Ministry of Housing and Infrastructure, Maldives

KULHUDHUFFUSHI HARBOUR EXPANSION PROJECT

GEO TECHNICAL INVESTIGATION REPORT

WAPCOS

CONSULTANT

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POSSIBLE SOIL PROFILE

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GEOTECHNICAL INVESTIGATION FOR PROJECT MANAGEMENT CONSULTANT FOR KULHUDHUFFUSHI HARBOR EXPANSION PROJECT, MALDIVES

1.0 Background

The Government of Maldives has applied for a grant from the Asian Development Bank (ADB) for the Kulhudhuffushi Harbour Expansion Project and intends to apply a portion of proceeds to engage a consultant to support the Ministry of Housing and Infrastructure in the project implementation process for development of Kulhudhuffushi Harbour Expansion Project

2.0 Project Area

Kulhudhuffushi is one of the major population centers in the region with a total population of around 8,200 in 2014. Kulhudhuffushi is the capital of Haa Dhaalu Atoll and is one of the biggest and most populous Islands in the Northern part of the Maldives. Fishing (Tuna, Snapper, Marlin) is one of the biggest industries here, bringing in significant income for the islanders. Fishing is the lifeblood for Maldivians. The local men also work on the cargo vessels. Currently, Kulhudhuffushi is home to the regional hospital that provides general medical and specialist services, dental services, emergency services and intensive care units. The Island also hosts a range of education facilities such as primary schools, secondary schools, and a vocational training center, all designed to cater for the approximately 2,500 students from Kulhudhuffushi and other nearby Islands.

2.1 Objectives

The objectives of the Project are as follows:

a) Dredging and reclamation works
b) Breakwaters, revetments and quay-wall structures including harbor separation walls and finger piers
c) Pavement
d) Harbor navigational beacons and quay lighting
e) Ice Plant
f) Buildings – Administration/Retail/Terminal

g) Market – Fish/ Fruits and Vegetable

2.2 Scope of Work

The main requirement of the consultant is to assist the employer in

i. The overall project management,
ii. Detailed Engineering Design of the project,
iii. Procurement of Civil work contract,
iv. Construction Supervision and Contract Administration, and
v. Project Compliance and Monitoring.

However, the consultant shall carry out detailed tasks outlined under each component as per the ToR / RFP, as detailed below for ready reference.

2.2.1 Component 1: Overall Project Management

Task 01	Provide project management services throughout detailed design, procurement, construction, and commissioning stages and post-defect liability period.
Task 02	Prepare project schedule and corresponding projected cash flow in conjunction with the Employer and provide ADB a realistic schedule for design, approvals, tendering, construction and commissioning, The consultant is to maintain and update the project schedule throughout the project.
Task 03	Formulate and maintain a project performance management system in the format acceptable by the Employer and ADB, which consists of (1) preparing in the initial stage a project performance management system, in accordance with the ADB's project design and monitoring framework (DMF) to monitor (i) the progress of the overall project implementation, and (ii) the development impact of the project; and (2) collecting/updating the project performance indicator benchmarks, this includes updating the baseline data in the DMF.
Task 04	Develop a project management plan in sufficient detail to enable the project to be monitored as per the Employer's requirements, and to support the Employer to prepare quarterly progress report to evaluate the scope,

	implementation arrangement, progress, and achievement of the project objectives.

2.2.2 Component 2: Detail Design Engineering and Cost Estimates

Task 05	Review the preliminary design prepared during the project preparatory stage, validate/improve in accordance with best international standards and recommended practices. This includes carrying out value engineering - evaluating and proposing cost effective alternatives as deemed necessary. The detailed design should be prepared by considering the inputs from public consultation in Kulhudhuffushi.
Task 06	Review the existing surveys, identify and carryout additional detail surveys and undertake full detail design namely: ❖ Carryout detail design for all improvement works – including preparation of detailed design drawings in sufficient details for accurate determination of quantities and cost and to facilitate construction. ❖ Compile existing data and carry out limited hydrographic/oceanographic surveys as required to enable numerical modeling of the harbor and coastal structures to ensure sufficient safeguards against overtopping, harbor stilling and safe entry. Data collection may be required within the time available in the overall program. ❖ Geotechnical site investigation to verify soil conditions for dredging and coastal structures
Task 07	Prepare estimated quantities and cost of all proposed works and equipment with best possible accuracy.

2.2.3 Component 3: Procurement Support

Task 08	Review the indicative contract packages, prepared during the project preparatory stage, and, if warranted, recommend better alternatives to in order to optimize contract administration, construction coordination, and competitive pricing.
Task 09	Based on the type of bidding procedures and contracts, as advised by the

	Employer, prepare bidding documents for all works and equipment packages. The bidding documents shall be prepared in accordance with ADB's latest applicable Standard Bidding Documents (SBD) available in the ADB website.
Task 10	Provide all necessary assistance for the procurement of contracts, including but not limited to, advertising the invitation to bid, bid clarifications, addenda, pre-bid meetings, bid openings, bid evaluation and reports, contract negotiations, and draft contract documents.

2.2.4 Component 4: Construction Supervision and Contract Administration

Task 11	Approve contractor's work program, method statements, material sources, safety plan and environmental management plan.
Task 12	Review and check working drawings, the setting out of the works, and provide instructions to the contractor.
Task 13	Review the quality control programs of the contractors.
Task 14	Inspect materials and works to ensure compliance with the contract specifications and give notice to the contractor in the event that such materials and works fail to comply with the specifications.
Task 15	Accept or reject any part or parts of the completed works.
Task 16	Make measurements and keeping measurement records.
Task 17	Maintain records, correspondence, and diaries.
Task 18	Certify work volume and interim certificates for progress payments.
Task 19	Assist the Employer's representative with the maintenance of consolidated project accounts, and with preparation of financial statements and withdrawal applications for submission to ADB.
Task 20	Certify completion of part or all of the works.
Task 21	Periodically check the remaining quantities for completion, and undertake regular monitoring of each contract through an earned value management framework

Task 22	Provide assessments to the Employer in relation to Contractor's variation claims, extensions of time claims, and other technical and contractual matters that may arise.
Task 23	Negotiate with each contractor and recommend the Employer the rates for any unscheduled items of work that may arise.
Task 24	Advise the Employer's representative on all matters relating to the execution of the works; and assist the representative with processing the contractor's possible claims.
Task 25	Prepare, at the completion of the contracts, a consolidated project completion report in a format provided by ADB.
Task 26	Check and certify as-built drawings for the works prepared by the contractors.
Task 27	Inspect the works at appropriate intervals during the defects liability period and certify the defects liability certificate for issuance by the Employer's representative.
Task 28	Provide the Employer with complete records, and inception, monthly, and completion reports.
Task 29	Assist the Employer to provide on-site training where required for the Employer's field staff on quality assurance and contract administration.

2.2.5 Component 5: Social Safeguard

Task 30	During the detailed design stage, conduct consultation with local communities in Kulhudhuffushi for input to the harbor design where appropriate.
Task 31	Support the Employer in matters relating to land acquisition and resettlement, if impact is identified during project implementation period. Tasks include preparing Resettlement Plan, monitoring the implementation of the resettlement plan and providing expert advice in all matters relating to acquisition and resettlement.
Task 32	Design, prepare and conduct HIV/AIDS, anti-trafficking and child labor awareness campaign at the project influence areas, monitor the status of contractor's compliance with HIV/AIDS, and Core Labor Standards.
Task 33	Implement gender-specific project features and ensure Contractor is in compliance with equal payment for equal work for men and women.

Task 34	Ensure compliance with social impact mitigation requirements of civil works contracts, and provide information to ADB on those processes in the semi-annual safeguard report.

2.2.6 Component 6: Environmental Assessment and Monitoring

Task 35	Review the Initial Environmental Examination (IEE) report and carry out additional studies and public consultations if recommended or required by the IEE. If there are changes in the project design or discovery of new environmental impacts update the IEE report and disclose it on the ADB website as necessary. Review the general engineering design and in discussion with the engineering team identify needs if any for design modification to enhance environment safeguard and/or mitigate climate risks. Update the Environmental Management Plan (EMP) and provide more specific details based on site visits, the revised design and new information acquired, if any. Review the bidding documents and ensure the inclusion of the EMP, related mitigation costs and all necessary provisions for compliance to environment safeguard requirements. The environment management plan will be updated as part of the updated IEE.
Task 36	Monitor the project's compliance to environment safeguards as given in the IEE report and implementation of the EMP by the contractor and ensure compliance with the environmental safeguard requirements of civil works contracts. Provide necessary training and technical advices including on-site advisory to the contractors as found necessary. Review and confirm that the EMP implementation records are maintained by the contractor. Prepare monthly and semi-annual environmental monitoring reports based on these records and on-site spot checks carried out and submit to the Employer. The semi-annual reports which will also cover social safeguard issues with inputs from the Social Development Specialist will be for submission for ADB for disclosure on the ADB website.

3.0 Geo technical Investigation

With reference to the task 6, WAPCOS has been undertaken the Geo technical investigation works at Kudhulffushi from 23rd September to 17th October, 2017 with the proposed Project

for **Project Management Consultant for Kudhulffushi Harbour Expansion Project, Maldives.**

A comprehensive Geotechnical assessment has been conducted by **M/s. ELS International (Pvt) Limited, Male** for **M/s. WAPCOS Limited**, Maldives to determine the geotechnical conditions present within the investigated land.

This Geotechnical investigation work includes borehole drilling, sampling of disturbed and un-disturbed materials, laboratory investigation of samples and in-situ testing.

This report embodies the findings of the site investigation including, nature and depth of soil strata, ground water levels at the site, physical and mechanical properties of soils and other relevant details of the geotechnical investigation.

3.1 Site Description

The investigated boreholes are at Kulhudhuffushi harbour premises for expansion of Kulhudhufffushi harbour. The location map shows the points were the Geo technical Investigations are carried out.

Fig 1 Geotechnical Investigation locations

Table.1 Borehole Locations

Borehole No.	Latitude	UTM	Longitude	UTM	Remarks
MBH 1	6°37'22.33"N	285902.00 m E	73° 3'48.52"E	732476.00 m N	Quay wall area
MBH 2	6°37'0.15"N	286033.00 m E	73° 3'52.87"E	731794.00 m N	Break water

MBH 3	6°37'6.50"N	285892.00 m E	73° 3'48.25"E	731990.00 m N	area
MBH 4	6°37'17.23"N	285846.00 m E	73° 3'46.71"E	732320.00 m N	
MBH 5	6°37'15.07"N	285940.00 m E	73° 3'49.78"E	732253.00 m N	Separation Wall
LBH 1	6°37'5.64"N	286068.00 m E	73° 3'53.99"E	731963.00 m N	Quay wall area
LBH 2	6°37'9.81"N	286040.00 m E	73° 3'53.06"E	732091.00 m N	
LBH 3	6°37'15.28"N	286005.00 m E	73° 3'51.90"E	732259.00 m N	
LBH 4	6°37'4.85"N	285984.00 m E	73° 3'51.26"E	731939.00 m N	Ferry terminal Building area
LBH 5	6°37'25.11"N	285912.00 m E	73° 3'48.83"E	732562.00 m N	Fish Market Building area

Layout of for expansion of Kulhudhufffushi harbour

3.2 General Geological and Sub Grade Characteristic of Site Area

The underneath geological formation of the site is considered, the coral reef formation is predominated at all the Maldivian islands, it may be stated that a classic atoll chain and the reef limestone, of which they are built, have accumulated on a volcanic ridge foundation

associated with a transform fault on the floor of the Indian ocean which is now inactive. As mentioned above the Male Island also had been formed under volcanic ridge foundational phenomena.

Describing the soil conditions in the Maldives, it has been observed from previous investigations that the structure of the reef flats generally consists of either coral sand, soft or hard coral rock and is usually overlaid with a relatively thick layer of coral sand. On the lagoon side of the reef edge the reef is mostly covered with dead corals and a few colonies of live corals. The cavities between the coral heads are constantly being filled up with coral sand and pieces of broken and dead corals and will ultimately become a substantially hard cemented material.

When considering the climatic characteristics, Maldives experience a monsoonal climate, as the northeast monsoon is from January to March; hot days, cooler nights and relatively dry periods are common feature during this season. The wet, southwest monsoon prevails from mid-May to November. Gales and heavy rainfall occur during this season.

3.3 Formation of Coral in the Region

With respect to coral formation in general corals are preserved as calcareous skeletons, originally secreted by a simple animal known as polyps. Reef building polyps avoid deep water more than 25m deep and grow optimally at depths within 10m. The sea water temperature should be between 25^0C-29^0C. Emersion or exposure above water could be tolerated only for short periods during tidal cycles. Salinity levels should generally be between 2.7% and 4.0%. The water turbulence is desirable in order to disperse carbon-dioxide to bring in plank tonic food and oxygen.

A moderate fall out of fine sediments from the water can be tolerated because corals have self cleansing mechanisms but burial beneath sediment for lengths of time could result in an asphyxiation and death. The polyp sack like body had an internal cavity which acted as its stomach. There was only a single opening to the out side, surrounded by tentacles. The polyp sat in a cup like depression on to pot its calcareous skeleton, or corallites, which is built

upwards to form a support as it grew. Coral are classified according to this internal structure, which cannot often be observed directly.

3.4 Field Investigation

Field investigation consisted of advancing ten boreholes at the locations marked in Figure 1. The Field investigation was commenced on 23rd September to 17th October.

3.5 Borehole Investigation

The boreholes were advanced by means of rotary drilling machine and the drilling was carried out with overburden cutting tools and the wash boring process was adopted to remove the cuttings from the bottom of the borehole. During the drilling operation the walls of the boreholes were supported by 82 mm dia. NX type flush coupling casings. In order to achieve better alignment of borehole NWY flush coupling drill rods were used. Details of the depths of drilling are indicated in the Table 2.

Table 2 Summary of the Borehole Investigation

Borehole No.	Water Level (m)	Overburden / Soil Drilling (m)	Rock / Boulder Drilling (m)	Total Depth (m)
M BH – 01	+2.00	18.45	-	18.45
M BH – 02	+2.00	18.45	-	18.45
M BH – 03	+2.00	18.45	-	18.45
M BH – 04	+2.00	18.45	-	18.45
M BH – 05	+2.00	18.45	-	18.45
L BH – 01	+2.00	18.45	-	18.45
L BH – 02	-0.80	13.50	3.00	16.50
L BH – 03	+2.00	18.45	-	18.45
L BH – 04	+2.00	18.45	-	18.45
L BH – 05	-1.20	15.50	3.00	18.50

3.6 Standard Penetration Test (SPT)

The SPT was carried out in regular intervals in the overburden, at each of the borehole. The performance of this test is based on the test method specified in BS 1377. Disturbed samples of soil were collected from SPT tube.

3.7 Test Procedure

- SPT sampler (Split spoon sampler) inserted in to the boring and it has been connected via steel rods to 63.5kg hammer.
- Using automatic safety hammer mechanism, hammer was raised a distance of 760mm and allowed it to fall freely and the energy drives the sampler in to the bottom of the boring. The process was repeated until the sampler has penetrated a distance of 450mm. The numbers of blows were recorded for first 150mm (Seating drive) and then two consecutive 150mm intervals (Test drives).
- The N value was computed by summing the blow counts for the two 150mm intervals of penetration. The blow count for the first 150mm is retained for reference purposes but not used to compute N value because the bottom of the boring is likely to be disturbed by drilling process and may be filled with loose soil that fell from the side of the boring.
- The SPT samples were extracted from the sampler and saved the obtained soil samples in appropriate manners.
- Boring to the depth of the next test been done with the above procedure.

