



ENVIRONMENTAL IMPACT  
ASSESSMENT FOR POULTRY FARM  
DEVELOPMENT IN  
**Kureli, Meemu Atoll**

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Maldives

02<sup>nd</sup> May 2017

Hon. Mr. Thoriq Ibrahim  
Minister  
Ministry of Environment and Energy  
Male'  
Maldives

Dear Mr. Thoriq Ibrahim,

**Re: Environmental Impact Assessment**  
**Poultry Farm development in M. Kureli**

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.

Your sincerely



Aishath Arsha

## 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: Aishath Arsha

Signature:



Date: 02<sup>nd</sup> May 2017

## **DECLARATION OF CONSULTANT**

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

Mahfooz Abdul Wahhab (EIA P22/2016)

A handwritten signature in black ink, appearing to read 'Mahfooz', with a long horizontal stroke extending to the right.

## **EXECUTIVE SUMMARY**

This report discusses the findings of an environmental impact study for the proposed poultry farming project at M.Kureli. Maldives is a country heavily dependent on the import of food for the daily consumption. Government has taken several measures to introduce numerous technologies in food production. Therefore, as such a step, island of Kureli was provided to practice poultry farming. As of now there are no infrastructures on Kureli, except for a well and a small hut made of roofing sheets. The proponent will build all the required project facilities on the island. This would include the infrastructure needed for the poultry production and the utility services for the facility. The water is proposed to be provided by the means of a desalination plant. The sewer is proposed to be collected to a discharge pump station via a gravity line. The sewerage will be discharged beyond the reefs edge as per the respective technical specifications. One number of 300 KW and one number of 50KW generator sets would be utilized to cater for the electricity needs. While a waste storage area will be developed, the waste is planned to be routinely shipped to the nearest waste management facility.

Alternatives have been identified in the project document, whereby the alternatives of combining the outfall for brine and waste water is deemed feasible as the exiting lagoon is too shallow to diffuse the concentrate brine discharge effectively. The most significant impact from the proposed project would be temporary deterioration of local freshwater quality and seawater quality at the disposal site; however, these are low magnitude impacts.

There are some significant environmental impacts identified for the proposed project, however these can be minimized by adhering to the respective regulations and adopting the necessary mitigation measures. A monitoring program has been proposed for the project to assess and examine changes to the environment, if any in the long run.



# 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. Project background and Justification**

Maldives is a country heavily dependent on the import of food for the daily consumption. Government has taken several measures to introduce numerous technologies in food production. Various technologies have been introduced in the field of agriculture and aquaculture by the government and the private sector. In addition to this, technologies in poultry farming also have been introduced and is being practiced in Maldives. Use of poultry farming will reduce the dependency on imported dietary products and also increase the food security. Increased use of alternative technologies of food production is a main part of the country's economic diversification plan and for sustainable development. Therefore, to develop this, island of *Kureli* was provided to practice poultry farming. There are no infrastructures on *Kureli*, except for a well and a small hut made of roofing sheets. The proponent will have to build all the required project facilities on the island.

When the poultry farm in *Kureli* runs at full capacity the proponent expects to cater for 15% of chicken in Maldives market. Chicken is one of the most consumed food item in the Maldives.

A project like this can improve our own productivity and decrease dependence on other countries. The intention of this project is to cultivate and promote local sustainable food solutions. Therefore, it reduces importation along with inflation and improve economy on long run.

## **1.3. Project objectives**

The immediate and long term goals / objectives of the project are as follows

### Immediate Goals

- Increase protein consumption and ensure food security in the community.
- Develop local economy with the introduction of scale-optimized poultry production.
- Facilitate knowledge transfer to locals

### Long Term Goals

- Enrich Students, youth and the community farmers through creation of a poultry business.
- Facilitate a transition from subsistence farming toward commercial production.

## **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.

### **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 EPA of the Maldives has identified the poultry farm development project in Kureli under concern as likely to have negative impacts on the surrounding natural environment. As such, a scoping 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 development of poultry farm on Kureli under concern. 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)**

As part of the EIA process, a scoping meeting for the proposed project was held at the EPA on 13<sup>th</sup> March 2017. The project proponents, EIA consultants and representatives from EPA attended this meeting. The scope of the meeting as discussed at the meeting were approved and the ToR issued on the 14<sup>th</sup> March 2017 (the approved ToR is attached in Appendix B 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:-

- Mohamed Ibrahim Jaleel
- Mahfooz Abdul Wahhab (P22/2016)

### **1.8. The proponent**

The proponent of this project is Aishath Arsha.

## **2. STATUTORY REQUIREMENTS**

All statutory requirements pertaining to this project have been considered in the concept development and assessment of this proposal. It is considered that all matters have been addressed where applicable and that the proposal fully complies with the objectives and requirements of all relevant statutory instruments. National legislations, existing policies and guidelines as well as international conventions relevant to the proposed project are outlined below:-

### **2.1. Law on general public services (4/96)**

Under this law, the general public services are electricity, telephone, water and sewerage services. Relevant articles under this law pertaining to the proposed project are:-

- Article 3 states that any party can provide general public services only after getting registered in the competent authority and according to its regulations;
- Article 4 states that any public service must be provided after a contract agreement has been made between the service provider and the customer. The agreement must be made according to the regulations put forward by the competent authority;
- Article 5 states that a transfer of service between customers must be made only after a contract has been made between the customers according to the service providers regulations. If the customer fails to comply with the agreement, the service provider can discontinue service only after approval from competent authority;
- Article 7 states that the service provider can permanently discontinue its services according to regulation mentioned in article 3 of this law. However temporary discontinuation can be made after giving prior notification to the customers and according to the agreement made between the service provider and the customer;
- Article 8 states that the tariffs for the services must be approved from the competent authority prior to implementation. Further, any amendments to tariff structure also must be approved from the competent authority before implementation; and
- Article 9 states that any damage made to service provider's facilities by anyone, he can be charged with 10 prison penalty or banishment. Further, any action against this law (excluding what is mentioned in article 9 (a) of this law) can be charged between MVR 100 to MVR 5000 by the competent authority.

## **2.2. Law on safety of public health**

The law on public health safety was passed by the peoples Majlis on the 28th November 2012 and gazzetted on 17th December 2012. The law deals with all the aspects with relation to public health safety. Relative to the proposed project, it deals out the aspects of spread of all kinds of diseases including viral and does include the aspects of health quality standards for a food service facility. All the relevant articles of the law are understood and adhered to in the propose project.

## **2.3. Law on Uninhabited islands of Maldives 20/98**

The law on uninhabited islands determines the leasing of uninhabited islands for all other purposes except resort development, which includes the proposed project. Also it includes leasing of the islands for community use and other uses such as plantation of trees, uprooting of trees in the uninhabited islands. The methods of the leasing are mentioned from the article 11 to article 16. All the articles in the act are understood and adhered to in the proposed project.

## **2.4. 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.
- 

#### **2.5. 1<sup>st</sup> 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.

#### **2.6. Environmental Impact Assessment Regulation 2012**

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.

Since the development of roads is in the inclusive list, an EIA report needs to be submitted to the competent authority before the implementation of the project. An EIA application form was submitted to the EPA and a scoping meeting was held on 2<sup>nd</sup> March 2017. During the meeting the ToR for the project was issued. The EIA report is this document and will be submitted to EPA for approval.

#### **2.7. 1<sup>st</sup> addendum to Environmental Impact Assessment Regulation 2012**

With this amendment the competent Authority has to check the submitted EIA report if everything mentioned in the regulations article K is in order and inform the proponent

whether or not the EIA report has been accepted or not accepted within 2 working days. Further the penalties for repeated offense under this regulation were amended.

### **2.8. 2<sup>nd</sup> addendum to the Environmental impact Assessment Regulation 2012**

With the 2nd addendum 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. Other than that slight changes were made to the process such as the finalization of the ToR during the scoping meeting(article 11(b)) and changes in the fees for the review processes under three different categories (article 7(c)).

Under article 8(a) the decisions for a screening form is 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.

Under article 9(b) the decisions for an IEE is as follows:-

- 1) Environmental Impact Assessment report if the project is anticipated to have major environmental impacts;
- 2) Environment Management Plan; and
- 3) Approval to go forth with the project if the project is not anticipated to have major environmental impacts.

Under article 10 two reviewers are required to review the Environmental Management plan. The reviewers are to be selected according to article 13(b) of the regulation.

### **2.9. 3<sup>rd</sup> addendum to the Environmental Impact Regulation 2012**

One of the main modifications to the EIA regulation is that the EIA consultants are classified into 2 categories. 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. As such, this report is prepared by registered category A EIA consultants.

### **2.1. 4<sup>th</sup> addendum to the Environmental Impact Regulation 2012**

One of the main modifications to the EIA regulation is that the exclusive list for EIAs were changed such that EIAs are not required for reclaimed lands until three years from the reclaimed date unless the project involves dangerous chemicals, oil storage, incinerators, release of toxic chemicals to atmosphere, and fiber works.

## **2.2. Waste Management Regulation**

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. Waste generated during the construction and operational phases of this project will be treated in accordance with the waste management regulation.

## **2.3. Waste management policy**

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.

This project will comply with this guideline such that any wastes generated during the construction and operation phases of this project will be dealt with in accordance with the waste management plans of Male' city.

## **2.4. National wastewater guideline**

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. All relevant sections in the guideline are conformed for the proposed project.

Through dewatering approval process, the groundwater quality of Kureli will be tested and if deemed already polluted then the dewatered water will be pumped into the sea according to the dewatering approval from EPA.

## **2.5. National wastewater guideline**

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

the discharge of specific waste water. All the relevant sections in the guidelines are understood for the proposed project.

### **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, 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 50 or more 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.

The amendment to this regulation (regulation no 2014/R) 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.

The trees removed from this project will be replanted in other areas of Kureli as much as possible.

### **2.7. Regulation on the hygiene standards for food service facility**

The regulation on the hygiene standards for food service facility stems from the law on safety of public health. The regulation includes; the hygiene standards of the employees who work at food service facilities, hygiene standards for the food products, measures of food hazard control and registration of such facilities. All the relevant articles of the regulation are understood and will be adhered to in the propose project.

### **2.8. Regulation on advertisement of food products**

According to the regulation of advertisement of food products, any advertisement relative to a food product must go through the approval process of the department of public health. Thereby the advertiser must submit the details of the product, details of the advertisement, method of delivery and details of the advertiser to the department for prior approval. Furthermore, any claims in the advertisement such as “cholesterol free” must be properly justified to the department through adequate means such as laboratory test reports. All the relevant articles of the regulation are understood and will be adhered to in the propose project.

### **2.9. Regulation on the works of port health**

The regulation details out the aspect of health on the importing of products through sea freighting. It includes the aspects of disease control, quarantine and import of live animals. In the article 14 which relates to the import of chickens it states that the any chicken that is imported must be have the documentation of proper vaccination such as fowl pox. All the relevant articles of the regulation are understood and will be adhered to in the propose project

## **2.10. Regulation on uninhabited island of Maldives**

The regulation on uninhabited islands stems from the law of uninhabited islands of Maldives. In the regulation it states that the mandate for leasing under the article 11 of the law for Uninhabited islands lies with the Ministry of Fisheries, Agriculture and marine resources and that it shall do so after discussions with the relevant Ministries. The regulation also details out the method of application for any uninhabited islands to carry out activities of fisheries and farming. All the sectors in the regulations are understood and adhered to in the proposed project.

## **2.11. International Conventions**

### **2.11.1. *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.

### **2.11.2. *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.

### ***2.11.3. 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 cooperation 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.

### ***2.11.4. 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).

### ***2.11.5. 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 Janeiro, 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.

#### **2.11.6. 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.

#### **2.11.7. 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.

#### **2.12. 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;

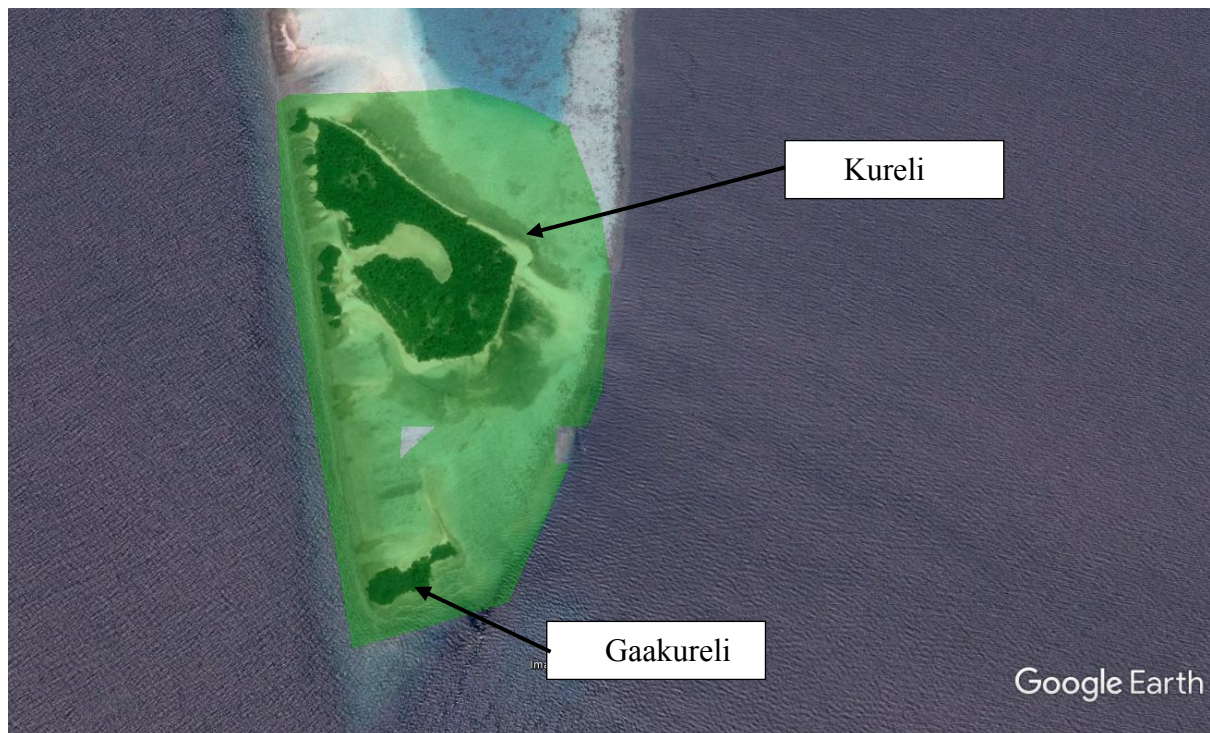
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- South Asian Seas Program; and
- Male' Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia (1998).

### 3. PROJECT DESCRIPTION

#### 3.1. Study area, project boundary and surroundings

The study area for the project is *Kureli* and its surrounding reef system as shown in figure 1. This includes the vegetation and groundwater on *Kureli*, the coral reefs on the reef system and marine water quality. Further since this project is expected to impact the socioeconomics of the nearest island M. *Kolhufushi*, the socioeconomics of the island were included in the surveys. In addition to *Kolhufushi* the socioeconomics of the entire atoll is also included as the entire atoll is expected to be impacted indirectly during the operation of the poultry farm. The outcomes of the public consultations done in *Kolhufushi* and consultation with the Atoll Council are shared in the stakeholder consultation section. During the public consultations, the locals highlighted that *Gaakureli* (referred to in the ToR as project site) is actually a different island and the real name of the project site is actually *Kureli* as shown in figure 1. Therefore in this report we have referred the project site as *Kureli*.



*Figure 1: study area*

The proposed infrastructures of the poultry farm with their size and location on *Kureli* is shown in the land use plan shown in figure 2.

**3.1.1.      *Relevant development(s) in the area***

There are currently no developments proposed to *Kureli* besides the poultry farm project.

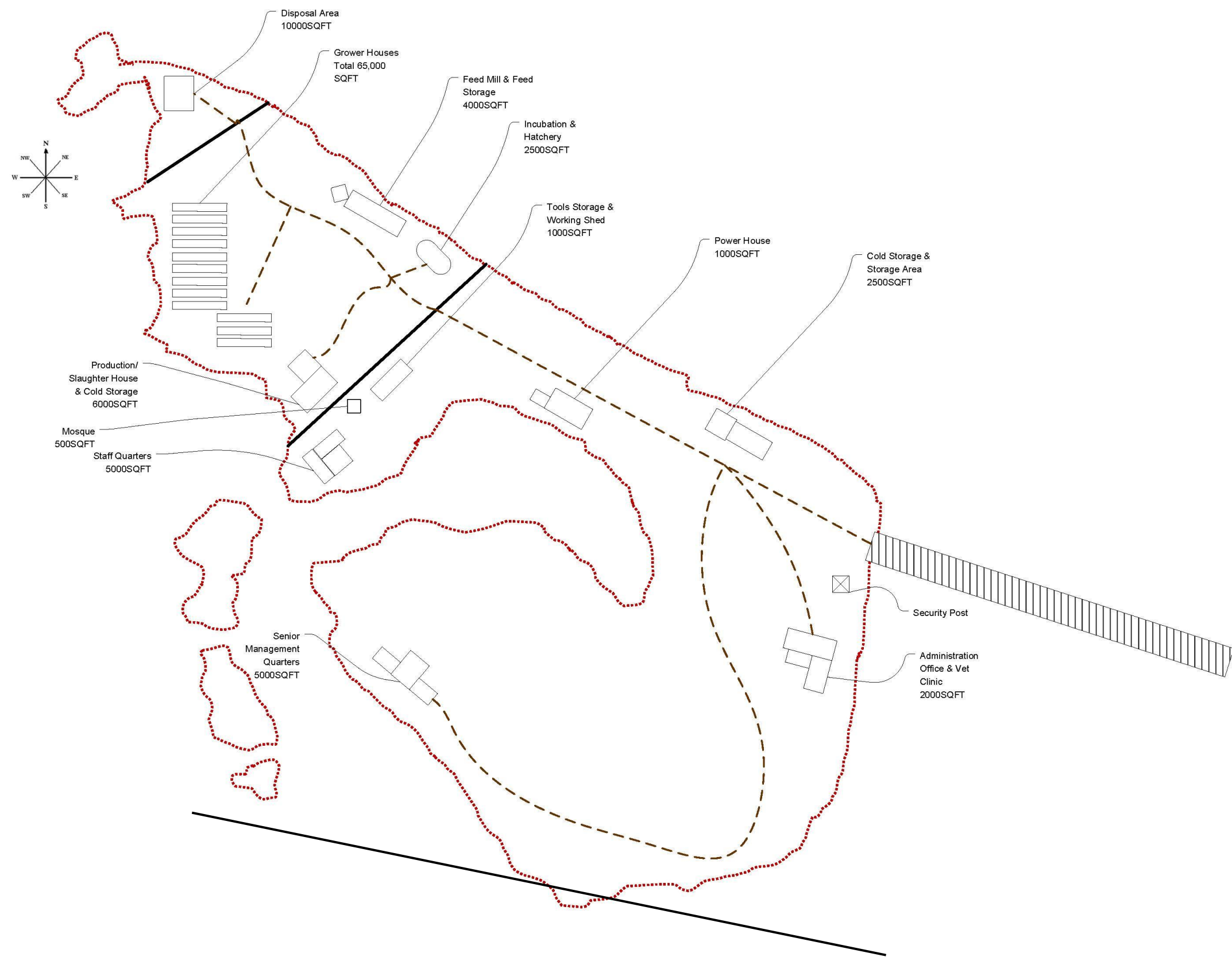


Figure 2: land use plan for development of Kureli as a poultry farm

### **3.2. Description of existing facilities on Island**

There are no existing facilities on the island except for a well which has been constructed and some remains of walls from previously constructed buildings on the island.

### **3.3. Project description and proposed works**

The major components of the project are as follows;

- Situation Analysis
- Project Execution plan
- Establishment of Poultry farm
- Establishment of Utilities for the operation of the poultry farm
- Construction of Jetty

#### **3.3.1. *Situation Analysis***

##### **Trends in Production & Import**

Local production of Chicken meat is insignificant at present. No poultry farm exist to cater commercial to local demand. Spread across the country, there are inhabited islands where people rear chicken for their own consumption. A handful of companies, who have been assigned an island for farming, do rear chicken supplied to their own resort or hotel.

With the increase in both tourism sector and population, the consumption of chicken meat products have been growing over the years. From 2005 to 2014, the import of chicken meat have been growing at an annual rate of 20%, whilst cost per KG have been rising at an annual rate of 10%.

Government have taken initiatives in promoting farming including Poultry. Throughout the Maldives, by incorporating business centers like cooperatives the local farmers are getting a better opportunities to sell their produce. Presently in a very small scale D. Kudahuvadhoo has a poultry farm. Such initiatives by the government would lead to a sustainable economy in the future.

##### **Natural Environment**

Maldives enjoys a pleasant temperatures all year round that feature two main weather conditions, the dry and rainy season. The dry season is between end of October until end of March and the rainy season is between end of April and end of October. The temperatures during the dry season range from 25°C to 29°C. March and April are the hottest months in Male when temperatures can reach up to 32°C. The rainy season has also plenty of sunny days and the temperatures remain reasonably high, rarely dropping below 25°C.

For best outcome for chicken brooding, different temperature have to been maintained in the growing house. As the chick grows the temperature ideally should drop for the chicks' comfort. Those temperatures are shown in the following table:

Age of Poultry (Feathered) Chick	Degrees in Celsius	Relative Humidity %
1st Week	32-35	30-50
2nd Week	29-32	40-60
3rd Week	27-29	40-60
4th Week	24-27	50-70
5th Week	21-24	50-70
6th Week	21	50-70

Maldives weather temperature not too hot or too cold for rearing chicken. This means that investment cost for building growing houses can be reduced significantly as the temperature in the chicken houses can be controlled naturally with airflow and ventilation without resorting to heavy cooling or heating mechanisms.

#### **Environmental Policies**

Project takes the obligation to the environment seriously, and indeed the success relies on a harmonious relationship with the environment in particular. For the long term sustainability of the business and in order to maximize the productivity, it is essential that the farm put in place the highest standards of ecological and environmental practices. These practices are to be based on nationally recognize standards.

Both staff housing and chicken housing will be constructed with minimal damage to natural flora as much as possible. More importantly natural shade will provide required cooling for the chicken houses. Staff housing and other operational structures will be constructed where possible on a vegetation free patch of land.

#### **Risk preventive measures**

The environmentally friendly approach to this operation will ensure a harmonious and mutually beneficial relationship with the environment. To protect both chicken and human at the site for any potential contamination strict practices will be followed. Some of the practices include:

- Both staff area and chicken area will be located in separate location, and entry will be only limited to authorize personal. Visitors should take prior permission before visiting.
- Protective clothing will be provided for workers and visitors.
- Regular maintenance and cleaning of the island.

Chicken houses will be regularly cleaned and disinfected.

- Live chicken imported will come with prior health check and vaccination.
- Disposal of waste.
- Regular risk assessment of environmental impact and implementation of

procedures to minimize risk.

### **Economical Benefits**

This project will make significant contributions to the key social and economic development objectives of the Country. Some of the key contributions that the proposed investment will generate include:

- Creating of numerous employment opportunities for Islanders of Nearby.
- A sustainable, self-sufficient and profitable poultry farm, which produces a range of Maldivian products;
- Environmentally and socially responsible approach to Poultry policies for the conservation of natural resources;
- Research and development will contribute to the country's knowledge of technology, Poultry biology and the economics of sustainable business;
- Increase in skilled Maldivian labour, both male and female, for poultry related activities through on the job training and education.

#### Immediate Goals

- Increase protein consumption and ensure food security in the community.
- Develop local economy with the introduction of scale-optimized poultry production.
- Facilitate knowledge transfer to locals.

#### Long Term Goals

- Enrich Students, youth and the community farmers through creation of a poultry business.
- Facilitate a transition from subsistence farming toward commercial production.

### **3.3.2. Project Execution plan**

#### **Establishment & Construction**

Due to the nature of the project there will be a significant amount of lead time before any revenue can be generated. A minimum of 2 month might be required to mobilize and obtain all the necessary approvals. It is planned to build a temporary accommodations and other setups at first to initiate the Construction phase even.

Construction works of permanent accommodation, dining & kitchen hall, jetty, chicken houses...etc. with the packaging facility would be tendered on contract basis after designs and drawings works are finished. Once construction work begins, it is estimated that it will take a further 12 months to complete the construction stage of the project, ensuring that proper environmental and ecological practices are established. Given this extended initialization period before commercial phase can begin, it is anticipated that it will take approximately 8 months before any commercial revenue can be generated from the project.

