INITIAL ENVIRONMENTAL EXAMINATION

For the Development of 11 story building of 90 Housing Units and associated Commercial Units

At M. Wayside

Ministry of Housing and Environment

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October 2011

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Executive Summary

This Initial Environment Examination is an evaluation of the potential environmental, socio-economic and natural impacts for the development of an 11 storey building at M. Wayside. This Initial Environmental Examination is prepared in order to meet the requirements of Clause 5 of the Environmental Protection and Preservation Act of the Maldives to assess the impacts of proposed development at M. Wayside, Male'. The report has looked at the justifications for undertaking the proposed project components. Alternatives to proposed components or activities in terms of location, design and environmental considerations were suggested. A mitigation plan and monitoring programme before, during and after the works has also been proposed.

It is inevitable that there would be some negative environmental impacts, especially when excavation and dewatering is carried out. The potential adverse impacts from the overall project includes water contamination, shortage of groundwater, generation of waste, air pollution, noise pollution and disruption to traffic and unavailability of parking space. After a survey and the study undertaken for this IEE, these negative impacts identified are not severe enough to not allow the project. In light of possible impacts assessed, a comprehensive monitoring component has been suggested to monitor environmental (natural and social) impact during the course of this project. This monitoring component will be adhered and will allow the assessment of long term changes, despite the limited nature of the impact. In addition, the socioeconomic impacts that have been assessed have been identified as mostly positive impacts, not just in short term but also in long term.

Therefore, from an environmental and technical point of view and in light of the existing socio-economic developments it appears justifiable to carry out the proposed project.

Chapter 1

Introduction

1.1 Background, Project Need and Justification

This report is an Initial Environmental Examination for the proposed 11 storey building of 90 Housing Units and Commercial area development at M. Wayside, Male'. This document has been produced to fulfil the requirements under Article 5 of the Environment Protection and Preservation Act (4/93) of the Maldives and has been structured to meet the requirements of the EIA Regulations 2007.

Male' hosts over one third of the total population of the Maldives. Many of them lack proper and adequate housing in Male'. Due to the inadequate supply to cater for this need, there is an acute shortage of housing. This has created poor living conditions for the residents of Male'.

One of the key pledges of the government is to provide adequate and affordable housing for the people of the Maldives. In this regard the government is committed to develop 10,000 housing units throughout the country by 2013. In order to achieve this plans have been made to develop 1100 housing units in Male'. This project aims to contribute towards achieving this target of developing 1100 housing units in Male'.

The total area of the development is approximately 13,542 square feet. The building is a multi-purpose building where the ground floor and mezzanine floor is to be used for commercial purposes and the remaining nine floors are to be used for 90 housing units.

1.2 Structure of the IEE

The structure of this report conforms to the necessary provisions of the Environmental Impact Assessment Regulation 2007, which is outlined below;

- Information about the existing baseline environmental conditions of the site
- An assessment of the potential impacts during both construction and operational stages
- Identification of the potential mitigation measures to prevent or reduce significant negative impacts during these phases
- Assessment of alternatives and
- Details of the environmental monitoring plan.

1.3 Terms of Reference

The terms of reference for this IEE have been attached as an annex in Appendix A. This IEE has been prepared based on these terms of reference.

1.4 IEE Team Members

Team members of this IEE are:

Miruza Mohamed (Consultant)
Abdullah Ziyad (Civil Engineer)

Chapter 2

Project Description

2.1 Project Proponent

This project is proposed by the Ministry of Housing and Environment. On behalf of the Ministry, the project will be implemented by 18SG Developers Private Limited, a Private Limited Company registered under the Companies Act, 1956, of the Republic of India, having its Registered Office at Omkar Esquare, Lower Ground, 102, Sion, Mumbai, 4000 022, Republic of India.

The project was awarded on 26th day of May, 2010

2.2 Location and Study Area

The project site is located at M. Wayside as shown in Figure 1. The proposed project site has an area of 13,542 square feet.

