Environmental Impact Assessment

For the Proposed Development on Kohdhdhipparu Island, North Malé Atoll, for the Development of Fresh Fish Packing Facility and Construction of a Harbour

February 2008

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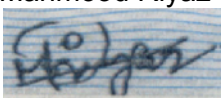
List of Acronyms

MoTCA	Ministry of Tourism and Civil Aviation
EPAA	Environmental Protection and Preservation Act
ERC	Environmental Research Centre
EIA	Environmental Impact Assessment
MTDC	Maldives Tourism Development Cooperation
MoEEW	Ministry of Environment, Energy and Water
MoFAMR	Ministry of Fisheries, Agriculture and Marine Resources
NHL	National Health Laboratory (of Maldives Food & Drug Authority)
MFDA	Maldives Food and Drug Authority
MoH	Ministry of Health
SAARC	South Asian Association Regional Cooperation
SACEP	South Asian Association for Coastal Environmental Protection
UNCLOS	United National Convention of Law of the Sea
CZMC	Coastal Zone Management Centre (of SAARC)
NCPE	National Commission for the Protection of the Environment
NDP	National Development Plan
GPS	Global Positioning System

Declaration of the Consultant

I certify that the statements made in this Environmental Impact Assessment study are true complete and correct

Mahmood Riyaz



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1 Non-technical Summary

This is the Environmental Impact Assessment (EIA) report carried out for the development of necessary facilities in Kodhdhipparu Island to establish a business of purchasing packaging and export of fresh fish products. The proposed project includes dredging a harbor (201x102m), reclaiming area of 20,500 sqm by using dredged material and development of project facilities and infrastructure to establish and operate the business of purchasing packaging and export of fresh fish products in Kodhdhipparu Island. Due to the small size of the island any such development could not be accommodated and the proposed dredging and reclamation has been identified as a necessary need to establish and operate the proposed development. The EIA was prepared as fulfilment of the requirement by the Ministry of Fisheries, Agriculture and Marine Resources (MoFAMR) for granting permission for the project. Environmental Impact Assessment (EIA) of development projects is a requirement by the Environmental Protection and Preservation Act (EPPA) (law 4/93) of the Government of the Republic of Maldives.

The total cost of the proposed project is approximately 61.74 million Maldivian Rufiyaa. The project will be developed within 18 months. The project will create a relatively large number of direct and indirect employment opportunities throughout the country. Therefore the project will significantly contribute to the economic growth, particularly fisheries sector, and other relevant socio economic activities

This report has been prepared in accordance with the Environmental Impact assessment Regulations published by the Ministry of Environment Energy and Water in May 2007 and covers both negative and positive environmental and socio-economic impact arising from the proposed project in Kodhdhipparu Island. Major findings of this report are based on previous IEIA report prepared for the reclamation of the island and information gathered during the field inspection of both the existing environment and possible effects of the project activities, through extensive literature review and experiences gained from similar projects elsewhere in the Maldives.

The proposed project activity will take place in Kodhdhipparu island (man-made island by the act of accreting sand around existing small sand bank by using coastal structures constructed on the shallow areas on the eastern side of Kodhdhipparu Falhu). The island lies on an irregular shape reef, with a deep lagoon at the center. Kodhdhipparu Island is located on the eastern end of the E-W oriented Kodhdhipparu Falhu on the southwestern side of North Male Atoll. Kodhdhipparu being located on the southwester rim of the atoll it is exposed to high energy oceanic swells during the southwest monsoon and refracted, reflected and regenerated indirect fetch waves during the northeasterly monsoon. Due to the exposure of Kodhdhipparu reef to the direct oceanic waves during southwest monsoon the calmest area within the Falhu is on the eastern end. Hence Mr.Ali Fulhu who started constructing the island was aware that the eastern end of the reef is the most stable area with the least energy within Kodhdhipparu Falhu. Analysis of the aerial photo of the 1969 shows, that the island was initiated and developed on the lee side of Kodhdhipparu reef from a nodal point. The nodal point was formed on the northwestern part of Kodhdhipparu reef where incident wave energy from both NW and western side of the reef was low and sediment load carried by the wave were dumped and deposited around this nodal point and shaped by the prevailing current direction. The fact that Kodhdhipparu Island being a man-made cay, it does not have a proper soil layer with humus content. Most of the existing plant species are very young and introduced by the workers in order to stabilize the cay and hold sediments. Most of the vegetation consists of very basic salt and spray tolerant coastal plants, dominated mainly with,

Scaevola sp. *Tournafortia* sp. *Pemphis* sp. and some coastal shrubs. Recently planted beach hibiscus, coconut trees, and *Thespesia* sp exist at the central part of the island. Love birds and parrots are being introduced and reared at the island in cages. Shorebirds and seabirds were known to visit the island. Two species of reptiles were observed, these were the mourning gecko (*Lapidodactylus lugubris*) and the garden lizard (*Calotes versicolor*). The overall reef of Kodhdiipparu reef is not in a good condition However, small Acropora colonies were observed which indicates that coral recruitment is taking place. Generally the live coral cover does not exceed 10% in any part of the surveyed area and consists of coral mainly branching and table corals. Percentage of dead coral was found to be very high 30-75% in most areas, particularly on the northern and northwestern side. Sixty species of fish belonging to 16 families were observed during the survey. Large school of red-toothed trigger fishes, *Odonus niger* were observed on the reef slope. The water in Kodhdhipparu is highly saline and not usable for washing or gardening. At present fresh water on the island is transported from Male and supplemented by the rainwater catchments.

During the preparation of the EIA report an impact matrix, which is a standard tool for identifying the possible impacts of project activities, has been created for proposed development project in Kodhdhiipparu. The activities carried out during the construction and post-construction or operational phases are arrayed against a selection of environmental factors that may be affected directly or indirectly as a result of project activities.

The report has identified and described in detail possible change that would occur to the existing condition of the environment caused during the construction phase and have suggested appropriate mitigation measures for each and every impact identified in the report. Sedimentation and increase in suspended sediment level in the water, has been identified as the most significant negative environmental impact that could be associated with dredging and reclamation, breakwater construction, improper location of stockpiles and storage of construction material etc. High level of sedimentation and suspended sediment in the water will increase lagoon turbidity, which affects benthic organism and fish and prolonged periods of sedimentation could cause 'suffocation' and smothering of coral and the overall ecology of the shallow marine environments. Installation of silt screens construction of settling ponds and bundwalls has been suggested as mitigation measures of anticipated impacts from increased sedimentation and turbidity level of the water column during dredging and reclamation. The report recommended to take the dredging and reclamation activities in calmer weather condition and preferably at low tides during NE monsoon period because it is expected to transport the bulk of sediments suspended in the water by the currents into the deep waters and disperse faster, this will contribute for significant reduction in impacts associated with sedimentation. Liquid, solid and other forms of wastes and particularly hazardous waste generated during the construction and operational phase has also been identified as significant impact associated with the project and appropriate mitigation measures are suggested for each and every waste related impact identified in the study. The report has recommended that if the proposed Kodhdhipparu facility is to be maintain the international industry standards it should achieve and maintain the emission and effluent levels as the guideline for the industry, which is the environmental management and performance indicator, yardstick to weigh the performance of similar project in the world.

The study has evaluated alternative options for some components of the project and has suggested some modifications for the harbour and breakwater design to allow

better protection of the harbor and water circulation within the harbour basin. For the safe disposal of chemicals, laboratory wastes plastic wastes and other wastes that are non-biodegradable, the report recommends to procure an incinerator of appropriate capacity for the project. Also the report found, based on the similar project activities elsewhere in the Maldives, the island and the reef will recover from the expected impacts rapidly and will re-establish a new ecological balance soon. However the report has come-up with an extensive monitoring programme that will keep on monitoring the environmental changes associated with the development and make necessary adjustment to the activities of the project based on the findings of various measured environmental parameters suggested in the monitoring and environmental management plan.

On the basis this environmental impact assessment study and the impact mitigation measures proposed in the report will be duly implemented and recommendations are given due consideration, it is concluded that the benefits of the planned redevelopment in Kodhdhipparu Island will substantially outweigh its imposition on the environment.

2 Introduction

2.1 Project Justification

Kodhdhipparu Island is leased out to Mr. Abdulla Mohamed. G. Galolhufehi by the Ministry of Fisheries Agriculture and Marine Resources (Agreement number K-01/2002), to undertake number of economic activities. These activities include; agriculture, poultry, fisheries related activities such as maintaining live lobster and fish stock in cages, yellow fin tuna freezing and exporting fresh/chilled, installation of ice planting to provide ice flakes to fisherman, and to make traditional carving products to be marketed for the tourists. However, due to the small size of the island any such development could not be accommodated in the island. Therefore the only way an economic activity could be conducted in the island is by increasing the size, and easing the accessibility to the island, to develop and operate the necessary facilities required for the intended development activity.

Private sector participation and diversification in all the major economic activities such as fisheries and agriculture has been identified as an important need in National Development Plan. The need also has been further emphasized and encouraged in the "Vision 2020". Government policy and strategy for economic development has clearly been set out in its development plans. Therefore the proposed development in Kodhdhipparu would maximize the economic benefit through diversification of the fisheries product. Also the facility in Kodhdhipparu would provide the necessary services needed for the growing yellow fin tuna industry. The proposed fisheries development in Kodhdhipparu seems to be the only feasible development that could be accommodated in the island due to the size of the island, even after the proposed reclamation.

Products of the project would be fresh fish (chilled and frozen yellow fin tuna and reef fish), live tropical fish, live reef fish and lobsters.

The total investment of the project is estimated to be 61.74 million Mrf and this will be completed within the first two years of the project. The project will create large number of direct and indirect employment opportunities throughout the country. Therefore the project will significantly contribute to the economic growth, particularly fisheries sector, and other relevant socio economic activities.

The following is breakdown of costs is Mrf:

Building and structures	47,481799.00
Plant and Machinery	8,807,555.00
Furniture and fittings	601,766.00
Vehicle (Dhoni and speed boats)	3,550,009.00
Tools and Equipments	917,525.00

2.1 Aim and Scope of the Environmental Impact Assessment

This EIA covers the environmental impact assessment arising from the proposed development works at Kodhdhipparu Island located in North Male Atoll. A project on fisheries development has been proposed by the proponent to the MoFAMR and this EIA report is aimed to address the environmental impacts arising from the facilities development in Kodhdhipparu. This involves:

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1. Deepening of the harbor at the south eastern end of the island
2. Uses of the material from the harbor deepening for land reclamation to increase the size of the island
3. Impacts arising from the construction various supporting facilities to the environment on the island.
4. Overall design of the developments in the island.
5. Impacts arising from the operation of fish processing and packing facility in Kodhdhipparu Island.

2.2 EIA Methodologies

The methodologies available to undertake and EIA process are numerous. They are subject of several text books and vast amount literature is available. The EIA process in the Maldives was initiated more than 10 years ago, with the proclamation of the Environmental Protection and Preservation Act, and development of Environmental Impact Assessment Regulations in 2007 the process is developing in the right path and has become more transparent. Comparing with the Field work and public consultation are minimal, still in most of the cases expert judgments of consultants from their previous works are drawn for impact prediction and analysis.

This EIA is based on three important sources of information:

1. Data and qualitative information gathered during the field visit made from 7-14 January 2007.
2. IEIA report prepared on reclamation of Kodhdhipparu Island in 2002.
3. Discussions held with the and the present lease of the island
4. Expert judgment of the consultants

Baseline conditions of the existing environment were assessment using standard scientific methods. Where possible quantitative data has been obtained and variability of the estimates provided. The IEIA report gives the baseline conditions of the island in 2002 and the recent survey has compared and documented the changes occurred in the Island since 2002. However the initial development of the island started prior to the requirement of the EIA reports.

3 Project Description

3.1 Introduction

This report highlights the findings of the Environmental Impact Assessment (EIA) carried out for the development of necessary facilities in Kodhdhipparu Island to establish a business of purchasing packaging and export of fresh fish products (hereinafter referred to as the Project). The project has been undertaken by Mr. Abdulla Mohamed G. Galolhu Fehi, Amin Constructions, Pvt. Ltd. (hereinafter referred to as the Proponent). The EIA was prepared as fulfilment of the requirement by the Ministry of Fisheries, Agriculture and Marine Resources (MoFAMR) for granting permission for the establishment of a business of purchasing packaging and export of fresh fish products as well as to conduct activities such as export of live-tropical fish, trails of rearing wild caught juvenile lobsters and sale of reared fish in enclosure in the Maldives. Further, Environmental Impact Assessment (EIA) of development projects is a requirement by the Environmental Protection and Preservation Act (EPPA) (law 4/93) of the Government of the Republic of Maldives.

The project proponent has submitted the detail project proposal to the (MoFAR) on the 25th of April 2007. An Initial Environmental Impact Assessment (IEIA) for land reclamation project in Kodhdhipparu was submitted to the (MoFAMR) in 2003, and based on that permission to reclaim 250,000 sq.ft was granted for the proponent. However, only, 20,000 sq.ft was reclaimed at that time due to various reasons. When the proponent wanted to continue reclaiming the remaining permitted area, the authorities informed him that the regulations has already changed so they should follow the new regulation, which means that a new EIA has to be submitted to the MoEEW prior to starting the development. Hence, this report has been mainly focussed on the environmental impacts associated with the project development. Major findings of this report are based previous studies on the island and on assessments and studies undertaken in a week long field trip made to the project site by the EIA team.

This document has been produced in accordance with the Terms of Reference (ToR) provided by the Environment Research Centre (ERC) of the MoEEW communicated to the proponent on the 3rd of May 2007(Appendix I). The Ministry of Environment, Energy and Water (MoEEW) has the mandate to implement and enforce EIA guidelines and procedures in the Maldives.

3.2 The Proponent

The project is proposed by Abdulla Mohamed G. Galolhu Fehi, Lonuziyaa raiy Magu, Male (ID Card No. A023157).

3.3 Project Location

Kodhdhipparu is a man-made small sand bank located at the rim of south western part of North Male Atoll in an irregular shape house reef. The vegetated part of the man-made island is located at about latitude of 4° 1’ N and longitude of 73° 21’ E. Figure 1 shows the location of Kodhdhipparu in North Male Atoll. Project site is located northwest of Giraavaru island.

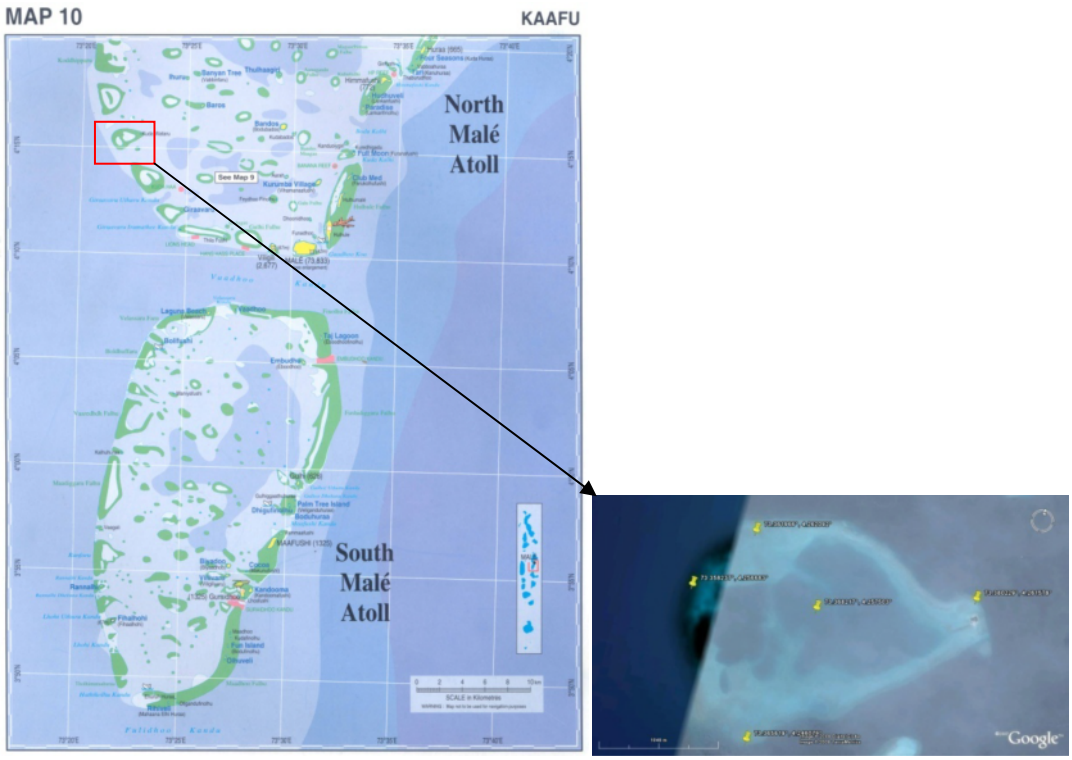

Figure 1: Location of Kodhdhipparu in North Male Atoll.