The planed work schedule for the project development is given in section 3.4.8. The

work plan is scheduled to commence once all preliminary agreements and approvals have been met. It also assumes some lead time in order to liaise with consultants and key staff, ensuring their availability to start on day 1. Hence the work plan below does not take into time required for the following:

- Time to obtain necessary approvals.
- Time to procure locally available construction materials.
- Time to advertise, interview and hire for local staff.
- Time to advertise, interview and hire for certain skilled positions.
- Time to procure plants, machinery and equipment available locally.
- Time to purchase plants, machinery and equipment from overseas.

This process may require travelling to various international locations and then hand picking the required goods. It is likely that some goods will have a manufacture/supply lead time which could delay the shipment of other goods. Furthermore it is likely that foreign knowhow will be required to build Brooder Houses for the chicken. Within the period of 18-22 months it is expected that the project will be brought to commercial production.

The project will be executed under consultation with a poultry farming expert. Such expertise is almost non-existent at present in the Maldives. The poultry farm and necessary facilities will be constructed and developed with minimal damage to the island's natural landscape and flora. The proposed site plan is shown on figure 3.

### **Employment Plan**

Project's employment policy is aimed first and foremost at attracting employees from nearby inhabited islands. Preference will be given to these people in particular. Next, preference will be given to Maldivians from neighboring Atolls and subsequently other parts of the country, particularly those who can travel to and from their homes via existing low cost transport routes. This policy is aimed at developing a family of long term employees, who can frequently visit their homes and maintain close relationships with their families, while satisfying the commercial needs of the project.

A range of employment opportunities will be created, many of which can be carried out by unskilled workers. Hence, these positions will be available to all job seekers in the area. Furthermore skilled position will also be available and training will be provided. As the project grows its business and new skilled positions become available, preference for these positions will also be given to people from the atoll. It is envisaged that in the long term, all higher management positions will be held by locals from nearby islands, who can then reach out to attract new employees from these islands as the business expands.

In order to attract staff and then retain their services, project will offer generous salaries, employment benefits, incentives, additional entertainment and recreation facilities, and most importantly a health, satisfying and enjoyable work environment. The benefits and incentives to staff will include:

- Only Maldivians will be staffed permanently.
- Education and Training opportunities.
- Generous salary.

## Environmental Impact Assessment for Poultry Farm Development at M. Kureli

- Travel to and from their local island.
- Performance incentives.
- Recognition programs.
- Coverage of medical costs.
- Ramadan allowance.
- Staff recreation facilities.

Furthermore, project intends to increase these benefits based on commercial growth. Future plans include introducing a rewarding long-term staff with long service leave/benefits and increasing the annual leave of all staff. These generous remuneration packages are in line with project's human resources (HR) policies aimed at maximizing long term sustainability and profitability. Project believes that the benefits from these HR policies will include:

- High staff retention rates.
- Containment of intellectual property.
- A high efficient and finely turned operation.
- Simplified management requirements.

Technology and know-how in a commercial large scale poultry farm is almost non-existent at present. The project will allow knowledge transfer to locals. Hence in the long-term the operation could be 100% Maldivians operated.

### **Corporate Social Responsibility**

As a business which will operate in the local community, the project recognizes that the relationship with both the environment and local community must be mutually beneficial for long term sustainability. In order to minimize travel costs, it will be beneficial to employ people from nearby island, thus improving the standard of living for the community. Furthermore, it is likely that purchasing goods and services locally will also minimize the operation expenses. By developing strong community ties within the atoll, project can develop mutually beneficial relationship that can contribute to the development of the local economy and the business simultaneously.

In order to meet some of the social obligations, while developing relationship with neighbors, project intend to put the following practices in place in addition to local employment:

- Purchasing and collection of community integrated raw materials from atoll islanders.
- Purchasing of goods and services during construction will first and foremost be obtained from the atoll, with preference given to the neighboring islands.
- General good neighbor policy with the surrounding islands.
- Assisting in promoting the local business center/cooperatives.
- Providing chicken manure as a fertilizer to local agricultural farmers.

### **Risk Assessment**

#### Financial risks

- Changes in our pricing policies or that of our competitors
- Changes in costs from critical suppliers e.g. fuel

- Fluctuation in revenue from distributors and retailers
- Timing of costs related to acquisitions or payments Health risks
- High import duties levied is also a financial risk. it will be good somewhere that support is provided by waiving import duty for the project like done for resort development currently and this project contributes to import substitution long term.

Contagious disease and virus outbreak is very deadly; if one of the chickens should catch the disease, all of them will be affected and if it's not recognized and treated early it will lead to the death of all the chickens which is a great loss for the business. And also some of the diseases are also contagious to human not just between the chickens which will affect the workers and also those that eat it.

Disease prevalence varies from one area to the other. The problems that may trigger disease conditions are direct sunlight on egg trays or nests, poor ventilated houses and very high temperatures in and outside the poultry house, which may weaken egg shells resulting in poor egg quality. All these conditions will be avoided to the best of Farm's abilities.

Another thing considered in the risk assessment is the mortality of the chickens which is inevitable since Farm is dealing with living things. This can be managed with good management and has been calculated to range between 5-10%.

### **Technological risks**

Technology is good but they also have their disadvantages. There are normally problems involved in using technology; for example the use of the machine that plucks the chicken may fail to work or spoil, making the work slow and adding more cost to the business by repairing it. The cost for electricity/power is dependent on fuel, any delay to fuel delivery can lead to halt in machineries and equipment. Furthermore any electric problems can lead to fire outrage and burn the properties causing the loss of assets and perhaps the entire business.

### **Contingency plans**

The project considered these risks and have made contingency plans for unprecedented events or occurrences. As per the health risks, the Farm have plans with a veterinary doctor that will have regular check-ups with the chickens while giving them the best environmental conditions. Another contingency plan will make is insurance that will protect all assets. Other risks that have been mentioned above, proper preventive management practices will allow to minimize occurrence of such events.

### **Regarding Potential disease outbreaks:**

It has been shown that in more than 90% of the cases, people are the cause of disease transmission among poultry farms. In other words, more than 90% of breaks in biosecurity are the result of human activity. Humans, in direct or indirect contact with poultry, are the primary route of introduction or spread of diseases among poultry farms. Mobility, tasks (as employee, manager or veterinarian), curiosity, lack of knowledge, and negligence are among the factors that can result in humans spreading disease.

The Poultry Farm being located in an isolated Island with minimum human movement (except for Employees on the island), the movement of people can be controlled and hence such disease problems or outbreaks can be significantly reduced. In addition, in a

circumstance where a disease is discovered among the chicken flock or outbreak is imminent, controlling is an advantage since the island is isolated.

The Poultry farm will strictly take and adhere preventive measures, such that a disease outbreak is minimised. The following are the preventive measures that would be adhered strictly on the Farm but not limited to:

- Farm Visits – Outside visitors will not be allowed without prior check from the Male Office.
- Biosecurity – All employees on the Farm will follow and respect the sanitation rules. Which are not limited to changing clothes or taking showers, wearing coveralls and disinfecting boots. Biosecurity measures apply to everyone within a company.
- Pest Control – Strict measures would be taken to control mosquitos and rodents on the island
- Restricted Poultry Buildings – Only certain employees will have authorize access to the poultry related buildings on the Farm
- Quarantine – any person fallen sick will be quarantined from rest of the people and birds on the Farm.
- Monitoring – regular monitoring for bird behavior and for sick birds.
- Vaccination – Periodic vaccination for the birds for common diseases such as Newcastle, Bronchitis, Avian Influenza (Bird Flu), Marek's Disease and Mycoplasma

#### Information on Potential diseases:

##### **Newcastle Disease**

**Synonyms:** pneumoencephalitis

The highly contagious and lethal form of Newcastle disease is known as viscerotropic (attacks the internal organs) velogenic Newcastle disease, VVND, exotic Newcastle disease, or Asiatic Newcastle disease. VVND is not present in the United States poultry industry at this time.

**Species affected:** Newcastle disease affects all birds of all ages. Humans and other mammals are also susceptible to Newcastle. In such species, it causes a mild conjunctivitis.

**Clinical signs:** There are three forms of Newcastle disease—mildly pathogenic (lentogenic), moderately pathogenic (mesogenic) and highly pathogenic (velogenic). Newcastle disease is characterized by a sudden onset of clinical signs which include hoarse chirps (in chicks), watery discharge from nostrils, labored breathing (gaspings), facial swelling, paralysis, trembling, and twisting of the neck (sign of central nervous system involvement). Mortality ranges from 10 to 80 percent depending on the pathogenicity. In adult laying birds, symptoms can include decreased feed and water consumption and a dramatic drop in egg production.

**Transmission:** The Newcastle virus can be transmitted short distances by the airborne route or introduced on contaminated shoes, caretakers, feed deliverers, visitors, tires, dirty equipment, feed sacks, crates, and wild birds. Newcastle virus can be passed in the egg, but Newcastle-infected embryos die before hatching. In live birds, the virus is shed in body fluids, secretions, excreta, and breath.

**Treatment:** There is no specific treatment for Newcastle disease. Antibiotics can be given for 3–5 days to prevent secondary bacterial infections (particularly *E. coli*). For chicks, increasing the brooding temperature 5°F may help reduce losses.

**Prevention:** Prevention programs should include vaccination (see publication PS-36, Vaccination of Small Poultry Flocks), good sanitation, and implementation of a comprehensive biosecurity program.

### **Infectious Bronchitis**

**Synonyms:** IB, bronchitis, cold

**Species affected:** Infectious bronchitis is a disease of chickens only. A similar disease occurs in bobwhite quail (quail bronchitis), but it is caused by a different virus.

**Clinical signs:** The severity of infectious bronchitis infection is influenced by the age and immune status of the flock, by environmental conditions, and by the presence of other diseases. Feed and water consumption declines. Affected chickens will be chirping, with a watery discharge from the eyes and nostrils, and labored breathing with some gasping in young chickens. Breathing noises are more noticeable at night while the birds rest. Egg production drops dramatically. Production will recover in 5 or 6 weeks, but at a lower rate. The infectious bronchitis virus infects many tissues of the body, including the reproductive tract (see Table 1). Eggshells become rough and the egg white becomes watery.

**Transmission:** Infectious bronchitis is a very contagious poultry disease. It is spread by air, feed bags, infected dead birds, infected houses, and rodents. The virus can be egg-transmitted, however, affected embryos usually will not hatch.

**Treatment:** There is no specific treatment for infectious bronchitis. Antibiotics for 3–5 days may aid in combating secondary bacterial infections. Raise the room temperature 5°F for brooding-age chickens until symptoms subside. Baby chicks can be encouraged to eat by using a warm, moist mash.

**Prevention:** Establish and enforce a biosecurity program. Vaccinations are available.

### **Avian Influenza**

**Synonyms:** AI, flu, influenza, fowl plague

**Species affected:** Avian influenza can occur in most, if not all, species of birds.

**Clinical signs:** Avian influenza is categorized as mild or highly pathogenic. The mild form produces listlessness, loss of appetite, respiratory distress, diarrhea, transient drops in egg production, and low mortality. The highly pathogenic form produces facial swelling, blue comb and wattles, and dehydration with respiratory distress. Dark red/white spots develop in the legs and combs of chickens. There can be blood-tinged discharge from the nostrils. Mortality can range from low to near 100 percent. Sudden exertion adds to the total mortality. Egg production and hatchability decreases. There can be an increase in production of soft-shelled and shell-less eggs.

**Transmission:** The avian influenza virus can remain viable for long periods of time at moderate temperatures and can live indefinitely in frozen material. As a result, the disease can be spread through improper disposal of infected carcasses and manure. Avian influenza can be spread by contaminated shoes, clothing, crates, and other equipment. Insects and rodents may mechanically carry the virus from infected to susceptible poultry.

**Treatment:** There is no effective treatment for avian influenza. With the mild form of the disease, good husbandry, proper nutrition, and broad spectrum antibiotics may reduce losses from secondary infections. Recovered flocks continue to shed the virus. Vaccines may only be used with special permit.

**Prevention:** A vaccination program used in conjunction with a strict quarantine has been used to control mild forms of the disease. With the more lethal forms, strict quarantine and rapid destruction of all infected flocks remains the only effective method of stopping an avian influenza outbreak. If you suspect you may have Avian Influenza in your flock, even the mild

form, you must report it to the state veterinarian's office. A proper diagnosis of avian influenza is essential. Aggressive action is recommended even for milder infections as this virus has the ability to readily mutate to a more pathogenic form.

### **Mycoplasma synoviae**

**Synonyms:** MS, infectious synovitis, synovitis, silent air sac

**Species affected:** chickens and turkeys.

**Clinical signs:** Birds infected with the synovitis form show lameness, followed by lethargy, reluctance to move, swollen joints, stilted gait, loss of weight, and formation of breast blisters. Birds infected with the respiratory form exhibit respiratory distress. Greenish diarrhea is common in dying birds. Clinically, the disease is indistinguishable from MG.

**Transmission:** MS is transmitted from infected breeder to progeny via the egg. Within a flock, MS is spread by direct contact with infected birds as well as through airborne particles over short distances.

**Treatment:** Recovery is slow for both respiratory and synovitis forms. Several antibiotics are variably effective. The most effective are tylosin, erythromycin, spectinomycin, lincomycin, and chlorotetracycline. These antibiotics can be given by injection while some can be administered in the feed or drinking water. These treatments are most effective when the antibiotics are injected.

**Prevention:** Eradication is the best and only sure control. Do not use breeder replacements from flocks that have had MS. The National Poultry Improvement Plan monitors for MS.

### **Marek's Disease**

**Synonyms:** acute leukosis, neural leukosis, range paralysis, gray eye (when eye affected)

**Species affected:** Chickens between 12 to 25 weeks of age are most commonly clinically affected. Occasionally pheasants, quail, game fowl and turkeys can be infected.

**Clinical signs:** Marek's disease is a type of avian cancer. Tumors in nerves cause lameness and paralysis. Tumors can occur in the eyes and cause irregularly shaped pupils and blindness. Tumors of the liver, kidney, spleen, gonads, pancreas, proventriculus, lungs, muscles, and skin can cause incoordination, unthriftiness, paleness, weak labored breathing, and enlarged feather follicles. In terminal stages, the birds are emaciated with pale, scaly combs and greenish diarrhea.

Marek's disease is very similar to Lymphoid Leukosis, but Marek's usually occurs in chickens 12 to 25 weeks of age and Lymphoid Leukosis usually starts at 16 weeks of age.

**Transmission:** The Marek's virus is transmitted by air within the poultry house. It is in the feather dander, chicken house dust, feces and saliva. Infected birds carry the virus in their blood for life and are a source of infection for susceptible birds.

**Treatment:** none

**Prevention:** Chicks can be vaccinated at the hatchery. While the vaccination prevents tumor formation, it does not prevent infection by the virus.

### **Infectious Bursal Disease**

**Synonyms:** Gumboro, IBD, infectious bursitis, infectious avian nephrosis

**Species affected:** chickens

**Clinical signs:** In affected chickens greater than 3 weeks of age, there is usually a rapid onset of the disease with a sudden drop in feed and water consumption, watery droppings leading to soiling of feathers around the vent, and vent pecking. Feathers appear ruffled. Chicks are listless and sit in a hunched position. Chickens infected when less than 3 weeks of age do not develop clinical disease, but become severely and permanently immunosuppressed (see Table 2).

**Transmission:** The virus is spread by bird-to-bird contact, as well as by contact with contaminated people and equipment. The virus is shed in the bird droppings and can be spread by air on dust particles. Dead birds are a source of the virus and should be incinerated.

**Treatment:** There is no specific treatment. Antibiotics, sulfonamides, and nitrofurans have little or no effect. Vitamin-electrolyte therapy is helpful. High levels of tetracyclines are contraindicated because they tie up calcium, thereby producing rickets. Surviving chicks remain unthrifty and more susceptible to secondary infections because of immunosuppression.

**Prevention:** A vaccine is commercially available

### **Measures to be taken in case of an Outbreak**

By following the preventive measures any disease outbreak would be minimized. However, in an event of an outbreak or upon preliminary signs of major disease, the following measures would be taken:

- a) Isolate the sick birds from the healthy ones to limit exposure
- b) Consult animal health expert / veterinarian
- c) Massive die-off that is disaster related, all dead and sick birds should be handled and treated to prevent spread of the disease.
- d) If no immediate treatment found for the sick birds:
  - i. Notify relevant Authorities
  - ii. Cull and incinerate all infected birds in a designated area on the Poultry Farm Island.
- e) Disinfect all machineries and equipment including the poultry houses.
- f) Medical check-up done on people on the island and seek necessary medical treatment.

### **3.3.3. Establishment of poultry farm**

Chicken meat is one of the most consumed food in the Maldives, both in the local domestic market and the resort/hotel market. Currently an insignificant quantity of chicken meat is locally produced for consumption.

The project entails development of a poultry farm for the production of Chicken Meat. In the long run building on the success of chicken farm, the business will allow related diversification into ducks and turkey. The intention is cultivating and promoting local sustainable food solutions.

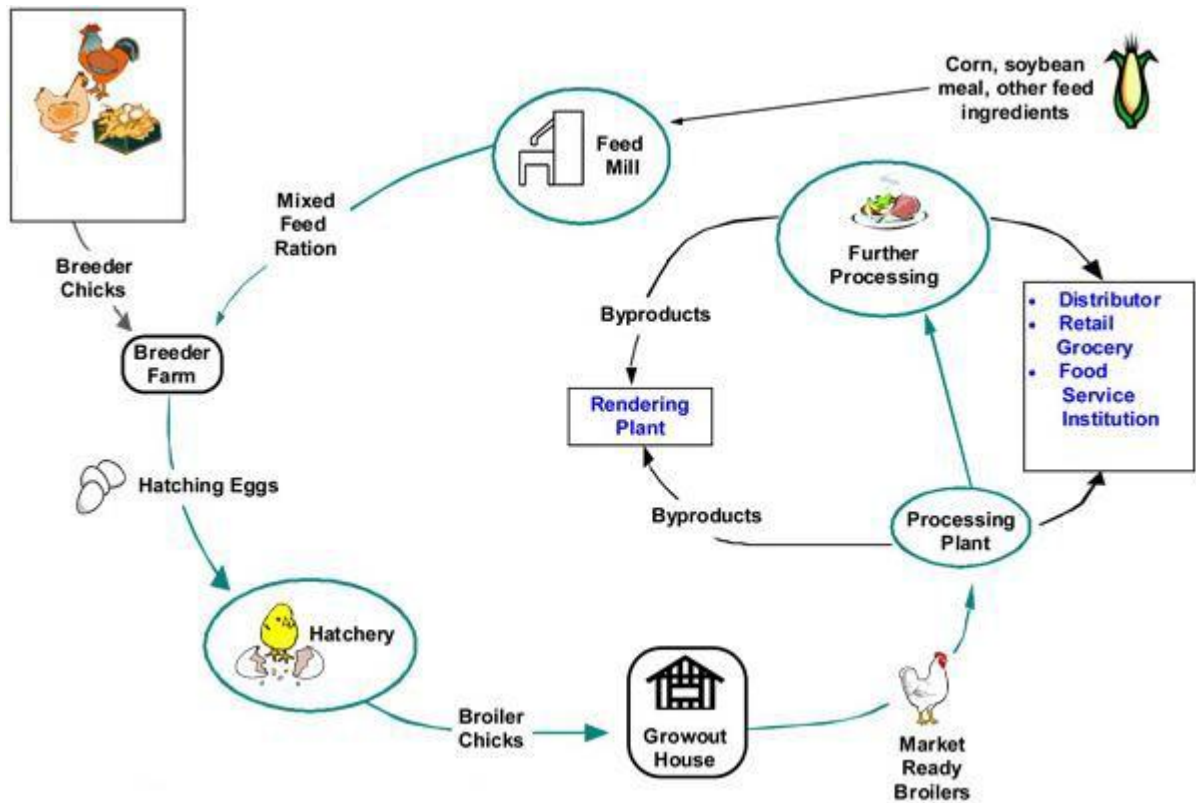
#### Meat Production

Based on the types of chicken, Broiler Chicken are normally reared for meat production. Main reason is the broilers grows faster and are ready for sale at 10-12 weeks from hatch. The scientific name of the bird that will be farmed under this project is *Gallus gallus domesticus*.

At present there are no supporting industries for such poultry farms. Hence all production

process have to be in-house, from Breeding to Slaughter.

Process for rearing market ready broiler chicken is as follows:



### Feed Mill

Healthy feed leads to healthy chickens. Rates of feed consumption and growth are affected by many factors, such as the breed, the management system, and even the weather. The feed mill is responsible for preparing chicken feed. Different feed rations and diet are used for newly hatched chicks (starter), birds in the development phase (grower) and mature birds (finisher). A high protein diet will result in quicker growth rates.

### Feed consumption and body weight

The table below provides data on typical feed consumption and bodyweight from modern broiler chickens in relation to age. A broiler chicken on average will eat about 1kg of starter, 2kg of grower and 2.5kg of finisher to reach a market weight of 2.5kg – 3kg.

Age (weeks)	Type Feed	Feed consumption (weekly per of bird) kg	Live Weight kg	Body
1	Starter	0.15	0.17	
2	Starter	0.32	0.44	
3	Starter	0.61	0.82	
4	Grower	0.85	1.33	
5	Grower	1.09	2.00	

6	Finisher	1.25	2.50
7	Finisher	1.44	3.08
8	Finisher	1.40	3.60
9	Finisher	1.40	4.05

Chicken feed for different stages of broiler growth have to be imported. This would represent 60-75% of the production cost. Even with the best of efforts for proper care and feeding, it is expected an average mortality rate of 5%-10% (based on industry findings) per flock until maturity, it will vary at different stages of the bird growth.

#### Breeder Farm

Broiler breeders are both Male (rooster) and Female (hen) chickens that are of reproductive age. Fertile eggs that develop to produce broilers.

Young broiler breeder birds are kept in relatively small single-sex flocks (about 2,500-3,000 birds) and are transferred to the production farms at the age of 16-21 weeks and stay there (in mixed sex groups). Egg production usually starts between 18-22 weeks of age and lasts until 60-65 weeks of age. Group size during the production period ranges from 3,000-8,000 birds and the percentage of males in the group ranges between 7 and 11 % when egg production starts. A typical hen will lay approximately 180 eggs in its life time, however it's quite variable depending on hen's health, diet, weather and age.

Weight control is important during the laying period and separate feeding is applied for males and females, so that feeding is carefully controlled. Egg production and body condition determine the amount of feed provided. Food restriction is used to limit body weight gain and achieve desired levels of fertility. Feed restriction is practiced because if broiler breeders were fed standard broiler diets, they would grow too rapidly and become too heavy to maintain good health before reaching the age of sexual maturity. This would have detrimental effects on their health, their fertility and their welfare. However, feed restriction causes welfare problems associated with hunger and increased aggression around feeding time.

Broiler breeders are usually reasonably well muscled at the end of their production period and weigh between 4 - 5 kg. As there is there is potential value in the meat from these birds, end-of-lay broiler breeders are sent for commercial slaughter, like standard broilers.

#### Hatchery & Incubation

The hatchery is responsible for the incubation and hatching of chicks from fertile eggs obtained from broiler breeders. The hatchery consists of incubation equipment responsible for maintaining ideal environment conditions for embryo development. This process mainly consists of two phases:

##### Incubator

- Fertile eggs are incubated in the setter for 18 days.
- The setter provides ideal temperature and humidity conditions for embryo

development.

- The eggs are stored on trays that are secured to incubator racks.
- The setter also rotates eggs to ensure proper orientation of the developing

embryo in the egg. Hatcher

- After 18 days in the setter, eggs are transferred from trays to hatching baskets and are moved to the hatcher.
- The hatcher provides ideal temperature and humidity for late-stage embryo development and hatching.
- Unlike the incubator, the hatcher does not rotate eggs.
- The chicks hatch after 3 days in the hatcher, resulting in a total incubation period of 21 days.
- While in the egg, chicks use their beak to break out of the shell, a process referred to as pipping.
- Chicks are damp when they exit the shell, or hatch and the warm temperature in the hatcher plays an important role in drying the chick and maintaining their body temperature.

Chicks need extra heat and high humidity during the first weeks of life. Newly hatched chicks require ambient temperatures of 32°C to 35°C and relative humidity of 60% to 70% which can be difficult to achieve at these high temperatures. Chicks are inspected and are serviced (vaccinated, counted and loaded into boxes) prior to delivery to a grow-out farm.

#### Grow-out House & Vaccination

Grow-out houses are where broiler chickens are raised. These farms are specialized buildings that allow age- appropriate control of temperature, humidity, food delivery, water delivery and lighting for the broilers. The house provides birds the freedom to move through as they want. These houses are either curtain-sided or tunnel-ventilated.

##### Curtain-sided

- These houses contain a curtain that runs along both sides of the house that can be raised or lowered depending upon external temperatures to maintain desired environmental conditions in the house.

##### Tunnel-ventilated

- These houses contain solid walls on all sides of the house. One end of the house contains large exhaust fans while the other end do the house contains large cool cells. The exhaust fans function to exchange air within house.

