



**FUGRO GEOTECH PVT. LTD.**

<b>Project</b> : GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT			
<b>Client</b> : COCHIN PORT TRUST			
<b>Equipment</b> : Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b> : LPG Berth	<b>Borehole No.</b> : BH 01	
<b>Drilling orientation</b> : Vertical	<b>Type of core barrel</b> : NA	<b>Co-ordinates</b> : N 1102561.8 E 635008.6	
<b>Drilling method</b> : Rotary borehole drilling, sampling and testing	<b>Type of Bit</b> : NA	<b>Date</b> : 01/03/2013-01/04/2013	
<b>Casing size,mm</b> : HX/SX/NX	<b>Drilling Fluid</b> : Water	<b>Bed Level (m)</b> : -3.10 w.r.t. CD	
<b>Casing depth from deck (m)</b> : SX-20.50m,HX-41.00m,NX-68.00m	<b>Core diameter,mm</b> :	<b>T.D. (m)</b> : 62.45 w.r.t SBL	

BOREHOLE LOG								LABORATORY DATA								
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
0	0.00 - 0.45	▼	0/0/0	0	0	1.50	-3.10		0.00 m to 1.50 m - Very soft dark grey sandy silty CLAY							
1										10	73	17	1			
2	1.50 - 1.95	▼	0/1/1	2	2	3.00	-4.60		1.50 m to 4.50 m - Very loose dark grey clayey sandy SILT							
3																
4	3.00 - 3.45	▼	2/1/2	3	3											
5	4.50 - 4.95	▼	3/3/4	7	7	3.00	-7.60		4.50 m to 7.50 m - Loose to medium dense dark grey clayey sandy SILT	0	76	24	0		5	29
6										0	69	31	0			
7	6.00 - 6.45	▼	3/5/7	12	12											
8	7.50 - 7.95	▼	2/5/5	10	10	1.50	-10.60		7.50 m to 9.00 m - Loose to medium dense dark grey clayey SAND with shell fragments.							
9										29	70	1	0			
10	9.00 - 9.45	▼	2/3/4	7	7	9.00	-12.10		9.00 m to 18.00 m - Firm to soft dark grey clayey SILT							
11										10	89	1	0	49		
12	12.00 - 12.45	▼	1/1/3	4	4											
13																
14	13.50 - 13.95									29	70	1	0	22.5		
15																

**Abbreviations & Symbols**

- ▼ - SPT (standard penetration test)
- - UDS (undisturbed sample)
- ⊗ - DS (disturbed sample)
- - RC (Rock Core)
- CD - Chart Datum
- E - Extrapolated SPT Value
- R - SPT Refusal
- T.D. - Termination Depth
- SBL - Sea Bed Level
- RL - Reduced Level
- PI - Plasticity Index
- LL - Liquid Limit
- c1 - Cohesion value obtained from unconfined Compression Test
- c2 - Cohesion value obtained from direct shear Test
- Phi - Angle of internal friction from direct shear test
- NA - Not Applicable

**Water Depth (m)**

Date	Depth (m)
01/03/2013	2.20



<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
<b>Casing depth from deck (m)</b>	: SX-20.50m,HX-41.00m,NX-68.00m	<b>Core diameter,mm</b>	: NA
		<b>Borehole No.</b>	: BH 01
		<b>Co-ordinates</b>	: N 1102561.8 E 635008.6
		<b>Date</b>	: 01/03/2013-01/04/2013
		<b>Bed Level (m)</b>	: -3.10 w.r.t. CD
		<b>T.D. (m)</b>	: 62.45 w.r.t SBL

BOREHOLE LOG										LABORATORY DATA						
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
15	15.00 - 15.45	▼	2/3/3	6	6	9.00	-12.10		9.00 m to 18.00 m - Firm to soft dark grey clayey SILT							
16																
17	16.50 - 17.00	□								32	67	1	0	36.3		
18	18.00 - 18.45	▼	3/4/4	8	8	3.00	-21.10		18.00 m to 21.00 m - Loose grey silty clayey SAND	12	35	52	1			
19																
20	19.50 - 19.95	⊗													8	32
21	21.00 - 21.45	▼	13/20/23	43	43	15.00	-24.10		21.00 m to 36.00 m - Dense to very dense grey silty SAND, with occasional shell fragments	0	18	82	0			
22																
23																
24	24.00 - 24.39	▼	19/50(24)	50	50											
25																
26																
27	27.00 - 27.18	▼	50(3)	50(3)	500										0	40
28																
29	28.50 - 28.95	⊗													0	36
30																

<b>Abbreviations &amp; Symbols</b>			<b>Water Depth (m)</b>	
▼ - SPT (standard penetration test)	CD - Chart Datum	LL - Liquid Limit	Date	Depth (m)
□ - UDS (undisturbed sample)	E - Extrapolated SPT Value	c1 - Cohesion value obtained from unconfined Compression Test		
⊗ - DS (disturbed sample)	R - SPT Refusal	c2 - Cohesion value obtained from direct shear Test		
■ - RC (Rock Core)	T.D. - Termination Depth	Phi - Angle of internal friction from direct shear test		
	SBL - Sea Bed Level	NA - Not Applicable		
	RL - Reduced Level			
	PI - Plasticity Index			





