INITIAL ENVIRONMENTAL EXAMINATION

FOR THE CONSTRUCTION OF A 12 STOREY RESIDENTIAL BUILDING AT HUSHAM RESIDENCE, HENVEIRU

MALE' ATOLL, MALDIVES

Proposed by

Hussain Husham

Prepared by

CDE Consulting

December 2010

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Consultant's Declaration

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

Name: Simad Saeed (EIA 13/2007)

Signature:

EXECUTIVE SUMMARY

The purpose of this Report is to fullfil requirements under Article 5 of the Environment Protection and Preservation Act (4/93) of the Maldives to develop a 12 storey multi-purpose building at Husham Residence, Male', Maldives.

Introduction and Key Features of the Project

Project Background and objectives

Husham Residence is 1200 square feet and the owner wishes to develop the land for commercial purposes and residential purposes.

The objective of the project is to improve living conditions and create opportunities for income for the owner through the development of a multi-purpose building.

Project Scope and Life Span

The proposed project involves the construction of a 12 storey building. Twelve floors are including a basement which will be used for parking. First floor and ground floor will be used for commercial purposes and the remaining floors as residences.

The project activities are expected to begin in December 2010 and the completion of construction is expected to take eighteen months.

Conformance to Laws and Regulations of Maldives and International Conventions

The key laws and regulations of the Maldives which are applicable to this proposal are:

1) Environmental Protection and Preservation Act,
2) Environmental Impact Assessment Regulations 2007,
3) Planning Regulation of Male'
4) Maldives Building Code

The project components will fully comply with all pertinent laws and regulations.

Environmental Impacts

The potential significant impacts from the project are summarized below:

Potential Adverse Impacts from the Overall Project

1) Noise pollution
2) Air pollution

3) Vibration
4) Water contamination
5) Groundwater salinisation
6) Shortage of groundwater
7) Generation of waste
8) Disruption to traffic and unavailability of parking space
9) Interruption to commercial activities

Potential Positive Impacts from the overall Project

1) Employment opportunities during construction works
2) Business opportunity for local suppliers
3) Opportunity for local contract workers
4) Opportunity for locals to rent out equipments, machinery, vehicles and vessels.
5) Increase in sales for the local businesses such as shops and cafés.

Stakeholder Consultations

Key discussions from the stakeholder consultations are:

1) Actual foundation thickness shall be provided in the monitoring report.
2) Foundation of adjacent buildings will be protected through the set up of a retaining wall using sheet piles that will be driven into the ground by the means of a hydraulic hammer mounted on an excavator.
3) Expected vibration from pile driving is expected to be negligible.

Alternatives

The key alternatives considered for this project are as follows:

1) "No-project" Alternative
2) Alternative Foundation Type

Environmental Monitoring Program

The key areas highlighted in the monitoring program are:

1) Actual foundation thickness.
2) Groundwater salinisation - Once at mid-term of construction and once upon completion of the project.
3) Noise pollution - Pre-determined high noise activity stages

The proponent is committed to undertake the monitoring programme.

Conclusion

This report includes a comprehensive evaluation of the components of the proposed project and the existing environment, and predicted impacts of these project components on the natural and socio-economic environment. Specific mitigation measures to avoid and minimize such impacts have been suggested. In conclusion, the project is expected to result in significant short-term impacts, but they can be mitigated by the proper implementation of the measures prescribed in this report. This includes regular monitoring, in order to anticipate, identify and remediate unforeseen impacts.

1 INTRODUCTION

1.1 Purpose of the EIA

The purpose of this Report is to fullfil requirements under Article 5 of the Environment Protection and Preservation Act (4/93) of the Maldives to develop a 12 storey multi-purpose building at Husham Residence, Male', Maldives.

This report is prepared for Mr.Hussain Husham by CDE Consulting.

1.2 Project Overview and Background

The total area of development is approximately 1,200 square feet. The development concept of Husham Residence is a mixed use building where the basement is planned to be used for parking, ground floor and first floor are planned to be used for commercial purposes and the remaining floors are to be used for residential purposes.

The project activities are expected to begin in December 2010 and the completion of the building is expected to take 18 months.

The contractor for the project is Jausa Holdings Pvt Ltd.

1.3 Project Need, Justification and Objectives

The construction of the 12 storey building is expected to provide housing for the family. In addition, the project will also increase land available for commercial purposes in Male'.

The objective of the project is to improve living conditions and create opportunities for income for the family through the development of a multi-purpose building that can be used for living as well as commercial purposes.

1.4 Scope and Terms of Reference of EIA

This IEE is based on the Environmental Impact Assessment Regulations 2007, within the scope specified in the Terms of Reference (ToR) issued by the Environmental Protection Agency on 30 November 2010. The ToR is based on scoping meetings held between the stakeholders on 24 November 2010. A copy of the ToR is attached in Appendix A. The IEE study includes the following main aspects.

Chapter 1 and 2: A description of the project including the need for the project, how the project will be undertaken, full description of the relevant parts of the project, implementation schedules, site plans and summary of project inputs and outputs.

Chapter 3: A description of the pertinent national and international legislation, regulations and policies that are relevant and applicable to the project and a demonstration of how the project conforms to these aspects

Chapter 4: Information about the exiting baseline environmental conditions of the site.

Chapter 5: An assessment of the potential impacts during construction stages of the project as well as identification and cost of the potential mitigation measures to prevent or reduce significant negative impacts during both construction and operation stages of the project.

Chapter 6: An account of the stakeholder consultations held.

Chapter 7: Assessment of alternatives for the proposed project.

Chapter 8: Details of the environmental monitoring plan.

1.5 Assessment Methodology

The process followed in the preparation of this IEE study consists of five parts. These are: scoping consultations; literature review; field surveys; analysis of results; and compilation of the assessment in the form of a report.

The first step of the process covered consultations with client and government agencies to determine the scope of the impact assessment. During this stage the client clearly outlined their development needs and assessment was geared to match the development plan and environmental assessment needs. The environmental assessment needs was determined based on the EIA Regulations 2007 and the issues brought forward by the stakeholders in the scoping meeting.

During the second stage, a literature review was conducted to acquire background information on the site and its environment as well as to identify possible environmental impacts of similar developments. In this context, the EIA Regulations 2007, best practices from similar development activities, scientific studies undertaken in similar settings around Maldives and previous documents/historical publications was considered.

Conditions of the existing environment were analysed using established scientific methods and in-house analysis of the field data was conducted using scientific analysis methods. These methods will be explained in detail in later sections.

The final stage involved compilation of individual consultants' findings.

1.6 EIA Team Members

The team members of this EIA are:

1. Dr. Simad Saeed (Environmental Management and Planning Consultant, Team leader)
2. Lubna Moosa (Environmental Management and Development Consultant)
3. Ali Moosa (Surveying and Mapping)

The curriculum vitae of the consultants are attached in Appendix B of this report.

2 Project Description

2.1 Project Location

The project site is Husham Residence, Henveiru, Male'. The site is located on Moonimaa Hingun as shown in Figure 2-1. The plot has a maximum of 12.192 m and 9.144 m. The area of the plot is 111.48 sqm and the proposed building footprint is 111.48 sqm as well.

