





**Section – I**  
**Technical specification**

## **1. MOBILIZATION AND DEMOBILIZATION**

### **1.1 Scope of Works**

- a) This includes mobilization and demobilization of all constructional plant, and equipment, including testing equipment deemed necessary to complete the Works
- b) The Contractor shall mobilize and deliver all constructional plant and equipment required to undertake the works and all the materials for any temporary facilities required.
- c) Mobilization shall include the importation and transportation to the job-site of all equipment, constructional plant and all necessary items for the execution and completion of the works. Mobilization shall also be deemed to include any site clearance work that is necessary.
- d) It is the responsibility of the Contractor to ensure that all plant and equipment brought for the project are in working condition. In the event of a break-down of constructional plant/equipment when it is beyond the ability of the personnel or when there are insufficient tools or materials at site to affect a repair in a reasonable time, the Contractor will be instructed to provide a replacement for the same at no additional cost (including mobilization) to the Owner. In such a case, no extension will be given for completion of Works. The Contractor may also be required to remove the broken plant from the Site if it is hindering the completion of any components of the Project.
- e) Demobilization shall include the removal from site of all constructional plant and equipment and the removal of all temporary facilities erected by the Contractor for his convenience.
- f) Mobilization costs of plant and equipment referred to herein shall be paid after the Consultant / Engineer has certified and accepted that all equipment listed for the Project and material for Temporary Works have been delivered to site or part three off, as the requirement deemed necessary.
- g) Mobilization and demobilization costs have been specified for each Airport separately. The contractor may be required to provide a breakdown for the mobilization costs if in the opinion of the Consultant / Engineer, the item appears to be unbalanced or for any budgetary constrains that may have by the Owner.
- h) Demobilization costs shall be paid after the Consultant / Engineer has certified and accepted that all equipment listed or as agreed has been removed form site and all temporary facilities dismantled and removed form the Site.

## **2. TEMPORARY FACILITIES**

### **2.1 Scope of Works**

This item consists of the following:

- a) Furnishing, erection and maintenance of all site facilities such as Contractor's camp and yard, temporary utilities and services, safety provisions, temporary roads and temporary navigations aids required for the execution of the Works as specified below;
- b) Erection of all construction plant and equipment after being delivered to site; and,
- c) Disassembly and removal of all site facilities, constructional plant and equipment from the site for de-mobilization.

### **2.2 Provisions and Requirements**

- a) The Contractor shall be responsible for temporary facilities, utilities, services and safeguards as required under the Contract.
- b) Temporary and permanent utility facilities used for the construction work shall be adequate for the intended use and not be overloaded or otherwise used or arranged in any manner which will endanger persons, premises or the works themselves.
  - i. Upon completion of the Works, unless otherwise directed or required, all site facilities, installations, utility services, constructional plant and equipment shall be disconnected, disassembled and removed from the Site.
  - ii. The camp area shall be kept in a clean and tidy condition throughout the construction period. The Consultant / Engineer shall have the authority to order periodical clearings at the Contractor's cost, provided that the site for disposing of Garbage / Debris allocated by the owner and is within the stipulated distance from the work site.
  - iii. All accommodation, latrine and shower facilities and canteen, shall conform in every respect with regulations imposed by local health authorities.
  - iv. The Contractor shall provide and maintain the necessary equipment as specified in contract and accessories, for construction use for the entire construction period.
  - v. The Contractor shall be responsible to arrange water, electricity etc. as required to execute the work throughout the project.
- c) The Contractor shall provide and maintain a temporary electricity service and distribution lines of adequate capacity for power, lighting and other construction needs.
  - i. All utility systems shall conform to local codes and regulations.
  - ii. All costs associated with the provision of utilities shall be borne by the Contractor.
  - iii. The Contractor shall maintain appropriate safety measures on site and around the work areas.
  - iv. The Contractor shall adhere to all local codes and regulations with respect to work-safety.

- v. The Contractor shall maintain appropriate notices and safety measures to warn public of dangers on site.
- vi. The Contractor shall provide and maintain any temporary roads and access ways Project Site when required.

### **3. SITE EXPENSES**

#### **3.1 Scope of Works**

This item shall cover all expenses for the staff related to the management of the site and office.

#### **3.1 Provisions and Requirements**

- (a) The site costs shall include but not be limited to the following:
- (b) Site office costs, including basic staff salary, overtime payments, bonuses, travel, medical fees, overseas and other allowances. Costs should also allow for stationery and office equipment.
- (c) Communication Facilities, to include the costs telephone, as well as walkie-talkie communication between the job site proper and the site office. Communication costs for the Contractor's site office shall also be included here.
- (d) Site safety costs to include all matters related to workplace health and safety issue.
- (e) Site security costs.
- (f) First aid, to include all reasonable first aid supplies and equipment.
- (g) Insurance, costs of insuring the works and temporary facilities as required.
- (h) Waste management, to include all costs incurred in keeping the site clean.

### **4. NATURAL CONDITIONS OF CLIMATE**

4.1 General climatic conditions are depending on the location of the site and surrounding atmosphere environment. It is no doubt that Maldives is governed by oceanographic circumstances rather than influence by the atmospheres of nearby continental.

#### **4.2 Temperature**

Daily temperature varies little throughout the year with a mean annual temperature of 28 CC. The mean daily minimum temperature recorded for Male', 2009 was 26.3 °C and the daily mean maximum temperature for the same year was 31.1 °C.

The highest temperature ever recorded in the Maldives was 36.8 °C, recorded on 19 May 1991 at Kadhdhoo Meteorological Office. Likewise, the minimum temperature ever recorded in the Maldives was 17.2 °C recorded at the National Meteorological Center on 11th April 1978.

#### **4.3 Rainfall**

Rainfall in Maldives varies from north to south with the amount of rainfall increasing towards the south. This difference in rainfall patterns is primarily due to the NE monsoon period and April being much drier in the north than in the south.

Rainfall patterns measured throughout the country by eight rainfall stations and it is evident that there are variations in rainfall from north to south through the atoll chain, with the north being drier and the south wetter. Average monthly and annual rainfall for Male' is 165.6 mm and 1987.7 mm respectively. There are been considerable inter-annual variation in rainfall from 1407 mm to 2711 mm over the last 35 years.

#### 4.4 Humidity

The Maldives has a warm and humid tropical climate. The weather is dominated by two monsoon seasons: the north-east (dry) monsoon season from December to March and the south-west (rainy) monsoon season from May to October when winds blow predominantly from either of these two directions. The annual average relative humidity ranges from 77% to 83%.

#### 4.5 Wind Record

Wind directions in the area are seasonal and governed mainly by two monsoon seasons-the NE monsoon (December to March) and SW monsoon (May to October).

Slightly stronger winds are associated with winds from the west typical of the SW monsoon season. On average wind speeds vary between 7-12 knots. The sever monsoon months are typically May, June and July during the early part of the SW monsoon, and September and October at the latter half Squally gusty winds of 50-60 knots have been recorded at Male' (DoM, 2000).

Department of Meteorology indicates the monthly wind data at Hdh. Hanimaadhoo which is located in Haa Dhaalu Atoll and closest wind observation point. This data is shown in A-1:

**Table A-1:  
Mean Wind Speed With frequent Direction**

H.Dh. Hanimaadhoo

Years & Months	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Day 8		Day 9		Day 10	
	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd
2010-01	ENE	04	E	04	NN E	03	NN W	03	N	04	EN E	05	E	05	VR B	02	NN W	03	NN W	03
2010-02	ENE	05	E	05	EN E	06	E	05	E	05	E	05	E	08	NN W	05	NN E	05	NN W	05
2010-03	ENE	05	EN E	06	N	04	NW	05	WN W	04	W	05	NW	08	NW	07	NN W	05	EN E	06
2010-04	NW	07	NW	06	NW	04	W	05	W	05	W	04	WN W	03	ESE	04	NN W	03	NN W	05
2010-05	SSE	04	NW	04	NW	04	W	05	WN W	06	WN W	07	W	06	WN W	07	SS W	06	SW	05
2010-06	WSW	05	W	06	W	06	W	08	W	09	W	09	W	08	W	11	W	14	W	14
2010-07	WSW	11	WS W	11	WS W	08	W	10	WN W	11	WN W	08	WN W	09	NW	09	NN W	11	NW	09
2010-08	WNW	07	W	09	W	10	W	11	WN W	10	WN W	09	W	09	WN W	09	NW	07	WN W	11
2010-09	W	04	NW	06	WN W	06	W	05	SS W	05	WS W	04	W	06	WS W	05	WS W	07	WN W	06
2010-10	WSW	06	WS W	09	WS W	10	W	08	WS W	09	W	09	W	08	W	10	W	07	W	06
2010-11	WSW	07	WS W	06	SS W	04	SS W	04	WS W	05	W	08	W	08	WS W	07	WS W	05	WS W	06
2010-12	WSW	03	W	03	WS W	03	WS W	04	WS W	06	WS W	04	VR B	02	W	03	W	04	W	05