# FUGRO GEOTECH PVT. LTD.

<b>Project</b> : GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT			
<b>Client</b> : COCHIN PORT TRUST			
<b>Equipment</b> : Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b> : LPG Berth	<b>Borehole No.</b> : BH 01	
<b>Drilling orientation</b> : Vertical	<b>Type of core barrel</b> : NA	<b>Co-ordinates</b> : N 1102561.8 E 635008.6	
<b>Drilling method</b> : Rotary borehole drilling, sampling and testing	<b>Type of Bit</b> : NA	<b>Date</b> : 01/03/2013-01/04/2013	
<b>Casing size,mm</b> : HX/SX/NX	<b>Drilling Fluid</b> : Water	<b>Bed Level (m)</b> : -3.10 w.r.t. CD	
<b>Casing depth from deck (m)</b> : SX-20.50m,HX-41.00m,NX-68.00m	<b>Core diameter,mm</b> :	<b>T.D. (m)</b> : 62.45 w.r.t SBL	

BOREHOLE LOG										LABORATORY DATA						
Depth below E.G.L. (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
30	30.00 - 30.27	▼	100(12)	100(12)	250	15.00	-24.10	[Symbol]	21.00 m to 36.00 m - Dense to very dense grey silty SAND, with occasional shell fragments							
31																
32																
33	33.00 - 33.24	▼	78(9)	78(9)	260			[Symbol]		0	9	91	0			
34																
35	34.50 - 35.00	⊗						[Symbol]								
36	36.00 - 36.45	▼	10/11/14	25	25	7.50	-39.10	[Symbol]	36.00 m to 43.50 m - Very stiff to hard brown sandy silty CLAY / clayey sandy SILT							
37										24	75	1	0	13.7		
38	37.50 - 38.00							[Symbol]								
39	39.00 - 39.45	▼	10/14/12	26	26			[Symbol]								
40																
41	40.50 - 41.00	⊗						[Symbol]								
42	42.00 - 42.45	▼	8/16/15	31	31			[Symbol]								
43																
44	43.50 - 43.95	⊗				15.00	-46.60	[Symbol]	43.50 m to 58.50 m - Dense to very dense dark grey silty SAND							
45																

**Abbreviations & Symbols**

- ▼ - SPT (standard penetration test)
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- R - SPT Refusal
- T.D. - Termination Depth
- SBL - Sea Bed Level
- RL - Reduced Level
- PI - Plasticity Index
- LL - Liquid Limit
- c1 - Cohesion value obtained from unconfined Compression Test
- c2 - Cohesion value obtained from direct shear Test
- Phi - Angle of internal friction from direct shear test
- NA - Not Applicable

**Water Depth (m)**

Date	Depth (m)



<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
<b>Casing depth from deck (m)</b>	: SX-20.50m,HX-41.00m,NX-68.00m	<b>Core diameter,mm</b>	: T.D. (m) : 62.45 w.r.t SBL
		<b>Borehole No.</b>	: BH 01
		<b>Co-ordinates</b>	: N 1102561.8 E 635008.6
		<b>Date</b>	: 01/03/2013-01/04/2013
		<b>Bed Level (m)</b>	: -3.10 w.r.t CD

BOREHOLE LOG										LABORATORY DATA							
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees	
45	45.00 - 45.45	▼	10/16/24	40	40	15.00	-46.60		43.50 m to 58.50 m - Dense to very dense dark grey silty SAND								
46																	
47	46.50 - 46.95	⊗															
48	48.00 - 48.45	▼	18/22/47	69	69												
49																	
50	49.50 - 49.95	⊗															
51	51.00 - 51.45	▼	8/22/21	43	43						0	25	75	0	4	37	
52																	
53	52.50 - 52.95	⊗															
54	54.00 - 54.45	▼	25/28/36	64	64												
55																	
56	55.50 - 55.95	⊗															
57	57.00 - 57.45	▼	19/22/19	41	41					11	60	19	0				
58																	
59	58.50 - 58.95	⊗				3.00	-61.60		58.50 m to 61.50 m - Hard dark grey sandy clayey SILT, with shell fragments								
60																	

<b>Abbreviations &amp; Symbols</b>										<b>Water Depth (m)</b>						
▼	- SPT (standard penetration test)	CD	- Chart Datum	LL	- Liquid Limit					Date	Depth (m)					
□	- UDS (undisturbed sample)	E	- Extrapolated SPT Value	c1	- Cohesion value obtained from unconfined Compression Test											
⊗	- DS (disturbed sample)	R	- SPT Refusal	c2	- Cohesion value obtained from direct shear Test											
■	- RC (Rock Core)	T.D.	- Termination Depth	Phi	- Angle of internal friction from direct shear test											
		SBL	- Sea Bed Level	NA	- Not Applicable											
		RL	- Reduced Level													
		PI	- Plasticity Index													





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<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
<b>Casing depth from deck (m)</b>	: SX-20.50m,HX-41.00m,NX-68.00m	<b>Core diameter,mm</b>	: T.D. (m) : 62.45 w.r.t SBL
		<b>Borehole No.</b>	: BH 01
		<b>Co-ordinates</b>	: N 1102561.8 E 635008.6
		<b>Date</b>	: 01/03/2013-01/04/2013
		<b>Bed Level (m)</b>	: -3.10 w.r.t. CD

BOREHOLE LOG										LABORATORY DATA						
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
60	60.00 - 60.45	▼	13/23/24	47	47	3.00	-61.60	[Symbol]	58.50 m to 61.50 m - Hard dark grey sandy clayey SILT, with shell fragments	19	66	15	0			
61																
62	61.50 - 61.95	⊗				0.95	-64.60	[Symbol]	61.50 m to 62.45 m - Very dense light grey silty clayey SAND with gravel	6	26	41	27	5	35	
	62.00 - 62.45	▼	78/26/13	39	39	0.01	-65.55	[Symbol]	62.45 m - borehole terminated as per the instruction of Engineer In-charge							
63																
64																
65																
66																
67																
68																
69																
70																
71																
72																
73																
74																
75																