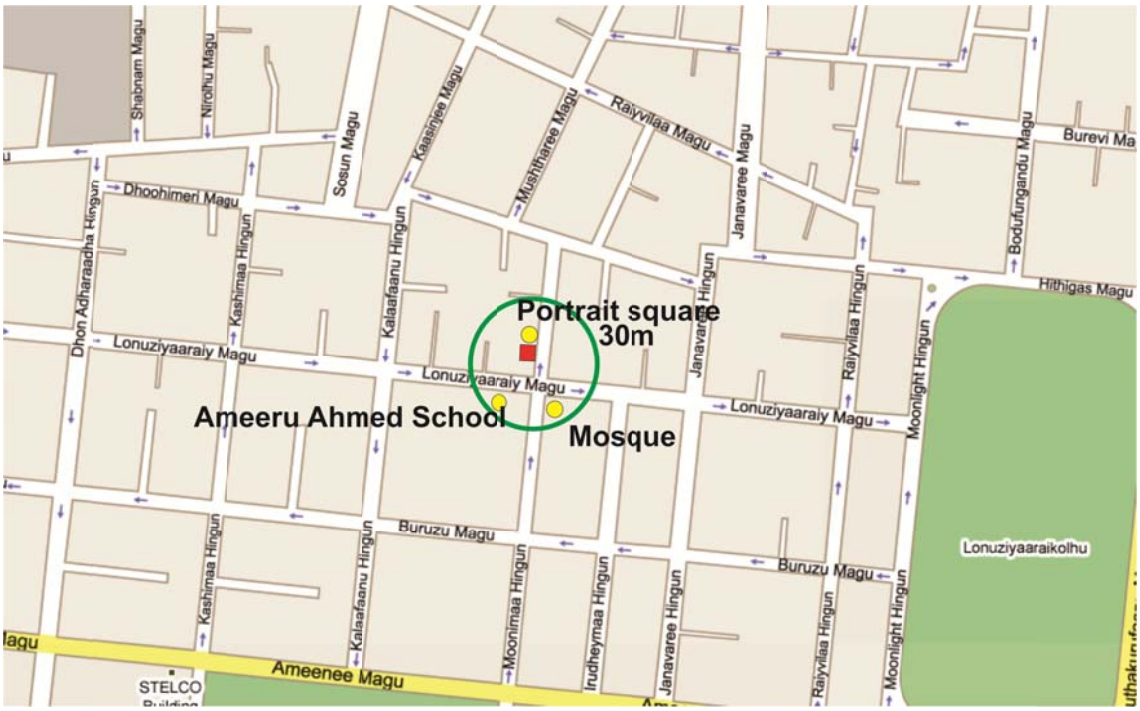

FIGURE 2-1: LOCATION OF PROPOSED PROJECT SITE

2.2 Project Site Plan

The proposed site plan and drawings for the project is provided in Appendix C.

2.3 Existing Site Conditions

The building at the site has been demolished and the debris has been cleared. At the time this EIA is undertaken the site is an empty plot of land with excavation equipment on-site.

2.4 Project Outline and Work Methodology

The proposed project involves the construction of a 12 storey building. Twelve floors are including a basement which will be used for parking. First floor and ground floor will be used for commercial purposes and the remaining floors as residences.

2.4.1 Site Preparation

Site preparation involves cleaning of the site, metal sheet piling, excavation and dewatering.

Initial excavation will be done to a depth of 1.0m to 2.0m (after determination of the foundation level of existing structures), which is as per Male' Municipality's regulations, to be at a depth of 1.2m with an allowance of 0.2m for safety reasons.

Excavation will be done after piling the metal sheets and angles. Metal sheets with a thickness of 6mm will be driven in the ground along the periphery of the building simultaneously with vertical angles as proposed for the foundation protection method.

The sheet piles will be driven into the ground using a hydraulic hammer mounted on an excavator.

2.4.2 Foundation

The type of foundation proposed is raft foundation to a depth of 2.0m. For protection of the foundation angles will be driven vertically at 1.2m C/C (center to center) along the periphery of the building where adjacent existing foundations (footings/strips) remain. A second set of vertical angles mat also be driven in at a distance of 1.2m. This is to be used for shoring and bracing of the initial set of vertical angles. Bracing and shoring is done by welding horizontal and diagonal members. Details of the foundation are provided in Appendix C.

Raft foundation is used to spread the load from a structure over a large area, normally the entire area of the structure. They are used when column loads or other structural loads are close together and individual pad foundations would interact. A raft foundation normally consists of a concrete slab which extends over the entire loaded area. It may be stiffened by ribs or beams incorporated into the foundation.

Raft foundations have the advantage of reducing differential settlements as the concrete slab resists differential movements between loading positions. They are often needed on soft or loose soils with low bearing capacity as they can spread the loads over a larger area.

2.4.3 Construction Materials and Load Estimations

The main construction material that will be used is concrete component material, ie: Cement sand aggregate and reinforcing steel, and masonry component ie: Cement and Sand. Interior doors and windows are made of imported mixed hardwood and exterior doors and windows are made of powder coated aluminium and reflective glass glazing.

The structure of the building will be a reinforced concrete frame building with masonry infill. Lightweight aerated concrete blocks will be used for the walls with cement rendering on both sides.

The foundation is designed to spread the load such that as an ultimate loading of 200KN/sqm is not exceeded.

2.5 Project Schedule and Life Span

The project is expected to take eighteen months.

2.6 Labour Requirements

The expected number of employees required for the project is 23 including one supervisor and one engineer. In addition, the architect will be the consultant of the project on behalf of the proponent.

2.7 Waste Management, Logistics and Safety Measures

2.7.1 Construction Waste Management and Disposal

Wastes created during construction would include mostly construction material (mainly steel and wood), empty cement bags, excavated earth and general packaging waste. Small amounts of waste oil may be generated from the operation and maintenance of vehicles.

All construction waste will be disposed by the contractor at the waste site of Male' as and when needed. Excavated earth may be reused by the contractor for other projects. Waste will be stored within the site until transfer to the disposal area. All waste oil will be disposed according to the standards established by the Environment Ministry.

2.7.2 Pollution and Emission Control Measures

The following measures will be taken to ensure minimal pollution during construction stage.

- Machinery will be properly tuned and maintained to reduce emissions and minimize risk of spills/leaks.

- All paints, lubricants, and other chemicals used on site will be stored in a secure and bunded location to minimize risk of spill.
- Waste will be stored within the site until transfer to the construction waste disposal site in Male'.
- Washings from concrete mixer, paint and other chemicals used will not be allowed to be disposed in the drain.

2.7.3 Health and Safety Measures

All reasonable precautions will be taken for the safety of employees and equipment will be operated by competent persons. Construction activities would be carried out under the supervision of a suitably experienced person. Warning signs, barricades or warning devices will be provided and used. Necessary safety gear will be provided to all employees and proper supervision will ensure that the gears are worn at all times.