In hotter countries, like Maldives, investment in chicken houses can be minimized by keeping the houses more open (Curtain sided) so that the chickens are exposed to daylight and natural ventilation.

The size of the house depends on the number of chickens to be accommodated. The recommended stocking density for broiler chicken is approximately 1.45 ft<sup>2</sup> per chicken. The maximum number of live chicken at any given time, 33,100 birds. This would mean a

total brooding area of 48000 ft<sup>2</sup>, which can be divided into any number of houses.

#### Vaccination

The modern broiler reaches slaughter weight within several weeks. This leaves little time to develop a mature immune system. Therefore, broiler chicks are vaccinated against several different diseases. Some infectious pathogens (such as Salmonella) can also be transmitted via the egg (vertical transmission) from the breeder hen to the chick. The breeder hen should therefore also be vaccinated. The most common vaccines used are against Newcastle disease virus, infectious bronchitis virus, avian pneumovirus and infectious bursal disease. Vaccines are delivered via spraying or via drinking water. Spray vaccination is the preferred and most effective administration technique for respiratory type vaccines.

#### Processing Plant

The processing plant is where the chicken that meets the weight are process for slaughter. The average slaughter age is 6-7 weeks at a minimum live weight of 2.5kg. This would result an average carcass weight of 1.9 kg; approximately 25% will go to waste. The chicken meat is cleaned then packaged for ice storage prior to distribution.

#### Religious slaughter

According to Halal, Qurrbani/Udhia (Muslim) slaughter laws, an animal needs to be slaughtered without prior stunning. It requires an accurate cut of the throat with a sharp knife to minimize suffering and the slaughter needs to take place in an officially regulated slaughterhouse.

#### Rendering – By-products/waste

Many of the by-products of chicken slaughter can be used. Many chickens die before slaughter, either at the growing-out farm or on route to the processing plant. These birds are carried with waste. Sick or deformed chicks are culled—taken from the flock and killed after hatching, and these bodies must also be disposed. Unused viscera and parts also produce waste in chicken processing. A significant waste produced in chicken farming is the faeces of the birds. Because the flocks are so large, with 20,000 birds typical for a broiler growing-out farm, the amount of faeces is enormous. With right rendering process these waste can be used to produce fertilizer for crops for local farmers.

### **3.3.4. *Establishment of Utilities for the operation of the poultry farm***

#### **Water**

A 10 ton standalone RO plant will be established on the island and this would cater for all the needs of the employees and operations. The feed water will be taken from the lagoon through piping. The proposed intake bore well locations are shown in figure 3. The brine

discharge will be laid to the lagoon side. The clean water supply system will be connected to the civil structures through piped network. All the pipes will be HDPE pipes. A clean water collection tank would be established which can cater for the demand of 7 days as backup. In case even the backup storage fails, water from the nearest inhabited island will be supplied. The proposed locations of the utility services are shown in figure 4.

#### **Water demand**

An estimated 50 people will be on the island once the operations is started fully. The EPA technical specification for water systems states the per capita usage demand is 20 liters per person. Therefore the water demand for the employees would be 1000 liters. However a lot more water will be consumed during the industrial process in the island. An estimated 5000 liters maybe consumed, bringing the total water demand to 6,000 liters. Further, a 4000 is kept as for catering the growing demand and storage of backup water at the facility.

#### **Sewer**

The sewer will be collected in a Discharge pump station (DPS) through gravity flow. The DPS would have two submersible pumps which would work alternatively. The need to have two pumps is as a backup in case of pump servicing or failure. The sewer outfall line would be made with HDPE pipe OD160 and will be anchored with concrete blocks. It will follow the reef contour and be discharged 30 meters beyond the reef on the western side. The location is shown in figure 3, there is adequate mixing in the area to disperse the sewerage effectively. A vent stack of 15 meters would also be established to disperse gases acting out due to sewerage. All the water and sewer infrastructure would be built according the Environmental Protection Agency's respective specifications.

A good alternative would be to combine the brine and sewer to be discharged at the proposed outfall locations shown in figure 6.

#### **Electricity**

For electricity generation, generator sets of capacities 300KW (1 Nos) and 50 KW (1 Nos) will be established with a proper day tank for storage of oil. Fuel will be transported from the source points through a sea going vessel to the jetty. As the distance between the jetty and the facility is near, the oil storage and the day tank via fuel hose. The fuel hose will be inspected regularly for any leaks and will be halted and replaced if any leaks are found. During the day, one 300KW generator will be operational whilst the other would be kept as back up. The 50 KW generator set would be operated during the night time. The proposed method of operations are in order to reduce fuel wastage and for more efficient operations from the power side.

#### **Waste management**

The Waste house or storage shed will be located at an acceptable distance to the farm houses. The waste house will be completely covered or roofed with proper air ventilation. A proper leachate collection mechanism will be established at the base of the waste house. Every week however the accumulated cake of chicken manure, urine, feathers, dropped feed and whatever else ends up on the floor is scooped up and piled to this storage shed.

Two methods will be utilized to dispose of the waste:

1- Transfer

The waste will be dried in the waste house for three to weeks. Then the waste will be transferred to the designated waste collection points nearby.

2- Fertilizers

By storing droppings for 3, 6 or 12 months, they are converted into excellent manure, which can be applied directly to soil or used as fertilizers. If market demands these can be sold to local farmers, this option is to be carried out at a later stage with relation to the development speed of the facility.

**Disposal of Dead Birds**

A systematic disposal of dead birds will be undertaken to control any outbreak. The poultry farm will dispose the dead birds by either of following two ways:

- 1- They will be dumped into deep manure or carcass pit where their carrion is auto-digested by hot fermentation.

**3.3.5. Construction of Jetty**

The jetty will be built with concrete foot paddings which is approximately 70 meters long. The width will be 2.8 meters. The location and the size of the jetty is adequate considering the size of operations and the weather conditions of the nation. No other coastal structures are involved in the proposed project.

**3.4. Project inputs and outputs**

The materials required for construction which is not available locally, shall be imported and transferred to the site.

The major inputs required are outlined in Table 1 below:-

*Table 1. Major inputs required for the proposed project*

Input	Source
Labour force ( Supervisor, Managers, skilled and unskilled labour)	Contractor

Water supply for construction phase	Rainwater or portable water bottles until the RO plant is operational
Electricity for construction phase	Gensets to be provided by contractor
Machineries (Borehole driller, excavator, dump truck..)	Contractor
Food and accommodation	Contractor

Main output of the project is a new asphalted road. Other outputs anticipated to be generated from the project are outlined in Table 2 below:-

*Table 2. Project outputs anticipated to be generated from the proposed project*

<b>Project outputs</b>	<b>Method of generation/Qty</b>	<b>Method of control</b>
Brine	From water production	Disposed to lagoon where adequate mixing exists to dissolve and dilute the reject water
Sewerage	From workers	Collected at the Pump Station through gravity pipes and discharged beyond the reef edge as per existing guidelines
Construction wastes	Demolition wastes Waste oils Wastewater Greenhouse gases, effluents	Demolition and green waste gathered for one month and 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.
Green waste	Vegetation removal	Relocate all vegetation that could be relocated. The other waste would be stocked and naturally decomposed.

### **3.5. Workforce**

The workforce required for the construction shall be stationed in the island, all temporary facilities shall be made in the foot print of the permanent structures. The work profile required for the proposed project is outlined in Table 3 below.

*Table 3. Work profile required for implementation of the proposed project*

<b>Designation</b>	<b>Number</b>	<b>responsibility</b>
Project manager	1	Overall responsibility for the implementation of the project
Project engineer	1	Ensure that works are in accordance to drawings and specifications
Surveyors	3	Provide layout and levels
Site manager	1	In charge of site work implementation and coordination

Implementation Supervisors	2	Ensures that works are carried out according to project managers instructions
Safety supervisors	2	Assess risk and ensure that everyone follows the safety rules and regulations.
Skilled and unskilled Laborers	12	Carries out all the tasks

### 3.6. Mobilization

The heavy machinery required for the project, which are not available in Male' will be brought from abroad via a barge to Male'. All other equipment and materials will be transferred to the site through the roads.

### 3.7. Establishment of temporary project facilities

The proposed temporary project site setup would include a small hut constructed from metal pipes joined together by brackets, with tin roofing, It will be built on the footprint of permanent structures. Waste generated will be temporarily stored and disposed of to Thilafushi. The location for the temporary project site setup is shown in figure 3. The workforce will be staying in the constructed temporary facilities.



Figure 3: location of temporary site setup

### 3.8. Detailed construction methods

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 to the nearest waste management facility. The construction shall be limited to being carried out during the day time as to reduce the disturbance caused to the fauna of the island. If only due to great need shall the construction be carried out at night and proper lighting

facilities will be carried prior to starting the work. Proper construction sign boards shall be placed as for the safety of the workers, this is due to the fact that multiple works will be carried out on the island and all of the workers might not be updates on the progress of all the facilities.

### **Jetty**

The jetty will be built with concrete foot paddings which is approximately 70 meters long. The width will be 2.8 meters. The location and the size of the jetty is adequate considering the size of operations and the weather conditions of the nation. No other coastal structures are involved in the proposed project.

### **Water, sewerage, electricity and waste management**

As mentioned above, a standalone RO plant will be established on the island and this would cater for all the needs of the employees and operations. The feed water will be taken from the lagoon through piping. All the piping will be HDPE pipes. The brine discharge will be laid to the lagoon side. The clean water supply system will be connected to the civil structures through piped network. A clean water collection tank would be established which can cater for the demand of 7 days.

The sewer will be collected in a Discharge pump station through gravity flow. The DPS would have two submersible pumps which would work alternatively. If on peak flow, two pumps will act together to discharge the effluent. It would be made with HDPE pipe OD160 and will be anchored with concrete blocks A vent stack of 15 meters would also be established to disperse gases acting out due to sewerage. All the water and sewer infrastructure would be built according the Environmental Protection Agency's respective specifications.

For electricity a generator set of capacities 300KW (1 Nos) and 50 KW (1 Nos) will be established with a proper day tank for storage of oil. The storage tanks would be built with the necessary containment wall such that the accidental spill volume could be contained. During the day, one 300KW generator will be operational whilst the other would be kept as back up. The 50 KW generator set would be operated during the night time. The proposed locations of the utility services are shown in figure 3.

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Two methods will be utilized to dispose of the waste:

#### 1- Transfer

The waste will be dried in the waste house for three to weeks. Then the waste will be transferred to the designated waste collection points nearby.

## 2- Fertilizers

By storing droppings for 3, 6 or 12 months, they are converted into excellent manure, which can be applied directly to soil or used as fertilizers. If market demands these can be sold to local farmers, this option is to be carried out at a later stage with relation to the development speed of the facility.

### **3.9. Health and safety measures**

Basic first aid facilities and safety gears shall be made readily available by the contractor during the construction phase of the project. In case of an emergency, the workers shall be taken to the health care facilities deemed necessary by the contractor. Other specific safety measures during construction phases are detailed in the respective components under the project description.

### **3.10. 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.

### **3.11. Project duration and schedule of implementation**

The detailed proposed work schedule for the project is shown in appendix D of this report.

## 4. METHODOLOGY

### 4.1. Water quality

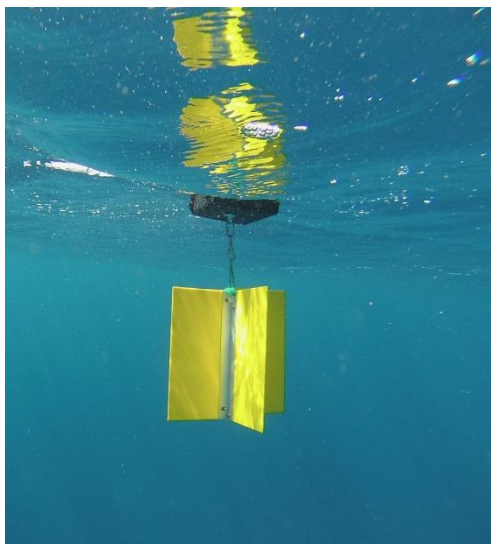
3 groundwater sample was collected; two from wells on both ends of the island and one by digging a well at the proposed powerhouse location. Four marine water sample were collected from different locations. Samples were collected in 1500 mL plastic bottles by first rinsing the bottle with the sampling water tap three times. Marine water samples were collected just below the surface. Samples were then sent to Maldives Water and Sewerage Company's (MWSC) water quality assurance laboratory for testing.

### 4.2. Terrestrial vegetation

A 30 meter long measuring tape was laid. The types of plants touching the measuring tape at every 5 meter intervals were recorded. To give an indication of the maturity of the trees the height of the trees were recorded into 4 categories; ground: all small plants, vines and shrubs growing on the ground, 1<sup>st</sup> storey: plants whos height is below 2 m, 2<sup>nd</sup> storey: plants whos height is between 2-4 m, 3<sup>rd</sup> storey: plant whos height is 4 m and above.

### 4.3. Current measurement

A drogue constructed from plastic plates joined together by bolts to make four fins (figure 4) to catch the currents, were used to measure currents. The drogue was deployed for five minutes, the start and end location of the drogue was geo-referenced using a hand-held GPS (figure 3). The distance travelled was later calculated and the speed of currents determined.



*Figure 5: drogue deployed at sea*



*Figure 4: hand-held GPS used to geo-reference sampling locations*

#### **4.4. Benthic substrate analysis**

CPCe software is used to assess the benthic substrate, which is one of the most widely used tools for marine assessments. 20 pictures were taken at each respective site from which 10 photos are chosen for analysis. CPCe used 25 points on each photograph to point out the substrate found at each point. The software calculates the percentage of each substrate for the 10 photographs. The method is repeated to take 7 transects at different locations.

#### **4.5. Fish census**

A Go Pro camera was used to capture 2 minutes of video footage while swimming in a straight line on the reef. The video was later then analyzed. For every 10 seconds the frequency of fish on the video which were target species of fish watch Maldives was recorded for 2 minutes. Video transects were taken at the 7 locations where benthic substrate analysis were undertaken.

#### **4.6. Mangrove dynamics**

To baseline the maturity of the *Bruguiera cylindrical* trees growing at the banks of the embayment, randomly three patches were taken and the height, canopy area and trunk circumference was recorded. The trunk circumference was recorded by wrapping the measuring tape at the base of the most mature tree within the patch. The canopy area and height was estimated using the measuring tape as a guide since the vegetation was so thick it was impossible to go to the other side of the trees.

To baseline the flora and fauna within the embayment the frequency of species encountered during low tide and high tide while walking at the banks of the embayment was recorded. Each time a species is found it was tallied. The pathway was along the bank of the embayment from start to finish.

#### **4.7. Topographic surveys**

The topographic surveys for the island were done by Foresight Surveyors Pvt Ltd., their methodology is copied below;

- Single point base Reference was used. Base coordinates derived based on average autonomous reading taken for 20 minutes.
- Using RTK GNSS two more bench mark were observed to create a control network with horizontal tolerance of  $\pm 0.015\text{m}$  and vertical tolerance of  $0.020\text{m}$ .
- Large trees and other observation which is needed inside the vegetation was taken using the GeoMax Zenith04 GIS unit. For this observation Sub-meter Accuracy was achieved.
- Field software Carlson SurvCE was used for the observation.
- Processing and production of final output was done in Auto CAD Civil 3D 2016.

#### 4.8. Geo-referencing

All the sampling locations were geo-referenced using a hand-held GPS. The geo-coordinates for each sampling locations is shown in figure and table below.

Table 4: Geo-coordinates for all sampling locations and kulhi on Kureli

Code	Type	Location	GPS Coordinates	
			Longitude	Latitude
KP1	Kandoo Patch (mangroove tree analysis)	Embayment	73.3728273583544	2.7795688447502
KP2	Kandoo Patch (mangroove tree analysis)	Embayment	73.3729575578637	2.7796232785425
KP3	Kandoo Patch (mangroove tree analysis)	Embayment	73.3730352644988	2.7798949121217
VT1	Vegetation transect 1	Eastern middle part of island	73.3727307247180	2.7811146876495
VT2	Vegetation transect 2	Northern island	73.3712559234855	2.7824359491811
VT3	Vegetation transect 3	Embayment	73.3729788109258	2.7796883179291
DR1	Drogure run 1 for current measurement	North East <i>Vilu</i>	73.3732597602641	2.7840667954037
DR2	Drogure run 2 for current measurement	North East <i>Vilu</i>	73.3723126400722	2.7847713595480
DR3	Drogure run 3 for current measurement	Eastern reef edge	73.3761785216160	2.7797137108224
M1	Marine transect for benthic substrate analysis	Eastern reef	73.3762261120779	2.7798775259965
M2	Marine transect for benthic substrate analysis	Southern reef	73.3747283676151	2.7748331101252
M3	Marine transect for benthic substrate analysis	Western reef	73.3698161438910	2.7799737896250
M4	Marine transect for benthic substrate analysis	North East <i>Vilu</i>	73.3731252154659	2.7838810478593
M5	Marine transect for benthic substrate analysis	Eastern reef	73.3747813423795	2.7757069534751
M6	Marine transect for benthic substrate analysis	Southern reef	73.3726251558627	2.7732784059225
M7	Marine transect for benthic substrate analysis	Northern reef	73.3694002807151	2.7826293456874

Environmental Impact Assessment for Poultry Farm Development at M. Kureli

K	Kulhi location	Southern island	73.3730148058840	2.7785222326466
OF1	Outfall location option 1	North East <i>Vilu</i>	73.3733691697159	2.7834651639971
OF2	Outfall location option 2	Eastern reef	73.3759223471094	2.7785630035946
OF3	Outfall location option 3	Southern reef	73.3706396144383	2.7778471530307
N.MA_LA	Marine Water sample	Eastern lagoon	73.3747708164201	2.7804750017717
E.MA	Marine Water sample	South Eastern reef	73.3747177643809	2.7751504634149
S.MA	Marine Water sample	Western reef	73.3704145725720	2.7785136733968
M.MA	Marine Water sample	Embayment	73.3728090182233	2.7797679569613
SE_IL	Ground Water sample	South Eastern island	73.3734260259235	2.7792289552737
N_IL	Ground Water sample	North Eastern middle island (proposed powerhouse location)	73.3722192047759	2.7809815293861
NW_IL	Ground Water sample	North island	73.3710980460536	2.7817794345441

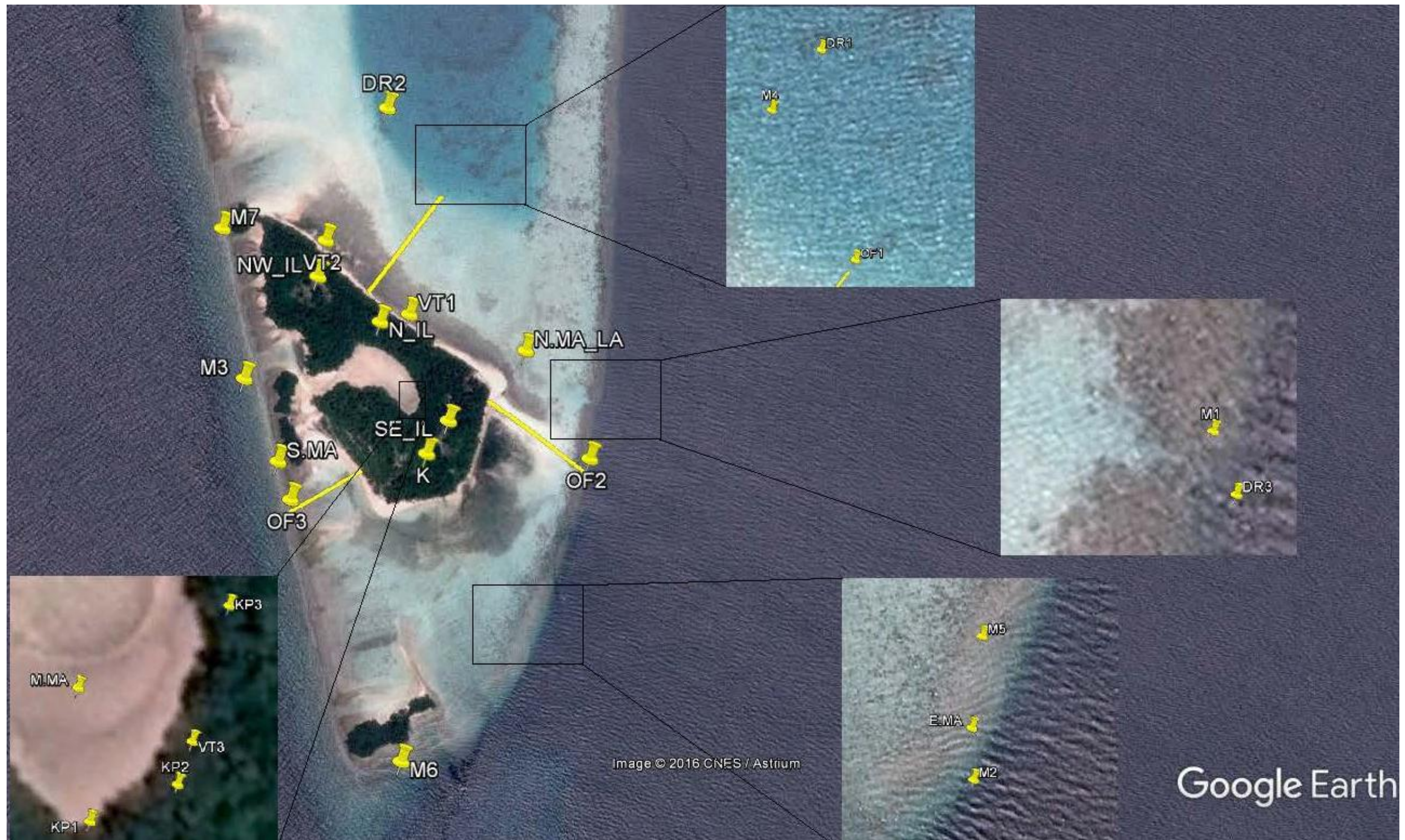


Figure 6: sampling locations with possible outfall options

## 5. EXISTING ENVIRONMENT

### 5.1. The Maldivian setting

Maldives, officially known as the Republic of Maldives and sometimes referred to as the Maldivian Islands, is an island nation (ZMorinder citrifoliad, 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 (Ministry of Environment & Construction [MEC], 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<sup>2</sup> of which roughly 300 km<sup>2</sup> of landmass (ZMorinder citrifoliad, 2011), with a population of about 338, 434 (as per September 2014 census) (UNFPA, 2016) spread over 194 inhabited islands (Department of National Planning [DNP], 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 (ZMorinder citrifoliad, 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 (MEC, 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<sup>2</sup> to around 5.0 km<sup>2</sup> 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 (MEC, 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 (MEC, 2004). The southwest season brings in torrential rain (ZMorinder citrifoliad, 2011) and rainfall varies from north to south along the atoll chain, with a drier north and wetter south (MEC 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 (MEC, 2004).

The annual and seasonal temperatures vary very little with a mean annual temperature of 28°C (MEC, 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 (ZMorinder citrifoliad, 2011). The

highest and lowest temperatures on record are 36.8°C on May 1991 and 17.2°C on April 1978 respectively (MEC, 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 (ZMorinder citrifoliad, 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 (MEC, 2004).

## 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. Since the nearest station to Kureli is Hulhule, the data from this station is used to analyze the climate variables at the study area.

### 5.2.1. Temperature

Analysis of temperature data shows that the variation in temperature throughout the year is very minimal, however, daily temperature ranges from 31°C during the day to 23 °C at night. Looking at monthly variation in temperature, the highest temperature was recorded for the month of April with a temperature of 32.3 °C. With regards to the mean minimum temperature, the lowest temperature at Hulhule, 26.3 °C, was recorded for December (Figure 7).