3.8 Ground water conditions

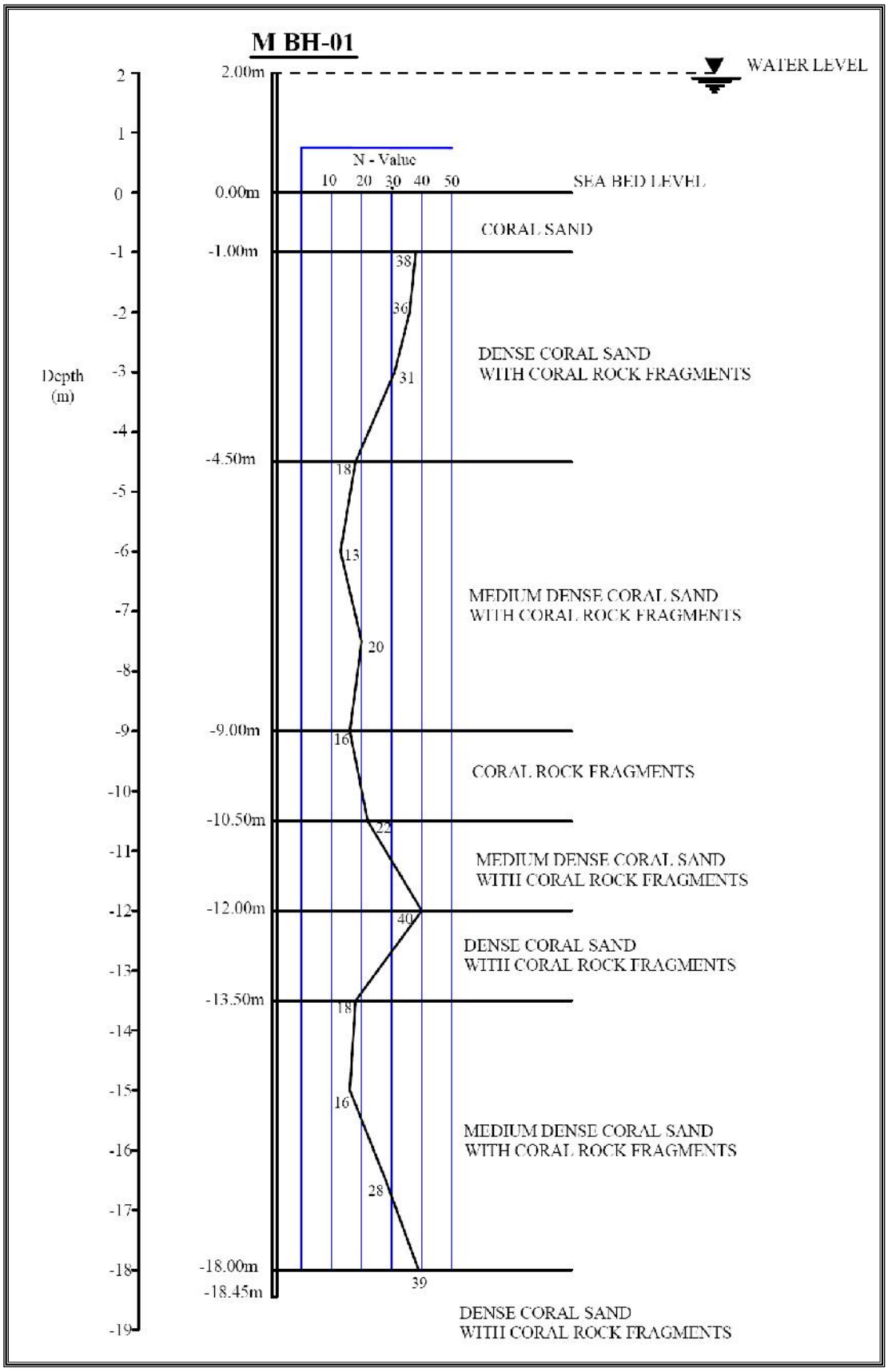
Ground water measurements were obtained from the open boreholes where the water levels were obtained after a considerable response time. The ground water levels obtained can fluctuate with the seasons, periods of precipitation and temperature.

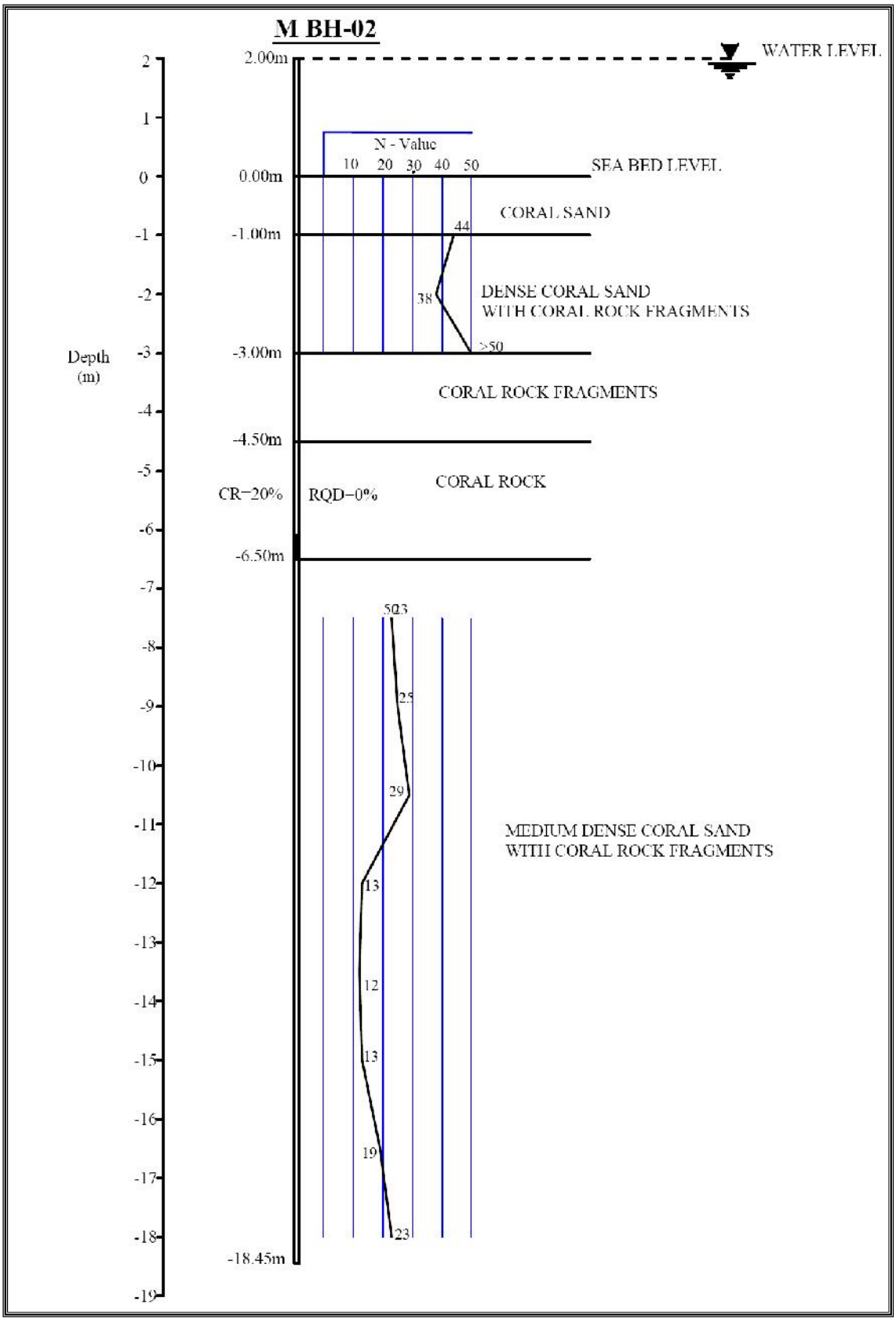
4.0 Sub-Surface Conditions

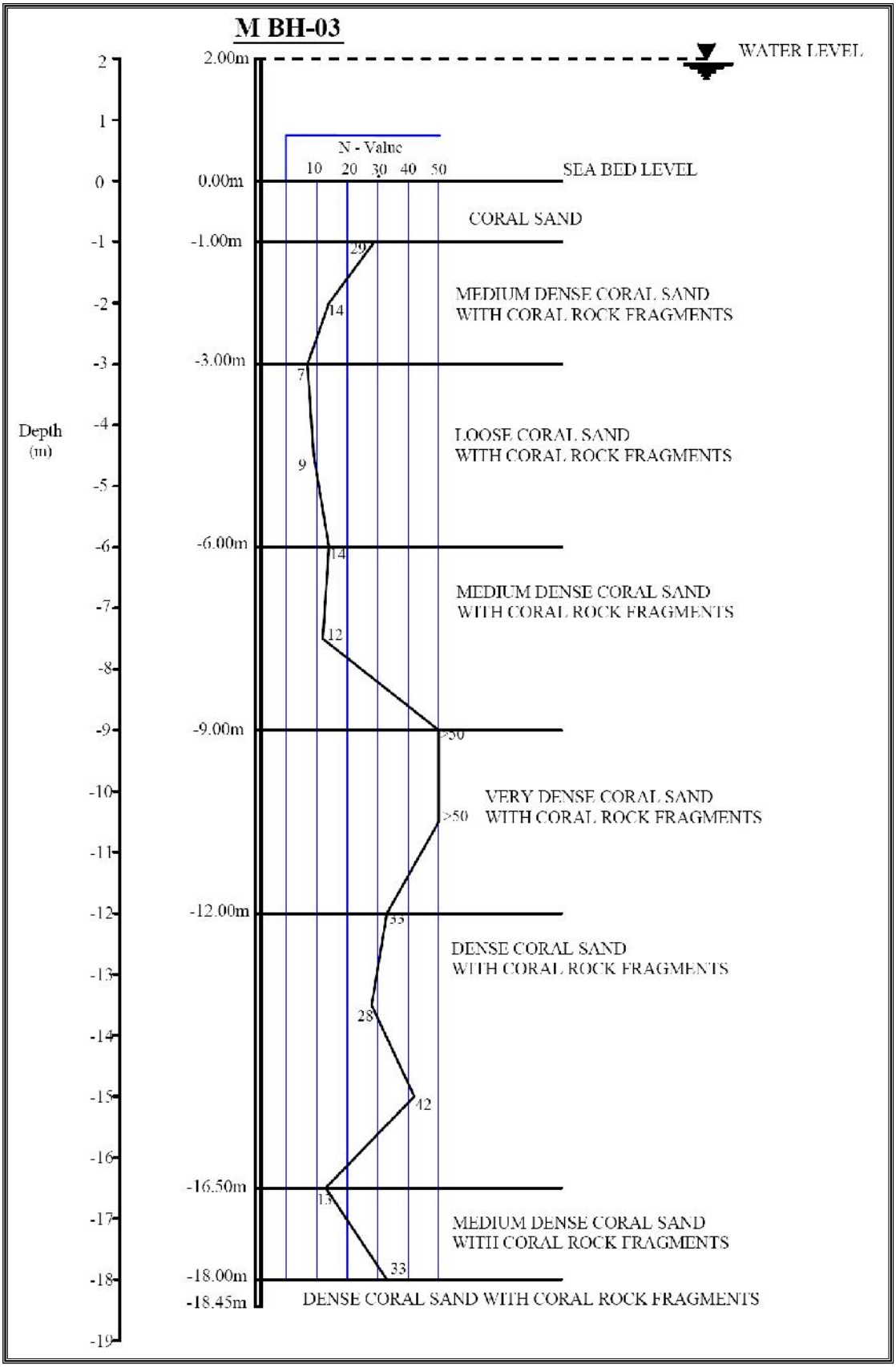
The sub surface conditions encountered at the site are graphically presented in the borehole logs attached in Annex I. The soil horizons identified at the borehole locations are inferred from the samples taken from the borehole locations. Soil horizons/layers generally represent

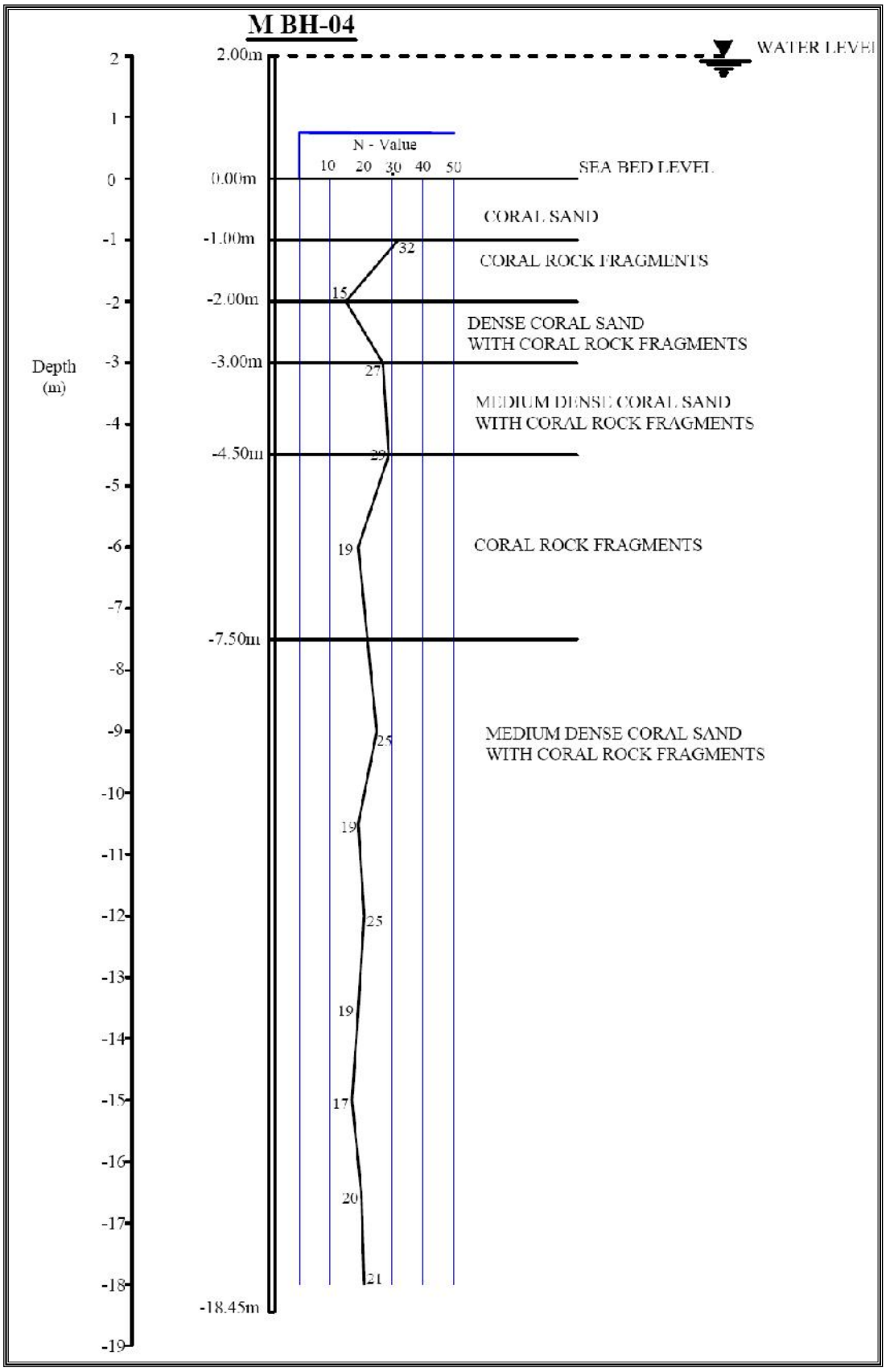
a transition from one soil type to another and that should not be assumed to be representing an exact plane of geological change.