Years & Months	Day 11		Day 12		Day 13		Day 14		Day 15		Day 16		Day 17		Day 18		Day 19		Day 20	
	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd	Dir	Spd
2010-01	E	05	SE	05	EN E	05	NE	07	E	09	EN E	05	N	04	NE	06	NN E	04	NN E	05
2010-02	ENE	06	EN E	05	N	05	NE	06	EN E	05	NE	05	N	06	NW	04	NE	03	NE	05
2010-03	ENE	07	EN E	07	E	06	NN E	04	N	04	NN W	04	NN W	03	EN E	04	EN E	06	EN E	04
2010-04	NNW	05	WN W	05	W	06	NW	07	W	05	WN W	04	SS W	03	W	03	WN W	04	W	05
2010-05	WSW	07	W	07	W	10	W	10	WS W	08	WS W	11	WS W	10	WS W	11	W	12	W	10
2010-06	WNW	14	W	11	WS W	12	WS W	07	SS W	05	SS W	07	W	07	W	05	W	06	W	07
2010-07	NNW	07	NW	05	WS W	05	W	08	W	11	W	11	W	11	W	11	W	10	W	09
2010-08	WNW	12	WN W	13	WN W	11	WN W	15	WN W	13	W	12	W	12	WN W	09	NW	07	NW	08
2010-09	NW	04	NW	06	WN W	07	W	07	WN W	06	WN W	07	WN W	09	W	12	W	10	WN W	07
2010-10	W	05	WS W	05	WS W	04	W	05	W	07	W	09	W	09	W	08	W	06	W	06
2010-11	W	06	WN W	05	WN W	04	NW	03	W	03	W	05	W	04	WS W	03	VR B	02	WS W	05
2010-12	WNW	05	NW	05	NN W	04	VR B	02	VR B	01	VR B	01	VR B	01	VR B	02	E	03	E	05

Years & Months	Day 21		Day 22		Day 23		Day 24		Day 25		Day 26		Day 27		Day 28		Day 29		Day 30		Day 31	
	Dir	Spd																				

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2010-01	NNE	05	ENE	06	NE	05	ENE	05	E	07	E	08	ENE	07	NE	05	NE	05	NE	05	NNE	03
2010-02	ENE	06	NNW	04	N	04	N	04	NE	04	ENE	04	NW	04	NNW	03						
2010-03	N	06	NW	06	W	06	W	05	W	04	W	04	WNW	03	VRB	02	VRB	02	W	05	W	06
2010-04	W	06	W	05	W	06	W	07	W	06	WSW	05	WSW	05	WNW	03	E	04	SSE	05		
2010-05	WSW	10	SW	09	SW	09	WSW	11	WSW	10	WSW	09	WSW	09	SW	09	WSW	10	WSW	09	W	07
2010-06	W	08	W	09	W	08	W	09	W	12	W	11	W	09	WNW	13	W	09	WSW	10		
2010-07	W	09	W	07	W	08	W	07	W	10	W	08	W	10	W	11	W	07	WSW	08	W	05
2010-08	WNW	08	NW	09	NW	10	WNW	11	W	10	W	09	W	11	WNW	10	W	10	WNW	06	W	04
2010-09	W	08	W	07	WSW	08	WSW	07	W	07	WNW	05	W	05	WSW	08	WSW	06	W	06		
2010-10	W	07	W	07	W	06	W	05	WNW	04	WNW	04	WNW	05	WNW	05	NW	05	W	06	WNW	07
2010-11	W	04	WNW	03	WNW	03	NNW	03	VRB	02	WSW	05	WNW	06	WNW	03	WSW	03	SE	05		
2010-12	E	03	VRB	02	VRB	02	VRB	01	VRB	02	VRB	02	NE	03	NE	03	NE	04	VRB	02	NW	03

Years & Months	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Day 8		Day 9		Day 10	
	Dir	Spd	Dir	Spd																
2011-01	NNW	05	N	04	N	03	NNW	03	NNW	03	WNW	04	WNW	03	NNW	03	NNW	03	NNW	03
2011-02	VRB	02	VRB	01	VRB	01	NNW	03	VRB	01	CAL	00	VRB	01	VRB	02	VRB	01	VRB	01
2011-03	NNE	05	N	05	N	04	NNW	05	N	05	ENE	06	ENE	04	N	03	NNE	04	NNW	04
2011-04	W	05	WSW	05	WSW	06	NW	05	NW	05	NNW	04	NNW	03	NNW	04	NW	05	N	05
2011-05	WSW	08	WSW	08	W	10	WNW	08	WNW	07	WNW	08	WNW	10	W	08	NW	04	W	03
2011-06	W	16	SW	11	SW	09	WSW	10	W	09	W	08	W	08	W	09	WSW	08	SW	07
2011-07	W	10	W	08	WSW	06	WSW	07	W	14	W	13	W	13	NW	08	WNW	08	W	09
2011-08	W	06	SW	06	SSW	07	S	07	W	09	W	09	W	10	W	11	W	11	W	07
2011-09	SW	09	W	09	W	07	W	06	W	04	WSW	05	W	07	W	07	WSW	07	W	09
2011-10	WNW	08	WNW	08	WNW	07	NW	06	NW	03	NW	04	W	05	W	05	W	06	W	06
2011-11	NNW	04	W	05	WSW	08	SSW	08	S	09	SSE	05	NW	04	NNW	05	SSE	05	ESE	06
2011-12	VRB	02	E	03	SE	03	SSE	03	E	04	VRB	02	N	04	ENE	06	E	09	E	07

Years & Months	Day 11		Day 12		Day 13		Day 14		Day 15		Day 16		Day 17		Day 18		Day 19		Day 20	
	Dir	Spd																		
2011-01	VRB	02	VRB	02	VRB	02	N	03	N	03	VRB	02	VRB	02	NE	03	E	04	NE	04
2011-02	VRB	01	ENE	04	VRB	02	VRB	01	CAL	00	NNE	03	NNW	03	N	03	N	03	NNW	04
2011-03	WNW	06	W	04	WNW	06	NW	06	NW	04	WNW	03	W	03	SE	03	E	04	E	04
2011-04	N	03	VRB	02	VRB	02	NW	05	WNW	05	VRB	02	W	03	NNW	04	W	06	NNE	03
2011-05	VRB	02	W	04	WNW	04	W	05	WSW	04	SSE	03	WSW	04	W	04	W	05	W	04
2011-06	SSW	05	SSW	06	WSW	08	WSW	09	WSW	08	WSW	09	WSW	11	W	11	WNW	11	W	11
2011-07	WNW	13	W	11	W	12	SW	08	SW	08	SSW	08	W	10	W	07	WNW	09	W	07
2011-08	NW	06	W	09	WNW	07	W	06	W	05	WNW	07	W	08	WNW	09	W	10	WNW	13
2011-09	W	12	W	12	W	12	W	12	W	11	W	07	W	04	W	04	W	04	WNW	05
2011-10	W	06	WNW	06	W	05	W	04	W	04	W	03	VRB	02	S	04	SSE	04	WSW	03
2011-11	ENE	05	SE	04	E	04	NE	05	ENE	05	ENE	04	NNE	04	E	03	E	08	ENE	06
2011-12	E	07	E	07	VRB	02	VRB	02	NE	03	VRB	02	ENE	05	ENE	03	N	05	N	05

Years & Months	Day 21		Day 22		Day 23		Day 24		Day 25		Day 26		Day 27		Day 28		Day 29		Day 30		Day 31	
	Dir	Spd																				