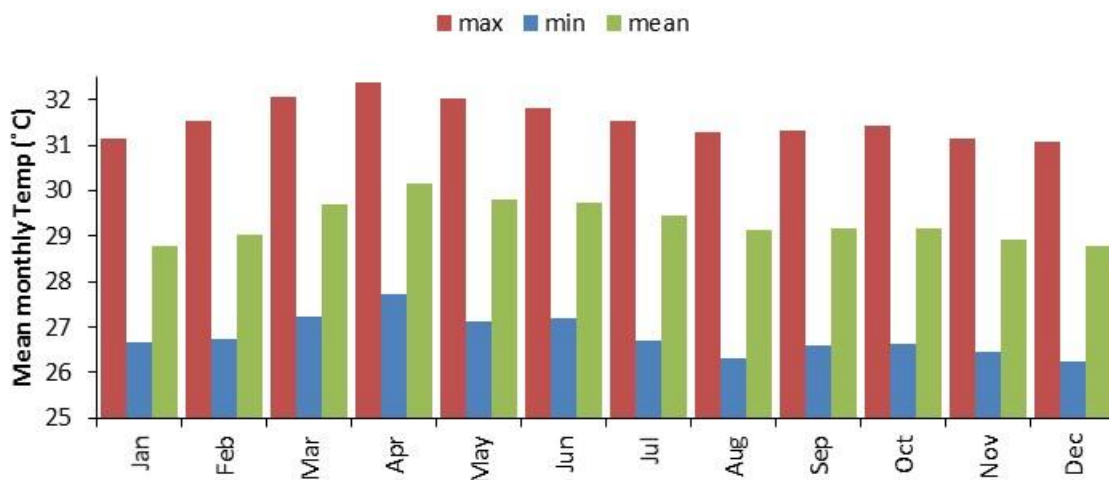


Figure 7. Mean, minimum and maximum monthly temperatures (°C) for Hulhule from 2008 to 2015 (Data obtained from the Bureau of Meteorology, Maldives)

### 5.2.2. Rainfall

The rainfall pattern at Hulhule region and for the rest of the Maldives is driven by the monsoonal cycles. Rainfall data for the period between January 2006 and December 2016 from the meteorological station in Hulhule' were used to study the rainfall patterns at Naifarau.

The average annual rainfall for Hulhule was found to be 6.83 mm and the heaviest rainfall recorded over the 10 year period was 142.3 mm. Monthly mean rainfall shows that the driest months are January to April and the wettest months are May, August and September. (Figure 8).

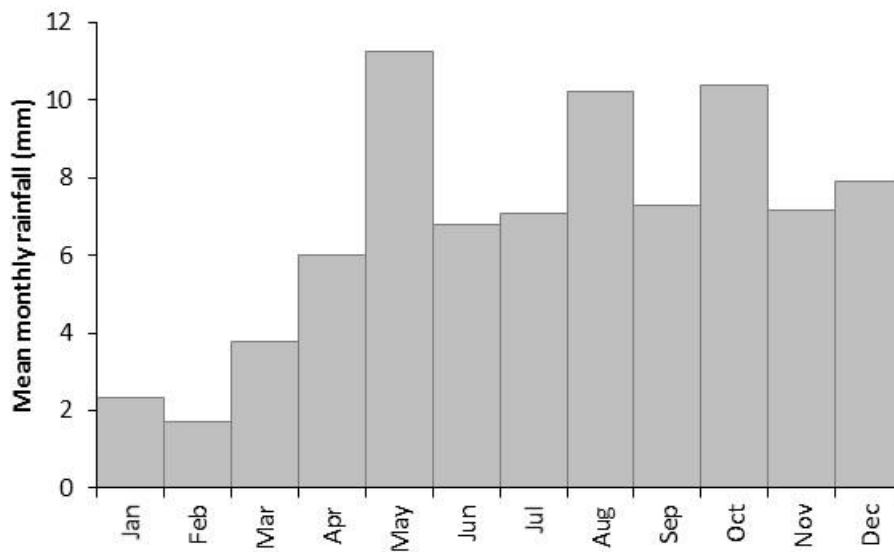


Figure 8. Mean monthly rainfall (mm) for Hulhule from 2006 to 2015 (Data obtained from the Bureau of Meteorology, Maldives)

### 5.2.3. Wind

Looking at the frequency plot data and wind rose plots, it was observed that the mean wind speed had gone as high as 36 kn towards the WNW direction. But the probability of occurrence was very low (only 0.02 % of the times). In general, the strongest winds occur from WSW, W and WNW directions. Winds from the south and SE as well as north were less prevalent and with comparatively low speeds. Majority of the times (about 12 to 19 % of the times), winds occur at a speed of 4 to 14 kn which is generally known as light to moderate breeze. Wind speeds above 18 kn were a rare occurrence, occurring about 1.67 to 0.02 % of the times (Figure 9).

With respect to maximum wind speeds, visual inspection of the wind rose plot coincides with that of the mean wind speeds. Approximately 1.57 % 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 54 kn in the month of July during the data collection period. Winds higher than 18 kn were frequent, occurring about 45 % of the times. The most common maximum wind speed is between 12-16 kn.

Wind rose plots for both maximum and mean wind speeds show that winds from the western quadrant are dominant (about 23 % of the times) (Figure 9).

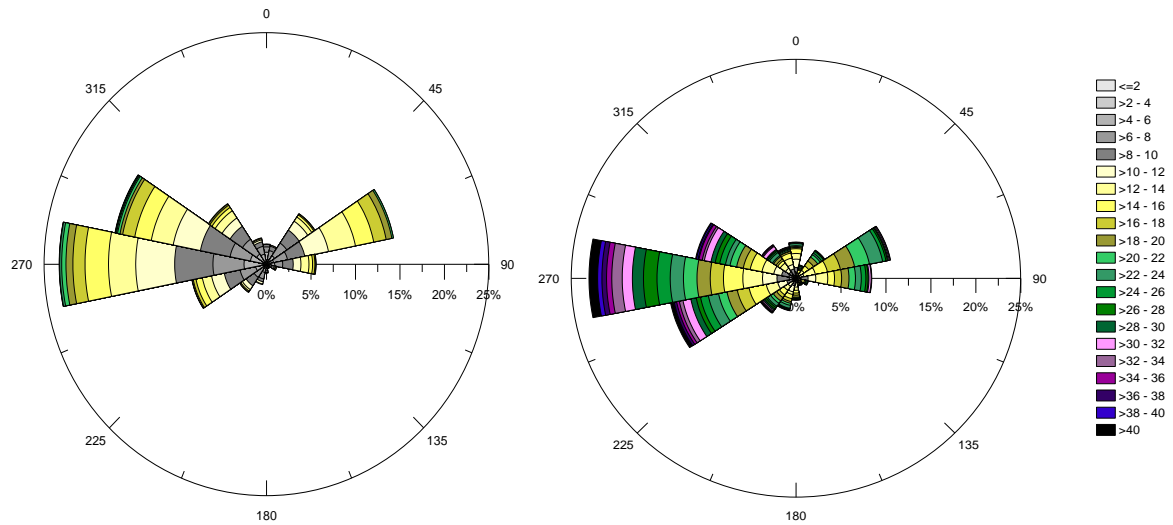


Figure 9. Mean (right) and maximum (left) wind speeds for Hulhule from June 1998 to December 2015 (Sourced from LaMer, 2016)

### 5.3. General setting of M. Kureli

*Kureli* is a small island measuring 13.9 Hectares, which is located in the south west rim of meemu Atoll. The island has approximately 310 m at its widest point and approximately 700 m in length. There is a small island approximately 436 m South of *Kureli*, which is referred to as *Gaakureli* by locals. This island is much smaller than *Kureli*, which is also an uninhabited island. The nearest inhabited Island is *Kolhufushi* which is approximately 5.8 Km East of *Kureli*. *Kolhufushi* is located on a separate reef system from *Kureli*.



Figure 10. Location of Kureli in Meemu Atoll

### 5.4. Environmentally sensitive areas

*Kureli* is a declared environmentally sensitive site by EPA as the island is a roosting place for birds and a nursery for sharks and rays. The island is home to a freshwater *kulhi*, the location is shown in figure 6. Furthermore there is a rapidly growing mangrove at the sides of the embayment. Lastly there is a manta aggregation point 1.4 Km South of *Kureli*. As this manta point is far away from *Kureli* and is on a separate reef system, it is not expected that there will be any impacts to the manta point from the operation of a poultry farm at *Kureli*. However all the other environmentally sensitive sites will be likely impacted if proper mitigation measures are not followed, hence these sites were studied during the field visit to the island and the description of the existing environment at these sites are detailed in section 5.8 and 5.9.

### 5.5. Water quality

#### Ground water quality

Groundwater test results were compared with the EPA standards for the parameters with a specified guideline value as follows (some of the tests were not available at MWSC laboratory at the time of testing and the letter is attached in Appendix F of this report):-

*Table 5: ground water quality optimal ranges*

<b>Location</b>	<b>Optimal Range</b>	<b>Reference</b>
pH	6.5-8.5	EPA
Conductivity (µS/cm)	<1500	EPA
TDS (mg/L)	<1000	EPA
TSS (mg/L)	NA	EPA
Turbidity (NTU)	<5	EPA
BOD (mg/L)	NA	EPA
Salinity (%)	NA	EPA
Temperature(°C)	NA	EPA
Nitrate (mg/L)	<50 mg/l	EPA
Nitrogen Ammonia (mg/L)	<1.5 mg/l	EPA
Sulphate (mg/L)	<250mg/l	EPA
Phosphate (mg/L)	NA	EPA
Total Petroleum Hydrocarbon(mg/L)	NA	EPA

Groundwater test results from MWSC water quality assurance laboratory is attached in Appendix F of this report.

Only the sample from the well in the North West of the island has all tested parameters within the optimal range. The other samples had parameters out of optimal range especially the sample from the South East which has highest conductivity (2540), and TDS (1269). The pH of the sample from South East Island seems to have a very acidic pH of 2.64 which maybe an outlier. All the samples had high BOD which suggests that the water maybe contaminated, the confirmation is from the presence of Nitrate and Ammonia in all the samples. These results indicate there has been intense agriculture done on the island as mentioned by some locals.

*Table 6: Groundwater quality test results (parameters exceeding EPA standards are highlighted in red)*

<b>Parameter</b>	<b>Locations</b>		
	N_IL	NW_IL	SE_IL

pH	7.16	7.82	<b>2.64</b>
Conductivity ( $\mu\text{S}/\text{cm}$ )	1214	480	<b>2540</b>
TDS (mg/L)	607	240	<b>1269</b>
TSS (mg/L)	45	677	35
Turbidity (NTU)	<b>25.2</b>	518	1.79
BOD (mg/L)	11	7	10
Nitrate (mg/L)	2.2	0.6	2
Nitrogen Ammonia (mg/L)	0.28	0.26	0.94

### Marine water quality

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

*Table 7: marine water quality optimal ranges*

Location	Optimal Range	Reference
pH	8.0-8.3 *Levels below 7.4 pH cause stress	EPA
Conductivity ( $\mu\text{S}/\text{cm}$ )	NA	-
TDS (mg/L)	NA	-
TSS (mg/L)	NA	-
Salinity(%)	3.2% - 4.2%	GBRMPA, 2009
Nitrate (mg/L)	$<5 \text{ mg l}^{-1} \text{ NO}_3 \text{ N}$	UNESCO/WHO/UNEP, 1996
Turbidity (NTU)	3-5 NTU >5 NTU causes stress	Cooper <i>et al.</i> 2008
Nitrogen Ammonia (mg/L)	Max. $2\text{-}3 \text{ mg l}^{-1} \text{ N}$	UNESCO/WHO/UNEP, 1996
Sulphate (mg/L)	$2 \text{ mg l}^{-1}$ and $80 \text{ mg l}^{-1}$	UNESCO/WHO/UNEP, 1996
Phosphate (mg/L)	$0.005 \text{ - } 0.020 \text{ mg l}^{-1} \text{ PO}_4 \text{ P}$	UNESCO/WHO/UNEP, 1996
Biological Oxygen Demand (mg/L)	$< 2 \text{ mg l}^{-1} \text{ O}_3$	UNESCO/WHO/UNEP, 1996

Marine water test results from MWSC water quality assurance laboratory is attached in Appendix F of this report.

Almost all the parameters in all the samples were within the optimal range except for sample taken from the embayment which had pH 8.72 and sample taken from the Western side of the island which had BOD 3 which is barely above the optimal range. The alkalinity of water at the embayment maybe due to the muddy soil at the location. Nitrates are found at a concentration of at least 3.5 mg/L at all the locations, this presence of nitrate maybe the cause of healthy sea grass beds flourishing around the island.

*Table 8: marine water quality test results (parameters exceeding optimal ranges are highlighted in red)*

<b>Location</b>	<b>M.MA</b>	<b>N.MA_LA</b>	<b>S.MA</b>	<b>E.MA</b>
pH	<b>8.72</b>	8.14	8.16	8.14
Conductivity (µS/cm)	53900	52300	52900	53100
TDS (mg/L)	26900	26100	26400	26500
TSS (mg/L)	<5	<5	<5	<5
Turbidity (NTU)	1.42	0.189	0.273	0.192
BOD (mg/L)	1	2	<b>3</b>	2
Nitrate (mg/L)	4.7	4.8	3.8	3.6
Nitrogen Ammonia (mg/L)	<0.02	<0.02	<0.02	<0.02

### **5.6. Terrestrial vegetation**

14 different types of vegetation species were found on *Kureli*, the scientific name and Dhivehi names of these are mentioned in the table 9. It was observed that the coastline of the island is dominated by *Scaevolo taccada Roxb.* Towards the western part of the island (figure 9) a patch of *Hernandia nymphaeifolia* trees were found. Almost all the *Cocos nucifera L.* encountered were mature trees with most above 4m.



Figure 11: large *Hernandia nymphaeifolia* tree on kureli

Transect 1 is on the Eastern side of the island, transect 2 towards the Northern tip of island, Transect 3 is on the western side of the island at the embayment. The dominant species on the coastline is *Scaevola taccada* Roxb.. However at the embayment the dominant species is *Pemphis acidula*. The results of the vegetation transects are shown in the tables below.

### Transects 1

Table 9: results of vegetation transect 1

Distance / m	Ground	1 <sup>st</sup> Storey (0-2m)	2 <sup>nd</sup> Storey (2-4m)	3 <sup>rd</sup> Storey (>4m)
0-5		Pemphis acidula Scaevola taccada Roxb.	Pandanus tectorus	
5-10		Guettarda Speciosa L. Scaevola taccada Roxb.		Cocos nucifera L.
10-15		Scaevola taccada Roxb. Pandanus		

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		tectorus		
15-20		Scaevolo taccada Roxb.	Cocos nucifera L.	
20-25	Clitoria ternatea	Scaevolo taccada Roxb.		
25-30	Cocos nucifera L.		Guettarda Speciosa L.	

**Transects 2**

*Table 10: results of vegetation transect 2*

<b>Distance / m</b>	<b>Ground</b>	<b>1<sup>st</sup> Storey (0-2m)</b>	<b>2<sup>nd</sup> Storey (2-4m)</b>	<b>3<sup>rd</sup> Storey (&gt;4m)</b>
0-5		Scaevolo taccada Roxb.	Cocos nucifera L.	
5-10		Pandanus tectorus	Guettarda Speciosa L. Morinder citrifolia	
10-15		Cocos nucifera L.		Cocos nucifera L.
15-20		Scaevolo taccada Roxb.		
20-25		Guettarda Speciosa L. Cocos nucifera L.		
25-30				Guettarda Speciosa L.

**Transects 3**

*Table 11: results of vegetation transect 3*

<b>Distance / m</b>	<b>Ground</b>	<b>1<sup>st</sup> Storey (0-2m)</b>	<b>2<sup>nd</sup> Storey (2-4m)</b>	<b>3<sup>rd</sup> Storey (&gt;4m)</b>
0-5		Pemphis		Bruguirea

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		acidula		cylindrica
5-10			Pemphis acidula	Bruguirea cylindrica
10-15			Pemphis acidula	Bruguirea cylindrica
15-20			Pemphis acidula	Bruguirea cylindrica
20-25			Pemphis acidula Bruguirea cylindrica	
25-30			Pemphis acidula	Bruguirea cylindrica

**Dhivehi names for vegetation**

Following table shows the different species of trees which were encountered during the field surveys throughout the entire island. Hence some species of trees which were not on the transects but found during the walks around the island will be in the table.

*Table 12: scientific names and dhivehi name for vegetation species found on Kureli*

<b>Scientific Name</b>	<b>Dhivehi Name</b>
<i>Guettarda Speciosa L.</i>	<i>Uni</i>
<i>Scaevolo taccada Roxb.</i>	<i>Magoo</i>
<i>Pandanus tectorus</i>	<i>Boa kashi keyo</i>
<i>Wedelia calendulacea</i>	<i>Mirihi</i>
<i>Cocos nucifera L.</i>	<i>Ruh</i>
<i>Cyperus polystachyos</i>	<i>kiruthundi / kunaa hai</i>
<i>Hibiscus tiliaceus</i>	<i>Dhiggaa</i>
<i>Hernandia nymphaeifolia (C.presl) Kubitzki</i>	<i>Kandhu</i>
<i>Premna obtusifolia/syn.p. acuminata</i>	<i>Ginaveli</i>
<i>Terminalia catappa</i>	<i>Midhili</i>
<i>Morinder citrifolia</i>	<i>Ahi</i>
<i>Pemphis acidula</i>	<i>Kuredhi</i>
<i>Bruguirea cylindrica</i>	<i>Kandoo</i>
<i>Clitoria ternatea</i>	<i>Nanreethi</i>
<i>Lumnitzera racemosa</i>	<i>Burevi</i>

**5.6.1.1. Land clearance**

For the establishment of different facilities of the poultry farm land needs to be cleared at the proposed locations mentioned in the land use plan on figure 2. The locations for the facilities of the poultry farm were chosen at area where vegetation has been already cleared, thus the vegetation which needs to be cleared is actually less. The number of mature trees that require removal are detailed in the table below. In addition to the mature trees a large area of *Scaevola taccada Roxb.* needs to be cleared, it was difficult to count the number of *Scaevola taccada Roxb.* trees as it grows as a shrub.

Species	1 <sup>st</sup> Storey (0-2m)	2 <sup>nd</sup> Storey (2-4m)	3 <sup>rd</sup> Storey (>4m)
<i>Cocos nucifera L.</i>			45
<i>Pandanus tectorius</i>		29	6
<i>Hibiscus tiliaceus</i>	3	4	
<i>Guettarda Speciosa L.</i>	19		
<i>Terminalia catappa</i>		6	
<i>Premna obtusifolia</i>		4	

**5.7. Terrestrial flora and fauna**

During our surveys on the island we observed that a lot of birds were present on the Northern tip of the island. Mostly it was *Tringa hypoleucos* followed by *Sterna sumatrana* which was flying over the reef towards the Northern tip of the island. Furthermore at the exposed beach rock on the Northern tip a lot of *Tringa hypoleucos* was observed and *Nycticorax nycticorax*, *Ardea cinerea* was observed around the coastline of the island.

We did not encounter many huge *Cardisoma carnifex* around the banks of the embayment. However as the embayment slowly changes into a full mangrove ecosystem the crab population is expected to rise.

**5.8. Kulhi**

Towards the South-Western middle part of the island (figure 6) a freshwater *kulhi* is present. Although the *Kulhi* is very small, the water in it was home to schools of *Chanos chanos*. The bank of the *Kulhi* is lined with mostly *Hibiscus tiliaceus*. There was one *Lumnitzera racemosa* tree growing on the bank.

### 5.9. Mangroove

The embayment formed on the South-Western side (figure 6) of the island is now becoming into a full mangrove ecosystem. The *Bruguiera cylindrica* growing at the inner banks of the embayment is spreading to the entire embayment, and if left to grow this embayment is likely to become a full mangrove ecosystem dominated by true mangrove species. Currently the dominant species at the banks of the embayment is *Pemphis acidula* (transect 3). However due to the roots of the *Bruguiera cylindrica* the characteristics of the soil at the embayment is already changing, towards the corner of the embayment where the *Bruguiera cylindrica* are most abundant, the soil is already muddy with lot of humus content. Some of the *Bruguiera cylindrica* patches were 9m in height with trunk circumference of 2 ft at the very bottom near the roots and with an estimated canopy area of 30 m<sup>2</sup>. The details of three *Bruguiera cylindrica* patches which were randomly surveyed are detailed in the table below.

Table 13: details of *Bruguiera cylindrica* patches

Species	Trunk Circumference/ft	Height/m	Canopy area/m <sup>2</sup>
<i>Bruguiera cylindrica</i> patch 1	2	5	24
<i>Bruguiera cylindrica</i> patch 2	1	4	4
<i>Bruguiera cylindrica</i> patch 3	2	9	30

During the time of the field surveys the mouth of the embayment is close (figure 10), due to this not a lot of fish enter the embayment. However according to the locals the mouth of the embayment will re-open again in the South-West monsoon, but looking at the trees growing on the sand bank formed at the mouth of the embayment, it is unlikely that this might happen.

The different species of terrestrial and marine animals which were found during the field surveys are detailed in the table below. At the embayment, small rays were found resting near the banks. Further juvenile fish like *Mugil cephalus* were found in schools.

Table 14: frequency of species found in embayment

Survey time: low tide	
Species	Frequency
<i>Pastinachus sephen</i>	6
Survey time: high tide	
<i>Guettarda Speciosa L.ya</i>	3
<i>Ardea cinerea</i>	1

<i>Mugil cephalus</i> (small schools)	3
<i>Cardisoma carnifex</i>	1



*Figure 12: aerial picture of embayment, the mouth of embayment is closed*

#### **5.10. Marine environment**

During the field survey it was found that almost the entire sea grass bed systems surrounding the island of *Kureli* become exposed in low tide. The Eastern side dries up more than the Western side and is mostly completely exposed in low tide. On the Eastern side during low tide, the maximum depth of water is approximately 2 feet, which also in small deeper pools within the sea grass beds. On the eastern side, the sea grass beds extend from the low water tide line up to approximately 100 m, followed by sandy bottom with very few coral colonies until the reef flat.



Figure 13: exposed sea grass beds on low tide

### 5.10.1. Benthic substrate

#### Major coral categories

The results show that the total live coral cover of the island reef is very poor (11%), the dominant substrate is rock (65%) followed by sand (12%). Live coral cover is highest in Transect 5 (27%) and transect 6 (15%), and lowest coral cover is at Transect 4 (2%). The detailed percentages of coral covers in the transects are shown in the table and figures below.

Table 15: major coral categories

MAJOR CATEGORY (% of transect)	T1	T2	T3	T4	T5	T6	T7	Mean	CI 95%+	CI 95%-
CORAL (HC)	8.0	2.8	11.2	2.0	27.2	14.8	8.8	10.7	13.9	7.5
SOFT CORAL (SC)	0.0	0.0	0.0	0.0	0.4	0.4	0.0	0.1	0.2	0.0
NUTRIENT INDICATOR ALGAE (NIA)	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.5	0.8	0.2
OTHERS (OT)	2.0	0.0	0.4	0.4	0.8	0.0	0.0	1.4	2.9	0.0
ROCK (RC)	82.4	62.4	84.8	16.8	70.8	80.8	63.2	65.9	74.8	57.0
RUBBLE (RB)	6.0	34.4	0.4	0.0	0.8	0.8	5.6	6.9	11.5	2.2
SAND (SD)	1.6	0.4	3.2	80.8	0.0	3.2	12.4	14.5	25.7	3.4

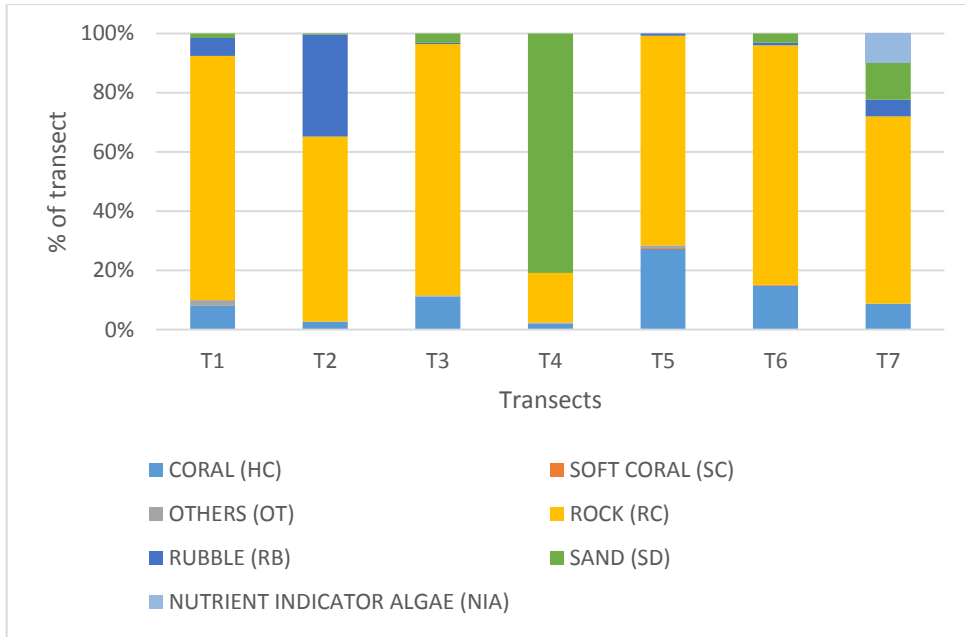


Figure 14: major coral categories of transects

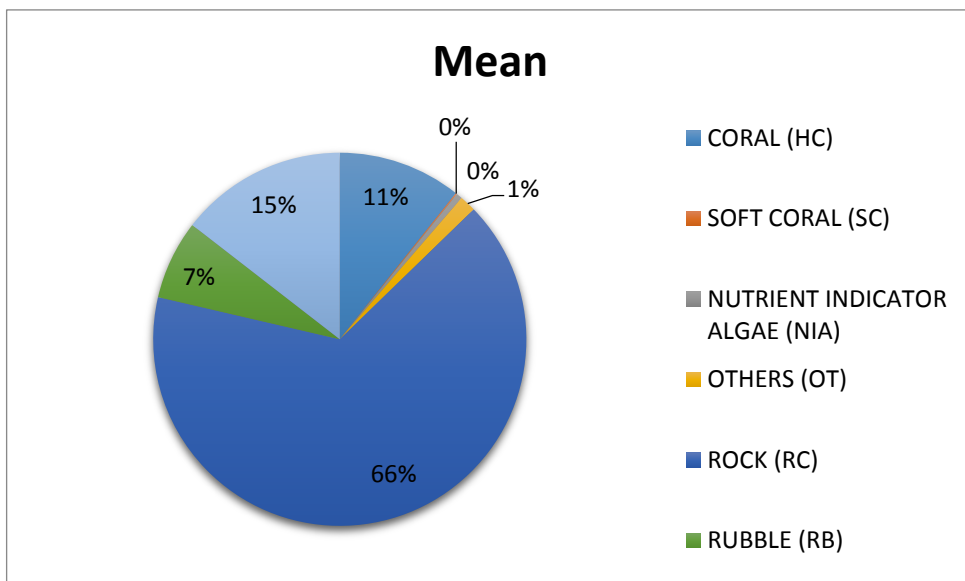


Figure 15: mean major coral category of all transects

### Sub categories

Out of the 14 coral categories 5 categories were encountered on the reefs of *Kureli*, which shows that there is poor diversity of corals.