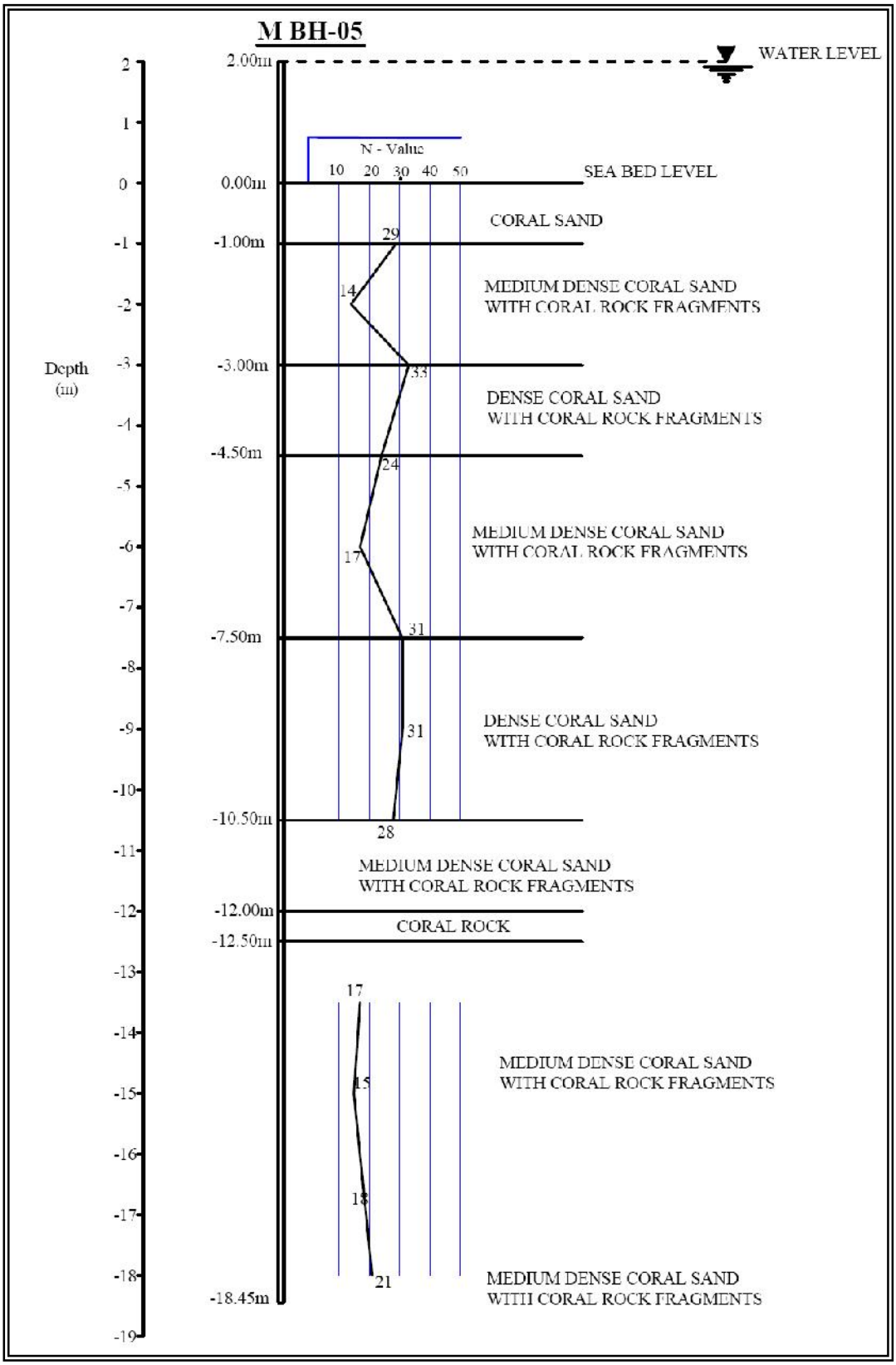
Further, the conditions may vary between and beyond the borehole locations. A comprehensive detail about the sub soil conditions at /across the boreholes is graphically shown in the Figure 2(a) to 2(j) as **Annexure I**. The sub soil profile drawings are shown in the Figure 2(k) to 2(m) as **Annexure II**. Few photographs were shown in **Annexure III** taken during the Geo technical investigations works.

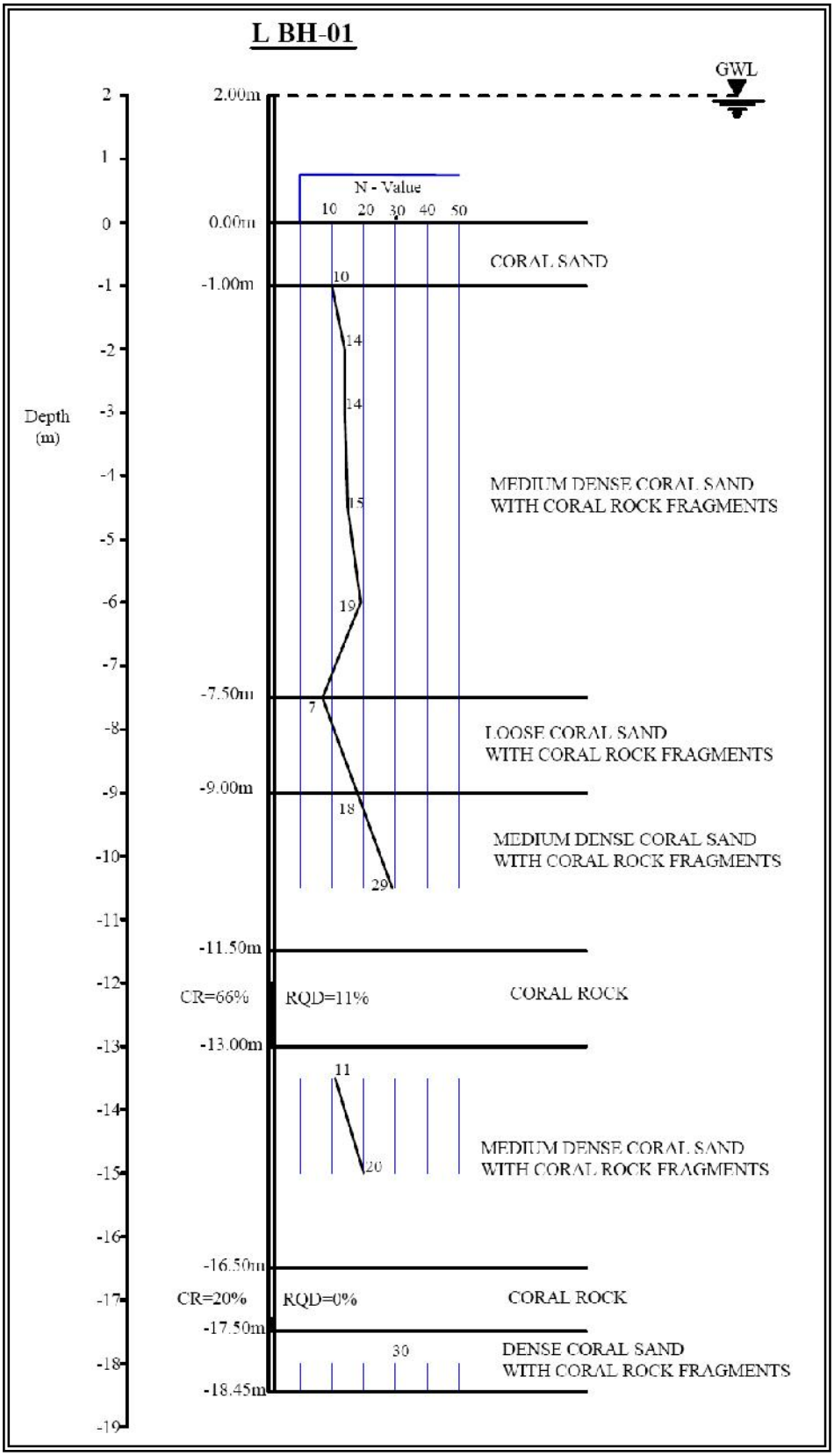

M BH-01
WATER LEVEL
2.00m
N - Value
10 20 30 40 50
SEA BED LEVEL
0.00m
CORAL SAND
-1.00m
38
36
DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
31
Depth (m)
-4.50m
18
13
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
20
-9.00m
16
CORAL ROCK FRAGMENTS
-10.50m
22
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-12.00m
40
DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-13.50m
18
16
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
28
-18.00m
-18.45m
39
DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS

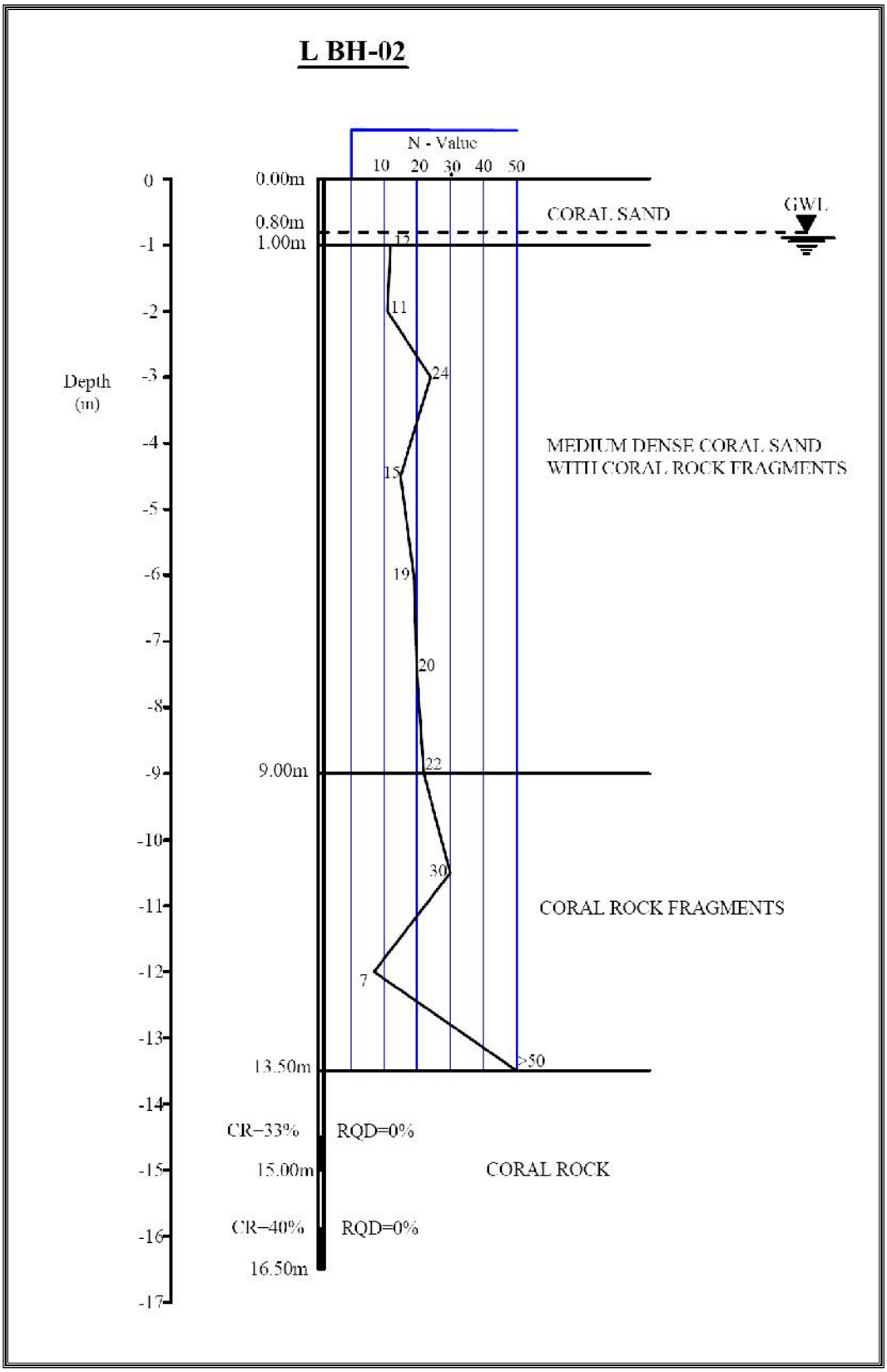

M BH-02
WATER LEVEL
2.00m
N - Value
10 20 30 40 50
SEA BED LEVEL
0.00m
CORAL SAND
-1.00m
44
38
DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
>50
-3.00m
Depth (m)
CORAL ROCK FRAGMENTS
-4.50m
CORAL ROCK
CR=20%
RQD=0%
-6.50m
50/3
25
29
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
13
12
13
19
23
-18.45m

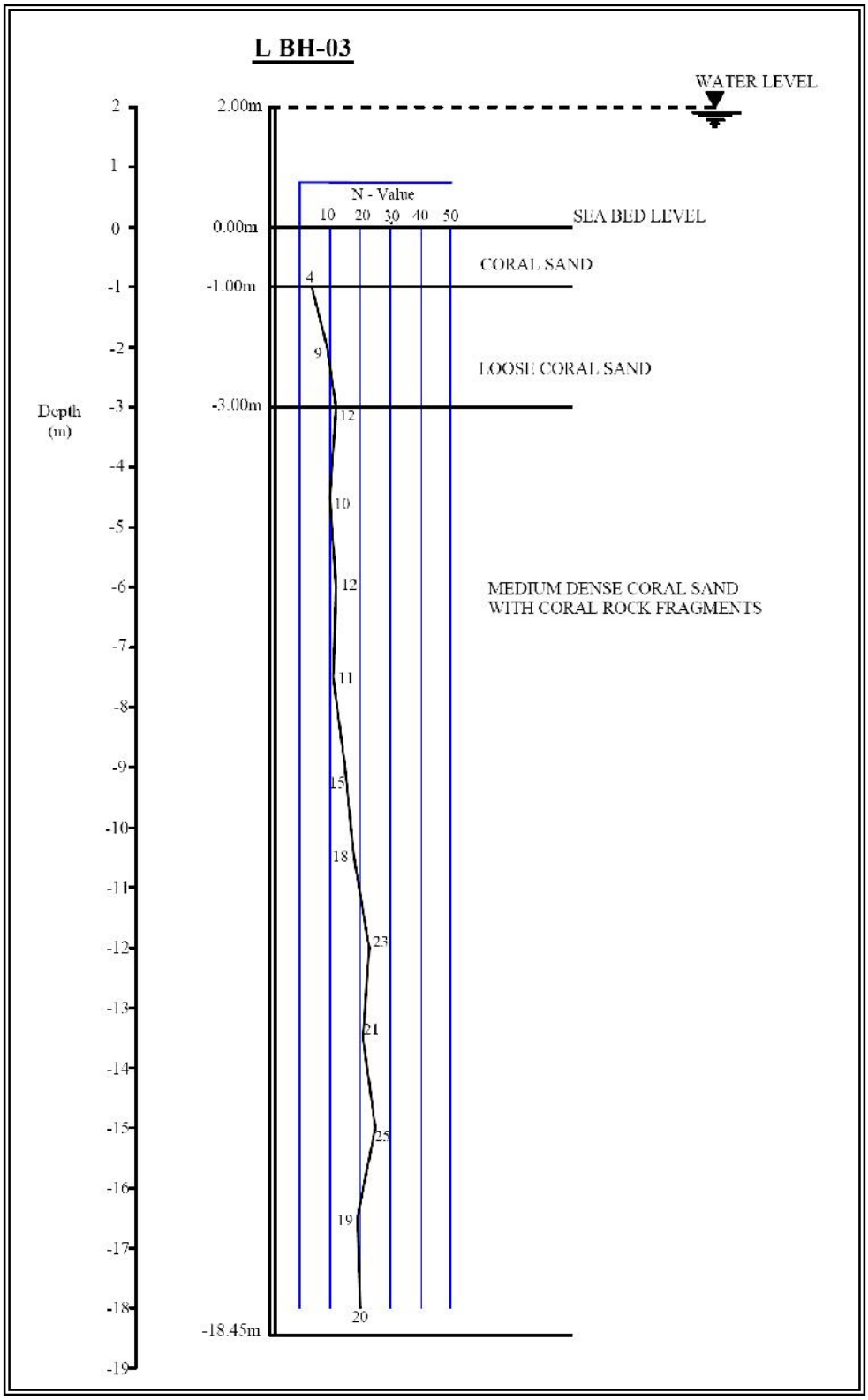

M BH-03
WATER LEVEL
2.00m
N - Value
10 20 30 40 50
SEA BED LEVEL
0.00m
CORAL SAND
-1.00m
20
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
14
-3.00m
7
LOOSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
9
-6.00m
14
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
12
-9.00m
>50
VERY DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
>50
-12.00m
33
DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
28
42
-16.50m
13
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
33
-18.00m
-18.45m
DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
Depth
(m)
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
-19