2.8 Summary of Project Inputs and Outputs

The types of materials that will go into the development and from where and how this will be obtained are given in Table 2.2 and the type of outputs (products and waste streams) and what is expected to happen to the outputs are given in Table 2.3

TABLE 2-1: MAJOR PROJECT INPUTS

Input resource(s)	Source/Type	How to obtain resources
Construction workers	Local and foreign	Contractor's employees or by announcement
Engineers and Site supervisors	Local and foreign	Contractor's employees or by announcement
Water supply (during construction)	Desalinated water	MWSC
Electricity/Energy (during construction)	Diesel	STELCO
Machinery	Concrete Mixer, barge, excavators, trucks and general construction tool	Contractor's machinery or hire locally where available
Construction materials	Aggregate, sand, cement, wood, steel	Import or local purchase where available
Maintenance material	Maintenance parts and fluids required for the machinery and piping.	Import or purchase locally where available
Telecommunication	Mobile phones, fax machines and internet facilities	Dhiraagu

TABLE 2-2: MAJOR PROJECT OUTPUTS

Products and waste materials	Anticipated quantities	Method of disposal
Construction waste	10 cubic metres	Transferred to Construction Waste Site

Waste oil	Small quantities	Barrelled and sent to designated site.
Hazardous waste (diesel)	Small quantities	Barrelled and sent to designated site.
Noise	Only localised	NA
Air pollution	Only localised	NA
General packaging waste	Small quantities	Transferred to Male' Construction Waste Depot

3 POLICY AND LEGAL FRAMEWORK

These legal and policy provisions have to be fully respected in carrying out the proposed development. All contractors and sub-contractors will be informed of these requirements.

3.1 Relevant Environment Legislation

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

- Environment Protection and Preservation Act of Maldives (4/93) is the framework law on environmental management in the Maldives. Articles 2, 5, 6, 7, and 8 of the law are relevant to this project.
- Article 2 states that the concerned government authorities shall provide the necessary guidelines and advise on environmental protection in accordance with the prevailing conditions and needs of the country. All concerned parties shall take due considerations of the guidelines provided by the government authorities. The project proponent shall abide by any guidelines or advice given by the concerned Government authorities for the project. The concerned Government authorities are identified in this Chapter.
- According to Article 5 (a) of the Act, an Environmental Impact Assessment study shall be submitted to the Ministry of Housing, Transport and Environment (MHTE) before implementing any activity that may have an impact on the environment. This EIA report is prepared and submitted by the project proponent to fulfil the legal requirement stipulated in Act (4/93) Article 5.
- According to Article 6, the Ministry of Housing, Transport and Environment has the authority to terminate any project that has any undesirable impact on the environment. A project so terminated shall not receive any compensation. The project proponent is aware of this provision and will take all practical measures to ensure there is no irreversible and significant negative impact of the project.
- Article 7 of the Environment Protection Act (4/93) prohibits the disposal of wastes, oil and gases in a manner that will damage the environment. Wastes, oil and gases has to be disposed off in areas designated by the Government. Hence, the project proponent shall inform the contractor of Article 7 so that the contractor may ensure proper disposal of all types of waste arising from the project.
- Article 8 of the Environment Protection Act (4/93) prohibits the disposal of hazardous wastes. Any hazardous wastes that may be generated from the project shall be transferred to the construction waste site in Male'.

3.2 Relevant Regulations and Guidelines

3.2.1 Environmental Impact Assessment Regulations, 2007

- Environmental Impact Assessment regulations were issued by Environment Ministry on 1st May 2007. The first step in environmental assessment process involves screening of the project to be classified as one that requires an EIA or not. Based on this decision, the Ministry then decides the scope of the EIA which is discussed with the proponent and the EIA consultants in a "scoping meeting". The consultants then undertake the EIA starting with baseline studies, impact prediction and finally reporting the findings with impact mitigation and monitoring programme. This report follows the principles and procedures for EIA outlined in the EIA regulations.
- The EIA report is reviewed by MHTE following which an EIA Decision Note is given to the proponent who will have to implement the Decision Note accordingly. As a condition of approval, appropriate environmental monitoring may be required and the proponent shall have to report monitoring data at required intervals to the Ministry. The project proponent is committed to implement all impact mitigation measures that are specified in this EIA report. Furthermore, the proponent is committed to environmental monitoring and shall fulfil environmental monitoring requirements that may be specified in the EIA decision note as a condition for project approval.

3.2.2 Planning Regulation of Male'

- Ministry of Housing and Environment implements regulation on the construction of buildings in Malé. The regulation deals with building heights, design guidelines and requirements for building permits. The regulation states that any building could be developed with a building permit. The building permit must be displayed at all times in the construction site. The proposed project has been approved for the development of 11 stories based on this regulation.

3.2.3 Regulation on Sand and Aggregate Mining

- This regulation addresses sand mining from uninhabited islands that have been leased; sand mining from the coastal zone of other uninhabited islands; and aggregate mining from uninhabited islands that have been leased and from the coastal zone of other uninhabited islands.
- Neither sand nor aggregate will be mined for this project. This regulation would not have any implication on the proposed project.

3.2.4 Regulation on Cutting Down, Uprooting, Digging Out and Export of Trees and Palms from One Island to Another

This regulation prohibits the cutting down, digging out and export of trees and palms from one island to another unless absolutely necessary and in the absence of alternatives. Each tree or palm that is removed in the Maldives must be replaced by two trees or palms planted and grown on the island.

- Furthermore, this regulation explicitly prohibits the removal of:
    - Coastal vegetation extending to a distance of 15 meters into the island.
    - Trees and palms growing in mangroves and wetlands, extending to 15 meters of land area.
    - All trees in government protected areas.
    - Trees or palms protected by the government to protect the species of organisms that live in such trees.
    - Trees or palms of abnormal structure.

The project proponent is committed to adhering to the stipulations of this regulation.

3.2.5 Maldives Building Code

The building code hand book of Maldives details the guidelines and standards that should be used for designing building in Maldives. All construction projects are required to meet the standards specified in the building code.

All construction activities of the project will follow the Building code.

3.3 Environmental Permits Required for the Project

3.3.1 Environmental Impact Assessment (EIA) Decision Note

The most important environmental permit to initiate project work would be a decision regarding this EIA. The EIA Decision Note shall govern the manner in which the project activities must be undertaken. This EIA report assists decision makers in understanding the existing environment and potential impacts of the project. Therefore, the Decision Note may only be given to the Proponent after a review of this document following which the Ministry may request for further information or provide a decision if further information is not required. In some cases, where there are no major environmental impacts associated with the project, the Ministry may provide the Decision Note while at the same time requesting for further information.

3.3.2 Building Permit

A building permit is issued under the Regulation on the Construction of Buildings in Male'. The building permit will be displayed at the project location at all times during construction as required by this regulation.

3.4 Responsible Institutions

The main government institutions that have roles and responsibilities relevant to this project are the Ministry of Housing, Transport and Environment and Male' Municipality. Their respective roles and responsibilities are described below.

3.4.1 Ministry of Housing and Environment

The Ministry of Environment is mandated for the effective implementation of the Environmental Protection Act of the country and has the statutory power over issues related to the environment. It has the central control over the environment protection, management, conservation and environmental emergencies. The Ministry operates mainly at a policy level and the more regulatory and technical assessment activities are mandated to the Environmental Protection Agency (EPA). In this respect EPA has now been mandated to manage all issues relating to Environmental Impact Assessment of individual projects.

The Housing Department of the Ministry is responsible for implementation of the building code and building regulations of Maldives. They also retain the power to approve building structural and architectural designs and issue building permits. This power has been delegated to Male' Municipality for all buildings constructed in Male' and Viligili Island.

3.4.2 Male' Municipality

Male' Municipality is responsible for evaluating structural and architectural designs of all building to check for compliance with the building regulations, leasing buildings for commercial use and building code. They also have the responsibility to issue building permits for all buildings.

The proponent has sought approval of Male' Municipality for the project.