### Abbreviations & Symbols

- ▼ - SPT (standard penetration test)
- - UDS (undisturbed sample)
- ⊗ - DS (disturbed sample)
- - RC (Rock Core)
- CD - Chart Datum
- E - Extrapolated SPT Value
- R - SPT Refusal
- T.D. - Termination Depth
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- RL - Reduced Level
- PI - Plasticity Index
- LL - Liquid Limit
- c1 - Cohesion value obtained from unconfined Compression Test
- c2 - Cohesion value obtained from direct shear Test
- Phi - Angle of internal friction from direct shear test
- NA - Not Applicable

### Water Depth (m)

Date	Depth (m)



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<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
<b>Casing depth from deck (m)</b>	: SX-20.50m,HX-40.50m,NX-68.50m	<b>Core diameter,mm</b>	: T.D. (m) : 62.95 w.r.t SBL
		<b>Borehole No.</b>	: BH 02
		<b>Co-ordinates</b>	: N 1102581.4 E 635075.7
		<b>Date</b>	: 01/31/2013-02/01/2013
		<b>Bed Level (m)</b>	: -3.01 w.r.t. CD

BOREHOLE LOG										LABORATORY DATA						
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
0	0.00 - 0.45	▼	0/0/0	0	0	4.50	-3.01		0.00 m to 4.50 m - Very loose dark grey clayey SILT with sand							
1									From 3.00 m to 3.45 m - sandy Silt							
2	1.50 - 1.95	▼	0/0/0	0	0											
3																
4	3.00 - 3.45	▼	0/0/2	2	2					6	88	6	0			
5	4.50 - 4.95	▼	0/0/0	0	0	7.50	-7.51		4.50 m to 12.00 m - Very soft to soft dark grey clayey SILT, with occasional shell fragments	27	72	1	0			
6																
7	6.00 - 6.45	▼	0/0/1	1	1					30	64	4	2			
8																
9	7.50 - 8.00									29	71	0	0			
10																
11	9.00 - 9.45	▼	1/2/2	4	4											
12										18	81	1	0	5.8		
13	12.00 - 12.45	▼	2/2/3	5	5	12.00	-15.01		12.00 m to 24.00 m - Soft to firm dark grey clayey SILT, with occasional shell fragments							
14																
15	13.50 - 13.95									14	84	2	0	43.1		

<b>Abbreviations &amp; Symbols</b>										<b>Water Depth (m)</b>					
▼ - SPT (standard penetration test)	CD - Chart Datum	LL - Liquid Limit													
□ - UDS (undisturbed sample)	E - Extrapolated SPT Value	c1 - Cohesion value obtained from unconfined Compression Test													
⊗ - DS (disturbed sample)	R - SPT Refusal	c2 - Cohesion value obtained from direct shear Test													
■ - RC (Rock Core)	T.D. - Termination Depth	Phi - Angle of internal friction from direct shear test													
	SBL - Sea Bed Level	NA - Not Applicable													
	RL - Reduced Level														
	PI - Plasticity Index														
										Date	Depth (m)				
										01/31/2013	2.40				





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<b>Client</b> : COCHIN PORT TRUST			
<b>Equipment</b> : Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b> : LPG Berth	<b>Borehole No.</b> : BH 02	
<b>Drilling orientation</b> : Vertical	<b>Type of core barrel</b> : NA	<b>Co-ordinates</b> : N 1102581.4 E 635075.7	
<b>Drilling method</b> : Rotary borehole drilling, sampling and testing	<b>Type of Bit</b> : NA	<b>Date</b> : 01/31/2013-02/01/2013	
<b>Casing size,mm</b> : HX/SX/NX	<b>Drilling Fluid</b> : Water	<b>Bed Level (m)</b> : -3.01 w.r.t. CD	
<b>Casing depth from deck (m)</b> : SX-20.50m,HX-40.50m,NX-68.50m	<b>Core diameter,mm</b> :	<b>T.D. (m)</b> : 62.95 w.r.t SBL	

BOREHOLE LOG										LABORATORY DATA							
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees	
15	15.00 - 15.45	▼	0/1/3	4	4	12.00	-15.01		12.00 m to 24.00 m - Soft to firm dark grey clayey SILT, with occasional shell fragments								
16										22	76	2	0	12.7			
17	16.50 - 17.00																
18	18.00 - 18.45	▼	2/3/5	8	8												
19																	
20	19.50 - 19.95										19	80	1	0	9.8		
21	21.00 - 21.45	▼	2/3/4	7	7												
22																	
23	22.50 - 22.95									26	72	2	0	30.4			
24	24.00 - 24.45	▼	3/4/6	10	10	16.50	-27.01		24.00 m to 40.50 m - Firm to stiff dark grey SILT, with occasional shell fragments								
25																	
26	25.50 - 25.95										22	78	0	0	5.8		
27	27.00 - 27.45	▼	3/5/6	11	11												
28																	
29	28.50 - 28.95										24	75	1	0	8.8		
30																	

Abbreviations & Symbols		
▼	- SPT (standard penetration test)	CD - Chart Datum
□	- UDS (undisturbed sample)	E - Extrapolated SPT Value
⊗	- DS (disturbed sample)	R - SPT Refusal
■	- RC (Rock Core)	T.D. - Termination Depth
		SBL - Sea Bed Level
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		c1 - Cohesion value obtained from unconfined Compression Test
		c2 - Cohesion value obtained from direct shear Test
		Phi - Angle of internal friction from direct shear test
		NA - Not Applicable

Water Depth (m)	
Date	Depth (m)