The most abundant category coral was *Coral massive* at 4.6% followed by *Acropora branching* at 2.2%. Details are shown in table below.

Table 16: coral subcategories

SUBCATEGORIES (% of transect)	T1	T2	T3	T4	T5	T6	T7	Mean	CI 95%+	CI 95%-
Acropora Branching (ACB)	0.4	0.0	0.0	0.0	13.	0.0	1.2	2.2	4.1	0.3

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					6					
Acropora Digitate (ACD)	1.2	0.0	0.0	0.4	3.6	0.8	2.0	1.1	1.6	0.7
Acropora Submassive (ACS)	2.8	0.8	1.6	0.0	1.2	5.2	0.4	1.7	2.4	1.0
Acropora Tabular (ACT)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acropora encrusting (ACE)	0.0	0.0	2.0	0.0	0.4	0.0	0.0	0.3	0.6	0.1
Coral Branching (CB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coral Foliose (CF)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coral Massive (CM)	3.2	2.0	6.8	1.6	6.8	7.2	4.4	4.6	5.5	3.7
Coral Mushroom (CMR)	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.1	0.2	0.0
Coral Submassive (CS)	0.4	0.0	0.8	0.0	0.8	1.6	0.8	0.6	0.8	0.4
Coral encrusting (CE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heliopora (CHL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Millepora (CME)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Soft Coral (SC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zoanthid (ZO)	0.0	0.0	0.0	0.0	0.4	0.4	0.0	0.1	0.2	0.0
Halimeda (HA)	2.0	0.0	0.0	0.0	0.4	0.0	0.0	0.3	0.6	0.1
Other (OT)	0.0	0.0	0.0	0.4	0.4	0.0	0.0	0.1	0.2	0.0
Sponges (SP)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coralline Algae (CA)	0.0	0.0	0.4	0.0	0.4	0.0	0.0	0.1	0.2	0.0
Dead coral with Algae (DCA)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rock (RCK)	78. 8	62. 4	69. 2	16. 4	64. 4	78. 0	31. 2	57.2	66.3	48.1
Turf Algae (TA)	3.6	0.0	15. 2	0.4	6.0	2.8	32. 0	8.6	12.9	4.2
Rubble (RB)	6.0	34. 4	0.4	0.0	0.8	0.8	5.6	6.9	11.5	2.2
Sand (S)	1.6	0.4	3.2	80. 8	0.0	3.2	12. 4	14.5	25.7	3.4
Silt (SL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



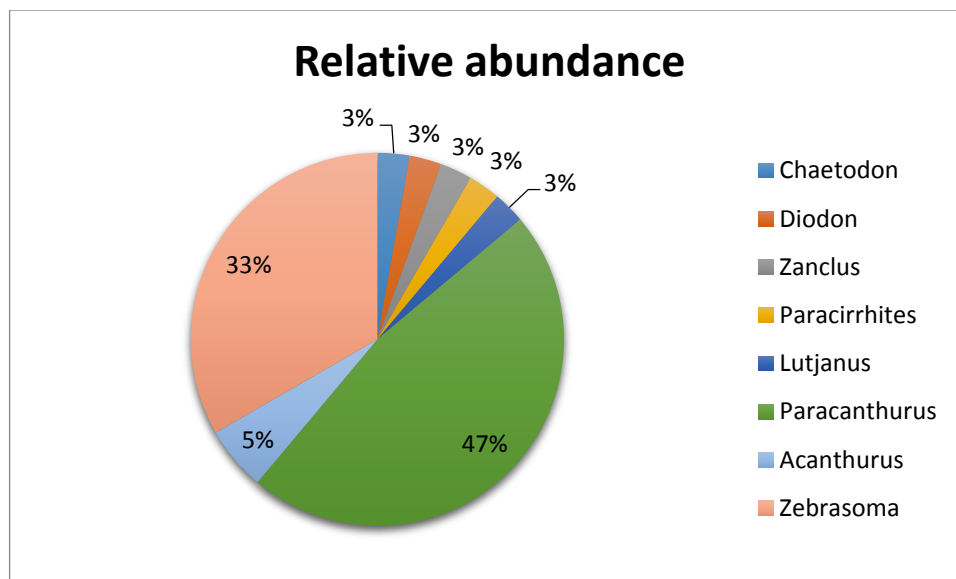
Figure 16: subcategories of each transect and their mean

**5.10.2. Fish census**

Out of the 41 genus of fishes from the target fishes, only 8 genus was found at *Kureli* reef. Therefore the diversity of the fish is poor. The following pie chart shows the relative abundance of the species found.

*Table 17: mean relative abundance of fish*

Genus	Relative abundance
Chaetodon	2.78%
Diodon	2.78%
Zanclus	2.78%
Paracirrhites	2.78%
Lutjanus	2.78%
Paracanthurus	47.22%
Acanthurus	5.56%
Zebrasoma	33.33%



*Figure 17: mean relative abundance of fish*

The genus with the highest abundance is *Paracanthurus* with 47% followed by *Zebrasoma* with 33% and the lowest is *Chaetodon*, *Diodon*, *Zanclus*, *Paracirrhites*, and *Lutjanus*, at 3% abundance.

Looking at the frequency of fish species at the different sites, the site with the poorest fish diversity is at site 6 where no indicator species was encountered. The highest diversity is at site 1 with 4 indicator species encountered. Following graph illustrates these differences.

Table 18: abundance of fish at different sites

Genus	Frequency						
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Chaetodon	1						
Diodon				1			
Zanclus					1		
Paracirrhites	1						
Lutjanus					1		
Paracanthurus	2		5		3		7
Acanthurus		2					
Zebrasoma	7	5					

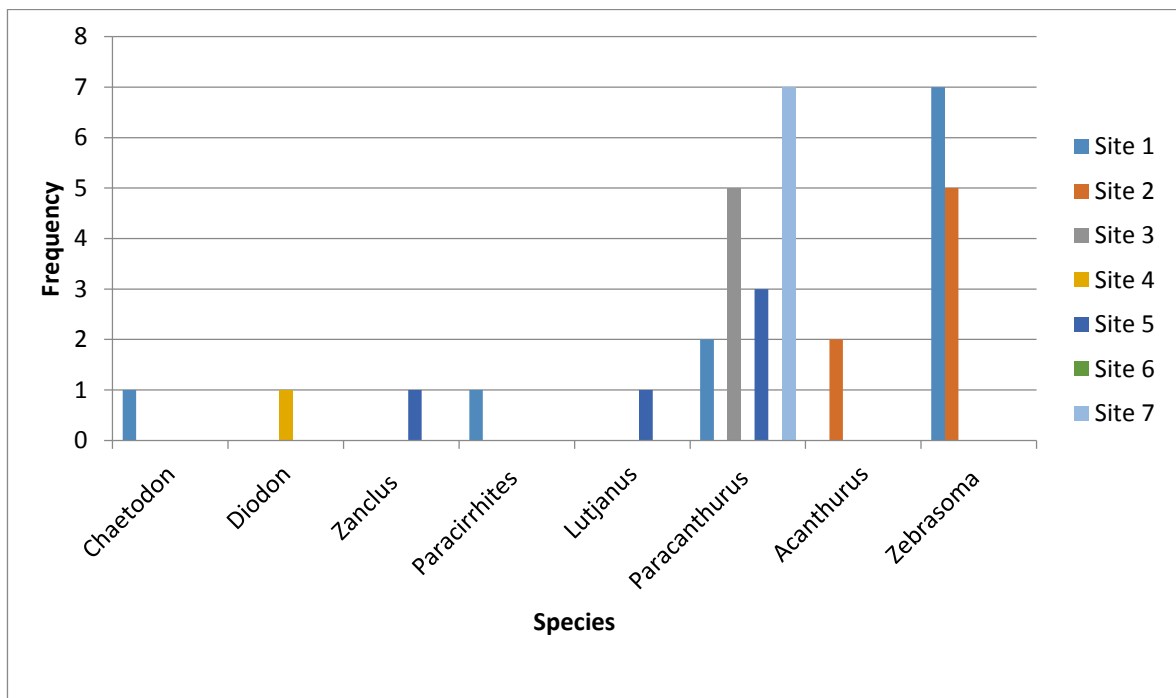


Figure 18: abundance of fish at different sites

### 5.11. Topography of island

The topographic maps and the bathymetric profiles of *Kureli* are attached in appendix G. The maps also show the locations for some of the environmentally significant trees on *Kureli* which was discussed in section 5.6, 5.8 and 5.9.

### 5.12. Island movement

Aerial pictures reveal that there haven't been any major island movements. However at the Eastern tip of the island the shallow area directly towards the reef flat seems to have started forming in the 2005 and gradually it has become shallower. Another thing which could be noticed is the seasonal erosion on the Western side of the island North of the embayment. As the locals have mentioned the mouth of the embayment is open previously. Further, the aerial pictures suggest that the mouth of the embayment has closed and opened in the past, however as there is gaps in the available aerial pictures it cannot be certain.

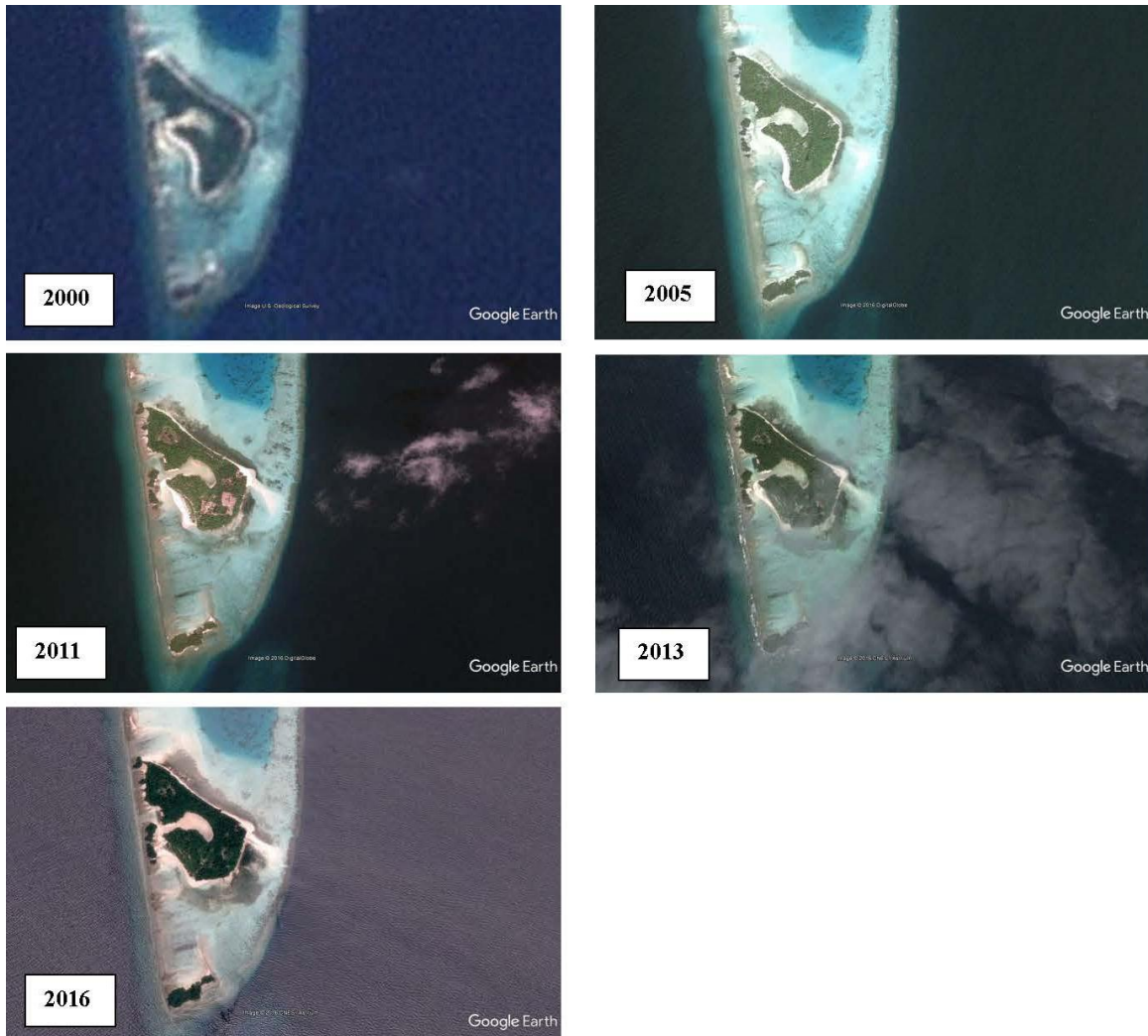


Figure 19: aerials pictures of Kureli over the past years(adopted from google earth)

### 5.13. Current and Coastal dynamics

Schematic diagrams showing the monsoonal swell patterns and sediment transport around *Kureli* is shown in figure below.



Figure 20: Monsoonal swells and sediment transport

*Kureli* is well protected from the North Eastern swells due to the extensive reef flat of Meemu Atoll on the Eastern side hence the island does not receive much wave energy from the North East side. However as the island sits on the Western rim of the atoll it faces the full forces of the South Western swells which has led to the formation of the hard beach rock and reef on the western side of the island, but the island is protected from the three small islands in front of the island. And also because the island is towards the middle of the reef flat the much of the wave energy from the South is dissipated before it reaches *Kureli*.

As such the near shore current around *Kureli* is weak except for near *Gaakureli* where there is strong currents on the North Eastern side of the island. Near the North Eastern tip of *Gaakureli* there is a strong current that flows directly towards *Kureli*. The influx of water from this current combined with the influx of water from the waves that comes onto the reef flat generates an alongshore current along the South Eastern side of *Kureli* which flows North West hugging the beach which causes the seasonal erosion at the South Western side of *Kureli*. On the Northern tip of *Kureli* the waves that comes onto the reef flat generated an alongshore current on the Northern side of the island that flow towards east hugging the coast. On the North Western part of the island towards the embayment, there is only one channel which was cut naturally across the reef flat that brings in water into the embayment. During high tide the water comes through this channel into the embayment and during low tide the water goes back through this channel. This happens because the major channel at the mouth of the embayment is closed. However according to the elderly on Kolhufushi this closed area will be eroded during the South West monsoon due to high wave energy and the majority of water to the embayment will be through this channel. Furthermore during the

South West monsoon the submerged beach rock (figure 17) extending from *Gaakureli* to *Kureli* will create a sand bank. The sand for the bank will come from the erosion at the mouth of the embayment.



*Figure 21: beach rock extending from Kureli towards Gaakureli*

Schematic diagrams showing the measured current patterns and strength around *Kureli* is shown in figure below. As discussed previously the currents around *Kureli* is weak especially on the North Eastern side. These results are derived from the drogue runs that were undertaken during low to high tide. According to the locals the currents would reverse during high tide. This means Southerly flowing current on the Eastern side of *Kureli* would flow towards North during high to low tide.



Figure 22: Current patterns around Kureli

#### 5.14. Local knowledge about Kureli

According to the elderly the small islet found in front of the embayment on *Kureli* was formed some 30 years ago. It seems there was a tornado that hit the island which caused sand to be washed away from the island on to the reef flat making a sand bank. Later trees started to grown on the sand bank, which eventually formed into a islet.

According to the locals turtles nest very often on the island.

According to the elderly one *Bruguiera cylindrica* tree was planted on the embayment which later caused the growth of other trees. However this story seems a bit contradicting as almost all the *Bruguiera cylindrica* patches are almost similar in canopy height, trunk circumference and canopy area.

The freshwater *Kulhi* was larger before.

According to the elderly when the mouth of the embayment was open during high tide the locals would close the mouth with a net at night and they would catch lots of fish this way.

According to some locals the island was used as an agricultural island.

#### 5.15. Socioeconomic status

##### 5.15.1.1. Socioeconomics of Meemu Atoll

The main economic activities of the islands in M. Atoll are fisheries which include grouper fishery, Skip Jack tuna fishery, Yellow fin tuna fishery, and sea cucumber fishery. Further, thatch production is also a very promising economic activity in the islands.

*Kolhufushi* is the biggest island in M. Atoll however it has the second largest population (1388) next to *Mulah* (1706). The demographic details of the island are given below.

*Table 19: demographics of M. Atoll*

Island	Population (March 2016)	Female:Male	Population (March 2015)	Land Size
Raimandhoo	220	109:111	220	0.2626 Km <sup>2</sup>
Veyvah	309	134:175	304	0.452 Km <sup>2</sup>
Mulah	1735	853:882	1706	0.578 Km <sup>2</sup>
Muli	976	472:504	958	0.298 Km <sup>2</sup>
Naalaafushi	525	252:272	518	0.08 Km <sup>2</sup>
Kolhufushi	1417	684:733	1388	1.11 Km <sup>2</sup>
Dhiggaru	1367	713:654	1347	0.134 Km <sup>2</sup>
Maduvvari	721	357:364	712	0.103 Km <sup>2</sup>

#### **5.15.1.2. Socioeconomics of Kolhufushi**

##### **Community needs**

According to the locals after the tsunami the groundwater of the island has a coloration and smell to it. Therefore the groundwater maybe polluted, hence an assessment needs to be done to assure the safety of the groundwater.

According to the island councilor and some of the locals consulted the awareness level of the locals is very poor with regard to development of the island. The island councilor believes this is because the educated person in each family is out of the island. Therefore it is very important to create opportunities to keep them in the island. Only way he suggested this could be achieved is by developing a resort near *Kolhufushi* so that they could come to the island each day after their work in the resort. If the educated person is with his family then his knowledge will be passed on to the other family members.

##### **Main economic activities**

According to the island councilor about 80% of the islands youth is employed in resorts. Agricultural is done on the island to some extent and the products are sold to resorts. In addition the thatch produced locally are also sold to resorts. In about 95% of the households thatch works are done. The price for 16 feet of thatch is MVR 75.

A portion of the elderly and the youth are employed in the tuna fishing and reef fisheries. Further there are 2 fish cooking centers on the island which makes dried fish.

### **5.15.2. Hazard Vulnerability**

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) (UNDP, 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 (UNDP, 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 (UNDP, 2006).

#### **5.15.2.1. Cyclonic wind hazard**

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 Maldivian 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 (UNDP, 2006).

On a scale of 1-5, with 5 being the highest risk zone, *Kureli* falls within Moderate to low risk zone (Figure 23) (UNDP, 2006), however, it should be noted that only 11 cyclones have been recorded across the Maldives since 1877.

#### **5.15.2.2. Storm surge hazard**

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, *Kureli* falls into the moderate risk zone of storm surge hazard (UNDP, 2006) (Figure 23).

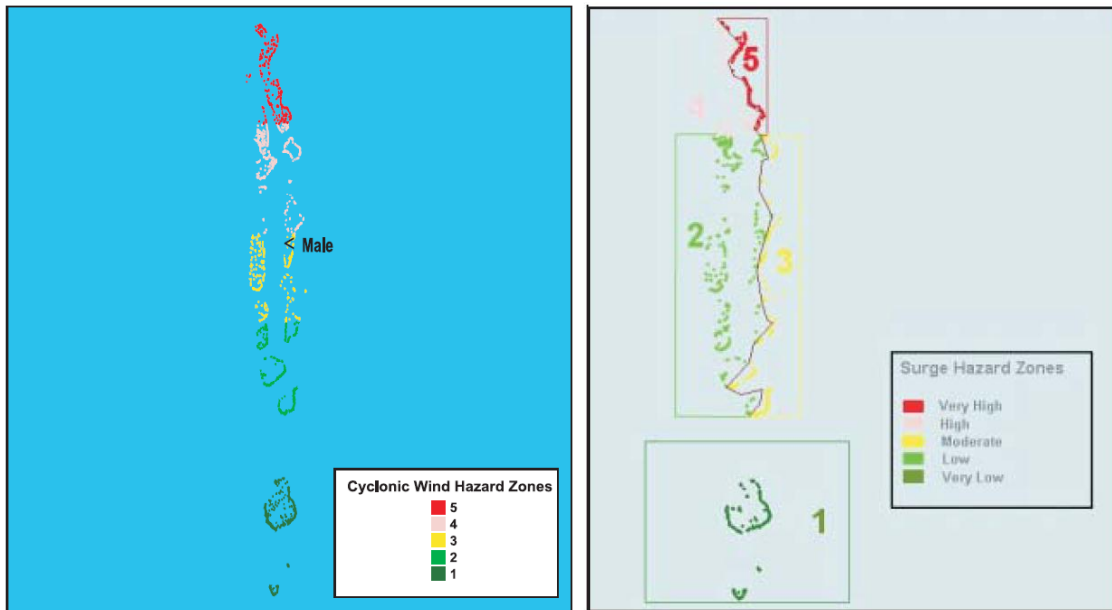


Figure 23. Cyclonic wind hazard map (left) and storm hazard map (right) of the; category 5 is the highest risk zone and category 1 is the lowest (Adapted from UNDP, 2006)

According to locals there have been no incidents of storm surges on the island. Further, the erosion on the island is only seasonal.

### 5.15.3. Flooding

Rainfall data from *Hulhule*' meteorological station have been used to analyze the flood and drought years near *Kureli*. 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 at *Hulhule* region showed that 6 years had experienced rainfall  $>1$  standard deviation from long term mean (Figure 24) indicating that flooding is a rare occurrence at this part of the Maldives.

## Environmental Impact Assessment for Poultry Farm Development at M. Kureli

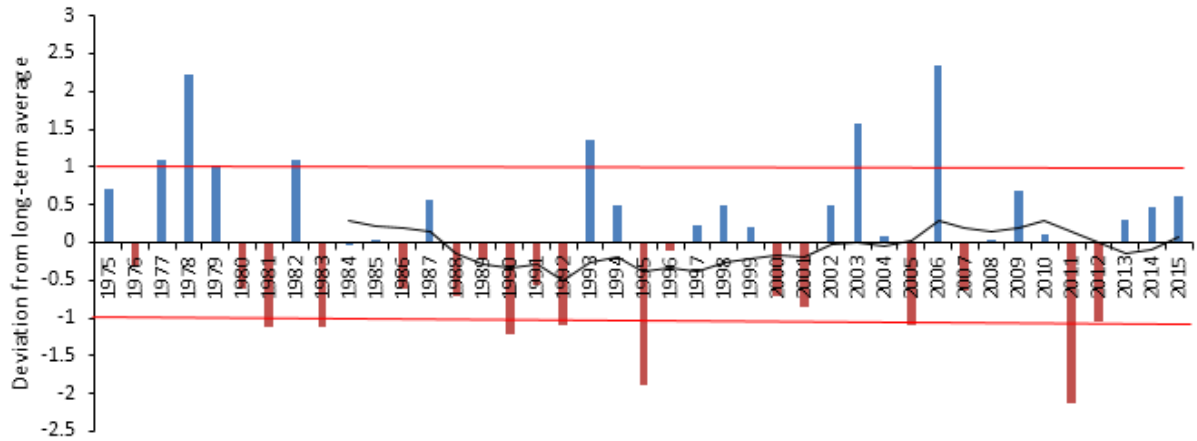


Figure 24. Rainfall anomalies for Hulhule from 1992 to 2015 with the 10 year moving average. Red lines indicate +1 and -1 standard deviations from the mean. (Data obtained from the Bureau of Meteorology, Maldives).

