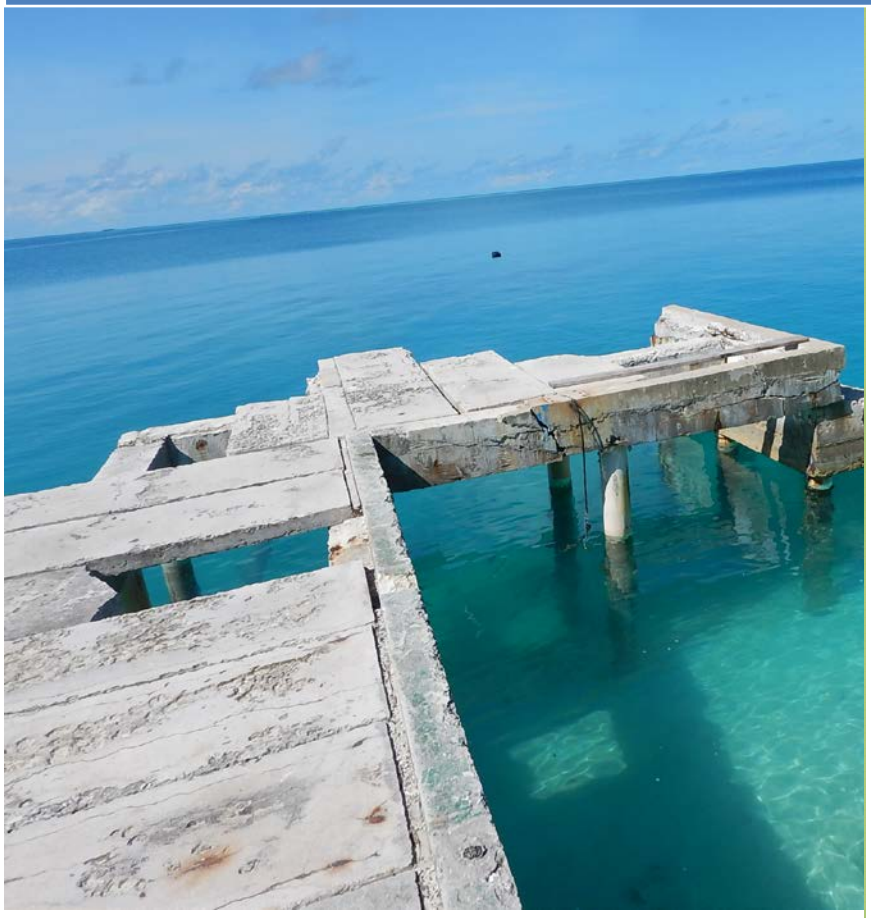
ENVIRONMENTAL IMPACT ASSESSMENT FOR ISLAND ACCESS JETTY RECONSTRUCTION PROJECT INMANDHOO, SOUTH ARI ATOLL



Prepared For:
Ministry of Housing and Infrastructure

July 2017

Prepared by:

Dr. Mahmood Riyaz (EIA 03/07)

Dr. Mohamed Shiham Adam (EIA 01/07)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Declaration of the Consultant:

I certify that the statements made in this Environmental Impact Assessment are true, complete and correct to the best of my knowledge and available information at the time of writing this report.

Dr. Mahmood Riyaz (EIA03/07)
18 July 2017

Declaration of the Proponent

1 ސާދާ ޚުލާސާ

1. މިރިޕޯޓަކީ، އދ. މަންދޫގައި ބަނދަރު އަޅައި ފާލަމް ހެދުމުގެ ޕްރޮޖެކްޓް ކުރިއަށް ގެންދިއުމަށް ކަނޑައަޅާފައިވާ ގޮތުން، ތިމާވެށްޓަށް ކުރާނެ އަސަރުތައް ދިރާސާކޮށް ތައްޔާރުކުރި ރިޕޯޓެވެ. ކުރުމުގެ މަސައްކަތުގެ ތިމާވެށްޓަށް ކުރާ އަސަރުތަކާ ބެހޭ ޤަވާޢިދާއި އެއްގޮތަށް ތައްޔާރުކުރެވިފައިވާ ރިޕޯޓެކެވެ. މިގޮތުން ތިމާވެށްޓާ ބެހޭ ޤާނޫނާއި ގަވާއިދުތަކާއި ޤައުމީ ސިޔާސަތުތަކާ އެއްގޮތަށް ތައްޔާރުކޮށްފައިވާ އެންވަޔަރަމަންޓަލް އިމްޕެކްޓް އެސެސްމަންޓް (އީއައިއޭ) ރިޕޯޓެވެ. މަޝްރޫޢުގެ ޕްރޮޕޯނަންޓަކީ މިނިސްޓްރީ އޮފް ހައުސިންގ އެންޑް އިންފްރާސްޓްރަކްޗަރއެވެ. އދ. މަންދޫގައި ބަނދަރު އަޅައި ފާލަމް ހެދުމުގެ ޕްރޮޖެކްޓް ކުރިއަށް ގެންދިއުމަށް ކަނޑައަޅާފައިވާ ކުރުމުގެ މަސައްކަތް ކޮންޓްރެކްޓް ކުރެވިފައިވަނީ ދިވެހި ސަރުކާރުގެ ކޮމްޕެނީ ކަމަށްވާ މޯލްޑިވްސް ރޯޑް ޑިވެލޮޕްމަންޓް ކޯޕަރޭޝަން (އެމް. އާރް. ޑީ. ސީ) އަށެވެ.

2. ރިޕޯޓް ތައްޔާރުކުރުމުގައި މަސައްކަތް ކުރަމުންދާ ސަރަހައްދުގެ ތިމާވެށީގެ ހާލަތު ދިރާސާކޮށް ކަނޑައެޅިފައިވާ ޤަވާޢިދާ އެއްގޮތަށް ފީލްޑް ސާވޭތައް ހިންގާފައިވާނެއެވެ.

3. މިރިޕޯޓް ތައްޔާރުކޮށްފައިވަނީ މަޝްރޫޢުގެ ޕްރޮޕޯނަންޓް އެންވަޔަރަމަންޓަލް ކޮންސަލްޓަންޓް އަލީ ޝާހިދު ތަރައްޤީ ކޮށްދިނުމަށް ފާލަމް ހެދުމުގެ ޕްރޮޖެކްޓްގެ މަޢުލޫމާތު ބޭނުންކޮށްގެންނެވެ.

4. އދ. މަންދޫ އިދާރީ ގޮތުން އަރިއަތޮޅު ދެކުނުބުރީގައި ހިމެނޭ 2 ވަނަ އަހަރުގެ ބޮޑު ރަށެކެވެ. މި ރަށް ތިބޭ ވިލު ...

5. އދ. މަންދޫ ރަށުގެ ބަނދަރަށް ފޯރުކޮށްދިނުމަށް ...

6. މިރިޕޯޓުގައި އދ. މަންދޫ ...

7. އދ. މަންދޫއަށް އަރައި ފޭބުން ވަސީލަތް ތައް ފާހަގަ ކުރުމުގެ ގޮތުން ފުރަތަމަ އެދުމާއި ހުރަހަކާފައިވާ ވައިންޖަހަންނަން ޖެޓީހުރުގެ ގެ ސަރަހައްދު ތިމާވެއްޖެއަށް ކުރިމަތިވާފަދަ މައްސަލަތައް ދެނެގަތުމަށްޖެހޭނީ ބޮޑުންނާ ދިރާސާތައް ވާނީ މި ދިރާސާ ތައްޔާރުކުރުމުގެ ކަންސަލްޓަންޓުގެ ތަޖުރިބާގައި ފުރިހަމަ ކަށަވަރުވާތީއެވެ. އެގޮތުން އެއްގަމާއި ކަނޑާއި ގޮސްޖެހުނުގެ ތަފާތު ދިރާސާތައް ވާނީ ފުރިހަމަ ކުރެވިފައެވެ. އަދި އިތުރުން އިންޖިނިއަރިންގެ ޖިއޯޓެކްނިކަލް ސާރވޭގެ ތަރުތީބު މިދިރާސާގައި ބޭއްވުނު މަޢުލޫމާތު އެއްކުރެވިފައި ވާނީ ދިރާސާގައި ހިމެނޭ ގޮތަށެވެ. މިގޮތުން އެއްކުރެވުނު މަޢުލޫމާތުގެ ތެރޭގައި ހިމެނެނީ:

ހ. ރަށުގެ ގޮސްޖެހުނުގެ، މަސައްކަތުގެ ކުރިމަތީ ހަމަޖެހިފައިވާ ސަރަހައްދާއި ތިމާވެށީގެ ގޮތުން ބަލާއިރު އަސަރު ފޯރާފާނެކަމަށް ތަފާތުކުރެވޭ ސަރަހައްދުގެ މޫދާއި މޫދުގައިވާ ދިރުމާއި ތަފާތު މާހައުލުތަކުގެ މަޢުލޫމާތު އެއްކުރެވުނެވެ.

ށ. ގޮސްޖެހުނުގައި ވެލި ދައްކާވާ ގޮތާއި އާއި މަސައްކަތް ކުރެވޭ ސަރަހައްދުގެ މޫދުގެ ފެންމިން އަދި އެސަރަހައްދުގެ އާދައި ރަށުގެ ދިރާސާ ކުރެވުނެވެ.

ނ. މޫސުމާ ބެހޭ މައުލޫމާތު އެއްކުރެވުނު ތަފާސީލް ދިރާސާ ކުރެވުނެވެ.

8. މިދިރާސާތަކުން ހޯދުނު މައިގަނޑު ކަންތައްތަށް ތިރީގައި އެވަނީއެވެ.

ހ. އދ. މަންދޫގައި ރަތްއަރުތަށް އަރައި ފޭބުމަށް ބޭނުންކުރާ ފާލަން ވީރާނާވެ، ފެއްޓި ބޭނުން ނުކުރެވޭ ވަރަށް ހަލާކުވެފައި ވާކަން

ށ. ރަށުގެ ފާލަން ސަރަހައްދު ވިލުގަނޑު އާއި ވިލުތެރެ ފެންމިން 5-7މ ފެންމިންގައި ހުރިކަން، މިހާރުގެ ހުރަހަކާފައިވާ ގޮތަށް ވައިންޖަހަންނަން ޖެޓީން އެއްވެސް މިންވަރަކަށް ބޭނުން ނުވާކަން

ނ. ރަށުގެ ރަތްއަރުތަށްނާ ކުރެވުން މަސްވެރިންނާ އާދޭހެއް އިތުރުވެފައި މިހާރު ހުރަހަކާފައިވާ ފާލަން އަދި ސަރަހައްދު 20މ ދުރުންނަށް ޖަނަވާރު ދިރުމަކާއި ޓ-ޗޭޕް ދިރުމާން 4-5މ ހިފުރު ކުރުމާއި އަދި ޓ-ގެ ދިރުމާން 30-40 ދިރުމާރިސްކުރެވެ.

9. އދ. މަންދޫގައި އެދުމަން ހަމަޖެހިފައިވާ ފާލަން އަދި ސަރަހައްދު ބަދި ބެދުމަން ފާހަގަ ކުރެވުނީ މިމަސައްކަތުގައި ހުރަހަކާފައިވާ ވައިންޖަހަންނަން ޖެޓީހުރުގެ މަސައްކަތް ކާނާ ފާލަން ކައިރި ފެންކުރަން ނުޖެހޭ ކަމެވެ. ފެންކުރުމުގެ މަސައްކަތް މި މަޝްރޫޢުގައި ނިމިމަންނަމަ މަޝްރޫޢު ސަލާމަތް ހަމަ އެކަށި ފާލަން އެދުމުގެ މަސައްކަތްތަކުން ބަދަލުވެގެން ދެއެވެ. ތިމާވެށްޓަށް އަސަރުކުރާ މިންވަރު ދުރުކުރަން ބޭނުންވާ ދުރުކަމާއި ބޭނުން (ހ) ބޮޑެތި ތަކެތީގެ ބޯޓު ގޮތަށް ފޮނުވުމާއި ތަނުގެ ތެރެއިން ބެހެއްޓުމާއި ފާލަން ތަކުގެ އިހަށް އެ ރީފްގެ ހަތަރުކަން ނުލާޒިމުކުރެވެ. ސަރަހައްދު އެތެރެ މަސައްކަތް ތަކެއް ތިމާވެށްޓަށް ބޭނުން ނެތްމަސައްކަތްތައް ކުރެވޭ ބައި ކުރަން ފާހަގަ ނުކުރެވޭނެއެވެ.

10. ތިމާވެށީގެ ގޮތުން ބަލާއިރު ހުރަހަކާފައިވާ ގޮތަށް ތަނުގެ ދިރުން ގޮތަށް އޭރުގެ ގޮތަށް ފާލަން އެދުމުން ތިމާވެއްޖަށް ކުރާ ނުރާވާ އަސަރު ވަރަށް ކުޑަވާނެއެވެ. އަދި މިއީ ކުރުމުގެ ދިރިއުޅުމަށް ނިސްބަތްވުން ކުޑަ އަސަރެއް ކަމުގައި ފާހަގަ ކުރެވުނެވެ.

11. ނަމަވެސް ފާހަގަކުރެވުނު ކަންކަން ބަނދަރު ކުރުން ނުވަތަ ކުރާ ކުޑަނަމަވެސް ނޭދެވޭ އަސަރު ކުޑަ ކުރުމަށްޓަކައި އެޅިދާނެ ފިޔަވަޅުތައް ވެސް މިޕްރޮޖެކްޓުގައި ހިމަނާފައި ވާނެއެވެ. ކޮންޓްރެކްޓަރުގެ ކުންފުނިތަކުގައި ފިޔަވަޅުތައް ގެނައުމާ ބެހޭ އަސަރުތައް މޮނިޓަރކުރާނެ ޕްލޭނެއް މިޕްރޮޖެކްޓުގައި ހިމަނާފައިވާނެއެވެ. މިގޮތުން މޮނިޓަރިންގ ޕްލޭނުގެ ބޭނުމަކީ ތިމާވެއްޓަށް ކުރާއަސަރުތައް ދެނެގަނެ ފިޔަވަޅުވެސް އަވަހަކަށް އެކަންކަން ބަދަލުކުރުމުގެ ގޮތުގެ އޮތުމެވެ.

12. ހުރިހާ ފަރާތަކާ މަސައްކަތްތެރިން ކުރުމުގައި ބަލަހައްޓާނެ ކަމަށް ވާގޮތަށް ބައްދަލުތަކެއް މިޕްރޮޖެކްޓުގައި ބަޔާންކުރާ ވަގުތު ކުރެވިފައިވާނެއެވެ. މިމަސައްކަތުގައި ނިސްބަތުން އަދަދު ބަޔަކު ހިމެނޭ މިގޮތުގެ ބޭނުން ކުރާ ބިމުގެ 20ދ ދުވަސްތެރޭ މަސައްކަތް ވާނީ ފުރިހަމަ ކުރެވިފައެވެ. އަދި އެކަމަށް ބަޔާންކުރެވޭ އޮތުމެވެ.

13. މީ. މަސްދޫގައި ބަނދަރު އަދި ފާލަމު ފަރާތުގެ އެކުލަވާލި އެކަށީގެންވާ މަސައްކަތް މަސްޤަތަކާއި ބަނދަރު އަދި ފާލަމު ހިމާޔަތްކުރުމާއި މަސައްކަތް ކުރެވޭނެ ދިމަބަޝ އިޖްތިމާޢީ ފައިދާތަކާއި ނަމަވެސް އަދި ބަނދަރު ބަހައްޓާ ކުރިއަރުވުމުގެ އިތުރު ފުރުސަތުތަކާއި ބަދަލު ޖެހުމުގެ މަސައްކަތްކަމެވެ. މިކަމުގެ ސަރަހައްދު އިޖްތިމާޢީ ފުރުސަތުތަކާއި އިތުރު ހުރިކަމަށް ބެލެވޭ ކަމެވެ. ގައުމީ ފުރިހަމަގޮތުގައި އިޖްތިމާޢީ ބަހައްޓާ ކުރުމުގެ އަދި މަސްދޫގެ ހިމާޔަތް ބެލުން އަދި ސަރަހައްދު ބަނދަރުގެ ތަރައްޤީ ކުރެވޭނެ. އިތުރުގޮތްތަކެއް ފާހަގަ އެކަމަކީ ފަރާތްތަކުން އަސަރުކުރާ ކަމަށް ފެންނަތީ މެދުވެރިކޮށް ފުރުސަތު ބޭނުންކުރާ ފަރާތް (ބ) ބަނދަރުގެ ފާލަމު މަރާމާތު ކުރުން އަލުން ބިނާކުރުމަކީ ނޭދެވޭ. ނަމަވެސް މިޕްރޮޖެކްޓުގެ ކުރިން ޖެހޭ މިމަސްދޫގައި ކޮންމެވެސް ވަރަކަށް މަސްދޫގެ ހުރިހާ ގޮތްތަކުން މަސައްކަތުގެ ސަލާމަތީ މީހުންގެ ފާހަގަ ކުރުން ދެ.އެ.އެ. ގައި ފާހަގަކުރެވޭ މިފަދަ ވަގުތު ކުރުމުގެ ގޮތުގައި ނަމަވެސް މިޕްރޮޖެކްޓުގެ މަސައްކަތުގެ ބެހޭ ފަރާތް ފާހަގަ ކުރުވުނު އެއްވެސް މިފަދަ ކަމެއް މީ. މަސްދޫ ފަރާތް ކަމެއް ފުރުސަތު ނެތެވެ. މިހެން ކަމުން މިފަދަ މަސްދޫގައި ހިންގާ ފަރާތް އިތުރު މަސައްކަތެވެ. އަދި ހުރިހާ ބަޔަކާ ބައްދަލު ކުރުމުގެ ފަރާތް ބޮޑު ފަރާތް އިތުރު ބޭނުންވާ ބަޔަކާ ބިނާކުރާ ގުޅުން އިތުރު ގޮތް ކުރާ ކަމަށް ފާހަގަ މި މަސްދޫގެ ކުރިއަށް ގެންދިޔުން ކަމަށް ފެނެއެވެ.

++++

2 NON TECHNICAL SUMMARY

1. The proponent of ADh. Mandhoo Island access Jetty reconstruction and maintenance dredging project is the Ministry of Housing and Infrastructure (MHI). The Ministry is the government's responsible body for the development and regulate the housing and infrastructure of the country. Maldives Road Development Cooperation (MRDC) has been contracted to undertake the access jetty reconstruction and maintenance dredging work in ADh. Mandhoo.

2. Two freelance EIA consultants has been contracted through public bidding process to provide preparation services of an Environmental Impact Study (EIA) by (MHI) for the access jetty reconstruction project in ADh. Mandhoo Island.

3. The assessment addresses specific key issues stated in the Terms of Reference (ToR) as agreed between EPA and the Proponent following the scoping meeting held on the matter.

4. ADh Mandhoo is an inhabited island located on the southern half of south western side of Ari Atoll. The island lies on huge reef system with fairly large deep lagoon with large number of patch reefs. The lagoon is accessible from the eastern side and can reach very close to the island shoreline.

5. The island can be accessed by using two jetties constructed from the shore and extend into the deep lagoon on the eastern side of the island. The jetty on the south eastern end of the island was constructed by the management of Conrad Maldives (Rangali) to use to access the land plot (southern part of the island) during the period they rented land from the council to establish resort support facilities. The second jetty is located approximately 190m north of the jetty, constructed by the island community in early 2008 to access the island. This is the main jetty that is used by the island community to go in and out of the island.

