



Ministry of Housing and Infrastructure
Male', Republic of Maldives.

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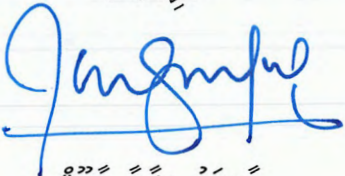
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ENVIRONMENTAL IMPACT
ASSESSMENT FOR ROAD
DEVELOPMENT IN
Male' Izzudheen magu

Prepared by:

Mahfooz Abdul Wahhab
Mariyam Shujaa-ath

April 2017

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LETTER OF COMMITMENT



Ministry of Housing and Infrastructure
Male', Republic of Maldives.

ދިވެހިސަރުކާރުގެ ގެޒެޓް ގައި ބަޔާންކޮށްފައިވާ ގޮތުގައި
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Date: 25 April 2017

No: 138-PIS1/203/2017/52

Mr. Ibrahim Naeem

Director General

Environmental Protection Agency,

Ministry of Environment and Energy,

Green Building, Male',

Maldives.

Dear Sir,

This is in reference to the EIA report for the proposed Road development Project in Izzudheen Magu Male'.

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

Thanking you

Sincerely,

Fathimath Shaana Fardooq,

Director General

DECLARATION OF PROPONENT

Proponents Declaration

Re: EIA for Road Development in Izzudheen Magu Male'

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

Signature:



Name: Fathimath Shaana Farooq

Designation: Director General

On behalf of: Ministry of Housing and Infrastructure

Date: 25 April 2017

DECLARATION OF CONSULTANTS

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

Mahfooz Abdul Wahhab (EIA P22/2016)

Mariyam Shujaa-ath A.Fathah (EIA T03/2016)

DECLARATION OF CONSULTANTS

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

Mahfooz Abdul Wahhab (EIA P22/2016)



Mariyam Shujaa-ath A.Fathah (EIA T03/2016)



EXECUTIVE SUMMARY

1. The purpose of this EIA is to critically analyse and assess the potential environmental impacts associated with the proposed development of Izzudheen Magu and expose the solutions and preferred alternatives as well as mitigation measures to minimize any negative impacts whilst trying to derive the maximum positive impacts from the project;
2. Izzudheen Magu is one of the key access roads to Male' Industrial Village area and also shall be a major route within the ring road plan of the city. Therefore it is very important to develop this road by asphaltting and developing drainage system as heavy machinery will be travelling on this road. The drainage systems are critical to control the flooding which occurs on this road almost every time there is a heavy rainfall.
3. A full baseline of water quality was established at the proposed development area as it is anticipated to impact negatively on the groundwater quality. In addition to this, it was found that 18 Sea Hibiscus trees and 3 Coconut Palm would need to be removed from the project area;
4. Additionally, this study also involved identification of alternative options in place of the proposed development. The considered options were no project scenario and use of concrete paving instead of asphalt, both of which are economically less feasible.
5. The construction works of the proposed development presented in this report are not expected to adversely impact the environment if the mitigation measures mentioned in the report are followed. The most important mitigation measures are daily maintenance of machinery, following chemical handling procedures, waste segregation and storage in closed labelled containers until disposal to Thilafushi;
6. Potential groundwater contamination from chemical spills and oil spills and vegetation clearance are the most significant environmental impacts associated with the project;
7. Overall, the proposed project is expected to bring in positive outcomes. It is expected that the newly developed road will improve traffic flow of the area, increase water infiltration during heavy rainfall and reduce flooding as well as improve landscape integrity of the area;
8. Monitoring is essential to ensure that environmental thresholds are not exceeded and mitigation measures proposed are working. Water quality monitoring will be done according to the proposed monitoring schedule.

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

An ongoing project is underway by the Ministry of Housing and Infrastructure (MHI) to develop an industrial village on the South-Western corner of Male'. As part of the ongoing project to develop the industrial village, the roads leading to the industrial village have already been developed by laying new utility network, drainage and asphalt.

The scope of this EIA includes road reconstruction work of Izzudheen Magu using asphalt. The utility networks on this road will be upgraded by the respective utility companies ie STELCO and MWSC. The asphalt and drainage will be done by MHI. This project will be aligned with the Male' Industrial village road and utility component. The duration for this work is approximately 4 months.

1.3. Need for the project

This road is one of the key access roads to Male' Industrial Village area and also shall be a major route within the ring road plan of the city. Therefore it is very important to develop this road by asphalt and developing drainage system as heavy machinery will be travelling on this road. The drainage systems are critical to control the flooding which occurs on this road almost every time there is a heavy rainfall.

1.4. Project objectives

The primary objective of the proposed project is to asphalt the izzudheen magu and to put in an effective drainage system on the road.

1.5. 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.

1.6. 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 road development project in izzudheen magu 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 road development works on izzudheen magu 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.

1.7. Terms of reference (ToR)

As part of the EIA process, a scoping meeting for the proposed project was held at the EPA on 2nd 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 5th March 2017 (the approved ToR is attached in Appendix B of this report).

1.8. EIA implementation

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

- Mariyam Shujaa-ath Abdul Fathah- (EIA T03/2016)
- Mahfooz Abdul Wahhab (P22/2016)

1.9. The proponent

The proponent, MHI is the ministry responsible for housing and infrastructure in the Maldives. As such the ministry handles all the housing and infrastructure projects throughout the Maldives.

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. 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.

**2.3. 1st addendum to Environmental Protection and Preservation Act (4/93)
law no 12/2014**

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

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

2.4. 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 2nd 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.

2.1. 1st 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.

2.2. 2nd 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.

2.3. 3rd 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. 4th 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 fibre 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. Regulation on provision of electricity to Male' and islands

This regulation was made in accordance to article 3 of law on general public services (number 4/93) and is enforced by the MEA. This regulation governs the standards which need to be followed by the service provider as well as the agreements that has to be made between the service provider and customer.

Since the electrical cables will be layed by STELCO the responsible utility, they will be responsible to lay the cables in accordance with this regulation.

2.5. 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 izzudheen magu 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.

2.6. 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 the Male' industrial village as much as possible.

2.7. International Conventions

2.7.1. 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.

2.7.2. 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.

2.7.3. 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.

2.7.4. 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).

2.7.5. 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.

2.7.6. 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.

2.7.7. 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.

2.8. Regional plans and programs

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

- South Asian Association for Regional Corporation (SAARC) Environment Action Plan adopted in Male' in 1997;
- SAARC Study on Greenhouse Effect and its Impacts on the Region;
- South Asian Regional Seas Action Plan and Resolutions concerning its implementation (1994); SAARC Study on Causes and Consequences of Natural Disasters;
- South Asian Seas Program; and
- Male' Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia (1998).

3. PROJECT DESCRIPTION

3.1. Study area, project boundary and surroundings

The study area for the project is izzudheen magu and its surroundings. As such the water quality analysis and vegetation analysis was restricted to the road itself. The location of water sampling is shown in the Figure 1. Since this project is very much in line with utilities, the utility company was consulted and the outcomes are shared in the stakeholder consultation section.

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

In addition to the development of road, there are other development projects proposed within the vicinity of izzudheen magu. Relevant developments in the proposed areas include:-

- Shifting of all the go-downs on izzudheen magu
- South harbor food court development project

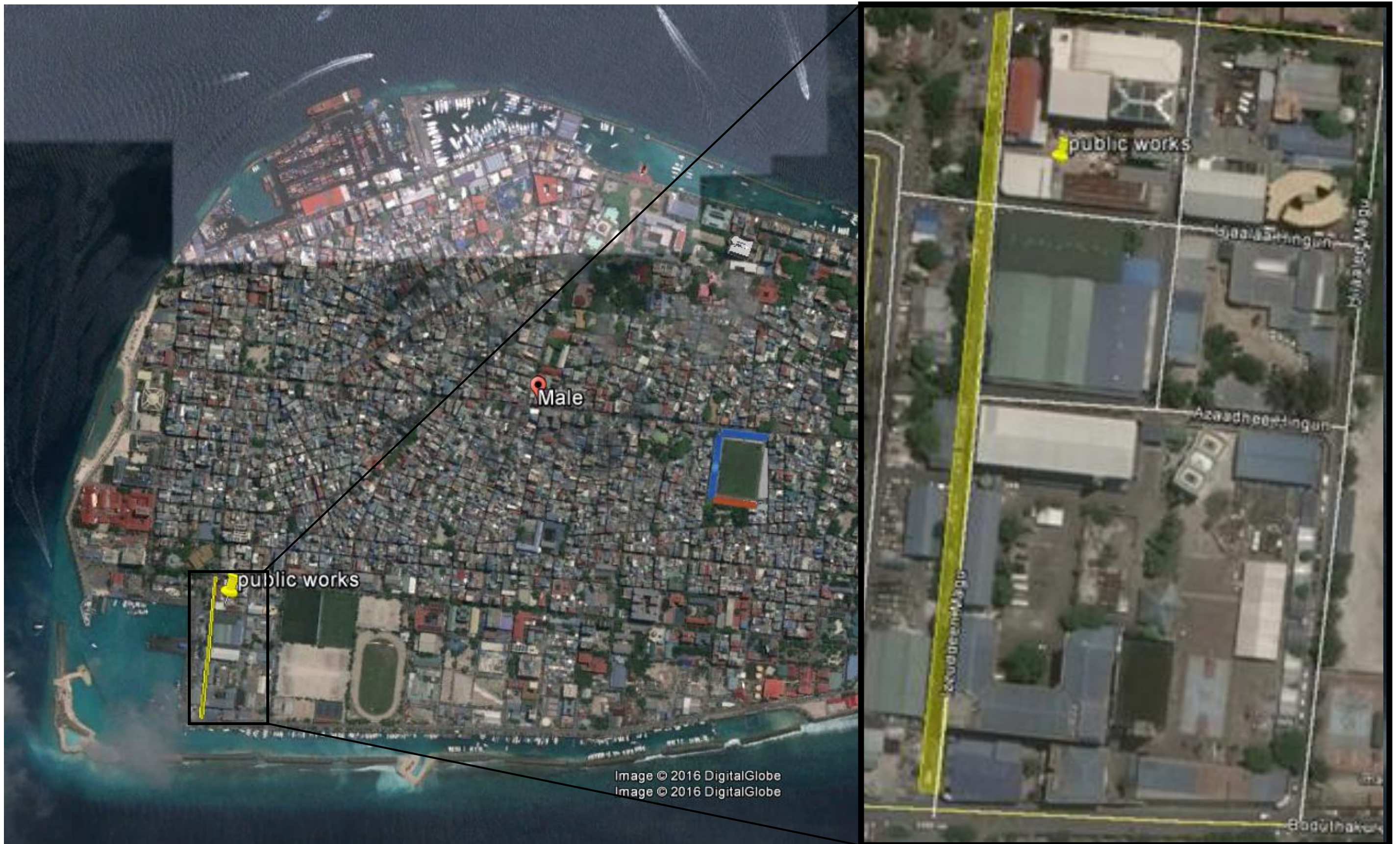


Figure 1. Map of Male' showing project location and groundwater quality survey locations

3.2. Description of existing facilities

The roads of Male' have been paved with bricks and is the same for izzudheen magu. The road has open drainages. Underground runs the water, sewer and electricity lines.