## 6. STAKEHOLDER CONSULTATION

An integral part of this EIA has been consultation with all relevant parties including public consultation, relevant government authorities and community members.

As such a stakeholder consultations were undertaken with the Meemu Atoll council, HPA, and public of *Kolhufushi*.

### 6.1. Public consultation with Kolhufushi locals

Date: 24<sup>th</sup> March 2017, 0800 PM

Name	House	Contact
Abdul Latheef Ali	Kinaara aseeru	7733784
Mohamed Naasir	Manzil	7931756
IbrMorinder citrifoliam Riyaaaz	Pinkrose	9180443
Hussain Shaamil	Dreamylife	7974746
Ahmed Ali	Husnuheenaage	-
IbrMorinder citrifoliam Waheedh	Kuri	7543500
Naafiu Rasheedh	Satharuge	-
Hassan Zuhan	Hudhuasurumaage	-
Mohamed Majudhee	Nalareethi villa	-
Ahmed	Reyvillaa	7852059

The public consultations were carried out by visiting homes and inviting people for a coffee to talk about the project and the island. As *Kolhufushi* was the nearest to *Kureli*, it was anticipated that the people most affected by the project would *Kolhufushi*, hence the locals of *Kolhufushi* were consulted.

The main concern raised by the locals were that *Kureli* is an island most suited for a tourism project. The consulted locals highlighted that *Kureli* had rich biodiversity both on land (the beach, mangroves and *Kulhi*) and surrounding marine environment (the extensive *Vilu*). They highlighted that *Mahuraa* did not have any such features hence is best suited for an agricultural project as such a project would not need a beautiful beach and pristine marine environment. Further they highlighted that there were actually not against the poultry farm project, but they would very much like the project to be undertaken at *Maahura* (the initial location given for the proponent) rather than at *Kureli*. When explained that *Mahuraa* is not option as the island is not under Fisheries Ministry, the locals indicated that *Thuvaru* island is a good island for the poultry farm project.

The locals were very positive about the poultry farm project. They understood that it is important to diversify and improve our own productivity. In this regard they highlighted that the chicken and eggs are actually very much needed in the booming tourism industry. Further, the locals believe that the poultry farm would create job opportunities for the people of *Kolhufushi*.

## 6.2. Consultation with M. Atoll Council

Since this EIA was needed as the previous EIA done for poultry farm development in M. *Maahura* failed due to an error with Ministry of Fisheries, and since the project is the same with a different location, the outcomes of the consultation with M. Atoll council during the previous EIA for *Kureli* is included below. However regardless, the council was again consulted during this EIA again, emails were send to the council and asked to send their comments regarding the change in location of the project but no response from the council.

Following is the details of council members that were present in the meeting.

*Table 20: details of M. Atoll council members that provided information*

<b>Name</b>	<b>Designation</b>	<b>Contact</b>
Hassan Abdul Rahman	President	7777215
Ahmed Hassan	V. President	7764902
Hassan Amjad	Member	7715111

Following is the issues, concerns and suggestions highlighted by the council;

- No islands for locals to enjoy and relax
- Proponents must corporate in activities of islands and provide technical knowledge (to school) as CSR
- The proponent must not disturb the neighbors (neighboring islands in anyway)
- Proponent must give preference to the atoll while providing job opportunities.
- Requested corporation with atoll council from the proponent.
- Proponent should not do any activities beyond their approval. Highlighted that *Fenfuraaveli* given to Beyond Pvt Ltd for agriculture is using the island for purposes besides their approval. For instance they were found to be giving trees to resorts.
- Council assured that they will give cooperation to the proponent.
- Council requested from the proponent to give more benefits to locals.
- Generally council and people were very positive towards the project.

### 6.3. Consultation with Maldives Food and Drug Authority MFDA

We were unable to have an official meeting with MFDA after requesting on two separate occasions and hence they were consulted via phone conversation. Following is the details of MFDA employee that was consulted with.

Table 18: detail of personnel consulted from MFDA

Name	Department	Contact
Bun Yaamin	Food Control Division	3014303

Following is the issues, concerns and suggestions highlighted by MFDA;

- If the proponent wants to export their products they will have to get registered in MFDA
- While selling the chicken products locally, the proponent needs to get the *halaal* stamp from the Ministry of Islamic Affairs. Furthermore the proponent will need to strictly abide by the regulations of Health Protection Agency (HPA).
- To import the chicks, the proponent will have to get the necessary approvals from the Ministry of Fisheries

### 6.4. Consultation with Ministry of Fisheries

On 02<sup>nd</sup> May and 03<sup>rd</sup> may we tried to arrange a stakeholder consultation with Ministry of Fisheries (MoF) but the Ministry could not arrange a meeting. Further we sent an email requesting for stakeholder consultation on 03<sup>rd</sup> May 2017 to [info@fishagri.gov.mv](mailto:info@fishagri.gov.mv) but did not receive any response from the Ministry.

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## 7. OPTIONS ASSESSMENT

### 7.1. Alternatives

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 two alternatives identified for this project. The “do nothing” or no project scenario and use of a different material for paving. Details of which are further discussed below:-

#### 7.1.1. *Option 1: Maintain status-quo*

In any project, the no project option must be not be ruled out without a proper consideration. If the proponent does not go forth with the project, the following potential advantages maybe lost

- Creating of numerous employment opportunities for Islanders of Nearby.
- A sustainable, self-sufficient and profitable poultry farm, which produces a range of Maldivian products;
- Environmentally and socially responsible approach to Poultry policies for the conservation of natural resources;
- Research and development will contribute to the country’s knowledge of technology, Poultry biology and the economics of sustainable business;
- Increase in skilled Maldivian labour, both male and female, for poultry related activities through on the job training and education.
- Greater food security for the country

.Due to these reasons the “no project option” is not advisable to consider for this project.

#### 7.1.2. *Option 2: Alternative location*

To move the whole project concept to another location would result in increase in the project cost and timeline. As, all the relevant approvals for the current site have already been acquired it is not advisable to consider to change the project site without a significant reason to do so. Therefore it is advised to carry out the project at the current site.

#### 7.1.3. *Option 3: Alternative technology*

##### **Feed water for RO plant**

Currently the proposed feed water for the plant is intake from lagoon through piping. An alternative to be considered is boreholes. However, this option is more costly and impose greater environmental damage than taking feed water from the lagoon. As boreholes might have negative impacts on the groundwater aquifer if not proper carried out as aquifer might

leak into the borehole during operations. Also boreholes require chemical during construction phase, if not handled with care can contaminate the soil and may leach to aquifer. Therefore as a mitigation factor, the chemical handling procedures must be clearly informed to staff and supervised if the proposed alternative is considered. Furthermore, the costs involved in boreholes is greater than lagoon intake and usually boreholes are preferred to larger plants. Boreholes are usually accompanied with larger plants, however as the proposed project has an RO of only 10-20 tons and due to the aforementioned reasons, it is recommended to go lagoon intake as feed water.

### **Brine discharge**

The current proposed method is to release the brine into the lagoon. However as the lagoon around the island dries up significantly during the changing tide where most of the lagoon is exposed on low tide, it is proposed to combine the brine to the sewer discharge. This method could dissolve the sewer effluents even further and reduce the negative impacts of sewer as well. However, as mitigation methods, it has to be ensured that there the brine line is properly connected to the sewer line and that the hydrodynamics of the effluents are correct. If this alternative has no practical engineering difficulties, it is advised to go for this alternative.

It is recommended to mix the brine with the sewerage, so that the brine will be diluted. The location of alternative brine discharge locations are shown in figure 6.

Option 1	The current at the <i>vilu</i> are very weak. Further, it is very calm on both monsoons according to locals. Therefore there is high possibility of discharged sewerage to be stagnated in the area.
Option 2	The currents at this location moves along the reef from South to Northwards during low tide and North to Southwards during high tide. Therefore the discharged sewerage can be taken away from the site out of the reef. However this area is also calm on both monsoons and the currents here are also still weak although stronger than inside the <i>vilu</i> .
Option 3	Stronger current and better wave action compared to other 2 locations which could facilitate good mixing and dilution of

	discharged sewerage. According to locals the area gets very rough during the South West monsoon. The strong waves can damage the outfall pipeline which induces the potential for leakage of sewerage onto the reef. Further the rectification of such damages would be very costly for the proponent to bear, hence is not economically feasible.
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### **Use of Energy recovery device for RO plant**

The proposed RO plant does not state to have an Energy Recovery Device built in it which can reduce the electrical consumption of energy for the plant. As the RO technology is very expensive, an ERD would help in minimizing this cost by reducing the energy consumption for the plant. Therefore, it is recommended to have an ERD for the RO plant.

### **Harvesting rain water from the civil structure**

Currently all the water is aimed to be supplied from the RO plant, however, rainwater could also be harvested from all the civil buildings and used. Essentially rainwater that is collected should also be used with some sort of treatment, may it be chlorination or otherwise. Furthermore, it is seen that it would reduce the costs of operating the RO plant. Therefore it is recommended to include this feature all the civil structures, especially buildings that have higher cover area.

### **Solar for electricity.**

Currently the power is proposed to be provided from diesel dependent generator sets. However, the options of renewable energy could also be considered for the project. In renewable energy, the most tried and tested method is solar. Therefore, it is recommended to go for solar hybridization of the power supply at some point in the life cycle of the project as it might not be able to meet immediately. The roof of some structure could be utilized or currently there is a method of floating solar panels in the lagoon which can also be considered.

### **Prefabricated civil structures**

The proposed method includes the constructive the civil buildings as per the normal construction materials and methods. However, the prefabrication could be considered for some civil structure such as the staff accommodations. This method would save time during the construction phase of the project. However, as the prefabrication also includes chemical

handling there is a potential negative impact on ground and the groundwater aquifer. Therefore, as a mitigation measure, proper chemical handling must be conveyed to all staffs involved and supervised during the construction phase.

## 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 asphalted roads become operational.

### 8.1. Risk 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:-

- Environmental Impact Assessment for the proposed poultry farm development in M. Maahura (Shareef, 2016)

The risk 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 risk assessment methodology utilized was also consistent with the methodology outlined in AS/NZS ISO31000 Risk Management-Principles and Guidelines.

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

1. Constructional impacts:-
  - Air quality;
  - Noise, vibration and disturbance;
  - Groundwater quality;
  - Generation of constructional and decommissioning wastes;
  - Oil and chemical leakage;
  - Introduction of non-native species;
  - Vegetation clearance;
  - Impacts on marine environment;
  - Mobilization impacts; and
  - Risk of accidents and pollution on workers and local population.
2. Operational impacts:-
  - Groundwater quality;
  - Marine environment;

- Noise disturbance;
- Socio economic;
- Air quality;
- Hydrodynamics;
- Impacts from waste;
- Risk of flooding; and
- Impacts on landscape integrity and scenery.

Hazards were assessed using the following matrix (Table 21).

Table 21. Risk assessment matrix

Likelihood		Consequences				
		Minimal (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
	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

Criteria used for assessing the identified hazards 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 hazards, the level of risk is determined (Table 21). 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 22 below.

*Table 22. 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
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 are limited mainly due to lack of long term data and complexity of the ecosystem. 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 require a benchmark against which these conditions can be compared, however, lack of such benchmarks are a great hindrance to analyzing the environmental impacts at 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 have 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 23. Predicted impacts and risk analysis anticipated during construction phase of the project*

Potential impacts	Likelihood	Consequence	Risk rating
Air quality- GHG emissions	Certain	Minimal	Medium
Noise pollution, vibration and disturbance due to operation of	Certain	Moderate	Very high

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heavy machinery			
Groundwater quality from oils and chemical spills	Possible	Moderate	Medium
Water quality from waste water	Certain	Moderate	Very high
Impacts on marine environment from turbidity and direct damage to benthos	Certain	Moderate	Medium
Generation of constructional and decommissioning wastes	Certain	Minimal	Medium
Oil and chemical leakage	Possible	Moderate	Medium
Introduction of non-native species	Remote	Major	Negligible
Vegetation clearance	Certain	Moderate	Medium
Risk of accidents and pollution on workers and local population	Possible	Major	High

Impacts during construction phase of the project are mainly anticipated to be short-term and reversible (Table 24) as most impacts will last only for the duration of the construction phase of the project.

*Table 24. Summary of impacts during the construction phase of the project*

Potential impact	Type	Nature	Range	Duration	Reversibility
Air quality- GHG emissions	Direct	Negative	Local	Short-term	Reversible
Noise pollution, vibration and disturbance due to operation of heavy machinery	Direct	Negative	Local	Short-term	Reversible
Groundwater quality from oils and chemical spills	Direct	Negative	Local	Short-term	Irreversible
Water quality from waste water	Direct	Negative	Local	Short-term	Irreversible
Impacts on marine environment from turbidity and direct damage to benthos	Direct	Negative	Local	Short-term	Irreversible
Generation of constructional and decommissioning wastes	Direct	Negative	Local	Short-term	Irreversible
Oil and chemical leakage	Direct	Negative	Local	Long-term	Irreversible
Introduction of non-native species	Direct	Negative	Island	Long-term	Irreversible
Vegetation clearance	Direct	Negative	Island	Long-term	Irreversible
Risk of accidents and pollution on workers and local population	Direct	Negative	Local	Short-term	Reversible

### ***8.3.1. Impacts on air quality***

Impacts on air quality during the constructional phase is generally credited to operation of machinery and equipment which require electricity and vehicles which burn fuel. Release of GHGs and any other gases into the atmosphere during the construction phase is very low and since construction site is close to the coast, it is expected that any released gases will not remain stagnant to a particular area to cause a public nuisance.

Risk analysis shows that impacts on air quality is medium (Table 23) and is expected to be limited to project site and last only for the duration of the construction phase of the project hence is not expected to cause any significant adverse impacts on the environment and community.

### ***8.3.2. Noise pollution, vibration and disturbance***

Similar to air quality, impacts on noise level during the constructional phase is generally credited to operation of machinery, equipment and vehicles. Although this aspect scored a

risk rating of “very high” (Table 23), it is anticipated that the noise levels will be localized to the project site and will be short-term.

Nuance due to vibration and noise is inevitable in projects like this, however is short term and limited to only the construction phase of the project.

### **8.3.3. Water quality**

Impacts on groundwater quality is anticipated to root from 3 different aspects:-

- Due to oils and chemical spills- In case of improper use of machinery and equipment, there is the possibility of oils and chemical spillage into the groundwater. Even 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;
- Due to waste water discharge- Waste water should not be discharged into the ground and should be discharged out of the reef flat into the sea;

Wastewater will be disposed of directly into the sea during the construction phase, however, chemicals used for concreting, painting, and other construction materials is composed of very hazardous chemicals. If these chemical are spilled on the ground, there is a high risk that it will contaminate groundwater of the island. Further, there is the added risk of oil spills from operation of machinery.

Even though the likelihood of this happening is narrow, due to its irreversibility the impact is of high significance.

### **8.3.4. Impacts on marine environment from turbidity and direct damage to benthos**

Marine environment will be moderately affected during the construction of the jetty. The main impact will be direct damage on benthic substratum during the construction of columns for the jetty. Sea grass on the immediate footprint of the pad footing will be completely destroyed. Further sea grass within the vicinity will be smothered due to sedimentation during construction. However they are likely to recover once conditions return to normal after construction. Fish will most likely move away from the site during construction and will return back once conditions return to normal.

Due to the low magnitude of direct damage and considering the recovering of smothered sea grass, the impact was considered of moderate significance.

### **8.3.5. *Impacts from waste***

It is expected that a considerable amount of waste would be generated as the existing bricks need to be removed from the project area. It is highly advised to recycle any usable bricks and use them elsewhere.

Generally, the waste generated are to be compiled in one area and taken to Thilafushi based on the amount of waste generated. The impacts from wastes would be immediately levitated once the waste is transported to the waste management center and then to Thilafushi. This is also a short-term and reversible impact.

### **8.3.6. *Oil leakage and chemical leakage***

There is the possibility of oil leakage and chemical leakage from the operation of heavy machinery and oil utilizing equipment. In case a chemical or oil spill occur, potential impacts include contamination of groundwater, degradation of soil profile such that vegetation does not thrive and risk of fire and/or accidents. This is a highly localized and short-term impact.

### **8.3.7. *Introduction of non-native species from abroad***

As of now there is no plan in the proposed project to import any non-native species for the the poultry farming project. Therefore, the significance of this impact is determined to be negligible. However, if it may be considered even in operational phase, a separate EIA amendment with adequate consultation with relevant stakeholders shall take place with the fulfilment of all legislative requirements before commencing with any such activities.

### **8.3.8. *Vegetation clearance***

Removal of vegetation is inevitable as there is need to clear the land to establish infrastructure and facilities for the poultry farming. All vegetation that could be relocated shall be relocated in adjacent areas to development footprint. Although there would be some negative impact such as loss of habitat for the flora, the impact is envisaged to be limited to the small areas of infrastructure development footprint only.

### **8.3.9. *Risk of accidents and pollution on workers and local population***

As typical of any construction project, there lies the risk of accidents and pollution on workers as well on the local population from this project as well. It should be noted that the proposed project have taken occupational health and safety measures into consideration in addition to placement of danger signs around the project area.

#### 8.4. Operational impacts

Table 25. Predicted impacts and risk analysis anticipated during operation phase of the project

Potential impact	Likelihood	Consequence	Risk rating
Groundwater quality from leachate and oil spills	Likely	Major	Very high
Impacts on marine water quality from sewerage	Certain	Major	Very high
Noise disturbance to wildlife	Likely	Moderate	High
Air quality	Certain	Minor	Low
Hydrodynamics	Likely	Minimal	Negligible
Impacts from waste	Likely	Moderate	High
Socioeconomic	Certain	Major	Significant
Impacts on landscape integrity	Certain	Major	Significant

Unlike constructional impacts, operational impacts are anticipated to be more long-term and irreversible (Table 26). 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 26. Summary of impacts during the operation phase of the project

Potential impact	Type	Nature	Range	Duration	Reversibility
Groundwater quality from leachate and oil spills	Direct	Negative	Local	Long-term	Irreversible
Impacts on marine water quality from sewerage	Direct	Negative	Local	Long-term	Irreversible
Noise disturbance to wildlife	Direct	Negative	Island	Long-term	Reversible
Air quality	Direct	Negative	Local	Long-term	Reversible
Hydrodynamics	Direct	Negative	Local	Long-term	Reversible
Impacts from waste	Direct	Negative	Local	Long-term	Reversible
Socioeconomic	Direct	Positive	Local	Long-term	Reversible
Impacts on landscape integrity	Direct	Negative	Island	Long-term	Irreversible

##### 8.4.1. Groundwater quality from leachate and oil spills

There is always risk of groundwater contamination during the operation of powerhouse and other machinery on the island. Further, there is risk of contamination of groundwater from the waste management center as leachate may permeate down into groundwater lens.

Due to the irreversibility of any contamination to groundwater it is considered of high significance

##### 8.4.2. Impacts on marine water quality from sewerage

Impacts of marine water quality during operation will be minimal as the jetty will not cause much turbidity because water will be able move freely under it.

The discharge of brine is not expected to cause any significant impacts on salinity of water. The volume brine discharged will be low as the desalination capacity is 10-20 tons per day.

However the discharge of sewerage into water will slightly increase the BOD of water within the immediate vicinity of outfall location. It is expected the biological content will be decomposed immediately away from the outfall location.

Considering the low magnitude and extent of the impact, the impacts on marine water quality is considered of low significance.

During operation there will be no direct impacts to marine environment. However indirect impacts may arise from changes in marine water quality at the outfall location. It is expected that these impacts will be localized to outfall location. The high BOD at outfall location may encourage growth of algae which will impact the corals negatively.

Due to the low magnitude, extent and reversible nature of the impact, it is considered of low significance.

#### **8.4.3. Noise disturbance to wildlife**

The operation of RO plant and powerhouse will generate noise. Further the chicks in grower houses and staff working will also generate noise. The ambient noise level of the island will increase which may scare off birds.

Due to the moderate magnitude of the impact, it is considered of moderate significance.

#### **8.4.4. Air quality**

The operation of the powerhouse and RO plant will release greenhouse gases to the atmosphere. Any smoke and gases from the exhaust will not remain stagnant due to its proximity to coast and will be carried away immediately with the wind. Due to the negligible magnitude of the impact it is considered negligible.

#### **8.4.5. Hydrodynamics**

The jetty is designed in way that does not interfere with the currents. It is expected that water will move in between the columns freely and hence not much changes will be made to current patterns.

Due to the low likelihood the impact is considered of low significance.

#### **8.4.6. Impacts from waste**

It is likely that a considerable amount of solid waste will be generated during the operation. If the waste is not stored appropriately there is chance of it being carried into surrounding marine environment with the wind. Any plastic waste in the marine environment will be very hazardous to marine life.

Organic waste will be produced from the grower houses, which will be transferred daily to the waste management center. Leachate will be produced especially during rainy season which may percolate into groundwater lens.

Due to the likely indirect impacts from waste which are irreversible, the impact is considered of high significance.

**8.4.7. Socioeconomic**

It is expected that the project will generate about 50 jobs once it runs at full capacity. The proponent aims to bring in locals from M. Atoll to the island. Therefore job opportunities will be made available to locals in M. Atoll.

Further, the reliance on other countries for chicken will reduce considerably. The project will improve our productivity and promote local sustainable food solutions. Therefore, it reduces importation along with inflation and improves economy on long run.