6. The existing jetty was built manually by the people of the island. Hence pad columns structures are not placed deep enough consequently they started scouring at the base, particularly columns in deeper water and the sandy slope. Columns are slowly collapsing and the whole structure is unstable at present. The concrete sheet on top of the pillars has crashed leaving large holes and making the jetty unsafe and risky for the public to use. The people of Mandhoo requested for Government's assistance to reconstruct a jetty to access the island. As a response for their request the Government proposed this project to reconstruct a T- jetty at the footprint of the existing jetty. The project involves development of a T-jetty, maintenance dredging of areas near the jetty.

7. The study investigates impacts associated access jetty reconstruction and proposed maintenance dredging neat the jetty area of ADh. The access jetty will be 35 long and 6m wide the project also proposes to do some maintenance dredging in the vicinity of the jetty.

8. Main focus this reports is to document the general baseline condition surrounding island and particularly the proposed area for jetty reconstruction and maintenance dredging. The following studies have been carried out as part of this assessment.

    a. Assessment of the marine and coastal species and habitats in surrounding impact areas.

    b. Coastal conditions and coastal processes.

c. Wave and shoreline assessment study to evaluate the potential for the proposed jetty reconstruction and maintenance dredging to impact adjacent shorelines.

d. Climatic and oceanographic conditions of the project site.

9. Findings from the environmental studies are summarized as follows;

e. The pillars in the deeper water at the slope of lagoon have already collapsed and the concrete sheet on top of the pillars has crashed leaving large holes thus, making the jetty unsafe and risky for the public to use.

f. Jetty area is very deep within the range of 5-7m, therefore, it is not necessarily required to undertake maintenance dredging as proposed in the project.

g. Based on the discussion with the people of the island they have requested to shift the location of the new jetty 20m south of the existing one and lengthen the jetty 4-5m into the deep lagoon and extend the shore parallel section of the T-jetty 30-40m to accommodate larger vessels.

10. Field investigation during the EIA report preparation process has identified that the initially proposed maintenance dredging of the jetty area can be excluded from the scope of the project as the area is deep enough to accommodate larger vessels. With this finding the major activity that will cause significant environmental impact has been eliminated. The proposed method for reconstruction of jetty will have very negligible environmental impact on the near-shore areas of the Mandhoo Island. In fact environmental impact assessment is not required as per the EIA regulation schedule (Raa) for jetties standing on pillars that allows water and sediment flow underneath it. However, this EIA has been completed to fulfil the requirements of the ToR issued by the EPA on 13th June 2017 based on the discussions at the scoping meeting held on the 11th of June 2017.

11. Based on the scale of the proposed development project, environmental impacts associated with the proposed jetty reconstruction work is insignificant and negligible. The positive socio economic impacts from the proposed development outweigh the temporary negligible impacts related to jetty construction work.

12. Even though the impact is negligible and of short-term the report has come-up with a monitoring programme that will keep on monitoring coastal and marine environmental changes associated with the development to make necessary adjustment based on the findings of various measured environmental parameters suggested in the monitoring plan.

13. Therefore, on the basis of this environmental impact assessment study and the impact mitigation measures in the report, it is concluded that the benefits of the access jetty reconstruction project in ADh. Mandhoo eastern coast will substantially outweigh its imposition on the environment.

*****

3 INTRODUCTION

3.1 BACKGROUND AND CONTEXT

This Environmental Impact Assessment (EIA) addresses the proposed island access and jetty redevelopment project in ADh. Mandhoo. Two freelance EIA consultants prepared this document in accordance with the EIA Regulations (2012) and Regulation on Dredging and Reclamation (Regulation 2013/R-15) of the Environmental Protection Agency (EPA). This EIA provides a focused assessment of the proposed island access jetty reconstruction and maintenance dredging work in terms of existing environmental conditions and potential environmental impacts to the surrounding near shore marine environment and shorelines as detailed in the Terms of Reference (TOR) for undertaking EIA for this project. TOR is given in Annex 1.

Studies conducted to evaluate the proposed island access and jetty reconstruction project in Mandhoo include coastal mapping, assessment of the marine habitat, assessment of existing environment of the area proposed for development, assessment of island dynamics using satellite image aerial photography, wave and shoreline impact assessment studies of the area.

ADh Mandhoo is an inhabited island located on the southern part of South western side of Ari Atoll. The island lies on huge reef system with fairly large deep lagoon with large number of patch reefs. The lagoon is accessible from the eastern side and can reach very close to the island shoreline.

The island can be accessed by using two jetties constructed from the shore to the deep lagoon on the eastern side on the island. The jetty on the southern end of the island was constructed by the management of Conrad Maldives (Rangali) to use to access the land plot (southern part of the island) during the period they rented land from the council to establish resort support facilities. The second jetty is located approximately 190m north of the jetty, constructed by the island community in early 2008 to access the island. This is the main jetty that is used by the island community to go in and out of the island.

The deep lagoon in the island is an excellent natural harbour providing sheltering and safe mooring space for the vessels. The existing jetty used by the people has been broken down and slowly falling apart. The existing jetty was built manually by the people of the island. Hence pad columns structures are not placed deep enough consequently they started scouring at the base, particularly columns in deeper water and the sandy slope. Columns are slowly collapsing and the whole structure is unstable at present. The concrete sheet on top of the pillars has crashed leaving large holes and making the jetty unsafe and risky for the public to use (***Figure 1***). The people of Mandhoo requested for Government's assistance to construct a jetty to access the island in response the Government proposed this project to reconstruct a jetty at the footprint of the existing jetty and to undertake maintenance dredging of the lagoon near the jetty. The project involves development of a T-jetty, maintenance dredging (***Figure 2*** and ***Figure 3***).

Figure 1: Status of the existing jetty in ADh Mandhoo (Main jetty)

Figure 2: Existing jetty on the south eastern side, constructed by the Management of Conrad Maldives (Rangali)

The following are the scope and dimensions island access and jetty reconstruction work proposed the government in ADh Mandhoo:

- Construction of 35m long T-jetty with 6m width walkway.
- Construction of the T- Platform parallel section to the shoreline with 20m length and 6m width.
- Ground leveling the jetty area.
- Maintenance dredging near Jetty area.

Figure 3: Proposed location for the new jetty development at the footprint of the existing jetty, a magnified map will be provided in Annex 2.

3.2 PURPOSE OF THE EIA

According to the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012 schedule Raa , construction of jetties, standing on pillars, in a way that will allow flow of water and sediment will not requires an EIA report. This is due to potentially negligible and insignificant environmental impacts associated with the construction and operation of the structure. The main reason for preparing this EIA report is that maintenance dredging near the jetty area is included in the scope of the work of this project. Potential adverse environmental impacts associated with dredging in the marine environment at ADh. Mandhoo, the proponent has hired a freelance EIA consultant through public bidding process and assigned the preparation and submission of an Environmental Impact Assessment (EIA) report to EPA to comply with the Environmental Protection and Preservation Act (4/93) and EIA Regulations 2012.

The objective of the EIA study is:

a) To provide an assessment of the potential environmental effects of the proposal and to determine which of these, if any are likely to result in a significant effect on the environment and to propose ways and means of avoiding, mitigating and or compensating the perceived negatives effects of the project;

b) To provide necessary information to EPA applicable to the proposed development; and

c) To assess how the proposals have been developed to achieve a satisfactory level of environmental performance in line with the EIA Regulations

3.3 PROJECT SETTING

ADh Mandhoo is an inhabited island located on the south western side of Ari Atoll. The island lies on huge reef system with fairly large deep lagoon with large number of patch reefs. The lagoon is accessible from the eastern side and can reach very close to the island shoreline.

The island can be accessed by using two jetties constructed from the shore to the deep lagoon on the eastern side on the island.

Visual observations and studies conducted for similar environment suggested to be dredged the substrate to be consisted mostly of medium to fine calcareous sand that forms the sea substrate. Areas earmarked for dredging in the initial concept does not require dredging as the average depth of the area is within the range of 5-7m at low tide.

3.4 SCOPE OF THE EIA

The scope of this EIA is based on the consultations held during the scoping meeting at the Environmental Protection Agency on 11th June 2017. Following the scoping meeting, the Consultant drafted a ToR which was finalized and endorsed by the EPA. The approved ToR highlighted 8 major tasks to be covered including;

1. Description of the proposed project;
2. Description of the existing environment;
3. Legislative and regulatory considerations;
4. Potential impacts of the proposed project;
5. Alternatives to the proposed project;
6. Mitigation and management of negative impacts;
7. Development of monitoring plan; and
8. Stakeholder consultation.

A copy of the ToR is attached in Annex 1. The EIA for the island access and jetty development project in ADh. Mandhoo closely followed the approved ToR for the assessment.

3.5 PROJECT JUSTIFICATION

ADh. Mandhoois an inhabited island with a registered population of 367 people, located on the south western of Ari Atoll in an isolated house reef. The island lies on huge reef system with fairly large deep lagoon with large number of patch reefs. The lagoon is accessible from the eastern side and can reach very close to the island shoreline. The island can be accessed by using two jetties constructed from the shore to the deep lagoon on the eastern side on the island. The access jetty constructed by the island community in early 2008 to access the island is used by the public to go in and out of the island. The deep lagoon in the island is an excellent natural harbour providing sheltering and safe mooring space for the vessels. The existing jetty used by the people has been broken down and slowly falling apart. The existing jetty was built manually by the people of the island. Hence pad columns sturctures are not placed deep enough consequently they started scouring at the base, particularly columns in deeper water and the sandy slope. Columns are slowly collapsing and the whole structure

is unstable at present. The concrete sheet on top of the pillars has crashed leaving large holes and making the jetty unsafe and risky for the public to use (Figure x).

Since this is an inhabited island the island should be accessible all the time throughout the year. Island access related developments such jetties, in inhabited island, are considered to be the most important infrastructure everyone craves for, and viewed as a necessity for the development of the island to open up to the rest of the country. Therefore such development projects are socially-driven project to improve the livelihoods of people who have been waiting impatiently for an appropriate island access. The primary objective of the project is to improve access to the island because it is envisaged to be necessary to bring economic growth and to improve living conditions of people of Mandhoo Island.

Mandhoo has a large number of Dhoni used in the nearby resorts for various purposes such as diving. Cargo supplies, ferries also number of Yellowfin tuna fishing vessels enters into the lagoon to catch bait fish. Therefore properly functioning access jetty is an important and necessary infrastructure required for the island. In response to people's request to replace the broken jetty the Government proposed this project to construct a new T-jetty in the same location of the existing jetty and undertake maintenance dredging of the lagoon near if necessary.

The proposed design is a standard island access facility infrastructure with a T-jetty and to undertake maintenance dredging if necessary at the end of T-Jetty. Consultations with the island council and elders have suggested to relocate the proposed jetty 20 south of the existing jetty. They also suggested extending the T jetty (shore perpendicular section) 4-5m into the deep lagoon and lengthening the shore parallel section of the T to 30-40m so the vessels can alongside the jetty.

Construction of a shore perpendicular T-jetty standing on pad-column structure will do little to disrupt the sediment movement around the island and unlikely to contribute significant erosion in the island. Given the specific circumstances of ADh. Mandhoo a functional access jetty is the bare minimum required to access the island.

3.6 PROJECT BOUNDARY

Major construction work of island access infrastructure development activities will take place in the boundary shown in ***Figure 4***. Project impact boundary and study area is shown in ***Figure 5*** and ***Figure 6***.

Figure 4: ADh Mandhoo island access and Jetty reconstruction project boundary

Figure 5: ADh Mandhoo island access and Jetty reconstruction project study area

Figure 6: ADh. Mandhoo access and jetty development project impact boundary

3.7 METHODOLOGY

Field studies have been undertaken using methods generally employed for EIA studies in the Maldives. This study was based mainly on data collected during a field investigation mission from 15-17th June 2017, by the consultant. Field studies have been undertaken using methods generally employed for EIA studies in the Maldives. Environmental impacts are predicted by using descriptive 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.

3.8 REVIEW OF RELEVANT STUDIES

As part of relevant literature review and preparation of the report, the following EIA studies on dredging, reclamation and coastal protection related work in various parts of the Maldives have been reviewed and used as reference;

Environmental impact assessment for harbour development in R. Fainu island, Raa. Atoll by Riyaz M (2014).

Environmental Impact Assessment For Proposed Levelling And Earthworks Of Football Arena In Nadella, South Huvadhu Atoll by Riyaz M. (2016.

Environmental impact assessment for beach nourishment and maintenance dredging of access channels and harbour in Thulhaagiri island by Riyaz M. and M. Shiham (2014)

4 DESCRIPTION OF THE PROJECT

4.1 THE PROPONENT

The proponent of ADh. Mandhoo Island access and jetty development project is the Ministry of Housing and Infrastructure. The Ministry is the government responsible body for the development and regulate the housing and infrastructure of the country. Jetties and access channels being a public infrastructure the Ministry's mandate in relation to infrastructure development projects is at three levels.

- National Harbour and Reclamation Programme, which involves the construction of major harbours and reclamation projects in the country
- Access Improvement Programme, which was initiated in 2004 with a scope to provide a minimum access to all islands that had no means of a proper access
- Repair and Rehabilitation Programme, which was initiated following the catastrophic event of December 2004 tsunami that damaged a large number of harbours and jetties. This programme was initially implemented by National Disaster Management Centre (NDMC) and later handed over to the Ministry of Housing and Environment.

Harbour development project of all the inhabited islands fall under access improvement programme of which Mandhoo has been craving for an appropriate jetty to access the island.

Maldives Road Development Cooperation (MRDC) has been contracted to undertake the jetty reconstruction work in ADh. Mandhoo.

4.2 PROJECT LOCATION AND BOUNDARY

ADh. Mandhoo is located on the south western side of ADh Atoll. The island is located at the north eastern rim of the atoll at Longitude 72.709615°, Latitude 3.698151° (Figure 7). The Island is elongated wider on the southern side and narrower on the northern side. The island is oriented N-S and is found in a single reef with a huge deep lagoon. The island occupies south western part of the reef flat. The island has approximately 1.11km in length and 475m on the widest part and 155m wide on the narrow part of the island and has an approximate land area of 39ha. Closest inhabited island located within the vicinity of Mandhoo Island include Himandhoo and Malhos on the north and Dhangethi and Omandhu on the east.

The proposed jetty reconstruction work will take place on the eastern side of the island.

The project boundary is confined to the near-shore areas of ADh. Mandhoo Island and the lagoon environment in which the island is found (***Figure 7***).

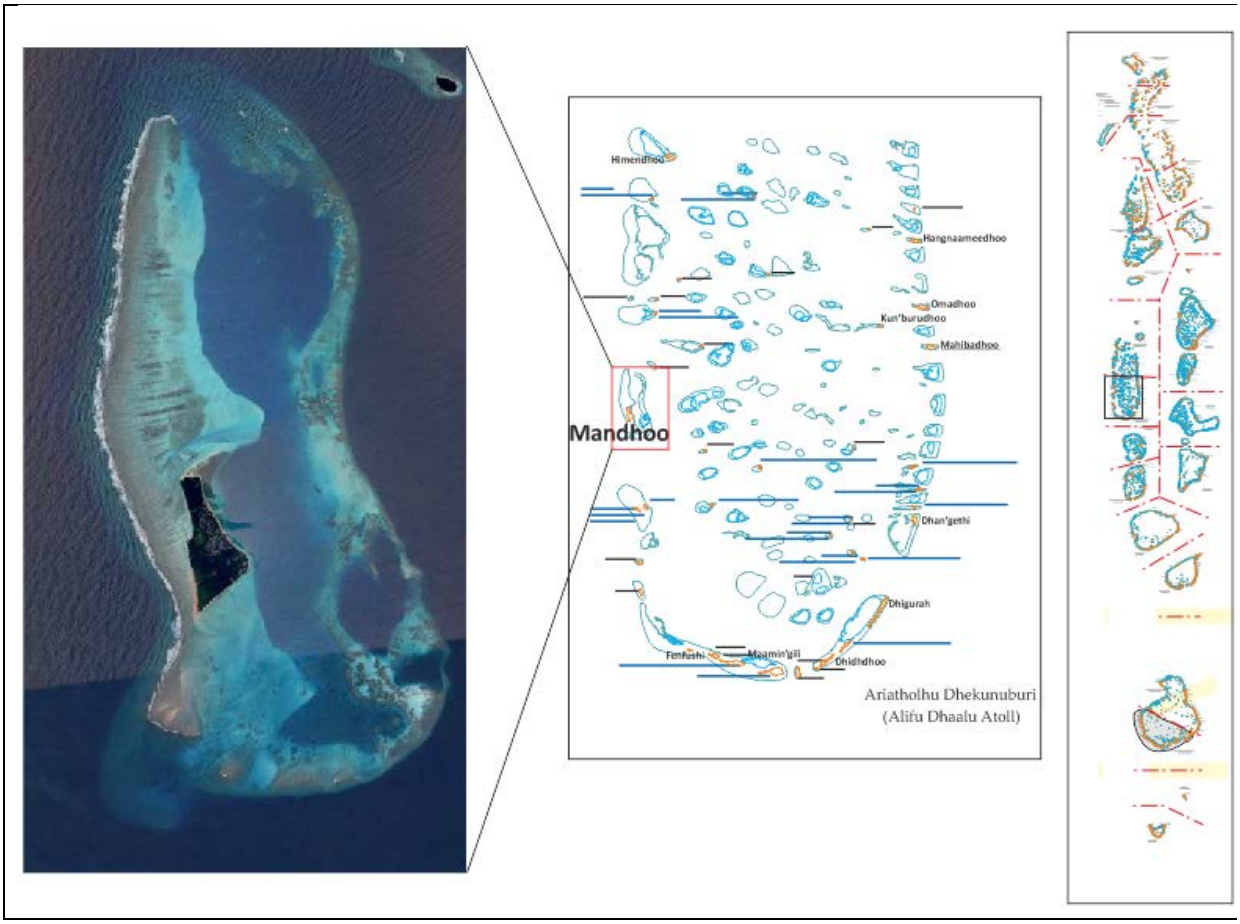


Figure 7: Location of ADh. Mandhoo Island in ADh Atoll

4.3 PROJECT OUTLINE AND SITE PLAN

The proposed T- jetty design and dimensions are standard island access related infrastructure government develops in islands with the population size of Mandhoo. In general Island access related structures include an access channel, small mooring area and a jetty. There is a fairly large natural lagoon, and number of access points to the reef therefore; only a T-Jetty will be constructed in Mandhoo. (***Figure 3***). To do so the initial proposal of the Government includes the following components

- Construction of 35m long T-jetty with 6m width walkway
- Ground levelling the jetty area.
- Construction of T section parallel to the shoreline with (20m length and 6m width)
- Maintenance dredging near Jetty area if necessary

Dredging would be considered necessary if the water is less than -3m with respect to the MSL in the areas near the jetty. ***Figure 3*** shows a conceptual drawing and location of the proposed access jetty that will be constructed at the footprint of the existing jetty.

Field verification of the project site has revealed that dredging is not required near the jetty area. At present the area has an average depth of 5m. Discussion with the people of the island has suggested shifting the location of the jetty 20m south of the existing jetty for the convenience of the community. Also they have suggested lengthening both the shore perpendicular and parallel sections of the T-

jetty. These alternative changes will be discussed in detail in the alternatives section of this report which would be the preferred location to develop island access jetty in Mandhoo.

4.4 MAIN DEVELOPMENT FEATURES OF THE PROJECT

The following are the main development features of Mandhoo access jetty development project:

1. Construction of 35m long T-jetty with 6m width walkway
2. Ground levelling the jetty area.
3. Construction of T section parallel to the shoreline with (20m length and 6m width)
4. Maintenance dredging near Jetty area if necessary

Above features are depicted in the (***Figure 3***). The people of the island are hoping to increase the length of the jetty few meters and making the shore parallel section of the T jetty longer than the proposed to be able to anchor their vessels alongside the jetty. Therefore, they have suggested shifting the jetty 20m south of the proposed location.

