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DCT BERTHS 203 TO 205 - RECONSTRUCTION, DEEPENING AND LENGTHENING

PORT OF DURBAN

FACTUAL GEOTECHNICAL REPORT

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1.0 INTRODUCTION AND TERMS OF REFERENCE

1.1 Introduction

Extensive geotechnical site investigations have been undertaken as part of the DCT Berths 203 to 205 Reconstruction, Deepening and Lengthening Project in the Port of Durban. This Report is a collation of the factual geotechnical information relevant to the Project.

The geotechnical site investigations have concentrated on four main areas, namely the new quay wall line, within the dredge basin, at the offshore borrow site and at the Lot 10 casting yard. The field investigation data and laboratory testing data are presented separately and further subdivided according to the exploratory area as described above.

1.2 Site Description

Berths 203 to 205 are being deepened and a new quay wall constructed which is to be offset by approximately 50 m seaward of the existing quay wall, as shown in Figure 1.2-1. The quay is also being lengthened by extending the western (205) end of the new quay into the existing crane yard, known as the Berth 205 extension.

The basin dredge area comprises the existing basin adjacent to the existing Berths 203 to 205 and the existing turning circle adjacent to the T-Jetty and Pier 1. The offshore borrow site is located 2 km east of the Port entrance and is shown in Figure 1.3-1. The lot 10 casting yard is located approximately 1.2 km south west of Pier 2 as seen in Figures 1.3.1 and 1.3.2.

Figure 1.2-1: Satellite Image Showing the Location of Pier 2 and Dredge Area.

1.3 General Geological Environment

Durban harbour is underlain at depth by bedrock of Cretaceous age. This Cretaceous bedrock in the vicinity of Pier 2 is generally located at a depth of between -30 m CDP and -40 m CDP (See Figure 5.1-1). The bedrock depth is locally as deep as -65 m CDP where a paleo channel cuts across the site at Berths 203 and 204.

Overlying the bedrock is a thick sequence of unconsolidated soils comprising sands, silts, and clay. These transported soils are known as the Harbour Beds and are of variable but mostly estuarine origin. Their depositional environment has resulted in both lateral and vertical variation of sediment type and thickness. The soil profile at Pier 2 can generally be described as having an upper unit comprising silty clays, which is generally underlain by a unit comprising mainly sands, with bedrock at depth.

The offshore borrow site comprises thick accumulations of slightly calcareous sands with a few scattered reef outcrops. The sea bed level at the borrow site is at approximately -20 m CDP.

Figure 1.3-1: Satellite Image Showing the Location of the Offshore Borrow Site and the Lot 10 Casting Yard.

Figure 1.3-2: Satellite Image Showing the Approximate Boundaries of the Lot 10 Casting Yard.

2.0 SUMMARY OF GEOTECHNICAL INVESTIGATIONS AND REPORTS

Various geotechnical investigations have been undertaken as part of the Project. The latest phase of geotechnical investigations, namely the FEL 3 phase, supplemented the FEL 2 investigation, adding exploratory data points along the new quay wall line as well as in the basin dredge area.

Table 1.3.1 presents the previous geotechnical investigation reports relevant to the Project. These reports are provided in the Annexure 5 of this Report.

Table 1.3.1: Previous Studies and Factual Geotechnical Reports Relevant to the Project

Annexure 5.1	**Factual Geotechnical Report for Phase 2: Pier 2: Berths 203 to 205** (MSJ RPT No. 07-395R07Rev0; May 2009)
Annexure 5.2	**Laboratory Report for Phases 1, 2 & 3: Volume 1 & 2** (MSJ RPT No. 07-395Rev0; June 2009)
Annexure 5.3	**Factual Report on Marine Cone Penetration Tests** (Frankie RPT No. Rev.0; June 2009)
Annexure 5.4	**Desk Study Appraisal for the Durban Berth Deepening Feasibility Study** (MSJ RPT No. 07-395; May 2008)
Annexure 5.5	**A Geophysical and Sediment Sampling Survey of Two Proposed Sand Winning Areas in the Durban Bight** (CGS RPT No. 2001-0158; 2001)
Annexure 5.6	**A Geophysical and Sedimentological Investigation of the Offshore Dredge Disposal Site, Durban** (CGS RPT No. 2001-0002; 2001)

3.0 FIELD INVESTIGATIONS

The following subsections summarise the field investigations relevant to the Project.

3.1 Locations of Exploratory Points

The various geotechnical investigations have concentrated on four main areas. The first area covers the new quay wall, including the return quay. The second area is defined by the dredging limits for the berth deepening. The third area is defined by the extents of the offshore borrow site where sand will be won for reclamation and the fourth area covers the Lot 10 casting yard.

The exploratory points comprise borehole drilling with *in situ* SPT testing and sampling, cone penetration testing (CPTu), vibro coring, and grab sampling.

Drawing 1370-CO-180-DWG-0001-01 and 1370-CO-180-DWG-0003-01 in Annexure 1 show the locations of the various types of exploratory points within the new quay wall area and dredge area. The points relevant to the offshore borrow site are shown in Figure 1 of geotechnical report A6 (Refer to Section 2.0). The exploratory point locations at Lot 10 can be seen in Figure 1.3-2.

3.2 Exploratory Drilling, SPT Testing and Sampling

3.2.1 Quay Wall

General:

A total of 23 No. exploratory boreholes have been drilled along a centreline that coincides with the new quay wall cope line (Refer to drawings 1370-CO-180-DWG-0001-01 and 02, and 1370-CO-180-DWG-0002-01 and 02). This centreline is approximately 50 m seaward of the existing quay wall cope line. Of the 23 No. exploratory boreholes, 9 were land based boreholes and 8 were marine based boreholes. An additional 6 No. marine based boreholes from the FEL 2 study have been included in this Report.

The boreholes were drilled from land or seabed level to a depth terminating 10 m to 15 m into bedrock. The borehole drilling involved Standard Penetration Testing, disturbed sampling, and undisturbed thin wall Shelby sampling.

The exploratory boreholes were drilled during the FEL 2 and FEL 3 phases of investigation. The “BHM 2##” and “BHL 2##” series of boreholes are from the FEL 2 investigation. The “BHS##” and “BHL##” series of boreholes are from the FEL 3 investigation.

Methodology:

The exploratory drilling, sampling and logging methodologies are detailed in Annexure 2 of this Report for the FEL 3 phase investigation, and in geotechnical report A4 (Refer to Section 2.0) for the FEL 2 phase investigation.

Results:

As-built coordinates, elevations, logs and photographs for the exploratory boreholes are located in Annexure 2 of this Report.

The laboratory test results on disturbed and undisturbed samples are described in Section 4.0 of this Report.

3.2.2 Dredge Area

General:

A total of 10 No. marine based exploratory boreholes have been drilled in the dredge area. These boreholes were used to proof selected CPTu profiles. The boreholes were positioned directly over selected CPTu's (Refer to drawings 1370-CO-180-DWG-003-01 & 02) in order to calibrate the CPTu classification of soil type and state.

The boreholes were drilled from seabed level, to a depth approximately 7 m below seabed level. The borehole drilling involved Standard Penetration Testing and disturbed sampling.

The boreholes were drilled during the FEL 3 phases of investigation and are identified as the "BDS#" series of boreholes.

Methodology:

The exploratory drilling, sampling and logging methodologies are detailed in Annexure 2 of this Report.

Results:

As-built coordinates, elevations, logs and photographs for the exploratory boreholes are summarised Annexure 2.

The laboratory test results on disturbed and undisturbed samples are described in Section 4.0 of this Report, and are presented in Annexure 4.

3.3 Vibro-Coring and Grab Sampling

3.3.1 Borrow Site

General:

A total of 3 No. vibro-cores were collected at the borrow site to a depth of approximately 4.0 m below seabed level. A total of 16 No. grab samples were collected from the seabed.

Methodology:

The coring, sampling and logging methodologies are detailed in geotechnical report A5.6 (Refer to Section 2.0).

Results:

The as-built coordinates, location and elevations for the vibro-core and grab samples, as well as the core logs are provided in geotechnical report A5.6.

The laboratory testing on disturbed samples is also described in geotechnical report A5.6. A summary table of the results of the testing can be found in Section Table 4.1.3 of this Report.

3.4 Cone Penetration Testing (CPTu)

3.4.1 Quay Wall

General:

A total of 50 No. CPTu tests with dissipation testing have been carried out along the centreline that delineates the proposed new quay wall copeline (Refer to drawings 1370-CO-180-DWG-0001-01 to 03). This centreline is approximately 50 m seaward of the existing quay wall cope line. Of the 50 No. CPTu probes, 8 were land based probes and 42 were marine based probes. 2 No. CPTu's from the FEL 2 study have been included in this Report.

The "CPT##" series of CPTu's are from the FEL 3 investigation. The "CPTM 2##" series of tests are from the FEL 2 investigation.

Methodology:

The CPTu test methodology is detailed in Annexure 2 and Annexure 3 of this Report for the FEL 3 phase investigation and in geotechnical report A5.3 and A5.4 (Refer to Section 2.0) for the FEL 2 phase investigation.

Limitations and Exceptions:

The marine CPTu's refused at approximately -24 m CDP. Sleeve friction was not measured for the majority of tests (FEL3).

Results:

As-built coordinates, elevations, dissipation tests and logs for the CPTu tests are presented in Annexure 3 of this Report.

3.4.2 Dredge Area

General:

A total of 88 No. CPTu tests with dissipation tests have been carried out within the dredge area on a grid spacing of 100 m by 100 m. The CPTu estimation of soil type and state has been calibrated with proofing boreholes as discussed in Section 3.2.2.

CPTu testing was carried out from seabed level, to a depth of approximately 7 m below seabed level.

The CPTu tests formed part of the FEL 3 phase of investigation and are identified as the "CPTS## or CPTP##" series of CPTu's.

Methodology:

The CPTu test methodology is detailed in Annexure 2 and Annexure 3 of this Report.

Limitations and Exceptions:

Sleeve friction was not measured for the dredge area tests.

Results:

As-built coordinates, elevations, dissipation tests and logs for the CPTu tests are tabled in Annexure 3 of this Report.

3.4.3 Lot 10 Casting Yard

General:

A total of 5 No. CPTu tests with dissipation testing have been carried out within the Lot 10 casting yard.

CPTu testing was carried out from ground level to a depth of approximately 20 m. The CPTu tests formed part of the FEL 3 phase of the investigation and are identified as the "CPTU" series of CPTu's.

Methodology:

The CPTu test methodology is detailed in Annexure 2 and Annexure 3 of this Report.

Limitations and Exceptions:

Sleeve friction was not measured for the casting yard tests.

Results:

As-built coordinates, elevations, dissipation tests and logs for the CPTu tests are tabled in Annexure 3 of this report.

4.0 LABORATORY TESTING

The following subsections summarise the laboratory testing relevant to the Project. Laboratory testing was carried out for both the FEL 2 and FEL 3 phases of investigation. Various laboratories were used and therefore there is some variation in the testing standards used. The summarised laboratory test results presented in the following tables represent the factual information only without engineering interpretation (unless otherwise stated).

The type of laboratory test, numbers of tests, testing laboratory and testing standards, are summarised in Table 3.4.1. The laboratory test results are presented in Annexure 4.

The soils have been classified according to BS EN ISO 14688-1:2002+A1:2013, BS EN ISO 14688-2:2004+A1:2013 and BS 5930:2015.

Table 3.4.1: Summary of Laboratory Testing

Investigation area	Test type	Test	No of tests	Testing laboratory	Test standard
Quay wall	Classification	Specific Gravity	5	SW	-
		Hydrometer	31	TS, SW, SC, NMTL	TMH A6, ASTM D422, ASTM D422, BS 1377
		Sieve analysis	36	TS, SW, SC, NMTL	TMH A1, ASTM D6913, TMH A1, BS 1377
		Atterberg limits	32	TS, SW, SC, NMTL	BS 1370, ASTM D4318, TMH A3, BS 1377
	Compressibility	Oedometer Tests	12	SU	BS 1377
	Shear strength	Triaxial UU Tests	14	TS, SU, NMTL	BS 1377
		Triaxial CIUC Tests	7	SU, NMTL	BS 1377
		Shear Vane Tests	22	SU	-
Dredge area	Classification	Hydrometer	11	TS	TMH A6
		Sieve analysis	11	TS	TMH A1(a)
		Organic content	11	TS	BS 1377
Borrow Site	Classification	Sieve analysis	46	CGS	-
		Carbonate content	46	CGS	Carbonate bomb analysis

Note: TS - Thekwini Soils Laboratory cc, SW - GeoTegnniese Laboratorium Somerset-wes, SC - Soilco Materials Investigations (Pty) Limited, SU - Stellenbosch University, NMTL - National Materials Testing Laboratory LTD, CGS - Council for Geoscience

4.1 Classification Tests

Table 4.1.1 toTable 4.1.3 summarise the classification tests carried out for the Quay Wall, Dredge Area and borrow site.

Grain size distribution (or grading) was determined by sieve analysis and sedimentation analysis (Hydrometer method). Other classification tests included moisture content, Atterberg Limits, particle density, organic content, and carbonate content.

4.1.1 Quay Wall

Table 4.1.1: Summary of Classification Tests for the Quay Wall Area

BH No	Sample No.	Testing laboratory	Sample Details		Grading (BS 5930:2015 classification)						Atterberg Limits			Moisture content	Specific Gravity	Soil Name BS EN 5930:2015
			Top CDP	Base CDP	Clay <0.002 mm (%)	Silt .002-0.063 mm (%)	Fine Sand 0.063-0.2 mm (%)	Medium Sand 0.2-0.63 mm (%)	Coarse Sand 0.63-2.0 mm (%)	Gravel >2mm (%)	LL (%)	PI (%)	Linear Shrinkage (%)	(%)		
BHL01	S01	SW	-16.28	-16.88	20.0	46.0	30.0	4.0	0.0	0.0	51	19	13	60	2.49	high plasticity, slightly sandy clayey SILT/silty CLAY
BHL01	S02	SW	-17.78	-18.38	20.0	47.0	33.0	0.0	0.0	0.0	69	28	15	91	2.42	high plasticity, slightly sandy clayey SILT/silty CLAY
BHL01	S03	SW	-21.78	-22.38	31.0	48.0	21.0	0.0	0.0	0.0	66	29	16	72	2.46	high plasticity, slightly sandy clayey SILT/silty CLAY
BHL01	S06	SW	-25.38	-25.98	45.0	43.0	12.0	0.0	0.0	0.0	57	24	14	57	2.75	high plasticity, slightly sandy clayey SILT/silty CLAY
BHL01	S07	SW	-26.48	-27.08	31.0	48.0	16.0	4.0	1.0	0.0	46	15	12	53	2.55	intermediate plasticity slightly sandy clayey SILT/silty CLAY
BHS04	S01	TS	-20.33	-20.98	49.9	42.7	5.8	0.9	0.4	0.0	55	24	13	53	-	high plasticity slightly sandy clayey SILT/silty CLAY
BHS05	S01	TS	-20.00	-20.60	50.5	28.9	12.5	7.1	0.7	0.3	50	21	12	56	-	intermediate/high plasticity slightly sandy clayey SILT/silty CLAY
BHS06	S02	TS	-22.30	-22.90	47.1	38.6	5.4	4.6	3.8	0.5	49	20	11	53	-	intermediate/high plasticity slightly gravely slightly sandy clayey SILT/silty CLAY
BHS06	S03	TS	-26.80	-27.40	25.4	41.3	24.0	8.9	0.5	0.0	35	12	5	30	-	low/intermediate plasticity slightly sandy clayey SILT/silty CLAY
BD-BHM207	*5129	SC	-25.01	-25.46	-	5.0	94.0			1.0	NP	-	-	-	-	slightly silty SAND
BD-BHM207	*5130	SC	-32.51	-32.96	-	20.0	79.0			1.0	NP	-	-	-	-	silty SAND
BD-BHM208	*5131	SC	-20.62	-21.07	-	7.0	93.0			0.0	NP	-	-	-	-	silty SAND
BD-BHM208	*5132	SC	-26.62	-27.07	-	19.0	79.0			2.0	NP	-	-	-	-	silty SAND
BD-BHM209	1	NMTL	-17.51	-17.98	26.0	73.0	1.0			0.0	89	50	-	56.8	-	very high/extremely high plasticity slightly sandy clayey SILT/silty CLAY
BD-BHM209	*5141	SC	-17.98	-18.43	18.0	43.0	39.0			0.0	45	18	-	-	-	intermediate plasticity sandy clayey SILT/silty CLAY
BD-BHM209	*5142	SC	-31.88	-32.33	9.0	38.0	53.0			0.0	33	11	-	-	-	low plasticity sandy clayey SILT/silty CLAY
BD-BHM209	1	NMTL	-0.78	-1.25	26	73	1			0	89	50	-	1	-	very high/extremely high plasticity slightly sandy clayey SILT/silty CLAY
BHS03	S01	TS	-20.94	-21.51	39.0	55.5	4.9	0.7	0.0	0.0	35	21	11	62	-	low/intermediate plasticity slightly sandy clayey SILT/silty CLAY
BHS03	S02	TS	-22.94	-23.51	53.2	40.9	4.7	1.1	0.0	0.0	62	26	13	54	-	high plasticity slightly sandy clayey SILT/silty CLAY
BHS03	S03	TS	-24.94	-25.51	29.7	59.6	7.8	2.7	0.2	0.0	45	18	9	39	-	intermediate plasticity slightly sandy clayey SILT/silty CLAY
BHS03	S04	TS	-26.94	-27.51	21.7	53.3	18.6	6.0	0.3	0.0	41	16	8	-	-	intermediate plasticity slightly sandy clayey SILT/silty CLAY
BD-BHM210A	1	NMTL	-25.78	-27.28	14.0	74.0	12.0			0.0	71	47	-	44	-	very high plasticity slightly sandy clayey SILT/silty CLAY
BD-BHM210A	2	NMTL	-25.78	-27.28	10.0	67.0	18.0			5.0	61	39	-	36	-	high plasticity slightly sandy clayey SILT/silty CLAY
BD-BHM211	*5133	SC	-15.19	-15.64	20.0	52.0	27.0			1.0	47	20	-	-	-	intermediate plasticity slightly sandy clayey SILT/silty CLAY
BD-BHM211	*5134	SC	-22.59	-23.04	16.0	45.0	39.0			0.0	42	18	-	-	-	intermediate plasticity sandy clayey SILT/silty CLAY
BD-BHM211	*5135	SC	-24.09	-24.54	16.0	39.0	45.0			0.0	37	16	-	-	-	intermediate plasticity sandy clayey SILT/silty CLAY
BD-BHM211	*5136	SC	-25.59	-26.04	-	8.0	92.0			0.0	NP		-	-	-	silty SAND
BD-BHM211	1	NMTL	-27.27	-27.42	24.0	73.0	3.0			0.0	81	52	-	61.1	-	very high plasticity slightly sandy clayey SILT or silty CLAY
BD-BHM211	2	NMTL	-27.42	-27.61	14.0	82.0	4.0			0.0	76	50	-	55.2	-	very high plasticity slightly sandy clayey SILT or silty CLAY
BD-BHM211	3	NMTL	-27.61	-27.75	14.0	69.0	17.0			0.0	62	41	-	52.2	-	high plasticity slightly sandy clayey SILT or silty CLAY
BD-BHM211	4	NMTL	-27.75	-28.11	21.0	65.0	13.0			0.0	77	47	-	53.6	-	very high plasticity slightly sandy clayey SILT or silty CLAY
BD-BHM211	5	NMTL	-28.11	-28.29	26.0	65.0	9.0			0.0	86	57	-	63.5	-	very high plasticity slightly sandy clayey SILT or silty CLAY

Dredge Area

Table 4.1.2: Summary of Classification Tests for the Basin Dredge Area

BH No	Sample No.	Testing laboratory	Sample Details		Grading (BS 5930:2015 classification)					Organic content	Soil Name BS EN 5930:2015
			Top CDP	Base CDP	Clay <0.002 mm (%)	Silt .002 - 0.06 mm (%)	Fine sand 0.06 - 0.2 mm (%)	Medium Sand 0.2 - 0.6 mm (%)	Coarse Sand 0.6-2.0 mm (%)	(%)	
BDS01	S04	TS	-18.57	-19.57	5.5	5.1	59.6	29.8	0.0	1.8	slightly organic clayey silty SAND
BDS02	S06	TS	-19.51	-20.21	5.8	3.8	52.2	38.0	0.2	1.8	slightly organic clayey silty SAND
BDS03	S05	TS	-16.15	-17.25	5.7	2.9	51.5	39.6	0.4	1.7	slightly organic clayey silty SAND
BDS03	S07	TS	-17.65	-18.45	41.2	31.2	20.1	7.1	0.4	11.6	organic slightly sandy clayey SILT/silty CLAY
BDS04	S02	TS	-14.66	-15.16	30.1	36.1	22.7	11.0	0.2	1.8	organic slightly sandy clayey SILT/silty CLAY
BDS04	S03	TS	-20.66	-21.11	5.8	6.7	30.0	50.7	6.9	1.8	slightly organic silty clayey SAND
BDS04	S08	TS	-16.66	-17.16	41.8	51.9	4.9	0.0	0.0	14.1	organic slightly sandy clayey SILT/silty CLAY
BDS04	S09	TS	-17.66	-19.16	46.5	46.8	5.8	0.7	0.1	13.5	organic slightly sandy clayey SILT/silty CLAY
BDS05	S01	TS	-18.61	-19.06	6.7	6.5	54.5	32.2	0.1	1.8	slightly organic clayey silty SAND
BDS08	S01	TS	-15.06	-18.51	6.9	2.6	32.7	50.9	0.0	1.1	slightly organic slightly clayey silty SAND
BDS10	S01	TS	-13.57	-19.02	7.3	5.4	51.6	35.2	0.2	1.0	slightly organic clayey silty SAND

4.1.2 Borrow Site

Table 4.1.3: Summary of Classification Tests for the Borrow Site

Sample number *(n)*= 16	Median (mm)	Mean (mm)	Sorting (mm)	Grading (BS 5930:2015 classification)			Carbonate (%)	Soil Name BS EN 5930:2015
				*Clay & Silt <0.063 mm (%)	Sand 0.063 - 2mm (%)	Gravel >2mm (%)		
Min	0.213	0.227	0.25	0.97	99.03	0.00	8.85	calcareous slightly silty/clayey SAND
Max	0.444	0.474	0.62	1.75	96.90	1.35	23.47	calcareous slightly gravelly slightly silty/clayey SAND
Ave	0.304	0.322	0.45	1.34	98.17	0.49	12.77	calcareous slightly gravelly slightly silty/clayey SAND
Colour	**Light olive - light reddish brown**							
Sediment type	**Well sorted medium-grained sand**							
Sediment maturity	**Subangular to subrounded**							

* Termed "Mud" in Council for Geoscience Report

4.2 Compressibility Tests

The standard oedometer consolidation test was performed on selected undisturbed samples for the determination of the consolidation characteristics of the soils of low permeability. The two parameters required were:

- Coefficient of volume compressibility, M_v (Compressibility of soil)
- Coefficient of consolidation, C_v (Time related parameter)

The preconsolidation pressure (Pc) is estimated based on an interpretation of the consolidation test data. The Casagrande graphical method and the Work method were used to determine the preconsolidation pressure.

The coefficient of consolidation was not determined by oedometer testing. An estimation of the coefficient of consolidation may be made based on CPTu dissipation test results.

Table 4.2.1 presents the compressibility test results for the Quay Wall Area.

4.2.1 Quay Wall

Table 4.2.1: Summary of Oedometer Tests for the Quay Wall Area

BH no	Sample No.	Testing laboratory	Top CDP	Base CDP	Initial MC (%)	Bulk density (kg/m3)	Dry density (kg/m3)	Pc' (kPa)	Mv (100-200 kPa)) (m^2/MN)	Mv (200-400 kPa (m^2/MN)	Initial void ratio (e_0)	Soil Name BS EN 5930:2015
BHL01	S01A	SU	-16.28	-16.88	48	1731	1168	117	0.604	0.288	1.31	high plasticity, slightly sandy clayey SILT/silty CLAY
BHL01	S01B	SU	-16.28	-16.88	61	1574	977	173	0.591	0.527	1.76	high plasticity, slightly sandy clayey SILT/silty CLAY
BHL01	S02A	SU	-17.78	-18.38	79	1362	760	108	0.450	0.520	2.55	high plasticity, slightly sandy clayey SILT/silty CLAY
BHL01	S02B	SU	-17.78	-18.38	93	1321	684	240	0.254	0.337	2.95	high plasticity, slightly sandy clayey SILT/silty CLAY
BHL01	S03	SU	-21.78	-22.38	66	1517	914	100	0.350	0.383	1.95	high plasticity, slightly sandy clayey SILT/silty CLAY
BHL01	S05A	SU	-24.28	-24.88	56	1703	1093	95	0.460	0.351	1.47	*high plasticity silty CLAY
BHL01	S05B	SU	-24.28	-24.88	48	1657	1119	100	0.429	0.338	1.41	*high plasticity silty CLAY
BHL01	S07A	SU	-26.48	-27.08	48	1677	1135	92	0.309	0.350	1.38	intermediate plasticity slightly sandy clayey SILT/silty CLAY
BHL01	S07B	SU	-26.48	-27.08	57	1638	1046	70	0.422	0.256	1.58	intermediate plasticity slightly sandy clayey SILT/silty CLAY
BHS03	S05	SU	-28.94	-29.50	45	1636	1132	125	0.275	0.321	1.39	*high plasticity silty CLAY
BHS03	S06A	SU	-30.94	-31.14	40	1767	1260	388	0.107	0.160	1.14	*high plasticity silty CLAY
BHS03	S06B	SU	-30.94	-31.14	41	1632	1155	358	0.155	0.114	1.34	*high plasticity silty CLAY

Note: * Field description

4.3 Shear Strength Tests

4.3.1 Quay wall

Shear strength tests were performed on undisturbed samples and on selected double tube core samples. Three types of shear strength tests were performed:

- Hand shear vane test
- Triaxial Unconsolidated Undrained Compression (UU) Test
- Triaxial Consolidated Isotopically Undrained Compression (CIUC) Test

The shear strength testing enabled the determination of both undrained and effective shear strength parameters. Table 4.3.1 presents the shear strength test results for the Quay Wall Area.

Table 4.3.1: Summary of Shear Strength Tests for the Quay Wall Area

BH no	Sample No.	Testing laboratory	Sample type	Test type	Top CDP	Base CDP	Soil Name BS EN 5930:2015	Ave Bulk density (kg/m3)	Ave Dry density (kg/m3)	Initial MC %	Av initial MC %	Cu (kPa) - Triaxial	Av Cu (kPa)	Cu (kPa) - Hand vane	Av Cu (kPa)	CIUC (Φ',c')
BHL01	S01	SU	Shelby	UU	-16.28	-16.88	high plasticity, slightly sandy clayey SILT/silty CLAY	-	-	61.11, 61.11, 48.11	57	30, 42, 27	33	28, 32, 32, 34	32	-
BHL01	S02	SU	Shelby	UU, HV	-17.78	-18.38	high plasticity, slightly sandy clayey SILT/silty CLAY	-	-	93.0, 93.0, 79.17	88	42, 34, 46	41	32, 36, 34, 36	35	-
BHL01	S03	SU	Shelby	UU, HV	-21.78	-22.38	high plasticity, slightly sandy clayey SILT/silty CLAY	-	-	-	-	43, 42	43	36, 38, 38, 39	38	-
BHL01	S05	SU	Shelby	CIUC, HV	-24.28	-24.88	*high plasticity silty CLAY	-	-	48.02, 55.82	52	-	-	38, 38, 39, 41, 40	39	Yes
BHL01	S07	SU	Shelby	UU, HV	-24.28	-24.88	intermediate plasticity slightly sandy clayey SILT/silty CLAY	-	-	56.53, 56.53, 47.72	54	13, 9, 13	12	7, 9, 6, 9	8	-
BHS04	S01	TS	Shelby	UU	-20.33	-20.98	high plasticity slightly sandy clayey SILT/silty CLAY	1697	1111	51.1, 52.9, 54.0	53	105, 144, 181	143	-		-
BHS05	S01	TS	Shelby	UU	-20.00	-20.60	intermediate/high plasticity slightly sandy clayey SILT/silty CLAY	1688	1079	56.0, 56.2, 57.1	56	65, 102, 119	95	-		-
BHS06	S02	TS	Shelby	UU	-22.30	-22.90	intermediate/high plasticity slightly gravely slightly sandy clayey SILT/silty CLAY	1674	1097	52.0, 52.2, 53.6	53	167, 184, 252	201	-		-
BHS06	S03	TS	Shelby	UU	-26.80	-27.40	low/intermediate plasticity slightly sandy clayey SILT/silty CLAY	1951	1471	33.1, 32.0, 23.4	30	374, 407, 524	435	-		-
BD-BHM209	1	NMTL	Shelby	CIUC	-17.51	-17.98	very high/extremely high plasticity slightly sandy clayey SILT/silty CLAY	1581	1010	56.8	57	-	-	-	-	Yes
BD-BHM209	2	NMTL	Shelby	CIUC	-17.51	-17.98	*high plasticity silty CLAY	1651	1110	47.77	48	-	-	-	-	Yes
BD-BHM209	3	NMTL	Shelby	CIUC	-17.51	-17.98	*high plasticity silty CLAY	1581	980	60.65	61	-	-	-	-	Yes
BHS03	S01	TS	Shelby	UU	-20.94	-21.51	low/intermediate plasticity slightly sandy clayey SILT/silty CLAY	1589	981	62.1	62	185	185	-		-
BHS03	S02	TS	Shelby	UU	-22.94	-23.51	high plasticity slightly sandy clayey SILT/silty CLAY	1685	1096	53.6	54	415	415	-		-
BHS03	S03	TS	Shelby	UU	-24.94	-25.51	intermediate plasticity slightly sandy clayey SILT/silty CLAY	1806	1303	38.4, 39.5, 38.1	39	129, 146, 151	142	-		-
BHS03	S05	SU	Shelby	UU	-28.94	-29.51	*high plasticity silty CLAY	-	-	36.07, 36.04	36	47, 57	52	-	-	-
BD-BHM210A	-	NMTL	TW	UU	-25.97	-26.17	very high plasticity slightly sandy clayey SILT/silty CLAY	1721	-	44.2	44	46.8	47	-	-	-
BD-BHM210A	-	NMTL	TW	UU	-26.77	-26.96	high plasticity slightly sandy clayey SILT/silty CLAY	1741	-	36	36	57.9	58	-	-	-
BD-BHM211	1	NMTL	TW	CIUC	-27.27	-27.42	very high plasticity slightly sandy clayey SILT or silty CLAY	1661	1000	66.87	67	-	-	-	-	Yes
BD-BHM211	2	NMTL	TW	CIUC	-27.42	-27.61	very high plasticity slightly sandy clayey SILT or silty CLAY	1661	1070	55.19	55	-	-	-	-	Yes
BD-BHM211	3	NMTL	TW	CIUC	-27.61	-27.75	high plasticity slightly sandy clayey SILT or silty CLAY	1751	1150	52.18	52	-	-	-	-	Yes
BD-BHM211	4	NMTL	TW	CIUC	-27.75	-28.11	very high plasticity slightly sandy clayey SILT or silty CLAY	1761	1150	53.42	53	-	-	-	-	Yes

Note: *Field description, TW - samples retrieved from double tube coring, UU - Unconsolidated Undrained Triaxial Compression Test, HV - Shear Vane, CIUC - Consolidated-Undrained Triaxial Compression Test

5.0 GENERAL GEOTECHNICAL CONDITIONS

5.1 Quay Wall

The geology along the new quay wall line has been divided into seven zones based on the changing geotechnical conditions. A brief description of each zone is provided in the following subsections. The seven geotechnical zones are shown in drawings 1370-CO-180-DWG-0001-01 to 03 as well as Figure 5.1-1.

5.1.1 Geology between berth chainage 960 m and 1220 m (Zone 1)

Zone 1 is characterised by an upper unit comprising predominately clay. This unit is approximately 17 m thick, starting at seabed level (-12.72 MCDP), and terminating at approximately -30 m CDP. Underlying the silty clay is a sand unit with minor alternating horizons of gravel and clayey sand. This sand unit varies in thickness from 13 m to 36 m and has accumulated in a paleo channel cuts through the Cretaceous bedrock. Bedrock comprises very soft to hard siltstone and varies in depth from -65 m CDP in the east, shallowing to -32 m CDP in a westerly direction.

Typical uncorrected SPT N values in the upper silty clay unit range between 0 and 46 with an average of 16. Typical uncorrected cone resistance values range between 3 – 4 MPa, with an average value of 3.5 MPa.

Typical uncorrected SPT values in the lower sand unit range between 13 and 60 with an average of 35, although there is considerable localised variation.

5.1.2 Geology between berth chainage 750 m and 960 m (Zone 2)

Zone 2 is characterised by a thick unit of sand, with isolated lenses of silty clays in the upper 16 m. The total thickness of this upper unit is 21m, starting at seabed level and terminating at -30 m CDP. Underlying these sands is a dense to very dense sand with isolated boulders of very soft to hard siltstone. The thickness of this unit varies from 0 m to 35 m as the bedrock profile dips steeply to the west. The bedrock level varies from -28 m CDP to > -68 m CDP.

Typical uncorrected SPT N values in the upper and lower sand units range from 15 to 62 with an average of 34. Typical uncorrected cone resistance values in the upper sand unit range between < 1 – 30 MPa, with an average value of 7.5 MPa becoming 20 MPa with depth.

5.1.3 Geology between berth chainage 430 m and 750 m (Zone 3)

Zone 3 is characterised by an upper unit comprising clays interbedded with silty sands. This unit is approximately 13 to 18 m thick, starting at seabed level and terminating at approximately -26 to -30 m CDP. Underlying the silty clay is a sand. This sand unit varies in thickness from 8 m to 24 m. Bedrock comprises very soft to hard siltstone and varies in depth from -67 m CDP in the east, shallowing to -41 m CDP in a westerly direction.

Typical uncorrected SPT N values in the upper silty clay unit range between 0 and 17 with an average of 7. Typical uncorrected cone resistance values range between 1.5 – 5 MPa. Thin interbeds of silty clays result in cone resistance values < 1MPa locally.

Typical uncorrected SPT N values in the lower sand unit range between 10 and 29 with refusal at depth.

5.1.4 Geology between berth chainage 170 m and 430 m (Zone 4)

Zone 4 is characterised by an upper unit comprising silty clay. This unit is approximately 10 m thick, starting at seabed level and terminating at a maximum depth of -28 CDP. Underlying the silty clay is a sand unit comprising sand with minor interbeds of clayey sand and gravels. This sand unit varies in thickness from 6 m to 10 m. A continuous unit of residual sand, 2m thick, overlies bedrock which varies in depth from -32 m CDP in the west to -42 m CDP in the east.

Typical uncorrected SPT N values in the upper silty clay unit range between 0 and 19 with an average of 7. Typical uncorrected cone resistance values range between < 1 – 2 MPa with an average of 1 MPa. CPTM07 is the exception with an average cone resistance of 2 MPa.

Typical uncorrected SPT N values in the lower sand unit range between 6 and 53, with an average of 24; two instances of refusal were recorded.

5.1.5 Geology between berth chainage 40 m and 170 m (Zone 5)

The existing return wall defines the eastern boundary between zone 5 and zone 4. Land level is at approximately + 3.7s m CDP. This zone is characterised by an upper unit comprising medium dense to dense sand. This unit is approximately 14 m thick, terminating at approximately -10 m CDP. Underlying the sand is a clay unit similar in consistency to zone 4, comprising silty clay. Underlying the silty clay is a sand unit fine sand. This sand unit is 10 m thick, thinning to the east. A continuous unit of residual sand, 1 m thick, overlies bedrock which varies in depth from -34 m CDP in the east to -38 m CDP in the west.

Typical uncorrected SPT N values in the upper sand unit range between 1 and refusal with an average of 27. Typical uncorrected cone resistance values range between 4 – >12 MPa with an average of 10 MPa.

Typical uncorrected SPT N values in the middle silty clay unit range between 0 and 1 with an average of 1. Typical uncorrected cone resistance values are 1MPa.

Typical uncorrected SPT N values in the lower sand unit range between 11 and 70 with an average of 43.

5.1.6 Geology between berth chainage 0 m to 40 m and return wall chainage 0 to 72 m (Zone 6)

As in zone 5, zone 6 is characterised by an upper unit comprising medium dense to dense sand. This unit is approximately 16 m thick, terminating at approximately -12 m CDP. Underlying the sand is a silty clay unit which extends to bedrock at -37 m CDP. The silty clay has a maximum thickness of 25 m. The extent of the silty clay and absence of the lower sand unit are what distinguishes zone 6 from zone 5. Bedrock comprises very soft siltstone.