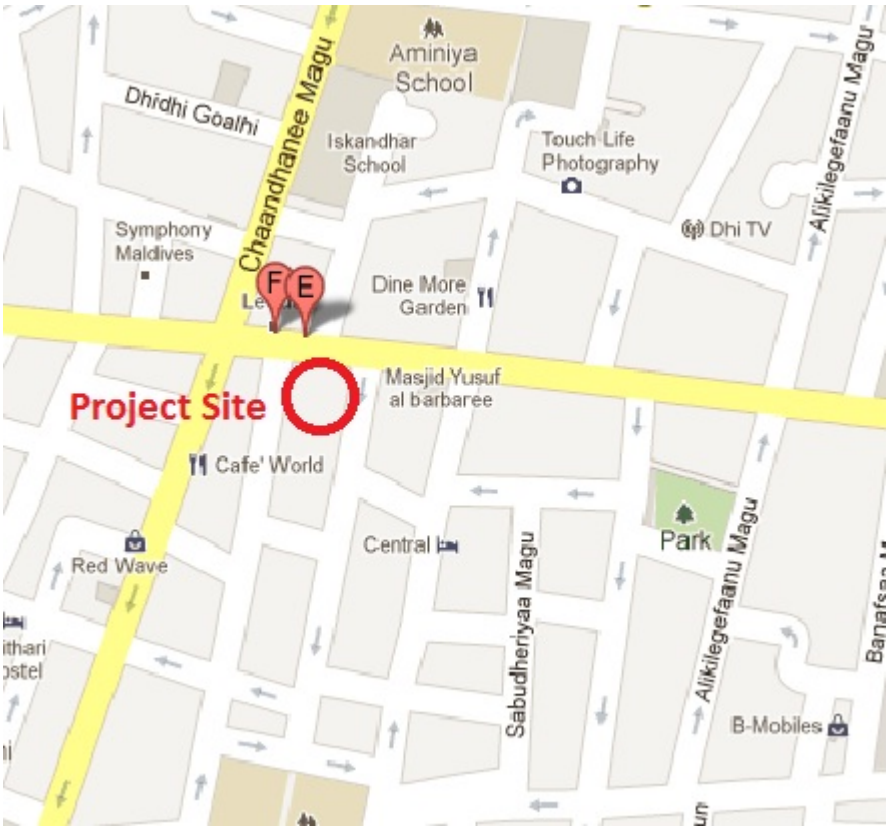

Figure 1: Location of the Project site.

Figure 2: Existing condition of the project site.

2.3 Project Duration and Schedule

The project is expected to commence as soon as EIA clearance is sought and will be completed within 24 months.

2.4 Existing Site Conditions

- All the building structures that were erected at this site were demolished to make way for this development. At the time of compilation of this IEE, this site has been totally cleared of all debris.

- The boundary walls are intact with a steel gate on the front facing Majeedee Magu Magu.

- The Figure 2 shows the existing condition of the site.

2.5 Work Methodology

The following description attempts to capture the work methodology of the sub-structures that would have the highest impact on the environmental setting of the locality.

2.5.1 Decision on type of foundation:

As part of the initial site investigations, a couple of bore holes were drilled to a depth of 15m, where the hard rock strata were encountered. A series of "N" values were recorded at varying depths to identify the level of resistance to penetration, as a first step to determine the bearing strength of the soil. The bore-hole investigation report will form a part of this assessment.

The data collected from the borehole investigation was then correlated with the design parameters. The finite element analysis done to another structure of similar loading condition at the base revealed that the maximum required capacity was around 240KN/m2.

Deriving from the borehole data and correlating the results with previous studies of similar scale and condition, the engineer assess that a raft foundation would be more economical and less time consuming, in comparison to a pile foundation. Thus a raft foundation of 700mm thickness was designed with adequate beam sections intersecting the column positions, capable of transferring column loads safely to the soil strata.

2.5.2 Depth of the foundation:

Based on the previous load testing at various localities in Male', the bearing capacity requirement is achieved at about 1.60 - 1.80 m depth with adequate soil stabilization in the form of layered compaction. This is employed after removal of garbage and other deleterious substance that may not withstand long-term pressure. For a raft foundation, as is designed for this structure, no unappreciable settlement is anticipated. Should any event of a physical soil disturbance leads to settlement; it will be of uniform settlement that will have the least impact on the structural stability.

2.5.3 Site Preparation:

The entire previous infrastructure at the site were demolished and cleared for excavation. In order to lay the raft foundation site will be excavated to 1.2m depth.

As there are no adjacent foundations of buildings that may adversely affect during excavation, no retention structure to prevent collapse of soil is required. However, some form of structure may be required along the road periphery at the sides that will be subject to higher loading instances than the front boundary line, where the existing bicycle/cycle

parking space provides the property line with adequate set-back from severe traffic loads.

As for the sides adjacent to two roads with lesser set-back between the boundary and the plinth line of the building structure, extra precautionary measures should be put in place against soil subsidence during a raining event.

For the front boundary with the main steel gate entrance, there is sufficient set-back between the boundary and the plinth line of the building structure. Here, provision of a stabilized slope by trimming the soil is sufficient.