4.5 MOORING AREA BASIN

There is no need to dredge a mooring basin as the existing lagoon is deep enough to accommodate large vessels. It is planned to complete all activities within the scope of this project in 365 days. But the actual work is expected to take less than 90 days.

4.5.1 The Entrance Channel

There is no need to dredge an access channel as there are many access points on the eastern and southern side of the reef.

.

4.5.2 Jetty Works

Footing of the jetty will be made from concrete columns placed on pre-cast concrete footings. The footing will be made on land and placed using a barge and crane/Highmark/excavator. The columns will be transported to the jetty area on trucks or excavators. Existing roads of the island would be used for this purpose whenever possible. Once the concrete columns are in place, in-situ beams will be cast to receive timber deck. Detail drawing of the jetty is provided in Annex 3.

4.5.3 Ground levelling of Jetty area

Excavated material obtained from jetty construction and maintenance dredging will be used for ground levelling of the jetty.

4.6 VOLUMES AND TYPES OF SEDIMENT TO BE DREDGED

From existing water depth information there is no need to do the maintenance dredging or excavation near the jetty area. The jetty area is deep enough water depth is within the range of 5-7m. Therefore it is very unlikely that dredging will necessarily take place in this project.

4.7 TIMINING

Timing of the jetty reconstruction work is proposed to be coincided during the period between August and November to allow the sediment plume to move south and northward influenced by the predominant wind direction and ocean currents. The sediment plume that will be generated from the

jetty reconstruction work will be very localised within or not more than100m radius from the working area. The proposed dredging schedule is given below in ***Table 1***

4.8 ACCIDENTS AND HAZARDS

A major risk associated with the project is the impact on marine environment from the proposed island access and Jetty reconstruction work. The construction works will be carried out using excavators/crane placed on a barge, which will be floating during the entire operation. It is a possibility that the barge may run on to the reef flat during low tide, however, this can be avoided with work scheduling at high tide. Deployment of precast pad-column units will replace the natural seabed at direct construction footprint of the proposed structures, which cannot be avoided.

4.9 PROJECT SCHEDULE

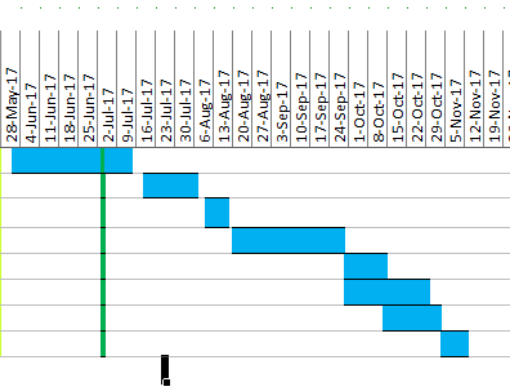
The project is scheduled to be completed in 365 days but the actual construction work will take about 90 days to complete including the time needed for seeking necessary approvals. The main milestones include; obtaining approvals, mobilization, and onset of work, jetty works, and demobilization. ***Table 1*** shows the project schedule and project inputs and outputs are given in ***Table 2***.

Table 1: Project Schedule – Indicative

Project - Adh. Mandhoo Island Jetty construction Project

Today's Date: 07/04/17 0
Start Date: 05/30/17

Ser.	Tasks	Start	End	Duration days
1	EIA preperation and approval	05/30/17	07/14/17	45
2	Contract award preliminary survey	07/19/17	08/08/17	20
3	Mobilisation	08/10/17	08/20/17	10
5	Concrete precasting	08/21/17	09/30/17	40
6	Transportation of precasts	10/01/17	10/16/17	15
7	Beach levelling work	10/01/17	10/31/17	30
8	Jetty Construction	10/15/17	11/04/17	20
15	Decomissioning	11/04/17	11/14/17	10



4.10 PROJECT INPUT AND OUTPUTS

Table 2: Matrix of project major inputs and outputs

Input resource(s)	Source/type	How to obtain resources
Workers	Skilled and semi-skilled labour, Manager (1) Supervisor (1) Excavator Operator (2), Loader operator (1), Welder (1), Driver (2), Carpenter (2), Bar bender (2), Mason (2) Labourer (11) Cook (1) Cook	Trained and licensed staff of the contactor

	helper (1) total of 27 people, skilled and semi skilled 16 and unskilled labourers 11.	
Machinery (excavator, barge, operational tools)	02 excavators 02 dump trucks 01 loader 01 Concrete machine 01 Barge 01 Workshop container 01 Office Container 03 Diesel tank 5,000litres 01 Welding Genset 20KvA	To be obtained and operated by the contractor. Contractor will be required to bring to the site machines in good working conditions to avoid loss of time due to breakdown of machines, vehicles and equipment.
Output	**Anticipated quantities**	**Comments**
Maintenance dredging	May be required quantity is not known	Over time is it expected that substrate will be re-colonized by benthic / sessile organism, resuming a new ecological balance.
T-Jetty	Total length of the jetty sections 35m	Built using concrete, jetty columns will be pre-caste on land and transported to the site
Dredged material	Minor quantity	Levelling the jetty base
Wastes	Minor amount	No wastes during the excavation will be allowed to be dumped into the sea. Solid wastes and human wastes will be managed through the existing wastewater and solid waste management system on the island
Waste oil and lubricants	Minor amount	Gathered in a barrel and sent to Thilafushi through existing waste management system
Noise and light	Localized	Excavator and truck operation will generate some noise during the project execution. If work is carried out in the night lights will be necessary in the harbour area. Work will not be carried out late into the night to avoid disturbance to local population.
Plastics and packaging waste	Minor amount	Managed through existing waste management system of the island

5 ADMINISTRATIVE AND REGULATORY FRAMEWORK

This is section highlights relevant government stakeholders, their roles and reviews relevant legal framework applicable to the proposed project.

5.1 MINISTRY OF ENVIRONMENT, ENERGY

The Ministry of Environment and Energy (MEE) is key Ministry in the government mandated with the protection of the environment. Environmental responsibilities assigned to MEE includes formulating environmental policies, coordinating, preservation and management of the environment throughout the country, and enforcing Environmental Protection and Preservation Act (EPPA) (04/93). Under Article 5(a) of EPPA, Environmental Impact Assessment (EIA) is mandatory for projects that may cause potential harm to the environment. The EIA report has to be submitted to the EPA for approval before commencement of a project. As per this legislation, any project that has any undesirable impact on the environment can be terminated without compensation by MEE.

5.2 ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA is the key regulatory body on environment, which is an autonomous body formed under the umbrella of MEE. It is mandated with implementing the EIA process in the Maldives, implementing the Environment Act and subsequent regulations on behalf of MHE, regulating water and sanitation, biodiversity conservation, waste management and coastal zone management. Also, it is responsible for developing environmental standards and guidelines in the country.

5.3 MINISTRY OF HOUSING AND INFRASTRUCTURE

The Ministry of Housing and Infrastructure is mandated to undertake reclamation, harbour development and coastal protection infrastructures as per the government policies. The Ministry of Housing and Infrastructure has a harbour and jetties development programme where there are minimal requirements for harbours and jetties in local inhabited islands. The Access Improvement Programme, which was initiated in 2004, had a scope to provide minimum access to all islands that had no means of a proper access. The Ministry undertakes all coastal infrastructure projects except those specifically focused on shore protection. Depending on the environmental conditions of specific islands, breakwaters or side quay walls would be provided to make the harbour basin safe from adverse conditions.

Although there are no published local guidelines, the Ministry uses British standards for coastal structures specifications. The environmental requirements considered are those provided by the Ministry of Environment and Energy such as that of Dredging and Reclamation Regulation. The environmental criteria for each project are, however, defined according to the findings of the Environmental Impact Assessment, which is required to be undertaken for each and every harbour project.

5.4 LEGAL FRAMEWORK

Four regulations pertaining to the proposed project have been reviewed and the project's conformity to these has been assessed.

a) EIA Regulations 2012
b) Regulations on cutting down of Trees
c) Regulation on Dredging and Reclamation
d) Regulation and Waste Management

5.4.1 EIA Regulations 2012

The most important governing law as far as the environmental impact assessment is concerned is Environment Protection and Preservation Act (Law No. 4/93) (EPPA).

EPPA mandates all development projects in the Maldives to undertake an Environmental Impact Assessment prior to undertaking any such project.

Further the EPPA states an impact assessment study shall be submitted to the relevant Government authority before implementing any development project that may have a potential impact on the environment.

It goes on to say that the relevant Authority of Government shall formulate the guidelines for environmental impact assessment and shall determine the projects that need such assessment as mentioned in above.

The law also gives power to the relevant Government authority to terminate any project that has any undesirable impact on the environment. A project so terminated shall not receive any compensation.

According to the EPPA waste disposal, oil and poisonous substances any type of waste, oil, poisonous gases or any substance that may have a harmful effect on the environment shall not be disposed within the territory of the Maldives.

Government of Maldives reserves right to claim compensation for all the damages that area caused by the activities that are detrimental to the environment.

Environment Impact Regulations, 2012 & other relevant regulations

Under the provisions of EPPA the Government of Maldives has formulated and gazetted Environmental Impact Assessment Regulations (2012) detailing the EIA process and the EIA preparation.

In addition to EIA regulations, other relevant regulation will be followed in development and implementation of the proposed project. These regulations include ban on coral mining. Coral mining from house reef and atoll rim reef has been banned since 1990. Sand mining from any island has also been banned since March 2000.

The EPPA, EIA Regulations and other relevant regulations will be duly taken into consideration in preparing the EIA report and in the implementation of the project.

5.4.2 Regulation on Cutting down Trees

Cutting down and relocating of mature trees is regulated in Maldives under the by-law on cutting down, uprooting, digging out and export of trees and palms from one island to another. In the preamble of the law, made in pursuant to Law No. 4/93, it states the purpose of the law is to educate citizens and developers about the importance of trees including sound management to maintain trees and provide standards for the preservation of trees in the Maldives.

Under the law certain tree are prohibited to remove from island. They include:

- The coastal vegetation growing around the islands extending to about 15m into the island
- All trees and palms growing in mangroves and wetlands spreading to 15m of land area
- All trees in Government protected areas

- Trees that are being protected by the Government in order to protect species of animal / organisms that inhabit on such trees
- Trees / palms those are unusual in nature.

The law states that prior permission must be obtained for removal and/or relocation of 10 or more trees or palms. For indiscriminate removal and land clearances and EIA Decision Note is required. The size of the trees and palms that are allowed to be relocated should have more than 15feet from lowest point to the crown spread for palms and 8 feet from the lowest point to the trunk to tip of the highest branch for trees other than palms.

The law also states that cutting down and uprooting of the trees shall be made under supervision of the island / atoll offices (in the current context Atoll / Island Councils).

The project does not involve removal of any tree from the island hence the regulation will be fully complied to.

5.4.3 Regulation on Dredging and Reclamation

Regulation on Reclamation and Dredging of Islands Lagoons (Regulation 2013/R-15) came into effect in April 2013. The regulation requires having permission of EPA on projects requiring alternation of the island, either by reclamation of dredging. Specifically the regulation requires producing scaled-maps of the island before and after the proposed intervention. Special provisions have been made on protected and sensitive area restricting changes to the environment of the islands.

According to the new enforcement arrangement made since November application for Dredging and Reclamation Permit for the projects has to be submitted along with the EIA/Addendums to the Environmental Protection Agency. Therefore the application for Dredging and Reclamation Permit for this project is submitted together with the EIA report.

5.4.4 Regulation and Waste Management

Waste management Regulation (No. 2013/R-58) is more recent coming into effect on 6 February 2014. The regulation was gazetted on 05 August 2013. The regulation provides set of comprehensive guidelines on collecting, storing, transporting and managing waste. In the preamble its states the objective of the regulation is in line with the Article 22 of the Constitution which requires that development activities designed for achieving socioeconomic targets should ensure that environment and its constituent living component is not compromised and that resources are utilized effectively.

The regulation talks of the responsibilities of collection, transport, treating and storage of waste. It also talks of management centres and landfill sites and managing hazardous waste. Various sectors and entities (including tourist resorts) encouraged having their own waste management plans consistent with the Regulation.

EPA is the implementing agency of environmental law and the implementing agency of the EIA regulation.

Wastes produced from the project will be disposed in compliance to this regulation.

5.4.5 Summary

In summary, if maintenance dredging is not involved in the project the proposed project will not need to do an EIA as per the schedule Raa of the EIA regulations, jetties (standing on pillar) that allow natural flow of sediment and water will not be required to conduct a full EIA report. However this EIA is prepared assuming that maintenance dredging near the jetty area may be required. The project

will comply with all applicable environmental regulations requirements, relevant legislation, and legal and regulatory statutes. The EIA process ensured that this project has followed relevant laws and regulations and the scoping meeting and the stakeholder consultations enabled all related stakeholders participate in the process.

6 METHODOLOGIES

The study approach involved undertaking data collection through field surveys and literature review.

The project scoping was carried out to narrow down the project issues to those requiring detailed analysis. The process involved discussions with stakeholders on key project issues. The primary data was collected through the qualitative and quantitative methods of data collection. Qualitative data was collected through filed visits/site walks, public and stakeholder consultations and direct consultation with the people of the island. Stakeholder discussions were conducted to collect as much relevant information and views. Specific methodologies adopted to assess various aspects of the environment have been discussed in details in the respective sections of this report.

The secondary data was collected through literature reviews which included a study of the following:

Policies, Acts and Regulations;
Aerial photographs and satellite images; and

In undertaking baseline studies using available data and knowledge have been used. Key issues have been identified during scoping as given in the TOR. Based on the scoping need for further in-depth studies and additional data requirement were identified. Local knowledge was used as much as possible to ensure key questions are addressed in the assessment. To avoid delay in decision making and to provide a conservative assessment of environmental impacts a short term data collection and use of existing data and expert judgments were adopted.

6.1 MARINE ENVIRONMENT

6.1.1 Reef and Surveys

Equipment and tools used

- Still photograph camera
- Digital globe multispectral satellite data

Status of coral reef was assessed from area proposed for the development. Due to time limitation photographic assessment was made.The lagoon in front of the proposed jetty reconstruction area on the on the flat on the eastern side is deep and has a sandy bottom. Photographs are taken from the reef edge and which has an average depth of 5-7 meter.

6.1.2 Bathymetry

Bathymetric survey of the area proposed for jetty reconstruction in Mandhoo, was carried out by using echo sounder and a GPS. Differential GPS technique is used for correction of GPS locations points. Echo sounder measurements are corrected and related to the mean sea-level for the area. Bathymetry of the surveyed area is in shown ***Figure 17***

6.1.3 Waves and Currents

Generalised wave predictions and wave pattern predicted using hindcast for the Indian Ocean was obtained from weather information providing sites. Site specific data was not collected during the survey.

6.1.4 Coastal Dynamics

Combination of remote sensing and GIS technology and field mapping and ground truthing were used to assess the long term coastal and morphological changes of the islands. Google earth historical image sequence was co-georeferenced with the survey data and comparatively evaluated using GIS

technology to assess the long term geomorphological developments of the island. Changes in the shoreline from 2008-2016 was documented using Google earth images. Shoreline mapping of the eastern coast was conducted.

6.1.5 Geology, Sediment, Marine Benthic Assessment

Due to the homogenous nature of the geological characteristics of Maldivian Atolls, site specific investigation for reef and lagoon geomorphology was not conducted whereas coring studies conducted elsewhere in the Maldives was reviewed (Gischler, et. al.,2008). Visual observations were also made during the field on the geomorphological aspects of the island lagoon and reef. The proposed site for development of the jetty is homogenous consists of medium –fine grained sand that is usually found in deep lagoons.

6.2 TERRESTRIAL ENVIRONMENT

6.3 CLIMATE

Official meteorological observations services in Maldives are limited to airports. A total of 11 airports are in operation, however meteorological observation takes place only on 5 airports. They are Hanimaadhoo in the north, Ibrahim Nasir International Airport in the centre, Kahdhdhoo, in the south centre, Kaadehdhoo, in the south, and Gan Island in the extreme south. Observation routinely monitored and measured include, surface wind speed and direction, daily minimum and maximum air temperature at near-sea level, humidity, cloud cover. Monitoring of sea-level height takes place only in Hulhule (central), Hanimaadhoo (North) and in Gan Island (in south). Apart from the official meteorological observations, number of resort islands and individuals are installing portable mobile weather stations. Such weather stations are providing real time measurements to popular weather forecasting sites such as http://www.wunderground.com and htpp://www.windfinder.com. Data collected from these stations are now publicly available from those internet sites (accessed June 2017).

In the absence site specific weather data the normal procedure is to obtain whatever is available from the nearest weather station in an airport and apply it to the site assuming that average climate conditions do not show much variation between different islands. For the purposes of ADh. Mandhoo EIA meteorological observations from the Male, which is located approximately 102km north east of Mandhoo was used for description of specific local climate condition of Mandhoo Island.

6.4 IMPACT ASSESSMENT METHODOLOGY

The environmental impacts that may be associated with the proposed island access and jetty construction project on ADh Mandhoo Island are predicted by using a simple matrix. Island and access development is a very common and necessary infrastructure development that is needed in almost all the islands of the Maldives. People are very familiar with the environmental impacts associated with the development. Due to its necessity socio economic benefit of island access related development always overweight environmental concerns. Impacts from various activities of the proposed project both construction and operational phases have been identified through consultation with the project management team, field surveys, observations and assessment, as well as based on field experience and expert opinion on similar development projects in the country.

Other sources of information have been used wherever possible. Data collected during field surveys can be used to predict outcomes of various operational and construction activities on the various related environmental components. Data presented in this report can also be used as a baseline for environmental monitoring of the project activities.

6.5 DATA GAPS

In the Maldives it is common to expect a detailed environmental analysis for an EIA to be undertaken in a relatively short period of time. Therefore, limitation of the time spent on site has been the key limiting factor to get a more detailed assessment on all environmental aspects surrounding the island. Given the seasonal climatic variations in Maldives and the differences in island dynamics and climate settings in individual islands such a short time frame is too little to assess selected aspects of the environment. This problem is compounded by the absence or extreme difficulty in obtaining grey literature (held in technical reports in some government officers) and of long-term studies in other parts of Maldives. Hence, most EIA's end up being based on an environmental snapshot of specific point in time. However, experienced EIA specialists can deliver a close match to reality based on a number of similar assessments and expert judgments of the team. In this regard, the following gaps could be identified in information.

- Absence of long-term site specific or even regional data (at least1- 2 years). Most critical data include current, wave and coastal dynamics.
- Absence of historical and long-term records on reef and lagoon environment.

These gaps are seriously considered in the assessment and care has been taken to address the issue in designing mitigation measures and the monitoring programme. Nonetheless, most of the assessments, including sea water quality, island dynamics, reef health, bathymetry were done in accordance with the TOR and other relevant information are collected through literature review to reflect closest match to existing environment of the island at the time of these assessments.

Figure 8: Mapping and survey area and magnified view of sampling locations of ADh. Mandhoo

7 EXISTING ENVIRONMENTAL CONDITIONS

7.1 OBJECTIVES

The purpose of this was to assess the existing environmental conditions of the coastal environment of the area proposed for island access and jetty reconstruction in Mandhoo Island. This is critical in assessing potential impacts and to determine the actual extent of damage should an unforeseen impact occur during the implementation phase. The current assessment is more focussed on locations planned for entrance channel dredging, jetty reconstruction and associated activities.

7.2 METEOROLOGY AND CLIMATE

7.2.1 Temperature

The daily average temperatures rarely drop below 25°C and rarely go above 32°C. The warm period of the year is from March to May with an average daily high temperature above 31°C. The hottest day of the year is during April, with an average high of 32°C and low of 28°C.

The cool periods lasts from October/November to January with an average daily high temperature below 30ºC. The coldest day of the year is around mid-December, with an average low of 26°C and high of 30ºC. The sea surface temperature in the Indian Ocean in July 2014 is recorded to be around 29-30°C.