3.4 Project Scope

The project involves develop, establish and operate a business of purchasing packaging and export of fresh fish products as well as to conduct activities such as export of live-tropical fish, trails of rearing wild caught juvenile lobsters and sale of reared fish in enclosure in the Maldives. The project is to develop all the necessary facilities required for the smooth operation of the business in the island. The scope of the infrastructure development for the project involves the following:

- Dredging reclamation and civil work of harbor including the quay wall, break waters and jetty
- Construction of EU standard two storey fish processing factory with office, chilled storage and laboratory
- Construction of two storey storage building (warehouse) including ice plant
- Construction of a powerhouse and fuel tanks
- Construction of desalination plant house and sewage disposal plant
- Construction of lobster breeding and harvesting facilities
- General infrastructure (staff accommodation, mosque kitchen with mess shop and other necessary facilities for staffs and administrations)

Figure 2 shows the proposed development and infrastructure in Kodhdhipparu Island.

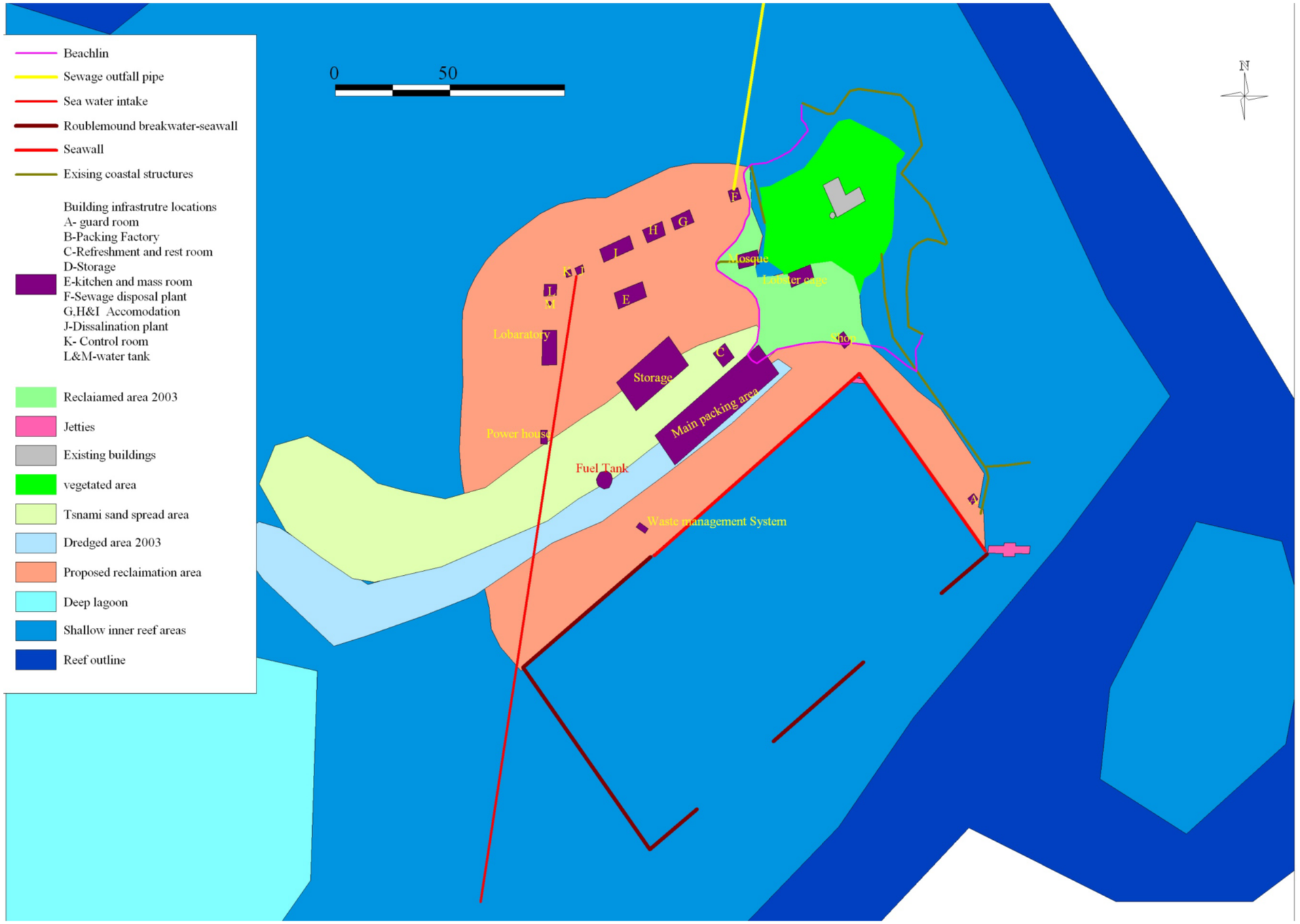

Figure 2: proposed infrastructure development in Kodhdhipparu Island.

3.5 Project Workforce

During the construction phase the project will have 20-50 direct employment positions. In employing people priority will be given for the Maldivians. During the operational phase the Kodhdhipparu will have approximately 30-70 direct and indirect employment opportunities.

3.6 Facility Design

Project Components and Facilities

The primary object of the project is to conduct business of purchasing, packaging, processing and fresh-export of fish and fish products. Hence all the necessary facilities at Kodhdhipparu Island has been designed to facilitate the process of packaging, processing and fresh-export of fish and fish products and to supply yellowfin tuna to Europe and far east markets.

Aside from the infrastructure for fisheries, service infrastructure has been established on the island.

Under the proposed project, the main infrastructure required for the operation will include complete accommodation blocks for staff, kitchen and dining and other service facilities necessary for the operations in the island. Operation related facilities include; harbour, collecting and freezing capacity, rainwater storage tanks, a powerhouse, fuel tanks, main stores, EU standard laboratory, cold storage, fish processing facility, ice plants, desalination plants, land and sea vehicle maintenance garage and workshop, fish receiving, butchering packing areas.

Environmental considerations have been given in the layout and designing the necessary infrastructures. The design scheme took into account the preservation and enhancement of the natural beauty of the island. Buildings will be located in the reclaimed areas and the existing small vegetation of the island will be left untouched. Local coastal trees and shrubs will be planted in the reclaimed area.

Staff facilities are designed to be located further away from powerhouse and factory facilities, to keep accommodation buildings away from the operational areas and noise.

The layout of the infrastructure development on the island is given in Figure 2 and brief description of the facilities on the island is given in the subsequent paragraphs.

Harbour

A 201m long, 102m wide harbour will be dredged, on the south eastern side of the existing island, to minimum depth of 3m at low tide. The harbour is designed to make use of the existing deep area to allow natural access passage into the harbour area (Fig 2). The harbour is designed to accommodate 10-20 fishing vessels at a time. Material obtained from harbour dredging would be used for the reclamation of the island.

Jetty

Existing long Y-shape groyne would be further strengthened and used as the main arrival jetty to the island. However, the harbour seawall and side quaywall could also be used for loading and unloading of fish and supply to the island.

3.6.4 Administrative buildings and services

Staff accommodation plots generally 14x7m 4 rooms with toilets and necessary furniture and fittings. Other common facilities such as kitchen, mess room mosques office buildings storage facilities would be constructed on the reclaimed land (Figure 2).

Fuel and water storage tanks

Water storage tanks capable of storing more than 26000 liter will be constructed. Fuel tanks with a storing capacity of 500 liter will be constructed in addition to the existing 200 liter tank.

Power house and desalination plant

A 6m wide and 8m long power house will be constructed in the island. Two generator sets each with 250KVa generation capacity will be installed. Almost all the water needed for the island will be produced by using a reverse osmosis desalination plant with a capacity to produce 50 tons per day. Beside this water storage tanks will be used to store water and also to collect rain water from the roofs. Location of the power house and the desalination plant is shown in (Figure 2).

Cold Storage

Reefer containers will be set as the cold storage in the island. The plan is to install 5 reefer containers with a capacity of 10 tons/ container. It is estimated that these containers would be sufficient to store 30 days of fish purchasing. The long term investment plan is to construct the 100 ton cold storage after five years of operation.

Fish processing facility

This is a single story building with ample space for packing and storage activities. The building will also have facilities for a packing plant for loin and fish fillet. The building will also have designated areas for gutting, packing, processing. The following flow diagram briefly shows the operational plan of the fish processing facility (Figure 3).

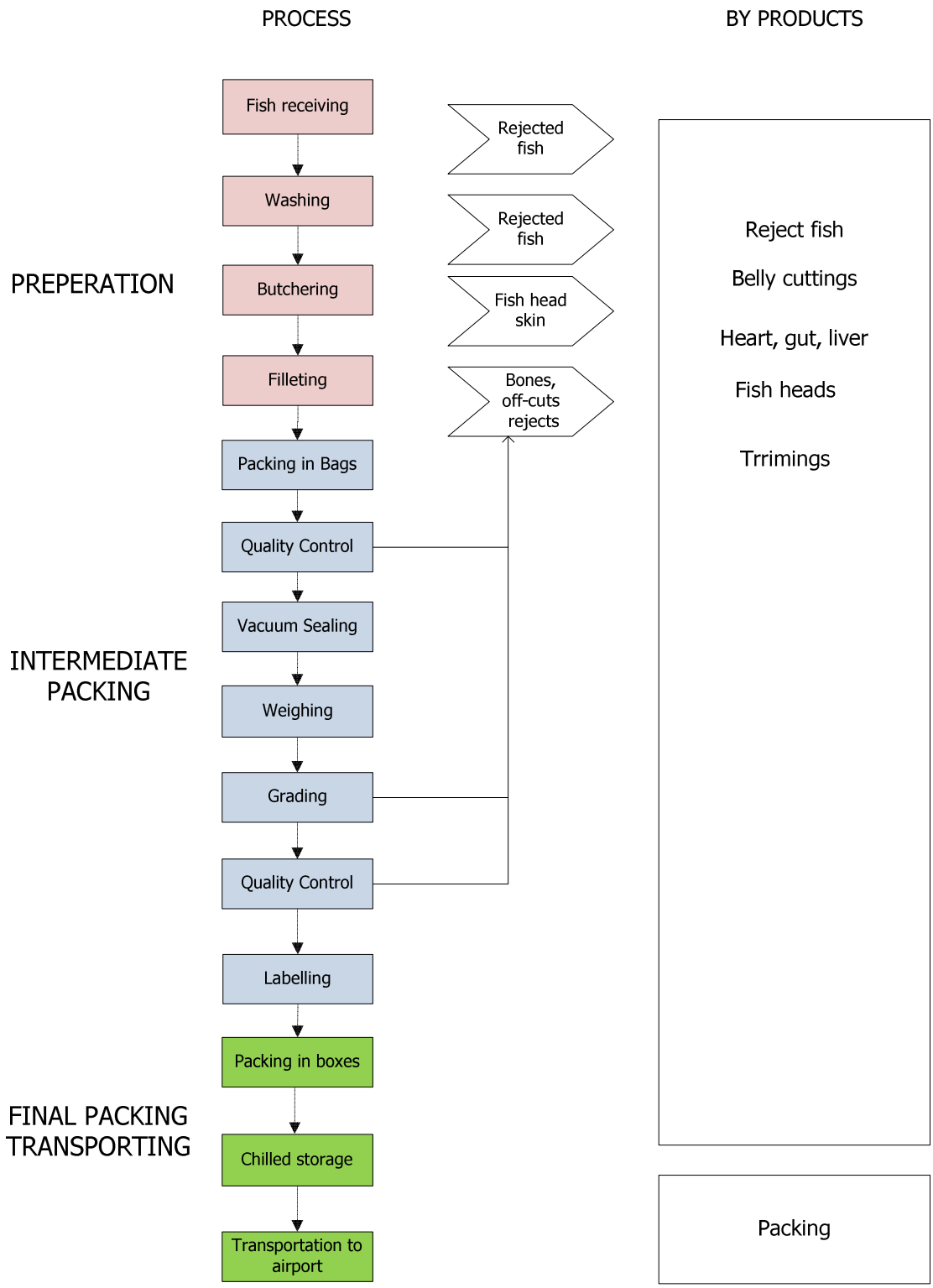

Figure 3: Generic flow diagram of the fish processing showing the by-products

Solid wastes and human waste management

The proponent is aware of the fact that unsuitable management of waste generated on the island can deteriorate the health and hygiene of the island's environment and hence every effort will be made to sustainably manage solid waste and other wastes

generated on the island. The proponent has proposed to establish an appropriate waste collection and disposal plan during the operation phase of the project. The management will follow the principles of integrated waste management generally reputed as the most environmentally sound way of managing waste. It will give most priority to reduce waste at the first place and where waste generation is inevitable it will sort the waste so that wastes can be reused and recycled. The management will ensure that wastes requiring disposal is minimized to best extent possible.

A waste management/disposal site would be established and demarcated on the island, and appropriate mechanism to collect and transport waste generated in the island will be planned and executed. Workers have been employed to regularly clean, collect and manage waste on the island.

The greatest proportion of waste generated during the operation phase will be organic in nature and all such wastes will be transported to Thilafushi on daily basis. Plastics, metal, glass wastes will be stored at the waste management area later removal and transportation to Thilafushi.

Sewage and grey water will be discharged into the open ocean. The amount of sewage generated and disposed is not expected to pose a major environmental problem considering the amount of people based on the island at any given time which is not expected to be more than 70.

3.7 Project Inputs and Outputs

The input / output analysis of a project helps us to define and understand the potential environmental impacts of the project in systematic ways and help to address the environmental issues more effectively. Linking inputs to processes and activities leads us to outputs and consequently to impacts. The inputs and outputs relating to the construction and operation fresh fish processing facility maybe primarily derived from the project concept and the project description, including the two main activities of the development namely the construction of the harbour and infrastructure required for the fish processing and packaging and transport.

It should be noted that Kodhdhipparu Island has been in the process of development and has already deployed some the equipment required for the construction works. Following may be required for the project works.

1. Construction workers and labourers: A large proportion of construction workers are expected to be expatriate labourers imported from countries within the region. Various socio economic impacts result from the import and management of such labourers. It is important to note that Amin Construction is very well established construction firm which is ‘mega’ projects being implemented. Therefore it is likely that additional labourers specifically for this work may not be required. Instead the developer may wish to re-locate some of the workers for certain period of time. But for harbour dredging works it is likely that the contract will be given to a professional party, such as the MTCC

2. Construction materials: Multitudes of materials are required for the construction harbour and the fresh fish packing facility. Imported river sand and aggregate, concrete, timber and timber products, metal and aluminium products, plastics of sorts, gypsum boards and plywood, fibreglass materials, paints, varnish, thinners and hydrocarbons, ceramic tiles, electrical wires and

many types of industrial cables, glass and plastic sheets. In addition to this very specific equipment will be imported. These include ice-plant, packing lines (vacuum packing of fish) and its associated equipment. Procurement of will have to take place early in the project and it is likely that they may be temporarily stored in the ware houses on Malé.

3. Construction tools and machinery: small vehicles and construction machinery, excavators, lorries, concrete machines, and tools.

4. Power generation: 250 KVA Diesel generator and cables and appliances

5. Water production: 50 ton RO desalination plant and piping and accessories

6. Diesel and other heavy oils and lubricants for power generation and operation of all types construction and other machinery

7. Fish processing and packing machinery; cutting tables, knives, and vaccum packing machines plus the specialist material and cooling/refrigeration equipment required for the cold storage.

8. Office equipment: Televisions, Computers, fax and copying machines, telephones and accessories, air conditioning equipment.

9. Kitchen appliances and tools: Refrigerators, ovens, microwaves and cooling equipment

10. Transport: Speed boats and power motors use highly inflammable fuels such as petrol and kerosene. Slow boats such as dhonis use diesel and other fuels. Floating jetties and anchorage for seaplanes will also need to be established.