The highest precaution should be exercised at the rear periphery where a hardware shop is currently in operation. Here, extra care should be exercised to avoid any adverse affect during excavation and to the vibration resulting from construction activities. Therefore, retention structure to prevent collapse of soil is required.

In general, throughout the periods of construction works, precautionary notices and adequate lighting will be in place to minimize any likely incidences. Adequate site security will also be in place to prevent unauthorized access.

2.5.4 Trial pit examination:

In order to establish a safe foundation depth, a trial pit was excavated to examine the nature of the strata.

The ground conditions from a trial pit dug at the proposed site revealed that the top layer (300mm) consisted of black sand followed by uniform sand layer (white to yellow coral sand) down to the proposed foundation level 1.5m. Traces of roots from previously existing trees were extracted. This indicates the possibility of finding roots running within the top soil layer, and should be removed during final excavations for foundation preparation. The sub-strata soil remained largely intact with no sign of loose patches.

No garbage has been observed and the water table is at 1350mm at mean tide.

2.5.5 Dewatering process:

Dewatering will lower the ground water table from its natural level at the site, allowing construction to be conducted in dry environment. This is a necessary step to create an adequate working condition to commence working for building substructure.

For dewatering process to be operational, a series of sumps will be placed at predetermined locations and drain pipes located in a manner to allow water table to be drawn down from the natural level from water table.

The water sample tested at site records a high level of salinity, which would be increased as the pumping commences during physical implementation. Hence, this extracted water cannot be recharged into the ground, and is best disposed by a direct piped connection to the waterfront, about 800m from the construction site. The option of connecting to the drainage system should not be sought before extensive consultation with Male' city council

who are in charge of maintaining the drainage network.

The most severe impact to the environmental condition is likely to occur at this stage. This may be due to the following:

- Noise pollution due to continuous working of generators for pumps will cause great nuisance. The pumping of water will be continuous until the foundation structure is fully cast and cured, a process that normally takes about 3 weeks

- Draw-down of water wells at the immediate vicinity will result in flushing water shortage to households. This would directly impact their monthly utility bills. In addition, increased salinity would accelerate deterioration of metal components of equipments such as pumps.

- Loss of fines from the soil medium along with water extraction will contribute to partial loss of stability and subsequent settlement. A cataloguing of building conditions of neighbouring properties may have to be done to limit claims.

2.5.6 Lean concrete and base preparation:

With proper dewatering in place during layered compaction and removing of loose patches, the ground will be prepared to receive pouring of stabilized mix of cement and sand to spread out and achieve a lean-concrete leveled base.

Once this layer is hardened enough for workers to engage in their activities, footing slab mesh reinforcement and assembly could commence. Then, the footing beam reinforcement would follow, along with the shuttering works to prepare for casting.

2.5.7 Mobilization of mechanical equipments:

The site is not large enough to accommodate materials stockpiled for concrete mixing. In addition, due to the narrow width of the roads leading to the site and the location being one of the busiest traffic arteries of Male', heavy vehicles that are required to be used during construction would cause immense traffic congestion, and inconvenience to pedestrians.

To minimize the inconvenience, proper measures such as road blocks could be used to re-route the traffic from the main entrance. In addition, a suitable methodology should also be sought from the contractor to mitigate the delays resulting from the factual conditions, such as operating time of some machinery such as cranes, and hauling works utilizing dump trucks.

2.5.8 Casting of concrete:

A predominantly submerged condition of the foundation is anticipated, that requires adopting measures to prevent ingress of water through capillaries formed within the concrete matrix during its hardening stage. The most favoured method, as to be adopted here as well, is the use of proper admixtures in their correct proportions in the concrete mix. The engineer would exercise caution to ensure this material does not adversely affect

the water table.

The management team would work in coordination with the contractor to maximize the concrete production potential of the Contractor and achieve smooth continuity during casing time. This is to ensure that the work consumes less time. It is recognized that the huge volume of pour would take a number of hours, but proper planning could mitigate the level of inconvenience the general public is subjected in this nature of works.

The close proximity of the site to a large population entails exercising caution during this work, in particular due to cement dust that would be emitting throughout the mixing time. As such, all nearby households/commercial outlets should be given advance notice of a major concrete production activity. This would allow sufficient time to release the households from some activities such as outdoor drying, venturing to balconies and closing windows to prevent cement dust from accumulating inside the households.

2.5.9 Backfilling of site:

As soon as the foundation casting and column stumps are well completed, adequate form of concrete surface treatment will be given prior to backfilling.