The annual average rainfall is approximately 1,950mm. As Maldives lies on the equator, Maldives receives plenty of sunshine throughout the year. Significant variation is observed in the climate between the northern and the southern atolls. The annual average rainfall in the southern atolls is higher than the northern atolls. In addition, greater extremes of temperature are also recorded in the southern atolls. On average southern atolls receive 2,704 hours of sunshine each year. Table 5 provides a summary of key meteorological findings for Maldives.

Table 3: Key meteorological features of the Maldives

Parameter	Data
Average Rainfall	9.1mm/day in May, November 1.1mm/day in February
Maximum Rainfall	184.5mm/day in October 1994
Average air temperature	30.0 C in November 1973 31.7 C in April
Average wind speed	3.7 m/s in March 5.7 m/s in January, June
Maximum wind speed	W 31.9 m/s in November 1978
Average air pressure	1012 mb in December 1010 mb in April

Seawater surface temperatures (SST) are usually 28-29ºC, but can reach 30 or more in shallow near shore areas. The Maldives are reported to experience a mixed layer of relatively saline water (36 ‰) from Arabian Sea which mixes with occasional intrusion of 34 ‰ waters from Bay of Bangal.

7.2.2 Monsoons

The climate of Maldives is characterised by the monsoons of Indian Ocean. Monsoon wind reversal significantly affects weather patterns. Two monsoon seasons are observed in Maldives: the Northeast (*Iruvai*) and the Southwest (*Hulhangu*) monsoon. The parameters that best distinguish the two monsoons are wind and rainfall patterns. The southwest monsoon is the rainy season while the northeast monsoon is the dry season. The southwest monsoon occurs from May to September and the

northeast monsoon is from December to February. The transition period of southwest monsoon occurs between March and April while that of northeast monsoon occurs from October to November.

7.2.3 Winds

Winds affect sedimentation process both during the formation and development of islands. Winds help regenerate waves that are weakened by traveling over reefs and also cause locally generated waves over lagoons. The following figure (Figure 9) is an analysis of wind data for the period July 2002 to May 2017, which shows a general picture of winds in terms of direction and strength. The analysis was done on www.windfinder.com, which was accessed on 7th July 2017. .

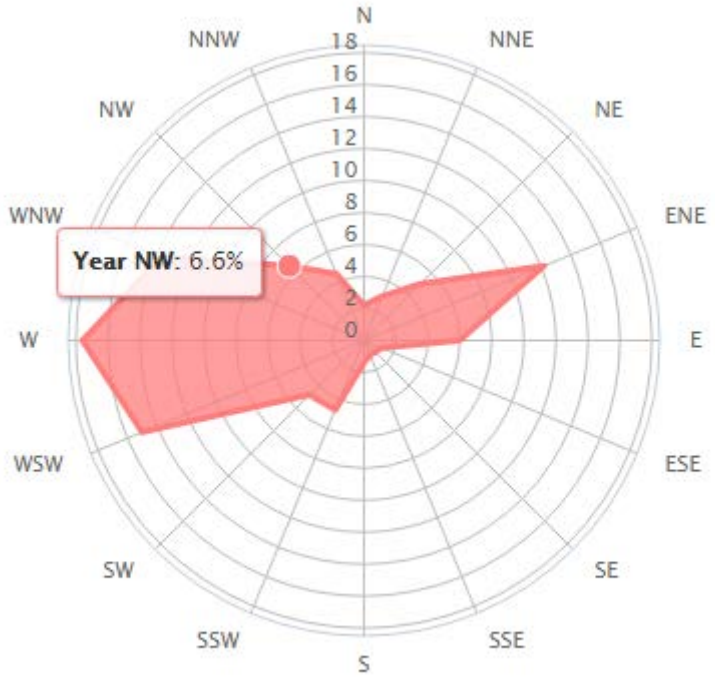


*Figure 9: Average wind speed and direction Male (from **www.windfinder.com**)*

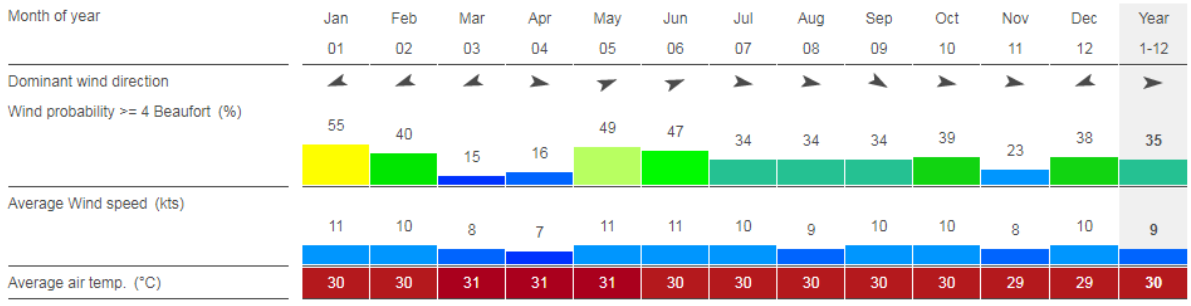


Figure 10: Wind direction and speed for Male region

The average wind speed for the sum of the years (2002-2017) is 9 knots for Male region and the predominant wind directions are W, WSW and WNW, which is the main feature during the SW monsoon. During the NE monsoon, predominant wind occurs from ENE direction with an average

wind speed of 6-7 knots. Thus, strong winds are associated with the southwest monsoon season. Gales are uncommon, and cyclones are very rare in the Maldives.

The below figure (Figure 11) is a regionalized prediction of wind direction for the Indian Ocean done on www.windfinder.com, which shows that the predominant wind direction during the month of July 2017 will be from the west with a wind speed of 4-8 knots.

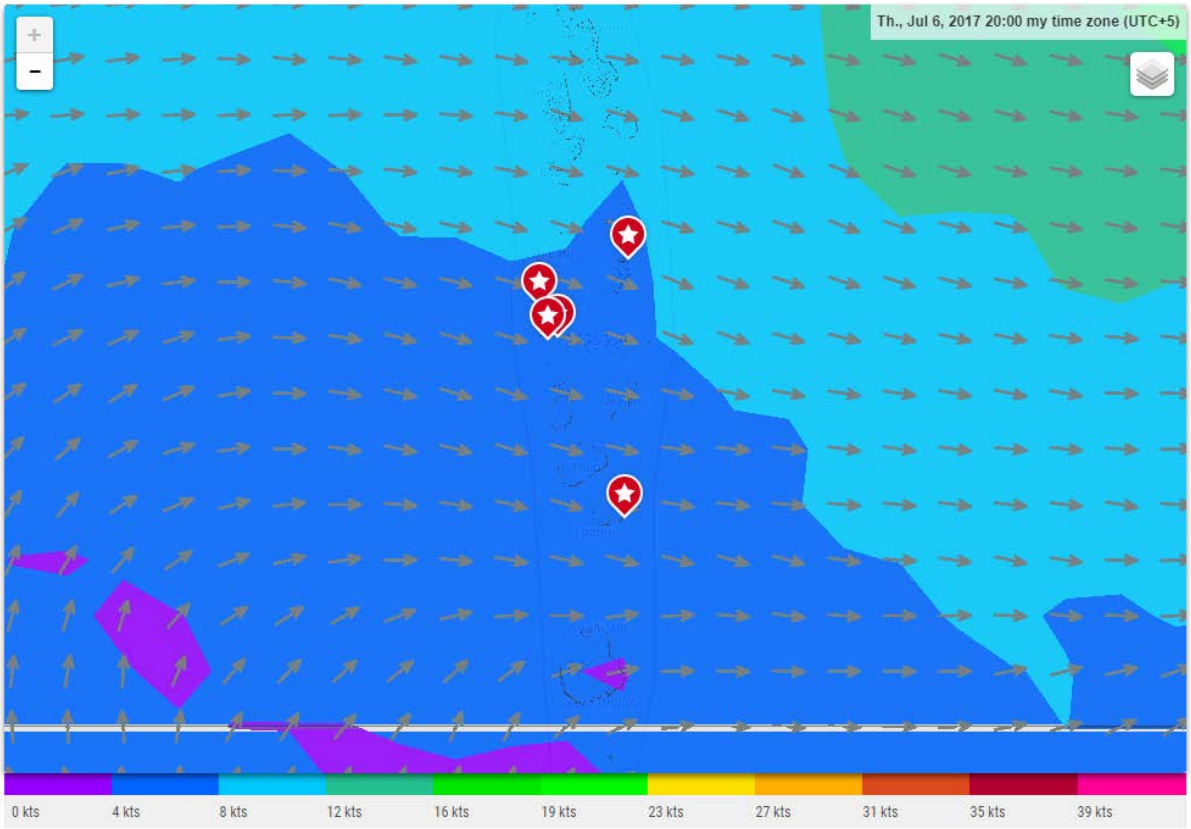


Figure 11: Wind speed and direction prediction for July 2017

7.2.4 Rainfall

The wet season- southwest monsoon runs from mid-May to November. In this season Maldives experiences torrential rain. Central, Southern and Northern parts of the Maldives receive annual average rainfall of 1924.7mm, 2277.8mm, and 1786.4mm, respectively. The highest rainfall ever recorded in the Maldives with in 24 hour period was recorded on 9th July 2002 at Kaadedhdhoo Meteorological Office and amounts to 219.8mm of rainfall. The fact that the Maldives is located at the equator, Maldives receives plentiful of sunshine throughout the year. On average Southern atolls (Gan) of the Maldives receives 2704.07 hours of sunshine each year. Furthermore, on average central (Hulhule) parts of the country receives 2784.51 hours of sunshine per year (MMS).

The probability that precipitation will be observed at Hulhule varies throughout the year. Precipitation is most likely around September 9, occurring in 57% of days. Precipitation is least likely around March 1, occurring in 18% of days (See Figure 12).

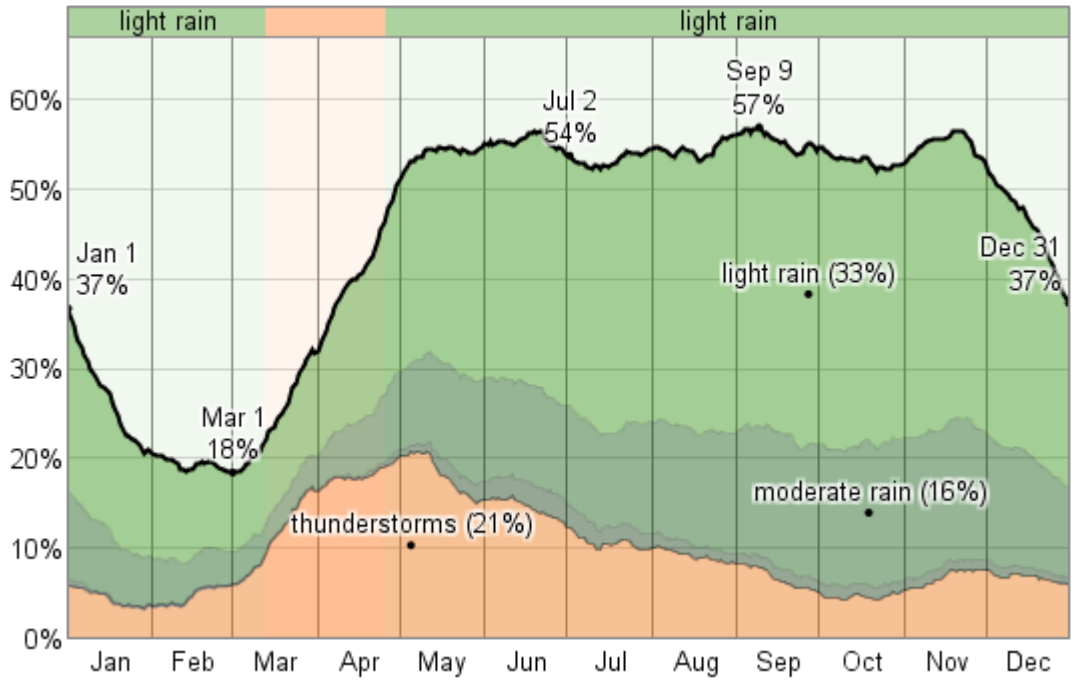


Figure 12: Probability of Participation at some point in the day for Hulhule, Maldives (weatherspark.com).

Wind and rain fall pattern expected for ADh. Mandhoo show that the higher wind speed during southwest monsoon is coincided with higher precipitation.

7.3 TIDES, CURRENTS AND WAVES

7.3.1 Tides

Tides experienced in Maldives are mixed and semi-diurnal/diurnal. Typical spring and neap tidal ranges are approximately 1.0m and 0.3m, respectively. Maximum spring tidal range in the central atolls is approximately 1.1m. There is also a 0.2m seasonal fluctuation in regional mean sea level, with an increase of about 0.1m during February to April and a decrease of 0.1m during September to November. Like in most other atolls, semidiurnal tides are experienced in ADh Atoll - that is two high tides and two low tides a day. The tide varies from place to place, depending on the location and on the shape and depth of the basin, channels and reefs and also time of the year. Tidal variations in Maldives are presented in ***Table 4***.

Table 4: Tidal variation observed at Velaanaa International Airport (Mean levels reported by the Maldives Meteorological Services).

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

Astronomical tides are related to the motion of the earth-moon-sun system, and have a range of periodicities. The highest astronomical tide was recorded as 0.64 m above the mean sea level and the lowest astronomical tide was recorded as 0.56 m below the mean sea level. Tidal variation of 1.2m from lowest to the highest tide levels were recorded in the country. Tidal fluctuations (rise and fall of tides) cause changes in current flow pattern around the island and bring subsequent changes in physical aspects of the shoreline. At low tide water movement is very slow, therefore low tide period is considered to be a good time to conduct dredging and reclamation work.

7.3.2 Currents

Currents which affect the sea area around the Maldives are caused by one or more of the following systems:

a) Oceanic currents
b) Tidal currents
c) Wind-induced currents
d) Wave-induced currents

The oceanic currents flowing across the Maldives are notorious for their strength. The exposure of the Maldives to the vast Indian Ocean ensures that an immense body of water is constantly flowing across the plateau on which the atolls are built. In the Arabian Sea, as one gets closer to the equator, the prevailing winds become more and more indicative of the oceanic surface current. Thus, wind (especially during monsoons) can be a major factor affecting current velocity and direction, and currents can be of great strength (wind-induced currents). For example: currents in the channels near Malé have been recorded at 4 knots or more. Inside an atoll, current speeds are more settled. Oceanographic currents are driven by two monsoonal winds, namely the westerly and easterly wind. The westerly flowing current tend to dominate from January to March while the easterly currents dominate from May to November. The changes in current flow patterns occur in April and December. The current velocities are about 0.5 m/s, only in May values may increase to 0.8 m/s.

The vertical water movements associated with the rise and fall of the tide are accompanied by horizontal water motion termed tidal currents. These tidal currents have the same periodicities as the vertical oscillations, but tend to follow an elliptical path and do not normally involve simple to- and-from motion. Generally the tidal currents are eastward in flood and westward in ebb. Tidal currents, which flow according to the height of the tide, are generally not strong. There is a strong diurnal influence, which governs the tides in the Maldives, but in general the tidal range is less than 1m.

On a more local scale, especially on the reef flats, wave-induced currents (cross-shore and/or long-shore) also form an important factor affecting the current regime.

7.3.3 Waves

The swell and wind waves experienced on the Maldives are governed mainly by the two monsoon periods. Swell caused by cyclonic storms in the area west of Australia may also reach the southern atolls of the Maldives on occasion.

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 south-west 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 Maldives also experiences swells originating from cyclones and storm events occurring well south of the equator. It is reported that the swell waves from southeast to south-

south-east occur due to strong storms in the southern hemisphere in the area west of Australia with direction towards the Maldives.

Local wave periods are generally in the range 2-4 seconds and are easily distinguished from the swell waves. Due to the shallow depths on the reef flat, significant wave breaking (energy dissipation) will take place at the reef's edge, reducing the wave height of waves, which pass over the reef flat. A general swell forecast and swell periods are available from various weather related websites. These forecasts are very general and it does not reflect local variations in wave period and wave height (***Figure 13***).

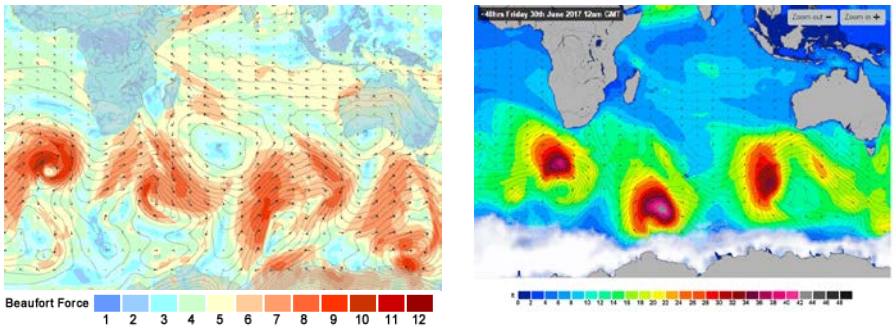


Figure 13: Generalised wave height (right) and wind direction and speed (left) prediction for the Indian Ocean on 28th June 2017 (http://magicseaweed.com/, accessed 28th June 2017)

As per the wind record observations Mandhoo Island is subjected to average wind speed of 4-10 knots. Wind speed of 4-6 knots can generate small wavelets with glassy appearing crest without breaking. Wind speed of 7-10 knots can generate large white-capped fetch waves. Wind speed around Mandhoo area could reach 20-40 knots at gale, rain and thunderstorms periods. This means that Mandhoo region has potential to generate medium-high waves with long wave lengths. The proposed site for development of island access and jetty is exposed to wind regenerated fetch during NE monsoon and during transition periods.

7.4 ISLAND MORPHOLOGY AND COASTAL ENVIRONMENT

Historic Digital Globe, Google Earth images (2008-2016) and island surveys are comparatively evaluated using GIS technology to assess the beach dynamics of the island. Co-georeferencing technique of historical digital globe images taken in various months of the year was used to map the beach end of the island and overlaid to quantify long term changes in island area. Both seasonal and monthly changes in beach erosion, accretion and sediment dynamics were quantified using this technique.

Figure 14 shows beach end change and dynamics over time in the island and a magnified view of the designated beach area for the proposed development. A comprehensive sequence of digital globe images are available from 2008-2016. The result shows that the overall area of the island in 2008 and 2016 remained very close (39ha in 2008 and 38.ha in 2016). Sequence of images of also shows that a the existing jetty was still intact in 2008 and the beach width is wider on the eastern side in 2016 than the width in 2008. This indicates that the beach area proposed for the development of jetty in Mandhoois a highly dynamic subjected to change in beach width seasonally. The most dynamic area of the island is the south western tip of the island where seasonal shifting erosion and accretion was observed from comparison of historical images (***Figure 14***and ***Figure 15***).