11. Chemicals: laundry detergents, cleaning products for kitchens and bathrooms, household chemicals such as floor cleaners, window cleaners, fire fighting and prevention equipment

12. Household paper materials including all types of cleaning tissues.

The Outputs of the development can be summarised as below:

1. Dredged and scoured coral sand and aggregate which will have be temporarily stored on the island. In this case the dredged material will be used to reclaim the island as planned.

2. Construction wastes including leftover concrete, pieces of wood, binding wire, deformed iron rods, empty bags etc.

3. Waste from the assembly of machinery and equipment: pacing material, rubber, polythene, compressed ammonia, copper pipes, pieces of sheet, plastic sheeting, etc.

4. Organic wastes: Fish offal, blood water mixed with disinfectants and other chemicals, plant materials resulting from land clearings, kitchen waste (potatoes peelings, etc),

5. Burnt fuel emissions and left over oil wastes and bilges from transport vessels.

6. Plastic and glass bottles and containers

7. Treated Wastewater and dehydrated sludge and composting

3.8 Stakeholder Consultation

As briefed in the project background, Kodhdhipparu is a man-made island. The island was merely a sand bank during the early 1980s and was leased to Mr. Ali Fulhu. The sandbank was reclaimed from the material brought outside Kodhdhipparu reef in the latter part of 1980s. The lease of the island was later 'sold' to Mr. Abdulla Mohamed of G. Galholhu Fehi, the present 'owner' and the developer of the island. The Ministry of Fisheries, Agriculture and Marine Resources, in consultation with the various line Ministries has given permission to increase the land area of the island for the purposes of commercial investment related to fisheries. To this end and IEIA was undertaken during September 2002.

The developer has also submitted a comprehensive project proposal during October 2006 as per MoFAMR's Guideline for Fisheries Project Proposals. The MoFAMR's *ad hoc* 'project evaluation committee' has, after consultation with various line Ministries and interested parties, approved the project provided the EIA for the harbour development and for the fish processing facility is undertaken and approvals are sought from MoEEW. This report attempts to fulfil the requirements for EIA of the development project.

From the foregoing narrative it is clear that stakeholder consultations has already been carried out more than one occasion and the approval from the Government (i.e., Ministry of Planning and National Development and Ministry of Atolls Administration and MoEEW) has been granted. No further consultation deemed necessary.

4 Policy and Legal Matters

The guiding legal instrument on environmental management in the Maldives is the Environmental Protection and Preservation Act (EPPA, Law no. 4/93). This was enacted by the People's Majlis during 1993 and forms the basis of environmental management in the Maldives. By virtue of the powers conferred in the Article 5 of the EPPA, responsible Government authorities can make regulations. With regards to EIA the Environmental Impact Assessment Regulation 2007 that came in to force during May 2007 follows on the specific case of the environmental impact assessments. Schedule D of the EIA Regulations 2007 states that development proposal of 'fish processing facilities' requires undertaking an EIA.

The Ministry of Fisheries, Agriculture and Marine Resource (MoFAMR) is mandated for management and conservation of living marine resources. As such management and regulation of fisheries related development comes under purview of MoFAMR. Fisheries projects depending on the nature and extent of the project activities to require to undertake the EIA, but the in the specific case the of the fish processing facilities the regulation requires to undertake complete EIA studies for fish processing facilities similar to the ones proposed here.

The activities that will be undertaken in the operational phase of the project, i.e., catching large yellowfin tuna for fresh export requires that fishing vessels be registered with the MoFAMR and that vessels carry a health certificate from the Public Health. The idea being that processing or handing of fresh fish for export should be undertaken in hygienically clean condition at all stages of production.

Development projects that involves harbor constructions and reclamation would be reviewed by the Ministry of Planning and National Development. Under their spatial planning policy the MPND requires to keep tab on the reclamation projects and extent of the reclamations.

The authority for regulating the environmental affairs is the Ministry of Environment, Energy and Water. Under the Environmental Protection and Preservation act, MoEEW is mandate to implement the EIA process for the development projects. The revised guideline for EIA process has been published early 2007. EIA regulations are implemented by the Environment Research Centre of the MoEEW. All EIA are evaluated by the MoEEW and the responsibility of implementing the EIA recommendations falls under the MoEEW. Main EIA related licensing and responsible agencies and their authority is given in Table 13.

Table 1: Main EIA related licensing and responsible agencies and their authorities of the proposed project

Licensing/Responsible Agency	Relevant EIA required project
Ministry of Health	Any project relating to public health
Ministry of Environment Energy and Water	Construction, infrastructure development, any project related to energy generation (diesel solar bio-gas etc)
Maldives Water and Sanitation Authority	Projects related to drinking water issues, watering, dewatering and swage.
Ministry of Tourism and Civil Aviation	All projects related to tourism development and tourism re development

Ministry of Construction and Public Infra Structure	Project related to infrastructure design Harbours buildings, structural design
Ministry Fisheries Agriculture and marine Resources	Protection and conservation of living marine resources includes mariculture (land and marine based)
Ministry of Transport/ Maldives Ports authority	Port development, transport of hazardous material, issues relating to marine pollution MARPOL
Ministry of Economic Development and Trade	Import/export of raw materials/ final products for wholesale and retail.
Ministry of Planning and National Development	Harbour Construction and land reclamation projects

The fish processing facility would require a health certificate from the Department of Public Health. Although DPH is the competent authority in issuing the certificate of clearance of the facility on health issues many developers opt for development internationally recognized protocols such a development of HACCP and/or additional clearance of specific issues of the European importer. For instance, as consumer awareness in the UK/EU grows many wish to have the some form eco-labelling on their products. But normally this is done on whole fishery basis and is under the Government Agency, the MoFAMR.

5 Baseline Conditions

5.1 Geography

Kodhdhipparu is a man-made island by the act of accreting sand around existing small sand bank by using coastal structures constructed on the shallow areas on the eastern side of Kodhdhipparu Falhu. According to the aerial photos of 1969 no sand cay exists in the island lies on an irregular shape reef, with a deep lagoon at the center. Kodhdhipparu Island is located on the eastern end of the E-W oriented Kodhdhipparu Falhu on the southwestern side of North Male Atoll.The nearest resorts to Kodhdhipparu is Giraavaru Island 7km to the south, and Thilafushi Island (the Garbage dumpster) is 11 km to the south and. The capital island Malé is 17km to the SE of Kodhdhipparu. The total length of Kodhdhipparu Falhu along the long axis (E-W) is 2km while the short axis (N-S) is 1.6km. Existing reclaimed Kodhdhipparu Island is approximately 95m long and 75m wide, and has an area of 7466m^2, and the total area of Kodhdhipparu Falhu is 41,434,000.00 m$^{2.}$ The island occupies 0.018% of the total reef area. With the addition of proposed reclamation to the island, the island will occupy 0.079% of the Kodhdhipparu reef.

5.2 Geological Setting

North Malé Atoll is at the central region of Maldives and it is located on the eastern side of the double chain of atolls of Maldives. Kodhdhipparu being located on the southwester rim of the atoll it is exposed to high energy oceanic swells during the southwest monsoon and refracted, reflected and regenerated indirect fetch waves during the northeasterly monsoon. Due to the exposure of Kodhdhipparu reef to the direct oceanic waves during southwest monsoon the calmest area within the Falhu is on the eastern end. Hence Mr.Ali Fulhu who started constructing the island was aware that the eastern end of the reef is the most stable area with the least energy within Kodhdhipparu Falhu. During the NE monsoon Kodhdhipparu Falhu is very much sheltered and only exposed to refracted, reflected and regenerated indirect oceanic swells, and the period of exposure is shorter than the western monsoon. This might be the main reason for sustaining the island on the eastern edge of Kodhdhipparu Falhu.

Analysis of the aerial photo of the 1969 shows, that the island was initiated and developed on the lee side of Kodhdhipparu reef from a nodal point. The nodal point was formed on the northwestern part of Kodhdhipparu reef where incident wave energy from both NW and western side of the reef was low and sediment load carried by the wave were dumped and deposited around this nodal point and shaped by the prevailing current direction. Therefore it is evident that the wave energy generated from the SW and western sides are stronger and has more influence in bringing sediments to the island while the prevailing current were more engaged in distributing the sediment within the reef and shaping the cay.

Comparison of island areas of Kodhdhipparu between 2002 before the permitted reclamation and the present indicates that the area of Kodhdhipparu has increased from 5540-7466 m^2 (Figure 4). Hence the reclamation has added 1926 size to the island. This is approximately 34% increase in area from the island size in 2002. Addition of the proposed reclamation area will increase the island size to 2589 m^2. Increase in size of the island is maintained sustainably by the coastal structures

placed around the island. Existing coastal structures in Kodhdhipparu Island and its impact will be discussed elsewhere in this report.

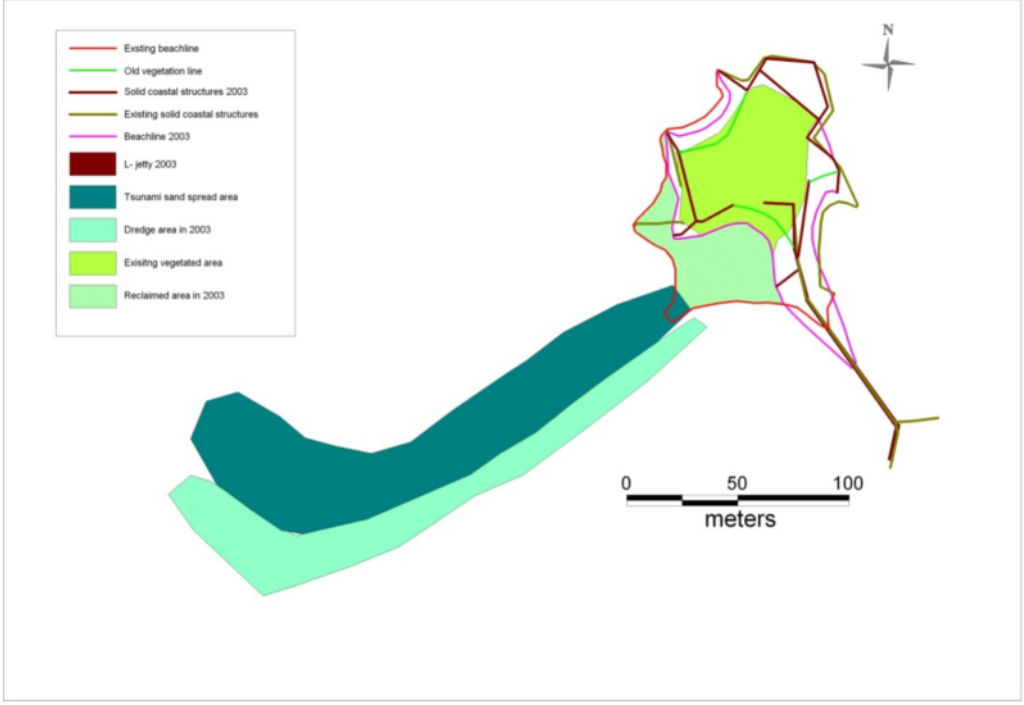

Figure 4: Comparison of the changes in Kodhdhipparu between 2003 and the present.

5.3 Hydrogeological Setting

In small coral islands, coral sand, coral limestone are the main water bearing formations. The small size of the island and soft coral sand indicates that water retention of the island will be very low. The mean monthly rainfall is roughly 170mm and occurs mostly during March to December. Normally there is high rate of percolation through very permeable coral sands, the net storage of fresh groundwater is minimal on such small islands.

The height of the water table above the sea-level will have a significant bearing on the movement of saline water into the freshwater zone. While in large and mature islands the fresh water lens sits significantly higher than the sea-level (e.g., Kvarati in Lakshadweep; Singh & Gupta, 1999) small coral cays, like the Kodhdhipparu this is unlikely. Water lens of the island is not developed because the size of the island is extremely small.

The water is Kodhdhipparu is highly saline and not usable for washing or gardening. At present fresh water on the island is transported from Male and supplemented by the rainwater catchments.

Figure 5: shows an idealized cross-section through a typical limestone or coral island, showing the main features of a freshwater lens. In most cases, the thickest part of the freshwater lens is not in the centre as shown, but is displaced towards the lagoon side. This is due to the lower permeability sediments on the lagoon side slowing down the mixing of the freshwater and sea-water, thus enabling a thicker freshwater zone to develop.

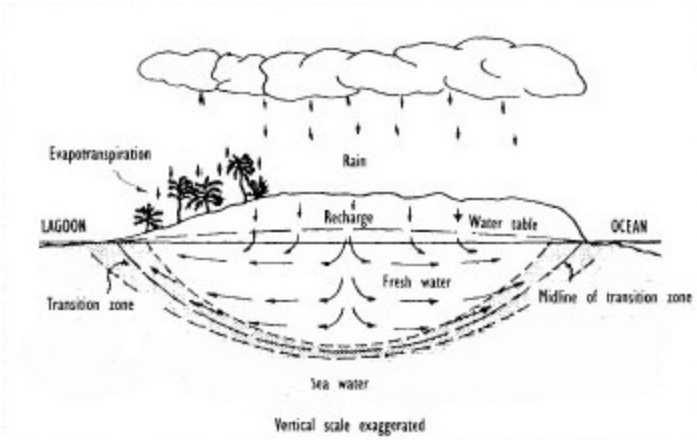

Figure 5: An idealized cross section of an coral island showing the relationship of the ground water lens and the sea-level.

5.4 Climate

The climate of Maldives is dominated by the monsoons; the North East (NE) monsoon from December to February and the South West (SW) monsoon from May to September. The period between, March-April is the transition period from the NE monsoon to SW monsoon known locally as the Hulhangu Halha, while the transition period from SW monsoon to NE monsoon known as Iruvai Halha is from October to November. The SW monsoon is generally rough and wetter than the NE monsoon.

Analysis of weather records from 1986-2002 at Hulhule meteorological station indicates that the predominant wind direction during the SW monsoon is from W-WNW, while the predominant wind direction during the NE monsoon is a NE northeast to east north east (ENE) direction and strongest wind is during May-July reaching to a wind speed of more than 8m/s (Figure 6).

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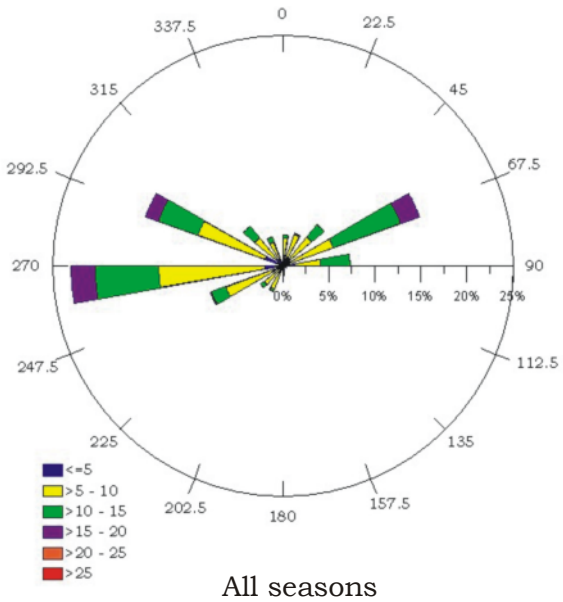


Figure 6: Typical wind rose plot for Hulhule Malé data (2002-2003), closest meteorological station to Kodhdhipparu (extracted from LaMER EIA reports).

Generally precipitation is lower in the north of Maldives than the south. Average of the total monthly rainfall during NE monsoon is 140 mm/month and during SW is 200

mm/month and average annual rainfall at Hulhule ranges between 1900-2200mm (Figure 7:).