Typical uncorrected SPT N values in the upper sand unit range between 10 and 50 with an average of 29. Typical uncorrected cone resistance values range between 3 – >12 MPa with an average of 10 MPa.

Typical uncorrected SPT N values in the middle silty clay unit range between 0 and 1 with an average of 1. Typical uncorrected cone resistance values are 1MPa.

Typical uncorrected SPT N values in the lower clay unit range between 0 and 9 with an average of 1. Typical uncorrected cone resistance values range between 0.8 MPa and 1 MPa.

5.1.7 Geology between return wall chainage 72 m and 221 m (Zone 7)

Zone 7 is characterised by an upper unit comprising sand. This unit is approximately 14 m thick, terminating at approximately -10 m CDP. Underlying the sand is a clay unit similar in consistency to zone 6,. Underlying the silty clay is a sand unit. This sand unit is 10 m thick and thins towards zone 6. A continuous unit of residual sand, 1 m thick, overlies bedrock which varies in depth from -32 m CDP to -34 m CDP.

Typical uncorrected SPT N values in the upper sand unit range between 1 and 50 with an average of 26.

Typical uncorrected SPT N values in the middle silty clay unit range between 0 and 5 with an average of 2.

Typical uncorrected SPT N values in the lower sand unit range between 0 and 50 with an average of 22.

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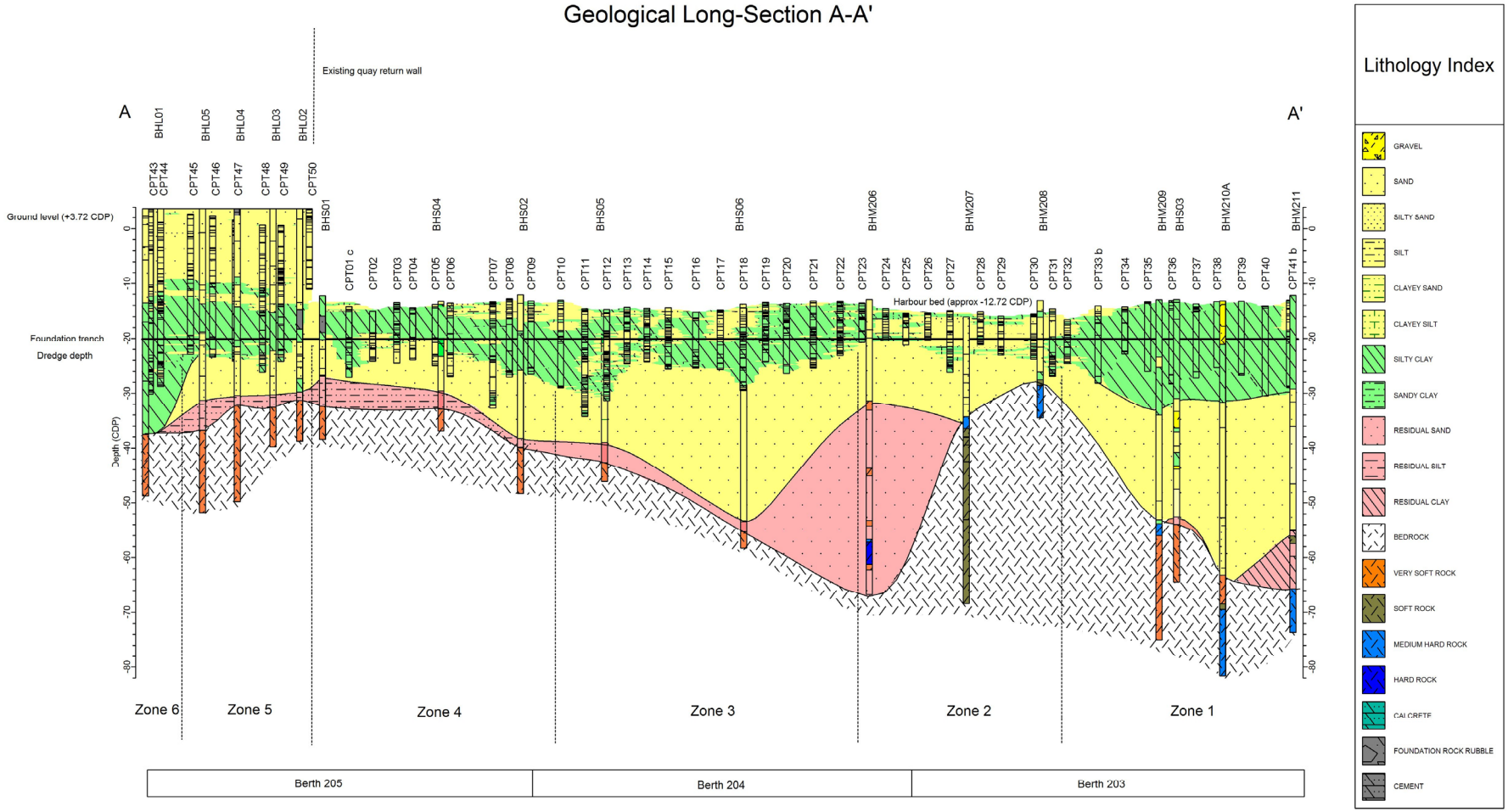


Figure 5.1-1: Quay Wall Geological Long Section

5.2 Dredge Area

The soils in the dredge area comprise predominantly fine sands with local deposits of silty clay, and a thin surficial layer of transported silty clay. Drawing 1370-CO-180-DWG-0003-02 shows the distribution and thickness of these units. Section B-B which runs east-west shows the sandy zone lensing out towards the turning circle as the profile becomes predominantly clay-rich with smaller volumes of sand.

The lateral and vertical distributions of sand and clay are shown on drawings 1370-CO-180-DWG-0003-02 and are derived from the results of widely spaced CPTu probes and exploratory boreholes. Due to the distance between sampling points and the local variability of the soil profile, variations from the distributions shown on the drawings can be expected.

From the shallow sampling conducted by the CSIR on the central sandbank as well as more recent exploratory boreholes at Berth 205 extension, the sandbank is characterised by an upper unit of fine to medium grained sands approximately 8 m thick. Underling the sands is a silty clay unit approximately 10 m thick which is in turn underlain by sand to bedrock.

5.3 Borrow Site

The bathymetric survey conducted at the offshore borrow site shows two distinct features namely the northern and southern sand mounds. The northern mound encompasses an area of approximately 1.5 km^2 and is approximately 10 m high. The southern mound encompasses an area of 1.12 km^2 with an average height of 3 m. Apart from the distinct sands mounds present at site, the bathymetry is found to be gently undulating with submarine slopes steepening gently to the east. Rocky reef outcrops can be found scattered sparsely across the site. In general sea floor can be found at around -20 m CDP for the majority of the site with a submarine slope dropping down to approximately -31 m CDP towards the east.

The sand sediments comprise well graded medium slightly calcareous sands. The thickness of this unit ranges from 0 m in areas where rocky outcrop is present to 9.5 m. The average sediment thickness is 3.6 m.

5.4 Lot 10 Casting Yard

CPTu's probing at the Lot 10 casting yard reveals a uniform soil profile across site. The profile comprises an upper predominantly ł sand unit approximately 10 m thick. The sand unit overlies a predominantly silty clay. CPTU coverage is limited with depth, but it appears the silty clays are underlain by dense sands at approximately -19 m CDP.

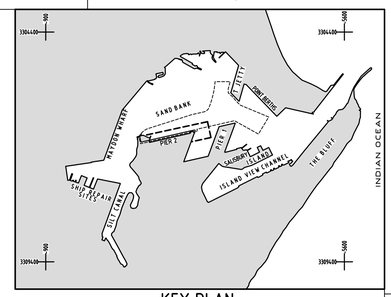
Typical uncorrected cone resistance values in the upper sand unit range between 8 – 12 MPa Typical uncorrected cone resistance values in the lower clay unit range between 2 – 4 MPa.

ANNEXURES

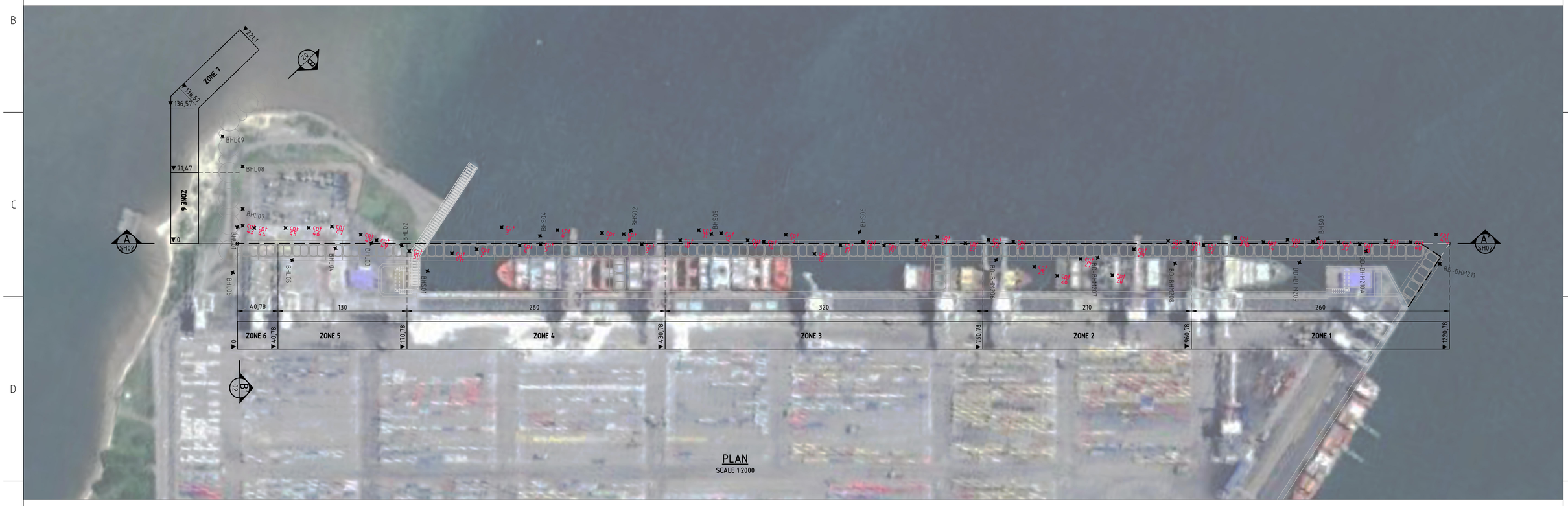
ANNEXURE 1: DRAWINGS

DRAWING NUMBER

DO NOT SCALE - IF IN DOUBT, ASK



KEY PLAN



PLAN
SCALE 1:2000

LEGEND

BHM SERIES BOREHOLES	MSJ MARINE BOREHOLE	2009 INVESTIGATION
BHL SERIES BOREHOLES	LAND BOREHOLE	2012 INVESTIGATION
BHS SERIES BOREHOLES	MARINE BOREHOLE	2012 INVESTIGATION

0m 100m 200m 300m 400m

DRAWING NO.	REFERENCE
1370-CO-180-C-DWG-0002-02	GEOLOGICAL LONG SECTION WITH SPT RESULTS
1370-CO-180-C-DWG-0002-01	GEOLOGICAL LONG SECTION - RETURN QUAY
1370-CO-180-C-DWG-0001-03	RELATIVE DENSITY AND CONSISTENCY SECTION
1370-CO-180-C-DWG-0001-02	GEOLOGICAL LONG SECTION - QUAY WALL

REFERENCE DRAWINGS

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PROJECT NO	DIS CODE	AREA	DISP	TYPE	DRG NO	SHEET	STATUS	REV
1370	CO	180	C	DWG	0001	01	P	00

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
P00	ISSUED FOR INFORMATION	AS	MC	JZ	16.05.31

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ENG. MANAGER			
AREA MANAGER			
PROJECT MGR.			
DIVISION			

DIV.	TITLE	NAME	SIGNATURE	DATE

ORIGINATOR: ZAA

TITLE	NAME	SIGNATURE	DATE
DRAWN	WV		16.05.31
CHECKED	AS		16.05.31
ENG. COORD	MC		16.05.31
DISCIP. ENG			
ENG. MANAGER			
AREA MANAGER			

PR.ENG. / PR.TECH.			
NAME	J. ZIETSMAN	DATE	16.05.31
SIGNATURE			
REG. NUMBER	760293		
SCALE :	1:750	OR AS NOTED	A1

TRANSNET

DCT BERTH 203 to 205 RECONSTRUCTION DEEPENING AND LENGTHENING

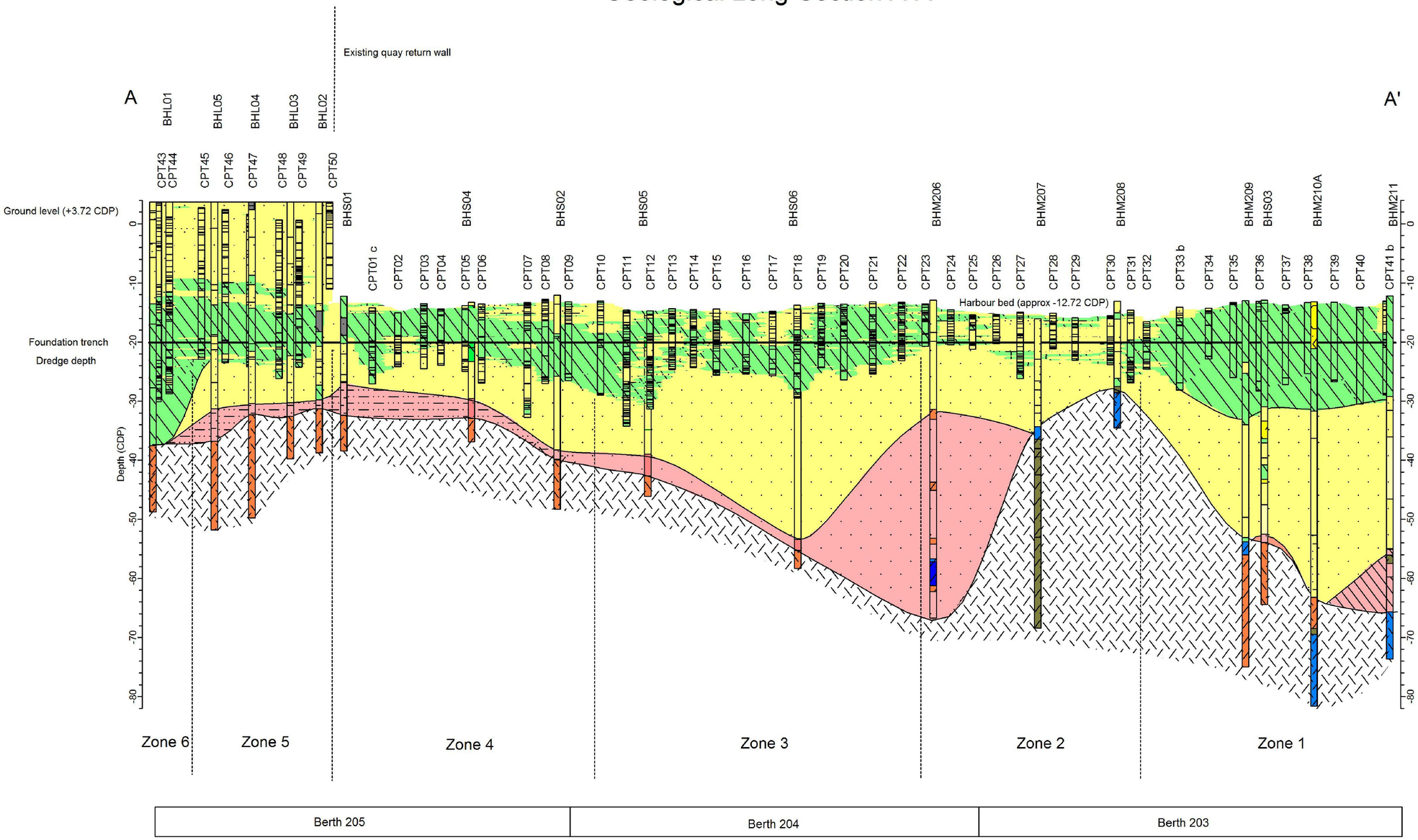
GEOTECHNICAL INVESTIGATION CPTU AND BOREHOLE POSITIONS QUAY WALL AND RETURN QUAY

PROJECT NUMBER	DV	FBS	DIS	TYPE	DRG. NO.	SHT.	REV.	ID
2122830	1	026	C	GA	0001	01	0A	

DRAWING NUMBER

DO NOT SCALE - IF IN DOUBT, ASK

Geological Long-Section A-A'



Lithology Index

- GRAVEL
- SAND
- SILTY SAND
- SILT
- CLAYEY SAND
- CLAYEY SILT
- SILTY CLAY
- SANDY CLAY
- RESIDUAL SAND
- RESIDUAL SILT
- RESIDUAL CLAY
- BEDROCK
- VERY SOFT ROCK
- SOFT ROCK
- MEDIUM HARD ROCK
- HARD ROCK
- CALCRETE
- FOUNDATION ROCK RUBBLE
- CEMENT

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ENG. COORD.				CHECKED	MC		16.05.31
ENG. MANAGER				ENG. COORD.	JZ		16.05.31
AREA MANAGER				DISCIP. ENG.			
PROJECT MGR.				ENG. MANAGER			
DIVISION				AREA MANAGER			
DIV.	TITLE	NAME	SIGNATURE DATE				
				PR.ENG. / PR.TECH.			
				NAME	J. ZIETSMAN		DATE
				SIGNATURE			16.05.31
				REG. NUMBER	760293		
				SCALE :	1: 750	OR AS NOTED	A1

TRANSNET

DCT BERTH 203 to 205 RECONSTRUCTION
DEEPENING AND LENGTHENING
GEOTECHNICAL INVESTIGATION
GEOLOGICAL LONG SECTION
QUAY WALL

PROJECT NUMBER	DV	FBS	DIS.	TYPE	DRG. NO.	SHT.	REV.	ID
2122830-1	0	26	C	GA	0001	02	0A	

DRAWING NO.	REFERENCE
1370-CO-180-C-DWG-0001-01	CPTU AND BOREHOLE POSITIONS

REFERENCE DRAWINGS

PROJECT NO	DIS CODE	AREA	DISP	TYPE	DRG NO	SHEET	STATUS	REV
1370	CO	180	C	DWG	0001	02	P	00

DRAWING NUMBER

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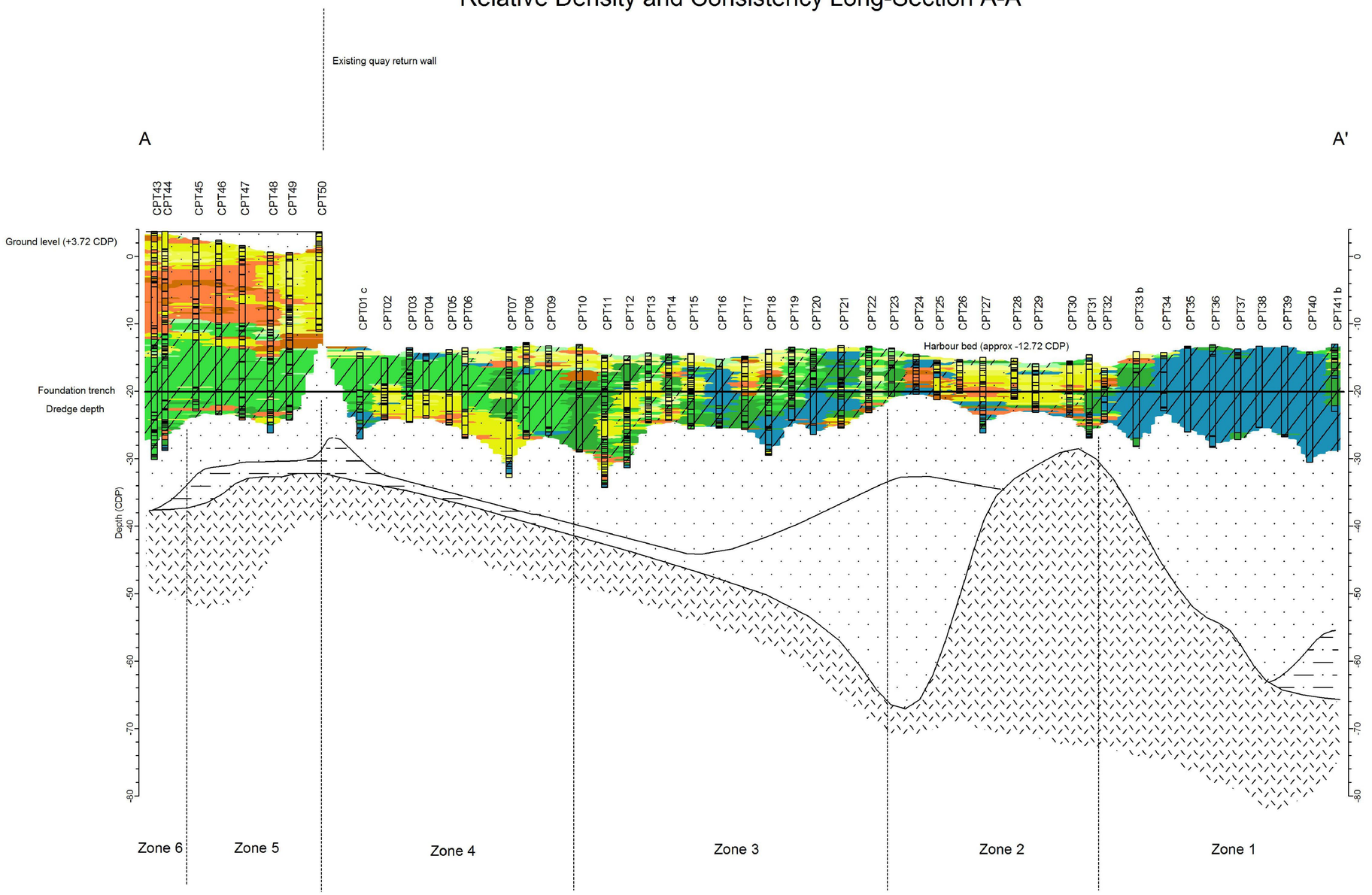
Relative Density and Consistency Long-Section A-A'



Relative Density / Consistency Legend

- Very Loose
- Loose
- Medium Dense
- Dense
- Very Dense
- Very Soft
- Soft
- Soft to Firm
- Stiff
- Very Stiff

This section presents the CPTu interpreted relative density and consistency for the various soils as reported by Osimo cc

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TITLE	NAME	SIGNATURE	DATE
DRAWN	AS		16.05.31
CHECKED	MC		16.05.31
ENG. COORD.	JZ		16.05.31
DISCIP. ENG.			
ENG. MANAGER			
AREA MANAGER			
PR.ENG. / PR.TECH.			
NAME	J. ZIETSMAN		DATE
SIGNATURE			16.05.31
REG. NUMBER	760293		

SCALE : 1:750 OR AS NOTED A1

TRANSNET

DCT BERTH 203 to 205 RECONSTRUCTION
DEEPENING AND LENGTHENING
GEOTECHNICAL INVESTIGATION
RELATIVE DENSITY & CONSISTENCY
LONG SECTION – QUAY WALL

PROJECT NUMBER	DV	FBS	DIS	TYPE	DRG. NO.	SHT.	REV.	ID
2122830-1		026	C	GA	0001	03	0A	

DRAWING NO.	REFERENCE
1370-CO-180-C-DWG-0001-01	CPTU AND BOREHOLE POSITIONS

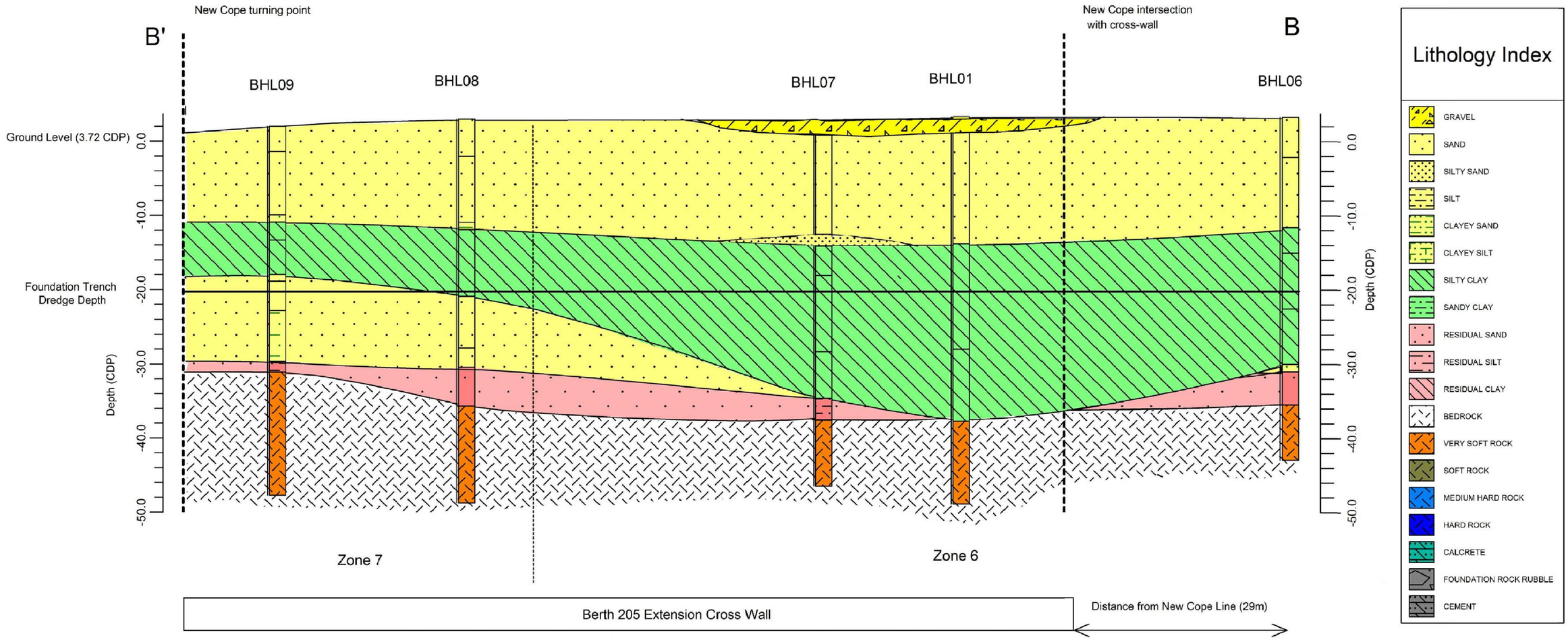
REFERENCE DRAWINGS

PROJECT NO	DIS CODE	AREA	DISP	TYPE	DRG NO	SHEET	STATUS	REV
1370	CO	180	C	DWG	0001	03	P	00

DRAWING NUMBER

DO NOT SCALE - IF IN DOUBT, ASK

Generalised Geological Long-Section B-B'



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1370-CO-180-C-DWG-0001-01	CPTU AND BOREHOLE POSITIONS
DRAWING NO.	REFERENCE

REFERENCE DRAWINGS

PROJECT NO	DIS CODE	AREA	DISP	TYPE	DRG NO	SHEET	STATUS	REV
1370	CO	180	C	DWG	0002	01	P	00

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
P00	ISSUED FOR INFORMATION	AS	MC	JZ	16.05.31

REVISIONS / ISSUE AUTHORIZATION

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TITLE	NAME	SIGNATURE	DATE
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ENG. COORD.			
ENG. MANAGER			
AREA MANAGER			
PROJECT MGR.			
DIVISION			
DIV. TITLE	NAME	SIGNATURE	DATE

ORIGINATOR: ZAA			
TITLE	NAME	SIGNATURE	DATE
DRAWN	AS		16.05.31
CHECKED	MC		16.05.31
ENG. COORD.	JZ		16.05.31
DISCIP. ENG.			
ENG. MANAGER			
AREA MANAGER			
PR.ENG. / PR.TECH.			
NAME	J. ZIETSMAN		DATE
SIGNATURE			16.05.31
REG. NUMBER	760293		
SCALE :	1:750	OR AS NOTED	A1

TRANSNET

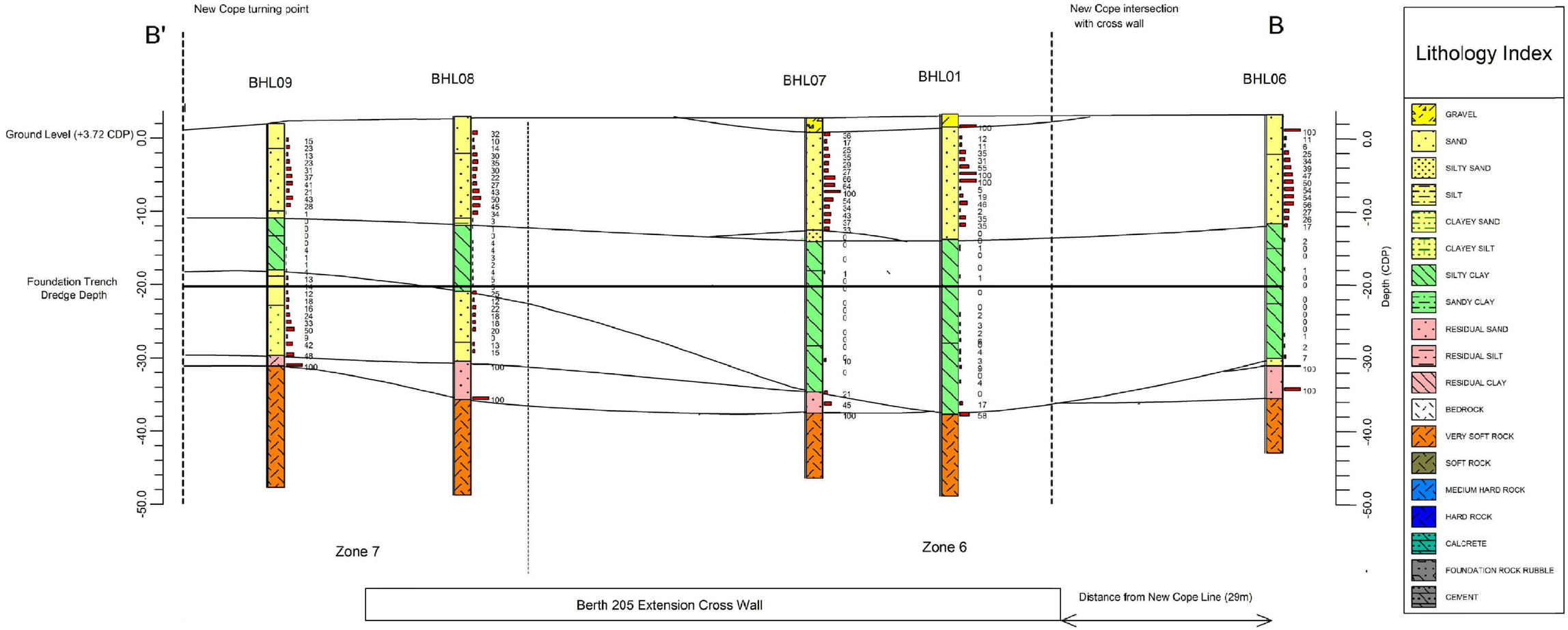
DCT BERTH 203 to 205 RECONSTRUCTION
DEEPENING AND LENGTHENING
GEOTECHNICAL INVESTIGATION
GEOLOGICAL LONG SECTION
RETURN QUAY

PROJECT NUMBER	DV	FBS	DIS.	TYPE	DRG NO.	SHT.	REV.	ID
2122830	1	026	C	GA	0002	01	0A	

DRAWING NUMBER

DO NOT SCALE - IF IN DOUBT, ASK

Generalised Geological Long-Section B-B' with SPT N Values



Lithology Index

- GRAVEL
- SAND
- SILTY SAND
- SILT
- CLAYEY SAND
- CLAYEY SILT
- SILTY CLAY
- SANDY CLAY
- RESIDUAL SAND
- RESIDUAL SILT
- RESIDUAL CLAY
- BEDROCK
- VERY SOFT ROCK
- SOFT ROCK
- MEDIUM HARD ROCK
- HARD ROCK
- CALCRETE
- FOUNDATION ROCK RUBBLE
- CEMENT

Note:
This section presents the SPT results for the various soils. SPT N values are uncorrected

1370-CO-180-C-DWG-0001-01	CPTU AND BOREHOLE POSITIONS
DRAWING NO.	REFERENCE
REFERENCE DRAWINGS	

Engineers
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PROJECT NO	DIS CODE	AREA	DISP	TYPE	DRG NO	SHEET	STATUS	REV
1370	CO	180	C	DWG	0002	02	P	00

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
P00	ISSUED FOR INFORMATION	AS	MC	JZ	16.05.31

REVISIONS / ISSUE AUTHORIZATION

EPCM CONSULTANT: TCP			
TITLE	NAME	SIGNATURE	DATE
LEAD DES. ENG.			
ENG. COORD.			
ENG. MANAGER			
AREA MANAGER			
PROJECT MGR.			
DIVISION			
DIV. TITLE	NAME	SIGNATURE	DATE

ORIGINATOR: ZAA			
TITLE	NAME	SIGNATURE	DATE
DRAWN	AS		16.05.31
CHECKED	MC		16.05.31
ENG. COORD.	JZ		16.05.31
DISCIP. ENG.			
ENG. MANAGER			
AREA MANAGER			
PR.ENG. / PR.TECH.			
NAME J. ZIETSMAN			DATE
SIGNATURE			16.05.31
REG. NUMBER 760293			
SCALE : 1:750 OR AS NOTED			A1

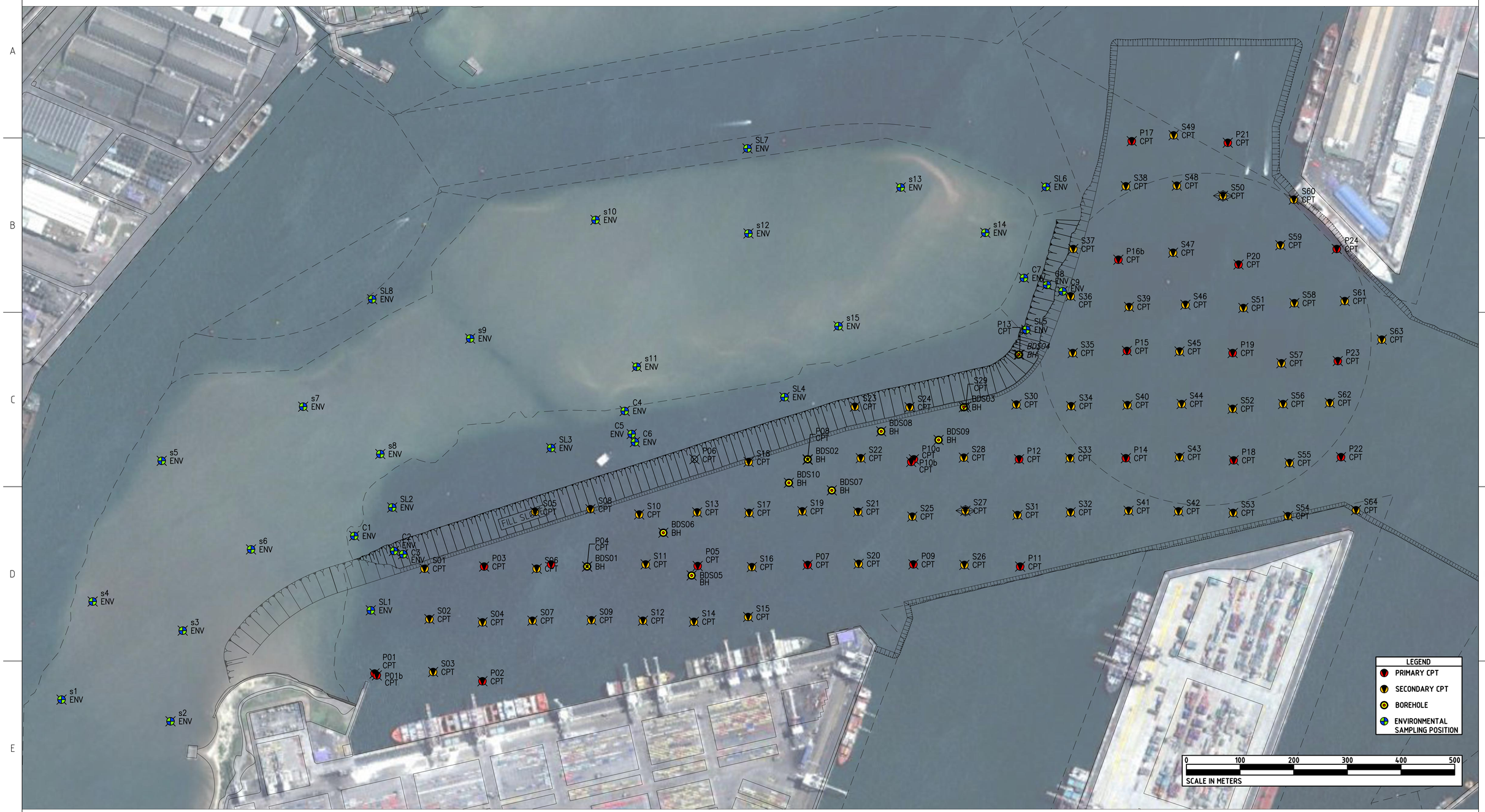
TRANSNET

DCT BERTH 203 to 205 RECONSTRUCTION
DEEPENING AND LENGTHENING
GEOTECHNICAL INVESTIGATION
GEOLOGICAL LONG SECTION WITH
SPT RESULTS – RETURN QUAY