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2011-01	VRB	02	NE	03	EN E	03	NE	03	VR B	02	NE	03	VR B	02						
2011-02	NNW	04	N	04	N	04	NN W	03	N	04	N	05	N	06	N	04				
2011-03	NNE	03	NW	04	W	06	WN W	07	NW	07	NW	05	WN W	06	NW	06	WN W	05	W	04
2011-04	W	03	W	05	WS W	08	W	06	WN W	08	WN W	09	WN W	09	W	11	WN W	09	W	08
2011-05	WSW	07	W	07	W	11	W	09	W	08	W	09	W	11	WS W	10	W	08	W	09
2011-06	WNW	09	WN W	11	WN W	11	W	12	W	13	W	12	W	12	WN W	10	WN W	08	W	10
2011-07	W	07	WS W	05	W	07	W	10	W	09	WS W	08	SW	05	W	06	W	05	WS W	05
2011-08	WNW	10	WN W	08	WN W	07	W	07	WN W	04	W	05	W	06	SW	06	WS W	06	SW	06
2011-09	WNW	07	NW	06	W	05	WN W	06	W	06	NW	06	NW	06	WN W	07	NW	07	NW	06
2011-10	NNW	04	S	05	WS W	03	E	03	ESE	06	WS W	09	SW	05	SSE	04	S	04	W	06
2011-11	E	09	E	05	N	03	N	07	N	06	W	12	W	08	WS W	05	VR B	02	VR B	01
2011-12	NNW	05	SE	05	SE	04	NN E	03	NN W	03	N	04	N	04	NN W	05	NW	06	WN W	08

Years & Months	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Day 8		Day 9		Day 10	
	Dir	Spd	Dir	Spd																
2012-01	S	07	SSE	06	E	06	NE	06	N	04	E	06	EN E	08	NN E	06	EN E	05	E	04
2012-02	N	03	EN E	06	NN E	05	N	04	EN E	04	N	05	N	05	N	05	NN E	05	E	05
2012-03	N	03	N	03	NN W	05	NN W	04	W	03	NN W	05	WN W	06	N	07	NW	08	NW	07
2012-04	NW	03	VR B	02	VR B	02	NN E	03	NN W	03	WN W	05	NW	05	NN W	04	VR B	02	VR B	02
2012-05	NW	04	WN W	04	W	03	WS W	06	W	07	W	06	NW	05	NW	04	NW	04	WN W	05
2012-06	W	10	WN W	09	WN W	11	W	11	W	11	W	12	W	10	W	11	W	10	W	10
2012-07	WSW	11	W	11	W	11	W	09	W	10	WN W	11	W	10	W	13	WN W	13	WN W	11
2012-08	VRB	02	WS W	03	WS W	05	WS W	07	WS W	06	WS W	04	S	05	S	05	WS W	05	WS W	07
2012-09	W	05	W	07	W	11	W	07	S	04	W	04	W	04	W	10	WN W	11	W	06
2012-10	W	08	W	06	W	05	WS W	04	WN W	03	VR B	02	NW	04	NN W	04	NW	05	NW	06
2012-11	W	07	W	05	NW	03	N	03	WN W	04	VR B	02	VR B	01	VR B	01	VR B	02	VR B	02
2012-12	VRB	01	VR B	01	VR B	01	N	03	E	04	E	09	E	07	E	05	E	07	E	07

Years & Months	Day 11		Day 12		Day 13		Day 14		Day 15		Day 16		Day 17		Day 18		Day 19		Day 20	
	Dir	Spd																		
2012-01	N	06	NN E	05	NN E	05	N	05	N	04	E	05	EN E	06	NE	04	NN E	04	NW	04
2012-02	E	04	EN E	05	NE	04	NN E	04	N	05	N	04	NN E	04	NE	05	NN E	05	N	04
2012-03	WNW	04	N	04	N	04	WN W	04	E	05	SE	03	NE	03	NW	03	NW	04	NW	03
2012-04	WSW	03	NW	04	N	03	NN W	03	W	03	WS W	04	W	05	W	07	W	06	W	05
2012-05	WNW	07	W	07	WN W	06	WN W	06	W	05	WS W	04	WN W	04	WN W	07	W	10	WN W	08
2012-06	W	10	W	10	WS W	12	W	10	W	09	W	10	WS W	10	WS W	09	WS W	07	WS W	07
2012-07	WNW	10	WN W	11	WN W	12	WN W	10	NW	10	NW	07	WN W	08	WN W	08	WN W	07	W	10
2012-08	W	09	W	07	WN W	06	W	08	WN W	08	WN W	11	WN W	10	WN W	11	WN W	08	W	07
2012-09	W	07	W	05	W	06	W	08	W	09	WN W	08	WN W	08	WN W	09	N	04	NN W	05
2012-10	NW	07	NW	06	N	04	S	04	SSE	06	SSE	04	VR B	02	W	03	W	04	WN W	04
2012-11	W	03	S	04	NW	03	VR B	01	VR B	01	VR B	02	VR B	01	VR B	01	CAL M	00	VR B	01
2012-12	ENE	09	EN E	06	NE	06	E	06	EN E	06	NE	05	NE	07	NE	06	EN E	06	E	13

Years & Months	Day 21		Day 22		Day 23		Day 24		Day 25		Day 26		Day 27		Day 28		Day 29		Day 30		Day 31	
	Dir	Spd																				

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2012-01	N	03	ESE	03	EN E	04	E	05	NE	04	NE	05	E	04	NN E	05	N	05	N	05	NN W	05
2012-02	N	05	NN W	04	NN W	04	E	07	E	04	N	05	E	05	N	04	N	04				
2012-03	WSW	04	W	06	NW	06	NN W	04	N	03	N	03	NW	04	E	03	NW	03	NW	06	NW	06
2012-04	WNW	08	WN W	08	WN W	09	WN W	10	WN W	10	W	09	WS W	10	W	10	WN W	09	WN W	07		
2012-05	WNW	10	WN W	08	WN W	06	W	06	W	06	W	06	W	08	NW	08	WN W	08	WN W	10	W	13
2012-06	WSW	06	W	07	W	07	W	06	WN W	05	W	04	W	07	WN W	08	WN W	10	W	09		
2012-07	W	11	W	12	W	10	W	11	W	10	WN W	09	WN W	09	WN W	08	WN W	06	W	05	W	04
2012-08	WNW	08	NW	08	WN W	09	NW	08	WN W	10	WN W	08	W	07	WS W	06	SW	08	SW	07	SS W	06
2012-09	NNE	03	NN W	04	NW	04	NW	04	NN W	04	NW	04	WN W	07	NW	08	NW	08	W	09		
2012-10	S	05	S	06	SE	03	EN E	03	EN E	06	E	05	E	05	EN E	08	E	09	N	08	W	06
2012-11	VRB	01	VR B	01	N	04	NW	04	E	04	EN E	04	VR B	01	N	05	NN W	03	S	04		
2012-12	E	08	E	04	E	04	N	04	N	04	VR B	02	NW	04	N	05	N	05	N	03	E	04

Years & Months	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Day 8		Day 9		Day 10	
	Dir	Spd	Dir	Spd																
2013-01	E	06	VR B	1	VR B	1	N	5	NN W	7	N	6	N	8	NW	7	NN W	6	N	3
2013-02	ENE	06	E	04	VR B	02	VR B	02	E	03	NN E	03	NN E	03	N	03	NN E	05	EN E	05
2013-03	NNW	05	NW	03	N	03	N	04	N	03	E	07	E	07	E	07	EN E	06	EN E	05
2013-04	NW	06	NN W	06	N	06	NN W	06	NW	05	NW	06	NW	06	NN W	04	VR B	02	NW	03
2013-05	NW	05	WS W	07	W	07	WN W	10	WN W	09	W	07	WN W	05	WN W	06	W	08	WN W	08
2013-06	W	10	W	10	W	10	W	09	W	09	WN W	12	W	18	WS W	11	W	10	W	10
2013-07	W	08	W	10	W	10	W	09	WN W	10	NW	09	W	12	W	11	W	11	NW	11
2013-08	WSW	10	W	10	W	11	W	11	WN W	09	WN W	11	WN W	09	WN W	09	WN W	08	WN W	07
2013-09	NW	08	WN W	04	WS W	04	W	06	W	06	WN W	07	NW	07	WN W	11	WN W	10	WN W	09
2013-10	WNW	10	WN W	08	W	06	W	06	W	06	WN W	08	W	07	W	06	W	06	W	07
2013-11	ENE	03	VR B	02	EN E	03	EN E	06	E	10	ESE	06	E	05	NN W	05	NE	04	ESE	03
2013-12	ENE	03	NN W	04	EN E	03	VR B	02	N	03	NW	04	N	05	WN W	05	NN W	04	NN W	05