3.3. Proposed works

The major components of the project are as follows;

- Application of aggregate base
- Asphaltic concrete construction
- Application of road marking

The detailed construction methodologies for these three major works are explained in detail from section 3.8 – 3.10. The site plan and detail drawings are attached in appendix C of this report.

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 for the development of izzudheen magu are outlined in Table 1 below:-

Table 1. Major inputs required for the proposed project (per island)

Input resource(s)	Source/ type	Qty/Volume	Source of resource	
Machinery and equipment	Bulldozer	1	Contractor	
	Motor Grader	1	Contractor	
	Shovel	6	Contractor	
	Water tankers	1	Contractor	
	Smooth wheeled Rollers with vibrator	1	Contractor	
	Tipplers to carry ABC materials from stockpile to site.	2	Contractor	
	Approved Hot mix plant	1	Contractor	
	Trucks to transport AC Mix material.	1	Contractor	
	Mechanical self-powered pavers with receiving hopper,	1	Contractor	
	Tandem or three wheeled or vibratory steel wheeled tandem roller,	1	Contractor	
	Pneumatic tyred rollers	1	Contractor	
	Hand tampers, or mechanical tampers or with small vibrating plate compactors	1	Contractor	
				Contractor
				Contractor
Fuel for operation	Petrol	80 L/day	Contractor	
Power	Electricity for operation	-	Obtained from existing grid	
Materials	Graded Crushed rock Aggregates of 37.5mm	383 m ³	Contractor	
	Graded Crushed rock Aggregates of 12mm	89 m ³	Contractor	
	Graded Crushed rock Aggregates of 10mm	56 m ³	Contractor	

	Dust	93 m ³	Contractor
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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

Project outputs	Method of generation/Qty	Method of control
New asphalted road	To be built from aggregates	NA
Construction wastes	Demolition wastes Waste oils Green waste Wastewater Greenhouse gases, effluents	Demolition and green waste gathered for one month and transferred to Thilafushi for disposal Some trees planted in Male' industrial village Connection made to sewer system of the island to dispose waste water
Wastes generated from workforce	1.2 m ³ per day	Managed according to the existing waste and sewerage scheme of island
Noise	Localized to the project site	Unavoidable, but could be minimized by limiting working hours to daytime only and completing the project within the earliest possible duration.

3.5. Workforce

The workforce required for the construction shall be stationed in housing facilities in Male'. Utility services such as water, sewer and electricity networks utilized will be of the existing facility on the housing facility. 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

Designation	Number	responsibility
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.
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

No temporary project housing facilities will be required as the workforce will be staying in housing facilities in Male'.

Project site setup will be done within Male' industrial village location. The proposed temporary project site setup would include a small hut constructed from metal pipes joined together by brackets, with tin roofing. Waste generated will be temporarily stored and disposed of to Thilafushi.

3.8. Detailed construction method for aggregate base course works

1. Approved ABC material will be tested for gradation after arrival from supplier to our stockpile.
2. In stock pile ABC material will be placed separately as shown in attached photo1, from mixing with other materials.
3. Sampling will be done as per BS 812:Part 103:1984 clause 5, and tested with approved laboratory.
4. After verifying ABC material with consultants date for laying will be scheduled.
5. Prior to start laying ABC following precaution will be taken for safety as per company safety plan and the same has to be confirmed from Engineers In charge:
6. Existing road crossing will be closed by using warning tapes, flash lights, warning boards etc.
7. Prior to start of laying Asphalt Base course material, consultants and traffic Department will be informed one day before.
8. The foundation to receive ABC should be prepared to the required grade, camber and the dust and either loose material are cleaned.
9. Also existing sub base surface depression and pot-holes are filled and the corrugations are removed by scarifying and reshaping the surface to the required grade and camber as necessary.
10. The ABC material will be cartage to site and deposited/placed at suitable intervals, and by using level grader spread uniformly over the full width of the formation to the required thickness as shown in the drawings in one layer, not exceeding 100mm compacted thickness.
11. At each point base course material shall be process with water as necessary to bring its moisture content to a uniform level throughout the material suitable for compaction.
12. The base material after grading/spreading properly, compaction is done by a three wheeled power roller/vibrator roller of capacity 8 tonnes.
13. Compaction will be started from the edges, the roller run forward and backward until the edges are compacted. The run of roller is then gradually

shifted towards the centre line of the road, uniformly overlapping each preceding rear wheel track by one half widths. This process is repeated by rolling from either edge towards the centre line until adequate compaction is achieved.

14. At site ABC layer shall be compacted using suitable compaction equipment approved by the Engineer to not less than 95% of the maximum dry density determined in lab by B.S. 1377-75 Compaction Test (4.5 km rammer method).
15. The top of base course layer shall be maintained for required thickness, shape, levels and grades as required in the drawings and shall be within the tolerances as specified in the specifications.
16. In the course of the construction, the level shall be checked using control/dipping pegs, set out at regular interval along both sides of the pavement.
17. Joint survey works on the existing road profile level shall be carried out to establish the original profile of the location being overlaid.

To maintain a high quality output and safety the following procedures will be followed;

3.8.1.1. QUALITY CONTROL:

1. Ensure that the consultant has approved all the requirements such as test and inspection for Aggregate base course materials, existing sub base course levels and condition.
2. All documents are in proper order.

3.8.1.2. INSPECTION/TESTS:

1. Gradation of material at site.
2. Test for thickness and evenness.
3. AIV & Degree of compaction tests as specified in contract documents.

3.8.1.3. SAFETY:

1. Warning signs/tapes shall be installed as and where necessary.
2. Equipment are checked and in good condition.
3. Access to working area must be secured and with precautionary signs.
4. Safety supervisor must assess site for any hazard and to inform Project engineer to avoid untoward incidents.

3.9. Detailed construction method for asphaltic concrete construction works

This work describes the procedure for Construction of Asphaltic Concrete Surface in single layer of 40mm thick as per specifications and drawings shown in appendix C.

3.9.1. Materials

1. **Binder** material for prime coat: Medium Curing Cutback Bitumen MC 30 on ABC surface.

2. **Binder** material for AC mix: 80-100 grade Bitumen.
3. **Aggregate and filler:** The *coarse aggregate* should fulfill the following requirements:

Aggregate Impact Value, Maximum Percentage : 30

Flakiness index, max percentage : 35

Los Angeles abrasion value, max percentage : 40

Fine aggregates passing 4.75mm sieve, either crusher fines or river sand.

The gradation of aggregates and *filler* (quarry dust) should confirm to those given in table1.

Table1. Gradation of aggregates for Asphaltic concrete.

Sieve size,mm	μ	Total % by weight passing including filler if used
25		
19		100
12.5		80-100
9.5		73-93
4.75		52-69
2.36		32-50
1.18		25-43
	600	19-35
	300	14-27
	150	9-18
	75	5-10

4. **Asphalt concrete mix:** Marshal stability test-number of blows to be applied on either side of specimen : 75

Marshal Stability value, minimum KN : 3.3

Marshal Flow value (0.25) : 8 to 18

Air voids in mix, percent : 3 to 5

Voids filled with bitumen, percent : not less than 14

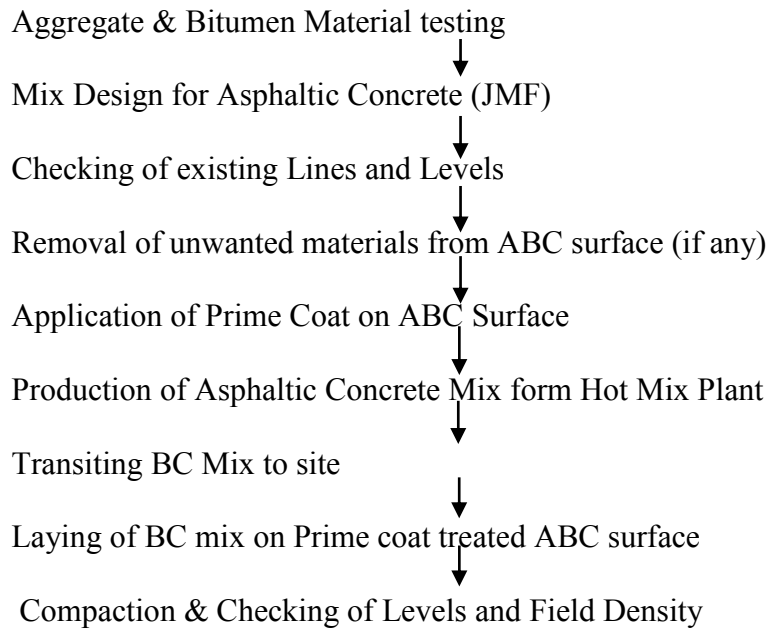
Percentage binder content by total weight of mix : 5.0-7.0.

3.9.2. **Equipment's required**

Following is the list of equipment's that would be required for the asphaltic concreting works;

1. Approved Hot mix plant.
2. Trucks to transport AC Mix material.
3. Mechanical self-powered pavers with receiving hopper,
4. Tandem or three wheeled or vibratory steel wheeled tandem roller,
5. Water tanker,
6. Pneumatic tyred rollers
7. Hand tampers, or mechanical tampers or with small vibrating plate compactors

3.9.3. **Work sequence programme**



3.9.4. **Work procedure**

1. **Verification of all approved documents:**

1. All materials used in AC construction, with their tested results, their combined gradation and JMF (Job Mix Formula) will be proposed 2 weeks before for consultants approval with type, source, composition of aggregate, binders with mix design details.
2. After approval of Mix design, source of Hot Mixing Plant will be approved.
3. After verifying and approving of Asphaltic concrete with consultants date for laying will be scheduled.
4. In case of change in material or source of material a new JMF will be submitted and the same will be approved.
5. All safety precaution will be followed near existing road crossing with warning tapes, flash lights, warning boards etc., and also a separate method statement will be approved for road joining to existing road.
6. Prior to start laying Asphaltic Concrete material consultants and traffic Department will be informed one day before.