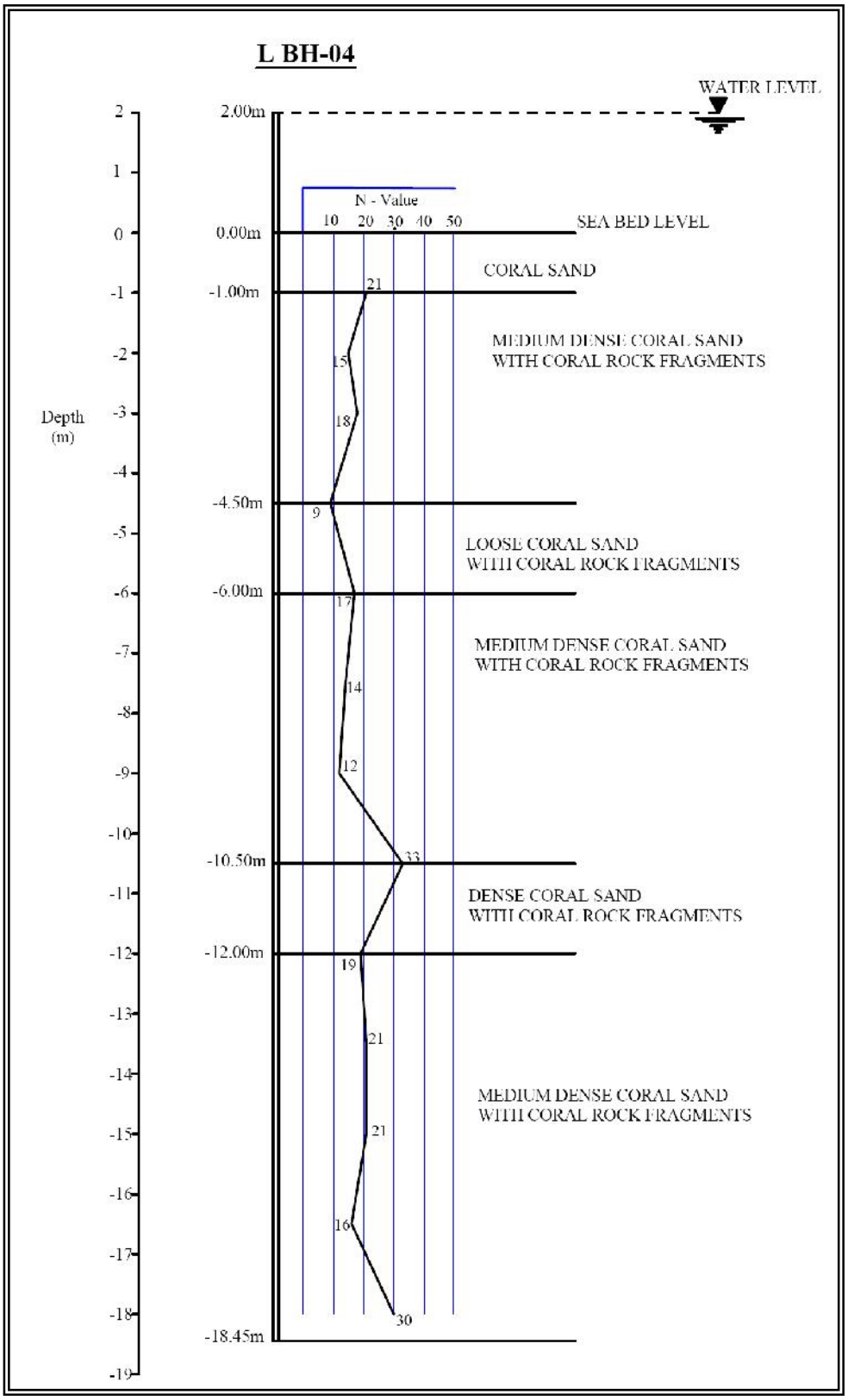

M BH-04
WATER LEVEL
2.00m
N - Value
10 20 30 40 50
SEA BED LEVEL
0.00m
CORAL SAND
-1.00m
CORAL ROCK FRAGMENTS
-2.00m
DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-3.00m
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-4.50m
CORAL ROCK FRAGMENTS
-7.50m
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-18.45m
Depth (m)
32
15
27
29
19
25
19
25
19
17
20
21

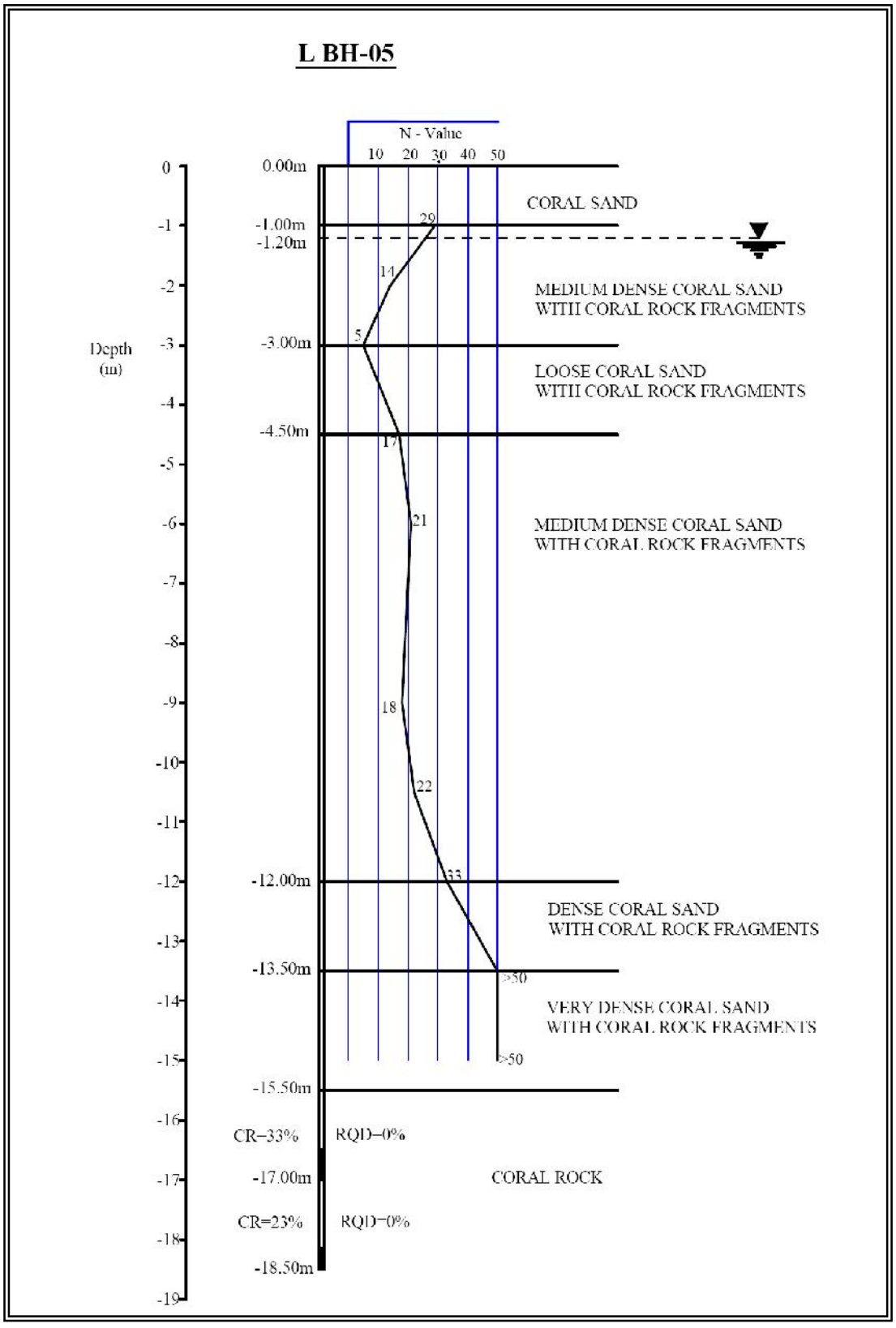

M BH-05
WATER LEVEL
2.00m
N - Value
10 20 30 40 50
SEA BED LEVEL
0.00m
CORAL SAND
-1.00m
29
14
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-3.00m
33
DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-4.50m
24
17
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-7.50m
31
31
DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-10.50m
28
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-12.00m
CORAL ROCK
-12.50m
17
15
13
21
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-18.45m
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
Depth
(m)
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
-19


L BH-01
GWL
2.00m
N - Value
10 20 30 40 50
0.00m
CORAL SAND
-1.00m
10
14
14
15
19
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
Depth (m)
-7.50m
7
LOOSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-9.00m
18
29
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-11.50m
CR=66%
RQD=11%
CORAL ROCK
-13.00m
11
20
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-16.50m
CR=20%
RQD=0%
CORAL ROCK
-17.50m
30
DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-18.45m


L BH-02
N - Value
10 20 30 40 50
Depth (m)
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
0.00m
0.80m
1.00m
CORAL SAND
GWL
12
11
24
15
19
20
22
9.00m
30
7
>50
MEDIUM DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
CORAL ROCK FRAGMENTS
13.50m
CR=33%
RQD=0%
15.00m
CORAL ROCK
CR=40%
RQD=0%
16.50m


L BH-03
WATER LEVEL
2.00m
N - Value
10 20 30 40 50
0.00m
SEA BED LEVEL
CORAL SAND
-1.00m
4
9
LOOSE CORAL SAND
-3.00m
12
10
12
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
11
15
18
23
21
25
19
20
-18.45m
Depth
(m)
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
-19


L BH-04
WATER LEVEL
2.00m
N - Value
10 20 30 40 50
SEA BED LEVEL
0.00m
CORAL SAND
-1.00m
21
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
15
18
Depth
(m)
-4.50m
9
LOOSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-6.00m
17
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
14
12
-10.50m
33
DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
-12.00m
19
21
MEDIUM DENSE CORAL SAND
WITH CORAL ROCK FRAGMENTS
21
16
30
-18.45m
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
-19


L BH-05
N - Value
10 20 30 40 50
Depth (m)
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
-19
0.00m
-1.00m
-1.20m
-3.00m
-4.50m
-12.00m
-13.50m
-15.50m
-17.00m
-18.50m
CORAL SAND
MEDIUM DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
LOOSE CORAL SAND WITH CORAL ROCK FRAGMENTS
MEDIUM DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
VERY DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
CORAL ROCK
29
14
5
17
21
18
22
33
>50
>50
CR=33%
RQD=0%
CR=23%
RQD=0%

ANNEXURE-I

BOREHOLE LOGS

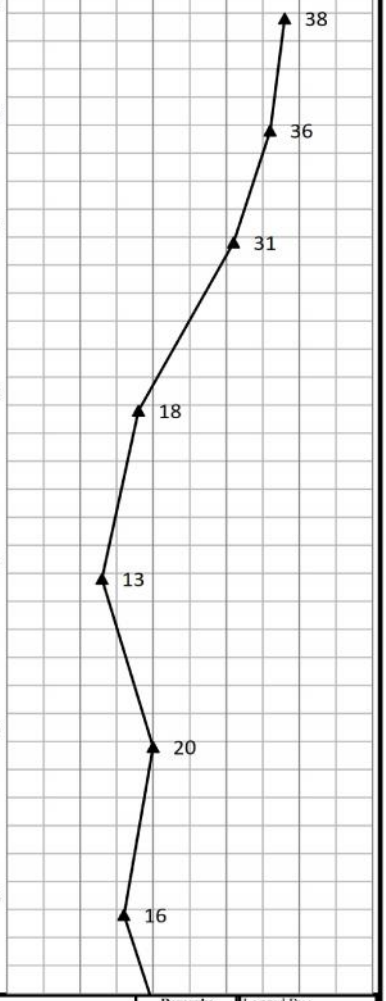
Figure 2 (a)

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	Geotechnical Investigation at Kulhudhuffushi Island					Borehole No	M BH-01
Client	M/s. WAPCOS Limited					Sheet	1 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	12.10.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	732476.00N
Date of Finished	13.10.2017	Casing Diameter	76mm	Elevation (m)			285902.00E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
0.00							Ground level				
		D1	DS		0.00		Light gray, sub anguar to angular coral SAND				
1.00											
		D2	SS		1.00		Dense, light gray, sub anguar to angular coral SAND with coral rock fragments	6	20	18	38
			WS								
2.00		D3	SS	G.W.L at 2.00m				8	21	15	36
			WS								
3.00		D4	SS					15	14	17	31
4.00			WS								
		D5	SS		4.50		Medium dense, light gray, sub anguar to angular coral SAND with coral rock fragments	10	7	11	18
5.00			WS								
6.00		D6	SS					8	7	6	13
			WS								
7.00		D7	SS					10	9	11	20
8.00								NO SAMPLE			
			WS								
9.00		D8	SS		9.00		Medium dense, light gray, fine to coarse, coral rock fragments	8	8	8	16
10.00			WS								



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		CT - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground, Clay, Silt, Sand, Gravel, Organic Matter, Laterite Nodules, Silty Sand, Completely Weathered Rock, Highly Weathered Rock, Fresh Rock

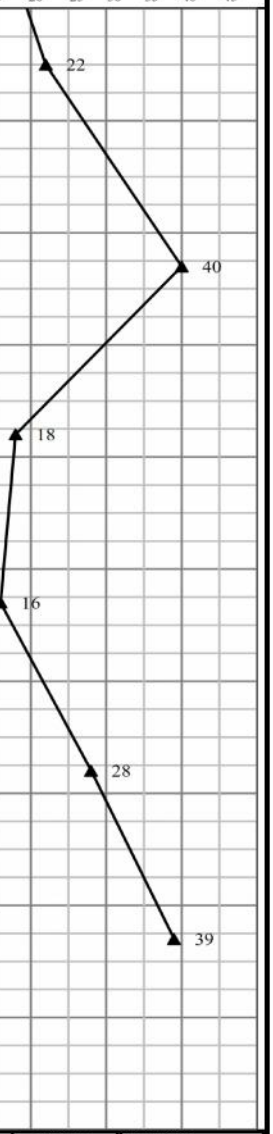
ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation at Kulhudhuffushi Island**					Borehole No	M BH-01
Client	**M/s. WAPCOS Limited**					Sheet	2 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	12.10.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	732476.00N
Date of Finished	13.10.2017	Casing Diameter	76mm	Elevation (m)			285902.00E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
10.00							Continue from Page 1				
							Same as previous description				
11.00		D9	SS		10.50		Medium dense, light gray, sub anguar to angular coral SAND with coral rock fragments	14	12	10	22
			WS								
12.00		D10	SS		12.00		Dense, light gray, sub anguar to angular coral SAND with coral rock fragments	7	11	29	40
13.00			WS								
14.00		D11	SS		13.50		Medium dense, light gray, sub anguar to angular coral SAND with coral rock fragments	10	7	11	18
			WS								
15.00		D12	SS					6	7	9	16
16.00			WS								
17.00		D13	SS					12	18	10	28
			WS								
18.00		D13	SS		18.00		Dense, light gray, sub anguar to angular coral SAND with coral rock fragments	7	21	18	39
					18.45		The borehole was terminated at the depth of 18.45m				
19.00											
20.00											

Moisture Content - %
Undrained Shear Strength - t/m²: 10 20 30 40 50 60 70 80 90
SPT Resistance - Blows/ft: 5 10 15 20 25 30 35 40 45



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_3^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		CT - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By: Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground | Silt | Gravel | Laterite Nodules | Completely Weathered Rock
Clay | Sand | Organic Matter | Silty Sand | Highly Weathered Rock | Fresh Rock

Figure 2 (b)

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION
Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	M BH-02
Client	**M/s. WAPCOS Limited**					Sheet	1 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	29.09.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	731794N
Date of Finished	30.09.2017	Casing Diameter	76mm	Elevation (m)			286033E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
0.00							Ground level				
		D1	DS		0.00		Light gray, fine to coarse, angular to sub angular coral SAND with sea shell fragments and coral rock fragments				
1.00		D2	SS		1.00		Dense, light gray, fine to coarse, angular to sub angular coral SAND with coral rock fragments and sea shell fragments	13	24	20	44
2.00		D3	SS					15	20	18	38
			WS								
3.00		D4	SS		3.00		Light gray, offwhite, coral rock fragments	30	HB		>50
4.00											
5.00					4.50		Highly fractured, discolored, light gray, light brown, CORAL ROCK	CR=20%		RQD=0%	
6.00											
7.00					6.50		Medium dense, light gray, fine to coarse, angular to sub angular coral SAND with coral rock fragments	13	10	13	23
8.00		D5	SS								
			WS								
9.00		D6	SS					7	10	15	25
10.00			WS								

Moisture Content - %
Undrained Shear Strength - t/m^2 (10 20 30 40 50 60 70 80 90)
SPT Resistance - Blows/ft (5 10 15 20 25 30 35 40 45)

Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		Cl - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By:
Prasad
Drilled By:
Nimal

Made Ground, Clay, Silt, Sand, Gravel, Organic Matter, Laterite Nodules, Silty Sand, Completely Weathered Rock, Highly Weathered Rock, Fresh Rock

