1ST ADDENDUM REPORT FOR THE ENVIRONMENTAL IMPACT ASSESSMENT FOR PROPOSED

Installation and Operation of Commercial Scale WEC Units in Holiday Inn Kandooma Maldives, South Male' Atoll

July 2020

Proposed by: Ocean Paradise Maldives Pvt Ltd
Prepared by: Hamdhoon Mohamed (EIA P03/2017)

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Consultants Declaration

As the lead consultant of this EIA,

This EIA has been prepared according to the EIA Regulations. I hereby, declare that the content in this EIA is complete, true, and correct to the best information that I had while compiling this EIA.

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Proponents Declaration

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PROPONENT DECLARATION

23th July 2020

Ocean Paradise (Maldives) Pvt. Ltd hereby declare that the contents of this 1st Addendum to Environment Impact Assessment (EIA) Report for the Proposed Commercial Scale WEC at Kandooma have been read and understood by us.

Also, we are aware that this EIA Report has been prepared to fulfill the requirements of the EIA Regulation 2012 and Amendments for regards to obtaining environmental clearance for the project from Environmental Protection Agency (EPA).

Name : Mohamed Niyaz

Designation : Director

Signature :

Stamp :

Date : 23rd July 2020

Executive Summary

This report is the 1st Addendum to the Environmental Impact Assessment (EIA) for the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma. The initial EIA report was submitted to Environmental Protection Agency (EPA) on 31st December 2019 and the decision statement was issued by the 22nd January 2020. This report is prepared in accordance with Environmental Impact Assessment Regulation (2007) under the Environmental Protection and Preservation Act (1993) and the Amendments to the EIA regulation. The purpose of this 1st Addendum report is to fulfill the requirements of the aforementioned law and regulation and conduct an assessment of possible impacts on the ecological, biophysical and socioeconomic environment arising from the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives.

The main rationale of this project to ensure the energy security of the resort and reduce the dependence on the fossil fuels for energy generation. This project is expected to improve the air quality of the resort since diesel generators known to deteriorate the ambient air quality.

The proposed project will involve installation and operation of 4 commercial scale WEC units in the south eastern side of Holiday Inn Kandooma Maldives. The energy generated from the WEC units will be integrated to the existing grid of the resort at a pilot scale. The project will involve installation of cable for transmission and establishment of a WEC monitoring station in the power house of Holiday Inn Kandooma Maldives.

The scope of this 1st Addendum report is to cover the additional works which are not included in the initial EIA report for the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives. This include;

- Temporary WEC units

The WEC units shipped from Japan and transported to project location. However, they were not installed in the designated area for installation since the technical team of experts could not travel Maldives due to COVID19 pandemic. The WEC units are currently stored at a depth of 3 to 3.5 metres at low tide at south eastern side of Holiday Inn Kandooma. This addendum report will cover the environmental and social impact assessment associated with the following;

- Temporary Storage of WEC units;
- Installation of WEC units;
- Operation of WEC units

Key Impacts

The project will involve impacts both during the storage and installation phase and the operational phase of the project. The main project activities which may result in impacts during the construction phase include; temporary storage of WEC units, drilling of project location for WEC unit installation, excavation for installation of power cables for transmission and potential oil spills from the equipment. However, the impacts from these activities is expected to me minor and short lived.

The main project activities during the operational phase which may have a significant impact on the environment include: operation of commercial scale WEC units, maintenance work of Installed WEC units and WEC monitoring station and decommission of the WEC units.

The major socioeconomic impact is found to be positive. The improved air quality, provision of renewable energy and reducing the dependence on fossil fuel is expected to have benefits to the management of the resort was well as the tourist visiting the Holiday Inn Kandooma Maldives.

Mitigation Measure

The mitigation measures were proposed based on conducting appropriate field surveys and environmental assessment of the Holiday Inn Kandooma Maldives, proposed and alternative locations for commercial scale WEC unit installation. The mitigation measures for the storage phase of the project has been already taken. They include painting of anti-corrosive paints at the WEC units and installation of steel bars to avoid larger fishes and turtles entering the WEC units. The main mitigation measures which need to be taken during the installation phase include carrying the drilling required for mounting of the WEC units only during low tide and making oil confinement equipment available in order to prevent oil spill accidents.

The main mitigation measures to be taken during the operation phase of the project include painting the WEC units and caisson with white paint to improve the visibility. Warnings signs will be erected to identify the transmission cables and WEC units. The decommissioning of the WEC units will involve transferring the WEC units to Okinawa Institute of Science and Technology.

Alternate location and method of deployment

Alternative location for the WEC units installation was proposed on the south eastern side of the island. However, the field assessments suggested that installation of WEC units at the alternative location will have greater environmental impacts of Holiday Inn Kandooma Maldives. Hence, the proposed location was chosen.

The preferred method of deployment of WEC units is to use floaters (floating buoys) and divers. However, if this is not possible due to adverse weather condition, the WEC units will be deployed using a crane mounted in the project site.

Environmental Management and Monitoring

An environmental management plan with environmental monitoring was developed taking into consideration the impacts and mitigation measures to be implemented. The important elements that require checks such as seawater quality and benthic environment at the project site will be monitored according to the developed monitoring program during construction and operation period.

Although the project involves inevitable negative environmental impacts, such impacts are not serve as to not undertake the project. Mitigation measures have been proposed to adequately minimize the significant impacts. Hence, the project is justifiable in light of the socioeconomic conditions and anticipated benefits from the project which clearly outweigh the negative environmental impacts.

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- މިރިޕޯޓަކީ ހޮލިޑޭއިން ކަނޑޫމާ މޯލްޑިވްސް ރިސޯޓުގައި ކޮމާޝަލް ސްކޭލް ވޭވް ޖު އެނާރޖީ ކޮންވާޓަރ(ވީ،އީ،ސީ) ޔުނިޓު ބެހެއްޓުމުގެ މަޝްރޫއުގެ ސަރަހައްދުން ތިމާވެއްޓަށް ކޮށްފާނެ އަސަރުތަކާއި ދެކޮޅުހެދުމުގެ ގޮތުން، އޮޕަރޭޝަން ފެސިލިޓީ ކޮންސްޓްރަކްޝަން ދ އޮޕަރޭޝަނުގެ، ތިމާވެށީގެ ކޮންސަލްޓަންސް އަލްޓަރނޭޓިވް ހުށަހަޅާ މުޅިމަހަށް ބެހިގެންވާ އެންވަޔަރަންމަންޓަލް އިމްޕެކްޓް އެސެސްމަންޓް (އީ.އައި.އޭ) ރިޕޯޓްގެ ފުރަތަމަ އެޑެންޑަމެވެ.
- މި އެޑެންޑަމް ރިޕޯޓް ތައްޔާރުކުރެވިފައިވާ މަޝްރޫއުގެ ބަދަލުތަކާއި އެންވަޔަރަންމަންޓް ޕްރޮޓެކްޝަން އެޖެންސީއާ ދެމެދު އެއްބަސްވެފައިވާ ޓާމްސް އޮފް ރެފަރެންސްގެ މައްޗަށެވެ.
- ހޮލިޑޭއިން ކަނޑޫމާ މޯލްޑިވްސް ރިސޯޓުގައި ކަރަންޓް އުފައްދަނީ ޑީސަލް ތެލު އަންދައިގެން ކަރަންޓުފޯރުކޮށްދޭ ޖެނެރޭޓަރު ފަރާތުން ވިޔަފާރި މަރުކަޒު މިމަޝްރޫއުން އުފެއްދޭނެ ހަކަތައިން. އަދި މިމަޝްރޫއުގެ ސަރަހައްދުން ރިސޯޓުން ޑީސަލް ތެލު ގެނައުން ކުޑަ ހަމައެކަނި ކުރެވޭނެއެވެ.
- ހޮލިޑޭއިން ކަނޑޫމާ މޯލްޑިވްސް ރިސޯޓުގައި ކޮމާޝަލް ސްކޭލް ވޭވް ޖު އެނާރޖީ ކޮންވާޓަރ(ވީ،އީ،ސީ) ޔުނިޓު ބެހެއްޓުމުގެ މަޝްރޫއުގައި ހިމެނޭ ރިސޯޓުގެ އިރުދެކުން ފަރާތުގައި 4 ވީ،އީ،ސީ ޔުނިޓު ބެހެއްޓުމާއި، ވީ،އީ،ސީ ޔުނިޓުން ރިސޯޓުގެ އިންޖީނުގެއަށް ކަރަންޓް ފޯރުކޮށްދިނުމަށް ކޭބަލް ގެއްލުވުމާއި ވީ،އީ،ސީ ޔުނިޓު މޫރިންގ ކުރުމަށް ސްޓީލްބަނދު ބެހެއްޓުމެވެ.
- މީގެއިތުރުން، ވީ،އީ،ސީ ޔުނިޓުތައް ދިވެހިރާއްޖޭގެ ގޮތުގައި އަދި ހޮލިޑޭއިން ކަނޑޫމާ މޯލްޑިވްސްއާއި ވަނީ ގުޅުވާލެވިފައެވެ. ނަމަވެސް ކޮވިޑް19 ގެ ސަބަބުން ދަތުރުގެ ފުރުސަތު ބޮޑުވެފައި ހުރުމާއި ރިވޮލިއުޝަން އެއްޗެއް ގޮތް ގެއްލިގެންދާތީ ސަބަބުން ވީ،އީ،ސީ ޔުނިޓުތައް މިވަގުތު ހުރީ ހޮލިޑޭއިން ކަނޑޫމާ މޯލްޑިވްސް އިން ދުރުން ފަހަރު ތޫފާނުގައި ރައްކާކުރެވިފައެވެ.
- ވީ،އީ،ސީ ޔުނިޓުތައް ރައްކާ ކުރެވިފައި ހުރި ހިސާބުތަކުގައި 3.5-3 މީޓަރު އަޑިގައެވެ. އަދި ވީ،އީ،ސީ ޔުނިޓުތަކުގެ ބޮޑުމިނާ އިންޖީނިއަރ ވަނީ ބަޔާން ކުރުމަށް ފަރާތުން ރިޕެއަރކުރުމަށް ޖަހާލުމަށް ކުރެވިފައެވެ. އަދި ވީ،އީ،ސީ ޔުނިޓުތައް ވަކިކޮށް ނުހަރާން ފަހަރެއް ދެވިފައެވެ.
- ހޮލިޑޭއިން ކަނޑޫމާ މޯލްޑިވްސް ރިސޯޓުގައި ކޮމާޝަލް ސްކޭލް ވޭވް ޖު އެނާރޖީ ކޮންވާޓަރ(ވީ،އީ،ސީ) ޔުނިޓު ބެހެއްޓުމަށް ޓާރގެޓަކީ މަޝްރޫއުގެ ސަރަހައްދުން ތިމާވެއްޓަށް ކުރިމަތިވާފަދަ މަސްހުރަވަތައް ދުރުކުރުމަށް ހުރިހާ ކުރެވޭނެ ކަންތައް ގެންދިޔުމަށް ސަޕޯޓް ކުރުމާއި، ޕާކްސްޓޭޝަނާއި ރިސޯޓުގެ ތައްޔާރުކުރުން ކޮންސްޓްރަކްޝަން ވިލާވުމާއި މަސައްކަތުގެ ތަފްސީލު ތައްޔާރުކުރެވިފައެވެ. އެކަމުގެ މަޝްރޫއުގެ ގޮތުގައި ތަސްވީރުތަކެއް ހިމެނިގެން ހިމެނިފައިވާތީ ފިޔަވަޅުތަކުގެ ލިސްޓެއް ވަނީ މަޝްރޫއުގެ ގޮތުން ހުށަހަޅާފައެވެ. ފިޔަވަޅުތަކުގެ ތެރޭގައި ތަފްސީލު ތަކުރާރުކުރުމާއި ނަތީޖާ ބަލައިގަނެވިފައެވެ.
  - ހޮލިޑޭއިން ކަނޑޫމާ މޯލްޑިވްސް ރިސޯޓުގައި ކޮމާޝަލް ސްކޭލް ވޭވް ޖު އެނާރޖީ ކޮންވާޓަރ(ވީ،އީ،ސީ) ޔުނިޓު ބެހެއްޓުމަށް ޓާރގެޓަކީ މަސައްކަތް ކުރުމަށް ތިމާވެއްޓަށް ކުރާ ހުރިހާ އަސަރެއް މިއެންސޮރުގެ ފުރިހަމަކުރުމަށް ފާހަގަކުރެވިފައެވެ. އަދި މަޝްރޫއުގެ ސަބަބުން ނުރައްކާތެރި ތިމާވެށީގެ މައްސަލަތަކުގެ ގޮތުގައި ހިމެނެން ޖެހޭ މަޝްރޫއުގެ ސަބަބުން ލިބޭނެ ފައިދާއާ އަދި އިޖުތިމާއީ ފައިދާތަކަށް އެއްވެސް ބަދަލެއް ފާހަގަކުރެވިފައެވެ.

- ނަމަވެސް، ވީ،އީ،ސީ ޔުނިޓު ބެހެއްޓުމުގެ މަސައްކަތުގެ ތެރޭގައި ކޮންމެވެސް ވަރަކަށް ކިސަޑު ބޮރުވެ، ފަރުގެ ރަނގަޅު ސަރަހައްދުތަކުގެ މައްޗަށް ކިސަޑު އެރުމުގެ ފުރުޞަތު އެބައޮތެވެ. ނަމަވެސް ވީ،އީ،ސީ ޔުނިޓު ބެހެއްޓުމުގެ މަސައްކަތުގެ ތޮރުފަތި ވަރަށް ކުޑަ ޕުވަތައް ކަމުން ކިސަޑު ބޮރުވާ މިންވަރު ވަރަށް މަދުވާން ކަމަށް ލަފާކުރެވެއެވެ.
- އަދި ވީ،އީ،ސީ ޔުނިޓު ބެހެއްޓުމުގެ ސަބަބުން ރިސޯޓުގެ އޮއިވަރަށް މާބޮޑު ބަދަލެއް އަންނާނެ ކަމަށް ލަފާނުކުރެވެއެވެ.

- 6 ހޮލިޑޭއިން ކަނޑޫމާ މޯލްޑިވްސް ރިސޯޓުގައި ކޮމާޝަލް ސްކޭލް ވިންޑް އެނާޖީ ކޮންވަޓަރ(ވީ،އީ،ސީ) ޔުނިޓު ބެހެއްޓުމަށް ފޮނުވިފައިވާ މަޝްރޫޢަކީ މުހިއްމު އަދި ބޭނުންތެރި މަޝްރޫޢަކެވެ. މަޝްރޫޢުގެ ސަބަބުން ރިސޯޓުން ކަރަންޓް އުފެއްދުމަށް ބޭނުން ކުރާ ތެލުގެ މިންވަރު މަދުވާނެއެވެ. މަޝްރޫޢަކީ ސަރުކާރުގެ ސިޔާސަތުތަކާއި އެއްގޮތަށް ހޮވި ކުރިއަށް ގެންދާ މަޝްރޫޢެއް ކަމުން ވެފައި، މަޝްރޫޢުގެ ސަބަބުން ނުކުންނަ ތިމާވެށީގެ އަސަރުތައް ކުޑަކުރުމަށް ފިޔަވަޅުތައް އަޅަންޖެހޭ ވެއްޓަކަށް މަޝްރޫޢުގެ ފިޔަވަޅުތަކުން އަޅަމުން ގެންދާނަމަ ކުރެވޭ ބައްލަވާފައިވާ ތިމާވެށީގެ އަސަރުތައް ފިޔަވައިލެވޭނެ ތިމާވެށީގެ ދަށުން ޓެކްނިކަލް ފިޔަވަޅުތަކުގެ އަދި އަސަރުތަކުގެ ކުރިން އަޅަންޖެހޭ އަދި އެ ވަރަށް ފިޔަވަޅުތައް އަޅާ މަޝްރޫޢަކީ މިނިވަން ކަމެއް ކަމަށް ބަލާ ރިޕޯޓުގައި ބަޔާނާ ގުޅިގެން ޕްރޮޖެކްޓު މޮނިޓަރިންގެ ވީއްސަށް ގުޅޭ ކަމަކީ މި މަޝްރޫޢު ކުރިއަށް ގެންދިއުމަށް ކަމަށް ލަފާކުރެވެއެވެ.

1. Introduction

1.1 Purpose of this report

This report is an addendum to the environmental impact assessment for the proposed installation and operation of commercial scale wave to energy converter (WEC) at Holiday Inn Kandooma Maldives. The EIA report was submitted to Environmental Protection Agency (EPA) on 31st December 2019 and the decision statement was issued by the 22nd January 2020.

The scope of this addendum is to provide information on the current status of deployment of the WEC units due to delays as a result of COVID19 pandemic. The WEC units were expected to be deployed in April 2020. However, the technical team from Okinawa Institute of Science and technology was unable to travel Maldives to due to the national border closures and air travel restrictions implemented to limit the spread of the corona virus.

This 1st Addendum report for the EIA for proposed installation and operation of commercial scale WEC units at Holiday Inn Kandooma Maldives is an evaluation of the potential environmental impacts which will accompany with the proposed changes to the project. This report will provide background information on the project components of aforementioned project and their potential impacts on the natural and social environment of Holiday Inn Kandooma Maldives resort. Mitigation measures to minimize the environmental impact will be proposed in this report. An Environmental Management Plan and monitoring program will be formulated to evaluated the effectiveness of the proposed mitigation measure. Alternatives for the project components included but not limited to locations, designs, environmental considerations will be suggested in this report. Overall, this report will contribute to minimization of the environmental impact due to project interventions especially the changes made to the deployment of the WEC units. Extensive information has been adapted from the initial EIA report for the proposed installation and operation of commercial scale WEC units at Holiday Inn Kandooma Maldives.

1.2 Project proponent

The proponent of this project is Ocean Paradise Maldives Pvt Ltd. The proponent came with a memorandum of understanding (MOU) with Kandooma Holdings Pvt Ltd who is the lease holder for the Holiday Inn Kandooma Maldives and Leisure Holidays Pvt Ltd who are the resort operator. A MOU has been signed between the proponent and Ministry of Environment which is mandated with policy formulation and implementation of renewable energy projects in the Maldives. As per the MOU between the proponent and Ministry of Environment, the results of the experimental WEC units previously installed were shared with ministry. The proponent collaborates with Okinawa Institute of Science and Technology (OIST) who manufacture the WEC units and is a patented technology of the aforementioned institution.

The following is the address of the proponent of the project;

Ocean Paradise (Maldives) Pvt Ltd

1st Floor, H. Fehivinamaage

Male', Maldives

1.3 Scope of the first addendum to the EIA report and Terms of Reference

As per the approved terms of reference, the scope of this addendum is to generally assess, identify and predict the environmental and social impacts of the proposed changes to the installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives. The focus of this addendum is given to the changes to the deployment and additional works to the project. The main additional works to the project include;

- Storage of WEC units at a different location in Holiday Inn Kandooma Maldives

The main project components include installation and operation of WEC units, Installation of power cables for transmission and establishment of WEC monitoring station. Importance was given to given to include all the project components and predict the environmental and social impacts which may arise due these project interventions. Furthermore, significance was given to ensure compliance with legal requirements of project of this nature.