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<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNALocation	: LPG Berth	<b>Borehole No.</b> : BH 02
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b> : NA	<b>Co-ordinates</b> : N 1102581.4 E 635075.7
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b> : NA	<b>Date</b> : 01/31/2013-02/01/2013
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b> : Water	<b>Bed Level (m)</b> : -3.01 w.r.t. CD
<b>Casing depth from deck (m)</b>	: SX-20.50m,HX-40.50m,NX-68.50m	<b>Core diameter,mm</b> :	<b>T.D. (m)</b> : 62.95 w.r.t SBL

BOREHOLE LOG										LABORATORY DATA							
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees	
30	30.00 - 30.45	▼	4/6/6	12	12	16.50	-27.01		24.00 m to 40.50 m - Firm to stiff dark grey SILT, with occasional shell fragments								
31										21	79	0	0	13.7			
32	31.50 - 31.95																
33	33.00 - 33.45	▼	5/7/8	15	15												
34																	
35	34.50 - 35.00										22	78	0	0	111.8		
36	36.00 - 36.45	▼	2/3/5	8	8												
37																	
38	37.50 - 37.95									27	70	3	0	30.4			
39																	
40	39.00 - 39.45	▼	4/5/7	12	12												
41	40.50 - 40.95					4.50	-43.51		40.50 m to 45.00 m - Hard dark brownish grey silty sandy CLAY	40	49	11	0	120.6			
42	42.00 - 42.45	▼	18/28/30	58	58												
43																	
44	43.50 - 43.95	⊗															
45																	

### Abbreviations & Symbols

- ▼ - SPT (standard penetration test)
- - UDS (undisturbed sample)
- ⊗ - DS (disturbed sample)
- - RC (Rock Core)
- CD - Chart Datum
- E - Extrapolated SPT Value
- R - SPT Refusal
- T.D. - Termination Depth
- SBL - Sea Bed Level
- RL - Reduced Level
- PI - Plasticity Index
- LL - Liquid Limit
- c1 - Cohesion value obtained from unconfined Compression Test
- c2 - Cohesion value obtained from direct shear Test
- Phi - Angle of internal friction from direct shear test
- NA - Not Applicable

### Water Depth (m)

Date	Depth (m)





# FUGRO GEOTECH PVT. LTD.

<b>Project</b> : GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b> : COCHIN PORT TRUST		
<b>Equipment</b> : Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b> : LPG Berth	<b>Borehole No.</b> : BH 02
<b>Drilling orientation</b> : Vertical	<b>Type of core barrel</b> : NA	<b>Co-ordinates</b> : N 1102581.4 E 635075.7
<b>Drilling method</b> : Rotary borehole drilling, sampling and testing	<b>Type of Bit</b> : NA	<b>Date</b> : 01/31/2013-02/01/2013
<b>Casing size,mm</b> : HX/SX/NX	<b>Drilling Fluid</b> : Water	<b>Bed Level (m)</b> : -3.01 w.r.t. CD
<b>Casing depth from deck (m)</b> : SX-20.50m,HX-40.50m,NX-68.50m	<b>Core diameter,mm</b> :	<b>T.D. (m)</b> : 62.95 w.r.t SBL

BOREHOLE LOG										LABORATORY DATA						
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
45	45.00 - 45.45	▼	3/25/30	55	55	3.00	-48.01		45.00 m to 48.00 m - Very dense reddish to brownish grey clayey silty SAND with mica							
46																
47	46.50 - 46.95	⊗														
48	48.00 - 48.45	▼	9/16/21	37	37	3.00	-51.01		48.00 m to 51.00 m - Hard whitish light grey silty CLAY.							
49																
50	49.50 - 49.95	⊗														
51	51.00 - 51.45	▼	11/27/24	51	51	1.50	-54.01		51.00 m to 52.50 m - Very dense light grey clayey silty SAND							
52																
53	52.50 - 52.95	⊗				3.00	-55.51		52.50 m to 55.50 m - Hard black silty CLAY 52.50 m to 52.95 m - with wooden fragments							
54	54.00 - 54.45	▼	15/27/40	67	67											
55																
56	55.50 - 55.95	⊗				6.00	-58.51		55.50 m to 61.50 m - Very dense whitish light grey silty clayey SAND							
57	57.00 - 57.45	▼	22/34/51	85	85										0	35
58																
59	58.50 - 58.95	⊗														
60																

**Abbreviations & Symbols**

- ▼ - SPT (standard penetration test)
- - UDS (undisturbed sample)
- ⊗ - DS (disturbed sample)
- - RC (Rock Core)
- CD - Chart Datum
- E - Extrapolated SPT Value
- R - SPT Refusal
- T.D. - Termination Depth
- SBL - Sea Bed Level
- RL - Reduced Level
- PI - Plasticity Index
- LL - Liquid Limit
- c1 - Cohesion value obtained from unconfined Compression Test
- c2 - Cohesion value obtained from direct shear Test
- Phi - Angle of internal friction from direct shear test
- NA - Not Applicable

**Water Depth (m)**

Date	Depth (m)



# FUGRO GEOTECH PVT. LTD.

<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
<b>Casing depth from deck (m)</b>	: SX-20.50m, HX-40.50m, NX-68.50m	<b>Core diameter,mm</b>	: NA
		<b>Borehole No.</b>	: BH 02
		<b>Co-ordinates</b>	: N 1102581.4 E 635075.7
		<b>Date</b>	: 01/31/2013-02/01/2013
		<b>Bed Level (m)</b>	: -3.01 w.r.t. CD
		<b>T.D. (m)</b>	: 62.95 w.r.t SBL

