September 2022

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED 300 TPD RO PLANT INSTALLATION AND BOREHOLE CONSTRUCTION AT LH. KANUHURA

Proponent;

Kanuhura Maldives (Leisure Oceans Pvt Ltd)

Consultants;

Mahfooz Abdul Wahhab (Lead Consultant)

Ibrahim Rashihu Adam

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LETTER OF COMMITMENT & DECLARATION OF PROPONENT

Leisure Oceans Private Limited
#02-01 Millennia Tower, 10 Ameer Ahmed Magu
Male', Republic of Maldives

Reference no: 06

Mr. Ibrahim Naeem
Director General
Environment Protection Agency
Male'
Maldives

14th September 2022

Dear Mr. Naeem,

Re: Environmental Impact Assessment for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura

As per the requirements of the EIA regulation, we hereby confirm our commitment to implement the mitigation and monitoring measures according to what is proposed in the EIA report attached herewith.

Yours sincerely

Mohamed Riza
Head of Operations

C03032021

Declaration of the proponent

As the representative of the proponent of the proposed development I guarantee that I have read the report thoroughly and that to the best of my knowledge all information provided here is accurate and complete. In addition, I confirm our commitment to making sure that the contractor implements all mitigation measures proposed in the present report and adhere to the monitoring schedule given.

Name: Mohamed Riza

Signature:

LEISURE OCEANS PRIVATE LIMITED
C03032021
REPUBLIC OF MALDIVES

Date: 14th September 2022

DECLARATION OF CONSULTANTS

We certify that the statements made in this Environmental Impact Assessment report are true, complete and correct to the best of our knowledge and available information.

Mahfooz Abdul Wahhaab (Lead Consultant)

Ibrahim Rashihu Adam

EXECUTIVE SUMMARY

1. The purpose of this EIA is to critically analyze and assess the potential environmental impacts associated with the proposed new water system upgrading works at Lh.Kanuhura resort and propose the solutions and preferred alternatives as well as mitigation measures to minimize any negative impacts whilst trying to derive the maximum positive impacts from the project.
2. Kanuhura Resort is looking to upgrade its facilities with some modifications over the current building scheme. Essentially the upgrade is required in order to diversify the current facilities looking forward to meet the existing tourist demand. As such the resort is undergoing a major renovation where additional pools are added to existing villas, new villas are being constructed and all of its facilities are being upgraded. These new pools, additional villas and facilities will increase the water demand of the resort; hence the resort is undergoing upgrade works to its water system in order to cater for this new demand and also to improve the existing systems with the most recent technology to reduce the environmental impacts. The resort currently uses a beach intake for the RO plant and has decided to change the intake of RO plant to a borehole. Further, an additional 300 TPD RO plant is to be installed under the current project.
3. The impacts of the proposed project during the construction phase are the impacts arising from mobilization, noise pollution, groundwater contamination and waste generation during constructional and decommissioning, impacts from oil and chemical spill and risk of accidents on the workers. The major impact during operational phase is on the marine environment, which is mainly from the increased effluent of the brine discharge. High positive impacts are envisaged due to increased capacity of the resort to cater for the new water demands resulting from the recently initiated upgrading activities.
4. Major mitigation measures include, precautionary measures while handling oil and chemicals, proper maintenance of machinery and vehicles and appropriate waste management practices. Care should also be also be given to ensure that the workforce will abide by the health and other regulatory measures to minimize the risk of the Covid-19 episode within the workforce. It is also proposed to wear appropriate safety gear for health and safety during the operational phase.
5. Main alternatives that were studied were the no-project option, establishing a second borehole as a backup raw water source and utilizing renewable energy. The establishment of a second borehole and integration of renewable energy were the preferred alternatives.

6. In terms of environmental monitoring, it is recommended to monitor the marine and ground water quality, noise, and waste generation during the construction phase of the project. Furthermore, continuation of monitoring the marine environment is recommended in the operational phase with monitoring the changes to benthic substrate and marine water quality.
7. The socioeconomic benefits during the operations far outweigh the negative impacts of the construction phase of the proposed project. Hence, with the mitigation measures outlined in the report, it is recommended to proceed with the project as planned.

ސާރާ ޚުލާސާ

1. މި ރިޕޯޓަކީ ލ.ކަނޑުހުރާގައި ކުރިއަށް ގެންދިއުމަށް ހަމަޖެހިފައިވާ ފެން ޕްރޮޑަކްޝަންގެ ކެޕޭސިޓީ އިތުރުކުރުމާއި ބޯހޯލް އެޅުމުގެ މަސައްކަތްތަކުގައި ގެނެވޭނެ ތިމާވެއްޓަށް އަސަރު ފޯރާނެ މިންވަރު ބަޔާންކޮށް ކުރިމަތި ވެދާނެ ނުރައްކާ އަސަރުތައް ހައްލު ނުވަތަ ކުޑަކުރުމަށް ކުރެވިދާނެ ގޮތްތަކާއި އެހެން އަލްޓަރނޭޓިވް އޮޕްޝަންތަކަށް އަލިއަޅުވާލައިފައިވާ ރިޕޯޓެވެ.
2. ކަނޑުހުރާ މޯލްޑިވްސް އެންމެ އަރަހުމިއަތޮޅުކަން ދޫކުރާ އެރިސޯޓުގައި ދުރުން އަންނަ ހިދުމަތްތަކުގެ ފެންވަރު ހިފެހެއްޓުމަށާއި ކުރިއަށްދިއުމުގެ. އެގޮތުން މި މަޝްރޫޢު އެކުލެވިގެންވާ ފަރުވާވެސް، މިހާރު ކުރިއަށް ގެންދަމުންދާ އޮޕަރޭޝަން މަސައްކަތްތަކުގެ ދަށުން ތާއީދުކުރާ ޕްރޮޖެކްޓްތަކެއް، ބޭނުން ވާ ބަދަލުވާ ސަޕްލައިގެ ދިގު ރިސޯޓުގެ ފެނުގެ ޑިމާންޑް ޕޫރާކުރުމަށާއި، އިތުރުވެފައިވާ ޑިމާންޑަށް ފެން އުފެއްދުމުގެ ބާރުވެރި ވަސީލަތްތައް ތައްޔާރުކުރުމެވެ.
3. މި މަޝްރޫޢުގެ ސަބަބުން ތިމާވެއްޓަށް ކުރާނެ މައިގަނޑު އަސަރަކީ ކަމުގައި ބެލެވޭނީ، މަޝްރޫޢުގެ މަސައްކަތް ކުރިއަށްދާއިރު އުފެދޭ ކުނީގެ ސަބަބުންނާއި، ނޮއިސް ޕޮލިއުޝަނާއި، ތެޔޮ އަދި ކެމިކަލް ލީކުވުމުގެ ސަބަބުން ބިމުގެ ފެން ތަޣައްޔަރު ވުމާއި، މަޝްރޫޢަށް ބޭނުންވާ ވަސީލަތްތައް މަޝްރޫޢު ހިންގާ ސަރަހައްދަށް ގެންދިއުމުގައި ފެއިލްވެގެން ކުރާނެ ނުރައްކާ އަސަރުތަކެވެ. އަދި މަޝްރޫޢުގެ ހިންގާ ބަޔަކަށް ފުރަތަމަގައި އެންމެ ބޮޑު އަސަރެއް ކުރާނީ ފެންޕްރޮޑަކްޝަން ބޮޑުކުރުމާއެކު ބޭރަށް ނެރެވޭ ބްރައިން ސަބަބުން ކަނޑުގައި ބޮޑުވެދާނެއެވެ. ނަމަވެސް މަޝްރޫޢު ނިމިގެން އޮޕަރޭޝަން ފެށުމުން މިމަޝްރޫޢުގެ ސަބަބުން ރިސޯޓްގެ ފެން އުފެއްދުމުގެ ޤާބިލްކަން ހުރި މިންވަރަށް ވުރެ ބޮޑު ކުރިއެރުމެއް ލިބިގެން ދާނެއެވެ.
4. މި ނޭދެވޭ އަސަރުތައް ކުޑަކުރުމަށް ޒާތީ ރިޕޯޓުގައި ވަނީ ގެއްލުން ކުޑަކުރުމަށް އެޅޭނެ ފިޔަވަޅުތައް ފާހަގަކޮށްފައެވެ. މީގެ ތެރޭގައި، ތެޔޮ އަދި ކެމިކަލް ގެންގުޅުމުގައި ސަލާމަތްވުމާއި، އުޅަނދު އަދި ވެހިކަލް ބަރުގަދަ މެޝިނަރީސް ހިންގުމާއި، މަޝްރޫޢުގެ ސަބަބުން އުފެދޭ ކުނި ބަރުގަދަ ގޮތުގައި މެނޭޖްކުރުން ހިމެނެއެވެ. އަދި، މީގެ އިތުރުން، މިހާރު ރައްޖޭގައިވެސް ފެތުރިފައިވާ ކޮވިޑް 19 ގެ ބަލިމަޑުކަމަށް ރައްކާތެރިވުމުގެ ފިޔަވަޅުތައް އެޅުމަކީ މުހިއްމުކަމެއް ކަމުގައިވެސް ފާހަގަ ކޮށްފައެވެ.
5. މަޝްރޫޢަށް ގެނެވިދާނެ ބަދަލުތަކުގެ ތެރޭގައި ބެލެވެނީ، މަޝްރޫޢު ކުރިއަށް ނުގެންގޮސް ހުއްޓާލުމާއި ދިރާސާކޮށް ފެން ފުރާނަ އާއި ގެއްލުމަށާއި، ދިމާވެދާނެ ހުރިހާ ސަރަހައްދުތަކުގައި އިތުރު ބޯހޯލް އެއް ބޮޑުކުރުމާއި، އިއާދަކުރަނިވި ހަކަތައިން ފެންޕްރޮޑަކްޝަން ބާރުލާ ކަރަންޓްގެ މިންވަރުން ބައެއް ހިއްސާ ކުރުމަށްޓަކައި ސޯލާ ޖެހުމެވެ. މިގޮތަށް ބަލާބެލުމުން، އިތުރު ބޯހޯލް ބޮރުޖެހުމާއި އިއާދަކުރަނިވި ހަކަތަ ބޭނުންކުރުމަކީ ވަރަށް ފައިދާ ބޮޑު ގޮތްތަކެއް ކަން ފާހަގަކޮށްފައެވެ.
6. މަޝްރޫޢުގެ އަމަލީ މަސައްކަތް ކުރިއަށްގެންދާ މުއްދަތާއި، ހިންގާ ބަލަހައްޓާ މުއްދަތުގައި މޮނިޓަރިންގ އެންމެމުހިންމު ބަދަލުތައް ފާހަގަކުރުމަށް ބެލުމަކީ ކޮންމެހެން ކުރަންޖެހޭ ކަމެއްކަން ފާހަގަކުރެވިފައެވެ. މިގޮތުން އަމަލީ މަސައްކަތް ކުރިއަށް ގެންދާ މުއްދަތުގައި ފެނުގެ ކޮލިޓީއާއި އެހެނިހެން ބަދަލުތަކާއި، މަޝްރޫޢުގެ މަސައްކަތް ކުރިއަށްދާ ސަރަހައްދުގައި އަޑުގެ މިންވަރު ހުރި ވަރު ބެލުމާއި، ކުނި މެނޭޖް ކުރުމުގެ ކަންތައްތައް ބެލުން ހިމެނެއެވެ. މީގެ އިތުރުން މަޝްރޫޢު ހިންގާ ބަލަހައްޓާ މުއްދަތުގައި ފެންޕްރޮޑަކްޝަން ބޮޑުކުރާ ފެނުގެ ސަބަބުން އެހެނިހެން ދިރުމަށް އަސަރު ބަދަލުތައް މޮނިޓަރ ކުރުން ހިމެނެއެވެ.

7. މި ރިޕޯޓުގައި ބަޔާންކޮށްފައިވާ ގޮތުން ކުޑަކުރުމަށް އަޅަންޖެހޭނެ ފިޔަވަޅުތަކާއި އެއްގޮތަށް މަޝްރޫޢުގެ މަސައްކަތް ކުރިއަށް ގެންގޮސްފިނަމަ، މަޝްރޫޢުގެ ސަބަބުން ލިބިދާނެ ގެއްލުމަށް ވުރެ ލިބޭނެ ފައިދާ ބޮޑުވާނެ ކަމަށް ފެންނާތީ، މަޝްރޫޢުގެ މަސައްކަތް ކުރިއަށް ގެންދިއުން އެންމެ ރަނގަޅުކަމުގައިފެނެއެވެ.

1. INTRODUCTION

1.1. Structure of the EIA

This Environmental Impact Assessment (EIA) addresses the potential impacts of the proposed development on the physical, biological, environmental and socio-economic aspects of the development area in addition to providing safeguards to reduce any environmental effects.

In addition to forming a basis for the assessment and approval of the proposed changes, this EIA provides the community and government authorities with information on all aspects of the proposal. The EIA has been divided into following sections:-

- **Section 1**: INTRODUCTION- Provides an outline of the structure and purpose of the EIA as well as objectives of the proposed development;
- **Section 2**: STATUTORY REQUIREMENTS- Outlines the relevant legislative requirements pertaining to the proposed project;
- **Section 3**: PROJECT DESCRIPTION- Described the proposed development in detail;
- **Section 4**: METHODOLOGY- Describes the detailed methods used for data collection on the existing environment and baseline conditions;
- **Section 5**: EXISITING ENVIRONMENT- Describes the present conditions of the physical components of the study area and sets baseline conditions;
- **Section 6**: STAKEHOLDER CONSULTATION- Provides details on the consultation process and parties consulted for this study;
- **Section 7:** OPTIONS ASSESSMENT- Discusses all the available alternatives for the project and justifies the preferred option;
- **Section 8**: POTENTIAL IMPACT ANALYSIS- Describes the prevailing environmental characteristics and constraints of the site and locality being investigated and an assessment of the potential environmental impacts associated with the proposed changes. Mitigation measures that would be implemented to reduce any potentially adverse impacts are also identified;
- **Section 9**: ENVIRONMENTAL MANAGEMENT- Outlines the environmental management plans which would be used to mitigate/monitor the changes;
- **Section 10**: JUSTIFICATION AND CONCLUSION- The conclusions drawn from the proposed project and impact analysis with the justification of the preferred options;
- **Section 11**: ACKNOWLEDGEMENTS; and

- **Section 12**: REFERENCES

Supporting documents are provided as appendices to this EIA.

1.2. Need for the project

Kanuhura Resort is looking to upgrade its facilities with some modifications over the current building scheme. Essentially the upgrade is required in order to diversify the current facilities looking forward to meet the existing tourist demand. As such the resort is undergoing a major renovation where additional pools are added to existing villas, new villas are being constructed and all of its facilities are being upgraded through the EIAs;

- Environmental impact assessment for additional water villa, expanding existing water villas and associated works in Lhaviyani Kanuhura
- Environmental impact assessment for upgrading of water system, powerhouse and maintenance dredging at Lhaviyani Kanuhura.
- EIA for proposed refurbishment, beach nourishment and seagrass removal at Lhaviyani Kanuhura

These new pools, additional villas and facilities will increase the water demand of the resort; hence the resort is undergoing upgrade works to its water systems in order to cater for this new demand and also to improve the existing systems with the most recent technology to reduce the environmental impacts. The resort currently uses a beach intake for the RO plant and has decided to change the intake of RO plant to a borehole. Further, an additional 300 TPD RO plant is to be installed.

1.3. Project objectives

The primary objective of the proposed project is to establish additional 300 TPD RO plant with borehole in the Kanuhura resort. Detailed drawings of the proposed changes are provided in the Appendix D- Detail drawings for RO Plant. Concept approval for the work was acquired through the letters (No. 88-DS/PRIV/2022/247).

1.4. The EIA process

The EIA process in the Maldives is coordinated by the Environmental Protection Agency (EPA) of the Maldives in order to ensure that environmental considerations are included in decisions regarding projects which may have an adverse impact on the environment.

The first step in the process involves screening of the project to determine whether a particular project warrants preparation of an EIA. Based on this decision, the EPA then decides the scope of the EIA which is conferred to the project proponents, the consultants as well as any relevant stakeholders to the project at a scoping meeting. A document ideally encompassing the issues and impacts that have been identified during the scoping meeting will then be issued known as the Terms of Reference (ToR). The consultant then prepares the EIA in accordance with the ToR and/or the range of issues identified during the scoping process. Once the findings of the EIA has been reported to the EPA, it gets reviewed following which an EIA Decision Note (DN) is issued to the proponent who is responsible for implementing the project according to the DN and undertake appropriate environmental monitoring if required and report to the EPA. However, in light of the current Covid-19 situation stakeholder consultations are allowed to be undertaken through telephone or through e-conference.

1.5. Purpose of this EIA

As per article 5 (a) of the Environmental Protection and Preservation Act of the Maldives (Law No. 4/93) and the EIA Regulation 2012 of the Maldives, any development projects/activities that may have a significant impact on the environment are required to have an EIA submitted to the EPA prior to implementation.

The EIA application was provided to the EPA by the consultant and this EIA has been completed as per the requirements outlined within the approved ToR (Refer to Appendix B).

The purpose of this EIA is to critically analyze the environmental and socio-economic impacts which may arise due to the construction and operation of the proposed project. After analyzing the impacts it would be then possible to suggest proper mitigation measures to prevent/reduce any negative impacts and to enhance any positive impacts. The study involves evaluation of baseline conditions, prediction of the likely impacts, stakeholder consultation and design mitigation measures.

1.6. Terms of reference (ToR)

No scoping meeting was held for the project. Upon submission of draft ToR, EPA reviewed the draft ToR and issued the approved ToR on 25th August 2022 (the approved ToR is attached in Appendix B- Terms of reference of this report).

1.7. EIA implementation

This EIA has been prepared by registered consultants as per EIA Regulation 2012 of the Maldives. The team members were:-

- Mahfooz Abdul Wahhab; lead consultant (P22/2016)
- Ibrahim Rashihu Adam (P06/2017)

1.8. Review of Relevant Studies

As part of relevant literature review and preparation of the report, the available relevant Environmental Impact Assessment studies have been used as reference in addition to professional experiences of the environmental consultant who have prepared this EIA Report. These are;

- Environmental impact assessment for additional water villa, expanding existing water villas and associated works in Lhaviyani Kanuhura
- Environmental impact assessment for upgrading of water system, powerhouse and maintenance dredging at Lhaviyani Kanuhura.
- EIA for proposed refurbishment, beach nourishment and seagrass removal at Lhaviyani Kanuhura
- Environmental Impact Assessment for first addendum to partial renovation and upgrade works of Four Seasons, Kuda Huraa
- Environmental Impact Assessment for establishment of micro-grid desalination plants in Ha. Kelaa, R. Alifushi, K. Kaashidhoo, Lh. Olhuvelifushi, Ga. Dhaandhoo.

1.9. The proponent

Kanuhura Resort was previously operated and managed by Sun Resort Limited Kanuhura. Sun Resorts, founded in 1983, is one of the principal Mauritian hotel groups. They own and manage six hotel complexes, including Kanuhura. The current owner and operator of the resort is Leisure Oceans Pvt Ltd since May 2021.

2. STATUTORY REQUIREMENTS

This section describes the statutory requirements relevant to the proposed proposal. Section 2.1 describes all the relevant laws, policies and strategic action plans that must be complied to for this proposal. Section 2.2 describes all the pertinent regulations, section 2.3 all the guidelines and section 2.4 describe all the international conventions that the Maldives are a party to.

2.1. Laws, Policies and Strategic Action Plans

2.1.1. Environmental Protection and Preservation Act (4/93)

The Environmental protection and Preservation Act of the Maldives was enacted to protect the environment and its resources for the current and future generations. Relevant articles under this law pertaining to the proposed project are:-

- Article 2 states that the instructions for environmental protection will be given from the competent authority and everyone must respectfully follow these instructions;
- Article 3 states that all matters relating to environmental protection and preservation must be handled by the Ministry of Planning, Human Resource and Environment (MPHRE);
- Article 4 states that MPHRE must declare protected sites and species and formulate the regulations to manage them. If any other party wants to declare a protected site or species they must be registered in the MPHRE and managed according to regulations made by the Ministry;
- Article 5 states that any projects which pose significant impacts to the environment, an EIA report has to be made and submitted to the MPHRE. The projects which require an EIA and the regulation must be made by MPHRE;
- Article 6 states that if any project is found to cause significant adverse impacts, MPHRE have the right to stop the project;
- Article 7 states that any waste, oil or hazardous gas must not be dumped into any part of the Maldives, however, if strictly needs to be disposed it should be disposed of in an area designated by the Government. If such hazardous gas, waste or oil is to be disposed by combustion, it should be done in a way it does not impact human health and environment;

- Article 8 states that any hazardous waste must not be disposed into any part of the Maldives. Before trans-boundary transfer of such waste, approval must be taken from the Ministry of Transport and Communication by writing to the Ministry at least 3 months beforehand.
- Article 9 states that any party who violates this law or any regulation under this law is punishable to no more than MVR 100 million according to the offence. The fine will be applied by the MPHRE.
- Article 10 states that any offence to this law or any regulation under this law or any action resulting in environment damage, the compensation for such damages can be taken through judicial processes.

1st addendum to Environmental Protection and Preservation Act (4/93) law no 12/2014

Article 3 and 11 of the Environmental Protection and Preservation Act (4/93) of Maldives is amended as follows:-

Under article 3, all matters relating to environmental protection and preservation must be handled by the Ministry charged with implementation of environmental policy.

2.1.2. Water and sewerage Act (8/2020)

The water and sewerage Act was published on 05th August 2020 with the aims to provide safe water and sanitation services to the general public by implementing guidelines for providing water and sanitation service, operation and maintenance of water and sewer facilities, and other related guidelines. Relevant articles under this law pertaining to the proposed project are:-

- Article 5 states that, to provide the water and sanitation services entitled for every citizen of Maldives, it is the duty of the government to implement the following;
    - establishing facilities required to provide water and sanitation services sustainably
    - ensuring that safe water and adequate sanitation services are provided
    - overcoming any hindrance to provide water and sanitation service
    - establishing standards for water and sanitation service
    - ensuring that the water and sanitation service providers follow the set standards
    - researching and developing the water and sanitation sector

- Article 6 states that the water and sanitation policies shall be declared by the Minister as advised by the President. These policies shall be made available to the general public. All parties involved in the water and sanitation sector must fully comply with these policies.
- Article 7 states that Utility Regulatory Authority shall be responsible to implement this law.
- Article 8 states the duties of the Ministry in detail. These include drafting the polices, laws and regulations required to implement this law, establishing water and sanitation facilities in all inhabited Islands of the Maldives within 05 years of implementation of this law, ensuring that proper sewerage facilities are established on tourist and other industrial islands, and all the works to develop the water and sanitation sector.
- Article 9 states that the Council has the authority to declare the fees that could be taken from the water and sanitation service in accordance with the Utility Regulatory Authority and Governments policies and regulations. Additional responsibilities of the Council include; monitoring the third party water and sanitation service provider, monitoring environmental impacts due to water and sewer systems, providing information about water and sanitation service on the Island to the Competent Authorities, ensuring that enough water is available to the living population of the Island, and providing water and sanitation service via a licensed third party.
- Article 10 states the points that must be included in the third party agreement mentioned in article 9.
- Article 11 states the duties of Utility Regulatory Authority, which is to give licenses to all water and sewerage facilities in the Maldives and monitoring them.
- Article 15 states that the licensed all water and sanitation service providers must submit a plan to provider water and sanitation service annually with an implementation report which specifies; (1) water quality, (2) lost water, (3) service interruption, (4) costs, (5) revenue generated, and (6) CSR activities.
- Article 18 states that the groundwater presents in Tourism, Industrial and Reclaimed Islands are protected.

- Article 19 states that the groundwater presents in Tourism, Industrial and Reclaimed Islands cannot be used for commercial purposes. For existing agricultural Island a period of 2 years must be given for them to install RO plants and for inhabited islands, RO plants must be installed for agricultural field larger than 10,000 m^2.
- Article 20 states that any activity that contaminates the ground water is prohibited. Exclusive of this clause is using fertilizer for agricultural purpose and installing septic tanks in households. The article further states that fuel and other chemicals must be handled properly such that spills do not occur and if a spill occurs, the proponent must be responsible for clean-up. Finally, it is prohibited to dispose water which contains fuel and chemicals from Engine maintenance to the sea.
- Article 21 states that dewatering must be done in accordance with the regulations made under this law.
- Article 22 states that it is prohibited to dispose brine into ground or wetlands. Further, mixing of permeate water and rain water must be done according to set guidelines of the Utility Regulatory Authority.
- Article 24 states that there must be 05 days of water stored in case of emergency by all the service providers. Emergency water storage must be allocated in reference to the living population on the island, available water, and land availability for water storage.
- Article 25 states that operating license for water and sanitation service must be issued after the EIA process.
- Article 27 states that power required for the operation of RO plants must be from renewable energy sources. However, a period of 05 years shall be given to existing RO plants for transition. Nonetheless during an emergency situation due to a disaster on in case of renewable energy system failure, power from Diesel generators could be used.
- Article 28 states that rain water must be included as much as possible in the provision of Desalinated water.
- Article 29 states that it is the duty of the water and sanitation service provider to do all works required to provide the service in the assigned region for them. Additional responsibilities include; providing reports to Utility Regulatory

Authority, upgrading water and sewerage facilities according to new technology, providing the first house connection free of charge, and water testing to ensure quality of water.

- Article 30 states that the water and sanitation service provider reserved the right to prohibit certain substances being disposed into the sewer system, installing meters, and entering households and commercial places.
- Article 31 states that the water facilities on inhabited islands of the Maldives must be established in accordance with MFDA's regulations. Additional points under this article include; the established water systems must have the capacity to test for water quality and disinfect, and it is the responsibility of the building's owner to establish measure to manage pressure in tall buildings, if a license for providing water has already been issued to an inhabited Island a second RO plant by another party could be installed with the approval of the Utility Regulatory Authority.
- Article 32 states that the Ministry shall declare publicly the Islands which require an STP and duration for establishing STP's on these Islands. On the islands where the Ministry has declared that an STP is required, on these islands sewerage services must only be provided with an STP. However, during an emergency situation due to flooding, disposal of this storm water is allowed without the involvement of an STP. Additional points include; Disposing of water from dewatering to the sewerage network is prohibited and technical specification for sewerage facilities must be made by the Utility Regulatory Authority.
- Article 34 states that an agreement must be made prior to giving approval to any water and sanitation service provider and this agreement must be registered in the Utility Regulatory Authority.
- Article 35 states that all water and sewer systems in the Maldives must be operated after registering in the Utility Regulatory Authority.
- Article 36 states that water and sewer services in inhabited Islands of the Maldives must be given after taking the operating license from the Utility Regulatory Authority.
- Article 37 states that an exclusive operating license could only be given after getting the written approval from the president as advised by the Parliament if it is needed for the betterment of the country.

- Article 38 states the requirements of the operating license, these include; operation and maintenance of water and sewer systems in accordance with the regulations set by the Utility Regulatory Authority, implementing the business plan mentioned in article 41(a-2), reporting, and fulfilling other requirements set by the Utility Regulatory Authority.
- Article 41 states that the procedures for obtaining the operating license must be publicly made available. The article further details the information the service provider must submit while applying for the operating license.
- Article 42 states that the fees for water and sewer for inhabited Islands will be declared by the Utility Regulatory Authority.
- Article 43 states that the service provider must submit a performance report to the Utility Regulatory Authority, Council, and Ministry annually
- Article 44 states that customers have the right to report any complaints regarding the service provider to the Utility Regulatory Authority.
- Article 45 states that the Utility Regulatory Authority has the right to investigate the service provider of any misconduct or even if the Utility Regulatory Authority deems necessary.
- Article 60 states that if there are any overlaps with other laws regarding water and sanitation, this law shall take precedence.
- Article 61 states that with the implementation of this law, the articles pertaining to water and sanitation services under the law on general public services (4/96) is void.

2.1.3. Utility Regulatory Authority Law (26/2020)

This Utility Regulatory Authority Law was drafted to establish an Authority that will oversee the general public services given in the Maldives. The specific objectives of this law include;

- Ensure that the general public services given in the Maldives are provided sustainably
- Ensure that general public services are given efficiently and with minimal damage to the environment
- Ensure that general public services are given at adequate standards

- Create a competitive environment to develop general public services in the Maldives
- Draft and implement regulations on general public services
- Regulate the general public service providers
- Create awareness on the rights of the customers and the service providers

This law has 16 chapters. Chapter 1 states the objectives of the law, Chapter 2 states the responsibilities of the Utility Regulatory Authority, Chapter 3 states how the board of directors are to be established and their responsibilities, Chapter 4 states the organizational structure of the Utility Regulatory Authority, Chapter 5 states the responsibilities of the Minister, Chapter 6 states details about operating licenses, Chapter 7 states how tariffs are to be implemented, chapter 8, 9 and 12, 13, 14 sates the rights of the Utility Regulatory Authority in relation to monitoring service providers, Chapter 10 states the discipline that the Utility Regulatory Authority must have, Chapter 11 states guides on conflict resolution, Chapter 15 states the budget and reporting by the Utility Regulatory Authority, Chapter 16 states the changes in existing institutional framework such as the transfer of Maldives Energy Authority and EPA Water, Sanitation and Waste section to the Utility Regulatory Authority. Relevant articles under this law pertaining to the proposed project are:-

- Article 4 states all the responsibilities of the Utility Regulatory Authority. The most important responsibilities include; giving operating license to service providers, implementing all laws and regulations pertaining to general public services and ensuring that the service providers abide by them, implementing tariff, drafting and implementing regulation and guidelines for providing general public services.
- Article 23 states that a license must be obtained in order to provide any general public service in the Maldives.
- Article 24 states that the license for general public services will be given by the Utility Regulatory Authority.
- Article 25 states that an exclusive operating license will only be given after getting the written approval from the president as advised by the Parliament if it is needed for the betterment of the country.
- Article 29 states that the fees taken for general public services must be as per the approved tariffs from the Utility Regulatory Authority.

- The Service providers must strictly follow the directions of the Utility Regulatory Authority as mentioned in chapters 8, 9, 12, 13, and 14.

2.1.4. National Water and Sewerage policy 2017

The National Water and Sewerage Policy (NSWP) 2017 sets out the government's plans for water and sewerage services in the future and the steps that will be taken to ensure provision of appropriate and sustainable water and sewerage services to all. The NSWP has a 10-year time frame with a mid-term year review in the 5th year. The progress of implementation is to be monitored and reviewed by the water and sanitation department of the Ministry of Environment, Climate change and Technology along with an independent review process. The NSWP has 09 goals, these are;

- Ensure access to safe water supply and adequate sewerage services
- Adopting coast-effective, environment friendly and appropriate technologies
- Strengthening legal framework
- Encourage private sector investments
- Building institutional capacity
- Maintain financial and environmental sustainability
- Strengthen advocacy and awareness
- Promote research and development
- Protect and conserve water resources

2.1.5. The National Water and Sewerage Strategic Plan (The NWSSP 2020-2025)

The NWSSP 2020-2025 is an action plan made under the article 14(a) of Water and Sewerage Act (8/2020). The strategies and targets included in the action plan is derived from the National Strategic Action Plan 2019-2023 endorsed by the Government in 2019. The vision of this action plan is to ensure equitable access to safe water and improved sewerage serviced for all. The mission is to provide efficient, effective and reliable water supply and sewerage services, promote conservation and management of the water resources, and to develop sector capacity for sustainable management of resources and services. The action plan has 6 policy goals with its associated target in order to reach the vision. These are;

- Policy 1: Ensure access to safe water supply and adequate sewerage services

  - Target 1.1: By 2020, Water and Sewerage Act is ratified
  - Target 1.2: By 2020, Utility Regulatoryy Authority (URA) for integrated utility services is functional
  - Target 1.3: By 2021, Water and Sanitation coordination committee is functional
  - Target 1.4: By 2023, all water and sewerage utility providers have an operating license
- Policy 2: Adopt cost-effective and environment-friendly water and sewerage infrastructure
  - Target 2.1: By 2020, a standard mechanism to foster private sector investment in the water and sanitation sector will be in effect
  - Target 2.2: By 2023, all inhabited islands, will have access to safe water supply and sewerage facilities
  - Target 2.3: By 2023, 30% of energy consumption for water and sewerage facilities across the Maldives will be met with renewable energy
- Policy 3: Build sector capacity in water resources, water supply and sewerage services
  - Target 3.1: By 2023, at least 60% of technical staff in utility service providers are licensed (/ By 2023, all technical staff operating and maintaining the water and sewerage facilities will have at least certificate level 3 qualification and will be licensed)
  - Target 3.2: By 2023, at least 40 engineers will be trained in water and sanitation related field
  - Target 3.3: By 2023, at least 30% of all employees working in water and sewerage facilities in each island shall be women
  - Target 3.4: By 2022, collaborative partnership arrangements will be made with at least 3 local/international educational institutes for capacity building of water and sewerage sector programmes and services
  - Target 3.5: By 2024, two (2) staff at each island or city council will be trained for overall utility operational services, governance and best practices
- Policy 4: Strengthen advocacy and awareness programs on water resources, water supply and sewerage

  - Target 4.1: By 2022, public perceptions on safe water and sanitation practices improved by 33% compared to 2018 levels
  - Target 4.2: By 2023, at least 40% of households phased out single-use bottled water use
  - Target 4.3: By 2023, WASH awareness programs targeting to island functionaries, front line workers, CBOs and NGOs that are active in all island communities are carried out
- Policy 5: Protect and conserve natural water resources
  - Target 5.1: By 2023, water resource conservation and management plans are implemented in all inhabited islands.
- Policy 6: Build flood resilient island communities
  - Target 6.1: By 2021, identify and map flood prone islands
  - Target 6.2: By 2022, develop and enforce design criteria’s and guidelines for flood mitigation

2.1.6. Decentralization Act (7/2010)

This act was drafted in accordance to the article 8 of the Constitution of Maldives in order to declare the Institutions required to decentralize the governing of Maldives. The Institutions that would be established under this Act are; Local Councils, Atoll Councils, and City Councils. The Act specifies the jurisdiction of all of these Institutions. Relevant articles under this law pertaining to the proposed project are:-

- Article 8(b) states that it is the duty of the Atoll Council to inform the project proponents, of the general public’s suggestions and concerns for any developmental projects within its jurisdiction.
- Article 8(g) states that it is the duty of the Atoll Council to allocate land for investments that promote social and economic growth within its jurisdiction in accordance with the built environment and any other relevant regulations.
- Article 23(c) states that it is the duty of the Local Council to implement developmental projects that the government assigns to the Council.
- Article 23(d) states that is the duty of the Local Council to properly monitor and report on developmental projects that are being carried out on the Island to the respective Ministry.

- Article 23(i) states that is it the duty of the Local Council to allocate land for developmental projects as advised by the Atoll Council in accordance with the LUP and Built Environmental Regulations.
- Article 68 states that the Local Councils must be involved in the planning stage of any developmental projects.
- Article 69 states that, if an EIA is required for any developmental project, an EIA must be done for the project and the report must be shared with the Atoll Council. Further, the project proponent must share with the Atoll Council the potential environmental impacts mentioned in the report along with the proposed mitigation measures.

<u>8th amendment to Decentralization Act</u>

With the 8th amendment to the Decentralization Act, Local Councils were given additional authority. Relevant articles under this amendment pertaining to the proposed project are:-

- Article 68 was amended as follows; Local Councils must be involved in the planning stage of any developmental projects. Further, if an EIA is required for any developmental project, an EIA must be done for the project and the report must be shared with the Local Council. Further, the project proponent must share with the Local Council the potential environmental impacts mentioned in the report along with the proposed mitigation measures.
- Article 69 was amended as follows; for PSIP projects, if the total value of the project is less than 5 million rufiyaa, then those projects must be implemented through the Local Council. For Projects higher than 5 million rufiyaa, the government agency could still implement the project via the Local Council under certain set guideline by the government agency.
- An additional section was also added to Article 69 which states that;
    - 69-1(a) the Councils must provide the following general public services; (1) electricity, (2) water, and (3) Sanitation.
    - 69-1(b) the general public services must be given in accordance with the competent authority's guidelines and regulations.

- 69-2(a) if the general public services are to be provided via a third party, an agreement must be made between the Council and the third party service provider.
- 69-3 (a)electricity, water and sewerage facilities must be established in accordance with the LUP.

2.1.7. National Strategic Action Plan

The Strategic Action Plan (SAP) of the Government of Maldives is a central policy framework and planning document that guides the overall development direction of the Maldives for the next five years. The SAP consolidates the current Government’s manifesto pledges with existing sectoral priorities. The SAP serves as the main implementation and monitoring tool to track the progress of the delivery of the Government’s policies and development priorities. The SAP is formally rolled out into the line ministries’ day to day operations from 1 October 2019. The SAP consists of 5 Sectors and 33 subsectors. The project specifically falls under 4th Sector “Jazeera Dhiriulhun”, subsector 4.6 water and sanitation. Wherein the first policy is to “Ensure access to safe water supplies and adequate sewerage services”.

2.1.8. Waste management policy

With the implementation of waste management policy 2015, the 2011 and 2007 policy is void. The waste management policy which came into effect on 2015 is to ensure that the Maldivians are well aware of the waste management techniques and maintains cleanliness as well as the natural aesthetics and clean air quality of the country is well maintained. Under this policy, all the inhabited islands need to implement a waste management plan and manage all the wastes generated from that island in accordance with that policy.

2.1.9. Public Health Protection Act (7/2012)

The purpose of this act is to establish policies for protection of public health, identify persons responsible for protection of public health, define how public health protection policies will be implemented and establish policies to limit basic rights ensured under the Maldives Constitution to Maldivians and people living in Maldives to necessary extents to protect public health. Chapter 5 of the act outlines health hazards, eliminating risk, reporting health hazards, and order of things that can be done and not done in relation to a building. Chapter 6 of the act outlines the procedures for declaring state of emergency.

2.1.10. Immigration Act (1/2007)

This act lays down the rules for the departure and entry of Maldivian Nationals and foreign Nationals. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 3; all persons shall enter the Maldives from an authorised port, unless a person is compelled to do otherwise, due to sudden natural causes, or an emergency which is beyond the control of the person. Persons departing from the Maldives shall also depart from an authorised port unless in cases of emergency as stated above.
- Article 7; (a) A foreign national may enter the Maldives if he/she can produce a valid passport and a valid permit of entry. (b) A foreign national may leave the Maldives provided that he/she has a valid passport. (c) Pursuant to subsection (a), a foreign national may enter the Maldives, unless as stated otherwise in the Regulations made under this Act, by filling a disembarkation form as specified in the Regulations and by submitting it with the passport to an immigration officer, and upon the leave to grant a permit of entry for the Maldives. (d) A foreign national may depart from the Maldives, unless as stated otherwise in the Regulations made under this Act, by filling an embarkation form as specified in the Regulations, and submitting it with the passport to an immigration officer and upon the leave to grant departure.
- Article 8; (a) For the purposes of this Act, permits to remain in the Maldives shall be divided into the following eight types;
    - (1) Tourist Visa
    - (2) Diplomatic Visa
    - (3) Student Visa
    - (4) Business Visa
    - (5) Dependant Visa
    - (6) Work Visa
    - (7) Resident Visa
    - (8) Special Visa

  (b) The permits specified in subsection (a) are subject to the Regulations made under this Act.

2.1.11. Maldives Tourism Act (2/99)

This act encompasses the issues related to the development of tourism in the Maldives. It came into effect on the November, 1999, repealing the Law on Tourism in the Maldives (Act No. 15/79) and the Law on Leasing of Uninhabited Islands for the Development of Tourist Resorts (Act No. 3/94). Act No. 15/79 was the primary legislation that was passed by the Citizen's Majlis in November 1979 and the main aim was to provide for the collection of a bed tax from the visiting tourists and to control their movement in the Maldives. While this Act only dealt with tourist resorts, hotels and guest houses, the amended act (Act No. 2/99) incorporates the determination of zones where tourism development can occur, as well as the development and management of marinas and the operation of tourist vessels, diving centers and travel agencies. This is evidence that the tourism industry has expanded since the enactment of the initial laws, both in magnitude and in the diversity of facilities that are provided for the visiting tourists.

The environmental legislation that directly applies to the development is outlined under article 15 (a) and (b). Article 15 (a) provides for the felling of Ruh's and trees, dredging of lagoons, reclamation of land or any other activity that may cause permanent change to the natural environment of an island leased as a tourist resort. It states that the activities mentioned above can only be carried out after obtaining written permission from the Ministry of Tourism and in accordance with the relevant regulations.

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

There are several regulations under the Maldives Tourism Act (Law No. 2/99) and those pertaining to the environment are presented below.

2.1.12. Maldives Third Tourism Master Plan

The Maldives Third Tourism Master Plan (TTMP) was launched in August 2007. The planning horizon is from 2006 to 2010. The strategies recommended will integrate with the policies and strategies for tourism, air and sea transport proposed in the 7th National Development Plan which is also being developed.

The TTMP will focus on the following areas:

- Identification of potential product expansion and diversification and Maldives tourism product review.
- Increasing the share of Maldivians working in the tourism industry.
- Greater community involvement in the tourism sector.
- Improvements in the retention of economic benefits of tourism within the Maldives economy.
- Improvements to the tourism related infrastructure and support services.
- Protecting, preserving and promoting the natural resource base, heritage and culture in relation to tourism development.
- Strengthening the institutional capacity of Ministry of Tourism
- Developing domestic tourism.
- Improving the legislative framework in relation to the tourism industry.

2.1.13. Anti-Human Trafficking Act (12/2013)

This act was enacted to combat human trafficking in the Maldives in order to protect human rights and human dignity. As per international best practices this act includes three main components of criminalization, prevention and rehabilitation of victims, making human trafficking a criminal offense in the Maldives. The law also strictly prohibits forced labor and fraudulent recruitment. The main objective of this act include;

- Preventing human trafficking in the Maldives
- Establish crimes of human trafficking and prescribe the punishments
- Provide for prosecution of perpetrators under this act
- Providing protection and assistance to victims of human trafficking
- Promote and protect the human rights of trafficked victims
- Engage in cooperation with local and international NGOs working against human trafficking to combat human trafficking

2.1.14. Law on uninhabited Islands (20/98)

The law is put forth by the government to regulate the leasing process, to define the leasing procedure, payment, lease turn over, and to safeguard the island ensuring that the leased island is not misused, destroyed or scope modified by the lessee.

The project and the proponent follow the law and clauses set forth by the government.

2.1.15. National Biodiversity Strategy and Action Plan

The National Biodiversity Strategy and Action Plan 2016-2025 (NBSAP 2016-2025) seeks to ensure that threats to biodiversity are addressed, biodiversity is conserved, sustainably used and benefits arising from them are shared equitably. It also encompasses ways of addressing gaps, challenges and constraints highlighted in earlier sections. It is a living document that will have the capacity to adapt to changes in national conditions, capacities and to the changes in the in- trinational arena.

<u>Relevance to the project:</u> Will be applied with respect to minimizing the threats to terrestrial and marine biodiversity during construction works, by ensuring that all mitigation measures are taken so there is no harm to endangered species.

2.1.16. Climate Emergency Act (9/2021)

Climate Emergency Act was enacted in the Maldives in order to tackle the dangers that Maldives and its citizens face due to climate change. This act aims to bring forth regulations and mitigation measures to face the impacts of climate change, and to make Maldives a leading nation in advocating for action on climate change. It also aims to make the country carbon neutral while reaching its sustainable development goals.

- Article 2 states that Maldives should be a carbon neutral country by the year 2030, offsetting the same amount of carbon as those emitted. Any changes to the regulations can only be brought in consideration of new scientific findings and changes in international climate mitigation policies.
- Article 5 states that an action plan must be created to analyse the current situation and strategies to reach the climate goas in the country. The action plan must include regulations to make the country carbon neutral and resilient to climate change, adaptation and mitigation measures to respond to climate impacts, implementation of climate adaptation and mitigation in developmental plans, methods of monitoring of greenhouse gas emissions, development and implementation of renewable energy and its storage, and the roles of the government and other related bodies in strategizing and reaching climate mitigation goals.

- Article 7 states that any emissions from flights and ships travelling through Maldives under circumstances not stated in the law will not be considered when calculating total national emissions.

2.1.17. Maldives Energy Policy and Strategy 2016

Maldives Energy Policy and Strategy 2016 consists of revised policies derived from Maldives Energy Policy and Strategy 2010. The 9 policies are reduced to 5 key policy statements.

- Strengthen the institutional and regulatory framework of the energy sector
- Promote energy conservation and efficiency
- Developing and enforcing standards for exhaust emissions for power plants, vehicles and vessels that use fossil fuel in order to improve air quality
- Increase the share of renewable energy in the national energy mix
- Improve the reliability and sustainability of electrical services and maintain universal access to electricity
- Devising means to reliably meet energy demands in a consistent manner assuring security and reliability of supply
- Improve the operational performance of service providers to manage the electrical power infrastructure
- Increase efficiency of the energy systems and quality of energy services provided
- Review and regularly implement electricity tariff adjustments
- Develop and update an integrated system management and expansion plan for utilities
- Increase national energy security
- Ensure environmentally safe and adequate storage, supply and distribution of fuel to meet the demand.

2.1.18. Heritage Act (12/2019)

This law aims at safeguarding the perpetuation of items and sites of historical significance to future generations and ensures the documentation, preservation, and protection of cultural heritage.

- Article 2 states that portable heritage items, historic constructions or buildings, historic sites, and any cultural skills or talent all fall under heritage to be protected under this law. It also defines each category and states that they will be valued by the importance of their inheritance to future generations.

  Article 3 states that all policies regarding heritage protection will be made under the guidance of the president. Under this law, ‘Department of Heritage’ was renamed ‘National Center for Cultural Heritage’.
- Article 5 states that a catalogue of all heritage artefacts and sites must be published and reviewed to update once every 2 years.
- Article 6 states that a written permit must be obtained from the NCCH if any artefacts are to be moved from its place of origin. If any artefacts are found being moved without necessary permits, they must be detained immediately, and NCCH must be informed. It also states that any historical buildings or heritage sites must have a boundary marked and disclosed at protected. If any work needs to be carried out that encroaches this boundary, a permit must be acquired from the NCCH
- Article 6 also states that NCCH will determine the ownership of heritage artefacts and sites and their guardians.
- Article 7 states that the following heritage items and sites legally belong to the government:
    - All artefacts and sites under the legal custody of the government at the time of passing of this legislature;
    - All artefacts and sites legally renounced by their owners which meets the requirements outlined in this legislature;
    - Any artefacts or sites historically important which have not yet been found within the maritime boundary of Maldives, be it in water or on land.
- Article 7 also states that in order to claim ownership of an artefact or site, one must inform the local council. If any items or sites are not claimed, they will be considered government property until someone claims ownership. If a historical item is found on a land leased by the government, all works must be halted on site until the items are assessed by NCCH.

- Article 8 states that all names historically given to islands, lagoons, reefs, and other places must be documented by NCCH without any changes. Paperwork for developmental plans carried out in such places must include these names.
- Article 10 states that any damages caused to heritage artefacts or sites can be fined, depending on its value, an amount between MVR10,000 and MVR1,000,000.

2.2. Regulations

2.2.1. Regulation on the Protection and Conservation of Environment in the Tourism Industry

This regulation is made pursuant to Law No. 2/99 (Maldives Tourism Act). The purpose of this regulation is to protect the environment in the tourism industry and to encourage and facilitate sustainable development of tourism. Relevant clauses are described below

2.2.1.1. Protection of environment during construction

Any of the following activity in an island or place leased for the purpose of tourism shall be carried out after obtaining permission from the Ministry of Tourism and Civil Aviation.

- Dredging of the lagoon and reclamation of land
- Construction on the beach and lagoon
- Beach enhancement by pumping sand
- Construction of breakwater
- Construction of sea wall, revetment or groyne
- Dredging of lagoon or reef for safe access
- Dredging of reef

- Felling of trees
- Importing and exporting living species
- Conducting research of land, sea and lagoon
- Demolition of a building or facility
- Anything which may adversely affect the vegetation or fresh water lens of the island

In addition to the provisions of clause 2.1 above, any activity that may cause damage or adversely affect the environment shall be carried out after obtaining permission from the Ministry of Tourism and Civil Aviation.

In making an application to obtain the permission to carry out any activity stipulated in clause 2.1, the applicant must submit the details of the activity together with a site plan of the island or designated area prepared to a reasonable scale. The site plan must include the following:

- Beach toe
- Vegetation line
- High tide line
- Low tide line
- Reef crest line
- Deep lagoon line

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 Ministry of Tourism and Civil Aviation prior to the commencement of any construction project or any activity stipulated in clause 2.1

Trees shall not be felled in order to construct buildings or for other purpose in an island, resort, or other place leased for the purpose of tourism, except with prior written permission from the Ministry of Tourism and Civil Aviation.

In the event any tree or coconut palm is felled for construction or any other reason in any resort, picnic island, or marina or such other place leased for the purpose of tourism, two trees or coconut palms shall be replanted in the same island.

In the event trees has to be felled for infrastructure development in an island or land leased for the development of tourism, and if the said island or land does not have space to replant two trees for each tree felled, then evidence to sustain the same shall be submitted to the Ministry of Tourism and Civil Aviation and a special permission to be exempted from the requirement in clause 2.6 shall be obtained.

Huge, aged or rare trees shall not be felled in any resort, picnic island, marina or such place leased for the development of tourism. While allocating land for the purpose of construction, an unused area of five meters radius around such trees shall be spared.

Ground water shall not be extracted for the purpose of construction in an island or land leased for the development of tourism.

Any infrastructure or facility in an island or land leased for the development of tourism shall be built five meters inwards from the vegetation line.

A distance of at least two meters shall be spared in between two guest rooms or guest room blocks in building guest rooms in any resort, picnic island, marina or such place leased for the development of tourism.

In order to preserve and maintain the natural environment of islands or part of it leased for purpose of tourism, at least 80% of the island shall be spared un-built. The area inwards from the vegetation line shall be taken as the area of the island. If the relevant area is a designated part of an island, the area inwards from the vegetation line of that area shall be taken.

It is prohibited to extract coral stones from any part of the lagoon or the reef of an island in the Maldives, for any purpose of an island leased for the development of tourism

In an island or land leased for the development of tourism, all jetties built in all resorts, picnic islands, marinas or other islands shall be built in such a way that allows free movement of water current and sand beneath the jetty.

Coral stone shall not be extracted from any reef in the Maldives for renovation or repair of any jetty or breakwater built (prior to the passing of this regulation) in accordance with clause 2.14 of this regulation.

2.2.1.2. Protected Species

Protected birds or marine living species shall not be caught or kept in cages or other enclosed space in an island or land leased for the development of tourism.

It is prohibited to carry out any activity that would harm the protected living species in an island or place leased for the development of tourism, or harming or shifting their nests or habitat or eggs.

It is prohibited, except as may be permitted by a competent government authority, to carry out any renovation, improvement or alteration to a protected area.

It is prohibited to anchor any vessel in a protected area. If buoys are placed in a protected area, those must be used for anchoring vessels.

Places, items, building or structures of historical, cultural or natural and environmental significance in an island leased for tourism purpose shall be properly maintained and conserved in accordance with the instructions from relevant government authorities.

Any place designated by the government as of historic significance in any island or part of it leased for tourism development shall be properly maintained. An un-built area with a radius of at least 5 meters shall be left surrounding such places.