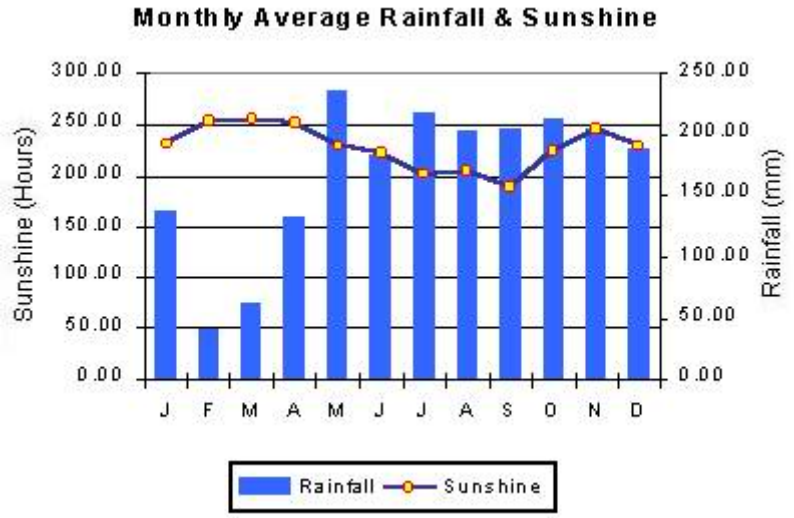


Figure 7: Monthly average rainfall over the Maldives, Dept. of Meteorology, Source: http://www.meteorology.gov.mv

5.5 Hydrographic & Hydrodynamics at Kodhdhipparu

Bathymetry

Lagoon and reef bathymetry survey Kodhdhipparu was carried out to study the bottom topography and lagoon depth. Depth readings were taken from a handheld eco-sounder, initially in a zig-zag fashion followed by random points. There are number deep pocket-lagoons on the western side of Kodhdhipparu Falhu. Bathymetry surveyed area (proposed dredging and reclamation area) of Kodhdhipparu Falhu shows fairly uniform depth within the nearshore areas.

Lagoon

The lagoon in Kodhdhipparu could be divided into physiographically distinct zones. The shallow lagoon and the 4 pockets of deeper blue lagoon. The average depth of the shallow lagoon ranges between 0.8-2m and deep lagoon ranges between 3-10 meters. The shallow lagoon is mostly on the southern half of the reef, and the deep area is almost in the middle of the reef. Small and deep areas exist on the southern, eastern and northern part of Kodhdhipparu Falhu. The shallow areas are alternated by deep blue area. The margins of deep and shallow lagoon clearly are marked by a high loose sandy berm and an abrupt increase in water depth.

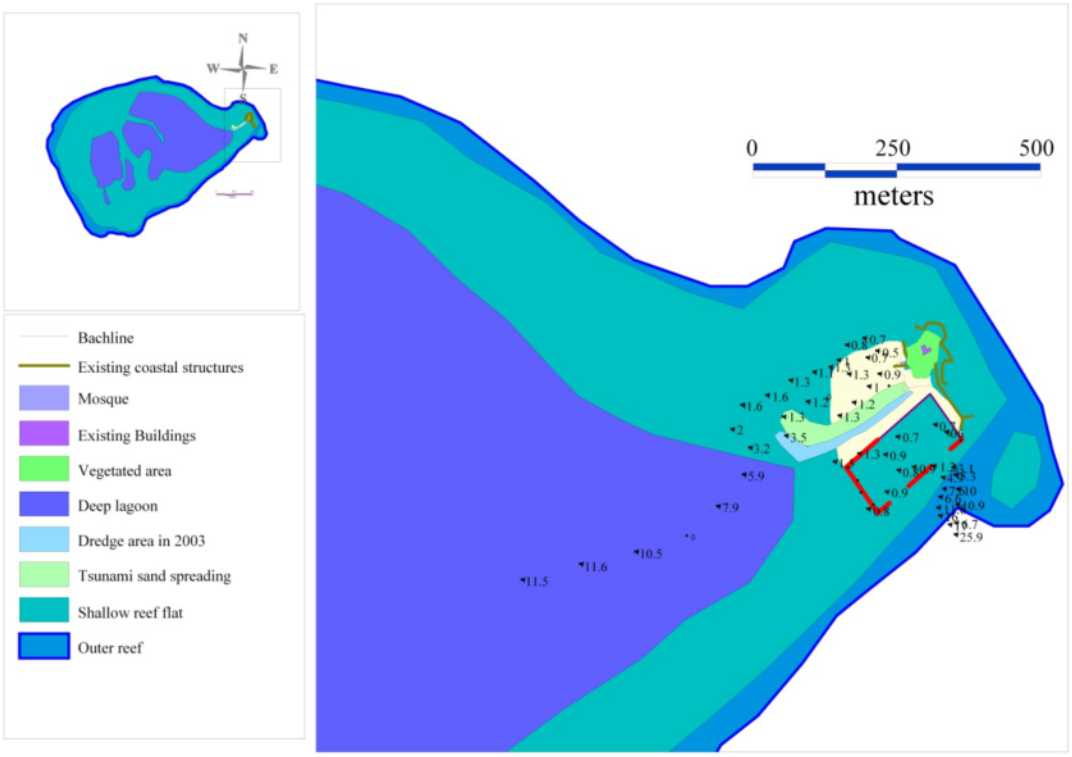


Figure 8: A map of Kodhdhipparu Falhu showing the water depth of the proposed dredging and reclamation areas.

Tides

Tides in the Maldives are diurnal-semidiurnal type, and can be further divided into spring and neap tide periods. The tidal range is about a meter. Analysis of tide prediction data for Hulhule tidal station, obtained from the University of Hawaii Sea Level Centre from 2000-2007 indicated that the lowest predicted tide level in five years is equal to the chart datum (CD). The lowest predicted level for Hulhule is 22.1cm equal to LLWL +0.0CD (LLWL). Tide station at Hulhule is the closest station to Kodhdhipparu, approximately 17km East. It has been assumed because of the close proximity to Hulhule that the Kodhdhipparu tidal variations are the closest standard tidal station. Tidal ranges recorded for Malé area is given in Table X.

Highest Astronomical Tide (HAT)	+0.64m
Mean Higher High water (MHHW)	+0.34m
Mean Low High Water (MLHW)	+0.14m
Mean Sea Level (MSL)	0m
Mean Higher Low Water (MHLW)	-0.16m
Mean Lower Low Water (MLLW)	-0.36m
Lowest Astronomical Tide	-0.56m
Tidal range	1.2m

Waves

Kodhdhipparu being located in the SW rim of the North Malé Atoll it is exposed to direct oceanic swells from the western side during the SW monsoon. The island is

exposed to regenerated local wind-waves from the east during the easterly or NE monsoon. Being located between two atoll openings the reef is exposed to wedge waves from the southern and northern side of the reef. These waves are very much limited in their height and energy by the depth of water over which they travel before reaching the shoreline of the island. Surf waves breaking into the reef flat were observed on the western side of the island and this type of waves will continue to break into reef flat during the SW monsoon. The observed wave height on the south and western side of the island is between 0.3-0.7m with a period of 5-12seconds.

Figure 9 shows the calculated maximum and significant wave height for the surveyed area (dredging and reclamation area).

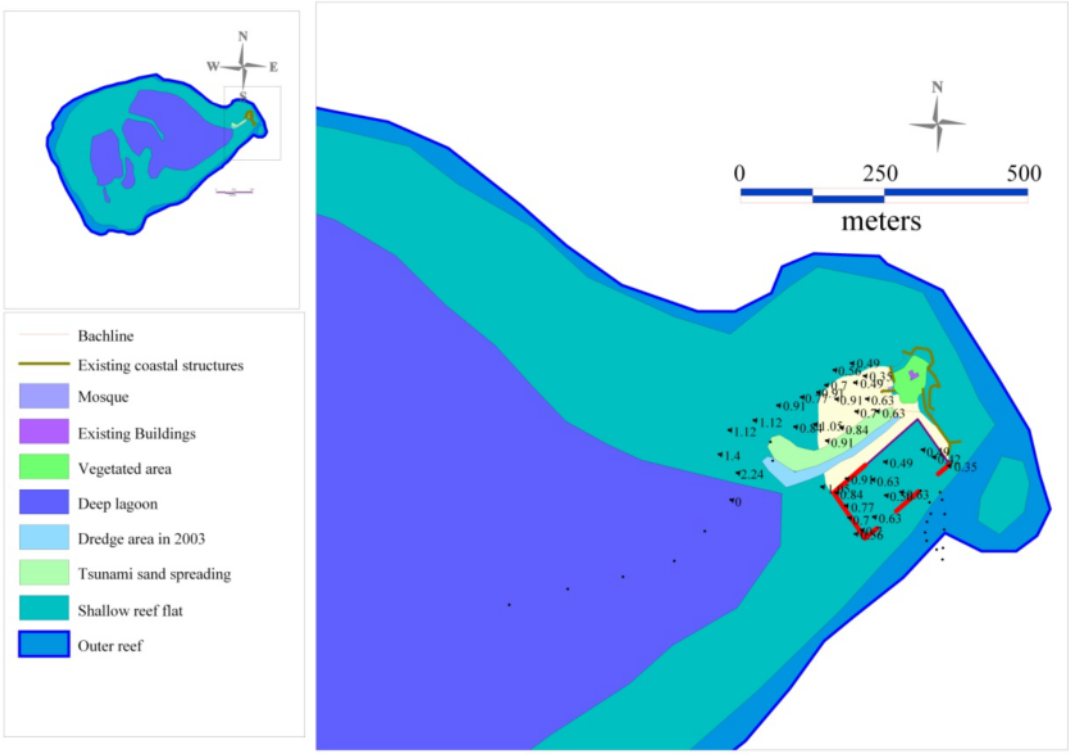


Figure 8: Calculated maximum wave height around the proposed dredging and reclamation area

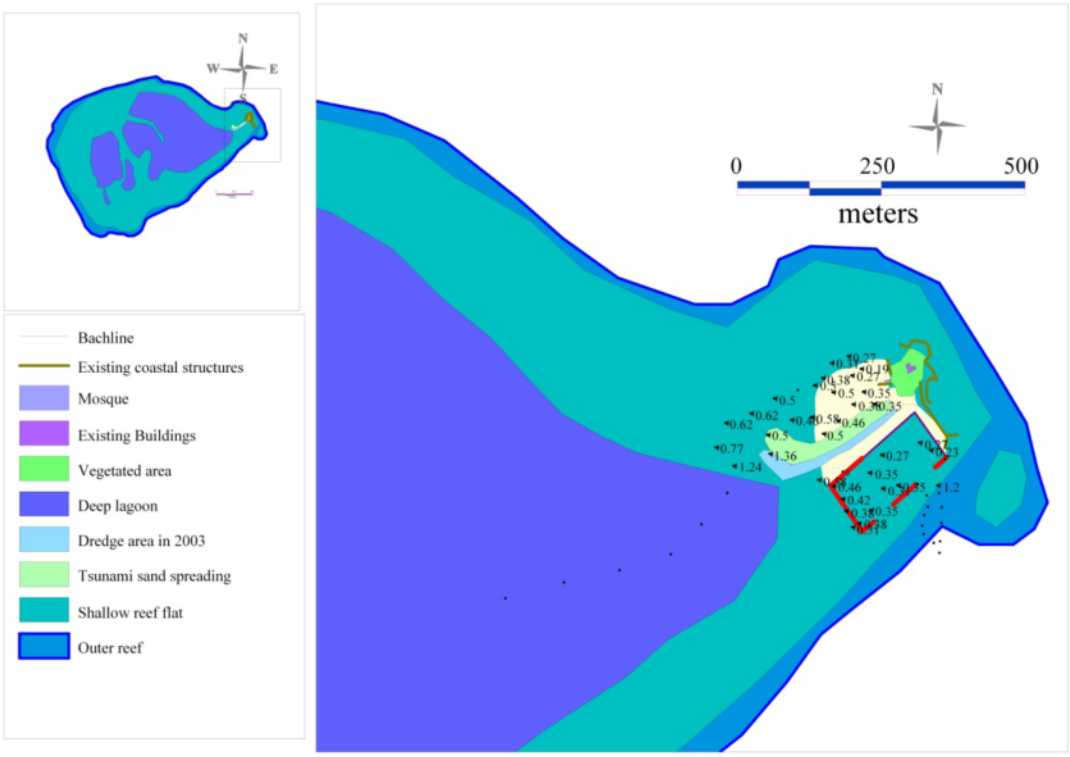


Figure 9: Calculated significant wave height in the proposed dredging and reclaimation area

Currents

Currents within the lagoon of Kodhdhipparu can be originated from the tides, winds, wind generated wave. However the greatest contribution to the current patterns would be the local wind-generated waves and surf breaking and over washing on the reef flat. The main driving force for the surface current is wind. Therefore it is expected that the surface current around within the Kodhdhipparu Falhu will follow the general wind direction of central Maldives. According to wind data obtained from Hulhule the Average wind velocity during NE monsoon ranges between 5.6-6.3m/s and 5.3-6.3m/s during SW monsoon. The average wind speed at transition periods Hulhangu Halha, March –April is 3.75m/s and Iruvai Halha October-November is 5.1m/s.

Based on this information it could be concluded that at Kodhdhipparu general surface current flow pattern would be W-NW during SW monsoon and E-ENE during NE monsoon. long shore current is expected to have from W-E during westerly monsoon and E-W flow during NE monsoon. Currents would be expected to be stronger from may-October, and current flow would be low during March, April and November.

5.6 Existing Coastal Structures and its Impacts

Large number of groynes (shoreline perpendicular coastal structures) and seawalls (shore parallel adjacent coastal structures) are constructed around the island to stabilize and maintain the island. From a coastal engineering point of view these coastal development are necessary to sustain the island in its shape. However, some of the structures are not properly aligned and therefore ineffective in achieving the

desired objective. These structures are responsible for redirecting current and wave action around the island. Effects of the coastal structures are briefly described below:

a) Seawalls both on the Northern half and the southern ends of the island caus seaward migration of the shoreline into the lagoon, therefore, no space is available on both ends of the island for sediment to accumulate.
b) The seawall on the southern end of the island extends seaward on the western side, and acts as a groyne that gives protection to the sandy beach are on the northwestern side of the island.
c) The groyne that extends northwards from the NE corner of the fish holding tank also serves to protect the sandy beach on the northwestern side of the island.
d) Approximately 100 meter long Y-shape solid jetty exists on the southern side of the island acts as a terminating groyne. This groyne prevents sediments on the eastern side moving N-S directions. Therefore, most of the time, sediment moving N-S directions are accumulated on the lea of this structure.

Shape of the coastal structures have been altered and directions, dimensions and orientation has been changed since the 2002, to adjust to the changes brought by the reclamation in 2002 (fig 11.).

Figure 10: Existing coastal structures on the island, Island as seen from a distance (a); fish pond (b), breakwater going to south (c) and main T-breakwater facing east (d).

5.7 Marine Environment

The marine environment was studied using rapid assessment methods that allow assessing the reef qualitatively in the broader sense. Following methods were were adopted due to limitation on the field work that can be carried out.

1: Photo-quadrate: A sequence of photo images were taken on a belt transect of roughly 200 m x 2m. While swimming on the reef top, about 2 - 2.5 m deep, a photo-image of the plan view of the reef was taken at every 4 fin-kicks until completion of the 200m. The images may be later studied using Coral Point Count for Excel Extension (CPcE). Either percent cover or species diversity can be estimated, or just rough estimates of the coral can be assessed.

2: Fish count: At each site where quadrat samples were taken, fish census was undertaken. A ten minute observations noting all fish in the visual field were noted.

3: Manta tow survey: A broad scale survey methodology known as manta tow survey was used to assess the general status of the reef topography on two sites of the reef. Manta tow technique is often used to assess broad changes in the benthic community of coral reefs where the unit of interest is often an entire reef or large portion thereof. It enables visual assessment of large areas of reef within a short time. Information from the manta tow reef assessment has been used for the selected sites for more detailed reef assessments that are representative of the various habitats have been used (English et al., 1997).

3: Vegetation Survey: A series of walking traverses on both coasts and through sections of the vegetation to identify the plants. Plants encountered were also photographed. The information gathered traverses was used to create a list of all the plant species occurring at the study site and to determine the level of dominance/importance of each plant species in the form of a DAFOR (Dominant, Abundant, Frequent, Occasional & Rare) ranking.