2. **Preparation of the existing base course layer:**

7. The Layer on which the Asphaltic Concrete (AC) to be laid will be checked for proper profile, pot holes, ruts, shape and conditioned to the specified lines, grades and cross section in accordance with the working drawing.
8. The surface on which the Asphaltic Concrete layer to be laid will be kept swept clean free from dust foreign matter using broomer.

9. Bituminous works will not be started during rainy weather or when the surface is damp or wet or when Equipment required for completing the job are not available at site.
3. **Application of prime coat:**
 10. The bitumen binder is heated to a specified temperature 60⁰C before its application on the existing ABC surface.
 11. Prime coat will be applied by means of hand sprayers at an range between 0.5 and 1.5 liters per square meter (1.0 and 3.0 gallon/square) as rate shall will be such that surface becomes dry with a matt finish within 24 hours. Also where surface condition necessitates additional binder will be applied with the approval of Engineer in charge.
 12. Spraying temperature for binder will be within the contract specified temperature ranges shown in table 1.

Table1. Binder heating temperature as per contract specification.

Binder type	Temperatures degrees C
MC 30 or 45 percent Cutback Bitumen	40-50

13. Asphalt concrete will not be constructed until prime coat has cured in opinion of Engineer in charge, and also in areas being treated precaution will be taken to prevent surface being spattered or marred.
4. **Preparation and placing of premix:**
 14. The premix is prepared in a hot mix plant of a required capacity with the desired quality control.
 15. Attached *temperatures record sheet1* will be completed in presence of consultant satisfying temperatures of mix in mixing plant, during transportation, during delivery of mix at site and during compaction.
 16. The premix material will be transported form hot mix plant to the site with well condition trucks and will be spread by means of self-propelled sensor paver with suitable screeds capable of spreading tamping and finishing the mix to a specified grade, lines and cross sections.
 17. The camber and the thickness of the layer are accurately verified.
 18. The premix will be laid manually in restricted location if any and in narrow widths where paver cannot be operated.
 19. With the approved Method statement for transverse joints, sealing will be made by which it will be cut vertical to the full thickness of the existing road and the surface will be coated with heated bitumen, prior to the placing of fresh mix material.

5. **Rolling:**
Rolling

20. Rolling will be completed in three stages Initial, intermediate and final reading. In all stages rolling will commence at the low side of the spread and progress towards the higher side parallel to the center line of the pavement.
21. Initial or breakdown rolling is done by using 8-10 tonnes static weight (tandem or three wheel) or vibratory steel wheeled tandem rollers Under controlled temperature ranges as shown in attached temperature sheet. Speed of the roller will be as given in clause D.9.6.7 (g) shown in table 2.
22. Also wheels of roller are kept damp with water to prevent the mixture form adhering to the wheels.
23. All necessary precautions will be taken to prevent dropping of oil, grease, petrol or other foreign matter on the pavement either when the rollers are operating or standing.
24. Rolling of the longitudinal joints will be done immediately behind the paving operation. After this, the rolling will commence at the edge parallel to the centering to the pavement.
25. Intermediate rolling will be done with a fixed wheel pneumatic tyred roller (PTR) of 15 to 30 tonnes having a tyre pressure of 7 kg per cm².
26. Each pass of the roller will uniformly overlap not less than 1/3rd of the tack made in the preceding pass.

Table 2. Speed of rollers.

Type of roller	Speed in Km/hr		
	Breakdown	Intermediate	Finish
Steel Wheeled Roller	3	5	5
Pneumatic Tyred Rollers	5	5	8
Vibratory Rollers	5	5	-

27. Final rolling will be accomplished with static tandems or vibratory tandems without vibration.
 28. In inaccessible area to rollers compaction shall be done by hand tampers, or mechanical tampers or with small vibrating plate compactors with approval of Engineer in charge.
 29. Rolling will be continued till the density achieved is at least 98% of the Marshall Density.
- 6. Quality control of Asphaltic concrete construction.**
30. Material inspection and testing will be carried out in accordance with the contract specification, with periodical check made for aggregate grading, grade of bitumen, temperature of aggregates and paving mix during mixing and compaction.
 31. Attached sheet2 will be filled at site covering compacted AC layer thickness, density achieved at site from extracted cores.

7. Finished surface:

32. After laying and compaction, Bituminous Concrete (BC) surface levels will be jointly checked by the Engineer and consultant representative.

To maintain a high quality output and safety the following procedures will be followed;

QUALITY CONTROL:

1. Ensure that the consultant has approved all the requirements such as test and inspection for Asphaltic concrete materials, existing Aggregate base course levels and condition.
2. All documents are in proper order.

INSPECTION/TESTS:

1. Inspection for any change of source material from the approved one.
2. Temperatures of mix at all stages as indicated in sheet1.
3. Test for thickness and evenness.
4. Test for field density.

SAFETY:

1. Warning signs/tapes shall be installed as and where necessary.
2. Equipment are checked and in good condition.
3. Access to working area must be secured and with precautionary signs.
4. Safety supervisor must assess site for any hazard and to inform Project engineer to avoid untoward incidents

3.10. Detailed construction method for road markings

This work describes the procedure for the application of road marking paints;

3.10.1. Materials and tools

Road marking Paint - White, Road Marking Paint – Yellow, Soap Solution (not detergent) Cleaning Cloth, Roller Brush, Paint Brush etc.

Technical characteristics – White Road Marking Paint

1. Density – approx. 1.56gr/cm^3
2. Viscosity – 80-85 KU at 20°C
3. Dry time – $\pm 20\text{min}$ at 20°C and wet layer thickness of 0.3 - 0.6mm
4. Thinning – maximal 3% with Velunine thinner VG40 aromat free
5. Consumption – 0.47 - 0.63kg/m^2

Technical characteristics – Yellow Road Marking Paint

1. Density – approx. 1.35gr/cm^3
2. Viscosity – 80-85 KU at 20°C
3. Dry time – Less than 20 min. and wet layer thickness of 0.3 – 0.6mm
4. Thinning – maximal 3% with Velunine thinner VG40 aromat free
5. Consumption – 0.6 - 0.7 kg/m^2

3.10.2. Application procedure

1. Prepare the surface to ensure that there are no foreign matters and also dry.
2. Surveyor will Mark the boundary lines of painting area using choke or a pint marker as per the issued drawing. And get approval from Consultant prior to application of Road paint.
3. Carefully mix and prepare paint materials in accordance with manufacture direction. Use suitable thinner approved by Paint manufacture and maximal 3%.
4. Using Roller Brush/paint brush a single coating of road marking paint is applied on to the prepared surface evenly and let to dry. Before painting adjacent areas shall be protected by using of masking tape or a boarder made of plywood shall be used.
5. Apply paint to an even and fine texture, leave no evidence of rolling such as laps, irregularity in texture, skid marks.
6. All lines shall appear by eye to be straight or where designated as a true curve.
 - Tolerances for location with respect to the drawings are:
 1. Transverse location 20mm
 2. Longitudinal location 50mm
7. Monitor applied paint dry time to maintain quality.
8. Maintain average thickness of 0.4mm.

3.10.3. Precautions

1. Maintain containers used in mixing and application of paint in a clean condition, free from foreign materials and residue.
2. Stir the paint before application to produce the mixer uniform density, stir as required during application.
3. Do not stir surface film in to materials. Remove film and if necessary, strain materials before using.
4. Don't paint over dirt, rust, scale, grease, moisture.
5. Don't apply succeeding coats until the previous coat has dried properly

3.10.4. Safety

Personnel Protective Equipment such as Respiratory mask, Safety Shoes, Hard Hat etc. shall be worn at the time of painting.

3.11. 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.

3.12. 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.

3.13. Project duration and schedule of implementation

The izzudheen magu road development project is intended to be awarded to a contractor once the EIA process have been completed. Estimated date is around April 2017. Construction works shall commence as soon as the contract has been awarded and is expected to be completed by August 2017.

The entire project is estimated to be completed within 120 days from project commencement date. The major milestones of the project are as follows:-

Table 4: estimated durations required to achieve major milestones of the project

Task Name	Duration/Days
Road Works	120
Preparation of sub-base	50
Installation of curbstones	45
Construction of pavement	50
Laying of ABC	50
Asphalt works	50
Road painting	15
Road lights	30

4. METHODOLOGY

4.1. Water quality

One groundwater sample was collected from a well in public services. Public services is located on the side of izzudheen magu and hence would give a good picture of the quality of ground water in izzudheen magu. Sample was collected from a tap inside the public works, the location is sound on Figure 1 and the geo coordinates are shown on Table 5.

Samples were collected in 500 mL plastic bottles by first rinsing the bottle with the sampling water tap three times. Samples were then sent to NHL laboratory for testing.

Table 5. Descriptions of groundwater sampling location with GPS coordinates

Island	Location	GPS Coordinates	
		Longitude	Latitude
Male'	Public works	73.50362726285123	4.171605143856486

4.2. Terrestrial vegetation

Since all the trees in izzudheen magu needs to be removed, all the trees on the road were visually counted.

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 (Zahid, 2011) consisting of nearly 1192 islands on a double chain of 26 natural atolls (administratively divided into 20 atolls), 80-120 km wide, in the Laccadive Sea in the Indian Ocean (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 km² of which roughly 300 km² of landmass (Zahid, 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 (Zahid, 2011). These coral Atolls are located on the 1600 km long Laccadives-Chagos submarine ridge extending into the central Indian Ocean from the SW coast of the Indian sub-continent (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 km² to around 5.0 km² 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 (Zahid, 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 (Zahid, 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 (Zahid, 2011).

Sea surface temperature (SST) is reasonably constant throughout the year and ranges between 28 to 29 °C. Mean monthly SST rises from December/January to April/May. However, May 1998 experienced a mean monthly SST of 30.3 °C which is expected to occur every 20 years. Furthermore, temperature drops rapidly to below 20 °C at a depth of 90-100 m (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 Male' is Hulhule (about 1.36 km away), the data from this station is used to analyse 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 2).