3.4.3 Ward Offices of Male'

The ward offices of Male' monitors the compliance of proponents to building permits issued by Male' Municipality. They are also responsible for issuing temporary road closures within their jurisdiction if required for construction activities.

The contractor will seek permission of the respective ward office for temporary road closure when necessary.

3.5 International Conventions

3.5.1 UNFCCC and Kyoto Protocol

The Maldives is party to the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the UNFCCC. The objective of the Convention is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

The IPCC defines mitigation as "an anthropogenic intervention to reduce the sources or enhance the sinks of green house gases." The greenhouse gas inventory of the Maldives forms an integral part of the First National Communication of the Maldives to the UNFCCC. In March 2009, the President of the Maldives has announced the target to make Maldives carbon neutral by 2020. Hence, in the implementation of the project, careful attention needs to be given to ensure energy efficiency and reduce fuel consumption.

The IPCC defines adaptation "as an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects." Various type of adaptation include anticipatory and reactive adaptation; private and public adaptation; and autonomous and planned adaptation. The adaptation policies and strategies of the Maldives are given in the Maldives National Adaptation Programme of Action (NAPA).

4 EXISTING ENVIRONMENT

4.1 Introduction

This section includes the compilation and evaluation of baseline data on the relevant environmental characteristics of the study area, comprising of the following subsections:

I. Study Methodologies
II. Physical environment
    a) Groundwater quality
II. Built environment
    a) Buildings and commercial activity in the vicinity of project site
    b) Structural assessment of adjacent buildings
III. Human environment
    a) Noise
    b) Traffic

4.2 Study Methodologies

The environmental components of the study area were divided into physical environment and human environment. The description of the physical environment includes an assessment of groundwater conditions and an observation of buildings in the vicinity of the project site to identify any buildings or structures of significance or potential hazard. The human environment considers noise levels and disturbances to traffic in the area during construction.

Mapping of project site including locations of all data collection points was carried out using a handheld differential GPS.

Groundwater sample was collected from the middle of the plot area and from three households within 30m radius of the project site. Groundwater sample was assessed by the laboratory of Maldives Food and Drug Authority as required for dewatering permit.

Noise was measured using Center 320 series sound level meter.

A traffic count was carried out for a duration of one hour by observing the number of vehicles by type that are passing by a chosen point of observation.

4.3 Physical Environment

4.3.1 Groundwater

Groundwater is typically 1.5 m below mean sea level in Male'. Therefore, it is assumed for the purposes of this IEE that groundwater is 1.5 m below mean sea level at project site.

Groundwater sample has been collected by CDE Pvt LTd on 2 December 2010 and the samples are being analysed by the National Health Laboratory of Maldives. The results of the groundwater samples will be submitted to the Environmental Protection Agency once the report is received from the National Health Laboratory.

4.4 Built Environment

4.4.1 Buildings and Commercial Activities in the Vicinity of Project Site

Buildings in the vicinity of the project site were observed within a radius of 30 m from the project location. A mix of residential, commercial and social infrastructure and buildings are found in the area.

Buildings adjacent to Husham Residence as shown in Figure 4-2 are:

- Bright Villa — 10 storey building under construction with 3 storey completed
- Magnolia — 7 storey structure with 3 storey completed
- Kiuba Villa — 4 storey building
- Hinhura — 2 storey building

In the vicinity of project site there is a school, Ameer Ahmed School, a mosque and small shops.

Moonimaa Hingun is a one way street with traffic flowing into the 30m radius of the project site from south to north direction. In addition, Lonuziyaraiy Magu is main road and is a one way street that has traffic flowing into Moonimaa Hingun.

4.4.2 Structural Assessment of Adjacent Buildings

The structural condition assessment of nearby buildings was carried out by Gedor Architecture Pvt Ltd on 19 November 2010. The report is provided in Appendix E.

A detailed visial inspection of the abutting buildings was done to record visible physical damages to structural elements including walls. Four buildings adjacent to Husham Residence were inspected as shown in Figure 4-2.

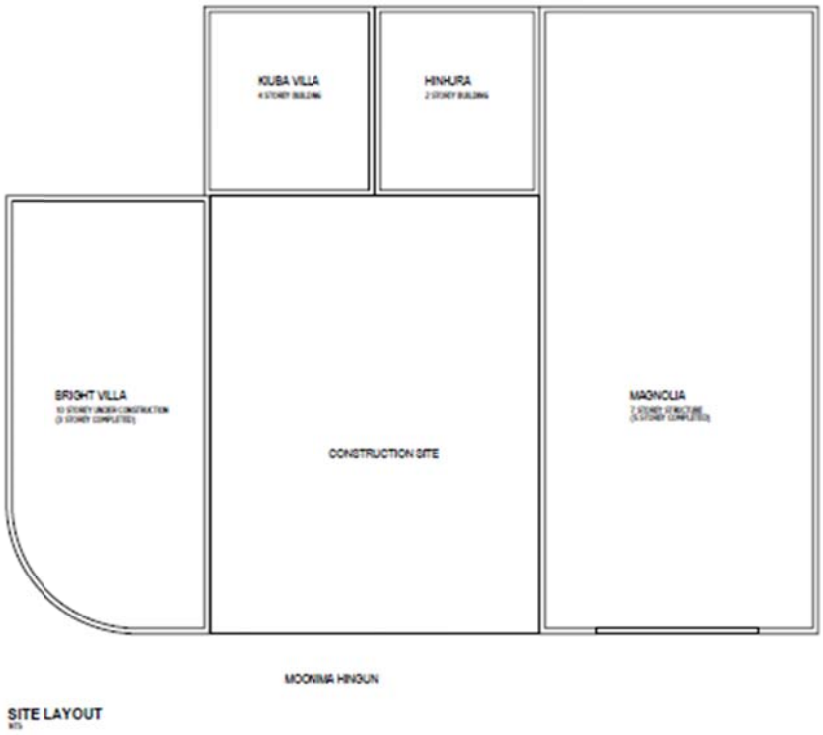

FIGURE 4-1 SITE LAYOUT OF INSPECTION LOCATIONS

Locations, length and width of cracks were estimated. Following limitations were faced during inspection:

- Magnolia – surveyors could not gain access to the room facing the street on second floor.
- Bright Villa – being under construction, a detailed inspection of cracks was possible only on the first floor.
- Some areas of walls and structures were not visible due to the presence of heavy furniture.

Several cracks were observed on the walls, columns and beams adjacent to the project site in all the buildings. It must be noted that this is only a visual inspection and therefore the report does not provide the magnitude of risks to these buildings from the project activities.

4.5 Human Environment

4.5.1 Traffic and Parking

A traffic count in the project area was undertaken on 25 November 2010 to assess the volume of traffic that may be impacted by the project activities. The traffic count was carried out for a duration of 45 minutes from 1230 hrs to 1315 hrs. An estimate is made for one hour and presented in Table 4-1. The location from where the traffic count was taken is the corner of Lonuziyaraiy Magu and Moonimaa Hingun. Both streets are one way streets. Number of vehicles was counted by type and by direction of traveling. Count on Lonuziyaraiy Magu was taken from east to west and on Moonimaa Hingun from south to north and of vehicles travelling from Lonuziyaraiy Magu to Moonimaa Hingun . Table 4-2 shows the volume of traffic that was observed.