Years & Months	Day 11		Day 12		Day 13		Day 14		Day 15		Day 16		Day 17		Day 18		Day 19		Day 20	
	Dir	Spd																		
2013-01	VRB	2	VR B	2	N	3	E	4	EN E	5	EN E	10	NN E	8	NN E	6	NE	5	EN E	5
2013-02	ENE	05	NE	05	N	05	E	08	SE	05	SE	05	SSE	05	E	04	EN E	05	E	05
2013-03	E	03	EN E	03	W	03	N	04	NN E	04	NE	04	ESE	05	VR B	02	VR B	02	NN W	03
2013-04	NNW	03	NW	04	NW	04	W	04	WS W	06	NW	06	NW	06	NW	05	NW	06	NW	06
2013-05	W	09	W	09	W	08	WN W	08	WS W	09	W	04	WS W	09	WS W	10	W	10	W	07
2013-06	WSW	12	WS W	14	W	12	W	13	WS W	13	WS W	12	WS W	11	WS W	10	W	10	W	09
2013-07	WNW	09	W	09	WN W	09	WN W	10	WN W	09	W	06	WS W	05	WS W	07	WS W	07	SS W	06
2013-08	WNW	08	WN W	08	W	10	WN W	09	WN W	07	W	06	W	06	W	05	W	04	W	06
2013-09	W	08	W	08	W	11	W	10	W	11	W	14	W	13	W	11	W	13	W	10
2013-10	W	10	WN W	09	W	07	WN W	07	WN W	08	WN W	11	WN W	08	W	08	WS W	09	WN W	10
2013-11	SSW	06	SW	09	SS W	04	W	05	E	03	E	03	VR B	02	SSE	03	VR B	02	W	03
2013-12	NNW	06	NW	08	WN W	07	SSE	03	E	03	NN E	03	NN E	05	EN E	05	NN E	04	NE	06

Years & Months	Day 21		Day 22		Day 23		Day 24		Day 25		Day 26		Day 27		Day 28		Day 29		Day 30		Day 31	
	Dir	Spd																				

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2013-01	NNE	5	VRB	2	ENE	3	ENE	03	N	05	NNE	06	E	07	E	09	ENE	04	E	06	E	09
2013-02	N	05	N	05	NNE	04	E	04	ENE	05	NW	03	N	06	N	05						
2013-03	N	04	NW	03	NW	04	N	04	NW	05	NW	05	NW	06	NW	05	NW	07	NW	06	NW	05
2013-04	WNW	04	VRB	02	ENE	03	N	03	W	04	NW	03	NW	03	W	04	NW	07	NW	06		
2013-05	W	08	W	06	WSW	07	WSW	08	W	08	WSW	07	W	06	W	08	W	09	WSW	10	W	11
2013-06	W	11	W	13	W	10	WSW	11	SW	08	SSW	06	SSW	05	S	04	W	06	W	05		
2013-07	W	06	W	09	SW	08	WSW	08	SW	07	SSW	05	S	08	WNW	10	W	06	WSW	07	WSW	09
2013-08	WNW	07	WNW	06	WNW	08	NW	10	WNW	10	NW	09	NW	13	WNW	12	NW	12	NW	12	NW	08
2013-09	W	08	W	07	WNW	06	WNW	07	WNW	05	WNW	03	W	03	W	05	W	07	W	10		
2013-10	W	10	W	09	W	07	WNW	08	W	07	WNW	05	WNW	03	NW	04	W	04	N	04	VRB	02
2013-11	VRB	02	VRB	01	SSW	04	WSW	03	W	04	WNW	05	N	03	N	03	SE	05	E	06		
2013-12	NE	06	ENE	05	E	08	E	08	NNE	05	NNE	03	E	03	E	05	E	04	E	05	ENE	06

Years & Months	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Day 8		Day 9		Day 10	
	Dir	Spd	Dir	Spd																
2014-01	ENE	05	NNE	04	E	03	VRB	01	VRB	02	NE	03	NNE	04	NNE	05	E	07	E	06
2014-02	NW	03	ENE	04	ENE	05	ENE	03	N	04	NE	07	NNE	05	NE	05	NE	04	NNE	04
2014-03	NNE	04	N	05	N	04	E	05	E	05	ENE	06	NE	08	E	06	N	04	E	05
2014-04	WNW	07	NW	06	WNW	05	NW	03	NW	03	S	04	E	04	SSE	05	SSW	05	W	05
2014-05	WNW	4	WNW	4	W	5	W	6	NW	7	WNW	6	NW	3	WSW	9	W	7	W	6
2014-06	WSW	9	WSW	10	WSW	10	WSW	11	W	10	W	10	W	13	WSW	13	WSW	12	WSW	13
2014-07	WNW	10	WNW	12	WNW	14	WNW	13	W	13	W	11	W	11	W	9	W	11	WSW	11
2014-08	WSW	10	W	11	WSW	12	W	9	W	10	W	8	W	7	W	5	W	7	W	10
2014-09	WSW	9	WSW	8	W	5	W	5	W	5	W	8	W	8	W	7	WNW	7	WNW	7
2014-10	WSW	4	W	4	W	6	NW	4	W	3	WSW	4	W	8	W	8	W	7	WNW	5
2014-11	W	7	W	6	W	7	W	6	W	7	NW	6	NW	4	WNW	4	WNW	6	WNW	5
2014-12	VRB	2	SSE	3	VRB	1	NW	3	N	3	E	6	E	5	VRB	2	NW	3	E	4

Years & Months	Day 11		Day 12		Day 13		Day 14		Day 15		Day 16		Day 17		Day 18		Day 19		Day 20	
	Dir	Spd																		
2014-01	E	06	E	05	NNE	06	ENE	05	E	08	E	06	E	04	WNW	03	E	06	E	06
2014-02	NW	03	VRB	02	E	04	E	05	ESE	03	E	04	NNE	06	N	05	N	05	NW	03
2014-03	ENE	08	E	10	NNE	06	ENE	05	E	04	NNE	06	NNE	04	N	04	E	06	E	03
2014-04	W	06	NW	05	NW	04	WNW	03	NW	04	WNW	03	W	04	NW	06	NW	08	W	06
2014-05	W	5	WNW	4	NW	4	NW	4	NW	5	WNW	5	WNW	6	NW	6	VRB	2	SSW	3
2014-06	WSW	11	WSW	10	W	9	WNW	9	WNW	9	W	9	W	9	WSW	10	WSW	11	W	11
2014-07	W	10	W	12	W	12	W	11	W	10	W	8	WSW	7	WSW	10	WSW	9	WSW	8
2014-08	W	9	W	7	W	6	NW	6	WNW	6	WNW	5	NW	6	NW	13	NW	11	WNW	12
2014-09	NW	6	NW	6	WNW	8	WNW	8	W	7	WNW	7	WNW	8	NW	8	NW	8	NW	8
2014-10	W	6	WNW	9	W	7	W	3	N	4	N	4	W	4	SSW	4	VRB	2	S	5
2014-11	WNW	4	NW	5	W	3	SE	3	E	6	E	7	E	5	SSE	3	E	9	NE	5
2014-12	E	5	E	6	E	5	SE	6	SSE	4	VRB	2	N	5	E	5	E	10	E	9

Years & Months	Day 21		Day 22		Day 23		Day 24		Day 25		Day 26		Day 27		Day 28		Day 29		Day 30		Day 31	
	Dir	Spd																				

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2014-01	E	06	E	07	E	08	E	04	E	05	E	07	EN E	06	E	03	E	03	NN E	04	EN E	03
2014-02	N	04	NN E	05	N	05	EN E	09	E	08	E	07	EN E	04	e	03						
2014-03	NW	03	NN W	04	NN W	03	NN W	03	NE	08	E	04	N	04	NE	06	NN E	04	W	03	NW	05
2014-04	W	04	N	03	W	04	W	04	WN W	05	W	05	WN W	05	WN W	05	WN W	04	W	05		
2014-05	W	4	WS W	5	WS W	6	WS W	9	W	7	W	6	SS W	3	SW	4	SS W	4	WS W	7	WS W	8
2014-06	W	11	W	11	WN W	12	WN W	12	WN W	11	WN W	9	WN W	9	WN W	9	W	11	WN W	12		
2014-07	WSW	7	WS W	8	WS W	8	W	7	WS W	7	W	8	W	9	W	10	W	9	W	9	WS W	11
2014-08	WNW	15	W	14	W	9	W	4	VR B	2	S	4	WS W	6	W	7	W	9	W	10	WS W	9
2014-09	NW	8	NW	8	NW	10	NW	9	WN W	8	WN W	6	N	4	E	3	S	7	W	9		
2014-10	S	6	S	7	S	7	WS W	5	WS W	4	SS W	4	VR B	2	W	3	WN W	5	W	7	W	5
2014-11	E	7	W	5	N	8	SS W	3	NN E	3	VR B	2	CAL M	0	S	3	VR B	2	N	3		
2014-12	E	4	E	3	VR B	2	VR B	1	W	5	N	5	NN E	4	NN W	4	WN W	6	NW	7	NW	6