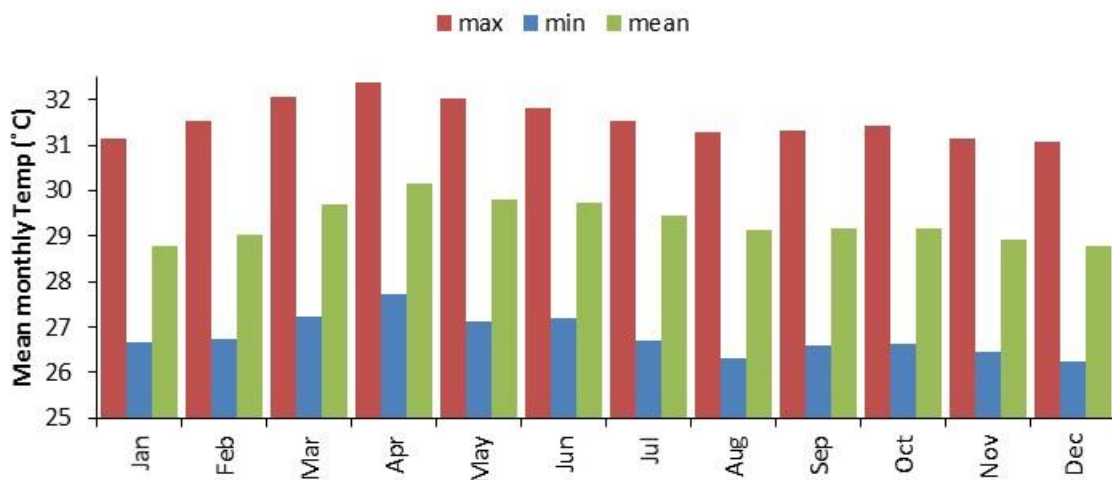


Figure 2. Mean, minimum and maximum monthly temperatures (°C) for Hulhule from 2008 to 2015 (Data obtained from the Bureau of Meteorology, Maldives)

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 Naifaru.

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 3).

Generally majority of the roads in Male' floods during heavy rainfall as the drainage systems are not maintained. As for Izzudheen road, it also gets flooded badly. But with the introduction of the recent drainage system the flooding is not as severe as it was previously. Nonetheless when there is heavy rain the road still gets flooded. Generic analysis of vulnerability of Male' area to flooding is given under hazard vulnerability.

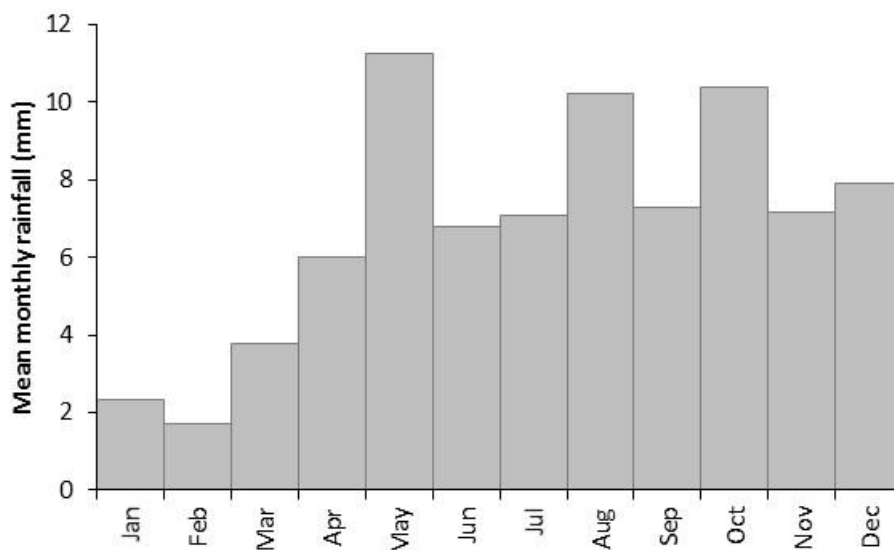


Figure 3. Mean monthly rainfall (mm) for Hulhule from 2006 to 2015 (Data obtained from the Bureau of Meteorology, Maldives)

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 4).

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 4).

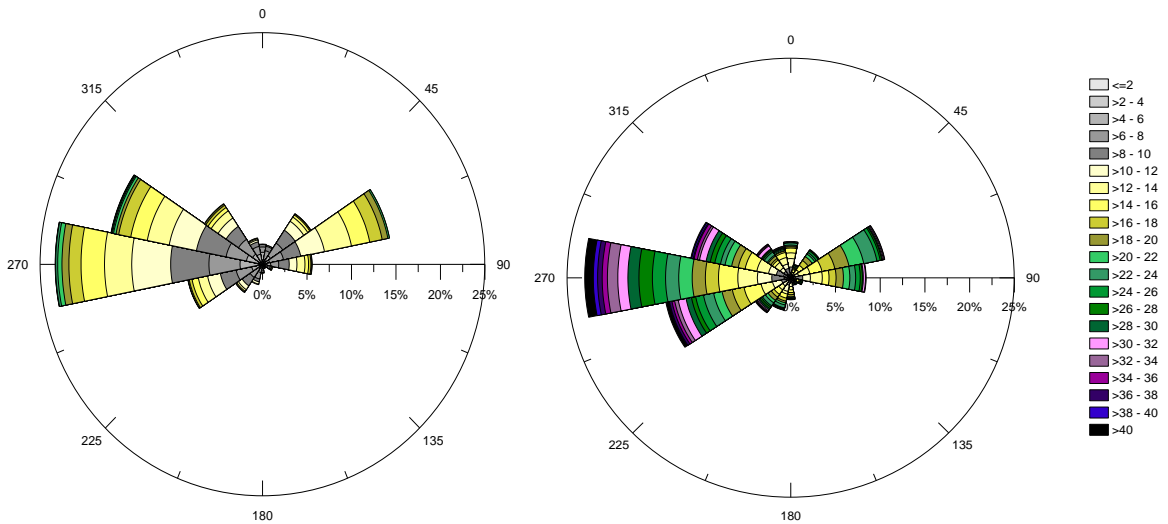


Figure 4. Mean (right) and maximum (left) wind speeds for Hulhule from June 1998 to December 2015 (Sourced from LaMer, 2016)

5.3. General setting of Male'

Located in the centre of Maldives, Male' is the capital city of the country located at the southern periphery of north Male' Atoll at geographic coordinates of 4°10'29.06"N and 73°30'36.69"E. The reef system hosting the island is exclusive to the island. The land area of Male' is only about 194 ha and the island has been reclaimed to the edge of the reef. The closest inhabited islands to Male' are Villingili and Hulhumale' at distances of approximately 1.58 km and 4.25 km respectively. The island hosting the major international airport of the country, Hulhule' is located just 1.36 km to the east of Male' (Figure 5).

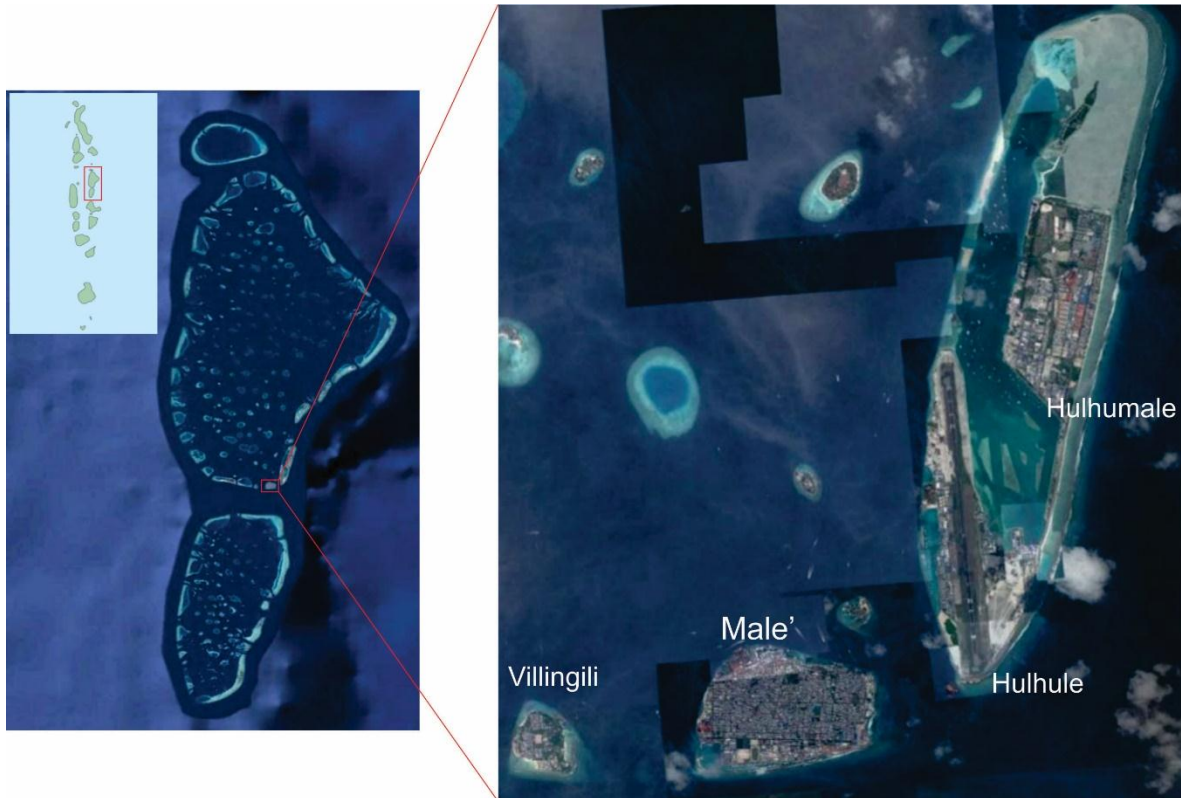


Figure 5. Location of Male' Atoll within Maldives (left) and location of Male' and neighboring islands within Male' Atoll (right)

5.4. Water quality

Groundwater test results were compared with the EPA standards for the parameters with a specified guideline value as follows:-

- Conductivity - < 1500 $\mu\text{S}/\text{cm}$;
- pH – 6.5-8.5;
- Nitrate - < 50 mg/L

Groundwater test results from NHL laboratory are attached in Appendix D of this report.

Surprisingly all the parameters were within the optimal ranges. The conductivity of the area is especially lower at 554 $\mu\text{S}/\text{cm}$.

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

Parameter	Public works
Physical appearance	Clear
Conductivity ($\mu\text{S}/\text{cm}$)	554
pH	7.1
Nitrate	0.01 mg/L
TPH	<2 ppm
Salinity (‰)	0.24

5.5. Terrestrial vegetation

Only 2 types of vegetation species were found on izzudheen magu, Sea Hibiscus (*Hibiscus tiliaceus*) and Coconut Palms (*Cocos nucifera*). While the Sea Hibiscus trees were all mature trees, the Coconut Palms were not mature and less than 4 ft tall.