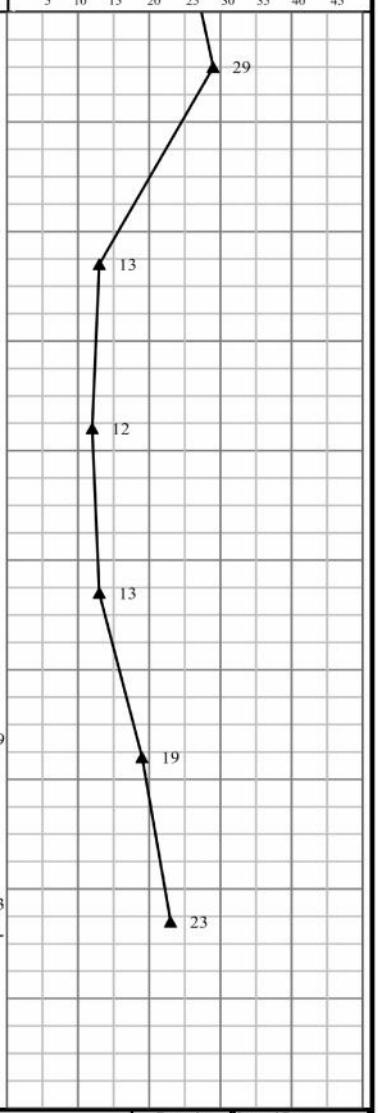
ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	M BH-02
Client	**M/s. WAPCOS Limited**					Sheet	2 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	29.09.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	781794N
Date of Finished	30.09.2017	Casing Diameter	76mm	Elevation (m)			286033E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
10.00							Continue from Page 1				
11.00	☒	D7	SS					9	16	13	**29**
			WS								
12.00	☒	D8	SS					10	7	6	**13**
13.00			WS								
	☒	D9	SS					9	6	6	**12**
14.00			WS				Same as previous description				
15.00	☒	D10	SS					8	7	6	**13**
16.00			WS								
	☒	D11	SS					12	10	9	19
17.00			WS								
18.00	☒	D12	SS					15	13	10	23
					18.45		The borehole was terminated at the depth of 18.45m				
19.00											
20.00											

Moisture Content - %
Undrained Shear Strength - t/m²
SPT Resistance - Blows/ft



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		Cl - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground, Clay, Silt, Sand, Gravel, Organic Matter, Laterite Nodules, Silty Sand, Completely Weathered Rock, Highly Weathered Rock, Fresh Rock

Figure 2 (c)

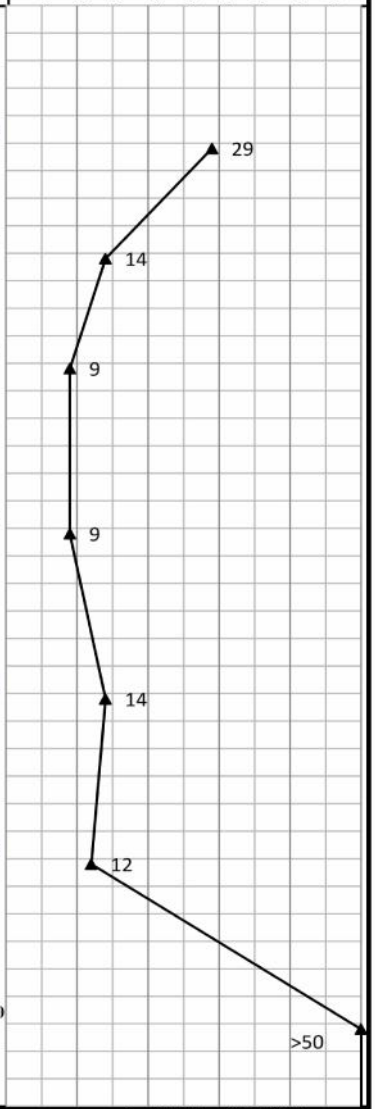
ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	M BH-03
Client	**M/s. WAPCOS Limited**					Sheet	1 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	03.10.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	731990N
Date of Finished	03.10.2017	Casing Diameter	76mm	Elevation (m)			285892E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N.
0.00							Ground level				
		D1	DS		0.00		Light gray, offwhite, fine to coarse, angular to sub angular coral SAND with sea shell fragments				
1.00		D2	SS		1.00		Medium dense, light gray, fine to coarse, angular to sub angular coral SAND with coral rock fragments	9	20	9	29
2.00		D3	SS					15	5	9	14
			WS								
3.00		D4	SS		3.00		Loose, light gray, fine to coarse, angular to sub angular coral SAND with coral rock fragments	2	3	4	7
4.00			WS								
		D5	SS					3	3	6	9
5.00			WS								
6.00		D6	SS		6.00		Medium dense, light gray, fine to coarse, angular to sub angular coral SAND with coral rock fragments	8	8	6	14
7.00			WS								
		D7	SS					6	5	7	12
8.00			WS								
9.00		D8	SS		9.00		Very dense, light gray, fine to coarse, angular to sub angular coral SAND with coral rock fragments	HB			>50
10.00			WS								

Moisture Content - %
Undrained Shear Strength - t/m²
SPT Resistance - Blows/ft



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation	**Remarks**
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression	Existing ground level considered as the zero level
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained	
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained	
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical	
	CS- Core Sample	V - Vane Shear Test	O - Organic content	
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content	
	RQD-Rock Quality Designation (%)		CT - Cloride Content	

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground | Silt | Gravel | Laterite Nodules | Completely Weathered Rock
Clay | Sand | Organic Matter | Silty Sand | Highly Weathered Rock | Fresh Rock

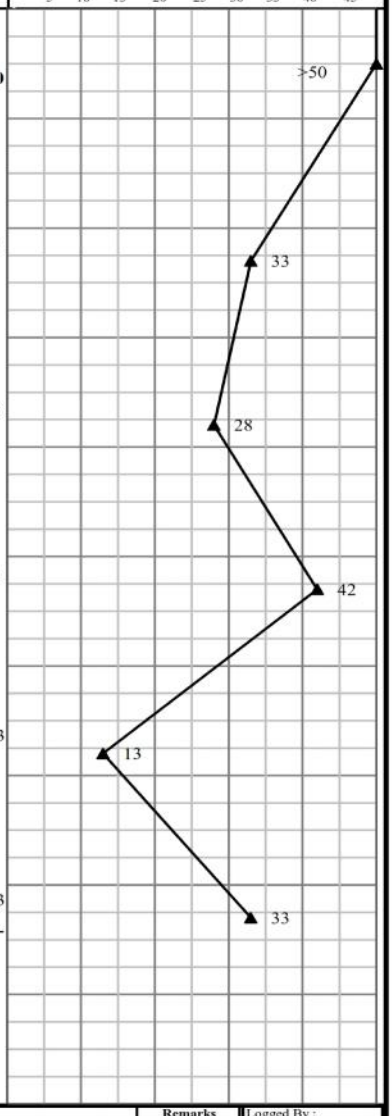
ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	M BH-03
Client	**M/s. WAPCOS Limited**					Sheet	2 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	03.10.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	731990N
Date of Finished	03.10.2017	Casing Diameter	76mm	Elevation (m)			285892E

Moisture Content - %
Undrained Shear Strength - t/m²
SPT Resistance - Blows/ft

Depth (m)	Sa. Cond	Sa.NO.	Sa. Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
10.00							Continue from Page 1				
11.00		D9	SS				Same as previous description	HB			>50
12.00			WS								
		D10	SS		12.00			11	13	20	33
13.00			WS								
14.00		D11	SS				Dense to medium dense, light gray, fine to coarse, angular to sub angular coral SAND with coral rock fragments	8	12	16	28
15.00			WS								
		D12	SS					6	18	24	42
16.00			WS								
		D13	SS		16.50		Medium dense, light gray, fine to coarse, angular to sub angular coral SAND with coral rock fragments	8	6	7	13
17.00			WS								
18.00		D13	SS		18.00		Dense, light gray, fine to coarse, angular to sub angular coral SAND with coral rock fragments	18	20	13	33
					18.45		The borehole was terminated at the depth of 18.45m				
19.00											
20.00											



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation	**Remarks**
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression	Existing ground level considered as the zero level
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained	
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained	
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical	
	CS- Core Sample	V - Vane Shear Test	O - Organic content	
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content	
	RQD-Rock Quality Designation (%)		Cl - Cloride Content	

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground, Silt, Gravel, Laterite Nodules, Completely Weathered Rock
Clay, Sand, Organic Matter, Silty Sand, Highly Weathered Rock, Fresh Rock

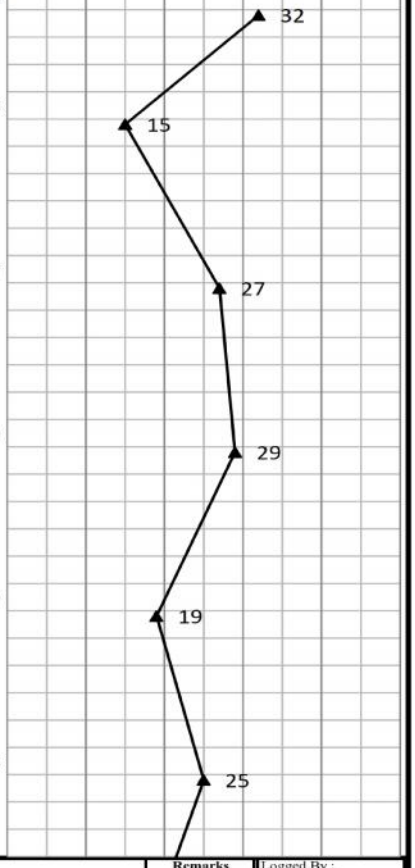
Figure 2 (d)

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION
Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	M BH-04
Client	**M/s. WAPCOS Limited**					Sheet	1 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	14.10.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	732320N
Date of Finished	15.10.2017	Casing Diameter	76mm	Elevation (m)			285846E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
0.00							Ground level				
		D1	DS		0.00		Light gray, fine to coarse, sub angular to angular, coral SAND with sea shell fragments				
1.00					1.00		Light gray, coral rock fragments				
2.00		D2	SS	G.W.L at 2.00m	2.00		Dense, light gray,sub angular to angular, coral SAND with coral rock fragments with some silt	16	12	20	32
			WS								
3.00		D3	SS		3.00		Medium dense, light gray,sub angular to angular, coral SAND with coral rock fragments with some silt	6	7	8	15
4.00			WS								
		D4	SS		4.50		Light gray, offwhite CORAL ROCK fragments with some coral sand	10	16	11	27
5.00			WS								
6.00		D5	SS					8	17	12	29
7.00			WS								
		D6	SS		7.50		Medium dense, light gray,sub angular to angular, coral SAND with coral rock fragments with some silt	6	10	9	19
8.00			WS								
9.00		D7	SS					8	10	15	25
10.00			WS								

Moisture Content - %
Undrained Shear Strength - t/m^2 (10 20 30 40 50 60 70 80 90)
SPT Resistance - Blows/ft (5 10 15 20 25 30 35 40 45)



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation	
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression	
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained	
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained	
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical	
	CS- Core Sample	V - Vane Shear Test	O - Organic content	
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content	
	RQD-Rock Quality Designation (%)		CT - Cloride Content	

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground, Silt, Gravel, Laterite Nodules, Completely Weathered Rock
Clay, Sand, Organic Matter, Silty Sand, Highly Weathered Rock, Fresh Rock

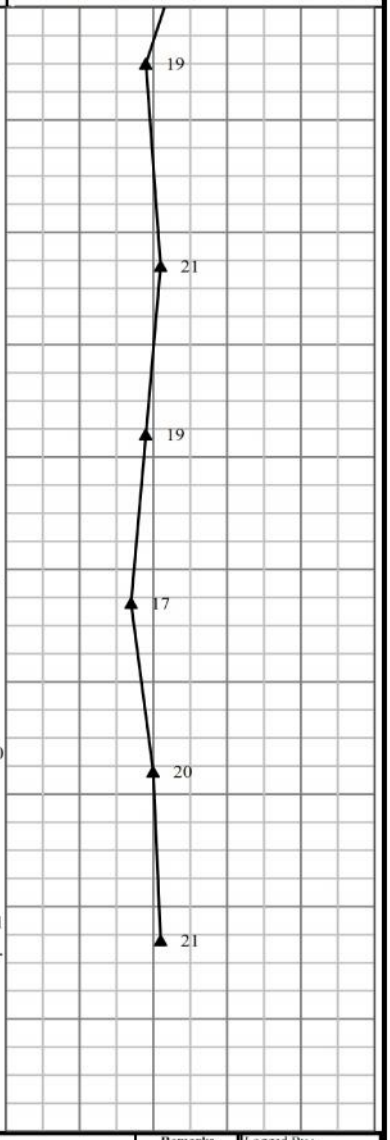
ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	M BH-04
Client	**M/s. WAPCOS Limited**					Sheet	2 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	14.10.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	732320N
Date of Finished	15.10.2017	Casing Diameter	76mm	Elevation (m)			285846E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
10.00							Continue from Page 1				
11.00		D8	SS				Same as previous description	5	12	7	19
			WS								
12.00		D9	SS					6	11	10	21
13.00			WS								
14.00		D10	SS					8	13	6	19
			WS								
15.00		D11	SS					10	11	6	17
16.00			WS								
17.00		D12	SS					10	14	6	20
			WS					NO SAMPLE			
18.00		D13	SS					13	10	11	21
19.00					18.45						
20.00											

Moisture Content - %
Undrained Shear Strength - t/m^2 (10 20 30 40 50 60 70 80 90)
SPT Resistance - Blows/ft (5 10 15 20 25 30 35 40 45)



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation	**Remarks**
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression	Existing ground level considered as the zero level
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained	
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained	
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical	
	CS- Core Sample	V - Vane Shear Test	O - Organic content	
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content	
	RQD-Rock Quality Designation (%)		Cl - Cloride Content	

Made Ground | Silt | Gravel | Laterite Nodules | Completely Weathered Rock
Clay | Sand | Organic Matter | Silty Sand | Highly Weathered Rock | Fresh Rock

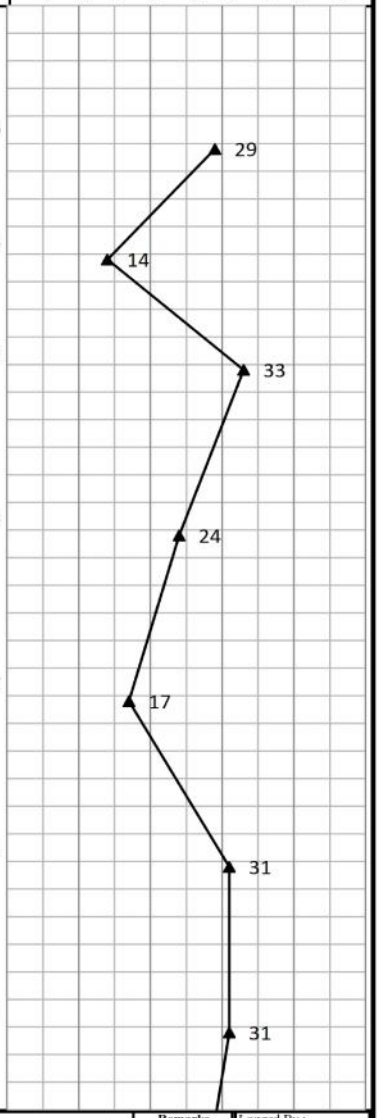
Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Figure 2 (e)

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION
Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	M BH-05
Client	**M/s. WAPCOS Limited**					Sheet	1 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water column height	2.00m
Date of Started	14.10.2017	Drilling Method	Wash	Casing depth	18.0m	Coordinates	732253.00N
Date of Finished	15.10.2017	Casing Diameter	76mm	Elevation (m)			285940.00E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
0.00							Ground level				
		D1	DS		0.00		Light gray, offwhite, fine to coarse, coral SAND				
1.00											
		D2	SS		1.00		Medium dense, light gray, fine to coarse, sub angular to angular, coral SAND with coral rock fragments	23	11	18	29
			WS								
2.00		D3	SS					13	6	8	14
			WS								
3.00		D4	SS		3.00		Dense, light gray, fine to coarse, sub angular to angular, coral SAND with coral rock fragments	9	10	23	33
4.00			WS								
		D5	SS		4.50		Medium dense, light gray, fine to coarse, sub angular to angular, coral SAND with coral rock fragments	19	6	18	24
5.00			WS								
6.00		D6	SS					18	10	7	17
7.00			WS								
		D7	SS		7.50		Dense, light gray, fine to coarse, sub angular to angular, coral SAND with coral rock fragments	19	11	20	31
8.00			WS								
9.00		D8	SS					17	20	11	31
10.00			WS								