This Environmental Impact Assessment Addendum study also include the existing bio-physical environment of Holiday Inn Kandooma Maldives resort and predicts the environmental impacts which may arise due to project and how these impacts can be managed, mitigated and reduced.

The assessment more specifically adheres to the Terms of Reference (TOR) issued by Environmental Protection Agency (EPA) on 29th June 2020. A draft TOR was proposed by the EIA consultant and EPA shared the draft TOR with all the identified stakeholders on 24th June 2020. A copy of the TOR is attached in Annex 1 of this report.

The EIA report contains the following main aspects:

- A description of the project including the need for the project, how the project will be undertaken, full description of the relevant parts of the project, methodology used in the assessment, implementation schedules, site plans and summary of project inputs and outputs;
- A description of the pertinent national and international legislation;
- Information about the exiting baseline environmental conditions of the site. These include and marine environment of the site and natural hazard vulnerability of the site;
- An assessment of the potential impacts during both construction and operational stages of the project as well as identification and cost of the potential mitigation measures to prevent or reduce significant negative impacts during both construction and operation stages of the project;
- Assessment of alternatives for the proposed project;
- Details of the environmental monitoring plan;
- Conclusions

1.4 EIA Methodology

The methodology adopted to predict identify, predict & assess impacts of the project intervention include the following;

- Assessment of the baseline of the environmental indicators within the project area prior to project work initiation. This assessment was conducted via field survey which was aimed to determine the environmental components required under the approved TOR.
- Prediction of impacts on various environmental indicators by the project interventions such as installation of WEC units and installation of cables for transmission if required during the operational phase of the project using environmental impact matrix.

- Ranking the predicted environmental impacts using significance analysis.
- Professional judgment, expert opinion and review of similar environmental impact assessment studies were used to for prediction and identification of environmental impacts and evaluation of these impacts.
- A specific section of this report has been dedicated to discuss various methods used for collection of baseline environmental data.
- The impact assessment methodology (environmental impact matrix) and significance analysis will be discussed in the Environmental Impact & Mitigation Measures.

1.5 Reviewed Reports

The following Environmental Impact Assessment (EIA) reports and Environmental Management Plan (EMP) reports have been reviewed as background information and for familiarization of project of similar nature. These reports were reviewed as a part of literature review for preparation of this EIA report;

- Environmental Impact Assessment for the installation and operation of commercial scale wave to energy converter units at Holiday Inn Kandooma Maldives;
- Environmental Management Plan for the proposed wave to energy convertor unit installation experiment in Holiday Inn Kandooma Maldives;
- Environmental Management Plan for Installation of 1.5MW of Rooftop Solar Photovoltaic System at Hulhumale' Island;
- Environmental Management Plan for Sea Solar Dispersion Plant Installation at Adhaaran Club Rannalhi Resort;

All these aforementioned EMPs were elaborated for renewable energy projects and the nature of the island settings are similar to Holiday Inn Kandooma Maldives. Hence, these EMPs were used as a reference to understand the environmental impacts involved with establishment of renewable energy technologies.

1.6 Project Aims and Objectives

The aims and objectives of the install and operate commercial scale WEC units which will contribute to the energy security and contribute to climate change mitigation efforts of the country. In addition, this project is a follow-up to the Installation of half-scaled and full scaled WEC units experiment in Holiday Inn Kandooma Maldives. This project will monitor the commercial scale WEC units which will be installed in the resort and the electricity produced by the commercial scale WEC units will feed into the electricity grid of the resort. However, the electricity produced will be in a minor scale (approximately 300W per the WEC units). The main components of the project include;

- Installation and operation of WEC units;
- Installation of power cables for transmission;
- Establishment of a WEC monitoring station.

2. Project Description

2.1 Background

The proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives is a follow-up project to the wave to energy convertor unit installation experiment in Holiday Inn Kandooma Maldives which was conducted from April 2018 to December 2018. The concept approval for this experiment was obtained from Ministry of Tourism on 20th March 2018 and an EMP was prepared to meet the requirements of the concept approval. This EMP was submitted to Ministry of Tourism which was mandated with administration of the environmental impact assessment process for tourism related projects at that time. A decision statement was issued by Ministry of Tourism on 05th April 2018.

The wave to energy converter unit installation experiment in Holiday Inn Kandooma Maldives involved installation of two half-scaled WEC units and two full scaled WEC units. These half scale units were installed at geographic coordinates of the location is N 3°54'07.08" and E 73°28'32.58" which was just 5 m north of the current proposed project site. The Figure 1 is a photograph of Full Scaled WEC unit during the operational phase of the experiment.

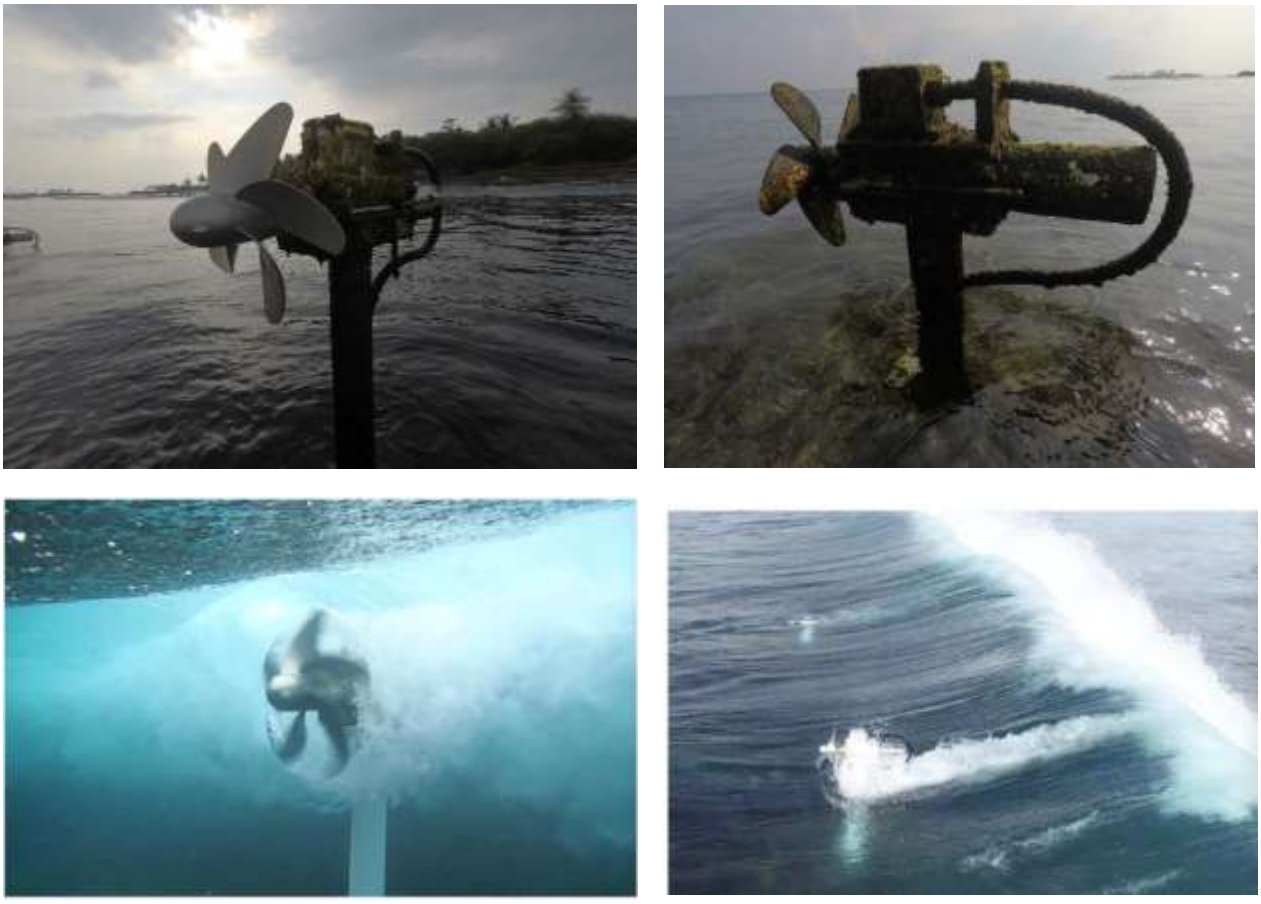

Figure 1: The full scaled WEC units installed in Holiday Inn Kandooma Maldives

The proponent conducted monitoring of the activities as outlined in the approved EMP for the wave energy converter unit installation project. The monitoring report was submitted to the Ministry of Tourism as per the requirements. The results of the WEC installation experiment was shared with relevant stakeholders including the energy department of Ministry of Environment.

2.2 Project Location and Study Area

Holiday Inn Kandooma Maldives is one of the tourist resorts of South Male' atoll of Maldives. Holiday Inn Kandooma Maldives is located 3° 54′ 11.54″ N and 73° 28′ 25.46″ E. The distance between the resort island and the capital Male' is approximately 29.5 km. The island measures approximately 0.481 km in length and 0.408 km in width. The Table 1 provides key information regarding Holiday Inn Kandooma Maldives. The Figure 2 is a map showing the location and Holiday Inn Kandooma Maldives and **Error! Reference source not found.** scaled site plan of the proposed installation of commercial scale WEC units.

Table 1: Key information on Holiday Inn Kandooma Maldives

Island Name	**Holiday Inn Kandooma Maldives Resort**
Location	3° 54′ 11.54″ N and 73° 28′ 25.46″ E
Length	Approx. 481 m
Width (at the widest)	Approx. 408 m
Distance to Male' city	Approx. 29.5 km

Figure 2: The location of Holiday Inn Kandooma Maldives in South Male' atoll

MAP LEGEND	ADDITIONAL INFORMATION	PROJECT TITLE	PROJECT LOCATION	DEVELOPER	CONSULTANT (REGISTERED)	CONSULTANT DESIGNED BY:
■ Commercial Scale WEC Units	Concept plan for installation of commercial scale WEC units in Holiday Inn Resort Kandooma Maldives	Installation of commercial scale WEC units in Holiday Inn Resort Kandooma Maldives	Atoll: South Male Atoll (Kaafu Atoll)	Name: Ocean Paradise Maldives Pvt Ltd	Name: Hamdhoon Mohamed (EIA P03/2013)	Name: Alif-Haa LLP
			Island: Holiday Inn Resort Kandooma Maldives	Address: 1st Floor H.Fehivinamaage, Meheli goalhi Male, Maldives	Address: M.Hikigulalaage Shameemee Goalhi Male', Maldives	Address: G.Nilandhoo Buruzu Magu Maldives
			Lagoon (GPS Coordinates): 3°54'15.4"N 73°28'28.4"E		Date: 30/Oct/2019	Date: 04/Nov/2019

2.3 Justification for the project

Despite of extreme vulnerability to the adverse impacts of global climate change, Maldives depends on fossil fuels to meet the energy demands. This makes the country extremely vulnerable to fluctuation of the global petroleum prices. The proposed installation and operation of WEC units in Holiday Inn Kandooma Maldives is expected to contribute the diversification of the energy resources of the country.

This project is expected to have a transformational change to energy sector of the Maldives. Once, these commercial scale installation of the WEC units is proven successful this technology can be easily adopted by other tourist facilities as well as residential islands of the country.

Holiday Inn Kandooma Maldives depends on diesel generators to meet the energy demands of the resort operations. Electricity generation through diesel generator requires significant amount of expenditure on fossil fuel import. The proposed project is expected to reduce the spending on fossil fuels thus enhancing the energy security of the resort. This project will involve integration of the electricity produced by the WEC units to the existing grid of the resort however at a minor scale. In addition, this project is expected to improve the ambient air quality of the resort environment as the air pollutants will not be emitted during electricity generation using the installed WEC units.

2.4 The project

2.4.1 The project outline and project site plan

The project mainly involves installation and operation of WEC units on the south eastern side of Holiday Inn Kandooma Maldives. The project main components include the following;

- Installation and operation of WEC units;
- Installation of power cables for transmission;
- Establishment of a WEC monitoring station.

The aforementioned project activities have been described in the EIA report for the proposed installation and operation of commercial scale WEC units at Holiday Inn Kandooma Maldives. Hence, this addendum report will only contain the following aspects of the project;

- Installation of WEC units
- Storage location for the WEC units

2.5 Detailed Project Outline

2.5.1 Installation of the WEC units

2.5.1.1 Dimensions and characteristics of WEC units

The dimensions of the WEC units are 2.4 m in length 1.4 m in width and 1.4 in height. It weights approximately 7,000 kilograms. It consists of a turbine and a caisson which will be mounted to the sea bed using four small holes (110 mm diameter x 500 mm) on the lagoon substrate (lime stone) by a core-drill. The main purpose of the caisson is to prevent marine organism entering the turbine chamber of the WEC units. The Figure 3 and Figure 4 are pictures of WEC units with the caisson which will be installed in the South Eastern Side of the Holiday Inn Kandooma Maldives resort.

Figure 3: The commercial scale WEC units with caisson installed in Okinawa, Japan

Figure 4: The turbine chamber of the commercial scale WEC units to be installed in Holiday Inn Kandooma Maldives

2.5.1.2 Method and equipment used for deployment and mounting

The initially proposed method for deployment of the WEC units has been described in the initial EIA for the proposed installation of commercial scale WEC units in Holiday Inn Kandooma Maldives. This section of this addendum will describe the deployment of the WEC units from the current storage location to the designated location for installation.

In order to transfer the WEC units from the storage location to the proposed location of installation, floating buoys will be attached to WEC units and these buoys will be removed once the WEC units are stably mounted.

The Figure 6 illustrates the deployment method used for installation of commercial scale WEC units in Okinawa, Japan. In addition, the alternative section (See Chapter 8, page 60) of this report will evaluate different deployment method and justification for using the aforementioned deployment method.

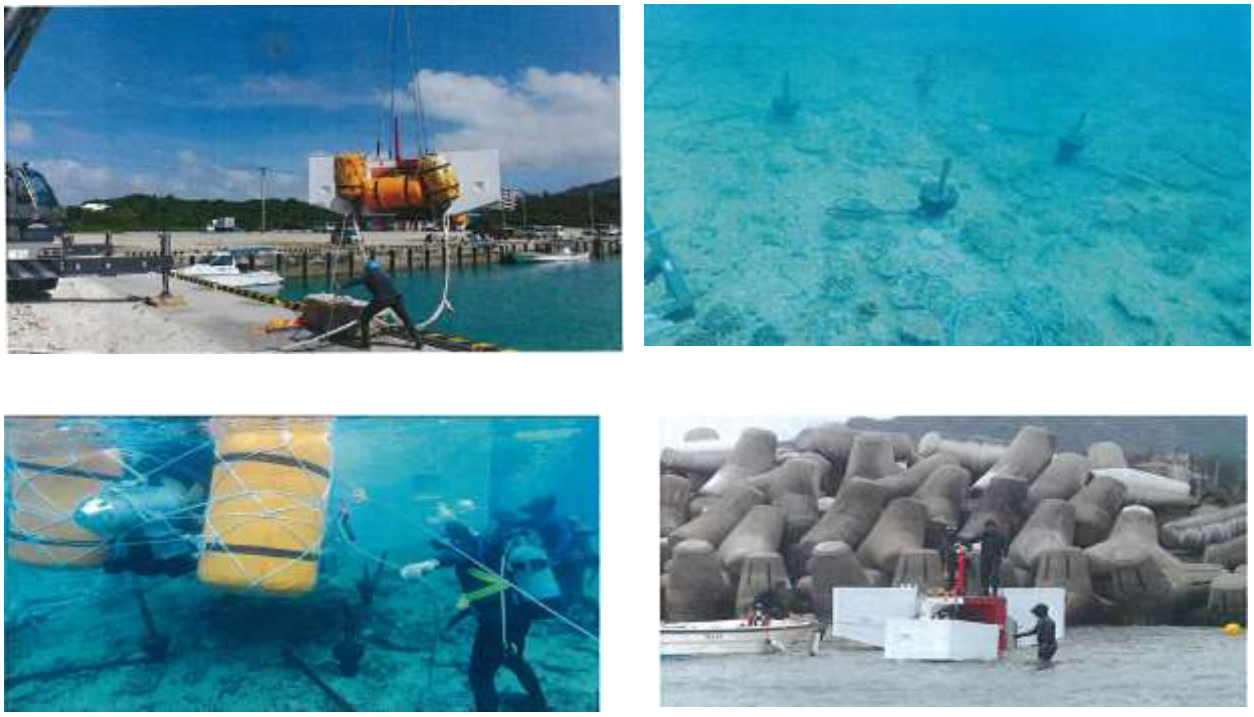

Figure 5: Deployment of the commercial scale WEC units in Okinawa, Japan

2.5.1.3 Justification for selecting the methods and equipment

This section of the report will provide justification for the above-mentioned method of deployment and equipment to be used.

The prime reason for using floating buoys and divers to guide the WEC units to the project location is the sedimentation, vibration and noise impacts on the marine ecosystem will be minimal using this method. The alternative method for deployment of WEC units is using a barge and a crane. However, due to shallow nature of the project site it is not possible to use the barge even at high tide conditions.

Another alternative method of deployment will be having a temporary structure such as a small jetty or a platform constructed for a short period of time. Instead, a crane can be placed in proximity to the project site which will lift and place the WEC units in the desired location for mounting. However, both of these methods will have more adverse impacts on the marine ecosystem. Hence, these two methods of deployment were not considered for this project.

2.5.1.4 Project Schedule

As previously stated, the Decision Statement (DS) for the Initial EIA for the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma was issued on 22nd January 2020. The initial works such as assembly of the WEC units were completed in Okinawa Institute of Science and Technology (OIST) and the WEC units were shipped to Maldives and transferred to Holiday Inn Kandooma. However, the technical team which carry out installation and commissioning of the WEC units

were unable to travel due to border restriction in the amidst of COVID19 pandemic. Hence, it was decided to store the WEC units at deeper water near the project site.

The installation and commissioning work can be only done during the month of March and April due to wave condition at the project site. The installation and commissioning works will be conducted during March 2021 and the WEC units will be stored in the current storage location till then.

The estimated duration of the installation and commissioning is 30 calendar days. The Table 2 is a updated project schedule for the installation and commissioning phase of the project.