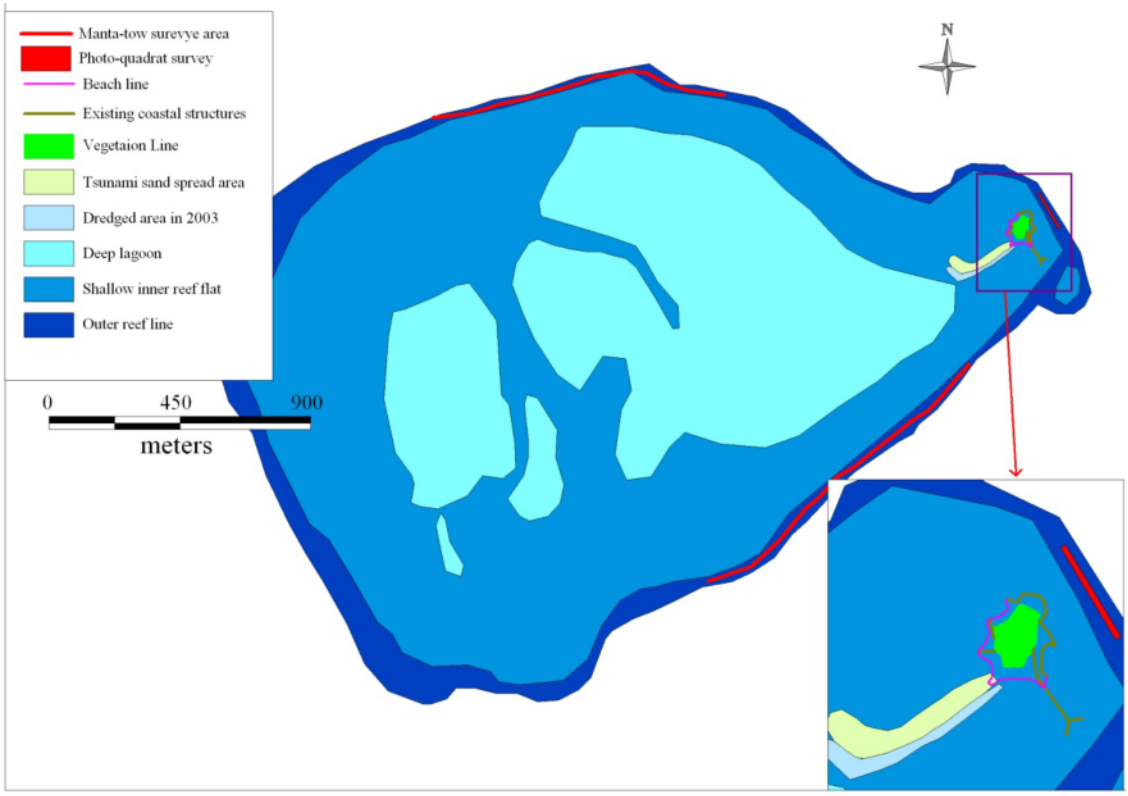


Figure 11: Locations on the reef showing photo-quadrate and manta tow survey.

Reef

Three areas of the reef were surveyed which are shown in Figure 11. On the northern side, just outside the fish pond, photos were taken on a belt transect about 2m by 200 m for further study. On the eastern and north western side the Manta tow technique was used for broad scale assessment. The summary results of manta tow survey are given in Table 2. Representative images of the photo-survey are given Figure 12.

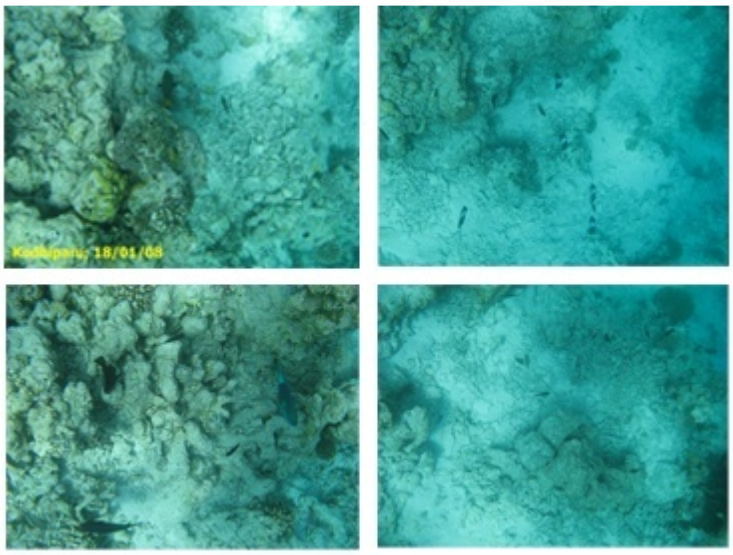


Figure 12: Typical image of the of the reef substrate on the transect. Roughly over 90% of the cover is rock, rubble and sand and only 3-8% is the live coral cover. The complete sequence of images are given in Appendix.

Rough assessment of the photo-images shows live coral cover on the substrate is about 3-4%.

About 60 species of fish were observed on the transect (north of the fish pond) of which the largest numbers were Labridae followed by Acanthuridae & Chaetodontidae. Fish belonging to 16 families were observed. Large school of red-toothed trigger fishes, *Odonus niger* were observed on the reef slope. Mass mortality of this species occurred from about September – December 2007. On Kodhdhipparu fish deaths occurred from 02 December through 30 December. The cause of these death are not yet know, but investigation shows they were not due to harmful algal blooms or depletion of oxygen in the water columns as it has been suspected earlier (MRC, 2007).

It should be noted that fish census can be very subjective and the type of results one may obtain may, among other things, depend on competency of the observer, time of the day, physical conditions on the reef, etc. These assessments therefore should be taken as very rough assessment of the fish fauna in the area. In general it is fair to say that the assessment is not dissimilar form a typical habitat on reel like Kodhdhipparu.

Manta tows were done on the on the eastern side and on the north western side. Due to poor visibility and rough weather the number of tows done was limited. The results are presented in Table 3. Live coral was estimated less than 10% on both sites. Rock, rubble and sand were dominant on both sites.

The reef on the northwestern is discontinuous in several places and sand sheets in between. The sand sheets appear to go to the atoll floor. Isolated bommies and large patches were seen in several places.

These assessments, from the photo images and from the manta tow surveys shows that Kodhdhipparu reef is not in good shape. However, it must be emphasized that small Acropora colonies observed in the photo images are indication that coral recruitment is taking place. It is also worth noting Kodhdhipparu management is aware of this and is strictly restricts activities on coral reefs that may further degrade the reef (e.g., spear fishing and coral removal). It must however, be emphasized that relatively large number of the tuna fishermen regularly visit to the eastern side for bait fishing. In fact large schools of rehi (*Spratelloides delicatulus*) were seen on the eastern side.

Table 2: Visual assessment survey of fish (top) and summary (bottom)

Family	Species	Abundance
Acanthuridae	*Zebrasoma veliferum*	R
Acanthuridae	*Zebrasoma desjardini*	r
Acanthuridae	*Acanthurus leucosternon*	C
Acanthuridae	*Acanthurus lineatus*	R
Acanthuridae	*Naso brevirostris*	C
Acanthuridae	*Naso vlamigi*	R
Acanthuridae	*Ctenochaetus binotatus*	C
Acanthuridae	*Acanthurus triostegus*	C
Acanthuridae	*Ctenochaetus striatus*	C
Acanthuridae	*Ctenochaetus strigosus*	C
Balistidae	*Odonus niger*	V Common
Balistidae	*Balistoides conspiculum*	R
Chaetodontidae	*Chaetodon auriga*	R
Chaetodontidae	*Forcipiger longirostris*	C
Chaetodontidae	*Hemitaurichthys zoster*	A
Chaetodontidae	*Chaetodon guttatissimus*	R
Chaetodontidae	*Chaetodon klenii*	C
Chaetodontidae	*Chaetodon triangulum*	R
Chaetodontidae	*Chaetodon trifasciatus*	C
Chaetodontidae	*Chaetodon faculua*	R
Chaetodontidae	*Chaetodon trifascialis*	R
Chaetodontidae	*Chaetodon citrnellus*	C
Pomacentridae	*Abudefduf sexatilis*	R
Pomacentridae	*Chromis dimidiata*	C
Pomacentridae	*Chromis ternatensis*	C
Pomacentridae	*Chromis viridis*	C
Pomacentridae	*Dascyllus aruanus*	C
Pomacentridae	*Abudefduf vaigiensis*	C
Pomacentridae	*Amphiprion niripes*	R

Family	Species	Abundance
Labridae	*Thalassoma harwicki*	C
Labridae	*Labroides dimidiatus*	C
Labridae	*Chelinus fasciatus*	R
Labridae	*Epibulus insidiator*	R
Labridae	*Halichoeres scapularis*	R
Labridae	*Halichoeres hortulanus*	R
Labridae	*Thalassoma lunare*	R
Labridae	*Thalassoma ambycephalum*	R
Labridae	*Thalassoma jansenni*	R
Labridae	*Anampses meleagrides*	R
Labridae	*Bodianus axillaris*	R
Labridae	*Pseudochelinus envanidus*	R
Labridae	*Gomphosus caeruleus*	C
Labridae	*Hemigymnus fasciatus*	R
Labridae	*Pseudochelinus hectaenia*	R
Labridae	*Stethojulis albivittata*	R
Labridae	*Bodianus diana*	C
Lethrinidae	*Monotaxis grandoculis*	R
Mullidae	*Parapeneus bifasciatus*	R
Nemipteridae	*Scolopsis bilineatus*	R
Scaridae	*Scarus rubriviolaceus*	R
Serranidae	*Cephalopholis argus*	R
Serranidae	*Anthias spp.*	C
Zanclidae	*Zanclus cornutus*	C
Syngnathidae	*Corythoichthys sp*	R
Lutjanidae	*Lutjanus kasmira*	C
Lutjanidae	*Lutjanus bohar*	R
Heamulidae	*Plectorhinchus vittats*	R
Caesionidae	*Pterocaseio tile*	C
Caesionidae	*Caesio caerulaurea*	C

Family	#species	Family	#species
Labridae	17	Heamulidae	1
Acanthuridae	10	Lethrinidae	1
Chaetodontidae	10	Mullidae	1
Pomacentridae	7	Nemipteridae	1
Balistidae	2	Pomacanthidae	1
Caesionidae	2	Scaridae	1
Lutjanidae	2	Syngnathidae	1
Serranidae	2	Zanclidae	1
Totals	52		8

In general the reefs in the Maldives are recovering from the mass coral bleaching event of 1998. Biophysical monitoring of the reef has shown the reef recovery is highly variable with the good recovery rates in south.

Table 3: Manta tow results (site 1 and Site 2).

Tow#	Dead Corals	Live	Soft	Sand	Rubble	Fish	Bomb Crater	Notes
Site 1: Northern side								
1	4	1	0	+	+	+	no	murky large dead bommies
2	4	1	0	+	+	+	no	realtively steep slope
3	4	1	0				no	
4	3	1	0	++	+	+	no	
5	5	1	0	++	+	+	no	
6	4	1	0	+	++	+	no	
site 2: North western side								
1	4	1	0	++	+	++	no	
2	4	1	0	+++	+	+++	no	slipped sand sheets
3	4	1	0	+	++	++	no	sand sheets
4	4	1	0	+	+	++	no	
5	4	1	0	++	+	++	no	
6	3	1	0	+	+	++	no	
7	4	1	0	+	+	++	no	

Numbers refer to coral cateogories, i.e., 0 = no hard bottom for corals, 1 = <10% living coral cover on hard bottom, 2 = 11-30%, 3 = 31-50%, 4 = 51-75%, 5= 76-100%. Abundance indicators: 0 = absent, — = rare, - = uncommon, + = common, ++ abudant, +++ superabundant

5.8 Vegetation

Vegetation Survey: a series of walking traverses in the island and through sections of the vegetation were undertaken to identify the plants. Plants encountered were also photographed. The information gathered in the traverses was used to create a list of all the plant species occurring at the study site and to determine the level of dominance/importance of each plant species in the form of a DAFOR (Dominant, Abundant, Frequent, Occasional & Rare) ranking.

Table 4: Summary of main types of vegetation on Kodhdhipparu Island

Scientific name	Common name /Divehi name	DAFOR Ranking
Cocos nucifera	Dhivehi ruh	C
Crinum asiaticum	Kandholhu	R
Cyperus polystachyos	Hai	R
Fcus benghalensis	Nika	R
Guettarda speciosa	Uni	R
Morinda citrifolia	Ahi	R
Ochrosia borbonica	Dhunburi	R
Pemphis acidula	Kuredhi	C
Surinama maritima	Halaveli	C
Scaevola taccada	Magoo	C
Terminaalia catapa	Midhili	R
Thespesia populnea	Hirundhu	C
Hibiscus tiliaceus	Dhigga	R

The island is man-made and the trees have been planted, not natural colonization. A variety of garden and exotic plants were seen. Divehi run (*Cocos nucifera*) is fairly common and are in relatively large numbers. In fact they are too close together and

so would require to be removed at some stage. The island has an approximately 5 meter wide coastal vegetation cover, consists of very basic salt and spray tolerant coastal plants , dominated mainly with, S*caevola* sp. *Tournafortia* sp. *Pemphis* sp. and some coastal shrubs

A number of Hirundhu trees (*Thespesia populnea*) were present. They are now relatively large and about 10 trees were present. The coastal areas had Kuredhi (*Pemhis acidula*) and Halaveli (Suriana maritima), but also magoo (*Scaevola taccada*) and few trees of boashi (*Tournefortia argentea Meeserschimidia argentea*) (***Figure 13***).

Figure 13: Typical vegetation scene on the island. Large number of small coconut palms have been grown in the all the places, and some of them are too close to each other (a),, Hirundhu tree (b) typical vegetation scene outside the living quarters (c) and kurehi tree (d).

5.9 Island Fauna

Love birds and parrots are being introduced to the island and reared at the island. Most of them are in cages but also a large number of them do live out of cages but rarely do they go away from the island. Based on the accounts given by the project staff a number of species of shorebirds and seabirds were known to visit the island. Two species of reptiles were observed, these were the mourning gecko (*Lapidodactylus lugubris*) and the garden lizard (*Calotes versicolor*). The management has prohibited catch or keeping of any of the resident or migratory birds on the island be it protected or otherwise.

6 Environmental Impacts and Mitigation Measures

Assessments and prediction of environmental impacts involves certain degree of uncertainty as natural and anthropogenic impacts can vary from place to place due to differences in ecological, environmental or socio-economic conditions in a particular place. Like in many development projects there is no long term data that can be used to model and predict the environmental impacts over time. Impacts can be minimized if monitored properly and appropriate measures are taken promptly during and after the developmental period. A summary of the impacts during the construction phase is given in Appendix 2

6.1 Definition and Classification of Environmental Impacts

An environmental impact is any change to the existing condition of the environment caused by human activity or an external influence. Impacts may be positive (beneficial) or negative (adverse). They may also be direct or indirect, long-term or short-term in duration, and wide-spread or local in the extent of their effect. Impacts are termed cumulative when they add incrementally to existing impacts. In the case of Kodhdhipparu development project, potential environmental impacts would arise during the construction and the operations phases of the project and at both stages positive and negative impacts would occur.

Impact Significance

The purpose of an EIA is, *inter alia*, to identify the significant impacts related to the project or activity under consideration and then to determine the appropriate means to avoid or mitigate those which are negative. Significant impacts are defined, not necessarily in order of importance, as being those which:

1. Are subject to legislative control;
2. Relate to protected areas or to historically and culturally important areas;
3. Are of public concern and importance;
4. Are determined as such by technically competent specialists;
5. Trigger subsequent secondary impacts;
6. Elevate the risk to life threatening circumstances; and
7. Affect sensitive environmental factors and parameters.

Impact Matrix

An impact matrix is a simple but effective tool for identifying the possible impacts of project activities on the environment and this has been done for the proposed development project in Kodhdhipparu (Appendix 2). Here, the activities carried out during the, construction and operational phases are arrayed against a selection of environmental factors that are deemed relevant to the site, or which may be affected indirectly as a result of project activities. The construction phase activities have been sub-divided into the three key areas of activity; a) building works, b) coastal works, and c) construction activities. The impact matrix should not be misinterpreted to mean that all the identified impacts would occur during implementation of the project. However, the matrix does serve to identify the potential impacts and significant concerns and this leads to the next step of the EIA process, mitigation, which considers the appropriate measures to remove or ameliorate the adverse impacts that have been identified. At this stage measures to enhance the positive aspects of the development can also be devised.

6.2 Construction Phase Impacts – Building Works

Dredging

Impacts: Excessive rates of sedimentation as a result of dredging can adversely affect the structure of coral communities in three ways: physically, chemically or phtosynthetically which in turn influences negatively on calcification growth and net accretion rates. Direct impacts associated with excessive sedimentation includes; physical smothering of corals and other benthic reef organisms, reduces light penetration thus decreasing the rate of photosynthesis and net productivity of corals, reduces coral growth and reproduction, reduces fish diversity and abundance in the vicinity of dredged area.