BOREHOLE LOG								LABORATORY DATA								
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
60	60.00 - 60.45	▼	20/27/40	67	67	6.00	-58.51	[Symbol]	55.50 m to 61.50 m - Very dense whitish light grey silty clayey SAND							
61																
62	61.50 - 61.95	⊗				1.45	-64.51	[Symbol]	61.50 m to 62.95 m - Hard grey silty CLAY							
63	62.50 - 62.95	▼	18/22/2	43	43	0.01	-65.96	[Symbol]	62.95 m - borehole terminated as per the instruction of Engineer In-charge							
64																
65																
66																
67																
68																
69																
70																
71																
72																
73																
74																
75																

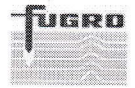
<b>Abbreviations &amp; Symbols</b>										<b>Water Depth (m)</b>	
▼	- SPT (standard penetration test)	CD	- Chart Datum	LL	- Liquid Limit			Date	Depth (m)		
□	- UDS (undisturbed sample)	E	- Extrapolated SPT Value	c1	- Cohesion value obtained from unconfined Compression Test						
⊗	- DS (disturbed sample)	R	- SPT Refusal	c2	- Cohesion value obtained from direct shear Test						
■	- RC (Rock Core)	T.D.	- Termination Depth		- Angle of internal friction from direct shear test						
		SBL	- Sea Bed Level	Phi	- Angle of internal friction from direct shear test						
		RL	- Reduced Level	NA	- Not Applicable						
		PI	- Plasticity Index								



<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
		<b>Borehole No.</b>	: BH 08
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
		<b>Co-ordinates</b>	: N 1102641.4 E 635293.6
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
		<b>Date</b>	: 01/12/2013-01/15/2013
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
		<b>Bed Level (m)</b>	: -2.00 w.r.t. CD
<b>Casing depth from deck (m)</b>	: SX-20.500m,HX-48.00m,NX-67.00m	<b>Core diameter,mm</b>	: T.D. (m) : 63.45 w.r.t SBL

BOREHOLE LOG								LABORATORY DATA								
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
0	0.00 - 0.45	⊗				3.00	-2.00		0.00 m to 3.00 m - Very soft dark grey silty CLAY							
1																
2	1.50 - 1.95	▼	0/0/0	0	0											
3																
4	3.00 - 3.45	□				3.00	-5.00		3.00 m to 6.00 m - Loose grey clayey SILT, with shell fragments	11	88	1	0	19		
5																
6	4.50 - 4.95	▼	1/2/3	5	5											
7																
8	6.00 - 6.45	▼	0/0/1	1	1	19.50	-8.00		6.00 m to 25.50 m - Very soft to soft dark grey clayey SILT 22.50 m to 24.00 m - wooden fragments	22	77	1	0			
9																
10	7.50 - 7.95	▼	0/1/1	2	2				From 24.00 m to 25.50 m - sandy							
11																
12	9.00 - 9.50	□								32	68	0	0	69		
13																
14	10.50 - 10.95	▼	0/1/1	2	2											
15																
16	12.00 - 12.50	□								35	63	2	0	46		
17																
18	13.50 - 13.95	▼	1/1/1	2	2											
19																

<b>Abbreviations &amp; Symbols</b>			<b>Water Depth (m)</b>	
▼ - SPT (standard penetration test)	CD - Chart Datum	LL - Liquid Limit	Date	Depth (m)
□ - UDS (undisturbed sample)	E - Extrapolated SPT Value	c1 - Cohesion value obtained from unconfined Compression Test	01/22/2013	1.70
⊗ - DS (disturbed sample)	R - SPT Refusal	c2 - Cohesion value obtained from direct shear Test		
■ - RC (Rock Core)	T.D. - Termination Depth	Phi - Angle of internal friction from direct shear test		
	SBL - Sea Bed Level	NA - Not Applicable		
	RL - Reduced Level			
	PI - Plasticity Index			



# FUGRO GEOTECH PVT. LTD.

<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
<b>Casing depth from deck (m)</b>	: SX-20.500m,HX-48.00m,NX-67.00m	<b>Core diameter,mm</b>	: T.D. (m) : 63.45 w.r.t SBL
		<b>Borehole No.</b>	: BH 08
		<b>Co-ordinates</b>	: N 1102641.4 E 635293.6
		<b>Date</b>	: 01/12/2013-01/15/2013
		<b>Bed Level (m)</b>	: -2.00 w.r.t. CD

BOREHOLE LOG										LABORATORY DATA						
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
15	15.00 - 15.50					19.50	-8.00		6.00 m to 25.50 m - Very soft to soft dark grey clayey SILT	16	83	1	0	55		
16									22.50 m to 24.00 m - wooden fragments							
17	16.50 - 16.95	▼	1/1/1	2	2				From 24.00 m to 25.50 m - sandy							
18	18.00 - 18.50									22	77	1	0	42		
19																
20	19.50 - 19.95	▼	1/1/2	3	3											
21	21.00 - 21.50									26	73	1	0	51		
22																
23	22.50 - 22.95	▼	5/9/12	21	21											
24	24.00 - 24.50									22	77	1	0	42		
25																
26	25.50 - 25.95	▼	4/3/5	8	8	3.00	-27.50		25.50 m to 28.50 m - Loose dark grey silty clayey SAND with less % of shell particles							
27	27.00 - 27.50	⊗														
28																
29	28.50 - 28.95	▼	2/5/6	11	11	10.50	-30.50		28.50 m to 39.00 m - Stiff to very stiff dark grey clayey SILT, with occasional shell fragments							
30																

Abbreviations & Symbols			Water Depth (m)		
▼	- SPT (standard penetration test)	CD	- Chart Datum	LL	- Liquid Limit
□	- UDS (undisturbed sample)	E	- Extrapolated SPT Value	c1	- Cohesion value obtained from unconfined Compression Test
⊗	- DS (disturbed sample)	R	- SPT Refusal	c2	- Cohesion value obtained from direct shear Test
■	- RC (Rock Core)	T.D.	- Termination Depth	Phi	- Angle of internal friction from direct shear test
		SBL	- Sea Bed Level	NA	- Not Applicable
		RL	- Reduced Level		
		PI	- Plasticity Index		
				Date	Depth (m)