5.5.1.1. Land clearance

For the asphaltting of izzudheen magu all the vegetation on the road needs to be cleared. There are only two types of trees on izzudheen magu; 18 Sea Hibiscuses and 3 small Coconut Palms.



Figure 6. Sea Hibiscus (*Hibiscus tiliaceus*) trees found on izzudheen magu

5.6. Socioeconomic status

5.6.1.1. Demography

Until very recent, the Maldives had been a highly centralized country whereby the basic necessities such as economic opportunities, education, health and employment opportunities to a satisfactory level were only available in Male'. Even now, employment and economic opportunities as well as health facilities are not satisfactory in the outer Atolls of Maldives. The ultimate result of this is the overcrowding of the island due to immigration of citizens from other islands for better employment, education, health and economic opportunities.

It is estimated that about 38 % of the Maldivian population live in greater Male' region (ENFPA, 2016). The registered population of Male' as of 2014 was 65,667 however, 103,963 have been enumerated to be residing in Male. Indicating that about 63 % of the population living in Male' are immigrants. The annual population growth rate had however, decreased

from 5.6 in 2006 to 2.69 in 2014 (Table 7). Male-to-female sex ratio of the city is 108% as per the enumerated population in 2014.

Taking approximately 1,852,547 m² as the total land area, the population density of Male' city works out to be about 0.07 people per m².

Table 7. Population details of greater Male' region (sourced from NBS, 2014)

Census	Both sexes	Male	Female	Annual population growth rate (expn)
Enumerated 2006	103,963	51,992	51,701	5.6
Enumerated 2014	133,412	66,328	67,084	2.96
Registered 2014	65,667	34,078	31,589	



Figure 7. High rise buildings in Male' for housing purposes (sourced from UNFPA, 2016)

5.6.1.2. Social amenities and accessibility

Currently, utility services are provided to Male' by 2 utility companies, State Electric Corporation (STELCO) and MWSC. Clean desalinated water and sewerage facility is provided by MWSC while electricity is provided by STELCO. Waste disposal services are now provided by Waste Management Corporation (WAMCO). Waste is collected at the waste management center of Male' which is later transferred to Thilafushi for disposal.

Liquefied petroleum gas is used for cooking in the households and is currently provided by 2 main parties, Maldivian Gas Pvt. Ltd. And Villa

There is 1 public hospital in Male', Indhiraa Gaandhee Memorial Hospital (IGMH) and 1 private hospital, ADK as well as 1 hospital owned by the MNDF known as Senahiya. In addition to the hospitals, there are about over 45 private clinics and medical centers in operation in Male'.

There are over 38 education providing facilities in Male' from preschool to tertiary education facilities, government, community and private owned (Ministry of Education, 2015).

5.6.1.3. Road based transportation

Public road based transportation in Male' include taxi and pickup services. There are about 9 registered taxi/pickup centers in the Maldives (Transport authority of Maldives). Recently, the GoM has authorized taxi services via motor cycles. Moreover, heavy load Lorries are used for unloading of containers imported from abroad via the Maldives Ports Limited (MPL).

The most common road based vehicle owned by the public is motorcycles. Motorcycle overcrowding is a major issue in Male' especially lack of parking spaces as every household owns at least 1 motorcycle in Male'. In fact according to Transport Authorities statistics there are 7,778 motor cycles in Male' as of 31st December 2016.

5.6.2. 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).

5.6.2.1. 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, Male' falls within high to moderate risk zone (Figure 8) (UNDP, 2006), however, it should be noted that only 11 cyclones have been recorded across the Maldives since 1877.

5.6.2.1. 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, Male' falls into the moderate risk zone of storm surge hazard (UNDP, 2006) (Figure 8).

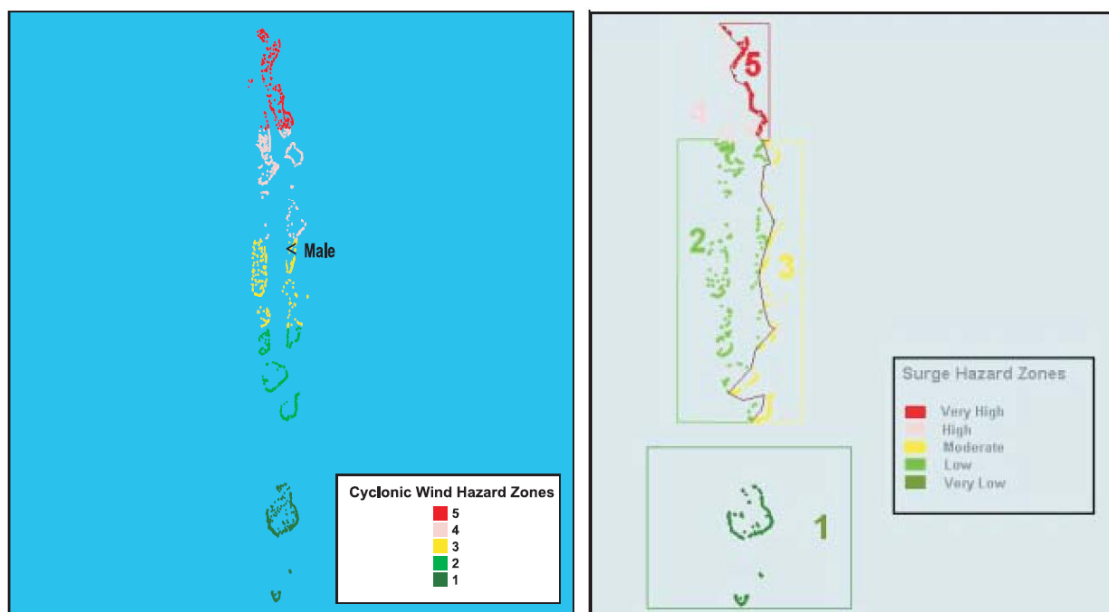


Figure 8. Cyclonic wind hazard map (left) and storm hazard map (right) of the; category 5 is the highest risk zone and category 1 is the lowest (Adapted from UNDP, 2006)

5.6.3. Flooding

Rainfall data from Hulhule' meteorological station have been used to analyze the flood and drought years across Male'. 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 9) indicating that flooding is a rare occurrence at this part of the Maldives.

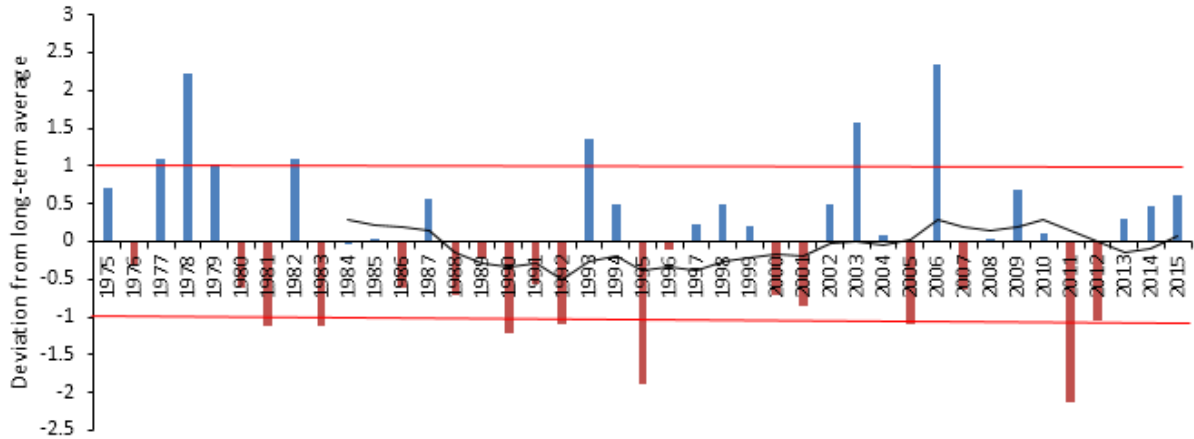


Figure 9. Rainfall anomalies for Hulhule from 1992 to 2015 with the 10 year moving average. Red lines indicate +1 and -1 standard deviations from the mean. (Data obtained from the Bureau of Meteorology, Maldives).

6. STAKEHOLDER CONSULTATION

An integral part of this EIA has been consultation with the relevant stakeholders. As such STELCO, MWSC, MTCC and HPA were consulted. The main discussions of the consultations are highlighted in the following sections. The attendance sheets are attached in appendix E of this report.

6.1. Consultation with STELCO, MWSC, MTCC

A stakeholder consultation meeting was held at Housing Ministry on 17th January 2017 at 1400 hours. The meeting included representatives from MHI, STELCO, MWSC, MTCC and EIA consultant. The attendees of the meeting are shown on the table below.

Table 8: participants of consultation meeting with STELCO, MWSC and MTCC

Name	Designation	Office	Contact
Nafha Aujaz	Environment Analyst	MHI	7721554
Mohamed Niyaz	Senior Engineer	STELCO	7787021
Ali Niyaz	Engineer	STELCO	7771520
Mahfooz Abdul Wahhab	Environmental Consultant	-	9994467
Umar Zahir	Project Manager	MTCC	7786598
Mohamed Ali	Project Engineer	MWSC	7797975
Aishath Bariyya	Engineer	MHI	7938587
Anoosha Hashim	Assistant Project Officer	MHI	-

Following are the key discussions of the meeting;

MHI highlighted that the whole of water and sewerage component of any land of Male' comes under the mandate of MWSC and hence the component has been collaborated with them from the initial stage of MIV project. However, since the works of water and sewerage has been much delayed, as any further delay cannot be allowed to the overall development schedule, it has been decided that works that will impact road construction works such as pipe network laying shall be undertaken as part of the road project. Otherwise the road project would be much delayed with much impact on the overall development of the Industrial Zone. The detail design of the water and sewerage network has been undertaken by MTCC and the design shall match the requirements of MWSC. Moreover, as ultimately the network laid within MIV road project shall be ultimately used by MWSC, the works are closely collaborated with MWSC. MHI highlighted that as izzudheen magu will be asphalted in this project MWSC and STELCO need to be prepared to lay their cables and pipelines once the pipelines and chambers have been installed on the road.

6.2. Consultation with HPA

The participants of the consultations with HPA are listed in the table below.