Long term and irreversible loss of immobile marine biota, in particular, the coral life and habitat loss for benthic organisms living on the lagoon due to dredging and reclamation is inevitable to a large extent. However, some of the adverse impacts associated with dredging and reclamation could be mitigated if appropriate measures are taken in a timely manner.

Sedimentation will be the main impact of dredging works. The sand is dumped on the southwester side of the island adjacent to the dredging area and gradually the size of the island is increased. Although there minor effect at the source end there will be considerable amount of sedimentation on the receiving end. Sedimentation causes in the reduction of water quality in the lagoon, which affects benthic organism and fish. If the sedimentation persists for prolonged periods 'suffocation' and smothering of coral may occur. A summary of the impacts, mitigation measures is given in the Table 5.

Mitigation: One way to mitigate effects of sedimentation would be to construct settling ponds to contain sediments in a confined area to be settled by time. It is recommended that beach filling and reclamation takes in smaller areas that are embanked with the sand bags. Once the area is filled the sand bags may be moved to the next area before the sand pumping can takes place. Installation of silt screens would minimize sedimentation and turbidity level of the water column during dredging and beach filling and construction of settling ponds to receive the dredged material would minimize sedimentation problems. Dredging and beach filling activity may be undertaken in calmer weather and preferably at low tides.

Timing of sand pumping Study on the dispersion pattern of dredged material in the Maldives has shown that as soon as the material reaches the deep water, the rate of dispersion is fast and the sediment plume disappears faster due to the strong current and wave actions. Therefore in the case of Kodhdhipparu it is recommended to conduct the dredging and beach filling activities during the NE monsoon when the current flow and wave direction is from NE. Timing of NE monsoon period it is expected to carry the sediment plume into the deep waters and disperse faster, this will contribute for significant reduction in impacts associated with sedimentation.

Land reclamation

Impacts: Similar to the dredging, sedimentation will be the main impact of reclamation. Sedimentation results in the reduction of water quality in the lagoon, particularly on the shallow reef flat and on western side. Sedimentation affects benthic organism and fish, and other natural processes. The reclamation through sand pumping is also expected to increase local turbidity sediment dispersal, changes in salinity or reduction in dissolved oxygen levels thereby favoring anaerobic conditions. There is relatively less changes of moving suspended fined towards the

reef on the reef flat area as normally this side is calm and the work is expected to take place during calm periods.

The sand pumping causes re-suspension of fine sediment, and is often responsible for increase in local turbidity levels, changes in salinity, release of toxicants or bio-stimulants from fill materials, introduction of petroleum products or reduction in dissolved oxygen levels thereby favoring anaerobic conditions. However, most of these impacts would be minimal in this project since fill material would be from local environment, which is pristine condition

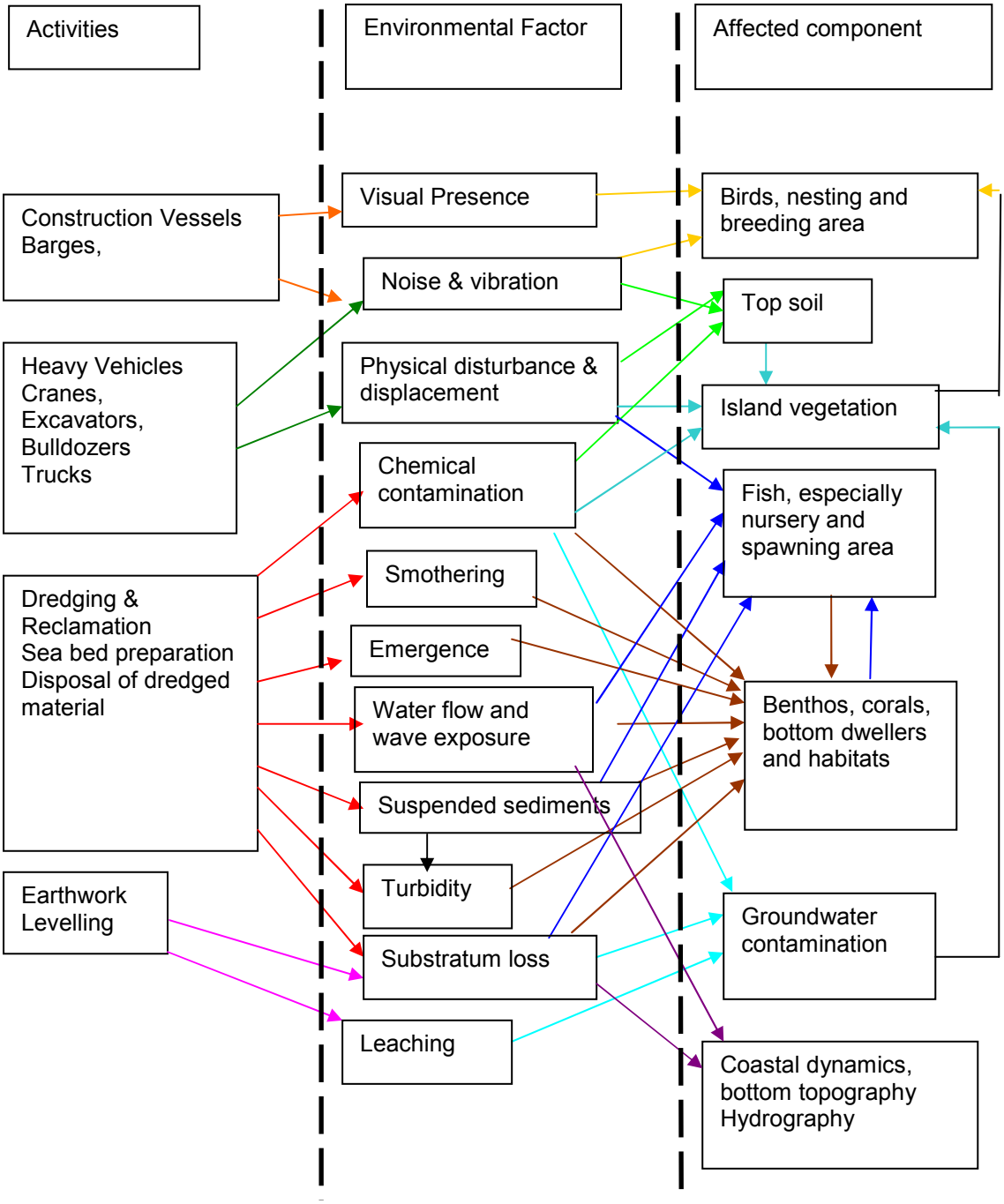
Mitigation: In order to reduce sedimentation within the lagoon, filling will be undertaken by placing sand in an enclosed area embanked with sand bags. These sand bags will only removed once the works are completed. This activity will be undertaken during clam weather at low tides.

Construction of the breakwater

Impacts: Impacts from the construction of the breakwater would impact on benthic fauna underneath the break water area and sedimentation or disturbance caused by the physical activities of the construction it. The boulders shall be imported granite stone of size 15-30 kg range.

Mitigation: The activity should be taken in low tide so as to minimize the physical disturbance on to the bottom. The boulders may be transported to the site on a floating platform. Alternative a barge with a crane / excavator may be used to transport and place the boulders appropriately.

Table 5: Summary of the environmental Impacts during the construction phase of harbour development, beach protection works and breakwater installation.



7 Socio-economic Analysis of the Project Impacts

The project effectively proposeS to undertake two major activities leading to creation of capital infrastructure; i.e., that of a protected harbor in the southwestern side of the North Malé atoll and a fresh fish processing factory. Both of these will have socio-economic implications.

At this stage it not known if the developer intends to make use of the harbor for the purposes other than activities related to fish processing. It is likely that harbor may be used as a safe anchoring area for safari or liveaboard vessels en-route to Malé or going to Ari Atoll. If this is the case the

There are several fresh fish packing and exporting companies established in the area; the MIFCO's facility on Kanduoiy Giri Island, two in the Himmafushi, two in HulhuMalé, and one located in the harbor on a barge. An additional such facility will bring about increased competition in this rapidly expanding sub-sector of the fisheries. Export of fresh yellowfin tuna rose rapidly from around 1,000 t to over 8,000 t in 2006 fetching and export value of close US$ 30 million. This mounts to roughly one third of the total marine export value making one of the fastest growing fisheries sub-sector

Table 6: Export quantity and value of large yellowfin tuna from Maldives (1998-2006). Source: Basic Fishery Statistics, MoFAMR.

Year	Mt	Million MRf	Million US$
1998	2,344	72.04	6.12
1999	584	13.42	1.14
2000	4,013	63.30	5.38
2001	1,245	65.37	5.11
2002	3,100	131.11	10.24
2003	4,709	191.72	14.98
2004	6,688	271.12	21.18
2005	7,484	324.21	25.33
2006	8,048	373.53	29.18

The ex-vessel price of the yellowfin tuna range from MRf 40-70 per kg and because of the higher prices many pole-and-line fishermen have recently switched to large yellowfin handline fishing. Additional source of fresh yellowfin tuna is the EEZ-longline fishery which is also on the increase. All these points to the scope for increase in this sub-sector.

The fish processing factory will also bring new employment opportunities to the Malé area. It is expected that roughly 25-30 people would be required to employ in facility that process about 10-15 t a day. This is excluding the other opportunities that will inevitably arise in the island.

Staff requirements at the construction stage is also expected to be higher. These include drivers, mechanics and labourers, and supervisors

8 Identification and Analysis of Alternatives

Processing and packaging of yellowfin tuna for export to the European market would be conducted to standards specified by the market. However better alternative technologies in terms of being friendly with the environment might be used elsewhere The proponent will explore such technologies and will bring the necessary changes to the processing and packaging work at Kodhdhipparu to make the project even more environmentally sound. The following paragraphs highlight some of the alternatives that the EIA team believes may bring improvements to the environment of the island.

- Instead of the proposed rectangular-shape harbour with solid walls, it is recommended to cut openings on the side walls of the harbour to allow better water circulations within the harbour.

- At present a sea wall is not proposed around the reclaimed area, particularly the opposite side of the harbour. Instead of leaving the reclaimed area exposed it is proposed to build a seawall adjacent to the reclaimed area. This will give protection as well as prevent from long term erosion and sedimentation.

- Proposed breakwater design at the centre of the harbour area might not be the best way because it will only break waves effectively when the wave is perpendicular to it, this means when the wind is from east. This is a very rare case where generally wind is in an angle to the proposed design so most of the time the harbour would be rough. Therefore it is advised to redesign the entrance of the harbour.

- For the safe disposal of chemicals and other laboratory wastes an incinerator of appropriate capacity is recommended. Such a machine can also be utilized to manage plastic wastes and other wastes that are non-biodegradable. In addition, in the events of an uncontrolled disease biological materials may be destroyed by this mechanism. Purchasing and maintenance of an incinerator will also have cost implications and if not appropriately maintained can result in emission of toxic gases into the environment.

9 Mitigation Actions / Mitigation Management

Like any commercial entity the objective of the fish packing and export business at Kodhdhipparu is to maximize profit. However, within this purely economic objective, environmental consideration such as minimizing waste and maintaining high environmental standards is one of the key principles that the business will operate.

The emerging market for fresh-packed large yellowfin tuna is the UK's environmentally conscientious customers. They buyers in UK are major fresh fish buyers and top of the range supermarkets (e.g., Sainsbury's, MCM Select Foods). They demand that products displayed on their supermarket shelves have been harvested from sustainable fisheries using environmentally friendly methods of catch. It is public knowledge the these elite group of fish buyers through collaboration with Maldives Fish Exporters Association are putting pressure to Government for certification of large yellowfin fishery or the tuna fishery in general.

It is therefore imperative that Kodhdhipparu facility has be able to demonstrate the facility meets requirements of the EU buyers.

The following mitigation measures will be taken:

1: Minimizing waste: The primary source of waste during operational phase is fish waste; fish offal and blood water produced by heading, gutting, filleting and cleaning of fish. Some of these 'waste' are recoverable and often may be sold at high prices. In the project proposal submitted to MoFAMR it was proposed that two major line of produce would be vacuum packed fillets/loins and dressed whole fish (head and gutted, head-gutted and tail off). The majority of waste generated would be from fish cuttings which will be used for other purposed. For instance belly cuttings will be packed and sold in supermarkets in Malé, heads and fish offal may be sold to parties who to be used as bait on night fishing trips. A substantial proportion would be used as feed for the fish pond that is also maintained at Kodhdhipparu. These operational issues have been dealt in the proposal submitted to the MoFAMR.

Blood water will be released to the grey water drainage. Other type of waste that will be generated during operation is paper and cardboard items such as stationary and packaging, glass and plastics bags, cans and tins discarded from the office and living quarters.

2: Energy savings: For an island that has to be powered from diesel generator there is little one can do on major energy savings. Regardless of power consumption there is a certain minimum load that generators have to bear. By turning down the power consumption does not necessarily reduce fuel consumption. One way of gaining energy efficiently is using several generator sets connected in parallel linked to load sharing module. The load sharing module will measure the load and frequency at the generator, while it constantly adjusts the engine speed to shift load to and from the remaining power sources. As the prime mover of a diesel generator runs at constant speed, it will take more active load when the fuel supply to its combustion system is increased, while load is released if fuel supply is decreased. Given these technical constraints on generating power on a relatively small island, consideration would be given for optimal adjustments of power generation and consumption.

3: Reduction on water consumption: Water on the island is produced by desalination plants, powered by the diesel generators. As a profit maximizing entity is therefore in

the best interest to reduce the water production and therefore usage. IN order to achieve this all the roofs would have gutters for catching the rain water. Large 2,000 liters storage tanks will be placed for storing rain water. The overall water production by desalination would be optimized based on rain water harvest and consumption on the island.

4: Waste water: Fish processing requires large amounts of water, primarily for washing and cleaning purposes, but also as media for storage and refrigeration of fish products before and during processing. In addition, water is an important lubricant and transport medium in the various handling and processing steps of bulk fish processing. Fish processing wastewater has a high organic content, and subsequently a high biochemical oxygen demand (BOD), because of the presence of blood, tissue, and dissolved protein. It also typically has a high content of nitrogen (especially if blood is present) and phosphorus.

Detergents and disinfectants may also be present in the wastewater stream after application during facility cleaning activities. A range of chemicals is typically used for cleaning, including acid, alkaline, and neutral detergents, as well as disinfectants. The disinfectants commonly used include chlorine compounds, hydrogen peroxide, and formaldehyde. Other compounds also may be used for select activities (e.g., disinfection of fishmeal processing equipment). The following recommended methods may be used to enhance the removal of solid waste prior to entry into the wastewater stream.

- Collect internal organs and other organic materials separately, for processing into by-products according to the recommendations for solid waste management above;
- Design the production line so that cooling water, drainage, and process effluents can be kept separate to permit appropriate treatment options;
- Conduct a dry pre-cleaning of equipment and production areas before wet cleaning (e.g. rubber scraping of work tables and plant floor before hosing);
- Establish procedures for the dry removal of offal, using dry vacuum systems where feasible;
- Fit and use floor drains and collection channels with grids and screens, and / or traps, to reduce the amount of solids entering the wastewater;
- Equip the outlets of wastewater channels with screens and fat traps to recover and reduce the concentration of coarse material and fat in the combined wastewater stream;
- Avoid submersion of open products (e.g. fillets) in water, as soluble protein may leak out and enter the wastewater effluent stream;
- Ensure that tanks are effectively bunded and provide overfilling protection on bulk storage tanks;
- Choose cleaning agents that do not have adverse impacts on the environment in general, or on wastewater treatment processes and sludge quality for agricultural application.
- Optimize their use through correct dosage and application.
- Avoid cleaners that contain active chlorine or prohibited, banned, or restricted chemicals.

5: Odor Prevention: The following recommended measures should be undertaken to prevent the generation of odor emissions:

- Avoid processing batches of raw material that are of considerably lower than average quality; this will reduce the odor components;
- Reduce the stock of raw materials, waste, and by-products and store this stock for short periods of time only in a cold, closed, well-ventilated place;
- Seal by-products in covered, leak-proof containers;
- Keep all working and storage areas clean and remove waste products immediately from the production line;
- Empty and clean fat traps on a regular basis;
- Cover all transfer systems, wastewater canals, and wastewater treatment facilities to reduce the escape of foul odors.

6: Odor Control: The recommended odor control techniques in fish processing include the following:

- Install condensers on all appropriate process equipment (e.g., cookers and evaporators) to treat air emissions for odor, including sulfides and mercaptans;
- Install biofilters as the final method of air treatment and acid scrubbers for ammonia removal ahead of the biofilter;
- Install cyclones and filtration (fabric filters normally are adequate) to remove particulates;
- Reduce fugitive odor sources from open doors, open windows, and general room ventilation through the use of negative pressure-controlled ventilation systems.