PROJECT NUMBER	DV	FBS	DIS.	TYPE	DRG. NO.	SHT.	REV.	ID
2122830-1		026	C	GA	0002	02	0A	

DRAWING NUMBER

DO NOT SCALE - IF IN DOUBT, ASK



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NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
P00	ISSUED FOR INFORMATION	AS	MC	JZ	16.05.31

REVISIONS / ISSUE AUTHORIZATION

EPCM CONSULTANT: TCP				ORIGINATOR: ZAA			
TITLE	NAME	SIGNATURE	DATE	TITLE	NAME	SIGNATURE	DATE
LEAD DES. ENG.				DRAWN	WV		16.05.31
ENG. COORD.				CHECKED	AS		16.05.31
ENG. MANAGER				ENG. COORD.	MC		16.05.31
AREA MANAGER				DISCIP. ENG.			
PROJECT MGR.				ENG. MANAGER			
DIVISION				AREA MANAGER			
DIV.	TITLE	NAME	SIGNATURE	DATE			
					PR.ENG. / PR.TECH.		
					NAME	J. ZIETSMAN	DATE
					SIGNATURE		16.05.31
					REG. NUMBER	760293	
					SCALE :	1:750 OR AS NOTED	A1

TRANSNET

DCT BERTH 203 to 205 RECONSTRUCTION DEEPENING AND LENGTHENING

GEOTECHNICAL INVESTIGATION CPTU AND BOREHOLE POSITIONS BASIN

DRAWING NO.	REFERENCE
1370-CO-180-C-DWG-0003-02	GEOLOGICAL LONG SECTION - BASIN

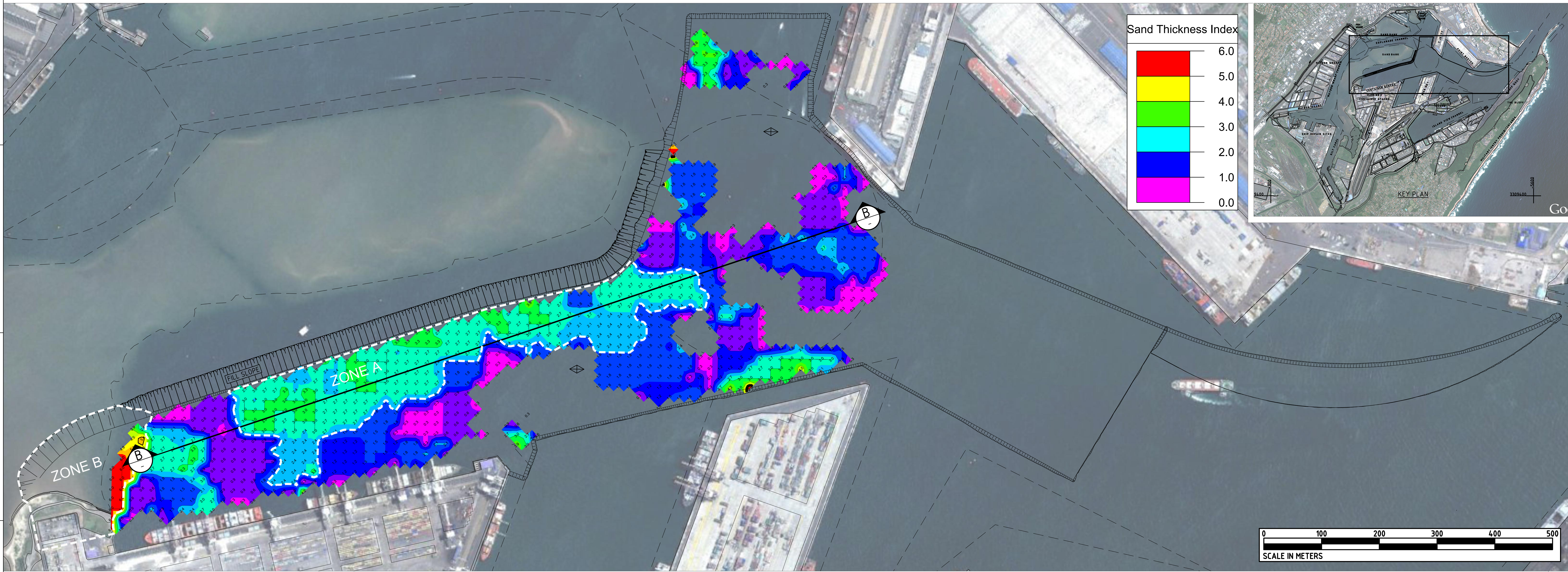
REFERENCE DRAWINGS

PROJECT NO	DIS CODE	AREA	DISP	TYPE	DRG NO	SHEET	STATUS	REV
1370	CO	180	C	DWG	0003	01	P	00

PROJECT NUMBER	DV	FBS	DIS.	TYPE	DRG. NO.	SHT.	REV.	ID
2122830	1	026	C	GA	0003	01	0A	

DO NOT SCALE - IF IN DOUBT, ASK

DRAWING NUMBER



DRAWING NO.	REFERENCE
1370-CO-180-C-DWG-0003-01	CPTU AND BOREHOLE POSITIONS

REFERENCE DRAWINGS

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PROJECT NO	DIS CODE	AREA	DISP	TYPE	DRG NO	SHEET	STATUS	REV
1370	CO	180	C	DWG	0003	02	P	00

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
P00	ISSUED FOR INFORMATION	AS	MC	JZ	16.05.31

REVISIONS / ISSUE AUTHORIZATION

EPCM CONSULTANT: TCP

TITLE	NAME	SIGNATURE	DATE
LEAD DES. ENG.			
ENG. COORD.			
ENG. MANAGER			
AREA MANAGER			
PROJECT MGR.			

DIVISION

DIV.	TITLE	NAME	SIGNATURE	DATE

ORIGINATOR: ZAA

TITLE	NAME	SIGNATURE	DATE
DRAWN	WV		16 05 31
CHECKED	AS		16 05 31
ENG. COORD.	MC		16 05 31
DISCIP. ENG.			
ENG. MANAGER			
AREA MANAGER			

PR.ENG. / PR.TECH.

NAME	J. ZIETSMAN	DATE
SIGNATURE		16 05 31
REG. NUMBER	760293	
SCALE :	1:750 OR AS NOTED	A1

TRANSNET

DCT BERTH 203 to 205 RECONSTRUCTION DEEPENING AND LENGTHENING

GEOTECHNICAL INVESTIGATION GEOLOGICAL LONG SECTION BASIN

PROJECT NUMBER	DV	FBS	DIS.	TYPE	DRG. NO.	SHT.	REV.	ID
212830	1	026	C	GA	0003	02	0A	

ANNEXURE 2: EXPLORATORY BOREHOLE LOGS

2.1: EXPLANATORY NOTE ON BOREHOLE LOGS AND SAMPLING

EXPLANATION OF BOREHOLE LOGS

This explanation describes the information provided in each of the twelve columns on the borehole logs. The explanations are applicable to ZAA's borehole logs.

An explanation of the borehole logs that form part of the FEL 2 study can be found in Annexure 5.1 of this Report. TCP Documentation No. H500272-1-221-H-RPT-0002-MJ.

The borehole naming convention is as follows:

- BD - BHM series boreholes – Marine boreholes drilled as part of Moore Spence and Johnes's FEL 2 investigation.
- BHL or BHS – Land and marine boreholes drilled as part of ZAA's FEL 3 geotechnical investigation.
- BDS – Marine dredge area boreholes drilled as part of ZAA's FEL 3 geotechnical investigation.

ELEV. (CDP)

This column indicates the elevation relative to the chart datum in the Port of Durban (CDP).

DEPTH OF THE RUN ELEV. (CDP)

The drill run depth recorded in the core boxes has been converted to chart datum in this column.

MATERIAL/CORE RECOVERY (%)

The material recovery is the measured material recovery per drill run expressed as a percentage. The core recovery columns represents the measured core recovery per drill run expressed as a percentage.

RQD (%)

The RQD (Rock Quality Designation) for rock core is presented in this column. The RQD is defined as the total cumulative lengths of all pieces of core greater than 100mm in length expressed as a percentage of the length of the drill run. Where only soil was recovered, no RQD is indicated.

FF (J/M)

The fracture frequency is the number of joints per meter per drill run. The fracture frequency is only measured in rock.

METHOD AND SAMPLE

The method of drilling and sample recovery is indicated in this column. The following abbreviated are used:

- WB - Wash boring
- SPT - Standard Penetration Test.
- Shelby – 60 mm (inner diameter) pressure tube sample
- NDW4 – 55 mm diameter, split double tube core barrel
- TNW.DT - TNW 60 mm diameter, double tube core barrel

SPT VALUE, 'N'

SPT testing was performed in accordance with ASTM D1586.

The field (uncorrected) SPT 'N'-values are recorded in this column. N=R indicates SPT refusal. Refusal was recorded if more than twenty one blows were measured per 75mm of penetration depth.

SPT 'N' BAR GRAPH

The 'N' value is shown as a bar graph.

LITHOLOGY

A combination of symbols and colours are used to differentiate thirteen different soil and rock types.

GENERAL DESCRIPTION

The soil and rock recovered is described according to standard South African practise using the methods described by Jennings, Brink and Williams (Soil Profiling for Civil Engineering in South Africa).

The depth of each soil and rock layer is shown relative to CDP.

REMARKS

Additional remarks, generally on small variations in soil type are given in these columns. 2.

DEPTH (MBGL- METERS BELOW GROUND LEVEL) OR DEPTH (MBPL – METERS BELOW PLATFORM LEVEL)

For land boreholes (BHL01 to BHL09), the depths in this column are given in meters below ground level (mbgl) at the drill positions.

For marine boreholes (BHS01 to BHS03 & BD-BHM206 to BD-BHM211 & BDS01 to BDS01 to BDS10), the depth is given in meters below platform level.

In both cases, the drill run depths in the core boxes are relative to these depths.

SAMPLE STORAGE AND PREPARATION

Cohesive samples contained in Shelby tubes were sealed with wax upon extraction from the borehole.

Core and wash bore samples were placed into airtight plastic bags. In both instances samples were labelled with a permanent marker indicating sample name and depth.

The samples are stored in labelled core boxes..

2.2: FAIRBROTHER GEOTECHNICAL METHOD STATEMENT

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MARINE BASED GEOTECHNICAL DRILLING AND CONE PENETROMETER TEST.
PIER 2 DURBAN HARBOR

METHOD STATEMENT
REVISION: 001

This method statement describes the procedures and equipment used for marine based geotechnical drilling and cone penetrometer tests on a self-erecting work platform.

1. SCOPE OF WORK:
- Marine based drilling of geotechnical borehole and cone penetrometer tests.

2. AREA OF WORK:
- CPTu sampling will take place at 25 metre intervals along a line at 25metre in front (seaward) of Pier 2 in Durban Harbour.

3. EQUIPMENT TO BE USED:
- Gouritz-F SEWP (Self-Erecting Work platform) with power pack.
- CPTu cylinder
- HD300 (Rotary Drill Rig)
- Rotary coring tools (N-size)
- Standard Penetration Test Equipment
- OSIMO CPTu equipment
- Safety equipment and personal protective equipment

4. ESTABLISHMENT OF PLANT:
- Transporting equipment to site.
- Offloading of equipment with rear mounted crane.
- Construction of self-erecting work platform.
- Lifting of Gouritz-F with mobile crane into harbor.
- Move equipment to designated area.

5. PREPARATION OF EQUIPMENT:
- The Gouritz-F platform will be placed alongside the quay wall at a position convenient to the operations management.
- The Gouritz–F platform will be towed to sampling positions in a sequence determined by operations management so as to minimize any disruption to shipping.
- The mobile crane will be used to lower the four legs into place. Each leg will be mechanically locked until the hydraulic system is in place and commissioned.
- All equipment will be lifted and fitted using the mobile crane.
- One crew boat with an independent skipper will be employed.
- The Gouritz-F will be towed using two lines each at least 30m in length.
- The drilling supervisor will control the speed of the Gouritz-F and in contact with the skipper by means of a two-way radio.
- Once the Gouritz-F is in position, at the first approved sampling location, it will be lifted by using the hydraulically operated legs and that the platform is at least 3m above chart datum.
- Locking pins will be inserted into the appropriate holes in the legs.
- Once all four legs are in place and secure, CPTu sampling operations will commence.

6. OPERATIONS METHOD:

- **CONE PENETROMETER TESTS (39 number)**
  - The boom will be vertically positioned.
  - CPTu Casings will be lowered into the water until it reached the ocean bed.
  - The CPTu probes will be lowered into the casing until it reached the ocean bed.
  - The CPTu casings will be connected to the hydraulic unit.
  - The probe (with the casings) will be hydraulically pressed to refusal depth.
  - Electronic readings will be taken continuously and presented to the consultant at completion of the test.

- **BOREHOLE DRILLING (1 number)**
  - The drill will be vertically positioned at the selected site (CPT profile determined by site Geologist).
  - The drill will be fitted with the appropriate drilling tools: (N-size)
  - SPT sampling will commence at 1metre depth intervals to the required depth at bedrock
  - Undisturbed Shelby samples will be taken at depth intervals specified by the site Geologist.
  - The drill tools will be extracted from the hole.
  - All samples will be marked, documented and packed in core boxes

- **STANDARD PENETRATION TESTING**
  - The Raymond spoon will be fitted to the drilling rods.
  - The SPT- hammer is self-tripping and drops a 63.5kg weight through 750mm.
  - Sampling will be conducted at 1.0 metre depth intervals through to bedrock depth.
  - On removal, the split tube will be opened and logged by the site Geologist. Thereafter, the sample will be plastic wrapped.
  - All samples will be marked, documented and packed in core boxes.

7. DE ESTABLISMENT OF PLANT:

- The legs of the Gouritz-F will be lowered.
- Tow the Gouritz-F with vessel to the quay.
- Remove legs from the leg guides with the mobile crane and place on the quay.
- Lifting the power pack, HD300 and equipment with the mobile crane.
- Dismantle the Gouritz-F.
- Loading of equipment with rear mounted crane
- Transporting equipment from site.

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LAND BASED GEOTECHNICAL DRILLING
AT PIER 2 DURBAN HARBOR

METHOD STATEMENT
REVISION: 001

This method statement describes the procedures and equipment used for Geotechnical Rotary drilling.

1. SCOPE OF WORK:
- Drilling of two (2) geotechnical boreholes into required areas

2. AREA OF WORK:
- Drilling will take place Durban Harbor; (Pier 2 Container Terminal).

3. EQUIPMENT TO BE USED:
- HD300 (Rotary drill rig)
- Rotary coring tools (N-size)
- SPT sampler.
- Shelby sample tubes (63mm diameter).
- Safety equipment and personal protective equipment

4. ESTABLISHMENT OF PLANT:
- Transporting HD300 and equipment to site.
- Offloading of equipment with Rear mounted crane.
- Move equipment to designated area.

5. PREPARATION OF PLANT:
- All holes will be vertically drilled.
- All holes will be pre-set out.

6. OPERATIONS METHOD:
- The drill will be placed on the first drilling position with the boom vertical.
- The drill will be fitted with the appropriate drilling tools (P-size)
- SPT sampling will commence at 1.0m depth intervals.
- Wash boring will be conducted between SPT sample depths.
- Shelby undisturbed samples will be taken in cohesive horizons as per site geologist instructions.
- Upon hole completion at bedrock (2m penetration into), the drill tools will be extracted from the hole and the drill will be moved to the next drilling position.
- All samples will be marked, documented and packed in core boxes.

7. DE ESTABLISHING OF PLANT:
- Loading of equipment with Rear mounted crane
- Transporting equipment from site.

Members: I J **Fairbrother** B Sc Eng(Civ), **PC Fairbrother** B Com C.A.(S.A.) A.C.M.A., **A. Meerburg** NHD(Civil)
CK 85/03036/23

- **SPT Sample.**
  - Using a Raymond Split-spoon connected onto the rod lowered into hole using rig winch.
  - Connect drop weight onto drill rods and lift with rig winch.
  - Ensure that the weight is locked with a d-shackle before lifting.
  - Guide weight safely into position.
  - Fasten weight on rods.
  - Mark SPT measurements with chalk on the rods.
  - The measurements must be 75mm intervals at a total penetration length of 450mm.
  - Lifting weight using the winch.
  - A 63.5kg monkey falling through 760mm.
  - The drop weight shall be free-falling with one central guide.
  - Recording number of blows per 75mm intervals up to 450mm or refusal.
  - Remove Weight.
  - Extraction of Raymond-spoon by using the winch.
  - Strip Raymond-spoon to recover SPT sample.
  - SPT sample will be place into clear plastic, sealed off and place into sample boxes and the depth will be clearly marked on the core blocks.

- The above mentioned method will be continued until competent soils are encountered.

- **Using of core barrels (TNW, NWD4) in competent soils.**
  - When rock is encountered a core barrel will be used to drill and extract samples.
  - Connect rods to core barrel and lift using the rig winch.
  - Lower drill rods with diamond core bit and core barrel to bottom of hole.
  - Use stilsens the lock the rod to prevent the rod from falling into the drilled hole during the next connection.
  - When reaching bottom of hole connect to the rod inside rotation unit.
  - Remove all tools from Rods and rotation.
  - Start-up mono pump and check water circulation.
  - Start-up drilling process.
  - Drill 1.5m and detached rods from rotation unit.
  - Extract the rods using the rig winch from the hole and use stilsens to loosen the rods.
  - Place rods at safe area.
  - Strip core barrel using stilsens.
  - Remove sample from core barrel and ensure no contamination of sample.
  - Place sample in clear plastic, sealed off and place into sample box and the depth will be clearly marked on the core blocks.
  - Continue above process until required depth, instructed by the client is reached.

SAFE WORK INSTRUCTION

Subject: Diamond Core Drilling.
Number: **SWI007**

	Ref/Resp
1.0 What is it?	
• The instruction to diamond core drilling.	
2.0 Why is it performed?	
• To ensure the safety of operators and assistants during diamond core drilling.	
3.0 When is it performed?	
• When samples of soil material are required by clients at designated areas.	
4.0 How is it performed?	
• **Loading and offloading of drill rigs and equipment.**	
• Safe work instruction to be followed and adhere to.	Truck Driver (Compelent)
• **Setup of drill rigs and equipment.**	
• Attached derrick (Boom) by using crane truck.	Operator
• Stabilize rigs by using cables, pens and turn buckles.	
• Inspection on drill rig and grease all required areas.	
• Ensure that the rig is fitted onto a drip pan to prevent any soil pollution.	
• Dig sump for water circulation and use plastic sheet or use the specified circulation tank.	
• Attached mono pump onto drill rig.	
• Attached hoses to mono pump and water swivel at the rotation unit.	
• Fill sump or circulation tank with clean water and additional 1000L tank.	
• Start-up rig.	
• Fit starter NX Casing.	
• Check water circulation and add drill mix.	
• **Drilling of Borehole for sampling.**	
• Fit 1m interval NX casing to drill rig rotation.	
• Start drilling into required marked position.	
• Start-up water circulation at Mono pump.	
• Ensure that the water and drill mix always circulate from the hole into the sump or circulation tank to prevent the casing and rods from getting stuck or damaged inside hole.	
• When soil is soft a wash sample will be taken and a SPT will be carried out.	
• Loosen casing-head with stilsen and remove from casing.	

- **Core Orientation (IF REQUIRED)**
  - Insert plasticized clay into a core orientator.
  - Lowered into bottom of borehole using the rig winch with caution.
  - Ensure that the orientator reached bottom of hole.
  - Extract Orientator from the bore hole with rig winch cable.
  - Detached orientator from cable.
  - Place orientator with plasticized clay in cool area to prevent the clay from deforming.

- **Completion of hole**
  - After required depth of client is reached NX casing must be removed using the rig winch.
  - Loosen casing using stilsens.
  - Place all casing at safe flat area.
  - Clean sump and remove plastic liner where applicable.
  - Clear work area and ensure all equipment and rubbish is cleared.

- **Loading of equipment.**
  - Loading of all equipment onto truck and moved to next specified area.

Safety requirements:

Hazard	Risk	Control
Slipping conditions when working	Body Injury	Clean and stable operating area.
Falling equipment	Head Injury	Hard hats to be warn
Moving parts	Body injury	Clear from rotation and moving parts
Slipping stilsens	Hand and body injury	Checklist of equipment and using gloves
Moving casings and sleeves	Falling onto workers causing body injury	Competent Operators and equipment inspections
Lifting heavy equipment	Back and body injury when equipment fall	Using of winch and straps to guide rods and casings




2.3: BOREHOLE LOGS – QUAY WALL

EXPLORATORY BOREHOLE LOGS – QUAY WALL

BH	Location	End	Start depth	End depth	y	x
-	-	-	CDP	CDP	-	-
BHL01	Land	2012/03/25	3.720	-48.780	-1177.11	3306779.02
BHL02	Land	2012/07/18	3.671	-38.780	-1331.30	3306765.10
BHL03	Land	2012/07/12	3.482	-39.780	-1303.90	3306770.90
BHL04	Land	2012/06/25	3.417	-49.780	-1265.50	3306776.90
BHL05	Land	2012/06/18	3.457	-51.780	-1233.80	3306797.40
BHL06	Land	2012/07/07	3.630	-42.780	-1172.00	3306824.20
BHL07	Land	2012/07/01	3.180	-45.780	-1168.00	3306760.40
BHL08	Land	2012/08/13	3.380	-48.280	-1151.00	3306715.00
BHL09	Land	2012/08/18	2.410	-46.280	-1132.00	3306693.00
BHS01	Marine	2012/07/22	2.595	-38.405	-1357.87	3306773.03
BHS02	Marine	2012/07/27	2.689	-48.311	-1554.20	3306694.60
BHS03	Marine	2012/07/15	3.060	-64.440	-2230.81	3306549.66
BHS04	Marine	2012/10/19	2.666	-36.934	-1466.00	3306720.00
BHS05	Marine	2012/10/16	2.500	-46.100	-1634.00	3306680.00
BHS06	Marine	2012/10/14	2.700	-58.300	-1778.59	3306654.11
BD-BHM-206	Marine	2008/08/12	*-12.900	-65.810	-1919.43	3306642.01
BD-BHM-207	Marine	2008/07/03	*-16.010	-67.400	-2018.85	3306617.19
BD-BHM-208	Marine	2008/07/02	*-13.118	-33.668	-2096.11	3306605.56
BD-BHM-209	Marine	2008/07/04	*-13.010	-74.110	-2218.11	3306577.19
BD-BHM-210A	Marine	2008/09/25	*-13.205	-80.705	-2280.97	3306551.30
BD-BHM-211	Marine	2008/07/21	*-12.187	-73.727	-2356.11	3306547.08

Note: * Indicates sea floor depth in CDP

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL01

Start Date	2012/03/19	**End Date**	2012/03/25
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.72 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306779.02
Drilling -	Fairbrother		Y: -1177.11
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
3.00	2.220	-	-	-	WB				(3.72, 1.93) Slightly moist, light brown-grey, cohesionless, loose (estimate), Medium SAND with minor gravel fill and shell fragments (<1mm). Imported, SAND FILL.		0.00
2.00	1.925	78	-	-	SPT	N=R					1.00
1.00	0.720	-	-	-	WB				(1.93, -13.53) Moist to Wet, pale yellow-brown to light grey, cohesionless, generally medium dense (locally very or dense), thickly bedded, medium to Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits. (Many shell fragments in upper portions).	+1.925 CDP: Approximate FILL / IN SITU contact	2.00
	0.270	47	-	-	SPT	N=12					3.00
0.00	-0.280	-	-	-	WB						
	-0.730	33	-	-	SPT	N=11					4.00
-1.00	-1.280	-	-	-	WB						
	-1.730	78	-	-	SPT	N=35					5.00
-2.00	-2.280	-	-	-	WB						
	-2.730	67	-	-	SPT	N=31					6.00
-3.00	-3.280	-	-	-	WB						
	-3.730	73	-	-	SPT	N=55					7.00
-4.00	-4.280	-	-	-	WB					-3.280 to -5.655 CDP: Cohesionless, very dense, clayey Fine SAND.	
	-4.580	100	-	-	SPT	N=R					8.00
-5.00	-5.280	-	-	-	WB						
	-5.655	88	-	-	SPT	N=R					9.00
-6.00	-6.280	-	-	-	WB						
	-6.730	29	-	-	SPT	N=5					10.00
-7.00	-7.280	-	-	-	WB						
	-7.730	-	-	-	SPT	N=19					11.00
-8.00	-8.280	-	-	-	WB						
	-8.730	67	-	-	SPT	N=46					12.00
-9.00	-9.280	-	-	-	WB						
	-9.730	22	-	-	SPT	N=2					13.00
-10.00	-10.280	-	-	-	WB						
	-10.730	78	-	-	SPT	N=35					14.00
-11.00	-11.280	-	-	-	WB						
	-11.730	73	-	-	SPT	N=35					15.00
-12.00	-12.280	-	-	-	WB						
	-12.730	67	-	-	SPT	N=0					16.00
-13.00	-13.280	-	-	-	WB						
	-13.880	100	-	-	SPT	N=0			(-13.53, -27.78) Very moist, dark grey, cohesive, very soft, silty CLAY with minor & isolated nodules & shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		17.00
-14.00	-14.280	-	-	-	WB						
	-15.080	44	-	-	SPT	N=1					18.00
-15.00		-	-	-	WB						
	-16.080	75	-	-	SPT	N=0					19.00
-16.00		-	-	-	WB						
	-16.880	86	-	-	SHELBY S01						20.00
-17.00	-17.680	-	-	-	SPT	N=0					21.00
		-	-	-	WB						
-18.00	-18.380	86	-	-	SHELBY S02						22.00
	-18.830	-	-	-	SPT	N=1					
-19.00	-19.480	-	-	-	SHELBY (n/s)						23.00
-20.00	-20.380	-	-	-	SHELBY (n/s)						24.00
-21.00	-21.380	-	-	-	SPT	N=0					25.00
	-21.780	-	-	-	WB						
-22.00	-22.380	60	-	-	SHELBY S03						26.00
	-22.830	133	-	-	SPT	N=0					
-23.00	-23.480	92	-	-	SHELBY S04						27.00
-24.00	-24.080	100	-	-	SPT	N=2					28.00
		-	-	-	WB						
	-24.880	75	-	-	SHELBY S05						29.00
-25.00	-25.330	133	-	-	SPT	N=3					
-26.00	-25.980	92	-	-	SHELBY S06						30.00
	-26.430	133	-	-	SPT	N=2					
-27.00	-27.080	92	-	-	SHELBY S07						31.00
	-27.530	111	-	-	SPT	N=6					
		-	-	-	WB						
-28.00	-28.230	86	-	-	SPT	N=0			(-27.78, -37.53)		32.00

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205

Borehole No.: 1370 BHL01

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL01

Start Date	2012/03/19	**End Date**	2012/03/25
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.72 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306779.02
Drilling -	Fairbrother		Y: -1177.11
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (mbgl)
	-28.780	100	-	-	TNW				Very moist, dark grey, cohesive, very soft, silty CLAY alternating with sandy clay horizons. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		32.00
-29.00	-29.230	71	-	-	SPT	N=4					33.00
	-29.780	80	-	-	TNW						
-30.00	-30.230	100	-	-	SPT	N=3					34.00
	-30.780	-	-	-	WB						
-31.00	-31.230	-	-	-	SPT	N=9					35.00
	-31.780	-	-	-	WB						
-32.00	-32.380	58	-	-	SPT	N=0					36.00
	-32.780	-	-	-	WB						
-33.00	-33.230	111	-	-	SPT	N=4					37.00
-34.00	-34.280	95	-	-	TNW						38.00
	-34.730	122	-	-	SPT	N=0					
-35.00	-35.780	-	-	-	WB						39.00
-36.00	-36.230	100	-	-	SPT	N=17					40.00
-37.00	-37.280	-	-	-	WB						41.00
	-37.730	89	-	-	SPT	N=58			(-37.53, -48.78)		
-38.00	-38.280	-	-	-	WB				Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation.		42.00
-39.00	-39.780	99 / 83	77	5	NWD4				No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons.		43.00
-40.00	-41.280	79 / 79	63	5	TNW.DT				Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous.		44.00
-41.00											45.00
-42.00	-42.780	62 / 60	47	5	NWD4				Note the presence of fossil shells and imprints associated with, but not confined to, hard calcrete layers.		46.00
-43.00	-44.280	51 / 46	37	5	TNW.DT						47.00
-44.00											48.00
-45.00	-45.780	65 / 43	31	4	NWD4						49.00
-46.00	-47.280	93 / 89	77	3	TNW.DT						50.00
-47.00											51.00
-48.00	-48.780	85 / 85	85	3	NWD4					END OF BOREHOLE (-48.78 CDP / 52.50 mbgl)	52.00

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHL01

1370-BHL01: Box 1 of 6

1370-BHL01: Box 2 of 6

1370-BHL01: Box 3 of 6

1370-BHL01: Box 4 of 6

1370-BHL01: Box 5 of 6

1370-BHL01: Box 6 of 6

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL02

Start Date	2012/07/14	**End Date**	2012/07/18
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.671 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306765.10
Drilling -	Fairbrother		Y: -1331.30
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
3.00	1.720	-	-	-	WB				(3.67, 1.67) Slightly moist (estimate), brown grey speckled orange & white, cohesionless, medium Coarse SAND with gravel. Imported, SAND FILL.		0.00
	1.270	80	-	-	SPT	N=70			(1.67, -13.53) Moist, light brown grey, cohesionless, generally medium dense (locally very loose or very dense), layered, medium Fine SAND. Imported, SAND FILL.	Some conspicuous shell rich layers	1.00
2.00	0.720	-	-	-	WB						2.00
1.00	0.270	60	-	-	SPT	N=19					3.00
	-0.280	-	-	-	WB						4.00
0.00	-0.730	73	-	-	SPT	N=21					5.00
	-1.280	-	-	-	WB						6.00
-1.00	-1.730	67	-	-	SPT	N=14					7.00
	-2.280	-	-	-	WB						8.00
-2.00	-2.730	58	-	-	SPT	N=19					9.00
	-3.280	-	-	-	WB						10.00
-3.00	-3.730	67	-	-	SPT	N=15					11.00
	-4.280	-	-	-	WB						12.00
-4.00	-4.730	47	-	-	SPT	N=14					13.00
	-5.280	-	-	-	WB						14.00
-5.00	-5.580	100	-	-	SPT	N=R					15.00
	-6.280	-	-	-	WB						16.00
-6.00	-6.730	62	-	-	SPT	N=17					17.00
	-7.280	-	-	-	WB						18.00
-7.00	-7.730	67	-	-	SPT	N=20					19.00
	-8.280	-	-	-	WB						20.00
-8.00	-8.730	44	-	-	SPT	N=26					21.00
	-9.280	-	-	-	WB						22.00
-9.00	-9.730	62	-	-	SPT	N=25					23.00
	-10.280	-	-	-	WB						24.00
-10.00	-10.730	60	-	-	SPT	N=31					25.00
	-11.280	-	-	-	WB						26.00
-11.00	-11.730	71	-	-	SPT	N=36					27.00
	-12.280	-	-	-	WB						28.00
-12.00	-12.730	67	-	-	SPT	N=0					29.00
	-13.280	-	-	-	WB						30.00
-13.00	-13.730	73	-	-	SPT	N=0			(-13.53, -14.78) Moist, dark brown grey, slightly cohesive, very soft, clayey SAND. Imported, SAND FILL.		31.00
	-14.280	-	-	-	WB						32.00
-14.00	-14.730	71	-	-	SPT	N=0					
	-15.280	49	-	-	NWD4				(-14.78, -18.33) Dolerite & Tillite BOULDERS. Imported, BOULDER FILL. Clayey SAND (assumed) matrix material washed away during drilling.		
-15.00	-15.580	33	-	-	SPT	N=R					
	-16.280	57	-	-	NWD4						
-16.00	-16.710	53	-	-	NWD4						
	-17.280	75	-	-	NWD4						
-17.00	-18.280	10	-	-	NWD4						
	-18.730	118	-	-	SPT	N=0			(-18.33, -20.78) Slightly moist, dark brown grey, cohesive, very soft, friable, silty CLAY with intermittent & isolated nodules and shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-18.280 CDP: Approximate FILL / IN SITU contact	
-18.00	-19.280	-	-	-	WB						
	-19.880	100	-	-	Shelby S01						
-19.00	-20.280	-	-	-	WB						
	-20.730	129	-	-	SPT	N=0					
-20.00	-21.280	-	-	-	WB				(-20.78, -28.41) Moist, brown grey banded turquoise & orange brown, slightly cohesive, generally medium dense (locally very loose or very dense), bedded, clayey SAND with sandy clay & fine sand beds. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-21.730	29	-	-	SPT	N=0					
-21.00	-22.280	-	-	-	WB						
	-22.730	38	-	-	SPT	N=22					
-22.00	-23.280	-	-	-	WB						
	-23.730	73	-	-	SPT	N=18					
-23.00	-24.280	-	-	-	WB						
	-24.880	75	-	-	Shelby S02					-24.280 to -25.280 CDP: Cohesionless, fine SAND.	
-24.00	-25.280	-	-	-	WB						
	-25.730	40	-	-	SPT	N=37					
-25.00	-26.280	-	-	-	WB						
	-26.730	124	-	-	SPT	N=45					
-26.00	-27.280	-	-	-	WB						
	-27.730	111	-	-	SPT	N=15					
-27.00	-28.280	-	-	-	WB				(-28.41, -29.83)		
-28.00											

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHL02

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL02

Start Date	2012/07/14	**End Date**	2012/07/18
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.671 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306765.10
Drilling -	Fairbrother		Y: -1331.30
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (mbgl)
	-28.655	83	-	-	SPT	N=R					32.00
-29.00	-29.780	71 / 0	0	-	NWD4				Grey & orange brown, slightly weathered, medium hard rock, CALCRETE. No definitive fabric, typical of calcrete cementation of subaerial sands. Many voids filled with material as above.		33.00
-30.00	-31.280	80 / 0	0	-	NWD4				(-29.83, -31.33) Slightly moist, olive green brown, cohesionless, very dense, fine sandy SILT. Residual, St Lucia Fm.		34.00
-31.00	-32.780	56 / 55	51	4	NWD4				(-31.33, -38.83) Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard calcrete layers.		35.00
-32.00	-34.280	33 / 22	9	5	NWD4						36.00
-33.00	-35.780	100 / 72	61	7	NWD4						37.00
-34.00	-37.280	100 / 51	45	4	NWD4						38.00
-35.00	-38.780	100 / 96	79	11	NWD4						39.00
-36.00										END OF BOREHOLE (-38.78 CDP / 42.50 mbgl)	40.00
-37.00											41.00
-38.00											42.00

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Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHL02