Years & Months	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Day 8		Day 9		Day 10	
	Dir	Spd	Dir	Spd																
2015-01	NW	03	VR B	01	N	04	EN E	04	ESE	04	VR B	02	N	04	N	04	EN E	05	E	05
2015-02	SE	03	E	05	EN E	08	EN E	03	NE	04	N	03	N	03	N	05	NE	05	NN E	04
2015-03	SSE	04	WN W	03	NN W	04	VR B	02	NE	04	NE	05	NN E	05	NN E	04	EN E	04	EN E	03
2015-04	ENE	04	E	03	NN W	03	NN W	05	N	03	NW	04	NW	05	NN E	03	EN E	04	E	05
2015-05	W	3	W	4	WN W	4	W	3	WN W	4	SW	5	W	7	W	7	W	8	W	7
2015-06	SW	7	SW	6	SW	7	W	11	SS W	7	SS W	9	SS W	12	WS W	8	WS W	4	SW	5
2015-07	WNW	6	NW	5	WN W	7	WN W	9	NW	10	NW	10	WN W	9	WN W	6	W	7	W	9
2015-08	NW	5	NW	6	WN W	5	W	8	WN W	7	WN W	8	WN W	9	WN W	11	WN W	12	WN W	12
2015-09	NW	9	NW	7	NW	10	NN W	6	NW	5	W	4	WS W	6	WS W	6	W	5	WS W	6
2015-10	SSW	6	SW	6	W	5	WN W	7	W	9	W	8	WS W	8	WS W	11	SW	11	WS W	7
2015-11	W	7	S	5	S	4	W	5	NN W	4	NN W	5	W	5	NN W	6	WN W	4	WN W	5
2015-12	VRB	2	WN W	4	WN W	7	N	7	N	5	EN E	5	NE	4	EN E	5	SSE	5	SSE	5

Years & Months	Day 11		Day 12		Day 13		Day 14		Day 15		Day 16		Day 17		Day 18		Day 19		Day 20	
	Dir	Spd																		
2015-01	E	06	E	06	EN E	04	EN E	05	EN E	06	E	06	E	05	EN E	05	E	04	E	06
2015-02	NNE	05	NE	04	N	04	NN E	05	NN E	05	NN W	04	NN W	03	VR B	02	VR B	02	NE	05
2015-03	ENE	04	NN E	04	NW	05	EN E	06	E	07	ESE	06	E	03	W	03	NW	03	NN W	03
2015-04	SSE	04	SS W	03	VR B	02	WS W	04	WS W	03	W	04	W	07	NN W	04	VR B	02	VR B	02
2015-05	W	5	WN W	8	WN W	10	NW	9	NW	7	W	10	W	7	WS W	8	WN W	7	W	4
2015-06	WSW	7	W	6	W	8	W	7	W	8	W	8	W	9	W	10	W	10	W	10
2015-07	W	10	WN W	8	NW	11	NW	14	NW	13	WN W	13	W	10	W	8	WN W	10	WN W	9
2015-08	WNW	10	W	7	NW	11	WN W	8	NW	7	NW	8	NN W	11	NW	11	NW	7	W	5
2015-09	W	8	W	6	W	5	W	6	W	9	WN W	10	NW	11	WN W	12	WN W	11	WN W	13
2015-10	W	5	VR B	2	N	3	E	3	SE	4	SE	4	VR B	2	VR B	2	VR B	2	E	5
2015-11	NNW	4	SW	6	NN W	5	NW	5	NW	5	W	5	WN W	6	W	7	W	5	SE	4
2015-12	SE	5	SE	4	S	3	VR B	2	VR B	2	N	4	E	4	SSE	4	E	6	E	7

Years & Months	Day 21		Day 22		Day 23		Day 24		Day 25		Day 26		Day 27		Day 28		Day 29		Day 30		Day 31	
	Dir	Spd																				

2015-01	E	06	ENE	05	NE	05	ENE	04	NE	04	E	03	E	04	E	04	NNE	04	ENE	06	E	04
2015-02	E	06	ENE	05	E	04	NNE	05	NNE	05	E	04	E	04	SSE	05						
2015-03	ENE	05	E	04	NE	04	N	05	NNW	03	E	03	N	03	NNE	04	NNE	04	ENE	03	NE	03
2015-04	SSW	03	VRB	02	WNW	04	W	05	NW	03	NE	03	VRB	02	VRB	02	VRB	01	W	03		
2015-05	W	5	WSW	5	WSW	6	SW	6	W	6	WSW	6	W	5	W	5	WNW	8	W	6	WSW	7
2015-06	W	10	WSW	9	SW	7	SW	8	WSW	8	W	12	W	12	W	11	W	9	W	7		
2015-07	WNW	9	WNW	12	WNW	11	WNW	9	WNW	9	W	5	NW	4	VRB	2	VRB	1	VRB	1	VRB	2
2015-08	NW	5	NNW	4	WNW	4	NW	6	NNW	6	NW	6	WNW	8	NW	5	NW	5	W	6	NNW	7
2015-09	WNW	11	W	10	WNW	10	NW	9	NW	9	NW	7	NW	7	NW	6	WNW	6	W	5		
2015-10	SSE	5	SSE	6	S	4	S	8	SW	7	SW	8	W	6	VRB	2	NW	3	NW	6	WSW	4
2015-11	SSE	5	E	4	S	5	E	6	E	7	E	4	WSW	4	NE	4	E	3	W	3		
2015-12	E	7	ENE	6	E	5	E	4	ENE	5	ENE	7	ENE	5	E	8	E	11	E	9	E	9

### Wind frequency Distribution from 2010 - 2015

H.Dh. Hanimaadhoo

2010		2011		2012		2013		2014		2015	
Dir	Spd	Dir	Spd								
ENE	5	NNW	3	N	5	ENE	5	E	5	E	4
ENE	5	N	3	N	5	E	4	E	5	NNE	4
ENE	5	NW/WNW	5	NW	4	NNW	4	E	5	ENE	4
W	5	W	5	WNW	5	NW	5	W	5	VRB	3
WSW	8	W	7	WNW	6	W	8	W	5	W	6
W	9	W	10	W	9	W	10	WSW	10	W	8
W	9	W	8	W/WNW	10	W	8	W	10	WNW	8
WNW	10	W	8	W	7	WNW	9	W	8	NW	7
W	7	W	7	W	6	W	8	NW	7	NW	8
W	7	W	5	NW	5	W	7	W	5	W	5
WSW	5	E	5	VRB	3	E	4	W	5	W	5
WSW	3	E	4	E	5	E	5	E	4	E	5
<b>W</b>	<b>7</b>	<b>W</b>	<b>7</b>	<b>W</b>	<b>6</b>	<b>W</b>	<b>7</b>	<b>W</b>	<b>7</b>		<b>7</b>

#### 4.6 General Conditions of Waves

Wave condition at Maldives is rather moderate. No serious cyclone is recorded. The swells and wind waves experienced by the Maldives are conditioned by the prevailing biannual monsoon wind directions, and are typically strongest During April-July in the SW monsoon season. During this season, swells generated north of the equator with heights of 2-3 m with periods of 18-20 seconds have been reported in the region. However, the Maldives also experiences swells originating from cyclones and storm events occurring well south of the equator.

## 5. ENVIRONMENTAL REQUIREMENTS

### 5.1 Introduction

The proposed construction works are, under conditions given below, expected to have only

minor impact on the surrounding coastal zone.

However, this is to be expected only if relevant mitigation measures are incorporated during the construction phase as well as during the long term operational period. In this section the objectives, obligations and criteria of such mitigation measures will be outlined.

## 5.2 Feedback Monitoring

During the period of dredging and reclamation, working activities may have adverse effects on the coral reef community and the terrestrial coastal zone. One of the main activities will be the dredging of basin for the reclamation.

The most widespread and visible consequence of dredging and excavation is the generation of suspended sediments and turbidity, both of which affect the corals adversely.