10 Environmental Management and Performance Indicators

In the Maldives there are no performance indicators of the industry as of yet. Like the tourism industry is generally a self regulating one due to the high compliance that has to be maintained to satisfy the environmental conscious overseas buyers. Table 7 and Table 8 provide emission and effluent guidelines for the industry in the developed world. These are indicative of good international industry practice and reflected in relevant standards of countries with recognized regulatory frameworks (WB 2007).

Table 7: Effluent levels in fish processing: Source International Finance Cooperation Report (WB/IFC, 2007) Environmental Health & Safety Guidelines.

Pollutant	Units	Guideline Value
PH	pH	6-9
BODs	mg/l	50
COD	mg/l	250
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Temperature increase	Deg C	<3[1]
Total coliform bacteria	MPN[2] / 100 ml	400

[1] At the edge of a scientifically established mixing zone which takes into account f ambient water quality, receiving water use, potential receptors and assimilative capacity.
[2]Notes: MPN = Most probable number

Table 8: Energy and water consumption for common fish production processes. Source: International Finance Cooperation Report (WB/IFC, 2007), Environmental Health and Safety Guidelines.

Output per unit of product	Unit	Energy consumption per ton of raw material
Processing of shrimps	MJ	350
Freezing (contact freezer)	MJ	328
Freezer (blast freezer)	MJ	350
Fillet production	MJ	18
Fish-meal production	MJ	2300
Output per unit of product	Units	Water consumption per ton of raw material[1]
White fish	m^3/t	5-11
Herring filleting	m^3/t	5-8
Mackerel filleting	m^3/t	5-8

[1] UNEP: Cleaner Production: Fish processing; http://www.agrifood-forum.net/publications/guide/f_chap0.pdf

If the Kodhdhipparu facility are to maintain the international industry standard the effluent levels achieved without dilution, at least 95% of the time that the plant or unit is operating.

It should be noted that discharges into water from islands like Kodhdhipparu quickly dissipates to insignificant levels. In these cases that outflow pipes are strategically located to allow this dilution to take place (depth and place and timing of release if that is possible), dilution will take place almost immediately. Once the harbor works are complete, it is recommended to re-assess the outflow points.

Table 9: Air emission levels for fish processing: Source: International Finance Cooperation (WB / IFC, 2007)

Pollutant	Units	Guideline Value
Ammonia	mg/m^3	1
Amines and amides	mg/m^3	4
Hydrogen sulphide, sulphides, and mercaptans	mg/m^3	2

10.1 Environmental Monitoring

Environmental monitoring program for this project should be implemented to address all activities that have been identified to have potentially significant impacts on the environment during construction and operation phase. Environmental monitoring activities should be based on direct or indirect indicators of coastal erosion, reef degradation, effluent discharges, and resource use. Monitoring frequency shall be sufficient to provide representative data for the parameter being monitored.

Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with normal operating standards so that any necessary corrective actions can be taken.

10.2 Coastal Shoreline monitoring

The coastal processes and performance of costal structure can be significantly enhances by monitoring the coastal processes around the coastal structures and evaluating the design performance of the structures over a long period of time. Information gathered from such monitoring can result in significant cost reduction for future coastal works and planning environmental mitigation measures. The proposed coastal monitoring activities for the coastal environment at Kodhdhipparu are as following:

1. Shoreline and nearshore response to the coastal structures and changes to the morphology of the island
2. Onshore/offshore sediment movement near coastal structures,
3. Stability of the structures,
4. Waves and current patterns around coastal structures,

5. Seasonal beach dynamic (erosion and accretion),

The above monitoring activities shall be continued for over a period of 2 – 3 years and the results of the monitoring activities shall be reported to the person heading the technical department and to relevant government authorities as required. It is also proposed that modification of shore-stabilizing structures be adjusted, if necessary, based on the findings of these monitoring works.

Table 10: Summary schedule of Environmental monitoring at Kodhdhipparu Island.

	Coastal changes	**Coral reef habitats**	**Terrestrial habitats**
Beach line survey of the island	2 times/year		
Beach vegetation line	once/year		
Beach profiles	2 times/year		
Wave data and currents	2 times/year		
Coral and benthic cover		quarterly	
Water quality		quarterly	yearly

The developer is fully committed to undertake impact monitoring according to the above environmental monitoring schedule (Table 10). The cost of monitoring is estimated to be US$ 3,000 per annum.

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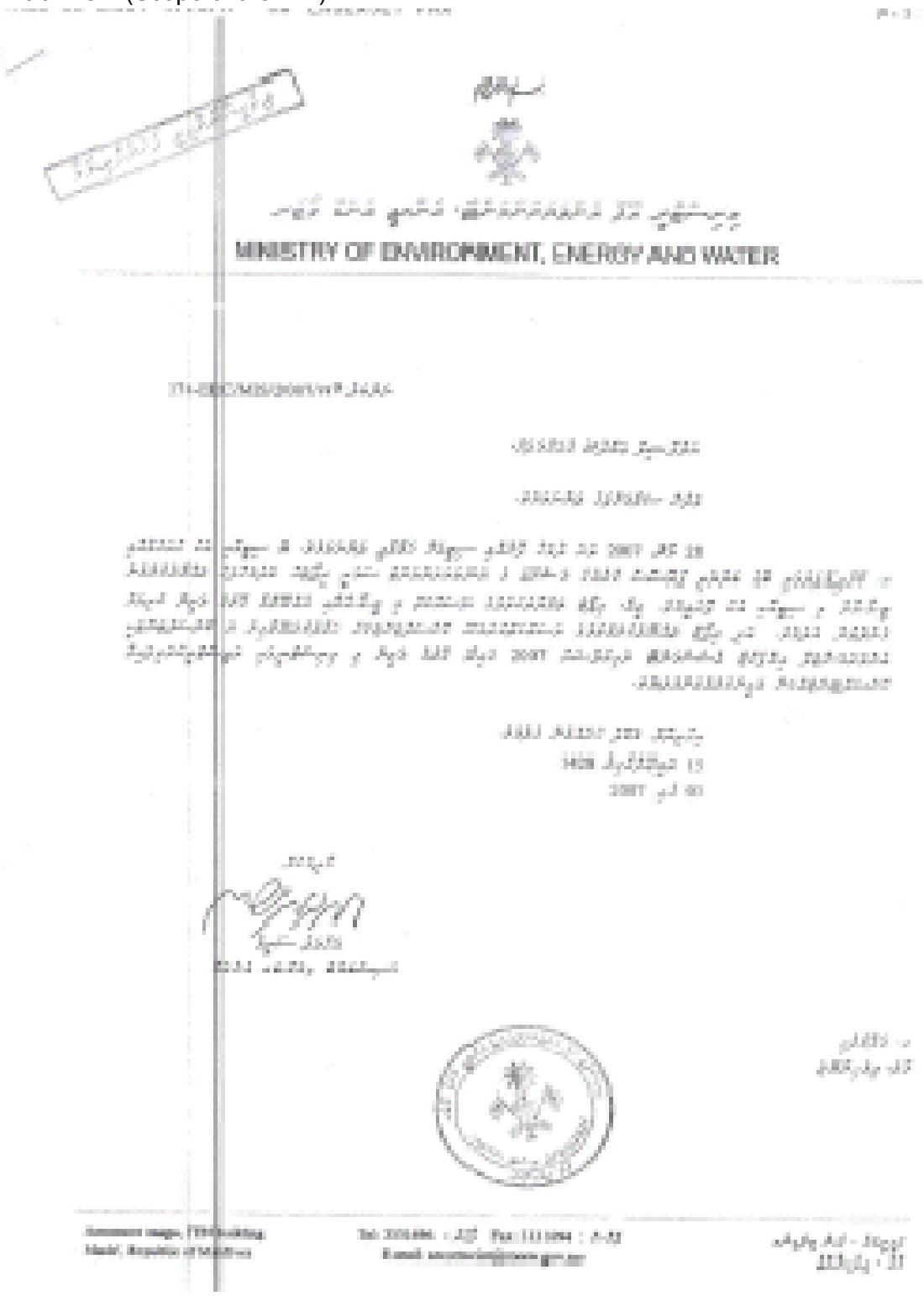
Appendices:

1. Official TOR (Scope of the EIA)



MINISTRY OF ENVIRONMENT, ENERGY AND WATER

Terms of Reference for the preparation of the Environmental Impact Assessment Report

Prepare an Environmental Impact Assessment (EIA) Study on the above development proposal to enable the Ministry of Environment, Energy and Water to make an informed decision about the project. The format of the report should follow the general format given in the EIA Regulations, 2007. The consultant should pay a particular attention on the following when preparing the EIA Study.

- **EIA Report**

The EIA report should contain an introduction explaining the need and justification for and context of the project. Other critical contents inlcude,

- executive summary;
- policy, legal and administrative framework;
- description of the environment;
- description of the proposed project in detail;
- stakeholder consultations and its outcomes;
- significant environmental impacts;
- socio-economic analysis of project impacts;
- identification and analysis of alternatives;
- mitigation action/mitigation management plan;
- environmental management and monitoring programme;
- list of references; and
- appendices

- **Policy, Legal and Administrative Framework**

A description of the policy and legal basis within which the project may be implemented. Regulations and standards applicable to the project should be referred to.

- **Description of the Environment**

Descriptions of conditions prior to implementation of the proposed project. It is primarily a benchmark against which to measure environmental changes and to assess impacts.

- **Description of the Proposed Project**

Determine and describe exactly what is proposed, the exact site of construction work, and the nature of operations and processes that will be undertaken. Any available building plans will be required as well as information on the number of employees, expected throughput of fish, power and water requirements and other project inputs and outputs. In accordance with best international practice, the description should include all operations including use of port facilities by the boats, transport of fish to the plant, onshore processing of the catches, arrangements for export of the product and quality control measures.

- Stakeholder consultation

All stakeholders (both public and private) should be identified and their views should be stated in the report.

- **Significant Environmental Impacts**

The following key environmental issues associated with fish processing, but not limited to, shall be addressed in detail.

- high consumption of water
- the generation of effluent streams (Fish processing effluent contains high levels of organic matter due to the presence of oils, proteins and suspended solids. It can also contain high levels of phosphates and nitrates),
- high consumption of energy,
- the generation of by-products.
- management of construction waste, management of hazardous wastes
- installation and operations of the desalination plant and the power plant.

- **Analysis of Alternatives**

All the alternatives taken into account in developing the project should be documented. For example, if the project were to be sited elsewhere, the impacts associated should be reviewed and the associated mitigation action and costs defined. Each alternative should be evaluated in respect of its potential environmental impact and capital and operating costs. The environmental losses and gains must be combined with the economic costs and benefits to give the full picture for each alternative. An analysis of the "no action" alternative should be included.

- **Mitigation Action/Mitigation Management Plan**

For each potential significant adverse impact identified in the impact section reasonable, cost effective measures should be proposed for its mitigation at each stage of the project and its cost assessed. It is essential that these costs of mitigation be adequately assessed and be fully documented. This is very important in the selection of the preferred alternative. In the case of beneficial impacts it should be demonstrated how these can be maximised. The following areas, but not limited to, should be covered in the mitigation section.

- strategies for reducing the pollutant load of fish processing effluent focus on avoiding the loss of raw materials and products to the effluent stream.
- ways of making substantial savings in energy should be given including the opportunities for using more environmentally benign sources of energy.
- noise and odour may also be concerns.
- strategies for reducing water consumption
- analysis of ways and means of recovering marketable by-products from fish wastes

e Environmental Management and Monitoring

The proponent should propose how the environment will be managed during the implementation of th project both construction and operational phases. The training programme for employees of the facilit hould be outlined. This section should identify any institutional needs for implementing th ecommendations of the EIA. A detailed environmental monitoring programme/plan should be describe The reasons for and the costs associated with the monitoring activities should be covered.

The monitoring programme should clearly state the:

- institutional arrangements for carrying out the work;
- parameters to be monitored;
- methods to be employed;
- standards or guidelines to be used (national, international where applicable);
- evaluation of the results;
- schedule and duration of monitoring;
- initiation of action necessary to limit adverse impacts;
- disclosed by monitoring; and
- format and frequency of reporting.

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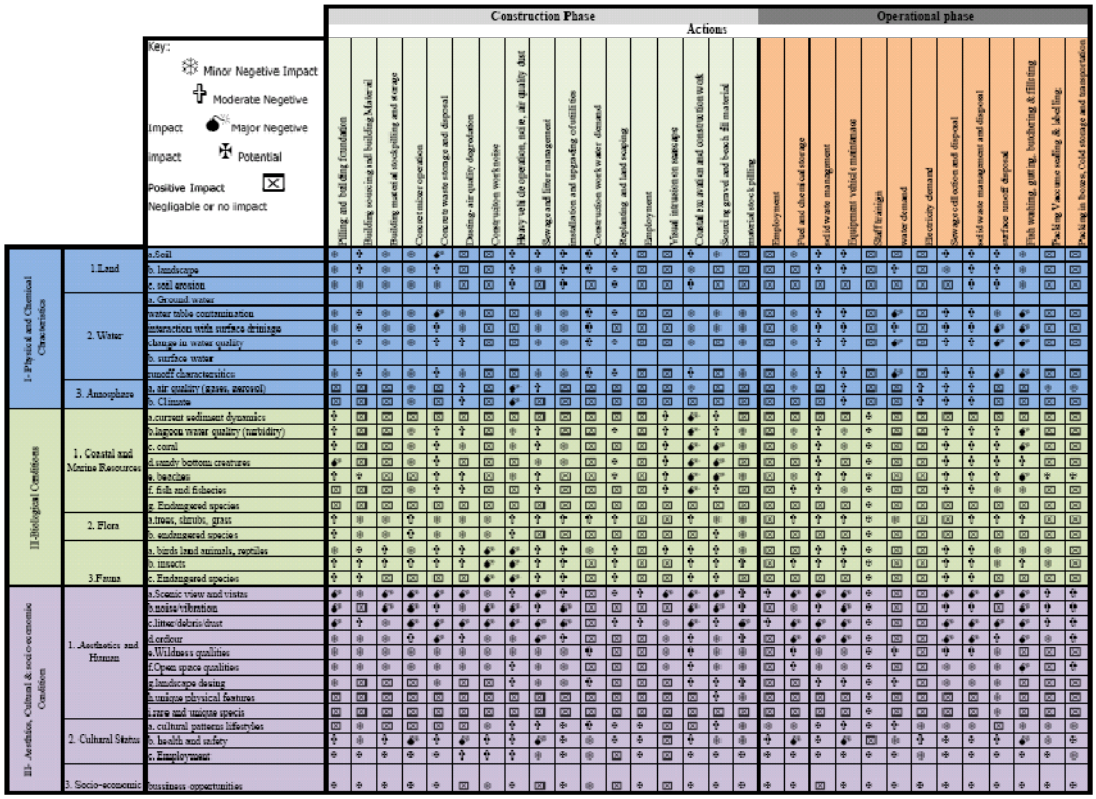
2. Appendix 2: Environmental Impact Matrix for Kodhdhipparu development project .



Note: **"Major Negetive impact"** cannot be completely avoided even if mitigation measures are taken .it is considered as a key factor in decision making process.
"Moderately negetive impacts" cannot be completely avoided even mitigation measures are taken but can be minimimized to an accepted level. These are not considered as key issues in decision making pr
"Minior negetive impacts" Have no significance with regard to decision making process

3. Appendix 3: Response to the letter no (174-ERC/MISC/2008/97) address to the developer on the 26th of February 2008 upon submission of the EIA report.

   This appendix contains all the necessary information requested by the ERC and includes the following:

   1- Curriculum Vitae of consultants involved to prepare the report
   2- Detail drawing of the harbour
   3- Equipments to be used
   4- Cost of environmental monitoring already included in the monitoring part of the report. It is estimated to be 3000US$/ annum.
   5- Two hard copies of the report and PDF document in a CD provided.