In taking tourist to diving areas, no harm should be caused to the marine flora and fauna of the Maldives and no item shall be extracted or removed from such places.

If any item or place of historic or cultural significance is found while diving with tourists, it shall be reported to the Ministry of Tourism and Civil Aviation without causing any damage to such item or place.

2.2.1.3. Penalty

If any provision of this regulation is contravened by any tourist resort, picnic island, marina, hotel, guest house, or tourist vessel, shall be guilty of an offence, and shall be liable to a fine, taking into consideration the seriousness of the non-compliance, between MRF 1000.00 and MRF 10,000.00 in the first instance. Parties repeatedly in non-compliance shall be liable to a fine between MRF 50,000.00 and MRF 100,000.00 If non-compliance of a provision occurs more than once, the Ministry reserves the right to revoke the licence.

This regulation shall come into force commencing from the 20th day of July 2006

2.2.2. Environmental Impact Assessment Regulation 2012 (2012/R-27)

The EIA Regulation, which came into force in 2007, has been revised and this revised EIA Regulation is currently in force since May 2012. The Regulation sets out the criteria to determine whether a development proposal is likely to significantly affect the environment and is therefore subject to an EIA. Schedule D of the EIA Regulation defines the type of projects that would be subject to EIA. The main purpose of this Regulation is to provide step-by-step guidance for proponents, consultants, government agencies and general public on how to obtain approval in the form of an Environmental DS. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 6 states that when government agencies propose a project, while finalizing the location for the project, they should reflect on the criteria's mentioned in Schedule B of this regulation. Furthermore, they should reflect on all the laws and regulations pertaining to environmental protection in the Maldives as well as international conventions, plans and programs to which Maldives is a party to.
- Article 7 states that the proponent must apply for an Environmental DS prior to commencement of any developmental project in accordance with article 8 of this regulation.
- Article 8 states that the proponent must apply for a screening if the developmental project is not listed in the inclusive list for EIAs (Schedule D of this regulation). If the proposed developmental project is listed under Schedule D of this regulation, then the proponent must submit an EIA application form.
- Article 11 states that a scoping meeting must be conducted and a ToR must be agreed upon by the proponent and the competent authority.
- Article 12 states that the EIA report must be written as per the approved ToR and the report must be a technical report with scientifically proven alternatives, impacts, and mitigations.
- Article 13 states that the competent authority must assign two independent reviewers to review the submitted EIA report and within 28 working days the competent authority must issue an Environmental DS or for additional information.
- Article 14 states that the Environmental DS must be; (1) Approval with the condition that the proponent follows the proposed mitigation measures (2) EIA report rejection due to poor quality of the report (3) Rejection of the proposal by the competent authority due to potential irreversible negative impacts. The approval has a validity of 1 year. If the proponent could not start the works within one year of the approval due to force major, then the competent authority could give an extension.
- Article 15 states that if the proponent is not contented with the DS, then the proponent may apply to review the DS.

Since the enactment of the EIA regulation in 2012 there have been five amendments to the regulation. These five amendments are discussed below.

1st amendment to the Environmental Impact Assessment Regulation 2012 (2013/R-18)

The first amendment to the EIA regulation 2012 involved the establishment of a guideline for fining environmental offences under article 20. According to the guideline fines are as follows; (1) MVR 20,000 for first offence (2) MVR 60,000 for second offence (3) MVR 120,000 for 3rd offence (4) MVR 200,000 for repeated offences after the 3rd time.

2nd amendment to the Environmental Impact Assessment Regulation 2012 (2015/R-174)

With the 2nd amendment to the environmental impact assessment regulation 2012, there were some procedural changes made to the EIA process. The most important was the shifting of tourism related development projects EIAs to the Ministry of Tourism (article 4). The detailed amendments made to the relevant articles are discussed below;

- Article 7 was amended to have three categories of review period as follows; (1) MVR 5000 for a 15 day review period, (2) MVR 5000 for a 10 day review period, (3) MVR 5000 for a 05 day review period
- Article 8 was amended to have 5 categories of Environmental DS for screening as follows; (1) Environment Management Plan, (2) Initial Environmental Examination, (3) Environmental Impact Assessment, (4) Approval to go forth with the screened project, and (5) Approval to go forth with the project according to the mitigation measures proposed by EPA.
- Article 9 was amended to have 3 categories of Environmental DS for an IEE as follows; (1) Environmental Impact Assessment report if the project is anticipated to have major environmental impacts, (2) Environment Management Plan, (3) Approval to go forth with the project if the project is not anticipated to have major environmental impacts.
- Article 14 was amended to have a guideline for extending the Environmental DS as follows; (1) Extension for Environmental DS must be applied by the proponent with the justification for the delay, (2) If extension was applied before the deadline for Environmental DS, an extension shall be granted without a fine, (3) If extension was applied within one month of the deadline for Environmental DS, a fine of MVR 5000 will be charged, (4) If extension was applied within 2 month of the deadline for Environmental DS, a fine of MVR 10,000 will be charged, (5) an extension shall not be granted if applied after 2 months of the deadline for Environmental DS, (6) extension for environmental DS shall be granted for a maximum of 1 year and only once. Further points were added to article 14 to set out the guideline for applying, review and issuing Environment DS for addendums. In this regard a proponent can apply for an addendum for an approved EIA report if; (1) it has not been 5 years

since the Environmental DS was issued, (2) scope change, (3) works within 500 m of the proposed project.

- Schedule D of the regulation was amended to exclude all tourism related projects and some further changes to the list of project were also made.
- Schedule U was added to the regulation. For the projects under this schedule, approval to go ahead with the project will be granted once the proponent submits a commitment to implement the mitigation measures prescribed by EPA. There project are; (1) maintenance dredging without any changes to the initial footprint, (2) removing vegetation by local plot owners, (3) clearing roads for new housing plots after getting approval from island Council, (4) drilling borehole on land for extracting water.

3rd amendment to the Environmental Impact Regulation 2012 (2016/R-66)

One of the major amendments to the EIA regulation with this amendment is that the EIA consultants are classified into 2 categories (article 16). To be eligible for a category A consultant, the applicant should hold a minimum of level 7 qualification in an environment related field recognized by the Maldives National Qualification Framework. Likewise, to be eligible for a category B consultant, the applicant should hold a minimum of level 7 qualification in specific fields relevant for the nature of the project recognized by the Maldives National Qualification Framework. Additional detailed amendments made to the relevant articles are discussed below;

- Article 5 was amended to mention the implementing agency to be EPA on behalf of the Ministry.
- Article 6 was amended such that except for EMP and Environmental monitoring reports, all other reports under this regulation shall be made by a registered EIA Consultant. Further points were added to the article which mentions to submit data which could be used for environmental monitoring and the proponent must inform the Ministry in writing prior to commencement of the project once the approval has been granted for a project.
- Article 11 was amended such that while applying for EIA, the ToR must be submitted in an editable format along with the application form and project brief. Furthermore, it is now mentioned that that the ToR must be agreed upon during the scoping meeting and that only another registered EIA Consultant could replace the projects EIA Consultant if he cannot attend the scoping meeting, and the proponent

could apply for an extension on the validity of the ToR during a 1-year period from the scoping meeting date.

- Article 13 was amended to include more guidelines on how to manage the EIA review process. An additional point was also added which gives the authority to EPA to conduct a review meeting with the Consultant and Proponent if they deem necessary.
- Article 14 was amended to include 2 more points which states that the Environmental DS must have the parameters for the environmental monitoring report and the schedule. The Ministry could ask the proponent to submit environmental monitoring reports up to 5 years or more if the Ministry deems necessary. Additionally, the proponent must share the Environmental DS with the Contractor ad a copy of this Environmental DS and a copy of the approved EIA report must be made available at the project site.
- Article 20 was amended to include the guideline on how to penalize offences under this regulation.

4th amendment to the Environmental Impact Regulation 2012 (2017/R-7)

Under this amendment the Schedule U which was added under the 2nd amendment to the EIA regulation (2015/R-174) was amended to include two more type of projects; (5) all projects except for the projects mentioned in point N of this schedule for newly reclaimed areas on natural islands until three years from the reclaimed date, (6) all projects except for the projects mentioned in point N of this schedule for newly reclaimed islands until three years from the reclamation date. The projects mentioned in point N of this schedule are any project that involves dangerous chemicals, oil storage, incinerators, release of toxic chemicals to atmosphere, and fiber works. However, if the reclaimed lands were to be populated then any major developmental project shall be subjected to EIA.

5th amendment to the Environmental Impact Regulation 2012 (2018/R-131)

With this 5th amendment, Tourism related developments are again included under this regulation. Additionally, the Schedule D was amended to include tourist resort development and tourist hotel developments in the inclusive list for EIAs.

2.2.3. Waste Management Regulation (2013/R-58)

The waste management regulation dictates the principles needed to follow when handling waste. The aim is to minimize adverse impacts to the environment and human health from waste. Under this regulation, island councils are required to make a waste management plan and submit it to the competent authority. This plan must be reviewed at least every five years. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 8 states that hazardous waste are specified in Schedule J and under no circumstance should it be burned or disposed off in any area of the Maldives. While transporting hazardous waste, it must be in a closed container without any leaks. Further a sign must be on the container, specifying that it is hazardous waste. The import of any hazardous waste mentioned in Schedule J to Maldives is an offense.
- Article 11 states that waste generated at islands must be disposed off in areas specified for the purpose or areas approved by competent authority. Disposal of waste to following areas is prohibited under this regulation and is an offense;
    - Mangroves
    - Island Lagoon
    - Reef
    - Lagoon(falhu)
    - Finolhu
    - Beach
    - Vegetation line
    - Harbor
    - Park
    - Road

    Approval to dispose waste to areas not approved by competent authority will be given under following circumstances;

    1. Waste is disposed as a measure to protect human health
    2. Situation created by natural disaster or a state of emergency

    Approval to manage waste at household level is not required for the following actions;

    1. Waste segregation at household
    2. Composting at household
- Article 12 states that anybody responsible for public sites must place and manage a dustbin. The waste in these dustbins must be managed according to this regulation. Disposal of waste to public sites (besides the dustbin) is an offense.
- Article 16 states that approval must be taken from the competent authority for the following waste management works
    1. Waste collection
    2. Transportation of waste by land and sea

3. Waste treatment
4. Storage of waste
5. Management of waste disposal sites
6. Landfill
7. Handling of hazardous waste

The number of waste management approvals for a particular area or areas will be decided by the competent authority based on the following;

1. Waste generation
2. Economic gains from waste management actions
3. Environmental protection requirements for the area

- Article 25 states that waste must be transported from one place to another in accordance with the standards set in schedule A of this regulation. If waste is to be removed from an Island, it should be taken to a regional waste management facility.

1st amendment to waste management regulation (2014/R-10)

This amendment only included the amendment of dates to start implementing articles of this regulation (article 4).

2nd amendment to waste management regulation (2014/R-10)

This amendment also only included the amendment of dates to start implementing articles of this regulation (article 4). The date to implement the articles 13, 14, and 16 were amended to 05th October 2014.

3rd amendment to waste management regulation (2017/R-90)

This amendment included amendments to the schedule A and K of this regulation. Further article 25 was amended to include that action will be taken against parties which does not transport waste according to the standards set under this regulation.

4th amendment to waste management regulation (2018/R-63)

With this amendment the most notable, was the establishment of a system for fining offences under this regulation under Schedule N. Further article 25 was amended such that waste that needs to be removed from an Island must be taken to the nearest waste management center.

2.2.4. Regulation on Environmental Liabilities (2011/R-9)

This regulation was made in order to emphasize on sustainable development according to Article 22 of the Constitution of the Republic of Maldives 2008 and penalize environmental offences to the regulations made under Environmental Protection and Preservation Act (4/93) in the intention to prevent such offences. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 5 states that this regulation will be implemented by the EPA on behalf of the Ministry of Environment, Climate change and Technology.
- Article 7 states that, if there is a potential environmental damage or if there was an environmental damage due to a project, then the proponent must report to the Competent Authority and take measures to prevent such damages. The Competent Authority must assert to the proponent to implement mitigation measures.
- Article 8 states that, instead of the proponent under following circumstances the Competent Authority reserves the right to implement measures to prevent or mitigate environmental damages;
    - In an emergency
    - The proponent did not implement the mitigation measures prescribed by the Competent Authority under article 7
    - The proponent must bear the cost of implementing the mitigation measures mentioned in article 7 and for inspection visits from the Competent Authority
- Article 9 states that, for potential environmental damages imposed for works done by getting written approval from a government institution or advice, the cost of mitigation measures implemented maybe reclaimed from the government institution that gave the approval.
- Article 10 and 11 states that, if the Competent Authority found that there were environmental damages due to the actions of anybody, the Competent Authority could ask them to submit the mitigation measures that could be implement along with the information mentioned in Schedule 6 of this regulation.
- Article 12 states that the proponent has the right to review the decisions of the Competent Authority to the Minister if;
    - The environmental damages were not due to the actions of the proponent
    - If the decisions of the Competent Authority regarding the environmental damages were questionable by the proponent
    - If the environmental damage was imposed due to the proponent following a regulation

    - If the environmental damage was imposed due to a third party while the proponent was diligently following all the mitigation measures
- Article 13 states that the Competent Authority has the right to visit and inspect the project sites, take copies of the documents photographs, and samples.
- Article 14 states that when inquired by the Competent Authority about information regarding any investigations under this regulation, correct information must be provided by the inquired entity or person.
- Article 15, 16 and 17 states the procedures for fining offences for environmental liabilities.

2.2.5. Regulation on Safety Standards for Construction Work (2019/R-156)

This regulation was made under the Building Act (4/2017) with the aims to improve working conditions for laborers and to protect the general public from potential health hazards due to construction activities. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 5 states that the following are Contractors responsibilities;
    - If the contractor's work exceeds MVR 1,500,000 a health and safety plan has to be prepared and followed for the safety of employees as well as the public.
    -
    - While handling construction materials, must ensure the safety of the workers and the general public
    - Informing the workers of any potential health hazards during construction works
    - Have an emergency response plan
    - Ensure that works are proceeding in accordance with the health and safety plan
    - Providing personal protective equipment for workers and they must be trained to use the equipment
    - Ensure construction site is safe for the workers and general public
    - Ensure that there is no disturbance to the general public from the construction site
    - Ensure waste is managed properly at the worksite
    - Ensure that the construction materials are properly stored
    - Ensure that safety boards and signs are installed around the construction site

- Article 6 states that if the contractor's work exceeds MVR 1,500,000 an emergency response plan must be made and the following must be fulfilled accordingly;
    - Emergency response plan must be made available at the constructions site
    - Inform the workers on the emergency response plan and its protocols
    - Have at least 2 emergency response drills every year
    - Ensure that a first aid personnel is always available at all times at the construction site
    - First aid kit must be readily available at the construction site
    - Ensure that the equipment's in the first aid kit is in proper condition
    - Installing safety boards at the construction site
    - Contacts for Emergencies must be available on a notice board at the construction site
- Article 7 states that the contractor must appoint a safety supervisor with more than five years of experience for the project.
- Article 8 states that the responsibilities of the site safety supervisor is to carrying out daily site inspections to ensure the proper measures are being taken to ensure safety and to report to the contractor/Competent Authority if the measures are not being implemented.
- Article 9 states that if the contractor's work exceeds MVR 5,000,000, the contractor must have an insurance policy taken to compensate for any damages to the workers and the surrounding people.
- Article 10 states that all contractor's must ensure that the general public is protected from the construction site by doing the following;
    - Installing pedestrian detour boards
    - Ensure construction materials and equipment's are stored in a way that does not pose any difficulties to the general public
    - Installing safety boards, fences, tapes, sheets to protect the general public
- Article 11 states that the contractor should ensure that workers are always using personal protective equipment when on site. These include safety helmets, safety boots, safety goggles, noise cancellation headphones, gloves, masks, safety belt, and other safety equipment's necessary as per the type of work.
- Article 12 states that all construction sites must be fenced off. The article also explains in details how the fence must be erected.
- Article 13 states that the contractor must ensure the required safety equipment's are provided to the works if they are handling hazardous substances.

- Article 14 explains in detail the safety procedures that must be followed while working at higher than 3 m.
- Article 15, 16, and 17 explains in detail the safety measures that must be taken while working on an overhead platform, roofs, and ladders.
- Article 18, 19 explains how scaffolding are to be used.
- Article 20, 21, 22, 23 states the safety measures that must be followed for using electrical equipment's,
- Article 24 states that the contractor must implement a chemical handling procedure for handling chemicals. The article also explains in details what is to be included in the chemical handling procedure.
- Article 25, 26, 27, 28 states the safety measures that must be followed while working with asbestos, gas cutters, and compressed gas welding.
- Article 29 states that, if there are flammable materials at the construction site, fire prevention equipment must be made available.
- Article 30, 31, and 32 states the safety measures that must be followed for using equipment's powered by mechanical power and electricity, cranes,
- Article 33 states the safety measures that must be followed for while working in closed spaces.
- Article 34 states the measures that must be followed while decommissioning a building.
- Article 35 states the construction materials must be stored within a close area. Approval must be taken from the Competent Authority to store at the designated area and the approval must be shown on a board.
- Article 36 states the measures that must be followed while loading and unloading materials to a construction site.
- Article 37 and 38 explains the requirements for the safety board and other signs that must be installed at construction sites.
- Article 39 states that, when an accident occurs at a construction site, it must be immediately reported to the police. The record of accidents must be maintained by the contractor.
- Article 49 states that, if there is no entity responsible for implementing the measures mentioned under this regulation, then the proponent shall be responsible for implementing the measures. The proponent must report any offences against this regulation to the Ministry.

- Article 50 states that with the enforcement of this regulation the Male' Planning Regulation Chapter 3 is void.

2.2.6. Regulation on uprooting, cutting and transportation of palms and trees

This regulation was implemented on 1 February 2006 by the Ministry of Environment, Climate change and Technology, Energy and Water. The primary purpose of the regulation is to control and regulate large-scale uprooting, removal, cutting and transportation of palms and trees from one island to another. According to the regulation, certain types of trees and plants that have unique attributes are prohibited to be removed from its natural environment. Also, uprooting and removal of a vast number of trees and palms are subjected to an EIA, which is required to be submitted to the EPA and written approval is required prior to implementation of the project. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 3 states that the following types of vegetation is prohibited to be removed;
    - Vegetation found from 15 m inland of the vegetation line
    - Vegetation found on and around 15 m of wetlands and mangroves
    - Vegetation found on any protected areas of the Maldives
    - Any protected trees
    - Vegetation which has environmentally unique characteristics
- Article 5 (a) states that, to clear large number of trees for any purpose, an EIA must first be done and approval from the competent authority must be obtained. Article 5 (b) states that, if trees are to be transported with soil, the allowable limit is an 8-inch x 10-inch black bag. Article 5 (e) states that, trees larger than what is mentioned in article 8 (a) of this regulation, must be transported with only the soil in their root balls. Article 5 (f) states that, if machinery is to be used for uprooting trees, no damages must be done to any trees besides the trees concerned for uprooting.
- Article 6 states that, if the total number of a particular species of tree is less than 05 on an island, then this species of tree can only be transported with a special permit from the Ministry of Environment, Climate change and Technology. Furthermore, this applies to trees on which birds roost or live in inhabited and uninhabited islands.
- Article 7 states that, the maximum number of trees which could be removed from an island shall be declared by the Ministry of Environment, Climate change and Technology, based on the existing numbers of trees on the Island.
- Article 8 states that, coconut trees taller than 15 feet and other trees taller than 8 feet, their limit for removal is 10 trees, to uproot greater than 10 trees require an

approval from Ministry of Environment, Climate change and Technology. Smaller trees could be removed by taking an approval from Island Council and the limit for uprooting is less than 1/3rd of the trees present in the area. For any purpose uprooting and transport of trees must be done under the supervision of the Island Council on inhabited Island; personnel responsible to manage the island in case of uninhabited Island.

- Article 9 states that, after uprooting trees, the holes must be backfilled with soil. It is prohibited to put in any waste into the holes.
- Article 10 states that, any offences against this regulation will be punishable under Act 4/93 accordingly.

1st amendment to regulation on uprooting, cutting and transportation of palms and trees (2014/R-7)

The amendment to this regulation has specified a set of categories and any tree falling under these categories is not allowed to be removed unless it is a project of the government, approved by the parliament. Relevant articles under this law pertaining to the proposed project are:-

- Article 3 was amended such that the prohibited trees for removal could be removed for a project approved by the parliament with the condition that the proponent must plant 6 trees for each tree removed instead of 2. Furthermore, a monitoring plan must be made and the proponent must implement it.
- Article 11 was amended to mention that this regulation will be enforced by the EPA on behalf of the Ministry of Environment, Climate change and Technology.

2.2.7. Regulation on management and conservation of water resources (2021/R-22)

This regulation has been formulated under the Article 17,18,19,20 and 23 of the Water and Sewerage Act (08/2020). The main purpose of the regulation is to ensure sustainable use, conservation, protection, improvement, and beneficial use of the water resources. Relevant articles under this regulation pertaining to the proposed project is:

Article 6:

- None shall do any harm or damage to the water resources.
- Groundwater and other naturally occurring water resources on the islands, shall not be utilised for any economic or business use.
- Dewatering for building construction shall be carried out as per the relevant regulation.

Article 8: Overflow from all roofs shall be connected to the well of the building or a designated recharge structure. No overflow from the roofs shall be connected to the sewer system of the islands.

Article 10: All activities shall be carried out in a manner that would not contaminate the water resources in accordance to the clause 20 of the water and sewerage act (08/2020)

Article 11:

- After the establishment of an improved sewerage system, all household in the spatial coverage of the system shall be connected. After 1 year of official service innuageration of the system, no households within the spatial coverage of the system shall use other means of sewerage management where the effluent is decipated into the ground (such as sceptic tanks).
- Within 1 year of the from establishing the water, all the existing operational sceptic tanks within the spatial coverage of the system, shall be safely desludged, treated and closed off by the service provider of the island. The service provider may charge a fee that is approved by the regulator for the service.
- Managing the operation and maintenance of the sewer system without any contamination of the groundwater resources is the responsibility of the licensed service provider.
- In any island with a sewerage treatment plant (STP), the treated water should only be recharged to the ground if the effluent is at a standard that is equivalent to the requirement set in the appendix 4 of the regulation. Furthermore, in the case of treated water recharge, the service provider is required to submit and implement a groundwater monitoring plan after the approval of the regulator. Recharging any treated effluents that does not meet the requirement is prohibited.

Article 12: Spillage of any oil and chemical to the ground is prohibited. Oil and chemical shall be store in shaded, appropriately bunded areas and in a manner that even if the total volume of the dedicated storage is leaked, the leaked volume is able to be recovered without contamination of the soil or the groundwater. Transfer of oil and chemical on land must be carried out with appropriate safety measures to prevent spillage. Discarding of waste oil and chemicals must be carried out in a manner that does not contaminate any of the water resource, and at a facility that is approved by the regulator.

Article 17: All responsibilities of rectification of a polluted groundwater resource from spillage of oil and chemicals shall be borne by the polluter. Any incidence of groundwater pollution from oil and chemical spillage should be reported to the regulator within 24 hours. The rectification works shall be carried as per the instruction of the regulator.

2.2.8. Regulation on protection of environmentally sensitive areas (2018/R-78)

This regulation was under article 4 of the Environmental Protection and Preservation Act (4/93) in order to declare standards to declare areas for protection, manage protected areas, establish environmentally sensitive areas, establish a network of protected areas, create public awareness and participation in management of protected areas, protection and preservation of Maldivian biodiversity for future generations. According to this regulation there are 7 types of protected areas; (1) Internationally recognized areas, (2) Strategic Nature Reserve, (3) Wilderness area, (4) National Park, (5) Natural Monument, (6) Habitat / Species Management area, and (7) Protected Area with Sustainable use. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 12 states that a management plan must be made in order to manage the protected areas. This management plan must reflect on the developmental plans for the region.

2.2.9. Regulation on Construction Material Import and Production Control

The purpose of the regulation is to control the quality of imported and produced materials that are used in the construction industry. The regulation specifies the materials which would be controlled under the regulation in its annex 1. Furthermore, the regulation details out the registration requirements, permits, procedures, quality controls and applicable fine of those that breach the regulation.

2.2.10. Regulation on Construction Material and Construction materials testing facilities

Under the regulation all contractors involved in the construction industry are to be registered. The regulation includes the requirements of contractor's registration, grading, implications on participating in international tenders, insurance, project licenses, Joint venture registrations, responsibilities of the registered contractors and applicable fine for breaching the regulation.

2.2.11. Regulation on protection of old trees

This regulation was made under article 4 of the Environmental Protection and Preservation Act (4/93) in order to declare standards to manage protected trees in the Maldives. The regulation states the criteria for trees to be protected; (1) trees older than 50 years, (2) trees that are threatened to extinction locally, (3) ecologically important species, and (4) due to the request of public. Relevant articles under this regulation pertaining to the proposed project are:

- Article 6 and 7 states that a radius of 2 m from the crown of the protected tree shall be protected and while allocating land of purposes special attention must be given to not disturb such trees. Further any activities that may cause damage to the trees shall not be undertaken.

2.2.12. Carrying Capacity for Islands to be developed as Tourist Resorts

A set of standards has been imposed under this regulation to ensure preservation of the natural beauty and the environment of the islands as well as the consumer's image of the islands. As such, the following guidelines are provided:

- The felling of trees has to be carried out evenly throughout the island with the intention of conserving the natural façade and the beauty of the island.
- Sufficient trees have to be left untouched when clearing trees for construction in order that they block the view of the buildings. All buildings, including two storey buildings are to be constructed below the highest canopy level so that they are not visible above the treetops.
- The maximum number of buildings to be constructed on the island should be dependent on how much space can be cleared of vegetation, with consideration of the above factors.
- The maximum area utilized for the construction of buildings should not exceed 20% of the total land area.
- All buildings should be located at least 5 m landwards from the vegetation line of the island. In the event that over water bungalows are built on the reef flat or lagoon, an equal area has to be left free on the island.
- To provide the visiting guests with sufficient beach area, the guest rooms should face the beach with a minimum of 5 m of beach allocated for each room.

2.2.13. Disposal of Garbage from Tourist Resorts

- Garbage from the resorts should be disposed of appropriately to avoid impacts on the environment. Waste disposed of at sea should be thrown away far out to sea, ensuring that it does not get washed back on the beach of any islands.
- All resorts are required to have incinerators and compactors to be utilized for burning all flammable material and compact the cans respectively. Glass is to be broken into small pieces and plastic and polythene bags burnt.
- A fine between Rf100 and Rf2000 is to be charged if the regulation is breached, and the sum doubled for those who violate it a second time.
- In addition to the Maldives Tourism Act and the relevant Regulations, there are Circulars issued by the Ministry of Tourism, advising the Tourism industry of their new policies or strengthening the existing ones.
- Circular no. 21/90 (21.04.1990) advices all resorts having filled jetties to be modified so that they allow free flow of currents through them or new jetties composed of reinforced concerted stilts to be built in their place by the end of June 1991.
- Circular no. CIR-ES/98/07 issued on the 27th of January 1998 states that all resorts have to obtain permission from the Ministry of Tourism before commencing any coastal modifications. Hard engineering solutions are discouraged while environmentally friendly structures are supported.
- Circular no. 88-ES/CIR/2002/12 (05.05.2002) deals with the proper disposal of garbage from the resorts in response to concerns that floating garbage from resort islands were washing up on beaches of nearby islands.

2.2.14. Regulation on Use, Handling, and Storage of Oil

The purpose of the regulation is to reduce fire hazards caused by the mishandling of oil, to raise awareness on the proper handling methods of oil and to standardize the infrastructure of oil handling and storage facilities.

- Article 2 of the regulation details out all the aspects of vehicles that handle and transport oil on land.
- Article 3 deals with all the aspects of petrol handling in storage areas and service centres.
- Article 4 highlights the aspects of fuel handling in diesel and kerosene service centres.

Article 5 highlights the aspects of fuel pipeline from storage to meters

2.2.15. Heritage Preservation Regulation (2020/R-37)

This regulation is brought forth under article 11 of Heritage Act (12/2019) to determine, protect, and preserve the heritage of Maldives.

- Article 4 states that cultural heritage can be portable artefacts, historical buildings, historical sites, and cultural skills or talents such as "kasabu viyun".
- Article 5 states that the value of a heritage item or site will be determined depending on its historical importance, age, category, preservation of authentic condition, and amount of damage.
- Article 6 states that National Center for Cultural Heritage must be informed within 48 hours via the respective island (if from an inhabited island) or atoll council (if from an an inhabited island) if any historical items or sites that could be a heritage item or site is found. Portable artefacts must immediately be handed over to the island or atoll council without any damage.
- Article 6 also states that if the landowner refuses NCCH from assessing the site or items found or refuses to adhere to NCCH's advice on how to deal with items or site, NCCH can acquire a court order under the Heritage Act (12/2019).
- Article 8 states that a 50 feet distance surrounding a heritage site will be protected. And if this distance cannot be acquired, then an adequate distance will be determined by NCCH and council after assessing the importance of the site. No developmental plans aside from those decided by NCCH can be carried out in this area without approval from NCCH.
- Article 9 states that if anybody wishes to excavate or search for heritage artefacts from a predicted historical site, necessary permits must be taken from NCCH.
- Article 12 states no heritage artefacts can only be moved within the country or abroad by its legal owner or guardian with permit from NCCH.
- Article 16 states that:
    - Damaging historical artefacts or sites will be fined an amount between MVR200,000 and MVR1000,000, and trying to damage one will be fined an amount between MVR10,000 and MVR 500,000.
    - Changing the authentic form of any heritage artefacts or sites will be fined an amount between MVR100,000 and MVR800,000, and trying to change one will be fined an amount between MVR10,000 and MVR 300,000.
    - Illegally importing or exporting heritage artefacts of Maldives or any other country will be fined an amount between MVR100,000 and MVR500,000,

and trying to import or export will be fined an amount between MVR10,000 and MVR 100,000.

- Excavating sites to acquire valuable artefacts without the permission of NCCH will be fined an amount between MVR10,000 and MVR100,000, and trying to excavate without permission will be fined with MVR10,000.
- Not informing NCCH or the local council when an artefact or site is found while excavating any area in Maldives will be fined with an amount between MVR10,000 and MVR100,000.
- Spreading false rumors or information regarding heritage artefacts will be fined an amount between MVR10,000 and MVR50,000.

2.2.16. Maldives National Building Code (2019/R-1020)

The Maldives National Building Code R-1020 has been published in the year 2019 and consists of the following chapters.

Part I: building code for type 1 buildings.

- Clause A1 (Classified users): For the purposes of this building code, Type 1 Buildings are classified according to type, under seven categories. A building with a given classified use may have one or more intended uses. The seven categories are:
    - Housing
    - Communal residential
    - Communal non-residential
    - Commercial
    - Industrial
    - Outbuildings
    - Ancillary
- Clause A2 (Interpretation): In PART II of building code unless the context otherwise requires, words shall have the meanings given under this Clause
- Clause B1 (Structure): The objective of this provision is to:
    - Safeguard people from injury caused by structural failure,
    - Safeguard people from loss of amenity caused by structural behaviour, and
    - Protect other property from physical damage caused by structural failure
- Clause B2 (Durability): The objective of this provision is to ensure that a Type 1 Building will, throughout its life, continue to satisfy the other objectives of this code
- Clause C1(means of escape): The objective of this provision is to:

  - Safeguard people from injury or illness from a fire while escaping to a safe place
  - Facilitate fire rescue operation
- Clause C2 (spread of fire): The objective of this provision is to:
  - Safeguard people from injury or illness when evacuating a Type 1 Building during fire.
  - Provide protection to fire service personnel during firefighting operations.
  - Protect adjacent household units and other property from the effects of fire.
  - Safeguard the environment from adverse effects of fire
- Clause C3 (structural stability during a fire): The objective of this provision is to:
  - Safeguard people from injury due to loss of structural stability during fire, and
  - Protect household units and other properties from damage due to structural instability caused by fire.
- Clause C4 (access & facilities for the fire services): The objective of this provision is to:
  - Provide reasonable facilities to assist fire fighters in the protection of life
  - Enable fire appliances to gain access to the building.
- Clause D1(access routes): The objective of this provision is to:
  - Safeguard people from injury during movement into, within and out of Type 1 buildings,
  - Safeguard people from injury resulting from the movement of vehicles into, within and out of Type 1 buildings, and
  - Ensure that people with disabilities are able to enter and carry out normal activities and functions within Type 1 buildings.
- Clause D2 (mechanical installations for access): The objective of this provision is to:
  - Safeguard people from injury and loss of amenity while using mechanical installations for movement into, within and out of Type 1 buildings,
  - Safeguard maintenance personnel from injury while servicing mechanical installations for access, and
  - Ensure that people with disabilities are able to carry out normal activities and processes within Type 1 buildings
- Clause E1(surface water): The objective of this provision is to:

  - Safeguard people from injury or illness, and other property from damage, caused by surface water
  - Protect the outfalls of drainage systems.
- Clause E2 (external moisture): The objective of this provision is to safeguard people from illness or injury which could result from external moisture entering the Type 1 building
- Clause E3 (internal moisture): The objective of this provision is to:
  - Safeguard people against illness or injury which could result from accumulation of internal moisture
  - Protect household units and other properties from damage caused by free water from occupancy in the same building.
- Clause F1(hazardous agents on site): The objective of this provision is to safeguard people from injury or illness caused by hazardous agents or contaminants on a site
- Clause F2 (hazardous building materials): The objective of this provision is to safeguard people from injury and illness caused by exposure to hazardous building materials.
- Clause F3 (hazardous substances and processes): The objective of this provision is to safeguard people from injury or illness, and other property from damage, caused by hazardous substances or processes in buildings
- Clause F4 (Safety from Falling): The objective of this provision is to safeguard people from injury caused by falling
- Clause F5 (Construction and Demolition hazards): The objective of this provision is to safeguard people from injury, and other property from damage, caused by construction or demolition site hazards.
- Clause F6 (lighting for emergency) : The objective of this provision is to safeguard people from injury due to inadequate lighting being available during an emergency
- Clause F7 (warning systems) : The objective of this provision is to safeguard people from injury or illness due to lack of awareness of an emergency
- Clause F8 (signs) : The objective of this provision is to:
  - Safeguard people from injury or illness resulting from inadequate
  - identification of escape routes, or of hazards within or about the Type 1 building,
  - Safeguard people from loss of amenity due to inadequate direction, and
  - Ensure that people with disabilities are able to carry out normal activities and processes within buildings

- Clause G1(personal hygiene) : The objective of this provision is to:
    - Safeguard people from illness caused by infection or contamination,
    - Safeguard people from loss of amenity arising from the absence of appropriate personal hygiene facilities, and
    - Ensure people with disabilities are able to carry out normal activities and processes within Type 1 buildings.
- Clause G2 (laundering) : The objective of this provision is to ensure:
    - Adequate amenities for people to do laundering, and
    - That people with disabilities are able to carry out normal activities and processes within Type 1 buildings
- Clause G3 (food preparation and prevention of contamination) : The objective of this provision is to:
    - Safeguard people from illness due to contamination,
    - Enable hygienic food preparation without loss of amenity, and
    - Ensure that people with disabilities are able to carry out normal activities and processes within Type 1 buildings
- Clause G4 (ventilation) : The objective of this provision is to safeguard people from illness or loss of amenity due to lack of fresh air.
- Clause G5 (interior environment) : The objective of this provision is to:
    - Safeguard people from illness caused by excessive air temperature,
    - Safeguard people from injury or loss of amenity caused by inadequate activity space,
    - Ensure that people with disabilities are able to carry out normal activities and processes within Type 1 buildings
- Clause G6 (airborne and impact sound) : The objective of this provision is to safeguard people from illness or loss of amenity as a result of undue noise being transmitted between abutting occupancies
- Clause G7 (Natural Light): The objective of this provision is to safeguard people from illness or loss of amenity due to isolation from natural light and the outside environment.
- Clause G8 (Artificial light): The objective of this provision is to safeguard people from injury due to lack of adequate lighting.
- Clause G9 (Electricity): The objective of this provision is to ensure that: In Type 1 buildings supplied with electricity, the electrical installation has safeguards against outbreak of fire and personal injury

- Clause G10 (Piped service) : The objective of this provision is to safeguard people from injury or illness caused by extreme temperatures or hazardous substances associated with building services.
- Clause G11(gas as an energy source): The objective of this provision is to:
  - Safeguard people from injury arising from the use of gas as an energy source,
  - Safeguard people and other property from the risk of fire or explosion, and
  - Safeguard people from loss of amenity due to the gas supply being inadequate for the intended use.
- Clause G12 (water supplies): The objective of this provision is to:
  - Safeguard people from illness caused by infection from contaminated water or food,
  - Safeguard people from injury due to the explosion of a pressure vessel or from contact with excessively hot water,
  - Ensure that people with disabilities are able to carry out normal activities and functions within Type 1 buildings
- Clause G13(Foul water) : The objective of this provision is to:
  - Safeguard people from illness due to infection or contamination resulting from personal hygiene activities, and
  - Safeguard people from loss of amenity due to the presence of unpleasant odours or the accumulation of offensive matter resulting from foul water disposal
- Clause G14 (industrial liquid waste) : The objective of this provision is to safeguard people from injury or illness caused by infection or contamination resulting from industrial liquid waste
- Clause G15 (solid waste) : The objective of this provision is to safeguard people from injury or illness caused by infection or contamination from solid waste
- Clause H1 (energy efficiency) : The objective of this provision is to facilitate efficient use of energy.

2.3. Guidelines and technical specifications

2.3.1. National wastewater quality guidelines (published on January 2007)

The purpose of the guideline is to assist all stakeholders in the water cycle to manage the discharge of wastewater in such a way that it does not limit water's fitness for use by different water users. The guideline suggests specific values of maximum concentrations that can be tolerated by future users of each parameter potentially present in wastewater. These values may not be exceeded when treated wastewater is released back into surface water, groundwater or into the ocean. The values are generic and should be used together with the EIA and clean Production Protocols to finalize the license for the discharge of specific waste water.

2.3.2. Guideline for power system approval

The guideline for power system approval highlights the sets of information required to be submitted to URA for the approval process which includes details about the generation system, generator control panel and distribution panel, fuel system, distribution network, electric cable, firefighting system and lighting protection, EIA of the generation facility, tariff and rules and regulations of powerhouse for consumers.

The registration process of the newly constructed powerhouse will commence as soon as the construction of the powerhouse is completed.

2.3.3. Requirement for Fire Prevention Equipment in the building

This is a guideline enforced by the Ministry of Defense and National Security of the Maldives which sets out a list of requirements and standards that need to be met in fire prevention equipment provided in buildings prone to fire hazards. As the whole guideline pertains to any power generating facility, hence to this project, the main points have been highlighted as follows:-

- **Hose reel**: Should comply with the specified standards under the guideline. The overall width of the reel should be no more than 850mm. The overall height of the Reel should be less than 850mm including Hose and integral Flexi guide for hose withdrawal guide. The overall depth of the hose reel should be no more than 150mm. The colour of the Reel should be Red, fitted with an operating instruction plate. The Hose Reels nozzle retainer or hose guide and the inlet valve should be fitted at a height of about 900mm above floor level;
- **Hose reel cabinets**: The hose reel cabinet should be Recess mounting type with or without glass-paneled door for use with the above-mentioned sized Hose Reels. Hose Reel Cabinet dimension should be no more than 900mm in width, 900mm in height, 160mm in depth (including door). The colour of the cabinet should be Red. Special permission should be taken for other Colour. Recessed Latch Type handle should be installed. Hose reel signage should be in accordance with BS 5499 or any other equable International Standard. Fixing hole should be provided;

- **Water supply for hose reel system**: Should be such that when the two topmost reels in the building are used simultaneously, each should provide a jet of about 6 m in length and will deliver less than 0.5 L. Minimum storage required for the hose reel is 2275 L and 1137.5 L up to a maximum of 9100 L for each additional reel. Tanks supplying water for domestic purposes should not be used as a suction tank for hose reel installation. The pipings for the supply of water for hose reel should be in and out galvanized schedule 40. Diameter of the piping should not be less than 50 mm;
- **Hose reel booster pump system**: Hose reel booster pump set, complete with in and out galvanized steel pipework with or without expansion vessels;
- **Fire extinguishers**: 2kg CO_2 stored pressure Extinguisher approved to BS EN 3. Aluminium Alloy Body approved to BS5045 Part 3 or any other equable International Standard. Red body with black band or Black colored head cap, swivel Horn, English screen. Fully charged. 6 Kg DCP Extinguisher (Gas Cartridge Type) approved to BS EN 3 or any other equable International Standard. Blue Body Headcap, English Screen, Fully charged. 9 Liter Water Extinguisher (Gas Cartridge Type) approved to BS EN 3 or any other equable International Standard. Red Body Headcap, English Screen, Fully charged. Fire Extinguishers should be located in conspicuous positions on brackets or stands where they will be readily seen by person. The carrying handle of larger heavier extinguishers should be about 01m from the floor level. But smaller extinguishers should be mounted so as to position the handle 1.5m from the floor level;
- **Cabinets for fire extinguishers**: Cabinets for fire extinguishers should be of stainless steel with or without glass-fronted doors. The colour of the cabinet should be Red or to suit the requirements of architectural surroundings. Recessed Latch Type handle should be installed. Fire Extinguisher Single Cabinets dimension should be no more than 190mm in width, 640mm in height, 180mm in depth (including door). Fire Extinguisher Double Cabinets dimension should be no more than 440mm in width, 640mm in height, 180mm in depth (including door);
- **Fire Blankets**: Fire Blankets should be certified to BS EN 1869: 1997 or any other equable International Standard. Fire Blankets should be extremely flexible and drape easily the slim pack of fire blanket should be Red or White;
- **Dry riser gate valve**: Dry riser gate valve to BS 5041/2, or any other equable International Standard, Gunmetal c/w Padlock strap, blank cap and chain. Inlet 2 ½” ASA 150 F/F. Outlet 2 ½” Inst. Female couplings to BS 336. Colour red;

- **Dry riser outlet box**: Dry riser outlet box for Dry Riser gate valve. Construction should be similar to BS 5041. Standard finish colour Red. Dry Riser outlet cabinet dimension should be as specified in the guideline;
- **Pumping in breeching**: Twin pumping in breeching, approved to BS 5041, or any other equable International Standard, Gunmetal inlets 2 x 2 ½” BS Instantaneous Male Coupling c/w non-return valves. Outlet 4” ANSI 150 F/F flange;
- **Dry riser inlet box**: Dry Riser inlet box for horizontal/vertical pattern. Double inlet to BS 5041 or any other equable International Standard finish color Red. Dry riser inlet cabinet dimension for flush mounting should be as specified in the guideline.
- **Air release valve**: Air release valve, Gunmetal, Inlet 1” BSP Male;
- **Piping for dry riser system**: The Piping for Dry Riser System should be In and Out Galvanized schedule 40. The diameter of the Piping should be not less than 100mm.
- **Fire doors**: All fire doors should be opened to the direction of the flow of people while on emergency. These doors should be installed with a self-closing device including the Panic Latch. These Panic Latch devices should conform to BS 5725 Pt 1 or any other equable International Standard. Fire doors conforming to the method of construction as stipulated in the guideline;
- **Fire exit signs**: Photoluminescent Fire exit signs should sign each Fire Exit Door. The Symbol height should be no more than 100mm;
- **Fire detection and alarm system**: Fire Detection and Alarm System should conform to BS 5839 or any other equable International Standard. Fire Detection and Alarm System should be Analogue Addressable System with mimic diagram. A system in which signals from each detector and/or call point are individually identified at the control panel. Fire Detection and Alarm System should consist of Automatic Detectors, Manual Call Points, Control and Indicating equipment, etc. It should also cover System capable of providing signals to initiate, in the event of fire, the operation of ancillary services such as fixed fire extinguishing systems and other precautions and actions. Main Fire Control Panel should be located at the reception and the Repeater Panel should be located in the guardroom;
- **Installation and testing of wet riser system**: Wet rising systems shall be provided in every building in which the topmost floor is more than 30.5 meters above the fire appliance access level. A hose connection shall be provided in each firefighting access lobby. Wet risers shall be of minimum 152.4 millimeters diameter and shall be hydrostatically tested at a pressure 50% above the working pressure required and

not less than 14 bars for at least twenty-four hours. Each wet riser outlet shall comprise standard 63.5 millimeters instantaneous coupling fitted with a hose of not less than 38.1 millimeters diameter equipped with an approved typed cradle and a variable fog nozzle. A wet riser shall be provided in every staircase which extends from the ground floor level to the roof and shall be equipped with a three-way 63.5 millimeters outlet above the roofline. Each stage of the wet riser shall not exceed 61 metres unless expressly permitted by D.G.F.S but in no case exceeding 70.15 meters;

- **Wet or dry rising systems for buildings under construction**: Where either wet or dry riser system is required, at least one rise shall be installed when the building under construction has reached a height of above the level of the fire brigade pumping inlet with connections thereto located adjacent to a useable staircase. Such riser shall be extended as construction progress to within two floors of the topmost floor under construction and where the designed height of the building requires the installation of wet riser system fire pumps, water storage tanks, and water main connections shall be provided to serve the riser;
- **Wet riser booster pump system**: Wet riser booster pump set, complete with In and Out galvanized steel pipework with or without expansion vessel and specified in the guideline;
- Symbols, as well as installation of firefighting systems on the basis of building usage, are outlined on the table in the guideline; and
- All equipment mentioned above should be approved by the Maldives National Defense Force (MNDF) fire and rescue services before installation. Special permission should be taken if different from the guideline specifications.

2.3.4. Waste Incinerator Guideline

The waste incinerator guideline (WIG) of the EPA Maldives came into effect in 2016 aimed at facilitating the construction and operation of incinerators safely and to mitigate the adverse environmental and health impacts that may arise. The objective of the guideline is to prevent or limit, as far as practicable, negative effects on the environment, in particular pollution by emission into air, soil, surface and groundwater, and the resulting risks to human health, from combustion of waste using incinerators.

As per article 4.1 of the WIG, the site for waste incinerators must be selected in ways that it would not pose any hazard to the surrounding environment and the local community. The proposed project complies with this article such that the chimneys of the powerhouses will be installed far away from the residential area and sensitive land uses. Additionally, the site is selected so that the prevailing winds carry the emitted gases away from the residential area/island. Preconstruction environmental clearance permits and monitoring will be carried out at the proposed location and background emissions established in order to enable future changes to be identified.

2.3.5. Design Criteria and Technical Specifications for Conventional Gravity Systems and Water Supply systems

The technical specification of the EPA on designing a gravity based sewer system includes all technical details and requirements that need to be followed in the design of a gravity based sewer system. Likewise, the technical specification for water treatment and supply systems include all the technical details and requirements that need to followed while designing a water supply system.

It guides on the flow rates that need to be maintained in the water and sewer system and most importantly the limitations on depth of the network pipes along with sizes of the network pipes. In addition, it also reflects on the layout design of the sewerage collection network, pump stations, pumping mains, waste water treatment plant, marine outfall, sludge drying beds, administration buildings, water supply distribution system, water meters, sampling taps, raw water intake, reverse osmosis plant, brine disposal and all other facilities of the water and sewer system.

Construction of all civil engineering works and associated works shall continue in accordance with the approved design and these specifications. The general design parameters shall be followed including the design shall be done for the projected population for 30-year period for sewer systems and 35-year period for water systems.

The specification also highlights on the general obligations of the contactor and the operator with regard to environmental protection during both construction and operational phases.

2.4. International Conventions, plans and programs

2.4.1. United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol

UNFCCC is the first binding international legal instrument that deals directly with the threat of climate change. It was enacted at the 1992 Earth Summit in Rio de Janeiro and came into force on the 21st of March 1994.

Signatory countries have agreed to take action to achieve the goal outlined in Article 2 of the Convention which addresses the “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system,” Thus all Parties to the Convention are committed under Article 4 to adopt national programs for mitigating climate change, promote sustainable management and conservation of greenhouse gas (GHG) sinks such as coral reefs, to develop adaptation strategies, to address climate change in relevant social, economic and environmental policies, to cooperate in technical, scientific and educational matters and to promote scientific research and exchange of information.

The Kyoto Protocol entered into force on the 16th of February 2005 and is an international and legally binding agreement to reduce GHG emissions globally. It strengthens the Convention by committing Annex I Parties to individual, legally-binding targets to achieve limitations or reductions in their GHG emissions. Maldives has signed and ratified both the Convention and the Protocol.

2.4.2. Paris Agreement

The Paris Agreement is also an agreement within the framework of the UNFCCC dealing with GHG emission mitigation, adaptation and finance proposed to start in the year 2020. Upon opening for signatories on 22 April 2016, 180 UNFCCC members have signed the treaty (including Maldives), however, only 22 of which ratified it so far which is not enough for the treaty to enter into force yet. The aim of the convention as described in Article 2 of the treaty is “enhancing the implementation” of the UNFCCC through:-

i. Holding the increase in global average temperature to well below 2° C above pre-industrial level and to pursue efforts to limit the temperature increase to 1.5° C above pre-industrial levels, recognising that this would significantly reduce the risk and impacts of climate change;

ii. Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and lower GHG emissions development in a manner that does not threaten food production; and

iii. Making finance flows consistent with a pathway towards low GHG emissions and climate resilient development.

2.4.3. The Vienna Convention for the Protection of the Ozone Layer

The Vienna Convention for the Protection of the Ozone Layer is a multilateral environmental agreement which entered into force in 1988. It acts as a framework for the international efforts to protect the ozone layer. In 2009, the Vienna Convention became the first convention of any kind to achieve universal ratification. The objective of the Convention were for the Parties to promote corporation by means of systematic observations, research and information exchange on the effects of human activities on the ozone layer and to adopt legislative or administrative measures against activities likely to have adverse effects on the ozone layer. Maldives has signed and ratified this convention and adheres to it.

2.4.4. The Montreal Protocol on Substances that Deplete the Ozone Layer

The Montreal Protocol on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the Protection of the Ozone Layer) is an international treaty designed to reduce production and consumption of ozone depleting substances in order to phase out the production and abundance of substances that are responsible for depletion of the ozone layer. This protocol entered into force on 1 January 1989. Since its adoption, it has undergone 8 revisions and the Maldives abide by 4 of those addendums mentioned below:-

- The London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1990);
- The Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1992);
- The Montreal Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1997); and
- The Beijing Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1999).

2.4.5. Agenda 21

Agenda 21 is a non-binding voluntary implemented action plan of the United Nations (UN) with regards to sustainable development. It is a comprehensive plan of actions taken globally, nationally and locally by organizations of the United Nations System, Governments and Major Groups in every area in which humans impact on the environment. It is also an outcome of the Earth Summit (UN Conference of Environment and Development) held in Rio De Jeneiro, Brazil in 1992. Maldives is among the 178 countries which adopted this action plan. Out of the 4 sections it is grouped into, the proposed development pertains to:-

i. Section I: *Social and Economic Dimensions* which is directed towards combating poverty, especially in developing countries, changing consumption patterns, promoting health, achieving a more sustainable population and sustainable settlement in decision making; and

ii. Section II: *Conservation and Management of Resources for Development* which includes atmospheric protection, combating deforestation, protecting fragile environments, conservation of biodiversity, control of pollution and the management of biotechnology and radioactive wastes.

2.4.6. Sustainable Development Goals

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.