<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
		<b>Borehole No.</b>	: BH 08
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
		<b>Co-ordinates</b>	: N 1102641.4 E 635293.6
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
		<b>Date</b>	: 01/12/2013-01/15/2013
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
		<b>Bed Level (m)</b>	: -2.00 w.r.t. CD
<b>Casing depth from deck (m)</b>	: SX-20.500m,HX-48.00m,NX-67.00m	<b>Core diameter,mm</b>	: T.D. (m) : 63.45 w.r.t SBL

BOREHOLE LOG										LABORATORY DATA						
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
30	30.00 - 30.50					10.50	-30.50		28.50 m to 39.00 m - Stiff to very stiff dark grey clayey SILT, with occasional shell fragments	16	84	0	0	43		
31																
32	31.50 - 31.95	▼	6/11/9	20	20											
33																
34	33.00 - 33.50												49			
35	34.50 - 34.95	▼	5/10/8	18	18											
36										24	76	0	0	56		
37	36.00 - 36.50															
38	37.50 - 37.95	▼	1/6/10	16	16											
39																
40	39.00 - 39.50	⊗				4.50	-41.00		39.00 m to 43.50 m - Very loose brownish grey clayey silty SAND							
41																
42	41.00 - 41.45	▼	0/1/2	3	3											
43	42.50 - 42.95	⊗														
44	43.50 - 43.95	▼	13/25/17	42	42	9.00	-45.50		43.50 m to 52.50 m - Dense brown to light grey silty clayey SAND							
45																

**Abbreviations & Symbols**

- ▼ - SPT (standard penetration test)
- - UDS (undisturbed sample)
- ⊗ - DS (disturbed sample)
- - RC (Rock Core)
- CD - Chart Datum
- E - Extrapolated SPT Value
- R - SPT Refusal
- T.D. - Termination Depth
- SBL - Sea Bed Level
- RL - Reduced Level
- PI - Plasticity Index
- LL - Liquid Limit
- c1 - Cohesion value obtained from unconfined Compression Test
- c2 - Cohesion value obtained from direct shear Test
- Phi - Angle of internal friction from direct shear test
- NA - Not Applicable

**Water Depth (m)**

Date	Depth (m)
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**FUGRO GEOTECH PVT. LTD.**

<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
<b>Borehole No.</b>	: BH 08		
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
<b>Co-ordinates</b>	: N 1102641.4 E 635293.6		
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
<b>Date</b>	: 01/12/2013-01/15/2013		
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
<b>Bed Level (m)</b>	: -2.00 w.r.t. CD		
<b>Casing depth from deck (m)</b>	: SX-20.500m,HX-48.00m,NX-67.00m	<b>Core diameter,mm</b>	: T.D. (m) : 63.45 w.r.t SBL

BOREHOLE LOG										LABORATORY DATA							
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees	
45	45.00 - 45.50	⊗				9.00	-45.50	▨	43.50 m to 52.50 m - Dense brown to light grey silty clayey SAND								
46																	
47	46.50 - 46.95	▼	16/17/18	35	35						0	23	77	0	0	0	32
48	48.00 - 48.50	⊗															
49																	
50	49.50 - 49.95	▼	5/12/30	42	42									0	0	34	
51	51.00 - 51.50	⊗															
52																	
53	52.50 - 52.95	▼	12/25/21	46	46	7.50	-54.50	▨	52.50 m to 60.00 m - Hard dark grey silty CLAY with wooden fragments								
54	54.00 - 54.50	⊗															
55																	
56	55.50 - 55.90	▼	12/42/51	93	93												
57	57.00 - 57.50	▼	11/15/24	39	39												
58																	
59	58.50 - 58.95	▼	8/16/28	44	44												
60																	

**Abbreviations & Symbols**

- ▼ - SPT (standard penetration test)
- - UDS (undisturbed sample)
- ⊗ - DS (disturbed sample)
- ▨ - RC (Rock Core)
- CD - Chart Datum
- E - Extrapolated SPT Value
- R - SPT Refusal
- T.D. - Termination Depth
- SBL - Sea Bed Level
- RL - Reduced Level
- PI - Plasticity Index
- LL - Liquid Limit
- c1 - Cohesion value obtained from unconfined Compression Test
- c2 - Cohesion value obtained from direct shear Test
- φ - Angle of internal friction from direct shear test
- NA - Not Applicable

**Water Depth (m)**

Date	Depth (m)





<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
<b>Casing depth from deck (m)</b>	: SX-20.500m,HX-48.00m,NX-67.00m	<b>Core diameter,mm</b>	: T.D. (m) : 63.45 w.r.t SBL
		<b>Borehole No.</b>	: BH 08
		<b>Co-ordinates</b>	: N 1102641.4 E 635293.6
		<b>Date</b>	: 01/12/2013-01/15/2013
		<b>Bed Level (m)</b>	: -2.00 w.r.t. CD

BOREHOLE LOG								LABORATORY DATA								
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
60	60.00 - 60.50	⊗				3.45	-62.00		60.00 m to 63.45 m - Dense dark brown clayey silty SAND							
61																
62	61.50 - 61.95	▣	10/14/18	32	32											
63	63.00 - 63.45	▣	9/15/21	36	36	0.01	-65.45		63.45 m - borehole terminated as per the instruction of Engineer In-charge						8	31
64																
65																
66																
67																
68																
69																
70																
71																
72																
73																
74																
75																