Curriculum Vitae
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Education

Post Graduate Diploma	Remote Sensing and Geographic Information System, Centre for Space Science and Technology Education In Asia and Pacific (CSSTEAP) Affiliated to the United Nations, Indian Institute of Remote Sensing (IIRS) 2003-2004
Master of Science M.Sc.	Tropical Coastal Management University of Newcastle Upon Tyne, UK (1998- 1999)
B.Sc. Hon.	Geology Al Azhar University Cairo Egypt (1991-1995)
Secondary Education	Institute of Cairo, Cairo, Egypt (1988-1991)

Training Courses

	Hydrographic Department Oceanography and data Processing Course Japan Coast Guard (21 Nov. 2001- 8th March 2002)
GCRMN Coral reef Monitoring	
	IOC-UNESCO/ UNEP/IUCN GCRMN South Asia, Coral Reef Survey Methods Training Workshop, Bandos, Maldives, 3-14th May 1998
IOI/ UWICED,	Deep sea-bed Mining Training Workshop, Kingston Jamaica, 4-29 August 1997

Employment

Deputy Director Coastal Management
Ministry Environment Energy and Water (2004 July)
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Male` 20-05, Maldives.
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Telephone (960) 335952 Fax: (960) 335953

Languages

Languages :	Dhivehi mother tongue,
Fluent	English and Arabic,
	Good reading, writing and speaking ability in Indonesian
	language. Basic Japanese communication skills.

Research Activities

I. Conference papers

M. Riyaz, K.-H. Park (2008) Reef slope failure in the northeastern corner of Malé, Maldives, Accepted for the 11th International Coral Reef Symposium to be held in Florida, USA, 7-11 July 2008.

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Recreational

PADI certified open water, advanced open water and PADI Research diver.

Referees

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C U R R I C U L U M V I T A E

Name:	M. Shiham Adam		Registered EIA Consultant: EIA/01/07
Year of Birth	1964	**Marital Status:**	Married with one daughter
Years of Experience	20 years	**Nationality:**	Maldivian

Education

1989-1992	BSc (Hons.), Marine Biology, University of Newcastle upon Tyne, United Kingdom
1992-1993	MSc, Fisheries Biology and Management, University of College of North Wales, Bangor, United Kingdom
1996-2000	PhD, Biology, Imperial College of Science Technology and Medicine, University of London, London, United Kingdom.

Employment Record

Sept 2005 - Present	Executive Director, Marine Research Centre, Ministry of Fisheries, Agriculture and Marine Resources, Malé, Republic of Maldives. Freelance environmental consultant (worked for LaMER <see above> from 2003-2005 and presently working privately as a freelance consultant
May 2003-Sept 2005	Director Fisheries Research, Marine Research Centre Ministry of Fisheries Agriculture and Marine Resources, Malé, Republic of Maldives
Jan 2000 – May 2003	Post-doctoral research fellow, University of Hawaii at Manoa, Honolulu, Hawaii.
Sept 2006 – Jan 2000	Studying for PhD, Imperial College, University of London, United Kingdom
Oct 1993 – Sept 2006	Fisheries Biologist, Marine Research Centre, Ministry of Fisheries, Agriculture and Marine Resources, Malé, Republic of Maldives
Sept 1989 – Oct 1993	Studying for the undergraduate (BSc) and post graduate (MSc) degrees, United Kingdom
Aug 1989 – July 1984	Marine Biology Trainee at the Marine Research Section of the Ministry of Fisheries.

Environment Impact Assessment Related Work

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Vulnerability and Adaptation Assessment for Integrated Climate Change Project, Ministry of Environment, Energy and Water, Malé, Maldives, August 2006.

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Vulnerability and Adaptation Assessment of the Fisheries Sector in the Maldives - NAPA Project, Integrated Climate Change Strategy (ICCS), Maldives, October 2006, Ministry of Environment, Energy and Water, Government of Republic of Maldives

Consultant for the Third Tourism Master Plan, December 2006, Ministry of Tourism and Civil Aviation, Government of Republic of Maldives.

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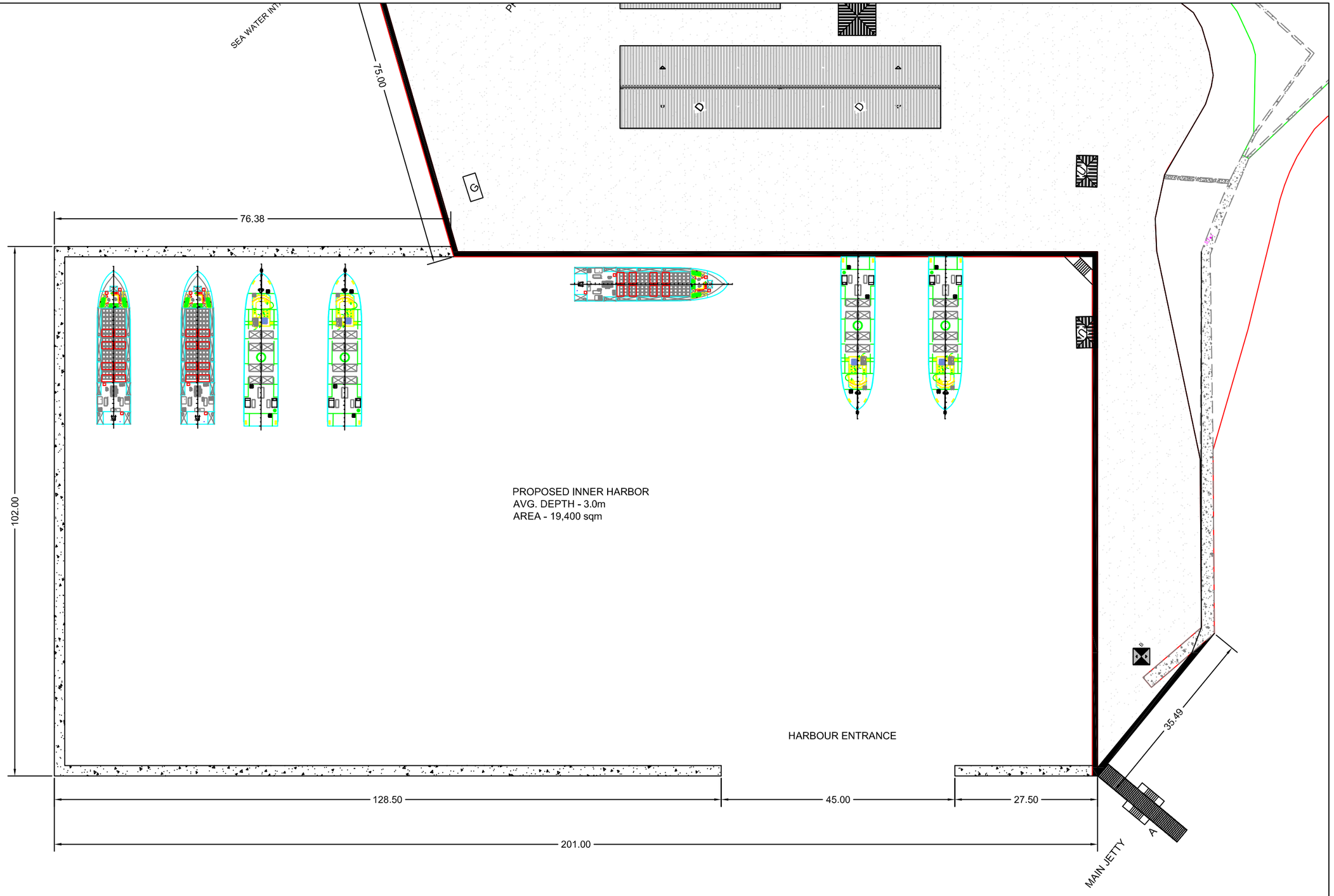
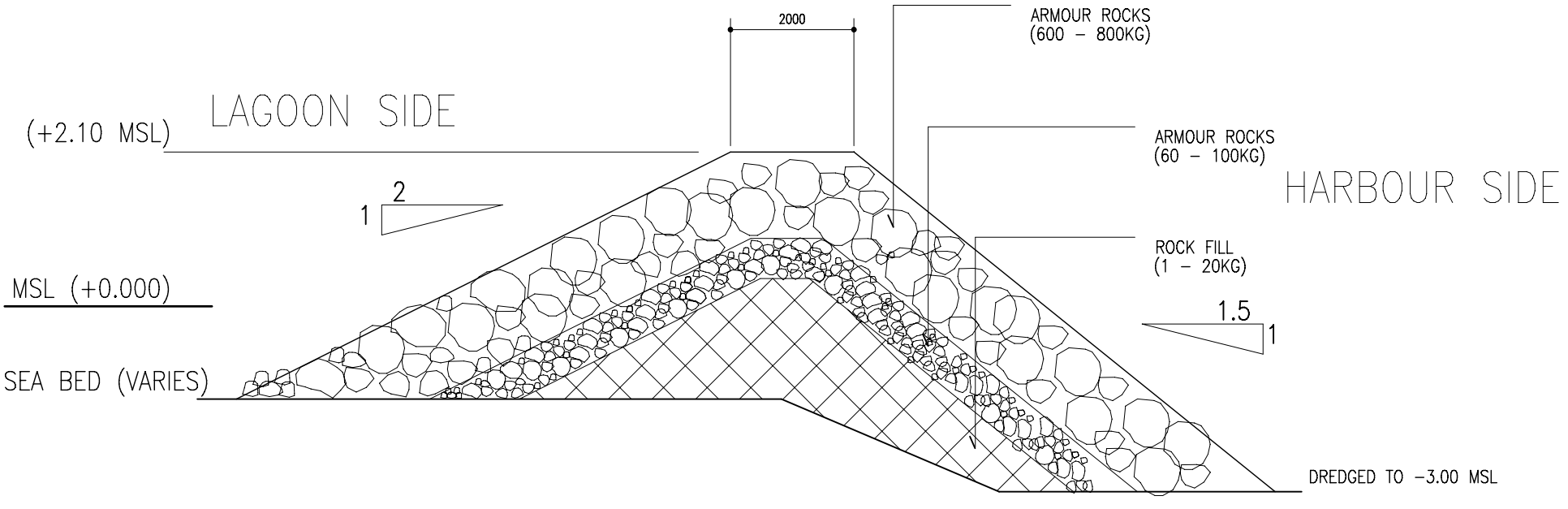
Adam, M. S., N. R. Merrett & R. C. Anderson (1998). Additions to the fish fauna of the Maldive Islands. Part 1. An annotated checklist of the deep demersal fishes of the Maldive Islands. Icthyological Bulletin of the J.L.B.Smith Institute of Ichthyology, 67 (Part 1): 1-19

M. Shiham Adam

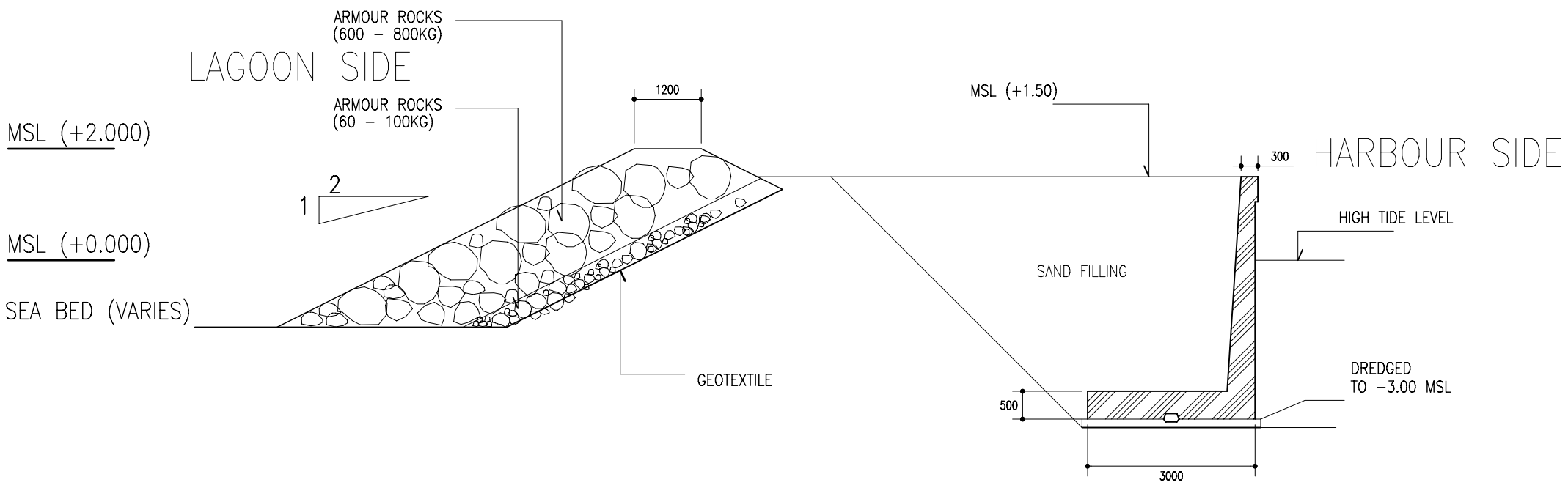
October 17, 2007



TITLE: HARBOUR DETAILS	SCALE: 1:750	DRAWING NO:	PROJECT NAME: DEVELOPMENT FOR YELLOWFIN TUNA FISH PACKAGING FACTORY AT KODHIPPARU
DESIGN BY: FitBack up from Shalk-Obl system\D Drive\Anilnbmp	DRAWING TYPE: ARCHITECTURAL		0 1 2
			Date 23/04/07



SECTION THRO BREAKWATER



SECTION THRO QUAY WALL & REVETMENT

PROJECT

KODHDHIPPARU
FISHERY HARBOUR PROPOSAL

TYPICAL SECTIONS

CLIENT

3: Machinery used for the reclamation works.
The reclamation work was carried out 1.8 m^3 excavator dredger. Lorries and dump-trucks were used to carry the dredged material and spread across the reclamation area. In some cases it was necessary that excavator be mounted on a shallow draft barge. The barge is about 10x 20m, the normal size used in the Maldives.

The following specific equipments will be procured for the project and will be used for the development activities of the project:

1- Dump truck See specifications below:

Make & Model	:	Dong Feng Model EQ3242GY Dump Truck. (Factory Built body)
Year of Manufacture	:	Year 2007
Engine	:	Cummins 6 Cylinder, water cooled, Diesel engine developing 243 Hp (179 kW) at 2400 rpm.
Payload Capacity	:	11.0 M^3 Volume Max. 15,000 Kg
Transmission	:	6 forward speeds and 01 reverse speed synchromesh Type.
Steering	:	Integral power assisted type.
Tyre Size	:	10.00 - 20 – 16PR

2- Kobelco Model SK 330-8 Hydraulic Excavator, See specifications below:

MAKE & MODEL	:	Kobelco SK 330-8
MANUFACTURER	:	Kobelco Construction Machinery Co Ltd., Japan.
COUNTRY OF ORIGIN	:	Japan
OPERATING WEIGHT	:	34,700 Kg
BUCKET CAPACITY	:	1.4 m^3
ENGINE MODEL	:	HINO J08E
ENGINE TYPE	:	Direct Injection, water cooled, 6 cylinder, 4 cycle diesel engine with intercooled turbocharger developing 265 PS at 2100 rpm.
EXCAVATOR ARM (Standard):		3.3 m
SHOE WIDTH	:	800 mm
MAX. DIGGING REACH	:	11.26 m
MAX. DIGGING DEPTH	:	7.56 m
MAX. DIGGING HEIGHT	:	10.58 m
OPTIONAL FITTED	:	Air Conditioner

3- Kobelco Rough terrain Crane, see specification below:

Make & Model	:	Kobelco Model RK450-2
Manufacturer	:	Kobelco Construction Machinery Co., Ltd, Japan
Machine Serial No.	:	ET03269
Year of Manufacture	:	1994
Machine Hours	:	7,983 hours
Odometer	:	11,569 Km
Max. Lifting Capacity	:	45 Tons at 3.5 M
Outrigger	:	X type
Jib	:	Power Tilt
Condition of Machine	:	In Good condition

4- Wheeled loader, see specifications below:

Make & Model	:	JCB 430 Z
Manufacturer	:	JCB Inida Ltd., India.
Bucket Capacity	:	1.7 m^3 Loader bucket
Engine Model	:	Ashok Leyland ALU 402
Type	:	4 stroke, direct injection, 6 cylinder diesel engine developing 127 HP
Max. Dumping Height	:	2,896 mm
Tyres	:	14.00 x 25 – 20 PR Heavy duty

FEATURES

- ROPS/FOPS Cab
- General purpose loader bucket with teeth
- Reverse Alarm
- Smoothshift transmission
- Multi – track axles