TABLE 4-1 ESTIMATED VOLUME OF TRAFFIC IN THE PROJECT AREA

Type of vehicle	Lonuziyaaraiy Magu	Moonimaa Hingun
Bikes	261	100
Cars	61	12
Bicycles	37	11
Lorries	5	0
Vans	5	0
Pickups	4	1
Others	0	0
Total	375	124

A total of 499 vehicles is estimated for one hour at the corner of Lonuziyaraiy Magu and Moonimaa Hingun. Within one hour a total of 124 vehicles travel along Moonimaa Hingun including vehicles from Lonuziyaraiy Magu and Buruzu Magu.

On Moonimaa Hingun Magu adjacent to the project site there is a designated parking space for motorbikes.

4.5.2 Noise Levels

Noise level is measured as ambient noise which is defined as background noise that is always present. In residential areas most noise comes from transportation, construction, industrial and human sources. Road traffic noise is generally known to be the major source of noise.

Noise level was measured using Center 320 series sound level meter in 'A' weighting. Measurement of sound meter that is similar to human ear which does not have a flat

frequency response, is in 'A' weighting. Ambient noise measurement was undertaken during day time at approximately 1530hrs on 29 November 2010 at four locations. The locations of noise measurement were taken using a handheld GPS. As noise measurements have not been undertaken in the area prior to this environmental impact assessment, noise levels below are taken as baseline for the purposes of this report.

Ambient noise levels varied between 61.9dBA and 67.4dBA within the 30m radius. Noise level just outside the project site was the maximum with 67.4dBA.

Maldives at present does not have national standards for noise limits. In the absence of national standards, noise standards set by US EPA and WHO shown in Table 4-2 are used as a standard to gauge the impact of noise due to the project.

TABLE 4-2 NOISE STANDARDS USED BY US EPA AND WHO

Authority	Specified Noise levels in dB (A) L_{eq}	Criteria objective
US EPA (1974)	55 (outdoors)	For the protection of public health and welfare with an adequate margin of safety
	45 (indoors)	
WHO document (1980)	50 – 55 (15 hours, outdoors/day)	Recommended guidelines for physiological and psychological well-being
	45 (outdoor/night)	
	30 (bedrooms)	
	45 (24hours, bedrooms)	

Source: Cavanaugh and Tocci 1998

Based on Table 4-2 noise levels within the 30m radius of the project site is above the recommended levels of US EPA and WHO. The project is expected to cause increase in noise levels in the area during certain construction activities for a limited number of hours.

5 POTENTIAL IMPACTS AND MITIGATION MEASURES

5.1 Introduction

This Chapter will discuss all the potential impacts (positive and negative) associated with the proposed development activities and suggest mitigation measures for all potential negative impacts. Impact identification and mitigation measures were primarily based on stakeholder consultations, literature reviews, professional judgment and past experience from similar projects.

As the cause-effect relationship between a specific activity and its potential impacts are rarely linear and in most cases, a series of causal factors linked to different activities create the conditions that cause an impact, the chain of events linking activities to specific impacts and knock-on effects are represented in flowcharts to allow for easier interpretation. Accordingly, the flowcharts were developed and organized to display logically the following sequence of events:

Activity → *Causal Factor* → *Potential Impacts* → *Short Term Effects* → *Long Term Effects*

In addition, the significance of impacts was determined based on the following characteristics:

- Nature of impact (direct/ indirect/cumulative)
- Spatial distribution of impact
- Duration of impact
- Reversibility of impact
- Magnitude of impact
    - Negligible: No significant impact
    - Minor: The impact is only short term and reversible on the long run
    - Moderate: The impact maybe irreversible and cause long term concerns but most likely short term and reversible.
    - Major: the impact is long term and irreversible

Table 5-1 shows a summary of the characteristics of the potential impacts identified and the significance of each impact. It should be noted that impacts correspond to the worst-case scenario in absence of any mitigation measures.

TABLE 5-1: SUMMARY CHARACTERISTICS OF THE POTENTIAL IMPACTS IDENTIFIED AND THE SIGNIFICANCE OF EACH IMPACT

Impact	Nature	Spatial Distribution	Duration	Reversibility	Magnitude	Significance
Noise pollution	Direct	20 m radius from project site	Short term (during project only)	Yes	Minor	Significant during construction
Air pollution	Direct	Ambient	Long term	Maybe	Moderate	Insignificant
Water contaminatio n	Direct	Project site	Short term	Maybe	Minor	Insignificant
Groundwater salinisation	Direct	Project site	Short term	Yes	Moderate	Insignificant
Shortage of groundwater	Direct	Neighbouring houses	Short term	Yes	Moderate	Significant
Generation of waste	Direct	Project site	Short term (during project only)	No	Moderate	Insignificant
Disruption to traffic and availability of parking space	Indirect	Majeedhee Magu near project site and Dhanburuh Goalhi	Short term (during project only)	Yes	Minor	Insignificant
Interruption to commercial activities	Indirect	Extent of road block	Short term (during project only)	YEs	Minor	Insignificant

5.2 Description of Potential Impacts and Suggested Mitigation Measures

This section will provide a brief description of each of the potential impacts illustrated in the flowcharts and suggest appropriate mitigation measures for all potential adverse impacts.

A summary of the potential negative and positive impacts during construction is provided in the Figure 5-1 and Figure 5-2. Details of the key impacts are provided in the following subsections.