**Abbreviations & Symbols**

- ▣ - SPT (standard penetration test)
- ▣ - UDS (undisturbed sample)
- ⊗ - DS (disturbed sample)
- - RC (Rock Core)
- CD - Chart Datum
- E - Extrapolated SPT Value
- R - SPT Refusal
- T.D. - Termination Depth
- SBL - Sea Bed Level
- RL - Reduced Level
- PI - Plasticity Index
- LL - Liquid Limit
- c1 - Cohesion value obtained from unconfined Compression Test
- c2 - Cohesion value obtained from direct shear Test
- Phi - Angle of internal friction from direct shear test
- NA - Not Applicable

**Water Depth (m)**

Date	Depth (m)



<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
		<b>Borehole No.</b>	: BH 09
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
		<b>Co-ordinates</b>	: N 1102654.5 E 635352.7
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
		<b>Date</b>	: 01/09/2013-01/11/2013
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
		<b>Bed Level (m)</b>	: -2.16 w.r.t. CD
<b>Casing depth from deck (m)</b>	: SX-20.50m,HX-48.00m,NX-66.50m	<b>Core diameter,mm</b>	:
		<b>T.D. (m)</b>	: 63.00 w.r.t SBL

BOREHOLE LOG										LABORATORY DATA						
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
0	0.00 - 0.45	⊗				1.50	-2.16		0.00 m to 1.50 m - Dark grey silty CLAY							
1																
2	1.50 - 1.95	▼	0/0/0	0	0	3.00	-3.66		1.50 m to 4.50 m - Very loose dark grey clayey SAND with less % of shell and mica particles.							
3																
4																
5	4.50 - 4.95	▼	2/9/11	20	20	3.00	-6.66		4.50 m to 7.50 m - Medium dense dark grey clayey silty SAND, with shell fragments						0	30
6																
7	6.00 - 6.45	▼	0/5/7	12	12											
8	7.50 - 7.95	▼	0/1/1	2	2	6.00	-9.66		7.50 m to 13.50 m - Very soft to soft dark grey clayey SILT							
9										32	68	0	0	32		
10	9.00 - 9.50															
11	10.50 - 10.95	▼	0/0/1	1	1											
12										22	77	1	0	36		
13	12.00 - 12.50															
14	13.50 - 13.95	▼	1/2/2	4	4	7.50	-15.66		13.50 m to 21.00 m - Soft to firm dark grey clayey SILT							
15																

**Abbreviations & Symbols**

- ▼ - SPT (standard penetration test)
- - UDS (undisturbed sample)
- ⊗ - DS (disturbed sample)
- - RC (Rock Core)
- CD - Chart Datum
- E - Extrapolated SPT Value
- R - SPT Refusal
- T.D. - Termination Depth
- SBL - Sea Bed Level
- RL - Reduced Level
- PI - Plasticity Index
- LL - Liquid Limit
- c1 - Cohesion value obtained from unconfined Compression Test
- c2 - Cohesion value obtained from direct shear Test
- Phi - Angle of internal friction from direct shear test
- NA - Not Applicable

**Water Depth (m)**

Date	Depth (m)
01/09/2013	1.00





<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
<b>Casing depth from deck (m)</b>	: SX-20.50m,HX-48.00m,NX-66.50m	<b>Core diameter,mm</b>	: T.D. (m) : 63.00 w.r.t SBL
		<b>Borehole No.</b>	: BH 09
		<b>Co-ordinates</b>	: N 1102654.5 E 635352.7
		<b>Date</b>	: 01/09/2013-01/11/2013
		<b>Bed Level (m)</b>	: -2.16 w.r.t. CD

BOREHOLE LOG										LABORATORY DATA						
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
15	15.00 - 15.50					7.50	-15.66		13.50 m to 21.00 m - Soft to firm dark grey clayey SILT	19	80	1	0	35		
16																
17	16.50 - 16.95		2/3/4	7	7											
18	18.00 - 18.50									8	92	0	0	39		
19																
20	19.50 - 19.95		1/3/3	6	6											
21	21.00 - 21.50					1.50	-23.16		21.00 m to 22.50 m - Soft dark grey sandy clayey SILT, with shell fragments	22	47	31	0	18		
22																
23	22.50 - 22.95		4/15/14	29	29	6.00	-24.66		22.50 m to 28.50 m - Medium dense to dense light grey SAND, with less % of shell fragments						0	32
24	24.00 - 24.45		7/16/18	34	34											
25																
26																
27	27.00 - 27.45		7/19/29	48	48										0	36
28																
29	28.50 - 28.95		5/10/11	21	21	9.00	-30.66		28.50 m to 37.50 m - Stiff to very stiff dark grey clayey SILT							
30																

**Abbreviations & Symbols**

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- RL - Reduced Level
- PI - Plasticity Index
- LL - Liquid Limit
- c1 - Cohesion value obtained from unconfined Compression Test
- c2 - Cohesion value obtained from direct shear Test
- Phi - Angle of internal friction from direct shear test
- NA - Not Applicable

**Water Depth (m)**

Date	Depth (m)



**FUGRO GEOTECH PVT. LTD.**

<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
		<b>Borehole No.</b>	: BH 09
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
		<b>Co-ordinates</b>	: N 1102654.5 E 635352.7
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
		<b>Date</b>	: 01/09/2013-01/11/2013
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
		<b>Bed Level (m)</b>	: -2.16 w.r.t. CD
<b>Casing depth from deck (m)</b>	: SX-20.50m,HX-48.00m,NX-66.50m	<b>Core diameter,mm</b>	: T.D. (m) : 63.00 w.r.t SBL