The Sustainable Development Goals are:

- No Poverty
- Zero Hunger
- Good Health and Well-being
- Quality Education
- Gender Equality
- Clean Water and Sanitation
- Affordable and Clean Energy
- Decent Work and Economic Growth
- Industry, Innovation, and Infrastructure
- Reducing Inequality
- Sustainable Cities and Communities
- Responsible Consumption and Production
- Climate Action
- Life Below Water

- Life On Land
- Peace, Justice, and Strong Institutions
- Partnerships for the Goals

2.4.7. Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD), formally known as the Biodiversity Convention, is a multilateral treaty which entered into force on 29 December 1993. The convention has 3 main goals:-

i. Conservation of biodiversity;
ii. Sustainable use of its components; and
iii. Fair and equitable sharing of benefits arising from genetic resources.

The objectives of the convention is to develop national strategies for the conservation and sustainable use of biodiversity.

2.4.8. Washington Declaration on Protection of the Marine Environment from Land-based Activities

Maldives is a signatory to the Washington Declaration on Protection of the Marine Environment from Land-based Activities which intends at setting a common goal sustained and effective action to deal with all land-based impacts upon the marine environment, specifically those resulting from sewage, persistent organic pollutants, radioactive substance, heavy metals, oils (hydrocarbons), nutrients, sediment mobilization, litter and physical alteration and destruction of habitat.

2.4.9. Regional plans and programs

In addition to the international treaties and conventions, Maldives is also a key player in the formulating and adopting of various regional plans and programs to protect the environment by actively participating in activities organised by several regional bodies. As such, Maldives is committed to the following which pertains to the proposed project: -

- South Asian Association for Regional Corporation (SAARC) Environment Action Plan adopted in Male' in 1997;
- SAARC Study on Greenhouse Effect and its Impacts on the Region;
- South Asian Regional Seas Action Plan and Resolutions concerning its implementation (1994); SAARC Study on Causes and Consequences of Natural Disasters;
- South Asian Seas Program; and

- Male' Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia (1998).

2.5. Required permits and Approvals

The following permits and approvals shall be obtained from the relevant authority prior to commencement of construction phase of the project:-

Table 1. Permits and Approvals required for the proposed development

Permits/Approvals	Approving Agency/Authority	Status
Concept Approval	MoT	Received
EIA Decision Note	EPA	Ongoing through the current EIA

2.6. Compliance of the Proposed Proposal to Statutory Requirements

All statutory requirements pertaining to this project shall be adhered to by the proponent during detail design phase, construction and operational phase. Furthermore, any changes to the legislative framework shall be considered and required changes shall be brought to project components as necessary.

3. PROJECT DESCIRPTION

3.1. Study area, project boundary and surroundings

The project island is 150 km away from the capital Male' and located 5°31'57.48"N and 73°30'22.56"E in the northern side of Lhaviyani atoll. The island has 1.4km in length and 0.35km in width. The nearest inhabited island is Lh.Hinnavaru, which is located around 10.9km from Kanuhura. The project site generally include the island as a whole, more specific to the water plant site. The Figure 2 shows a partial print of the major areas of the water infrastructure. The full location drawing and other detailed drawings of the proposed infrastructure and renovation are given in Appendix D- Detail drawings for RO Plant of the report.

There are two protected areas, *Kuredhi Kanduolhi* and *Fushi faru* area which are located approximately 2 – 2.5 km from the proposed major civil works region of the proposed project as indicated in Figure 1. The nearest environmentally sensitive area is approximately 2.8km southwest of the project island which is known as *Maagiri*. This sensitive area is noted to have lots of reef fish, overhangs, sharks and turtles. However, given the considerable distance between the project site and the protected and sensitive areas, no significant disturbance are envisaged to the areas from the works of the proposed project.

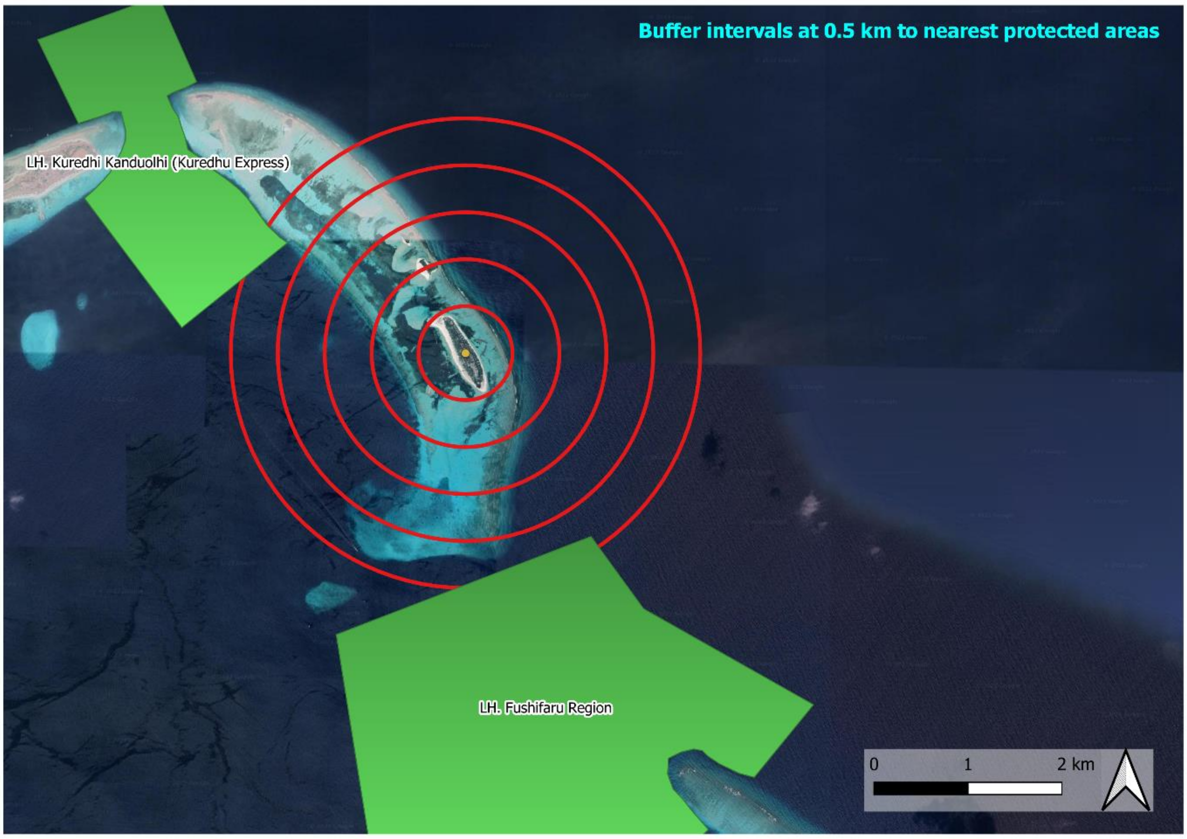


Figure 1: Nearest protected areas

3.2. Description of existing facilities

The resort is a five-star accommodation centre and has 11 types of residences with a total of 80 villas. This includes 12 beach bungalows, 10 beach villas, 18 water villas, 18 beach pool villas, 02 water pool villas, 06 retreat beach pool villas, 01 grand beach villa, 06 grand beach pool villas, 05 retreat grand beach pool villas, 01 retreat family beach pool villas and 01 sanctuary pool villa.

In terms of dining facilities, the resort also has 6 restaurants with a number of different cuisines to offer. As for leisure facilities, the resort has an infinity pool, wellness centre, beauty salon, 02 tennis courts, mini soccer field, squash court, kids club, game room, gym, yoga, diving center and water sports. Other amenities of the resort include the mosque, lounges and clinic. A detailed layout of the resort is also annexed to the report in the Appendix D- Detail drawings for for further information.

Existing water infrastructure of the resort

The RO plant house has a total of 437 sqft, hosting a RO plant of 300 cbm per day. The intake water is from the lagoon with a raw water collection tank of 51,000 lires. The RO plant consists of 04 sand filters and 040 cartridge filters. There are 02 product water tanks with a total capacity of 280,000 litres.

Figure 2: Important locations of the water infrastructure on the island

3.3. Relevant EIAs pertaining to the proposed project

Kanuhura resort is undergoing a major upgrade and refurbishment works due to the change in management to upgrade its facilities to meet their standards. As such, some upgrade works are ongoing through previous EIAs which has been studied in formulating the current one. They are;

1. Environmental impact assessment for additional water villa, expanding existing water villas and associated works in Lhaviyani Kanuhura
2. Environmental impact assessment for upgrading of water system (water tanks), powerhouse and maintenance dredging at Lhaviyani Kanuhura.
3. EIA for proposed refurbishment, beach nourishment and seagrass removal at Lhaviyani Kanuhura

3.4. Proposed works under this EIA

The proposed project is to establish additional 300 TPD RO plant with borehole in the Kanuhura resort. The process flow diagram of the proposed plant is provided Figure 3, while the equipment layout of the plant is provided in Figure 4 and the location of the new plant in the existing site is shown in Figure 5. The justification and details of different components of the proposed infrastructure are discussed in the following sub sections.

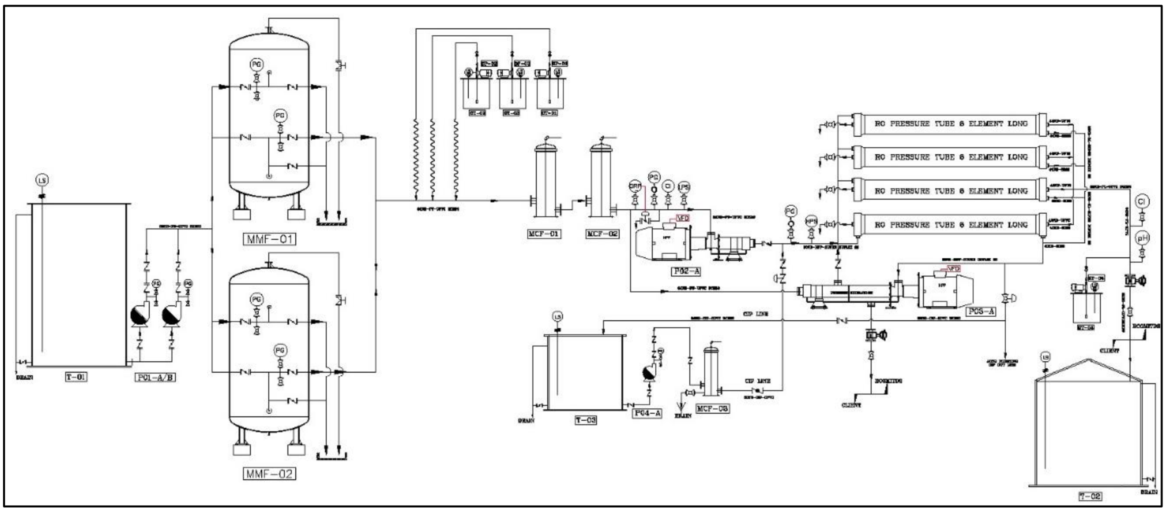


Figure 3: Partial print of process flow diagram of the RO plant

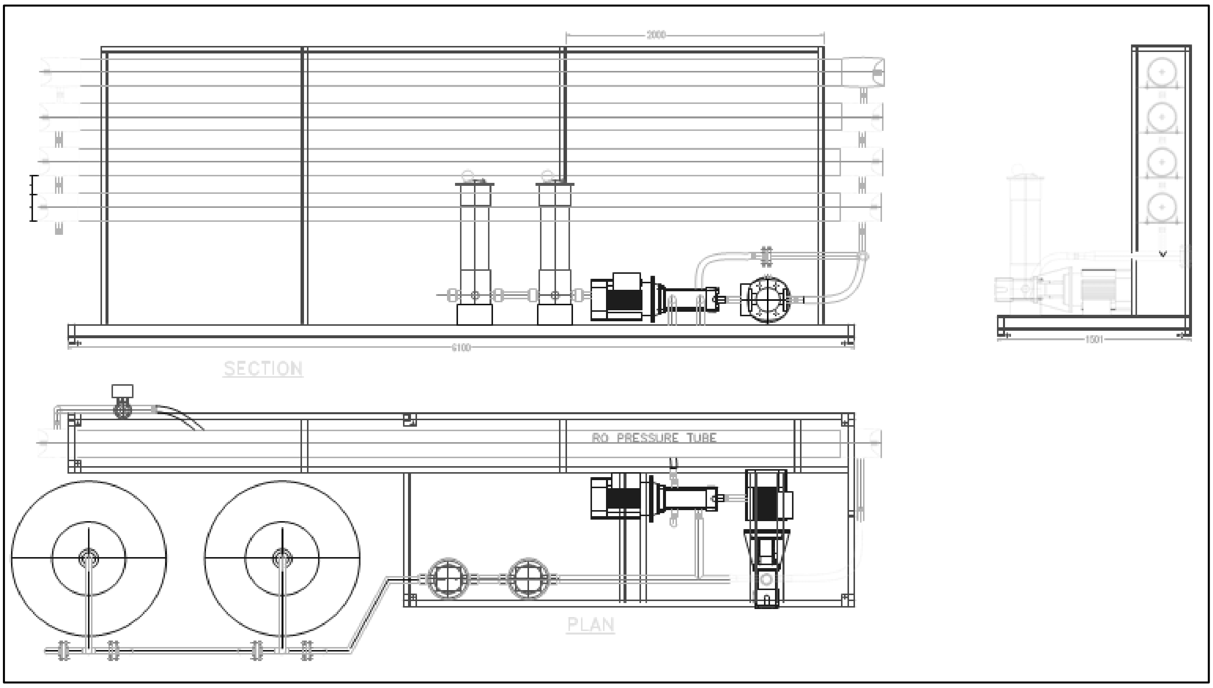


Figure 4: Equipment layout

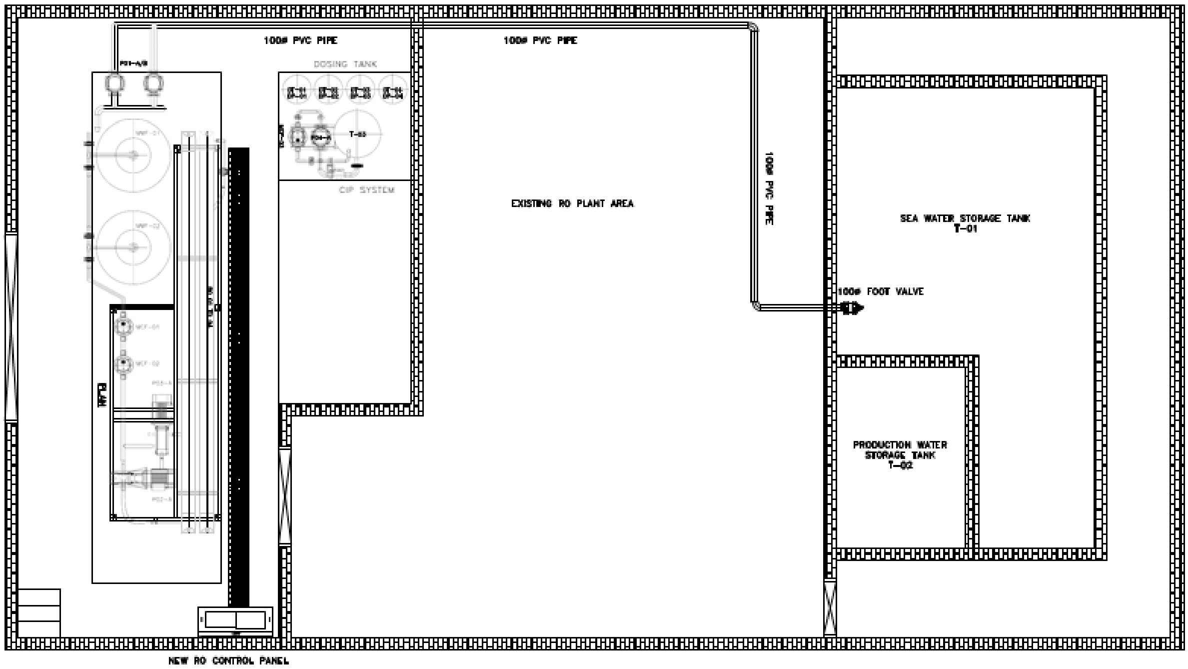


Figure 5:Partial print of RO plant location within the existing infrastructure

3.4.1. Justification

Kanuhura Resort is looking to upgrade its facilities with some modifications over the current building scheme. Essentially the upgrade is required in order to diversify the current facilities looking forward to meet the existing tourist demand. As such the resort is undergoing a major renovation where additional pools are added to existing villas, new villas are being constructed and all of its facilities are being upgraded. These new pools, additional villas and facilities will increase the water demand of the resort; hence the resort is undergoing upgrade works to its water system in order to cater for this new demand and also to improve the existing systems with the most recent technology to reduce the environmental impacts. The resort currently uses a beach intake for the RO plant and has decided to change the intake of RO plant to a borehole. Further, an additional 300 TPD RO plant is to be installed.

3.4.2. Borehole drilling methodology

The borehole will be located in the existing water plant plot depicted in Figure 2. A 5m x 5m area surrounding the drilling location shall be cleaned before setting up of drilling machine. Two mud pit (1.0 x 0.5 x 0.5 M) shall be made by using shovel and spade in front of drilling location and connected each other by a drain and canvas lining shall be done to prevent fluid loss. Drilling mud shall be prepared by mixing of bentonite with water with a proportion of 1:2 before 12 hours of drilling of borehole. Thickness of the mud shall be controlled as per the strata encountered during drilling. If there is severe caving encountered during drilling through a particular stratum, then 150 gram poly anionic cellulosic polymer shall be used by mixing with 50 kg bentonite and 100 liter water.

1. Drilling rig is placed on the drilling spot with proper platform and vertical alignment of the machine is done by using spirit level. During the whole drilling process this is checked frequently to maintain the verticality and alignment of borehole.
2. Drilling shall be started after attaching the mud pump and drilling machine with 50 mm hoses with 300 mm reamer bit up to the loose formation or overburden and 450 mm dia steel temporary casing will be placed up to the hard formation. The depth of outer casing shall be decided as per geological strata encountered at site.

After placing of temporary outer casing up to required depth drilling shall be continued with rotary mud circulation with 300 mm drag and rock roller bit. Suitable bit to be employed according to the hardness of lime rock. Soil and rock samples shall be collected from return water from borehole at every 10 m interval (if necessary) or change of strata. Soil/rock samples will be preserved in polythene bags marked with borehole number, depth and date of collection.

Bore Log shall be prepared as per the sample received during drilling from different depth. For future references, if required soil samples shall be kept for 3 months.

After bore hole drilling is completed for 35 to 40 meter (depending on salinity) it shall be flushed well until most of drilled particles are removed from hole prior to installation of the casing.

The standard threaded type bore well PVC casings to be installed with necessary screened casings according to the strata of the location. The screened casings to be placed in target aquifer to obtain the maximum yield of the well. After casings are placed the filter gravel of 5-10mm to be packed up to the required depth. Commonly the height of the filter pack to be 1.5 m above the screen casing. After pouring the filter pack surging and bailing to be done with drilling machine to compact the filter media.

Flushing of borehole shall be carried out after installing the filter pack by using the compressed air until sand particles are less than 2 mg per liter of water. The 24-hour yield test to be carried out by using multi stage pump and water levels to be taken as prior to pumping, while pumping and after pumping. A digital water meter to be installed at pumping main to record the output and these readings to be marked on every hour with water level of the well. The pumping water to be delivered and disposed at minimum 100 m from the test well. Once the pumping test is conducted the records to be submitted to the geologist to decide and recommend the pump installation depth and safe yield.

After completion of pumping test, the borehole head will be closed and locked for safety and perimeter fence to be install to avoid unwanted trespass. At final stage of pumping test water sample shall be collected in a sterilized 1 liter capacity bottle from outgoing water of borehole and sample shall be sent to chemical lab within a day for chemical and micro biological testing as per specification.

The water tests of E. Conductivity (µS/cm), TDS (mg/l), Chloride (mg/l), Calcium Hardness (mg/l), Magnesium Hardness (mg/l), Boron (mg/l), Phosphate (mg/l), Sulphate (mg/l), Iron (mg/l), Fluoride (mg/l), Ammonia (mg/l) and Lead (mg/l) shall be conducted and that report shall be submitted along with drill log. After completion of borehole drilling and installation completion, relevant tests from authorised Laboratories will be provided. Partial print of the borehole design is shown in Figure 6, full design details are provided in Appendix E- Detail drawings for Borehole. The borehole depth shall not be less than 30m. Drilling will continue up to 30m even if the electrical conductivity of discharge water has reached 50-60mS/cm before reaching 30m depth. If electrical conductivity of discharge water at 30 m depth is measured less than 50-60mS/cm, the drilling will be continued until electrical conductivity reaches to 50-60mS/cm.

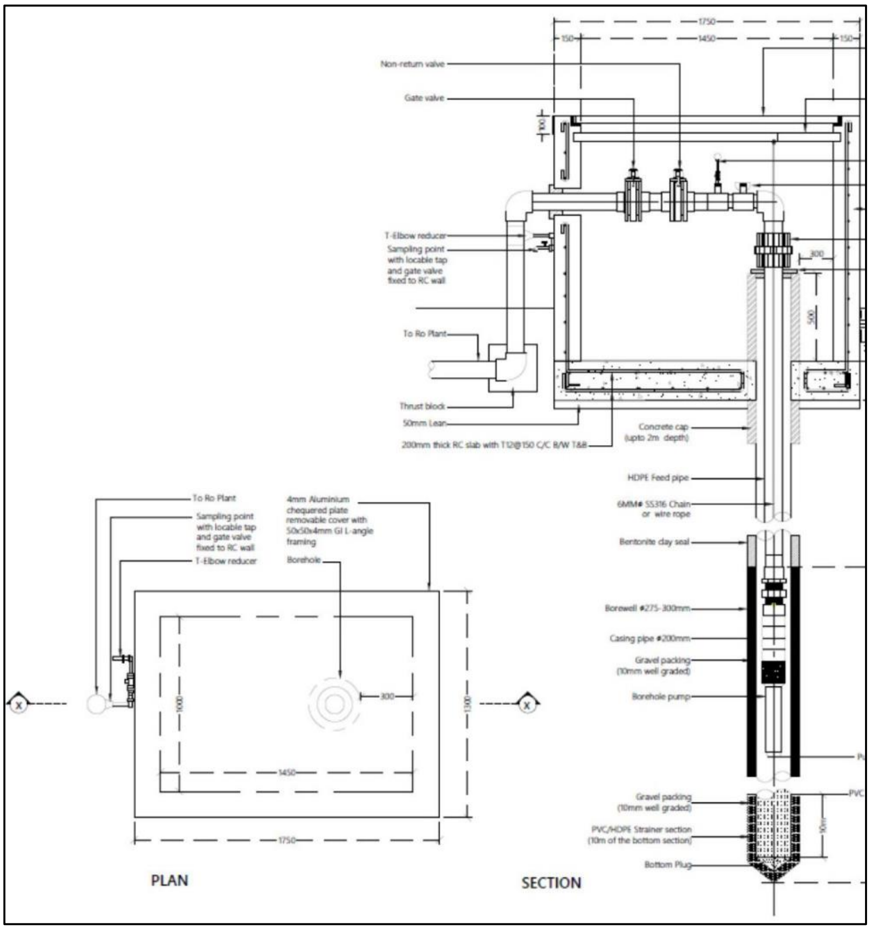


Figure 6: Partial print of borehole design

3.4.3. Water treatment

3.4.3.1. Pre-filter

The Filter feed pumps transfer the raw well water to Downstream Multimedia Filter for the removal of suspended solids, turbidity. The Multimedia filter offered will be a FRP vessel with Manual butterfly valve. One initial charge of filter media consisting of graded sand & Silex. The filtered water Disinfection with Sodium Hypo Chlorite (NaOCl) solution. The pressure sand filter will have to be backwashed at regular intervals to remove the accumulated dirt. The filter will have to be backwashed at regular intervals to ensure good quality filtered water. Backwashing will have to be done whenever the pressure drop across the filter exceed 1.2 kgs/cm2 or once every 12 hrs of continuous / intermittent operation.

3.4.3.2. Micron Cartridge Filter

The filtered water from the Multi Grade Filter is then passed to 10 and 5 Micron cartridge filter to prevent any suspended solids form entering the RO. Anti-Oxidant dosing system is deactivate the chlorine present in filtered water and Anti scalant dosing system is provided to prevent the scaling of membrane. Acid dosing system will correct the pH level before entering the RO Block. The filtered water is then pressurized using high-pressure pump to the RO block.

3.4.3.3. RO Block

The reverse osmosis system utilizes the latest generation thin film composite Polyamide membranes having Spiral wound configuration.

The RO membranes separate the feed into two streams, the permeate containing low dissolved solids will be collected in the RO permeate water collection tank & reject high TDS will be stored to reject water storage tank.

Process Monitoring

RO plant will be provided with following instrumentation for safe & easy operation.

- Pressure switches at the suction and discharge of the high-pressure pumps.
- Rota meter for the feed and Permeate
- Rota meter in the Reject
- Conductivity meter in the permeate

3.4.3.4. System Design flow

The system design flow are as follows:

Product water required per hour : 15 m^3/hr (300m^3/day)
Feed flow rate per hour : 37.5 m3/hr (System Recovery 40%)
Service cycle : 20 hours.
Average Flux considered : 16.8 LMH
Stages of process proposed : Filter Feed Pumps
: Multi Media Filter
: Chemical Dosing System
: Micron Cartridge Filter
: RO High Pressure Pump
: RO Block

3.4.3.5. Treatment scheme

The treatment scheme of the proposed system are:

1. Sodium Hypo Chloride Dosing System
2. Multi Media Filters
3. Anti-Oxidant Dosing System
4. Anti Scalent Dosing System

5. Acid Dosing System
6. Micron Cartridge Filter Stage – 1
7. Micron Cartridge Filter Stage – 2
8. RO Membrane block

The details of the process/sizing calculations of the proposed system are provided in Appendix D.

3.4.4. *Water quality monitoring systems and water security*

The output quality of the desalination plant shall comply to the supply water quality standards. The following parameters will be tested and in accordance to the below mentioned timelines during the operational phase.

3.4.4.1. *Daily tests*

Table 2:Product water quality reference ranges for daily monitoring

Parameter	Reference range
Free Chlorine	0.04 - 0.2 mg/l
pH	6.5 - 8.5
Physical Appearance	Clear & Colorless
Electrical Conductivity	<1000 µs/cm
Total Coliform	0/100ml CFU
Fecal Coliform	0/100ml CFU
Turbidity	<1 NTU
Total Dissolved Solids	<500 mg/L

3.4.4.2. *Monthly Tests*

The following parameters are to be tested and submitted along with the aforementioned Daily tests.

Table 3: Product water quality reference ranges for monthly monitoring

Parameter	Reference range
Chlorides	<200 mg/l
Nitrates	<50 mg/l
Ammonia	<0.02 – 2.50 mg/l
Iron	<0.3 mg/l
Hydrogen Sulphide	0.05 mg/l
Total Hardness	<75 mg/l
Suspended Solids	5-750 mg/L

3.4.4.3. *Bi-annual tests*

The following parameters are to be tested and submitted along with the aforementioned Daily and Monthly tests.

Table 4: Product water quality reference ranges for bi-annual monitoring

Parameter	Reference range
Total viable count at 22°C	100/1ml CFU
Total viable count at 37°C	20/1ml CFU

3.4.4.4. Annual tests

The following parameters are to be tested and submitted along with the aforementioned Daily, Monthly and Bi-annual tests.

Table 5: Product water quality reference ranges for annual monitoring

Parameter	Reference range
Anionic detergents	0.002 - 0.275 mg/l
Arsenic	<0.01 mg/l
Boron	<0.3 mg/l
Bromine	0.05 – 4.50 mg/l
Cadmium	<0.003 mg/l
Calcium hardness	<60 mg/l
Chromium	<0.05 mg/l
Copper	<2 mg/l
Cyanide	<0.07 mg/l
Enterococci	0/100ml CFU
Fluoride	<1.5 mg/l
Lead	<0.01 mg/l
Manganese	0.1 mg/l
Mercury	<0.001 mg/l
Phenolic compounds	0.002 - 0.2 mg/l
Phosphate	<5mg/l
Potassium	0 – 50 mg/l
Salmonella Typhi	0/100ml CFU
Shigella spp.	0/100ml CFU
Sodium	<200 mg/l
Sulphate	<250 mg/l
Total petroleum hydrocarbon	0 mg/l
Vibrio Cholerae	0/100ml CFU

3.4.4.5. Water security and storage

In the event that there is an issue with the borehole, the lagoon intake will be present as a backup. In terms of storage, the resort currently has a backup of 07 days with the recent upgrade of the water tanks via the approved EIA for upgrading of water system, powerhouse and maintenance dredging at Lhaviyani Kanuhura. In the event of failing of these backup systems, water will be delivered via vessel from the nearest water production facility.

3.4.5. Dewatering for pipeline installations and borehole construction

A minimal amount of dewatering is only anticipated during the borehole construction. As there is no works of the supply network or foundation works included in the proposed project, dewatering is not anticipated any other activities besides the borehole construction.

3.4.6. Vegetation clearance

No vegetation clearance is needed for the project.

3.5. Project Inputs and Outputs

The following two tables details the project inputs and outputs for the works to be undertaken in the proposed project.

Table 6: Major project inputs

Input resource(s)	Source/ type	Qty/Volume	Source of resource
Construction phase			
Man power	expatriate	Small numbers	Contractor
Construction material	**Temporary site setup for material storage**: Galvanized pipes, roofing sheets, toilet units, toilet fittings, cement, sand, timber, spun piles	Small quantities	Local purchase or import
	Concrete works: reinforcement steel bars, river sand, cement, aggregates	Large quantities	Local purchase or import
	Electrical: electrical cables and wires, DBs, MMCBs and MCBs, PVC pipes, light weight, telephone cable CAT 5, PVC conduits, 4 core armored cables, PP-R pipe, Multi pump,	Large quantities	Local purchase or import
	Water: HDPE pipes, fittings	Medium quantities	Local purchase or import
Machinery and equipment	drilling rig, excavator, lorry, air compressor, water pump & general construction tools.	1 drilling rig 1 excavator 1 lorry	Contractor
Water	Desalinated water	Large quantities	On island facilities
Fuel for operation	Petrol	Large quantities	On island facilities
Power	Electricity	Large quantities	On island facilities
Nose and mouth covering (COVID 19)	Face masks	Large quantities	Contractor
Operational phase			
Electricity	For RO Plant	62KW	On island facilities

Table 7: Major project outputs

Project outputs	Method of generation/Qty	Method of control
borehole	Through civil works, Qty: 1	works are to be supervised by supervision engineers
300 TPD plant	Through civil works, Qty: 1	works are to be supervised by supervision engineers

Construction wastes	Waste oils Packaging waste	Waste oil stored in closed labeled containers and transferred to Thilafushi for disposal Packaging waste stored in an area and routinely transferred to Thilafushi for disposal
Noise	Localized to the project site	Unavoidable, but could be minimized by limiting working hours to daytime only and completing the project within the earliest possible duration.

3.6. Project Construction

3.6.1. Mobilisation

All the equipment and material required for the project will be transferred to site via a barge and workforce will be transported in a ferry or a hired sea vessel. The barge will deliver the equipment and material on the Southern side of the island behind the service jetty.

3.6.2. Decommissioning

Once the project has been completed, contractor leaves the site after performing the required site clearance. Any temporary project facilities will be demolished and the waste will be transported to Thilafushi for disposal. All heavy machinery brought in by the contractor will be demobilized.

3.6.3. Labour requirement

During the construction phase, the following work profile will be utilized.

Table 8. Work profile required for implementation of the proposed project

Designation	responsibility
Project manager	Overall responsibility for the implementation of the project
Project engineer	Ensure that works are in accordance to drawings and specifications
Surveyors	Provide layout and levels
Site manager	In charge of site work implementation and coordination
Implementation Supervisors	Ensures that works are carried out according to project managers instructions
Safety supervisors	Assess risk and ensure that everyone follows the safety rules and regulations.
Laborers	Carries out all the tasks

3.6.4. Construction work regime and waste management

All the civil structures will be built using normal construction materials with least possible alterations to the natural environment. The construction waste shall be properly managed and shipped routinely to Thilafushi for disposal. Proper construction sign boards shall be placed for the safety of the workers and staff who use the areas.

The construction sites will be fenced off as per MoT regulations for safety of tourists and to minimize disturbances to any existing tourists on the resort with sign boards. Furthermore, the site will be monitored throughout the day to ensure that no trespassing is done to avoid any unfortunate incidences.

3.6.5. Health and safety measures

Mosquitoes, high temperature and drowning prevention measures are taken on site. Drugs are sprayed and mosquito nets are used in the accommodation area; Appropriate drugs are prepared in case of heatstroke. To prevent drowning, a strict management system is to be formulated and performed under supervision. Additionally, fencing the project site, set up entrance and exit, and arrange safety and civilization management personnel for on-site management.

Basic first aid facilities and safety gears shall be made readily available by the contractor during the construction phase of the project as per the regulation on safety standards for construction work. In case of an emergency, the workers shall be taken to the health centers on respective islands and if the need be, taken to Male'. Other specific safety measures during construction phases are detailed in the respective components under the project description.

Special consideration will be given to take all possible preventive measures of the current pandemic of Covid-19 during the construction and operation phase of the project. As such, the recommendations of the Health Protection Agency will strictly be enforced whilst sensitisation sessions will be undertaken to internal controls of health and safety to all the work force

During the operational phase basic first aid facilities and safety gears shall be made readily available to the working staff at the facilities. Occupation health and safety guidelines shall be strictly followed by all personnel. In case of an emergency, the workers shall be taken to the health centers on the respective islands and if the need be, taken to Male'.

3.6.6. Temporary facilities

As refurbishment works are ongoing in the island, the existing temporary material storage will be utilised for the project so that additional areas will not be impacted due to the proposed project. No facilities will be at the temporary site setup as the labor force will be housed at the back of the house (BOH) area of the resort and will utilize the existing utilities of the resort.

Figure 7: temporary material storage location at Kanuhura

Waste produced during the construction and operational phase will be managed through the existing waste management facilities and as per the set regulations.

3.6.7. Accidents and Spillage reduction

Fuel and chemical management are to be handle with utmost care as spillage and contamination of the groundwater is prohibited under the new Water and Sewerage Act (08/2020). Spillage control mechanisms will be in place prior to execution of works and labour force will be trained prior to commencement of the work. A dedicated environmental and social safeguards officer will be employed by the proponent to ensure the safety checks are in place to ensure the implementation of the mitigation and monitoring measures specified in the current report.

3.6.8. Grievance redress mechanism

Any complaints regarding the project will be addressed by the resort's operations manager and safeguards officer for the project Mr. Mohamed Riza in consultation with the resort management based in Singapore

3.7. Project Operation

Once the upgrade works are completed the new water system will be managed by the resort and the system will be operated as per the operation and maintenance manuals

3.8. Project duration and schedule of implementation

The construction will commence once the EIA process has been completed. Estimated date is early October 2022. Construction works is expected to be completed by January 2023. Borehole drilling works will be started as soon as the EIA is approved. Following is a brief work schedule proposed;

- Week 1: Drilling, temporary casing
- Week 2: Casing installation
- Week 3: Surge and flushing
- Week 4: Testing

The RO plant installation will commence once the borehole construction is completed. The entire project is estimated to be completed within 02 months from project commencement date. Refer to Appendix F- Detail work schedule for a detailed work plan of the proposed project.

3.9. Tasks already completed

No works has been carried with regard to the proposed scope of works. Currently, the concept approval has been acquired from Ministry of Tourism and is annex in the Appendix C- Concept Approval and Approved Site Plan of the current report.

4. METHODOLOGY

This chapter describes the methods used to collect and analyze data for this EIA report along with the potential limitations and uncertainty in data collection methods.

All site-specific data was collected on May to June and September 2022.

4.1. Water quality

2 ground water and 4 marine water samples were collected from project locations at Kanuhuraa Maldives (Refer to Figure 9 and Table 9 for sampling locations and respective GPS coordinates). Samples were collected in 500 mL plastic bottles by first rinsing the bottle with the sampling water three times. Samples for microbial testing was collected in two 100 mL sterilized Theobags. Before collecting the microbial sample, each time alcohol was applied to the sampler's hand to minimize cross contamination. Samples were then sent to Maldives Water and Sewerage Company's (MWSC) water quality assurance laboratory for testing.

4.2. Current measurement

A drogue constructed from plastic plates joined together by bolts to make four fins (Figure 8) to catch the currents, were used to measure currents. The drogue was deployed for a set time, the start and end location of the drogue was geo-referenced using a hand-held GPS (Figure 8). The distance travelled was later calculated and the speed of currents determined. Drogue runs were done at 15 different locations.

Figure 8. Drogue deployed at sea for current measurement (left) and hand-held GPS used to geo-reference sampling locations

4.3. Limitations and uncertainty in data collection

There are several sources of uncertainty and limitations in any data collection method, some of which we aren't even aware of it. Nonetheless, the possible sources of uncertainty and limitations for the methods used to collect data for this EIA is described below.

Firstly, the water quality tests were not done on-site, therefore the results may not reflect the actual physical parameters of water for example temperature.

Current measurements were taken only at one time. While currents may change depending on the time and the season.

4.4. Geo-referencing

The geo-coordinates for each sampling location are shown in Figure 9 and Table 9 below.

Table 9: Geo-coordinates for all sampling locations at Kanuhura

Code	Type	Location	GPS Coordinates	
			Easting	**Northing**
M1	Refers to location M1 of water sample and drogue run	North of brine discharge	334568.000	612074.000
M8	Refers to location M8 of water sample and drogue run	South of brine discharge	334841.000	611413.000
Brine outfall	Refers to location Brine outfall of water sample and drogue run	Just north of service jetty	334768.000	611563.000
C	Refers to location C of water sample and drogue run	(Control site) Eastern reef edge	334917.000	611690.000
BH	Ground water sample at location BH	(Project Construction site) Near existing RO plant and Powerhouse	334691.000	611557.000
G1	Ground water sample at location G1	(Control site) Near existing staff accommodations	334602.000	611706.000

Figure 9: Sampling locations at Kanuhura

5. EXISTING ENVIRONMENT

This chapter describes the existing environmental conditions of the proposed project site. Sections 5.1 describes the general environmental condition of the Maldives and 5.2 outlines the general climatic conditions by analyzing data from the meteorological center of the Maldives. Sections 5.3 to 5.4 details the specific environmental conditions at the proposed project site.

5.1. The Maldivian setting

Maldives, officially known as the Republic of Maldives and sometimes referred to as the Maldive Islands, is an island nation (Zahid, 2011) consisting of nearly 1192 islands on a double chain of 26 natural atolls (administratively divided into 20 atolls), 80-120 km wide, in the Laccadive Sea in the Indian Ocean (State of the Environment 2004, 2004). Elevating less than 3 meters above mean sea level, with 80% of land area less than 1 m, Maldives is the flattest country in the world. The total area is about 107,500 km^2 of which roughly 300 km^2 of landmass (Zahid, 2011), with a population of about 338, 434 (as per September 2014 census) (Maldives' Population Dynamics: Policy Prospects for Human Growth and Opportunity, 2016) spread over 194 inhabited islands (Statistical Yearbook of Maldives 2010, 2010). Stretching 860 km from latitude 7°6"35"N, crosses the Equator to 0°42"24"S, and lies between 72°32"19"E and 73°46"13"E longitude (Zahid, 2011). These coral Atolls are located on the 1600 km long Laccadives-Chagos submarine ridge extending into the central Indian Ocean from the SW coast of the Indian sub-continent (State of the Environment 2004, 2004).

The Atolls vary greatly in shape and size as well as the characteristics of the Atolls, reefs and reef islands vary considerably from north to south. The northern atolls are broad banks, discontinuously fringed by reefs with small reef islands and with numerous patch reefs and faros in the Lagoon whereas in the southern atolls, faros and patch reef are rarer in the Lagoon, continuity of the atoll rim is greater and a larger proportion of the perimeter of the Atolls is occupied by islands. The islands also differ depending on location, form and topography. The islands vary in size from 0.5 km^2 to around 5.0 km^2 and in shape from small sandbanks with sparse vegetation to elongated strip islands. Many have storm ridges at the seaward edges and a few are characterized by swampy depressions in the center (State of the Environment 2004, 2004).

Located on the equator, Maldives experiences a warm, humid tropical climate or a monsoonal climate with two distinct seasons known as the northeast monsoon (dry season) from January to March and southwest monsoon (wet season) from May to November (State of the Environment 2004, 2004). The southwest season brings in torrential rain (Zahid, 2011) and rainfall varies from north to south along the atoll chain, with a drier north and wetter south (State of the Environment 2004, 2004). Rainfall varied from 1,407 mm to 2,707 mm interannually over the last 30 years. May, August, September and December are the wettest months and January to April the driest (State of the Environment 2004, 2004).

The annual and seasonal temperatures vary very little with a mean annual temperature of 28°C (State of the Environment 2004, 2004); however, the diurnal temperature fluctuates from 31°C during the day to 23°C at night. This is associated with the small size of the islands and the tempering of the hot days by cooling sea breezes surrounding the islands (Zahid, 2011). The highest and lowest temperatures on record are 36.8°C on May 1991 and 17.2°C on April 1978 respectively (State of the Environment 2004, 2004).

Ocean currents are driven by the monsoon winds with the westerly flowing currents dominating the northeast monsoon and easterly currents dominating the southwest monsoon. Changes in current flow patterns occur in April and December corresponding to the transition periods of the southwest and northeast monsoons respectively. Currents near the shoreline slightly differ from oceanic currents depending on the location, orientation and morphology of the reefs and underwater topography (Zahid, 2011).

Sea surface temperature (SST) is reasonably constant throughout the year and ranges between 28 to 29 °C. Mean monthly SST rises from December/January to April/May. However, May 1998 experienced a mean monthly SST of 30.3 °C which is expected to occur every 20 years. Furthermore, temperature drops rapidly to below 20 °C at a depth of 90-100 m (State of the Environment 2004, 2004).

5.1.1. Geology and Geomorphology

Earth's crust, called the lithosphere, consists of 15 to 20 moving tectonic plates. The plates can be considered as cracked shell that rest on the hot and molten rock of Earth's mantle and fit closely against one another. The heat from radioactive processes within the planet's interior causes the plates to move toward and away from each other which is known as tectonic shifts (NOAA, 2021).

Maldives in located on the Indo-Australian plate which is among the 7 major plate tectonic boundaries found on Earth. The Indo-Australia plate which is a combination Australian and Indian Plates covering a total area of about 58,900,000km2. However, they are generally considered to be two separate plates (Earthhow, 2021).

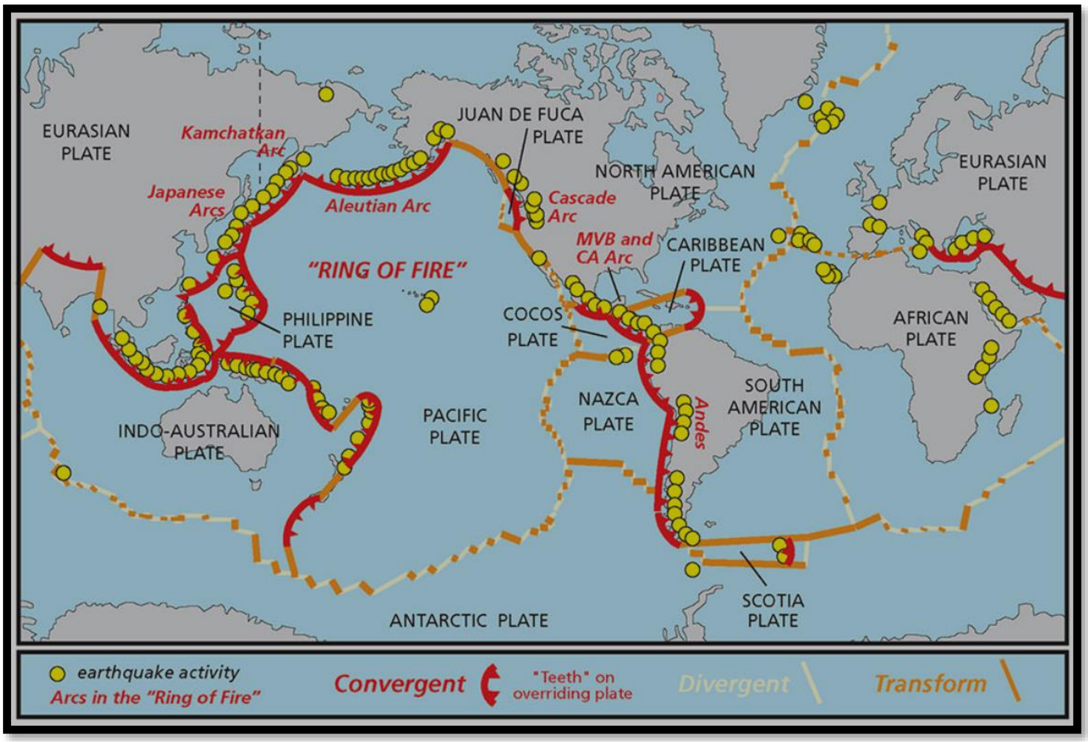


Figure 10 : Shows all the major tectonic plates and their general movements

Maldives is an archipelago of islands. Maldives is made up of 26 natural chain of atolls covering over 90000 square kilometer in the sea. The islands stretch for 822 km from north to south, with the greatest width from west to east being 130km. The land area of all the islands amounts to 298km2 (Belopsky & Droxler, 2004).

The inner sea of the atolls mostly have shallow depths compared to the rest of the outer sea with depths ranging from 300 to 500m (Purdy & Bertram, 1993). The following figure shows a general bathymetric map highlighting the changes in depth within and outside waters in and around Maldives.

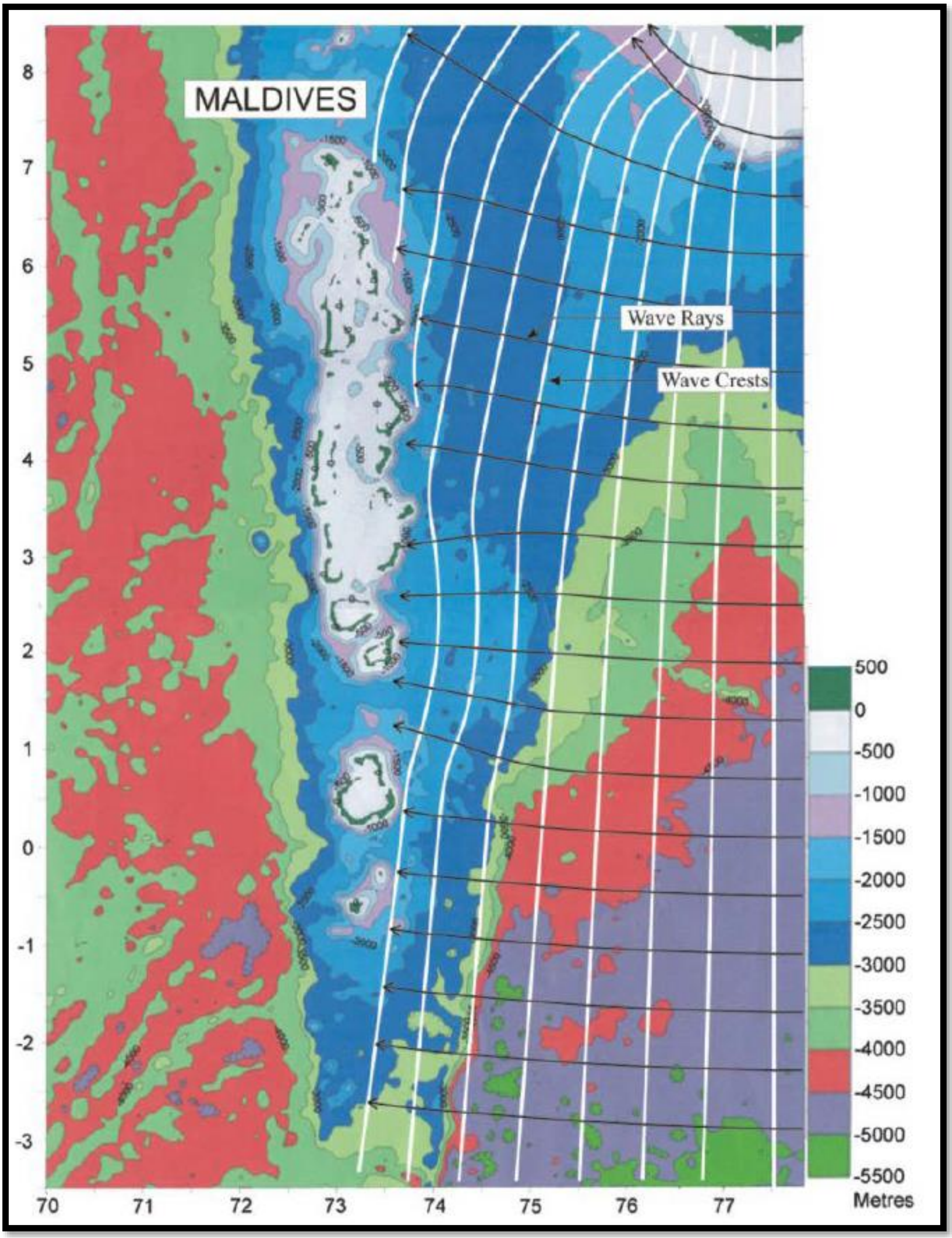


Figure 11: Shows the general bathymetry of Maldives (riyan Pte.Ltd, 2013)

Most of the islands have high peripheral storm berms formed due to overwash with maximum elevations of 2.2m above mean sea level (MSL). The present-day beach is deposited against the vegetation line of the island. The seaward boundary is defined by a distinct break in slope associated with the transition from unconsolidated beach sediment to the fixed reef flat substrate in which beach and shoreline move freely. Beach width varies considerably for each individual island (Kench, P S; Brander, R W, 2006).