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		Cl - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By: Dimuthu
Supervised By: Prasad
Drilled By: Nimal

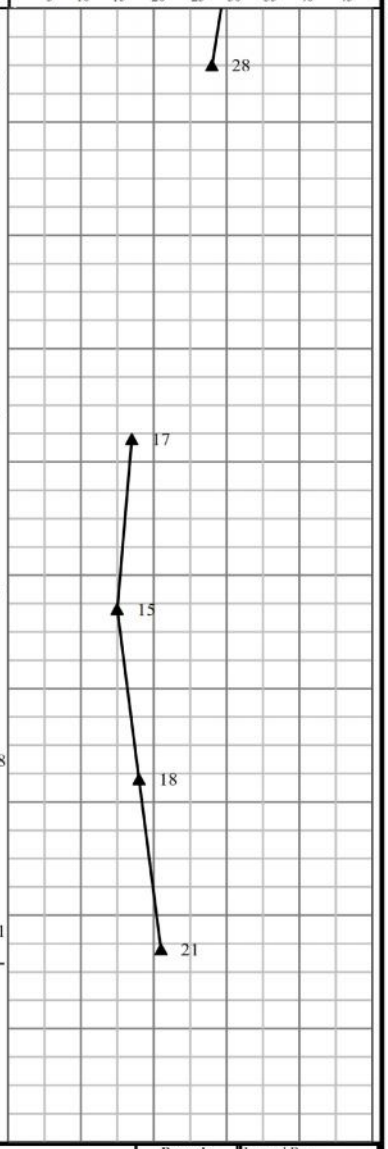
Made Ground, Silt, Gravel, Laterite Nodules, Completely Weathered Rock
Clay, Sand, Organic Matter, Silty Sand, Highly Weathered Rock, Fresh Rock

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**			Borehole No	M BH-05
Client	**M/s. WAPCOS Limited**			Sheet	2 of 2
Location	Kulhudhuffushi	Rig: Joy	Core Diameter: 54mm	Water column height	2.00m
Date of Started	14.10.2017	Drilling Method: Wash	Casing depth: 18.0m	Coordinates	732253.00N
Date of Finished	15.10.2017	Casing Diameter: 76mm	Elevation (m):		285940.00E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
10.00							Continue from Page 1				
							Same as previous description				
11.00		D9	SS		10.50		Medium dense, light gray, fine to coarse, sub angular to angular, coral SAND with coral rock fragments	15	12	16	**28**
			WS								
12.00			CS		12.00		Light gray, coral rock layer				
					12.50						
13.00											
14.00		D10	SS				Medium dense, light gray, fine to coarse, sub angular to angular, coral SAND with coral rock fragments	10	7	11	**17**
			WS								
15.00		D11	SS					12	7	8	**15**
16.00			WS								
		D12	SS					13	10	8	18
17.00			CS								
			WS		17.00		Light gray, porous, coral rock layer				
					17.50		Medium dense, light gray, fine to coarse, sub angular to angular, coral SAND with coral rock fragments				
18.00		D13	SS					13	9	12	21
					18.45						
19.00											
20.00											



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		CT - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground, Silt, Gravel, Laterite Nodules, Completely Weathered Rock
Clay, Sand, Organic Matter, Silty Sand, Highly Weathered Rock, Fresh Rock

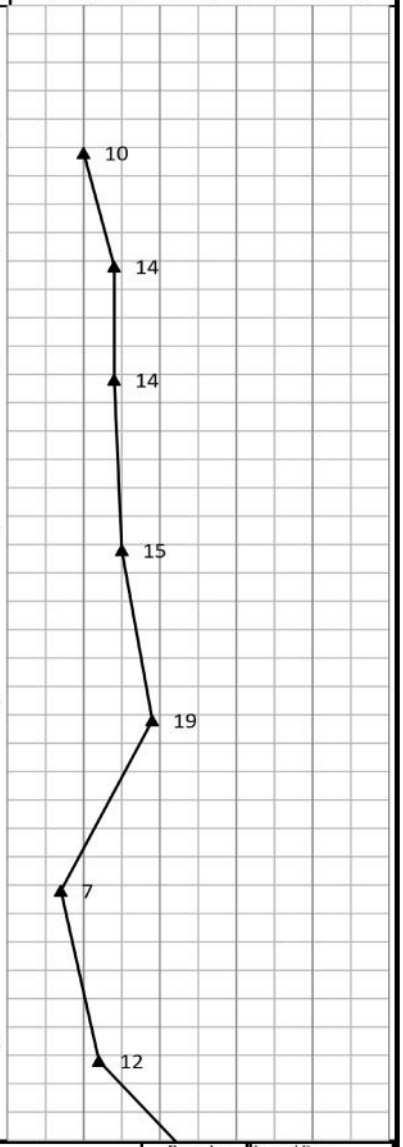
Figure 2 (f)

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	L BH-01
Client	**M/s. WAPCOS Limited**					Sheet	1 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	05.10.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	731963N
Date of Finished	06.10.2017	Casing Diameter	76mm	Elevation (m)			286068E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
0.00							Ground level				
		D1	DS		0.00		Light gray, fine to coarse, sub angular to angular, coral SAND with sea shell fragments				
1.00		D2	SS		1.00			3	5	5	10
2.00		D3	SS				Medium dense, light gray,sub angular to angular, coral SAND with coral rock fragments with some silt	6	4	10	14
			WS								
3.00		D4	SS					8	5	9	14
4.00			WS								
		D5	SS		4.50			8	8	7	15
5.00			WS								
6.00		D6	SS				Medium dense, light gray,sub angular to angular, coral SAND with some silt	10	12	7	19
7.00			WS								
		D7	SS		7.50			3	3	4	7
8.00			WS				Washed sample: light gray,sub angular to angular, coral SAND with some silt	NO SAMPLE			
9.00		D8	SS		9.00		Medium dense, light gray,sub angular to angular, coral SAND with some silt and coral rock fragments	13	10	8	18
10.00			WS								

Moisture Content - %
Undrained Shear Strength - t/m²
SPT Resistance - Blows/ft



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation	**Remarks**
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression	Existing ground level considered as the zero level
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained	
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained	
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical	
	CS- Core Sample	V - Vane Shear Test	O - Organic content	
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content	
	RQD-Rock Quality Designation (%)		CT - Cloride Content	

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground | Silt | Gravel | Laterite Nodules | Completely Weathered Rock
Clay | Sand | Organic Matter | Silty Sand | Highly Weathered Rock | Fresh Rock

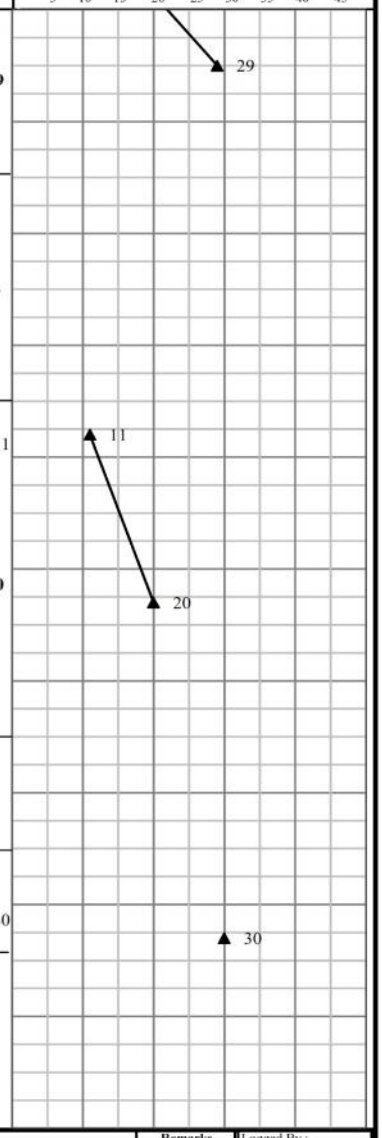
ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	L BH-01
Client	**M/s. WAPCOS Limited**					Sheet	2 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	05.10.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	731963N
Date of Finished	06.10.2017	Casing Diameter	76mm	Elevation (m)			286068E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
10.00							Continue from Page 1				
11.00		D9	SS				Same as previous description	40	9	20	**29**
									NO SAMPLE		
12.00					11.50		Light gray, porous, highly fractured, discolored, coral ROCK	**CR=66%**		**RQD=11%**	
13.00											
14.00		D10	SS		13.00		Medium dense, fine to coarse, angular to sub angular, coral SAND with coral rock fragments	4	5	6	11
			WS								
15.00		D11	SS					10	11	9	**20**
16.00											
17.00					16.50		Light gray, porous, highly fractured, discolored, coral ROCK	**CR=20%**		**RQD=0%**	
18.00		D12	SS		17.50		Medium dense, fine to coarse, angular to sub angular, coral SAND with coral rock fragments	15	18	12	30
19.00					18.45		The borehole was terminated at the depth of 18.45m				
20.00											

Moisture Content - %
Undrained Shear Strength - t/m²
10 20 30 40 50 60 70 80 90
SPT Resistance - Blows/ft
5 10 15 20 25 30 35 40 45



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		Cl - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

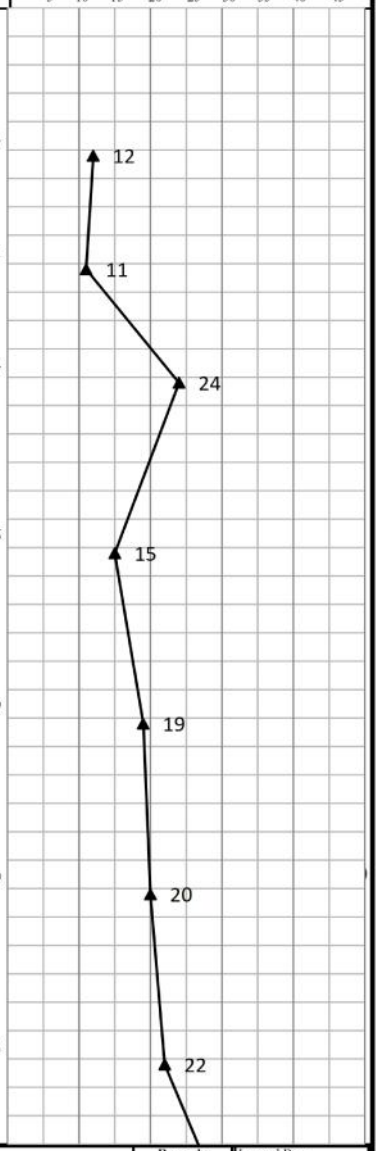
Made Ground, Clay, Silt, Sand, Gravel, Organic Matter, Laterite Nodules, Silty Sand, Completely Weathered Rock, Highly Weathered Rock, Fresh Rock

Figure 2 (g)

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Project	**Geotechnical Investigation at Kulhudhuffushi Island**					Borehole No	L BH-02
Client	**M/s. WAPCOS Limited**					Sheet	1 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Ground Water Level	0.80m
Date of Started	20.10.2017	Drilling Method	Wash	Casing depth	13.50m	Coordinates	732091N
Date of Finished	23.10.2017	Casing Diameter	76mm	Elevation (m)			286040E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
0.00							Ground level				
		D1	DS		0.00		Light gray, fine to coarse, sub angular to angular coral SAND with sea shell fragments				
1.00		D2	SS	G.W.L. at 0.80m	1.00		Medium dense, light gray, fine to coarse, sub angular to angular coral SAND with sea shell fragments	3	7	5	12
2.00		D3	SS					6	7	4	11
			WS								
3.00		D4	SS		3.00		Medium dense, light gray, fine to coarse, sub angular to angular coral SAND with coral rock fragments	5	10	14	24
4.00			WS								
		D5	SS					12	10	5	15
5.00			WS								
6.00		D6	SS					25	12	7	19
7.00			WS								
		D7	SS					13	9	11	20
8.00			WS								
9.00		D8	SS		9.00		Light gray, brown, coral fragments with fine to coarse, coral SAND	18	12	10	22
10.00			WS								



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation	**Remarks**
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression	Existing ground level considered as the zero level
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained	
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained	
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical	
	CS- Core Sample	V - Vane Shear Test	O - Organic content	
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content	
	RQD-Rock Quality Designation (%)		CT - Cloride Content	

Logged By :	Dimuthu
Supervised By:	Prasad
Drilled By:	Nimal

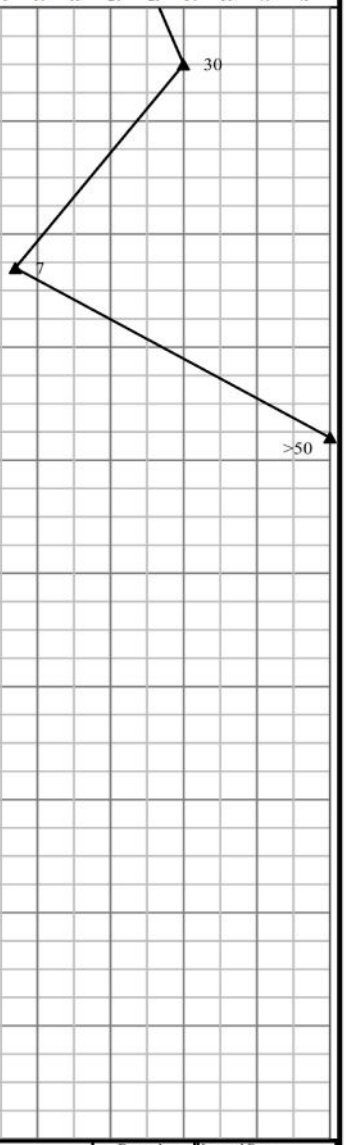
Made Ground | Silt | Gravel | Laterite Nodules | Completely Weathered Rock
Clay | Sand | Organic Matter | Silty Sand | Highly Weathered Rock | Fresh Rock

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation at Kulhudhuffushi Island**					Borehole No	L BH-02
Client	**M/s. WAPCOS Limited**					Sheet	2 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	**Ground** Water Level	0.80m
Date of Started	20.10.2017	Drilling Method	Wash	Casing depth	13.50m	Coordinates	732091N
Date of Finished	23.10.2017	Casing Diameter	76mm	Elevation (m)			286040E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
10.00							Continue from Page 1				
11.00		D9	SS				Same as previous description	26	18	12	**30**
			WS								
12.00		D10	SS					10	3	4	7
13.00			WS								
								NO SAMPLE			
							ROCK LEVEL	30	HB		**>50**
14.00		D11	SS		13.50		Moderately weathered, light gray, porous, moderately strong coral ROCK	**CR=33%**		**RQD=0%**	
			CS								
15.00					15.00						
16.00			CS				Moderately weathered, light gray, porous, moderately strong coral ROCK	**CR=40%**		**RQD=0%**	
					16.50		The borehole was terminated at the depth of 16.50m				
17.00											
18.00											
19.00											
20.00											



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		Cl - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

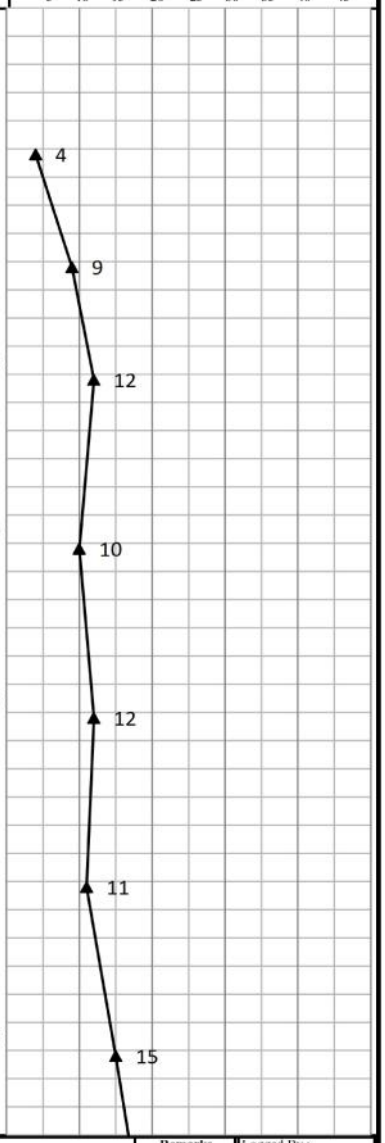
Made Ground | Silt | Gravel | Laterite Nodules | Completely Weathered Rock
Clay | Sand | Organic Matter | Silty Sand | Highly Weathered Rock | Fresh Rock