Table 2: The project schedule for Installation and operation of commercial scale WEC units at Holiday Inn Kandooma Maldives

Activity	March 2021				April 2021			
	W1	W2	W3	W4	W1	W2	W3	W4
Removal of the WEC units from storage location								
Preparation of the WEC units, cable box & WEC monitoring Station								
Deploying the WEC units								
Laying of Cables and connection								
Testing, trouble shooting and commissioning								
Finalizing and clean-up								

2.5.1.5 Emergency plan in case of spills (diesel, grease, oil)

An emergency response plan for spills involving diesel, grease & oil would be in place prior to commencement of the construction. This plan would be consisting of the following precautionary and preparatory measures including;

- Placement of the fuel storage area away from sensitive environment. In this case the fuel will be stored in the local fuel storage facility existing in Holiday Inn Kandooma Maldives;
- Storage in secure and bunded facilities;
- Training of the workers on good practices in fuel handling and response protocols;
- Installation of warning signs;
- Installation of response kits at easily accessible locations. The kit would include absorbents, personal protective equipment and clean-up equipment such as oil boom.
- Risk assessment, including identification of hazards, potential triggers, contaminant pathways, and impact thresholds for different chemicals
- Response procedure, defining roles and responsibilities of key personnel
- Communication protocols- among responsible personnel, and to authorities and neighbours, if required
- Long-term environmental monitoring, if required.

2.5.2 Storage location of WEC units

2.5.2.1Geographical coordinates of the storage location of WEC units

Currently the WEC units are stored at deeper water at the south eastern side of the Holiday Inn Kandooma Maldives. The geographical coordinates of the current storage location are 3° 54' 4.47" N and 73° 28' 29.82" E The figure 06 are photographs taken from the current storage location of commercial scale WEC units.

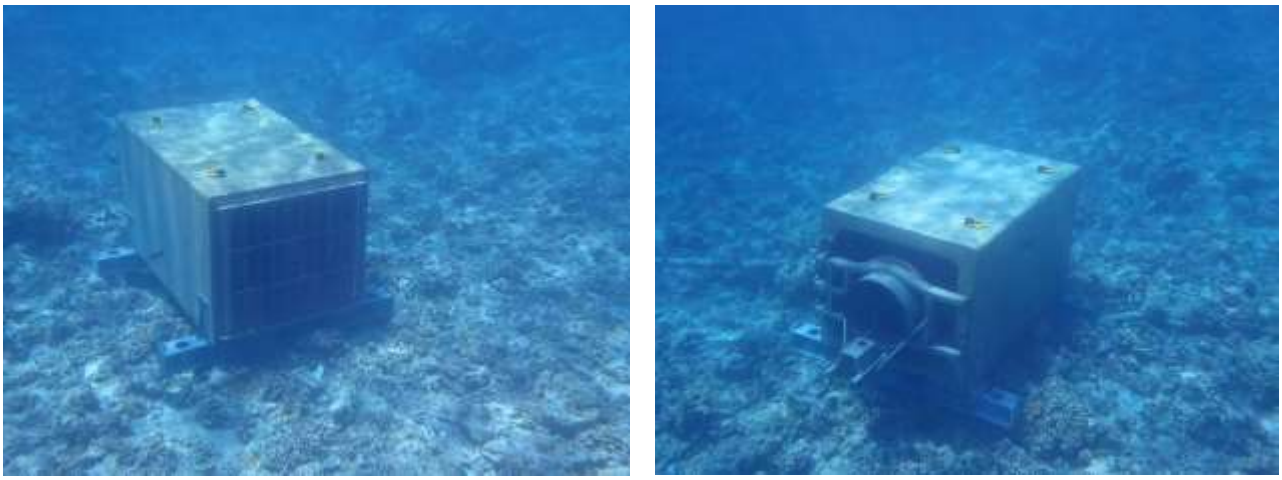

Figure 6: Photographs taken from the current storage location of the commercial scale WEC units

The WEC units was fixed using metal rims and shafts which was fixed in holes which were drilled using a core-drill. The dimension of each of these holes is approximately 110mm diameter x 500mm depth. The figure 06is a map showing the current location were the WEC units has been stored.

Figure 7: Map showing the temporary storage locations for WEC units

2.5.2.2Safety measures taken during storage of WEC units

The WEC units are stored at a depth of approximately 3-3.5 metres during low tide at the south eastern side of Holiday Inn Kandooma Maldives. The WEC units has been fixed so there is no risk of them moving to

shallow depth due to current movement. Furthermore, the southern side of Holiday Inn Kandooma Maldives is the leeward side island and no water sports or other recreational activities are at this side.

The WEC units are closed using steel bars as illustrated in the figure 06, hence there are minimal chance that sea turtles or large fishes can enter the WEC units. Moreover, due to lack of wave action at this depth WEC units are not in continuous rotation. Hence, small fish and other crustaceans will not be affected by the storage of these WEC units.

2.5.3 The project inputs and outputs

The Table 3 provides a synthesis of major project inputs and outputs including how the resources will be sourced for the project. This synthesis is closely linked to identifying potential impacts of the project and recommendation of associated mitigation measures.

Table 3: The Project Outputs and Inputs relevant to the works proposed in this addendum report.

Phase	Major Inputs/Outputs	Source/Type	How resource will be obtain/Remarks
Construction Phase	Construction materials	Epoxy Cement, Power Cables, Precast concrete Blocks, 16 Floating Buoys	Almost all construction materials will be purchased in bulk from abroad and will be brought to island in containers. Machines and equipment will also be purchased from abroad. The precast concrete blocks will be fabricated in Male' and transported to the project site.
	Equipment	01 core drill 01 concrete machine 01 crane 01 workshop container	To be obtained and operated by the proponent. Proponent 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.
	Workforce approximately 08 researchers	8 researchers from OSIT will be doing the installation works Supervisor role will be done by academics from Okinawa Institute for science and technology (OIST).	Main proponent is responsible for the workforce during construction period.

	Water	Water needed during the construction phase will be obtained from the resort from their desalination plants.	The water required for the project will be obtained from desalinated water in the resort.
	Electricity	Diesel Generators	The electricity demand for the project will be obtained from the existing electricity in the Holiday Inn Kandooma Maldives.
	Fuel	The main types of fuel to be utilized for the project work include petrol and diesel.	The fuel requirement for the project activities will be met via locally purchased fuel.
Operational Phase	Waste	Minor amounts	No wastes during the excavation will be allowed to be dumped into the sea. Human wastes will be managed through the existing wastewater management techniques available in the island. Solid waste may be transferred to Thilafushi due to proximity of the project location to Thilafushi waste disposal site.
	WEC (Wave to Energy Convertor) units	Four Commercial Scale WEC units with caisson installed at south-eastern side of Holdiay Inn Kandooma Maldives	The design, assembly and fabrication of the WEC units will be done in Japan and shipped to resort for installation.
	WEC monitoring station	The WEC monitoring station will be installed in a hutch which was constructed during the WEC units installation experiment.	

	Waste Oil and lubricants	Minor quantities	Gathered in a barrel and sent to Thilafushi.
	Noise	Localized disturbances	Operation of core drill and crane will result in some level of noise. No work will be conducted at night to avoid disturbance to guests accommodated close by.
	Plastic waste	Small quantities	Will be managed through proposed solid waste management regime for the resort.

3. Policy and Legislative Framework

The following section of this report addresses the legal, policy and administrative framework for environmental management and some regulatory guidelines and standards relevant for the proposed activities under this addendum report. Also, the section addresses international and regional instruments that the county has acceded with regards to protecting the environment of the country. Some of the relevant international instruments have been outlined.

3.1 Applicable laws and regulations

The most applicable laws and regulations are;

3.1.1 Environmental Protection and Preservation Act (Law no. 4/93)

The Environmental Protection and Preservation Act is the main legal framework for environmental protection in the Maldives. This law is the main legal instrument requires all the development project which may have a significant impact on the environment undergo environmental impact assessment process. The EIA process is administered by Environmental protection Agency (EPA) on behalf of the Ministry of Environment and Energy.

Article 2 of the Environmental Protection and Preservation Act has given mandate for Ministry of Environment and Energy to formulate relevant policies and regulations to preserve and protect the environment of the Maldives. These regulations and policies which are relevant for the project has been discussed in this section.

Article 5 (a) addresses the submission of an EIA. It states that any developing project that may have a potential impact on the environment requires an EIA submission. As per the article the Ministry of Environment and Energy is responsible for developing relevant regulations responsible for administration of the EIA process in the Maldives. These include implementation of EIA process and quality assurance of the EIA system in the Maldives.

Applicability to the proposed project

In order for compliance of this law, an EIA was carried out prior to the installation phase of this project. Also, an approval for the 1st Addendum to EIA for proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma will be obtained prior to removal of the WEC units from the storage location and installation of WEC units at the actual installation site.

3.1.2 Environmental Impact Assessment Regulation (2012) and subsequent amendments

The first amendment to the environmental impact assessment in 2012, outlined the prime EIA procedures to be conducted and the process which development projects which require EIA should follow. It also enlisted the project which will require an EIA study to be conducted prior to the commencement of the project.

The second amendment to the environmental impact assessment regulation in 2015, excluded tourism sector related EIAs as EIA process and procedures related to tourism sector development was included to the Tourism Act (Law no. 22/99). The second amendment to the environmental impact assessment regulation also included certain administrative changes to the EIA process in the Maldives.

The third amendment to the environmental impact assessment regulation was brought in 2019. This amendment reversed that inclusion of the EIA process and procedures related to tourism sector development to the Tourism Act (Law no. 22/99). The Ministry of Environment was given the mandate to administer the EIA process tourism sector projects as well.

The EIA regulation (2012) requires submission and approval of Addendum Report for any works which are subjected to changes after issuance of the Decision Statement (DS) by EPA. These Addendum reports enlist the scope of work which has been changed from the initial EIA report.

Applicability to the proposed project

This 1st Addendum to the EIA for proposed installation and operation of WEC units in Holiday Inn Kandooma is elaborated to meet the requirement of this regulation.

3.1.3 Tourism Act of Maldives (Law No. 2/99)

The Tourism Act recognizes a no. of regulations, standards and controls with regard to the development of tourist facilities in an environment friendly manner in the Maldives. This law and regulations under the law are implemented by the Ministry of Tourism. Under the Tourism Act the Ministry has developed important regulatory measures and controls as well as standards including building standards, food and sanitation standards, waste disposal, electricity code, carrying capacity, diving regulation, fire safety standards as well as water sports conduct.

Applicability to the proposed project

The overall any installation of equipment or development have to comply with all the design and operational aspects requirement outlined in the Tourism Act and regulations mentioned. The proposed works enlisted in this 1st Addendum report will comply with this legislation.

3.1.4 Regulation on Protection and Conservation of Environment in the Tourism Industry, 2006

The purpose of this regulation is to protect the environment in the tourism industry and to encourage and facilitate sustainable development of tourism. It is strictly enforced to islands and land areas leased for development of tourist resorts and hotels leased by the Ministry of Tourism.

The key attributes of the Regulation include;

- Protection of the environment during resort construction where the following activities are subject to prior approval of Ministry of Tourism;
- Dredging of the lagoon and reclamation of land;
- Beach enhancement by pumping sand
- Construction of breakwater
- Construction of sea wall, revetment and groyne
- Dredging of lagoon for safe access
- Dredging of reef
- Felling trees
- Importing and exporting living species
- Conducting research of land, sea and lagoon
- Demolition of a building or facility
- Anything that may adversely affect the vegetation or freshwater lens of the island

- Construction on the beach and lagoon

The main aspect of the regulation which is most applicable to the proposed project include the following;

- An environmental impact assessment report prepared in accordance with the Protection and Conservation of Environment Act of Maldives (Law No. 4/93) shall be submitted to the Environmental Protection Agency prior to the commencement of any construction project or any activity;
- Waste disposal in tourist resorts, picnic islands, and marinas operating in the Maldives shall be carried out in a manner that would have the least impact on the environment, and in accordance with the laws and regulations and in accordance with the rules prescribed by the Ministry of Tourism.

Applicability to the proposed project

This 1st Addendum report is prepared in order to meet the requirement of this regulation and all the provision of this regulation will be adhered during management of any waste produced during the construction and operational phase of the project.

3.1.5 Boundary Regulation (2012/R-7) and Amendment (2016/R-94)

The regulation has been developed under the Clause 15 (haa) of the Tourism Act (2/99) in order to facilitate marking of boundaries within the lagoon of islands leased by Ministry of Tourism for development of tourist resorts, tourist hotels, guest houses and yacht marinas. The Regulation was amended (2016/R-94) in November 2016 to reduce boundaries from 1000m to 500m in all aspects.

In this regard, the following measures relating to boundaries have been outlined;

- If a boundary has already been identified in the Lease Agreement, the boundary of the lagoon surrounding the island shall be as outlined in the Lease Agreement.
- If a boundary has not been identified in the Lease Agreement, the lagoon of the island extends more than 500m from the vegetation line of the island, the boundary shall be 500m into the lagoon from the vegetation line of the island.
- If the reef has less than 500m from the vegetation line of the island, then the boundary shall be up to the outer reef from the vegetation line of the island.
- If another island is found greater than 500m within the same lagoon, the boundary of the resort island shall be 500m from vegetation line of the resort island.
- If another island is found in less than 1000m within the same lagoon, the boundary shall be the middle point between the vegetation of the resort island and the other island
- If there are more than one islands within the same lagoon, a no development buffer of 100m shall be established from the outer boundary.
- If an island is reclaimed within a lagoon, the boundary shall still remain as the original boundary outlined for the resort.
- If a developer wishes to develop tourist facilities up to 2000m from the resort, the Ministry of Tourism has the authority to decide so with certain conditions.

Applicability to the proposed project

The proposed installation of the commercial scale WEC units will be done only 70 to 80m from the vegetation line of Holiday Inn Kandooma Maldives hence, the proposed project complies with the regulation.

3.1.6 Uprooting, Cutting and Transportation of Palms and Trees Regulation, 2006

The by-law on cutting down, uprooting, digging out and export of trees and palms states that the cutting down, uprooting, digging out and export of trees and palms from one island to another should only be done if there is an absolute necessity and no other alternative. It also states that for every tree removed two more trees should be planted in the island.

Removal of the following types of tree is totally prohibited under the by-law;

- The coastal vegetation growing 15m from the shoreline and inwards toward the center of the island;
- All the trees and palms growing in mangrove and wetlands spreading to 15 meters of land area;
- All trees and palms that are growing in a designated protected area;
- Trees which are protected by the government to protect animal species which lives in the tree;
- Trees that are unusual in their structure.

Applicability to the proposed project

The proposed installation of commercial scale WEC units in Holiday Inn Kandooma Maldives fully adheres to this bi-law as not vegetation clearance will be involved in the project. No vegetation clearance will be involved during the installation and operational phase of the project.

3.1.7 Environmental Damage Liabilities Regulation (2011)

As a regulation under the Environmental Protection and Preservation Act (No. 4/93), the Ministry of Environment and Energy has formulated the Environmental Damage Liabilities Regulation in February 2011. This regulation includes the basis to avoid environmental deterioration, extinction of biological resources, environmental degradation and avoid wastage of natural resources.

The prime purpose of this regulation is to cease any unlawful activities on environment and implement a punitive procedure for violations and also implement a compensation mechanism on environmental damages. The Schedules of this regulation forms the basis for levying fines on various environmentally damaging components and activities.

Applicability to the proposed project

The proposed project will be subject to this regulation for any activity outside of the Initial EIA and 1st Addendum scope and Initial EIA and 1st Addendum decision statement.

3.1.8 Protected Areas and Environmentally Sensitive Areas

Under article 4 of the Environment Protection and Preservation Act of Maldives, the Ministry of Environment is vested with the responsibility of identifying and designation of protected areas and natural and drawing up rules and regulations for the management of protected areas and natural reserves in the country.

Applicability to the proposed project

The proposed project does not propose development in a protected area and there are no protected sites in the vicinity of the site. The site surveys also showed that there no environmentally sensitive areas close to the proposed site.

3.2 Applicable Policies

The goal of the National Biodiversity Strategy and Action Plan (NBSAP) are:

- Conservation of biological diversity and sustainable utilization of biological resources
- Build capacity for biodiversity conservation through strong governance framework and improved knowledge and understanding
- Foster community participation and support for biodiversity conservation

Consideration of the goals of NBSAP shall be taken into account in implementation of the project activities for minimizing potential loss of biodiversity in the area. The proponent (Ocean Paradise Maldives Pvt Ltd) has committed on conservation and protection of environment while undertaking this project. Qualitative and quantitative surveys were undertaken to assess baseline coral reef and marine environment biological diversity. Practical mitigation to minimize the impact and monitoring strategies have been identified to protect the biodiversity.

3.2.1 Maldives Climate Change Policy Framework (2015)

The Maldives Climate Change Policy Framework was developed by Ministry of Environment and Energy in 2015. The main aim of the policy is to devise an action plan to combat the adverse impacts of climate change and build a resilient community. The main policy goals of the Maldives Climate Change Policy Framework include the following;

- Ensure and integrate sustainable financing into climate change adaptation opportunities and low emission development measures;
- Strengthen a low emission development future and ensure energy security in the Maldives; (3) Strengthen adaptation actions and opportunities and build climate resilient infrastructure and communities to address current and future vulnerabilities;
- Inculcate national, regional and international climate change advocacy role in leading international negotiations and awareness in cross-sectorial areas in favour of the most vulnerable and small developing states;
- Foster sustainable development while ensuring security, economic sustainability and sovereignty from the negative consequences of the changing climate.

The proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Project is expected to contribute towards the low emission development future and ensuring the energy security of the Maldives.

3.2.2 Maldives Energy Policy and Strategy (2016)

The Maldives Energy Policy and Strategy was formulated by Ministry of Environment and Energy and is implementing agency for the aforementioned policy. The main objectives of the policy include

- Strengthen the institutional capacity and regulatory framework of the energy sector;
- Promote energy conservation and efficiency;
- Promote renewable energy technologies;
- Improving reliability and sustainability of electrical services;

The proposed project is expected to contribute to increasing the share of renewable energy in the national energy mix thus increasing national energy security. Particularly, the proposed project is expected to contribute to the policy of promoting renewable energy technologies.

3.2.3 Waste Management Policy

Ministry of Environment has developed a framework for a national waste management policy. The main components of this policy include safe disposal of solid waste, ensuring safe disposal of chemical industrial and hazardous waste.

Waste management of the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives will be in line with the waste management policy.

3.3 International conventions, treaties and protocols

International conventions, treaties and protocols of most relevance to the proposed project may be identified as follows:

3.3.1 United Nations Convention on Biological Diversity (UNCBD)

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

The proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives will be in line with the UNCBD convention as the adverse impacts on marine biodiversity will be reduced via successful implementation of the mitigation measures.

3.3.2 The Marpol Convention

International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. Pollution and that from routine operations - and currently includes Prevention of Pollution by Oil; Control of Pollution by Noxious Liquid Substances in Bulk; Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form; Prevention of Pollution by Sewage from Ships; Prevention of Pollution by Garbage from Ships; and Prevention of Air Pollution from Ships.

Special consideration will be given to avoid spillage of fuel and other oils into the marine environment during the construction phase of the project involving installation of WEC units in Holiday Inn Kandooma Maldives.