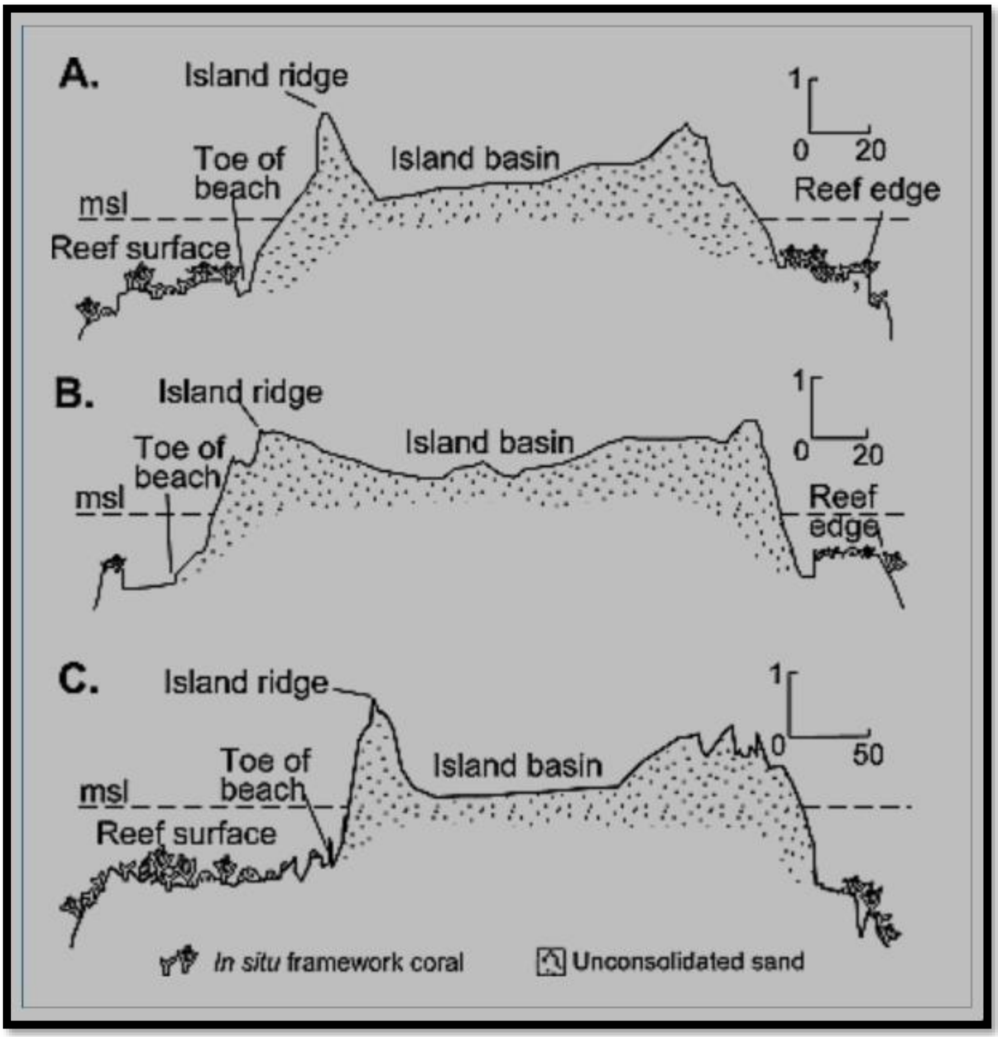


Figure 12: Shows some morphological features in an island system (Kench, P S; Brander, R W, 2006).

5.1.2. Waves

Hydrodynamics features in Maldives have been very poorly studied. (Young, 1999) shows wave climate data for a ten-year period for each world regional zone. Wave height was measured by satellite (Radar Altimeter), whereas a global wave model was used to precise wave directions. It indicates that the dominant swell approaches from southerly directions (Figure 13). On a seasonal basis, swell is from the south-southwest from April to November (SW monsoon) with a peak significant wave height (Hs) of 1.8m in June, and from the south to southeast directions from November to March (NE monsoon) with minimum Hs of 0.75m in March.

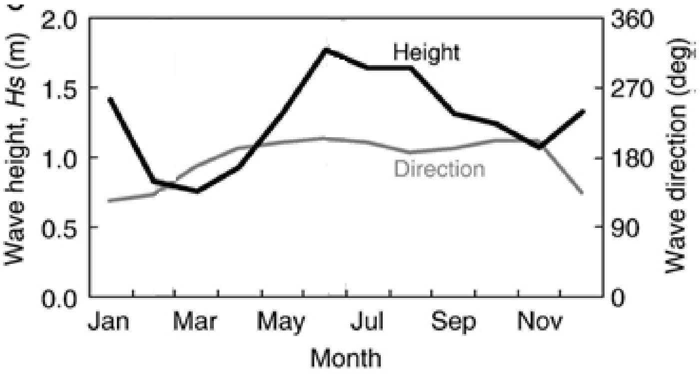


Figure 13: Ten year mean monthly wave height and direction for the central Maldives. Source: Young (1999).

The work of (Contestabile, Lauro, Galli, & Vicinanza, 2017) in a report published in 2017 regarding wave energy in the Maldives showed that Young's findings were accurate. They showed that the wave energy in the South (average significant wave height 1.5 m) is higher and diminishing towards the Northern islands (average significant wave height 1.3 m). Furthermore, there is a change in wave energy in the Eastern and Western side of the Maldives which are much more evident for extreme events. The maximum significant wave height in the West is 3.59 m and 3.05 in the East. The main reason for these difference in wave energy is because the majority of the swell waves approach the Maldives from the S-SW direction.

In addition to the swell waves Maldivian islands are impacted by local wind generated waves. Wind waves are generated due to monsoonal winds in the Maldives. Therefore, the strength and direction of wind waves is dictated by the strength and direction of the winds. Since the monsoonal winds are strongest in the SW monsoon between April-July, it is during this period the strongest wind waves would be generated.

5.1.3. Currents

In the Indian Ocean the Maldivian archipelago has relatively stronger currents (Riyaz, 2016). Current speeds in the channels between the atolls can vary between 0.51-0.77 m/s while the currents in the channels within the atolls are stronger and the E-W oriented channels having the strongest currents between 1.5-2.6 m/s (Rober Gordon Univeristy, 2011).

In the Maldives currents are predominantly caused by the complex interaction of oceanic currents, tidal currents and local wind induced currents. The major current that flows through the Maldives is caused by the monsoonal winds. During the SW monsoon the currents flow from W-E and during the NE monsoon from E-W (Rober Gordon Univeristy, 2011). Other factors which influence the currents are waves, local bathymetry and topography. The resultant currents at a specific location in the Maldives is determined by the complex interaction among the aforementioned factors.

Tidal currents are caused by the horizontal movement of water which is caused by the regular rise and fall of the sea level due to tides (Riyaz, 2016). The strength of the tidal currents are determined by the tidal ranges and follow the same periodicities as the tide meaning the tidal currents would be weaker during low tide and vice versa. In general, the tidal currents flow eastward during flood and westward during ebb.

5.1.4. Tides

The tides in the Maldives are semi-diurnal with diurnal inequalities meaning there are two high and two lows everyday with different heights (Rober Gordon Univeristy, 2011). In addition to the daily variation in tides, there are variations in tides due to the lunar cycle which are caused by the varying gravitation pull of the moon due to the position of the moon. When the moon and the sun is aligned in a straight line the gravitational pull is greatest and this causes a spring tide. When the moon and the sun are aligned at 90^0 their combined gravitational pull is at the minimum and this causes a neap tide.

With reference to mean sea level (MSL) the mean higher high water is +0.34 m and mean lower low water is -0.36 m (Riyaz, 2016). However, it has been reported that the highest astronomical tide was at +0.64 and lowest astronomical tide at -0.56.

Table 10: mean tidal variations in the Maldives (Riyaz, 2016).

Tide Level	*Referred to MSL*
highest astronomical tide (HAT)	+0.64
mean higher high water (MHHW)	+0.34
mean lower high water (MLHW)	+0.14
mean sea level (MSL)	0.00
mean higher low water (MHLW)	-0.16
mean lower low water (MHLW)	-0.36

lowest astronomical tide (LAT)	-0.56

5.2. Climatic conditions

The Bureau of Meteorology of Maldives has compiled a range of climate variables since 1975 from five different meteorological stations located across the Maldives. Climate variables including temperature and rainfall were analyzed for the Hulhule’ station as the Bureau of Meteorology of Maldives classify Lhaviyanu Atoll to the central region of the Maldives even though the measured distance from Kanuhura to Hanimaadhoo is shorter 141 Km (Kanuhura to Hulhule’ is 148.5 Km).

5.2.1. Temperature

Analysis of temperature data shows that the variation in temperature throughout the year is generally very minimal, however, daily temperature ranges from 34.9°C during the day to 19°C at night. Looking at the monthly variation in temperature, the highest temperature was recorded for the month of April from the meteorological station in Hulhule’ reading 31.8°C over the past 47 years. With regards to the minimum temperature, the lowest temperature at Hulhule’, 25.4°C was recorded for November (Figure 14).

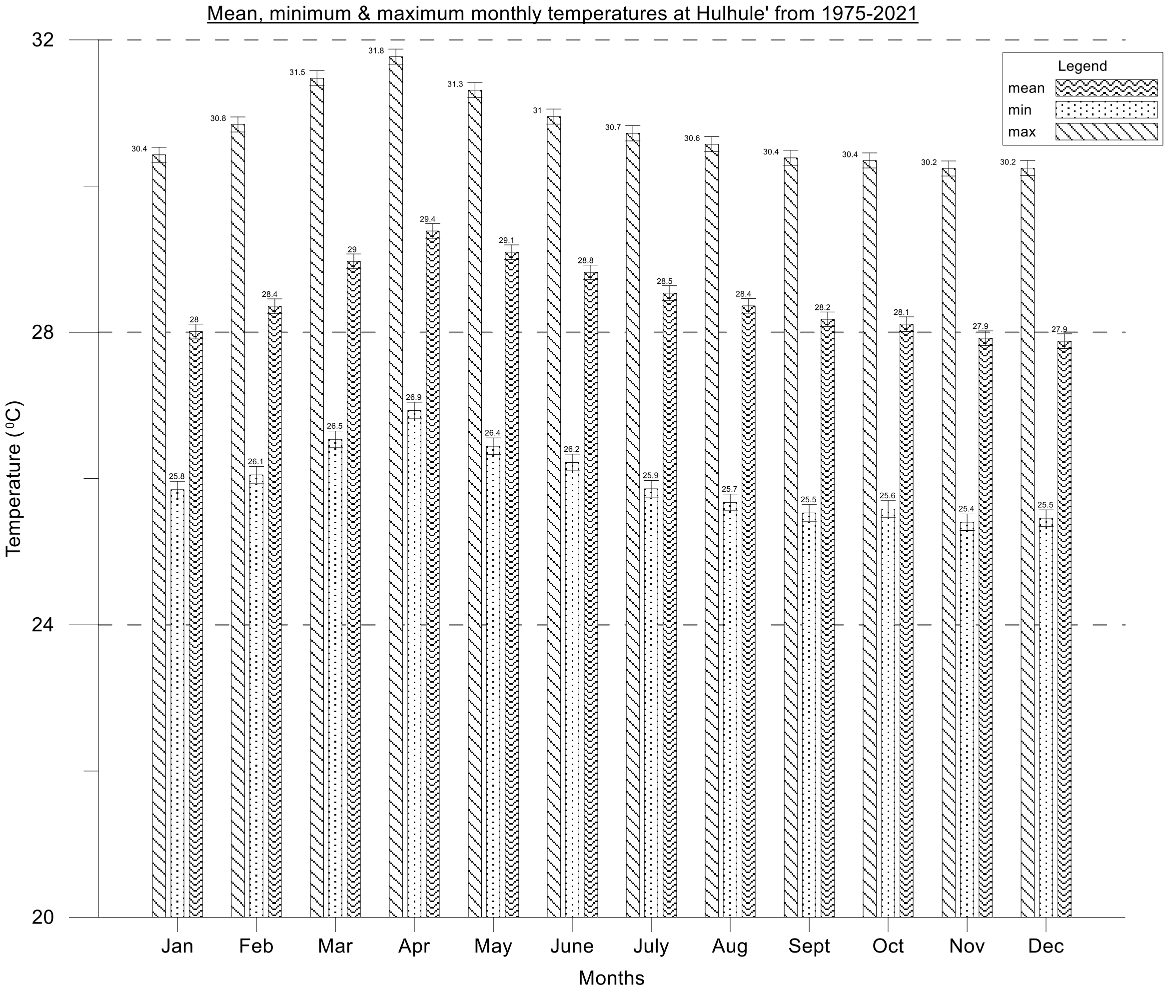


Figure 14. Mean, minimum and maximum monthly temperatures (°C) for Hulhule from 1975 to 2021 (Data obtained from the Bureau of Meteorology, Maldives)

5.2.2. Rainfall

Analysis of rainfall data from 1975 to 2021 at Hulhule’ meteorological station shows that the mean monthly rainfall follows the traditionally defined seasons with most rain occurring from May to December and little rain falling outside these months. The highest amount of rain was observed during the month of October with 235 mm of rain on average and the lowest rain was experienced in February, averaging only about 39.6 mm of rain over the past 47 years.

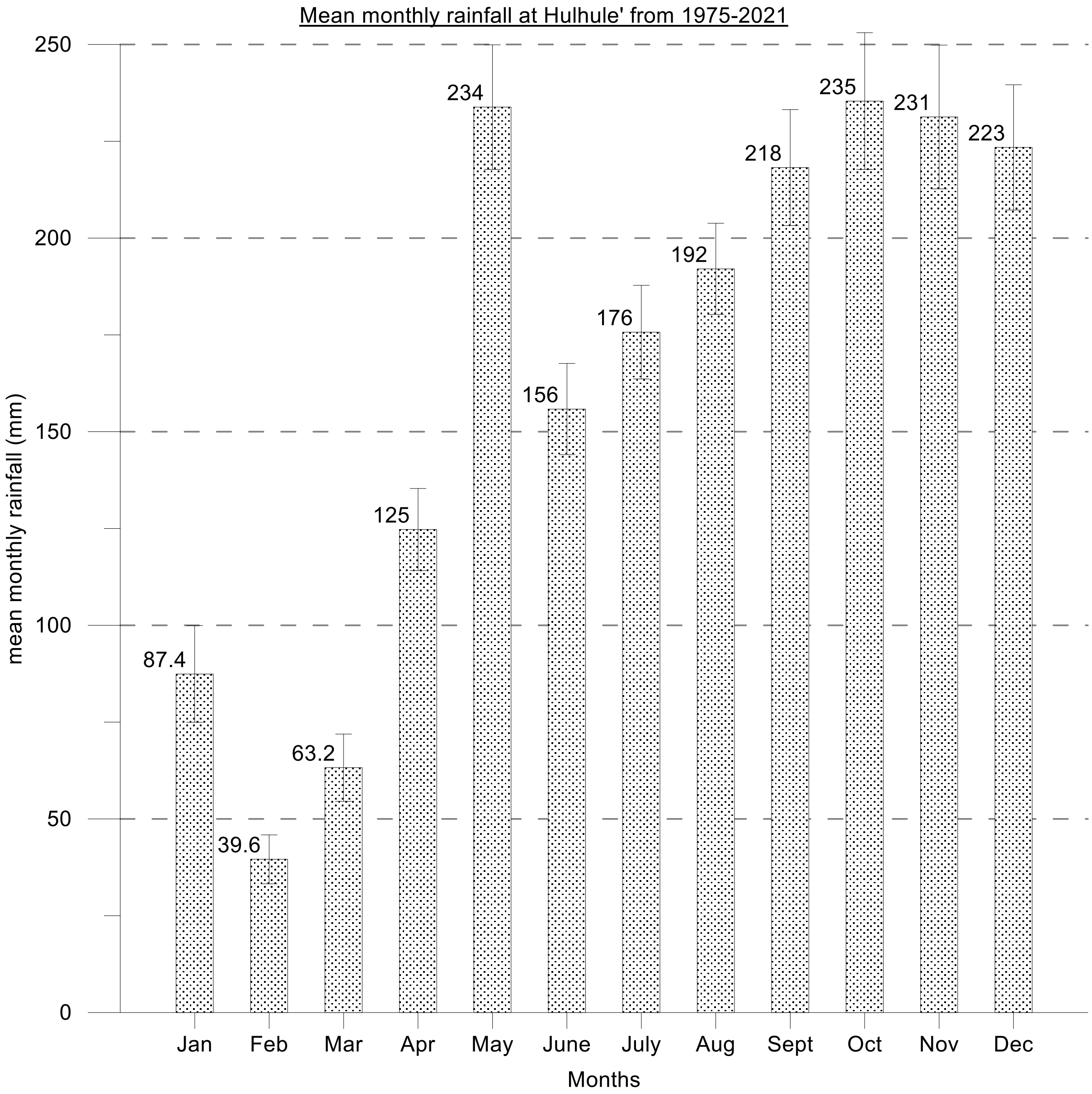


Figure 15. Mean monthly rainfall (mm) for Hulhule from 1975 to 2021 (Data obtained from the Bureau of Meteorology, Maldives)

5.2.3. Wind

Climate in the Maldives is dominated by the Indian monsoon climate South West (SW) monsoon and North East (NE) monsoon. The Indian monsoon system is one of the major climate systems of the world, impacting large portions of both Africa and Asia.

The period of the year during which prevailing winds are from south to westerly direction is known as the SW monsoon (Kench, Parnell, & Brander, 2009). The period during which prevailing winds are from north-easterly directions is known as NE monsoon. Transitions from

NE to SW monsoon and vice versa are distinctly different from SW or NE monsoon. During these transition periods the wind becomes more variable.

The SW monsoon lasts between May and September while the NE monsoon lasts between December and February. The period between March and April is the transition period from the NE monsoon to SW monsoon known locally as the *Hulhangu Halha*, while the transition period from SW monsoon to NE monsoon is known as *Iruvai Halha*. *Iruvai Halha* is from October to November (Table 11). SW monsoon is generally rough and wetter than the NE monsoon. Storms and gales are infrequent in this part of the globe and cyclones do not reach as far south as the Maldivian archipelago.

Table 11: The four seasons in the Maldives. Source (Danish Hydraulic Institute, 1999).

Season	Month
NE-Monsoon	December
	January
	February
Transition Period 1	March
	April
SW-Monsoon	May
	June
	July
	August
	September
Transition Period 2	October
	November

By analyzing the available wind data from the meteorological station a windrose was drawn (Figure 16 and Figure 17). The wind speed classes have been categorized according to the beaufort wind scale (Trujillo & Thurman, 2016). According to this scale wind speeds of 4-6 knots are light breeze, 28-47 knots are gales and wind speeds greater than 48 knots are considered as storm. The following table shows the beaufort wind scale.

Table 12: beaufort wind scale

Beaufort number	Descriptive term	Wind Speed (knots)
0	Calm	0-1
1	Light air	1-3
2	Light breeze	4-6
3	Gentle breeze	7-10
4	Moderate breeze	11-16
5	Fresh breeze	17-21
6	Strong breeze	22-27

7	Near gale	28-33
8	Gale	34-40
9	Strone gale	41-47
10	Storm	48-55
11	Voilent storm	56-63
12	Hurricane	64 +

Looking at the mean wind speeds and direction for Hulhule’, it was observed that the strongest winds occur from W and WNW directions (in the SW monsoon) and NE, ENE, and E direction (in the NE monsoon). Winds from the South and SE were less prevalent and with comparatively low speeds. Majority of the times, winds occur at a speed of 7 to 16 kn which is generally known as gentle to moderate breeze. Mean wind speeds above 22 kn occurred from the Western quadrant (W and WNW) to a very low occurrence.

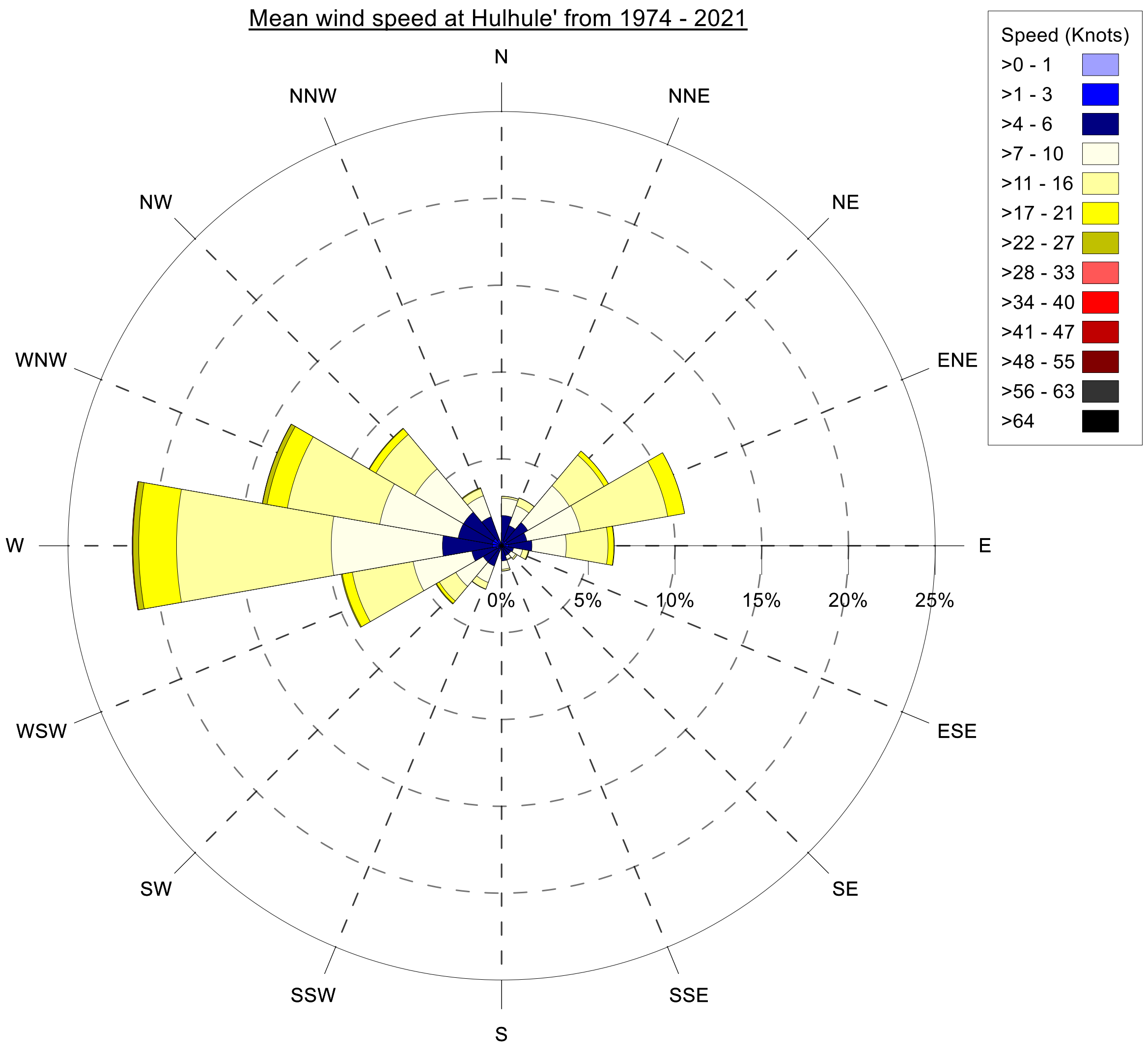


Figure 16. Mean wind speeds for Hulhule from 1975 to 2021 (Data obtained from the Bureau of Meteorology, Maldives)

With respect to maximum wind speeds, visual inspection of the wind rose plot coincides with that of the mean wind speeds. Approximately 2% of the times, wind speeds had gone as high as > 40 kn at this region. The highest recorded maximum wind speed for the region was 62 kn on 3rd November 1978 during the data collection period. The most common maximum wind speed is between 7-27 kn.

Wind rose plots for both maximum and mean wind speeds show that winds from the West are dominant (17 % of the times).

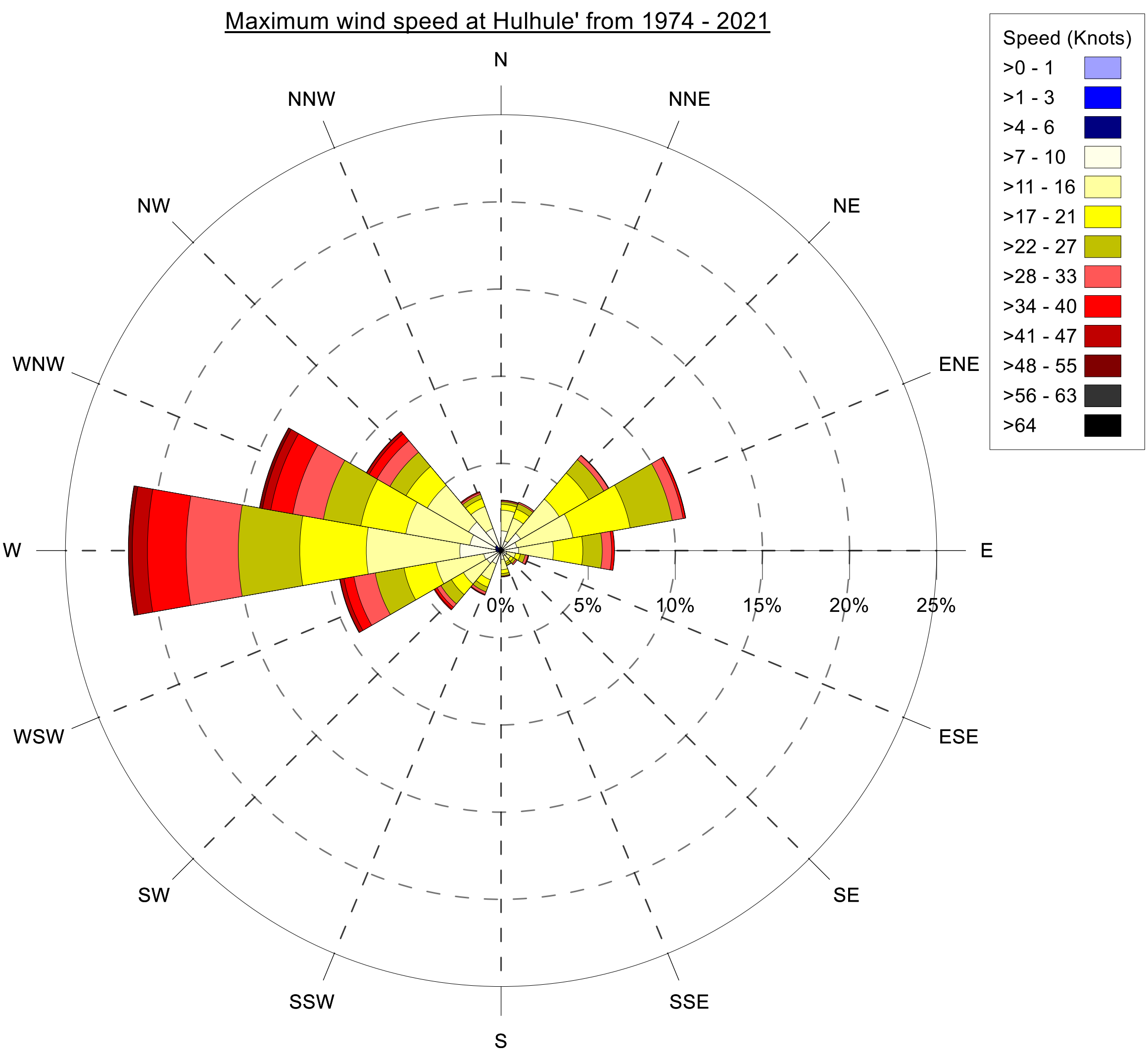


Figure 17: Maximum wind speeds for Hulhule from 1975 to 2021 (Data obtained from the Bureau of Meteorology, Maldives)

5.3. Marine environment of Kanuhura

This section describes the site-specific marine environmental conditions of the proposed project site. The general setting of Kanuhura with measured current patterns around the island, and marine water qualityresults are presented.

5.3.1. General setting

Located on the northern half of Maldives, Kanuhuraa is located at the northern periphery of Lhaviyani Atoll at geographic coordinates of 611730.00 m N and 334588.00 m E (Figure 18). The reef system hosting the island is exclusive to the island. The land area of Kanuhuraa is about 14.5 ha. The closest inhabited islands to Kanuhuraa is Hinnavaru at distances of approximately 11.3 km. The island hosting the major international airport of the country, Hulhule' is located 148.5 km to the south of Kanuhuraa (Figure 18).

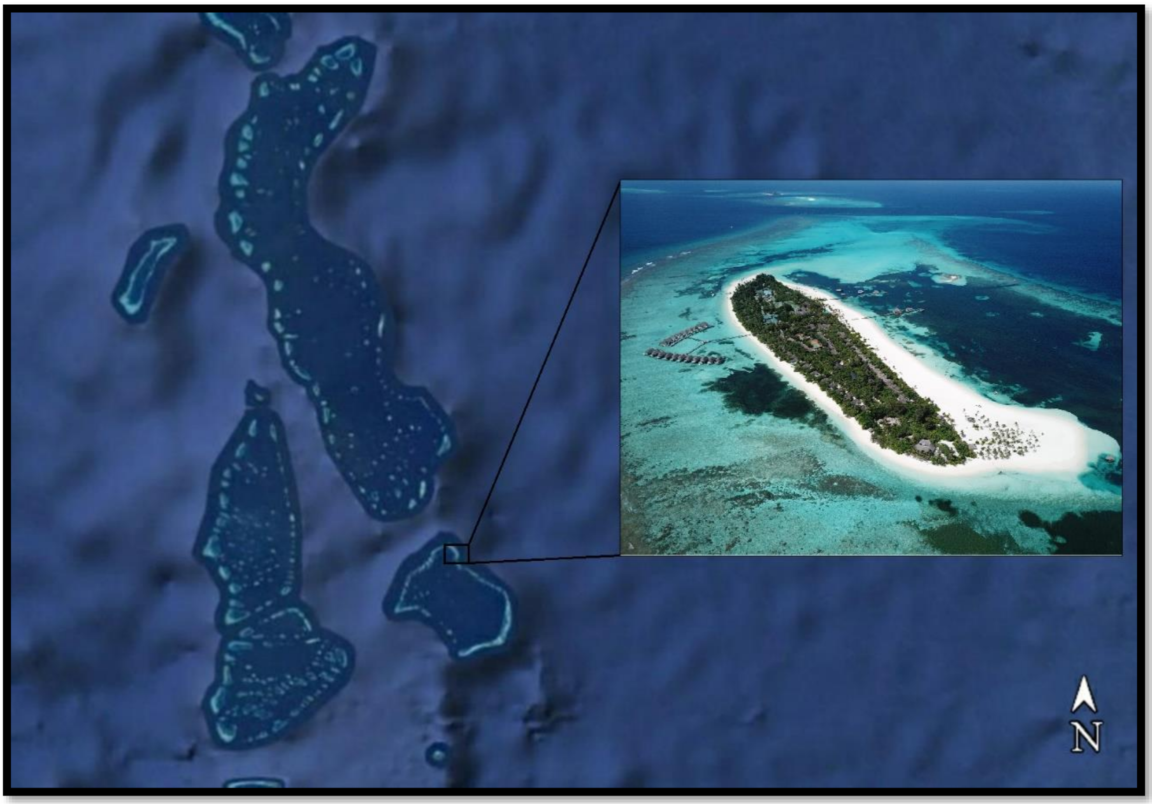


Figure 18. Location of Kanuhuraa (right) in Lhaviyani Atoll

5.3.2. Currents and Coastal dynamics

Kanuhuraa is located on the Northern rim of Lhaviyani atoll. To the S-SE of the Island lies number of reef systems at the outer rim of the atoll which would obstruct the incoming swells from S-SE direction. Therefore, the intensity of the Swell waves reaching the Island in the NE monsoon would be low.

During the NE monsoon the winds predominantly blow from ENE. Towards this direction there are no Atolls, Island or Reefs. Therefore, the effective fetch from this direction would be very high and hence the Island would experience strong wind waves from this direction.

Figure 19. Approach of wind and swell waves to Kanuhura in NE monsoon

During the SW monsoon, swells would approach the island from south to SW directions. To the South lies majority of Lhaviyani Atoll and to the SW lies Baa Atoll with extensive reef systems and Islands, therefore the intensity of swell waves reaching the Island from this direction would be very low.

The strongest winds during SW monsoon comes from the W and WNW direction. In this direction there are a few islands. These islands would reduce effective fetch to some extent, which in turn would reduce the intensity of the wind waves from this direction.

Overall, the strongest waves to Kanuhuraa would most likely come from the W, WNW and ENE direction.

Figure 20: approach of wind and swell waves to Kanuhura in SW monsoon

The current measurements were taken during the SW monsoon when the general pattern of currents through the Maldives is from west to east and currents generally flow eastwards during high tide. During data collection period the tide was at flood. The results show an easterly flowing current as expected of the SW moon and flood tide. The eastward flowing current seems to be diverted South due to the presence of Kanuhura Island and its reef. As the flow is diverted towards the Southern end of the Island, the speed of the currents is dramatically increased, and this is shown as the strongest current speed recorded from the drogue runs at 0.44 m/s.

Schematic diagrams showing the measured current patterns on Kanuhuraa reef flat is shown in below.

Figure 21: Current patterns around Kanuhura

5.3.3. Marine water quality

Marine water quality was compared with a set of internationally agreed optimal ranges as follows;

Table 13: marine water quality optimal ranges

Location	Optimal Range	Reference
Temperature (^{0}C)	18^{0}C - 32^{0}C *Changes should not surpass 1^{0}C above the average long-term maximum	GBRMPA, 2009
pH	8.0-8.3 *Levels below 7.4 pH cause stress	EPA
Salinity (%)	3.2% - 4.2%	GBRMPA, 2009
Turbidity (NTU)	3-5 NTU >5 NTU causes stress	Cooper *et al.* 2008

Marine water test results from MWSC water quality assurance laboratory is attached in Appendix G- Water Quality Assessment results of this report.

Among the tested parameters, most of the parameters were within the optimal ranges except for pH. pH exceeded with 0.1 at locations M1 and C.

Table 14: marine water quality test results (parameters exceeding optimal ranges are highlighted in red) for Kanuhura

Location	M1	M8	Brine Outfall	C
Temperature (^{0}C)	23.4	22.3	22.5	22.8
pH	**8.4**	8.1	8.1	**8.4**
Salinity (%)	3.34	3.30	3.30	3..31
Turbidity (NTU)	0.19	0.766	0.198	0.18

5.4. Terrestrial environment of Kanuhura

This section describes the site-specific terrestrial environmental conditions of the proposed project site. The structural environment, types of vegetation and ground water quality results are presented.

5.4.1. Structural environment

The RO plant and Powerhouse is at the BOH area of the resort. The proposed 300 TPD RO plant would be installed in the existing RO plant facility while the borehole would be constructed just outside, north of the RO plant area. Following figures shows relevant project sites.

Figure 22: existing RO plant

The proposed location where the borehole would be constructed is shown in the figure below.

Figure 23: proposed borehole location

5.4.2. *Vegetation*

There is no vegetation at the proposed project site. Refer to Figure 22 and Figure 23.

5.4.3. *Ground water quality*

Ground water quality was compared with the EPA supply water quality standard guideline value as follows:-

Table 15: ground water quality optimal ranges

Parameter	Optimal Range	Reference
Temperature (^{0}C)	NA	EPA
pH	6.5-8.5	EPA
Conductivity (µS/cm)	<1000	EPA

Nitrates (mg/L)	<50 mg/l	EPA
Dissolved Oxygen (mg/L)	NA	EPA
Total Coliform (MPN/100ml)	0/100ml CFU	EPA
Faecal Coliform (MPN/100ml)	0/100ml CFU	EPA

Groundwater test results from MWSC water quality assurance laboratory is attached in Appendix G- Water Quality Assessment results of this report.

Among the tested parameters, most were within optimal ranges. Conductivity is extremely high at location G1 at 8130 µS/cm. Conductivity at location BH is also high at 1096 µS/cm. Looking at the other tested parameters, DO at location BH (7.26 mg/L) is significantly higher than at G1 (3.99 mg/L). Total coliforms were found at very high concentrations at both locations. Faecal coliforms were found at very low numbers at location G1 while no faecal coliforms were detected at location BH.

Table 16: Groundwater quality test results (parameters exceeding EPA standards are highlighted in red)

Location	G1	BH
Temperature (^{0}C)	23.2	23.2
pH	7.7	7.9
Conductivity (µS/cm)	**8130**	**1096**
Nitrates (mg/L)	1.7	6.8
Dissolved Oxygen (mg/L)	3.99	7.26
Total Coliform (MPN/100ml)	**>2420**	**>2420**
Faecal Coliform (MPN/100ml)	**13**	Not Detected

5.5. Hazard Vulnerability

The United Nations Development Program (UNDP) has compiled a very thorough study to develop a risk profile for the Maldives in order to determine the probability of hazards across different regions of Maldives based on geological evidence, historical data and projections derived from theoretical analysis (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006). Likelihood of storm hazards for the island under concern are analyzed using this disaster risk management study done by the UNDP and likelihood of flooding is analyzed using rainfall data from the nearest meteorological center to each island. Some island specific data are also obtained from consultation with island councils and personal communication with the islanders.

5.5.1. Storms

In addition to monsoonal heavy rains and strong winds, hazardous weather events which regularly affect the Maldives are tropical storms or tropical cyclones and severe local storms (thunder storms/thunder squalls) (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

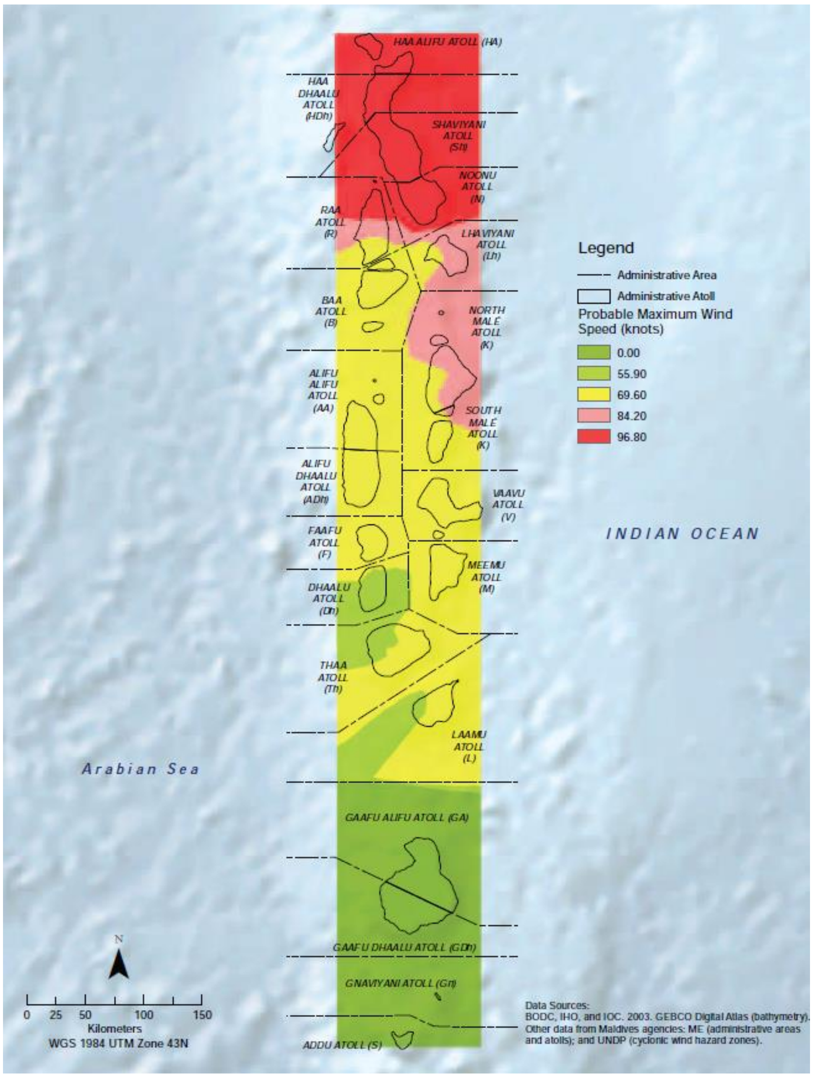
Every so often, tropical cyclones hitting the Maldives are highly destructive due to associated strong winds that exceed a speed of 150 km/hr, heavy rainfall of above 30-40 cm in 24 hrs and storm tides that often exceed 4-5 m. Strong winds often damage vegetation, houses, communication networks and roads. Heavy rainfall is associated with serious flooding. Cyclonic winds can sometimes cause a sudden rise in sea level along the coast, leading to a storm surge. The combined effect of surge and tide, which is known as 'storm tide', can cause catastrophic events in low lying areas, flat coasts and islands such as the Maldives (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

Hazards associated with thunder storms include strong winds often exceeding a speed of 100 km/hr, heavy rainfall, lightning and hail. Such thunder storms are very frequent in the equatorial region, which is where the Maldives lie, however, they are less violent at this region. Moreover, land areas are more frequently hit by thunder storms than the open ocean. Strong winds generated by severe local storms generate large wind-driven waves which are hazardous for the Maldives (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

5.5.2. Cyclonic winds

Studies of historic data suggests that even though the northern islands of the country were affected by weak cyclones which formed in the southern part of Bay of Bengal and the Arabian Sea, in general the Maldives islands were less prone to tropical cyclones. According to the cyclonic wind hazard zone classification, the north most islands represent the highest risk region and the hazard risk decreases moving down south *(Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).*

On a scale of 1-5, with 5 being the highest risk zone, Kanuhura falls under the high-risk zone (Figure 24) *(Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).*



Data Sources:
BODC, IHO, and IOC. 2003. GEBCO Digital Atlas (bathymetry).
Other data from Maldives agencies: ME (administrative areas and atolls); and UNDP (cyclonic wind hazard zones).

Figure 24: Cyclonic wind hazard map of the Maldives; from red to green, red being the highest at risk (Multihazard Risk Atlas of Maldives, 2020)

5.5.3. Storm surge

According to the bathymetric surveys of the entire Maldives, the ocean slope towards the eastern side is steeper than the west coast which indicates that the eastern islands of the Maldives are more vulnerable to higher surge hazard compared to the western islands. Accordingly, the country has been divided into 5 broad storm surge hazard zones from 1-5, with 5 being the highest risk category. According to this zoning, *Kanuhura* is in moderate risk zone (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

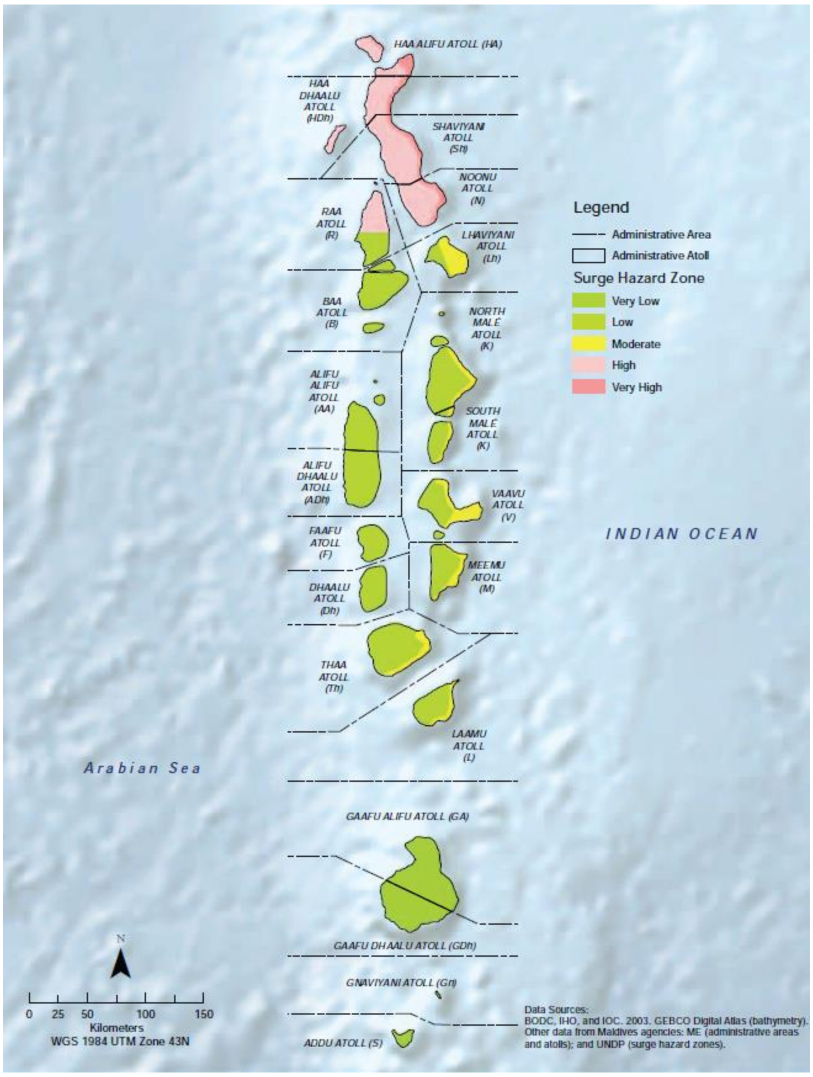


Figure 25: Storm hazard map of the Maldives from pink to green, pink being highest risk (Multihazard Risk Atlas of Maldives, 2020)

5.5.4. Flooding

Rainfall data from Hulhule' meteorological station have been used to analyze the flood and drought years across Hulhule'region. Data has been standardized against the overall mean from each station. Deducing from standard deviation of rainfall from long-term mean, it can be concluded that if the difference between long-term mean and standard deviation is >1, that corresponding year is a flood year whereas if this difference is <-1 it may be considered a drought year.

As such, analysis of rainfall data from Hulhule' station shows that this part of the Maldives experienced more rain deficient years than heavy rainfall years (10 years). As for flooding, 7 years (from 47 years of data) observed rainfall >1 standard deviation from the long-term mean (Figure 26) indicating that flooding is an uncommon occurrence at this part of the Maldives. In addition, the 10-year moving average predicts that 2022 will have a rainfall lower than the long-term mean.

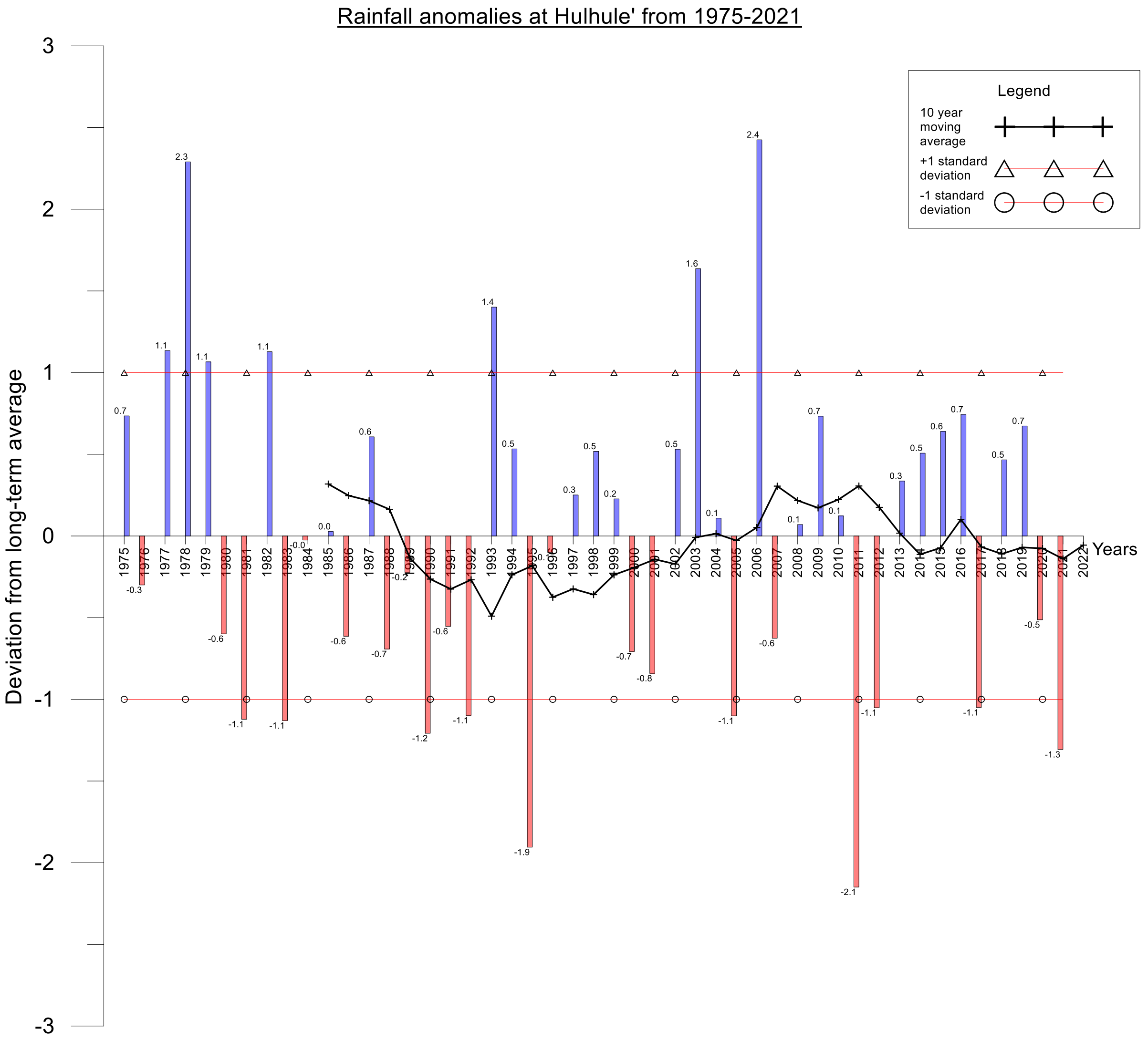


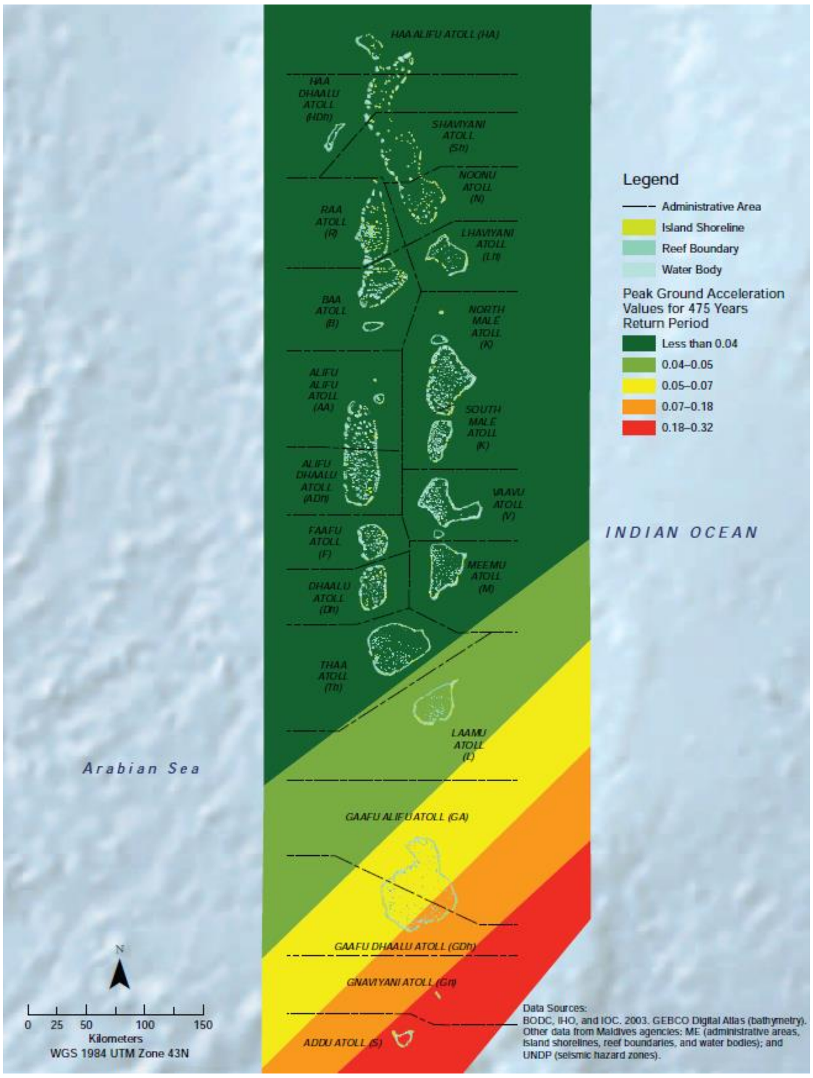
Figure 26: Rainfall anomalies for Hulhule' from 1975 to 2021 with the 10-year moving average. Red lines indicate +1 and -1 standard deviations from the mean. (Data obtained from the Bureau of Meteorology, Maldives).