Figure 2 (h)

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	L BH-03
Client	**M/s. WAPCOS Limited**					Sheet	1 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	09.10.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	732259N
Date of Finished	10.10.2017	Casing Diameter	76mm	Elevation (m)			286005E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
0.00							Ground level				
		D1	DS		0.00		Light gray, fine to coarse, sub angular to angular, coral SAND with sea shell fragments				
1.00		D2	SS		1.00		Loose, light gray,sub angular to angular, coral SAND with coral rock fragments with some silt	1	1	3	4
2.00		D3	SS					8	4	3	9
			WS								
3.00		D4	SS		3.00		Medium dense, light gray,sub angular to angular, coral SAND with coral rock fragments	10	6	6	12
4.00			WS								
		D5	SS					5	4	6	10
5.00											
			WS								
6.00		D6	SS					7	6	6	12
7.00			WS								
		D7	SS					10	6	5	11
8.00											
			WS								
9.00		D8	SS					8	7	8	15
10.00			WS								



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		Cl - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground, Clay, Silt, Sand, Gravel, Organic Matter, Laterite Nodules, Silty Sand, Completely Weathered Rock, Highly Weathered Rock, Fresh Rock

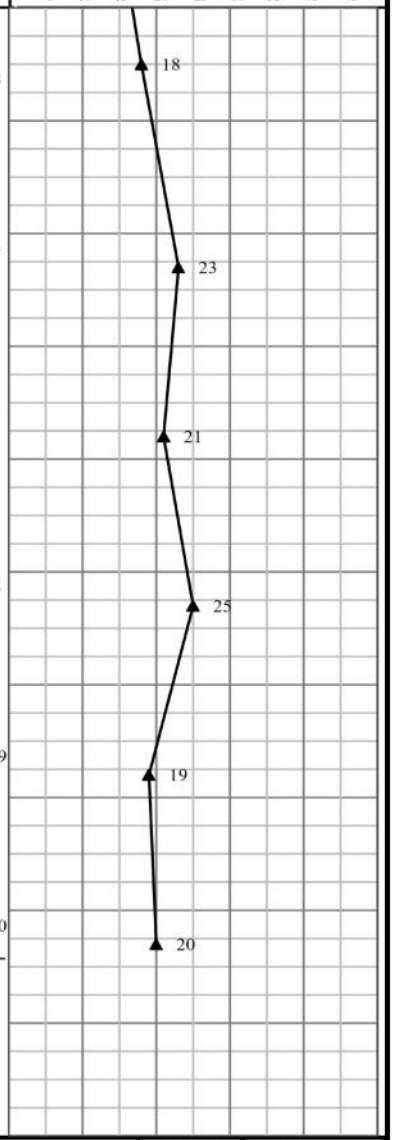
ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	L BH-03
Client	**M/s. WAPCOS Limited**					Sheet	2 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	09.10.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	732259N
Date of Finished	10.10.2017	Casing Diameter	76mm	Elevation (m)			286005E

Moisture Content - %
Undrained Shear Strength - t/m²
SPT Resistance - Blows/ft

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
10.00							Continue from Page 1				
11.00	☒	D9	SS				Same as previous description	15	10	8	18
			WS								
12.00	☒	D10	SS					18	8	15	23
13.00			WS								
14.00	☒	D11	SS					8	9	12	21
			WS								
15.00	☒	D12	SS					6	8	17	25
16.00			WS								
17.00	☒	D13	SS					9	12	7	19
			WS								
18.00	☒	D13	SS					6	9	11	20
19.00					18.45		The borehole was terminated at the depth of 18.45m				
20.00											



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation	Remarks: Existing ground level considered as the zero level
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression	Logged By: Dimuthu
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained	Supervised By: Prasad
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained	Drilled By: Nimal
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical	
	CS- Core Sample	V - Vane Shear Test	O - Organic content	
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content	
	RQD-Rock Quality Designation (%)		Cl - Cloride Content	

Made Ground | Silt | Gravel | Laterite Nodules | Completely Weathered Rock
Clay | Sand | Organic Matter | Silty Sand | Highly Weathered Rock | Fresh Rock

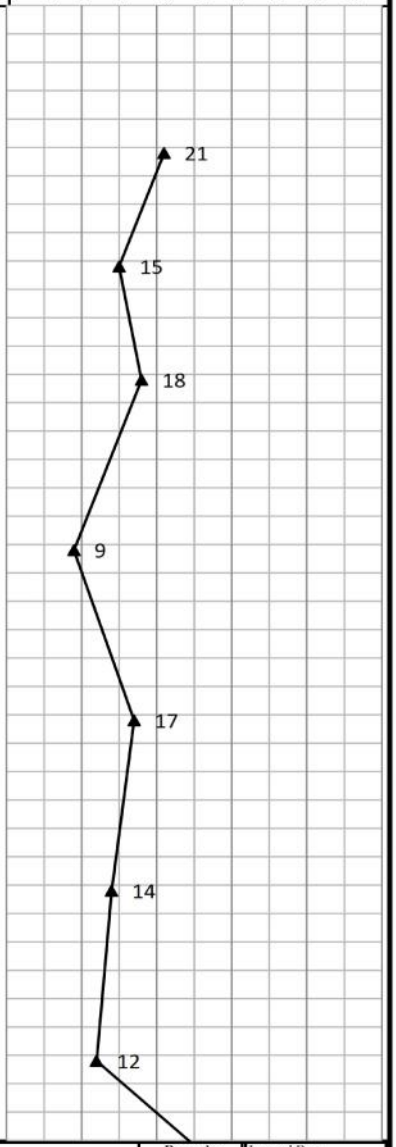
Figure 2 (i)

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	LBH-N-04
Client	**M/s. WAPCOS Limited**					Sheet	1 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	15.10.2017	Drilling Method	Wash	Casing depth	10.90m	Coordinates	731939N
Date of Finished	16.10.2017	Casing Diameter	76mm	Elevation (m)			285984E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
0.00							Ground level				
	X	D1	DS		0.00		Light gray, sub anguar to angular, coral SAND with coral rock fragments				
1.00	X	D2	SS		1.00			17	14	7	21
			WS								
2.00	X	D3	SS					12	9	6	15
			WS				Medium dense, light gray, sub anguar to angular coral SAND with coral rock fragments with traces of silt				
3.00	X	D4	SS					9	7	11	18
4.00			WS								
	X	D5	SS		4.50		Loose, light gray, sub angular to angular, coral SAND with traces of silt	7	5	4	9
5.00			WS								
6.00	X	D6	SS		6.00			8	11	6	17
7.00			WS								
	X	D7	SS				Medium dense, light gray, sub anguar to angular coral SAND with coral rock fragments with traces of silt	11	4	10	14
8.00			WS								
9.00	X	D8	SS					10	7	5	12
10.00			WS								

Moisture Content - %
Undrained Shear Strength - t/m^2 (10 20 30 40 50 60 70 80 90)
SPT Resistance - Blows/ft (5 10 15 20 25 30 35 40 45)



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)
GWL : Ground Water Level observed inside the Borehole, after the saturation
NE Not Encountered
HB -Hammer Bounce
FD - Free Down

D - Disturbed Sample
SS -SPT Sample
W - Water Sample
WS-Wgrey Sample
UD- Undisturbed Sample
CS- Core Sample
Cr - Core Recovery (%)
RQD-Rock Quality Designation (%)

N - Natural Moisture Content
L - Atterberg Limit Test
G - Grain Size Analysis
SG -Specific Gravity Test
B - Bulk Density
V - Vane Shear Test

C - Consolidation
UCT-Unconfined Compression
CU - Consolidated Undrained
UU-Unconsolidated Undrained
pH - Chemical
O - Organic content
SO_4^{2-} - Sulphate Content
CT - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

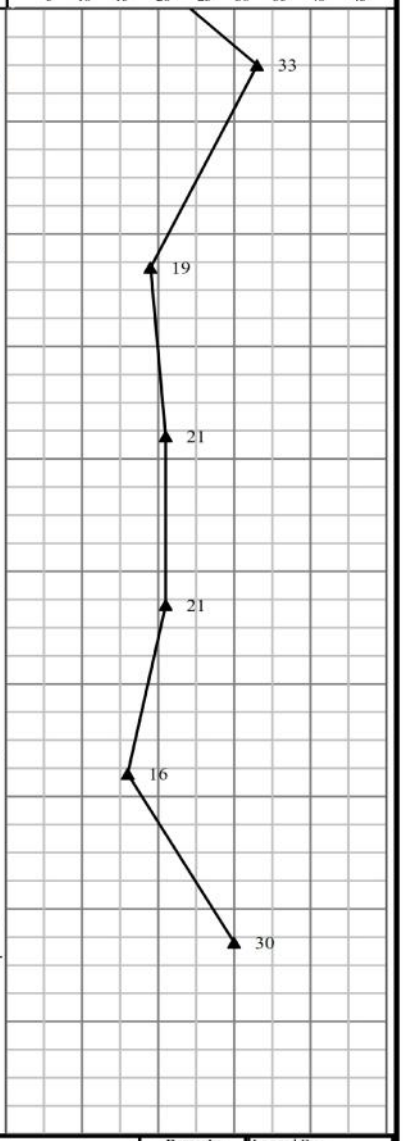
Made Ground, Silt, Gravel, Laterite Nodules, Completely Weathered Rock
Clay, Sand, Organic Matter, Silty Sand, Highly Weathered Rock, Fresh Rock

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	LBH-N-04
Client	**M/s. WAPCOS Limited**					Sheet	2 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Water Column Height	2.00m
Date of Started	15.10.2017	Drilling Method	Wash	Casing depth	10.90m	Coordinates	731939N
Date of Finished	16.10.2017	Casing Diameter	76mm	Elevation (m)			285984E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
10.00							Continue from Page 1				
							Same as previous description				
11.00		D9	SS		10.50		Dense, light gray, sub anguar to angular coral SAND with coral rock fragments with traces of silt	20	18	15	33
			WS								
12.00		D10	SS		12.00			8	13	6	19
13.00			WS								
		D11	SS					13	11	10	21
14.00			WS								
15.00		D12	SS				Medium dense, light gray, sub anguar to angular coral SAND with coral rock fragments with traces of silt	16	13	8	21
16.00			WS								
		D13	SS					9	10	6	16
17.00			WS								
18.00		D13	SS					15	13	17	30
					18.45		The borehole was terminated at the depth of 18.45m				
19.00											
20.00											



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		Cl - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground | Silt | Gravel | Laterite Nodules | Completely Weathered Rock
Clay | Sand | Organic Matter | Silty Sand | Highly Weathered Rock | Fresh Rock

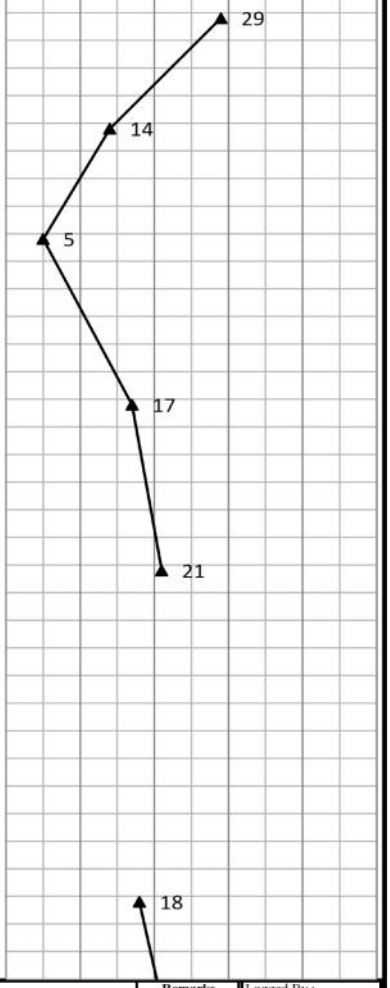
Figure 2 (j)

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	L BH-05
Client	**M/s. WAPCOS Limited**					Sheet	1 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Ground water level	1.20m
Date of Started	24.09.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	732562N
Date of Finished	25.09.2017	Casing Diameter	76mm	Elevation (m)			285912E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
0.00							Ground level				
		D1	DS		0.00		Light gray, fine to coarse, sub angular to angular, coral SAND with sea shell fragments				
1.00					1.00						
		D2	SS					13	24	5	29
2.00		D3	SS					7	6	8	14
			WS								
3.00		D4	SS					6	3	2	5
4.00			WS								
		D5	SS					7	7	10	17
5.00			WS				Medium dense, light gray,sub angular to angular, coral SAND with coral rock fragments with some silt				
6.00		D6	SS					10	9	12	21
7.00											
		D7	DD					NO SAMPLE			
8.00											
9.00		D8	SS					7	10	8	18
10.00			WS								



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)
GWL : Ground Water Level observed inside the Borehole, after the saturation
NE Not Encountered
HB -Hammer Bounce
FD - Free Down

D - Disturbed Sample
SS -SPT Sample
W - Water Sample
WS-Wgrey Sample
UD- Undisturbed Sample
CS- Core Sample
Cr - Core Recovery (%)
RQD-Rock Quality Designation (%)

N - Natural Moisture Content
L - Atterberg Limit Test
G - Grain Size Analysis
SG -Specific Gravity Test
B - Bulk Density
V - Vane Shear Test

C - Consolidation
UCT-Unconfined Compression
CU - Consolidated Undrained
UU-Unconsolidated Undrained
pH - Chemical
O - Organic content
SO_4^{2-} - Sulphate Content
CT - Cloride Content

Remarks: Existing ground level considered as the zero level

Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

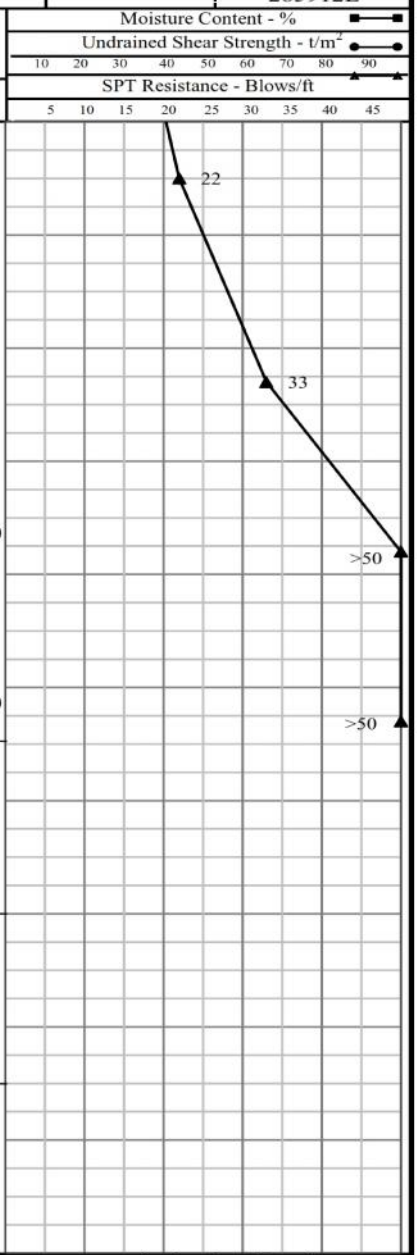
Made Ground, Clay, Silt, Sand, Gravel, Organic Matter, Laterite Nodules, Silty Sand, Completely Weathered Rock, Highly Weathered Rock, Fresh Rock

ELS INTERNATIONAL (PVT) LTD.
SITE INVESTIGATIONS DIVISION

Format No: ELS-SI-02

Project	**Geotechnical Investigation for Project Management Consultant for Kulhudhuffushi Harbor Expansion Project, Maldives**					Borehole No	L BH-05
Client	**M/s. WAPCOS Limited**					Sheet	2 of 2
Location	Kulhudhuffushi	Rig	Joy	Core Diameter	54mm	Ground water level	1.20m
Date of Started	24.09.2017	Drilling Method	Wash	Casing depth	18.00m	Coordinates	732562N
Date of Finished	25.09.2017	Casing Diameter	76mm	Elevation (m)			285912E