3.3.3 United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC is the multilateral environmental agreement which deals with mitigation and adaptation for the climate change. Under the UNFCCC the main legal instrument was Kyoto Protocol which ended on 2015. A new climate agreement known as Paris Agreement was negotiated on the Conference of the Parties number 21 in Paris, France. Maldives has ratified the Paris Agreement and has a Nationally Determined Contribution (NDC) of reducing its business as Usual (BAU) by 10 percent by the year 2030.

The proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives contributes to the effort of emission reduction as this is an experimental project for demonstration of a new renewable energy technology with immense applicability in the Maldives. There may be minor GHG emission during the construction phase due to operation of construction equipment. However, potentially fuel-efficient machinery and equipment will be explored in order to contribute to the Government effort to fulfill the NDC outlined in the Paris Agreement.

3.4 Administrative Considerations

Due to the cross-cutting nature of the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives and as can be seen from the governing legal framework of the renewable energy projects as described above, a number of governmental agencies have a stake in the Project. The most of important government stakeholders of the Project are the Ministry of Environment and the resort operator Leisure Holidays Pvt Ltd. The Ministry of Environment is responsible for EIA process in the Maldives. Leisure Holidays Pvt Ltd is the resort operator company whose premises the WEC units will be installed.

3.4.1 Ministry of Environment

The Ministry of Environment (ME) is key Ministry in the government mandated with the protection of the environment. Environmental responsibilities assigned to ME 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 either submit to EPA and 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.

3.4.2 Environmental Protection Agency (EPA)

EPA is the key regulatory body on environment, which is a semi-autonomous body formed under the umbrella of the MEE. It is mandated with implementing the EIA process in the Maldives, implementing the Environment Act and subsequent regulations on behalf of MEE, 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. EPA is also responsible for approving water and sewerage designs and registering RO plants.

3.4.3 Leisure Holidays Private Limited

Leisure Holidays Private Limted is the company which operates the tourist facility in Holiday Inn Kandooma Maldives. An MOU has been signed between the company and the proponent (Ocean Paradise Maldives Pvt Ltd) for the installation and operation of the commercial scale WEC units in Holiday Inn Kandooma Maldives.

Stakeholder consultations were done with Leisure Holidays Pvt Ltd and the initial EIA report was shared with Leisure Holidays Private Limited to orientate them regarding the environmental impacts and monitoring regime prescribed in this report. Furthermore, this 1st Addendum report to the EIA will be shared with Leisure Holidays Pvt Ltd as well.

3.4.4 Okinawa Institute of Science and Technology (OIST)

Okinawa Institite of Science and Technology (OIST) is a graduate school based in Okinawa, Japan. The WEC units which will be installed in Holiday Inn Kandooma Maldives is assembled in OIST. This techonology is a patented technology of OIST. OIST has previously piloted applicability of this technology in Maldives using half scaled and full scaled WEC units. This project is a follow-up project in which this WEC units will produce large quantities of electricity.

The initial EIA was shared with representatives of OIST to orientate them regarding the environmental impacts and monitoring regime prescribed in this report. Furthermore, this 1st Addendum report will be shared with OIST as well.

3.4.5 K. Guraidhoo Island Council

Guraidhoo is an inhabited island in South Male' atoll which is located in close proximity to the project area (Holiday Inn Kandooma Maldives). Guraidhoo is approximetly 160 m west of the Holiday Inn Kandooma Maldives.

However, due to the nature of the project no major impacts on the coastal morphology of both for resort and the inhabited island is anticipated as a result of project installations. Furthermore, the installation of the commercial scale WEC units will be done at the south western side of resort which is further away from Guraidhoo island hence no major impacts on the livelihood of the people of Guraidhoo is anticipated. Nevertheless, as a part of stakeholder consultation the island council of K. Guraidhoo has been consulted and their concerns is described in the stakeholder consultation section of the initial EIA report.

3.5 Permits Obtained and Required

The following the permits which are already obtained or required from the government agencies prior to implementation of proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives. These include;

3.5.1 Concept Approval for Coastal Modification

In order to compliant with the Regulation on Protection and Conservation of Environment in the Tourism Industry (2006) an application to obtain the Concept approval for coastal modification was applied to Ministry of Tourism on 30th October 2019.

A conditional approval for coastal modification was issued by Ministry of Tourism on 07th November 2019. According to the conditional approval an environmental clearance needs to be obtained from the Environmental Protection Agency. The Conditional Approval for the coastal modification has been attached in the Annex 02 of this report.

3.5.2 EIA Approval

The most important environmental permit to initiate the proposed installation and operation of commercial scaled WEC units in Holiday Inn Kandooma Maldives would be approval of this EIA report and issuance of an Environmental Decision Statement. The EIA Decision Statement, as it is referred to, shall govern the manner in which the project activities must be undertaken. It will be the final environmental clearance granted by the EPA for the proposed project.

The Decision Statement for the initial EIA report was issued on 22nd January 2020. This Decision Statement has been attached in the Annex 03 of this 1st Addendum report.

4. Survey Methods

This section of the report will describe the survey methods used by the EIA consultant to collect and record the baseline environmental conditions associated with the installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives. The following where done in order to complete this impact study. The key components that were considered are, physical, social and economic environment. Following methods were used in the analysis.

- Assessment of existing environment to identify significant environmental components that would be impacted
- Public consultations to exchange information on the project and consider their concerns
- Literature review of similar projects

4.1 General Methodology of Data collection

The methodologies used for scientific analysis of the environment are standard and internationally accepted methods of environmental assessment. Coastal and marine environment was studied using the methods and parameters that is widely practiced.

4.2 Marine Survey

4.2.1 Photo Quadrat Methodology

Photo Quadrat method was used to estimate the live coral coverage and the substrate composition at sample locations of the reef.

Equipment

- 0.5 m2 PVC quadrat
- 50 m transect tape
- Digital Camera

Procedure

- Survey sites were selected, and at each site the start point was marked at a 2 m depth along the top reef.
- The transect tape was tightly stretched along the bottom of the 2 m depth contour, covering a length of 50 meters.
- The quadrat was then placed alongside the transect tape at every 5 meters.
- A digital photograph of each quadrat was taken from a fixed distance from the bottom.
- On completion of the survey, the digital photographs were processed using Coral Point Count with Excel extension. For each quadrat image 20 random points were selected, and counted using the software.
- The mean count for each substrate type (e.g. Live Coral, Dead Coral with Algae (DCA), Sand/Rubble/Rock (SPR) etc.) was then calculated for the respective sites.

4.2.2 Fish Belt Transect Methodology

Fish belt transect method is used to count the abundance and estimate the composition of different fish species that occurs at a site.

Equipment

- Slate with Pencil
- 50 m transect tape

Procedure

- Fish belt transect surveys were carried out during day time hours
- Transect tapes laid for Photo Quadrat Survey were utilized for this survey
- An observer swam slowly along the transect tape recording the fishes encountered in a 5 m belt.
- Abundance categories recorded: Single (S - 1 Fish), Few (F - 2-10 Fishes), Many (M - 11 – 100 Fishes), and Abundance (A - > 100 Fishes)

4.3 Water Quality

The quality of the marine and ground water in the proposed development site was assessed by testing water samples at location in figure 09. The samples were tested at the MWSC laboratory. The parameter that was tested are conductivity, turbidity and pH and minerals tests.

4.4 Stakeholder consultations

A scoping meeting was held at Environmental Protection Agency with the involvement of the stakeholders. Stakeholder consultations was conducted using online meetings and telephone conversations due to safety concerns arising from COVID19 pandemic.

4.5 Uncertainties in Data Collection Method

Since most of the data on the existing environment was collected manually, human error could be the biggest uncertainty with reference to the data collection methods. However, Global Positioning System (GPS) coordinates have been recorded for future monitoring purposes. This utilization of GPS will reduce human error as exact GPS points can be monitored in future to assess changes as the result of project interventions.

Other uncertainty in the field data collected could be the timing in which assessments were conducted. The conditions in the existing environment such as waves, currents and fish populations changes from season to seasons. Nonetheless, the methods used for collection of data is very popular for environmental monitoring endeavors.

Another aspect which require special consideration which may affect the uncertainty of the data collected is limited time spend on field for environmental data collection. As a result of this, some of the assessments especially on the marine environment were done rapidly as a vast area from the surrounding environment has to be covered as part of this 1st Addendum Report.

5. Existing Environment

5.1 Introduction

This section of the report describes the existing environment of Holiday Inn Kandooma Maldives. The following parameters has been described in the Initial EIA report for the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives and significant amount of time has not passed since the Initial EIA these parameters will not be described in the section of this 1st Addendum report.

- Climate
  - Temperature, rainfall, wind and waves
  - Risk of hurricanes and storm surges
- Hydrology/Hydrodynamics
  - Tidal ranges and tidal currents;
- Ecology
  - Identify marine protected areas (MPAs) and environmentally sensitive sites;
- Hazard Vulnerability
  - Vulnerability of area to storm surges.

This section of the 1st Addendum report will include the following parameters which are relevant to the proposed activities under this addendum report. They are;

- Geology and geomorphology
  - Characteristics of seabed sediments to assess direct habitat destruction and turbidity impacts during construction at the WEC storage location;
- Hydrology/Hydrodynamics
  - Sea water quality measuring these parameters; temperature, pH, salinity, turbidity, Total Petroleum Hydrocarbons (TPH);
- Ecology
  - Benthic and fish community monitoring around the island;
  - Terrestrial vegetation which will be removed due to project interventions.

5.2 General Setting

Holiday Inn Kandooma Maldives is a resort island located in South Male' atoll. The island is approximately 481m in length and 408m in width. The nearest inhabited island is K. Guraidhoo which is just 160 m west of the resort.

Hoilday Inn Kandooma Maldives is located in a large reef system. The reef system is approximately 2.75 km long and 1.78 km wide. The reef system is oriented in east to west direction, however the islands in the reef system is oriented north to south direction. The figure 8 show the aerial view of Holiday Inn Kandooma Maldives.

Figure 8: The aerial view of Holiday Inn Kandooma Maldives

5.3 Locations of the survey

The following table 4 are the geographical positions of the surveyed locations. These coordinates were recorded so that they can be used during the field surveys. The figure 9 is a map showing different surveyed location enlisted in the table 4.

Figure 9: Map showing the surveyed locations during the field assessment

Table 4: The Geographical Coordinates for the surveyed location

Location	Significance	GPS Coordinates
Location 1	**The current storage location of WEC units** Marine survey location Water sample location 1	3° 54' 4.47" N 73° 28' 29.82" E
Location 2	**The proposed location for WEC unit installation** Water sample location 2	3° 54' 4.47" N 73° 28' 29.82" E
Location 3	**Control Site** Water sample location 3	$3^0 54' 02.77"$ N $73^0 28' 28.05"$ E

5.4 Geology and geomorphology

5.4.1 Characteristics of seabed sediments to assess direct habitat destruction and turbidity impacts during construction at the WEC storage location;

The seabed at the current storage location of the WEC units mostly consist of dead corals with algae and coral limestone rubble. The following figure 8 are photographs taken during the field visit. The following figure 9 is the coral cover assessment conducted using a photo quadrant survey. The WEC storage site mainly consists of Sand, Pavement and Rubble (44%) and Dead Coral with Algae which account for (40%). The bar which is labelled as others are the points which laid on the WEC units during the coral point count.

Figure 10: Seabed at the current storage location of WEC units in Holiday Inn Kandooma Maldives

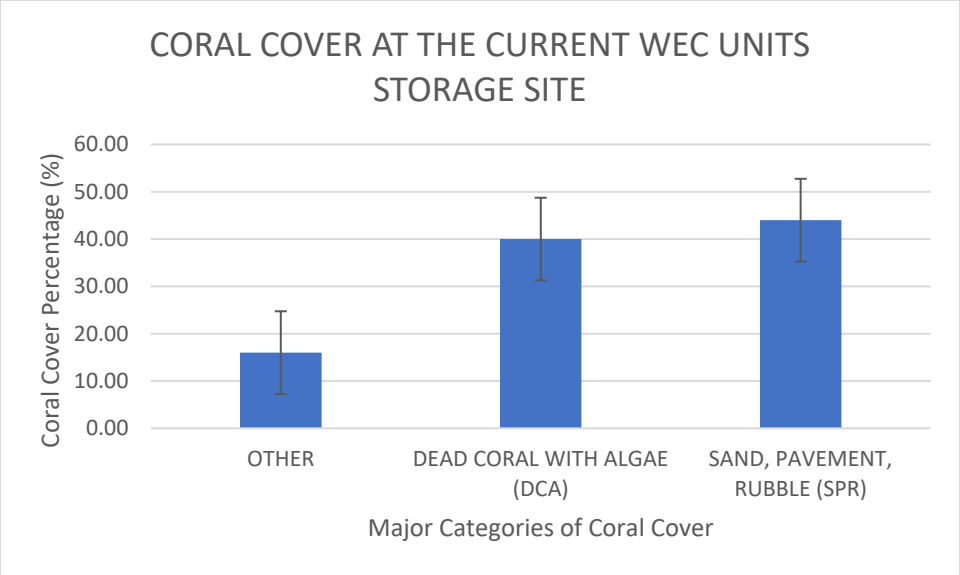

Figure 11: Coral cover at the WEC storage unit in Holiday Inn Kandooma Maldives.

The coral cover of the proposed location for installation of WEC units and two other control sites have been described in the initial EIA report.

5.5 Hydrology/Hydrodynamics

5.5.1 Seawater Quality

Due to the nature of project which only involves installation and operation of WEC units in the lagoon of Holiday Inn Kandooma Maldives only the sea water quality will be discussed in this section. The water samples were obtained from 3 different locations. They include current storage location of the WEC units (Location 1), the proposed location for WEC unit installation (Location 2) and a control location (Location 3). All the test samples were tested at the MWSC laboratory. The following table 09 shows the marine water quality respectively sampled from three different locations. Original result sheet is attached in the Annex 04 of this report.

The parameters are well within the acceptable ranges for marine water quality. pH range of 8.06 – 8.09 which is within the optimal range for pH in marine water. The level of turbidity was found between 0.144 to 0.110 NTU which is within the acceptable range for sediment level in marine waters. The Salinity value range is between 34.05 to 34.90%. Total Petroleum Hydrocarbon (TPH) was unable to be analzyed as it is currently not available from Male' Water and Sewerage Company (MWSC) laboratory.

Overall, the water quality at the temporary site for WEC units storage was found to be better than the other surveyed locations. The other tested locations include the designated site for the WEC units installation and a control site.

Table 5: Result of marine water quality analysis

Parameter	Location 1	Location 2	Location 3
GPS Coordinates	3° 54' 4.47" N 73° 28' 29.82" E	3° 54' 4.47" N 73° 28' 29.82" E	$3^0 54' 02.77"$ N $73^0 28' 28.05"$ E
Physical Appearance	Clear	Clear	Clear
Temperature (º C)	25.50	25.10	25.60
pH	8.06	8.09	8.08
Salinity (%)	34.90	34.01	34.05
Total Petroleum Hydrocarbon (TPH) (mg/L)	Unable to test at MWSC laboratory		
Turbidity (NTU)	<0.1 (LoQ 0.1 NTU)	0.144	0.110

5.6 Ecology

5.6.1 Fish Census Survey

The fish census survey was conducted at the location 1 which is the temporary storage site for WEC units. Dominant fish types observed across all sites were *Acanthurus nigricauda* (white-tailed surgeon fish), *Parupeneus macronemus* (Kalhu oh), *Gerres longirostris* (Strongspine silver-biddy or Uniya) and *Parupeneus crassilabris* (Double Bar Goat Fish). A summary of fish species recorded at each survey location is presented in Table 6 below.

Table 6: Fish Species Abundance at M1, M2, M3 sites (S: 1, F: 2-10, M: 11-100, A: > 100)

	Abundance Category
Fish Species	**Location 1**
Gerres longirostris	M
Parupeneus crassilabris	F
Acanthurus nigricauda	Nil
Rhinecanthus aculeatus	S
Paracanthurus hepatus	S

5.6.2 Vegetation which will be removed due to project interventions

Due to nature of the project interventions which is mainly based on marine environment and no new structures to be built on land, there will be no vegetation removed as a result of project interventions. The laying of the cables will be done along the existing roads of Holiday Inn Kandooma Maldives and the monitoring of WEC is done in a small hutch which is already build in the existing powerhouse of Holiday Inn Kandooma.

6. Environmental Impacts

6.1 Introduction

This section of the report provides a detail description of the methodology used to identify, predict and assess the environmental impacts due to stoagre, installation phase and the operation phase of the proposed installation of WEC units in Holiday Inn Kandooma Maldives. First, the potential impact will be identified and then the identified impact will be evaluated to determine its level of significance. This section consists of the method used for impact assessment, the limitation and uncertainties, the justification for the method used for impact prediction and description of impacts during both construction and operation phase of the project.

6.2 Method Used for Impact Prediction

The impacts on the natural and social environment that may be caused due the project interventions are predicted and is distinguished from construction and operation phases of the project. A simple descriptive matrix has been utilized to predicted the aforementioned impacts. The impact prediction was done using expert judgement and professional opinions of the EIA consultant and also the based on the information provided in the reviewed EIAs and EMPs mentioned earlier in this report. Once the impacts have been predicted, a detailed description has been given for the purpose of understanding the nature and type of the impact.

An impact is any change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity. The evaluation of baseline data provides crucial information for the process of evaluating and describing how the project could affect the biophysical and socio-economic environment.

Impacts are described as a number of types as summarized in table 7. Impacts are also described as associated, those that will occur, and potential, those that may occur;

Table 7: Types of Impacts (adapted from ERM 2008).

Nature or Type	Definition
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect	Impacts that result from other activities that are encouraged to happen as a consequence of the project (e.g. in-migration for employment placing a demand on resources).
Cumulative	Impacts that act together with other impacts (including those from

	concurrent or planned future third-party activities) to affect the same resources and/or receptors as the project.

6.3 Analysis for Significance of the predicted impacts

The analysis of environmental impacts is done in terms of their level of significance. According to Environmental Resource Management 2008, Significance is a function of the magnitude of the impact and the likelihood of the impact occurring. Impact magnitude (sometimes termed severity) is a function of the extent, duration and intensity of the impact. The criteria used to determine significance are summarized in table 8. Once an assessment is made of the magnitude and likelihood, the impact significance is rated through a matrix process as shown in table 9. For ease of review, the significance rating is colour-coded in the text according to table 10. Outlined in table 11 are the various definitions for the significance of an impact.

Significance of an impact is qualified through a statement of the degree of confidence. Confidence in the prediction is a function of uncertainties, for example, where information is insufficient to assess the impact. Degree of confidence is expressed as low, medium or high.