Other main activities with possible adverse effects are the disposal of the dredge spoils, site clearance on land and transport on land and at sea.

The Contractor shall during the construction period carry out an environmental control programme following a feedback design in order to ensure that adverse effects are detected before they become irreversible; The basic concept of a feedback monitoring program is that selected environmental key criteria, for instance live coral coverage or sedimentation rates, are observed regularly during the construction phase. If response, based on impact criteria indicating thresholds severe but yet not irreversible levels of impact, are crossed, steps of avoidance shall be enforced.

A metrology description for the environmental migration measures proposed for the environmental control programme shall be prepared by the Contractor for the Owners approval prior to the implementation of the environmental control programme and prior to any construction works on site.

The environmental key criteria and possible response thresholds are specified in the following sections.

## 5.3 Operational Key Criteria for Acceptable Environmental Impact

During construction the response on the following operational key criteria for acceptable environmental impact shall be measured at the perimeter of the construction zone. The perimeter of the construction zone shall be clearly identified at site and shall be approved by the Consultant / Engineer before taking of the measurements.

The Response Threshold (RT) for the operational key criteria shall be:

- (a) Live coral coverage; No significant decrease shall occur at selected sites, representative of the coral reef community in the area, compared to likewise representative reference sites.
- (b) Concentration of suspended solids in surface waters over reef slope: less than 10 mg/l above ambient concentration during daylight hours and less than 20 mg/l at night.
- (c) Sedimentation rate on coral reef slope (5-10 m depth zone): less than 10 mg/cm<sup>2</sup> day.

## 5.4 Environmental Obligations

The Contractor has the obligations mentioned below. He shall address the issues in the methodology description for his environmental mitigation measures designed to meet the criteria mentioned in section 4.3 and the subjects listed in section 4.5:

- (a) To describe methodology of, and carry out, an appropriate feedback monitoring programme, and see that the response thresholds given above are not surpassed. For this programme detailed and currently updated dredging schedules should be given currently calculate the amount of spill.
- (b) To describe, how possible adverse impacts related to subjects listed in section 4.5 are planned to be migrated.
- (c) Establish emergency measures and procedures for accidental spills of hazardous substances during the construction period.
- (d) Make an assessment of the possible impact of any temporary physical structure on the hydraulic situation and any possible erosion following this, and take mitigation constructions into the planning of the dredging and reclamation.
- (e) Report to the Owner.

### 5.5 **Subject of Environmental Concerns**

The following list included subjects considered of environmental relevance for the construction or part thereof. The list shall be considered as guideline for the contractor in his selection of mitigating measures of relevance for his selected construction methods and they shall be subject to adjustment when experience obtained during the environmental feedback monitoring program should call for this.

- (a) Dredged material. Dredged material to be used for consumption purposes must not be deposited on the reef flats or on landsides areas outside the limit of working areas. The excavation scheme should be set up in such a way that slurry plumes are minimised as much as possible on and in the vicinity of the reefs.
- (b) Surface run off. During the construction period surface Water caused by heavy rainfall may carry larger amounts of sediment to the reefs. Such surface run off shall be minimized.
- (c) Fresh water supplies for any construction purpose or labour force are to be brought in by the Contractor.
- (d) Solid waste and sewage: as a main principle, all waste is to be removed from the island before any nuisance of dust, smell or visibility is generated.
- (e) Waste: waste oil from machinery, bilge pumping or other use as well as any waste of hazardous substances connected to the construction activities is to be collected and transported as directed by the Consultant / Engineer.
- (f) Dumping: No dumping of any kind from support vessels are allowed on the reef or in the upstream waters of the island (and should otherwise follow any national regulations on dumping.
- (g) Dust nuisance: Activities creating dust nuisance are to be conducts under wind conditions that can the dot out to sea.
- (h) Anchoring of carrier and supporting ships and vessels: anchor is not allowed to be dropped on the reef crest or reef slope outside the working areas limit.

### 5.6 **The Contractor's Setting Out**

Ground markers shall be established for the above-mentioned main reference lines. The Contractor shall protect, and maintain these permanent pound markers during the period of the Contract. The Contractor shall install, protect, and maintain during the period of the Contract,

such additional permanent and/or temporary pound markers as are necessary for the execution of the Works, or as required by the Consultant / Engineer.

Sufficient working space shall be available around each pound marker to enable the Survey instruments to be erected and operated.

Further requirements regarding setting out, survey, etc. of the structures are stated in the specifications of the structures.

#### 5.7 **Survey of Sea Bed – “In survey”**

Initial surveying of the sea bed are required prior to any dredging or reclamation works.

The areas shall, in connection with in- and out-surveys, extend to cover at least 100m of the seabed beyond all dredging and reclamation limits in addition to the actual dredging/reclamation area.

The Contractor shall provide all necessary equipment, instruments, labour and crew necessary for bathymetric and pound surveys including an echo-sounder, to be available on Site for the entire period while dredging is carried out. The instrument shall record soundings with a horizontal accuracy of  $\pm 1.0$  m and a vertical accuracy of  $\pm 0.10$  m, for depths of 2 to 30 m. The survey set-up shall as a minimum include, but is not be limited to, positioning system, echo-sounder, heave-compensator, gyro-, pitch- and roll Sensors and sound-velocity probe. The survey shall be made through sounding in a grid of maximum 10m spacing between the survey lines in both directions.

The survey shall be detailed sufficiently for the recording of any major irregularities in the surveyed surface.

The Contractor shall shortly before the execution of any substantial survey work carry out calibration of is survey equipment in order to document that his setup can meet the specified requirements to surveys.

Maps shall be produced of all surveys in scale 1:1000 or 1:500, as approved by the Consultant / Engineer.

In addition to the specified Maps, raw data shall be made available to the Consultant / Engineer. The format in which the data shall be submitted shall consequently be final XYZ “raw” data in ASCII format. These data must be identical to those used by the Contractor as input in his final model and have consequently been corrected for erroneous reading, for odd-set gyro, pitch and roll and for off-set in the relation to vertical datum.

### 6. **DREDGING , RECLAMATION AND EARTH WORKS**

#### 6.1 **Scope of works**

The works decided in this section of the specifications comprise dredging for:

Dredging areas, dredging depths and dredging limits are specified in the drawing: REC/01/16, RWCS/01/16

The specified works comprise in addition use of dredged materials for fill in reclamation areas and other parts of the stockpile area specified by the Consultant / Engineer for utilisation

elsewhere on the island.

Areas required for Reclamation, fill and backfill works are specified on drawings provided with the document.

The dredging works consists of excavation of coral materials below the existing seabed regardless of the nature of the materials encountered during the course of dredging. Disposal of dredged material at either Stockpile or as fill, backfill, reclamation filling or core and filter materials in Runway structures, shall be carried out in accordance with these specifications and in compliance with the drawings as directed by the Consultant / Engineer.

The works include supply of all materials and the provision of all labour, plant and equipment required for the actual dredging, reclamation and other reuse of dredged materials as well as for all preparatory works surveys and testing required for the proper execution and completion of the works. In addition the works shall include all required measures for reduction of the environmental impact of the dredging and be included in the Contractors Environmental Control Programme according to the specifications in Section II.

## 6.2 **References**

The following Standards and Codes of Practice are referred to in this specification and fully or partly incorporated herein as specified:

<u>Designation</u>	<u>Title of Standards / Code of Practice</u>
BS 812	Sampling and Testing of Mineral Aggregates, Sand and Fillers
BS 6349, Part 5	Maritime structures. Code of Practice for dredging and land reclamation
CIRIA/CUR:	Manuel on the use of rock in coastal and shoreline Consultant / Engineering. Report no. 83/154

## 6.3 **Utilization of Dredged Materials**

All suitable material removed from the dredging areas shall, subject to the approval by the Consultant / Engineer, either be initially sorted by excavator and manual labour or by means of grizzly plant and/or hauled to a stockpile for screening, or shall be used for reclamation, subgrade for paving work, backfill for structures, or for other purposes shown on the drawings or as directed. Materials which are otherwise suitable but contain excess moisture shall be processed and utilized for fill.

Material from the dredging determined by the Consultant / Engineer as suitable for slope protection in revetments, filter or core material or other purposes shall be conserved and utilized as directed.

Materials from the dredging determined by the Consultant / Engineer to be for use in the Works shall be disposed of at the designated stock-pile areas or other areas approved by the Consultant / Engineer. Unless otherwise specified, compaction will not be required. However, the materials taken to disposal areas shall be levelled and shaped attractively to the approval by the Consultant / Engineer.