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1370-BHL02: Box 2 of 5

1370-BHL02: Box 3 of 5

1370-BHL02: Box 4 of 5

1370-BHL02: Box 5 of 5

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL03

Start Date	2012/07/09	**End Date**	2012/07/12
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.482 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306770.90
Drilling -	Fairbrother		Y: -1303.90
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
3.00	1.720	-	-	-	WB				(3.48, -2.52) Slightly moist, light brown grey, cohesionless, very dense to loose, layered, medium Fine SAND with shell fragments. Imported, SAND FILL.	+0.720 to +0.270 CDP: Intermittent pebbles (5 to 20 mm)	0.00
2.00	1.270	60	-	-	SPT	N=51					1.00
1.00	0.720	-	-	-	WB						2.00
0.00	0.270	56	-	-	SPT	N=39					3.00
-1.00	-0.280	-	-	-	WB						4.00
-2.00	-0.730	40	-	-	SPT	N=7					5.00
-3.00	-1.280	-	-	-	WB						6.00
-4.00	-1.730	51	-	-	SPT	N=6					7.00
-5.00	-2.280	-	-	-	WB					-2.280 CDP: Approximate FILL / IN SITU contact.	8.00
-6.00	-2.730	44	-	-	SPT	N=20			(-2.52, -6.97) Moist, light brown grey, cohesionless, dense to very dense, layered, medium Fine SAND with intermittent shell fragments and clay lenses. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		9.00
-7.00	-3.280	-	-	-	WB						10.00
-8.00	-3.730	56	-	-	SPT	N=53					11.00
-9.00	-4.280	-	-	-	WB						12.00
-10.00	-4.730	44	-	-	SPT	N=33					13.00
-11.00	-5.280	-	-	-	WB						14.00
-12.00	-5.730	67	-	-	SPT	N=38					15.00
-13.00	-6.280	-	-	-	WB						16.00
-14.00	-6.730	76	-	-	SPT	N=68					17.00
-15.00	-7.280	-	-	-	WB				(-6.97, -10.52) Moist, grey & dark grey, slightly cohesive, very soft, layered, clayey Fine SAND with clayey silt. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		18.00
-16.00	-7.730	82	-	-	SPT	N=0					19.00
-17.00	-8.280	-	-	-	WB						20.00
-18.00	-8.730	89	-	-	SPT	N=2					21.00
-19.00	-9.280	-	-	-	WB						22.00
-20.00	-9.880	67	-	-	Shelby S01						23.00
-21.00	-10.280	-	-	-	WB						24.00
-22.00	-10.730	89	-	-	SPT	N=23			(-10.52, -13.97) As for -2.28 to -6.73 CDP: Cohesionless, fine SAND.		25.00
-23.00	-11.280	-	-	-	WB						26.00
-24.00	-11.730	73	-	-	SPT	N=52					27.00
-25.00	-12.280	-	-	-	WB						28.00
-26.00	-12.730	56	-	-	SPT	N=36					29.00
-27.00	-13.280	-	-	-	WB						30.00
-28.00	-13.730	49	-	-	SPT	N=44					31.00
	-14.280	-	-	-	WB				(-13.97, -15.52) As for -6.73 to -10.28 CDP: Slightly cohesive, clayey silty Fine SAND.		32.00
	-14.730	111	-	-	SPT	N=1					
	-15.280	-	-	-	WB						
	-15.730	100	-	-	SPT	N=0			(-15.52, -22.52) Slightly moist, dark brown grey, cohesive, very soft, (pasty), silty CLAY with intermittent & isolated nodules and shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-16.280	-	-	-	WB						
	-16.880	100	-	-	Shelby S02						
	-17.280	-	-	-	WB						
	-17.730	100	-	-	SPT	N=0					
	-18.280	-	-	-	WB						
	-18.730	111	-	-	SPT	N=0					
	-19.280	-	-	-	WB						
	-19.730	93	-	-	SPT	N=0					
	-20.280	-	-	-	WB						
	-20.730	100	-	-	SPT	N=1					
	-21.280	-	-	-	WB						
	-21.730	93	-	-	SPT	N=7					
	-22.280	-	-	-	WB						
	-22.730	-	-	-	SPT	N=7			(-22.52, -26.52) Moist, green brown & turquoise & orange brown, cohesionless, loose (medium dense in places), layered, silty Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-23.280	-	-	-	WB						
	-23.880	100	-	-	Shelby S03						
	-24.280	-	-	-	WB						
	-24.730	53	-	-	SPT	N=9					
	-25.280	-	-	-	WB						
	-25.730	73	-	-	SPT	N=23					
	-26.280	-	-	-	WB						
	-26.730	96	-	-	SPT	N=16			(-26.52, -27.97) Silghtly moist, dark grey, cohesive, stiff to very stiff, friable, clayey SILT with clayey fine sand. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-27.280	-	-	-	WB						
	-27.730	100	-	-	SPT	N=39					
	-28.280	-	-	-	WB				(-27.97, -30.52)		

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205

Borehole No.: 1370 BHL03

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

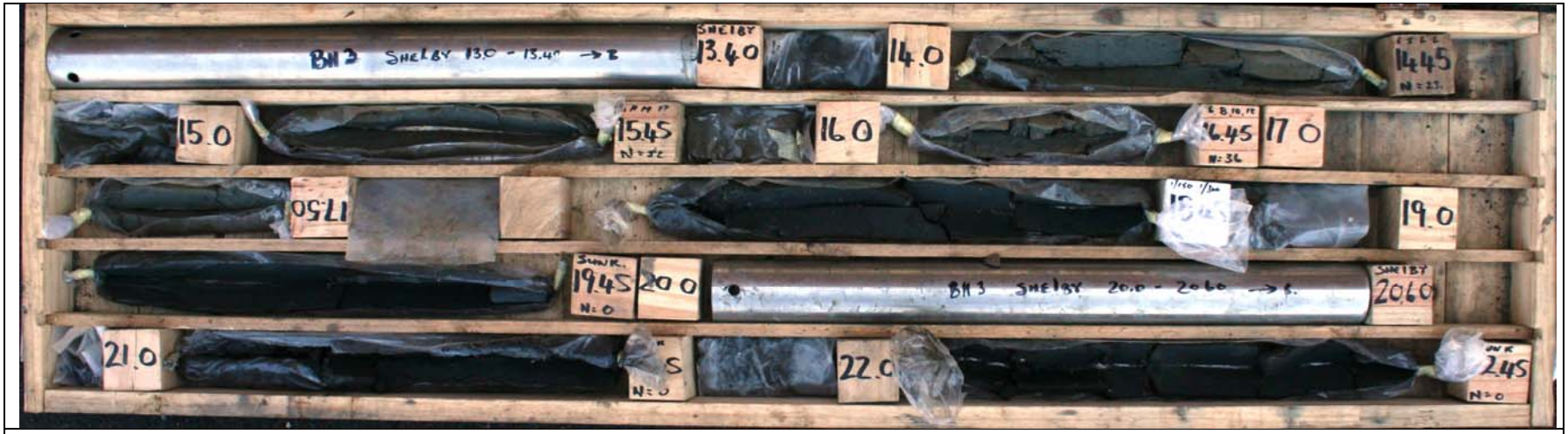
Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL03

Start Date	2012/07/09	**End Date**	2012/07/12
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.482 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306770.90
Drilling -	Fairbrother		Y: -1303.90
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
-29.00	-28.730	82	-	-	SPT	N=46			As for -22.28 to -26.28 CDP: Cohesionless, silty Fine SAND.		32.00
	-29.280	-	-	-	WB						
	-29.730	71	-	-	SPT	N=34					33.00
-30.00	-30.280	-	-	-	WB						
	-30.730	67	-	-	SPT	N=32					34.00
-31.00	-31.280	-	-	-	WB				(-30.52, -32.82) Slightly moist, olive green brown, cohesionless, very dense, fine sandy SILT. Residual, St Lucia Fm.	-31.280 to -31.680 CDP: Calcrete lens	35.00
-32.00	-32.280	40	-	-	NWD4						
	-32.580	80	-	-	SPT	N=R					36.00
-33.00	-33.780	93 / 87	59	13	NWD4				(-32.82, -40.02) Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard calcrete layers.	-33.380 to -33.610 CDP: Calcrete lens	37.00
-34.00											
-35.00	-35.280	60 / 53	7	12	NWD4						38.00
-36.00	-36.780	31 / 25	11	5	NWD4					-36.480 to -36.650 CDP: Calcrete lens	39.00
-37.00											40.00
-38.00	-38.280	29 / 15	8	1	NWD4						41.00
-39.00	-39.780	88 / 57	51	6	NWD4					END OF BOREHOLE (-39.78 CDP / 43.50 mbgl)	42.00
-40.00											43.00

1370-BHL03: Box 1 of 4



1370-BHL03: Box 2 of 4

1370-BHL03: Box 3 of 4

1370-BHL03: Box 4 of 4

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL04

Start Date	2012/06/19	**End Date**	2012/06/25
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.417 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306776.90
Drilling -	Fairbrother		Y: -1265.50
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
3.00	2.420	100	-	-	160 mm Coring Bit				(3.42, 2.12) Concrete Slab		0.00
2.00	0.720	-	-	-	WB				(2.12, -2.58) Moist, light brown grey, cohesionless, loose, layered, medium Fine SAND with shell fragments. Imported, SAND FILL.		1.00
1.00	0.270	44	-	-	SPT	N=8					2.00
0.00	-0.280	-	-	-	WB						3.00
-1.00	-0.730	56	-	-	SPT	N=7					4.00
	-1.280	-	-	-	WB						
-2.00	-1.730	42	-	-	SPT	N=9					5.00
	-2.280	-	-	-	WB						6.00
-3.00	-2.730	42	-	-	SPT	N=8			(-2.58, -9.03) Moist, brown grey, cohesionless, medium dense, layered, fine Medium SAND with shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-2.280 mCDP: Approximate FILL / IN SITU contact	
	-3.280	-	-	-	WB						7.00
-4.00	-3.730	60	-	-	SPT	N=24					8.00
	-4.280	-	-	-	WB						
-5.00	-4.730	58	-	-	SPT	N=28					9.00
	-5.280	-	-	-	WB						
-6.00	-5.730	76	-	-	SPT	N=34					10.00
	-6.280	-	-	-	WB						
-7.00	-6.730	60	-	-	SPT	N=24					11.00
	-7.280	-	-	-	WB					-7.280 to -8.730 CDP: Slightly cohesive, clayey silty Fine SAND.	
-8.00	-7.730	69	-	-	SPT	N=35					12.00
	-8.280	-	-	-	WB						
-9.00	-8.730	49	-	-	SPT	N=36			(-9.03, -10.58) Slightly moist, grey, slightly cohesive, very soft, friable, silty fine sandy CLAY with intermittent shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		13.00
	-9.280	-	-	-	WB						
-10.00	-9.730	78	-	-	SPT	N=0					14.00
	-10.280	-	-	-	WB						
-11.00	-10.860	100	-	-	Shelby S01				(-10.58, -13.58) As for -2.28 to -8.73 CDP: Cohesionless, fine SAND.		15.00
	-11.280	-	-	-	WB						
-12.00	-11.730	67	-	-	SPT	N=34					16.00
	-12.280	-	-	-	WB						
-13.00	-12.730	62	-	-	SPT	N=26			(-13.58, -14.58) Moist, dark brown grey, slightly cohesive, very soft, layered, silty clayey Fine SAND with shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		17.00
	-13.280	-	-	-	WB						
-14.00	-13.730	24	-	-	SPT	N=0					18.00
	-14.280	-	-	-	WB						
-15.00	-14.730	87	-	-	SPT	N=1			(-14.58, -20.58) Slightly moist, dark brown grey, cohesive, very soft, (crumbles), silty CLAY with intermittent & isolated nodules and shell fragments. Transported, estuarine-lagoonal deposits.		19.00
	-15.280	-	-	-	WB						
-16.00	-15.880	88	-	-	Shelby S02						20.00
	-16.280	-	-	-	WB						
-17.00	-16.730	100	-	-	SPT	N=0					21.00
	-17.280	-	-	-	WB						
-18.00	-17.730	89	-	-	SPT	N=0					22.00
	-18.280	-	-	-	WB						
-19.00	-18.880	100	-	-	Shelby S03						23.00
	-19.280	-	-	-	WB						
-20.00	-19.730	100	-	-	SPT	N=2					24.00
	-20.280	-	-	-	WB						
-21.00	-20.730	n/s	-	-	SPT	N=2			(-20.58, -21.88) Moist, brown grey, slightly cohesive, very soft, layered, silty sandy CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		25.00
	-21.280	-	-	-	WB						
-22.00	-21.880	25	-	-	Shelby S04				(-21.88, -26.83) Moist, banded orange brown & turquoise with grey, cohesionless, medium dense to dense, layered, clayey Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		26.00
	-22.280	-	-	-	WB						
-23.00	-22.730	44	-	-	SPT	N=29					27.00
	-23.280	-	-	-	WB						
-24.00	-23.730	38	-	-	SPT	N=38					28.00
	-24.280	-	-	-	WB						
-25.00	-24.730	87	-	-	SPT	N=20					29.00
	-25.280	-	-	-	WB						
-26.00	-25.730	64	-	-	SPT	N=19					30.00
	-26.280	-	-	-	WB						
-27.00	-26.730	91	-	-	SPT	N=12			(-26.83, -27.90) Moist, banded orange brown & turquoise, cohesive, stiff, sandy CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		31.00
	-27.280	-	-	-	WB						
-28.00	-27.730	100	-	-	SPT	N=25			(-27.90, -30.71)		32.00
	-28.280	-	-	-	WB						

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHL04

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL04

Start Date	2012/06/19	**End Date**	2012/06/25
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.417 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306776.90
Drilling -	Fairbrother		Y: -1265.50
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
-29.00	-28.730	82	-	-	SPT	N=28			As for -21.58 to -26.53 CDP: Cohesionless, clayey Fine SAND.		32.00
	-29.280	-	-	-	WB						
-30.00	-29.730	78	-	-	SPT	N=41					33.00
	-30.280	-	-	-	WB						
-31.00	-30.730	56	-	-	SPT	N=59			(-30.71, -32.58)	-30.410 to -30.730 CDP: Calcrete lens	34.00
	-31.280	-	-	-	WB				Slightly moist, olive green brown, cohesionless, very dense, fine sandy SILT. Residual, St Lucia Fm.		35.00
-32.00	-31.655	67	-	-	SPT	N=R					
	-32.280	-	-	-	WB						36.00
-33.00		70	-	-	SPT	N=R			(-32.58, -50.08)		
	-33.780	21 / 5	0	0	NWD4				Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation.		37.00
-34.00											
	-35.280	73 / 63	29	5	NWD4				No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons.	-34.410 to -34.530 CDP: Residual rock	38.00
-35.00	-35.655	83 / 0	-	-	SPT	N=R			Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous.		
-36.00										-35.580 to -35.700 CDP: Residual rock	39.00
	-36.780	80 / 57	52	9	NWD4				Note the presence of fossil shells and imprints associated with, but not confined to, hard concretionary layers.	-36.010 to -36.200 CDP: Calcrete lens	
-37.00										-36.350 to -36.780 CDP: Residual rock	40.00
-38.00	-38.280	87 / 82	65	8	NWD4					-37.790 to -37.920 CDP: Calcrete lens	41.00
-39.00										-38.130 to -38.250 CDP: Calcrete lens	
	-39.780	87 / 71	44	8	NWD4					-39.530 to -39.710 CDP: Residual rock	42.00
-40.00											43.00
-41.00	-41.280	18 / 15	13	2	NWD4						44.00
		75 / -	-	-	SPT	N=R					45.00
-42.00	-42.280	-	-	-	WB						
		100 / -	-	-	SPT	N=R					46.00
-43.00	-43.780	87 / 84	64	7	NWD4						47.00
-44.00											
-45.00	-45.280	89 / 74	74	3	NWD4						48.00
-46.00											49.00
-47.00	-46.780	75 / 70	43	7	NWD4						50.00
-48.00	-48.280	100 / 82	75	6	NWD4						51.00
-49.00											52.00
-50.00	-49.780	77 / 67	48	7	NWD4					END OF BOREHOLE (-49.78 CDP / 53.50 mbgl)	53.00

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ZAA Project Number: 1370

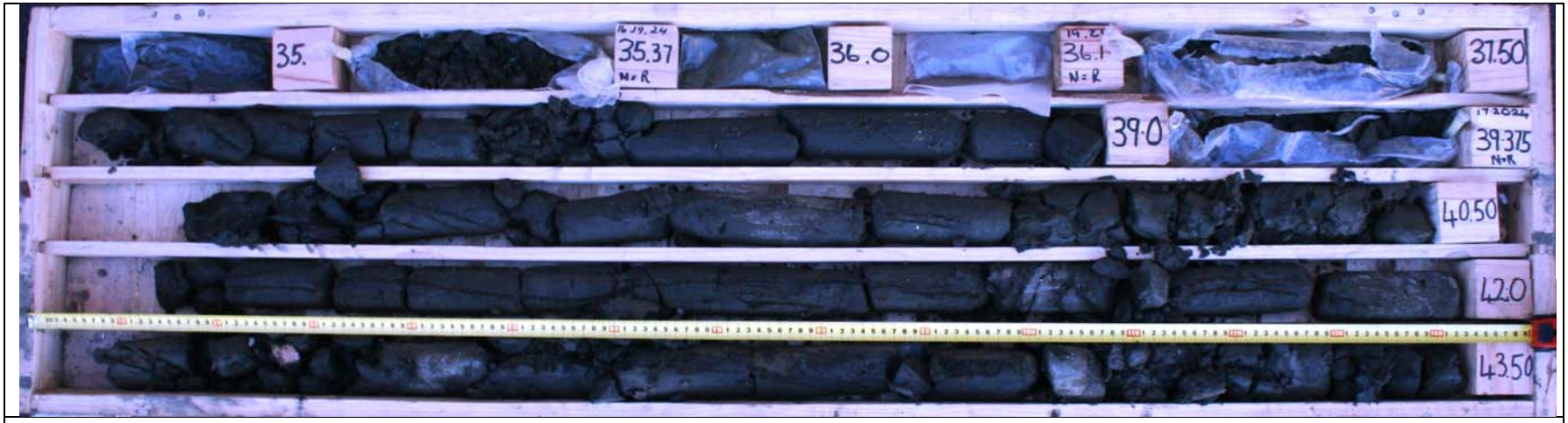
Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHL04

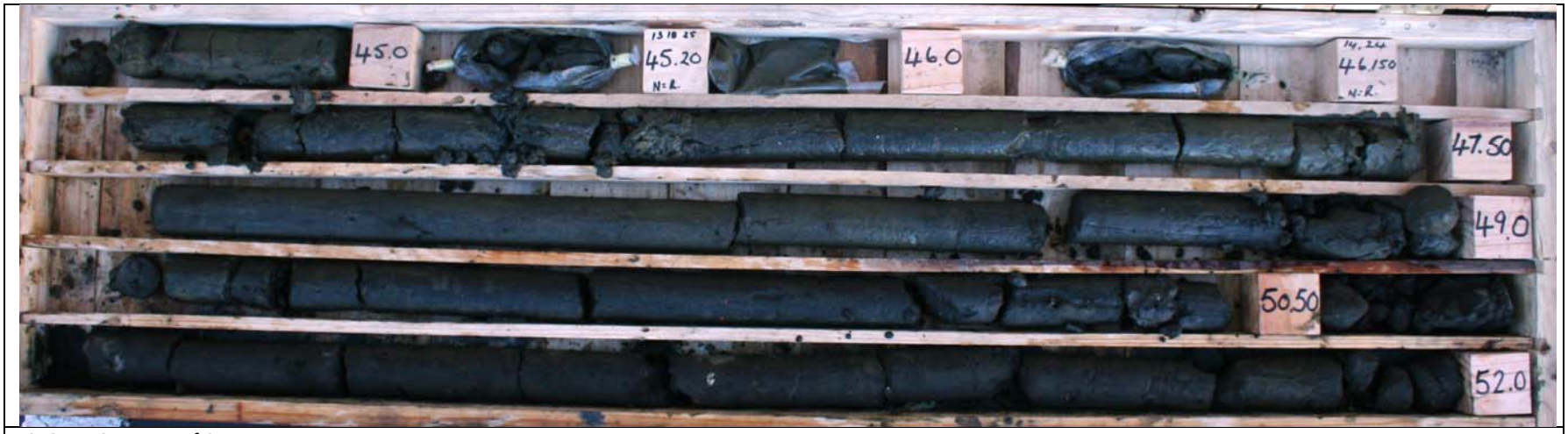
1370-BHL04: Box 1 of 6

1370-BHL04: Box 2 of 6

1370-BHL04: Box 3 of 6



1370-BHL04: Box 4 of 6



1370-BHL04: Box 5 of 6

1370-BHL04: Box 6 of 6

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL05

Start Date	2012/06/09	**End Date**	2012/06/18
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.457 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306797.40
Drilling -	Fairbrother		Y: -1233.80
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
3.350	3.350	100	-	-	160 mm						0.00
3.00									(3.46, -0.99) Slightly moist, light yellow brown, cohesionless, medium dense, layered, medium Fine SAND with pebbles and shell fragments. Imported, SAND FILL.	+3.720 to +3.350 CDP: Concrete slab	
2.00	1.720	-	-	-	WB						1.00
	1.270	89	-	-	SPT	N=12					2.00
1.00	0.720	-	-	-	WB						
	0.270	51	-	-	SPT	N=22					3.00
0.00	-0.280	-	-	-	WB						
	-0.730	67	-	-	SPT	N=8					4.00
-1.00	-1.280	-	-	-	WB				(-0.99, -10.54) Slightly moist to moist, light brown grey, cohesionless, medium dense to dense, layered, medium Fine SAND with shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-0.730 CDP: Approximate FILL / IN SITU contact	5.00
	-1.730	78	-	-	SPT	N=11					
-2.00	-2.280	-	-	-	WB						6.00
	-2.730	78	-	-	SPT	N=18					
-3.00	-3.280	-	-	-	WB						7.00
	-3.730	64	-	-	SPT	N=32					
-4.00	-4.280	-	-	-	WB						8.00
	-4.730	73	-	-	SPT	N=33					
-5.00	-5.280	-	-	-	WB						9.00
	-5.730	60	-	-	SPT	N=21					
-6.00	-6.280	-	-	-	WB						10.00
	-6.730	60	-	-	SPT	N=6					
-7.00	-7.280	-	-	-	WB						11.00
	-7.730	71	-	-	SPT	N=15					
-8.00	-8.280	-	-	-	WB						12.00
	-8.730	78	-	-	SPT	N=29					
-9.00	-9.280	-	-	-	WB						13.00
	-9.730	73	-	-	SPT	N=5					
-10.00	-10.280	-	-	-	WB						14.00
	-10.730	76	-	-	SPT	N=24			(-10.54, -13.99) Moist, dark brown grey, slightly cohesive, generally medium dense (locally very loose), layered, clayey silty Fine SAND with sandy clay. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-11.00	-11.280	-	-	-	WB						15.00
	-11.730	67	-	-	SPT	N=10					
-12.00	-12.280	-	-	-	WB						16.00
	-12.730	76	-	-	SPT	N=0					
-13.00	-13.280	-	-	-	WB						17.00
	-13.730	62	-	-	SPT	N=13					
-14.00	-14.280	53	-	-	NWD4				(-13.99, -19.04) Slightly moist, dark brown grey, cohesive, very soft, friable, silty CLAY with intermittent & isolated nodules and shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		18.00
	-14.730	89	-	-	SPT	N=0					
-15.00	-15.280	62	-	-	NWD4						19.00
	-15.730	100	-	-	SPT	N=1					
-16.00	-16.280	55	-	-	NWD4						20.00
	-16.730	78	-	-	SPT	N=0					
-17.00	-17.280	60	-	-	NWD4						21.00
	-17.730	78	-	-	SPT	N=2					
-18.00	-18.780	93	-	-	NWD4						22.00
-19.00	-19.230	93	-	-	SPT	N=0			(-19.04, -31.54) Moist, dark brown grey & orange brown & turquoise, slightly cohesive, generally medium dense (locally very dense), layered, clayey silty Fine SAND with sandy clay & fine sand. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-18.780 to -20.280 CDP: Slightly cohesive, very loose, clayey silty Fine SAND.	23.00
	-20.280	-	-	-	WB						
-20.00	-20.730	87	-	-	SPT	N=15				-20.280 to -21.280 CDP: Cohesionless, very loose, Fine SAND.	24.00
-21.00	-21.280	-	-	-	WB						
	-21.730	91	-	-	SPT	N=33				-21.280 to -21.730 CDP: Cohesive, stiff, sandy CLAY.	25.00
-22.00	-22.280	-	-	-	WB						
	-22.730	44	-	-	SPT	N=13					26.00
-23.00	-23.280	-	-	-	WB						
	-23.730	78	-	-	SPT	N=23					27.00
-24.00	-24.280	-	-	-	WB						
	-24.655	67	-	-	SPT	N=R					28.00
-25.00	-25.280	-	-	-	WB						
	-25.730	78	-	-	SPT	N=46					29.00
-26.00	-26.280	-	-	-	WB						
	-26.730	73	-	-	SPT	N=15					30.00
-27.00	-27.280	-	-	-	WB						
	-27.730	91	-	-	SPT	N=16					31.00
-28.00	-28.280	75	-	-	NWD4					-27.630 to -28.160 CDP: Cohesive, stiff (estimate), silty CLAY.	32.00

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205

Borehole No.: 1370 BHL05

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL05

Start Date	2012/06/09	**End Date**	2012/06/18
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.457 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306797.40
Drilling -	Fairbrother		Y: -1233.80
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
-29.00	-28.730	53	-	-	SPT	N=12					32.00
	-29.280	-	-	-	WB						
-30.00	-29.730	44	-	-	SPT	N=12					33.00
	-30.280	-	-	-	WB						
-31.00	-30.730	56	-	-	SPT	N=21					34.00
	-31.280	-	-	-	WB						
		67	-	-	SPT	N=R					35.00
-32.00		55	-	-	NWD4				(-31.54, -37.04) Slightly moist, olive green brown, cohesionless, very dense, fine sandy SILT. Residual, St Lucia Fm.	-32.200 to -32.430 CDP: Calcrete lens	36.00
-33.00	-32.780										
	-33.080	70	-	-	SPT	N=R					37.00
-34.00		-	-	-	NWD4						
	-34.280										38.00
-35.00	-34.730	49	-	-	SPT	N=25					
	-35.280	10	-	-	NWD4						39.00
		76	-	-	SPT	N=R				-35.500 to -35.710 CDP: Calcrete lens	
-36.00		21	-	-	NWD4						40.00
-37.00	-36.780	-	-	-	SPT	N=R			(-37.04, -52.04) Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard concretionary layers.		41.00
-38.00	-38.280	31 / 13	6	3	NWD4					-37.910 to -38.020 CDP: Calcrete lens	42.00
-39.00	-39.480	35 / 32	13	5	NWD4						43.00
-40.00	-39.780	100 / -	-	-	Shelby						44.00
-41.00	-41.280	60 / 43	29	11	NWD4						45.00
-42.00	-42.280	97 / 65	56	8	NWD4					-41.930 to -42.280 CDP: Residual rock	46.00
-43.00	-43.480	100 / 100	4	6	NWD4						47.00
-44.00	-44.280	104 / 89	78	15	NWD4						48.00
-45.00	-45.780	84 / 79	47	11	NWD4						49.00
-46.00	-47.280	70 / 68	65	5	NWD4						50.00
-47.00	-48.780	80 / 77	61	7	NWD4						51.00
-48.00											52.00
-49.00											53.00
-50.00	-50.280	100 / 100	81	7	NWD4					-50.100 to -50.280 CDP: Calcrete lens	54.00
-51.00		89 / 83	83	7	NWD4					-50.980 to -51.330 CDP: Calcrete lens	
-52.00	-51.780									END OF BOREHOLE (-51.78 CDP / 55.50 mbgl)	55.00

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205

Borehole No.: 1370 BHL05

1370-BHL05: Box 1 of 7

1370-BHL05: Box 2 of 7

1370-BHL05: Box 3 of 7

1370-BHL05: Box 4 of 7

1370-BHL05: Box 5 of 7

1370-BHL05: Box 6 of 7

1370-BHL05: Box 7 of 7

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL06

Start Date	2012/07/02	**End Date**	2012/07/07
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.630 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306824.20
Drilling -	Fairbrother		Y: -1172.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
3.00	1.720	-	-	-	WB				(3.63, -1.82) Slightly moist to moist, light brown grey, cohesionless, generally medium dense (locally loose or very dense), layered, fine Medium SAND with pebbles and shell fragments. Imported, SAND FILL.		0.00
	1.420	90	-	-	SPT	N=R					
2.00	0.720	-	-	-	WB						1.00
	0.270	58	-	-	SPT	N=11					2.00
1.00	-0.280	-	-	-	WB						
	-0.730	53	-	-	SPT	N=6					3.00
0.00	-1.280	-	-	-	WB						
	-1.730	53	-	-	SPT	N=25			(-1.82, -11.37) Moist, grey, cohesionless, medium dense to very dense, layered, medium Fine SAND with subordinate slightly clayey layers. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-1.730 CDP: Approximate FILL / IN SITU contact	4.00
-1.00	-2.280	-	-	-	WB						
	-2.730	58	-	-	SPT	N=34					5.00
-2.00	-3.280	-	-	-	WB						
	-3.730	60	-	-	SPT	N=39					6.00
-3.00	-4.280	-	-	-	WB						
	-4.730	73	-	-	SPT	N=47					7.00
-4.00	-5.280	-	-	-	WB						
	-5.730	73	-	-	SPT	N=50					8.00
-5.00	-6.280	-	-	-	WB						
	-6.730	64	-	-	SPT	N=54					9.00
-6.00	-7.280	-	-	-	WB						
	-7.730	67	-	-	SPT	N=54					10.00
-7.00	-8.280	-	-	-	WB						
	-8.730	67	-	-	SPT	N=56					11.00
-8.00	-9.280	-	-	-	WB						
	-9.730	49	-	-	SPT	N=27					12.00
-9.00	-10.280	-	-	-	WB						
	-10.730	51	-	-	SPT	N=26					13.00
-10.00	-11.280	-	-	-	WB						
	-11.730	91	-	-	SPT	N=17			(-11.37, -14.82) Slightly moist, dark brown grey, cohesive, very soft, layered, silty sandy CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		14.00
-11.00	-12.280	-	-	-	WB						
	-12.880	100	-	-	Shelby S01						15.00
-12.00	-13.280	-	-	-	WB						
	-13.730	67	-	-	SPT	N=2					16.00
-13.00	-14.280	-	-	-	WB						
	-14.730	73	-	-	SPT	N=0			(-14.82, -22.37) Slightly moist, dark brown grey, cohesive, very soft, silty CLAY with intermittent & isolated nodules and shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		17.00
-14.00	-15.280	-	-	-	WB						
	-15.730	60	-	-	SPT	N=0					18.00
-15.00	-16.280	-	-	-	WB						
	-16.880	100	-	-	Shelby S02						19.00
-16.00	-17.280	-	-	-	WB						
	-17.730	89	-	-	SPT	N=1					20.00
-17.00	-18.280	-	-	-	WB						
	-18.730	84	-	-	SPT	N=0					21.00
-18.00	-19.280	-	-	-	WB						
	-19.730	82	-	-	SPT	N=0					22.00
-19.00	-20.280	-	-	-	WB						
	-20.880	100	-	-	Shelby S03						23.00
-20.00	-21.280	-	-	-	WB						
	-21.730	100	-	-	SPT	N=0					24.00
-21.00	-22.280	-	-	-	WB						
	-22.730	91	-	-	SPT	N=0					25.00
-22.00	-23.280	-	-	-	WB						
	-23.730	89	-	-	SPT	N=0			(-22.37, -29.82) Slightly moist, dark brown grey, cohesive, very soft, layered, silty sandy CLAY with clayey fine sand. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		26.00
-23.00	-24.280	-	-	-	WB						
	-24.730	84	-	-	SPT	N=0					27.00
-24.00	-25.280	-	-	-	WB						
	-25.730	100	-	-	SPT	N=0					28.00
-25.00	-26.280	-	-	-	WB						
	-26.730	58	-	-	SPT	N=1					29.00
-26.00	-27.780	-	-	-	WB						
	-28.230	100	-	-	SPT	N=2					30.00
-27.00											31.00
-28.00											32.00

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205

Borehole No.: 1370 BHL06

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL06

Start Date	2012/07/02	**End Date**	2012/07/07
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.630 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306824.20
Drilling -	Fairbrother		Y: -1172.00
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (mbgl)
-29.00	-29.280	-	-	-	WB				(-29.82, -30.87) Moist, dark brown grey, slightly cohesive, loose, clayey SAND with some shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-30.980 to -32.280 CDP: Highly weathered, very soft rock, St. Lucia Fm.	32.00
	-29.730	78	-	-	SPT	N=7					
-30.00	-30.780	-	-	-	WB						33.00
-31.00		67	-	-	SPT	N=R					34.00
		62	12	8	NWD4				(-30.87, -35.37) Slightly moist, olive green brown, cohesionless, very dense, fine sandy SILT. Residual, St Lucia Fm.		35.00
-32.00	-32.280	-	-	-	SPT	N=R					36.00
-33.00	-33.780	7	-	-	NWD4						37.00
-34.00	-34.155	69	-	-	SPT	N=R					38.00
-35.00	-35.280	-	-	-	WB						39.00
-36.00	-36.780	73 / 65	35	11	NWD4				(-35.37, -42.87) Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard concretionary layers.		40.00
-37.00		80 / 77	72	7	NWD4						41.00
-38.00	-38.280	100 / 83	63	8	NWD4						42.00
-39.00	-39.780	100 / 99	89	10	NWD4						43.00
-40.00	-41.280	100 / 89	73	11	NWD4						44.00
-41.00											45.00
-42.00	-42.780									END OF BOREHOLE (-42.78 CDP / 46.50 mbgl)	46.00

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Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHL06

1370-BHL06: Box 1 of 5

1370-BHL06: Box 2 of 5

1370-BHL06: Box 3 of 5

1370-BHL06: Box 4 of 5

1370-BHL06: Box 5 of 5

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL07

Start Date	2012/06/26	**End Date**	2012/07/01
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.180 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306760.40
Drilling -	Fairbrother		Y: -1168.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
3.00											0.00
	1.720	-	-	-	PX				(3.18, 1.18) Slightly moist, light brown grey, cohesionless, loose (estimate), clast supported, Coarse GRAVEL with fine medium sand. Imported, GRAVEL FILL.		
2.00											1.00
1.00	1.270	64	-	-	SPT	N=36					2.00
	0.720	-	-	-	WB				(1.18, -12.27) Slightly moist to moist, lighty brown grey, cohesionless, medium dense to very dense, Fine SAND with shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	1.720 CDP: Approximate FILL / IN SITU contact	
0.00	0.270	51	-	-	SPT	N=17					3.00
	-0.280	-	-	-	WB						
-1.00	-0.730	53	-	-	SPT	N=25					4.00
	-1.280	-	-	-	WB						
-2.00	-1.730	69	-	-	SPT	N=35					5.00
	-2.280	-	-	-	WB						
-3.00	-2.730	76	-	-	SPT	N=29					6.00
	-3.280	-	-	-	WB						
-4.00	-3.730	78	-	-	SPT	N=27					7.00
	-4.280	-	-	-	WB						
-5.00	-4.730	60	-	-	SPT	N=66					8.00
	-5.280	-	-	-	WB						
-6.00	-5.730	44	-	-	SPT	N=64					9.00
	-6.280	-	-	-	WB						
-7.00	-6.505	98	-	-	SPT	N=R					10.00
	-7.280	-	-	-	WB						
-8.00	-7.730	69	-	-	SPT	N=54					11.00
	-8.280	-	-	-	WB						
-9.00	-8.730	80	-	-	SPT	N=34					12.00
	-9.280	-	-	-	WB						
-10.00	-9.730	69	-	-	SPT	N=43					13.00
	-10.280	-	-	-	WB						
-11.00	-10.730	47	-	-	SPT	N=37					14.00
	-11.280	-	-	-	WB						
-12.00	-11.730	76	-	-	SPT	N=33					15.00
	-12.280	-	-	-	WB				(-12.27, -13.82) Slightly moist, dark brown grey, slightly cohesive, very loose, clayey silty SAND, Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		16.00
-13.00	-12.730	87	-	-	SPT	N=0					
	-13.280	-	-	-	WB						17.00
-14.00	-13.730	111	-	-	SPT	N=0			(-13.82, -17.82) Slightly moist, dark brown grey, cohesive, very soft, friable, silty sandy CLAY with intermittent shell fragments and nodules. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-14.280	-	-	-	WB						18.00
-15.00	-14.880	n/s	-	-	Shelby S01						
	-15.280	-	-	-	WB						19.00
-16.00	-15.730	89	-	-	SPT	N=0					
	-16.280	-	-	-	WB						20.00
-17.00	-16.880	100	-	-	Shelby S02						
	-17.280	-	-	-	WB						21.00
-18.00	-17.730	84	-	-	SPT	N=1			(-17.82, -28.12) Slightly moist, dark brown grey, cohesive, very soft, silty CLAY with intermittent & isolated nodules and shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-18.280	-	-	-	WB						22.00
-19.00	-18.730	89	-	-	SPT	N=0					
	-19.280	-	-	-	WB						23.00
-20.00	-19.730	93	-	-	SPT	N=0					
	-20.280	-	-	-	WB						24.00
-21.00	-20.880	100	-	-	Shelby S03						
	-21.280	-	-	-	WB						25.00
-22.00	-21.730	100	-	-	SPT	N=0					
	-22.280	-	-	-	WB						26.00
-23.00	-22.730	78	-	-	SPT	N=0					
	-23.280	-	-	-	WB						27.00
-24.00	-23.730	98	-	-	SPT	N=0					
	-24.280	-	-	-	WB						28.00
-25.00	-24.880	100	-	-	Shelby S04						
	-25.280	-	-	-	WB						29.00
-26.00	-25.730	93	-	-	SPT	N=0					
	-26.280	-	-	-	WB						30.00
-27.00	-26.730	89	-	-	SPT	N=0					
	-27.280	-	-	-	WB						31.00
-28.00	-27.730	89	-	-	SPT	N=0					
		-	-	-	WB				(-28.12, -34.44)		32.00