Table 8: Criteria used to assign level of significance

Magnitude – the degree of change brought about in the environment	
Extent	**On-site:** impacts that are limited to the Site Area only. **Local:** impacts that affect an area in a radius of 20 km around the development area. **Regional:** impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystems. **National:** impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences. **Transboundary/International –** impacts that affect internationally important resources such as areas protected by international conventions.
Duration	**Temporary:** impacts are predicted to be of short duration and intermittent/occasional. **Short-term:** impacts that are predicted to last only for the duration of the construction period. **Long-term:** impacts that will continue for the life of the project, but ceases when the project stops operating. **Permanent:** impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the project lifetime.
Intensity	***BIOPHYSICAL ENVIRONMENT***: Intensity can be considered in terms of the sensitivity of the biodiversity receptor (E.g.: habitats, species or communities).

	Negligible: the impact on the environment is not detectable. **Low:** the impact affects the environment in such a way that natural functions and processes are not affected. **Medium**: where the affected environment is altered but natural functions and processes continue, albeit in a modified way. **High:** where natural functions or processes are altered to the extent that it will temporarily or permanently cease.
	SOCIO-ECONOMIC ENVIRONMENT: Intensity can be considered in terms of the ability of project affected people/communities to adapt to changes brought about by the project. **Negligible:** There is no perceptible change to people's way of life. **Low:** People/communities are able to adapt with relative ease and maintain pre-impact livelihoods. **Medium:** Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support. **High:** Those affected will not be able to adapt to changes and continue to maintain pre-impact livelihoods.
Likelihood - the likelihood that an impact will occur	
Unlikely	The impact is unlikely to occur.
Likely	The impact is likely to occur under most conditions.
Definite	The impact will occur.

Table 9: Significance Rating Matrix

SIGNIFICANCE				
		LIKELIHOOD		
		Unlikely	Likely	Definite
MAGNITUDE	Negligible	Negligible	Negligible	Minor
	Low	Negligible	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major

Table 10: Significance Color Scale

Negative Ratings	**Positive Ratings**
Negligible	Negligible
Minor	Minor
Moderate	Moderate

Major	Major

Table 11: The definition of difference level of significance

Significance definitions	
Negligible significance	An impact of negligible significance is where a resource or receptor will not be affected in any way by a particular activity, or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background levels.
Minor significance	An impact of minor significance is one where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value.
Moderate significance	An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that "moderate" impacts have to be reduced to "minor" impacts, but that medium impacts are being managed effectively and efficiently.
Major significance	An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. A goal of the EIA process is to get to a position where the project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a development. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors, such as employment, in coming to a decision on the project.

6.4 Limitations and the uncertainties of the impact assessment methodology

The following aspects are considered as limitation and the uncertainties which may be involved in the impact assessment process;

- All the potential environmental aspects have been predicted and assumed for the proposed project development hence they may differ in the natural context such as site conditions and uncertainties in scales and magnitude.
- The baseline data for the existing environmental conditions were taken in a very short period of time hence may affect the accuracy in prediction of the environmental impacts.
- The aforementioned baseline data for the existing environmental condition were collected for one monsoonal season (*Iruvai* season) and inferred based on that seasonal data hence the predicted environmental impacts may vary on the other (*Hulhangu*)season.
- Expert judgement and professional opinion of the EIA consultant were enhanced using the existing EIA reports of similar nature, however due to the unique nature of coastal processes, lagoons and reef system in the Maldives each island is unique. Hence the predicted environmental impacts may vary from island to island.

6.5 Justification for the Methodology used

There are many various methodologies used for impact assessment in environmental context. One of the most commonly used methodologies include check lists and matrices such as Leopold Matrix (Lohani et al., 1997) The Leopold matrix was conceived by geologist Luna B. Leopold and his colleagues in 1971, as a response to the US Environmental Policy Act of 1969, which didn't give clear instructions to the Federal Government agencies for preparing an impact report or for examining the environmental effects of the projects that an agency plans. The Leopold matrix addressed this challenge by 'providing a system for the analysis and numerical weighting of probable impacts' (Josimovic et al., 2014).

According to the Leopold matrix method, EIA should consist of three basic elements:

1. a listing of the effects on the environment that the proposed development may induce, including the estimate of the magnitude of each of the effects;
2. an evaluation of the importance of each of listed effects (e.g., regional vs. local); and
3. a summary evaluation, which is a combination of magnitude and importance estimates.

The impact assessment method used in this report is a matrix which is derived from the Leopold Matrix however this method uses a colour code to assign the significance level of each predicted impact. This method has been adapted from the Environmental Resource Management (2008).

Leopold Matrix is an effective impact assessment methodology which has been extensively used by EIA practitioners across the world. The colour coding enhance Leopold Matrix further. Since EIA is a technical report which are read by both technical experts of different field as well as the general public, the colour coding of the significance level will enhance the report in a manner which would be easily comprehended by general public and people with no technical expertise in this field.

6.6 Impact Prediction

The environmental impacts of the proposed storage, installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives project are predicted in this section of the report by using a simple descriptive matrix. The following matrix distinguishes the types of environmental impacts that may be associated with various project actions on key environmental components and distinguishes whether these are impacts during construction period or during post-construction and operations period.

The following table 12 predicts the nature and types of environmental impacts based on the existing environmental condition of the islands and the surrounding environment;

Table 12: Impact Identification matrix for installation of WEC units in Holiday Inn Kandooma Maldives Project

Project Activities	Natural Environment				Social Environment	
	Reef and Coastal Environment	**Soil and groundwater**	**Lagoon and seawater**	**Air/Noise**	**Services and Infrastructure of resort**	**Health and Safety of tourist and workers**
Storage/Installation Phase						
Temporary Storage of WEC Units	• Minute Damage to the corals at the storage site, however the field visit suggests that sea bed contained mainly Dead Corals with Algae and Coral limestone rubble. • Larger fishes and sea turtles may enter the WEC units and may get stuck inside the cassion units.	No significant impacts	• Slight deterioration of water quality due to corrosion of metal over time.	No significant impacts	No significant impacts	No significant impact
Drilling of project location for WEC unit installation.	• Sedimentation on immediate reef and turbid seawater for short term. • Physical damage on benthic sessile fauna in proposed project area. • Significant noise pollution and vibrations which may affect the marine species population in the vicinity.	No significant impact	• Direct affect to the habitats such as dead corals due to removal. Furthermore, sedimentation in lagoon and changes in hydrodynamics of immediate area leading to increase in turbidity of sea water. • The chemical in epoxy cement may	No significant impact	Temporary difficulty in operating wastewater outfall due to its proximity to the project site.	• Health risk for the workers during the installation stage of WEC as the sea outfall pipe is in close proximity to the project site. • The workers are prone for potential accidents during installation due to heavy nature of the WEC units.

			affect the water quality for a short period of time.			
Excavation for installation of power cables for transmission	No significant impact	Excavation and cable laying works may loosen sub layer of the soil.	No significant impact	Dust particles will be unsettled during the excavation and significant localized noise. pollution is anticipated.	A temporary disruption to the services may occur due to accidents during excavation. The services which are vulnerable for excavation accidents include electricity, sewerage network, internet and cable service.	Due to unsettling dust the community may be vulnerable to upper respiratory infections and asthma for a short period of time. There is a high probability of pedestrians and vehicles may face accidents during excavation.
Potential of oil spills from equipment	Damage to the reef habitat due to toxic effect of the oil and the marine water quality would be deteriorated.	Leakage of oil may contaminate groundwater.	Damage to the reef habitat due to toxic effect of the oil and the marine water quality would be deteriorated.	No significant impact	No significant impact	Indirect impacts due to deterioration of marine and ground water quality
Operational Phase						
Operation of Installed WEC units	Minor change to the local sediment transport and current patterns. Acoustic effect on the marine organism may occur due to rotation of turbine blades.	No significant impact	The localized water quality of the area may be affected due to operation of WEC units.	Some minor noise pollution at the vicinity of the project site.	The internet service of the resort will have to be shared with the WEC monitoring station.	Potential accident for snorkelers and users of lagoon for other recreational activities.
Maintenance work of Installed WEC units and WEC monitoring station	• Significant noise pollution and vibrations which may affect the marine species population in the vicinity. • Turbidity would increase in the marine water.	No significant impact	Turbidity may increase in the sea water due to maintenance work for short period of time.	Localized noise pollution during maintenance period.	Temporary difficulty in operating sea outfall due to its proximity to the project site.	Health risk for the workers during the installation stage of WEC as the sea outfall pipe is in close proximity to the project site.

Decommissioning of installed WEC units	• Significant noise pollution and vibrations which may affect the marine species population in the vicinity. • Turbidity would increase in the marine water.	No significant impact	Turbidity may increase in the sea water due to decommission work for short period of time.	No significant impacts.	The storage space of the resort may be utilized temporarily has the WEC units will be shipped back to Japan after decommission.	Health risk for the workers during the installation stage of WEC as the sea outfall pipe is in close proximity to the project site.

The above table illustrates project activities both during the construction and operational phase. The impacts of these project activities are predicted both for the biophysical environment of Holiday Inn Kandooma Maldives Resort is also shown the table 12. The following table 13 is a summary of project activities which has the greatest impact on both natural and social environment respectively. It can be noted that some of these impacts are considered to be positive.

Table 13: Classification of impacts based on construction phase and operational phase of the project

Phase of the project	Natural Environment	Social Environment
Construction Phase	Temporary Storage of WEC units (Negative impacts) Drilling of project location for WEC unit installation. (Negative Impacts) Excavation for installation of power cables for transmission on land(Negative Impacts) Potential of oil spills from equipment (negative impacts)	Drilling of project location for WEC unit installation. (Negative Impacts) Excavation for installation of power for transmission on land (Negative Impacts) Potential of oil spills from equipment (negative impacts)
Operational Phase	Operation of Installed WEC units (Negative Impacts) Maintenance work of Installed WEC units and WEC monitoring station (Negative Impacts) Decommissioning of installed WEC units (Negative impacts)	Operation of Installed WEC units (Negative Impacts) Maintenance work of Installed WEC units and WEC monitoring station (Negative Impacts) Decommissioning of installed WEC units (Negative impacts)

6.7 Description of Impacts

6.7.1 Storage and Installation Phase

6.7.1.1 Temporary Storage of WEC Units

As discussed in the project description section (See Section 2), the WEC units are currently stored at 3° 54' 4.47" N and 73° 28' 29.82" E at south eastern side of Holiday Inn Kandooma Maldives at a depth of 3-3.5 metres at low tide level.

The main predicted impacts on the bio-physical environment include the following;

- Minute Damage to the corals at the storage site, however the field visit suggests that sea bed contained mainly Dead Corals with Algae and Coral limestone rubble;
- Larger fishes and sea turtles may enter the WEC units and may get stuck inside the caisson units;
- Slight deterioration of water quality due to corrosion of metal over time.

6.7.1.2 Drilling of project location for WEC unit installation

As discussed in the project description section (See Section 2) four holes for each of the WEC units will be drilled using a core drill. The dimension of the 110 mm in diameter and 500 mm in depth. After the

placement of the footing of support stand for WEC units, the drilled hole will be sealed using epoxy cement. The drilling will be done in a depth of 1.5 meters in mean tide and 70 to 80 metres from the shoreline.

The main predicted impact on the bio-physical environment include the following;

- Sedimentation on immediate reef and turbid seawater for short term;
- Physical damage on benthic sessile fauna in proposed project area;
- Significant noise pollution and vibrations which may affect the marine species population in the vicinity;
- Direct affect to the habitats such as dead corals due to removal. Furthermore, sedimentation in lagoon and changes in hydrodynamics of immediate area leading to increase in turbidity of sea water;
- The chemical in epoxy cement may affect the water quality for a short period of time.

The main predicted impacts on the socio-economic environment include the following;

- Temporary difficulty in operating sea outfall due to its proximity to the project site;
- Health risk for the workers during the installation stage of WEC as the sea outfall pipe is in close proximity to the project site.
- The workers are prone for potential accidents during installation due to heavy nature of the WEC units.

6.7.1.3 Excavation for installation of power

The excavation will be done for a depth of approximately 1.5 m to bury the power cables for transmission. This excavation will be limited to land. The length of the power cable is approximately 300 metres and will be from cable connection box to the WEC monitoring station in the power house of Holiday Inn Kandooma Maldives.

The main predicted impacts on the bio-physical environment include the following;

- Excavation and cable laying works may loosen sub layer of the soil;
- Dust particles will be unsettled during the excavation and significant localized noise.

The main predicted impacts on the socio-economic environment include the following;

- A temporary disruption to the services may occur due to accidents during excavation. The services which are vulnerable for excavation accidents include electricity, sewerage network, internet and cable service;
- Due to unsettling dust the community may be vulnerable to upper respiratory infections and asthma for a short period of time;
- There is a high probability of pedestrians and vehicles may face accidents during excavation.

6.7.1.4 Potential of oil spills from equipment

Due to the type of the equipment used in the project the risk of oil spill will be minimal. However, equipment like excavator used for cable installation, core drill and concrete machine has the potential for oil spills. If the method of deployment is using a mounted crane at the project site the potential for oil spill will be higher. But this method of deployment is highly unlikely.

The main predicted impact on the bio-physical environment include the following;

- Damage to the reef habitat due to toxic effect of the oil and the marine water quality would be deteriorated;
- Leakage of oil may contaminate groundwater.

The main predicted impacts on the socio-economic environment include the following;

- Indirect impacts due to deterioration of marine and ground water quality.

6.7.2 Operational phase

6.7.2.1Operation of Installed WEC units

The operation of the installed WEC units will be for a duration of thee years. After the operational stage the installed WEC units will be decommissioned and shipped to Japan for further analysis. During the operational phase energy from breaking of waves will be transmitted to WEC monitoring station and connect to the grid of the resort at a piolet scale. Monitoring will be done via internet and by resarchers in Okinawa Institute of Science and Technology. A security camera and warning signs will be installed in the project area for security purposes.

The main predicted impact on the bio-physical environment include the following;

- Minor change to the local sediment transport and current patterns;
- The localized water quality of the area may be affected due to operation of WEC units;
- Some minor noise pollution at the vicinity of the project site.

The main predicted impacts on the socio-economic environment include the following;

- The internet service of the resort will have to be shared with the WEC monitoring station;
- Potential accident for snorkelers and users of lagoon for other recreational activities.

6.7.2.2Maintenance work of Installed WEC units and WEC monitoring station

The maintenance work of the installed WEC and WEC monitoring station is expected to be minimal. However, in case of any mechanical or technical failure the WEC units may be repaired and maintenance work may be conducted at scheduled time periods.

The main predicted impact on the bio-physical environment include the following;

- Significant noise pollution and vibrations which may affect the marine species population in the vicinity;
- Turbidity would increase in the marine water.

The main predicted impacts on the socio-economic environment include the following;

- Temporary difficulty in operating sea outfall due to its proximity to the project site;
- Health risk for the workers during the installation stage of WEC as the sea outfall pipe is in close proximity to the project site.

6.7.2.3Decommissioning of installed WEC units

Decommissioning of the installed WEC units will be done after six months of experimental operation. The WEC units will be removed and the drilled hole will be sealed with epoxy cement. The WEC unit will be temporarily stored in the resort storage area and shipped to Japan for further analysis.

The main predicted impact on the bio-physical environment include the following;

- Significant noise pollution and vibrations which may affect the marine species population in the vicinity;
- Turbidity would increase in the marine water.

The main predicted impacts on the socio-economic environment include the following;

- The storage space of the resort may be utilized temporarily has the WEC units will be shipped back to Japan after decommission;
- Health risk for the workers during the installation stage of WEC as the sea outfall pipe is in close proximity to the project site.

6.8 Impact Analysis and Evaluation

The following section will provide an analysis and evaluation of the previously described impacts on the biophysical and socio-economic environment in order to identify their significance.

The **Error! Reference source not found.** is an impact analysis table. From the table 14 it can be inferred that magnitude of the most of the negative impacts on the natural and social environment is moderate, minor or negligible.

The most significant impact during the storage and installation phase of the project is drilling of project location for WEC unit installation. The main reason being the likelihood of this impact is definite and its intensity is medium.

The most significant impact during the operational phase of the project is decommissioning of installed WEC units. The main reason being the likelihood of this impact is definite and its intensity is medium.

The socio-economic impacts of the project are expected to be positive.

Table 14: Impact Analysis Matrix

Project Activity/ Impact	Extent	Duration	Intensity	Likelihood	Significance	Color Scale
Storage and Installation Stage						
Temporary Storage of WEC units	Onsite	Short-term	Medium	Unlikely	Minor	
Drilling of project location for WEC unit installation.	Onsite	Short-term	Medium	Definite	Moderate	
Excavation for installation of power cables for transmission on land	Local	Short-term	Low	Definite	Minor	
Potential of oil spills from equipment	Onsite	Short-term	Medium	Unlikely	Minor	
Operational Phase						
Operation of Installed WEC units	Local	Long-term	Low	Definite	Minor	
Maintenance work of Installed WEC units and WEC monitoring station	Onsite	Long-term	Low	Unlikely	Minor	
Decommissioning of installed WEC units	Local	Long-term	Medium	Definite	Moderate	
Both Phases						
Socio-economic impacts	Local	Long-term	Medium	Definite	Moderate	

7. Mitigation Measures

The main objective of the following section is to provide environmental management and mitigation measures that will be undertaken and monitored in order to minimize and offset previously described environmental impacts of the proposed installation of WEC units in Holiday Inn Kandooma Maldives resort.

7.1 Justification for the proposed mitigation measures

The following factors were considered in order to evaluate the appropriateness of the proposed mitigation measures;

- Costs;
- Benefits;
- required manpower;
- equipment;
- expertise;
- timing and
- technology

The proposed mitigation measures will be the most cost-effective, have the maximum benefits and requires minimum utilization of manpower and equipment. Furthermore, the practicality of the proposed mitigation measures will be given a high priority. The technical aspects of the different project components were considered when evaluating the proposed mitigation measures.

7.2 Limitations of the proposed mitigation measures

The main limitation of the proposed mitigation measures is that these mitigation measures are proposed for an impact which is predicted. Since the impact has been predicted, there is an uncertainty regarding how the impact will affect the natural environment when the actual project is implemented. The nature of impacts even from similar project activities undertaken in a different location in the country could generate in a totally different manner.

7.3 Storage and Installation Stage

7.3.1 Temporary Storage of WEC units

The WEC units has been placed in the temporary storage location, hence the mitigation measures which are described in the section has been already implemented;

The following mitigation measures has been already implemented;

- Steel bars has been fixed at the entrance of caisson of the WEC units;
- WEC units has been painted with anti-corrosive paints to prevent rusting and colonization of barnacles.
- WEC units are stored at a depth of 3 to 3.5 metres at low tide level hence there will no low risk of accidents with boats. Furthermore, the south eastern side of Holiday Inn Kandooma is rearly used for recreational and water sports.

7.3.2 Drilling of project location for WEC installation

As can be seen from the previous section on environmental impacts from the proposed project, sedimentation impacts on the coral community in close vicinity of the project site and changes to lagoon water quality due to increased turbidity are identified as key environmental impacts from this project impact.