BOREHOLE LOG										LABORATORY DATA						
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
30	30.00 - 30.50					9.00	-30.66		28.50 m to 37.50 m - Stiff to very stiff dark grey clayey SILT	19	78	3	0	42		
31																
32	31.50 - 31.95	▼	3/6/8	14	14											
33	33.00 - 33.50									27	72	1	0	51		
34																
35	34.50 - 34.95	▼	2/5/6	11	11											
36	36.00 - 36.50									29	70	1	0	35		
37																
38	37.50 - 37.95	▼	0/1/1	2	2	3.00	-39.66		37.50 m to 40.50 m - Very loose dark grey silty clayey SAND						25	27
39																
40																
41	40.50 - 40.95	▼	5/2/3	5	5	1.50	-42.66		40.50 m to 42.00 m - Firm brown to dark grey silty sandy CLAY							
42	42.00 - 42.50	⊗				3.00	-44.16		42.00 m to 45.00 m - Dense light brown SAND							
43																
44	43.50 - 43.95	▼	17/16/16	32	32									0	34	
45																

Abbreviations & Symbols					Water Depth (m)		
▼	- SPT (standard penetration test)	CD	- Chart Datum	LL	- Liquid Limit	Date	Depth (m)
□	- UDS (undisturbed sample)	E	- Extrapolated SPT Value	c1	- Cohesion value obtained from unconfined Compression Test		
⊗	- DS (disturbed sample)	R	- SPT Refusal	c2	- Cohesion value obtained from direct shear Test		
■	- RC (Rock Core)	T.D.	- Termination Depth		- Angle of internal friction from direct shear test		
		SBL	- Sea Bed Level	Phi			
		RL	- Reduced Level	NA	- Not Applicable		
		PI	- Plasticity Index				





<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
<b>Casing depth from deck (m)</b>	: SX-20.50m,HX-48.00m,NX-66.50m	<b>Core diameter,mm</b>	: T.D. (m) : 63.00 w.r.t SBL
		<b>Borehole No.</b>	: BH 09
		<b>Co-ordinates</b>	: N 1102654.5 E 635352.7
		<b>Date</b>	: 01/09/2013-01/11/2013
		<b>Bed Level (m)</b>	: -2.16 w.r.t. CD

BOREHOLE LOG										LABORATORY DATA						
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
45	45.00 - 45.50	⊗				13.50	-47.16	.....	45.00 m to 58.50 m - Very dense dark grey silty SAND 52.50 m to 54.00 m - Hard light grey CLAY with very less % of sand.							
46																
47	46.50 - 46.95	▼	17/30/40	70	70											
48																
49	48.00 - 48.50	⊗														
50	49.50 - 49.80	▼	38/52/	104	104											
51																
52	51.00 - 51.50	⊗														
53	52.50 - 52.95	▼	12/19/21	40	40											
54																
55	54.00 - 54.50	⊗														
56	55.50 - 55.65	▼	54//	486	486										0	37
57																
58	57.00 - 57.50	⊗														
59	58.50 - 58.95	▼	4/16/18	34	34	3.00	-60.66	////	58.50 m to 61.50 m - Hard dark grey silty CLAY							
60																

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- c1 - Cohesion value obtained from unconfined Compression Test
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- Phi - Angle of internal friction from direct shear test
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**Water Depth (m)**

Date	Depth (m)
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# FUGRO GEOTECH PVT. LTD.

<b>Project</b>	: GEOTECHNICAL INVESTIGATION FOR LPG BERTH AND OUTER HARBOUR PROJECT AT PUTHUVYPEEN IN COCHIN PORT		
<b>Client</b>	: COCHIN PORT TRUST		
<b>Equipment</b>	: Hydraulic Rig mounted on Jack-up Fugro KRISHNA	<b>Location</b>	: LPG Berth
		<b>Borehole No.</b>	: BH 09
<b>Drilling orientation</b>	: Vertical	<b>Type of core barrel</b>	: NA
		<b>Co-ordinates</b>	: N 1102654.5 E 635352.7
<b>Drilling method</b>	: Rotary borehole drilling, sampling and testing	<b>Type of Bit</b>	: NA
		<b>Date</b>	: 01/09/2013-01/11/2013
<b>Casing size,mm</b>	: HX/SX/NX	<b>Drilling Fluid</b>	: Water
		<b>Bed Level (m)</b>	: -2.16 w.r.t. CD
<b>Casing depth from deck (m)</b>	: SX-20.50m,HX-48.00m,NX-66.50m	<b>Core diameter,mm</b>	: T.D. (m) : 63.00 w.r.t SBL

BOREHOLE LOG								LABORATORY DATA								
Depth below EGL (m)	Sample & in situ test depth (m)	Sample Type	Blow Counts	SPT "N" Value	E "N" Value	Layer thickness (m)	RL w.r.t. CD (m)	Symbol	Description	CLAY, %	SILT, %	SAND, %	GRAVEL, %	c1 (UCS), kPa	c2 (DST), kPa	Phi (DST), Degrees
60	60.00 - 60.50					3.00	-60.66		58.50 m to 61.50 m - Hard dark grey silty CLAY	45	51	4	0	47		
61																
62	61.50 - 61.95		11/26/34	60	60	1.50	-63.66		61.50 m to 63.00 m - Very dense dark brown clayey silty SAND	5	31	64	0		0	35
63	62.50 - 63.00					0.01	-65.16		63.00 m - borehole terminated as per the instruction of Engineer In-charge							
64																
65																
66																
67																
68																
69																
70																
71																
72																
73																
74																
75																

### Abbreviations & Symbols

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- Phi - Angle of internal friction from direct shear test
- NA - Not Applicable

### Water Depth (m)

Date	Depth (m)
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