All excess material shall be delivered for other utilization on the island or disposed of as directed. It is the Contractor's responsibility to determine if sufficient material is available for the completion of the works before delivering or disposing of any materials. Any shortage of suitable materials for Completion of the work caused by premature disposal of materials by the Contractor shall be replaced by the Contractor at no cost to Owner.

#### 6.4 **Materials**

The density of coral sand may be ranging from 23 to 26 kN/m<sup>3</sup>. It is estimated that the average density for coral sand and gravel from Lagoon is 24 kN/m<sup>3</sup>.

The density for coral varies considerably with the type and quality of the coral. It is estimated to 22 kN/m<sup>3</sup>. The loose state density shall not be less than 800kg/m<sup>3</sup> and the maximum dry density of dredged materials shall not be less than 1.7 g/c m<sup>3</sup> for reclamation of land.

Actual geotechnical parameters including specific gravity and density of dredged materials reused in the reclaimed structures shall be verified according to the function of the materials used in the structures and the specified quality requirements.

#### 6.5 **Testing of Materials**

Dredged materials shall be tested for registration of dredging classes shall include the cost in the price proposal.

Testing of dredged material used as fill for general reclamation and as backfill shall be in accordance with the Specification for Highway Works: 1994 - Department of Transport, London.

Testing will further be required when the dredged material is reused in the construction works. This testing shall provide sufficient documentation of the material quality and ensure fulfilment of all requirements specified for the material when used in the actual structures.

#### 6.6 **Workmanship**

##### 6.6.1 **Setting out of Dredging Works**

All boundaries of dredging areas shall be established on the site by installation of marked in the appropriate reference lines or electronically established subject to the Consultant / Engineer's approval.

Markers shall be robust and clearly visible from all parts of the repairing area.

All setting out of dredging works shall be carried out by the Contractor.

##### 6.6.2 **Execution of dredging**

All dredging sort and earthworks shall be carried out in compliance with the criteria and environmental mitigating measures outlined in Chapter 4.

Prior to dredging or disposal of materials in any area, such area shall be cleared and its surface level shall be surveyed in the presence of the Consultant / Engineer. The survey shall be made sounding in a grid of maximum 10m spacing between the survey lines in both directions.

The survey shall be detailed sufficiently for the recording of any major irregularities in the surveyed surface.

All materials dredged as specified on the drawings or as directed by the Consultant / Engineer shall be utilized as specified in 5.3.

The Contractor shall notify the Consultant / Engineer min. 48 hours in advance of dredging or disposal of materials in any area.

Dredging shall be carried out by using a backhoe, cutter suction dredger or other dredging equipment with sufficient capacity to dredge the dredging classes 1 thorough 3.

If the Contractor decides upon using a cutter suction dredger or similar equipment, he shall be obligated to familiarise himself with the local conditions on shore to prepare for the necessary arrangements of the spoiling area. Reference is moreover made to the environmental requirements as described in Section 3.

Pre-splitting methods for dredging in soils of class 4 shall be subject to the Consultant / Engineers acceptance. The Contractor is required to provide detailed dredging plans and adequate descriptions of solution and mitigating measures when it is found that pre-splitting is require; for the dredging. It shall be noted that blasting is not encouraged from an environmental point of view and it shall only be allowed after specify permission from the Government of the Maldives has been obtained.

The Consultant / Engineer may order the method of pre-splitting to be stopped if the materials encountered no longer warrant it.

The supply, placement and compaction of fill and backfill specified on Drawing: REC/01/16, RWCS/01/16 shall be in accordance with the Specification for Highway Works: 1994 - Department of Transport, London, unless otherwise permitted, fills and backfill materials from dredging work shall contain no organic or other deleterious matter. Rock or other solid matter may be placed in a reclamation area subject to the Consultant / Engineer's approval. Bulky materials shall not be used as reclamation materials.

For reclamation below HIGHEST WATER LEVEL, dredged materials shall be placed directly in reclamation areas as shown on the Drawings. Large pieces of coral deposited in reclamation areas shall be spread over the full width of the reclamation area with sufficient small coral pieces or other fine material used to fill the voids in order to produce a dense, compact reclamation.

For reclamation above the HIGHEST WATER LEVEL, coral material shall be placed in level, horizontal layers not exceeding 0.3 metre (loose measurement) thick and be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain a uniform thickness prior to compacting. As the compaction of each layer progresses, levelling and adjustments shall be performed continuously to ensure uniform density.

Material containing more than 25 per cent of large pieces of coral with the greatest diameter of more than 150 mm, and which cannot be placed in layers of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, shall be removed and used for Some other purpose.

## 6.7 Tolerances

Dredging shall be carried out to the designated depths in all parts of dredging areas with a maximum permissible over dredging of 0.3 m below the specified level (Maximum Depth) unless noted otherwise by or as agreed with the Consultant / Engineer.

Excess dredging below Maximum Depth is not accepted unless approved by the Consultant / Engineer and shall be replaced by suitable material at no cost to the Owner.

The tolerances relative to the Specified Depth for dredging of areas in general is +0 mm to 300 mm.

The natural unprotected profile of slopes resulting from the dredging has in general been indicated as 1:3 reflecting the expected result of dredging in sand and gravel exposed to moderate wave impact only.

## 6.8 Inspection

### 6.8.1 General

The Contractor shall, prior to commencement and after completion of dredging works carry out surveys of the respective areas (in-survey and out-survey)

### 6.8.2 In-survey of Existing Bottom or Ground

An area covering the entire working area, as shown in shall be surveyed.

Maps and "raw" data shall be submitted to the Consultant / Engineer not later than one week after the scheduled execution of the in-survey.

### 6.8.3 Inspection after Completion

The Contractor shall verify that the dredging has been carried out as required.

Supplementary verification of areas dredged to a specified level shall be carried out by suspending a 6 to 10 m long straight edge (rail) from a boat, so that the underside of the straight edge is horizontal and level with the indicated dredging level. A sounding rod shall extend vertically above the water table in order to disclose the vertical movements of the straight edge. The boat shall move slowly across the area in a manner which ensures that the total area is covered by the straight edge. Areas where the straight edge cannot pass freely shall be marked with buoys and the necessary corrections of the seabed carried out.

The verification of slopes shall be made by soundings.

Maps and "raw" data shall be submitted to the Consultant / Engineer not later than two weeks after the execution of the respective survey.

## **7. 3 BREAKWATERS AND REVETMENTS**

### **7.1.1 Scope of Works**

The works specified in this Chapter of the Specifications comprises the construction of Breakwaters and revetments.

The works include supply or dredging of all materials required. According to Drawings, the specifications and the instructions from the Employer the Contractor shall furnish all materials, equipment, tools, and labour which are required for the construction, testing, measurement and completion of the works.

### **7.2 References**

The following Standards and Codes of Practice are referred to in this specification:

Designation	Title of Standards/Codes of Practice
BS 812 Parts 100-103	Sampling and Testing of Mineral Aggregates, Sand and Fillers
BS 6349 Part 1, Part 2	Maritime Structures
ISO 5081	Textiles- Woven Fabrics – Determination of Breaking Strength and Elongation (Strip Method)
CEM	Coastal Engineering Manual. U.S. Army Corps of Engineers.

### **7.3 Materials**

#### **7.3.1 General**

All stone materials specified in the following as stone class I, II and III shall be of granite, basalt or equal igneous rock. The material shall have an apparent specific gravity of not less than 26KN/m<sup>3</sup> with 90% of the stones having a density of at least 25KN/m<sup>3</sup> when saturated and surface dry, according to BS 812.

The average water absorption of quarry stone must be less than 2% and the water absorption of nine of the individual stones less than 2.5%.

The loss for magnesium sulphate soundness test must be less than 12% for all rock.

Deleterious secondary minerals shall not be present. For all rock types, this is taken to be indicated by Methylene Blue absorption values of less than (0.7 g/100g).

Average point load index in the planar direction of the most pronounced layering should any visible anisotropy exist and for sampling, testing and reporting in accordance with the ISRM

1986 recommended method must be at least 4.0 Mpa with the average minus the standard deviation of the point load index of at least 3.0 Mpa.

The mill abrasion resistance index must be less than 0.004.

Quarried rock shall not contain visually observable or chemically detectable impurities or foreign matters in such quantities that these are damaging for the constructive application of the quarried stone or for the environment in which the quarried stone is applied.