The following measures will be undertaken in order to reduce the impacts discussed in the impacts section from the above-mentioned activities. Since the proposed excavation will be conducted at a very shallow depth of about 0.5 to 1 m hence the expected impact of sedimentation can be easily mitigated by taking the following mitigation measures. These include;

- Undertaking the drilling during the low tide and on calm days in order to minimize the spread of the sediments to the immediate vicinity;
- Clearly marking the project area which will enable to prevent the spreading of the sediments and impacting large area;
- Undertake drilling activity in the shortest time possible so that presence of the environmental impact will be short-lived due to short exposure period.
- Snorkelers and users of lagoon for recreational activity will have to be informed of the experiment and drilling works;
- Workers shall be provided with safety gears.

The following are key considerations for the most significant mitigation measure for reduction of impacts of drilling;

Mitigation Measure	**Carry out the work at low tide (Reduce sedimentation naturally)**
Cost	Zero
Benefits	At low tide the corals and other marine life will be visible hence the impacts on these marine organisms can be reduced. The impacts of sedimentation will be reduced.
Expertise	Local Knowledge, Environmental Protection & Sediment control
Required Manpower	2 - 4
Responsibility	Proponent
Equipment and Technology	Project Management
Timing	Low tide period depending on the day of construction work.

7.3.3 Excavation for installation of power cables for transmission on land

As described previously, major excavation will be done in the resort in order to install power cables for transmission on land. These excavations are expected to be only 1.5 meter and the requirement for dewatering is expected to be minimum.

The following measures will be taken during the excavation and pipe works on land;

- To ensure appropriate supervision and monitoring of the excavation and pipe laying work.
- Complete the work as soon as possible
- Keep workers informed with ways to minimize the impacts
- Wear safety and protection measures (personnel protection equipment)
- Keep appropriate signs for public safety

The following are key considerations for the most significant mitigation measure for reduction of impacts of excavation and pipe laying works.

Mitigation Measure	**Ensure appropriate supervision and monitoring**
Cost	Salary of the supervisors
Benefits	Appropriate care will be taken to minimize the impacts of dewatering, noise and dust impacts on the natural and social environment of the island.
Expertise	Supervisor, Management Skill and Engineering
Required Manpower	2 person
Responsibility	Proponent
Equipment and Technology	Not required
Timing	During the excavation and pipe lying works

7.3.4 Potential of oil spills from equipment

In case of the accidental spill, oil confinement equipment such as oil boom will be used to control spread of the oil spill. Also, during the emergency all the operations will be stopped and all manpower will be diverted to resolve the oil spill issue.

The following mitigation measures will be taken in order to prevent any environmental impact associated with oil spillage from the equipment used in the project.

- Take precautionary measures such as not storing any fuel in the crane or the barge and transport only the quantity of the oil required for the operation of the excavators.
- No drilling will be conducted during rough weather so that the possibilities of oil spill will be reduced.
- Oil confinement equipment such as oil boom will be made available in a case of oil spill.

The following are key considerations for the most significant mitigation measure for reduction of impacts of potential oil spill from project equipment;

Mitigation Measure	**Take precautionary measures and make oil confinement equipment available**
Cost	Around USD 10,000
Benefits	Risk mitigation and control potential oil spillage
Expertise	Oil spill remediation and control
Required Manpower	2 - 4 workers
Responsibility	Proponent
Equipment and Technology	Oil confinement equipment such as oil boom
Timing	During oil spill accidents

7.4 Operational phase

7.4.1 Operation of Installed WEC units

During the operation of the Installed WEC units for experimental purpose regular monitoring will be done on the existing environment of the project site.

The following mitigation measures will be taken in order to prevent any environmental impact associated with oil spillage from the equipment used in the project;

- The current, sedimentation transport pattern and water quality will be monitored in regular time periods;
- Security camera and warning sign will be installed at the project site to warn the users of the lagoon including snorkelers;
- The WEC units will be painted white in order to improve visibility.

The following are key considerations for the most significant mitigation measure for reduction of impacts of operating installed WEC units;

Mitigation Measure	**Paint the WEC unit with white paint**
Cost	Around USD 200
Benefits	Improve the visibility of the WEC units
Expertise	Project management
Required Manpower	1-2 workers
Responsibility	Proponent
Equipment and Technology	Marine paints
Timing	During operational phase of the experimental project

7.4.2 Maintenance work of Installed WEC units and WEC monitoring station

The likelihood for the requirement of maintenance work is minimal due to short nature of the experimental data collection phase of the project. However, the following mitigation measures will be taken in order to reduce the impacts from maintenance work of Installed WEC units and WEC monitoring station;

- Undertaking the maintenance during the low tide and on calm days in order to minimize the spread of the sediments to the immediate vicinity
- Undertake maintenance activity in the shortest time possible so that presence of the environmental impact will be short-lived due to short exposure period.
- Snorkelers and users of lagoon for recreational activity will have to be informed of the maintenance activity;
- Workers shall be provided with safety gears.

The following are key considerations for the most significant mitigation measure for reduction of impacts of maintenance works of WEC units and WEC monitoring station;

Mitigation Measure	**Carry out the maintenance work at low tide (Reduce sedimentation naturally)**

Cost	Zero
Benefits	At low tide the corals and other marine life will be visible hence the impacts on these marine organisms can be reduced. The impacts of sedimentation will be reduced.
Expertise	Local Knowledge, Environmental Protection & Sediment control
Required Manpower	2 - 4
Responsibility	Proponent
Equipment and Technology	Project Management
Timing	Low tide period depending on the day of construction work.

7.4.3 Decommissioning of installed WEC units

Decommissioning of the WEC units will be done at the end of the phase one of the project after six months of experimental data collection. The following mitigation measures will be taken in order to reduce the impact of decommission of WEC units.

- The decommissioning will be done at low tide and in calm weather;
- The hole drilled will be re-used for the second phase of the project where full sized WEC units will be installed however, the support stand dimension will be the same in both phases of the project.
- Pre-arrangement will be made to ship the decommissioned WEC units to Japan as soon as possible;
- Workers shall be provided with safety gears.
- At the end of the second phase of the project, the drilled holes will be completely sealed with epoxy cement.

The following are key considerations for the most significant mitigation measure for reduction of impacts of decommissioning of WEC units;

Mitigation Measure	**Shipping the decommissioned WEC units to Japan**
Cost	Approximately 20,000 USD
Benefits	The WEC units can be further analyzed in the laboratory of Okinawa Institute of Science and Technology; The burden of disposal & storage of WEC unit will not be on the resort.
Expertise	Logistics and posting service
Required Manpower	2 - 4
Responsibility	Proponent
Equipment and Technology	
Timing	Immediately after the decommissioning of WEC units

8. Alternatives

This section of the report contains the alternative means for the project in terms of alternative deployment of the WEC units, alternative ocean energy technologies and alternative location for Furthermore, the no project option was also explored in this section.

8.1 No Development Option

It is believed that the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives will have some environmental impacts. If the project does not go head the existing environment will be as it now.

However, Holiday Inn Kandooma Maldives will continue to utilize fossil fuels to meet the energy demand of resort operations. This will lead to emission of greenhouse gases and thus contributing to global climate change. Furthermore, any investment on renewable energy technology will have significant benefits in terms of improving the resorts image as an eco-friendly tourist facility. In addition, any endeavor to reduce dependency on fossil fuel for energy generation will contribute towards enhancing the energy security of the resort.

8.2 Alternative Deployment method for WEC units

Due to the heavy nature of the WEC units, some heavy machinery may be required for deployment of the WEC units in the South Eastern lagoon of Holiday Inn Kandooma Maldives. This section of the report will discuss different deployment methods evaluated for the project.

8.2.1 Deployment of WEC units using a barge and a crane

This method of deployment involves utilization of a crane which will be mounted on a barge to unload the WEC units from the cargo vessel to the project location. If successful, this method will have minimal impact on the benthic environment of the project location. However, due to the low depth of the project site, utilization of a barge is not possible even at high tide conditions.

8.2.2 Deployment of WEC units using a crane mounted at the project site

This method of deployment will involve mounting of a crane on the vicinity of the project area and unload the WEC units to project site. This method of deployment will have significant impact on the benthic environment of the project site and hence is not preferred.

8.2.3 Deployment of WEC units using floating buoys and divers

This method of deployment involves fixing of large floating buoys on the WEC units. Divers will be used to guide the floating WEC units to the project location. This method is expected to have only minor impact on the benthic environment of the project site.

8.2.4 Evaluation of the deployment methods for WEC units

This section will provide evaluation of the aforementioned deployment methods for WEC units. This includes description of resources required, anticipated impacts and applicable mitigation measures. The following table 15 enlists the anticipated impacts each deployment method and proposed mitigation measures.

Table 15: Analysis of the different methods for deployment of WEC units

Method of Deployment	Deployment using a barge and crane	Deployment using a mounted Crane	Deployment using floating buoys and divers
Resources required	• Barge • Crane • Cargo Vessel	• Crane	• 16 floating buoys
Anticipated environmental impacts	• Potential oil spill from the crane and barge; • Damages to the benthic environment due to collision of barge due to wave action and low tide	• Potential oil spill from the crane; • Direct damages to the benthic environment	• Accident may occur during deployment due to wave action on the project site
Proposed Mitigation	• The deployment should be carried out only during the high tide. • Take precautionary measures such as not storing any fuel in the crane or the barge and transport only the quantity of the oil required for the operation of the excavators. • Oil confinement equipment such as oil boom will be made available in a case of oil spill.	• The deployment should be carried out only during low tide. • Take precautionary measures such as not storing any fuel in the crane or the barge and transport only the quantity of the oil required for the operation of the excavators. • Oil confinement equipment such as oil boom will be made available in a case of oil spill.	• The deployment should be carried out during high tide. • The deployment should be carried out on during calm weather. • All the safety and precautionary measures should be taken to ensure the safety of the divers working on deployment of WEC units.

It can be inferred from the above table that the best method for deployment will be using floating buoys and divers. This method of deployment will be used during the installation of the commercial scale WEC units in Holiday Inn Kandooma Maldives. However, the installation period if the weather is too rough and the wave action is unfavorable for the deployment of WEC units using floating buoys and divers the method of deployment to be adopted is deployment using a mounted crane. However, all the measures will be taken to ensure that the proposed method of deployment (using floating buoys and divers) will be utilized before going for using the mounted crane on the project site.

8.3 Alternative location for installation of commercial scale of WEC units

The proposed location for installation of commercial scale WEC units was chosen due to the following reasons;

1. Shallow depth of location both in high and low tide;
2. There no live coral at the proposed location;
3. No visual impacts as the location is at the back-side of the Kandooma Island Resort;
4. The sea bed is made of coral lime stone which will have minimum sedimentation impacts due to drilling of small holes for mounting of WEC units.

Since, the aforementioned reasons are critical to reduce the environmental impacts of installation of WEC units in Holiday Inn Kandooma Maldives, the alternative location for installation of commercial scale WEC units is shown in the figure 12. The geographical coordinates for the alternative location for commercial scale WEC units installation is $3^0$54'02.77" N and $73^0$28'28.05" E.

Figure 12: The Alternative location for WEC units installation

8.3.1 The existing environment of the alternative location for installation of WEC units

The proposed alternative location has a similar existing environment to the project site due to proximity of both sites. However, there are some live corals present on the alternative site for commercial scale WEC units installation. The figure 13 compares the coral cover between the project site and the alternative location for installation of commercial scale WEC units. The figure 14 shows the benthic sediments present in the alternative site for installation of commercial scale WEC units.

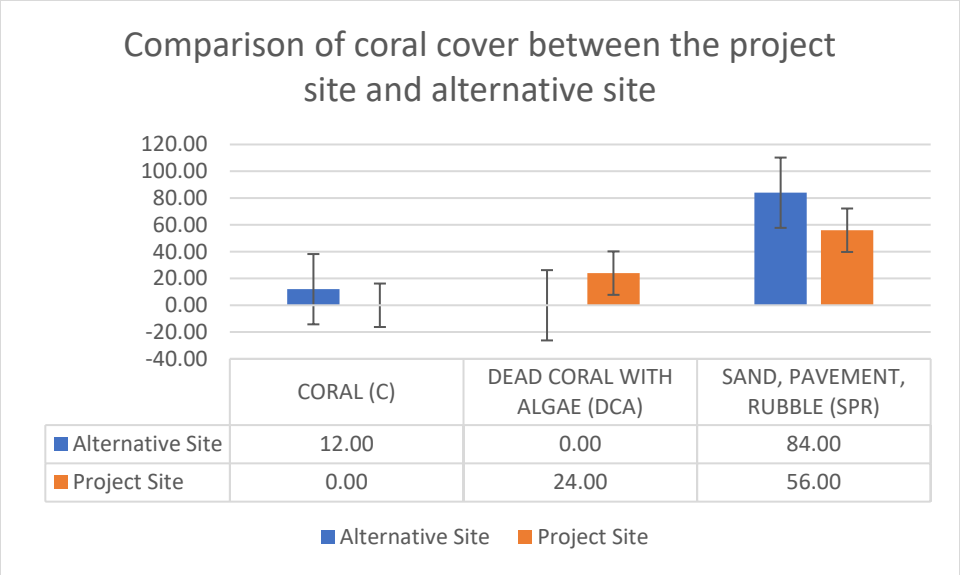

Figure 13: A graphical representation of comparison between the coral cover at the project site and alternative location

Figure 14: The seabed sediments at the alternative location for installation of WEC units

8.3.2 Potential Impacts & Mitigation measures for the proposed

When the considering the existing environment of the proposed alternative location for installation commercial scale WEC units, the following environmental can be envisaged;

- More coral communities and benthic organisms will be affected since the marine environment of the alternative location is more diverse in terms of the coral communities when compared to the proposed construction location.

The following mitigation measures need to be taken in addition to the mitigation measures described in the chapter 7.

- Transfer of any live coral present on the alternative location for installation commercial scale WEC units to another suitable location within Holiday Inn Kandooma Maldives house reef.

8.3.3 Evaluation between the alternative and the proposed location for installation of commercial scale WEC units

The environmental impacts of installation of commercial scale WEC units in the alternative location will be more severe when compared with commercial scale WEC units installation at the current proposed location. The additional mitigation measures required if the commercial scale WEC units are installed in the alternative location would create additional financial burden for the proponent and the island community.

More live corals and other benthic organisms will be affected if the commercial scale WEC units were to be installed at the alternative location. Due to these reasons, the current location for installation of commercial scale WEC units is ideal when compared to other locations.

8.4 Alternative ocean energy technologies

There are various technologies which aim to harness energy from oceans all around the world. Maldives is a country with immense potential for exploring ocean energy technologies. More than 98% of the country comprises of sea. This section of the report will explore different technologies available harnessing the energy from the oceans. The findings described on this section of the report are based on the following literature;

1. Centre for Understanding Sustainable Practice (2011), Marine Energy in the Maldives, Final Report, Robert Gordon University, Aberdeen, Scotland.
2. Constestabile, P, Di Lauro, ED, Galli, P, Corselli, C & Vicinanza, D (2017), Offshore Wind and Wave Energy Assessment around Male' and Magoodhoo Island (Maldives), Sustainability (2017), vol 9, pp.1-24.

8.4.1 Ocean and Tidal Currents

8.4.1.1 Background Information

Ocean surface currents are driven by the wind (Trujillo and Thurman, 2011). In the Indian Ocean the seasonal wind pattern causes the ocean surface currents to switch direction. During the summer (May to September) the current flows from west to east and during the winter (November to February) the current flows from east to west. The transition between the two current systems occurs in March/April and October.

Tides are the periodic raising and lowering of the sea level that occurs daily throughout the ocean. Tides are very long and regular shallow water waves with wavelengths of thousands of kilometres and heights which can range to more than fifteen meters (Trujillo and Thurman, 2011). The tidal regime in the Maldives is semi-diurnal with diurnal inequalities. This means that there are two high tides and two low tides of different heights a day. The time between successive high tides is approximately 12 hours and 25 minutes.

The figure 15 shows the flow of open ocean currents around the Maldives. Field studies and computer modelling suggest that many of the Maldivian island channels have a significant marine current resource. Initial modelling has provided an indication of which channels may be promising for energy extraction. The most applicable technologies for these channels are the devices designed for slower current speeds and shallow water sites.

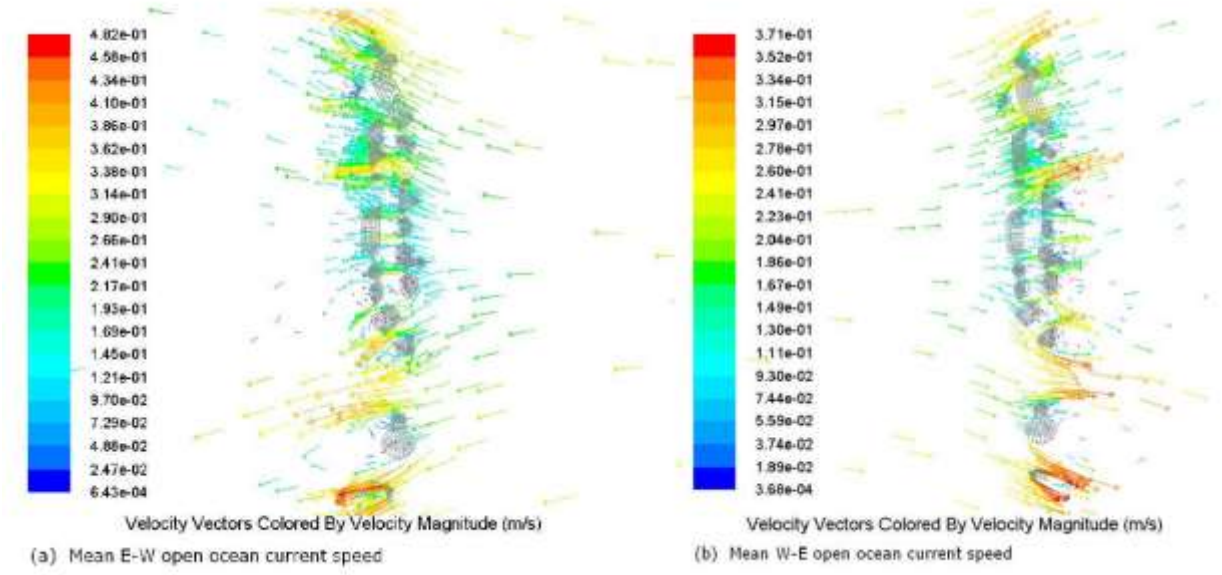

Figure 15: Flow around the Maldives for the mean W-E and E-W open ocean current speeds (adapted from: Marine Energy in the Maldives, Final Report, Centre for Understanding Sustainable Practice Robert Gordon University, Aberdeen, Scotland (2011)

8.4.1.2Proven Technology

A large number of concepts for extracting power from tidal currents have been proposed. These devices can be used to generate energy from any type of ocean current; they are not restricted simply to tidal currents. The devices can be split into three main categories: horizontal axis turbines, cross-flow turbines and oscillating hydrofoils. Most devices are at the concept design or laboratory scale prototype phase in development but a few are at an advanced demonstration phase.