The selection of materials for backfilling will be utilized from the stockpile of excavated material. As a near-thorough segregation of contaminated soil would be in place from the first excavation date, the suitable back-filling material will be reused and the contaminated soil disposed. This would also contribute to remediating the soil condition in the long run.

2.6 Material Specifications and Load Estimations

The main construction materials are:

- Cement BS12 (ordinary Portlant cement); Coarse sand Gr 1; Coarse aggregate Gr 1;
- Mild steel round bars BS4449 (6mm steel); and High tensile reinforced steel bars BS4461 (10mm, 12mm, 16mm, 20mm)
- High tensile reinforced steel bars BS4461 (10mm, 12mm, 16mm, 20mm)

The building structure will be a reinforced concrete frame building with masonry infill. Light- Weight aerated concrete blocks would be used for all walls with cement rendering on both sides.

Load estimation are as follows.

- Estimated final settlement of the depth = 65mm.
- Dead Load = 12.5 KN/m^2
- Live Load
- Apartments = 2.0 KN/m^2
- Shop = 5.0 KN/m^2

2.7 Waste Management, Logistics and Safety Measures

2.7.1 Management of wastes

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. The developer should be responsible for regular collection of the waste created during construction, and transfer of the waste to Male' waste yard from where the waste will then be transported to Thilafushi. Male' city council has agreed to accept both demolition and construction waste generated out of the project at the collection yard.

To minimize inconvenience to traffic and pedestrians, transport of wastes should be programmed at times of minimal commercial activity, and should not be kept outside of premise to avoid creating loss of efficiency to road use.

Temporary toilets should be set up at the construction site and connected to the main sewer network to provide proper sanitation facilities to the workers at site. Ministry has already completed the administrative process with the MWSC to ensure proper connection to their sewer network.

2.7.2 Pollution and Emission Control measures

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

- Dust generated during concrete mixing is expected to be controlled from excessive spreading due to the enclosed nature of the construction site. However, the impact will be significant to immediate vicinities, requiring proper mitigation measures.

- 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

- 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. Sign boards to indicate ongoing construction activities will be installed as a precautionary measure to avoid any potential harm that might be caused otherwise to the general public. Necessary safety gear will be provided to all employees and proper supervision will ensure that the gears are worn at all times.

2.8 Project Inputs and Outputs

2.8.1 Project Inputs

The types of materials that will go into the development and from where and how this will be obtained are given in Table 1

Table 1: Major Inputs

Input resources (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 materials	Maintenance parts and fluids required for the machinery and piping	Import or local purchase where available

2.8.2 Project Outputs

The major output of the project is an 11 storey building with 90 housing units to cater for at least 90 families or housing for 360 persons. In addition the project will also create new business opportunities for small entrepreneurs as 20,695 square feet of commercial space from the ground floor and mezzanine floor will be created.

Major outputs are summarized in Table 2

Table 2: Major Outputs

Products and waste Materials	Anticipated quantities	Method of disposal
Construction waste	10 cubic meters	Transferred to Male' waste yard
Waste oil	Small quantities	Contained and transferred to Male' waste yard
Hazardous waste (diesel)	Small quantities	Contained and transferred to Male' waste yard
Noise	Only localized	Work hours will be determined to avoid nuisance to the nearby residents, specially during night

Chapter 3

Policy, Legal and Administrative Framework

3.1 Overview

This section outlines the relevant environmental legislations that have to be respected in carrying out the proposed development.

3.2 Applicable Policies Laws and Regulations

3.2.1 Environmental Protection and Preservation Act

According to Article 5.(a) of the Environmental Protection and Preservation Act (Law No. 4/93) an Environment Impact Assessment study shall be submitted to the Ministry of Housing and Environment before implementing any development that may have a potential impact on the environment.

3.2.2 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.

This regulation would not have any implication on the project as sand and aggregate mining will not be carried for this project.

3.2.3 Environmental Impact Assessment Regulation 2007

New EIA regulations were issued by the Ministry of Housing and Environment on May 2007, which guides the process of undertaking the Environmental Impact Assessment in the Maldives.

This guideline outlines every step of the IEE/EIA process including the roles and responsibilities of the consultants and the proponents. This report adheres to the guidance provided in this Regulation.