Date: 05th April 2017

Time: 12:15

Table 9: participants of consultation meeting with HPA

Name	Designation	Office	Contact
Nafha Aujaz	Environment Analyst	MHI	7721554
Aminath Shaufa	Director, Public Health Program	HPA	7504075
Fathimath Shabana	Senior Public Health Program Officer	HPA	9832050
Anoosha Hashim	Assistant Project Officer	MHI	-

HPA highlighted that their main concerns was the safety of users during construction as well as in road operation. Moreover, the importance of health and safety of workers during construction was also stressed. It was also clarified if there would be any chances of trapped water being found in the working sites as it may lead to health issues such as that caused by mosquito breeding.

It was assured that purpose of the project is also improve the usability and safety of the road and standards mandated by the Transport Authority is well incorporated into the signs and safety measures of the road. Moreover, the required signs and precautionary measures during construction period shall be followed. Also the proper safety gears are provided to works and it is required that they use it during work. Standing or trapped water bodies would not be found within the site and shall not be an issue in this project.

6.3. Consultation with EPA

The participants of the consultations with EPA are listed in the table below.

Date: 23rd April 2017

Time: 11:00 AM

Name	Designation	Office	Contact
Aminath Mohamed	Environmental analyst	EPA	3335949
Mahfooz Abdul Wahhab	EIA consultant	-	9994467
Aishath Bariyya	Engineer	MHI	7938587

Ibrahim Rashihu Adam	Environment analyst	MHI	7785434
Hussain Ibrahim	Assistant Environment Officer	EPA	3335949
Adam Mubeen	Assistant Engineer	EPA	3335949

Following are the key discussions of the meeting;

- MHI highlighted that the vacating of go-downs in izzudheen magu is ongoing.
- MHI informed EPA that upon consultations with MWSC regarding the water and sewer pipelines on izzudheen magu have been communicated and that they have confirmed that they already have the necessary materials to lay the pipes in line with the izzudheen magu road development project.
- MHI highlighted that alternative access for MHI office and *Kalhuthukalaa koshi* will be provided before izzudheen magu is closed.
- MHI highlighted that all the equipment's height will be below the boundary wall of *Kalhuthukalaa koshi* and hence there won't be any security issues from the MNDF.
- Discussing about the removal of existing facilities on the road, MHI highlighted that the storm water pump on the road will not be removed as they have initially designed it such that it does not come into the expansion area of izzudheen magu.
- EPA highlighted that there would not be a high noise and smell disturbance to the public as there are no residential houses in the vicinity and the *Villingili* ferry terminal is far away to be impacted.

6.4. Consultation with Transport Authority

An invitation requesting for consultation was dispatched to Transport Authority from MHI on 2nd April 2017 but there was no response from the Transport Authority. A copy of the invitation is attached on appendix E of this report.

7. OPTIONS ASSESSMENT

7.1. Purpose and need for the proposed development

As discussed in the introductory section of this report, Izzudheen Magu is one of the key access roads to Male' industrial Village area and also shall be a major route within the ring road plan of the city. Therefore it is very important to develop this road by asphaltting and developing drainage system as heavy machinery will be travelling on this road. The drainage systems are critical to control the flooding which occurs on this road almost every time there is a heavy rainfall.

7.2. 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:-

7.2.1. Option 1: Maintain status-quo

The first option is a “Do Nothing” scenario, whereby Izzudheen Magu will remain in the condition as is now. Under this scenario, no trees will be removed, there will be no wastes generated during construction and any construction related hazards will be avoided, however, the positive outcomes which are anticipated from the project will not be achieved.

Currently, Izzudheen Magu is constantly used by heavy machinery and brick roads are not very effective for roads used by heavy vehicles. As a result, the bricks are cracked and in a bad condition, which also causes damage to the vehicles using this road. Moreover, due to negligence, the drainage system on this road is not very effective in infiltration of storm water, which leads to flooding of the road even during moderate rainfall. This is the condition of almost all roads in Male'.

The proposed project include asphaltting, installation of a proper drainage as well as broadening of Izzudheen Magu, which will ease traffic flow as well as reduce the risk of flooding. Since the road will give access to the newly developed industrial village, it will indirectly ease the traffic flow in other roads as well.

If the proposed project does not take place, however, the aforementioned benefits will not be achieved. This will ultimately decrease the credibility of the government as it will be labeled as not able to provide a solution to the highly congested, Male'.

7.2.2. Option 2: Use of tar in place of asphalt

The second available option is the use of concrete for paving in place of asphalt, however, concrete surfaces are very fragile, even more fragile than bricks, which would lead to costly maintenance of the road constantly.

Preferred material and justification: The preferred material for road paving is asphalt as asphalt pavements allow for land development plans that are more thoughtful, harmonious with natural processes, and sustainable. They conserve water, reduce runoff, promote infiltration which cleanses storm water, replenish aquifers, and protect streams. Asphalt is becoming the more widely used form of road development in most countries.

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 development of southwest harbor, Male' City. Maldives (Sandcays, 2015); and
- Environmental Impact Assessment for the proposed industrial village project, Male' City. Maldives (Sandcays, 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 from abroad;
 - Vegetation clearance;
 - Impacts on traffic flow of the area;
 - Mobilization impacts
 - Trenching; and
 - Risk of accidents and pollution on workers and local population.

2. Operational impacts:-

- Groundwater quality from asphaltting;
- Social wellbeing-road traffic flow;
- Risk of flooding; and
- Impacts on landscape integrity and scenery.

Hazards were assessed using the following matrix (Table 10).

Table 10. 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 10). 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 11 below.

Table 11. 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 12. 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 heavy machinery	Certain	Moderate	Very high
Groundwater quality from oils and chemical spills	Possible	Moderate	Medium
Water quality from waste water	Certain	Moderate	Very high

Generation of constructional and decommissioning wastes	Certain	Minimal	Medium
Oil and chemical leakage	Possible	Moderate	Medium
Introduction of non-native species from abroad	Possible	Major	High
Vegetation clearance	Certain	Major	Significant
Impacts on traffic flow of the area	Certain	Moderate	Very high
Impacts of trenching	Remote	Minimal	Negligible
Risk of accidents and pollution on workers and local population	Possible	Major	High
Mobilization impacts	Certain	Minimal	Medium

Impacts during construction phase of the project are mainly anticipated to be short-term and reversible (Table 13) as most impacts will last only for the duration of the construction phase of the project.

Table 13. 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
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 from abroad	Direct	Negative	Island	Long-term	Irreversible
Vegetation clearance	Direct	Negative	Island	Long-term	Irreversible
Impacts on traffic flow of the area	Direct	Negative	Island	Short-term	Reversible
Impacts of trenching	Direct	Negative	Local	Short-term	Reversible
Risk of accidents and pollution on workers and local population	Direct	Negative	Local	Short-term	Reversible
Mobilization impacts	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 12) 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 12), 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 directed the municipal waste water network;

Wastewater will be disposed of directly into the sea during the construction phase, however, chemicals used for asphaltting is composed of very hazardous chemicals. If these chemical are spilled on the ground, there is a high risk that it will contaminate groundwater at Izzudheen Magu. 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 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.

Genarally, 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.

8.3.5. 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.

8.3.6. *Introduction of non-native species from abroad*

The risk of introduction of a non-native species from the imported soil is very high in this project as soil is a major carrier of seeds and pollen which might germinate. In addition to seeds, soil could also host soil bugs and insects which are not found in the Maldives. In case a non-native species is introduced, the risk is major as they might outlive the native species, completely wiping out the native vegetation and (or) insects. In addition to this, they are extremely difficult and highly costly to get rid of once they become established.

8.3.7. *Vegetation clearance*

Due to the nature of the project, all the vegetation on the road to be developed will need to be removed. There are 18 Sea Hibiscuses and 3 small Coconut Palms which would need to be removed from the project area. This is one of the most environmentally significant impacts due to the proposed development as Male' is already short of vegetation.

8.3.8. *Impacts on traffic flow of the area*

Izzudheen Road is a highly utilized road, mainly by heavy load vehicles such as cargo Lorries, pickups and wheel loaders. Closure of this road is certain as the proposed development cannot commence without road closure which would have impacts on the traffic flow indirectly on the other roads as well.

8.3.9. *Trenching impacts*

One of the main impacts during trenching include generation of dust and cause public nuisance and outbreak of certain diseases such as common cold. People who are allergic to dust and with asthma or sinuses are particularly more vulnerable.

8.3.10. *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.

8.3.11. *Mobilization impacts*

Impacts due to mobilization is anticipated be low and mainly limited to social impacts due to mingling of expatriate workers with the local population, however, the impacts are predicted to be very minimal. Other impacts such as those expected to arise from provision of accommodation and utility services is negligible as the workforce will be stationed within the island in existing houses and utilizing existing utility facilities.

Mobilization and use of machinery and equipment such as excavators and trucks are anticipated to be low as they will be parked inside the project area.

8.4. Operational impacts

Table 14. Predicted impacts and risk analysis anticipated during operation phase of the project

Potential impact	Likelihood	Consequence	Risk rating
Groundwater quality from asphaltting	Likely	Major	Very high
Social wellbeing- road traffic flow	Certain	Major	Significant
Risk of flooding	Likely	Major	Very high
Impacts on landscape integrity	Certain	Major	Significant

Unlike constructional impacts, operational impacts are anticipated to be more long-term and irreversible (Table 15). 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 15. Summary of impacts during the operation phase of the project

Potential impact	Type	Nature	Range	Duration	Reversibility
Groundwater quality from asphaltting	Direct	Positive and negative	Local	Long-term	Irreversible
Social wellbeing- road traffic flow	Direct	Positive	Island	Long-term	Irreversible
Risk of flooding	Direct	Positive	Island	Long-term	Irreversible
Impacts on landscape integrity	Direct	Positive	Island	Long-term	Irreversible

8.4.1. Groundwater quality from asphaltting

Impacts on water quality due to asphaltting could be both positive and negative. Asphalt is a complex mixture of many chemical compounds which could infiltrate into the groundwater releasing chemical such as petroleum hydrocarbons into the groundwater. Therefore, it is important that the ratios and quality of asphalt composition be controlled.

A well laid porous asphalt pavement on the other hand, allow for land development plans that are more thoughtful, harmonious with natural processes, and sustainable. They conserve water, reduce runoff, promote infiltration which cleanses storm water, replenish aquifers, and protect streams. A typical porous pavement has an open-graded surface over an underlying stone recharge bed. The water drains through the porous asphalt and into the stone bed, then, slowly, infiltrates into the soil. If contaminants were on the surface at the time of the storm, they are swept along with the rainfall through the stone bed. From there they infiltrate into the sub-base so that they are subjected to the natural processes that cleanse water.