Depth (m)	Sa. Cond	Sa.NO.	Sa.Type	Reduced level	Depth (m)	Legend	Soil Description	Field Records (SPT) 15cm	15cm	15cm	N
10.00							Continue from Page 1				
11.00		D9	SS				Same as previous description	5	10	12	22
			WS								
12.00		D10	SS		12.00		Medium dense, light gray,sub angular to angular, coral SAND with coral rock fragments with some silt	13	17	16	33
13.00			WS								
14.00		D11	SS		13.50		Very dense, light gray,sub angular to angular, coral SAND with coral rock fragments with some silt	8	30	HB	>50
			WS								
15.00		D12	SS				ROCK LEVEL	HB			>50
16.00			CS		15.50		Highly fractured, porous, light gray, coral ROCK	CR=33%		RQD=0%	
17.00					17.00		Highly fractured, porous, light gray, coral ROCK	CR=23%		RQD=0%	
18.00			CS								
19.00					18.50		The borehole was terminated at the depth of 18.50m				
20.00											



Sample Key / Test Key

SPT Where full 0.3m penetration has not been achieved the number of blows for the quoted penetration is given (not N-value)	D - Disturbed Sample	N - Natural Moisture Content	C - Consolidation
GWL : Ground Water Level observed inside the Borehole, after the saturation	SS -SPT Sample	L - Atterberg Limit Test	UCT-Unconfined Compression
NE Not Encountered	W - Water Sample	G - Grain Size Analysis	CU - Consolidated Undrained
HB -Hammer Bounce	WS-Wgrey Sample	SG -Specific Gravity Test	UU-Unconsolidated Undrained
FD - Free Down	UD- Undisturbed Sample	B - Bulk Density	pH - Chemical
	CS- Core Sample	V - Vane Shear Test	O - Organic content
	Cr - Core Recovery (%)		SO_4^{2-} - Sulphate Content
	RQD-Rock Quality Designation (%)		CT - Cloride Content

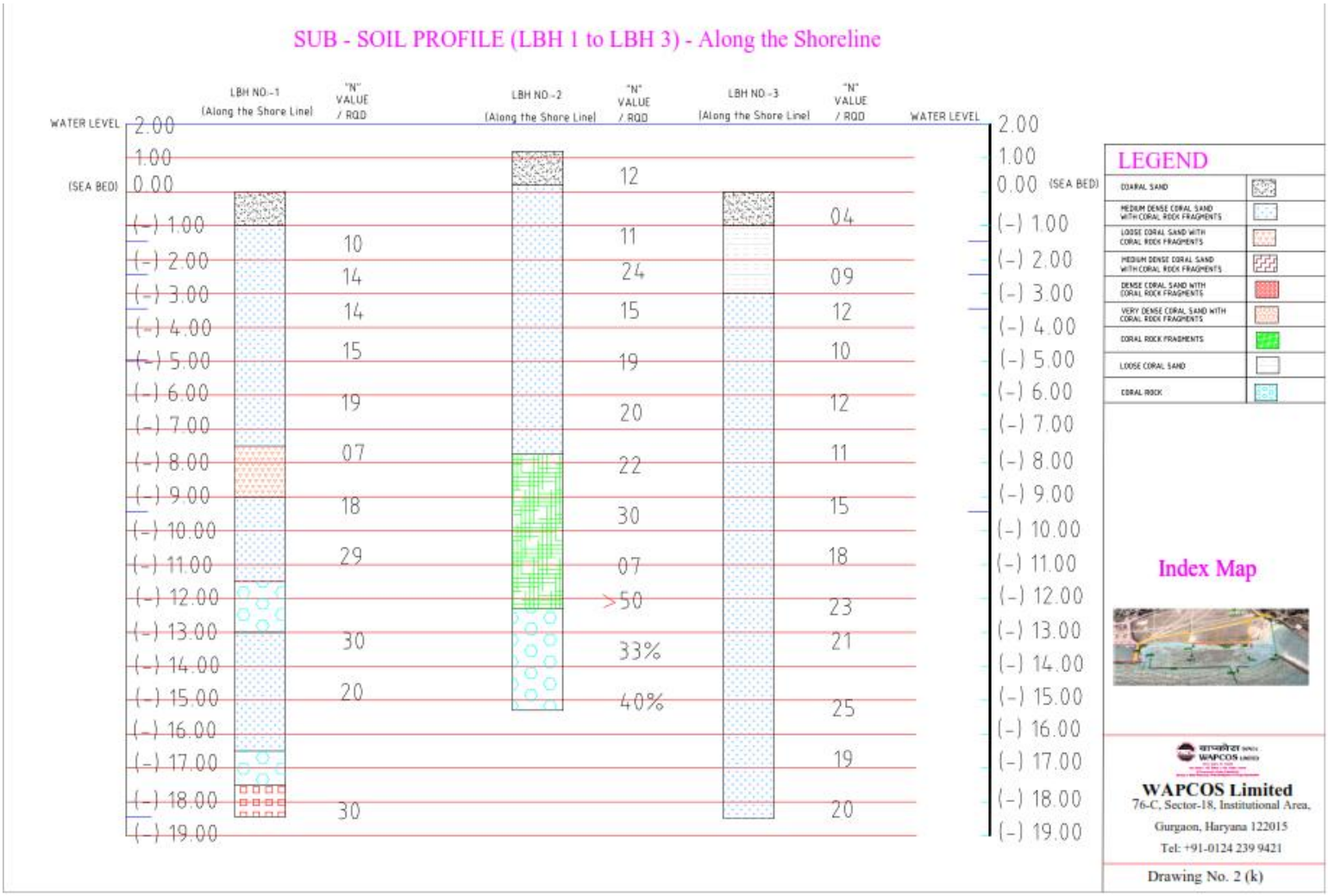
Remarks: Existing ground level considered as the zero level

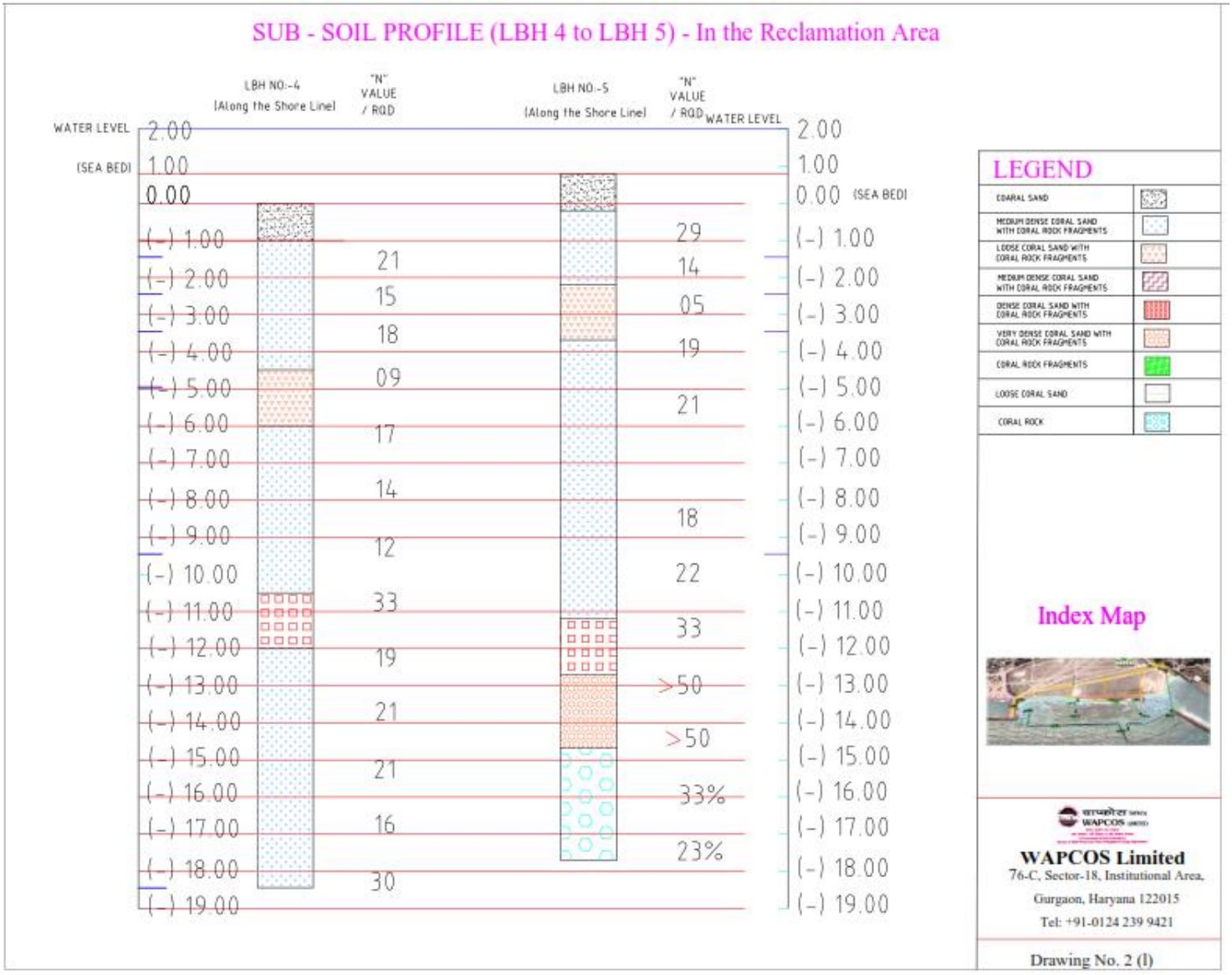
Logged By : Dimuthu
Supervised By: Prasad
Drilled By: Nimal

Made Ground, Silt, Gravel, Laterite Nodules, Completely Weathered Rock
Clay, Sand, Organic Matter, Silty Sand, Highly Weathered Rock, Fresh Rock

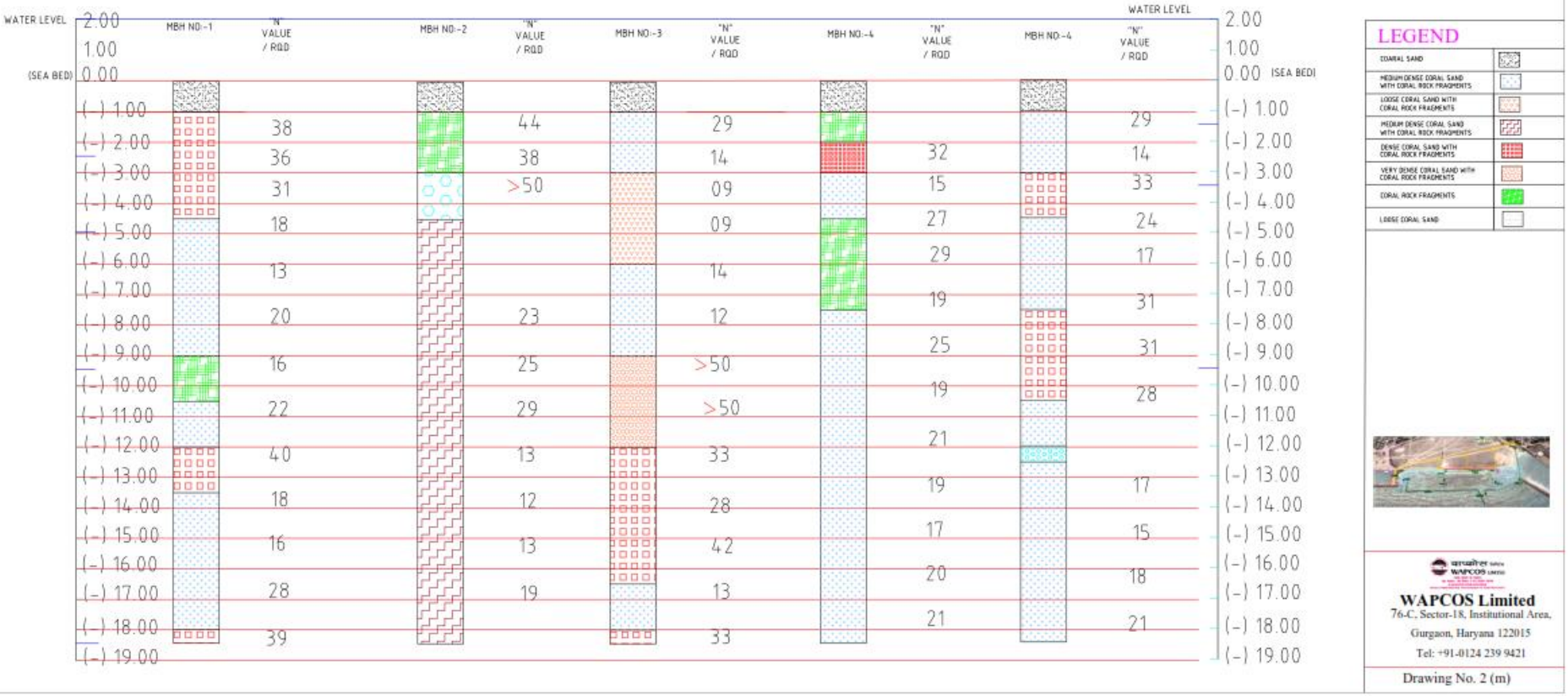
ANNEXURE-II

SUB SOIL PROFILE DRAWINGS


SUB - SOIL PROFILE (LBH 1 to LBH 3) - Along the Shoreline
LBH NO.-1 (Along the Shore Line)
"N" VALUE / RQD
LBH NO.-2 (Along the Shore Line)
"N" VALUE / RQD
LBH NO.-3 (Along the Shore Line)
"N" VALUE / RQD
WATER LEVEL
2.00
1.00
(SEA BED) 0.00
(-) 1.00
(-) 2.00
(-) 3.00
(-) 4.00
(-) 5.00
(-) 6.00
(-) 7.00
(-) 8.00
(-) 9.00
(-) 10.00
(-) 11.00
(-) 12.00
(-) 13.00
(-) 14.00
(-) 15.00
(-) 16.00
(-) 17.00
(-) 18.00
(-) 19.00
10
14
14
15
19
07
18
29
30
20
30
12
11
24
15
19
20
22
30
07
>50
33%
40%
04
09
12
10
12
11
15
18
23
21
25
19
20
LEGEND
CORAL SAND
MEDIUM DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
LOOSE CORAL SAND WITH CORAL ROCK FRAGMENTS
MEDIUM DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
VERY DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
CORAL ROCK FRAGMENTS
LOOSE CORAL SAND
CORAL ROCK
Index Map
WAPCOS Limited
76-C, Sector-18, Institutional Area,
Gurgaon, Haryana 122015
Tel: +91-0124 239 9421
Drawing No. 2 (k)


SUB - SOIL PROFILE (LBH 4 to LBH 5) - In the Reclamation Area
LBH NO:-4
(Along the Shore Line)
"N" VALUE / RQD
LBH NO.-5
(Along the Shore Line)
"N" VALUE / RQD
WATER LEVEL
(SEA BED)
2.00
1.00
0.00
(-) 1.00
(-) 2.00
(-) 3.00
(-) 4.00
(-) 5.00
(-) 6.00
(-) 7.00
(-) 8.00
(-) 9.00
(-) 10.00
(-) 11.00
(-) 12.00
(-) 13.00
(-) 14.00
(-) 15.00
(-) 16.00
(-) 17.00
(-) 18.00
(-) 19.00
21
15
18
09
17
14
12
33
19
21
21
16
30
29
14
05
19
21
18
22
33
>50
>50
33%
23%
LEGEND
COARAL SAND
MEDIUM DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
LOOSE CORAL SAND WITH CORAL ROCK FRAGMENTS
MEDIUM DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
VERY DENSE CORAL SAND WITH CORAL ROCK FRAGMENTS
CORAL ROCK FRAGMENTS
LOOSE CORAL SAND
CORAL ROCK
Index Map
WAPCOS Limited
76-C, Sector-18, Institutional Area,
Gurgaon, Haryana 122015
Tel: +91-0124 239 9421
Drawing No. 2 (I)

SUB - SOIL PROFILE (MBH 1 to MBH 5)



ANNEXURE-III

PHOTOGRAPHS

Drilling of Bore hole at LBH-02 location

Core Box for LBH-05 location

Drilling of Bore hole at LBH-05 location

Jack-up Barge Assembling for conducting Marine Boreholes

Shifting of Barge to MBH – 02 location

Drilling of Borehole at MBH – 02 location

Jack up Barge at MBH – 03 location

Drilling of Borehole at MBH – 03 location

Drilling of Borehole at MBH – 05 location

Drilling of Borehole at MBH – 05 location

Drilling of Borehole at LBH – 01 location

Drilling of Borehole at LBH – 03 location

Drilling of Borehole at LBH – 04 location

Drilling of Borehole at MBH – 04 location