3.2.4 The Land Act

The Land Law of the Maldives which was passed in 2002 deals with issues of land in the Maldives. The Land Law concerned with identifying the lands of Maldives for different purposes and uses, allocating such land, allocating government owned land for living, government land allocated for living, owning and using private land, selling, conveyance, leasing lands and other related matters. The law stipulates that except for trees and coconut palms owned by person, all other natural resources in the ground, gold, silver, jewellery, money, artefacts found during excavation of the Maldivian soil, and all metal found in the Maldivian soil are government property. The law also states that soil excavated from the plot can been distributed or sold with the approval of the Male' Municipality, and in accordance with the regulations made under this Act.

Since, excavation is part of the proposed project, all items found during excavation would be handed over to the government and soil excavated would not be sold.

3.2.5 Regulation on the Construction of Buildings in Malé

Ministry of Housing and Environment implements the regulation on the construction of buildings in Malé. This regulation deals with building heights, design guidelines and requirements for building permits for constructions in Male'. According to this regulation a permit is required by the local authority for the construction on site, which has to be displayed at the site at all times during the construction. The proposed project has been approved in line with this regulation.

3.2.6 Montreal Protocol on Substances that Deplete the Ozone layer

Maldives is a party to the Vienna Convention and the Montreal Protocol on Substances that Deplete the Ozone Layer. Maldives is classified as an Article 5 country of the Montreal Protocol, and has ratified all the amendments, including London, Copenhagen, Montreal and Beijing Amendments. The upgrade and redevelopment considers the Maldives commitment to the implementation of the Montreal Protocol on Substances that deplete the Ozone Layer. The accelerated HCFC phase-out schedule for Maldives is given in Table 3. Hence, the new infrastructure that would be added for the development in the area of cooling and refrigeration systems would comply with the national requirements.

Table 3: HCFC phase-out schedule

Control measure	Schedule
Baseline	Average 2009-2010 consumption
Freeze at baseline level	2011
10 % reduction	2013
20% reduction	2015
35% reduction	2016
67.5 % reduction	2018
100 % reduction	2020 except 2.5% for servicing use until: 2025

Chapter 4

Existing Environment

4.1 Introduction

This section covers the information regarding the existing environmental conditions for the proposed project site. It provides a brief outline of the methodology adopted in data collection, information about the physical and human environment. The physical environment consists of assessment of ground water conditions and an observation of the buildings in proximity (30 m radius) of the projects site. Factors such as traffic condition and the noise levels are considered to be human affecting environment.

4.2 Methodology

Sound levels were measured within a 30 m radius of the project site. Locations of the positions where sound were measured were taken by a hand held GPS. Since there was a water well which is already in use, Traffic was counted for duration of 1 hour and the time of observation was around 11 am on a Saturday.

4.3 Groundwater

Ground water condition of Male' is considered to be alkaline and high in salt content. Therefore, may not be suitable for human consumption. The general practice in Male' with regards to management of access water at the location of foundation laying is to pump directly into the sea as to avoid flooding of streets in the vicinity. Furthermore there is little or no value in trying to pump the water back in the ground due to the poor quality of the ground water.

4.4 Buildings in the vicinity

Buildings in the vicinity of the project site were observed within a radius of 30 m from the project location. Figure 3 shows the location of the project site and the buildings within the 30 m radius. The project vicinity consists of a mixture of residential, commercial and social infrastructure. Main buildings of concern during construction are the households/commercial outlets as these are on the front side of the road of the project location. However, should a road or traffic block be required for construction, this could be carried out during weekends to minimize the inconvenience due to construction work.

Figure 3: Location of the project site (green) and the 30 m radius (red) with main surrounding land marks.

4.5 Human Environment

4.5.1 Traffic

The traffic was counted for duration of 1 hour. It was counted in front of the project site. Due to the narrow width of the roads leading to the site and the location being one of the busiest traffic arteries of Male' significant amount of traffic on the road would be expected throughout the day and night. As there are two schools near the project location, significant amount of traffic on the road would be expected during the week days during the school sessions starting and finishing hours.

Traffic study was also undertaken to study the available parking spaces for the vehicles in the vicinity of the project site. From this study it was found that parking spaces have been allocated for motor cycles along the Majeedhee Magu. However, there are no parking spaces for 4 wheeler vehicles in Majeedhee Magu and minimum space can be utilized for 4 wheelers from the two small roads near the project location.

During the construction phase heavy vehicles needing to bring in materials to the project site is expected to be more frequent in the vicinity. And this may cause some degree of inconvenience to the traffic as well as pedestrians. In order to minimize this waiting time just outside the construction block will be kept to a minimum through proper arrangements and long term parking will be completely avoided.