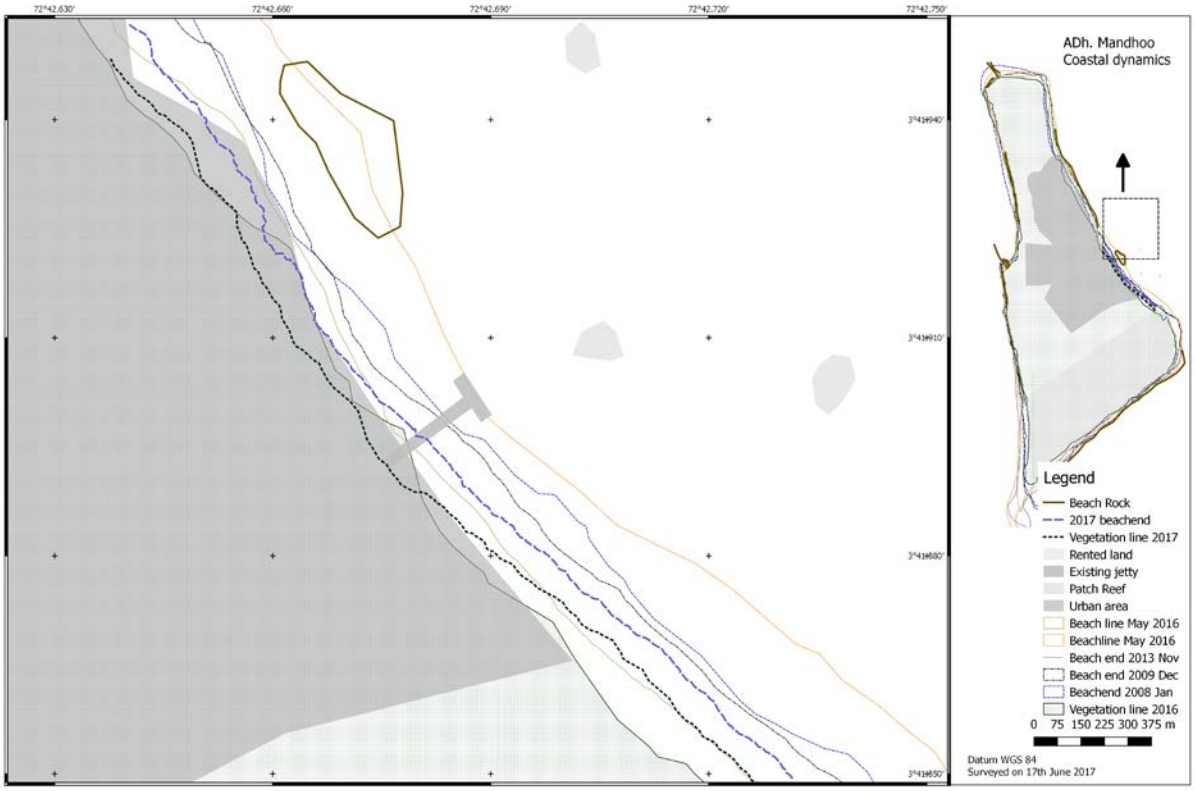


Figure 14: ADh. Mandhoo beach dynamics (2002-2017) showing beach change, magnified view of the proposed project site.

Figure 15: The eastern coast of Mandhoo is beach deposits comprise of well sorted medium –fine grained coral sand

From the field observation it was confirmed that the proposed island access jetty reconstruction work will not require any amount of maintenance dredging. Water depth of the lagoon is deep enough to accommodate ships and boats requiring 5-7m depth (***Figure 17***). Since the necessity of dredging is eliminated impacts associated with the proposed dredging will be very minor and falls the category of development that does not require and EIA report. The only change that will be ring due to the development will be negligible changes in sediment flow patter near the jetty area.

Beach material on the eastern coast of ADh. Mandhoo consists of is fairly uniform medium to fine grained coral sand ***Figure 15***. Beach rock, which is considered to be an indicator of erosion, is exposed on the eastern side and other parts of the island.

One beach profile is taken from the proposed jetty reconstruction area which was extended to the deep lagoon. The profile shows relatively high elevated island ridge followed by a gently sloping beach that falls into the deep lagoon abruptly in a steeping slope. The beach slope that falls into the deep lagoon consists of very loose sand which is an indication of dynamic nature of the beach. As can be noted from the profile that the water depth is 4.5m approximately 50m away from vegetation line which is the starting point of the profile. Geographic coordinate of the beach profiles are given ***Table 6*** and the location is shown in ***Figure 8***.

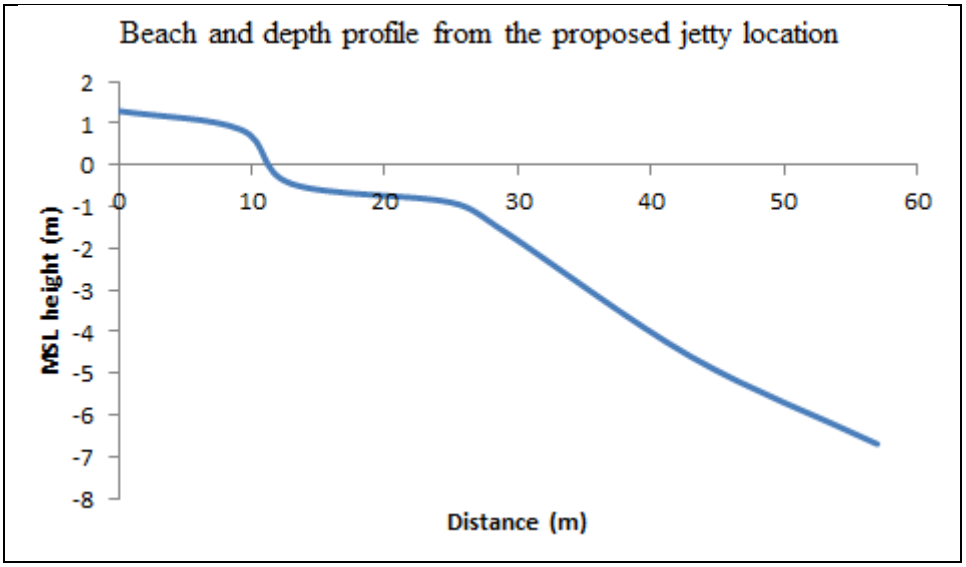


Figure 16: Beach profiles of ADH MandhooIsland eastern side

Table 5: Geographic coordinates and bearing direction of beach profile.

Profile No	Latitude	Longitude
Profile #1	3.6981 ^{o} N	72.711283 ^{o} E

Bathymetry of the area proposed for island access jetty reconstruction work in Mandhoo was measured by using handheld echo sounder and a GPS. Differential GPS technique is used for correction of GPS locations points.

Echo sounder measurements are corrected and related to the mean sea-level for the area. Lagoon depth of the area is within the range 4-10m less than 100m from the island vegetation line. The

shallow area where the footing of the jetty will be placed is within the range 0.4-0.9m at low tide. ***Figure 24***. There is a very sharp drop-off between the sandy beach and the deep lagoon within less than 1m distance from the beach toe.

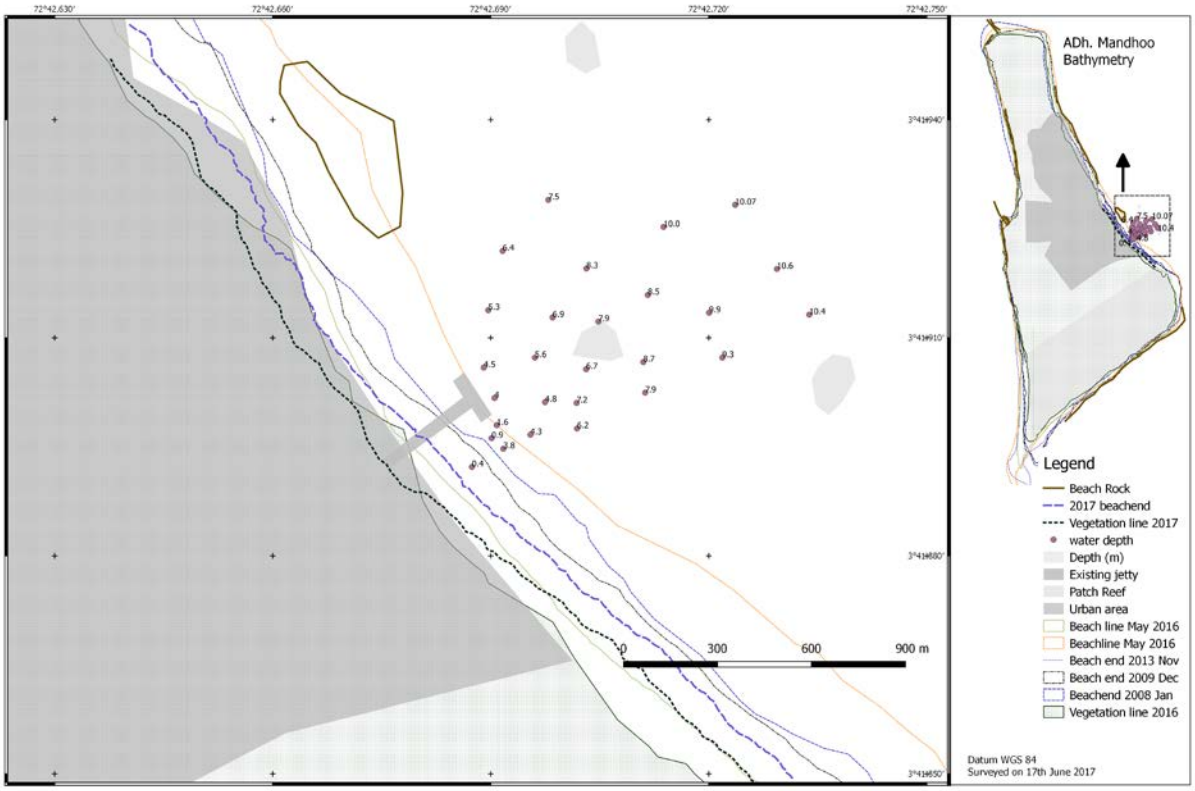


Figure 17: Bathymetry of the area proposed for access jetty reconstruction work in ADh. Mandhoo

7.5 MARINE ENVIRONMENT

7.5.1 Marine Environmental Setting

ADh. Mandhoo Island is found in single reef found in the south western parts of ADh Atoll. The island is found in a very large oval shape reef having approximately 7.5km in length and 2km in the width. The total area of the reef is estimated to be (1742. ha) *Figure 18*.

Figure 18: The extent of ADh. Mandhoo reef,

The island is approximately 38ha; hence the island occupies 0.02% of the whole reef. The island is located on the south western part of the reef, There is a fairly large deep lagoon inside the reef with numerous patch reefs. The deep lagoon occupies the eastern part of the reef. Depth of the lagoon varies between 1-12m and the water depth of deeper lagoon is 15m in some area. The total area of the deep lagoon is over 550 ha. This means that the deeper lagoon occupies over 30% of the total reef area. The deep lagoon is accessible from the northern and southern ends and also from various points from the eastern side.

The deep lagoon of Mandhoo is famous as a bait fishery ground, where large number of Yellowfin tuna fisherman from various parts of Ari Atoll comes for bait fishing. The numerous patch reefs in the lagoon serve as bait fish aggregating points where the coral patches provide necessary sheltering food and other ecological parameter required for bait fish aggregation.

7.5.2 Reef characteristic and formation

Mandhoo reef has a very distinct reef formation characteristic on its eastern and western sides. The eastern side reef which is facing the atoll lagoon has lagoonal characteristic. The reef flat on the eastern side consists of live coral patches on a sandy bottom and the reef slopes is fairly steep on this side. This side is exposed to fetch waves generated on the atoll lagoon.

The western side has a fairly hard consolidated reef-rock conglomerate with numerous large spares and groove structures. The reef flat is shallow within the range of 0.5-1.5m and the reef width on the western side is within the range of 300-500m. The western side is exposed to oceanic swells throughout the years and fairly large surfs break during the westerly monsoon period. The reef slope on the western side gently slopes ocean wards.

The reef slopes on the northern and southern ends of the reef are very gently sloping. The slope extends about 1km on the southern side while on the northern side slope extent is approximately 800m.

The proposed jetty construction work will be conducted in the nears-shore areas of Mandhoo Island. The island shoreline is far from the eastern reef separated by vast deep lagoon. Therefore it is very unlikely that the impact of the proposed jetty reconstruction activity will reach the reef area. But some of the patch reefs nearby the work area may be affected with excavation and subsequent sedimentation due to placement of pad-column structure of the jetty. Due to time constraint and the scope of the project particularly with the proposed adjustment to the scope based on the findings of the field work no reef survey was conducted.

8 SOCIO-ECONOMIC ENVIRONMENT

8.1 INTRODUCTION

ADh. Mandhoo is located on the south western side of ADh Atoll. The island is located at the north eastern rim of the atoll at Longitude 72.709615°, Latitude 3.698151° (Figure 7). The Island is elongated wider on the southern side and narrower on the northern side. The island is oriented N-S and is found in a single reef with a huge deep lagoon. The island is occupies south western part of the reef flat. The island has approximately 1.11km in length and 475m on the widest part and 155m wide on the narrow part of the island and has an approximate land area of 39ha. Closest inhabited island located within the vicinity of Mandhoo Island include Himandhoo and Malhos on the north and Dhangethi and Omandhu on the east.

8.2 POPULATION AND HOUSING

The total population of ADh Atoll based on Population and Housing Census undertaken in 2014 was 9086 people divided into 10 inhabited islands. The largest population in the atoll is found in Maamigili having 2359 and the smallest population is found in Dhidhdhoo having only 153 persons and the total registered population of Mandhoo 367 according the census 2014. Only 120-175 people actually live in the island. The rest of the registered population of Manhood is living out either for employment or migrated to other islands. The total number of households in the island is 78.

8.3 HEALTH AND EDUCATION

There is only one school on the island. The school was established late 1990's. The school approximately 25 student, two foreign and two local teachers. This is a primary level school teaching up to grade 7. Majority of the students from the island are studying either in Mahibadhoo or in Male.

Health services started in the island in in early 2000, where a private house was rented by the government and service of family health officer and community health officer was provided for the island. A family health officer, community health officer and a nurse are providing the health services to the island. Simple and most basic healthcare such as dressing, wounds, diabetes test, IV and injection fluid for patients. Also some very basic medicines are available in the Health Centre.

Figure 19: ADh Mandhoo Health Centre

8.4 ELECTRICITY

Electricity for the island is provided by the island community. There are two generator sets each with 50 KVA capacities. Monthly average usage is 18,156 kWh and approximately 90,000 litre/y of diesel fuels is consumed to generate electricity in the island. (Maldives energy outlook, MEE, 2013).

8.5 LOCAL ECONOMY

Major economic activities of Mandhoo are fisheries tourism and trade, employment in resorts and other parts of the country and construction, trade and tourism.. The island has a fairly reasonable fleet of seagoing vessels. Approximately 20 boats and Dhoni are operating from the island mostly engaged in fisheries and providing tourism related travel and trade services for the resorts. Also the house reef of the island is used by the Yellowfin tuna fishermen as a source is for baitfish.

8.6 SOCIO-ECONOMIC BENEFITS

Mandhoo has a large number of Dhoni used in the nearby resorts for various purposes such as diving. Cargo supplies, ferries also number of Yellowfin tuna fishing vessels enters into the lagoon to catch bait fish. Therefore properly functioning access jetty is an important and necessary infrastructure required for the island. In response to people's request to replace the broken jetty the Government proposed this project to construct a new T-jetty in the same location of the existing jetty and undertake maintenance dredging of the lagoon near if necessary.

Island access related developments such as harbours, access channel and jetties, in inhabited island, are considered to be the most important infrastructure everyone craves for and viewed as a necessity for the development of the island to open up to the rest of the country. The primary objective of the project is to provide access to the island. Access to the island is envisaged to bring economic growth and will improve living conditions of people of ADh Mandhoo Island. Therefore the proposed development project in ADh. Mandhoo is an important infrastructure development project that will open-up the island and improve travel and trade and movement of people to and from the island.

9 STAKEHOLDER CONSULTATION

The scoping meeting to determine the scope of the EIA report was held on 11th June 2017 at EPA. During the meeting the stakeholders were identified and the scope of the EIA report was determined. Methods used for stakeholder consultation include direct communication and interviews with locals in ADh. Mandhoo, formal meeting such as the scoping meeting, island council and the people of ADh Mandhoo.

9.1 KEY STAKEHOLDERS

As per the TOR the key stakeholders identified are

1- Mandhoo islands council
2- People of Mandhoo and boat owners island
3- Ministry of Housing and Infrastructure
4- Environmental Protection Agency

9.2 EIA SCOPING MEETING

EIA scoping meeting was held on the 11th June 2017. ADh. Mandhoo council was not present in the meeting (meeting attendance is in Annex 4). The meeting was chaired by Ms. Fathimath Reema, Director EPA. The MHI representative gave a briefing on the proposed development of access jetty on the eastern side of ADh. Mandhoo and explained the major activity under this project would be jetty reconstruction work and maintenance dredging required near the jetty area.

In the light of the discussions held in the scoping meeting, EPA requested to provide an Environmental impact assessment report on the proposed access jetty reconstruction and maintenance dredging in ADh. Mandhoo.

9.3 CONSULTATION WITH MHI

Formal consultation with MHI, the proponent of the project, was held on 9th July after the EIA scoping meeting and the field visit to the island. The consultant gave a briefing about the main findings from the field visit to ADh. Mandhoo and the consultations held with the people and island council. The consultant conveyed that the jetty area in Mandhoo Island does not require any dredging as the area is already deeper than the water depth of harbour basins developed in islands. Also he conveyed the concerns of the people and council and their need to relocate the jetty approximately 20m south of the existing jetty. Also the consultant conveyed other adjustment to the jetty that has been requested by the people, such as the length, width and extent etc. As a matter of principle MHI expressed their willingness to accommodate people's need and had no objection to fulfill the people's request as long as the adjustment proposed is within the budgetary limitations. They also expressed that they will discuss the matter further with council to ensure that people's needs fulfilled.

9.4 CONSULTATION WITH MANDHOO COUNCIL AND THE PUBLIC

Stakeholder consultation with Mandhoo Island Council was held on 15th June 2017 afternoon around 14:00 pm at the Council Office during the field visit (***Figure 20***). The meeting was held after the field visit and survey and inspection of the proposed location for island access and jetty construction in ADh. Mandhoo. Representatives of the general public, a selected group of youth, former council members, senior citizens, boat owners, present council members, women's committee etc., are invited for the meeting (***Figure 20***). A list of attendees to the meeting is given in Annex 4. The newly elected council president gave a brief introduction about the meeting. He said that the council could not attend the scoping meeting held at EPA because of the short notice. He also said that talks about the jetty reconstruction have been going on for some years now and they can only believe about the

project when the actual practical work starts on the site. Also he said that the news came as a surprise as they have not been discussed about dimensions and specifics of the jetty. Then the consultant gave a briefing about the project and the proposed dimensions of the jetty. He also briefed about the EIA process and the role of stakeholder consultation in environment related decision making. Former island council member said that the dimensions of the jetty have been discussed with them and also a screening meeting was held in EPA last year on preparation of the EIA report for the project. In that meeting it was decided that the area proposed for jetty reconstruction is deep enough and no dredging is required hence an EIA report is not required. Since the jetty will be standing on pillars and will allow sand and water to follow underneath it without obstruction, the project does not need an EIA study as per the EIA regulations. Therefore; he questioned about the sudden need for an EIA study for the jetty reconstruction work. To this end the consultant responded by saying that in fact the EIA regulation is very clear on this matter and the main reason for conducting an EIA report is that during the scoping meeting MHI representative indicated about the potential need for maintenance dredging near the jetty area. Also he said that his observation is that there is no need for dredging in the proposed jetty reconstruction area as the area is deep enough. He said that this issue will be discussed with the ministry and the necessary measures will be taken. The consultant explained the EIA process and shared some of the observations from the field assessment. Then the floor was open for discussions. Main adjustment to the proposed jetty design in priority order is given below:

1- Extend the T jetty (shore perpendicular section) 4-5m more than the proposed design into the deep lagoon
2- Lengthening the shore parallel section of the T to 30-40m so the vessels can stay alongside the jetty.
3- Shift the jetty 20m south of the existing jetty

Figure 20: Stakeholder consultation ADh Mandhoo Council members and representation of general public

9.5 MAIN CONCLUSIONS FROM THE STAKEHOLDER DISCUSSIONS

Following are the conclusions of the consultations

1. Everyone agrees that access jetty is one of the most important needs of the island that required to be addressed as soon as possible.