## 9. ENVIRONMENTAL MANAGEMENT

This section describes the environmental and operational management systems and plans for the proposed road development project 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 27 below is proposed with due consideration to their cost effectiveness and feasibility to be implemented. The mitigation measures mainly relate to fuel handling practices, design and quality of the proposed road 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 27. Proposed mitigation measures for the identified risks during the construction and operation phases of the proposed project*

Aspect	Mitigation measure	Implementing agency	Estimated cost (MRF)
<b>CONSTRUCTION PHASE</b>			
Air quality	<ul style="list-style-type: none"> <li>• Daily maintenance of vehicles and machinery</li> <li>• Use of light fuel (low sulphur content)</li> <li>• Avoid unnecessary use of machinery</li> </ul>	Contractor	N/A
Noise, vibration and disturbance	<ul style="list-style-type: none"> <li>• Well maintenance of vehicles and machinery</li> <li>• Avoid unnecessary use of machinery</li> <li>• Restrict working hours to day time only</li> <li>• Workers could wear voice cancellation headphones</li> <li>• Sound attenuation measures in powerhouse</li> <li>• All powerhouse aspects to be in accordance with MEA standard</li> <li>• Sound attenuation measures in grower houses</li> </ul>	Contractor	N/A
Water quality	<ul style="list-style-type: none"> <li>• Oil/chemical handling procedures should be made known to all staff members</li> <li>• Follow corresponding chemical handling procedure when handling chemicals</li> <li>• All machinery and equipment should be well maintained to avoid accidental spillage</li> <li>• Relevant staff members should be well trained about proper use of machinery and equipment</li> <li>• Have emergency oil spill cleanup crew on standby during construction</li> <li>• Wastewater should be disposed of through sea outfall pipes and no wastewater shall be allowed to discharge to the ground</li> <li>• Proper care should be taken as not to spill any oils or wastewater into the ground</li> <li>• Proper care should be taken during machinery transfer to avoid accidental oil leakage</li> <li>• Emergency response plans made for RO plant and Powerhouse oil spills</li> </ul>	Contractor	10000

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	<ul style="list-style-type: none"> <li>• Regular monitoring of water quality and Pump station location and outfall</li> <li>• Installation of leachate collector at waste management center</li> </ul>		
Generation of construction and decommissioning wastes	<ul style="list-style-type: none"> <li>• Littering, accidental disposal and spillage of any construction wastes should be avoided by pre-planning ways of their transportation and unloading</li> <li>• Careful planning of the work activities can also reduce the amount of waste generated</li> <li>• Waste segregation on site and reuse as much as possible</li> <li>• 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</li> </ul>	Contractor	5000
Oil and chemical leakage	<ul style="list-style-type: none"> <li>• Oil/chemical handling procedures should be made known to all staff members</li> <li>• Follow corresponding chemical handling procedure when handling chemicals</li> <li>• All machinery and equipment should be well maintained to avoid accidental spillage</li> <li>• Relevant staff members should be well trained about proper use of machinery and equipment</li> <li>• Have emergency oil spill cleanup crew on standby during construction</li> <li>• Wastewater should be disposed of through sea outfall pipes and no wastewater shall be allowed to discharge to the ground</li> <li>• Proper care should be taken as not to spill any oils or wastewater into the ground</li> <li>• Proper care should be taken during machinery transfer to avoid accidental oil leakage</li> </ul>	Contractor	10000
Mobilization impacts	<ul style="list-style-type: none"> <li>• Laborers shall be supervised by the site supervisor to avoid any socially or culturally unacceptable behavior</li> <li>• Limit access routes of vessels, excavators and heavy machinery to a small area</li> </ul>	Project manager/ contractor	N/A
Introduction of non-native species	<ul style="list-style-type: none"> <li>• Careful inspection of soil</li> </ul>	Contractor	N/A
Vegetation clearance	<ul style="list-style-type: none"> <li>• Replantation of any smaller trees within the industrial zone</li> <li>• Proper care should be taken when uprooting deeply rooted trees</li> <li>• Removed vegetation should be disposed of as green waste</li> <li>• Vegetation occurring outside project area should not be harmed at any cost</li> </ul>	Contractor	N/A
Impacts on traffic flow of the area	<ul style="list-style-type: none"> <li>• Try to finish off the project as soon as possible</li> <li>• Pre-planning of road closure activities</li> <li>• Open an adjoining road to allow traffic flow</li> <li>• Make sure entrance to any of the buildings is not blocked completely</li> </ul>	Contractor	N/A
Trenching	<ul style="list-style-type: none"> <li>• If necessary, the area should be sprayed with water to minimize human exposure to dust</li> <li>• Trenched material should be stockpiled at a designated area</li> </ul>	Contractor	1000
Risk of accidents	<ul style="list-style-type: none"> <li>• Proper signs should be installed and work area restricted with tape</li> <li>• All working staff must be well trained on occupational health and safety</li> <li>• All safety equipment should made provided</li> <li>• Unauthorized entry of unwanted people must be restricted</li> <li>• In case of accidents, workers should be taken to the regional hospital immediately and if the need be, to Male'</li> <li>• In case of oil/chemical spills, clean up kits shall be available at all times;</li> <li>• Emergency cleanup crew shall be on standby at all times;</li> <li>• Firefighting equipment must be made available at work site;</li> </ul>	Contractor	2000

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<b>OPERATIONAL PHASE</b>			
Water quality	<ul style="list-style-type: none"> <li>• Regular maintenance of machinery.</li> <li>• Following chemical handling procedures.</li> <li>• Staff training on emergency oil spill cleanup.</li> <li>• Emergency response plans made for RO plant and Powerhouse.</li> <li>• Oil spill cleanup materials made available at RO plant and Powerhouse.</li> <li>• Installation of leachate collector at waste management center</li> <li>• Composting fertilizers from the organic waste generated</li> </ul>	Proponent	N/A
Impacts on marine environment	<ul style="list-style-type: none"> <li>• Extension of brine outfall out of the reef flat.</li> <li>• Monitoring of water quality at the outfall location.</li> </ul>	Proponent	
Noise disturbance to wildlife	<ul style="list-style-type: none"> <li>• Sound attenuation measures in powerhouse</li> <li>• Powerhouse made in accordance with MEA and EPA standards</li> <li>• Sound attenuation measures in grower houses</li> </ul>	Proponent	
Air Quality	<ul style="list-style-type: none"> <li>• Chimneys at powerhouse constructed in accordance with MEA standard and height</li> <li>• Regular maintenance of generators</li> </ul>	Proponent	
Impacts from waste	<ul style="list-style-type: none"> <li>• Leachate collection system for waste management center.</li> <li>• Solid waste managed according to waste management regulation.</li> <li>• Ensure that the all the waste generated at all the sites will be collected and stored in closed containers</li> <li>• Installation of an incinerator to burn toxic/hazardous waste</li> <li>• Care should take to ensure that the fuel and lubricant oil drums are stored in the concrete floor</li> <li>• Any hazardous waste produced during the operations shall be stored inside a closed container</li> <li>• Waste segregation and stored in closed labeled containers.</li> </ul>	Proponent	

### **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 poultry farm development in M. Kureli were conducted in March 2017. 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 28 below.

*Table 28. Environmental monitoring plan proposed for the poultry farm development at M.Kureli*

Parameter	Phase	Method	Indicators	Frequency	Cost / MRF
Marine water quality	Construction and	Test of seawater parameters	Turbidity, TSS	Every 3 months	600

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	Operation				
Groundwater quality	Construction and Operation	Test of seawater parameters	Total Petroleum Hydrocarbon, Conductivity, Nitrates, Phosphates	Every 3 months	600
Benthic substrate	Operation	Photo transect	Percentage coral cover	Every 3 months	3500
Erosion	Operation	Photos	Percentage coral cover	Every 3 months	3500

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

*Table 29. Monitoring schedule recommended for the poultry farm development in M. Kureli assuming that the project commences in April 2017 and finishes in August 2017.*

<b>Description</b>	<b>Date</b>
EIA Decision statement issued	
Monitoring report during construction- 1	April 2017
Monitoring report during construction - 2	July 2017
Monitoring report during construction - 3	October 2017
Monitoring report after project completion- 1	August 2017
Monitoring report after project completion - 5	August 2018
Monitoring report after project completion - 6	August 2019
Monitoring report after project completion - 7	August 2020
Monitoring report after project completion - 8	August 2021

## **10. JUSTIFICATION AND CONCLUSION**

Two types of environmental impacts are associated with this project, constructional and operational impacts. While impacts due to construction phase of the project is temporary and short-term, impacts during the operational phase are long-term and permanent. Impacts of highest significance from this project are on water quality and terrestrial vegetation. While impacts on groundwater could be minimized or prevented altogether given that the proper mitigation measures are followed, impacts on vegetation are inevitable. It has been proposed that smaller plants will be relocated within the industrial village area.

It should be noted that even though some of the impacts are irreversible and could have detrimental effects on the environment, it should not be seen as a hindrance to the development of any place. As the main purpose of an EIA as well as environmental consultation is to facilitate sustainable development, this report ensures that best possible environmental solutions are provided for the development of poultry farm at M. Kureli. Mitigation measures have been proposed with respect to predicted outcomes as well as professional expertise of the consultants.

Risk analysis also shows that the project has far greater positive outcomes during the operational phase of the project which is longer term than the temporary negative impacts anticipated to occur during the construction phase of this project. Overall, the positive social impacts outweighs the negative impacts, therefore, the consultants conclude that the proposed project is feasible and given that the proper mitigation measures are applied, any negative environmental impacts could be minimized or even prevented.

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List of people who contributed to individual chapters of this report are given below.

<b>Chapter</b>	<b>Contributor's</b>
Chapter 1: Introduction	Mahfooz Abdul Wahhab Mohamed Ibrahim Jaleel
Chapter 2: Statutory Requirements	Mahfooz Abdul Wahhab Mohamed Ibrahim Jaleel
Chapter 3: Statutory Requirements	Mahfooz Abdul Wahhab
Chapter 3: Project Description	Mahfooz Abdul Wahhab Aishath Arsha Mohamed Ibrahim Jaleel
Chapter 4: Methodology	Mahfooz Abdul Wahhab
Chapter 5: Existing Environment	Mahfooz Abdul Wahhab Ibrahim Shajeehu
Chapter 6: Stakeholder Consultation	Mahfooz Abdul Wahhab Ibrahim Shajeehu
Chapter 7: Options Assessment	Mahfooz Abdul Wahhab Mohamed Ibrahim Jaleel
Chapter 9: Environmental Management	Mahfooz Abdul Wahhab Mohamed Ibrahim Jaleel
Chapter 10: Justification and Conclusion	Mahfooz Abdul Wahhab

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## Environmental Impact Assessment for Poultry Farm Development at M. Kureli

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**APPENDICES**

## **APPENDIX A- LIST OF ABBREVIATIONS**

EIA	Environmental Impact Assessment
MEA	Maldives Energy Authority
EPA	Environmental Protection Agency
ToR	Terms of Reference
DN	Decision Note
RO	Reverse Osmosis
IWRM	Integrated Water Resource Management
MPHRE	Ministry of Planning, Human Resource and Environment
MNDF	Maldives National Defense Force
WAMCO	Waste Management Corporation
WIG	Waste incinerator guideline
UNFCCC	United Nations Framework Convention on Climate Change
GHG	Greenhouse gas
UN	United Nations
CBD	Convention on Biological Diversity
SAARC	South Asian Association for Regional Corporation
BS	British Standards
EPDM	Ethylene Propylene Die Memonoma
MWSC	Maldives Water and Sewerage Company
GPS	Global Positioning System
NO <sub>2</sub>	Nitrogen dioxide
NO	Nitrogen monoxide
SO <sub>2</sub>	Sulphur dioxide
SST	Sea surface temperature
TPH	Total Petroleum Hydrocarbon
H <sub>2</sub> S	Hydrogen sulphide
UNDP	The United Nations Development Program

## **APPENDIX B- TERMS OF REFERENCE**



No: 203-EIARES/INDIV/2017/38

## Terms of Reference for Environmental Impact Assessment to build, own and operate poultry farm at Gaakureli, Meemu Atoll

The following is the Terms of Reference (ToR) following the scoping meeting held on 13/03/2017 for undertaking the EIA to build, own and operate poultry farm at M. Gaakureli. The Proponent of the Project is Aishath Arsha (ID No: A056304), M. Narugismaage Aage, K. Male'.

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

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

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

### Land preparation and construction of facilities

- Housing facilities
- Equipment required for operational phase;
- Access to facility

### Poultry farming

- Site map showing locations of all poultry farm/s
- Type of birds farmed



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Environmental Protection Agency



- Planned products
- Disease control plan
- Quarantine process in case of a disease outbreak
- Worker safety measures

#### Jetty construction

- Size of channel, location
- Justification for the selection of this location;
- Jetty construction methodology and materials to be used

#### Water supply

- Rainwater collection details
- Water storage details and capacity
- Desalination plant details, Location, desalination capacity, technology and water quality monitoring system;
- Pipeline construction methods, scheduling and drawings;
- Location, justification for the location of the water intake and brine outfall pipelines and construction methodology;
- Emergency water supply plan.

#### Power supply plant and oil storage

- Location and size of generators and facility;
- Fuel transportation technique, fuel storage and volume required;
- Measures to prevent oil spillage during fuel transport and storage
- Cooling water system including cooling pipe location (if any) and justification;
- Emergency supply;

#### Sewerage:

- Methodology for sewerage management and its details;
- Sewerage systems
- Identify potential alternatives including outfall locations with minimal impacts
- Specify an emergency plan
- Methodology of outfall pipe construction

#### Waste management plan

- Waste management plan including management within island and final disposal of waste
- Composting methodology if practiced;
- Incineration construction and operational plan.
- 

**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

Environmental Protection Agency

Green Building, 3<sup>rd</sup> Floor, HandhuvaareeHingun

Male', Rep. of Maldives, 20392

Tel: [+960] 333 5949 | +960] 333 5951

Fax: [+960] 333 5953

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Email: [secretariat@epa.gov.mv](mailto:secretariat@epa.gov.mv)

Website: [www.epa.gov.mv](http://www.epa.gov.mv)

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a way that they will be usefully applied to future monitoring. The report should outline detailed methodology of data collection utilized.

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

Climate

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

Physical parameters (use maps where appropriate)

- Tidal ranges and tidal currents;
- Wave climate and wave induced currents;
- Wind induced (seasonal) currents;
- Shoreline and vegetation line around the island
- Beach profiles at the jetty construction area
- (Seasonal) patterns of coastal erosion and accretion – this should include the seasonal patterns around the island including the changes in the environmental sensitive area.
- Characteristics of seabed sediments to assess direct habitat destruction and turbidity impacts during construction including channel dredging location and any outfall/ intake locations.
- Bathymetry of channel dredging area and any outfall pipe locations;
- Ground water quality assessment measuring these parameters: temperature, pH, salinity, phosphate, nitrate, ammonia, and sulphate, total and faecal coliforms. And hydrocarbons to be tested at powerhouse/ fuel storage location.
- Sea water quality measuring these parameters: temperature, pH, salinity, turbidity, phosphate, nitrate, ammonia, sulphate, and BOD.

Biological parameters: Land-water run-off could affect the marine environment:

- Identify marine protected areas (MPAs) and sensitive sites such as breeding or nursery grounds for protected or endangered species (e.g. coral reefs, spawning fish sites, nurseries for crustaceans or specific sites for marine mammals, sharks and turtles). This must include abundance and occurrence of such types of biodiversity.
- Include description of commercial species, species with potential to become nuisances or vector.
- Benthic community monitoring around the island
- Mangrove ecosystem dynamics,.
- Vegetation study of the island, emphasizing on the mangrove area. The vegetation survey must provide details of the types and number of trees that require to be cleared

Socio-economic environment

- The socio economic environment that may have an impact due to the project shall be identified.

Hazard vulnerability:

- Vulnerability of area to flooding and storm surge.

**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, Legal requirements:

- Approval from Ministry of Fisheries and Agriculture.

**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. Particular attention shall be given to impacts associated with the following:

Impacts on the natural environment

- Water run-off impacts on marine environment: include changes in seawater quality assessments.
- Changes in flow velocities/directions, resulting in changes in erosion/sedimentation patterns, which may impact shore zone configuration/coastal morphology;
- Impacts of noise, vibration and disturbance;
- Impacts on ground water quality and seawater quality;
- Impacts on unique or threatened habitats or species (coral reefs, sea turtles etc.),
- Impacts on the environmentally sensitive site and species within/occurring in this site.
- Impacts on landscape integrity/scenery.

Impacts on the socio-economic environment

- Impacts on food prices and availability;
- Impacts on employment, income and economy diversification;
- Impact equity (economic activities, employment, income);

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. The report should outline the uncertainties in impact prediction and also outline all positive and negative/short and long-term impacts.

**Task 5. Alternatives to proposed project** – Describe alternatives including the “no action option” should be presented. Alternatives examined for the proposed project that would achieve the same objective including the “no action alternative”. This should include alternative location/island, different options for access to island and water supply.

**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. The confirmation of commitment of the developer to finance and implement the proposed mitigation measures shall also be included.

**Task 7. Development of monitoring plan** - Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present monitoring plan. Ecological monitoring will be submitted to the EPA to evaluate the damages during construction, after project completion and

every three months thereafter, up to one year and then on a yearly basis for five years after. The baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided.

**Task 8. Stakeholder consultation, Inter-Agency coordination and public/NGO participation –** Identify appropriate mechanisms for providing information on the development proposal and its progress to all relevant stakeholders such as;

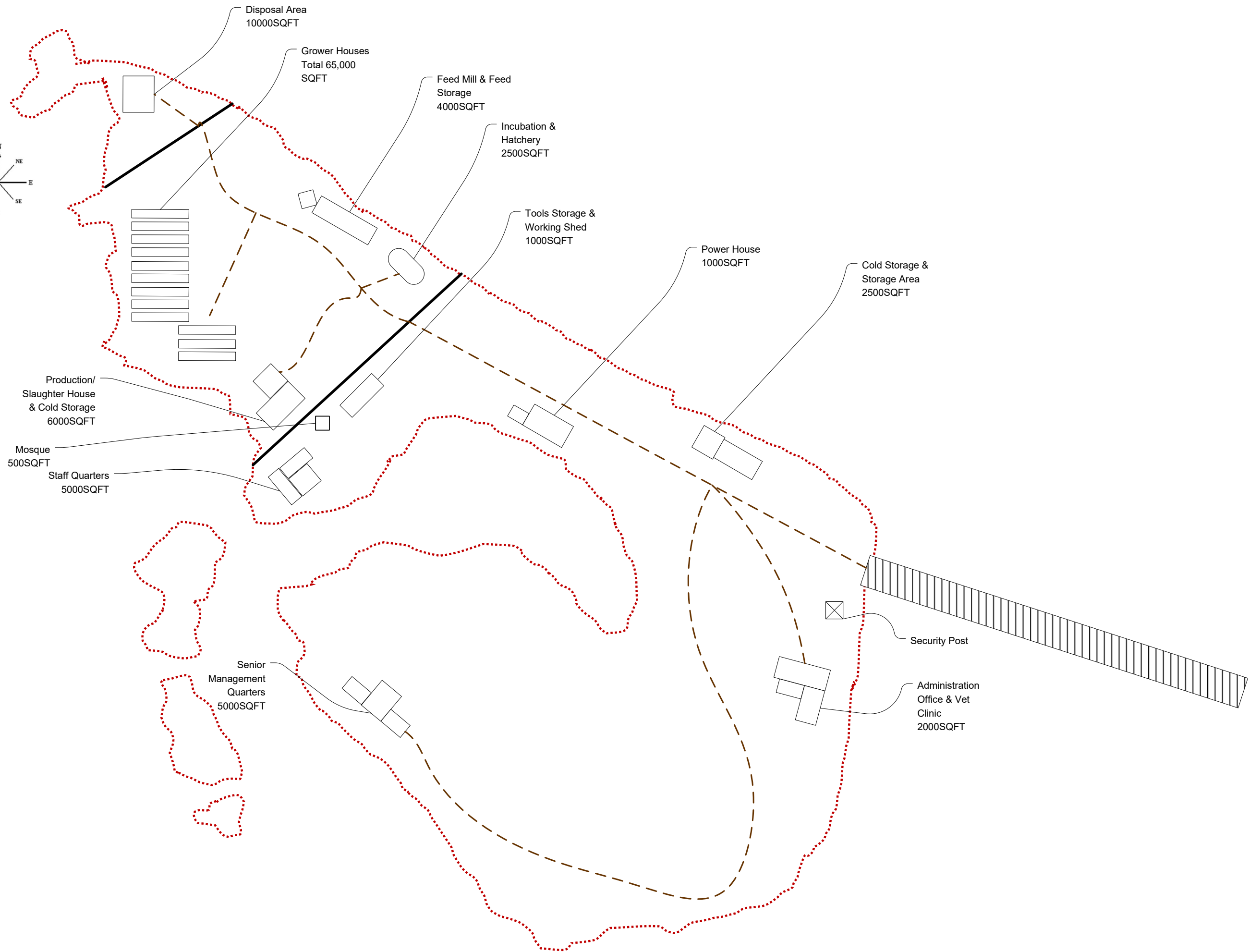
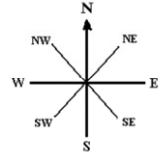
- Ministry of Fisheries and Agriculture
- Health Protection Agency
- Atoll Council

**Presentation** - The environmental impact assessment report, to be presented in digital format, will be concise and focus on significant environmental issues. It will contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations 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.

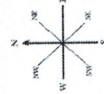
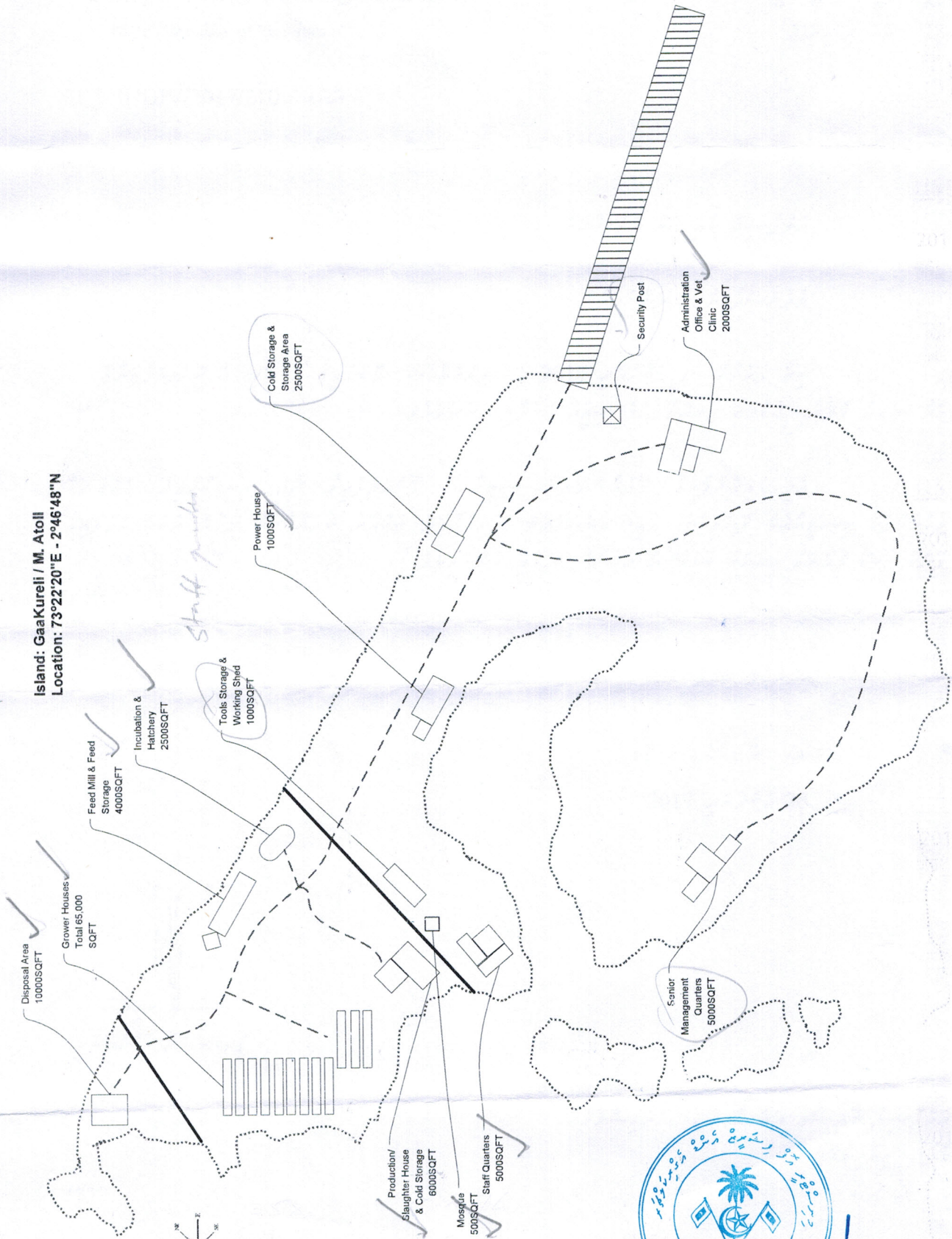
**Timeframe for submitting the EIA report** – The developer must submit the completed EIA report within 6 months from the date of this Term of Reference.

  
  
 14<sup>th</sup> March 2017

**APPENDIX C- DETAIL DRAWINGS OF LAND USE  
PLANS**



Island: GaaKureli / M. Atoll  
Location: 73°22'20"E - 2°46'48"N



## **APPENDIX D- DETAIL WORK SCHEDULE**



**APPENDIX E- APPROVAL FROM MINISTRY OF  
FISHERIES FOR THE PROJECT**











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(ނަންބަރު ފަރުޞަތުތަކުގެ ސަބަބުން)

ނަންބަރު	ފަރުޞަތުތަކުގެ ސަބަބުން (ނަންބަރު ފަރުޞަތު)
1	209,898.00 (ފަރުޞަތުތަކުގެ ސަބަބުން ފަރުޞަތުތަކުގެ ސަބަބުން ފަރުޞަތުތަކުގެ ސަބަބުން)
2	209,898.00 (ފަރުޞަތުތަކުގެ ސަބަބުން ފަރުޞަތުތަކުގެ ސަބަބުން ފަރުޞަތުތަކުގެ ސަބަބުން)
3	209,898.00 (ފަރުޞަތުތަކުގެ ސަބަބުން ފަރުޞަތުތަކުގެ ސަބަބުން ފަރުޞަތުތަކުގެ ސަބަބުން)
4	209,898.00 (ފަރުޞަތުތަކުގެ ސަބަބުން ފަރުޞަތުތަކުގެ ސަބަބުން ފަރުޞަތުތަކުގެ ސަބަބުން)
5	209,898.00 (ފަރުޞަތުތަކުގެ ސަބަބުން ފަރުޞަތުތަކުގެ ސަބަބުން ފަރުޞަތުތަކުގެ ސަބަބުން)



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- ޖުމްހޫރީ ޕާޓީގެ ސަރުކާރުގެ ދަށުން 90 ދުވަހުގެ ތެރޭގައި ދިވެހިސަރުކާރުގެ ގެޒެޓްގައި ވާ ގޮތްތަކާ ގުޅިގެން ދިވެހިސަރުކާރުގެ ގެޒެޓްގައި ވާ ގޮތްތަކާ ގުޅިގެން.