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205

Borehole No.: 1370 BHL07

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL07

Start Date	2012/06/26	**End Date**	2012/07/01
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.180 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306760.40
Drilling -	Fairbrother		Y: -1168.00
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
-29.00	-28.780								Slightly moist, dark brown grey, cohesive, very soft, silty sandy CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		32.00
	-29.230	38	-	-	SPT	N=0					
-30.00	-29.730	n/s	-	-	SPT	N=10					33.00
-31.00	-30.780	-	-	-	WB						34.00
	-31.230	96	-	-	SPT	N=0					
-32.00	-32.280	-	-	-	WB						35.00
-33.00	-32.880	n/s	-	-	Shelby S05						36.00
-34.00	-33.780	-	-	-	WB						37.00
	-34.230	82	-	-	SPT	N=21			(-34.44, -37.40)		
-35.00	-35.280	-	-	-	WB				Slightly moist, olive green brown, cohesionless, medium dense to very dense, clayey fine sandy SILT. Residual, St Lucia Fm.		38.00
-36.00	-35.730	36	-	-	SPT	N=45					39.00
-37.00	-36.780	-	-	-	WB						40.00
		93	-	-	SPT	N=R					
-38.00	-38.280	67 / 67	58.246	6	NWD4				(-37.40, -46.32) Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard concretionary layers.		41.00
-39.00	-39.780	96 / 87	68.000	11	NWD4						42.00
-40.00	-41.280	90 / 73	69.333	10	NWD4						43.00
-41.00	-42.780	23 / 3	-	-	NWD4					-40.980 to -42.780 CDP: Residual rock	44.00
-42.00	-44.280	70 / 70	51.333	5	NWD4						45.00
-43.00	-45.780	90 / 81	41.333	12	NWD4					-44.080 to -44.200 CDP: Calcrete lens	46.00
-44.00											47.00
-45.00											48.00
-46.00										END OF BOREHOLE (-45.78 CDP / 49.50 mbgl)	49.00

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ZAA Project Number: 1370

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Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: **1370 BHL07**

1370-BHL07: Box 1 of 5

1370-BHL07: Box 2 of 5

1370-BHL07: Box 3 of 5

1370-BHL07: Box 4 of 5

1370-BHL07: Box 5 of 5

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL08

Start Date	2012/07/24	**End Date**	2012/08/13
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.380 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306715.00
Drilling -	Fairbrother		Y: -1151.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
3.00	1.720	-	-	-	WB				(3.38, -1.67) Moist, light yelowish brown grey, cohesionless, loose to dense, layered, medium Fine SAND with pebbles & shell fragments. Imported, SAND FILL.		0.00
2.00	1.270	62	-	-	SPT	N=32					1.00
1.00	0.720	-	-	-	WB						2.00
0.00	0.270	47	-	-	SPT	N=10					3.00
-1.00	-0.280	-	-	-	WB						4.00
-2.00	-0.730	67	-	-	SPT	N=14					5.00
-3.00	-1.280	-	-	-	WB				(-1.67, -10.62) Moist, light brown grey, cohesionless, medium dense to very dense, layered, medium Fine SAND with intermittent shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-1.330 CDP: Approximate FILL / IN SITU contact	6.00
-4.00	-1.730	69	-	-	SPT	N=30					7.00
-5.00	-2.280	-	-	-	WB						8.00
-6.00	-2.730	64	-	-	SPT	N=35					9.00
-7.00	-3.280	-	-	-	WB						10.00
-8.00	-3.730	67	-	-	SPT	N=30					11.00
-9.00	-4.280	-	-	-	WB						12.00
-10.00	-4.730	56	-	-	SPT	N=22					13.00
-11.00	-5.280	-	-	-	WB						14.00
-12.00	-5.730	89	-	-	SPT	N=27					15.00
-13.00	-6.280	-	-	-	WB						16.00
-14.00	-6.730	62	-	-	SPT	N=43					17.00
-15.00	-7.280	-	-	-	WB						18.00
-16.00	-7.730	73	-	-	SPT	N=50					19.00
-17.00	-8.280	-	-	-	WB						20.00
-18.00	-8.730	84	-	-	SPT	N=45					21.00
-19.00	-9.280	-	-	-	WB						22.00
-20.00	-9.730	78	-	-	SPT	N=34					23.00
-21.00	-10.280	-	-	-	WB				(-10.62, -11.62) Very moist, dark brown grey, slightly cohesive, very loose, clayey Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		24.00
-22.00	-10.730	111	-	-	SPT	N=3					25.00
-23.00	-11.280	-	-	-	WB						26.00
-24.00	-11.730	120	-	-	SPT	N=1			(-11.62, -19.92) Slightly moist to moist, dark brown grey mottled brown & grey, cohesive, very soft to soft, layered, silty CLAY with intermittent & isolated nodules and shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-12.280 to -12.730 CDP: As for -10.280 to -11.280 CDP	27.00
-25.00	-12.280	-	-	-	WB						28.00
-26.00	-12.730	89	-	-	SPT	N=0					29.00
-27.00	-13.280	-	-	-	WB						30.00
-28.00	-13.730	109	-	-	SPT	N=4					31.00
	-14.280	-	-	-	WB						32.00
	-14.730	118	-	-	SPT	N=4					
	-15.280	-	-	-	WB						
	-15.730	111	-	-	SPT	N=3					
	-16.280	-	-	-	WB						
	-16.730	107	-	-	SPT	N=2					
	-17.280	-	-	-	WB						
	-17.730	111	-	-	SPT	N=4					
	-18.280	-	-	-	WB						
	-18.730	100	-	-	SPT	N=5					
	-19.280	-	-	-	WB						
	-19.730	98	-	-	SPT	N=5					
	-20.280	-	-	-	WB						
	-20.730	82	-	-	SPT	N=25			(-19.92, -20.67) Very moist, dark brown grey, slightly cohesive, soft, layered, silty sandy CLAY with some shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-21.280	-	-	-	WB						
	-21.730	89	-	-	SPT	N=12			(-20.67, -27.62) Very moist to wet, mottled grey & light brown grey, cohesionless, medium dense (loose in places), layered, Medium SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-22.280	-	-	-	WB						
	-22.730	84	-	-	SPT	N=22					
	-23.280	-	-	-	WB						
	-23.730	60	-	-	SPT	N=18					
	-24.280	-	-	-	WB						
	-24.730	44	-	-	SPT	N=18					
	-25.280	-	-	-	WB						
	-25.730	40	-	-	SPT	N=20					
	-26.280	-	-	-	WB						
	-26.730	n/s	-	-	SPT	N=0					
	-27.280	-	-	-	WB						
	-27.730	111	-	-	SPT	N=13			(-27.62, -30.22) Moist, dark brown grey & grey, slightly cohesive, medium dense,		
	-28.280	-	-	-	WB						

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHL08

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL08

Start Date	2012/07/24	**End Date**	2012/08/13
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+3.380 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306715.00
Drilling -	Fairbrother		Y: -1151.00
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (mbgl)
-29.00	-28.730	76	-	-	SPT	N=15			layered, medium Fine SAND interbedded clayey sand with isolated plant fragments, Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		32.00
	-29.280	-	-	-	WB					Shelby S01 Expansive material -29.930 to -30.280 CDP: Highly weathered, very soft rock, St. Lucis Fm.	33.00
-30.00	-29.880	100	-	-	Shelby S01						
	-30.280	158	-	-	NWD4	N=R			(-30.22, -35.47) Slightly moist to moist, orange brown to olive green brown, cohesionless, very dense, clayey sandy SILT. Residual, St Lucia Fm.		34.00
-31.00		100	-	-	SPT						
		66	-	-	NWD4						35.00
-32.00	-31.780										
-33.00		80	-	-	NWD4					-32.530 to -32.980 CDP: Calcrete lens	36.00
	-33.280										
-34.00		60	-	-	NWD4						37.00
-35.00	-34.780									-34.490 to -34.780 CDP: Residual rock	38.00
	-35.130	57	-	-	SPT	N=R					
-36.00		87 / 59	39	5	NWD4				(-35.47, -48.62) Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard concretionary layers.	-35.380 to -35.800 CDP: Residual rock	39.00
	-36.280										
-37.00		100 / 100	81	8	NWD4						40.00
-38.00	-37.780										41.00
-39.00		85 / 62	53	5	NWD4					-38.960 to -40.780 CDP: Residual rock	42.00
	-39.280										
-40.00		45 / 8	8	1	NWD4						43.00
-41.00	-40.780									-40.540 to -40.660 CDP: Calcrete lens	44.00
-42.00		89 / 81	81	3	NWD4						45.00
	-42.280										
-43.00		93 / 67	53	5	NWD4					-42.800 to -42.980 CDP: Calcrete lens -42.980 to -43.160 CDP: Residual rock	46.00 47.00
-44.00	-43.780									-43.780 to -44.150 CDP: Calcrete lens	
-45.00		100 / 98	71	8	NWD4						48.00
	-45.280										
-46.00		88 / 86	68	11	NWD4						49.00
-47.00	-46.780										50.00
-48.00		81 / 81	67	7	NWD4						51.00
	-48.280									END OF BOREHOLE (-48.28 CDP / 52.00 mbgl)	52.00

1370-BHL08: Box 1 of 6

1370-BHL08: Box 2 of 6

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1370-BHL08: Box 4 of 6

1370-BHL08: Box 5 of 6

1370-BHL08: Box 6 of 6

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL09

Start Date	2012/08/14	**End Date**	2012/08/18
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+2.410 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306693.00
Drilling -	Fairbrother		Y: -1132.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
2.00	1.720	-	-	-	WB				(2.41, -1.04) Moist, light yelowish brown grey, cohesionless, medium dense, layered, Fine SAND with shell rich layers. Imported, SAND FILL.		0.00
1.00	1.270	60	-	-	SPT	N=15					1.00
0.00	0.720	-	-	-	WB						2.00
	0.270	64	-	-	SPT	N=23					3.00
-1.00	-0.280	-	-	-	WB				(-1.04, -9.59) Very moist, light brown grey, cohesionless, medium dense to dense, layered, fine Medium SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	+0.270 CDP: Approximate FILL / IN SITU contact	4.00
-2.00	-0.730	73	-	-	SPT	N=13					5.00
	-1.280	-	-	-	WB						6.00
-3.00	-1.730	82	-	-	SPT	N=23				-3.280 to -3.730 CDP: Prominent shell rich unit	7.00
	-2.280	-	-	-	WB						8.00
-4.00	-2.730	80	-	-	SPT	N=31					9.00
	-3.280	-	-	-	WB						10.00
-5.00	-3.730	91	-	-	SPT	N=37					11.00
	-4.280	-	-	-	WB				(-9.59, -10.59) Moist, dark brown grey, slightly cohesive, very loose, layered, clayey Fine SAND with shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		12.00
-6.00	-4.730	69	-	-	SPT	N=41					13.00
	-5.280	-	-	-	WB				(-10.59, -13.04) Moist, dark brown grey, slightly cohesive, very soft, layered, Sandy CLAY with clayey sand and shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		14.00
-7.00	-5.730	64	-	-	SPT	N=21					15.00
	-6.280	-	-	-	WB						16.00
-8.00	-6.730	67	-	-	SPT	N=43			(-13.04, -17.69) Slightly moist, dark brown grey, cohesive, very soft to soft, expansive, friable, silty CLAY with intermittent shell fragments and isolated nodules. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		17.00
	-7.280	-	-	-	WB						18.00
-9.00	-7.730	78	-	-	SPT	N=28					19.00
	-8.280	-	-	-	WB				(-17.69, -18.59) Moist, brown grey, slightly cohesive, loose (estimate), layered, clayey Fine SAND with some shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		20.00
-10.00	-8.730	91	-	-	SPT	N=1					21.00
	-9.280	-	-	-	WB				(-18.59, -22.59) Very moist to wet, grey, cohesionless, medium dense, layered, Medium SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		22.00
-11.00	-9.730	107	-	-	SPT	N=0					23.00
	-10.280	-	-	-	WB						24.00
-12.00	-10.730	104	-	-	SPT	N=0				-21.280 to -21.730 CDP: Medium GRAVEL with clay matrix	25.00
	-11.280	-	-	-	WB				(-22.59, -29.44) Mosit, orange & orange brown & turqoise, slightly cohesive, medium dense to dense, interbedded & laminated, clayey Silty SAND with pebbles (> 20 mm). Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		26.00
-13.00	-11.730	98	-	-	SPT	N=0					27.00
	-12.280	-	-	-	WB						28.00
-14.00	-12.730	93	-	-	SPT	N=0					29.00
	-13.280	-	-	-	WB					-25.400 to -26.580 CDP: Cohesive, firm, fissured (< 1 mm, orange brown filling), sandy Silty CLAY.	30.00
-15.00	-13.730	116	-	-	SPT	N=4					31.00
	-14.280	-	-	-	WB						32.00
-16.00	-14.730	111	-	-	SPT	N=1					
	-15.280	-	-	-	WB						
-17.00	-15.730	111	-	-	SPT	N=1					
	-16.280	-	-	-	WB						
-18.00	-16.730	96	-	-	SPT	N=3					
	-17.280	-	-	-	WB						
-19.00	-17.730	93	-	-	SPT	N=13					
	-18.280	-	-	-	WB						
-20.00	-18.730	96	-	-	SPT	N=14					
	-19.280	-	-	-	WB						
-21.00	-19.730	96	-	-	SPT	N=12					
	-20.280	-	-	-	WB						
-22.00	-20.730	n/s	-	-	SPT	N=18					
	-21.280	-	-	-	WB						
-23.00	-21.730	31	-	-	SPT	N=16					
	-22.280	-	-	-	WB						
-24.00	-22.730	78	-	-	SPT	N=24					
	-23.280	-	-	-	WB						
-25.00	-23.730	78	-	-	SPT	N=33					
	-24.280	-	-	-	WB						
-26.00	-24.730	69	-	-	SPT	N=50					
	-25.280	-	-	-	WB						
-27.00	-25.730	91	-	-	SPT	N=9					
	-26.280	-	-	-	WB						
-28.00	-26.730	87	-	-	SPT	N=42					
	-27.780	n/s	-	-	NWD4						
-29.00	-28.230	87	-	-	SPT	N=48					

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHL09

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHL09

Start Date	2012/08/14	**End Date**	2012/08/18
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205 extension	**Elevation:**	+2.410 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306693.00
Drilling -	Fairbrother		Y: -1132.00
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (mbgl)
-30.00	-29.280	n/s	-	-	NWD4				(-29.44, -30.89) Slightly moist, orange brown, cohesionless, very dense, fine sandy SILT. Residual, St Lucia Fm.		32.00
	-29.580	97	-	-	SPT	N=R			(-30.89, -47.59) Dark brownish Olive-Green (orange brown to -31.78 mCDP), moderately to highly weathered, medium to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard concretionary layers.	-29.780 to -29.930 CDP: Calcrete lens -30.550 to -30.720 CDP: Calcrete lens -31.360 to -31.600 CDP: Calcrete lens -31.970 to -32.090 CDP: Residual rock -32.410 to -32.780 CDP: Residual rock	33.00
-31.00	-30.780	83 / 83	72	9	NWD4						34.00
-32.00	-31.280	100 / 56	24	18	NWD4						35.00
-33.00	-32.780	100 / 75	36	10	NWD4						36.00
-34.00	-34.280	85 / 85	69	8	NWD4						37.00
-35.00	-35.780	93 / 61	7	10	NWD4					-35.300 to -35.780 CDP: Residual rock	38.00
-36.00	-37.280	100 / 79	67	6	NWD4					-37.000 to -37.280 CDP: Residual rock -37.550 to -37.690 CDP: Calcrete lens	39.00
-37.00	-38.780	100 / 83	71	6	NWD4					-38.530 to -38.780 CDP: Residual rock -38.930 to -39.090 CDP: Calcrete lens	40.00
-38.00	-40.280	100 / 91	70	8	NWD4						41.00
-39.00	-41.780	67 / 55	31	11	NWD4						42.00
-40.00	-43.280	40 / 17	10	4	NWD4					-41.780 to -42.030 CDP: Calcrete lens -42.030 to -43.280 CDP: Residual rock	43.00
-41.00	-44.780	80 / 73	73	5	NWD4						44.00
-42.00	-46.280	87 / 87	79	7	NWD4					END OF BOREHOLE (-46.28 CDP / 50.00 mbgl)	45.00
-43.00											46.00
-44.00											47.00
-45.00											48.00
-46.00											49.00
-47.00											50.00

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ZAA Project Number: 1370

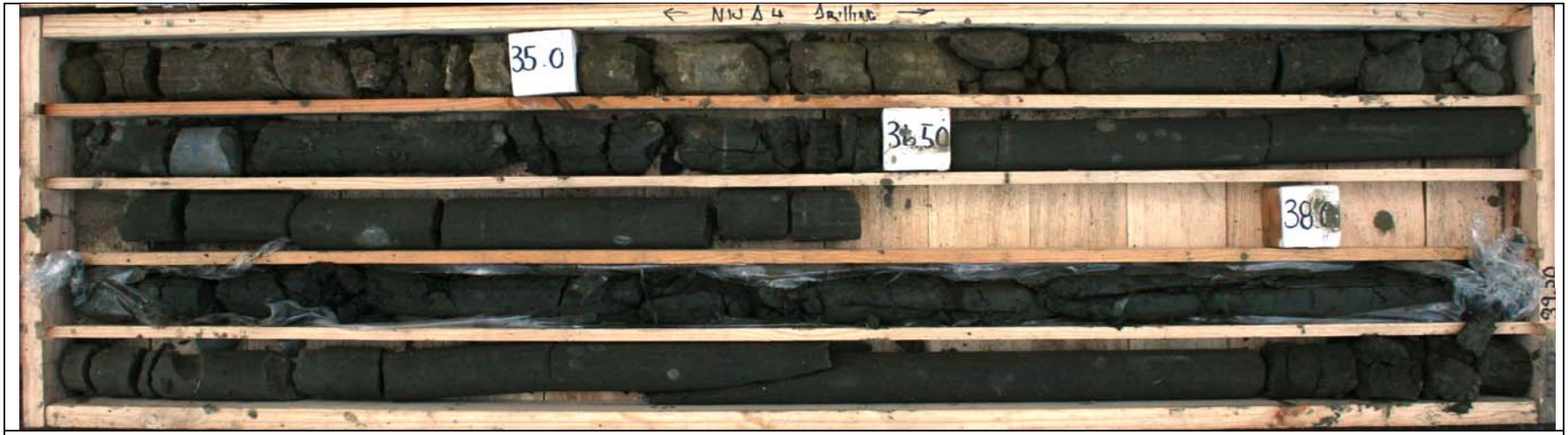
Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHL09

1370-BHL09: Box 1 of 5

1370-BHL09: Box 2 of 5

1370-BHL09: Box 3 of 5



1370-BHL09: Box 4 of 5

1370-BHL09: Box 5 of 5

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS01

Start Date	2012/07/18	**End Date**	2012/07/22
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205, Bollard 97	**Elevation:**	+2.595 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306773.03
Drilling -	Fairbrother		Y: -1357.87
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
									(2.60, -12.27) water		0.00
	-12.265	-	-	-	Casing						
	-14.905	-	-	-	Casing				(-12.27, -15.91) Harbour Floor Sediments No sample recovered. Assumed to be very soft unconsolidated MUD	-12.265 CDP: Sea Floor	
	-15.905	-	-	-	WB						
	-16.905	40	-	-	NWD4				(-15.91, -18.91) Dolerite and Dwyka BOULDERS. Imported, BOULDER FILL. Clayey SAND (assumed) matrix material washed away during drilling		
	-17.905	20	-	-	NWD4						
	-18.905	15	-	-	NWD4				(-18.91, -20.21) Slightly moist, dark brown grey, cohesive, very soft, silty CLAY with intermittent & isolated nodules and shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-18.905 CDP: Approximate FILL / IN SITU contact -19.260 CDP: Anomalous pebble Multiple drilling marks indicative of re-drilled cave-in material.	
	-19.355	100	-	-	SPT	N=7					
	-19.905	-	-	-	WB						
	-20.355	100	-	-	SPT	N=19					
	-21.405	-	-	-	WB				(-20.21, -26.86) Moist, dark brown grey banded turquoise & orange brown, cohesionless, medium dense to dense, layered, clayey silty SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-22.005	(n/s)	-	-	Shelby (n/s)						
	-22.455	100	-	-	SPT	N=12					
	-23.405	-	-	-	WB						
	-24.005	(n/s)	-	-	Shelby (n/s)						
	-24.455	89	-	-	SPT	N=20					
	-25.405	-	-	-	WB						
	-25.855	89	-	-	SPT	N=26					
	-26.405	-	-	-	WB						
	-26.855	100	-	-	SPT	N=37					
	-27.905	-	-	-	WB				(-26.86, -32.41) Slightly moist, olive green brown speckled white, cohesionless, very dense, fine sandy SILT. Residual, St Lucia Fm.		
	-28.000	100	-	-	SPT	N=R					
	-29.405	36	-	-	NWD4						32.00

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS01

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

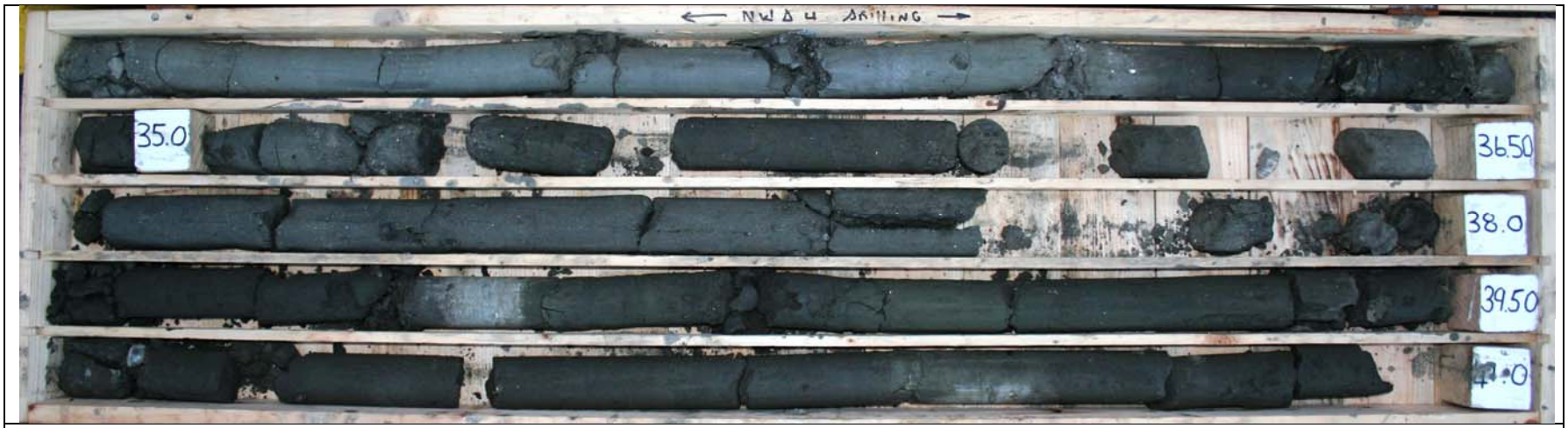
Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS01

Start Date	2012/07/18	**End Date**	2012/07/22
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205, Bollard 97	**Elevation:**	+2.595 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306773.03
Drilling -	Fairbrother		Y: -1357.87
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
-30.00	-29.855	67	-	-	SPT	N=44					32.00
	-30.905	10	-	-	NWD4						33.00
-31.00		100	-	-	NWD4						34.00
-32.00	-32.405										35.00
-33.00	-33.905	67 / 43	22	5	NWD4				(-32.41, -38.41) Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard concretionary layers.	-33.905 to -35.405 CDP: Residual rock -35.775 to -35.935 CDP: Calcrete lens	36.00
-34.00		87 / 3	-	-	NWD4						37.00
-35.00	-35.405										38.00
-36.00	-36.905	100 / 89	65	7	NWD4						39.00
-37.00		79 / 79	55	7	NWD4						40.00
-38.00	-38.405									END OF BOREHOLE (-38.31 CDP / 41.00 m below platform)	41.00

1370-BHS01: Box 1 of 2



1370-BHS01: Box 2 of 2

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS02

Start Date	2012/07/26	**End Date**	2012/07/27
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205, Bollard 82	**Elevation:**	+2.689 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306694.60
Drilling -	Fairbrother		Y: -1554.20
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
2.689									(2.69, -12.11) Water		0.00
		-	-	-	Casing						
-12.111											
-12.561		100	-	-	SPT	N=4			(-12.11, -13.61) Moist, dark brown grey, slightly cohesive, very soft to soft, layered, clayey Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-12.110 CDP: Sea Floor	
-13.311		-	-	-	WB						
-13.761		118	-	-	SPT	N=5					
-14.311		-	-	-	WB				(-13.61, -18.61) Slightly moist, grey, cohesionless, generally loose (locally dense), medium Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-14.761		22	-	-	SPT	N=7					
-15.311		-	-	-	WB						
-15.761		76	-	-	SPT	N=17					
-16.311		-	-	-	WB						
-16.761		n/s	-	-	SPT	N=0				No sample, tried twice	
-17.311		-	-	-	WB						
-17.761		71	-	-	SPT	N=33					
-18.311		-	-	-	WB				(-18.61, -25.76) Slightly moist, dark brown grey, cohesive,very soft to soft, layered, expansive, silty CLAY with many nodules and shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-18.761		116	-	-	SPT	N=8					
-19.311		-	-	-	WB						
-19.761		118	-	-	SPT	N=0					
-20.311		-	-	-	WB						
-20.761		120	-	-	SPT	N=1					
-21.311		-	-	-	WB						
-21.911		100	-	-	Shelby S01					Large nodules (0.2 to 2.5 cm) Pale brown grey, cohesive, firm (estimate), sandy silty CLAY.	
-23.311		-	-	-	WB						
-23.761		120	-	-	SPT	N=5					
-24.311		-	-	-	WB						
-24.761		111	-	-	SPT	N=4					
-25.311		-	-	-	WB						
-25.761		111	-	-	SPT	N=6					
-26.311		-	-	-	WB				(-25.76, -38.26) Moist, brown grey, cohesionless, generally loose (locally dense), Layered, Medium SAND with interbedded silty sand, clayey sand & gravel lenses. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-26.761		n/s	-	-	SPT	N=7					
-27.311		-	-	-	WB						
-27.761		78	-	-	SPT	N=42					
-28.311		-	-	-	WB						
-28.761		n/s	-	-	SPT	N=7					
-29.311		-	-	-	WB						32.00

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ZAA Project Number: 1370

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Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS02

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS02

Start Date	2012/07/26	**End Date**	2012/07/27
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205, Bollard 82	**Elevation:**	+2.689 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306694.60
Drilling -	Fairbrother		Y: -1554.20
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (m below platform)
	-29.761	111	-	-	SPT	N=9				-29.471 to -29.761 CDP: Cohesive, Silty Clay.	32.00
-30.00	-30.311	-	-	-	WB						
	-30.911	100	-	-	Shelby S02					-29.761 to -32.011 CDP: Slightly cohesive, clayey SAND.	33.00
-31.00	-31.361	100	-	-	SPT	N=6					
	-31.811	-	-	-	WB						34.00
-32.00	-32.261	111	-	-	SPT	N=7					
	-33.311	-	-	-	WB					-32.011 to -33.661 CDP: Cohesive, sandy CLAY.	35.00
-33.00	-33.761	67	-	-	SPT	N=24					
	-34.811	-	-	-	WB						36.00
-34.00	-35.261	78	-	-	SPT	N=10					
-35.00	-36.311	-	-	-	WB					-34.941 to -35.261 CDP: Cohesive, sandy CLAY.	37.00
	-36.761	67	-	-	SPT	N=35					
-36.00	-37.811	-	-	-	WB					-36.761 to -37.811 CDP: Cohesionless, fine GRAVEL	38.00
	-38.261	89	-	-	SPT	N=39					
-37.00	-39.311	-	-	-	WB						39.00
-38.00	-39.761	89	-	-	SPT	N=44			(-38.26, -39.96) Slightly moist, olive green brown, cohesionless, very dense, fine sandy SILT. Residual, St Lucia Fm.		40.00
-39.00	-40.811	95 / 95	95	4	NWD4				(-39.96, -48.31) Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard concretionary layers.	-40.291 to - 40.541 CDP: Residual rock -40.541 to -40.811 CDP: Calcrete lens	41.00
-40.00	-42.311	81 / 81	72	5	NWD4						42.00
-41.00	-43.811	42 / 35	15	7	NWD4						43.00
-42.00	-45.311	73 / 55	49	7	NWD4						44.00
-43.00	-46.811	73 / 57	29	6	NWD4					-45.311 to -45.741 CDP: Calcrete lens	45.00
-44.00	-48.311	40 / 32	0	5	NWD4					-48.011 to -45.741 CDP: Calcrete lens END OF BOREHOLE (-48.31 CDP / 51.00 m below platform)	46.00
-45.00											47.00
-46.00											48.00
-47.00											49.00
-48.00											50.00
											51.00

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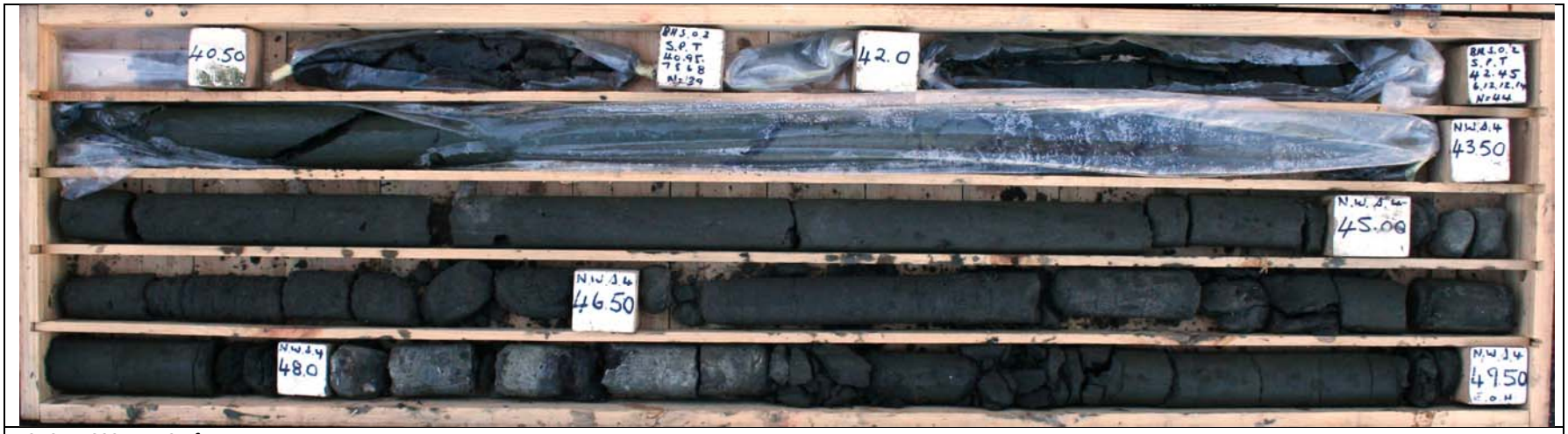
Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS02

1370-BHS02: Box 1 of 4

1370-BHS02: Box 2 of 4



1370-BHS02: Box 3 of 4

1370-BHS02: Box 4 of 4

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS03

Start Date	2012/07/06	**End Date**	2012/07/15
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 203, Bollard 41	**Elevation:**	+3.060 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306549.66
Drilling -	Fairbrother		Y: -2230.81
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
									(3.06, -12.92) Water		0.00
		-	-	-	Casing						5.00
-12.920									(-12.92, -13.44) Harbour Floor Sediments No sample recovered. Assumed to be very soft unconsolidated MUD.	-12.920 mCDP; Sea Floor	13.00
-13.440		-	-	-	Casing						
-13.890		100	-	-	SPT	N=14					
-14.440		-	-	-	WB				(-13.44, -30.94) Slightly moist, dark brown grey, cohesive, stiff to hard but predominantly very stiff, friable (between -13.44 & -16.89), expansive, silty CLAY with intermittent shell fragments and nodules. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		14.00
-14.890		100	-	-	SPT	N=10					
-15.440		110	-	-	TNW						15.00
-15.890		100	-	-	SPT	N=10					
-16.440		50	-	-	TNW						
-16.890		111	-	-	SPT	N=17					16.00
-17.440		100	-	-	TNW						
-17.890		111	-	-	SPT	N=18					17.00
-18.440		100	-	-	TNW						
-18.940		-	-	-	WB						18.00
-19.390		111	-	-	SPT	N=13					
-19.940		100	-	-	TNW						19.00
-20.390		100	-	-	SPT	N=15					
-20.940		100	-	-	TNW						20.00
-21.505		100	-	-	Shelby S01						
-21.955		100	-	-	SPT	N=10					21.00
-22.940		60	-	-	TNW						
-23.505		100	-	-	Shelby S02						22.00
-23.955		111	-	-	SPT	N=16					
-24.940		65	-	-	TNW						23.00
-25.505		100	-	-	Shelby S03						
-25.955		111	-	-	SPT	N=15					24.00
-26.940		60	-	-	TNW						
-27.505		100	-	-	Shelby S04						25.00
-27.955		100	-	-	SPT	N=32					
-28.940		60	-	-	TNW						26.00
-29.505		100	-	-	Shelby S05						
-29.955		100	-	-	SPT	N=12					27.00
-30.940		50	-	-	TNW					Gradational contact, downward coarsening from -28.94 to -30.94 CDP	
		100	-	-	Shelby				(-30.94, -33.39)		28.00
		-	-	-	WB						

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ZAA Project Number: 1370

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Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS03