2. Some adjustments to the location and dimensions of the jetty were proposed.

3. The people of the island are eagerly waiting for the project to materialize and starting of actual work on the site as soon as possible.

4. MHI has no objection for the proposed changes to project and expressed willingness to accommodate people's need and fulfill the people's request as long as the adjustment proposed is within the budgetary limitations.

Table 6: list of stakeholder consultation

Name	Designation	Contact No
Ibrahim Rasheed	General Public	
Ramzee Mohamed	General Public	
Husain Rasheed	Boat owner	
Naaziraa Idhrees		
Ali Adam		
Adam Abdul Wahid		
Abdu	General Public	
Haseen	General Public	
Hassan Irushad	General Public	
Shamsu Nisa		
Adam Mohamed		
Fathimath Ibrahim	General Public	
Azumeeru		
Ibrahim Ismail	Boat owner	
Mahmood Ahmed	General Public	
Saththar	General Public	
Badhoora Abdul Kareem	General Public	
Ameen		
Ahmed Farushan		
Ali Mohamed	Boat owner	
Ali Rizwan		
Ibrahim Shihab		
Ibrahim Hassan		
Mohamed Ibrahim	General Public	
Abdul Kareem		
Adam Shareef	Boat owner	
Adam Ibrahim		
Abdul Hadhi Abdul Rahman	General Public	
Ali Shameeh		
Mohamed Naseem	Council president	
Abbas Sauoodh	Council Memeber	
Fathimath Inaya	Council Admin Officer	
Dr. Mahmood Riyaz	Consultant	7890307
Ms. Nafha Aujaz	Environment Analyst (MHI)	7721554
Aroosha Hashim	Assit. Project Office (MHI)	
Mariyam Shidha	Snr Research Officer (EPA)	

Aiminath Mohamed	Asst. Project Officer (EPA)	
Moosa Naseem	FFehendhoo Council (president)	
Ali Azhar	Asst. Director (Fulhadhoo Council)	
Ahmed Asif	Fulhadhoo Council (member)	7787992
Hussain Rashad	Rasgetheem Council (President)	
Fathimath Reema	Director (EPA)	
Hashim Nabeel	Project officer (EPA)	

10 POTENTIAL IMPACTS AND MITIGATION MEASURES

This section of the report identifies the potential environmental impacts and possible issues that could arise from implementation of the jetty reconstruction work in ADh Mandhoo. The assessment has been made based on the field observation that the project does not need maintenance dredging. Their identification of potential impacts does not mean that they would necessarily occur or that they could not be successfully mitigated. Therefore the scope of the proposed work will be limited to jetty reconstruction on the eastern side of Mandhoo Only.

Possible impacts arising from the construction and operation works are categorized into reversible and irreversible impacts. Reversible and irreversible impacts are further categorized by intensity of impacts (negligible, minor, moderate and major) for identifying best possible remedial (mitigation measures) action to be taken. Below are the impact categories

- **Negligible:** the impact is too small to be of any significance (Reversible)
- **Minor:** the impact is undesirable but accepted (Reversible)
- **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 (May or may not be Reversible)
- **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 (Irreversible)

Severity of impact is assessed by reviewing the engineering design, detailed site plan as well as comparison of development with the existing environment and construction methodologies employed. Mitigation measures are derived based on the site specific assessment as well as similar project elsewhere in the Maldives. Impact identification matrix is provided in ***Table 7***. Potential impacts and their mitigation measures and detail discussion is the following sections. Table 8 gives a summary of impacts their reversibility significance and cost.

10.1 IMPACT IDENTIFICATION

The following section describes in detail and discusses the main potential environmental impacts that have been identified and predicted for the proposed island access and jetty reconstruction project in ADh. Mandhoo. Identified potential impacts are divided into construction phase and operation phase environmental impacts.

10.2 LIMITATION/UNCERTAINTY OF IMPACT PREDICTION

The methods used to predict and evaluate the environmental impacts that may be associated with the cutting the access channel, dredging and jetty reconstruction work on ADh. Mandhoo Island may not be the most comprehensive. The main shortcoming of these methods is that impacts are predicted by reviewing the survey data collected during the field visits and information revealed by the designers and engineers, therefore the assumptions have been made to predict the impacts which may or may not be accurate. Also, the data collected during the field visit is limited, which subsequently limits the overall understanding of even the short term environmental conditions (wave condition, currents, and littoral movement). Nonetheless, within the time limitation of EIA field data collection and report preparation the methods used are concise and provide a general overview as well as the range of impacts that can affect the environment.

Table 7: Impact Identification matrix

		Construction phase Activities					Operational phase Activities
Impact	Site setup and mobilization	Work force	Jetty construction	Jetty base leveling	Equipment and vehicle maintenance	Demobilization	Operation of the jetty
Noise	-	-	-	-	X	-	-
Dusting -Air Quality	-	X	-	-	-	-	-
Coastal process	X	X	-	-	X	-	X
Terrestrial flora	X	X	X	X	X	X	X
Ground water	X	X	X	X	-	X	X
Soil	X	X	X	X	-	X	X
Marine water	-	X	-	-	-	-	X
Hydrodynamics	-	X	-	-	X	X	-
Marine habitat and Fauna	-	X	-	-	X	-	X
Natural hazard risk and safety	X	X	+	X	X	X	+
Employment	+	+	+	+	+	-	+

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

10.3 IMPACTS AND MITIGATION MEASURES

Construction phase can be considered as the period in any developmental project that causes major direct and indirect long and short-term impacts on the environment. Anticipated potential direct and indirect environmental impacts from the proposed jetty reconstruction work in ADh. Mandhoo is includes the following

- Direct impacts from mobilization of equipment and labour
- Short term changes hydrodynamic regime and potential long term changes
- Impacts to marine habitat and coastal environment
- Direct impacts from noise, vibrations and air pollution
- Greenhouse Gas Emissions from the equipment
- Potential discharges of oil and broken parts during equipment & vehicle maintenance

The following paragraphs will provide detailed impacts and mitigation measures during the construction phase of the project.

10.3.1 Impacts from Mobilization of Equipment and Labour

Mobilization of heavy equipment and machinery needed for the project in ADh Mandhoo will have negligible impact on the marine and coastal environment. The major impact of the mobilization would be aesthetic unattractiveness of the vehicles and equipment camp site. Disposal of minor amounts of hazardous waste and sewage may be a concern but use of the existing systems in the island, e.g., sewerage system, water and waste disposal mechanism will make the impact negligible

10.3.2 Jetty Reconstruction and levelling

Jetty reconstruction and levelling work on the eastern side of the ADh Mandhoo will have a direct irreversible negative impact on the immediate location of pad-column footing area. Direct impact of this activity is limited to ADh. Mandhoo near-shore area in the vicinity of the construction site only.

Given below are relevant impacts that should be considered:

1. Physical damage on benthic sessile fauna in areas with direct contact with the jetty footing: The effect of this would be in the immediate to short term with the migration of benthic sessile and burrowing fauna living on sand.
2. Disturbance to the area during digging to place the jetty footing: Release of minor amount of sediments and potential migration of the fauna due to localised disturbance will undoubtedly occur.
3. Jetty reconstruction and placement of columns will slightly change in the flow patterns. It is unlikely to cause significant erosion or accretion of the island or coastal areas.
4. The reconstruction of jetty columns may kill some of the organism that fall on the foot print of the structure however the installation of columns will create new hard substrate suitable for habitation.
5. Jetty levelling work will not result in to lose any live corals or significant fauna as a direct result. Noticeable numbers of crabs have been observed to live on the beach crevices. Since they are highly mobile creatures they will move away from the disturbed area and retreat into elsewhere on the coast. However, sedentary organisms falling in the beach levelling area will be negatively impacted.

In order to minimize the impact from sediment, substrate digging activity to place the jetty footings should be completed in shortest time possible. Digging ought to take place during low tides or slack tides to minimize the release of sediment to the area.

10.3.3 Hydrodynamic regime

The proposed jetty development on the eastern part of the island will not interfere with shoaling characters of waves.
The proposed jetty standing on pad-and-column structures will not obstruct the long shore currents transporting sediment around the island.

10.4 NOISE, VIBRATIONS AND AIR POLLUTION

During the mobilisation of equipment and operation of heavy machinery for jetty reconstruction work, it is anticipated that significant noise will be generated. Minor ground vibration is anticipated during movement heavy vehicles. Furthermore, noise vibrations may alter species behaviour. In addition,

dust and emissions from vehicle and machinery exhausts will degrade the air quality. However, these impacts will be short term and can be mitigated to avoid nuisance to the locals in the island. With proper mitigation measures, it is unlikely that noise, vibration and air pollution impacts will cause long term effects such as human health risks leading to increased public and private health costs.

10.4.1 Equipment & vehicle maintenance

All sorts of motorized equipment, requiring fuel, lubrication and maintenance will be used on the site. Many will be fitted with lead batteries. Therefore the potential accidental spillage and contamination of the soil and the sea by hydrocarbons as well as the careless disposal of batteries exists during the reconstruction period.

10.5 POTENTIAL POSTIVE IMPACTS

Potential positive impact of the project would be on creation of employment during reconstruction period particularly for locals. The project will have a noticeable impact economically to ADh. Mandhoo Island as it will resolve the difficulties faced by the islanders to access the island and reduce the transportation cost through smooth access and operations of boats and launches and minimize damage by accidental grounding etc.. This in turn will contribute to overall economic growth of ADh. Mandhoo and islands in the region.

1. Better income to the region
2. Better employment opportunities in the region
3. Improved navigational safety and transport at local level
4. Improved regional economy as a result of the improved facility

10.6 NEGATIVE IMPACTS

1- Temporary loss of coral benthic biota that falls into the immediate footprint of the Pad-column structure.
2- Short-term localised sedimentation due to suspension and dispersal of fine sediments associated with digging jetty footings.
3- Possible localised minor impacts on pelagic environment due to suspended sediments.
4- Impaired minor visual/seascape impacts from the presence of the dredging equipment.
5- Increased noise levels in the work area.

10.7 IMPACT MITIGATION MEASURES

Table 9 below lists the potential impacts identified above describes the corresponding mitigation measures that should be put in place during implementation of the proposed jetty reconstruction work in ADh Mandhoo. As assess above the project will have negligible impact on the near shore environment since the project scope has been narrow down to jetty reconstruction work only and the maintenance dredging identified in the scoping meeting has been excluded and the project involves only jetty construction now. In summary the very minor and negligible impact mitigation measures proposed should entail:

1) In order to minimize the impact from sediment, substrate digging activity to place the jetty footings should be completed in shortest time possible. Digging ought to take place during low tides or slack tides to minimize the release of sediment to the area.

2) During the project activities and operational phases, all efforts should be made to prevent the intentional or accidental spill of oil, waste oil and hazardous materials release into the environment which could lead to further damage to the marine environment.
3) Contractor should take steps to ensure that there is no dumping of oily waste from vehicles or land-based activities related to the project. Careful consideration should be given to the requirements for storage and appropriate disposal of waste oil.

10.8 MITIGATION COST

The mitigation measures associated costs, is identified below in Table 8. Costs are based on the estimation of the magnitude activity

Table 8: Significant impacts, mitigation measures and associated costs

ACTIVITY	IMPACTS	IMPACT PREDICTION			MITIGATION MESURES	Mitigation cost (MVR)
		Magnitude	Reversibility	Duration		
1. Placement of jetty footing and substrate digging	Loss of benthic biota in the immediate footprint of the jetty footing	L	R	S	Digging should be completed in shortest time possible. Dredging during low tides or slack tides Apply above measures to control sediment dispersion	
	Modification of current and wave pattern	L	R	S		
	Sedimentation from dredging	L	R	S		
	Increased ambient noise level	L	R	S	All construction work that produces significant noise should be undertaken during day time to minimize noise pollution. Provide ear muffs for construction workers to wear when using machinery that produce significant noise.	1,000 cost of earmuffs
2. Leveling	Increased ground water salinity	L	R	S	Leave the material in rain prior to disposal	
3. Social impact: the people	Improvements in island accessibility	H	R	L	Major positive impact of the project	
	Employment	M	R	S	Short term employment	

Key

Magnitude	Reversibility	Duration
H=High	I=Reversible	L= Long Term (Over 10 years)
M=Medium	R=Reversible	M=Medium term (Over 5 years)
L=Low		S=Short term (Below 5 years)

11 ALTERNATIVES

11.1 NO DEVELOPMENT OPTION

Not implementing the proposed island access channel small mooring area and the jetty implies that the local population of ADh.Mandhoo will not be able to access the island easily. The locals will face considerable challenges as to basic need of accessing the island. There is no alternative to achieving socio-economic development without proper safe access to the island and developing an access channel mooring are and jetty to access the island is considered to be a necessity.

It is believed that very negligible short-term localized environmental impacts will have to be born as results of the proposed development access jetty in ADh Mandhoo. Although no impacts on the environment will be associated if the proposed development does not go ahead, but should the development goes ahead, it will improve and ensure accessibility to the island. The project is likely to facilitate economic opportunities and contribute directly and indirectly to health and wellbeing of the community.

Given the range of benefits that the proposed development will bring the project has been considered important and "No-Development" Option has been considered not favorable for the proposed development and decided to go ahead with the proposed development.

Development can take place only within the limits of the environment and the community with which the development is taking place. Hence, the aim is to ensure that all project activities are undertaken without serious adverse long term irreversible environmental damages that prove to be difficult to mitigate.

11.2 DEVELOPMENT OPTIONS

11.2.1 Relocation of Jetty

The main reason for relocating the jetty 20m south of the proposed location is to keep the jetty closer to the planned ferry terminal. The main advantage of the proposed new location is convenience and more appropriate and closer to the relevant infrastructures.

MHI in principal have agreed to relocate the proposed island access to the new location during the scoping meeting.

11.2.2 Existing environment of the proposed new location for island access

Existing environment of the proposed new location for jetty is similar to the old location

1.1.1 Mitigation measures for the preferred alternative

The mitigation measure for this option would same as the mitigation measure analysed for the project in the relevant section.

12 ENVIRONMENTAL MONITORING PLAN

Environmental monitoring is essential to ensure that post-construction and operational impacts are known and eliminated in a timely manner. Dealing with impacts earlier would save money and also help planning and operationalize the process.

The parameters that are most relevant for monitoring the impacts that may arise from the proposed project are included in the monitoring plan. Monitoring the shoreline changes that may occur due to the short-term impacts from the changes in coastal processes.

The purpose of environmental monitoring plan (EMP) is to monitor or control the environmental effects of the proposed project. It should be based on compliance, verification, feedback, and know-how. It is therefore suggested that the Contractor carries out the EMP. The EMP should be able to provide responses to the following three questions:

a) Why is monitoring being conducted?
b) What specifically is being carried out?
c) How are the data and information to be used in planning and decision-making?

Table 9, and ***Table 10*** shows the details of the proposed monitoring aspects including the monitoring parameters, indicators, baseline, proposed methods, frequency and estimated costs

Table 9: Monitoring of the shoreline, beach profiles and coastal environment

Parameter	Indicators	Baseline / Reference Values	Method / Technique	Frequency	Estimated cost in USD
Shorelines (high / low tides)	Beach morphology	Baseline to be re-established immediately after construction is complete	Differential GPS	Bi-annually in the first two years after completing the dredging activities.	100/ trip
Beach profiles	coastal changes	Requires to re-establish the baseline following the construction	Beach profile surveys	Bi-annually in the first two years after completing the dredging activities.	100 / trip
Currents	Nearshore currents	Baseline to be collected immediately constructions are over, especially on western side	Drogue survey	Bi-annually in the first two years after completing the dredging activities.	100/trip

Table 10: Monitoring of the sea water quality

Type	Parameters	Locations	Frequency	Estimated cost (USD)
In situ monitoring / sampling and testing from a laboratory	Dissolved oxygen Turbidity (NTU) Nitrates Sulphates TDS	All locations marked	Bi-annual	200/ set of tests

12.1 MONITORING COSTS

It is understood that costs of monitoring be borne by the proponent. It is also understood the mitigation measures would be accommodated in the contract costs. A commitment letter confirming compliance on mitigation measures is given in **Annex 5**.

12.2 MONITORING REPORT

Based on the data collected, a detailed monitoring report will be compiled annually and submitted to the relevant government authorities for compliance. The report will include methodologies and protocols followed for data collection and analysis, quality control measures and indicate the uncertainties.

Table 11: A tentative schedule for submission of EIA monitoring report to EPA

	2017	2018				2019				2020			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Monitoring report, Operational Phase													

13 CONCLUSIONS

This EIA has been carried out on the basis that it is necessary to carry out the T- jetty reconstruction work in ADh Mandhoo Island. Field investigation during the EIA report preparation process has identified that the initially proposed maintenance dredging of the jetty area can be excluded from the scope of the project as the area is deep enough to accommodate larger vessels. With this finding the major activity that will cause significant environmental impact has been eliminated. The proposed method for construction of jetty will have very negligible environmental impact on the near-shore areas of the Mandhoo. In fact environmental impact assessment is not required as per the EIA regulation schedule Raa for jetties standing on pillars that allows water and sediment flow underneath it. As per the former island councils of Mandhoo, in an EIA scoping meeting held in EPA last year on the same project decided that the project does not require an EIA report as per the EIA regulations mentioned above. In that sense with the potential change of scope of the project based on this assessment the proposed jetty reconstruction work in ADh Mandhoo will not require environmental impact assessment.

However, this EIA assessment has been completed to fulfil the requirements of the ToR issued by the EPA on 13th June 2017 based on the discussions at the scoping meeting held on the 11th of June 2017.

Based on the scale of the proposed development project, environmental impacts associated with the proposed jetty reconstruction work is insignificant and negligible. The positive socio economic impacts from the proposed development outweigh the temporary negligible impacts related to jetty reconstruction work.

The study has evaluated alternative locations for the jetty reconstruction project in ADh Mandhoo and recommended shifting the location 20-m south of the existing jetty. Even though the anticipated impact from the project is negligible, the report has come-up with an extensive monitoring programme that will keep on monitoring coastal and marine environmental changes associated with the development to make necessary adjustment based on the findings of various measured environmental parameters suggested in the monitoring plan.

Therefore, on the basis of this environmental impact assessment study and the impact mitigation measures in the report, it is concluded that the benefits of the access jetty reconstruction project in ADh. Mandhoo eastern coast will substantially outweigh its imposition on the environment.

14 REFERENCES

Adam, MS and A. Naseer (2007). Environmental Impact Assessment for the proposed Tourist Resort Development on Kihaavahuravalhi, Baa atoll, Report prepared for MINOR International, 125 pages + Appendices.

Gischlera, E, J. H. Hudsonb, and A. Piserac (2008). Late Quaternary reef growth and sea level in the Maldives (Indian Ocean). Marine Geology 250 (2008) 104–113.

Handbook on Compilation of Laws and Regulations on Protecting the Environment of Maldives, 2012, Ministry of Environment and Energy.

Maldives National Sustainable Development Strategy, 2009, Ministry of Housing, Transport and Environment.

MEE (2013)Maldives Energy Outlook 2013

National Framework for Development 2009 – 2013, Government of Maldives.

Naseer, A (2003). The integrated growth response to coral reef to environmental forcing: morphometric analysis of coral reefs of Maldives. PhD Thesis, Department of Biology, Dalhousie University, Halifax, Nova Scotia, Canda,

Sandcays Pvt. Ltd. (2010). Environmental Impact Assessment for the proposed development of a harbour, Fainu, Raa Atoll, Maldives. Proponent Ministry of Housing and Environment. 80pp.

Regulations on Environmental Impact Assessment Report Preparation, 2012, Ministry of Environment and Energy.