However, there are other factors that greatly influence risk of flooding for instance alterations to the islands size, width and topography, an island's risk to flooding may vary despite similar rainfall patterns.

5.5.5. *Seismic Activity*

Seismic waves are created when the earth's lithosphere releases a sudden burst of energy shaking the surface of the planet. Earthquakes are manifested when fault lines or tectonic plates move due to these seismic waves. When this occurs at large magnitudes at the seabed, it can cause tsunamis. Only three major events of magnitude above 7.0 had struck the region between 1979 and 2004 (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

Kanuhura is located in the Central region which is in the lowest risk zone.



Data Sources:
BODC, IHO, and IOC. 2003. GEBCO Digital Atlas (bathymetry). Other data from Maldives agencies: ME (administrative areas, island shorelines, reef boundaries, and water bodies); and UNDP (seismic hazard zones).

Figure 27 Seismic hazard zoning map of the Maldives from green to red, red being the highest at risk (Multihazard Risk Atlas of Maldives, 2020)

5.5.6. Tsunami

Tsunamis are destructive oceanic waves generated due to disturbances on the sea floor such as earthquakes, volcanic eruptions, underwater landslides, or even meteorite impacts.

In 2004 the second largest tsunamigenic earthquake globally recorded hit Indonesia and generated tsunamis 3-10 meters high travelling across the Indian Ocean striking Maldives with waves ranging 1.2-4.2 m. Out of 198 inhabited islands, 13 were destroyed, 56 sustained major physical damage, and 121 faced moderate damage from flooding.

95% of tsunamis that effect Maldives are generated from the eastern source zones. The risk is high for eastern fringe of eastern atolls, though eastern fringe of some western atolls is also at high risk. By observing bathymetric contours, the islands have been categorised into 5 zones with 1 being the lowest hazard level. *Kanuhura* is in a very high-risk zone.

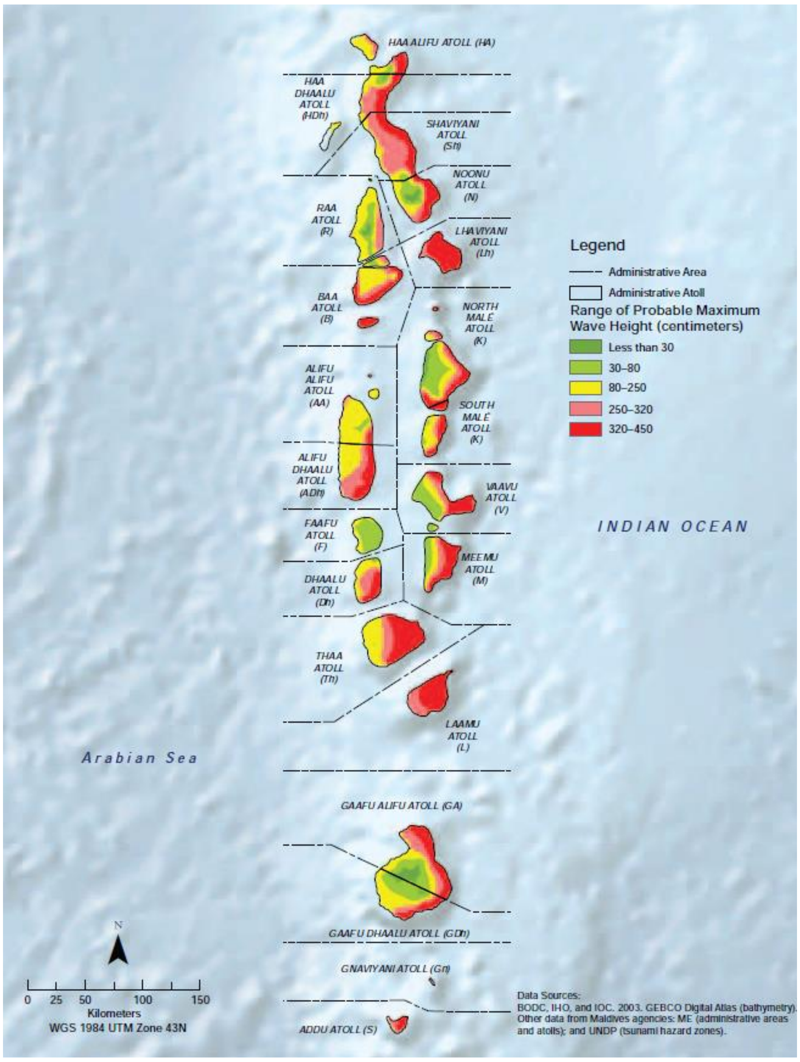


Figure 28: Tsunami hazard zoning map of Maldives (Multihazard Risk Atlas of Maldives, 2020)

6. STAKEHOLDER CONSULTATION

An integral part of this EIA has been consultation with all relevant parties. As such stakeholder consultations were undertaken with the Ministry of Tourism (MoT), Ministry of Environment, Climate Change and Technology, Utility Regulatory Authority (URA), and Health Protection Agency (HPA). The recommendations provided by each of the stakeholders for the project are provided in the following sections.

6.1. Stakeholder consultation with Ministry of Tourism

Date: 06/09/2022

Time: 09:50 hours

Place: Via email

Name	Designation	Organization	Contact
Fathimath Zaina Shareef	Senior Environment Officer	MoT	fathimath.zaina@tourism.gov.mv

Following are the recommendations made via email communication;

- To minimize environmental damage special care and protection measures need to be undertaken during the construction and operation of the new structures.
- Address all the terms highlighted in the approved (ref no. 203-ECA/INDIV/2022/84 dated 25th August 2022) ToR for this project.
- Include all possible information (permits/approvals) issued by the relevant authorities for the project.
- Proper waste management mechanisms should be in place during construction and operation.
- Should fulfill all regulatory requirements prior to the commencement of the project activities.

6.2. Consultation with Ministry of Environment, Climate Change and Technology

Date: 14/09/2022

Time: 09:58 hours

Place: Via email

Name	Designation	Organization	Contact

Afsal Hussain	Director	Ministry of Environment, Climate Change and Technology	afsal.hussain@environment.gov.mv

Following are the recommendations made via email communication;

- The documents indicates only 1 borehole to be developed, hence in case of maintenance or emergency a dual approach mechanism to be adopted with 2 boreholes where as possible which would lessen the risk.
- Take consideration to adopt a mechanism to add a buffer or required monitoring mechanism to adhere to any contamination measures due from smoke or borehole intake zone.

6.3. Consultation with Utility Regulatory Authority

Date: 08/09/2022 and 12/09/2022

Time: 10:24 hours and 08:30 hours

Place: Via email

Name	Designation	Organization	Contact
Mohamed Shujuan Ibrahim	-	URA	mohamed.shujuan@ura.gov.mv
Fathimath Fizna Yoosuf	Assistant Director	URA	fizna.yoosuf@ura.gov.mv

Following are the recommendations made via email communication;

- Recommends to have 2 boreholes (one in use and one standby).
- Recommends having 2 units of 150 TPD for redundancy.

6.4. Consultation with Health Protection Agency

Date: 04/09/2022

Time: 13:39 hours

Place: Via email

Name	Designation	Organization	Contact
Fathimath Leesha Abdhulla	Public Health Program Officer	HPA	fathimath.leesha@health.gov.mv

Following are the recommendations made via email communication;

General recommendations to consider during the construction phase;

- Access to the work site should be limited to the workers to ensure the safety of other staffs and tourists living in the area.
- Onsite supervisor should be allocated at the work site.
- Emergency procedures should be well explained to the workers.
- A mechanism should be established to transfer the workers to the nearest health care facility during any emergency.
- Ensure effective control of mosquito breeding at worksites to prevent vector borne diseases such as dengue, chikungunya, etc.

Safety measures during project period;

- Hazards/risks should be identified and informed to the workers, and safety measures ensured by the contractor.
- Safety measures/ rules should be clearly informed to the workers.
- Effective precautionary measures should be taken to prevent the collapse of structures when heavy lifting.
- Maximize the use of modern construction equipment that has been designed specifically to produce less noise.
- If the work includes working in confined space where there is a variation in oxygen concentration employer must ensure whether the employee does not have a medical condition that might threaten the life of the employee.

Work place accident prevention;

- Heavy equipment operations should be carried out by a trained personal and must be checked for any malfunctions at regular intervals.
- Ensure all machineries are used by trained workers and examine and maintain machines and instruments used for construction at a timely manner.
- Cover/keep enclosure of pit holes, proper marking to prevent accidental falls and place caution signs in appropriate areas that require high safety.
- Fall protection such as personal fall arrest system (safety harness/ belts), Guardrail systems and safety nets should be used where necessary.

Worker’s health and safety;

- Ensure the workers maintain cleanliness and hygiene at all times to prevent the spread of communicable diseases including COVID-19.
- COVID-19 preventive measures should be explained and updated information must be shared with all the workers.
- Provide personal protective equipment (face mask, glove, hard hat, safety footwear, earmuffs, etc.) and strictly ensure PPE’s are used in appropriate situations.
- To minimize heat related illness, ensure heat prevention measures are taken when workers are engaged in heavy works outdoor for a long period of time.

Note; MFDA water safety standards/guidelines must be followed during and after the project.

7. OPTIONS ASSESSMENT

The possible causes of actions, in place of another that would meet the same purpose and need, otherwise known as alternatives, have been well considered in this study as alternatives are essential to a sound decision-making process and central to an effective EIA.

With due consideration to the purpose and need for the proposed project, there are three alternatives identified for this project. The "no project" option, establishing additional borehole and incorporating renewable energy. Details of which are further discussed below:-

7.1. Option 1: Maintain status-quo

The "do-nothing" option would mean a loss of potential economic activity and no impact on the Kanuhura island environment. The resort will not be able to cater to the new demands of the of the pools and additional beach villas leading to opportunity loss as the guests will not be able to utilize the facility.

The proposed development is thought to pose mild impact to the environment and the intrinsic uncertainties can be overcome following a proper management.

7.2. Option 2: Establishing an additional borehole

Currently the resort intakes raw water from an inlet pipe near the lagoon. Furthermore, the inlet pipe is to be kept as a backup raw water source even after the establishment of the new system. However, the resort has an oil storage operation in an over water structure above the location of the inlet pipe which poses risk of contamination of the water supply. Therefore, it is proposed to discontinue and remove the inlet pipe and establish a backup second borehole within the facility of the water plant. Via this method, the risk of contamination is avoided and a backup raw water supply is also established.

7.3. Option 3: Incorporating renewable energy for desalination plant operation

Increase in water demand would result in an increase of energy demand of the resort. As of now, the resort does not have a renewable energy source. Therefore, it is proposed to integrate renewable energy via the establishment of solar panels. This option would reduce the overall operational cost of the resort whilst moving the overall resort operations towards environmental good practices and sustainability.

<u>Preferred alternative</u>: For the above-mentioned reasons, the preferred alternatives are to establish a backup second borehole for raw water intake or to move the existing lagoon intake line to another location and to integrate renewable energy to cater for the additional power demand arising due to the establishment of the RO plant.

8. POTENTIAL IMPACT ANALYSIS

The impacts from any project can be categorized into two broad categories; constructional and operational impacts. Constructional impacts are the potential impacts which might arise during the construction stage of the proposed project. Operational impacts are the potential impacts which might arise once the newly constructed project facilities become operational.

8.1. Impact Assessment methodology

The proponent and the consultants have conducted a risk-based environmental review as part of the planning process. Data has been drawn from a wide range of sources, including existing similar EIA reports. Similar EIA reports reviewed for the formulation of this EIA include but not limited to the reports mentioned under section 1.8.

The impact assessment was conducted based on professional judgment and expertise of the consultants as well as evaluation of the baseline data and consultation with the stakeholders. This provides an outline on how to identify potential hazards associated with the proposal and evaluate the likelihood and consequences. The impact assessment methodology utilized was also consistent with the methodology outlined in AS/NZS ISO31000 (AS/NZS ISO 31000 : 2009 Risk management - Principles and guidelines, 2009) and UNEP Environmental Impact Assessment Training Resource Manual (UNEP, 2002).

The first stage of this methodology was to identify potential impacts. To ensure that all potential impacts were identified, it was important that any specific environment and/or community impact issues were determined based on the locations of the project components as well as type of service to be provided. As such, the impacts identified were:-

1. **Constructional impacts:-**
    - Air quality - GHG emissions;
    - Noise pollution - operation of heavy machinery;
    - Vibration impacts – from operation of heavy machinery;
    - Impacts on structural environment – soil, road and buildings due to trenching, borehole drilling, operation of heavy machinery;
    - Ground water quality- chemical spills and dewatering;
    - Generation of constructional and decommissioning waste – packaging waste;
    - Mobilization impacts – transport of heavy machinery, workers;
    - Impacts on marine environment – chemical spills;
    - Impacts on terrestrial environment - vegetation clearance, birds scared away due to noise;

- Risk of hazards - accidents and pollution on workers;
- Impacts on landscape integrity and scenery;
- Socio-economic impacts;

2. **Operational impacts:-**
    - Air quality - GHG emissions;
    - Noise pollution - operation of pumps;
    - Vibration impacts – from operation of pumps;
    - Impacts on structural environment – soil, road and buildings due to operation of pumps;
    - Ground water quality- chemical spill, borehole failure;
    - Generation of solid waste;
    - Impacts on marine environment – brine discharge;
    - Impacts on terrestrial environment;
    - Health and safety of working staff;
    - Impacts on landscape integrity and scenery;
    - Risk of hazards - fire, sea level rise, storm surge;
    - Socio-economic impacts – cater to water demand;

Impacts were assessed using the following matrix (Table 17).

Table 17. Impact assessment matrix

		Consequences				
		Minimal (1)	**Minor (2)**	**Moderate (3)**	**Major (4)**	**Catastrophic (5)**
Likelihood	**Remote (1)**	Negligible	Negligible	Very low	Low	Medium
	Unlikely (2)	Negligible	Very low	Low	Medium	High
	Possible (3)	Very low	Low	Medium	High	Very high
	Likely (4)	Low	Medium	High	Very high	Significant
	Certain (5)	Medium	High	Very high	Significant	Significant

Characteristics of the impacts on Table 17 is used to determine the consequences (minimal (1), minor (2), Moderate (3), Major (4), Catastrophic (5)). For each specific consequence there is 5 likelihood categories (Table 14). Therefore, if an impact has Moderate (3) consequence but a likelihood of Remote (1), then that impact would have "very low" significance. However if the likelihood is Certain (5) then the impact would have "Very high" significance

Criteria used for assessing the identified impacts are as follows. Note that the realistic and consequences were judges based on the design consideration for the proposed facility. These criteria were measured against the impact (if the impact occurred), to ecological and/or human health:-

- Likelihood:-

  - Remote- May occur only in exceptional circumstances;
  - Unlikely- Could occur at some time;
  - Possible- Might occur at some time;
  - Likely- More likely to happen than not (i.e. a probability of > 50 %); and
  - Certain- Will probably occur in most circumstances.
- Consequences:-
  - Minimal- Impact has no significant risk to environment either short term or long term;
  - Minor- The impact is short term and causes very limited risk to the environment ;
  - Moderate- Impact gives rise to some concern, may cause long term environmental problems but are likely short term and acceptable;
  - Major- Impact is long term, small scale and environmentally risky. Impact severely damages the environment; and
  - Catastrophic- Impact is long term and irreversible, large scale and detrimental to the environment.

The likelihood measures the probability of occurrence of an event whereas consequences evaluate the significance of impact on the environment in the event of an incident. Based on the likelihood and consequences for each of the identified impacts, the level of risk is determined (Table 17). In addition to the level of risk, other impact characteristics such as the type of impact, nature of the impact, impact range, impact duration as well as reversibility of the impacts are also assessed, grading scales for which are given on Table 18 below.

Table 18. Grading scale of the characteristics of impacts

Characteristic of impact	Grading	Explanation
Type	Direct	Direct impacts without intervening factors or intermediaries
	Indirect	Triggered by but not immediate effect of the proposed project
Nature	Positive	Impacts resulting in a desirable effect
	Negative	Impacts resulting in an undesirable effect
	Cumulative	Impacts of an action when combined with impacts from projects or actions that have been undertaken recently or will be carried out in the near future.
Range	Local	Impacts limited to project site
	Island	Impacts of importance at island level
	Atoll	Impact of importance at Atoll level
	Nation	Impacts of national character
Duration	Short-term	Occurring over a short period of time
	Intermittent	Impacts occurring at irregular intervals
	Long-term	Occurring over a long period of time
	Continuous	Impacts occurring continuously
Reversibility	Reversible	Previous state (or equivalent) can be restored
	Irreversible	Not able to alter the consequence of impact

8.2. Limitations and uncertainties in impact prediction

Risks and uncertainties are inherent in any environmental and ecological problem-solving technique and needs to be acknowledged and incorporated in any decision-making process. Risk is the chance that an adverse outcome occurs while uncertainty arises from an imperfect understanding of a system due to uncertainty about facts (McAlpine, et al., 2010). Our understanding of the environment is limited mainly due to the lack of long-term data and complexity of the ecosystem. For example, the assessments were done during one season and impacts are predicted based on these assessments. However, how the magnitudes of these impacts and how they behave in nature during the other season is quite uncertain.

The potential environmental impacts from the proposed project are all predicted, hence there may be variables affecting the accuracy of these impacts due to natural variations such as site conditions and uncertainties in scales and magnitudes. While every attempt has been made to accurately predict the potential impacts from this project, there are unforeseen and uncertain factors which might cause deviations in the impacts outlined herein. For instance, a natural phenomenon.

Moreover, assessment of existing conditions requires a benchmark against which these conditions can be compared, however, lack of such benchmarks is a great hindrance to analyzing the environmental impacts in some instances. In addition to this, limited time availability and lack of available factual information are among major limitations to impact predictions. In the Maldives, more often than not, limited availability of published information on environmental and social environment of the islands has led to the dependency on verbal communication with locals and island councils which are not always very accurate.

Anyhow, based on the risk assessment outlined above, the environmental impact assessment is set out below:-

8.3. Constructional impacts

Table 19. Predicted impacts and anticipated significance of impacts during construction phase of the project

Potential impacts	**Likelihood**	**Consequence**	**Significance**
Air quality	Certain	Catastrophic	Significant
Noise pollution	Likely	Moderate	High
Vibration impacts	Possible	Moderate	Medium
Impacts on structural environment	Possible	Moderate	Medium
Ground water quality	Possible	Major	High
Generation of constructional and decommissioning waste	Unlikely	Moderate	Low
Mobilization impacts	Likely	Major	Very High
Impacts on marine environment	Certain	Major	Significant

Impacts on terrestrial environment	Unlikely	Minor	Very Low
Risk of hazards	Unlikely	Catastrophic	High
Impacts on landscape integrity and scenery	Likely	Minor	Medium
Socio-economic impacts	Unlikely	Major	Medium

Impacts during construction phase of the project are mainly anticipated to be short-term and reversible (Table 20) as most impacts will last only for the duration of the construction phase of the project.

Table 20. Characteristics of predicted impacts during the construction phase of the project

Potential impact	**Type**	**Nature**	**Range**	**Duration**	**Reversibility**
Air quality	Direct	Negative & Cumulative	Nation	Continuous	Irreversible
Noise pollution	Direct	Negative	Island	Short-term	Reversible
Vibration impacts	Direct	Negative	Local	Short-term	Reversible
Impacts on structural environment	Direct &Indirect	Negative &Cumulative	Island	Short-term	Reversible
Ground water quality	Direct	Negative	Local	Short-term	Irreversible
Generation of constructional and decommissioning waste	Direct	Negative	Local	Short-term	Reversible
Mobilization impacts	Direct	Negative	Island	Short-term	Reversible
Impacts on marine environment	Direct &Indirect	Negative & Cumulative	Nation	Long-term	Irreversible
Impacts on terrestrial environment	Direct	Negative	Island	Short-term	Reversible
Risk of hazards	Direct	Negative	Local	Short-term	Irreversible
Impacts on landscape integrity and scenery	Direct	Negative	Island	Short-term	Reversible
Socio-economic impacts	Indirect	Positive	Atoll	Short-term	Reversible

8.3.1. Impacts on air quality

Impacts on air quality during the constructional phase is a direct impact generally credited to operation of machinery and equipment which require electricity and vehicles which burn fuel. The main contributors would be the operation of the barge, drilling rig and land-based vehicles used for the construction of the borehole. The negative impact to air quality would be due to the release of GHGs and any other air pollutants to the atmosphere.

Release of GHGs into the atmosphere during the construction phase is comparatively low and for a short period of time, regardless this would contribute to the GHG emission of the nation; hence the cumulative nature of this impact. The rise in concentration of GHGs in the atmosphere has been a huge global environmental issue which is responsible for global warming, ocean acidification and many other environmental issues. The biggest concern is that even when the release of GHGs during the construction phase ends, the released GHGs in the atmosphere will continue to contribute to global warming for a long period of time and hence would cause a continuous impact. The cumulative impacts due to global warming and ocean acidification is not possible to reverse during a human time scale.

The other potential impact during the construction phase would be the release of dust during the operation of drilling rig and land-based vehicles. However, as the resort will be closed there won't be any nuisances to guests but it might impact working staff on the resort.

All in all, due to the cumulative catastrophic consequences of the increase in GHGs the impact scored a significance rating of Significant.

8.3.2. Noise pollution

Similar to air quality, impacts on noise level during the constructional phase is a direct impact generally credited to operation of machinery, equipment and vehicles. The highest noise would most likely be generated from the drilling rig that would be used to drill the borehole. The noise generated would be localized to the Southern side of the Island. Estimating that high enough noise to cause nuisance would be generated within a 100m of the project site, the noise may scare away shy birds on the SE and SW side of the Island for the duration but will eventually return once the disturbance ceases. There won't be any disturbances to guests due to noise pollution as no guest would be present during the construction phase of the project. Noise disturbances to working staff is likely as the staff accommodations are very close to the project site. However, the noise disturbance would be for a short period of time and alleviated once the borehole is drilled. Therefore, considering that this impact is likely with moderate consequences, this impact scored a significance rating of high.

8.3.3. Vibration impacts

Impacts due to vibration are direct negative impacts arising from the operation of the drilling rig during the construction of the borehole. The impact would be on the nearby buildings, which might include minor to moderate nuisance to staff working in the nearby buildings and initiating formation of cracks on the walls of nearby buildings. The impacts due to vibration would be short-term and the nuisance will be alleviated once the drilling is completed, however any damages that might occur to the nearby building will persist. Therefore, the consequences of this impact are moderate with a likelihood of possible, giving this impact a significance rating of medium.

8.3.4. Impacts on structural environment

The impacts to structural environment due to this project includes impacts to soil, road and buildings. This impact arises due to the direct activities of the proposed project and some impacts are caused indirectly. Operation of heavy machinery on the road is anticipated to cause soil compaction. Trenching to lay the pipes from the borehole to the RO plant and drilling of borehole will compromise the soil profile at the project location and may damage walls and buildings that are very close to the trenches. Additionally impacts to buildings will be due to an accident during the operation of the heavy machinery. The indirect and cumulative impact would be flooding on the compacted roads which will be further amplified due to the changing intensity and frequency of rainfall attributed to climate change. Therefore, while the consequences from this impact are moderate, the likelihood of this impact occurring is possible, hence this impact got a significance rating of medium.

8.3.5. Groundwater quality

Impacts to ground water quality during the constructional phase is a direct impact credited to the operation of land-based machinery and dewatering activities. Dewatering will be required for a small extent during the construction of the borehole but the scale which be much smaller to impact majorly on the ground water lens. The other impact on ground water arises from the potential for occurrence of oils and chemical spills during the operation of machinery and use of any chemicals. In case of improper use of machinery and equipment, there is the possibility of oils and chemical spillage into the groundwater. Even though it could be minimized with regular maintenance, in the event that oils and chemicals do spill, the impacts could have moderate to major effects on the groundwater quality. However, since there is an existing distribution network established, the project activities would be limited to the borehole construction site and RO plant house. Therefore, all the machinery would be operated at the project site and potential chemical spills would occur at the project site only. Due to the major consequences and irreversible nature of the impact, this impact scored a significance rating of High.

8.3.6. Generation of constructional and decommissioning waste

This impact arises due to the direct activities of the project. The negative impact would be due to improper management of waste generated during construction phase. Demolition waste is not anticipated for this project as there are no structures that require to be demolished. Few packaging waste would be generated from the borehole construction works and RO plant installation. Therefore, volume of waste that would be generated during the construction phase of the project site can be easily be managed at the construction site by storing and removing waste from the project area in a timely manner. Therefore, the likelihood of negative impacts due to these generated waste occurring is unlikely, the consequences from improper management is moderate, hence this impact scored a significance rating of low.

8.3.7. Mobilization impacts

Mobilization impacts for the project arises from two aspects; firstly, the mobilization of a barge with the drilling rig. Secondly the mobilization of the work force. The barge is proposed to dock at the southern side of the island to the South of the service jetty and depending on the draft of the barge and tug, the tug boat may not be able to tow the barge up to the service jetty area. In this case the normal practice is to use the excavator itself to reach the shore. The pathway from the access channel to the shore, around the arrival jetty and entrance channel is almost full of sea grass beds which could get damaged during mobilization. Even though the top part of the sea grass will be damaged, since its rhizomes lie deep inside the sea bottom, it is expected to recover. Fish will be able to move away but slow-moving marine organisms maybe squashed by the bucket of the excavator. As sea grass beds acts as important nursery beds for juveniles, it is important to keep their surrounding environment as pristine as possible, the death of sea grass beds even for a short duration could hence cause significant impacts to the species that depend on them. Hence this could cause significant damage to the marine environment.

Mobilization of the work force causes impact from two aspects; firstly, temporary housing facilities for the work force. Secondly the health implications to the working staff and tourists staying on the resort due to the Covid19 pandemic. Temporary housing facility is not anticipated to cause any impacts as prefab houses will be used and the houses will utilize the existing resorts utility scheme. If the workers are mobilized to the resort without proper screening as indicated by the HPA then there is the risk of an outbreak of the corona virus on the resort.

Therefore, the consequences from these impacts are major with a likelihood of likely, giving this impact a significance rating of very high.

8.3.8. Impacts on marine environment

Impacts on the marine environment due to this project arises from two aspects; impacts during mobilization which is covered under mobilization impacts. Secondly, from indirect and cumulative impacts arising from increasing GHGs.

While the contribution to GHGs from this project maybe minor, it is the cumulative nature of the impact that is concerning which arises from global warming and ocean acidification. The reason why there is so much concern about global warming is that it increases the temperature of the oceans as the ocean absorbs more heat. While many of the fishes maybe able to tolerate the rise in temperature, the corals are less tolerant. Nonetheless many of the reef fish species depend on the coral reef as a home and few fish species even depend directly on the corals for food and shelter. In a recent paper published by (Strona, et al., 2021) states that in a hypothetical world where coral reefs are not present the local tropical fish richness across the globe would decline by half. Ocean acidification is the process by which the pH of the oceans decreases due to more dissolving of CO_2 from the atmosphere into the oceans (Ferrero, 2018). Apart from impacts from temperature, the corals and other Calcium Carbonate skeleton based marine organisms are at great risk as lower pH would mean that these organisms would have a hard time maintaining their Carbonate skeletons. Therefore, just as higher temperatures threaten the marine organisms, ocean acidification also threatens marine life to a great extent.

Therefore, considering the above-mentioned factors, the impact on marine environment scored a significance rating of significant as this impact is certain and the consequences are major.

8.3.9. Impacts on terrestrial environment

Impacts on terrestrial environment arises from two aspects; firstly, vegetation clearance. Secondly impacts to terrestrial flora and fauna. Vegetation clearance is not required for this project. Impacts to terrestrial animals are due to noise disturbances which is covered under noise pollution impacts.

8.3.10. Risk of hazards

This impact arises due to the direct activities of the project. As typical of any construction project, there lies the risk of accidents and pollution on workers as well on the staff from this project as well. There is always the inherent risk of health and safety due to workplace incidents especially during this COVID-19 pandemic. Even though these are unlikely events the consequence of such an event would be catastrophic and irreversible as human health and wellbeing is at concern, therefore this impact significance is high.

8.3.11. Impacts on landscape integrity and scenery

This impact arises due to the direct activities of the project. As the resort would be closed during the construction phase of the project, there won't be any guests within the resort to have an impact on the duration of construction. So the view of construction works would have negligible impact on the resort even though it has direct negative impact on the scenery and landscape integrity of the resort.

The likelihood of this impact is likely with minor consequences as no guests would be in the resort. Therefore, the impact significance is regarded as Medium.

8.3.12. Socio-economic impacts

These impacts are triggered by the project as job opportunities will be open for locals once the project has initiated. However, the resort has already contracted an external company to carry out most of the necessary arrangements to complete the project in a given time frame. In such conditions there won't be any temporary job opportunities to the locals as they will have their own employed staff for the job. But if it does occur, it would provide short-term job opportunities for locals within the Atoll.

These impacts are unlikely to occur with major consequences if took place. Hence, the significance is regarded as medium.

8.4. Operational impacts

Table 21. Predicted impacts and anticipated significance of impacts during operation phase of the project

Potential impact	**Likelihood**	**Consequence**	**Significance**
Air quality	Certain	Catastrophic	Significant
Noise pollution	Unlikely	Moderate	Low
Vibration impacts	Possible	Moderate	Medium
Impacts on structural environment	Unlikely	Moderate	Low
Ground water quality	Unlikely	Major	Medium
Generation of solid waste	Remote	Minor	Negligible
Impacts on marine environment	Likely	Catastrophic	Significant
Impacts on terrestrial environment	Remote	Minor	Negligible
Health and safety of working staff	Possible	Major	High
Impacts on landscape integrity and scenery	Remote	Minimal	Negligible
Risk of hazards	Possible	Catastrophic	Significant
Socio-economic impacts	Certain	Catastrophic	Significant

Unlike constructional impacts, operational impacts are anticipated to be more long-term and continuous (Table 22). It should be noted that with the application of proper mitigation measures as outlined in section 9 of this report, almost every negative impact could be minimized.

Table 22. Characteristics of the predicted impacts during the operation phase of the project

Potential impact	**Type**	**Nature**	**Range**	**Duration**	**Reversibility**
Air quality	Indirect	Negative & Cumulative	Nation	Continuous	Irreversible
Noise pollution	Direct	Negative	Local	Continuous	Reversible

Vibration impacts	Direct	Negative	Local	Continuous	Reversible
Impacts on structural environment	Direct & Indirect	Negative	Local	Continuous & Short-term	Reversible
Ground water quality	Direct	Negative	Local	Continuous & Short-term	Irreversible
Generation of solid waste	Direct	Negative	Local	Continuous	Reversible
Impacts on marine environment	Direct	Negative & Cumulative	Local	Long-term	Irreversible
Impacts on terrestrial environment	Direct	Negative	Local	Continuous	Reversible
Health and safety of working staff	Direct	Negative	Local	Continuous	Irreversible
Impacts on landscape integrity and scenery	Direct	Negative	Local	Continuous	Reversible
Risk of hazards	Indirect	Negative & Cumulative	Island	Intermittent	Reversible
Socio-economic impacts	Direct	Positive	Island	Continuous	Reversible

8.4.1. Impacts on air quality

The impacts to air quality does not originate from the direct activities of the project. The newly installed RO plant would increase the electrical demand required to run the resort at full capacity during peak periods. To cater for this additional demand, the resort is upgrading its power system through the approved EIA for upgrading of water system, powerhouse and maintenance dredging at Lhaviyani Kanuhura. The additional power demand means that there would be an increase in the amount of GHG released to the atmosphere. The rise in concentration of GHGs in the atmosphere has been a huge global environmental issue which is responsible for global warming, ocean acidification and many other environmental issues. Due to the cumulative catastrophic and irreversible consequences of the increase in GHGs the impact scored a significance rating of Significant

8.4.2. Impacts from noise

Moderate noise pollution is expected within close proximity to the RO plant house due to the direct operation of the new RO plant. The highest noise would be generated from the pumps of the RO plant. It is unlikely that noise disturbance would reach the coast on the Southern side of the Island to scare away existing wildlife and staff accommodations. Therefore, the likelihood of this impact is unlikely, while the consequences are moderate. Hence, the significance of this impact is low.

8.4.3. Vibration Impacts

Vibration impacts arise due to the direct operation of the RO plant. The negative impacts would be localized to the RO plant house and nearby buildings. Impacts to RO plant house and nearby buildings are unlikely as the new RO plant will be installed on elevated concrete beds. The RO plant house will be subjected to continuous vibration impacts when the RO plant is operational and will cease once the RO plant is not running. The consequences from these vibration impacts are moderate as the continued subjection to vibrations will deteriorate the building over time. The likelihood of these impacts occurring is possible, giving this impact a significance rating of medium.

8.4.4. Impacts on structural environment

Impacts on structural environment include impacts to soil, road and buildings due to the operation of pumps in the RO plant and indirectly from the distribution network. The indirect impact to soil and road would occur in the unlikely event where a pressure line is damaged. The consequence from such an event would be flooding at the location which would cause moderate impacts. The impact would occur for a short period of time and will be reversed once the leak is contained. Hence the impact scored a significance rating of low.

8.4.5. Groundwater quality

The impacts to groundwater quality during operations arises from two aspects; firstly, from accidental spillages and secondly from failure of borehole. During the operation and maintenance of RO pant, there is a small risk of water contamination by accidental spillage of chemicals used to doze and clean the RO membranes. Flushing water generated from the RO plant pose great risks to the environment if not managed properly and is rated as a high-risk hazard. Impacts from any spills will be localized to the RO pant house area if immediate mitigative measures are taken. However, if mitigative measures are not taken, the effects would be irreversible. The other negative impact to ground water is from the unlikely event where the borehole is not constructed properly, if the borehole is not water proofed groundwater could seep into the borehole and this would cause groundwater to be extracted from the borehole exhausting the freshwater lens over time.

Even though the likelihood of a chemical spill and ground water seepage into borehole occurring is unlikely, the irreversible nature of the impact makes the consequences of it a major concern, therefore, the significance is medium.

8.4.6. *Generation of solid waste*

It is not expected that solid waste would be generated during the operation of the RO plant, hence the significance of this impact is negligible.

8.4.7. *Impacts on marine environment*

This impact arises due to the direct activities of the project, which is the expansion in RO plant operations that will increase the volume of the brine discharged which would further exacerbate the negative impacts to the marine environment from the water production facilities of the resort. Coupled with the global warming and ocean acidification impacts, the increase in salinity at the discharge point would greatly impact the marine environment. The likelihood of this impact is likely while the consequence of the impact is catastrophic. The significance of the impact is regarded as "significant".

8.4.8. *Impacts on terrestrial environment*

Impacts on terrestrial environment are impacts to vegetation, flora and fauna. No impacts are envisaged on these during the operational phase.

8.4.9. *Health and safety of working staff*

While impacts due to this project are anticipated to bring positive outcomes on the overall well-being of the resort staff by provision of clean safe water, RO plant staff may be exposed to some minor health risks. The risks include contact with chemicals causing skin irritation and inhalation of gases/fumes which may lead to even respiratory infections when exposure to grease, oil, grit and other hazardous chemicals in addition to high noise levels. This impact is limited to the working staff at the RO plant and for a long period of time as the staff would be continuously working every day. The impact is irreversible as any injuries to working staff would have lifelong health implications. Therefore, the consequences from this impact is major but the likelihood of it occurring is possible, earning a significance rating of high.

8.4.10. *Impacts on landscape integrity and scenery*

Minimal consequences are envisaged to landscape integrity and scenery during the operations, as the RO plant will be housed inside the already exiting RO plant house. Therefore, the significance of the impact can be regarded as negligible.

8.4.11. *Risk of Hazards*

Fire

The likelihood of fire risk is low at an electricity powered RO plant. If a fire does occur, depending on the degree of fire, the effects could range from low to catastrophic therefore is considered a significant impact. Impacts of fire are normally short-term and reversible over time however could be costly depending on the severity of impacts.

Sea level rise

As sea level rise is a phenomenon occurring around the world at a global scale, it is likely to produce a great deal of risk for low level islands such as Kanuhura. Moreover, the constant coastal erosion puts the island even more at risk of being affected by sea level. The probability of it happening may be low in the near future but it can happen at a distant future and will cause catastrophic consequences upon impact.

Storm surges

Kanuhura resort is located at a moderate risk zone for local storm surges compared to the rest of Maldives. As the island is located on the eastern side of the ocean slope, the island is more susceptible to storm surges and would require careful monitoring especially in the southwest monsoon.

8.4.12. Socio-economic impacts

The new upgrades, maintenance and improvements that steered under this project will surely improve the efficiency at which the resort runs in the operational phase, specifically to this project, the resort will be able to cater for the increase water demands due to the addition of new pools and villas under the ongoing major renovation works. All things considered this current project will certainly have a positive impact with level 5 consequences. The impact can be regarded as “Significant”.

8.5. Impact boundary

As shown in Figure 29 primary impact area for the projects is the construction site. The secondary impact area will be areas that could have noise disturbance during construction and operation. The whole island can be considered as tertiary impact area as this project is a developmental as well as a maintenance project that will benefit the whole resort in the future.

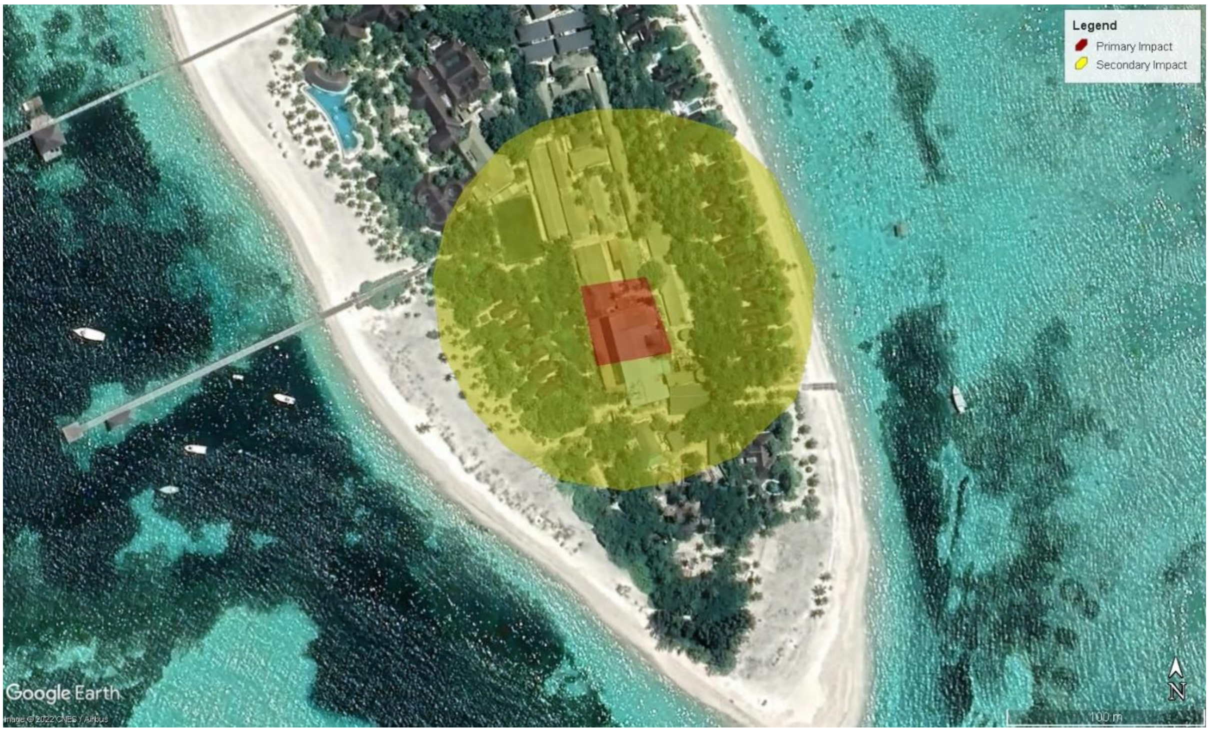


Figure 29: Impact boundary for the proposed project

9. ENVIRONMENTAL MANAGEMENT

This section describes the environmental and operational management systems and plans for the proposed development including practical mitigation measures for all identified impacts, a risk management plan, measures for sustainable development as well as environmental monitoring programs.

9.1. Proposed mitigation measures

The mitigation measures outlined in Table 23 below is proposed with due consideration to their cost effectiveness and feasibility to be implemented. The mitigation measures mainly relate to handling practices, design and quality of the proposed development and appropriate trainings which would ensure that environmental impacts would be minimized as effectively as possible.

It is the responsibility of the implementing agency to adhere to the proposed mitigation measures and bear any costs related to establishing them.

Table 23. Proposed mitigation measures for the identified risks during the construction and operation phases of the proposed project

Aspects	**Mitigation Measures**	**Justification**	**Implementing Agency**	**Estimated Cost**
CONSTRUCTION PHASE				
Air Quality	• Daily maintenance of vehicles and machinery • Use of light fuel (low sulfur content) • Avoid unnecessary use of machinery	Reduce GHG emissions	Proponent and Contractor	Included within contractual cost
Noise Pollution and impacts on terrestrial environment	• Well maintenance of vehicles and machinery • Avoid unnecessary use of machinery • Restrict working hours to daytime only	This will help reduce the noise pollution during construction	Proponent and Contractor	Included within contractual cost
Vibration impacts	• Ensure that drilling works are completed on the shortest possible timeframe	Reduce vibrations	Proponent and Contractor	Included within contractual cost
Impacts on structural environment	• Heavy machinery and equipment operators should be well trained • Park the heavy machinery within the work site to avoid unnecessary transfer	Minimize impact on soil, road and buildings due to heavy	Contractor	Included within contractual cost

	• Usage of heavy machinery and equipment should be restricted to smaller areas (eg take the shortest route possible when accessing to work site) • Shoring for adjacent buildings during trenching if there is any risk of collapse	machinery and trenching		
Groundwater quality	• Oil / chemical handling procedures should be made known to all staff members • Follow the corresponding chemical handling procedure when handling chemicals • All machinery and equipment should be well maintained to avoid accidental spillage • Relevant staff members should be well trained about proper use of machinery and equipment • Have emergency oil spill cleanup crew on standby during construction • Proper care should be taken as not to spill any oils or chemicals into the ground • Wastewater should be disposed of through sea outfall pipes • Proper care should be taken during machinery transfer to avoid accidental oil leakage • Follow borehole drilling guideline • Ensure salinity is carefully monitored during drilling • Water extracted from dewatering should be recharged back to the ground to a designated area proposed by the resort after checking the water quality	Prevent contamination of the groundwater and salinization	Proponent and Contractor	Included within contractual cost
Waste	• Littering, accidental disposal and spillage of any construction wastes should be avoided by pre-planning ways of their transportation and unloading	These measures will help in controlling and managing the waste generated in a	Proponent and Contractor	Included within contractual cost

	• Careful planning of the work activities can also reduce the amount of waste generated • Waste segregation on-site and reuse as much as possible • Trenched material should be stockpiled at a designated area • Health and safety materials should be made available to workers specifying instructions on how to handle hazardous wastes and how to act during a chemical spill	systematic and safe manner		
Mobilization impacts	• Laborers shall be supervised by the site supervisor to avoid any socially or culturally unacceptable behavior • Limit access routes of vessels, excavators and heavy machinery to a small area • Anchorage of barges and carrier vessels should be limited to a smaller area • Heavy machinery and equipment operators should be well trained • Park the heavy machinery within the work site to avoid unnecessary transfer • Usage of heavy machinery and equipment should be restricted to smaller areas (eg take the shortest route possible when accessing to work site) • Avoid unnecessary usage of machinery and equipment	Supervision would help maintain unity between the laborers and ultimately reduce or avoid unnecessary conflicts Mitigation measures for the use of heavy machinery and barge were suggested to improve their efficiency and reduce their footprint	Proponent and Contractor	Included within contractual cost
Impacts on marine environment	• Restrict movement of barges to a narrow area only • Avoid dragging of anchors over the sea bed and should be carefully placed at the exact location • Ensure all project activities remain within the project boundary • Take spill containment measures	Avoid unnecessary loss of habitats, fauna & live substrates Mitigate or avoid spillage or contamination	Proponent and Contractor	Included within contractual cost

	• Ensure that the staff are well informed of the mitigation measures and the significance of the matter • Wastewater shall be treated prior to disposal			
Risk of hazards	• Proper signs should be installed and work area restricted with tape • All working staff must be well trained on occupational health and safety • All safety equipment should made provided • Unauthorized entry of unwanted people must be restricted • In case of accidents, workers should be taken to the nearest regional hospital immediately and if the need be, to Male' • In case of oil/chemical spills, clean up kits shall be available at all times; • Emergency cleanup crew shall be on standby at all times; • Firefighting equipment must be made available at work site • Safety lights at night to avoid people from falling into open trenches • Backfilling any trenches made during the day before night by careful planning of pipe laying works	Prevent accidents and pollution on workers	Proponent and Contractor	Included within contractual cost
Impacts on landscape integrity and scenery	• Fencing the construction sites.	Minimize impacts to scenery	Proponent and Contractor	Included within contractual cost
Socio-economic impacts	• Hire locals as much as possible	Create local job opportunities	Proponent and Contractor	Included within contractual cost
OPERATIONAL PHASE				
Air quality	• Incorporate renewable energy	Reduce emission of GHGs	Proponent	Included in resort operational cost

Noise and Vibration impacts	• Regular servicing and maintenance of pumps	Minimize noise pollution	Proponent	Included in resort operational cost
Impacts on structural environment	• Monitor pressure loss in the distribution network for early detection of leakages • Establish an emergency response plan in case of leakages • In case of leakages, proper maintenance shall be done to prevent further leaks	Minimize impacts due to leakages	Proponent	Included in resort operational cost
Ground water quality	• Follow O&M manuals • Monitor groundwater close to the borehole for early detection of groundwater seepage into borehole	Prevent chemical spills and salinization of ground water	Proponent	Included in resort operational cost
Impact on marine environment	• Ensure the condition of the outfall is good and functional • Marine water testing according to operating license	Minimize further stress on marine environment	Proponent	500 USD
Health and safety of working staff	• All personnel must strictly abide by the occupational health and safety procedures • Safety gear such as masks, suites, noise cancellation headphones and safety goggles etc shall be provided by the operator • Wear essential personal protection attires at all times • Staff training on health and safety procedures • Follow chemical handling procedures and emergency response plans • All personnel must strictly abide COVID 19 guidelines set by HPA – social distancing, wearing masks and regular hand washing or sanitization	Ensure safe work environment	Proponent	Included in resort operational cost
Risk of hazards	• Signs for emergency procedures shall be in the vicinity • Ensure fitted smoke detectors are still operational • Ensure availability of firefighting equipment	To control and prevent fire hazards To minimize damages to RO plant in the event of a flood	Proponent	Included in resort operational cost

	• Ensure that the RO plant beds are elevated • Emergency response plans shall be made for fires and floods			

9.2. Risk management and incident response

Risk management procedures in this project are strengthened by adopting a more systematic risk management approach to safety. This is achieved by identifying all foreseeable hazards (as stated in section 8 of this report), assessing the risk of each hazard and providing a means to control the risks (mitigation measures).

9.3. Sustainable development management policy

The design and implementation of the project ensures that the proposed project is sustainable. As such, measures adopted to promote sustainable development include some guiding principles as well as components incorporated into the project design. These include:-

- Ensure environmental compliance with the Governmental policies and regulations;
- Protect people, property and the local environment;
- Reduce ecological impacts of the services provided; and
- Increase customer satisfaction.

9.4. Managing uncertainties

Uncertainty is an integral part of an EIA as EIA preparation involves prediction. The two types of uncertainties associated with the EIA process include those associated with the process and those associated with predictions. With the former, the question is whether the most important impacts have been identified and whether the recommendations will be acted upon. In order to reduce such uncertainties, a wide range of stakeholders have been consulted (Section 6) in the EIA process in order to minimize the risk of missing important impacts. For the latter, the uncertainty is in the accuracy of the findings. This can be improved by research and quality of the survey.

It should also be noted that even though EIA cannot give a precise picture of the future, it enables uncertainties to be better managed and is an aid to better decision making.

9.5. Environmental monitoring

Monitoring is an essential part of the EIA and project implementation and serves 3 purposes:-

1. Ensures that the proposed mitigation measures are being implemented;
2. Evaluates whether the proposed mitigation measures are working effectively; and
3. Validates the accuracy of models or projections that were used during impact assessment process.

The purpose of monitoring is to compare the predicted impacts with that of the actual impacts, particularly if the impacts are either very important or the scale of the impact cannot be predicted accurately. The results of monitoring can then be used to manage the environment, particularly to highlight problems early on so an action can be taken.

Monitoring should not be seen as an open-ended commitment to data collection and to minimize the expenses associated with collecting unnecessary data, the data collection should cease when the need for monitoring ceases. Therefore, it is important that a proper monitoring schedule is adhered to. Conversely, monitoring may also indicate the need for more intensive study. The information obtained from monitoring can be extremely useful for future EIAs in making them more accurate as well as more effective.

The baseline data collection for the proposed development was undertaken in May 2022. Baseline surveys were conducted to determine the reference range, so that comparisons can be made during the monitoring to determine the change.

All monitoring activities must be carried out under supervision of a registered EIA consultant. Details of the monitoring program are given in Table 24 below.

Table 24. Environmental monitoring plan proposed for the proposed development

Parameter	**Locations**	**Method**	**Indicators**	**Frequency**	**Cost / MRF**	**Staff requirement**
CONSTRUCTION PHASE						
Noise	Construction sites	Noise measurement	Elevated noise levels	Every 2 weeks during construction	500	1 surveyor
Structural environment	Buildings, roads and soil near construction sites	Visual inspection	Cracks on walls Flooding	Every 2 weeks during construction	500	1 surveyor
Groundwater	Construction site and control	Water quality test	TPH, Conductivity	Every 3 months during construction	1500	1 surveyor
Marine environment	Mobilization routes	Water quality test Benthic substrate Analysis Fish census	Compare with baseline	Every 3 months during construction	15000	2 surveyors

Waste	Construction sites	Visual inspection	Improper management of waste	Every 3 months during construction	500	1 surveyor
Health and safety of working staff	Construction sites	Visual inspection and Recording of accidents	Provision of safety equipment to staff Occurrence of accidents	Daily	500	1 surveyor
Landscape integrity and scenery	Construction sites	Visual inspection	Compromised scenery	Every 2 weeks during construction	500	1 surveyor
Socioeconomic impacts	Construction sites	Visual inspection	Number of local workers	Every 2 weeks during construction	500	1 surveyor
OPERATIONAL PHASE						
Noise	Inside and outside RO plant house	Noise measurement	Elevated noise levels	Every 3 months after construction for 1 year and annually for 5 years	500	1 surveyor
Structural environment	RO plant house	Visual inspection	Cracks on walls	Every 3 months after construction for 1 year and annually for 5 years	500	1 surveyor
Groundwater	Near borehole	Water quality test	Conductivity	Every 3 months during construction	1500	1 surveyor
Marine environment	Near brine discharge outlet	Water quality test Benthic substrate Analysis Fish census	Compare with baseline	Every 3 months after construction for 1 year and annually for 5 years	15000	2 surveyors
Health and safety of working staff	RO plant house	Visual inspection and Recording of accidents	Provision of safety equipment to staff Occurrence of accidents	Every 3 months after construction for 1 year and	500	1 surveyor

				annually for 5 years		
Risk of hazards	RO plant house	Visual inspection	Emergency response plans Firefighting equipment	Every 3 months after construction for 1 year and annually for 5 years	500	1 surveyor
Socioeconomic impacts	Resort	Visual inspection	Provision of clean water to all at resort	Every 3 months after construction for 1 year and annually for 5 years	500	1 surveyor

Monitoring reports must be submitted to the EPA as specified under the monitoring schedule below:-

Table 25. Monitoring schedule recommended for the proposed development assuming that the project commences in October 2022 and completes on January 2023

Description	**Date**
EIA Decision statement issued	October 2022
Project commencement	October 2022
Monitoring report during construction- 1	January 2023
Monitoring report during operation – 1	April 2023
Monitoring report during operation – 2	July 2023
Monitoring report during operation – 3	October 2023
Monitoring report during operation – 4	January 2024
Monitoring report during operation – 5	January 2025
Monitoring report during operation – 6	January 2026
Monitoring report during operation – 7	January 2027
Monitoring report during operation – 8	January 2028
Monitoring report during operation – 9	January 2029

9.6. Monitoring Report Format

Following is the environmental monitoring report format expected for this project. The report will include the details of the methods used to collect data, sampling sites, sampling frequency, results and analysis. All data collected in the monitoring period shall be presented in the monitoring without bias and data shall be compared with the baseline values presented in this EIA report. This will require a surveyor and an environmental consultant.