All stone materials specified in the following as stone class IV, V, VI and VII may as an alternative to the above mentioned rock be obtained from sound coral rock or beach rock. The material shall have an apparent specific gravity of not less than 24KN/m<sup>3</sup> when saturated and surface dry.

The stone materials shall be sound, compact, hard, durable and resistant to action of seawater and free of cracks and fissures determined for the proper performance of the material in question.

All fill material shall be dredge and stored to suit the specific demands in the structure.

### 3.3.2 Source of Stone Materials

The contractor shall select the source or sources of rock and shall be responsible for quarrying, supply and transport to the Site of suitable rock in sufficient quantities.

The suitability of the source or sources of rock selected by the Contractor shall be subject to the approval of the Employer. Approval of the quarry is only supplementary to other requirement of the rock.

The Contractor shall submit for the approval of the Employer an experienced geologist's determination of the type of stones based on visual inspection of 10 respective samples.

The coral rock or beach rock dredged may be used for stone classes IV, V, VI and VII if the testing shows it comply with these specifications.

### 3.3.3 Classification of Stone Materials

Armour layer in the break waters and filters overlaying sand fill and unspecified coral rock fill shall be constructed from the following stone classes specifying the minimum mean weight (or size) and the lower and the upper limit.

Granite:

- I:           Weight range: 2t to 8t  
              Mean weight: Min. 4t
- II:          Weight range: 1t to 4t  
              Mean weight: Min. 2t
- III:         Weight range: 350 kg to 1400 kg  
              Mean weight: 700 kg.  
              Granite or coral rocks.

IV: Weight range: 100 kg to 400 kg  
 Mean weight: 200 kg  
 V (filter): 150 – 300 mm  
 VI (filter): 75 – 150 mm  
 VII (filter): 50 – 100 mm

Stone materials shall be well graded between the specified limit and comply with the following filter criteria

$$d_{85} \geq D_{15}/4$$

$$d_{15} \geq D_{15}/7$$

$$d_{50} \geq D_{50}/7$$

In which d represents the finer material and D represents the coarser material.

$D_{nn}$  means that nn% of the material by weight passes a sieve having a square mesh width of D.

For stones used as armour stones or filter stones the following additional requirements shall apply:

- The stones shall be rough and angular in shape
- The maximum stone dimension (length) shall not exceed 2.5 times the minimum dimension (thickness) of the stone.

### 3.4 Testing of Materials

Inspection and testing of rock materials shall be carried out as an integral part of the Contractor's quality control programme with the objective to ensure the quality of all parts of the work. The requirement in the following subsection shall be understood as minimum requirements. Extended testing of properties shall always be when opening new quarry fronts and in connection with any significant change in the material properties from an existing quarry front.

The test specifications given in the following subsections shall be understood as 'State of art' specifications. Other test standards may, subject to the Engineers acceptance, be introduced for compliance with the Contractor's test procedures or procedures used by existing procedures. Test procedures related to possible stockpiling of rock materials near the construction site and in connection with placement of materials in the permanent works are not covered by this section of the Specification.

#### 3.4.1 Basic Procedures

From each quarry front the following properties shall be tested and fully documented prior to commencement of any production, in connection with any significant change of materials in the opinion of the engineer and as a minimum for every 5 000 m<sup>3</sup> of delivery (all classifications ) from the quarry front should be tested for the following:

- density
- water absorption
- resistance to weathering

- resistance to impact
- resistance to abrasion

The tests shall be carried out in accordance with the test specification accepted by the Engineer.

### **3.4.2 Testing of Stone Weights and Stone Gradation**

The Contractor shall at any time during working hours at the direction of the Engineer carry out test weighing of stones and the determination of the gradation of stones as indicated below:

#### **Stone Class I, II and III**

Test weighing of armour stones will be carried out at random. The Contractor shall include in his unit prices one control weighing per 80m<sup>3</sup> of armour stones. Stones which do not meet the weight requirements shall not count.

#### **Stone Class IV and V**

A test of the weight distribution of stone classes IV and V will be carried out on a representative sample of not less than 3.0 m<sup>3</sup> which is spread out on a clean, hard surface ( e.g. a floor of wooden boards or a concrete floor) provided by the Contractor. The Engineer selects 10 largest and the 20 smallest stones are then weighed/measured individually. The remaining stones are then weighed and counted and the mean weight determined.

The Contractor shall include in his unit prices the cost of one weight distribution test as the one described above per 1 000 m<sup>3</sup> of stones. Tests which do not meet the requirements shall not be counted.

#### **Stone Classes VI and VII**

A test of the weight distribution of the stones in classes VI and VII shall be carried out as described under Stone Classes IV and V above, except the sample shall not be less than 1.5 m<sup>3</sup>.

### **3.4.3 Testing of Coral Rock and Beach Rock Durability**

One durability test shall be made for each 1 000 m<sup>3</sup> of coral rock and beach rock to be used as Stone Classes IV, V, VI and VII.

The test result shall be made available for the Engineer's immediate approval.

## **3.5 Workmanship**

### **3.5.1 Placing of Stone Materials**

Placing of stones shall take place in a manner which will not damage the under laying layers of stones. When placing stones up to a theoretical boundary as defined by lines in the cross sections the Drawing, the Contractor shall aim at having the stones protrude the theoretical boundary over one third of its area.

The construction of rubble mound structures must be planned and carried out with due regard to the weather and sea conditions. The responsibility for the stability of the breakwaters and revetments under the various stages of completion rests solely with Contractor.

Construction of filters shall not commence prior to the Engineer's acceptance of the fill and the filter materials. The responsibility for the stability and integrity of the breakwaters and revetments under the various stages of completion tests solely with Contractor. To protect the structures against the wave action the Contractor shall place a shield of stone material in front of the structures. The individual filter layers shall be built up and trimmed from the bottom in such a manner, that the underlying layer is completed before commencing the overlying layer. The filter materials shall be placed with caution in order to ensure that the underlying layers already completed will not be disturbed. All materials shall be placed and compacted firmly in such a manner that the filter materials will remain fixed at the site.

### **3.5.2 Armour Stones**

When completed the armour layer shall be in a thoroughly stable condition and with the exposed surfaces reasonably uniform in appearance.

Haphazard dumping of armour stones will not be permitted. Above level of -0.5m armour stones shall be carefully place by crane. Below this level armour stones – one piece at the time may be dumped at the waterline immediately over their final position and care shall be taken to produce as dense and stable layer as possible.

Elongated stones shall be placed with their long axis perpendicular to the slope.

Voids in armour layers shall not be filled with small rocks.

### **3.5.3 Other Stones and Core Material**

All materials not forming part of the armour layers may be dumped, but undue segregation shall be prevented.

### **3.6 Tolerances**

At the time for completion the following tolerances shall be respected unless otherwise indicated or directed by the Engineer.

Slope of core/fill	±0.1
Filter layer, thickness of individual layer	+100/-50 mm

The surface of each layer shall be leveled before construction of the next layer in order to ensure that excess thickness of one layer shall not reduce the thickness of the next beyond the tolerance

## EMPLOYER'S REQUIREMENTS

Preliminary Reclamation depth assumed as 1.4 m from M.S.L. to all areas covered in the scope.

### Submit

- Source of Material ( location of barrow areas ) Barrow areas shall be finalized with inclusion of Entrance Channel and Jetty areas where natural access is not available.
- Details of proposed equipment to carry out the works.  
Including any equipment required for any alternative method proposed by the Contractor.
- Method statement  
Method statement: Any alternative method proposed by the Contractor.
- Project costing;  
BOQ for tender purpose is attached in the document to estimate the project cost. Contractor is responsible to check the accuracy of the quantities before submission of the bid. Any additions or Omissions of the quantity can be submitted by the Contractor as a separate bill.
- Work schedule;  
  
The contractor shall submit proposed work schedule. The work schedule shall indicate the major works to be carried out under the scope of the project. The work schedule shall clearly show the proposed date for the start of work on site.

### Other Information

1. It is contractors' responsibility to obtain all the permits required (from regulatory authorities, service providers etc.) for dredging and reclamation works.
2. The metric system of units shall be used throughout.
3. The maximum advance payment is 15% would be released on submission of a Bank Guarantee equal to the amount as specified in the contract.

### Note.

**All approvals required in relation to the project shall be the responsibility of the contractor including Environmental Impact Assessment.**

**Section – II**  
**Bills of Quantities**

**Section – III**  
**Drawings**