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS03

Start Date	2012/07/06	**End Date**	2012/07/15
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 203, Bollard 41	**Elevation:**	+3.060 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306549.66
Drilling -	Fairbrother		Y: -2230.81
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (m below platform)
-32.00	-31.940	100	-	-	SPT	N=R			Slightly moist, dark brown grey, cohesionless, very dense, bedded, coarse to Medium SAND with subordinate clayey fine sand. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		35.00
	-32.940	-	-	-	WB					-32.940 to -33.160 CDP: Clayey Fine SAND Wash bore drilling (WB) concentrates gravel sized material	
-33.00	-33.390	89	-	-	SPT	N=50			(-33.39, -36.32) Moist to very moist, brown grey speckled orange & white, cohesionless, medium dense to dense, bedded, medium coarse sandy Fine GRAVEL with sand and clay layers. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		36.00
-34.00	-34.640	-	-	-	Casing Sunk						37.00
	-34.940	-	-	-	WB					-34.940 to -35.340 CDP: Medium SAND	
-35.00	-35.390	89	-	-	SPT	N=46					38.00
	-35.940	-	-	-	WB						
-36.00	-36.390	60	-	-	SPT	N=21			(-36.32, -37.06) Slightly moist, dark brown grey, cohesive, very stiff, layered, silty sandy CLAY with sand and gravel seams. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	-36.190 to -36.320 CDP: Medium SAND	39.00
	-36.940	-	-	-	WB						
-37.00	-37.390	78	-	-	SPT	N=59			(-37.06, -39.82) Moist, brown & orange brown, cohesionless, very loose (assumed) to very dense, bedded, Fine SAND with clayey fine sand . Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		40.00
-38.00		-	-	-	Casing Sunk					Casing sank under own weight. Assume very loose conditions.	41.00
-39.00	-39.440										
	-39.890	78	-	-	SPT	N=25					42.00
-40.00	-40.440	-	-	-	WB				(-39.82, -40.77) Moist, dark brown grey, cohesionless, dense, layered, Fine SAND with minor gravel seams. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		43.00
	-40.890	100	-	-	SPT	N=40					
-41.00	-41.940	87	-	-	TNW						44.00
	-42.390	100	-	-	SPT	N=19			(-40.77, -43.24) Slightly moist, dark brown grey, cohesive, very stiff, friable, expansive, clayey fine sand to silty CLAY with nodules. Transported, fluvial-lacustrine / estuarine-lagoonal.		45.00
-42.00	-43.440	87	-	-	TNW						46.00
-43.00	-43.890	100	-	-	SPT	N=4			(-43.24, -47.54) Slightly moist, brown grey with layers of orange brown & green brown, cohesionless, medium dense to very dense, layered, coarse Medium SAND with subordinate fine gravel & fine sand layers. Transported, fluvial-lacustrine / estuarine-lagoonal.	-43.240 to -43.890 CDP: Fine GRAVEL	47.00
-44.00											
-45.00		-	-	-	Casing Sunk					Casing sank under own weight. Assume very loose conditions.	48.00
-46.00	-46.440										49.00
	-46.890	89	-	-	SPT	N=13					
-47.00	-47.440	-	-	-	WB						50.00
	-47.815	88	-	-	SPT	N=R			(-47.54, -52.64) Moist, light brown grey, cohesionless, very dense, bedded, clayey fine sand & medium sand and Coarse SAND. Transported, fluvial-lacustrine / estuarine-lagoonal.		51.00
-48.00											
-49.00		-	-	-	Casing Sunk					Casing sank under own weight. Assume very loose conditions.	52.00
-50.00	-50.940										53.00
	-51.165	100	-	-	SPT	N=R					
-51.00	-52.440	-	-	-	WB						54.00
	-52.740	83	-	-	SPT	N=R			(-52.64, -53.94) Slightly moist, olive green brown, cohesionless, very dense, fine sandy SILT. Residual, St Lucia Fm.		55.00
-52.00	-53.940	-	-	-	WB						56.00
-53.00											
-54.00		65 / 58	52	4	NWD4				(-53.94, -64.44) Dark brownish Olive-Green, moderately to highly weathered but predominantly highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard calcrete layers.		57.00
-55.00	-55.440										
-56.00		30 / 30	22	3	NWD4						59.00
	-56.940										
-57.00		16 / 16	0	3	TNW.DT						60.00
-58.00	-58.440										61.00
-59.00		27 / 19	0	5	NWD4						62.00
	-59.940										
-60.00		63 / 63	50	7	NWD4						63.00
-61.00	-61.440									-61.140 to -61.580 CDP: Calcrete lens	64.00
-62.00		30 / 30	30	2	TNW.DT					-61.580 to -62.940 CDP: Residual Rock	65.00
	-62.940										
-63.00		56 / 56	51	5	NWD4						66.00
-64.00	-64.440									END OF BOREHOLE (-64.44 CDP / 67.50 m below platform)	67.00

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS03

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1370-BHS03: Box 2 of 7

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1370-BHS03: Box 5 of 7

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Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS04

Start Date	2012/10/18	**End Date**	2012/10/19
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205, Bollard 86	**Elevation:**	+2.666 mCDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306720.00
Drilling -	Fairbrother		Y: -1466.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (m below platform)
2.67									(2.67, -13.26) Water		0.00
		-	-	-	Casing						
-13.264									(-13.26, -13.83) Harbour Floor Sediments	Sea Floor; -13.264 CDP	
-13.834		n/s	-	-	SPT	N=1			No sample recovered. Assumed to be very soft unconsolidated MUD.		
-15.334		-	-	-	WB				(-13.83, -16.33) Very moist to wet, dark brown grey, slightly cohesive, soft (medium dense where sand dominant), layered, sandy silty CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-15.784		22	-	-	SPT	N=13					
-16.334		-	-	-	WB						
-16.784		111	-	-	SPT	N=6					
-17.334		-	-	-	WB						
-17.784		111	-	-	SPT	N=8					
-18.334		-	-	-	WB						
-18.784		111	-	-	SPT	N=7					
-19.334		-	-	-	WB				(-16.33, -20.98) Slightly moist, dark brown grey, cohesive, firm, friable, silty CLAY with intermittent & isolated shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-19.784		111	-	-	SPT	N=7					
-20.334		-	-	-	WB						
-20.984		92	-	-	Shelby S01						
-21.434		22	-	-	SPT	N=12			(-20.98, -23.33) Very moist, dark brown grey, slightly cohesive, stiff, sandy silty CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-22.334		-	-	-	WB						
-22.784		n/s	-	-	SPT	N=11					
-23.334		-	-	-	WB						
-23.784		44	-	-	SPT	N=13			(-23.33, -29.55) Moist, orange brown & grey, cohesionless, dense (medium or very dense in places), some iron oxide staining on close joints, medium Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-24.834		-	-	-	WB						
-25.284		56	-	-	SPT	N=23					
-26.334		-	-	-	WB						
-26.784		67	-	-	SPT	N=13					
-27.834		-	-	-	WB						
-28.284		111	-	-	SPT	N=30				-27.834 to -28.234 CDP: Dark brown grey, cohesive, silty CLAY.	
-29.334		-	-	-	WB						32.00

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS04

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS04

Start Date	2012/10/18	**End Date**	2012/10/19
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 205, Bollard 86	**Elevation:**	+2.666 mCDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306720.00
Drilling -	Fairbrother		Y: -1466.00
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
-30.00	-29.784	78	-	-	SPT	N=50			(-29.55, -32.91) Slightly moist, olive green brown (earthy black in places), slightly cohesive, very dense, layered, clayey sandy SILT. Residual rock, St. Lucia Fm.		32.00
	-30.334	-	-	-	WB						
-31.00	-31.334	-	-	-	WB						33.00
	-31.784	67	-	-	SPT	N=52					34.00
-32.00	-32.834	-	-	-	WB						35.00
-33.00	-33.059	89	-	-	SPT	N=R			(-32.91, -36.93) Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard calcrete layers.		36.00
-34.00	-34.334	93 / 57	30	7	NWD4						37.00
-35.00	-35.834	-	-	-	NWD4						38.00
-36.00	-36.934	68 / 59	41	7	NWD4					END OF BOREHOLE (-36.934 CDP / 39.60 m below platform)	39.00

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Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS04

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Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS05

Start Date	2012/10/14	**End Date**	2012/10/16
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 204, Bollard 77	**Elevation:**	+2.500 mCDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306680.00
Drilling -	Fairbrother		Y: -1634.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
		-	-	-	Casing				(2.50, -15.11) Water		
	-15.110										
	-15.500	-	-	-	Casing				(-15.11, -15.50) Harbour Floor Sediments No sample recovered. Assumed to be very soft unconsolidated MUD.		
	-15.950	84	-	-	SPT	N=21				Sea Floor; -15.110 CDP	
	-16.500	-	-	-	WB				(-15.50, -15.95) Very moist, light brown, cohesionless, medium dense, Medium SAND with some shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-16.950	100	-	-	SPT	N=5					
	-17.500	-	-	-	WB						
	-17.950	100	-	-	SPT	N=3			(-15.95, -20.89) Slightly moist, dark brown grey, cohesive, soft, friable, silty CLAY with intermittent & isolated shell fragments. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-18.500	-	-	-	WB						
	-18.950	100	-	-	SPT	N=0					
	-20.000	-	-	-	NWD4						
	-20.600	100	-	-	Shelby S01						
	-21.050	111	-	-	SPT	N=0					
	-21.500	-	-	-	WB				(-20.89, -39.00) Moist to very moist, brown grey, slightly cohesive, medium dense (loose in places), layered, clayey SAND interbedded with sands and silty clay. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
	-21.950	100	-	-	SPT	N=12					
	-22.500	-	-	-	WB						
	-22.950	111	-	-	SPT	N=15				Pebble (20 mm)	
	-24.000	-	-	-	WB						
	-24.450	n/s	-	-	SPT	N=10					
	-25.500	-	-	-	WB						
	-25.950	n/s	-	-	SPT	N=10					
	-27.000	-	-	-	WB					Pebble (20 mm)	
	-27.450	111	-	-	SPT	N=5					
	-28.000	-	-	-						-28.450 to -29.950 CDP: Dark brown grey, cohesive, silty sandy CLAY.	
	-28.450	100	-	-	SPT	N=4					
	-29.500	-	-	-	WB						

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS05

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS05

Start Date	2012/10/14	**End Date**	2012/10/16
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 204, Bollard 77	**Elevation:**	+2.500 mCDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306680.00
Drilling -	Fairbrother		Y: -1634.00
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
-30.00	-29.950	44	-	-	SPT	N=0					32.00
	-31.000	-	-	-	WB						33.00
-31.00	-31.450	44	-	-	SPT	N=1					34.00
-32.00	-32.500	-	-	-	WB						35.00
	-32.950	100	-	-	SPT	N=14					36.00
-33.00	-34.000	-	-	-	WB						37.00
-34.00	-34.450	40	-	-	SPT	N=11					38.00
-35.00	-36.100	n/s	-	-	NWD4						39.00
-36.00	-36.500	-	-	-	WB						40.00
-37.00	-37.500	-	-	-	WB						41.00
	-37.950	100	-	-	SPT	N=29					42.00
-38.00	-39.000	-	-	-	WB						43.00
-39.00	-39.300	83	-	-	SPT	N=R			(-39.00, -42.62) Moist, kaki orange grey, slightly cohesive, very dense, layered, clayey sandy SILT. Residual, St. Lucia Fm.		44.00
-40.00	-40.500	70	-	-	NWD4						45.00
-41.00	-42.000	87	-	-	NWD4						46.00
-42.00	-42.500	n/s	-	-	NWD4				(-42.62, -46.10) Kaki orange grey to olive green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard calcrete layers.	-43.270 to -43.500 CDP: Calcrete lens -44.070 to -44.260 CDP: Calcrete lens -44.260 to -44.690 CDP: Residual rock END OF BOREHOLE (-46.10 CDP / 48.60 m below platform)	47.00
	-43.500	107 / 70	34	10	NWD4						48.00
-44.00	-45.000	91 / 51	26	9	NWD4						
-45.00	-46.100	91 / 51	-	16	NWD4						
-46.00											

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Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS05

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1370-BHS05: Box 3 of 3

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Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS06

Start Date	2012/10/11	**End Date**	2012/10/14
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 204, Bollard 69	**Elevation:**	+2.700 mCDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306645.11
Drilling -	Fairbrother		Y: -1778.59
Contractor:	Geotechnical Engineering CC		**Page 1 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (m below platform)
		-	-	-	Casing				(2.70, -14.35) Water		
-14.350											
-14.800		n/s	-	-	SPT	N=4			(-14.35, -17.60) Moist, green grey & orange brown, cohesionless, loose (medium dense in places), layered, Medium SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	Sea Floor; -14.350 CDP	
-15.300		-	-	-	WB						
-15.750		44	-	-	SPT	N=5					
-16.300		-	-	-	WB						
-16.750		56	-	-	SPT	N=16					
-17.300		-	-	-	WB						
-17.750		67	-	-	SPT	N=8					
-18.300		-	-	-	WB				(-17.60, -24.80) Slightly moist, marbled blue grey & brown green with pale yellow, cohesive, firm (stiff in places), fissured (iron oxide stain on closed joint surfaces), silty CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits. ("Slickenside structure not observed")		
-18.750		111	-	-	SPT	N=10					
-19.300		-	-	-	WB						
-19.900		100	-	-	Shelby S01						
-20.350		100	-	-	SPT	N=11					
-21.300		-	-	-	WB						
-21.750		129	-	-	SPT	N=7					
-22.300		-	-	-	WB						
-22.900		100	-	-	Shelby S02						
-23.400		114	-	-	SPT	N=8					
-24.800		24	-	-	NXM						
-25.250		91	-	-	SPT	N=12			(-24.80, -28.80) Slightly moist, dark brown grey, cohesive, stiff, layered, silty sandy CLAY with clayey sand laminations. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-26.300		-	-	-	WB						
-26.750		122	-	-	SPT	N=15					
-27.400		100	-	-	Shelby S03						
-27.850		122	-	-	SPT	N=11					
-28.800		100	-	-	NXM						
-29.250		78	-	-	SPT	N=17			(-28.80, -53.40) Moist, brown grey & orange brown, cohesionless, very dense (loose in places), layered, some iron oxide staining on closed joints, medium Fine SAND with thin gravel lenses and intermittent pebbles (5 to 25 mm). Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-30.300		-	-	-	WB						
-30.750		33	-	-	SPT	N=4					
-31.800		-	-	-	WB						

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Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS06

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PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BHS06

Start Date	2012/10/11	**End Date**	2012/10/14
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Berth 204, Bollard 69	**Elevation:**	+2.700 mCDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306645.11
Drilling -	Fairbrother		Y: -1778.59
Contractor:	Geotechnical Engineering CC		**Page 2 of 2**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
-32.00	32.175	67	-	-	SPT	N=R					35.00
		-	-	-	WB						
-33.00	-33.300									-33.300 to -33.720 CDP: Dark brown grey, cohesive, silty CLAY.	36.00
	-33.750	89	-	-	SPT	N=36					
-34.00		-	-	-	WB						37.00
	-34.800									-34.800 to -34.930 CDP: Dark brown grey, cohesive, silty CLAY. -34.930 to -37.800 CDP: Brown, cohesionless, coarse Medium SAND.	
-35.00		100	-	-	SPT	N=R					38.00
		-	-	-	WB						
-36.00	-36.300										39.00
		67	-	-	SPT	N=R				Ferricrete pebble (20mm)	
-37.00		-	-	-	WB						40.00
-38.00											41.00
-39.00	-39.300										
	-39.525	231	-	-	SPT	N=R					42.00
-40.00		-	-	-	WB						
	-40.800										43.00
-41.00	-41.250	89	-	-	SPT	N=R				-40.940 to -41.230 CDP: Dark brown grey, cohesive, silty CLAY.	44.00
		-	-	-	WB						
-42.00	-42.300										45.00
		100	-	-	SPT	N=R					
-43.00		-	-	-	WB						46.00
	-43.800										
-44.00		67	-	-	SPT	N=R				Ferricrete pebble (25mm)	47.00
		41	-	-	NWD4						
-45.00	-45.300										48.00
		97	-	-	SPT	N=R					
-46.00		-	-	-	WB						49.00
	-46.800										
-47.00	-47.100	93	-	-	SPT	N=R					50.00
		-	-	-	WB						
-48.00	-48.300										51.00
	-48.525	n/s	-	-	SPT	N=R					
-49.00		-	-	-	WB						52.00
	-49.800										
-50.00	-50.025	100	-	-	SPT	N=R					53.00
	-50.800	-	-	-	WB						
-51.00		-	-	-	WB						54.00
	-51.800										
-52.00		-	-	-	WB						55.00
	-52.800										
-53.00		67	-	-	SPT	N=R					56.00
	-54.300	-	-	-	WB				(-53.40, -55.30) Slightly moist, olive green brown, cohesionless, very dense, fine sandy SILT. Residual, St Lucia Fm.		57.00
-54.00											
-55.00	-55.300	-	-	-	WB						58.00
-56.00	-56.800	93 / 67	56	7	NWD4				(-55.30, -58.30) Dark brownish Olive-Green, moderately to highly weathered, closely to widely fractured, VERY SOFT ROCK, interbedded SILTSTONE and MUDSTONE. Cretaceous St. Lucia Formation. No definitive primary fabric with poorly defined bedding as coarser horizons grade into finer horizons. Joint surfaces are planar, smooth, no fill, sub-horizontal at irregular spacing (50-300mm), sub-vertical joints are conspicuous. Note the presence of fossil shells and imprints associated with, but not confined to, hard calcrete layers.	-56.600 to -56.800 CDP: Residual rock -57.930 to -58.300 CDP: Residual rock	59.00
-57.00		100 / 71	62	5	NWD4						60.00
-58.00	-58.300									END OF BOREHOLE (-58.30 CDP / 61.00 m below platform)	61.00

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ZAA Project Number: 1370

Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BHS06

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HOLE No: BD-BHM206
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JOB NUMBER: 07-395

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
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Client: TRANSNET PROJECTS
Project name: **Durban Harbour Berth Deepening**

HOLE No: BD-BHM206
Sheet 1 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
SPT	1.50	100	-	-	N=31	-	-	-	-	-	-	-	-		
	1.95														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
SPT	3.00	100	-	-	N=35	-	-	-	-	-	-	-	-		
	3.45														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
SPT	4.50	100	-	-	N=34	-	-	-	-	-	-	-	-		
	4.95														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
SPT	6.00	100	-	-	N= Ref 64	-	-	-	-	-	-	-	-		
	6.45														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
Wash Bore	7.55	-	-	-	-	-	-	-	-	-	-	-	-		
SPT	8.00	100	-	-	N=Ref 21	-	-	-	-	-	-	-	-		
	8.22														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
SPT	9.50	100	-	-	N=Ref 41	-	-	-	-	-	-	-	-		
	9.78														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		

DEPTH Scale 1:50: 1 2 3 4 5 6 7 8 9 10

Scale 1:50

0.00 Wet light brown medium dense becoming dense with depth, slightly silty fine to medium grained SAND. (Harbour Beds).

5.50 As above but very dense. (Harbour Beds).

7.00 Wet yellowish brown very dense slightly silty fine to medium grained SAND. (Harbour Beds).

HOLE No: BD-BHM206
Sheet 2 of 6

JOB NUMBER: 07-395

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MF -massive
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HOLE No: BD-BHM206
Sheet 2 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code (0 1 2 3 4 5)	Elevation (m.a.m.s.l.)
	11.00														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	12.50														
SPT		100	-	-	N=60	-	-	-	-	-	-	-	-		
	12.95														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	14.00														
SPT		100	-	-	N=60	-	-	-	-	-	-	-	-		
	14.45														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	15.50														
SPT		100	-	-	N=55	-	-	-	-	-	-	-	-		
	15.95														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	17.00														
SPT		100	-	-	N=50	-	-	-	-	-	-	-	-		
	17.45														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	18.50														
NWD4		41	33	-	-	1	0-5	C-M	PLA	SRJ	slt	<1	4		
	19.25														
NWD4		55	55	35	-	1	0-5	C-M	PLA	SRJ	slt	<1	4		
	20.19														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	21.69														

DEPTH Scale 1:50

11 12 13 14 15 16 17 18 19 20 21

18.50

Dark olive grey completely to highly weathered medium bedded closely jointed very soft rock SILTSTONE. Shells and fossil fragments fairly common. (Cretaceous) St Lucia Formation.

20.19

Wet olive to grey dense silty micaceous fine SAND. (Residual Cretaceous).

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HOLE No: BD-BHM206
Sheet 3 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
SPT		100	-	-	N=35	-	-	-	-	-	-	-	-		
	22.14														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	23.19														
SPT		100	-	-	N=36	-	-	-	-	-	-	-	-		
	23.64														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	24.60														
SPT		100	-	-	N=39	-	-	-	-	-	-	-	-		
	25.05														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	26.00														
SPT		100	-	-	N=32	-	-	-	-	-	-	-	-		
	26.45														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	27.50														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	27.79														
SPT		100	-	-	N=33	-	-	-	-	-	-	-	-		
	28.24														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	28.79														
SPT		100	-	-	N=36	-	-	-	-	-	-	-	-		
	29.24														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	29.79														
SPT		100	-	-	N=34	-	-	-	-	-	-	-	-		
	30.24														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	30.79														
TNW		88	88	35	-	1 2	0-5 45	C-M W	PLA PLA	SJ-SRJ SJ-SRJ	slt slt	<1 <1	9	0 1 2 3 4 5	
	32.29														
TNW		60	60	-	-	1	0-5	C	PLA	SJ-SRJ	slt	<1	2		

DEPTH Scale 1:50

22 23 24 25 26 27 28 29 30 31 32

30.79

Dark olive grey highly weathered thinly to medium bedded closely to medium jointed very soft rock SILTSTONE. (Cretaceous).
Note: medium hard to hard rock band at 32.6-32.8m. Fossil shell fragments fairly common.

HOLE No: BD-BHM206
Sheet 4 of 6

JOB NUMBER: 07-395

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HOLE No: BD-BHM206
Sheet 4 of 6

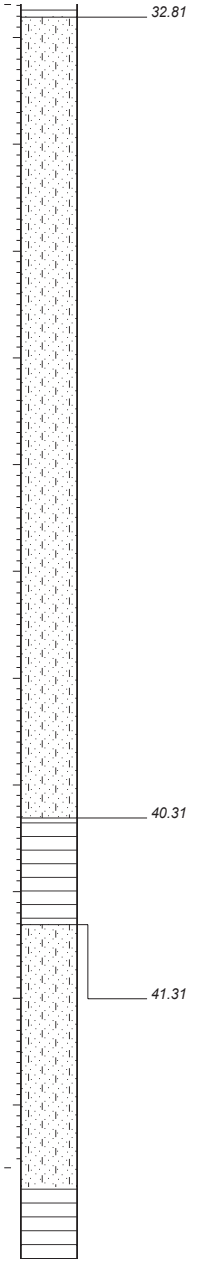
JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	32.81														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	33.31														
SPT		100	-	-	N=32	-	-	-	-	-	-	-	-		
	33.76														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	34.31														
SPT		100	-	-	N=35	-	-	-	-	-	-	-	-		
	34.76														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	35.31														
SPT		100	-	-	N=32	-	-	-	-	-	-	-	-		
	35.76														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	36.31														
SPT		100	-	-	N=33	-	-	-	-	-	-	-	-		
	36.76														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	37.31														
SPT		100	-	-	N=35	-	-	-	-	-	-	-	-		
	37.76														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	38.31														
SPT		100	-	-	N=37	-	-	-	-	-	-	-	-		
	38.76														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	39.31														
SPT		100	-	-	N=34	-	-	-	-	-	-	-	-		
	39.76														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	40.31														
NWD4		40	40	-	-	-	-	-	-	-	-	-	-		
	40.81														
NWD4		40	40	-	-	-	-	-	-	-	-	-	-		
	41.31														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	41.81														
SPT		100	-	-	N=33	-	-	-	-	-	-	-	-		
	42.26														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	42.31														
SPT		100	-	-	N=35	-	-	-	-	-	-	-	-		
	42.76														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	43.31														

0 1 2 3 4 5

DEPTH Scale 1:50

33 34 35 36 37 38 39 40 41 42 43



32.81

Wet olive to grey dense silty micaceous fine SAND. (Residual Cretaceous).

40.31

Dark and light olive grey completely to highly weathered with medium weathered bands generally very soft rock with thin bands of (100 to 300mm thick) medium hard rock SILTSTONE with fossil shell fragments fairly common. (Cretaceous). Core recovery very poor.

41.31

Wet olive to grey dense silty micaceous fine SAND. (Residual Cretaceous).

HOLE No: BD-BHM206
Sheet 5 of 6

JOB NUMBER: 07-395

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HOLE No: BD-BHM206
Sheet 5 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
SPT	43.76	100	-	-	N=33	-	-	-	-	-	-	-	-	-	
TNW	44.31	100	65	39	-	1	0-5	C-M	PLA	SRJ	slt	<1	2		
TNW	44.81	100	88	76	UCS=1.154MPa	1	0-5	C-M	PLA	SRJ	slt	<1	3		
TNW	45.31	96	96	28	-	1	0-5	C-M	PLA	SRJ	slt	<1	6		
TNW	45.81	100	76	50	UCS=1.317MPa	1	0-5	C-M	PLA	SRJ	slt	<1	3		
TNW	47.31	93	93	88	UCS=1.731MPa UCS=1.588MPa	1	0-5	C-W	PLA	SRJ	slt	<1	5		
TNW	48.81	52	39	7	-	1	0-5	C-M	PLA	SRJ	slt	<1	5		
TNW	49.31	70	60	-	-	-	-	-	-	-	-	-	-		
Wash Bore	49.81	-	-	-	-	-	-	-	-	-	-	-	-		
Wash Bore	50.81	-	-	-	-	-	-	-	-	-	-	-	-		
SPT	51.26	100	-	-	N=49	-	-	-	-	-	-	-	-		
Wash Bore	52.31	-	-	-	-	-	-	-	-	-	-	-	-		
SPT	52.76	100	-	-	N=50	-	-	-	-	-	-	-	-		
Wash Bore	53.81	-	-	-	-	-	-	-	-	-	-	-	-		

0 1 2 3 4 5

DEPTH Scale 1:50

43.76

Pale olive grey medium weathered thinly to medium bedded closely to medium jointed medium hard to hard rock SILTSTONE. (Cretaceous).
Note: Fossil shell fragments fairly common.

44.31

Dark olive grey with occasional light olive grey bands highly weathered medium bedded with zones of wide and thinly bedded medium jointed with widely and closely jointed zones very soft rock SILTSTONE. (Cretaceous).
Note: Bands of medium hard to hard rock at 44.81-45.15m; 45.7-49.0m; 47.31-47.40m. Fossil shell fragments fairly common.

48.30

Dark olive grey completely to highly weathered very soft rock with zones of very stiff silt, SILTSTONE. (Cretaceous).

49.31

Wet greyish brown very dense silty fine to medium grained SAND. Note: Possible (Residual Cretaceous).
However brown colour suggests contamination with harbour bed sand. Drillers log indicates casing final depth at 43.0m.

53.81

HOLE No: BD-BHM206
Sheet 6 of 6

JOB NUMBER: 07-395

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HOLE No: BD-BHM206
Sheet 6 of 6

JOB NUMBER: 07-395

NOTES

1) End of borehole at 53.81m below sea floor.

2) Final depth of NW casing at 43.0m.

3) Borehole carried out from jack up barge.

4) Possible contamination of Cretaceous has occured with Harbour Bed or fill materials from above.

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code (0 1 2 3 4 5)	Elevation (m.a.m.s.l.)	DEPTH Scale 1:50

CONTRACTOR : Geopractica
MACHINE :
DRILLED BY : Martin/ Lawrence/ Mike
PROFILED BY : MVR

TYPE SET BY : Rev 0
SETUP FILE : MSJA3.SET

INCLINATION : 90°
DIAM : N
DATE : 30/07/2008
DATE : 12/08/2008

DATE : 24/02/09 15:27
TEXT : ..\BHOLES\BD-BHM~1.TXT

ELEVATION : -12.9 (m) CD
X-COORD : 3306642.005
Y-COORD : -1919.433

HOLE No: BD-BHM206

dot.PLOT 5003 J&W

BD-BHM206 0.0 to 19.52m BOX 1 of 4

BD-BHM206 19.52 to 32.29m BOX 2 of 4

BD-BHM206 32.29 to 44.55m BOX 3 of 4

BD-BHM206 44.55 to 53.81m BOX 4 of 4

HOLE No: BD-BHM207
Sheet 1 of 5

JOB NUMBER: 07-395

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HOLE No: BD-BHM207
Sheet 1 of 5

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
Wash Bore		34	-	-	-	-	-	-	-	-	-	-	-		
	1.50														
Wash Bore		44	-	-	-	-	-	-	-	-	-	-	-		
	3.00														
SPT		0	-	-	N=15	-	-	-	-	-	-	-	-		
	3.47														
Wash Bore		54	-	-	-	-	-	-	-	-	-	-	-		
	4.50														
Wash Bore		40	-	-	-	-	-	-	-	-	-	-	-		
	6.00														
SPT		29	-	-	N=19	-	-	-	-	-	-	-	-		
	6.45														
Wash Bore		51	-	-	-	-	-	-	-	-	-	-	-		
	7.50														
Wash Bore		37	-	-	-	-	-	-	-	-	-	-	-		
	9.00														
SPT		40	-	-	N=17	-	-	-	-	-	-	-	-		
	9.45														
Wash Bore		30	-	-	-	-	-	-	-	-	-	-	-		
	10.50														

Fracture Frequency: 0 1 2 3 4 5

DEPTH Scale 1:50: 1 2 3 4 5 6 7 8 9 10

Scale 1:50

0.00

Wet medium dark brown speckled black orange and white medium dense slightly silty SAND with some shell fragments. (Harbour Beds).

10.50

HOLE No: BD-BHM207
Sheet 2 of 5

JOB NUMBER: 07-395

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VSR-very soft rock

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Client: TRANSNET PROJECTS
Project name: **Durban Harbour Berth Deepening**

HOLE No: BD-BHM207
Sheet 2 of 5

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
Wash Bore	12.00	0	-	-	-	-	-	-	-	-	-	-	-		
Wash Bore	13.50	17	-	-	-	-	-	-	-	-	-	-	-		
Wash Bore	15.00	0	-	-	-	-	-	-	-	-	-	-	-		
SPT	15.45	29	-	-	N=19	-	-	-	-	-	-	-	-		
Wash Bore	16.50	15	-	-	-	-	-	-	-	-	-	-	-		
SPT	16.95	38	-	-	N=22	-	-	-	-	-	-	-	-		
Wash Bore	18.20	10	-	-	-	-	-	-	-	-	-	-	-		
NWD4	19.35	10	10	-	-	-	-	-	-	-	-	-	-		
NWD4	20.35	9	9	-	-	-	-	-	-	-	-	-	-		
NWD4		20	20	-	UCS=1.184MPa	1	0-5	C	UND	SRJ	slt	<1	3	2-3	

0 1 2 3 4 5

DEPTH Scale 1:50

11 12 13 14 15 16 17 18 19 20 21

No sample recovery.

12.00

Wet medium dark greyish brown speckled black orange and white medium dense slightly silty SAND with some shell fragments. (Harbour Beds).

15.95

Wet dark grey medium dense fine grained silty SAND with some shell fragments. (Harbour Beds).

18.20

Light grey stained brown slightly weathered fine grained apparently medium hard rock SANDSTONE containing fossils. (Cretaceous). Very poor core recovery.

20.35

Dark grey moderately to highly weathered thinly bedded closely jointed soft rock SILTSTONE. (Cretaceous). Very poor core recovery.

HOLE No: BD-BHM207
Sheet 3 of 5

JOB NUMBER: 07-395

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

JOINT SPACING
VCJ-very close spacg
CJ -close spacing
MJ -medium spacing
WJ -wide spacing
VWJ-very wide spacng

JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
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HOLE No: BD-BHM207
Sheet 3 of 5

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	21.85														
NWD4		29	20	-	-	1	5-10	C	UND	SRJ	slt	<1	3	3-4	
	23.35														
Wash Bore		0	0	0	-	-	-	-	-	-	-	-	-	-	
	24.85														
Wash Bore		0	0	0	-	-	-	-	-	-	-	-	-	-	
	26.35														
NWD4		47	47	-	-	1	0-10	C	UND	SRJ	slt	<1	5	3-4	
	27.87														
NWD4		23	23	-	-	1	0-10	C	UND	SRJ	slt	<1	-	-	
	29.19														
NWD4		23	23	-	UCS=1.331MPa	1	0-10	C	UND	SRJ	slt	<1	6	3-4	
	30.69														
NWD4		36	36	11	-	1	0-10	C	PLA	SRJ	slt	<1	5	3-4	
	32.19														
NWD4		76	76	-	UCS=1.249MPa	1	0-5	C	PLA	SRJ	slt	<1	1	3-4	

0 1 2 3 4 5

DEPTH Scale 1:50

22 23 24 25 26 27 28 29 30 31 32

21.85 — As above but completely weathered.

21.98 — Dark grey highly to completely weathered thinly to medium bedded closely jointed soft rock SILTSTONE. (Cretaceous). Very poor core recovery.

23.35 — No sample recovery.

26.35 — Dark grey highly to completely weathered thinly bedded closely jointed soft rock SILTSTONE. (Cretaceous). Poor core recovery.

HOLE No: BD-BHM207
Sheet 4 of 5

JOB NUMBER: 07-395

ROCK FABRIC
MF -massive
BF -bedded
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HOLE No: BD-BHM207
Sheet 4 of 5

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	32.94														
NWD4		32	32	21	-	1	0-5	C	PLA	SRJ	slt	<1	2	3-4	
	33.69														
NWD4		42	28	24	-	1	0-5	C	PLA	SRJ	slt	<1	0	3	
	34.40														
NWD4		59	59	-	-	1	0-10	C	PLA	SRJ	slt	<1	4	3-4	
	35.19														
NWD4		25	25	-	-	1 2	0-10 85	C M	PLA UND	SRJ SRJ	slt slt	<1 <1	3	2-4	
	36.99														
NWD4		15	15	-	-	-	-	-	-	-	-	-	-	-	
	38.49														
NWD4		67	67	-	-	-	-	-	-	-	-	-	-	-	
	38.70														
NWD4		30	30	-	-	1	5-20	C	PLA	SRJ	slt	<1	8	2-4	
	40.20														
TNW		100	100	13	UCS=1.031MPa	1 2	0-5 40	C M	PLA UND	SJ-SRJ SJ-SRJ	slt slt	<2 <2	6	2-4	
	41.48														
TNW		100	100	47	UCS=1.058MPa	1	0-10	C	PLA	SJ-SRJ	slt	<2	12	2-4	
	42.96														
TNW		100	100	82	-	1	0-10	C	PLA	SJ-SRJ	slt	<2	4	3	
	43.29														

0 1 2 3 4 5

DEPTH Scale 1:50

33 34 35 36 37 38 39 40 41 42 43

36.90

Dark grey medium to highly weathered thinly to medium bedded closely to medium jointed soft rock SILTSTONE. (Cretaceous). Generally poor core recovery to 40.2m; thereafter improvement from 80 to 100%.

HOLE No: BD-BHM207
Sheet 5 of 5

JOB NUMBER: 07-395

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
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SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
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MG -medium grain
CG -coarse grain

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JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
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IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
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Project name: **Durban Harbour Berth Deepening**

HOLE No: BD-BHM207
Sheet 5 of 5

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
TNW		100	100	43	-	1 2	0-20 65	C C	PLA PLA	SJ-SRJ SJ-SRJ	slt slt	<2 <2	10	2-3	
	44.79														
TNW		100	100	67	UCS=1.219MPa	1	0-20	C	PLA	SJ-SRJ	slt	<2	4	2-3	
	46.29														
TNW		90	90	85	-	1	0-5	C	PLA	SJ-SRJ	slt	<2	4	3	
	47.79														
TNW		100	100	33	UCS=1.951MPa	1	0-5	C	PLA	SJ-SRJ	slt	<2	3	2-4	
	49.29														
TNW		80	80	28	UCS=1.781MPa	1	0-5	C	PLA	SJ-SRJ	slt	<2	3	3-4	
	50.79														
TNW		100	100	40	UCS=2.613MPa	1	0-5	C	PLA	SJ-SRJ	slt	<2	4	3-4	
	52.29														

0 1 2 3 4 5

DEPTH Scale 1:50

44 45 46 47 48 49 50 51 52

52.29

NOTES

1) End of borehole at 52.29m below sea floor.

2) Final depth of HW casing at 15.0m and NW casing at 38.5m.

3) Borehole carried out from jack up barge.

CONTRACTOR : Geopractica
MACHINE :
DRILLED BY : Martin/ Lawrence
PROFILED BY : LD

TYPE SET BY : Rev 0
SETUP FILE : MSJA3.SET

INCLINATION : 90°
DIAM : N
DATE : 27/06/2008
DATE : 03/07/2008

DATE : 24/02/09 16:18
TEXT : ..\BHOLES\BD-BHM~2.TXT

ELEVATION : -16.01 (m) CD
X-COORD : 3306617.188
Y-COORD : -2018.854

HOLE No: BD-BHM207

dot.PLOT 5003 J&W

BD-BHM207 0.0 to 23.35m BOX 1 of 4

BD-BHM207 23.35 to 41.48m BOX 2 of 4

BD-BHM207 41.48 to 47.79m BOX 3 of 4

BD-BHM207 47.79 to 52.29m BOX 4 of 4

HOLE No: BD-BHM208
Sheet 1 of 3

JOB NUMBER: 07-395

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
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GRAIN SIZE
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ROCK HARDNESS
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HOLE No: BD-BHM208
Sheet 1 of 3

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
Wash Bore		28	-	-	-	-	-	-	-	-	-	-	-		
	1.50														
SPT		60	-	-	N=13	-	-	-	-	-	-	-	-		
	1.95														
NWD4		29	-	-	-	-	-	-	-	-	-	-	-		
	3.00														
SPT		53	-	-	N=15	-	-	-	-	-	-	-	-		
	3.45														
Wash Bore		0	-	-	-	-	-	-	-	-	-	-	-		
	4.50														
Shelby		0	-	-	Shelby	-	-	-	-	-	-	-	-		
	5.05														
Wash Bore		21	-	-	-	-	-	-	-	-	-	-	-		
	6.00														
SPT		57	-	-	N=24	-	-	-	-	-	-	-	-		
	6.45														
Wash Bore		24	-	-	-	-	-	-	-	-	-	-	-		
	7.50														
SPT		51	-	-	N=32	-	-	-	-	-	-	-	-		
	7.95														
Wash Bore		21	-	-	-	-	-	-	-	-	-	-	-		
	9.00														
SPT		60	-	-	N=29	-	-	-	-	-	-	-	-		
	9.45														
Wash Bore		19	-	-	-	-	-	-	-	-	-	-	-		
	10.50														
Shelby		0	-	-	Shelby	-	-	-	-	-	-	-	-		

Weathering code: 0 1 2 3 4 5

DEPTH Scale 1:50

Scale 1:50

0.00 Wet medium dark brown speckled orange and black medium dense fine to medium grained SAND with tiny shell fragments. (Harbour Beds). (Logged from the wash sample).