Prototype turbines from Marine Current Turbines (2011), Hammerfest Strøm (2011), Open Hydro (2011), Ponte di Archimede (2006), Verdant Power (2009), Atlantis Resources (Nerus turbine) (Atlantis Resources, 2009), Tidal Generation Limited (2010) and Hydra Tidal (Morild, 2010) have all been grid connected. In addition to the grid connected devices a turbine from Clean Current, combined with a battery storage system, has provided power for an island community (Clean Current, 2010) and a device from Pulse Tidal is feeding electricity directly to a chemical plant (Pulse Tidal, 2011). Almost all of the types of turbine are represented in these power generating prototypes. The Marine Current Turbines, Verdant Power and Hammerfest Strøm turbines are horizontal axis turbines which resemble wind turbines. The Clean Current and Open Hydro turbines are also horizontal axis turbines but these are ducted and have a higher solidity than wind turbines. The Ponte di Archimede turbine is a vertical axis turbine. The Pulse Tidal and Atlantis Nerus turbines are designed for shallow water operation. The pulse tidal allows generation in shallow water by being of the oscillating hydrofoil type and hence able to have a large swept area by increasing the width of the device whilst maintaining a small depth. The Nerus turbine is also designed for shallow water sites.

The European Marine Energy Centre (EMEC) based in Orkney, Scotland, provides a test-site for full-scale grid connected marine energy prototypes. Whilst only some of the prototype tests mentioned above was carried out at EMEC, EMEC is becoming increasingly popular. Many prominent tidal technology developers have plans to install prototypes there, making it an excellent place to watch and see the latest developments in tidal technology.

When selecting a turbine for use at a specific site a number of factors need to be considered including the range of flow speeds at the site, the site depth and sea bed material. Knowledge of these parameters allows the selection of a turbine with a suitable foundation type and cut in speed.

8.4.1.3 Potential Environmental Impacts

Whilst tidal barrage systems have a large impact on the environment, tidal current turbines are thought to be much more environmentally benign. Since ocean current energy extraction is still a nascent industry, the environmental impacts of extracting energy from currents are not yet fully understood (Scott, 2007).

Potential impacts include changes to the flow and effects on the local marine ecology. Extracting energy from a current flow in a channel will affect the speed of the flow and, possibly, affect the water levels in the channel. The magnitude of the effect will depend on the amount of energy extracted allowing developments to be planned so that their impact on the flow is kept to an acceptable level. Extensive monitoring of the effects of the SeaGen turbine in Strangford Lough (Marine current turbines, 2011) has been carried out since 2008. The monitoring has focused on assessing the impact of the turbine on the local wildlife and has demonstrated that the turbine does not have a significant environmental impact (Downey 2010). Ocean current turbines also have minimal or no visual impact.

8.4.2 Ocean Thermal Energy

8.4.2.1 Background Information

The oceans are natural collectors of solar energy and absorb a tremendous amount of heat from solar radiation daily. In the waters surrounding tropical islands such as the Maldives, intense sunlight and long days of sunlight result in significant heating of the upper 35-100m of the ocean, yielding comparatively warm (27-30°C) oceanic surface waters. Below this warm layer the temperature decreases to an average of about 4°C at approximately 1,000m depths (CRRC, 2010a).

This temperature differential represents a significant amount of potential energy, which if harnessed is a renewable energy source. A differential of approximately 20°C between surface and sub-surface seawater temperatures is required for Ocean Thermal Energy Conversion (OTEC) to be feasible. OTEC converts the thermal energy into kinetic energy via turbines. The turbines can then be used to drive generators, producing electricity (CRRC, 2010a). Unlike most renewable energies, OTEC is base-load: the thermal resource of the ocean ensures that the power source is available day or night, and with only modest variation from summer to winter. Although the focus of OTEC is on energy generation, several cogeneration products are possible, including desalinization of seawater, mariculture, liquid fuels production (hydrogen and ammonia) and seawater air-conditioning (SWAC), all of which can contribute to its economic viability (CRRC, 2010b).

8.4.2.2 Proven Technology

An OTEC plant consists of a heat engine that converts thermal energy into kinetic energy through the temperature gradient between a ‘heat source’ and a ‘heat sink, using a similar principle to steam engines, although on a smaller scale. There are 3 major OTEC facility designs, open-cycle, closed-cycle and hybrid cycle. In all of the three cycles, it is necessary to obtain deep cold water to condense the working fluid, which is normally available at depths of 1,000m, where the temperature of the water is approximately 4°C (Plocek, Laboy and Martí, 2009). While closed-cycle facilities are more complex, they are significantly more efficient and result in greater output due to the greater efficiency of the working fluid.

To date they are also the most common of the proposed facilities (CRRC, 2010b). The hybrid-cycle combines the characteristics of the closed cycle and the open cycle, and has good potential for applications requiring higher efficiencies for the co-production of energy and potable water (Avery and Wu, 1994).

Depending on the location of the thermal resource, OTEC plants can be land-based, shelf-based or floating. Land based OTEC is appropriate for those cases where the cold water resource is close enough to shore to be reasonably accessible by pipeline, as is the case in the Maldives where the islands are situated on a narrow shelf with steep offshore slopes (Krock, 2006). A short as possible Cold Water Pipe (CWP) is preferable, given that CWP can represent approximately 30% of costs. The longer CWP length also means greater friction losses, as well as greater warming of the cold water before it reaches the heat exchanger, both of which result in lower efficiency (CRRC, 2010b).

8.4.2.3Potential Environmental Impacts

The environmental impacts associated with OTEC are primarily those associated with the vertical relocation of relatively large water volumes. It is estimated that 3-5m3/sec of warm surface water and cold deep water are required for each MWe of power generated. A small commercial facility (40MW) would require flows of 120-500m3/sec (Krock, 2006).

The warm and cold water intakes pose entrainment and entrapment dangers to plankton, fish and mammals. The discharge water will affect the temperature and density of the water into which it is released, causing localized changes to temperature and currents. There will also be a change to the water chemistry and pH in the discharge area, due to the dissolved gases and nutrients within the outflow.

The generation of noise (turbines, pumps, CWP vibration) and electromagnetic fields (from the power cable in floating designs) are a concern due to the large number of marine mammals that use acoustics, such as dolphins, whales, fish, and EMF for communication like sharks and turtles (CRRC, 2010a).

9. Monitoring Program

A detailed monitoring programme has been outline in the initial EIA for the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives. This Addendum report will not include an additional monitoring program since the poposed activities under this addendum does not require additional monitoring efforts.

10. Stakeholder Consultation

All the stakeholders required to be consulted as per the Addendum TOR has been already consulted during the elaboration of the initial EIA for the proposed installation and operation of commercial scale WEC units at Holiday Inn Kandooma Maldives. Moreover, these stakeholders have been informed regarding the project delay. Only one additional stakeholder which is the most relevant stakeholder for the addendum works has been consulted. They are management of Holiday Inn Kandooma Maldives. The following are the details of the consultation meeting.

Date: 21st July 2020

Time: 09:00 to 10:00 hrs

Type: Telephone Meeting

10.1 Main Discussion and Outcomes

The EIA consultant breifed the officials from Holiday Inn Kandooma Maldives regarding the delay in the project due to COVID19 pandemic and regarding the storage of WEC units till april 2021. The following are the main outcomes of the discussion.

- No major concerns;
- Looking forward for successful implementation of the project.

10.2 Participants and Contact Details

Table 16: Participants of the meeting with management of Holiday Inn Kandooma Maldives

Name	Designation	Contact
Hussain Shahid	Executive Assistant Manager	7911856

11. Summary and Conclusion

Following are the summary and conclusions with regards to the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives;

- The project has been proposed by Ocean Paradise Maldives Pvt Ltd to install and operate commercial scale WEC units in Holiday Inn Kandooma Maldives in South Male' atoll.
- The proposed project involves installation of (4) commercial scale WEC units, Installation of power cables for transmission, establishment of a WEC monitoring station.
- This project is a follow-up project of wave to energy convertor unit installation experiment in Holiday Inn Kandooma Maldives which was conducted from May to December 2019. The aforementioned experiment involved installation of two half-scaled and two full scaled WEC units in south eastern side of Holiday Inn Kandooma Maldives.
- An initial EIA report was approved and decision statement (DS) was issued by EPA on 22nd January 2020.
- WEC units were shipped and transported to Holdiay Inn Kandooma, however the installation was not completed since the technical team from OIST could not travel to Maldives due to COVID19 pandemic.
- The WEC units are currently stored in a temporary storage location until March 2021.
- As a result of the proposed project during the storage and installation phase it is expected to have turbidity of lagoon some direct damage to benthic organisms present in the project location may occur during drilling to mount the WEC units at the project site. Some minor impacts are anticipated due excavation for lying the cables for transmission on land.
- During the operational phase of the proposed project the main impacts predicted include changes to the water quality and currents due to operation of the WEC units, maintenance of installed WEC units and WEC monitoring station and decommissioning of the WEC units.
- The proposed mitigation measures include undertaking the WEC installation in low tide at calm weather, provision of oil containment booms to avoid impacts of oil spills and having warning signs to avoid any potential accidents during the operational phase of the project.
- Some alternative methods for deployment of the WEC units have been suggested. The preferred method of deployment is using floating buoys and divers. If this method of deployment is not possible the WEC units will be installed using a crane mounted on the project site. However, all necessary measures will be taken to ensure that the first method of deployment will be chosen.
- Deployment using a crane on a barge was not possible due to shallow depth at the project site.
- Environmental monitoring during both installation and operation stages has be given serious consideration in order to assess the degree and magnitude of environmental changes in the biophysical environment, through a follow-up monitoring of established baseline data.
- Monitoring of water quality and coral cover of the project location will be done once the installation of the WEC units are completed and every six months for a period of one year during operational phase of the project.
- Although there are some environmental impacts from the proposed project, most of these impacts can be reduced and mitigated by use of appropriate methodology and timing.
- The effectiveness of these methodologies can be documented by implementing a comprehensive monitoring programme. Also, with the need of the project to enhance energy security and prove the WEC technology, it is concluded that the project should go ahead as proposed.

12. References

Avery, W.H. & Wu, C., (1994). Renewable Energy from the Ocean, A Guide to OTEC. Oxford University Press. New York, NY.

Centre for Understanding Sustainable Practice (2011), Marine Energy in the Maldives, Final Report, Robert Gordon University, Aberdeen, Scotland.

Clean Current, 2010. Clean Current- renewable energy from the tides. [online]. Vancouver: Clean Current.

Constestabile, P, Di Lauro, ED, Galli, P, Corselli, C & Vicinanza, D (2017), Offshore Wind and Wave Energy Assessment around Male' and Magoodhoo Island (Maldives), *Sustainability (2017)*, vol 9, pp.1-24.

CRRC (Coastal Response Research Center) (2010a). Ocean Thermal Energy Conversion: Assessing Potential Physical, Chemical and Biological Impacts and Risks. University of New Hampshire, Durham, New Hampshire <Available from: http://www.cleancurrent.com>

CRRC (Coastal Response Research Center) (2010b). Technical Readiness of Ocean Thermal Energy Conversion (OTEC). University of New Hampshire, Durham, New Hampshire

Development Advisory Services (DAS) (2017) "Environmental Management Plan for Sea Solar Dispersion Plant at Adhaaran Club Ranaalhi resort, Maldives.

Development Advisory Services (DAS) (2017) "Environmental Management Plan for Installation of 1.5MW Rooftop Solar Photovoltaic system at Hulhumale' island', Maldives.

Downey, T., (2010) Royal Haskoning Monitors Interaction Between Strangford Lough Tidal Turbine and LocalWildlife. [online]. Peterborough: Royal Haskoning. Available from: http://www.royalhaskoning.co.uk/en-gb/news/Pages/strangford-lough-tidal-turbine.aspx

Erftemeijer, PLA, Riegl, B, Hoeksema, BW & Todd, PA (2012) "Environmental impacts of dredging and other sediment disturbances on corals: A review", *Marine Pollution Bulletin*, vol. 64, pp. 1737 – 1765.

Environment Resource Management (2014), "Amended Final Scoping Report: Proposed 90 MW Drennan Photovoltaic (PV) Power Facility, Eastern Cape", ERM South Africa.

Ge, Y & Jun-yan, Z (2011), "Analysis of the impact on ecosystem and environment of marine reclamation--A case study in Jiaozhou Bay', *Energy Procedia*, vol. 5, pp. 105-111

Mohamed, H (2020), Environmental Impact Assessment for the proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives.

Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu. (1997) "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 - Overview. 356 pp.

Joseph, C, Gunton, T & Rutherford, M (2015), "Good practices in environmental assessment", *Impact Assessment and Project Appraisal*.

Josimovic, B, Petric, J & Milijic, S (2014), "The Use of the Leopold Matrix in Carrying Out the EIA for Wind Farms in Serbia", *Energy and Environment Research*, vol. 4, pp. 43-54.

Krock, J.., 2006. Questions and Answers on OTEC in Taiwan [online]. Newsletter Vol. 7 (2), Paris, France: Club des Argonautes. <http://www.clubdesargonautes.org/otec/vol/vol7-2-1.htm>

Maldives Energy and Environment Company (MEECO) (2015) "Environmental Impact Assessment for Rehabilitation and Repair of Harbour at Kanduhulhudhoo Island, Gaafu Alifu Atoll", Maldives.

Maldives Energy and Environment Company (MEECO) (2015) "Environmental Impact Assessment for rehabilitation and repair of harbor at Kumundhoo Island, Haa Dhaalu Atoll", Maldives.

Marine Current Turbines (2011) Marine Current Turbines- turning the tide. [online]. Bristol: Marine Current Turbines. Available from: http://www.marineturbines.com

Mostafa, YS (2012), "Environmental impacts of dredging and land reclamation at Abu Qir Bay, Egypt", *Ain Shams Engineering Journal*, vol. 3, pp. 1-15.

Plocek, T., Laboy M. and Martí, J.A., (2009). Ocean Thermal Energy Conversion (OTEC): Technical Viability, Cost Projections and Development Strategies. Presented at 2009 Offshore Technology Conference held in Houston, Texas, USA, 4–7 May 2009.

Pulse Tidal (2011). "Tidal Power- clean, renewable and dependable". [online]. Sheffield: Pulse Tidal. Available from: http://www.pulsegeneration.co.uk/ [Accessed 12 April 2011].

Scott, B., 2007. A Renewable Engineer's Essential Guide to Marine Ecology. Proceeding of the Oceans 2007

Trujillo, A.P., Thurman, H.V, (2011) Essentials of Oceanography. 10th ed. Boston: Prentice Hall

United Nations Development Programme (2008), "Hazard Vulnerability Assessment", UNDP Maldives.

World Health Organization (2017), "Guidelines for drinking-water quality: fourth edition incorporating the first addendum", WHO publication.

13. List of Annexures

Annex 1: Approved TOR by EPA

Annex 2: Concept Approval from Ministry of Tourism

Annex 3: The Decision Statement for the Initial EIA

Annex 4: Water Quality report from MWSC

Annex 5: Letter of Commitment from the proponent

Annex 1: Approved TOR by EPA

Environmental Protection Agency EPA

No: 203-ECA/PRIV/2020/314

Terms of Reference for First Addendum to the Environmental Impact Assessment for proposed installation and operation of commercial scale Wave to Energy Converter (WEC) units in Holiday Inn Kandooma Maldives

The following is the Terms of Reference (ToR) for undertaking the **First Addendum to the EIA for the proposed installation and operation of commercial scale Wave to Energy Converter (WEC) units in Holiday Inn Kandooma Maldives**. The proponent of the project is **Ocean Paradise Maldives Pvt Ltd**. The consultant of the project is **Mr. Hamdhoon Mohamed (EIA P03/2017).**

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 purpose 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 including how work carried out under this project is linked and sequenced with other projects executed by other consultants, and how coordination between other consultants, contractors and government institutions will be carried out. List the donors and the institutions the consultant will be coordinating with and the methodologies used.

2. **Study area** – Submit a minimum A3 size scaled plan with indications of all the proposed infrastructures. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location and size.

3. **Scope of work** – Identify and number tasks of the project including site preparation, construction and operational 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 proposed construction of proposed installation and operation of commercial scale WEC units in Holiday Inn Kandooma Maldives;

- Installation of WEC units;
- Storage location for the WEC units.

Installation of WEC

- Dimensions and characteristics of WEC units;
- Method and equipment used for deployment and mounting;

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Environmental Protection Agency EPA

- Justification for selecting the methods and equipment;
- Project schedule;
- Emergency plan in case of spills (diesel, grease, oil).

Storage location of WEC units

- Geographical coordinates of the storage location of WEC units;
- Safety measures taken during storage of WEC units.

Task 2. Description of the existing environment – Assemble, evaluate and present the environmental baseline studies/data regarding the study area and timing of the project (e.g. monsoon season). Identify baseline data gaps, studies and the level of detail to be carried out by consultant. Consideration of likely monitoring requirement s 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 and vegetation transects for posterior data comparison. Information should be divided into the categories shown below:

Climate

- Temperature, rainfall, wind and waves;
- Risk of hurricanes and storm surges.

Geology and geomorphology (localized maps)

- Characteristics of seabed sediments to assess direct habitat destruction and turbidity impacts during construction at the WEC storage location.

Hydrography/hydrodynamics (localized maps)

- Tidal ranges and tidal currents;
- Sea water quality measuring these parameters; temperature, pH, salinity, turbidity, Total Petroleum Hydrocarbons (TPH).

Ecology

- Identify marine protected areas (MPAs) and environmentally sensitive sites;
- Benthic and fish community monitoring around the island;
- Terrestrial vegetation which will be removed due to project interventions.

Hazard vulnerability

- Vulnerability of area to storm surges.

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. Show that the proponent has applied for all necessary permits. Specifically show how the proposed project meets the required legislative and regulatory requirements.

Legal requirements:

- Concept approval from Ministry of Tourism

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

Impacts on the natural environment

- Changes in erosion/sedimentation patterns flow velocities/directions, which may impact shore zone configuration/coastal morphology;
- Loss of marine habitat during project operations;
- Impacts of noise, vibration and disturbance.

Social impacts:

- Noise impacts on local population during construction phase, if any;
- Aesthetics on-land and underwater impacts;
- Safety- worker and community safety during construction and operation;
- Risk of accidents and pollution on workers and guests.

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

Task 5. Alternatives to proposed project - Describe alternatives including the "no action option "should be presented. Determine the best practical environmental options. Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". This should include alternatives for environmental, social and economic considerations such as alternative for breakwater and revetment.

Task 6. Mitigation and management of negative impacts - Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. Mitigation measures must also be identified for both construction and operation phase. Cost of the mitigation measures, equipment and resource(s) required to implement those measures should be specified. The confirmation of commitment of the Proponent/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 six months thereafter, up to one year. 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;
- Condition of the sensitive ecosystems and marine resources.