Introduction

Description of initial EIA

Specify the author of monitoring report

Purpose

Describe the purpose of the monitoring

Methods

Describe the methods used to collect data

Sampling sites

Geographic coordinates

Results

Present results for the monitoring period

Comparison with baseline

Conclusion

Specify of environmental thresholds are being exceeded

Propose any additional mitigation measures

10. JUSTIFICATION AND CONCLUSION

The purpose of this EIA is to critically analyze and assess the potential environmental impacts associated with the proposed new water system upgrading works at Lh.Kanuhura resort and propose the solutions and preferred alternatives as well as mitigation measures to minimize any negative impacts whilst trying to derive the maximum positive impacts from the project.

Kanuhura Resort is looking to upgrade its facilities with some modifications over the current building scheme. Essentially the upgrade is required in order to diversify the current facilities looking forward to meet the existing tourist demand. As such the resort is undergoing a major renovation where additional pools are added to existing villas, new villas are being constructed and all of its facilities are being upgraded. These new pools, additional villas and facilities will increase the water demand of the resort; hence the resort is undergoing upgrade works to its water system in order to cater for this new demand and also to improve the existing systems with the most recent technology to reduce the environmental impacts. The resort currently uses a beach intake for the RO plant and has decided to change the intake of RO plant to a borehole. Further, an additional 300 TPD RO plant is to be installed under the current project.

The impacts of the proposed project during the construction phase are the impacts arising from mobilization, noise pollution, groundwater contamination and waste generation during constructional and decommissioning, impacts from oil and chemical spill and risk of accidents on the workers. The major impact during operational phase is on the marine environment, which is mainly from the increased effluent of the brine discharge. High positive impacts are envisaged due to increased capacity of the resort to cater for the new water demands resulting from the recently initiated upgrading activities.

Major mitigation measures include, precautionary measures while handling oil and chemicals, proper maintenance of machinery and vehicles and appropriate waste management practices. Care should also be given to ensure that the workforce will abide by the health and other regulatory measures to minimize the risk of the Covid-19 episode within the workforce. It is also proposed to wear appropriate safety gear for health and safety during the operational phase.

Main alternatives that were studied were the no-project option, establishing a second borehole as a backup raw water source and utilizing renewable energy. The establishment of a second borehole and integration of renewable energy were the preferred alternatives.

In terms of environmental monitoring, it is recommended to monitor the marine and ground water quality, noise, and waste generation during the construction phase of the project.

Furthermore, continuation of monitoring the marine environment is recommended in the operational phase with monitoring the changes to benthic substrate and marine water quality.

The socioeconomic benefits during the operations far outweigh the negative impacts of the construction phase of the proposed project. Hence, with the mitigation measures outlined in the report, it is recommended to proceed with the project as planned.

11. ACKNOWLEDGEMENTS

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13. APPENDICES

APPENDIX A- LIST OF ABBREVIATIONS

AS/NZS : Australia / New Zealand Standard 119
CBD : Convention on Biological Diversity 66
DN : Decision Note 12
EIA : Environmental Impact Assessment 10
EPA : Environmental Protection Agency 11
GHG : Greenhouse gas 63
GPS : Global Positioning System 83
MFDA : Maldives Food and Drug Authority 18
MNDF : Maldives National Defense Force 61
MPHRE : Ministry of Planning, Human Resource and Environment 15
MWSC : Male’ Water and Sewerage Company 103
NSWP : National Water and Sewerage Policty 21
NWSSP : National Water and Sewerage Strategic Plan 21
SAARC : South Asian Association for Regional Corporation 66
SDG : Sustainable Development Goal 65
ToR : Terms of Reference 12
TPH : Total Petroleum Hydrocarbon 140, 141
UN : United Nations 64
UNDP : United Nations Development Program 106
UNFCCC : United Nations Framework Convention on Climate Change 62
URA : Utility Regulator Authority 58

APPENDIX B- TERMS OF REFERENCE

بسم الله الرحمن الرحيم

އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ
Environmental Protection Agency
EPA

No: 203-ECA/INDIV/2022/84

Terms of Reference to the Environmental Impact Assessment for the Proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura

The following is the Terms of Reference (ToR) issued_for undertaking the 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura The proponent of the project is Kanuhura Maldives (Leisure Oceans Pvt Ltd) The EIA consultant of this project is Mahfooz Abdul Wahhab

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

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

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. The study area should include adjacent or remote areas, such as relevant developments and nearby environmentally sensitive sites (e.g. coral reef, sea grass, mangroves, marine protected areas, special birds site, sensitive species nursery and feeding grounds) if deemed significant for the study. Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites.

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

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

Desalination plant design

- Submit an A3 size site plan of the RO plant house with labelled drawings;
- Submit a process flow diagram of the RO system;
- Describe the technology and production capacity and how it is justified;
- Describe the proposed rainwater harvesting system;
- Water storage capacity and how it relates to predicted water consumption;
- Water quality monitoring systems and water security logistics;

- Dewatering and excavation/trenching for pump station and pipeline installations if required;
- Specify materials, equipment, heavy machinery, staff estimate, key personnel, positions, technical expertise required;
- Describe disinfection method and its alternatives
- Describe various chemicals that would be dozed to product water and how the chemical would be stored.
- Overall landscaping.

<u>Borehole water intake</u>

- Description of borehole design and location of boreholes;
- Description and justification of boreholes;
- Description of borehole construction methodology including equipment used;

<u>Existing water infrastructure</u>

- Describe the existing water infrastructure in the resort;

<u>Temporary facilities</u>

- Construction methods, scheduling and operation of temporary facilities including power generation, oil storage, water supply, wastewater treatment, accommodation facilities, waste management and decommissioning.
- Labour requirements;
- Material storage;
- Housing of temporary labour;
- Waste management at the temporary facility.

<u>Hazard Vulnerability</u>

- Fire, electrical and explosion hazard;
- Vulnerability of area to flooding and storm surge.

<u>Health and Safety</u>

- Availability of basic first aid facilities;
- Availability of safety gears.

<u>Waste Management</u>

- Details of waste management during construction and operational phase;
- Waste fuel and oil management details.

<u>Project Management</u>

- Project work schedule: Include project progress, target dates and duration of works, construction/operation/closure of labor camps, access to the site, safety, equipment and material storage, waste management from construction operations, power and fuel supply;
- Specify an emergency water supply plan if the system fails.

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

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

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

Geology and geomorphology
- Offshore/ Coastal geology and geomorphology (use maps to show major zones or geomorphological features such as reef line, vegetation line);

Hydrography/hydrodynamics (use maps)
- Tidal ranges and tidal currents;
- Surface water currents;
- Wind induced seasonal currents;

Ecology

- Assessment of terrestrial vegetation from areas that need to be cleared for the purpose of the project to include, area, number, and type of trees to be cleared (if any).
- Identify locations where any uprooted trees are to be transplanted.

Physical Parameters
- Ground water quality assessment of borehole location and control, measuring these parameters: temperature, pH, E-conductivity, Dissolved Oxygen (DO), Nitrates, Faecal Coliform, Total Coliform;
- Seawater quality measuring these parameters: temperature, pH, salinity, turbidity, (from all outfall sites, and alternative sites. Control site will be the site that the project components are not developed in)

Hazard vulnerability:
- Vulnerability of area to flooding, storm surge and tsunami events.

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.

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

Impacts on the natural environment

- Impacts on groundwater quality;

- Impacts from marine habitat destruction which may affect fish stocks and species diversity and density of invertebrates;
- Increased salinity due to increase volume of brine discharge through the existing outfall
- Equipment, technical and spillage impacts during construction;
- Impacts on marine water quality;
- Impacts of noise, vibration and disturbances;
- Impacts on landscape integrity/scenery;
- Impacts on soil.

Construction related hazards and risks
- Pollution of the natural environment (e.g. oil spills, discharge of untreated waste water and solid waste, including construction waste);
- Risk of accidents and pollution on workers and resort staff;
- Impacts of noise, and work-related safety issues.

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". Environmental, social and economic factors should be taken into consideration. The report should highlight how the various alternatives were determined. All alternatives must be compared according to international standards and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. Mitigation options should be specified for each component of the proposed project.

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. These will include both environmental and socio-economic mitigation measures. Measures for both construction and operation phase shall be identified. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included. In cases where impacts are unavoidable arrangements to compensate for the environmental effect shall be given. Mitigation measures shall be detailed to include expected costs of implementation and the personnel responsible for undertaking the mitigation measures.

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 ground water and sea water quality. Ecological monitoring will be submitted to the EPA to evaluate the damages during construction, after project completion and annually up to one year and then on a yearly basis for five years after. The baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided. A special attention shall be given to the following:

- Physical parameters such as ground quality assessments studies shall be provided as required by EPA;

Task 8. Stakeholder consultation, Inter-Agency coordination and public 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 ministries, government agencies, engineers/designers, Atoll Council and Utility service providers. The following parties should be consulted;

- Ministry of Tourism
- Ministry of Environment, Climate Change and Technology
- Utility Regulatory Agency
- Health Protection Agency

The EIA report needs to be submitted to island council and atoll council and evidence of submission needs to be included in the report. EIA report needs to include a list of those who are consulted, moreover, the report needs annex minutes of any meetings held. All issued raised by the stakeholders need to be addressed in the report

4. **<u>Presentation</u>**- 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 for 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 the subsequent amendments.

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

……………………………………………

25th August 2022

APPENDIX C- CONCEPT APPROVAL AND APPROVED SITE PLAN

بسم الله الرحمن الرحيم

GOLDEN YEAR · TOURISM 2022

MINISTRY OF TOURISM
REPUBLIC OF MALDIVES

Ref 88-DS/PRIV/2022/247

Monday, 14th February 2022

Mr. Mohamed Riza,
Director of External Affairs,
Leisure Oceans Pvt Ltd,
H.Millenia Tower, #02-01,
Ameer Ahmed Magu,
Male',
Republic of Maldives.

Dear Mr. Riza,

Re: Concept Approval for Kanuhura in Lhaviyani Atoll.

We refer to your application received on 02nd February 2022 submitted for the conceptual drawings of Kanuhura in Lhaviyani Atoll.

Approved Structures Include

- Proposed Deck Extension to Water Villa with Pools (16 units)
- Proposed Deck Extension to Water Villa with Pool and Kid's Room (3 units)
- Proposed New Grey Water Tanks
- Proposed New Water Tank
- Powerhouse & Desalination Plant – New Chimney and Switchboard Room Extension
- Additional Buggy Roundabout

A conditional approval is hereby granted to the revised development concept submitted for the project, subject to the fulfillment of the following requirements and procedures;

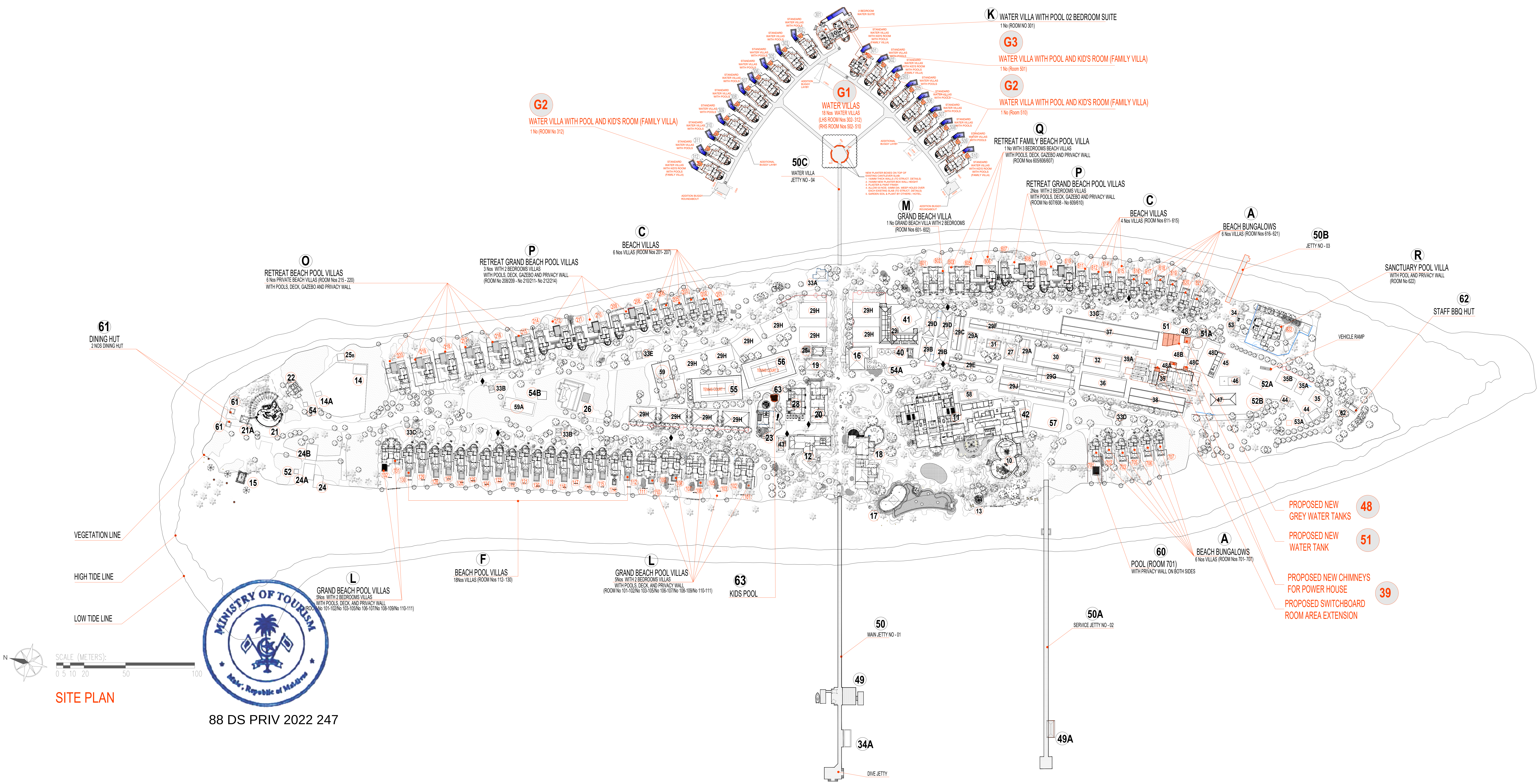
- Submission of Environment Clearance report for the project.
- Notify the Ministry in writing, upon submission of the EIA application to the Environment Protection Agency.
- Submission and approval of the detail drawings
- Built up area percentage and carrying capacity of the facility shall comply with the existing regulations.
- Development shall comply with all conditions specified in the lease agreement.

Furthermore, please be informed that once the construction work begins, you are required to arrange an inspection within 30 days from the commencement of the physical construction and also submit the development progress report before the 15th of each calendar month. We make note that upon completion of the project, the bed capacity of the resort would be 80 guest units (97 guest rooms, 194 beds) and the total build up area of the island is 14.85% (24,524.06 sqm) of the total land area 165,194.00 sqm.

Thank you

Yours Sincerely,

Ali Shinan
Deputy Director General



SITE PLAN

88 DS PRIV 2022 247

S/N	Buildings	Area/Unit (sq mts)	No. of Units	Total Floor Area
	GUEST VILLAS			
A	**Beach Bungalow** (Room Nos 616-621 & Nos 701-707)	62.87	12	816.00
C	**Beach Villas** (Room Nos 201-207 & Nos 611-615)	62.87	10	848.00
F	**Beach Pool Villas** (Room Nos 112 - 130)	63.27	18	1,526.40
K	**Water Villas with Pool 02 Bedroom Suite** (Room No 301)	226.00	1	226.00
L	**Grand Beach Pool Villas** (Room Nos 101-102/103-105/106-107/108-109/110-111/131-132)	119.71	6	718.26
M	**Grand Beach Villa** (Room No 601/602)	159.98	1	159.98
O	**Retreat Beach Pool Villas** (Room Nos 215-220)	72.32	6	433.92
P	**Retreat Grand Beach Pool Villas** (Room Nos 208-209/210-211/212-214/608-609/610-611)	135.60	5	678.00
Q	**Retreat Family Beach Pool Villa** (Room No 605-606-607)	270.95	1	270.95
R	**Sanctuary Pool villa** (Room No 622)	201.77	1	201.77
	PUBLIC AREAS			
10	**Amano - All Day Dining**	550.63	1	547.00
11	**Bottega/Kokaa Spa & Main Kitchen**	1,968.30	1	2,270.20
12	**Reception - Fenda Lounge**	479.16	1	467.90
13	**Fogo - Brazilian Cuisine**	16.78	1	13.10
14	**Chefs Herb Garden (New Glass House)**	65.06	1	65.06
14A	**Kitchen at Chef Garden**	13.15	1	13.15
15	**Iru Beach Lounge**	26.61	1	26.61
16	**Deli/Bridal Suite & Salon**	214.69	1	214.69
17	**Cowry Club (Pool Bar)**	198.38	1	198.38
18	**Games Room & Retail Shop**	622.34	1	622.34
19	**Aerobics**	95.09	1	95.09
20	**Dive Centre**	349.79	1	349.79
21	**Dagas - Maldivian Fusion Cuisine (Veli Café)**	765.70	1	765.70
21A	**Dagas Dining Pavilion**	22.58	1	22.58
22	**Restroom at Dagas**	38.11	1	38.11
23	**Kids Club**	136.59	1	136.59
24	**Water Sports Center**	61.51	1	61.51
24A	**Equipment Storage**	90.62	1	90.62
24B	**Board Canoe Rack**	90.62	1	90.62
25A	**Wheel Centre**	72.86	1	72.86
25B	**Ayurvedic Pavillion**	25.08	1	25.08

	SUPPORT FACILITIES			
26	**General Manager (GM) Villa**	267.65	1	288.60
27	**Coffee Shop**	74.02	1	74.02
28	**Dive & Financial Accomodation**	221.38	1	227.80
	STAFF FACILITIES			
29A	**Junior Staff 5 units**	90.93	2	181.80
29B	**Junior Staff 5 units(Extension of staircase to First floor)**	278.54	2	249.20
29C	**Junior Staff 8 units**	143.36	1	143.36
29D	**Junior Staff 6 units (Extension of staircase to First floor)**	236.68	2	215.40
29E	**Junior Staff + HR**	209.50	1	209.50
29F	**Junior Staff + Laundry + Casual workers**	482.30	1	34.00
29G	**Junior Staff + Tuck shop**	394.08	1	394.00
29H	**Senior staff accommodation**	218.80	12	2,625.60
29I	**New Staff Room Accommodation (BSA)**	350.49	1	354.10
29J	**Senior Staff Acoomodation**	322.53	1	354.10
30	**Staff Mess**	460.66	1	460.66
31	**Recreational Hut**	57.65	1	57.65
32	**Staff Training room**	198.70	1	198.70
33A	**Housekeeping Hut A**	46.20	1	46.20
33B	**Housekeeping Hut B**	7.74	2	15.48
33C	**Housekeeping Hut C**	10.90	2	21.80
33D	**Housekeeping Hut D**	15.90	1	15.90
33E	**Housekeeping Hut E**	15.34	1	15.34
34	**Security Hut**	10.30	1	11.20
34A	**Security Office at Jetty**	48.00	1	48.00
35	**Storage Shed 1**	84.76	1	84.70
35A	**Storage Shed 2**	47.80	1	47.80
35B	**Carpentry shed 1**	111.78	1	111.78
36	**Main Store**	373.40	1	373.40
37	**Engineering Store**	768.20	1	768.20
38	**Maintenance Store**	412.48	1	412.48
39A	**Brine Tank (6.1m2)**	6.14	1	6.14
40	**Radio room**	20.80	1	20.80
41	**Mosque**	233.76	1	233.76
42	**Cold Store at Main Kitchen (No11)**	46.55	1	46.55
43	**Communication room**	64.30	1	64.30
44A	**Exisitng Incinerator**	33.00	1	33.00
44B	**Incinerator Compactor Bottles Crusher**	48.00	1	48.00
45	**Garbage area**	92.30	1	92.30
46	**Mechanical workshop**	46.75	1	46.75
47	**Carpentry shed**	140.56	1	140.56

48A	**Processed Sewage Treatment Sludge**	92.58	1	92.58
48B	**Raw Sewage**	32.69	1	32.69
48C	**Sewage Treatment Plant**	85.80	1	85.80
48D	**Plantroom**	240.95	1	240.95
49	**Arrival Jetty Hut + External Decking**	116.85	1	116.85
49A	**Service Jetty Hut**	48.00	1	48.00
50	**Main Jetty No1**	-	1	-
50A	**Service Jetty No2**	-	1	-
50B	**Jetty No3**	-	1	-
50C	**Water Villa Jetty No4 (1483m2)**	-	1	-
51A	**Water Tank 2**	45.03	1	45.03
52	**Petrol and Disel Hut**	9.26	1	9.26
52A	**Diesel Tank 1 (62.4m2)**	62.62	1	62.62
52B	**Diesel Tank 2 (119.5m2)**	119.87	1	119.87
53	**Telecom Antenna Hut 1**	14.20	1	14.20
53A	**Antenna Hut 2 (12.4m2)**	13.48	1	13.48
54	**Pump Station 1**	8.96	1	8.96
54A	**Pump Station 2**	38.52	1	38.52
54B	**Pump Station 3**	38.69	1	38.69
55	**Tennis Court 1**	-	1	-
56	**Tennis Court 2**	-	1	-
57	**Mini Soccer Pitch**	-	1	-
58	**Badminton Court**	-	1	-
59	**Orchid Garden 1**	-	1	-
59A	**Orchid Garden 2**	-	1	-
60	POOL (ROOM 701)	-	1	-
61	DINING HUT	8.30	2	16.60
62	STAFF BBQ HUT	34.50	1	34.50
63	KIDS CLUB POOL	-	1	-
PROPOSED STRUCTURES				
G1	**Water Villas with Pool** (Room Nos 302-311 & 502-509)	88.80	16	1,420.80
G2	**Water Villas with Pool and Kid's Room (Family Villa)** (Room No 312 & 510)	108.80	2	217.60
G3	**Water Villas with Pool and Kid's Room (Family Villa)** (Room No 501)	120.10	1	120.10
39	**Power House & Desalination Plant**	790.81	1	790.81
48	**GRP Grey water tank**	17.64	1	17.64
51	**Water Tank 1**	99.32	1	99.32
	TOTAL PROPOSED AREA			2,666.27

LAND AREA (QM): 165,194
TOTAL PROPOSED BUILT UP AREA (SQM): 24,524.06
TOTAL BUILT UP PERCENTAGE (%) : 14.85%

SHIYARCH

No.	Revision	Checked By	Date
1	-	-	-

Project Title:
KANUHURA
MASTERPLAN UPDATING

Client:
SRL KANUHURA LTD

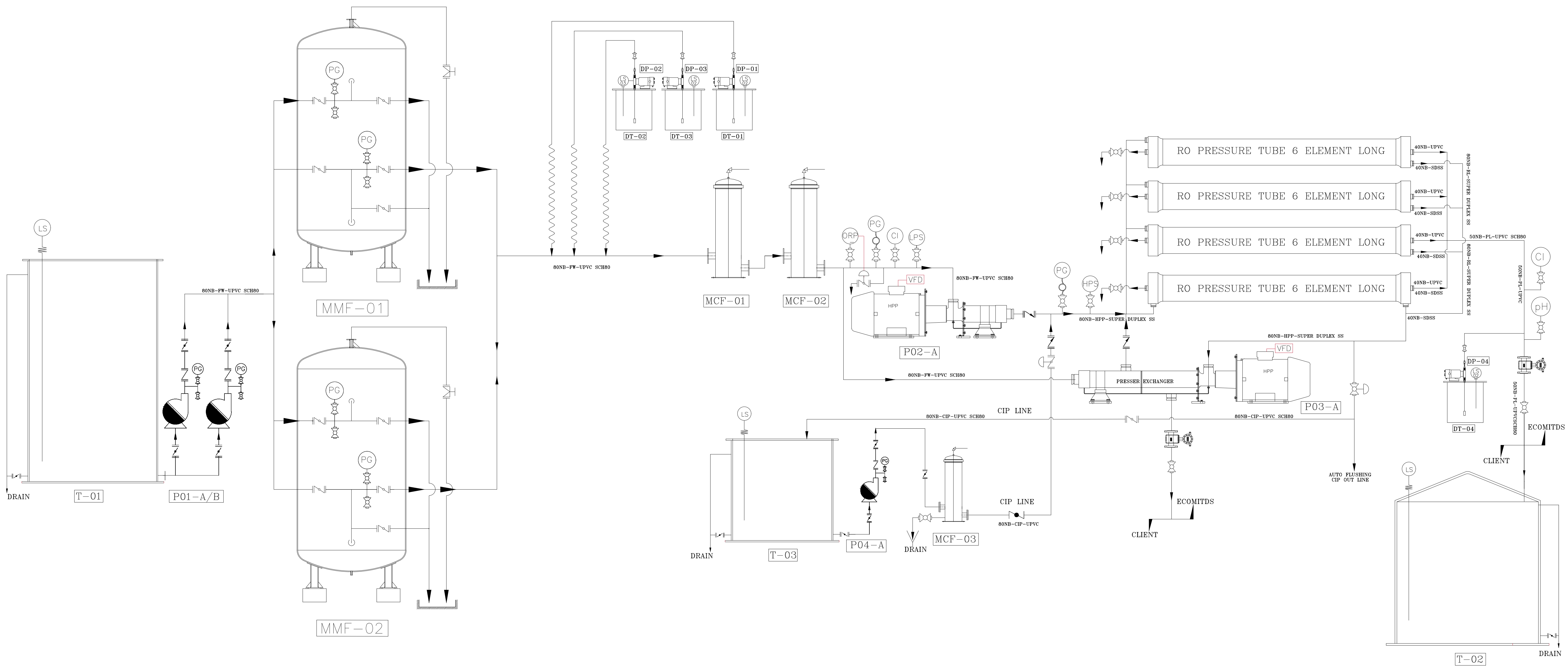
MASTERPLAN

Drawing Title:
MASTERPLAN

Architect: SHIYAZ FAKIR/ MUNISH ATHIF	Interior Designer: -
Drawn By: MUNISH/SHIYAZ	Checked By: -
Paper: -	Project No: -
Date: FEB 2022	Scale: AS GIVEN

Drawing No:
/01

APPENDIX D- DETAIL DRAWINGS FOR RO PLANT



LIST OF EQUIPMENTS				
TAG	DESCRIPTION	CAPACITY	MOC	QTY
T-01	RO FEED TANK	CLIENT	GRP	1
T-02	RO PERMEATE TANK	CLIENT	GRP	1
T-03	CIP TANK	1000 LITER	HDPE	1
P01-A/B	RO FEED PUMP	37.5M3/HR@ 30 MWC	SS 316	2
P02-A	RO HIGH PRESSURE PUMP	15.2M3/HR@ 580 MWC	DUPLEX SS	1
P03-A	PRESURE EXCHANGER BOOSTER PUMP	22.5M3/HR@ 580MWC	DUPLEX SS	1
P04-A	CIP PUMP	45M3/HR@30 MWC	SS316	1
DT-01	ACID DOSING TANK	125 LITER	LDPE	1
DT-02	RO ANTISCALANT DOSING TANK	125 LITER	LDPE	1
DT-03	RO ANTIOXIDANT DOSING TANK	125 LITER	LDPE	1
DT-04	PH CORRECTION DOSING TANK	125 LITER	LDPE	1
DP-01	RO ACID DOSING PUMP	10LPH@5BAR	PP	1
DP-02	RO ANTISCALANT DOSING PUMP	10LPH@5BAR	PP	1
DP-03	RO ANTIOXIDANT DOSING PUMP	10LPH@5BAR	PP	1
DP-04	pH CORRECTION DOSING PUMP	10LPH@5BAR	PP	1
MCF-01,02	MICRON CARTRIDGE FILTER-RO	40INCH LONG 9 ELEMENT	UPVC	2
MCF-03	MICRON CARTRIDGE FILTER-CIP	40INCH LONG 9 ELEMENT	UPVC	1
RO	RO- PRESSURE TUBE 4 : 0	8 INCH DIA 6 ELEMENT	FRP	4
MMF-01/02	MULTIMEDIA FILTER	4872 TB4"	FRP	2

INSTRUMENT LEGENDS	
PG	PRESSURE GAUGE
LS	LEVEL SWITCH
ORP	OXIDATION REDUCTION POTENTIAL
	ELECTRO MAGNETIC FLOW METER
RM	ROTAMETER
CI 01	CONDUCTIVITY INDICATOR
LPS 01	LOW PRESSUE SWITCH
HPS 01	HIGH PRESSUE SWITCH
pH 01	pH METER
VALVE LEGENDS	
	BUTTERFLY VALVE (BFV)
	NON RETURN VALVE (NRV)
	BALL VALVE (BLV)
	AUTO BUTTERFLY VALVE

ECOmitds
Sustainable Water Solutions

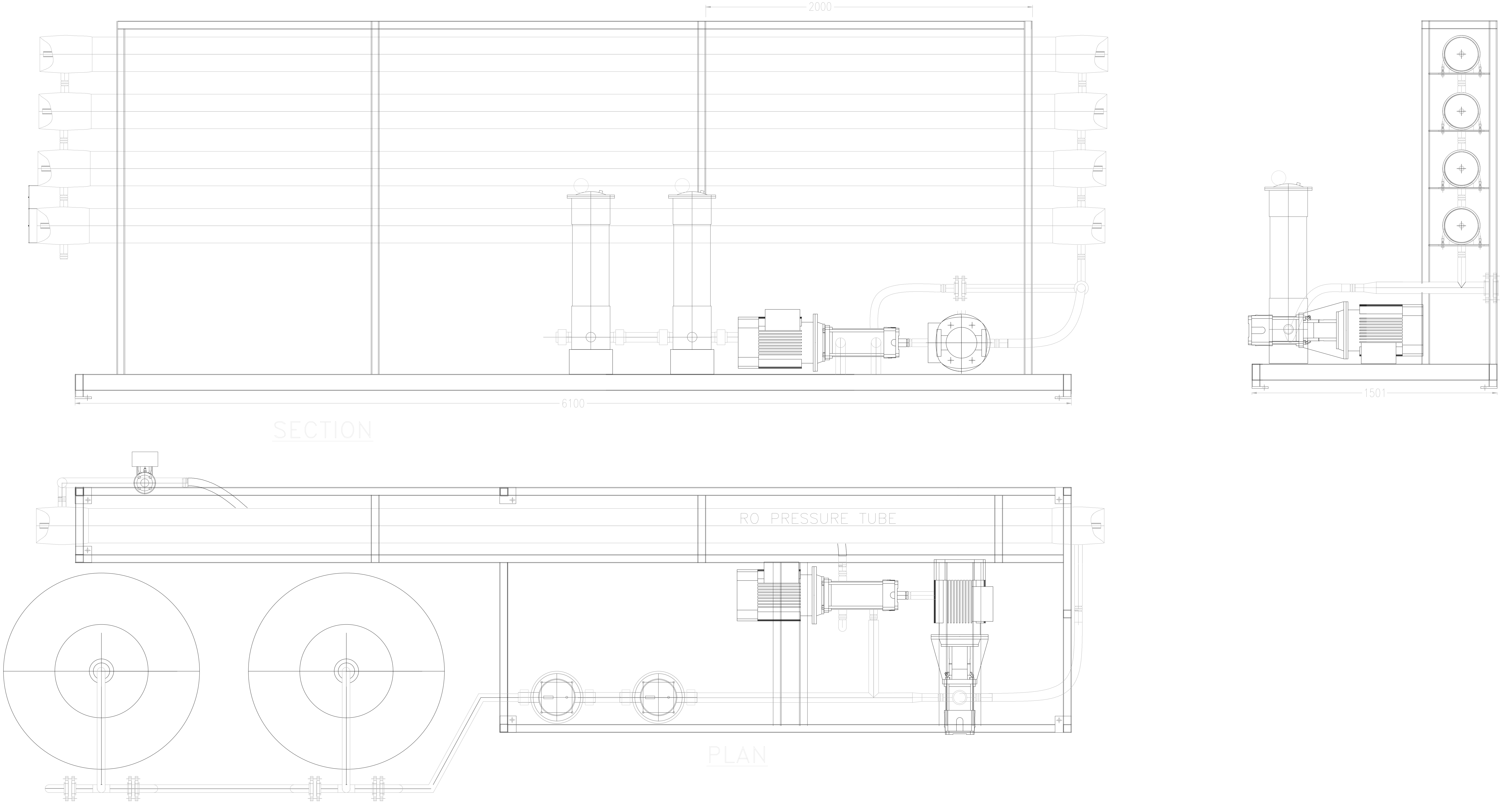
203 KALLANG BAHRU, SINGAPORE 339340

DRAWN	KUMAR
CHKD	SATHISH
APPD	GANESH
DATE	13.11.2021
SCALE	NTS
Ph No:	9952710159

CLIENT :	HPL HOTELS & RESORTS
PROJECT :	WATER TREATMENT PLANT-300 KLD
TITLE :	PROCESS AND INSTRUMENTATION DIAGRAM
DRG NO :	A3/ECO/PRO515/WTP/GA-001

SHEET : 1 OF 1

REV : '01'



NOTE:
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED
2. MOC: SKID – SS304 AND LOW PRESSURE LINE UPVC & HIGH PRESSURE LINE SUPER DUPLEX SS
3. ALL FLANGE ARE ANSI B16.5 #150 FOR LOW PRESSURE AND #600 HIGH PRESSURE LINE
4. ALL SHARP CORNERS SHALL BE SUITABLY ROUNDED OFF & GROUND FLUSH
5. ALL NECESSARY FITTINGS, BOLT & NUTS GASKET TO BE SUPPLIED BY ECOCHEM
6. SS TUBE – 50X100X2MM THK AND 50 X 50X2MM THK SS304
7. ALL VICTAULIC COUPLINGS ARE STYLE 75

ECOmitds
Sustainable Water Solutions

203 KALLANG BAHRU, SINGAPORE 339340

DRAWN	KUMAR
CHKD	SATHISH
APPD	GANESH
DATE	27.11.2021
SCALE	NTS
Ph No:	9952710159

CLIENT : HPL HOTELS & RESORTS
PROJECT : WATER TREATMENT PLANT–300 KLD
TITLE : SKID GA DIAGRAM
DRG NO : A3/ECO/PRO508/WTP/GA–001
SHEET : 1 OF 1
REV : '01'

BASIC DESIGN WITH Pressure/Work Exchanger

RO program licensed to:					
Calculation created by:	K.Sathish Kumar				
Project name:	RO 300 KLD		Permeate flow:	15.00	m3/hr
HP Pump flow:	15.2	m3/hr	Raw water flow:	37.5	m3/hr
Feed pressure:	55.4	bar	Permeate recovery:	40.0	%
Feedwater Temperature:	25.0	C(77F)			
Feed water pH:	7.50		Element age:	3.0	years
Chem dose, ppm (100%):	0.0	HCl	Flux decline % per year:	5.0	
			Fouling Factor	0.73	
			Salt passage increase, %/yr:	7.0	
Average flux rate:	16.8	lm2hr	Feed type:	Seawater-well or MF/UF Pretreatment	

Stage	Perm. Flow m3/hr	Flow/Vessel Feed m3/hr	Conc m3/hr	Flux l/m2-hr	Beta	Conc.&Throt. Pressures bar	bar	Element Type	Elem. No.	Array
1-1	15.0	9.4	5.6	16.8	1.02	54.6	0.0	SWC5-LD	24	4x6

	Raw water	Adjusted Water	Feed water	Permeate	Concentrate	ERD Reject
Ion	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Ca	550.0	550.0	563.8	0.732	939.2	916.1
Mg	420.0	420.0	430.6	0.559	717.2	699.6
Na	12504.7	12504.7	12817.5	79.728	21309.3	20786.3
K	2.0	2.0	2.0	0.016	3.4	3.3
NH4	0.0	0.0	0.0	0.000	0.0	0.0
Ba	0.000	0.000	0.000	0.000	0.000	0.0
Sr	0.000	0.000	0.000	0.000	0.000	0.0
CO3	8.4	8.4	8.8	0.005	19.2	18.6
HCO3	250.0	250.0	255.9	2.640	415.9	406.1
SO4	350.0	350.0	358.8	0.515	597.7	582.9
Cl	21066.5	21066.5	21593.7	123.878	35906.9	35025.3
F	0.0	0.0	0.0	0.000	0.0	0.0
NO3	1.0	1.0	1.0	0.044	1.7	1.6
B	0.00	0.00	0.00	0.000	0.00	0.0
SiO2	30.0	30.0	30.8	0.13	51.2	49.9
CO2	4.02	4.08	4.08	4.08	4.08	4.08
TDS	35182.6	35182.6	36062.8	208.2	59961.6	58489.7
pH	7.50	7.50	7.50	6.02	7.46	

	Raw water	Feed water	Concentrate
CaSO4 / Ksp * 100:	4%	4%	8%
SrSO4 / Ksp * 100:	0%	0%	0%
BaSO4 / Ksp * 100:	0%	0%	0%
SiO2 saturation:	23%	24%	40%
Langelier Saturation Index	0.94	0.96	1.35
Stiff & Davis Saturation Index	0.02	0.03	0.34
Ionic strength	0.64	0.66	1.09
Osmotic pressure	27.2 bar	27.9 bar	46.4 bar

H.P. Differential of Pressure/Work Exchanger	0.5	bar	Pressure/Work Exchanger Leakage:	1 %
Pressure/Work Exchanger Boost Pressure	1.3	bar	Volumetric Mixing	6 %

BASIC DESIGN WITH Pressure/Work Exchanger

RO program licensed to:					
Calculation created by:	K.Sathish Kumar				
Project name:	RO 300 KLD		Permeate flow:	15.00	m3/hr
HP Pump flow:	15.2	m3/hr	Raw water flow:	37.5	m3/hr
Feed pressure:	55.4	bar	Permeate recovery:	40.0	%
Feedwater Temperature:	25.0	C(77F)			
Feed water pH:	7.50		Element age:	3.0	years
Chem dose, ppm (100%):	0.0	HCl	Flux decline % per year:	5.0	
			Fouling Factor	0.73	
			Salt passage increase, %/yr:	7.0	
Average flux rate:	16.8	lm2hr	Feed type:	Seawater-well or MF/UF Pretreatment	

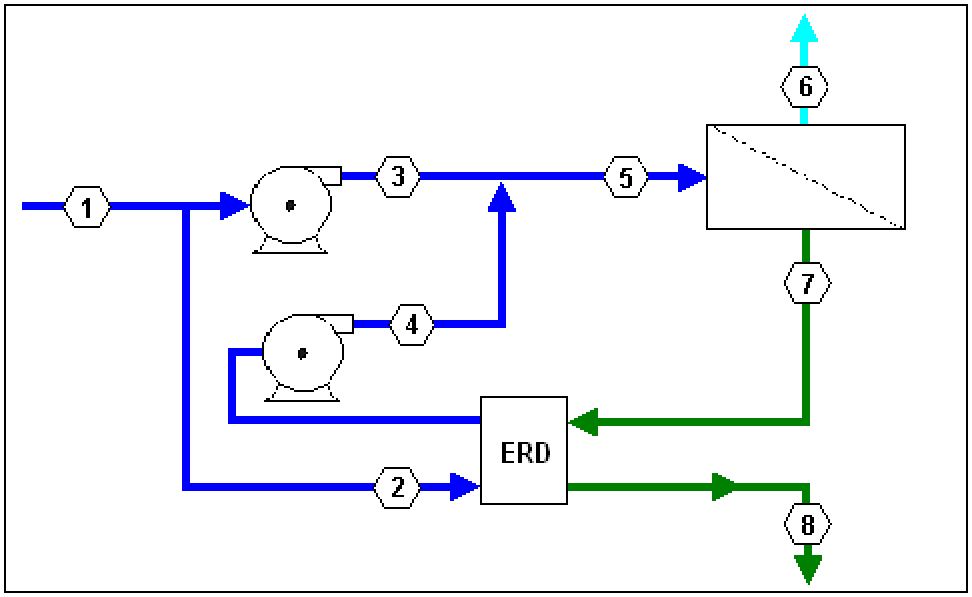
Stage	Perm. Flow m3/hr	Flow/Vessel Feed m3/hr	Flow/Vessel Conc m3/hr	Flux l/m2-hr	Beta	Conc.&Throt. Pressures bar	Conc.&Throt. Pressures bar	Element Type	Elem. No.	Array
1-1	15.0	9.4	5.6	16.8	1.02	54.6	0.0	SWC5-LD	24	4x6

Stg	Elem no.	Feed pres bar	Pres drop bar	Perm flow m3/hr	Perm Flux lm2hr	Beta	Perm sal TDS	Conc osm pres	Cumulative Perm Ion levels Ca	Mg	Cl	B	SiO2
1-1	1	55.4	0.2	1.0	28.2	1.04	97.4	31.4	0.36	0.28	56	0.00	0.06
1-1	2	55.2	0.2	0.9	22.9	1.03	113.9	35.0	0.42	0.32	65	0.00	0.07
1-1	3	55.1	0.1	0.7	18.1	1.03	133.0	38.4	0.49	0.38	75	0.00	0.09
1-1	4	54.9	0.1	0.5	13.9	1.02	154.7	41.5	0.57	0.44	88	0.00	0.10
1-1	5	54.8	0.1	0.4	10.3	1.02	179.9	44.2	0.67	0.51	102	0.00	0.12
1-1	6	54.7	0.1	0.3	7.7	1.02	207.2	46.4	0.77	0.59	117	0.00	0.13

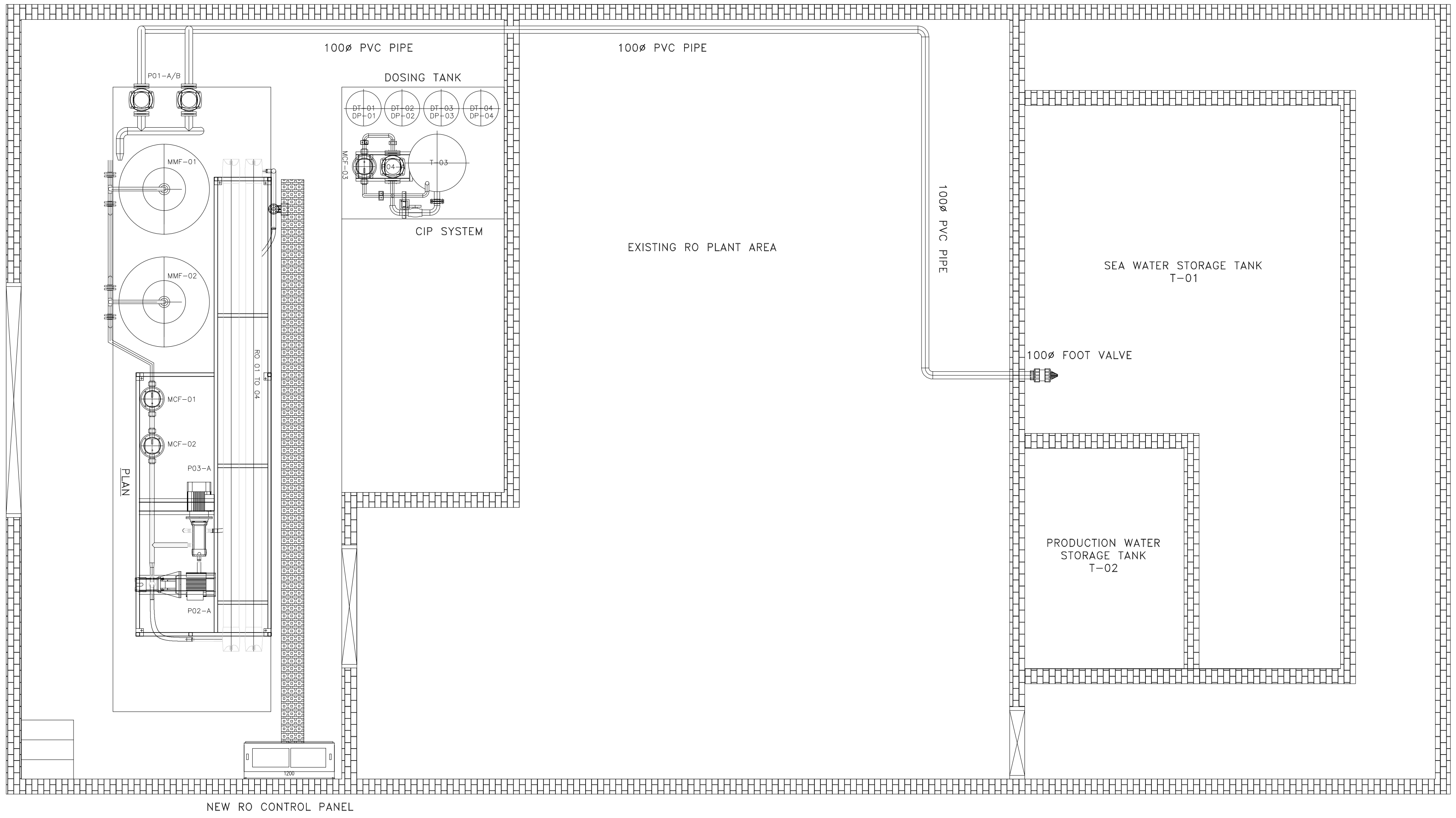
Stage	NDP bar
1-1	18.1

RO 300 KLD 11/25/21

SINGLE STAGE SYSTEM WITH Pressure/Work Exchanger



		1	2	3	4	5	6	7	8
Flow	m3/hr	37.5	22.3	15.2	22.3	37.5	15.0	22.5	22.5
Pressure	bar	0.0	0.0	55.4	55.4	55.4	0.0	54.6	0.0
TDS (ppm)		35182.6	35182.6	35182.6	36669.3	36062.8	208.2	59961.6	58489.7



RO PLANT ROOM

SHOP DRAWING

NOTE

PLEASE REFER TO PROJECT DIRECTORY FOR DETAILS OF CONSULTANTS.

REVISION

REV	DESCRIPTION	DATE

PROJECT TITLE

PROPOSED UPGRADING/
INTERIOR RENOVATION TO
EXISTING WATER VILLAS,
KANUHURA MALDIVES,
LHAVIYANI ATOLL, MALDIVES

OWNER

HPL HOTELS & RESORTS

C/O HPL PROPERTIES PTE LTD
50 CUSCADEN ROAD #05-01 HPL HOUSE
SINGAPORE 249724

INTERIOR DESIGNER

DESIGN BASIS
PRIVATE LIMITED
Interior Design
& Design Consultant
2 Alexandra Road #07-08
Delta House Singapore 159919
Tel: 6734-1633 Fax: 6736-0986

MECHANICAL & ELECTRICAL ENGINEER

ACE-TECH
Blk 164 #03-3633
Bt Merah Central
Singapore 150164
Tel: (65) 6278 7278
Website: www.acetech.com.sg

CONTRACTOR

MADD Projects Pte. Ltd.
203, Kallang Bahru
Singapore 339340

SERVICE
DESALINATION PLANT

SUB-SERVICE
SEA WATER REVERSE OSMOSIS PLANT

FLOOR LEVEL/CONTENT

BLOCK/BUILDING
RO PLANT ROOM

SHOP DRAWING

DRAWING NO.		REV
MADD/SSK/MEP/RO/SHOP/01		1
SCALE 1:75 (A3)	UNITS MM	DATE DEC 2021

ALL DIMENSIONS SHOWN ARE IN MM. UNLESS INDICATED OTHERWISE.

MATERIAL SUBMISSION

Seawater Desalination System

Document Number:
MADD/SSK/MEP/MAT/SWRO/001

Dec 2021

Rev	Date	Description	Prepared	Checked	Approved
0	7-Dec-21	For Acceptance	Jeremy	Fred	

General Submission Form

Project	:	Proposed Upgrading/Interior Renovation To Six Senses Kanuhura, Lhavi Yani Atoll, Maldives
Contractor		**MADD Projects Sdn Bhd**
Document Reference	:	**MADD/SSK/MEP/MAT/SWRO/001** Rev **0**
Submission Description	:	**Material Submission – Seawater Desalination System**
Submission date	:	**7th December 2021**

The item submitted with this General Submission Form is: **Issued for Acceptance**

Remarks:

Details of Submission (tick whichever is applicable)

Document ☑ (if ticked, state the document type) **Material Submission**

Sample / Material ☐ (if ticked, complete the details below)

For Materials / Samples: Submission Details

Equipment / Material Offer

Manufacturer	Ecomidts
Brand	Ecomidts
Country of Origin	India
Model No.	300 KLD

Location: Six Sense Kanuhura

Lead Consultant's Official Review Status

☐ A - No adverse comment, proceed according to this submission

☐ B - Proceed in accordance with the comment. Revise and re-submit.

☐ C - Do not proceed: incorporate comments and re-submit in accordance with Contractual requirements

Comments:

Reviewed by:	Approved by:	Date:

DESIGN ENGINEERING PACKAGE

FOR

SWRO BASED WATER TREATMENT PLANT

CAPACITY OF 300 KLD

SUBMITTED TO: ACE TECH

SUBMITTED BY:

JONATHAN

INDEX

ANNEXURE I

TREATMENT DESCRIPTION

1. Pre-Filter

The Filter feed pumps transfer the raw well water to Downstream Multimedia Filter for the removal of suspended solids, turbidity. The Multimedia filter offered will be a FRP vessel with Manual butterfly valve. One initial charge of filter media consisting of graded sand & Silex. The filtered water Disinfection with Sodium Hypo Chlorite (NaOCl) solution. The pressure sand filter will have to be backwashed at regular intervals to remove the accumulated dirt. The filter will have to be backwashed at regular intervals to ensure good quality filtered water. Backwashing will have to be done whenever the pressure drop across the filter exceed 1.2 kgs/cm2 or once every 12 hrs of continuous / intermittent operation

2. Micron Cartridge Filter

The filtered water from the Multi Grade Filter is then passed to 10 and 5 Micron cartridge filter to prevent any suspended solids form entering the RO. Anti-Oxidant dosing system is deactivate the chlorine present in filtered water and Anti scalant dosing system is provided to prevent the scaling of membrane. Acid dosing system will correct the pH level before entering the RO Block. The filtered water is then pressurized using high-pressure pump to the RO block.