1.95 Wet dark grey, apparently very stiff silty CLAY. (Harbour Beds).

3.00 Wet light brown speckled orange and black medium dense to dense with depth fine to medium grained SAND with tiny shell fragments. (Harbour Beds).

8.50 Wet medium dark brown speckled orange and black medium dense to dense fine to medium grained SAND with tiny shell fragments. (Harbour Beds).

HOLE No: BD-BHM208
Sheet 2 of 3

JOB NUMBER: 07-395

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JOINT SHAPE
CUR-curvilinear
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ROCK HARDNESS
EHR-extremely hard rock
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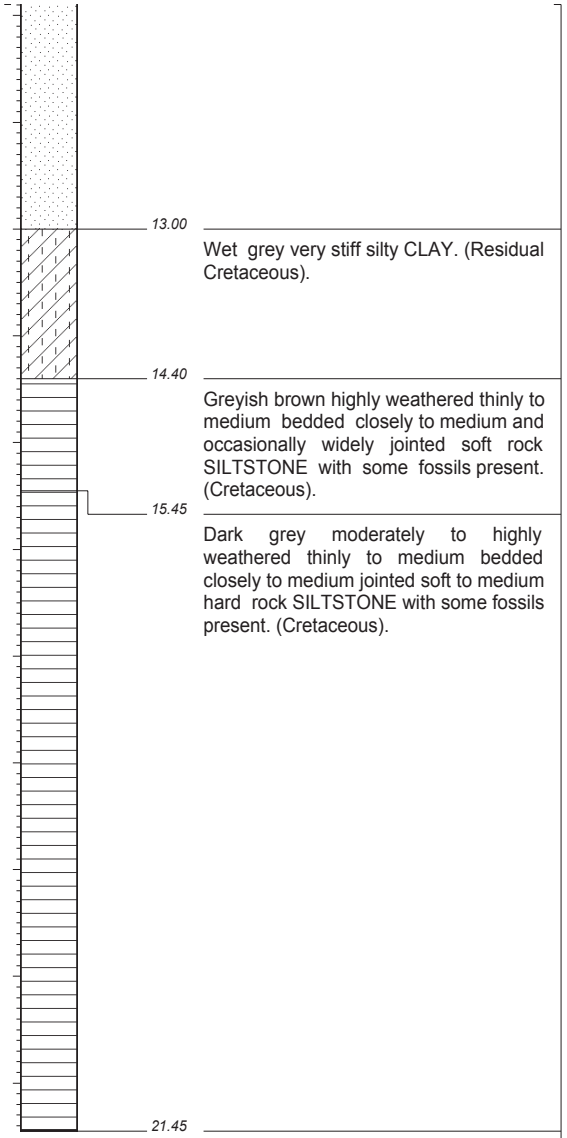
HOLE No: BD-BHM208
Sheet 2 of 3

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	11.05														
Wash Bore		21	-	-	-	-	-	-	-	-	-	-	-	-	
	12.00														
SPT		49	-	-	N=34	-	-	-	-	-	-	-	-	-	
	12.45														
Wash Bore		40	-	-	-	-	-	-	-	-	-	-	-	-	
	13.50														
SPT		44	-	-	N=62	-	-	-	-	-	-	-	-	-	
	13.95														
NWD4		97	86	50	UCS=1.9MPa	1 2	0-10 70	C-M W	PLA-UND PLA-UND	SJ-SRJ SJ-SRJ	slt cl	<1 <1	14	3-4	
	15.45														
NWD4		80	80	27	UCS=2.5MPa	1	0-10	C-M	PLA-UND	SJ-SRJ	slt	<1	16	2-3	
	16.95														
NWD4		85	85	15	UCS=2.4MPa	1	0-10	C-M	PLA-UND	SJ-SRJ	slt	<1	19	2-3	
	18.45														
NWD4		97	97	27	-	1	0-10	C-M	PLA-UND	SJ-SRJ	slt	<1	14	3-4	
	19.95														
NWD4		98	98	47	UCS=2.2MPa	1	0-5	C-M	PLA-UND	SJ-SRJ	slt	<1	15	2-3	
	21.45														

DEPTH Scale 1:50

11 12 13 14 15 16 17 18 19 20 21



13.00 — Wet grey very stiff silty CLAY. (Residual Cretaceous).

14.40 — Greyish brown highly weathered thinly to medium bedded closely to medium and occasionally widely jointed soft rock SILTSTONE with some fossils present. (Cretaceous).

15.45 — Dark grey moderately to highly weathered thinly to medium bedded closely to medium jointed soft to medium hard rock SILTSTONE with some fossils present. (Cretaceous).

21.45

HOLE No: BD-BHM208
Sheet 3 of 3

JOB NUMBER: 07-395

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HOLE No: BD-BHM208
Sheet 3 of 3

JOB NUMBER: 07-395

NOTES

1) End of borehole at 21.45m below sea floor.

2) Final depth of NW casing at 19.0m.

3) Borehole terminated due to passing tug rocking the floating platform causing the casing to snap.

4) Borehole carried out from floating platform.

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code (0 1 2 3 4 5)	Elevation (m.a.m.s.l.)	DEPTH Scale 1:50

CONTRACTOR : Geopractica
MACHINE :
DRILLED BY : PM
PROFILED BY : LD

TYPE SET BY : Rev 0
SETUP FILE : MSJA3.SET

INCLINATION : 90°
DIAM : N
DATE : 26/06/2008
DATE : 02/07/2008

DATE : 24/02/09 16:16
TEXT : ..\BHOLES\BD-BHM~3.TXT

ELEVATION : -13.118 (m) CD
X-COORD : 3306605.55
Y-COORD : -2096.114

HOLE No: BD-BHM208

dot.PLOT 5003 J&W

BD-BHM208 0.0 to 15.45m BOX 1 of 2

BD-BHM208 15.45 to 21.45m BOX 2 of 2

HOLE No: BD-BHM209
Sheet 1 of 6

JOB NUMBER: 07-395

ROCK FABRIC
MF -massive
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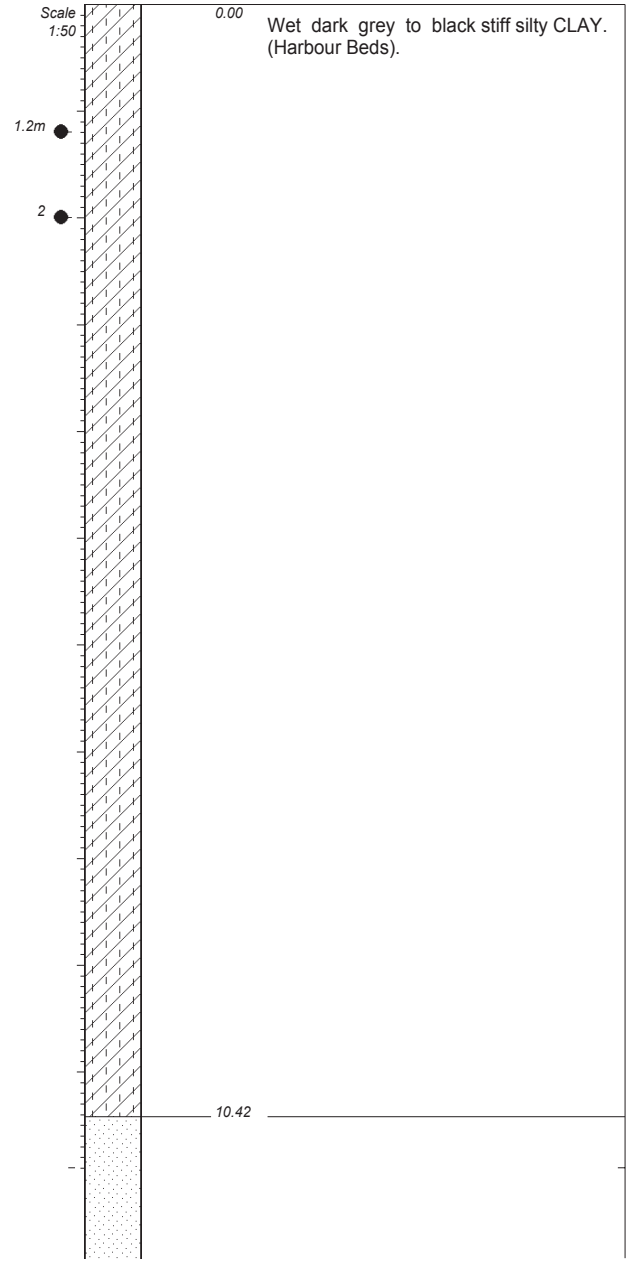
HOLE No: BD-BHM209
Sheet 1 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
Wash Bore		0	-	-	-	-	-	-	-	-	-	-	-		
	1.00														
HW		40	-	-	-	-	-	-	-	-	-	-	-		
	2.50														
SPT		44	-	-	N=16	-	-	-	-	-	-	-	-		
	2.95														
HW		48	-	-	-	-	-	-	-	-	-	-	-		
	4.00														
HW		44	-	-	-	-	-	-	-	-	-	-	-		
	4.50														
Shelby		100	-	-	Shelby	-	-	-	-	-	-	-	-		
	4.97														
SPT		100	-	-	N=19	-	-	-	-	-	-	-	-		
	5.42														
HW		77	-	-	-	-	-	-	-	-	-	-	-		
	6.91														
HW		36	-	-	-	-	-	-	-	-	-	-	-		
	8.47														
HW		53	-	-	-	-	-	-	-	-	-	-	-		
	9.97														
SPT		100	-	-	N=18	-	-	-	-	-	-	-	-		
	10.42														



HOLE No: BD-BHM209
Sheet 2 of 6

JOB NUMBER: 07-395

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
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JOINT SPACING
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JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
SR -soft rock
VSR-very soft rock

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Client: TRANSNET PROJECTS
Project name: **Durban Harbour Berth Deepening**

HOLE No: BD-BHM209
Sheet 2 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
HW	11.42	100	-	-	-	-	-	-	-	-	-	-	-	0 1 2 3 4 5	
HW	13.42	100	-	-	-	-	-	-	-	-	-	-	-	0 1 2 3 4 5	
SPT	13.87	44	-	-	N=32	-	-	-	-	-	-	-	-	0 1 2 3 4 5	
HW	15.37	57	-	-	-	-	-	-	-	-	-	-	-	0 1 2 3 4 5	
HW	15.87	100	-	-	-	-	-	-	-	-	-	-	-	0 1 2 3 4 5	
HW	17.37	23	-	-	-	-	-	-	-	-	-	-	-	0 1 2 3 4 5	
HW	18.87	20	-	-	-	-	-	-	-	-	-	-	-	0 1 2 3 4 5	
SPT	19.32	100	-	-	N=20	-	-	-	-	-	-	-	-	0 1 2 3 4 5	
HW	20.37	63	-	-	-	-	-	-	-	-	-	-	-	0 1 2 3 4 5	
Wash Bore	21.42	0	-	-	-	-	-	-	-	-	-	-	-	0 1 2 3 4 5	

DEPTH Scale 1:50

11.42

Wet slightly greyish apparently medium brown speckled black medium dense fine to medium grained SAND with tiny shell fragments. (Harbour Beds).

12.30

Wet dark grey to black stiff silty CLAY. (Harbour Beds).
At 21.42m the driller reports running sand from 21.42m to 27.32m. NW casing installed inside HW casing at this depth.

13.42m

21.00

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
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MG -medium grain
CG -coarse grain

JOINT SPACING
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HOLE No: BD-BHM209
Sheet 3 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
													0 1 2 3 4 5		
Wash Bore		47	-	-	-	-	-	-	-	-	-	-	-		
	22.82														
Wash Bore		17	-	-	-	-	-	-	-	-	-	-	-		
	24.34														
Wash Bore		18	-	-	-	-	-	-	-	-	-	-	-		
	25.82														
Wash Bore		36	-	-	-	-	-	-	-	-	-	-	-		
	27.32														
Wash Bore		15	-	-	-	-	-	-	-	-	-	-	-		
	29.33														
SPT		100	-	-	N=15	-	-	-	-	-	-	-	-		
	29.78														
Wash Bore		38	-	-	-	-	-	-	-	-	-	-	-		
	30.88														
Wash Bore		38	-	-	-	-	-	-	-	-	-	-	-		
	31.80														
Wash		25	-	-	-	-	-	-	-	-	-	-	-		

DEPTH Scale 1:50

22 23 24 25 26 27 28 29 30 31 32

Wet, slightly greyish medium brown speckled black medium dense fine to medium grained SAND with tiny shell fragments. (Harbour Beds). (Logged from wash samples and 1 SPT sample).
At 33.30m the HW casing and NW casing jammed. All casing removed and NW casing only reinstalled.

HOLE No: BD-BHM209
Sheet 4 of 6

JOB NUMBER: 07-395

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MF -massive
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HOLE No: BD-BHM209
Sheet 4 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
Bore															
	33.30														
Wash Bore		100	-	-	-	-	-	-	-	-	-	-	-	-	
	34.80														
Wash Bore		35	-	-	-	-	-	-	-	-	-	-	-	-	
	36.63														
Wash Bore		0	-	-	-	-	-	-	-	-	-	-	-	-	
	38.15														
SPT		44	-	-	N=14	-	-	-	-	-	-	-	-	-	
	38.60														
Wash Bore		21	-	-	-	-	-	-	-	-	-	-	-	-	
	40.10														
NWD4		67	-	-	UCS=2.1MPa	-	-	-	-	-	-	-	-	-	
	41.30														
NWD4		33	33	-	-	-	-	-	-	-	-	-	-	3-4	
	43.10														

DEPTH Scale 1:50

36.63
As above but slightly greyish brown.

40.10
Wet dark blackish grey apparently firm silty CLAY. (Harbour Beds).

40.80
Light grey to dark grey highly to completely weathered thinly to medium bedded very closely to closely jointed soft rock to medium hard rock SILTSTONE with some fossils present. (Cretaceous). Very poor core recovery.

43.00

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Project name: **Durban Harbour Berth Deepening**

HOLE No: BD-BHM209
Sheet 5 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
NWD4		20	20	8	-	1	0-10	C-M	PLA	SRJ	slt	<1	3	2-3	
	44.60														
NWD4		51	51	-	-	1	0-10	C-M	PLA	SRJ	slt	<1	3	3-4	
	46.10														
NWD4		20	20	-	-	1	0-10	C-M	PLA	SRJ	slt	<1	3	2	
	47.60														
NWD4		17	17	-	-	1	0-10	C-M	PLA	SRJ	slt	<1	3	2-4	
	49.10														
NWD4		97	97	21	UCS=2.9MPa	1	0-10	C-M	PLA	SRJ	slt	<1	>20	2-4	
	50.63														
NWD4		100	100	50	UCS=1.8MPa	1	0-10	C-M	PLA	SRJ	slt	<1	13	2-4	
	52.13														
NWD4		100	100	70	UCS=2.5MPa	1	0-5	M	PLA	SRJ	slt	<1	5	3-4	
	52.63														
NWD4		100	100	17	-	1	0-5	M	PLA	SRJ	slt	<1	7	3-4	

Weathering code: 0 1 2 3 4 5

DEPTH Scale 1:50

44 45 46 47 48 49 50 51 52 53 54

Light grey to olive, medium to highly weathered thinly to medium bedded closely to medium jointed very soft rock SILTSTONE with fossils. (Cretaceous). (Note: very poor core recovery to 49.10m).

HOLE No: BD-BHM209
Sheet 6 of 6

JOB NUMBER: 07-395

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HOLE No: BD-BHM209
Sheet 6 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	55.13														
NWD4		68	60	27	-	1	0-5	M	PLA	SRJ	slt	<1	9	2-3	
	56.65														
NWD4		100	100	77	UCS=2.4MPa UCS=2.4MPa	1	0-5	M	PLA	SRJ	slt	<1	6	2-3	
	58.15														
NWD4		64	64	34	-	1 2	0-5 45	M M	PLA PLA	SRJ SRJ	slt slt	<1 <1	12	2-3	
	60.63														
NWD4		78	78	30	-	1	0-5	M	PLA	SRJ	slt	<1	13	2-3	
	62.00														

0 1 2 3 4 5

DEPTH Scale 1:50

55 56 57 58 59 60 61 62

62.00

NOTES

1) End of borehole at 62.00m below sea floor.

2) Final depth of HW casing at 27.32m and NW casing at 40.10m)

3) From run 11.42 to 13.42m (2m) there are 2 drill runs on the drillers log but only 1.2m of sample in the core box.

4) Borehole carried out from jack up barge.

5) The depths on the core markers in the core boxes are labled as refernced from the deck level of the jack up barge, while the drillers log has been corrected to sea bed level.

CONTRACTOR : Geopractica
MACHINE :
DRILLED BY : Martin / Mike / Daniel
PROFILED BY : SAP

TYPE SET BY : Rev 0
SETUP FILE : MSJA3.SET

INCLINATION : 90°
DIAM : N
DATE : 16/06/2008
DATE : 04/07/2008

DATE : 24/02/09 15:28
TEXT : ..\BHOLES\BD-BHM~4.TXT

ELEVATION : -13.01 (m) CD
X-COORD : 3306577.189
Y-COORD : -2218.109

HOLE No: BD-BHM209

dot.PLOT 5003 J&W

BD-BHM209 18.00 to 30.30m BOX 1 of 5

Core markers in the core box indicate that the drilling started from the top of the jackup barge at 18.0m and not from sea bed level at 0m.

BD-BHM209 30.30 to 40.82m BOX 2 of 5

BD-BHM209 40.82 to 58.80m BOX 3 of 5

BD-BHM209 58.80 to 70.84m BOX 4 of 5

BD-BHM209 70.84 to 80.00m BOX 5 of 5

HOLE No: BD-BHM210A
Sheet 1 of 7

JOB NUMBER: 07-395

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HOLE No: BD-BHM210A
Sheet 1 of 7

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
NWD4		16	16	-	-	-	-	-	-	-	-	-	-		
	1.30														
NWD4		0	-	-	-	-	-	-	-	-	-	-	-		
	2.80														
NWD4		0	-	-	-	-	-	-	-	-	-	-	-		
	4.80														
NWD4		0	-	-	-	-	-	-	-	-	-	-	-		
	6.40														
NWD4		7	-	-	-	-	-	-	-	-	-	-	-		
	7.90														
NWD4		-	-	-	-	-	-	-	-	-	-	-	-		
	9.40														
SPT		33	-	-	N=48	-	-	-	-	-	-	-	-		
	9.85														
NWD4		-	-	-	-	-	-	-	-	-	-	-	-		

0 1 2 3 4 5

DEPTH Scale 1:50

Scale 1:50

0.00

Angular to subangular boulders of bluish grey slightly weathered hard to very hard rock Tillite. (Quay Wall Rockfill/Rip Rap).

7.90

Wet dark grey to very dark olive grey very stiff very silty CLAY. (Harbour Beds). Becomes slightly sandy with depth.

HOLE No: BD-BHM210A
Sheet 2 of 7

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Sheet 2 of 7

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	11.15														
SPT		44	-	-	N=46	-	-	-	-	-	-	-	-		
	11.60														
Shelby		100	-	-	-	-	-	-	-	-	-	-	-		
	11.96														
NWD4		100	-	-	-	-	-	-	-	-	-	-	-		
	12.57														
Solid Tube		100	-	-	-	-	-	-	-	-	-	-	-		
	14.07														
NWD4		0	-	-	-	-	-	-	-	-	-	-	-		
	15.57														
NWD4		100	-	-	-	-	-	-	-	-	-	-	-		
	16.07														
NWD4		100	-	-	-	-	-	-	-	-	-	-	-		
	16.57														
NWD4		100	-	-	-	-	-	-	-	-	-	-	-		
	17.07														
NWD4		80	-	-	-	-	-	-	-	-	-	-	-		
	18.07														
Wash Bore		100	-	-	-	-	-	-	-	-	-	-	-		
	19.65														
SPT		44	-	-	N=25	-	-	-	-	-	-	-	-		
	20.10														
Wash Bore		100	-	-	-	-	-	-	-	-	-	-	-		
	21.15														
SPT		44	-	-	N=27	-	-	-	-	-	-	-	-		
	21.60														

Fracture Frequency: 0 1 2 3 4 5

DEPTH Scale 1:50

11 12 13 14 15 16 17 18 19 20 21

18.50

Wet dark brown medium dense to dense with depth silty fine to medium grained SAND. (Harbour Beds).

HOLE No: BD-BHM210A
Sheet 3 of 7

JOB NUMBER: 07-395

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HOLE No: BD-BHM210A
Sheet 3 of 7

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code (0 1 2 3 4 5)	Elevation (m.a.m.s.l.)
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
SPT	22.65	44	-	-	N=33	-	-	-	-	-	-	-	-		
	23.10														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	24.10														
SPT		33	-	-	N=31	-	-	-	-	-	-	-	-		
	24.55														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	25.60														
SPT		100	-	-	N=34	-	-	-	-	-	-	-	-		
	26.05														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	27.10														
SPT		100	-	-	N=37	-	-	-	-	-	-	-	-		
	27.55														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	28.60														
SPT		100	-	-	N=34	-	-	-	-	-	-	-	-		
	29.05														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	30.10														
SPT		100	-	-	N=37	-	-	-	-	-	-	-	-		
	30.55														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	31.60														
SPT		100	-	-	N=34	-	-	-	-	-	-	-	-		
	32.05														
Wash		-	-	-	-	-	-	-	-	-	-	-	-		

DEPTH Scale 1:50

22
23
24
25
26
27
28
29
30
31
32

23.10

Wet orangey brown dense silty fine to medium grained SAND with sparse shell fragments. (Harbour Beds).

ROCK FABRIC
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HOLE No: BD-BHM210A
Sheet 4 of 7

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
														0 1 2 3 4 5	
Bore															
SPT	33.10 – 33.55	100	-	-	N=37	-	-	-	-	-	-	-	-		
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
SPT	34.60 – 35.05	100	-	-	N=38	-	-	-	-	-	-	-	-		
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
SPT	36.10 – 36.55	100	-	-	N=34	-	-	-	-	-	-	-	-		
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
SPT	37.60 – 38.05	100	-	-	N=39	-	-	-	-	-	-	-	-		
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
SPT	38.60 – 39.05	44	-	-	N=41	-	-	-	-	-	-	-	-		
Wash Bore		38	-	-	-	-	-	-	-	-	-	-	-		
SPT	40.10 – 40.55	44	-	-	N=45	-	-	-	-	-	-	-	-		
Wash Bore		43	-	-	-	-	-	-	-	-	-	-	-		
SPT	41.60 – 42.05	47	-	-	N=50	-	-	-	-	-	-	-	-		
Wash Bore		24	-	-	-	-	-	-	-	-	-	-	-		
SPT	43.10 –	44	-	-	N=51	-	-	-	-	-	-	-	-		

DEPTH Scale 1:50

33
34
35
36
37
38
39
40
41
42
43

39.50

Wet very dark greyish brown dense to very dense with depth clayey silty fine grained SAND with sparse shell fragments. (Harbour Beds).

HOLE No: BD-BHM210A
Sheet 5 of 7

JOB NUMBER: 07-395

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

JOINT SPACING
VCJ-very close spacg
CJ -close spacing
MJ -medium spacing
WJ -wide spacing
VWJ-very wide spacng

JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
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Client: TRANSNET PROJECTS
Project name: **Durban Harbour Berth Deepening**

HOLE No: BD-BHM210A
Sheet 5 of 7

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	43.55														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	44.60														
SPT		47	-	-	N=52	-	-	-	-	-	-	-	-		
	45.05														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	46.10														
SPT		100	-	-	N=44	-	-	-	-	-	-	-	-		
	46.55														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	48.00														
SPT		100	-	-	N=50	-	-	-	-	-	-	-	-		
	48.45														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	49.55														
SPT		100	-	-	N=55	-	-	-	-	-	-	-	-		
	50.00														
NWD4		100	100	25	-	1	90	M	UND	SRJ	slt	1	-		
	50.50														
NWD4		95	20	0	-	1	90	C	IRR	MRJ	slt	1	-		
	51.00														
NWD4		85	22	0	-	1	90	C	IRR	MRJ	slt	1	-		
	51.75														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	52.25														
		-	-	-	-	-	-	-	-	-	-	-	-		
	52.65														
NWD4		98	60	0	-	1	90	M	UND	SRJ	slt	1	-		
	53.25														
Wash Bore		-	-	-	-	-	-	-	-	-	-	-	-		
	53.75														
NWD4		54	54	-	-	-	-	-	-	-	-	-	-		
	54.25														
Wash		-	-	-											

DEPTH Scale 1:50

44 45 46 47 48 49 50 51 52 53 54

50.00

Dark olive grey medium to completely weathered very soft rock SILTSTONE with lenses / bands of medium hard rock and some lenses of residual dark grey medium to coarse grained SAND. (Cretaceous).

HOLE No: BD-BHM210A
Sheet 6 of 7

JOB NUMBER: 07-395

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HOLE No: BD-BHM210A
Sheet 6 of 7

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
Bore	54.75	-	-	-	-	-	-	-	-	-	-	-	-		
Wash Bore	55.25	-	-	-	-	-	-	-	-	-	-	-	-		
NWD4	55.75	100	100	33	-	1	90	C	UND	MRJ	slt	1	>20		
NWD4	56.25	68	68	-	-	-	-	-	-	-	-	-	-		
NWD4	56.75	100	100	60	-	1	0-50	C-M	UND	SRJ	slt	<1	6		
NWD4	57.25	100	100	80	-	1	0-50	C-M	UND	SRJ	slt	<1	2		
NWD4	57.75	100	100	80	-	1	0-50	C-M	UND	SRJ	slt	<1	4		
NWD4	58.25	72	72	70	-	1	0-50	C-M	UND	SRJ	slt	<1	4		
NWD4	58.75	76	76	-	-	1	0-50	C-M	UND	SRJ	slt	<1	8		
NWD4	60.25	100	100	67	-	1	0-50	C-M	UND	SRJ	slt	<1	7		
NWD4	61.00	93	93	93	-	1 2	0-50 65	M M	UND UND	SRJ SRJ	slt slt	<1 <1	2		
NWD4	61.70	97	97	43	-	1	0-50	C-M	UND	SRJ	slt	<1	5		
NWD4	62.50	100	100	75	-	1	0-50	C-M	UND	MRJ	slt	<1	13		
NWD4	63.30	100	100	81	-	1	0-50	M	UND	SRJ	slt	<1	4		
NWD4	63.90	100	100	-	-	-	-	-	-	-	-	-	-		
NWD4		100	100	73	-	1	0-50	M	UND	SRJ	slt	<1	9		

DEPTH Scale 1:50

55.25

Very dark olivish grey medium weathered soft rock SILTSTONE with abundant fossils. (Cretaceous).

56.25

As above but medium weathered soft to medium hard rock SILTSTONE with abundant fossils. (Cretaceous). With lenses of completely weathered very soft rock Siltstone at 63.30-63.90m.

HOLE No: BD-BHM210A
Sheet 7 of 7

JOB NUMBER: 07-395

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HOLE No: BD-BHM210A
Sheet 7 of 7

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	65.40														
NWD4		100	100	86	-	1	5	C	UND	SRJ	slt	<1	8		
	66.90														
NWD4		100	100	80	-	1	0-10	C-M	UND	SRJ	slt	<1	10		
	68.40														

0 1 2 3 4 5

DEPTH Scale 1:50

66
67
68

68.40

NOTES

1) End of borehole at 68.40m below sea floor.

2) Final depth of NW casing at 46.0m.

3) Borehole carried out from jack up barge.

CONTRACTOR : Geopractica
MACHINE :
DRILLED BY : Martin/ Mike / Lawrence
PROFILED BY : LD

TYPE SET BY : Rev 0
SETUP FILE : MSJA3.SET

INCLINATION : 90°
DIAM : N
DATE : 01/09/2008
DATE : 25/09/2008

DATE : 04/03/09 14:06
TEXT : ..\BHOLES\BDCF87~1.TXT

ELEVATION : -13.205 (m) CD
X-COORD : 3306551.300
Y-COORD : -2280.970

HOLE No: BD-BHM210A

dot.PLOT 5003 J&W

BD-BHM210A 0.00 to m 17.05m BOX 1 of 6

BD-BHM210A 17.05 to 32.05m BOX 2 of 6

BD-BHM210A 32.05 to 46.55m BOX 3 of 6

BD-BHM210A 46.55 to 55.25m BOX 4 of 6

BD-BHM210A 55.25 to 61.70m BOX 5 of 6

BD-BHM210A 61.70 to 68.40m BOX 6 of 6

HOLE No: BD-BHM211
Sheet 1 of 6

JOB NUMBER: 07-395

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HOLE No: BD-BHM211
Sheet 1 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
NWD4		63	-	-	-	-	-	-	-	-	-	-	-		
	1.50														
NWD4		82	-	-	-	-	-	-	-	-	-	-	-		
	3.00														
SPT		100	-	-	N=18	-	-	-	-	-	-	-	-		
	3.45														
NWD4		67	-	-	-	-	-	-	-	-	-	-	-		
	4.95														
NWD4		41	-	-	-	-	-	-	-	-	-	-	-		
	6.00														
NWD4		43	-	-	-	-	-	-	-	-	-	-	-		
	7.50														
Shelby		100	-	-	Shelby	-	-	-	-	-	-	-	-		
	8.05														
NWD4		100	-	-	-	-	-	-	-	-	-	-	-		
	9.00														
NWD4		71	-	-	-	-	-	-	-	-	-	-	-		
	10.40														
SPT		100	-	-	N=24	-	-	-	-	-	-	-	-		

0 1 2 3 4 5

DEPTH Scale 1:50

Scale 1:50

Wet dark grey to brownish dark grey stiff shattered silty CLAY. (Harbour Beds).

HOLE No: BD-BHM211
Sheet 2 of 6

JOB NUMBER: 07-395

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HOLE No: BD-BHM211
Sheet 2 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	10.85														
NWD4		48	-	-	-	-	-	-	-	-	-	-	-		
	11.90														
NWD4		100	-	-	N=22	-	-	-	-	-	-	-	-		
	12.35														
Wash Bore		100	-	-	-	-	-	-	-	-	-	-	-		
	13.40														
SPT		100	-	-	N=12	-	-	-	-	-	-	-	-		
	13.85														
Wash Bore		100	-	-	-	-	-	-	-	-	-	-	-		
	14.90														
Solid Tube		100	-	-	-	-	-	-	-	-	-	-	-		
	16.40														
SPT		100	-	-	N=16	-	-	-	-	-	-	-	-		
	16.85														
Wash Bore		97	-	-	-	-	-	-	-	-	-	-	-		
	17.90														
Wash Bore		32	-	-	-	-	-	-	-	-	-	-	-		
	19.40														
Wash Bore		17	-	-	-	-	-	-	-	-	-	-	-		
	20.90														
Wash		27	-	-	-	-	-	-	-	-	-	-	-		

0 1 2 3 4 5

DEPTH Scale 1:50

11 12 13 14 15 16 17 18 19 20 21

0.00

17.00

Wet greyish light brown speckled black and orange medium dense fine grained SAND. (Harbour Beds). (Logged from the wash sample).

19.40

Wet orangey brown medium dense fine grained SAND. (Harbour Beds). (Logged from the wash sample and 1 SPT sample).

HOLE No: BD-BHM211
Sheet 3 of 6

JOB NUMBER: 07-395

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HOLE No: BD-BHM211
Sheet 3 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
Bore															
	22.40														
SPT		100	-	-	N=24	-	-	-	-	-	-	-	-	0 1 2 3 4 5	
	22.85														
Wash Bore		31	-	-	-	-	-	-	-	-	-	-	-		
	23.90														
Wash Bore		20	-	-	-	-	-	-	-	-	-	-	-		
	25.40														
SPT		100	-	-	N=22	-	-	-	-	-	-	-	-		
	25.85														
Wash Bore		27	-	-	-	-	-	-	-	-	-	-	-		
	26.90														
Wash Bore		21	-	-	-	-	-	-	-	-	-	-	-		
	28.40														
SPT		100	-	-	N=23	-	-	-	-	-	-	-	-		
	28.85														
Wash Bore		29	-	-	-	-	-	-	-	-	-	-	-		
	29.90														
Wash Bore		18	-	-	-	-	-	-	-	-	-	-	-		
	31.40														
SPT		100	-	-	N=22	-	-	-	-	-	-	-	-		
	31.85														
Wash Bore		24	-	-	-	-	-	-	-	-	-	-	-		

DEPTH Scale 1:50

22 23 24 25 26 27 28 29 30 31 32

23.90

Wet dark greyish brown medium dense fine to medium grained SAND. (Harbour Beds).

HOLE No: BD-BHM211
Sheet 4 of 6

JOB NUMBER: 07-395

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HOLE No: BD-BHM211
Sheet 4 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	32.90														
Wash Bore		17	-	-	-	-	-	-	-	-	-	-	-	-	
	34.40														
Wash Bore		27	-	-	-	-	-	-	-	-	-	-	-	-	
	35.45														
SPT		100	-	-	N=65	-	-	-	-	-	-	-	-	-	
	35.90														
Wash Bore		41	-	-	-	-	-	-	-	-	-	-	-	-	
	37.50														
Wash Bore		41	-	-	-	-	-	-	-	-	-	-	-	-	
	38.80														
SPT		0	-	-	N=60	-	-	-	-	-	-	-	-	-	
	39.25														
Wash Bore		40	-	-	-	-	-	-	-	-	-	-	-	-	
	40.75														
Wash Bore		47	-	-	-	-	-	-	-	-	-	-	-	-	
	42.25														
NWD4		47	10	-	-	-	-	-	-	-	-	-	-	-	

0 1 2 3 4 5

DEPTH Scale 1:50

34.40

Wet light greyish brown very dense fine to medium grained SAND. (Harbour Beds). (Logged from the wash sample and 1 SPT sample).

42.75

HOLE No: BD-BHM211
Sheet 5 of 6

JOB NUMBER: 07-395

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Project name: **Durban Harbour Berth Deepening**

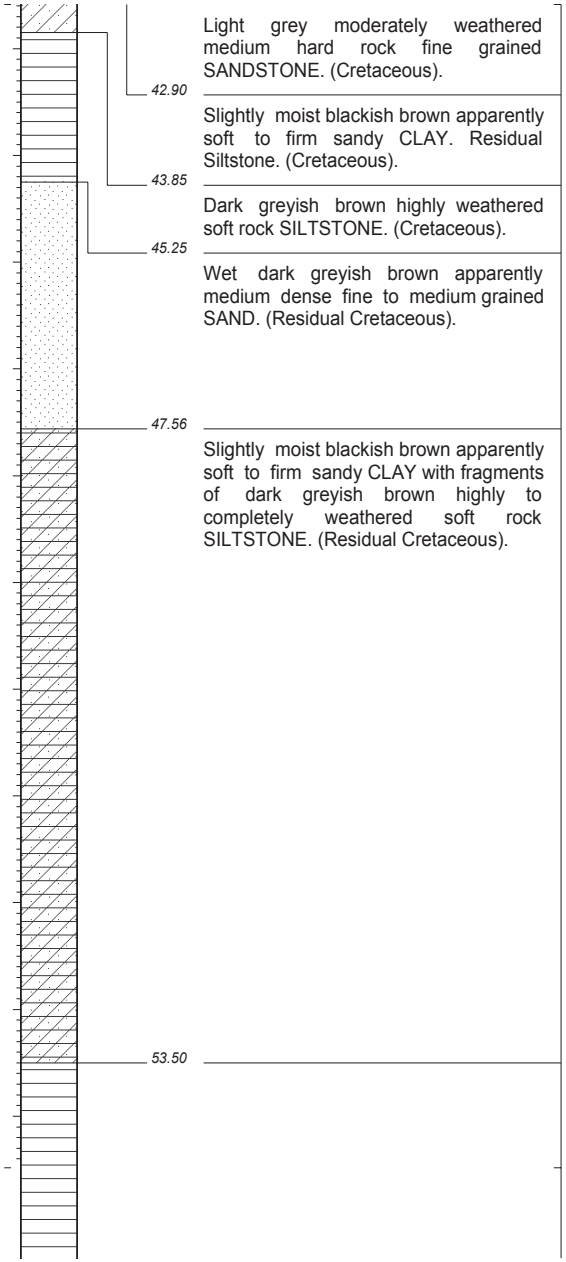
HOLE No: BD-BHM211
Sheet 5 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	43.75														
NWD4		68	60	20	UCS=1.875MPa	-	-	-	-	-	-	-	-	-	
	45.25														
Wash Bore		52	-	-	-	-	-	-	-	-	-	-	-	-	
	46.06														
Wash Bore		27	-	-	-	-	-	-	-	-	-	-	-	-	
	47.56														
NWD4		63	13	-	-	-	-	-	-	-	-	-	-	-	
	49.06														
NWD4		87	20	-	-	-	-	-	-	-	-	-	-	-	
	50.56														
NWD4		53	47	-	-	-	-	-	-	-	-	-	-	-	
	52.06														
NWD4		41	7	-	-	-	-	-	-	-	-	-	-	-	
	53.56														
NWD4		29	29	-	-	1	0-5	C-M	PLA-UND	SJ-SRJ	slt	<1	5	-	

0 1 2 3 4 5

DEPTH Scale 1:50



Light grey moderately weathered medium hard rock fine grained SANDSTONE. (Cretaceous).