Task 8. Stakeholder consultation, Inter-Agency coordination and public/NCO participation) – EIA report should include a list of people/groups consulted and what were the major outcomes. Identify appropriate mechanisms to supply stakeholders and the public with information about the development proposal and its progress. Major stakeholder consultation shall include relevant government agencies engineers/designers, development managers, island council and members of the general public. The report should include chronological evidence of consultation including contact details of those consulted and photographic evidence of consultation. The following should be consulted;

1. Kandooma Management;
2. K. Guraidhoo Island Council;
3. Ministry of Tourism;
4. Maldives Energy Authority;
5. Ministry of Environment.

If the surveys are undertaken at a time where public health emergency is declared due to COVID 19, consultation with stakeholders can be undertaken via conference calls. Public consultations instead of community gatherings can be undertaken as one on one surveys in person or through telephone (evidence and records of this need to be presented). The EIA report needs to be submitted to island council and atoll council and evidence of submission needs to be included in the report. Meeting minutes shall be annexed and the report shall include a list of those who are consulted and their contact details.

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 of 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 and subsequent amendments.

Timeframe for submitting the EIA report – The developer must submit the completed EIA report within 03 months from the date of this Term of Reference.

……………………………

29th June 2020

Annex 2: Concept Approval from Ministry of Tourism

بسم الله الرحمن الرحيم

MINISTRY OF TOURISM
REPUBLIC OF MALDIVES

Ref no: 88-ES/PRIV/2019/ 2915 Thursday, November 07th, 2019

Mr. Gan Kim Leng,
Alternative Director,
Leisure Holidays Pvt Ltd,
2nd Floor, M. Lux Loge
Male'
Republic of Maldives

Dear Mr. Gan Kim Leng,

Re: Conditional approval for coastal modification.

We refer to your application dated 04th November 2019 requesting to approve the proposed coastal modification project at Kandooma in Malé Atoll.

The main activities of the proposed project include:

- Installation of wave to energy conversion units (4 Unit).

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

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

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

Thank you.

Yours sincerely,

Aishath Ali
Director General

Copy: Kandoomaa Holdings Pvt. Ltd.

Ministry of Tourism, Velaanaage, Fifth Floor, Ameer Ahmed Magu, Male', Maldives
Tel: +(960)332 3224, +(960)302 2200, Fax: +(960)332 2512
E-mail: info@tourism.gov.mv, website: www. tourism.gov.mv


Concept Plan for Installation of Commercial Scale WEC units in Holiday Inn Kandooma Maldives
Holiday Inn Resort Kandooma Maldives
Commercial Scale WEC units
Image © 2018 DigitalGlobe
Image © 2018 Maxar Technologies
Imagery Date: 2/4/2019 3°54'05.74" N 73°28'29.88" E elev
823 ft
2001

Project briefs for the Installation and Operation of Commercial Scale WEC units in Holiday Inn Kandooma Maldives

Introduction

This project is about installation of Commercial Scale Wave to Energy Conversion (WEC) Units (4 units) at the south east side of Holiday Inn Kandooma Maldives Resort. The WEC Units generate clean energy in the form of electricity from daily breaking of ocean waves to the island.

The WEC units will be assembled in the Okinawa Institute of Science and Technology in Japan and freighted to Maldives through sea cargo. The WEC units will be transported to Holiday Inn Kandooma Maldives Resort using a cargo boat and will be unloaded using a crane on a barge.

The dimension of the WEC units are 2.4 m in length 1.4 m in width and 1.4 in height. The figure 01 illustrates the commercial scale WEC units. The WEC units will be placed at four different locations along the SE side of the Holiday Inn Kandooma Maldives Resort. Installation points are at mean water depth of 0.8 m and 1.3 m near the beach.

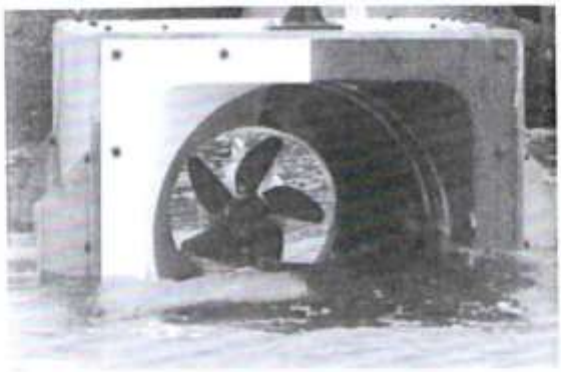

Figure 1: The Commercial Scale WEC units installed in Okinawa, Japan

Location of the Project

Island Name	Holiday Inn Kandooma Maldives Resort
Location	3° 54' 11.54" N and 73° 28' 25.46" E
Length	Approx. 481 m
Width (at the widest)	Approx. 408 m
Distance to Male' city	Approx. 29.5 km

Ref: 88-ES/PRM/2019/2415
07/11/2019.

Figure 2: The location of the proposed project activities

Brief Description of the existing environment

Holiday Inn Kandooma Maldives is a tourist resort located in the South Male Atoll. The closest inhabited island is K. Guraidhoo which is just 230 m to south-east of the resort. The project is proposed at the lagoon of the SE side of the island. . The rationale for selection of the proposed location include (1) shallow depth of location both in high and low tide. (2) There no live coral at the proposed location. (3) No visual impacts as the location is at the back-side of the Kandooma Island Resort (4) The sea bed is made of coral lime stone which will have minimum sedimentation impacts due to drilling of small holes as proposed by the experiment.

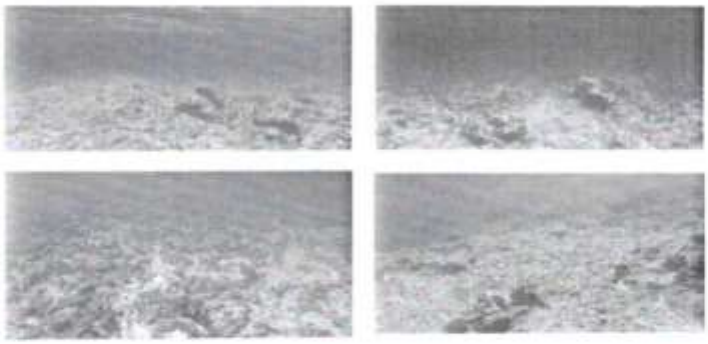

Figure 3: The seabed sediments at the proposed project site

The Proposed project

The proponent was Ocean Paradise Maldives Pvt Ltd signed an MOU with Holiday Inn Kandooma Maldives Resort. Ocean Paradise Maldives Pvt Ltd is working in collaboration with Okinawa Institute for Science and Technology.

This project is a follow-up for the WEC units experiment which was conducted during May 2018 to June 2019 where two half scaled and two full scale WEC units where installed. The concept for this WEC unit installation experiment was approved by Ministry of Tourism on 20th March 2018 and Environmental Management Plan was elaborated and decision statement was issued on 05th April 2018. Monitoring reports were submitted to Ministry of Tourism on December 2018.

All the Half scaled and full scaled WEC units has been already decommissioned in compliance with the proposed mitigation measures in aforementioned EMP.

This project involves installation of installation of commercial scale WEC units with dimension of 2.4 m in length 1.4 m in width and 1.4 in height at the project location. The WEC units will be assembled in the Okinawa Institute of Science and Technology in Japan and freighted to Maldives through sea cargo. The WEC units will be transported to Holiday Inn Kandooma Maldives Resort using a cargo boat and will be unloaded using a crane on a barge. The WEC units will be fixed using a metal rims and shafts which will be fixed in holes whuch are drilled (110 mm diameter x 500 mm) depth each on the lagoon substrate (lime stone) by a core-drill. All together 16 such holes will be drilled for mounting of the WEC units.

No temporary structure will be constructed such as a jetty. The socket (stainless tube) will be fixed into the holes using epoxy cement. The floaters attached to WEC units will be removed once the WEC is stably mounted.

A submerged cable will be layed to connect to the monitoring station located in the power house of Holiday Inn Kandooma.

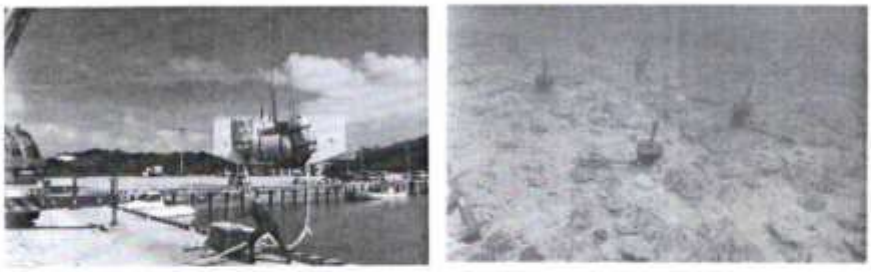

Figure 4: Unloading of the WEC units and metal rim and shafts attached to the holes drilled for WEC mounting

Figure 5: Deployment of the Commercial Scale WEC units

Equipment and Materials

Some equipment which will be used during the construction phase include the following

- Barge
- Crane
- Small boat

Some construction materials which will be used for Jetty works include

1. Small Scale of Epoxy cement
2. Metal Shafts and Rim

Impact on the environment and possible mitigation

The envisaged impact on the environment by this project could be moderately significant to negligible with positive and negative impacts. Some of the significant activities that might have an impact on the environment are as follows.

Minor sedimentation during the drilling process

Since the dimensions of the hole drill is just 110 mm diameter the sedimentation impact will be minimal.

Loss of marine habitat for

Due to deployment of commercial scale WEC units which has dimension of 2.4 m in length 1.4 m in width and 1.4 in height, fish communities and benthic organisms which inhabit the project area may be affected.

Operational Impacts such as oil and paint spillage

The Commercial scale WEC units will undergo maintenance and painting will be done to prevent colonization of barnicles. These activities may affect the marine water quality temporarily.

Annex 3: The Decision Statement for the Initial EIA

Environmental Protection Agency

EPA

APPROVAL OF ENVIRONMENTAL IMPACT ASSESSMENT

Number: 203-ECA/PRIV/2020/56

*This Environmental Decision Statement is issued for the purpose of communicating the decision regarding the **Environmental Impact Assessment for the Proposed Installation and Operation of Commercial Scale Wave to Energy Converter Units in Holiday Inn Kandooma Maldives, Kaafu Atoll,** which was submitted for evaluation on **31st December 2020** by **Ocean Paradise Maldives Pvt Ltd.** The EIA consultant of this project is **Mr. Hamdhoon Mohamed (EIAP03/2017).***

1. This Environmental Decision Statement has been issued on behalf of the Environmental Protection Agency (hereinafter referred to as the Ministry) pursuant to the Environmental Impact Assessment Regulations 2012 (2012/R-27) to advise that the Ministry has decided that the proposed Development Proposal can proceed according to the Environmental Impact Assessment Report.

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Page 1 of 5

2. The decision has been made by the Ministry on the following conditions:

2. މ. ގުއްދަ ފެނަވަރުކުރުމަށް ތިރީގައިވާ ޝަރުޠުތަކާ ގުޅިގެން ވަޒާރާއިން ނިންމާފައިވާ ގޮތަށެވެ:

i. In the event the project activity has not commenced within one (1) year from the date of issue, or if the duration of this Environmental Decision Statement has not been extended, this Environmental Decision Statement shall be considered null and void. In order to extend the duration of this Environmental Decision Statement, the Proponent shall write to the Minister for an extension according to clause 14 of the Environmental Impact Assessment Regulation 2012.

i. ތިލަދުންމަތީ ތަރައްގީ ފަށާ ތާރީޚުން 1 (އެއް) ހަފްތާ ދުވަހުގެ ތެރޭގައި ތަރައްގީ ކަންތައް ފެށިފައި ނުވާ ނަމަ، ނުވަތަ ތިލަދުންމަތީ ތަރައްގީ ގުއްދަ ދިގުލެވިފައި ނުވާ ނަމަ، ތިލަދުންމަތީ ތަރައްގީ ގުއްދަ ބާޠިލު ކަމަށް ބެލެވޭނެ ކަމުގައި ވާ ގުއްދަ 1 ވަނަ ނަންބަރުގައި ދެކޮޅަށް ހުށަހެޅިފައި ވާ ގޮތުގައި، ތިލަދުންމަތީ ތަރައްގީ ގުއްދަ ދިގުލުމަށް ތަކެއްޗާ ގުޅިގެން ތަރައްގީ ކުރާ ފަރާތުން ވަޒާރާއަށް ލިޔުމުން ގުއްދަ ދިނުމަށް ދަރުހަވާ ކަމަށް 2012 ވަނަ ސަނަ 14 ވަނަ ދަށުގެ ގަވާއިދުގެ ގޮތުގައެވެ.

ii. In the event the project activities have been delayed for more than one (1) year due to unforeseen circumstances, the Ministry shall have the discretion to extend the duration of the Environmental Decision Statement, or to terminate it. In such circumstances the proponent shall write to the Minister for an extension clearly stating out the reasons for the

ii. 1 ވަނަ ނަންބަރުގައި ބުނެފައިވާ ގޮތަށް ތަރައްގީ ކަންތައް ފެށުމަށް 1 (އެއް) ހަފްތާ ދުވަހުގެ ތެރޭ ކަންތައް ގެންދިއުމުގައި ނާކާމިޔާބުވުމުގެ ސަބަބުން ތަރައްގީ ގުއްދަ ދިގުލުމަށް ނުވަތަ ބާޠިލު ކުރުމަށް ވަޒާރާއަށް ބާރު ލިބިގެންވާ ކަމަށާ، ތިލަދުންމަތީ ތަރައްގީ ގުއްދަ ދިގުލުމަށް ތަކެއްޗާ ގުޅިގެން ތަރައްގީ ކުރާ ފަރާތުން ވަޒާރާއަށް ލިޔުމުން ގުއްދަ ދިނުމަށް ދަރުހަވާ ކަމަށާ، ގުއްދަ ދިނުމަށް ދަރުހަވާ ސަބަބުތައް ގަޑުގަޑަށް ބަޔާންކޮށް ލިޔުމުން ހުށަހެޅުމަށް ވާ ކަމަށެވެ.

delay.

iii. The Minister, or his designate, may issue a cessation order requiring persons working on a Development Proposal to cease working until the order is withdrawn, if:

a) This Environmental Decision Statement has been withdrawn or;

b) There has been a breach of the conditions of this Environmental Decision Statement.

iv. It is the Developer's responsibility to undertake all project activities in accordance with the relevant laws and regulations of the Maldives.

v. The Developer shall submit environmental monitoring report as outlined in Paragraph viii of this Environmental Decision Statement. Failure to submit the requisite monitoring report may result in the suspension or revocation of the permit under this Decision Statement.

vi. The Developer is aware that under the National Environment Protection Act (Law no. 4/93) and

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the Environmental Impact Assessment Regulations the Ministry reserves the right to terminate any activity without compensation if found that such an activity has caused significant, irreversible impacts on the environment.

vii. All mitigation measures proposed in the EIA report for all the phases of the project shall be fully implemented.

viii. The environmental monitoring program outlined in the Environmental Impact Assessment Report shall be undertaken and implemented and summary environmental monitoring reports shall be submitted to the Ministry.

ix. The date of expiry stated in this Environmental Decision Statement is the duration given to commence the project activities approved under this Environmental Decision Statement.

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Page 4 of 5

x. Once the project activities have started, the Proponent must inform the Environmental Protection Agency, the date of commencement of project activities.

x. ފްރޮޖެކްޓް ފުރިހަމަ ކުރިއަށް ގެންދަން ފަށާ ދުވަހު، ޕްރޮޕޯނެންޓް ވާދަ ކުރަންވާނީ ވާތావరణ ރައްކާތެރިކަން ބެލެހެއްޓުމުގެ ދާއިރާއަށް ފްރޮޖެކްޓް ފުރިހަމަ ކުރިއަށް ގެންދަން ފަށާ ދުވަހު ދަންނަވައި

Date of Issue: 22nd January 2020 — 2020 ޖެނުއަރީ 22 :ދޫކުރި ތާރީޚް

Date of expiry: 22nd January 2021 — 2021 ޖެނުއަރީ 22 :ހަމަވާ ތާރީޚް

Name: Ibrahim Naeem — ނަން: ބ. ދ. ނަޢީމް

Designation: Director General — ވަޒީފާ: ޑިރެކްޓަ ޖެނެރަލް

Signature: — ސޮއި:

Annex 4: Water Quality report from MWSC

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
Quality Assurance Building, 1st Floor, Male' Hingun, Villimale', Male' City, Maldives
Tel: +9603323209, Fax: +9603324906, Email: wqa@mwsc.com.mv

WATER QUALITY TEST REPORT
Report No: 500184706

Customer Information:
Hamdhoon Mohamed (A076983)
G Maavaarulu
Shabnam Magu
-

Report date: **15/07/2020**
Test Requisition Form No: **900190162**
Sample(s) Received Date: **08/07/2020**
Date of Analysis: **08/07/2020 - 08/07/2020**

Sample Description –	Location 1	Location 2	Location 3	**TEST METHOD**	**UNIT**
Sample Type –	Sea Water	Sea Water	Sea Water		
Sample No	83212736	83212737	83212738		
Sampled Date –	07/07/2020	07/07/2020	07/07/2020		
PARAMETER	**ANALYSIS RESULT**				
Physical Appearance	Clear with particles	Clear with particles	Clear with particles		
pH *	8.08	8.09	8.08	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	-
Salinity	34.90	34.01	34.05	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	‰
Temperature	25.5	25.1	25.6	Electrometry	°C
Turbidity *	<0.1 (LoQ 0.1 NTU)	0.144	0.110	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

Keys: ‰ : Parts Per Thousand, **°C** : Degree Celcius, **NTU** : Nephelometric Turbidity Unit

Checked by
Aminath Sofa
Laboratory Executive

Approved by
Mohamed Eyman
Manager, Quality

Notes: Sampling Authority: Sampling was not done by MWSC Laboratory
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********** END OF REPORT **********

Page 1 of 1

MWSC-A5-F-92 Rev 00

Annex 5: Letter of Commitment from the proponent

Ocean Paradise (Maldives) Pvt Ltd
Office Address:
H.Fehivinamaage, 1st Floor, 1-C
Male, Republic of Maldives
TIN 1000337GST002
Tel: +960 332 9884 Fax: +960 332 9885

Mailing Address:
P.O. Box 2135
Male, Republic of Maldives

Letter of Commitment

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

23rd July 2020

Dear Sir,

Commitment for monitoring and mitigation actions for 1st Addendum to Environment Impact Assessment (EIA) Report for the Proposed Commercial Scale WEC at Kandooma

As the proponent of the above-mentioned project, I hereby confirm that I have read the report to best of my knowledge and commit to carry out and bear the cost of environmental mitigation measures and monitoring outlined in the report.

Yours Sincerely,

OCEAN PARADISE (MALDIVES) PVT LTD

Mohamed Niyaz,
Director,
Ocean Paradise (Maldives) Pvt Ltd