3. RO Block

The reverse osmosis system utilizes the latest generation thin film composite Polyamide membranes having Spiral wound configuration.

The RO membranes separate the feed into two streams, the permeate containing low dissolved solids will be collected in the RO permeate water collection tank & reject high TDS will be stored to reject water storage tank.

We have considered brackish water membranes for RO.

Process Monitoring

RO plant will be provided with following instrumentation for safe & easy operation.

- Pressure switches at the suction and discharge of the high-pressure pumps.
- Rota meter for the feed and Permeate
- Rota meter in the Reject
- Conductivity meter in the permeate

ANNEXURE II - DESIGN BASIS

System Design Flow

Source of water : Bore Well Sea Water
Type of process proposed : Pre-Treatment followed by RO System.
Product water required per hour : 15 m^3/hr (300m^3/day)
Feed flow rate per hour : 37.5 m3/hr (System Recovery 40%)
Service cycle : 20 hours.
Average Flux considered : 16.8 LMH
Stages of process proposed : Filter Feed Pumps
: Multi Media Filter
: Chemical Dosing System
: Micron Cartridge Filter
: RO High Pressure Pump
: RO Block

Incoming Raw Water Quality

Design Notes:

- The Design Feed water analysis has been balanced to achieve a TDS of 35000 ppm.
- The following parameters that have a considerable effect on the pre-treatment and the RO are not provided in the analysis report, we have assumed the following values for design
  - pH : 7.0 – 7.5
  - Chloride : 22000 ppm
  - Iron : < 0.01 ppm
  - Reactive Silica : < 25 ppm
  - Colloidal Silica : < 3 ppm
  - Suspended Solids : < 1 ppm
  - Turbidity : < 1 NTU
  - Boron : < 1 ppm
  - Heavy Metals : Nil

Interconnecting piping all low pressure lines will be in UPVC SCH 80. High pressure lines from the booster pump to the reject valves will be Super Duplex SS

Expected Treated water Quality

Treated water qualities after RO Permeate are as follow (Maximum values)

S. No	Characteristics	Unit	Outlet Parameters
1.	Flow	m3/ day	300
2.	pH	-	6.5 to 7.5
3.	Suspended solids	mg/l	Nil
4.	Total Dissolved solids	mg/l	< 500

3. TREATMENT SCHEME

1. Filter Feed Pumps
2. Sodium Hypo Chloride Dosing System
3. Multi Media Filters
4. Anti-Oxidant Dosing System
5. Anti Scalent Dosing System
6. Acid Dosing System
7. Micron Cartridge Filter Stage – 1
8. Micron Cartridge Filter Stage – 2
9. RO High Pressure Pumps
10. Energy Recovery Booster Pump (Pressure Exchanger)
11. RO Membrane Block
12. RO Permeate Tank

ANNEXURE III

PROCESS / SIZING CALCULATION

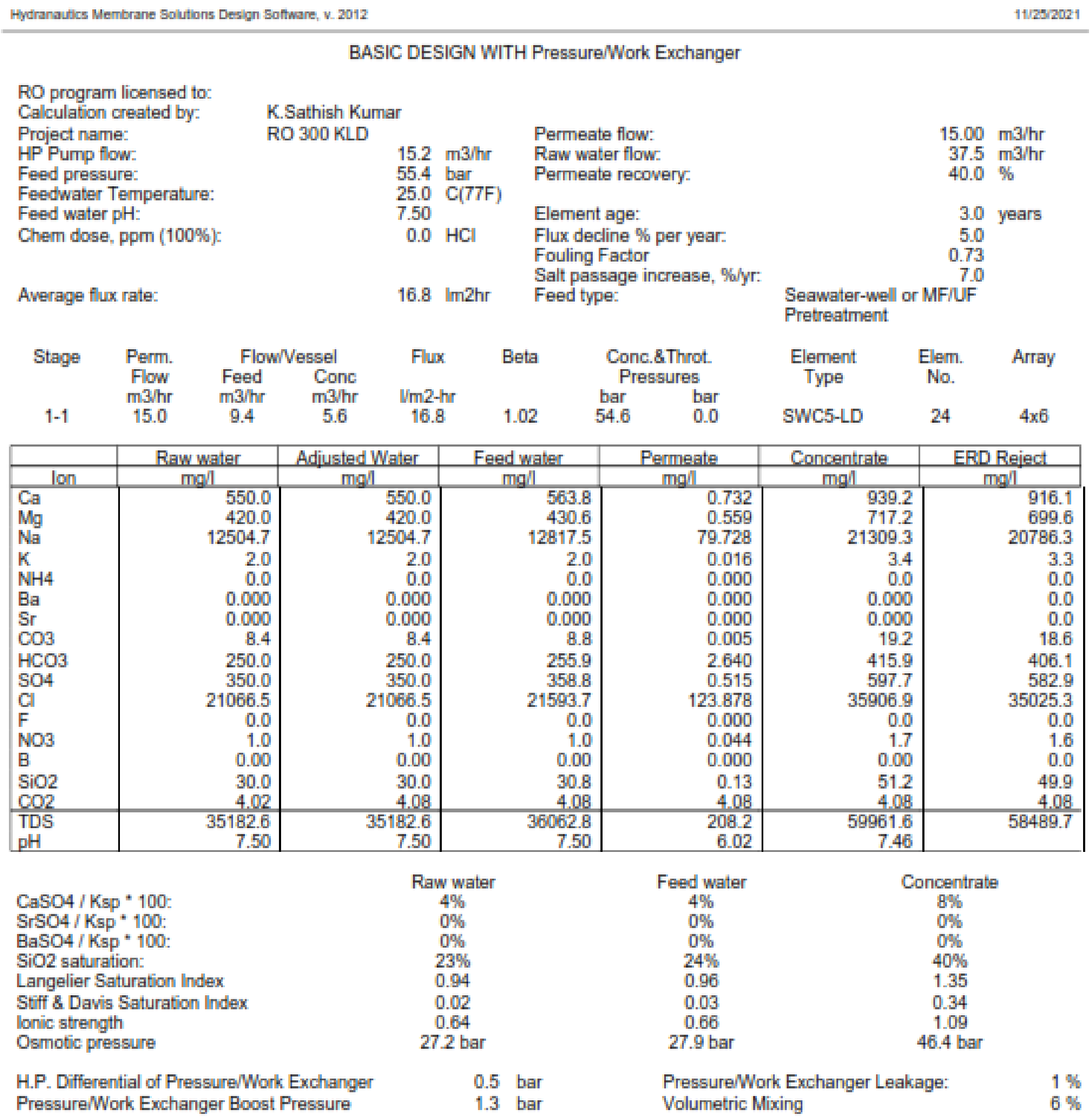
SL. NO	DESCRIPTION	UOM	DESIGN
A	**COLLECTION TANK**		
1.	Average Feed Flow Rate	M3/hr	**300**
2.	Hydraulic Retention Time	Hours	
3.	Volume of Collection Tank required	Cum	
4.	Volume of Collection Tank provided	Cum	
5.	Collection Tank Size provided	meters	
B	**HYPO DOSING SYSTEM**		
1.	Average Flow Rate	M3/hr	37.5
2.	Disinfection Dosage Recommended (Sodium Hypo Chlorite)	ppm	2
3.	Sodium Hypo Chlorite required per hour as 100%	kg/hr	0.075
4.	Commercial Concentration	%	6
5.	Actual Sodium Hypo Chlorite required at 6%	Kg/hr	1.25
6.	Operating hours of the Plant	hr	20
7.	Total Sodium Hypo Chlorite required at 6%	Kg/day	25
8.	Volume of Sodium Hypo Chlorite tank required	Liters	25
9.	Volume of Sodium Hypo Chlorite Tank provided	Liters	125
10.	Capacity of Sodium Hypo Chlorite Dosing Pump required	LPH	1
11.	Capacity of Sodium Hypo Chlorite Dosing Pump provided	LPH	10
12.	Pressure Rating of Sodium Hypo Chlorite Dosing Pump	Kg/cm2	3
13.	No. of Sodium Hypo Chlorite Dosing Pump Provided	Kg/cm2	5
14.	MOC of the Dosing Pump	-	PP
C	**FILTER FEED PUMP**		
1.	Feed Pumps Capacity	M3/hr	37.5

2.	Pressure Rating	Kg/cm2	3.0
3.	No. of Working Pumps	Nos	1
4.	No. of Stand by Pumps	Nos	1
5.	MOC - Casing of the Pump	-	SS 316
6.	Impeller of the Pump	-	SS 316
7.	Shaft of the Pump	-	SS 316
8.	Pump Type	-	Horizontal Vertical
9.	Motor rating	Kw	5.5
D	**MULTI MEDIA FILTER**		
1.	No. of Filters	Nos	2
2.	Total Flow Rate	M3/hr	37.5
3.	Flow rate / Filter	M3/hr	18.75
4.	Filtration Velocity	m/hr	16
5.	Area Required per Filter	m2	1.13
6.	Diameter	m	1.2
7.	Dia Provided	m	1.2
8.	Media Height	mm	1000
9.	Free Board	mm	500
10.	Filtration Velocity Calculated	m/hr	16
11.	Back wash Velocity	m/hr	24
12.	Back Wash Flow Rate Required	m3/hr	46
13.	Operating Pressure Rating	Kg/cm2	3.5
14.	Max. Operating Pressure Rating	Kg/cm2	10
E	**ANTI OXIDANT DOSING SYSTEM**		
1.	Average Flow Rate	M3/hr	37.5
2.	Anti-Oxidant Recommended (SMBS)	ppm	5
3.	Anti-Oxidant required per hour as 100%	Liters/Hr	0.187

4.	Commercial Concentration	%	100
5.	Operating hours of the Plant	hrs	20
6.	Total Anti-Oxidant required per day	Kgs	3.75
7.	Chemical Dosing Preparation concentration 5%	Liters	75
8.	Volume of dosing tank provided	Liters	125
9.	Capacity of Dosing Pump required	LPH	6.25
10.	Capacity of Dosing Pump provided	LPH	10
11.	Pressure Rating of Dosing Pump	Kg/cm2	3.0
12.	No. of Dosing Pump Provided	Kg/cm2	5.0
13.	MOC of the Dosing Pump	-	PP
F	**ANTI SCALENT DOSING SYSTEM**		
1.	Average Flow Rate	M3/hr	37.5
2.	Anti-Scalent Recommended	ppm	5
3.	Anti-Scalent required per hour as 100%	Liters/Hr	0.187
4.	Commercial Concentration	%	100
5.	Operating hours of the Plant	hrs	20
6.	Total Anti-Scalent required per day	Kgs	3.75
7.	Chemical Dosing Preparation concentration 20%	Liters	75
8.	Volume of dosing tank provided	Liters	125
9.	Capacity of Dosing Pump required	LPH	6.25
10.	Capacity of Dosing Pump provided	LPH	10
11.	Pressure Rating of Dosing Pump	Kg/cm2	3.0
12.	No. of Dosing Pump Provided	Kg/cm2	5.0
13.	MOC of the Dosing Pump	-	PP
G	**ACID DOSING SYSTEM**		
1.	Average Flow Rate	M3/hr	37.5
2.	Acid Dosing Recommended (HCL)	ppm	2

3.	Acid chemical required per hour as 100%	Liters/Hr	0.075
4.	Commercial Concentration	%	33
5.	Acid chemical required per hour as 33%	Liters/Hr	0.23
6.	Operating hours of the Plant	hrs	20
7.	Total Acid chemical required per day	Kgs	4.5
8.	Chemical Dosing Preparation concentration 5%	Liters	90
9.	Volume of dosing tank provided	Liters	125
10.	Capacity of Dosing Pump required	LPH	6.5
11.	Capacity of Dosing Pump provided	LPH	10
12.	Pressure Rating of Dosing Pump	Kg/cm2	3.0
13.	No. of Dosing Pump Provided	Kg/cm2	5.0
14.	MOC of the Dosing Pump	-	PP
H	**MICRON CARTRIDGE FILTER -1**		
1.	Cartridge Filter Capacity	M3/hr	37.5
2.	No. of Cartridge Filter	Nos	1
3.	No. of Cartridge Filter working	Nos	1
4.	No of Micron Cartridge Filter	Nos	9
5.	Flow rate per Cartridge Filter	m3/hr	4
6.	Micron Size	Micron	5
7.	Cartridge Sizes	hrs	2.5” dia X 40” Long
8.	MOC of Cartridge Filter Housing	-	UPVC
9.	MOC of Cartridge Filter	-	PP
I	**MICRON CARTRIDGE FILTER -2**		
1.	Cartridge Filter Capacity	M3/hr	37.5
2.	No. of Cartridge Filter	Nos	1
3.	No. of Cartridge Filter working	Nos	1
4.	No of Micron Cartridge Filter	Nos	9

5.	Flow rate per Cartridge Filter	m3/hr	4
6.	Micron Size	Micron	10
7.	Cartridge Sizes	hrs	2.5” dia X 40” Long
8.	MOC of Cartridge Filter Housing	-	UPVC
J	**RO PROJECTION**		



Hydranautics Membrane Solutions Design Software, v. 2012 11/25/2021

BASIC DESIGN WITH Pressure/Work Exchanger

RO program licensed to:
Calculation created by: K.Sathish Kumar
Project name: RO 300 KLD
HP Pump flow: 15.2 m3/hr
Feed pressure: 55.4 bar
Feedwater Temperature: 25.0 C(77F)
Feed water pH: 7.50
Chem dose, ppm (100%): 0.0 HCl
Average flux rate: 16.8 lm2hr

Permeate flow: 15.00 m3/hr
Raw water flow: 37.5 m3/hr
Permeate recovery: 40.0 %
Element age: 3.0 years
Flux decline % per year: 5.0
Fouling Factor 0.73
Salt passage increase, %/yr: 7.0
Feed type: Seawater-well or MF/UF Pretreatment

Stage	Perm. Flow m3/hr	Flow/Vessel Feed m3/hr	Flow/Vessel Conc m3/hr	Flux l/m2-hr	Beta	Conc.&Throt. Pressures bar	Conc.&Throt. Pressures bar	Element Type	Elem. No.	Array
1-1	15.0	9.4	5.6	16.8	1.02	54.6	0.0	SWC5-LD	24	4x6

Ion	Raw water mg/l	Adjusted Water mg/l	Feed water mg/l	Permeate mg/l	Concentrate mg/l	ERD Reject mg/l
Ca	550.0	550.0	563.8	0.732	939.2	916.1
Mg	420.0	420.0	430.6	0.559	717.2	699.6
Na	12504.7	12504.7	12817.5	79.728	21309.3	20786.3
K	2.0	2.0	2.0	0.016	3.4	3.3
NH4	0.0	0.0	0.0	0.000	0.0	0.0
Ba	0.000	0.000	0.000	0.000	0.000	0.0
Sr	0.000	0.000	0.000	0.000	0.000	0.0
CO3	8.4	8.4	8.8	0.005	19.2	18.6
HCO3	250.0	250.0	255.9	2.640	415.9	406.1
SO4	350.0	350.0	358.8	0.515	597.7	582.9
Cl	21066.5	21066.5	21593.7	123.878	35906.9	35025.3
F	0.0	0.0	0.0	0.000	0.0	0.0
NO3	1.0	1.0	1.0	0.044	1.7	1.6
B	0.00	0.00	0.00	0.000	0.00	0.0
SiO2	30.0	30.0	30.8	0.13	51.2	49.9
CO2	4.02	4.08	4.08	4.08	4.08	4.08
TDS	35182.6	35182.6	36062.8	208.2	59961.6	58489.7
pH	7.50	7.50	7.50	6.02	7.46	

	Raw water	Feed water	Concentrate
CaSO4 / Ksp * 100:	4%	4%	8%
SrSO4 / Ksp * 100:	0%	0%	0%
BaSO4 / Ksp * 100:	0%	0%	0%
SiO2 saturation:	23%	24%	40%
Langelier Saturation Index	0.94	0.96	1.35
Stiff & Davis Saturation Index	0.02	0.03	0.34
Ionic strength	0.64	0.66	1.09
Osmotic pressure	27.2 bar	27.9 bar	46.4 bar

H.P. Differential of Pressure/Work Exchanger 0.5 bar
Pressure/Work Exchanger Boost Pressure 1.3 bar
Pressure/Work Exchanger Leakage: 1 %
Volumetric Mixing 6 %

BASIC DESIGN WITH Pressure/Work Exchanger

RO program licensed to:					
Calculation created by:	K.Sathish Kumar				
Project name:	RO 300 KLD		Permeate flow:	15.00	m3/hr
HP Pump flow:	15.2	m3/hr	Raw water flow:	37.5	m3/hr
Feed pressure:	55.4	bar	Permeate recovery:	40.0	%
Feedwater Temperature:	25.0	C(77F)			
Feed water pH:	7.50		Element age:	3.0	years
Chem dose, ppm (100%):	0.0	HCl	Flux decline % per year:	5.0	
			Fouling Factor	0.73	
			Salt passage increase, %/yr:	7.0	
Average flux rate:	16.8	lm2hr	Feed type:	Seawater-well or MF/UF Pretreatment	

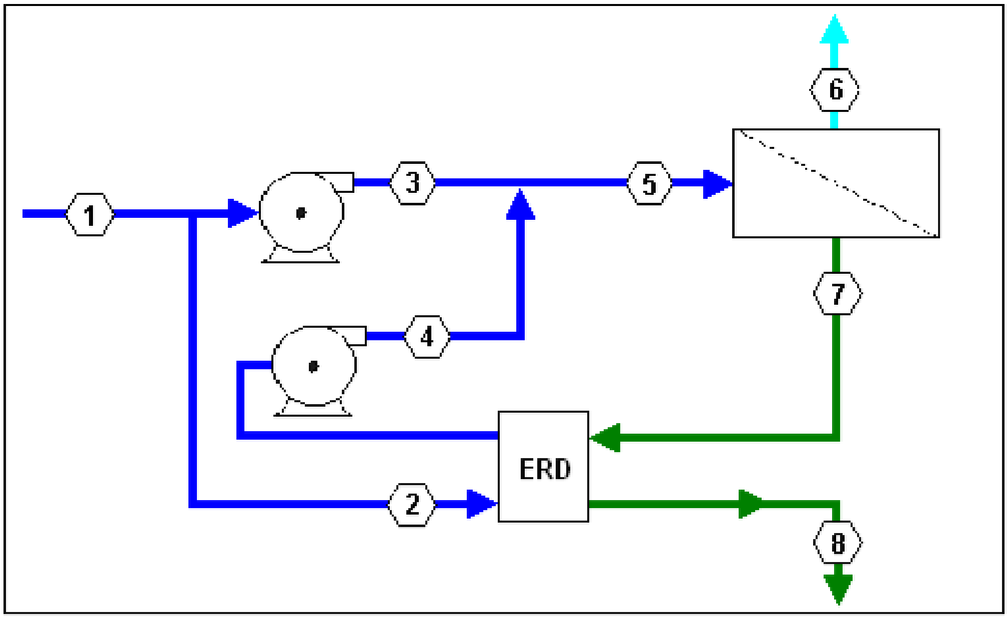
Stage	Perm. Flow m3/hr	Flow/Vessel Feed m3/hr	Flow/Vessel Conc m3/hr	Flux l/m2-hr	Beta	Conc.&Throt. Pressures bar	Conc.&Throt. Pressures bar	Element Type	Elem. No.	Array
1-1	15.0	9.4	5.6	16.8	1.02	54.6	0.0	SWC5-LD	24	4x6

Stg	Elem no.	Feed pres bar	Pres drop bar	Perm flow m3/hr	Perm Flux lm2hr	Beta	Perm sal TDS	Conc osm pres	Ca	Cumulative Perm Ion levels Mg	Cl	B	SiO2
1-1	1	55.4	0.2	1.0	28.2	1.04	97.4	31.4	0.36	0.28	56	0.00	0.06
1-1	2	55.2	0.2	0.9	22.9	1.03	113.9	35.0	0.42	0.32	65	0.00	0.07
1-1	3	55.1	0.1	0.7	18.1	1.03	133.0	38.4	0.49	0.38	75	0.00	0.09
1-1	4	54.9	0.1	0.5	13.9	1.02	154.7	41.5	0.57	0.44	88	0.00	0.10
1-1	5	54.8	0.1	0.4	10.3	1.02	179.9	44.2	0.67	0.51	102	0.00	0.12
1-1	6	54.7	0.1	0.3	7.7	1.02	207.2	46.4	0.77	0.59	117	0.00	0.13

Stage	NDP bar
1-1	18.1

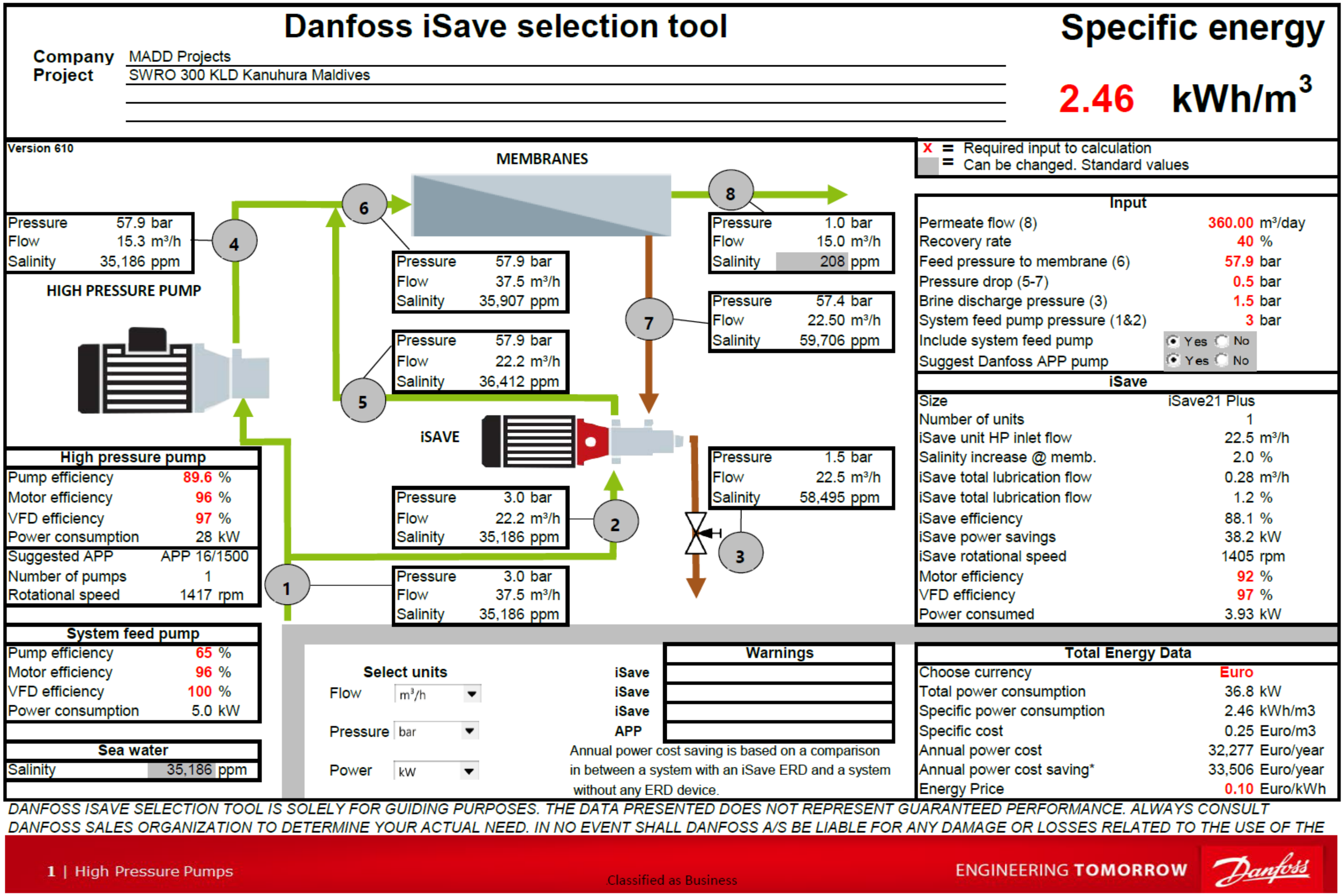
RO 300 KLD **11/25/21**

SINGLE STAGE SYSTEM WITH Pressure/Work Exchanger



		1	2	3	4	5	6	7	8
Flow	**m3/hr**	37.5	22.3	15.2	22.3	37.5	15.0	22.5	22.5
Pressure	**bar**	0.0	0.0	55.4	55.4	55.4	0.0	54.6	0.0
TDS (ppm)		35182.6	35182.6	35182.6	36669.3	36062.8	208.2	59961.6	58489.7

K	RO HIGH PRESSURE PUMPS		
1.	Capacity	M3/hr	15.2
2.	As per the projection required pressure	Kg/cm2	58
3.	No. of Pumps working	Nos	1
4.	Model	-	APP16/1500
5.	Pump Type		Positive displacement pumps with axial pistons
6.	Pressure rating per pump	Kg/cm2	58
7.	MOC - Casing of the Pump	-	Super Duplex SS
8.	MOC of Pump	-	Super Duplex SS
9.	Motor rating	Kw	37
10.	VFD	Nos	1
11.	Motor	-	4 Pole
12.	Frame		FRAME- 225 Suitable for VFD
L	**PRESSURE EXCHANGER AND BOOSTER PUMP**		
1.	Capacity	M3/hr	22.3
2.	As per the projection required pressure	Kg/cm2	58
3.	No. of Pumps working	Nos	1
4.	Pressure Exchanger	-	iSave21 Plus,
5.	MOC of Pump	-	Super Duplex SS
6.	Motor rating	Kw	7.5
7.	VFD	Nos	1
8.	Motor	-	4 Pole
9.	Connection Hydraulic Tube	Inch	2



Danfoss iSave selection tool

Company MADD Projects
Project SWRO 300 KLD Kanuhura Maldives

Specific energy

2.46 kWh/m^3

Version 610

Point	Pressure	Flow	Salinity
4	57.9 bar	15.3 m³/h	35,186 ppm
6	57.9 bar	37.5 m³/h	35,907 ppm
5	57.9 bar	22.2 m³/h	36,412 ppm
2	3.0 bar	22.2 m³/h	35,186 ppm
1	3.0 bar	37.5 m³/h	35,186 ppm
8	1.0 bar	15.0 m³/h	208 ppm
7	57.4 bar	22.50 m³/h	59,706 ppm
3	1.5 bar	22.5 m³/h	58,495 ppm

High pressure pump	
Pump efficiency	89.6 %
Motor efficiency	96 %
VFD efficiency	97 %
Power consumption	28 kW
Suggested APP	APP 16/1500
Number of pumps	1
Rotational speed	1417 rpm

System feed pump	
Pump efficiency	65 %
Motor efficiency	96 %
VFD efficiency	100 %
Power consumption	5.0 kW

Sea water	
Salinity	35,186 ppm

X = Required input to calculation
▨ = Can be changed. Standard values

Input	
Permeate flow (8)	360.00 m³/day
Recovery rate	40 %
Feed pressure to membrane (6)	57.9 bar
Pressure drop (5-7)	0.5 bar
Brine discharge pressure (3)	1.5 bar
System feed pump pressure (1&2)	3 bar
Include system feed pump	● Yes ○ No
Suggest Danfoss APP pump	● Yes ○ No

iSave	
Size	iSave21 Plus
Number of units	1
iSave unit HP inlet flow	22.5 m³/h
Salinity increase @ memb.	2.0 %
iSave total lubrication flow	0.28 m³/h
iSave total lubrication flow	1.2 %
iSave efficiency	88.1 %
iSave power savings	38.2 kW
iSave rotational speed	1405 rpm
Motor efficiency	92 %
VFD efficiency	97 %
Power consumed	3.93 kW

Select units
Flow m³/h
Pressure bar
Power kW

Warnings	
iSave	
iSave	
iSave	
APP	

Annual power cost saving is based on a comparison in between a system with an iSave ERD and a system without any ERD device.

Total Energy Data	
Choose currency	Euro
Total power consumption	36.8 kW
Specific power consumption	2.46 kWh/m3
Specific cost	0.25 Euro/m3
Annual power cost	32,277 Euro/year
Annual power cost saving*	33,506 Euro/year
Energy Price	0.10 Euro/kWh

DANFOSS ISAVE SELECTION TOOL IS SOLELY FOR GUIDING PURPOSES. THE DATA PRESENTED DOES NOT REPRESENT GUARANTEED PERFORMANCE. ALWAYS CONSULT DANFOSS SALES ORGANIZATION TO DETERMINE YOUR ACTUAL NEED. IN NO EVENT SHALL DANFOSS A/S BE LIABLE FOR ANY DAMAGE OR LOSSES RELATED TO THE USE OF THE

1 | High Pressure Pumps

Classified as Business

ENGINEERING TOMORROW

M	RO SYSTEM		
1.	Average Feed Flow Rate	m^3/hr	37.5
2.	Recovery of RO System	%	40
3.	RO Permeate Flow	m3/hr	15
4.	RO Reject Flow	m3/hr	22.5
5.	No. of Stage in RO System	-	One
6.	Array of RO System	No	5 : 0
7.	No of Pressure Tube	Nos	4
8.	Membrane per Pressure Tube	Nos	6
9.	No of Membrane Provided	Nos	24
10.	No of RO Skid Provided	Nos	1
11.	Average Flux	LMH	16.8
12.	Area per Membrane	Sq.ft	400
13.	Total Area of Membrane	Sq.ft	8000
14.	No of RO membrane per skid	Nos	24
15.	Size of RO Pressure Tube	Inch	8” dia X 6 Element Long
16.	Approximant Skid size	m	1.5x 6.0x2.0
N	**CIP SYSTEM**		
1.	No of Vessel	Nos	4
2.	Size of Vessel	Inch	8” dia X 6 Element Long
3.	Volume / Vessel	M3/hr	8
4.	Total capacity of Pump	M3/hr	48
5.	CIP Water Holding per vessel	Liters	120
6.	Total CIP Tank Volume Required	Liter	720
7.	CIP Tank Provided	Liter	1000
8.	Tank MOC	-	HDPE
9.	CIP pump MOC	-	SS 316

VALVES & PIPING MOC		
1.	Feed Line, Butterfly Valves (PN 16)	UPVC Disk, EPDM Seal
2.	Globe Valve for Reject Size: 2 Inch	UPVC or PP
3.	Auto Flushing Valve in High Pressure Line, Size:3 Inch Ball Valve Class 600	Wetted part Super Duplex SS, EPDM Seal
4.	Auto Flushing Valve in Low Pressure Line, Size:3 Inch Ball Valve Class 600	UPVC, EPDM Seal
5.	CIP Inlet Valve, Size:4 Inch BF-PN10	UPVC Disk, EPDM Seal
6.	CIP Outlet Valve, Size:4 Inch Class 600	Wetted part Duplex SS, EPDM Seal
7.	Low Pressure Line – Gray Colour	UPVC SCH80 - Industrial Grade
8.	High Pressure Line	Super Duplex SS SCH 40
9.	CIP Line – Gray Colour	UPVC SCH80 - Industrial Grade
10.	Dosing Line	PU or Nylon Tube
11.	Skid	SS 304, 50Sqmm & 100mm X 50Sqmm

ANNEXURE IV

EQUIPMENT DATA SHEET

DS 01: FILTER FEED PUMP

DATA SHEET		
1.	Designation	Filter Feed Pump
2.	Tag No	P01 – A /B
3.	Vendor Technical Data Sheet & Performance Curve	Enclosed
4.	Make	Grundfos
5.	Model	CRN 45-2-2 A-F-A-V-HQQV
6.	Duty	Continuous
7.	Quantity	Two Nos(1W+1S)
SPECIFICATIONS		
8.	Capacity	37.5 m^3/hr
9.	Pressure	3.5 kg/cm^2
10.	Type	Vertical Multistage
11.	Suction Size	80 NB
12.	Delivery Size	80 NB
13.	Connection	Flanged
14.	Pressure Rating	PN 16
15.	Max. Ambient Temp.	60 °C
16.	Maximum Density	≤ 998 kg/m^3
17.	pH Between	6.5 to 7.5
18.	Shipping Gross Weight	128 kgs
CONSTRUCTION OF MATERIAL		
19.	Impeller	SS 316
20.	Motor Body	Cast Iron
21.	Pump Housing	SS 316
MOTOR		
22.	Motor standard	IEC – 132SC
23.	Electrical Condition	380-480 Volts, 50 HZ, Three Phase - IP55 Protection
24.	Motor	3520-3550 rpm
25.	Efficiency Type	IE3
26.	Rated power - P2	5.5 kW
27.	Motor RPM	2950

DS 02: MULTI MEDIA FILTER

DATA SHEET		
1.	Designation	Multi Media Filter
2.	Tag No	MGF-01/02
3.	Medium	Raw Water
4.	Vendor Technical Data Sheet	Enclosed
5.	Model	4872T/B6”
6.	Duty	Continuous
7.	Quantity	Two Nos (2W)
SPECIFICATIONS		
8.	MOC	FRP
9.	Make	Pentair
10.	Type	Cylindrical Vertical
11.	Normal Flow Rate	37.5 m3/hr (Each Vessel 18.75m^3/hr)
12.	Filtration Velocity	16 m/hr
13.	Diameter	48 Inch
14.	Height	72 Inch
15.	Operating Pressure	3.5 kg/cm^2
16.	Test Pressure	10.0 kg/m^2
17.	Maximum Operating Temperature	65 Deg C
18.	Opening	Top & Bottom
19.	Size Of Opening –Top & Bottom	6 Inch
20.	Type Of Base	Triploid
21.	Weight	182 Kgs
22.	Backwash Flow Rate	35 m3/hr
23.	Backwash Velocity	24 m/hr
24.	Media	Grade Sand & Pebbles
25.	Media Height	1000 mm
26.	Valve	Manual Butterfly Valve
27.	MOC	UPVC

DS 03: DOSING SYSTEM

DATA SHEET		
1.	Designation	Dosing System
2.	Tag No	DP – 01,02, 03& 04
3.	Liquid Handled	Hypo, Anti Scalent , Anit Oxidant & pH Correction
4.	Vendor Technical Data Sheet	Enclosed
5.	Duty	Continuous
6.	Quantity	Four Nos
SPECIFICATIONS		
7.	Tag Number	DP-01 / DP-02/ DP-03/DP-04
8.	Make	AQUA - ITALY
9.	Capacity	10 LPH @ 50mwc
10.	Pump Type	Electronic Diaphragm
11.	End Connection	OD-6& ID- 4
12.	Model	HC899
13.	Stroke	200 Strokes/Min
MATERIAL OF CONTRACTION		
14.	Head	PP
15.	Diaphragm	PTFE
16.	Ball	Pyrex
17.	Suction Tube	PE
18.	Injection Fittings	PP
19.	O Ring	Viton
MOTOR & ACCESSORIES		
20.	Drive Details	Single, 230 V & 50 Hz
21.	Protection	IP65
22.	Power Rating	0.035 kw (35W)
23.	Accessories	Strainer Cum Foot Valve, Suction & Discharge Tubing 3 M &Antisyphoning Valve
Dosing Tank		
1.	Quantity	Four Nos
2.	Tag Number	DT 01/DT02/DT03
3.	Volume	125 Liter
4.	Type	Cylindrical Vertical
5.	Moc	LDPE
6.	Model	CV.12.01

DS 04: MICRON CARTRIDGE FILTER

DATA SHEET		
1.	Designation	Cartridge Filter
2.	Tag No	MCF-01&02
3.	Medium	Sea Water
4.	Vendor Technical Data Sheet	Enclosed
5.	Model	POLYFILT CF 40”X9
6.	Duty	Continuous
7.	Quantity	Two Set
SPECIFICATIONS		
8.	Make	Gopani
9.	Flow/Filter	37.5 m3/Hr
10.	Operating Pressure	4 kg/cm2
11.	MOC Of Filter Housing	UPVC
12.	MOC Of Cartridges	PP
13.	Max. Operating Pressure	6 kg/cm2
14.	Max. Operating Temperature	60 Dec C
15.	Connection Type	Union
16.	Connection Size	3 Inch
17.	Cartridge Rating	5 & 10 Micron
18.	Cartridge Size	40” Long
19.	No. Of Cartridges	9 Nos
20.	Per Cartridge Flow	4 m3/hr
21.	Type Of Cartridges	Spun Type

DS 05: RO HIGH PRESSURE PUMP

DATA SHEET		
1.	Designation	High Pressure Pump
2.	Tag No	P02 – A
3.	Vendor Technical Data Sheet & Performance Curve	Enclosed
4.	Make	Danfoss
5.	Model	APP16/1500
6.	Duty	Continuous
7.	Quantity	One Set
SPECIFICATIONS		
8.	Capacity	22.5 m^3/hr
9.	Pressure	58 kg/cm^2
10.	Type	Horizontal Positive displacement pumps with axial pistons
11.	Delivery Size	50NB
12.	Connection	Victaulic
13.	Pump Speed	1405 RPM
14.	Maximum Density	$\leq$ 1050 kg/m^3
15.	pH Between	6.5 to 7.5
CONSTRUCTION OF MATERIAL		
16.	Piston	Super Duplex SS
17.	Motor Body	Cast iron
18.	Pump Housing	Super Duplex SS
MOTOR		
19.	Motor Model	225S
20.	Electrical Condition	415 Volts, 50 HZ, Three Phase, IP 55
21.	Motor	1450 RPM
22.	Efficiency	IE3
23.	Motor	4 Pole
24.	Rated power - P2	37 kW
25.	Frame size	225
26.	VFD	1 Nos
27.	Rating of Current	A

DS 06: PRESSURE EXCHANGER

DATA SHEET		
1.	Designation	Pressure Exchanger Booster Pump
2.	Tag No	P03 – A
3.	Vendor Technical Data Sheet & Performance Curve	Enclosed
4.	Make	Danfoss
5.	Model	iSave21-7.5kW
6.	Duty	Continuous
7.	Quantity	One Set
SPECIFICATIONS		
8.	Capacity	22.5 m^3/hr
9.	Pressure	58 kg/cm^2
10.	Type	Pressure Exchanger
11.	Delivery Size	50NB
12.	Connection	Victaulic
13.	Pump Speed	1203
14.	Maximum Density	$\leq$ 1050 kg/m^3
15.	pH Between	6.5 to 7.5
CONSTRUCTION OF MATERIAL		
16.	Piston	Super Duplex SS
17.	Motor Body	Cast iron
18.	Pump Housing	Super Duplex SS
MOTOR		
19.	Motor standard	IEC
20.	Electrical Condition	415 Volts, 50 HZ, Three Phase, IP 55
21.	Motor	2950 RPM
22.	Efficiency	IE3
23.	Rated power - P2	7.5 kW
24.	Rating of Current	A
25.	VFD	1 Nos
26.	Motor	4 Pole

DS 07: RO PRESSURE TUBE

DATA SHEET		
1.	Designation	Pressure Tube
2.	Tag No	ROPV 01-04
3.	Medium	Sea Water
4.	Vendor Technical Data Sheet	Enclosed
5.	Model	80S100-6
6.	Duty	Continuous
7.	Quantity	Four Nos
SPECIFICATIONS		
8.	Make	Pentair – Code Line
9.	Port	Multi Port -2 Nos & Side Port 2 Nos
10.	Port Size	1 1/2 INCH
11.	Type	Reinforced Tube
12.	Capacity Of Membrane Holding	6 Element
13.	Reject Connection	Victaulic End
14.	Permeate Port Size	1 INCH
15.	Permeate Connection	Victaulic End or One Inch BSP
16.	Operating Pressure	870 PSI
17.	Maximum Operating Pressure	1000 PSI
18.	Qualification Pressure	6000 PSI
19.	Maximum Operating Temperature	66 DEG C
CONSTRUCTION OF MATERIAL		
20.	Housing	FRP
21.	End Cap	Engineering Thermoplastic
22.	Permeate Port	Engineering Thermoplastic
23.	Reject Port	Supper Duplex SS
24.	O Ring	Ethylene Propylene
25.	Adapter & Saddle	Engineering Thermoplastic

DS 08: RO MEMBRANE

GENERAL DATA		
1.	Designation	RO Membrane
2.	GA Drawing & Technical Reference	Enclosed
3.	Medium	Sea Water
4.	Duty	Continuous
5.	Quantity	One Set
6.	Application	RO Plant
FLOW RATE		
7.	Feed Water	37.5 m^3/hr
8.	Permeate	15 m^3/hr
9.	Reject	22.5 m^3/hr
RO MEMBRANE		
10.	Quantity	24 Nos
11.	Membrane Size	8 Inch dia X 40 Inch Long
12.	Model	SWC5 LD
13.	Make	Hydranautics
14.	MOC	Composite Polyamide
15.	Salt Rejection	99.7%
16.	Membrane Activity Area	400 ft^2 (37.1m^2)
17.	Dry Weight	14.5 kg
18.	Membrane Polymer	Composite Polyamide
19.	Maximum Chlorine Concentration	< 0.1 ppm
20.	Design Temperature	25 °C
21.	Maximum Operating Temp.	45 °C
22.	Maximum Applied Pressure	1200 PSI
23.	Maximum Pressure Drop	15 PSI
24.	pH Range, Continuous (Cleaning)	2-11

DS 09: RO SKID WITH VALVE & SUPER DUPLEX SS PIPING

GENERAL DATA		
1.	Designation	RO Skid
2.	Quantity	One Set
3.	Application	RO Plant
4.	MOC of Skid	SS 304 with Powder Coated
SPECIFICATION		
5.	Size	1.4m W X 4.5m L X 1.5 Height (Approximant)
6.	MOC	SS 304 with Powder Coated
7.	Skid	SS 304, 50 sq Tube & Base 50X100 mm Sq Tube
8.	Pipe & Fittings	High Pressure Super Duplex SS - SCH 40 Low Pressure UPVC SCH 80
9.	Finishing	Powder Coated
10.	Pipe Supports	PP Support Clamps & SS 304
BALL VALVE		
11.	Quantity	One No
12.	Location	Reject
13.	Type	Ball Valve
14.	Make	Macke Valve
15.	Pressure Rating	Class 600
16.	Operating Pressure	56 kg/cm2
17.	Body Tested Pressure	156 kg/cm2
18.	Seat Tested Pressure	156 kg/cm2
19.	MOC of Valve	Super Duplex SS
20.	Manufacturing Std	BS1873
21.	Face to Face	ASME B16. 10
22.	End Connection	Flanged End ASME
23.	Inspection & Testing Std	BS EN 12266-1
24.	GA Drawing & Technical Reference	Enclosed

UPVC BUTTERFLY VALVE		
1.	Quantity	10
2.	Make	Cepex
3.	Model	STANDED SERIES
4.	Size	80 NB
5.	Application	RO Plant
6.	Type Of Operation	Manual Hand Operated
7.	Operating Pressure	5
8.	Maximum Operating Pressure	16 (240 PSI)
9.	Pressure Rating	PN 16
10.	MOC Of Body	PVC-U
11.	MOC Of Disc	PVC-U
12.	MOC Of Handle	PP - GF
13.	MOC Of Rubber seal	EPDM
14.	MOC Of shaft	Zinc Plated Steel
15.	MOC Of O-ring seal	EPDM
16.	MOC Of Top Bearing	PP-GF
17.	MOC Of Throttle Plate	POM
18.	MOC Of Lever - Lock	POM

DS 10: ELECTRICAL PANEL

ELECTRICAL PANEL		
1.	Designation	Panel
2.	Duty	Continuous
3.	Quantity	One Set
4.	Application	RO Plant
SPECIFICATION		
5.	Make	Rittal
6.	MOC	Sheet Steel
7.	Surface Finish	Dipcoat Primer & Powder Coated
8.	Mounting Plant	Zinc Plate
9.	Colour	RAL 7035
10.	Mounting Plant	X15 Orange
11.	Protection	IP 55
12.	Protection Category NEMA	NEMA 4
13.	Contactor, OLR & MCCB	Siemens
14.	PLC & HMI	Siemens
15.	Start, Stop & Trip Lamp Indicator	Siemens
16.	Relay	Omron
17.	Cooling Fan 4 inch	Rexnord
18.	Panel Internal Cabling	Polycab
19.	Base Frame -400mm Height	MSEP
20.	GA Drawing & Technical Reference	Enclosed

DS 011: CIP PUMP

DATA SHEET		
1.	Designation	CIP Pump
2.	Tag No	P04– A
3.	Vendor Technical Data Sheet & Performance Curve	Enclosed
4.	Make	Grundfos
5.	Model	CRN45-2-2
6.	Duty	Continuous
7.	Quantity	One No
SPECIFICATIONS		
8.	Capacity	45m^3/hr
9.	Pressure	30 kg/cm^2
10.	Type	Vertical Multistage
11.	Suction Size	80 NB
12.	Delivery Size	80 NB
13.	Connection	Flanged
14.	Pressure Rating	PN 16
15.	Max. Ambient Temp.	60 ºC
16.	Maximum Density	≤ 998 kg/m^3
17.	pH Between	6.5 to 7.5
18.	Shipping Gross Weight	150 kgs
CONSTRUCTION OF MATERIAL		
19.	Impeller	SS 316
20.	Motor Body	Cast Iron
21.	Pump Housing	SS 316
MOTOR		
22.	Electrical Condition	380-480 Volts, 50 HZ, Three Phase - IP55 Protection
23.	Motor	4 Pole
24.	Efficiency Type	IE3
25.	Rated power - P2	5.5 kW
26.	Motor RPM	2950

DS 12: CIP TANK

DATA SHEET		
1.	Designation	CIP TANK
2.	Tag No	DS – 20
3.	Liquid Handled	Chemical Water
4.	Vendor Technical Data Sheet	Enclosed
5.	Duty	Continuous
6.	Quantity	One No
SPECIFICATIONS		
7.	Volume	1500 Litter
8.	Make	Sintex
9.	Type	Cylindrical Vertical
10.	Tank Dia	1300 mm
11.	Tank Height	1270
12.	Model	CV150.01
13.	Material Of Contraction	LDPE
14.	Design	Top Closer
15.	Max. Temperate	60 Deg C

DS 13: MICRON CARTRIDGE FILTER

DATA SHEET		
1.	Designation	Cartridge Filter
2.	Tag No	MCF-03
3.	Medium	Chemical Water
4.	Vendor Technical Data Sheet	Enclosed
5.	Model	POLYFILT CF 40"X9
6.	Duty	Continuous
7.	Quantity	One No
SPECIFICATIONS		
8.	Make	Gopani
9.	Flow/Filter	45 m3/Hr
10.	Operating Pressure	3 kg/cm2
11.	MOC Of Filter Housing	UPVC
12.	MOC Of Cartridges	PP
13.	Max. Operating Pressure	6 kg/cm2
14.	Max. Operating Temperature	60 Dec C
15.	Connection Type	Union
16.	Connection Size	3 Inch
17.	Cartridge Rating	10 Micron
18.	Cartridge Size	40" Long
19.	No. Of Cartridges	9 Nos
20.	Per Cartridge Flow	4 m3/hr
21.	Type Of Cartridges	Spun Type

DS 14: UPVC PIPE FITTINGS

DATA SHEET		
1.	Designation	uPVC Pipe Fittings
2.	Tag No	DS 14
3.	Liquid Handled	Water & Chemical Water
4.	Vendor Technical Data Sheet	Enclosed
5.	Duty	Continuous
6.	Quantity	One Lot
SPECIFICATIONS		
7.	Pipe Size	2 Inch, 3 Inch & 1 ½ Inch
8.	Make	Astral
9.	Type	Industrial Grade
10.	Colour	Grey Colour
11.	Pipe Schedule	SCH 80
12.	Pipe Fittings	SCH 80
13.	Max. Pressure	16 kg/cm^2
14.	Max. Temperate	80 Deg C
15.	Stranded	ANSI

DS 15: INSTRUMENTS

MULTI-CHANNEL TRANSMITTER		
1.	Make	JUMO – Germany
2.	Model	Multichannel Controller (JUMO AQUIS touch P)
3.	Measurement Parameters	mV, Temperature & TDS, pH
4.	Feed TDS Range	0 - 50,000ppm
5.	Feed ORP Range	– 1500 to + 1500 mV
6.	RO Permeate pH	0 - 14
7.	Permeate TDS Range	0 – 500 ppm
8.	Parameter Sampling Rate	< 2 Seconds
9.	Accuracy	+1 digit
10.	Location	RO Feed & RO Permeate
11.	Service	Water
12.	Display	(1) Touchscreen (2) Toolbar with buttons for operation (3) "Device settings menu" button with: • Display of date, time • Logged-in user ("Master" in the example) • Remaining memory display in percent for recording function (in the example: 100 %) (4) "Alarm/Event List" button (5) "Select operator screen" button (6) "Home" button (back to main screen) (7) Placeholder for context-sensitive buttons (assignment based on operator screen concerned) (8) "Next operator screen" button
13.	Dimensions	H 144mm X W 144mm X Depth 103mm
14.	Power	115 V
15.	Accessories	Amplifier, Din,3 M Cable

16.	Type	Panel Mounted
17.	Sensor cable length for pH & ORP	3m
18.	Sensor cable length for TDS	5m
PRESSURE GAUGES		
1.	Quantity	5 Nos
2.	Type	Bourdon
3.	Make	Wika
4.	Model	232.50
5.	Moving Material	Pointer
6.	Range Selection	0-7 Kg/Cm^3 & 0-70 Kg/Cm^3
7.	Dial Size	4”
8.	Accuracy	±1.0% Of F.S
9.	Ambient Temperature	- 25 C To +65 C
10.	Process Temp	Max 300°c
11.	Operating Pressure Range	75% Of Scale Value
	MOC	
12.	Case & Bezel	AISI 304 SS (BAYONET TYPE)
13.	Bourdon	AISI 316 L SS
14.	Socket	AISI 316L SS
15.	Movement	AISI 304 SS
16.	Joints	Tig Argon Arc Welding
17.	Dial	Aluminium, white, black lettering, NS 63 with pointer stop pin
18.	Pointer	Aluminium, black
19.	Window	Laminated safety glass
20.	Blow Off Disc	Neoprene

21.	Gasket & Filling Plug	Neoprene
22.	Filling Liquid	Glycerine 99.7 %
ROTA METER		
1.	Data Sheet No.	Rota Meter
2.	Quantity	One Nos
3.	Make	MaxFlo
4.	Medium	RO Feed
5.	Model	MFR 65-PI
6.	Range	As per Requirement
7.	Repeatability	+/- 1 % F.S
8.	Scale Accuracy	+/- 2 % F.S.D
9.	Mounting	Online Mount
10.	Process Connection	2 Inch NPT
11.	MOC Of End Connectors	ABS
12.	Temperature Limit	60 oC
13.	Tested Pressure	10 Kg/Cm2
14.	Float Materials	PVC
15.	O-Ring	Nitrile
16.	GA Drawing & Technical Reference	Enclosed
LOW PRESSURE SWITCH		
1.	Data Sheet No.	Low Pressure Switch
2.	Quantity	One No
3.	Make	Danfoss
4.	Model	KPS Series
5.	Medium	Water
6.	Range	0 - 7 Bar
7.	Repeatability	+/- 1 % F.S
8.	Scale Accuracy	+/- 5 % F.S
9.	Mounting	Field
10.	Process Connection	1/4” Female

11.	Enclosure Protection	IP 66
12.	Maximum Process Temperature	150 C
13.	Maximum Working Temperature	70 C
HIGH PRESSURE SWITCH		
1.	Data Sheet No.	High Pressure Switch
2.	Quantity	One No
3.	Make	Danfoss
4.	Model	KPS Series
5.	Medium	Water
6.	Range	55 - 70 Bar
7.	Repeatability	+/- 1 % F.S
8.	Scale Accuracy	+/- 5 % F.S
9.	Mounting	Field
10.	Process Connection	1/4” Female
11.	Enclosure Protection	IP 66
12.	Maximum Process Temperature	150 C
13.	Maximum Working Temperature	70 C
14.	Sensing Element	Diaphragm, AISI 316L
ELECTROMAGNETIC FLOW METER		
1.	Data Sheet No.	EMF
2.	Quantity	Two Nos
3.	Make	Kronemarshall
4.	Medium	RO Permeate & RO Reject
	ELECTROMAGNETIC FLOW SENSOR	
5.	Model	Optiflux 1000
6.	Size	2 Inch (50NB)
7.	Type	Pulsed DC
8.	Design	Sandwich
9.	Flow Tube	SS 304
10.	Coil Housing	Fully welded SS316

11.	Liner	PTFE
12.	Electrodes	HC22
13.	Enclosure Protection	IP 67
14.	Grounding type	Grounding rings
15.	Grounding rings	SS316
16.	Sensing Element	Non-Hazardous
17.	Cable entry	M20 x 1.5
18.	Protection class	IP 67
	ELECTROMAGNETIC SIGNAL CONVERTER	
1.	Model	IFC100
2.	Mounting	Integral
3.	Type	Microprocessor Based
4.	Output	4-20mA, HART
5.	Accuracy	± 0.5% of measured value
6.	Max load	500 Ohms
7.	Display	Large back lit LCD Display
8.	Parameters	Actual flow rate, totalized flow (8 digit), flow direction, flow velocity, conductivity, mass flow rate (at constant density)
9.	Diagnostics	Empty pipe detection, Conductivity etc
10.	Local indication	Programmable
11.	Power supply	85-250VAC, 48-63Hz
12.	Housing	Die cast Aluminium with PU finish
13.	Protection class	M20 x 1.5
14.	Area classification	Non-Hazardous
15.	Protection class	P 66 / 67

ANNEXURE V

ELECTRICAL & INSTRUMENT DETAILS

One No Free-standing cubicle type non compartment electrical panel for the RO Plant with the following:

- **Construction:** Non-Compartmentalized Type Skid Mounted. MCC with PLC Electrical panel will be free standing; vertical, fabricated from CRCA steel sheet conforming to degree of protection IP-55 or better. Cable entry will be from bottom. EPDM based gaskets on doors and at all joints including cable gland plate. Louvers to be provided at both side of the panel for proper air circulation. Tube light fitting of CFL of 230 VAC will provided with Door Limit switch interlock and proper illumination within panel.
- Colour- Shade: RAL7032
- System Voltage 380 to 410 Volts & 60HZ (380 V ±10%, AC, 60 HZ ±5% for KSA) Surge Protection to be provided at every applicable point.
- Power and Control cables, Cable Trays, Cable gland, earthing.