Statistical Yearbook of Maldives, 2011, Department of National Planning (DNP).

15 ANNEXURES

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

Annex 2: Approved site plan

Annex 3: Jetty reconstruction detail plans

Annex 4: List of participants in council meeting and scoping meeting

Annex 5: Commitment letter from the proponent

Annex 6: Letter from ADh. Mandhoo Atoll Council

Annex 7: Details of consultant's contributions to the report

Annex 8: Bathymetry

Annex-1

بسم الله الرحمن الرحيم

ދުނިޔެ ދަތުރުވެރިކަމާ ގުޅޭ ތަންތާ ދެއްކުންތެރި ދާއިރާ
Environmental Protection Agency EPA

No: 203-EIARES/138/2017/84

Draft Terms of Reference for Environmental Impact Assessment for Jetty construction and Island Access project, ADh. Mandhoo South Ari Atoll

The following is the Terms of Reference (ToR) following the scoping meeting held on 11/06/2017 for undertaking the EIA of the proposed Jetty development a Project at ADh. *Mandhoo South Ari Atoll*. The proponent if the project is *Ministry of Housing and Infrastructure.*

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

1. **Introduction to the project** -Describe the purposed artificial beach development project and, if applicable, the background of the project and the tasks already completed. Clearly identify the rationale and objectives to enable the formulation of alternatives. Define the arrangements required for the environmental assessment and how coordination between other consultants, project engineers, contractors and government institutions will be carried out.

2. **Study area** - Submit a minimum A3 size scaled plan with indications of the proposed infrastructure. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location, size and important elements of the proposed jetty development project. The study area should include adjacent or remote areas, such as relevant developments and nearby environmentally sensitive sites (e.g. coral reef, sea grass, marine protected areas, special birds site, sensitive species nursery and feeding grounds). Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites.

3- **Scope of work-** Identify and number tasks of the project including site preparation, construction and decommissioning phases. The following tasks shall be completed:

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

The main activities of the proposed development are:

- Construction of 35m long T-jetty with 6m width walkway.
- Construction of Platform parallel to the shoreline with 20m length and 6m width.
- Ground levelling the jetty area.
- Maintenance dredging near Jetty area
- Measures to protect environmental values during construction and operation phase;

Environmental Protection Agency
Green Building, 3rd Floor, HandhuvareeHingun
Male', Rep. of Maldives, 20392
Tel: (+960) 333 5949 (+960) 333 5951
Fax: (+960) 333 5953
ދުނިޔެ ދަތުރުވެރިކަމާ ގުޅޭ ތަންތާ ދެއްކުންތެރި ދާއިރާ
ގ. ދ. ހަނޑުވަރީ ހިންގުން، 3 ވަނަ ފަންގިފިލާ، ކ. ދ. ދ. ބ. ދ. ދ. ދ.
ދ. ދ. ދ. ދ. ދ. ދ. ދ. 20392
Email: secretariat@epa.gov.mv
Website: www.epa.gov.mv

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

Jetties and lagoon area:

- Justification for the selection of these locations;
- Labour requirements and (local) labour availability;
- Housing of temporary labour, and
- Emergency plan in case of spills (diesel, grease, oil)

The EIA report should investigate possibilities for alternatives:

- Operation and positioning options;
- Alternative locations: have these been considered and if so, give arguments why these alternatives have not been selected, and

Power water, and sewerage:

- Sources of power and water during the construction phase ;
- Detail solid waste disposal mechanisms, equipment used and periodicity (how often?).

Waste management:

- Materials to be collected and management, waste reduction and recycling;
- Transportation mechanisms and costs;

Ground levelling and beach nourishment activities:

- Access channel and mooring area size, location, including oceanographic justification and map;
- Quantity of dredged material;
- Beach nourishment details including locations and width
- Ground levelling work

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

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

Climate

- Temperature, rainfall, wind, waves, evaporation rates (including extreme conditions)
- Risk of hurricanes and storm surges;

Geology and geomorphology

- Shoreline of the project impact area
- Vegetation line of the project impact area
- Offshore/coastal geology and geomorphology (use maps);
- Bathymetry (bottom morphology) (use maps);
- (Seasonal) patterns of coastal erosion and accretion (see appendix for monitoring details), and
- Characteristics of seabed sediments to assess direct habitat destruction and turbidity impacts during construction;

Hydrography/hydrodynamics (use maps)

- Tidal ranges and tidal currents;
- Wave climate and wave induced currents;
- Wind induced (seasonal) currents;
- Sea water quality measuring these parameters: temperature, pH, salinity and turbidity

Ecology

- Identify marine protected areas (MPAs) and sensitive sites such as breeding or nursery grounds for protected or endangered species (e.g. coral reefs, spawning fish sites, nurseries for crustaceans or specific sites for marine mammals, sharks and turtles). Include description of commercial species, species with potential to become nuisances or vector.
- Benthic and fish community monitoring around the impact area ;

Socio-economic environment

- Demography: total population, sex ratio, density, growth and pressure on land and marine resources;
- Income situation and distribution
- Economic activities of both men and women (e.g. fisheries, home gardening, fish processing, employment in industry, government);
- Seasonal changes in activities;
- Land use planning, natural resource use and zoning of activities at sea;
- Accessibility and (public) transport to other island;
- Services quality and accessibility (water supply, waste/water disposal, energy supply, social services like health and education);
- Community needs;
- Sites with historical or cultural interest or sacred places (mosques, graveyard).

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

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

Impacts on the natural environment

- Impacts on marine habitats including damages to coral reefs and seagrass communities, fish stocks, protected areas and protected species;

Environmental Protection Agency
Green Building, 3rd Floor, HandhuvareeHingun
Male', Rep. of Maldives, 20392
Tel: [+960] 333 5949 [+960] 333 5951
Fax: [+960] 333 5953
20392
Email: secretariat@epa.gov.mv
Website: www.epa.gov.mv

- Changes in erosion/sedimentation patterns, which may impact shore zone configuration/coastal morphology;
- Temporary sediment dispersal in water column (turbidity at the dredging site, beach noursihment areas and jetty construction areas), possibly resulting in changes in visibility, smothering of coral reefs and benthic communities and affecting fish and shellfish etc.;
- Impacts on landscape integrity/scenery.

Impacts on the socio-economic environment

- Impacts on employment and income, potential for local people to have (temporary or long term) job opportunities (and what kind) in the execution of the works;
- Disturbance to local natural resource users such as fishing areas, other tourism ventures;
- Impacts to nearby industrial establishments;
- Impact equity (economic activities, employment, income);

Construction related hazards and risks

- Pollution of the natural environment (e.g. oil spills, discharge of untreated waste water and solid waste, including construction waste);
- Risk of accidents and pollution on workers and local population.

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

Task 5. Alternatives to proposed project – Describe alternatives including the *"no action option"* should be presented. Determine the best practical environmental options. Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". The report should highlight how the location was determined. All alternatives must be compared according to international standards and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. Mitigation options should be specified for each component of the proposed project.

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. These will include both environmental and socio-economic mitigation measures. Mitigation measures to avoid or compensate habitat destruction, e.g. temporal sediment control structures, coastal protection structures to reduce erosion. Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources required to implement those measures. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included. In cases where impacts are unavoidable arrangements to compensate for the environmental effect shall be given.

Task 7. Development of monitoring plan– Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan for coastal modification, beach morphology, sediment movement around the island. Ecological monitoring will be submitted to the EPA to evaluate the damages during construction, after project completion and every three months thereafter, up to one year and then on a yearly basis for five years after. The baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring

program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided.

- Water quality, especially turbidity;
- Erosion and accretion changes;
- Temporal sedimentation rates on nearby coral reefs, benthic system and seagrass beds;
- Condition of the sensitive ecosystems and marine resources;
- Environmentally sound removal of dredging and other equipment including construction materials, and
- Employment of available local labour force.

Task 8. Stakeholder consultation, Inter-Agency coordination and public/NGO participation) – Identify appropriate mechanisms for providing information on the development proposal and its progress to all stakeholders, government authorities such as Ministry Environment and EnergyIsland and Atoll Council, local community, government agencies, engineers/designers, development managers and members of the general public. The EIA report should include a list of people/groups consulted, their contact details and summary of the major outcomes.

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

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

13 June 2017

Environmental Protection Agency
Green Building, 3rd Floor, HandhuvareeHingun
Male', Rep. of Maldives, 20392
Tel: [+960] 333 5949 [+960] 333 5951
Fax: [+960] 333 5953
Email: secretariat@epa.gov.mv
Website: www.epa.gov.mv

Annex-2

ADH. MANDHOO JETTY

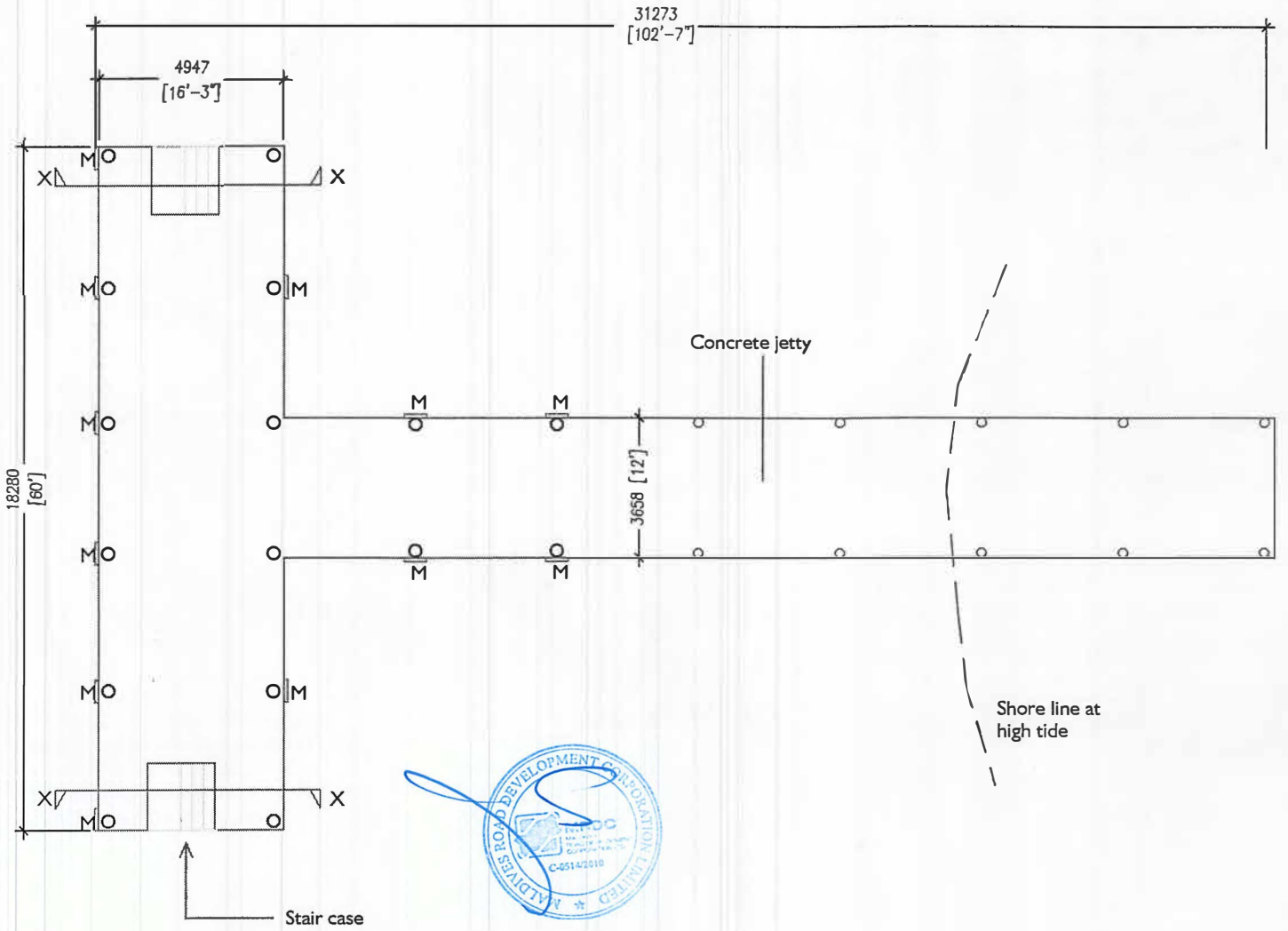
DRAWN BY:

AHMED EVAN WASEEM

DATE:

23 - 07 - 2015

INFRASTRUCTURE DEPARTMENT
MINISTRY OF HOUSING AND INFRASTRUCTU
IZZUDHDHEEN MAGU MALE' 20-01
REPUBLIC OF MALDIVES
TEL:323234, 323474, FAX:328300

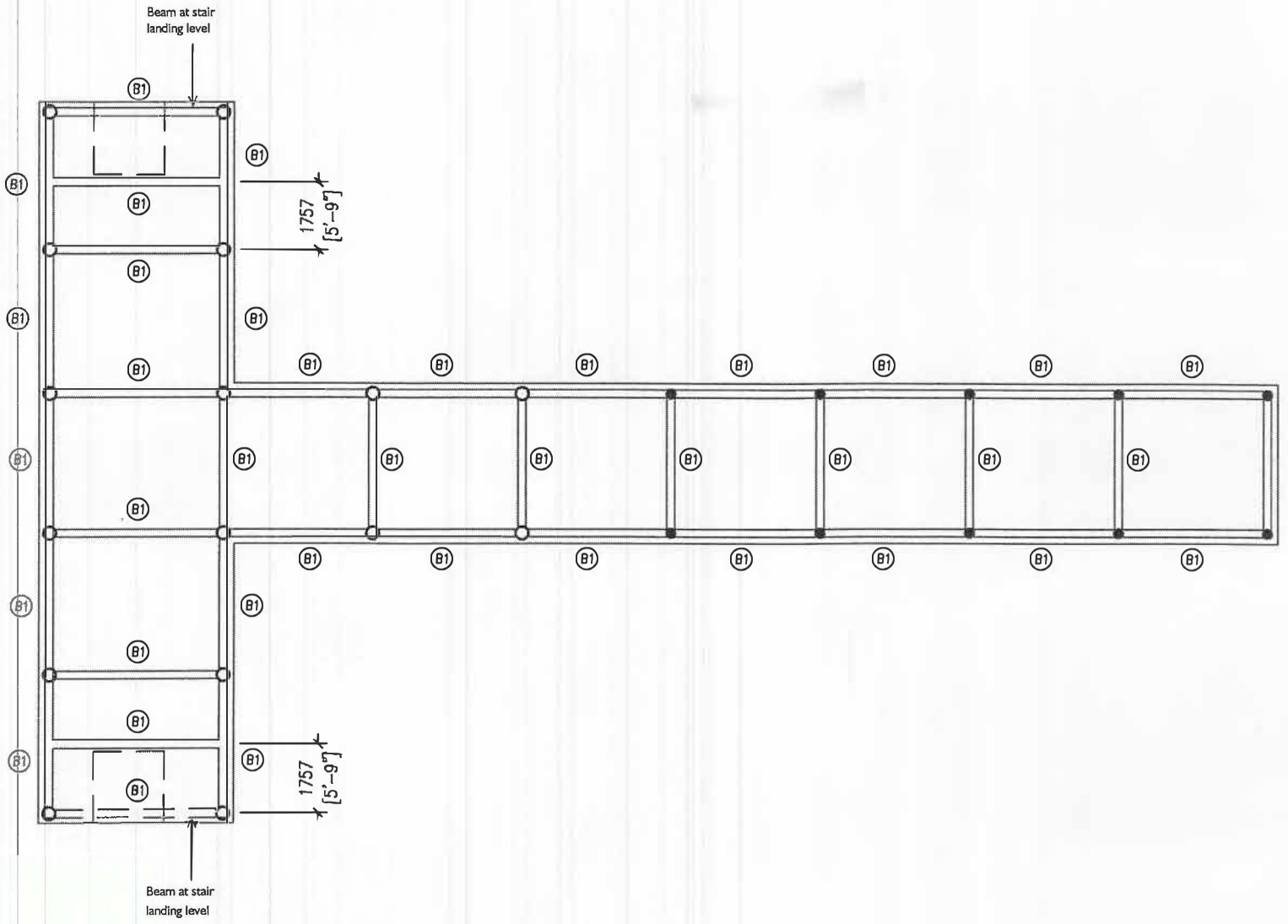


JETTY PLAN

SCALE 1:250

Note;
M-Mooring Hook

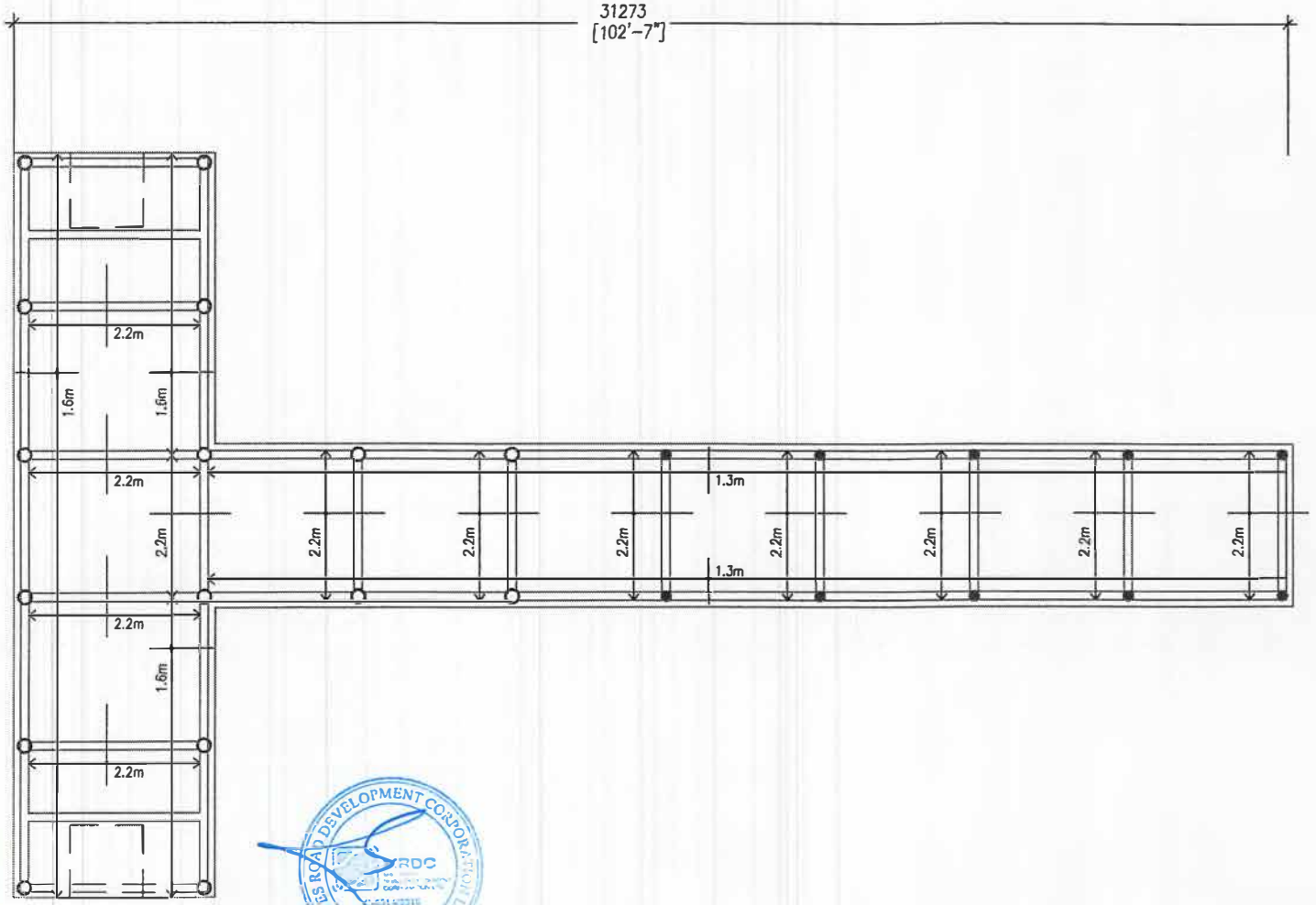
INFRASTRUCTURE DEPT.