4.5.2 Noise

Noise level was monitored using a hand held device. It measures the ambient noise which is always present. Since this is a residential and commercial area, the environmental noise composes mainly from transport and human. The largest contribution comes from the transport. Noise levels were measured during the day time at 11 AM. The average noise level measured is 65 dBA. Since there is no standard for noise levels in Maldives, noise levels in OECD countries are used for a reference. Table 4 shows the noise levels observed in most of the OECD countries. Comparing these noise levels to that measured in the field, it could be concluded that the noise level at the project site is more representative of mixed residential area. The observed sound level could be slightly higher during the use of heavy vehicles during the construction period for a limited number of hours.

Table 4: Standard noise levels in OECD countries.

Category of Area	Limits in dB (A)	
	Day Time	Night Times
	(6 am – 9pm)	(9 pm – 6am)

Industrial area	75	70
Commercial area	65	55
Mixed residential areas	60	45
Residential area	55	45
Silence Zone	50	40

Chapter 5

Environmental Impacts & Mitigation Measures

5.1 Introduction

This section covers the potential environmental impacts (positive and negative) which could be associated with the proposed project. It also describes the mitigation measures which could be undertaken to minimize the impacts. Impact identification and mitigation measures are based on literature reviews, professional judgment and past experience from similar projects.

Analysis of environmental issues within the lifecycle of the project identifies the major issues and concerns that are likely to evolve over the life of a project. For the proposed project, these issues include location and design, construction of the structures and longevity of the structures and their impacts. The environmental impacts of the project would be upon or due to the following resources or elements of the project.

- Site preparation
- Laying of the raft foundation of the building
- Construction of the building

A summary of the potential impacts of various activities pertaining to project components during planning and construction phase of the proposed project components and the significance of each impact is shown in Table 5.

Table 5: Summary of the potential impacts

Site preparation

Impact	Nature	Duration	Magnitude	Significance	Mitigation Cost (USD)
Loss of vegetation	N/A	N/A	N/A	N/A	N/A
Loss of top soil	Direct	Long term	Minor	Insignificant	N/A
Generation of waste	Direct	Short term	Moderate	Insignificant	N/A

Laying of Raft Foundation

Impact	Nature	Duration	Magnitude	Significance	Mitigation Cost (USD)
Loss of groundwater	Direct	Long term	Moderate	Significant	Reversible
Generation of waste	Direct	Short term	Moderate	Significant	N/A

Construction of the building

Impact	Nature	Duration	Magnitude	Significance	Mitigation Cost (USD)
Generation of waste	Direct	Short term	Moderate	Significant	N/A
Noise pollution	Direct	Short-term (during project only)	Minor	Significant during construction	Yes
Air pollution	Direct	Long term	Moderate	Significant	Maybe
Disruption to traffic and availability of parking space	Direct	Short term (during project only)	Moderate	Significant during construction	Yes

5.2 Impact Identification and Mitigation Measures

Following sections provide the details of potential environmental impacts and its associated mitigation measures which could be undertaken to minimize the environmental impacts due to the proposed project.

5.2.1 Loss of Vegetation and Soil

The site does not have any vegetation to be cleared since there was an infrastructure at the location before it was demolished and there was no vegetation there before. The soil test revealed that it was white coral and sand is the dominant types. The picture below shows the existing landscape of the site.

Mitigation measure

Loss of sand is unavoidable and impact due to soil loss is insignificant. No mitigation measures have to be considered.

5.2.2 Loss of Ground Water

Laboratory tests revealed that the ground water at the site is not safe for domestic purposes. Since the site would be de-watered, there is possibility of water draining out from wells within the neighbourhood. Furthermore, de-watering can introduce saline water into the water table and this could have an effect on the vegetation within the vicinity.

Mitigation measure

De-watering would be planned during the low tides and would be carried out in the shortest time possible. Trees within the vicinity will be watered to minimize the effect due to introduction of saline water into the water lens. In addition developer has to compensate for the water loss from neighbouring households in the event of complains with significant evidence.

5.2.3 Waste Generation

Construction projects produce a large amount of waste. The quantity of waste generated depends on various factors such as type, quality and contractor to mention a few. Possible

type of waste generated could be wood, concrete, metal, brick plastic etc... If the waste is not managed properly, this could be of nuisance to the neighbourhood.

Mitigation measure

Reusable construction materials would be isolated with much effort as possible. Collected waste would be carried to the dump yard on a regular basis. Construction workers will regularly clean the adjoining road sides in order to remove any debris arising from the project activities and adequate number and capacity of vehicles for removal would be maintained.