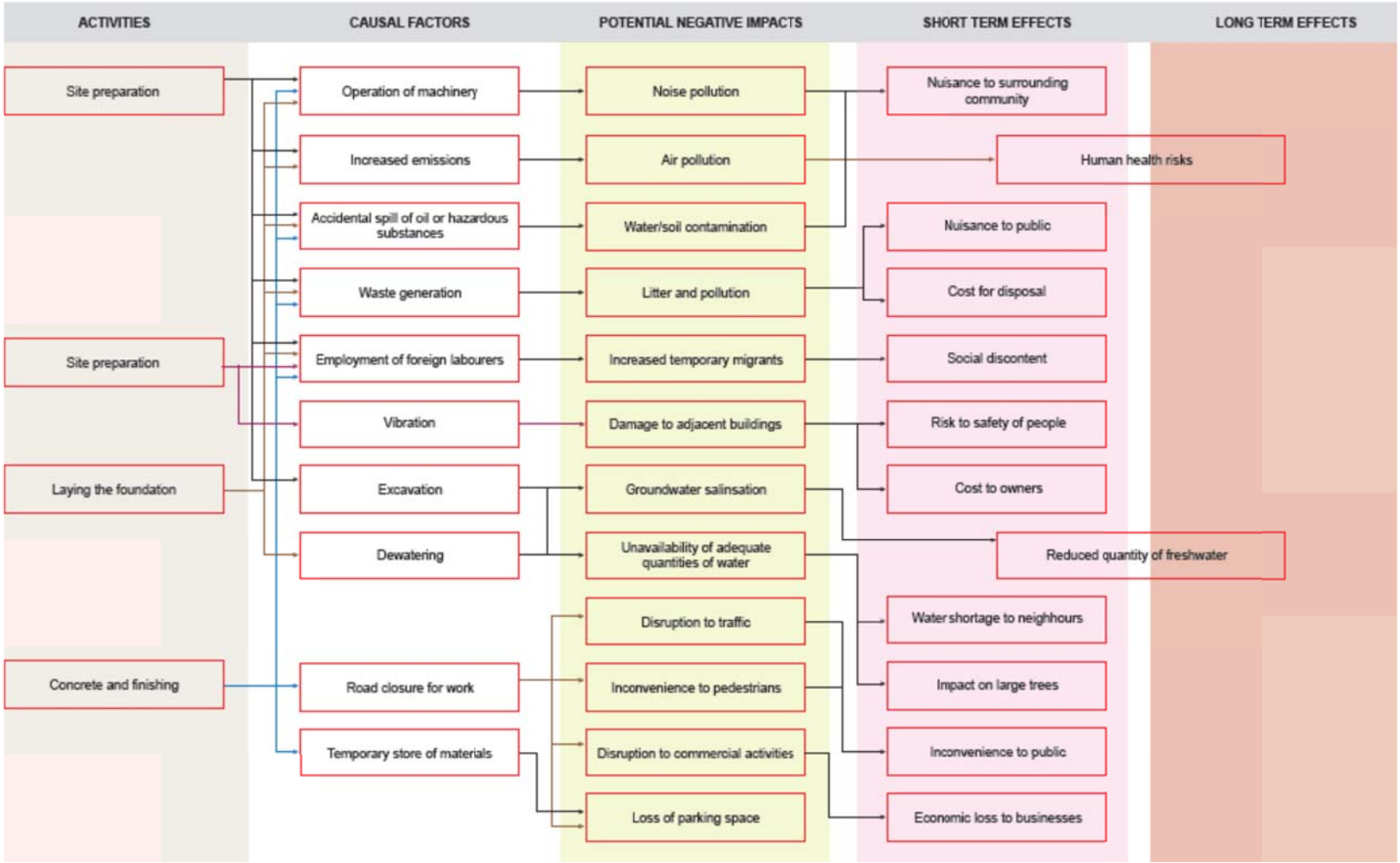

FIGURE 5-1 POTENTIAL NEGATIVE IMPACTS FROM THE CONSTRUCTION ACTIVITIES OF THE PROJECT

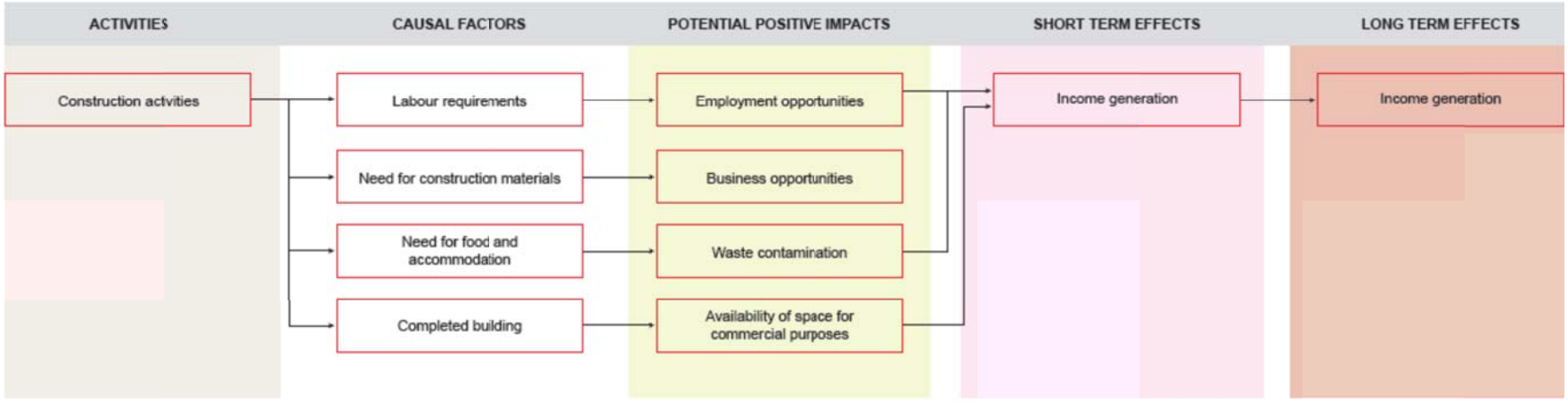

FIGURE 5-2 POTENTIAL POSITIVE IMPACTS FROM THE CONSTRUCTION ACTIVITIES OF THE PROJECT

5.2.1 Potential Adverse Impacts

5.2.1.1 Noise Pollution

Construction activities are expected to create noise that may affect nearby residents and general public in the area at any given time. Activities such as foundation laying and operation of machineries such as cement mixer will cause noise in the area. However, noise related to construction activities will be temporary and will depend on work load.

Mitigation Measures

- All machinery in use will be properly maintained to prevent unnecessary noise.
- Workers operating machinery will be provided with hearing protection gear.
- Noise levels will be monitored during construction.

5.2.1.2 Air Pollution

Construction activities that contribute to air pollution include land clearing, demolition, operation of diesel engines and working with toxic materials. Construction activities can generate dust typically from concrete, cement, wood and aggregates that can carry for long distances over long period of time. Construction dust is classified as PM10, particulate matter less than 10 microns in diameter, invisible to the naked eye.

Research reveals that PM10 penetrate deeply into the lungs and cause a wide range of health problems including respiratory illness, asthma, bronchitis and even cancer. Another source of PM10 on construction sites is from diesel engine exhausts of vehicles and heavy equipment called diesel particulate matter (DPM). DPM consists of soot, sulphates and silicates which readily combine with other toxins in the atmosphere and increase health risks of particle inhalation.

Diesel is also responsible for emissions of carbon monoxide, hydrocarbons, nitrogen oxides and carbon dioxide. Noxious vapours from oils, glues, thinners, paints, treated woods, plastics, cleaners and other hazardous chemicals that are widely used on construction sites, also contribute to air pollution.

Mitigation Measures

- Dust will be controlled through fine water sprays used to dampen down the site.
- All machineries will be tuned and maintained to ensure efficient operation.
- Any dust source will be screened by placing fine mesh over the source.

- All construction materials with potential to cause air pollution will be kept covered and dampened down with low levels of water.
- Non-toxic paints and solvents will be used wherever possible.

5.2.1.3 Vibrations

The project will be using a hydraulic hammer mounted on an excavator for pile driving of the metal sheets. Hydraulic pile driving is known to be the most efficient method for sheet piling. Some vibration is expected although the level of vibrations is likely to be minimal or negligible.

Mitigation Measures

- Pile driving will be undertaken in the presence of engineer with appropriate supervision.
- Work will be undertaken within the short duration possible.

5.2.1.4 Water Contamination

Sources of water pollution on building sites include: diesel and oil; paint, solvents, cleaners and other harmful chemicals; and construction debris and dirt. Pollutants on construction sites can also soak into the groundwater. Furthermore, significant quantities of waste will be generated from all construction related activities.

Mishandling of solid (non-biodegradable) waste and hazardous waste will contaminate groundwater and enter the marine environment through the drainage system. Therefore, special care should be taken when handling oil, solid waste and hazardous waste to entirely avoid any accidental spills and leakage.

Mitigation Measures

- Storage of all paints, lubricants, and other chemicals used on site in a secure and bunded location.
- Careful handling and transportation of oil, solid waste and hazardous waste in sealed containers, in properly bunded vehicles/vessels
- Proper tuning and maintenance of all machinery.
- Undertaking construction activities under the supervision of a suitably experienced person

5.2.2 Salinisation of Groundwater

Excavation and dewatering for laying of foundation can cause saltwater intrusion to groundwater lens leading to salinisation of groundwater in the project site. This may affect trees within the vicinity of the project site. Given that the water table is about 1.5 m below ground level, expected depth of excavation is 2.0 m below groundwater level. Dewatering will be carried out at 0.05 m^3 per second using two pumps.