BEAM PLAN

SCALE 1:250

INFRASTRUCTURE DEPT.

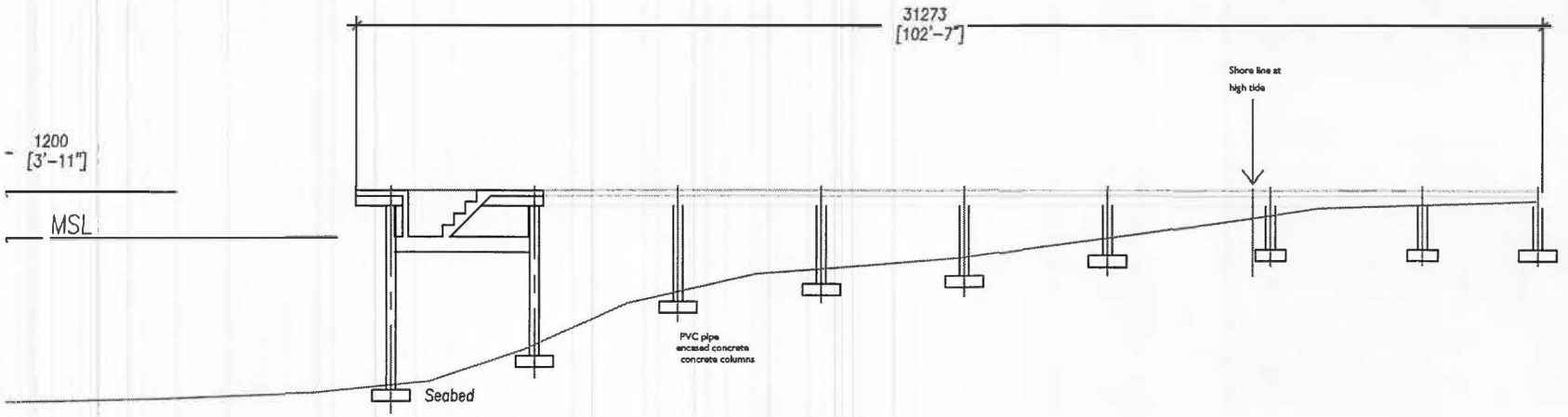


SLAB REINF. PLAN

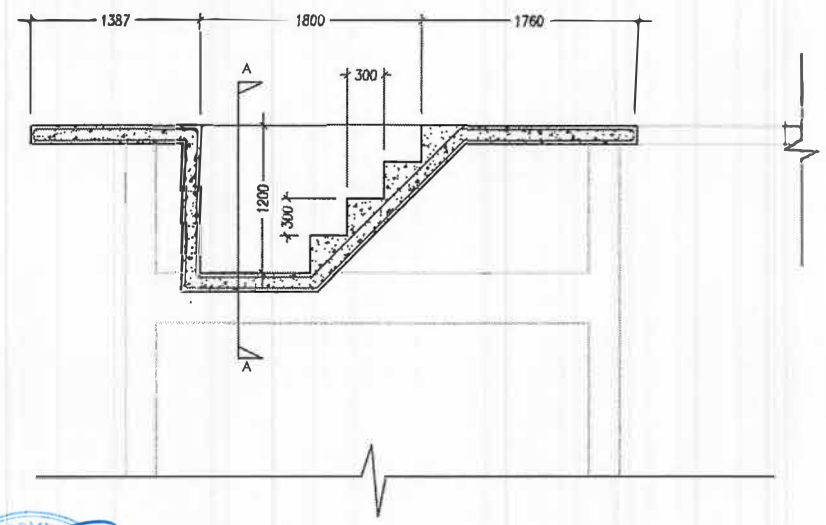
SCALE 1:250

SLAB
150MM THICK
BOTTOM T12 @ 150 B/W
TOP T12 @ 200 B/W + T12 @ 200 AS SHOWN
COVER 35mm

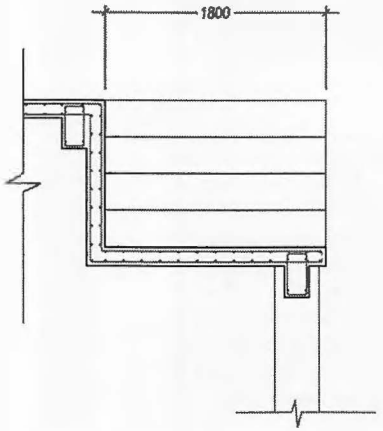
INFRASTRUCTURE DEPT.



INFRASTRUCTURE DEPT.



SECTION X-X

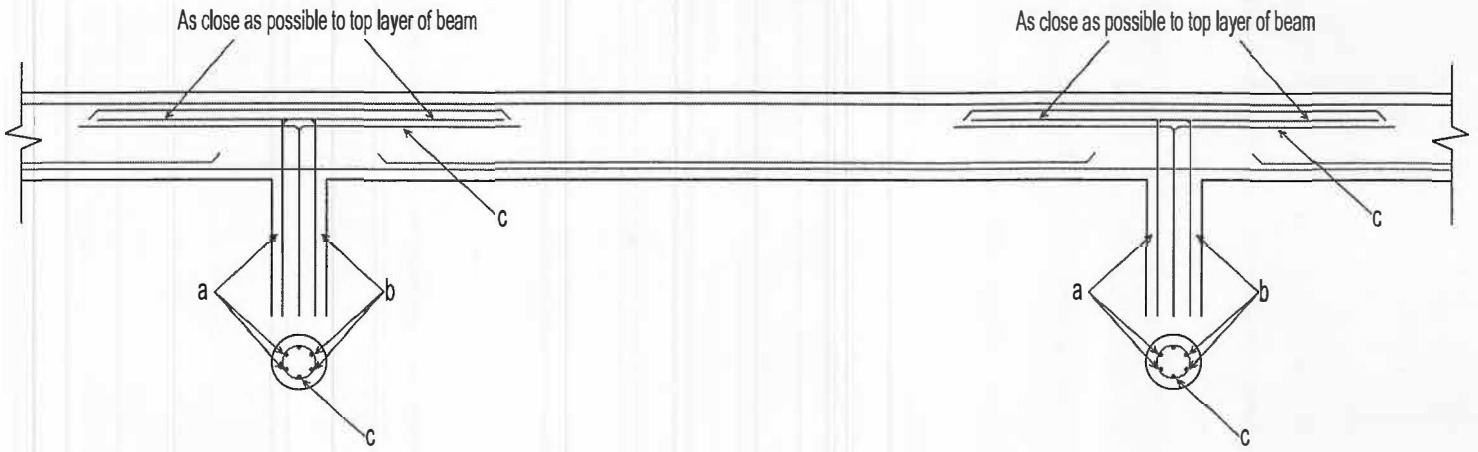


SECTION A-A

STAIR CASE DETAIL

SCALE 1:50

INFRASTRUCTURE DEPT.

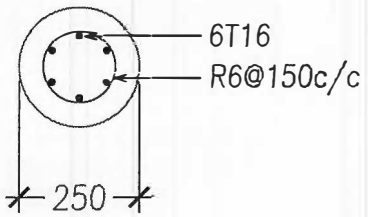


Note: Shear links not shown for clarity

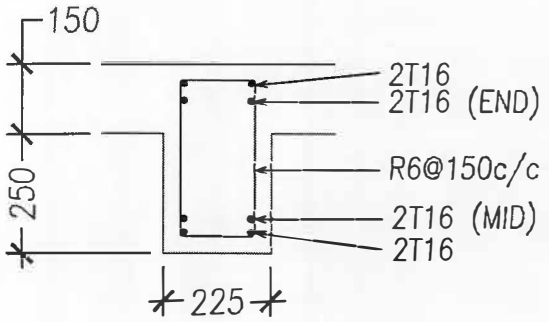
COLUMN - BEAM FIXED CONNECTION DETAIL

SCALE 1:25

INFRASTRUCTURE DEPT.



CIRCULAR COLUMNS
All encased in PVC pipes



B1

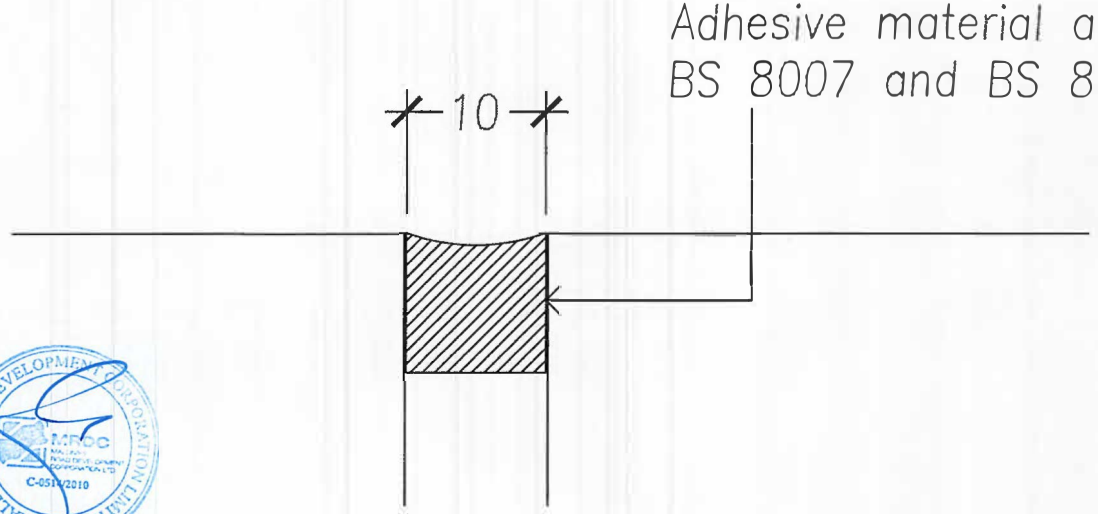
NOTE:

COLUMN CONCRETE COVER = 50mm
BEAM CONCRETE COVER = 40mm
Foundation for circular columns are
1200 x 1200 x 300
T12@150 BW at bot

STRUCTURAL DETAIL

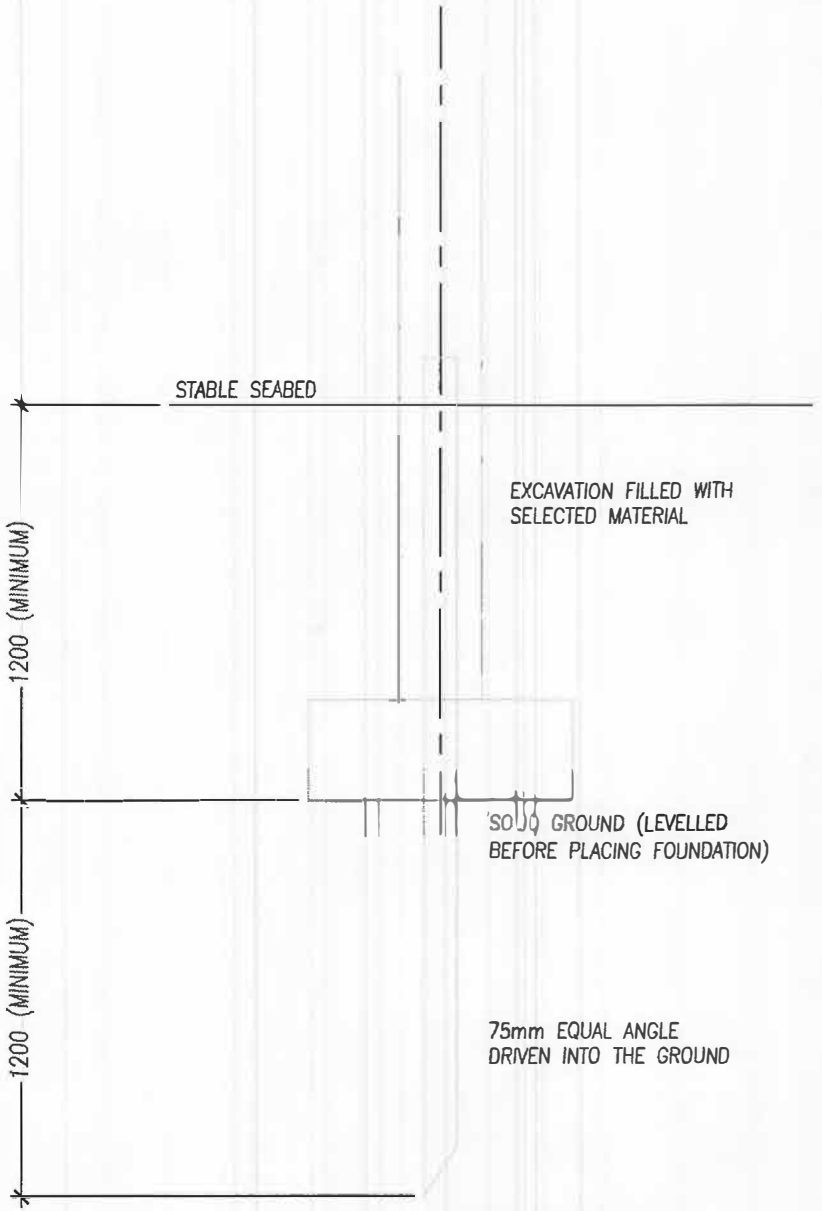
SCALE 1:20

INFRASTRUCTURE DEPT.



EXPANSION JOINT

INFRASTRUCTURE DEPT.



FOUNDATION PAD DETAIL

SCALE 1:20

INFRASTRUCTURE DEPT.

Environmental Protection Agency Annex-4
Male', Rep of Maldives

Meeting: Jetty construction in ADh. Mandhoo, 12. Rasgamee, B. Fehendhoo and B. Fulhadhoo
Date: 11/06/2017
Time: 13:00

MEETING ATTENDANCE

	Name	Designation	Office	Email	Phone No.	Signature
01	Mahmood Fiyaz	Consultant		Mahmood Fiyaz@gmail.com	7851037	
02	Nafha Anjas	Environment Analyst	MHI	envu@housing.gov.mv	7721554	
03	Anoosha Hashim	A. Project officer	MHI	envu@housing.gov.mv		
04	Mariam Shidha	Snr Research Officer	EPA	mariyam.shidha@epa.gov		
05	Aminath Mohamed	Asst. Project officer	EPA	aminath.mohamed@epa.gov		
06	MOOSA NASEEM	President	Fehendhoo Council			
07	ALI AZHAR	Asst Director	Fulhadhoo Council	laafulhadhoo@gmail.com	7775808	
08	AHMED ASIF	Council	fulhadhoo Council	"	7787992	
09	HUSSAIN RASHAD	council Rep	R. RASGETHEEMU	RASGETHEEMUOFFICE@gmail.com	7771409	
10	Farhana Fahmy	Senior Research officer	EPA	farhana.fahmy@epa.gov.mv	9874988	
11	Fathimath Reena					
12	Hashim Nabeel					

Proponents Declaration

Re: EIA for Island access and Jetty project in ADh.Mandhoo

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 construction 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.

Signature: 

Name: Fathimath Shaana Farooq

Designation: Director General

On behalf of: Ministry of Housing and Infrastructure

Date: 11 July 2017

ތ.ރ. ދަންޏާ ކައުންސިލްގެ ރިފާރު

ތ.ރ.ދަންޏާ

ފިލުވާހަރަކާ

01/2017 :ނަންބަރ

ވެލާނާ ގޮތުގެ ތެރެއިން ދަންޏާ ފަންނަދޫ

ރިވިއުކޮށް ހިއްދުވުމަށް ހުށަހެޅުނު ކަންކަން

ހިއްދުވުމަށް ހުށަހެޅި:

Draft environmental impact assessment for island access jetty reconstruction project in Mandhoo, South Ari Atoll

ބަލަހައްޓާ ފަރާތުގެ ނަން: ކައުންސިލް ސެކްރެޓަރިއެ

ދާއިރާ: ކާނާ ދާއިރާ

ރިފާރުގެ ނަން: ތ.ރ.ދަންޏާ ކައުންސިލް ހިއްދުވުން

ތާރީޚް: 10 ފެބްރުވަރީ 2017 ގަޑި: 11:00

ސޮއި

ސިކްރެޓަރީ

ކައުންސިލްގެ ކޮންފަރެންސް ހޯލްގައި

9 ފެބްރުވަރީ 2017

Annex-7

Chapter	Name of Consultant	Registration No.	Signature
Introduction	Dr. Mahmood Riyaz	(EIA 03/07)	
Project Description	Dr. Mahmood Riyaz	(EIA 03/07)	
Administrative and regulatory framework	Dr. Mahmood Riyaz Dr. Mohamed Shiham Adam	(EIA 03/07) (EIA 01/07)	
Methodology	Dr. Mahmood Riyaz Dr. Mohamed Shiham Adam	(EIA 03/07) (EIA 01/07)	
Existing Environment	Dr. Mahmood Riyaz Dr. Mohamed Shiham Adam	(EIA 03/07) (EIA 01/07)	
Stakeholder consultation	Dr. Mahmood Riyaz	(EIA 03/07)	
Potential impacts and mitigation measures	Dr. Mahmood Riyaz Dr. Mohamed Shiham Adam	EIA 03/07) (EIA 01/07)	
Alternatives	Dr. Mahmood Riyaz	(EIA 03/07)	
Environmental Monitoring plan	Dr. Mahmood Riyaz	(EIA 03/07)	
Conclusions	Dr. Mahmood Riyaz	(EIA 03/07)	

Annex_8

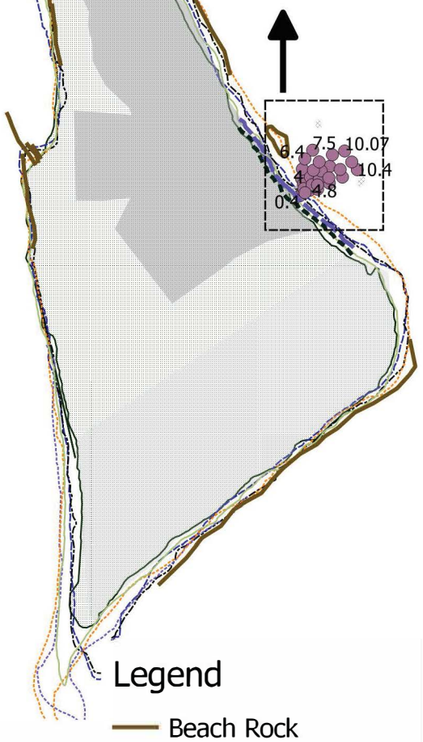
72°42.630′ 72°42.660′ 72°42.690′ 72°42.720′ 72°42.750′

3°41'940′ 3°41'910′ 3°41'880′ 3°41'850′

7.5 10.07 10.0 6.4 8.3 10.6 8.5 5.3 6.9 7.9 9.9 10.4 5.6 4.5 6.7 8.7 9.3 7.9 4 4.8 7.2 1.6 0.9 4.3 6.2 3.8 0.4

0 300 600 900 m

ADh. Mandhoo Bathymetry



Legend

- Beach Rock
- 2017 beachend
- Vegetation line 2017
- water depth
- Depth (m)
- Existing jetty
- Patch Reef
- Urban area
- Beach line May 2016
- Beachline May 2016
- Beach end 2013 Nov
- Beach end 2009 Dec
- Beachend 2008 Jan
- Vegetation line 2016

Datum WGS 84
Surveyed on 17th June 2017