5.2.4 Noise Pollution

Activities such as foundation laying and operation of machineries such as cement mixer will cause noise in the area and therefore, it may affect neighbouring places and general public in the area at any given time. However, noise related to construction would there be for a temporary duration. The noise level measured at the site is representative of that in an industrial area. This is considered high for the project site.

Mitigation measure

All the machineries used on site would be properly maintained to prevent unnecessary noise. The workers operating the machines would be wearing the proper protection gears. During the construction phase, work would be scheduled for the use of heavy vehicles (e.g. casting of slabs and beams could be carried out during the weekends to minimize noise impact on residential and commercial outlets).

5.2.5 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

5.2.6 Traffic and Parking

During week days and especially during school starting and finishing time, Majeedhee Magu has a heavy traffic. Parking spaces available on this road around the vicinity of the project site is almost fully utilized during the week days and at night. Therefore management of traffic during construction would be crucial. During peak construction days such as casting of columns and slabs, the traffic flow have to be managed as the cross junction in the main road is near to the project site.

Mitigation measure

During heavy construction days (e.g. casting of slabs and columns) traffic flow would have to be diverted and should be carried during weekends. Proper permission should have to be obtained from the City Council office with enough lead time. With the diversion of the traffic, it is not expected to have major impact on the traffic although it might cause some inconvenience.

Chapter 6

Stakeholder Consultations

6.1 Consultation with EPA

The scoping meeting was held on 6th October 2011 at the Environmental Protection Agency. The discussion was mainly focused on the construction stage specifically noise levels, road closures, construction waste and inconveniences to public.

6.2 Consultation with Engineers

Consultation with the engineers was done on 5th October 2011. The main points of discussion are as follows:

- The details of the foundation (type, depth) were discussed.
- Expected duration and how the work would be carried out.
- The type of machineries and how those would be utilized was briefed
- Some possible impacts and alternatives of construction methods were discussed.
- Details of the emergency generator to be used were discussed and how the setup and operation would be handled was also discussed.

Chapter 7

Alternatives

7.1 No Project Option

EIA Regulation requires two alternatives to be suggested for such developments. This section therefore, looks at alternative ways to the proposed project. There are two basic options: (1) leave the plot of land in its current condition i.e. as an empty plot of land (no project option), or (2) take measures to solve the problem of housing congestion. Although the proposed development at the proposed site has some environmental impacts there are more disadvantages than the advantages of the 'No development option'. The main advantages and disadvantages of 'no project option' is given in Table 6.

Table 6: Advantages and disadvantages of no project option

Strategy	Advantages	Disadvantages
Keep the existing situation as it is	• Very little or no advantage in leaving the land in its current state as Environmental problems related to development can be avoided or mitigated.	• Maintaining any empty plot of land without any proper use would indirectly translate into a significant loss to the government. • Land is very expensive in Male', but an empty plot of land has very little value. • Acute shortage of housing in Male'. And vertical expansion is the option for optimum utilization of land. In addition, according to the Male' planning regulation a land of this size is most suitable for a building of 11 storeys. • Vacant land of this size is not available in Male' and it has to be created by demolishing an existing structure which will incur additional costs.

Considering that the environmental impacts are mostly short term and reversible and, Male' is experiencing housing congestion along with unhealthy environment, "no project" alternative is not preferred.

7.2 Foundation

An alternative to raft foundation is deep pilling.

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.

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. 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'.

Until recently construction of buildings does not adhere to any recognized building standards and hence, there is high degree of uncertainty over the magnitude of vibration that such buildings can withstand. Therefore, unnecessary delays maybe unavoidable such as government intervention, public outcry etc.

Henceforth, this method of construction is too risky without an intensive assessment of the surrounding built environment and therefore not recommended.

Chapter 8

Environment Management & Monitoring Plan

This Chapter outlines the monitoring plan for the project. Adoption of appropriate mitigation measures can significantly reduce the environmental damages 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.

8.1 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
- eliminate or reduce environmental costs

8.2 Aspects of the Monitoring Plan

The following aspects will be monitored during the construction stage:

- Ground water salinisation- Once at mid-term of construction and once upon completion of the project
- Generation of waste – It is recommended to maintain a log of waste generated and disposed at the project site
- Dewatering- Maintain a log of the volume of water pumped out and the velocity/ speed.
- Relocation of trees- Relocate and maintain a progress of how many relocated trees survive.