Mitigation Measures

- Large trees within the vicinity of the project site will be watered to reduce impact of groundwater salinisation, if any

5.2.3 Shortage of Groundwater

Neighbouring houses and buildings may experience shortage of groundwater following dewatering at project site.

Mitigation Measures

- The pumping water level in a dewatering well shall be maintained at the minimum possible depth below the ground surface that will dewater the excavation.
- Duration of operation shall also be regulated by the contractor to minimize time of pumping to the period actually needed to dewater the excavation effectively.
- Freshwater will be supplied to neighbouring houses to ensure water shortage is compensated for.

5.2.4 Generation of Solid Waste

Construction projects usually generate a significant quantity of waste. Quantity of construction waste generated depends on many factors such as type of house, quality of materials used and contractor. Table 5-2 shows common sources of construction waste (US EPA 1998).

TABLE 5-2 COMMON SOURCES OF CONSTRUCTION WASTE

Waste type	Description	Sources
Wood	Dimensional lumber	Formwork, roof truss
	Plywood	Formwork
	Timber props	False work
	Sawn timber	Formwork, roof truss
Concrete	Substructure	Footings, piling
	Superstructure	Beams, columns, floor slabs

Waste type	Description	Sources
	Drains and gutters	Drainage works
Metal	Reinforcement bar	Reinforcement fixing
	Wire mesh	Reinforcement fixing
	Roofing sheet	Roof
	Aluminium frames	Window, false ceiling
Brick	Clay brick	Wall, fencing works, gutters
	Cement brick	Wall, fencing works, partition walling
	Cinder block	Wall, fencing works
Others	Packaging	Cement packaging, plastics, cardboard, timber pallets
	Gypsum & cement board	False ceiling
	Plaster	False ceiling, finishing works
	Ceramic	Roofing tiles, floor tiles, wall tiles
	PVC Pipe	Plumbing works
	Conduit & wiring	Electrical works

Mismanagement of construction waste can lead to accumulation of waste in the area causing nuisance to nearby residents and general public.

Mitigation Measures

- Reusable construction material will be recovered from the waste as much as possible.
- Waste will be collected and transferred to the construction waste site on a regular basis.

5.2.5 Disruption to Traffic and Availability of Parking Space

Project site is located on Moonimaa Hingun, a narrow lane connected to Lonuziyariay Magu, a one-way street that may be considered to have high flow of traffic especially during school hours. The area consists of houses, shops, a school and a mosque. The junction at Lonuziyaraiy Magu and Moonimaa Hingun as shown in Figure 5-3 will need to be closed once a month for approximately eight hours during pouring of the concrete slab for each floor. Eastward traffic on Lonuziyaraiy Magu has to be re-routed to Kalaafaanu Hingun. Northward traffic on Moonimaa Hingun has to be re-routed to Buruzu Magu.

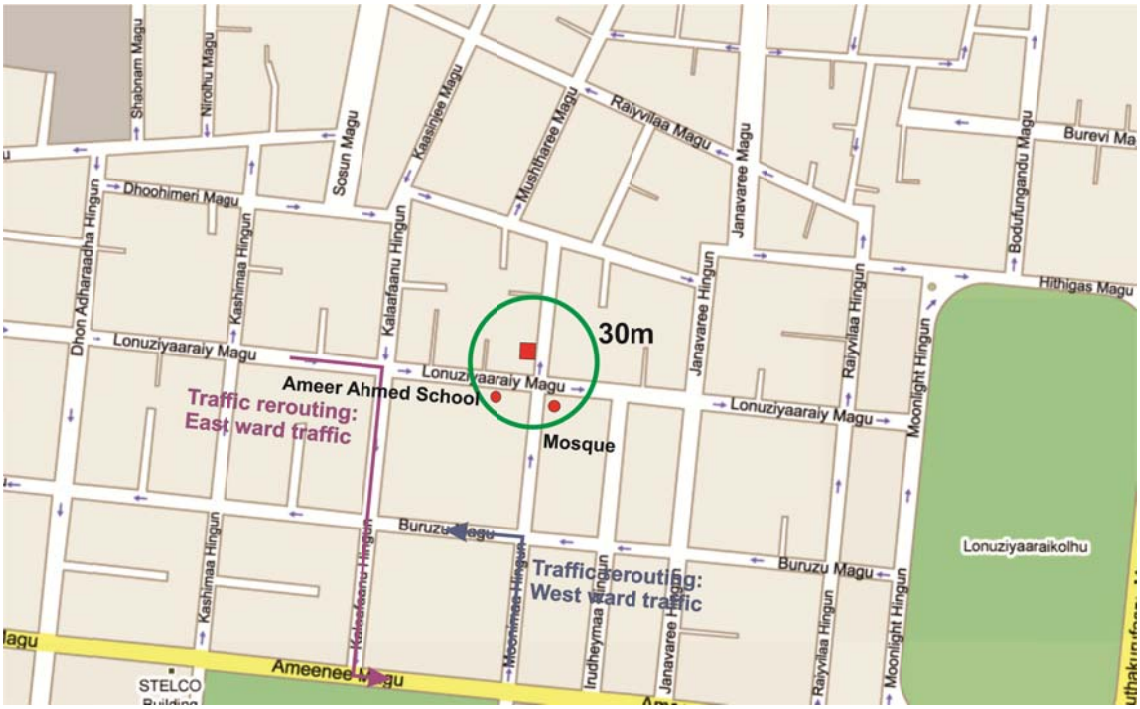

FIGURE 5-3 REROUTING OF TRAFFIC THAT MAY BE NECESSARY IN THE AREA DURING ROAD CLOSURE

In addition, there are parking spaces for motorcycles adjacent to the project site. These parking spaces may be temporarily occupied during the project.

Mitigation Measures

- Construction activities that require long duration of road closure will be carried out during night time and may cause disturbance to residents. Any nuisance is expected to be temporary and for a limited of hours during certain construction activities.
- Necessary permission will be sought from Henveiru Ward Office for road blocking whenever required so that appropriate signs may be put up.

5.2.6 Interruption to Commercial Activities

Temporary road closures may affect business activities in the nearby establishment. However, this impact is set to last only for the hours road closure is required and therefore temporary.

Mitigation Measures

- Construction activities that require long duration of road closure will utilize midnight hours as much as possible.
- Work that require road closure will be undertaken in the shortest time feasible.

- Road closure will allow access to the area by pedestrians as much as safety measures allow.

5.2.7 Potential Beneficial Impacts

The potential beneficial impacts are mainly socio-economic impacts. These include:

- Employment opportunities during construction works
- Business opportunity for local suppliers
- Opportunity for local contract workers
- Opportunity for locals to rent out equipments, machinery, vehicles and vessels.
- Increase in sales for the local businesses such as shops and cafés.

6 Stakeholder Consultation

6.1 Summary of Scoping Meeting

The scoping meeting was held on 24 November 2010 at the Environmental Protection Agency. The meeting was attended by the developer, engineer, EIA consultant, EPA, Male' Municipality and Ministry of Housing and Environment. The main points of discussions are as follows.