8.4.2. Risk of flooding

As mentioned in the earlier section, porous asphaltting improves infiltration capacity of the pavement, thus reduces the risk of flooding greatly. Moreover, proposed project also involves

installation of drainage systems which will contribute to the improvement of storm water infiltration into the ground.

8.4.3. *Social wellbeing*

Proposed project involves widening of one of the most heavily used roads in Male'. This will reduce to road traffic jams, indirectly improving the social wellbeing and social environment. Moreover since asphaltting is also anticipated to put an end to road flooding during heavy rainfall, this will indirectly contribute to social wellbeing of Male'.

8.4.4. *Impacts on landscape integrity*

Clearly, asphalted roads are visually more attractive than brick roads. In addition, asphaltting allows for better use of land, thus increasing the value and usability of land.

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 outlines in Table 16 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 16. 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)
CONSTRUCTION PHASE			
Air quality	<ul style="list-style-type: none"> • Daily maintenance of vehicles and machinery • Use of light fuel (low sulphur content) • Avoid unnecessary use of machinery 	Contractor	N/A
Noise, vibration and disturbance	<ul style="list-style-type: none"> • Well maintenance of vehicles and machinery • Avoid unnecessary use of machinery • Restrict working hours to day time only • Workers could wear voice cancelation headphones 	Contractor	N/A
Ground water quality	<ul style="list-style-type: none"> • Oil/chemical handling procedures should be made known to all staff members • Follow corresponding chemical handling procedure when handling chemicals • All machinery and equipment should be well maintained to avoid accidental spillage • Relevant staff members should be well trained about proper use of machinery and equipment • Have emergency oil spill cleanup crew on standby during construction • Wastewater should be disposed of through sea outfall pipes and no wastewater shall be allowed to discharge to the ground • Proper care should be taken as not to spill any oils or wastewater into the ground • Proper care should be taken during machinery transfer to avoid accidental oil leakage 	Contractor	10000
Generation of construction and decommission	<ul style="list-style-type: none"> • Littering, accidental disposal and spillage of any construction wastes should be avoided by pre-planning ways of their transportation and unloading • Careful planning of the work activities can also reduce the 	Contractor	5000

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

	<ul style="list-style-type: none"> • Emergency cleanup crew shall be on standby at all times; • Firefighting equipment must be made available at work site; 		
OPERATIONAL PHASE			
Ground water quality from asphaltting	<ul style="list-style-type: none"> • Proper ratio of chemicals should be used during asphaltting • Materials used should be of good quality • Monitoring of project activities during construction phase 	Contractor	N/A

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 road development at Izzudheen Magu 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 17 below.

Table 17. Environmental monitoring plan proposed for the road development project at Izzudheen Magu

Parameter	Phase	Method	Indicators	Frequency	Cost / MRF
Groundwater quality	Operation and Construction	Test of groundwater parameters	Hydrocarbons, EC, salinity, pH	Every 3 months during construction and every 6 months during operation	800

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

Table 18. Monitoring schedule recommended for the road development project at Izzudheen Magu assuming that the project commences in April 2017 and finishes in August 2017.

Description	Date
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

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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 groundwater 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 Izzudheen Magu. 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.

11. ACKNOWLEDGEMENTS

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

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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 ₂	Nitrogen dioxide
NO	Nitrogen monoxide
SO ₂	Sulphur dioxide
SST	Sea surface temperature
TPH	Total Petroleum Hydrocarbon
H ₂ S	Hydrogen sulphide
UNDP	The United Nations Development Program

APPENDIX B- TERMS OF REFERENCE



Environmental Protection Agency

ދިވެހިރާއްޖޭގެ ބިންގަނޑު ދިފާއުކުރުމުގެ ޖަމިއްޔާއި ދިވެހިރާއްޖޭގެ ބިންގަނޑު ދިފާއުކުރުމުގެ ޖަމިއްޔާ



Reference number: 203-EIARE9/138/2017/33

Terms of Reference for Environmental Impact Assessment: Proposed Road Development Project in Izzudheen Magu

The following is the Terms of Reference (ToR) following the scoping meeting held on the 02 nd March 2017 for undertaking the EIA of the Proposed Road Development Project at Izzudheen Magu, Male'. The Proponent of the Project is Ministry of Housing and Infrastructure.

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

- 1. Introduction and rationale** – 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. 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 preparation and construction phases.

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

The main addition to the Road Development Works in Izzudhdheen Magu EIA is:

- Provisions for existing utility networks
- Asphaltting of Izzudheen Magu
- Justification for the road construction works,
- Identify and list all materials related to construction of the roads,
- Sources of all materials used for road construction works,
- Method and equipment used for construction of all associated works,
- Measures to protect environmental values during road construction ,
- Project management (include scheduling and duration of the project and life span of

9-1-17

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reduce significant negative impacts to acceptable levels. These will include both environmental and socio-economic mitigation measures with particular attention paid to traffic control and future changes in land use plan. Mitigation measures to avoid or compensate habitat destruction will have to be considered. Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources required to implement those measures. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included. In cases where impacts are unavoidable arrangements to compensate for the environmental effect shall be given.

Task 7. Development of monitoring plan (see appendix)– Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan for terrestrial modification. 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 stakeholders, government authorities such as:

- Environmental Protection Agency
- STELCO
- MWSC
- Transport Authority of Maldives regarding road safety and traffic issues.
- Health Protection Agency

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.

5th March 2017



4th Flr Jamaaluddeen Complex

Nikages Magu

Male', Rep. of Maldives

Tel: 333 5949 / 333 5951

Fax: 333 5953

☎ ދަފްތަރު

Email:

secretariat@epa.gov.mv

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Website:

www.epa.gov.mv

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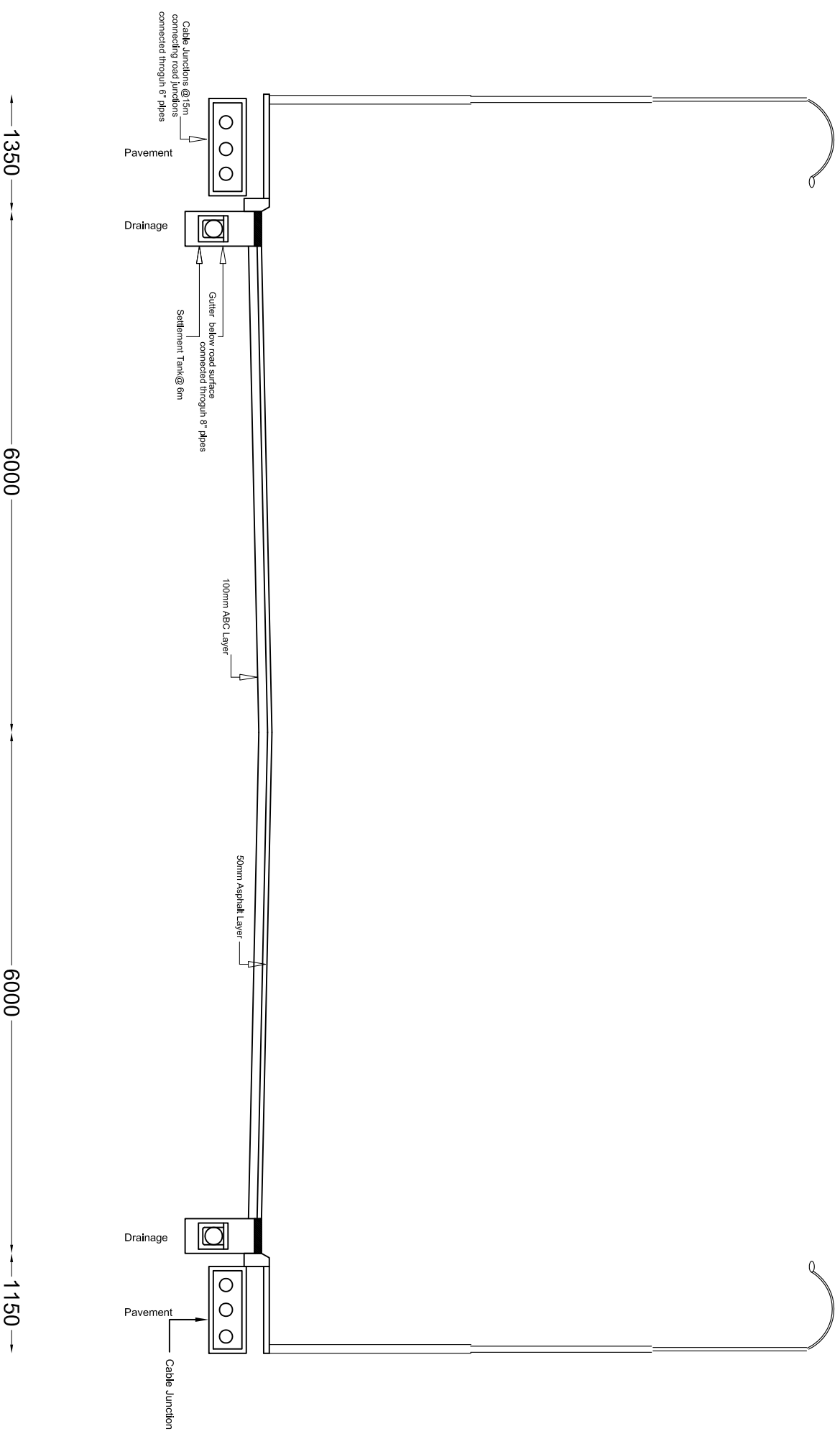
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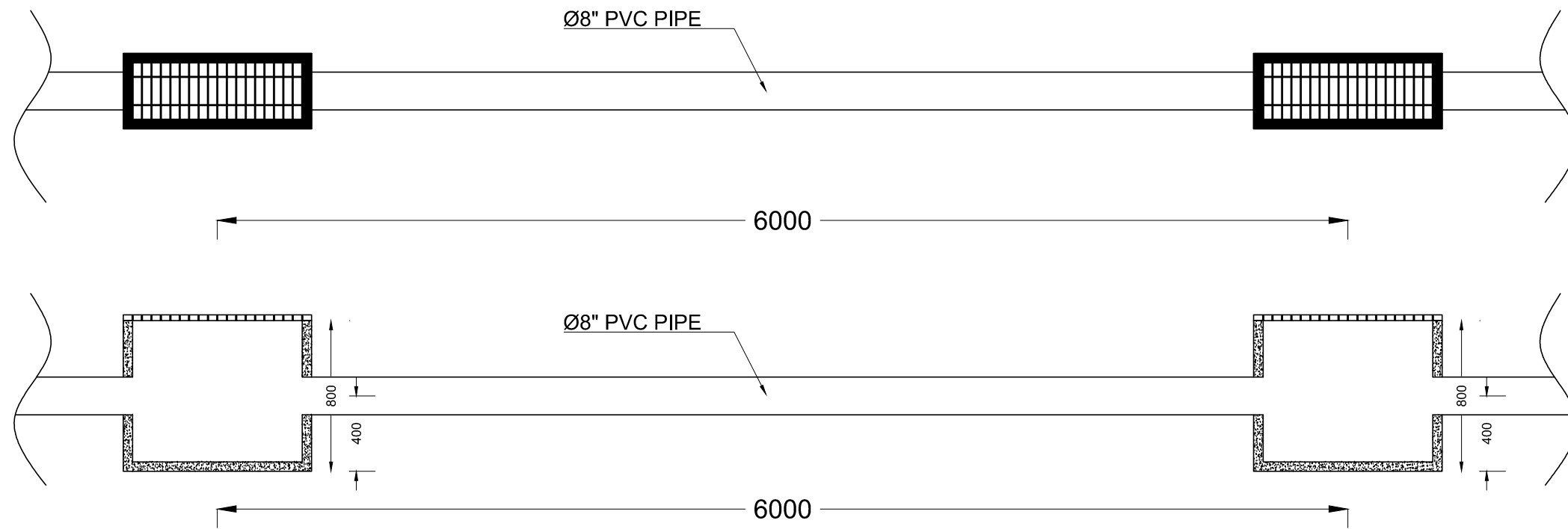
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APPENDIX C- DETAIL DRAWINGS