ELECTRICAL LOAD IN KW

DRIVES	SERVICE	WORKING	STAND BY	TOTAL
Filter Feed Pumps	1 No	5.5	5.5	11
Anit Scalent dosing pump	1 No	0.035	-	0.035
Anit Oxidant dosing pump	1 No	0.035	-	0.035
Hypo dosing pump	1 No	0.035	-	0.035
pH Correction dosing pump	1 No	0.035	-	0.035
RO High Pressure Pump	1 No	37	-	37
RO Pressure Exchanger -Booster	1 No	7.5	-	7.5
CIP Pumps	1 No	5.5	-	5.5

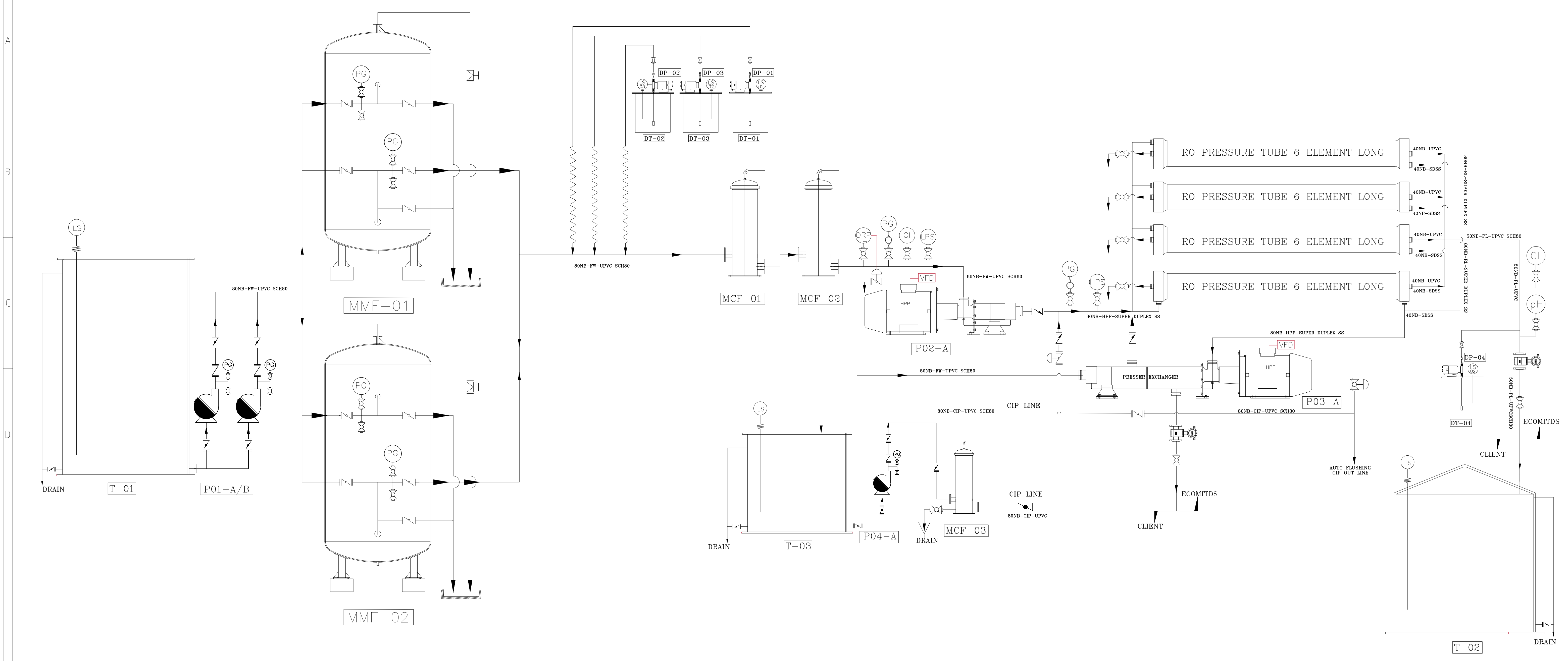
ANNEXURE VI

SUBVENDOR LIST

S. NO	CATEGORY	PREFERRED MAKE
MECHANICAL		
1.	Vertical Multistage Pump	Grundfos – Denmark, Assembled in India
2.	RO Membranes	Hydranautics – Japan
3.	High Pressure Pump	Danfoss –Europe
4.	Pressure Exchanger – Booster Pump	Danfoss –Europe
5.	Cartridge Filter	Gopani – India
6.	RO Housing	Pentair Codeline - India
7.	Motor	Siemens - India
8.	UPVC Ball & Butterfly Valve	Cepex - Spain
9.	Super Duplex SS Ball	Marck – India
10.	Actuator	Elgar Controls –India
11.	Chemical Dosing Pump	Aqua –Italy
12.	UPVC Pipes & Fittings	Astral – India/ FIP – Italy (Industrial Grade Gray Colour)
13.	Super Duplex SS	TUBACEX
INSTRUMENTS		
14.	pH Meter , TDS Meter & ORP Meter	Jumo – Europe
15.	Electromagnetic Flow Meter	Krone Marshall – Europe
16.	Low Pressure Switch	Danfoss – Poland
17.	High Pressure Switch	Danfoss – Poland
18.	Rota Meter	Flomax – India
19.	Pressure Gauge	Wika - USA
ELECTRICAL		
20.	Cables	Polycab - India
21.	Switch Gear Component	Siemens /Technic - India
22.	PLC & HMI	Siemens

Annexure VII

PROCESS & INSTRUMENT DRAWING



LIST OF EQUIPMENTS				
TAG	DESCRIPTION	CAPACITY	MOC	QTY
T-01	RO FEED TANK	CLIENT	GRP	1
T-02	RO PERMEATE TANK	CLIENT	GRP	1
T-03	CIP TANK	1000 LITER	HDPE	1
P01-A/B	RO FEED PUMP	37.5M3/HR@ 30 MWC	SS 316	2
P02-A	RO HIGH PRESSURE PUMP	15.2M3/HR@ 580 MWC	DUPLEX SS	1
P03-A	PRESURE EXCHANGER BOOSTER PUMP	22.5M3/HR@ 580MWC	DUPLEX SS	1
P04-A	CIP PUMP	45M3/HR@30 MWC	SS316	1
DT-01	ACID DOSING TANK	125 LITER	LDPE	1
DT-02	RO ANTISCALANT DOSING TANK	125 LITER	LDPE	1
DT-03	RO ANTIOXIDANT DOSING TANK	125 LITER	LDPE	1
DT-04	PH CORRECTION DOSING TANK	125 LITER	LDPE	1
DP-01	RO ACID DOSING PUMP	10LPH@5BAR	PP	1
DP-02	RO ANTISCALANT DOSING PUMP	10LPH@5BAR	PP	1
DP-03	RO ANTIOXIDANT DOSING PUMP	10LPH@5BAR	PP	1
DP-04	pH CORRECTION DOSING PUMP	10LPH@5BAR	PP	1
MCF-01,02	MICRON CARTRIDGE FILTER-RO	40INCH LONG 9 ELEMENT	UPVC	2
MCF-03	MICRON CARTRIDGE FILTER-CIP	40INCH LONG 9 ELEMENT	UPVC	1
RO	RO- PRESSURE TUBE 4 : 0	8 INCH DIA 6 ELEMENT	FRP	4
MMF-01/02	MULTIMEDIA FILTER	4872 TB4"	FRP	2

INSTRUMENT LEGENDS	
PG	PRESSURE GAUGE
LS	LEVEL SWITCH
ORP	OXIDATION REDUCTION POTENTIAL
	ELECTRO MAGNETIC FLOW METER
RM	ROTAMETER
CI 01	CONDUCTIVITY INDICATOR
LPS 01	LOW PRESSUE SWITCH
HPS 01	HIGH PRESSUE SWITCH
pH 01	pH METER
VALVE LEGENDS	
	BUTTERFLY VALVE (BFV)
	NON RETURN VALVE (NRV)
	BALL VALVE (BLV)
	AUTO BUTTERFLY VALVE

ECOmitds
Sustainable Water Solutions

DRAWN	KUMAR
CHKD	SATHISH
APPD	GANESH
DATE	13.11.2021
SCALE	NTS
Ph No:	9952710159

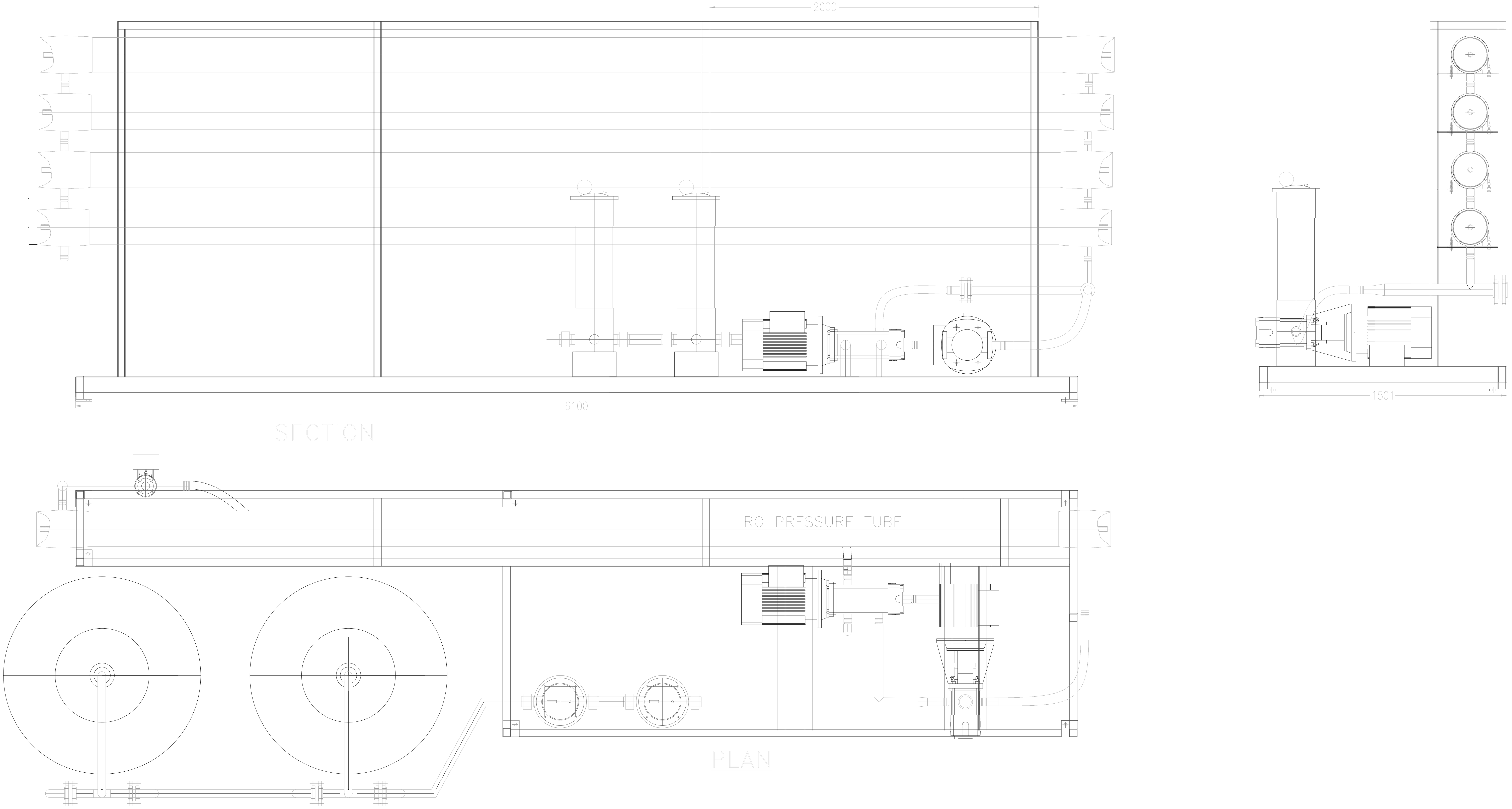
203 KALLANG BAHRU, SINGAPORE 339340

CLIENT : HPL HOTELS & RESORTS
PROJECT : WATER TREATMENT PLANT-300 KLD
TITLE : PROCESS AND INSTRUMENTATION DIAGRAM
DRG NO : A3/ECO/PRO515/WTP/GA-001

SHEET : 1 OF 1
REV : '01'

Annexure VIII

EQUIPMENT LAYOUT DRAWING



NOTE:

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED
2. MOC: SKID – SS304 AND LOW PRESSURE LINE UPVC & HIGH PRESSURE LINE SUPER DUPLEX SS
3. ALL FLANGE ARE ANSI B16.5 #150 FOR LOW PRESSURE AND #600 HIGH PRESSURE LINE
4. ALL SHARP CORNERS SHALL BE SUITABLY ROUNDED OFF & GROUND FLUSH
5. ALL NECESSARY FITTINGS, BOLT & NUTS GASKET TO BE SUPPLIED BY ECOCHEM
6. SS TUBE – 50X100X2MM THK AND 50 X 50X2MM THK SS304
7. ALL VICTAULIC COUPLINGS ARE STYLE 75

ECOmitds
Sustainable Water Solutions

DRAWN	KUMAR
CHKD	SATHISH
APPD	GANESH
DATE	27.11.2021
SCALE	NTS
Ph No:	9952710159

203 KALLANG BAHRU, SINGAPORE 339340

CLIENT :	HPL HOTELS & RESORTS
PROJECT :	WATER TREATMENT PLANT-300 KLD
TITLE :	SKID GA DIAGRAM
DRG NO :	A3/ECO/PRO508/WTP/GA-001

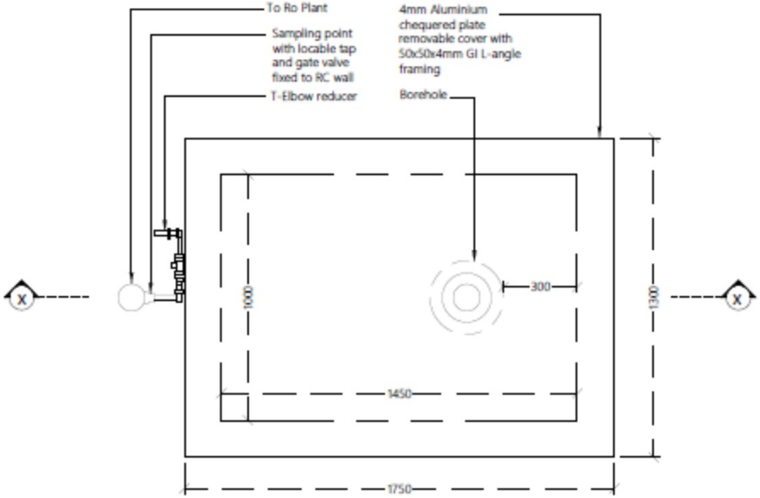
SHEET : 1 OF 1

REV : '01'

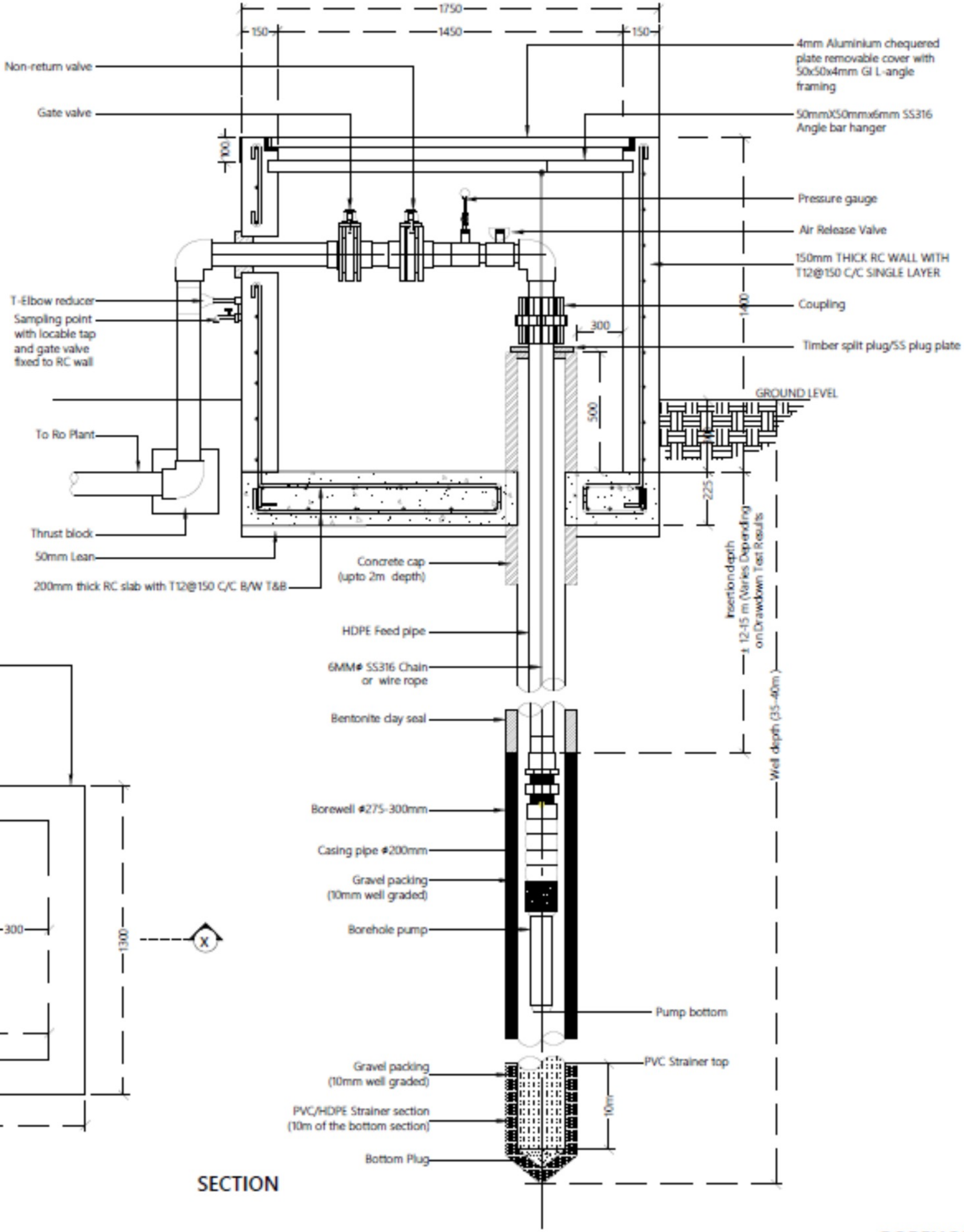
Annexure IX

ELECTRICAL WIRING DRAWING

APPENDIX E- DETAIL DRAWINGS FOR BOREHOLE



PLAN

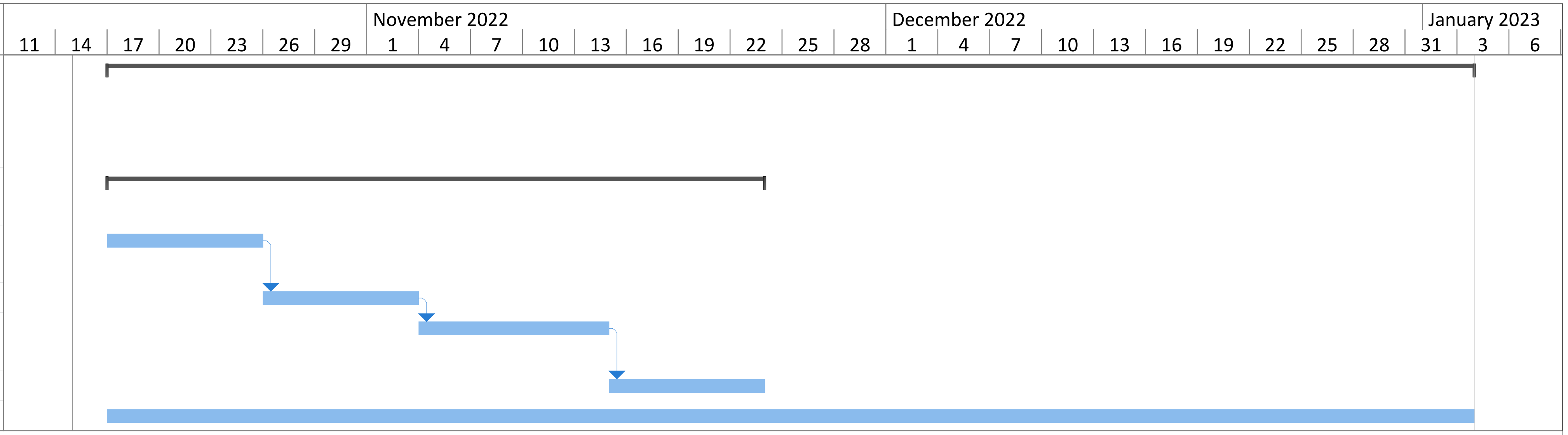


SECTION

BOREHOLE DETAILS

APPENDIX F- DETAIL WORK SCHEDULE

ID		Task Mode	Task Name	Duration	Start	Finish
1			**300 TPD RO plant installation and borehole construction at Lh.**	**57 days**	**Mon 10/17/22**	**Tue 1/3/23**
2			**Borehole construction**	**28 days**	**Mon 10/17/22**	**Wed 11/23/22**
3			Drilling and temporary	7 days	Mon 10/17/22	Tue 10/25/22
4			Casing installati	7 days	Wed 10/26/	Thu 11/3/22
5			Surge and flushing	7 days	Fri 11/4/22	Mon 11/14/22
6			Testing	7 days	Tue 11/15/2	Wed 11/23/2
7			RO plant installati	57 days	Mon 10/17/	Tue 1/3/23



Project: 300 TPD RO plant installa
Date: Thu 9/15/22

Task	▬	Project Summary	┌─┐	Inactive Milestone	◇	Manual Summary Rollup	▬	Deadline	⇩
Split	┈	External Tasks	▬	Inactive Summary	┌─┐	Manual Summary	┌─┐	Progress	─
Milestone	◆	External Milestone	◆	Manual Task	▬	Start-only	[	Manual Progress	─
Summary	┌─┐	Inactive Task	▭	Duration-only	▬	Finish-only	]		

APPENDIX G- WATER QUALITY ASSESSMENT RESULTS

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

LB-TEST-090

WATER QUALITY TEST REPORT

Report No: 500191649

Customer Information:
Eco-Tech Consultancy Pvt Ltd
Gama, 317, Malikuruvaa Goalhi

Report date: **09/06/2022**
Test Requisition Form No: **900194565**
Sample(s) Recieved Date: **02/06/2022**
Date of Analysis: **02/06/2022 - 03/06/2022**

Sample Description ~	G1	Kanuhura BH	**TEST METHOD**	**UNIT**
Sample Type ~	Ground Water	Ground Water		
Sample No	83229501	83229502		
Sampled Date ~	31/05/2022 09:45	31/05/2022 09:45		
PARAMETER	**ANALYSIS RESULT**			
Physical Appearance	Clear with particles	Clear with particles		
Conductivity *	8130	1096	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	µS/cm
pH *	7.7	7.9	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	4.51	0.54	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Temperature	23.2	23.2	Electrometry	°C
Total Dissolved Solids	4070	548	Electrometry	mg/L
Nitrate *	1.7	6.8	HACH Method 8171	mg/L
Dissolved Oxygen (DO)	3.99	7.26	In-house Test method (Adapted from HACH BOD LDO® Probe (Model LBOD10101) manual)	mg/L
Total Coliforms	>2420 (02/06/2022 15:00)	>2420 (02/06/2022 15:00)	Colilert®-18/Quanti-Tray®2000	MPN/100ml
Faecal Coliforms	13 (02/06/2022 15:00)	Not Detected (02/06/2022 15:00)	Colilert®-18/Quanti-Tray®2000	MPN/100ml

Keys: µS/cm : Micro Seimen per Centimeter, **‰** : Parts Per Thousand, **°C** : Degree Celcius, **mg/L** : Milligram Per Liter, **MPN/100ml** : Most Probable Number

Checked by

Nashath

Nashath Ali
Laboratory Executive

Approved by

Mohamed Eyman
Assistant General Manager, Quality

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

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

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

LB-TEST-090

WATER QUALITY TEST REPORT
Report No: 500192711

Customer Information:
Eco-Tech Consultancy Pvt Ltd
Gama, 317, Malikuruvaa Goalhi

Report date: **12/09/2022**
Test Requisition Form No: **900195365**
Sample(s) Recieved Date: **11/09/2022**
Date of Analysis: **11/09/2022 - 11/09/2022**

Sample Description ~	Kanuhura Brine Outfall	M8	**TEST METHOD**	**UNIT**
Sample Type ~	Sea Water	Sea Water		
Sample No	83231934	83231935		
Sampled Date ~	08/09/2022 11:00	08/09/2022 11:00		
PARAMETER	**ANALYSIS RESULT**			
Physical Appearance	Clear with particles	Clear with particles		
pH *	8.1	8.1	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	33.02	32.99	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Temperature	22.5	22.3	Electrometry	°C
Turbidity *	0.198	0.766	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

Nihaz A. Zahir
Assistant Quality Manager

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

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

WATER QUALITY TEST REPORT

Report No: 500191647

Customer Information:
Eco-Tech Consultancy Pvt Ltd
Gama, 317, Malikuruvaa Goalhi

Report date: **09/06/2022**
Test Requisition Form No: **900194565**
Sample(s) Recieved Date: **02/06/2022**
Date of Analysis: **02/06/2022 - 07/06/2022**

Sample Description ~	BA2	C	M1	**TEST METHOD**	**UNIT**
Sample Type ~	Sea Water	Sea Water	Sea Water		
Sample No	83229494	83229498	83229499		
Sampled Date ~	31/05/2022 09:45	31/05/2022 09:45	31/05/2022 09:45		
PARAMETER	**ANALYSIS RESULT**				
Physical Appearance	Clear with particles	Clear with particles	Clear with particles		
pH *	8.0	8.4	8.4	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	33.10	33.60	33.40	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Temperature	23.5	22.8	23.4	Electrometry	°C
Turbidity *	0.178	0.178	0.187	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU
Nitrate *	12.0	4.2	1.6	HACH Method 8171	mg/L
Nitrogen Ammonia	0.07	0.07	0.05	HACH Method 8038	mg/L
Sulphate *	2400	2350	2150	HACH Method 8051	mg/L
Phosphate *	0.06	<0.05 (LoQ 0.05 mg/L)	<0.05 (LoQ 0.05 mg/L)	HACH Method 8048	mg/L
Biological Oxygen Demand (BOD)	2	2	2	HACH Method 8043	mg/L

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

Checked by

Nashath

Nashath Ali
Laboratory Executive

Approved by

Mohamed Eyman
Assistant General Manager, Quality

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

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

APPENDIX H- EVIDENCE OF REPORT SUBMISSION TO ATOLL COUNCIL

Gmail

Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com>

EIA for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura

1 message

Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> Tue, Sep 13, 2022 at 1:26 PM
To: info@lhaviyani.gov.mv
Cc: Eco-Tech Consultancy <secretariate.ecotech@gmail.com>, Eco Tech <ecotechconsultancyeia@gmail.com>

Dear Sir,

Please follow the link below for the captioned EIA report.

https://drive.google.com/drive/folders/1YF6JtsgbKkiF4dJjLE4cokkM8z0PwhBn?usp=sharing

Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

APPENDIX I- EVIDENCE FOR STAKEHOLDER CONSULATIONS

Gmail **Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com>**

EIA stakeholder consultation invitation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.

2 messages

Fathimath Leesha Abdulla <fathimath.leesha@health.gov.mv> Sun, Sep 4, 2022 at 1:39 PM
To: "mahfoozabdullwahhab@gmail.com" <mahfoozabdullwahhab@gmail.com>
Cc: Aminath Shaufa <shaufa@health.gov.mv>

Dear Mahfooz,

Please find attached HPA recommendations for the project as requested.

Best Regards

Fathimath Leesha Abdhulla
Public Health Program Officer
Environment and Occupational Health
Health Protection Agency

LH.Kanuhura.docx
149K

Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> Mon, Sep 5, 2022 at 7:51 PM
To: Fathimath Leesha Abdulla <fathimath.leesha@health.gov.mv>
Cc: Aminath Shaufa <shaufa@health.gov.mv>, Eco-Tech Consultancy <secretariate.ecotech@gmail.com>, Eco Tech <ecotechconsultancyeia@gmail.com>

Dear Fathimath,

Thank you for sending your recommendations, we will incorporate all your recommendations in our report.

Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

[Quoted text hidden]

Gmail

Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com>

EIA stakeholder consultation invitation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.

10 messages

Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> Tue, Aug 30, 2022 at 11:44 AM
To: Ibrahim Fikree <ibrahim.fikree@tourism.gov.mv>, es@tourism.gov.mv, Haleemath Nahula Ahmed <haleemath.nahula@environment.gov.mv>, "Sanitation | Min. of Environment and Energy, MV" <sanitation@environment.gov.mv>, secretariat@ura.gov.mv, Mariyam Sheeza <mariyam_shyz@health.gov.mv>, hpa@health.gov.mv

To;
Ministry of Tourism
Ministry of Environment, Climate Change and Technology
Utility Regulatory Authority
Health Protection Agency

Dear Sir,

I am writing to you regarding the EIA stakeholder consultation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.

Attached herewith you will find the project brief description and approved ToR issued for the EIA.

You could either send us your comments via email or if you wish let us know a time for an e-conference.

Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

---

2 attachments

220825 Approved ToR_300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.pdf
592K

220814 Project brief_300 TPD RO plant and borehole_kanuhura.pdf
4173K

Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> Sun, Sep 4, 2022 at 7:47 AM
To: Ibrahim Fikree <ibrahim.fikree@tourism.gov.mv>, es@tourism.gov.mv, Haleemath Nahula Ahmed <haleemath.nahula@environment.gov.mv>, "Sanitation | Min. of Environment and Energy, MV" <sanitation@environment.gov.mv>, secretariat@ura.gov.mv, Mariyam Sheeza <mariyam_shyz@health.gov.mv>, hpa@health.gov.mv

Dear All,

Gentle reminder about sending your comments regarding this EIA.

Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

On Tue, Aug 30, 2022 at 11:44 AM Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> wrote:

> To;
> Ministry of Tourism
> Ministry of Environment, Climate Change and Technology
> Utility Regulatory Authority
> Health Protection Agency
>
> Dear Sir,
>
> I am writing to you regarding the EIA stakeholder consultation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.
>
> Attached herewith you will find the project brief description and approved ToR issued for the EIA.
>
> You could either send us your comments via email or if you wish let us know a time for an e-conference.
>
> Best,
>
> ECO-TECH
> CONSULTANCY
>
> Mahfooz Abdul Wahhab
> Managing Director
> Eco-Tech Consultancy Pvt. Ltd
> M. Husnoovilaa, Unigas Magu,
> Male', 20296, Kaafu Atoll, Maldives
> Website: www.ecotechconsultancy.com
> (+960) 9994467

---

fathimath.zaina@tourism.gov.mv <fathimath.zaina@tourism.gov.mv> Tue, Sep 6, 2022 at 9:40 AM
To: mahfoozabdullwahhab@gmail.com
Cc: es@tourism.gov.mv, ibrahim.fikree@tourism.gov.mv

Dear Mr. Mahfooz,

Greetings from the Ministry of Tourism!

With regards to your email below, please find the below comments:

1. To minimize environmental damage special care and protection measures need to be undertaken during the construction and operation of the new structures.

2. Address all the terms highlighted in the approved (ref no. 203-ECA/INDIV/2022/84 dated 25th August 2022) ToR for this project.
3. Include all possible information (permits/approvals) issued by the relevant authorities for the project.
4. Proper waste management mechanisms should be in place during construction and operation.
5. Should fulfill all regulatory requirements prior to the commencement of the project activities.

Also, please note that this email is only for the purpose of the aforementioned project.

Should you have any further queries please do not hesitate to contact us.

Thank you and best regards,
Fathimath Zaina Shareef
Senior Environment Officer

-------- Original Message --------
Subject: EIA stakeholder consultation invitation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.
Date: 2022-08-29 23:44
From: Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com>
To: Ibrahim Fikree <ibrahim.fikree@tourism.gov.mv>, es@tourism.gov.mv, Haleemath Nahula Ahmed <haleemath.nahula@environment.gov.mv>, "Sanitation | Min. of Environment and Energy, MV" <sanitation@environment.gov.mv>, secretariat@ura.gov.mv, Mariyam Sheeza <mariyam_shyz@health.gov.mv>, hpa@health.gov.mv

To;
Ministry of Tourism
Ministry of Environment, Climate Change and Technology
Utility Regulatory Authority
Health Protection Agency

Dear Sir,

I am writing to you regarding the EIA stakeholder consultation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.

Attached herewith you will find the project brief description and approved ToR issued for the EIA.

You could either send us your comments via email or if you wish let us know a time for an e-conference.

Best,

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com [1]
(+960) 9994467

Links:
------
[1] http://www.ecotechconsultancy.com/

Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> Tue, Sep 6, 2022 at 10:53 AM
To: fathimath.zaina@tourism.gov.mv
Cc: es@tourism.gov.mv, ibrahim.fikree@tourism.gov.mv, Eco-Tech Consultancy <secretariate.ecotech@gmail.com>, Eco Tech <ecotechconsultancyeia@gmail.com>

Dear Fathimath,

Thank you for sending your recommendations. We will incorporate your recommendations in our EIA report.

Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

On Tue, Sep 6, 2022 at 9:43 AM <fathimath.zaina@tourism.gov.mv> wrote:

> Dear Mr. Mahfooz,
>
> Greetings from the Ministry of Tourism!
>
> With regards to your email below, please find the below comments:
>
> 1. To minimize environmental damage special care and protection measures need to be undertaken during the construction and operation of the new structures.
> 2. Address all the terms highlighted in the approved (ref no. 203-ECA/INDIV/2022/84 dated 25th August 2022) ToR for this project.
> 3. Include all possible information (permits/approvals) issued by the relevant authorities for the project.
> 4. Proper waste management mechanisms should be in place during construction and operation.
> 5. Should fulfill all regulatory requirements prior to the commencement of the project activities.
>
> Also, please note that this email is only for the purpose of the aforementioned project.
>
> Should you have any further queries please do not hesitate to contact us.
>
> Thank you and best regards,
> Fathimath Zaina Shareef
> Senior Environment Officer
>
> -------- Original Message --------
> Subject: EIA stakeholder consultation invitation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.
> Date: 2022-08-29 23:44
> From: Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com>
> To: Ibrahim Fikree <ibrahim.fikree@tourism.gov.mv>, es@tourism.gov.mv,
> Haleemath Nahula Ahmed <haleemath.nahula@environment.gov.mv>,

> "Sanitation | Min. of Environment and Energy, MV"
> <sanitation@environment.gov.mv>, secretariat@ura.gov.mv, Mariyam Sheeza
> <mariyam_shyz@health.gov.mv>, hpa@health.gov.mv
>
> To;
> Ministry of Tourism
> Ministry of Environment, Climate Change and Technology
> Utility Regulatory Authority
> Health Protection Agency
>
> Dear Sir,
>
> I am writing to you regarding the EIA stakeholder consultation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.
>
> Attached herewith you will find the project brief description and approved ToR issued for the EIA.
>
> You could either send us your comments via email or if you wish let us know a time for an e-conference.
>
> Best,
>
> Mahfooz Abdul Wahhab
> Managing Director
> Eco-Tech Consultancy Pvt. Ltd
> M. Husnoovilaa, Unigas Magu,
> Male', 20296, Kaafu Atoll, Maldives
> Website: www.ecotechconsultancy.com [1]
> (+960) 9994467
>
> Links:
> ------
> [1] http://www.ecotechconsultancy.com/

Mohamed Shujuan Ibrahim <mohamed.shujuan@ura.gov.mv> Thu, Sep 8, 2022 at 10:21 AM
To: mahfoozabdullwahhab@gmail.com

Dear Mahfooz,

Please find the comments from URA:
1. We recommend having 2 boreholes (one in use and one standby)

Thank you,
Shujuan

Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> Thu, Sep 8, 2022 at 11:35 AM
To: Mohamed Shujuan Ibrahim <mohamed.shujuan@ura.gov.mv>
Cc: Eco-Tech Consultancy <secretariate.ecotech@gmail.com>, Eco Tech <ecotechconsultancyeia@gmail.com>, Mohamed Riza <mohamed.riza@sixsenses.com>

Dear Shujuan,

Thank you for providing your recommendation. We will relay this to the proponent of the project.

Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

On Thu, Sep 8, 2022 at 10:24 AM Mohamed Shujuan Ibrahim <mohamed.shujuan@ura.gov.mv> wrote:

> Dear Mahfooz,
>
> Please find the comments from URA:
> 1. We recommend having 2 boreholes (one in use and one standby)
>
> Thank you,
> Shujuan
>
> Please consider the environment before printing
>
>

Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> Thu, Sep 8, 2022 at 11:49 AM
To: Haleemath Nahula Ahmed <haleemath.nahula@environment.gov.mv>, "Sanitation | Min. of Environment and Energy, MV" <sanitation@environment.gov.mv>
Cc: Eco-Tech Consultancy <secretariate.ecotech@gmail.com>, Eco Tech <ecotechconsultancyeia@gmail.com>

Dear Sir/Madam,

Gentle reminder again to send your comments regarding this EIA.

Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com

(+960) 9994467

On Sun, Sep 4, 2022 at 7:47 AM Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> wrote:

> Dear All,
>
> Gentle reminder about sending your comments regarding this EIA.
>
> Best,
>
> ECO-TECH
> CONSULTANCY
>
> Mahfooz Abdul Wahhab
> Managing Director
> Eco-Tech Consultancy Pvt. Ltd
> M. Husnoovilaa, Unigas Magu,
> Male', 20296, Kaafu Atoll, Maldives
> Website: www.ecotechconsultancy.com
> (+960) 9994467
>
> On Tue, Aug 30, 2022 at 11:44 AM Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> wrote:
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> > To;
> > Ministry of Tourism
> > Ministry of Environment, Climate Change and Technology
> > Utility Regulatory Authority
> > Health Protection Agency
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> > Managing Director
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> > M. Husnoovilaa, Unigas Magu,
> > Male', 20296, Kaafu Atoll, Maldives
> > Website: www.ecotechconsultancy.com
> > (+960) 9994467

Fizna Yoosuf <fizna.yoosuf@ura.gov.mv> Mon, Sep 12, 2022 at 9:27 AM
To: Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com>
Cc: Ali Mishal <ali.mishal@ura.gov.mv>

Dear Sir,

With reference to the project brief, we propose to adopt 2 boreholes for redundancy. Also for the 300 TPD RO plant, we recommend having 2 units of 150 TPD for redundancy.

Regards,

Fathimath Fizna Yoosuf
Assistant Director
Planning and Market Development Section

Utility Regulatory Authority, Handhuvaree Hingun, Maafannu, Male', 20392, Maldives.

Office (PABX): +(960) 3019100 | Office (Direct): +(960) 3019113

Email: fizna.yoosuf@ura.gov.mv | Web: www.ura.gov.mv

On Sun, Sep 4, 2022 at 7:47 AM Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> wrote:

> Dear All,
>
> Gentle reminder about sending your comments regarding this EIA.
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> Best,
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> ECO-TECH
> CONSULTANCY
>
> Mahfooz Abdul Wahhab
> Managing Director
> Eco-Tech Consultancy Pvt. Ltd
> M. Husnoovilaa, Unigas Magu,
> Male', 20296, Kaafu Atoll, Maldives
> Website: www.ecotechconsultancy.com
> (+960) 9994467
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>> Ministry of Environment, Climate Change and Technology
>> Utility Regulatory Authority
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>> You could either send us your comments via email or if you wish let us know a time for an e-conference.
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>> Best,

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> > CONSULTANCY
> >
> > Mahfooz Abdul Wahhab
> > Managing Director
> > Eco-Tech Consultancy Pvt. Ltd
> > M. Husnoovilaa, Unigas Magu,
> > Male', 20296, Kaafu Atoll, Maldives
> > Website: www.ecotechconsultancy.com
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Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> Mon, Sep 12, 2022 at 11:12 AM
To: Fizna Yoosuf <fizna.yoosuf@ura.gov.mv>
Cc: Ali Mishal <ali.mishal@ura.gov.mv>, Eco-Tech Consultancy <secretariate.ecotech@gmail.com>, Eco Tech <ecotechconsultancyeia@gmail.com>

Dear Fizna,

Thank you for sending your recommendations. We will incorporate your recommendations in our report.

Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

On Mon, Sep 12, 2022 at 9:29 AM Fizna Yoosuf <fizna.yoosuf@ura.gov.mv> wrote:

> Dear Sir,

> With reference to the project brief, we propose to adopt 2 boreholes for redundancy. Also for the 300 TPD RO plant, we recommend having 2 units of 150 TPD for redundancy.
>
> Regards,
>
> **Fathimath Fizna Yoosuf**
> Assistant Director
> Planning and Market Development Section
>
> **Utility Regulatory Authority**, Handhuvaree Hingun, Maafannu, Male', 20392, Maldives.
>
> Office (PABX): +(960) 3019100 | Office (Direct): +(960) 3019113
>
> Email: fizna.yoosuf@ura.gov.mv | Web: www.ura.gov.mv
>
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>> Dear All,
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>> Best,
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>> ECO-TECH
>> CONSULTANCY
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>> Mahfooz Abdul Wahhab
>> Managing Director
>> Eco-Tech Consultancy Pvt. Ltd
>> M. Husnoovilaa, Unigas Magu,
>> Male', 20296, Kaafu Atoll, Maldives
>> Website: www.ecotechconsultancy.com
>> (+960) 9994467
>>
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>>> To;
>>> Ministry of Tourism
>>> Ministry of Environment, Climate Change and Technology
>>> Utility Regulatory Authority
>>> Health Protection Agency
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>>> Dear Sir,
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>>> Attached herewith you will find the project brief description and approved ToR issued for the EIA.
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>>> You could either send us your comments via email or if you wish let us know a time for an e-conference.
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>>> Best,

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> > > CONSULTANCY
> > >
> > > Mahfooz Abdul Wahhab
> > > Managing Director
> > > Eco-Tech Consultancy Pvt. Ltd
> > > M. Husnoovilaa, Unigas Magu,
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Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> Tue, Sep 13, 2022 at 8:06 AM
To: Haleemath Nahula Ahmed <haleemath.nahula@environment.gov.mv>, "Sanitation | Min. of Environment and Energy, MV" <sanitation@environment.gov.mv>
Cc: Eco-Tech Consultancy <secretariate.ecotech@gmail.com>, Eco Tech <ecotechconsultancyeia@gmail.com>

Dear Sir/Madam,

Gentle reminder again to send your comments regarding this EIA.

Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

On Thu, Sep 8, 2022 at 11:49 AM Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> wrote:

> Dear Sir/Madam,

> Gentle reminder again to send your comments regarding this EIA.
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> Best,
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> CONSULTANCY
>
> Mahfooz Abdul Wahhab
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> Eco-Tech Consultancy Pvt. Ltd
> M. Husnoovilaa, Unigas Magu,
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>>
>> On Tue, Aug 30, 2022 at 11:44 AM Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com> wrote:
>>
>>> To;
>>> Ministry of Tourism
>>> Ministry of Environment, Climate Change and Technology
>>> Utility Regulatory Authority
>>> Health Protection Agency
>>>
>>> Dear Sir,
>>>
>>> I am writing to you regarding the EIA stakeholder consultation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.
>>>
>>> Attached herewith you will find the project brief description and approved ToR issued for the EIA.
>>>
>>> You could either send us your comments via email or if you wish let us know a time for an e-conference.
>>>
>>> Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

Recommendations from WATSAN - MoECCT: EIA stakeholder consultation invitation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.

1 message

Afsal Hussain <afsal.hussain@environment.gov.mv> Wed, Sep 14, 2022 at 9:58 AM
To: Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com>
Cc: Aishath Nafua <aishath.nafua@environment.gov.mv>, Eco-Tech Consultancy <secretariate.ecotech@gmail.com>, Eco Tech <ecotechconsultancyeia@gmail.com>

Please find the observation and recommendation to proceed with consideration.

1. The documents indicates only 1 borehole to be developed, hence in case of maintenance or emergency a dual approach mechanism to be adopted with 2 boreholes where as possible which would lessen the risk.
2. Take consideration to adopt a mechanism to add a buffer or required monitoring mechanism to adhere to any contamination measures due from smoke or borehole intake zone.

No further comments from our end.

Best Regards

Afsal Hussain
Director
Policy and Strategic Planning
Water and Sanitation Department

Ministry of Environment, Climate Change and Technology, Green Building, Handhuvaree Hingun, Maafannu, Male', 20392, Maldives.
Office (Direct): +(960) 3018378 | Office (PABX): +(960) 3018300 | Fax: +(960) 3018301
Email: afsal.hussain@environment.gov.mv | Web: www.environment.gov.mv

---

From: Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com>
Sent: Tuesday, September 13, 2022 2:15 PM
To: Aishath Nafua <aishath.nafua@environment.gov.mv>
Cc: Haleemath Nahula <haleemath.nahula@environment.gov.mv>; Water and Sanitation | Min. of Environment, Climate Change and Technology, MV <sanitation@environment.gov.mv>; Eco-Tech Consultancy <secretariate.ecotech@gmail.com>; Eco Tech <ecotechconsultancyeia@gmail.com>
Subject: Re: EIA stakeholder consultation invitation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.

Dear Aishath,

Please follow the link below for the EIA report prepared for the proposed project which will have all the details regarding the project.
https://drive.google.com/drive/folders/1YF6JtsgbKkiF4dJjLE4cokkM8z0PwhBn?usp=sharing

Kindly please share your recommendations for this project.

Best,

ECO-TECH
CONSULTANCY

Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

On Tue, Sep 13, 2022 at 1:17 PM Aishath Nafua <aishath.nafua@environment.gov.mv> wrote:

> Dear Mahfooz,
>
> With reference to the mail below, I would like to request clarification on the following:
>
> 1. How many boreholes units are installed in this project?
> 2. How many RO plant units are installed in this project?
> 3. What is the proposed location of the brine outfall and other alternative locations?
> 4. What is the bathymetry and wave dynamics of the proposed area for brine outfall line?
> 5. What is the storage capacity of the water tanks?
> 6. What are the routine sampling points for water quality testing
> 7. What is the length of the brine outfall pipe from the shorelines? Is it directly connected to the RO system or via lift well?
> 8. What is the location of the water treatment plant? If the plant is constructed near an inhabited area, what is the possibility of noise pollution. Is a backup generator provided through the project?
> 9. Will a degasifer be provided?
>
> Thank you.
>
> **Best Regards,**
>
> **Aishath Nafua (Ms.)**
> Environmental Research Officer
> Water and Sanitation Department
>
> Ministry of Environment,Climate Change and Technology, Green Building, Handhuvaree Hingun, Maafannu, Male', 20392, Maldives.
> Mobile: +(960) 7592035 | Office (Direct): +(960) 301 8385 | Fax: (PABX) +(960) 301 8300
> Email: aishath.nafua@environment.gov.mv | Web: www.environment.gov.mv
>
> ---
>
> **From:** Mahfooz AbdullWahhab <mahfoozabdullwahhab@gmail.com>
> **Sent:** Tuesday, September 13, 2022 8:06 AM
> **To:** Haleemath Nahula <haleemath.nahula@environment.gov.mv>; Water and Sanitation | Min. of Environment, Climate Change and Technology, MV <sanitation@environment.gov.mv>
> **Cc:** Eco-Tech Consultancy <secretariate.ecotech@gmail.com>; Eco Tech <ecotechconsultancyeia@gmail.com>

Subject: Re: EIA stakeholder consultation invitation for the proposed 300 TPD RO Plant Installation and Borehole Construction at Lh. Kanuhura.

Dear Sir/Madam,

Gentle reminder again to send your comments regarding this EIA.

Best,

ECO-TECH
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Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
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>> Mahfooz Abdul Wahhab
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>> M. Husnoovilaa, Unigas Magu,
>> Male', 20296, Kaafu Atoll, Maldives

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>>>> To;
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>>>> Ministry of Environment, Climate Change and Technology
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>>>> You could either send us your comments via email or if you wish let us know a time for an e-conference.
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>>>> Best,
>>>>
>>>> ECO-TECH
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>>>>
>>>> Mahfooz Abdul Wahhab
>>>> Managing Director
>>>> Eco-Tech Consultancy Pvt. Ltd
>>>> M. Husnoovilaa, Unigas Magu,
>>>> Male', 20296, Kaafu Atoll, Maldives
>>>> Website: www.ecotechconsultancy.com
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