The main points of discussion were:

- Description of the existing environment should include groundwater, noise levels and the social impact within a 30 m radius.
- The IEE should focus on the construction stage specifically noise levels, road closures, construction waste and inconveniences to public.
- Monitoring should be undertaken for groundwater quality and noise levels.
- The actual depth and thickness of the foundation should be included in the monitoring report post-construction.
- Sheet piling is found to be the most effective as a retaining wall to prevent damage to adjacent foundations during excavation and dewatering.

6.2 Consultation with Engineers

A consultation was held with the Engineers of the project on 1 December 2010 at CDE Pvt Ltd. The meeting was attended by the following in addition to the EIA consultant:

Hussain Husham	Project Proponent
R. Thanapal	Civil Engineer, Jausa Construction
Mohamed Jinaah	Project Co-ordinator, Jausa Construction
Mohamed Ziyadh	Admin & HR Manager, Jausa Holdings Pvt Ltd
Fayaz Mansoon	Director, Gedor Architecture

Main purpose of the meeting was to discuss and clarify the work methodology of sheet piling and its implications on the adjacent buildings based on the building survey prepared by Gedor Architecture. Key points are:

- Work methodology for sheet piling will be using a hydraulic hammer mounted on an excavator.

- Some vibration will be felt during pile driving however the activity will not be continuous and will require a few impacts for a duration of about six or so minutes for each sheet. Any vibration is expected to be negligible.
- Interlocked sheet piles are known to be the best to prevent damage to adjacent foundations or soil stability during excavation and dewatering.

The meeting concluded with the understanding that the work methodology is not expected to cause any damages to the adjacent buildings and with the sheet piles in place abutting foundations will be protected during excavation and dewatering.

7 ALTERNATIVES

7.1 Introduction

This Chapter reports on the alternatives for the proposed project. Alternatives are mainly considered for type of foundation and construction materials.

7.2 "No-project" Alternative

The "no project" alternative refers to leaving the plot of land in its current condition i.e. as an empty plot of land. Table 7-1 lists the advantages and disadvantages of the "no-project" alternative.

TABLE 7-1 PROS AND CONS OF THE "NO PROJECT" ALTERNATIVE

Advantages	Disadvantages
Pollution including noise, air and water caused by construction activities will be prevented. Salinisation risk to groundwater from dewatering will be prevent avoided. Generation of construction waste will be prevented. Disruption to traffic and availability of parking spaces during the duration of construction will be avoided. Contribution to the risk of increasing population density in Male' is reduced.	Availability of housing opportunity for the registered owner(s) will be lost. Without the building and infrastructure the commercial value of the land may be reduced. Income generation opportunities for the registered owner(s) will be lost. Employment and business opportunities will be reduced.

Considering that the environmental impacts are mostly short term and reversible and, Male' is experiencing scarcity of land the "no project" alternative is not preferred.

7.3 Foundation

An alternative to raft foundation is deep pile foundation which is a type of deep foundation.

Deep foundation is used when the soil near the ground surface is weak. Deep foundations are sufficiently below the finished ground surface for their base bearing capacity to be affected by surface conditions, this is usually at depths >3 m below finished ground level. Deep foundations can be used to transfer the loading to deeper, more competent strata at depth if unsuitable soils are present near the surface.

Pile foundations are the part of a structure used to carry and transfer the load of the structure to the bearing ground located at some depth below ground surface. The main components of the foundation are the pile cap and the piles. Piles are long and slender members which transfer the load to deeper soil or rock of high bearing capacity avoiding shallow soil of low bearing capacity The main types of materials used for piles are Wood, steel and concrete. Piles made from these materials are driven, drilled or jacked into the ground and connected to pile caps (Abebe & Smith 1999).

Although deep pile foundation may be suitable for the soil conditions found in Male', in terms of noise pollution and cost, deep pile foundation is not a favourable option. Driving the piles deep into the ground will cause excessive noise that will inconvenience neighbouring residents. Deep pile foundation was commenced for the project Holiday Inn at Athireege Aage. This project was the first to try deep piling in Male'. The deep piling that was started in October 2007 using hammer technology was halted by the Government in December 2007 due to complaints from neighbours of tremors and cracks on their walls (Jameel 2010). Furthermore, the noise pollution caused by deep piling activity will also disrupt the commercial atmosphere of the project area. Therefore, deep piling technology may not be socially acceptable to Male'.

Mitigation Measures

- Use low noise pile driving technology to reduce noise pollution.
- Undertake the pile driving activity in the shortest duration possible in order to reduce any inconvenience caused.

8 ENVIRONMENTAL MONITORING PLAN

8.1 Introduction

This Chapter outlines the monitoring plan for the proposed project. Adoption of appropriate mitigation measures can significantly reduce the environmental damage caused by a development project. However, occurrence of unforeseen impacts is still possible, even with proper implementation of mitigation measures. Moreover, some of the predicted impacts may turn out to be greater than predicted, necessitating different or more rigorous mitigation measures. Therefore, regular and frequent monitoring of the environment is vital, in order to avoid or reduce the chances of such events, and to minimize the impact and cost of unforeseen events by taking prompt remedial action if such events occur.

8.2 Objectives of the Monitoring Plan

The main objectives of the monitoring plan are to:

- Identify whether the predicted impacts are accurate and mitigation measures taken are effective;
- Identify any unforeseen impacts so that appropriate mitigation measures can be taken at the earliest;
- Identify and resolve any issues of social unrest at the earliest and;
- Eliminate or reduce environmental costs

8.3 Aspects of the Monitoring Plan

Table 8-1 below summarizes the key aspects of the monitoring plan. The table indicates the methodology, frequency and estimated cost for each monitoring attribute that will be required for the proposed project.

TABLE 8-1: ASPECTS OF THE MONITORING PLAN

Monitoring Attribute	Indicator	Methodology	Frequency	Estimated Cost
Foundation thickness	Average thickness of the building shell structure in the subsurface of the soil	Measuring tool	Once after construction	NA

Groundwater salinisation	Water quality	Laboratory analysis	Once at mid-term of construction and once upon completion of the project	US$50 per survey
Noise pollution	Noise level	Ambient noise measurement equipment	Pre-determined high noise activity stages	US$20 per survey

Parameters that will be tested in the laboratory analysis of water quality for monitoring groundwater include physical appearance, pH and electrical conductivity.

8.4 Monitoring Report

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

8.5 Commitment to Monitoring

The proponent is committed to undertaking the monitoring program outlined in this Chapter (refer Appendix F of this report).

9 References

Abebe, A & Smith, I GN, 1999. *Pile Foundation Design: A Student Guide*. [online]. Available at: <http://sbe.napier.ac.uk/projects/piledesign/guide/index.htm> [Accesed 27 August 2010].

Cavanaugh, WJ and Tocci, GC 1998. *Environmental Noise: the Invisible Pollutant*. [online]. Available at: < http://nonoise.org/library/envarticle/index.htm> [Accessed 13 September 2010].

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United States Environmental Protection Agency (US EPA), 1998. *Characterization of building-related construction and demolition debris in the United States,* report no. EPA530-R-98-010, U.S. Environmental Protection Agency Municipal and Industrial Solid Waste Division Office of Solid Waste.

APPENDIX A – Terms of Reference

APPENDIX B – Curriculum VitaE of Consultants

APPENDIX C – Proposed Site Plan and Drawings

APPENDIX D – Groundwater Quality Test Reports

(To be submitted once the results report is received from National Health Laboratory of Maldives)

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Appendix E - Visual Condition Survey Report of Adjacent Buildings

Appendix F – Letter of Commitment