numerous high impact activities including impacts of land clearance, accidental spillages, and waste generation which has the highest negative impacts. The project also has specific environmental components such as ground water, terrestrial flora, air quality and soil that bears most of these negative impacts. For this project, the main positive impacts are social; such as general wellbeing and employment Thus, establishing that the direct and indirect positive economic and social impacts are present

The proponent, when faced with the challenges of land clearance for development, the environment friendly mode of transplantation was opted. The transplantation will be of exactly 150 and approximately[10] 197 plants from the football area and the water sports area respectively.

The main impact zone is confined to the project area. However, the wetland area is at the petrify of the work area with the buffer in place for the football area. If not mitigated, the development of the football area will have a negative impact on the wetland area. Such an instance will cause a negative impact that can have a lasting effect on the island food security and cause numerous negative impacts. Therefore, if the work is to be carried out, all mitigation measures must be met. In addition, the proponent must monitor and report the findings as prescribed.

To conclude, the locals and the council request the development of the proposed work. The island in need of the development to overcome the challenges of accommodating an ever-growing population.

[10] Since the area is developed as a green space, the bare minimum required to remove, will be removed.

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All CVs at Appendix 25

21 Appendix