14.5m Road Section
Izzudheen Magu

MALE' INDUSTRIAL VILLAGE ROAD CONCEPT



NOTE:

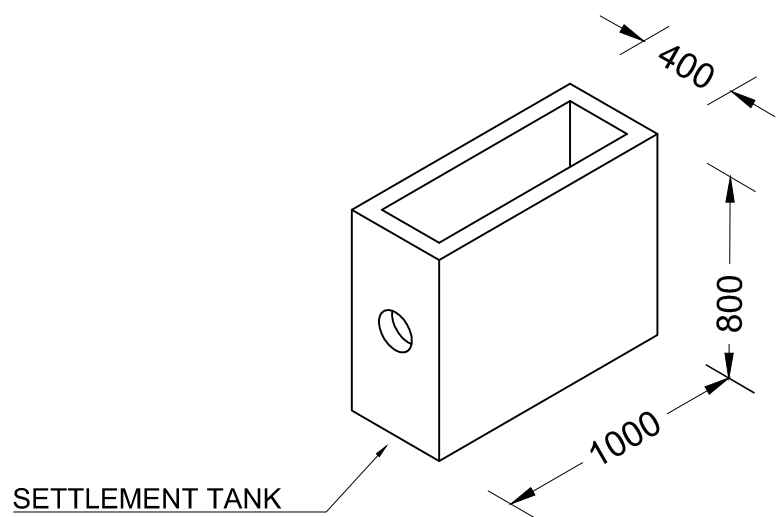
- Settlement tanks are installed as per the drawing at 6m c/c interval.
- 2% slope is provided on road surface to enable surface drainage either to settlement tank or green line.

SETTLEMENT TANK SPECS:

- Solid PCC settlement tank
- Size (1000mm x 400mm x 800mm and 100mm thick)
- Composition OPC + coral sand + coral stone
- Density Average 2174.9kg/m³
- Dry Weight 330kg approximately
- Strength Average 13.6N/mm²

- Cover for settlement tank is of Steel Grating (1000mm x 400mm)

- Tanks are interconnected via 8" PVC pipes.
- For tank and pipe level, refer to sectional drawing and settlement tank detail drawings.



SETTLEMENT TANK CONNECTION DETAILS

REVISED DATE :

LAST PRINTED:

PROJECT :

MALE' IZZUDHEEN
MAGU

TITLE :

SETTLEMENT TANK DETAILS

CLIENT :

SCALE :

As Shown

DATE :

20 JUL 2016

PROJECT NO :

ARCHITECT :

ENGINEER :

DRAWN BY : M.F

CHECKED BY :

APPROVED BY :

DWG NO :

MIV 06/2016

APPENDIX D- GROUND WATER SAMPLE RESULTS



Accreditation No: 1150/51

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National Health Laboratory
Maldives Food and Drug Authority,
Sosun Magu, Male' 20184, Republic of Maldives
Telephone # 3014346, 3014347, Fax # 3014307
WATER CHEMISTRY ANALYTICAL RESULTS

REPORT NUMBER: NHL/WC-2017/TR0259

•NAME AND ADDRESS OF CLIENT: MINISTRY OF HOUSING AND INFRASTRUCTURE,
HANDHUVAREE HINGUN, MALE'
TEL: (+960)3004300, FAX: (+960)3004301

TIME TESTED:-
•COLLECTED BY: Ibrahim Rashid Adam

•PURPOSE OF TESTING: Quality Monitoring

•LOCATION OF SAMPLE	MALE' PUBLIC WORK SERVICE GROUND WATER	TEST METHOD
Requisition Form No:	NHL/WC-2017/RQ0161	
•Date sampled	29/03/2017	
•Time Sampled	11:25	
•Type of water	Ground	
Date tested	02 nd April 2017	
Sample ID	290317WC126	
PARAMETER TESTED		
Physical Appearance	Clear	-
pH	7.1 at 24.4 °C	Method 4500-B ch4 page 65 electrometric method Adapted from standard methods 22 nd edition for the examination of water and waste water by APHA
*Total Dissolved Solids	279 mg/L at 24.2 °C	Standard Method for the Examination of Water and Wastewater, APHA, AWWA, WEF, 22nd Edition, 2012, Part 2510 / Adapted from corning checkmate II meter instruction manual
Electrical Conductivity	554 µs/cm at 24.2 °C	Standard Method for the Examination of Water and Wastewater, APHA, AWWA, WEF, 22nd Edition, 2012, Part 2510 / Adapted from corning checkmate II meter instruction manual
*Nitrate (as NO ₃ -N)	0.01 mg/L	Method 8039, 8171 (Adapted from DR4000™/5000™ Spectrophotometer procedure manual), Nitrate Test Spectroquant® 109713
*TPH (Total Petroleum Hydrocarbons)	<2 ppm	Method 10050 (Adapted from 4000™/5000™ Spectrophotometer procedure manual)
*Salinity	200 mg/L	Adapted from corning checkmate II meter instruction manual

COMMENT: -

Authorized by



Quality Manager
Fathimath Safoora

Date: 02nd April 2017

NOTE: *Information supplied by the client
This laboratory is not accredited for the test marked by *

This Result is valid only for this sample. This report is not for duplicate or advertisement without prior approval from NHL

**APPENDIX E- STAKEHOLDER CONSULTATION
MEETING ATTENDANCE SHEETS**



Meeting Attendance

AGENDA
Addendum 2 to Male' Industrial Village: road and utilities component - stakeholder consultation meeting

Date: 17 Jan 2017 Time: 14:00 pm

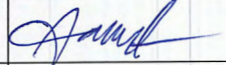
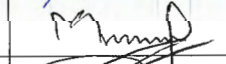
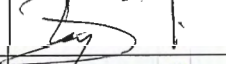
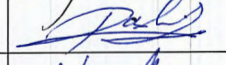
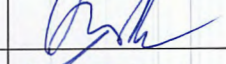
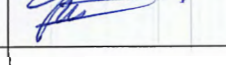
ATTENDENTS

NAME	DESIGNATION	OFFICE	EMAIL ADDRESS	CONTACT	SIGNATURE
Mohamed Nujaz	S. Engineer	STELCO	mohamed.nujaz@stelco.com.mv	7787021	
Ali Nujaz	Engineer		ali.nujaz@stelco.com.mv	7771520	
Manfoor Abdul Wahab	Environmental Consultant	-	manfoorabdulwahab@gmail.com	9994467	
UMAR ZAHIR	Project Mgr	MICC	umar.zahir@micc.com.mv	7786578	
Mohamed Ali	Project Engineer	MWSE	mohamed.ali@mwsc.com.mv	7797775	
Aishath Bariyya	Engineer	MHI'	aishath.bariyya@housing.gov.mv	7938587	
Nafha Aujaz	Environment Analyst	MHI	nafha-ujaz@housing.gov.mv	7721554	
Anoosha Hashim	Asst. Project Officer	MHI	anoosha.hashim@housing.gov.mv	-	

Environmental Protection Agency
 Male', Rep of Maldives

Meeting: ~~Weekly~~ stakeholder meeting
 Date: 23.04.2017
 Time: 11:00

MEETING ATTENDANCE






	Name	Designation	Office	Email	Phone No.	Signature
01	Aminath Mohamed	Env. Analyst	EPA	aminath.m@epa.gov.mv	3335949	
02	Munoor Abdul Wahab	EIA consultant	-	munoorabdulwahab@gmail.com	9994467	
03	Aishath Banlyga	Engineer	MHI	aishath.banlyga@housing.gov.mv	7938587	
04	Ibr. Rashika Adam	Env. Analyst	MHI	rashika@emu@housing.gov.mv	7785434	
05	Hussain Ibrahim	Asst. Ent-officer	EPA	hussain.ibrahim@epa.gov.mv	3335965	
06	Adam Mubeen	Asst. Engineer	EPA	adam.mubeen@epa.gov.mv	"	
07						
08						
09						
10						

Meeting: Scoping Meeting for the Proposed Road Development Project at Isaudheen Magu / Male

Date: 02-03-17

Time: 10:00

MEETING ATTENDANCE

	Name	Designation	Office	Email	Phone No.	Signature
01	Maniyam Shyam-ath	EIA Consultant	-	maniyam.shyamath@gmail.com	9696169	
02	Adam Mubeen	Asst. Engineer	EPA	adam.mubeen@epa.gov.mv	7588930	
03	Safa Ahmed	Assistant Director	EPA	safa.ahmed@epa.gov.mv	3335947	
04	Hanuma Nams	Asst project officer	EPA	hanuma.namsa@epa.gov.mv	9162638	
05	Nafsa Arifaz	Environmental Analyst	MHI	emul@housing.gov.mv	7721554	
06						
07						
08						
09						
10						

**APPENDIX F- EIA DELIVERY RECEIPT FROM MALE'
ATOLL COUNCIL**