9 ޖަހަވުމުގެ ދަށުން

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## **APPENDIX F- GROUND WATER SAMPLE RESULTS**

**WATER QUALITY TEST REPORT**  
 Report No: 500172250

**Customer Information:**  
 Foresight surveyors pvt ltd  
 M.Raaneevilla  
 4G06 M.Raaneevilla  
 Male' MALE'

Report date: 14/03/2017  
 Test Requisition Form No: 900172181  
 Sample(s) Recieved Date: 09/03/2017  
 Date of Analysis: 09/03/2017 - 14/03/2017

Sample Description	S.MA_RF/24642N 732213E	E.MA_RF/24632N 732230E	M_MA/ 24646N 732222E	TEST METHOD	UNIT		
Sample Type	Sea Water	Sea Water	Sea Water				
Sample No	83182149	83182150	83182152				
Sampled Date	07/03/2017	07/03/2017	07/03/2017				
PARAMETER	ANALYSIS RESULT						
Physical Appearance	Clear with particles	Clear	Clear with particles				
Conductivity	52900	53100	53900	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	µS/cm		
pH	8.16	8.14	8.72	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	-		
Temperature	20.2	20.8	20.2	Electrometry	°C		
Total Dissolved Solids	26400	26500	26900	Electrometry	mg/L		
Total Suspended Solids	<5 (LoQ 5 mg/L )	<5 (LoQ 5 mg/L )	<5 (LoQ 5 mg/L )	Method 8006 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L		
Turbidity	0.273	0.192	1.42	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU		
Nitrate	3.8	3.6	4.7	Method 8171 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L		
Nitrogen Ammonia	<0.02 (LoQ 0.02 mg/L )	<0.02 (LoQ 0.02 mg/L )	<0.02 (LoQ 0.02 mg/L )	Method 8038 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L		
Biological Oxygen Demand (BOD)	3	2	1	HACH Method 8043	mg/L		

**Keys:** µS/cm : Micro Seimen per Centimeter, °C : Degree Celcius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit

Checked by



Afnan Farooq  
 Laboratory Executive Gr.1

Approved by



Mohamed Eyman  
 Assistant 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

**WATER QUALITY TEST REPORT**  
 Report No: 500172250

Report date: **14/03/2017**  
 Test Requisition Form No: **900172181**  
 Sample(s) Received Date: **09/03/2017**  
 Date of Analysis: **09/03/2017 - 14/03/2017**

**Customer Information:**  
 Foresight surveyors pvt ltd  
 M.Raaneevilla  
 4G06 M.Raaneevilla  
 Male' MALE'

Sample Description	N.MA_LA/ 2475N 732229E	NW_IL/ 24654N 732216E	N_IL/ 24651N 732221E	TEST METHOD	UNIT
Sample Type	Sea Water	Sea Water	Sea Water		
Sample No	83182153	83182155	83182156		
Sampled Date	07/03/2017	07/03/2017	07/03/2017		
PARAMETER	ANALYSIS RESULT				
Physical Appearance	Clear with particles	Cloudy	Pale yellow with particles		
Conductivity	52300	480	1214	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	µS/cm
pH	8.14	7.82	7.16	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	-
Temperature	20.4	20.1	20.3	Electrometry	°C
Total Dissolved Solids	26100	240	607	Electrometry	mg/L
Total Suspended Solids	<5 (LoQ 5 mg/L )	677	45	Method 8006 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Turbidity	0.189	518	25.2	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU
Nitrate	4.8	0.6	2.2	Method 8171 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Nitrogen Ammonia	<0.02 (LoQ 0.02 mg/L )	0.26	0.28	Method 8038 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Biological Oxygen Demand (BOD)	2	7	11	HACH Method 8043	mg/L

**Keys:** µS/cm : Micro Seimen per Centimeter, °C : Degree Celcius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit

Checked by



Afnan Farooq  
 Laboratory Executive Gr.1

Approved by



Mohamed Eyman  
 Assistant Manager, Quality

**Notes: Sampling Authority:** Sampling was not done by MWSC Laboratory  
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 ~ Information provided by the customer



**WATER QUALITY TEST REPORT**  
 Report No: 500172250

Report date: 14/03/2017  
 Test Requisition Form No: 900172181  
 Sample(s) Recieved Date: 09/03/2017  
 Date of Analysis: 09/03/2017 - 14/03/2017

**Customer Information:**

Foresight surveyors pvt ltd  
 M.Raaneevilla  
 4G06 M.Raaneevilla  
 Male' MALE'

Sample Description	SE_IL/ 24645N 732224E	TEST METHOD	UNIT
Sample Type	Sea Water		
Sample No	83182157		
Sampled Date	07/03/2017		
PARAMETER	ANALYSIS RESULT		
Physical Appearance	Pale yellow with particles		
Conductivity	2540	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	µS/cm
pH	2.64	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 21st edition)	-
Temperature	20.2	Electrometry	°C
Total Dissolved Solids	1269	Electrometry	mg/L
Total Suspended Solids	35	Method 8006 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Turbidity	1.79	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU
Nitrate	2.0	Method 8171 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Nitrogen Ammonia	0.94	Method 8038 (Adapted from HACH DR5000 Spectrophotometer procedure Manual)	mg/L
Biological Oxygen Demand (BOD)	10	HACH Method 8043	mg/L

Keys: µS/cm : Micro Seimen per Centimeter, °C : Degree Celcius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit

Checked by

Afnan Farooq  
 Laboratory Executive Gr.1

Approved by

Mohamed Eyman  
 Assistant 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

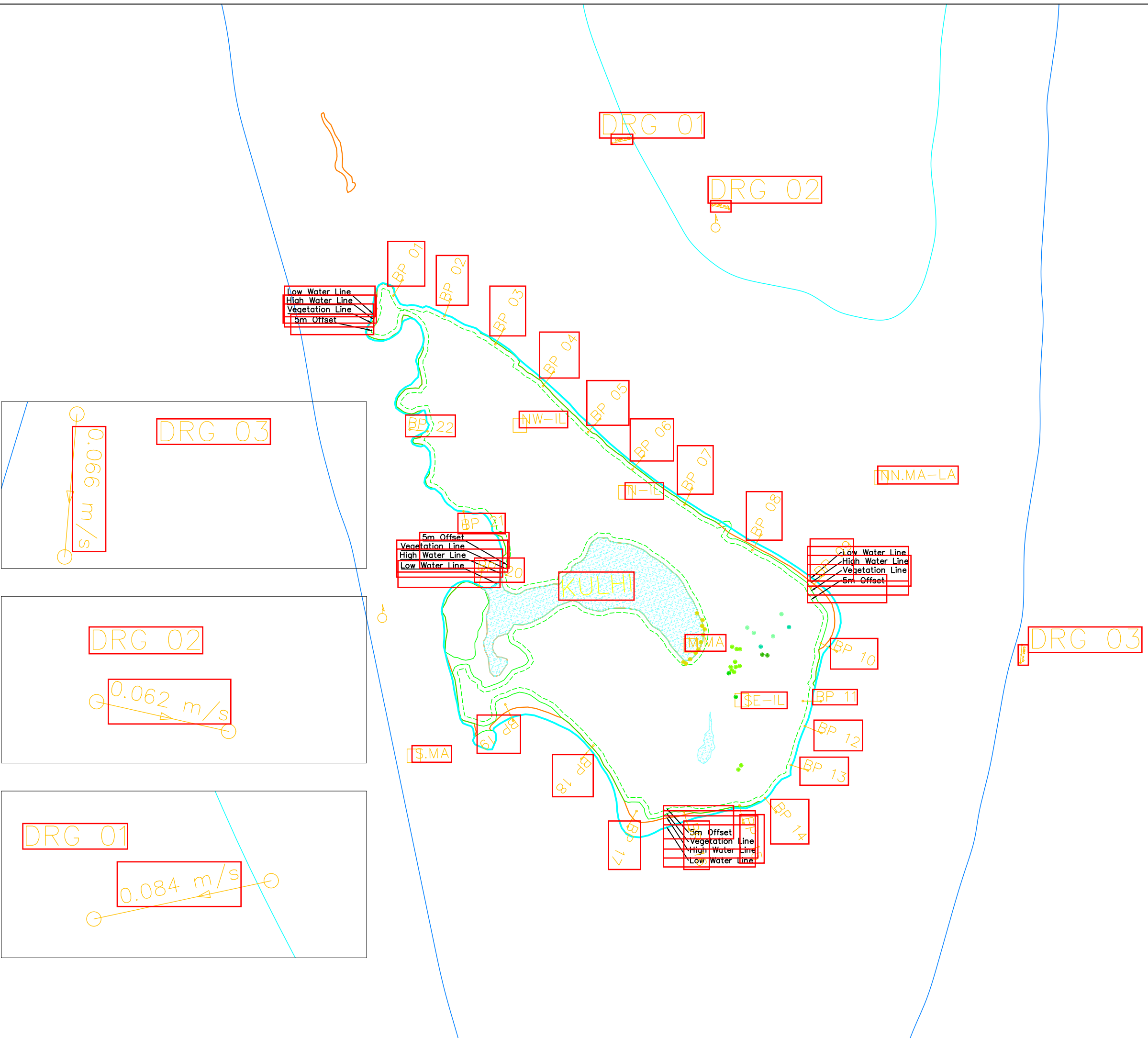
\*\*\*\*\* END OF REPORT \*\*\*\*\*

## **APPENDIX G – TOPOGRAPHIC MAPS**

# TOPOGRAPHIC SURVEY

Gaakurali  
Meemu Atoll

FORESIGHT SURVEYORS 2016



SURVEYED DATE	05 to 06 -March-2017
DRAWN DATE	18-March-2017

"IMPERIAL" DISTANCE SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

COORDINATES			
ALL COORDINATES ARE IN METRES REFERRED TO U.T.M. ZONE 43N (WGS84)			
POINT ID	NORTHING	EASTING	HEIGHT
BM 01	307277.091	319190.555	+1.424
BM 02	307307.278	319186.468	+1.616
BM 03	307610.872	318941.106	+1.064

LAND AREA		
ID	AREA/SQM	PERIMETER/M
LWL	149,663.533	2099.697
HWL	129,538.626	2860.069
VEG	124743.237	2973.482
TOTAL LAND AREA ((HWL+LWL)/2) = 139,601.080 SQM		

SCALE 1:1000

LEGEND	
	BM Bench Mark
	HWL High Water Line
	LWL Low Water Line
	VEG Vegetation Line

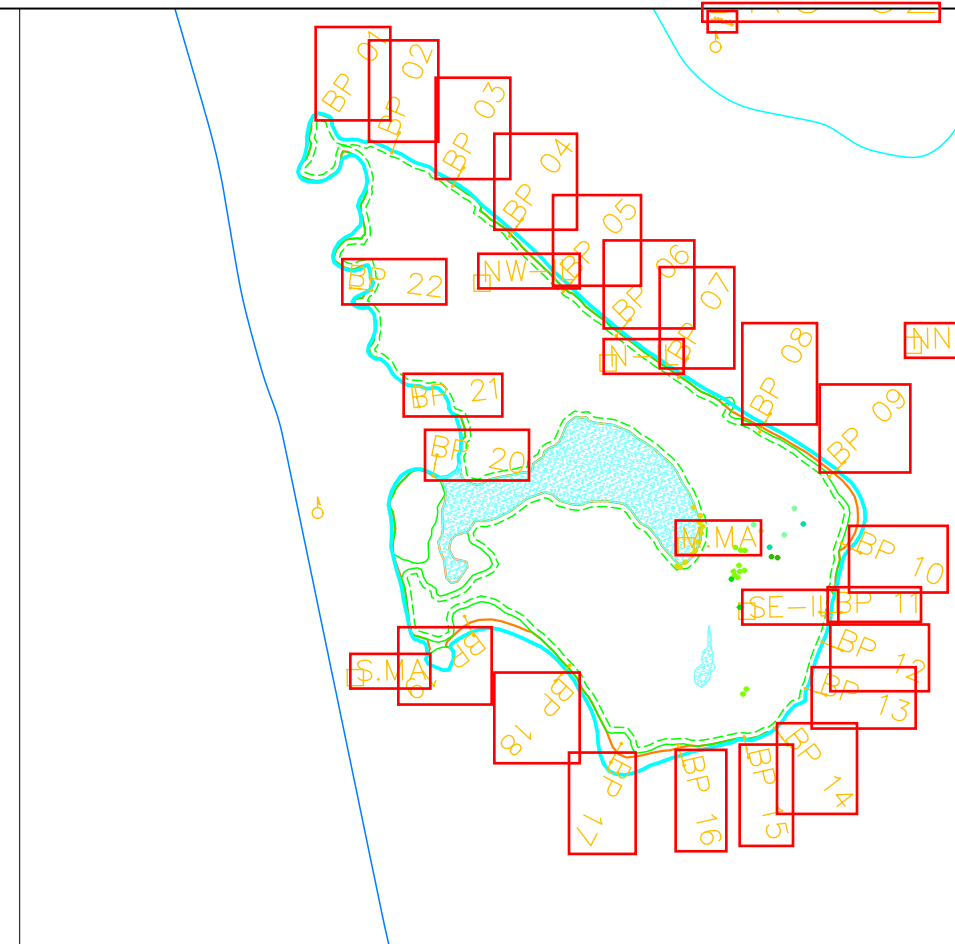
DRAWING TITLE:	M.GAAKURALI
SHEET TITLE:	SURVEYED MAP (GAAKURALI)
CLIENT:	Aishath Arsha
SURVEYED BY:	Abdulla Shalf   AS
DRAWN BY:	AS
CHECKED BY:	Ahmed Nuaim (BP02206)   AN
JOB NUMBER:	JB SUV-005-2017
FILE NO.:	



# TOPOGRAPHIC SURVEY

Gaakurali  
Meemu Atoll

FORESIGHT SURVEYORS 2016



SURVEYED DATE	05 to 06 -March-2017
DRAWN DATE	18-March-2017

"IMPERIAL" DISTANCE SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

COORDINATES			
ALL COORDINATES ARE IN METRES REFERRED TO U.T.M. ZONE 43N (WGS84)			
POINT ID	NORTHING	EASTING	HEIGHT
BM 01	307277.091	319190.555	+1.424
BM 02	307307.278	319186.468	+1.616
BM 03	307610.872	318941.106	+1.064

LAND AREA		
ID	AREA/SQM	PERIMETER/M
LWL	149,663.533	2099.697
HWL	129,538.626	2860.069
VEG	124743.237	2973.482
TOTAL LAND AREA ((HWL+LWL)/2) = 139,601.080 SQM		

SCALE 1:1000

LEGEND	
	BM Bench Mark
	HWL High Water Line
	LWL Low Water Line
	VEG Vegetation Line

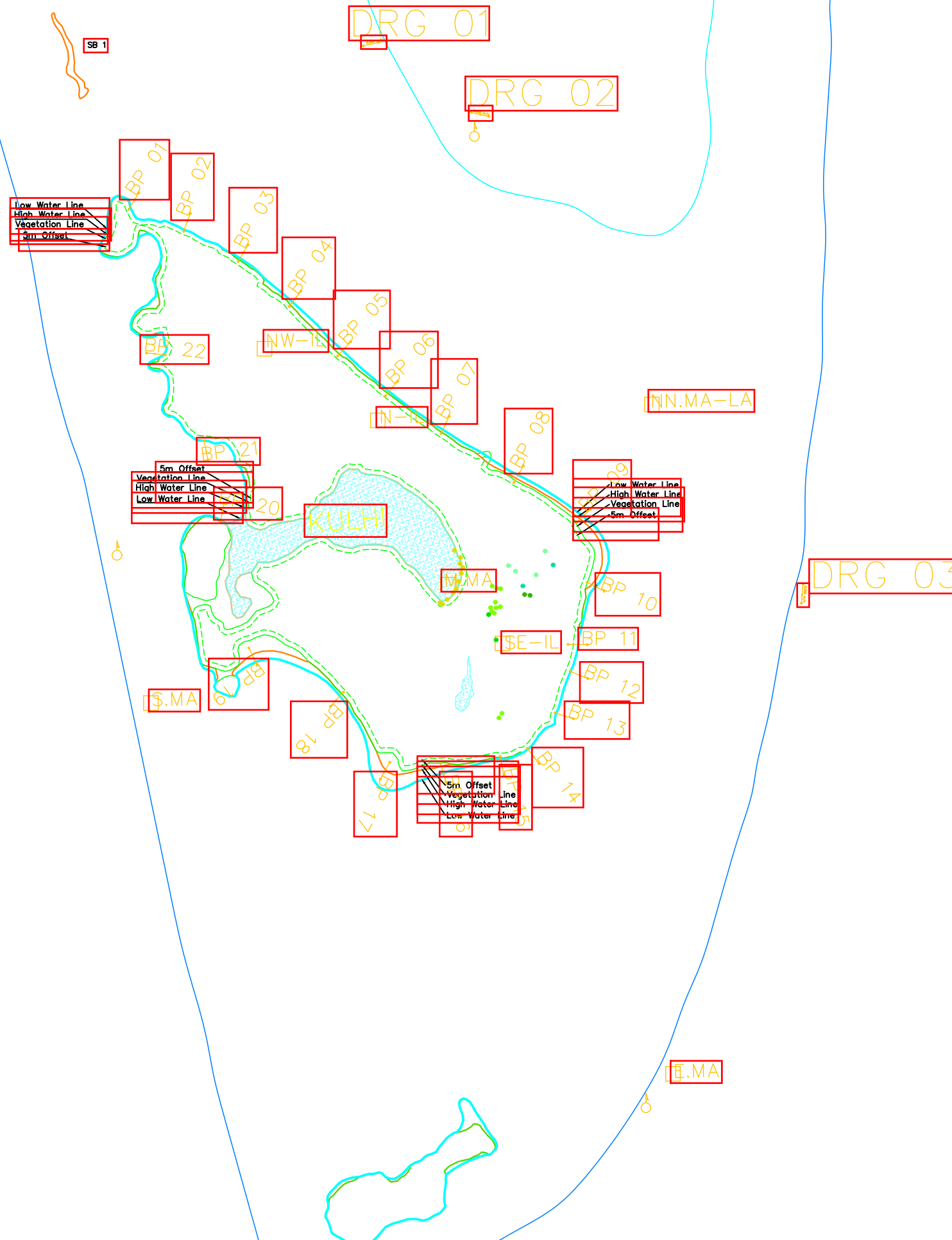
DRAWING TITLE:	M.GAAKURALI
SHEET TITLE:	SURVEYED MAP (GAAKURALI)
CLIENT:	Aishath Arsha
SURVEYED BY:	Abdulla Shalf   AS
DRAWN BY:	AS
CHECKED BY:	Ahmed Nuaim (BP02206)   AN
JOB NUMBER:	JB SUV-005-2017
FILE NO.:	



# TOPOGRAPHIC SURVEY

Gaakurali  
Meemu Atoll

FORESIGHT SURVEYORS 2016



SURVEYED DATE	05 to 06 -March-2017
DRAWN DATE	18-March-2017

"IMPERIAL" DISTANCE SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

COORDINATES			
ALL COORDINATES ARE IN METRES REFERRED TO U.T.M. ZONE 43N (WGS84)			
POINT ID	NORTHING	EASTING	HEIGHT
BM 01	307277.091	319190.555	+1.424
BM 02	307307.278	319186.468	+1.616
BM 03	307610.872	318941.106	+1.064

LAND AREA		
ID	AREA/SQM	PERIMETER/M
LWL	149,663.533	2099.697
HWL	129,538.626	2860.069
VEG	124743.237	2973.482

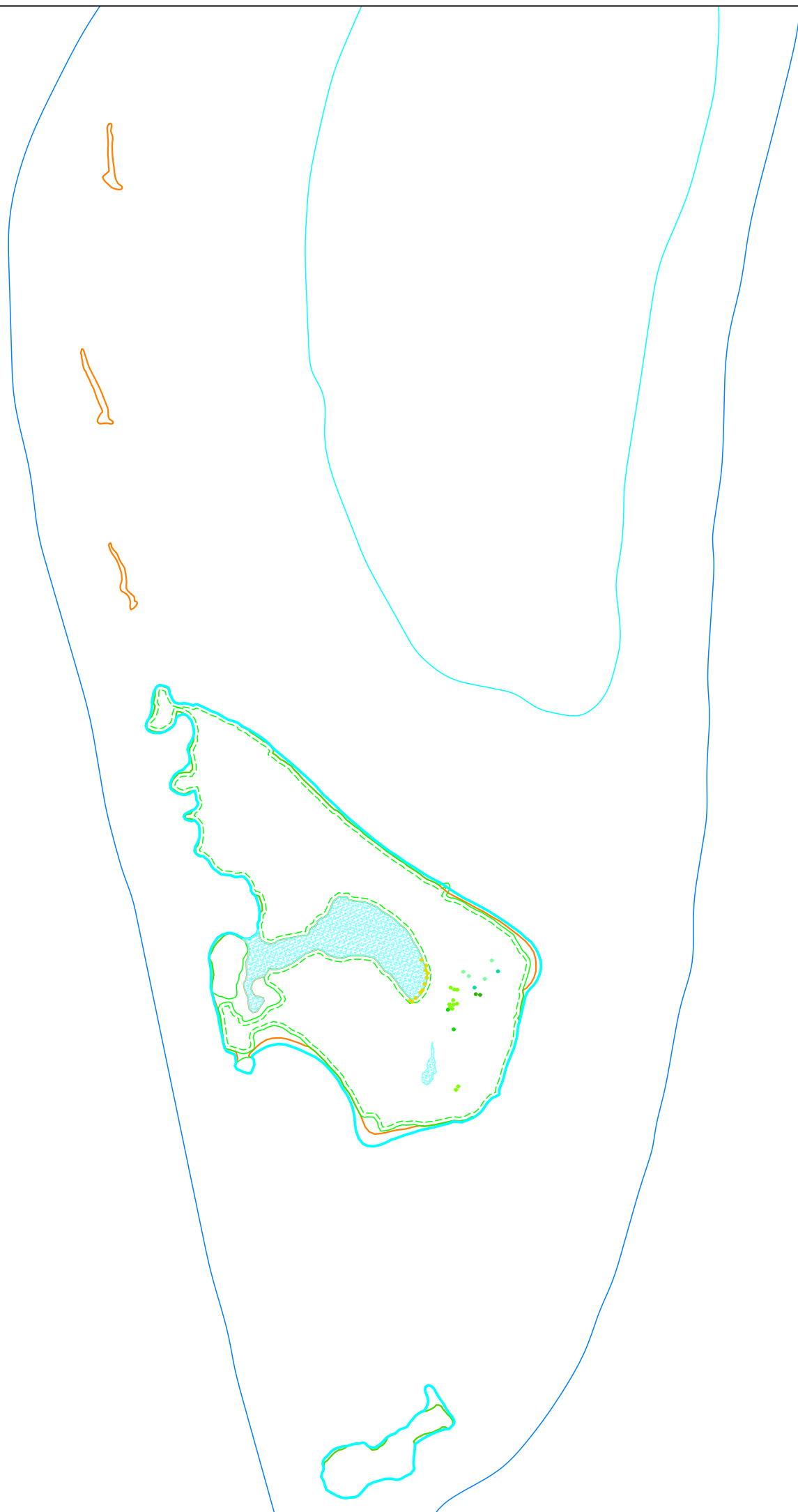
TOTAL LAND AREA ((HWL+LWL)/2) = 139,601.080 SQM

SCALE 1:1000

LEGEND	
	BM Bench Mark
	HWL High Water Line
	LWL Low Water Line
	VEG Vegetation Line
	funa
	Kandu
	Kandhu
	Enboo
	Maley Kashikeyo
	Fitharonu

DRAWING TITLE:	M.GAAKURALI
SHEET TITLE:	SURVEYED MAP (GAAKURALI)
CLIENT:	Aishath Arsha
SURVEYED BY:	Abdulla Shaif   AS
DRAWN BY:	AS
CHECKED BY:	Ahmed Nuaim (BP02206)   AN
JOB NUMBER:	JB SUV-005-2017
FILE NO.	





# BOUNDARY SURVEY

Gaakurali  
Meemu Atoll

FORESIGHT SURVEYORS 2016



SURVEYED DATE	05 to 06 -March-2017
DRAWN DATE	18-March-2017

"IMPERIAL" DISTANCE SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

COORDINATES			
ALL COORDINATES ARE IN METRES REFERRED TO U.T.M. ZONE 43N (WGS84)			
POINT ID	NORTHING	EASTING	HEIGHT
BM 01	307277.091	319190.555	+1.424
BM 02	307307.278	319186.468	+1.616
BM 03	307610.872	318941.106	+1.064

LAND AREA		
ID	AREA/SQM	PERIMETER/M
LWL	158,987.106	2630.439
HWL	137,938.627	3350.683
VEG	133,143.238	3464.096
TOTAL LAND AREA ([HWL+LWL]/2) = 148,462.867 SQM		
TOTAL LAND AREA with Sandbanks = 1150,547.990 SQM		

SCALE 1:7000

LEGEND	
	BM Bench Mark
	HWL High Water Line
	LWL Low Water Line
	VEG Vegetation Line

DRAWING TITLE:	M.GAAKURALI
SHEET TITLE:	SURVEYED MAP
CLIENT:	Aishath Arsha
SURVEYED BY:	Abdulla Shaif   AS
DRAWN BY:	AS
CHECKED BY:	Ahmed Nuaim (BP02206)   AN
JOB NUMBER:	JB SUV-005-2017
FILE NO.:	



**APPENDIX H – EVIDENCE OF REPORT SENT TO  
ATOLL COUNCIL**