8.3 Monitoring Report

Based on collected information two reports are recommended. One a mid-term monitoring report will be compiled and submitted to the relevant government authorities for compliance. The report will shall cover all aspects of environmental issues covered in this study including but not limited to waste management, trees relocation, traffic, control of dust.

A second report has to be submitted at the end of the project.

8.4 Declaration of the Consultant

This EIA has been prepared according to the EIA Regulations 2007.

We certify that the statements in this Environmental Impact Assessment study are true, complete and correct, to best of our knowledge and ability.

Miruza Mohamed (EIA Registration No: 1/10)

Reference:

Riyaz (2007) *Environmental Impact Assessment Report for Development of Holiday Inn Geoenvironmental and Geotechnical Aspects, Ameeneege, Male` Maldives, (Part I).*

Adam (2011) *Initial Environmental Examination for the construction of 11 storey housing unit and associated commercial area building at G. Gaakoshi, Block No: 135*

Appendix A – Terms of Reference

Environmental Protection Agency

EPA

Terms of Reference for Environmental Impact Assessment.

The following is the TOR based on the scoping meeting held on 6th Octorber2011 for undertaking the EIA of the proposed Development of an 11 Storey Housing Unit in Arabiya Complex, Male', Maldives.

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 – Identify the development project to be assessed. Provide background information on the project and its cost, the proponents and their experience with similar projects. Provide an executive summary of the EIA report highlighting important findings from the EIA study.

2. Study Area - Submit an A3 size scaled plan with indications of all the proposed infrastructures. Specify the boundaries of the study area for the intial environmental examination highlighting the location and size of all proposed developments. The study area should include adjacent and nearby environmentally important areas (if any) (e.g. coral reef, mangroves, marine protected areas, special birds site, sensitive species nursery and feeding grounds).

3. Scope of Work - The following tasks will be performed:

***Task 1. Description of the Proposed Project –** Provide a brief description of the proponent, location of the proposed project, how the project will be undertaken and full description of the relevant parts of the project using clearly labeled maps and scaled site plan. Inputs and outputs of the project, a detailed project schedule and life span of the project should be presented.*

Provide details of emergency power generation arrangements in the building (if any). In this respect, provide details of the area of power generator set, number of and capacity of generator sets, height of smoke stack, method of generator sets cooling water discharge outfall if any, details of emissions. Provide a brief description of the existing scfety measures in place in case of an emergencies (this shall include the details of availability of fire fighting equipment and measures taken to prevent any spills).

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Task 2: Description of the Environment *– Present baseline data on the following environmental characteristics:-*

- *Groundwater quality prior to the beginning of construction activities. Parameters shall include physical appearance, salinity, THC and ph.*
- *Noise before construction activities.*
- *Traffic flow in the project site before construction, number and type of vehicles during peak hour.*
- *Social impact arising from construction activities within a 30 metres radius of project site.*

Absence of facility in the country will not exempt the proponent from providing the requested water quality data.

Task 3: Legislative and Regulatory Considerations *– Describe the legislations, regulations, polices, standards and international conventions relevant to the proposed project.*

Task 4: Determine the Potential Impacts of the Proposed Project *– Use a checklist of parameters to identify impacts of significance. Impacts on the physical and human environment shall be explored. Distinguish between significant positive and negative impacts, short term and long term impacts during construction. Identify impacts that are cumulative, unavoidable or irreversible. Identify any information gaps and evaluate their importance for decision making.*

Task 5: Mitigation and Management of Negative Impacts *- Identify possible measures to prevent or reduce significant negative impacts to acceptable levels during construction. Cost of mitigation measures and commitment of the proponent to undertake the mitigation measures should be included.*

Task 6: Analysis of Alternatives to the Proposed Project *– Describe the alternatives examined for the proposed project that would achieve the same objective including the 'no project' alternative.*

Task 7: Environmental Monitoring *– Provide monitoring details for water quality monitoring, noise monitoring (during construction activities and during operational phase noise of the generators) and traffic monitoring during construction. Provide commitment of the propoenent to conduct monitoring and costs associated with it.*
A guideline for monitoring is attached to this ToR (Appendix-I). Relevant components of this ToR must be followed.

Task 8: Stakeholder Consultations *– Provide a list of persons consulted, information on how, when and where the consultations were conducted and a summary of the outcome of the consultations including the main concerns identified.*

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Presentation – The EIA report shall be presented in print and digital format and shall be concise, focusing on significant environmental issues. It shall 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 EIA report shall be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Regulations, 2007.

Timeframe for the submitting the EIA report – The developer must submit the completed EIA report within 3 months from the date of this ToR.

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06th Octorber 2011

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