Slightly moist blackish brown apparently soft to firm sandy CLAY. Residual Siltstone. (Cretaceous).

Dark greyish brown highly weathered soft rock SILTSTONE. (Cretaceous).

Wet dark greyish brown apparently medium dense fine to medium grained SAND. (Residual Cretaceous).

Slightly moist blackish brown apparently soft to firm sandy CLAY with fragments of dark greyish brown highly to completely weathered soft rock SILTSTONE. (Residual Cretaceous).

HOLE No: BD-BHM211
Sheet 6 of 6

JOB NUMBER: 07-395

ROCK FABRIC
MF -massive
BF -bedded
FF -foliated
CF -cleaved
SF -schistose
GF -gneissose
LF -laminated

GRAIN SIZE
FG -fine grained
MG -medium grain
CG -coarse grain

JOINT SPACING
VCJ-very close spacg
CJ -close spacing
MJ -medium spacing
WJ -wide spacing
VWJ-very wide spacng

JOINT ROUGHNESS
SLJ-slickensided
SJ -smooth
RJ -rough

JOINT SHAPE
CUR-curvilinear
PLA-planar
UND-undulating
STE-stepped
IRR-irregular

ROCK HARDNESS
EHR-extremely hard rock
VHR-very hard rock
HR -hard rock
MHR-medium hard rock
SR -soft rock
VSR-very soft rock

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GEOTECHNICAL, CIVIL & ENVIRONMENTAL ENGINEERS

Client: TRANSNET PROJECTS
Project name: **Durban Harbour Berth Deepening**

HOLE No: BD-BHM211
Sheet 6 of 6

JOB NUMBER: 07-395

Drill Method and Size	Depth (m)	Material Recovery (%)	Core Recovery (%)	RQD (%)	Test Results	Set No.	Inclination (°)	Spacing	Joint shape	Roughness	Fill type	Fill thickness (mm)	Fracture Frequency	Weathering code	Elevation (m.a.m.s.l.)
	55.06														
NWD4		64	64	-	-	1	0-5	C-M	PLA-UND	SJ-SRJ	slt	<1	13		
	56.56														
NWD4		53	36	-	-	1	0-5	C-M	PLA-UND	SJ-SRJ	slt	<1	5		
	57.94														
NWD4		87	80	-	UCS=2.152MPa	1 2	0-5 75-85	C-M C	PLA-UND PLA	SJ-SRJ SJ-SRJ	slt slt	<1 <1	4		
	59.44														
NWD4		100	100	17	UCS=1.830MPa UCS=2.10MPa	1	0-5	C-M	PLA-UND	SJ-SRJ	slt	<1	9		
	60.94														
		33	33	17	UCS=1.131MPa	1	0-5	C-M	PLA-UND	SJ-SRJ	slt	<1	3		
	61.44														
NWD4		0	0	0	-	-	-	-	-	-	-	-	-		
	62.44														

0 1 2 3 4 5

DEPTH Scale 1:50

55 56 57 58 59 60 61 62

Light grey to dark grey moderately to completely weathered thinly to medium bedded closely to medium jointed soft to medium hard rock SILTSTONE with some fossils present. (Cretaceous). Note: Clay lenses at the following depths of 57.63-57.83m and 59.28-59.44m.

61.44

No core recovery. Core dropped out of core barrel.

62.44

NOTES

1) End of borehole at 62.44m below sea floor.

2) Final depth of HW casing at 38.5m and NW casing at 59.44m. (Interpreted from the driller's log).

3) Borehole carried out from jack up barge.

CONTRACTOR : Geopractica
MACHINE :
DRILLED BY : Martin/ Mike/ Lawrence
PROFILED BY : SAP

TYPE SET BY : Rev 0
SETUP FILE : MSJA3.SET

INCLINATION : 90°
DIAM : N
DATE : 03/07/2008
DATE : 21/07/2008

DATE : 24/02/09 16:18
TEXT : ..\BHOLES\BD5C75~1.TXT

ELEVATION : -12.187 (m) CD
X-COORD : 3306547.080
Y-COORD : -2356.105

HOLE No: BD-BHM211

dot.PLOT 5003 J&W

BD-BHM211 0.00 to m 9.63m BOX 1 of 5

BD-BHM211 9.63 to 20.90m BOX 2 of 5

BD-BHM211 20.90 to 40.75m BOX 3 of 5

BD-BHM211 40.75 to 53.56m BOX 4 of 5

BD-BHM211 53.56 to 61.44m BOX 5 of 5

2.4: BOREHOLE LOGS – BASIN DREDGE AREA

EXPLORATORY BOREHOLE LOGS – BASIN DREDGE AREA

BH	Location	End	Start depth	End depth	y	x
-	-	-	CDP	CDP	-	-
BDS01	Marine	2012/10/04	2.430	-19.570	-1796.00	3306450.00
BDS02	Marine	2012/10/05	2.493	-23.207	-2207.00	3306250.00
BDS03	Marine	2012/10/06	2.350	-19.360	-2498.00	3306153.00
BDS04	Marine	2012/10/09	2.345	-21.105	-2600.00	3306055.00
BDS05	Marine	2012/10/10	2.390	-19.060	-1990.73	3306466.63
BDS06	Marine	2012/10/22	2.293	-19.157	-1938.00	3306387.00
BDS07	Marine	2012/10/23	1.855	-19.595	-2252.00	3306308.00
BDS08	Marine	2012/10/24	1.943	-19.507	-2344.00	3306198.00
BDS09	Marine	2012/10/25	1.780	-18.170	-2451.00	3306214.00
BDS10	Marine	2012/10/26	1.930	-19.020	-2172.00	3306294.00

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Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BDS01

Start Date	2012/10/04	**End Date**	2012/10/04
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Dredge Area Survey	**Elevation:**	+2.43 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306450.00
Drilling -	Fairbrother		Y: -1796.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 1**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
									(2.43, -13.93) Water		0.00
	-13.930	-	-	-	Casing						1.00
	-15.070	n/s	-	-	Casing Sunk						2.00
	-15.520	44	-	-	SPT	N=23			(-13.93, -15.07) Harbour Floor Sediments No sample recovered. Assumed to be very soft unconsolidated MUD.	Sea Floor; -13.930 CDP	3.00
	-16.020	n/s	-	-	SPT	N=6			(-15.07, -16.02) Very moist, light brown grey, cohesionless, lose to medium dense, layered, medium Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		4.00
	-17.070	-	-	-	Casing Sunk				(-16.02, -19.57) As Above Brown grey, silty Fine SAND.		5.00
	-18.070	60	-	-	SPT	N=7					6.00
	-18.570	-	-	-	Casing Sunk						7.00
	-19.570	60	-	-	SPT S04	-				END OF BOREHOLE (-19.57 CDP / 22.00 m below platform)	8.00
											9.00
											10.00
											11.00
											12.00
											13.00
											14.00
											15.00
											16.00
											17.00
											18.00
											19.00
											20.00
											21.00
											22.00

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Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205

Borehole No.: 1370 BDS01

1370-BDS01: Box 1 of 1

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BDS02

Start Date	2012/10/09	**End Date**	2012/10/09
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Dredge Area Survey	**Elevation:**	+2.493 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306250.00
Drilling -	Fairbrother		Y: -2207.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 1**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
									(2.49, -14.01) Water		0.00
	-14.007	-	-	-	Casing						
	-15.507	-	-	-	Casing				(-14.01, -16.01) Wet, dark brown grey, cohesive, very soft (estimate), silty MUD. Transported, fluvial-lacustrine / estuarine-lagoonal deposits. Harbour Floor Sediments	Sea Floor; -14.007 CDP	17.00
	-16.307	55	-	-	SPT	-					18.00
		-	-	-	WB						
	-17.407	42	-	-	SPT	-			(-16.01, -23.21) Very moist, light brown grey, cohesionless, lose to medium dense (estimate), layered, silty Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	All SPT's hammered to refusal, so as to fill SPT spoon	19.00
		-	-	-	WB						20.00
	-18.307	51	-	-	SPT	-					
		-	-	-	WB						21.00
	-19.407	44	-	-	SPT	-					
		-	-	-	WB						22.00
	-20.207	53	-	-	SPT S06	-					
		-	-	-	Casing Sunk					WB sample collected inside sunken casing.	23.00
	-23.207	48	-	-	Casing Sunk					END OF BOREHOLE (-23.207 CDP / 25.700 m below platform)	25.00

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Client: Transnet
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Berths 203 to 205
Borehole No.: 1370 BDS02

1370-BDS02: Box 1 of 1

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Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BDS03

Start Date	2012/10/06	**End Date**	2012/10/06
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Dredge Area Survey	**Elevation:**	+2.35 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306153.00
Drilling -	Fairbrother		Y: -2498.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 1**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
2.35									(2.35, -13.33) Water		0.00
		-	-	-	Casing						
-13.330									(-13.33, -13.65) Harbour Floor Sediments No sample recovered.	Sea Floor; -13.330 CDP	
-13.650		-	-	-	Casing				Assumed to be very soft unconsolidated MUD.		
-14.450	44	-	-	-	SPT Casing Sunk	N=38			(-13.65, -14.65) Very moist, light brown grey, cohesionless, dense, layered, Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-15.350	14	-	-	-	SPT	N=17			(-14.65, -18.20) Very moist, brown grey, slightly cohesive, medium dense, clayey silty Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	WB sample collected inside sunken casing.	
-16.150	69	-	-	-	Casing Sunk						
-17.250	54	-	-	-	NXM S05						
-17.650	61	-	-	-	Casing Sunk					WB sample collected inside sunken casing.	
-18.450	65	-	-	-	SPT S07	N=11			(-18.20, -19.36) Slightly moist, dark brown grey, cohesive, stiff, Silty CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	END OF BOREHOLE (-19.36 CDP / 21.71 m below platform)	
	-	-	-	-	WB						
-19.360	80	-	-	-	Shelby S??						

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Berths 203 to 205
Borehole No.: 1370 BDS03

1370-BDS03: Box 1 of 1

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Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BDS04

Start Date	2012/10/09	**End Date**	2012/10/09
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Dredge Area Survey	**Elevation:**	+2.345 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306055.00
Drilling -	Fairbrother		Y: -2600.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 1**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (m below platform)
									(2.35, -11.35) Water		0.00
		-	-	-	Casing						
-11.355									(-11.35, -12.66) Harbour Floor Sediments No sample recovered. Assumed to be very soft unconsolidated MUD.	Sea Floor; -11.355 CDP	11.35
		-	-	-	Casing						
-12.655									(-12.66, -13.66) Wet, brown grey, slightly cohesive, medium dense, layered, clayey silty Fine SAND with pebbles (>25.0 mm). Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		12.66
-13.355		43	-	-	SPT	N=21					13.35
-13.655		-	-	-	WB						13.65
-14.355		43	-	-	SPT	N=35			(-13.66, -16.30) Very moist, light grey, cohesionless, dense (lose or very dense in places), Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		14.35
-14.655		-	-	-	WB						14.65
-15.155		90	-	-	SPT S02	N=R					15.15
-15.655		-	-	-	WB						15.65
-16.155		60	-	-	SPT	N=9					16.15
-16.655		-	-	-	WB						16.65
-17.155		118	-	-	SPT S08	N=8			(-16.30, -19.16) Slightly moist, dark brown grey, cohesive, firm, Silty CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		17.15
-17.655		-	-	-	WB						17.65
-19.155		80	-	-	NXM S09						19.15
-20.655		-	-	-	NXM				(-19.16, -21.11) As for -13.655 to -16.295 CDP: Light brown grey, medium dense, Fine SAND.		20.65
-21.105		100	-	-	SPT S03	N=23				END OF BOREHOLE (-21.105 CDP / 23.450 m below platform)	21.10

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Client: Transnet
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Berths 203 to 205
Borehole No.: 1370 BDS04

1370-BDS04: Box 1 of 1

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Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BDS05

Start Date	2012/10/10	**End Date**	2012/10/10
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Dredge Area Survey	**Elevation:**	+2.390 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306463.00
Drilling -	Fairbrother		Y: -1994.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 1**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph 0 100	Lithology	General Description	Remarks	Depth (m below platform)
									(2.39, -13.94) Water		0.00
		-	-	-	Casing						
-13.940									(-13.94, -14.61) Harbour Floor Sediments		
-14.610		-	-	-	Casing				No sample recovered. Assumed to be very soft unconsolidated MUD.	Sea Floor; -13.940 CDP	
	44	-	-	SPT	N=27			(-14.61, -19.06)			
-15.410	-	-	-	WB				Very moist, light brown grey, cohesionless, layered, Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.			
	50	-	-	SPT	N=37						
-16.210	-	-	-	WB							
-16.610	20	-	-	SPT	N=7						
-17.110	-	-	-	WB							
-17.610	14	-	-	SPT	N=7						
-18.310	-	-	-	WB							
-18.610	89	-	-	SPT S01	N=40					END OF BOREHOLE (-19.06 CDP / 21.45 m below platform)	
-19.060											

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Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BDS05

1370-BDS05: Box 1 of 1

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BDS06

Start Date	2012/10/22	**End Date**	2012/10/22
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Dredge Area Survey	**Elevation:**	+2.293 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306387.00
Drilling -	Fairbrother		Y: -1938.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 1**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (m below platform)
2.293									(2.29, -13.16) Water		0.00
		-	-	-	Casing						
-13.157											15.00
-13.707		-	-	-	Casing				(-13.16, -13.71) Harbour Floor Sediments No Sample, assumed to be very soft unconsolidated MUD.	Sea Floor; -13.157 CDP	
-14.157		67	-	-	SPT	N=16			(-13.71, -14.31) Wet, brown grey, cohesive, stiff, silty sandy CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		16.00
-14.707		-	-	-	WB						
-15.157		78	-	-	SPT	N=12			(-14.31, -18.71) Very moist, brown grey, cohesionless, medium dense, medium Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		17.00
-15.707		-	-	-	WB						
-16.157		78	-	-	SPT	N=16					18.00
-16.707		-	-	-	WB						
-17.157		78	-	-	SPT	N=30					19.00
-17.707		-	-	-	WB						
-18.157		78	-	-	SPT	N=22					20.00
-18.707		-	-	-	WB				(-18.71, -19.16) Very moist, brown grey, slightly cohesive, dense, clayey SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	END OF BOREHOLE (-19.157 CDP / 21.450 m below platform)	21.00
-19.157		100	-	-	SPT	N=36					

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Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BDS06

1370-BDS06: Box 1 of 1

ZAA Engineering Projects & Naval Architecture (Pty) Ltd

Project

PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BDS07

Start Date	2012/10/23	**End Date**	2012/10/23
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Dredge Area Survey	**Elevation:**	+1.855 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306308.00
Drilling -	Fairbrother		Y: -2252.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 1**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (m below platform)
									(1.86, -13.65) Water		0.00
		-	-	-	Casing						-6.00
-13.645									(-13.65, -14.15) Harbour Floor Sediments No Sample, assumed to be very soft unconsolidated MUD.	Sea Floor; -13.645 CDP	-13.00
-14.145		-	-	-	Casing						-14.00
-14.595		44	-	-	SPT	N=22			(-14.15, -17.15) Moist, brown grey, cohesionless, medium dense (loose in places), Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		-14.00
-15.145		-	-	-	WB						-15.00
-15.595		44	-	-	SPT	N=3					-15.00
-16.145		-	-	-	WB						-16.00
-16.595		56	-	-	SPT	N=38					-16.00
-17.145		-	-	-	WB						-17.00
-17.595		22	-	-	SPT	N=12			(-17.15, -19.15) Moist, brown grey, slightly cohesive, firm, layered, silty sandy CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		-17.00
-18.145		-	-	-	WB						-18.00
-18.595		33	-	-	SPT	N=0					-18.00
-19.145		-	-	-	WB				(-19.15, -19.60) Slightly moist, dark brown grey, cohesive, soft, silty CLAY. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	END OF BOREHOLE (-19.595 CDP / 21.450 m below platform)	-19.00
-19.595		111	-	-	SPT	N=4					-19.00

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Client Project Number: M-2122830-408

Client: Transnet
Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BDS07

1370-BDS07: Box 1 of 1

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PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BDS08

Start Date	2012/10/24	**End Date**	2012/10/24
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Dredge Area Survey	**Elevation:**	+1.943 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306198.00
Drilling -	Fairbrother		Y: -2344.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 1**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (m below platform)
									(1.94, -13.51) Water		0.00
-13.507		-	-	-	Casing						
-15.057	-13.507	44	-	-	Casing				(-13.51, -15.06) Harbour Floor Sediments No Sample, assumed to be very soft unconsolidated MUD.	Sea Floor; -13.507 CDP	
-15.507	-15.057	-	-	-	SPT	N=10			(-15.06, -18.06) Very moist, dark brown grey, slightly cohesive, medium dense, layered, silty clayey SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-16.057	-15.507	44	-	-	WB						
-16.507	-16.057	-	-	-	SPT	N=8					
-17.057	-16.507	44	-	-	WB						
-17.507	-17.057	-	-	-	SPT	N=18					
-18.057	-17.507	56	-	-	WB						
-18.507	-18.057	-	-	-	SPT	N=41			(-18.06, -19.51) Moist, brown grey, cohesionless, very dense, layered, silty Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-19.057	-18.507	89	-	-	WB						
-19.507	-19.057		-	-	SPT	N=69				END OF BOREHOLE (-19.507 CDP / 21.450 m below platform)	21.00

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Berths 203 to 205
Borehole No.: 1370 BDS08

1370-BDS08: Box 1 of 1

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PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BDS09

Start Date	2012/10/25	**End Date**	2012/10/25
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Dredge Area Survey	**Elevation:**	+1.780 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306214.00
Drilling -	Fairbrother		Y: -2451.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 1**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (m below platform)
1.78									(1.78, -13.04) Water		0.00
											1.00
											2.00
											3.00
											4.00
											5.00
											6.00
											7.00
		-	-	-	Casing						8.00
											9.00
											10.00
											11.00
											12.00
											13.00
	-13.040								(-13.04, -13.22) Harbour Floor Sediments No Sample, assumed to be very soft unconsolidated MUD.		14.00
	-13.720	-	-	-	Casing				(-13.22, -18.17)		15.00
-14.00	-14.170	89	-	-	SPT	N=21			Moist to very moist, brown grey, cohesionless, medium dense, Fine SAND. Transported, fluvial-lacustrine / estuarine-lagoonal deposits.	Sea Floor; -13.040 CDP	16.00
	-14.720	-	-	-	WB						
-15.00	-15.170	56	-	-	SPT	N=17					17.00
	-15.720	-	-	-	WB						
-16.00	-16.170	22	-	-	SPT	N=16					18.00
	-16.720	-	-	-	WB						
-17.00	-17.170	44	-	-	SPT	N=31					19.00
	-17.720	-	-	-	WB						
-18.00	-18.170	n/s	-	-	SPT	N=14				END OF BOREHOLE (-18.170 CDP / 19.950m below platform)	

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Borehole No.: 1370 BDS09

1370-BDS09: Box 1 of 1

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PORT OF DURBAN BERTH DEEPENING

Berths 203 to 205

Sandy Materials		Clayey Materials	
Descriptions	**SPT N**	**Descriptions**	**SPT N**
Very loose	<5	Very Soft	<2
Loose	5-10	Soft	2-4
Medium dense	10-30	Firm	4-8
Dense	30-50	Stiff	8-15
Very dense	>50	Very Stiff	15-30

Borehole No. 1370 BDS10

Start Date	2012/10/26	**End Date**	2012/10/26
Project No:	1370 - DCT	**Orientation:**	Vertical
Location:	Dredge Area Survey	**Elevation:**	+1.930 CDP
Logged By:	MAS Baleta	**Coordinates:**	X: 3306294.00
Drilling -	Fairbrother		Y: -2172.00
Contractor:	Geotechnical Engineering CC		**Page 1 of 1**

Elev. (CDP)	Run Elev. (CDP)	Material / Core Recovery %	RQD %	FF (J/m)	Method & Sample	SPT Value 'N'	SPT 'N' Bar Graph (0 – 100)	Lithology	General Description	Remarks	Depth (m below platform)
1.93									(1.93, -13.51) Water		0.00
		-	-	-	Casing						
-13.510										Sea Floor; -13.510 CDP	
-13.570											
-14.020		56	-	-	SPT	N=12			(-13.51, -19.02) Moist, brown grey, cohesionless, dense (loose or very dense in places), layered, Fine SAND (clayey & silty in places). Transported, fluvial-lacustrine / estuarine-lagoonal deposits.		
-14.570		-	-	-	WB						
-15.020		n/s	-	-	SPT	N=4					
-15.570		-	-	-	WB						
-16.020		67	-	-	SPT	N=29					
-16.570		-	-	-	WB						
-17.020		78	-	-	SPT	N=36					
-17.570		-	-	-	WB						
-18.020		78	-	-	SPT	N=66					
-18.570		-	-	-	WB						
-19.020		67	-	-	SPT	N=69				END OF BOREHOLE (-19.020 CDP / 20.950 m below platform)	20.00

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Project: PORT OF DURBAN BERTH DEEPENING
Berths 203 to 205
Borehole No.: 1370 BDS10

1370-BDS010: Box 1 of 1

ANNEXURE 3: CPTu RESULTS

3.1: EXPLANATORY NOTE ON CPTu LOGS

EXPLANATION OF CPTU LOGS

This page will describe the information presented on the CPTU logs which follow.

The CPTU naming convention is as follows:

- CPT series CPTU's – Marine and land boreholes probed along the new quay wall line.
- P & S series CPTU's – Primary and Secondary marine CPTU's probed in the dredge area.

FIRST GRAPH (CONE RESISTANCE VS DEPTH)

These plots show cone resistance and pore pressure, measured in MPa and kPa respectively, against depth. Depth is recorded in meters below platform level or ground level depending on where the probing was performed.

SECOND GRAPH (CONE PRESSURE, PORE PRESSURE & HYDRODYNAMIC PRESSURE VS DEPTH)

The second series of plots present the same information however these plots introduce an additional variable that is the hydrostatic head, represented in kPa. The hydrostatic head increases linearly with depth

DISSIPATION TESTS

The dissipation graphs show the depth at which the dissipation test was performed, the peak pore water pressure (in kPa) and the time elapsed since the start of the dissipation test.

The red line indicates the hydrostatic head at the depth of testing.

SOIL IDENTIFICATION CHART

The soil identification chart utilises measured parameters (i.e. Pore water pressure and cone resistance) to classify the soil through which the probe is being pushed.

The soils identification chart may be found in the following document: A.C.Meigh-CIRIA,1987.

3.2: OSIMO METHOD STATEMENT

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Operating Procedure for Osimo Probe Rig

Get to specific probe position

Drive to the place of work
Drive under escort with vehicle lights on (if required).
Be aware of earth moving equipment as well as other heavy machinery
Give earth moving equipment right of way
Put vehicle in 4 x 4 when driving at inclines and declines
Drive at 10km per hour
Be aware of wet ground

Unloading testing equipment from trailer using ramps

Do a 'TAKE 5 RISK ASSESSMENT"
Check cable and hook arrangement for damage
Open the flap of the trailer and pull out the ramps
Inspect ramp for damage
Auger in anchors manually (Approx. 1 meter)
Wind down the rig slowly be means of the manual winch
Lift mast (cylinders) to the horizontal position (two persons – one lift, one secure)
Secure cylinders by means of a securing pin
Secure rig to anchors by screwing the nuts on
Complete daily check list and refuel by using the funnel arrangement attached to the Jerry can
(Check that engine is still cold before doing this)
Start engine and monitor if in good working condition
Connect electronic cables
Switch on logger
Install and align first rod in rig (Place rod in guide)
Push down the first rod and put second rod in guide – screw in
The operation is a hydraulic system that operates by means of hand operated lever system
Repeat this process until completion.

Taking out the rods

Reverse the process and pull out the first rod
Clamp the second rod (Hydraulic operated clamp)
Unscrew the first rod and place in trailer
Repeat process until completion

De-commission

Unscrew holding nuts
Auger out the anchors
Lower cylinders to transport position
Attached winch – winch the rig onto trailer
Secure the rig and move to the next position

Refueling during operation (petrol / oil)

1. Stop engine
2. Clean area around petrol tank.
3. Allow cooling period of 10 minutes
4. Fill tank
5. Ensure area clean of petrol/oil spillage
6. Start engine

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Reference test procedure.

The first International Reference Test Procedure (IRTP) for Cone Penetration Test (CPT) tips with electronic transducers was published in the First International Symposium on Penetration Testing (ISOPT -1, 1988) by the TC16 of the ISSMGE in Orlando, Florida. It is also included as part of the CIRIA report by A.C.Meigh on Cone Penetration Testing. A further IRTP, based on the 1988 document, was published by TC16 in 1999. Some minor amendments have been published since then.

Most countries where CPT testing is carried out have their own National Reference Test Procedure (NRTP) usually based on the 1988 or 1999 IRTP but with amendments to address their particular circumstances and these often differ significantly from the IRTP. Here are some examples:

- **Europe: CEN standard EN ISO 22476-1 (2007) for electrical piezocone**
- Austria: DIN 4094-1
- France: NF P94-113 CPT and NF P94-119 CPTu
- Germany: DIN 4094-1
- Netherlands: NEN 5140
- **United Kingdom: BS1377, BS5930**
- Bulgarian Standard (use German DIN 4094-90)
- Czech Standard STN 721033
- Slovakia Standard CSN 721033
- Estonia Reference LBN 207-01
- Latvia Reference LVS 437
- Lithunia Reference LBN 005-99
- Hungary Standard MI 15000/2 (1989)
- Poland: Polish Standard PN-B-04452 (2002)
- Romanian Standard NP 074-2007
- Russia Standards GOST 19912-2001 Code SP 11 105 97
- Egypt: Use British Standards: BS 1377 - Part 9 on In-Situ Testing
- USA and Canada: ASTM D 3441 (mechanical cone); ASTM D 5778 (2007) - electric piezocone
- Norway: Norwegian Geotechnical Society Guideline 5 (1995)
- Sweden: Swedish Geotechnical Society SGF Report 1:93E
- Spain: Reference is the UNE 103-804-93
- Australian National Standard: AS1289.6.5.1-1999
- New Zealand: National Standard NZS 4402.6.5.3:1988

The IRTP has not been formally adopted in South Africa and we have not drawn up our own NRTP. However, the general practice has been to comply with the IRTP as far as practically possible. The Osimo Piezocone was designed as a Reference Cone (R) with the pore pressure measured at position u_2, the “preferred position” as specified in the IRTP. The geometry is a

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standard 60^{o}, 36mm (10cm^{2}) cone with one metre rods with a diameter of 36mm. The CPT rig has a capacity of at least 100kN.
Calibration of the pore pressure transducer as well as the cone load cell is carried out on a Budenberg “dead-load hydraulic calibration rig” No 25470. The Budenberg has a calibration certificate valid until 14/03/2013. (IMP UHQ- 18065 dated 14/03/2012).

However there are some areas where we do not comply with the INTP.

The first is the presentation of the data. We prefer to plot the measured pore pressure and cone resistance on the same plot. It is more informative in highly layered profiles such as mine tailings where the interaction of these two measurements is more apparent plotted in this fashion. However, the data is available in electronic format so this could easily be changed to suit the requirements of the client.

The second is that we do not as a rule record sleeve friction in Piezocone (CPTu) testing. The reason for this is that pore pressure response to penetration is a far better indication of soil type than the friction ratio. The sleeve friction is also measured over 130mm which is often more than the layer thickness, especially in mine tailings which is a large proportion of CPTu testing in SA. The sleeve friction is therefore not applicable under these circumstances. Furthermore, our soils are often residual soils, or sedimentary soil (or tailings) over residual soils which often contain boulders. The cones capable of measuring sleeve friction are quite fragile and susceptible to damage in our residual soils. These conditions are rare in Europe or the US so they do not have this problem.

Prof. Eben Rust. BSc(Eng)Civil. BEng(Hons). MEng. PhD (Geotechnics)Surrey

3.3: CPTu LOGS – QUAY WALL

EXPLORATORY BOREHOLE LOGS – BASIN DREDGE AREA

CPT	Location	Date	Start depth	End depth	y	x
-	-	-	CDP	CDP	-	-
01c	Marine	2012/06/25	3.557	-24.443	-1382.73	3306756.41
2	Marine	2012/06/20	3.365	-25.105	-1406.22	3306746.82
3	Marine	2012/06/18	3.605	-24.395	-1426.44	3306720.30
4	Marine	2012/06/21	3.277	-24.143	-1446.81	3306734.96
5	Marine	2012/06/26	3.800	-25.500	-1469.72	3306729.06
6	Marine	2012/06/22	4.033	-25.967	-1481.97	3306710.49
7	Marine	2012/06/24	3.865	-32.135	-1526.40	3306703.31
8	Marine	2012/06/23	3.840	-26.810	-1544.20	3306703.49
9	Marine	2012/06/06	3.137	-26.463	-1568.23	3306705.75
10	Marine	2012/06/28	3.667	-28.333	-1597.75	3306694.66
11	Marine	2012/06/14	3.543	-34.257	-1620.31	3306678.86
12	Marine	2012/06/15	2.849	-30.751	-1643.43	3306677.06
13	Marine	2012/06/16	3.720	-23.580	-1665.74	3306677.68
14	Marine	2012/07/04	3.500	-24.200	-1686.51	3306675.07
15	Marine	2012/07/05	3.100	-25.200	-1707.32	3306664.23
16	Marine	2012/06/27	3.565	-24.735	-1739.48	3306676.34
17	Marine	2012/07/05	3.350	-25.300	-1762.98	3306661.79
18	Marine	2012/06/27	3.440	-29.060	-1785.97	3306654.34
19	Marine	2012/06/26	3.720	-24.280	-1809.11	3306649.93
20	Marine	2012/06/29	3.650	-26.350	-1830.02	3306641.90
21	Marine	2012/07/02	4.010	-25.290	-1856.76	3306632.69
22	Marine	2012/07/02	3.846	-23.054	-1885.63	3306632.39
23	Marine	2012/06/13	3.526	-21.774	-1907.47	3306624.08
24	Marine	2012/06/14	3.547	-20.553	-1932.31	3306620.35
25	Marine	2012/07/04	2.920	-21.080	-1958.52	3306640.29
26	Marine	2012/07/03	3.490	-19.510	-1983.13	3306644.16
27	Marine	2012/06/29	2.790	-26.510	-2002.34	3306622.44
28	Marine	2012/06/30	3.485	-21.615	-2037.19	3306631.35
29	Marine	2012/06/12	3.420	-21.750	-2052.54	3306601.04
30	Marine	2012/06/12	3.375	-23.245	-2084.30	3306585.08
31	Marine	2012/06/09	3.940	-26.410	-2103.97	3306581.39
32	Marine	2012/06/10	3.800	-24.200	-2119.98	3306581.64
33b	Marine	2012/06/07	3.835	-28.345	-2149.92	3306567.17
34	Marine	2012/06/08	3.855	-22.845	-2178.24	3306565.11
35	Marine	2012/06/03	3.257	-26.243	-2201.36	3306557.36
36	Marine	2012/06/02	4.307	-28.193	-2226.59	3306553.22
37	Marine	2012/06/01	3.803	-25.197	-2251.72	3306548.81

PIEZOCONE PENETRATION TEST

PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT01C
DATE: 2012/06/25 Probe: GHANA

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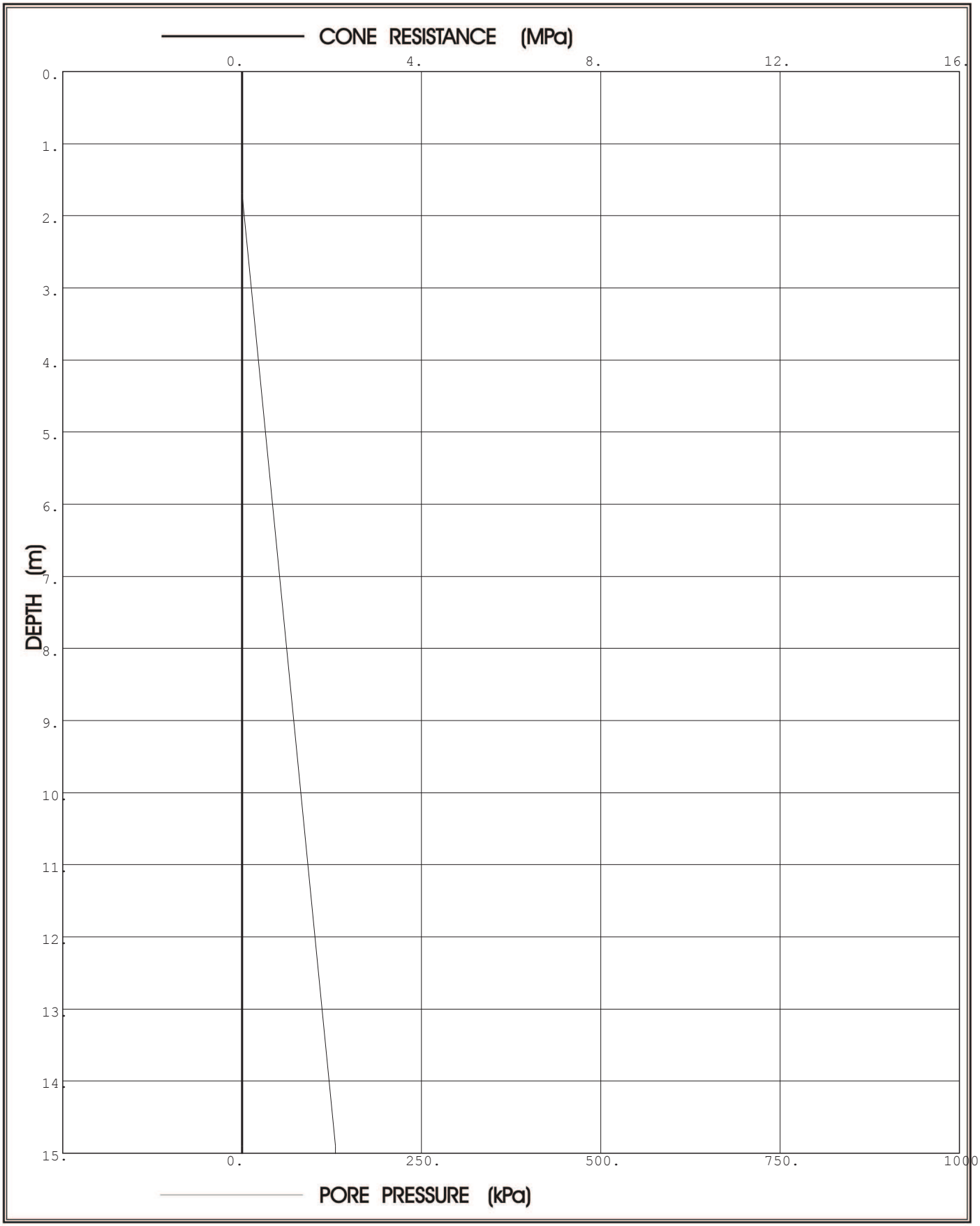

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PIEZOCONE PENETRATION TEST

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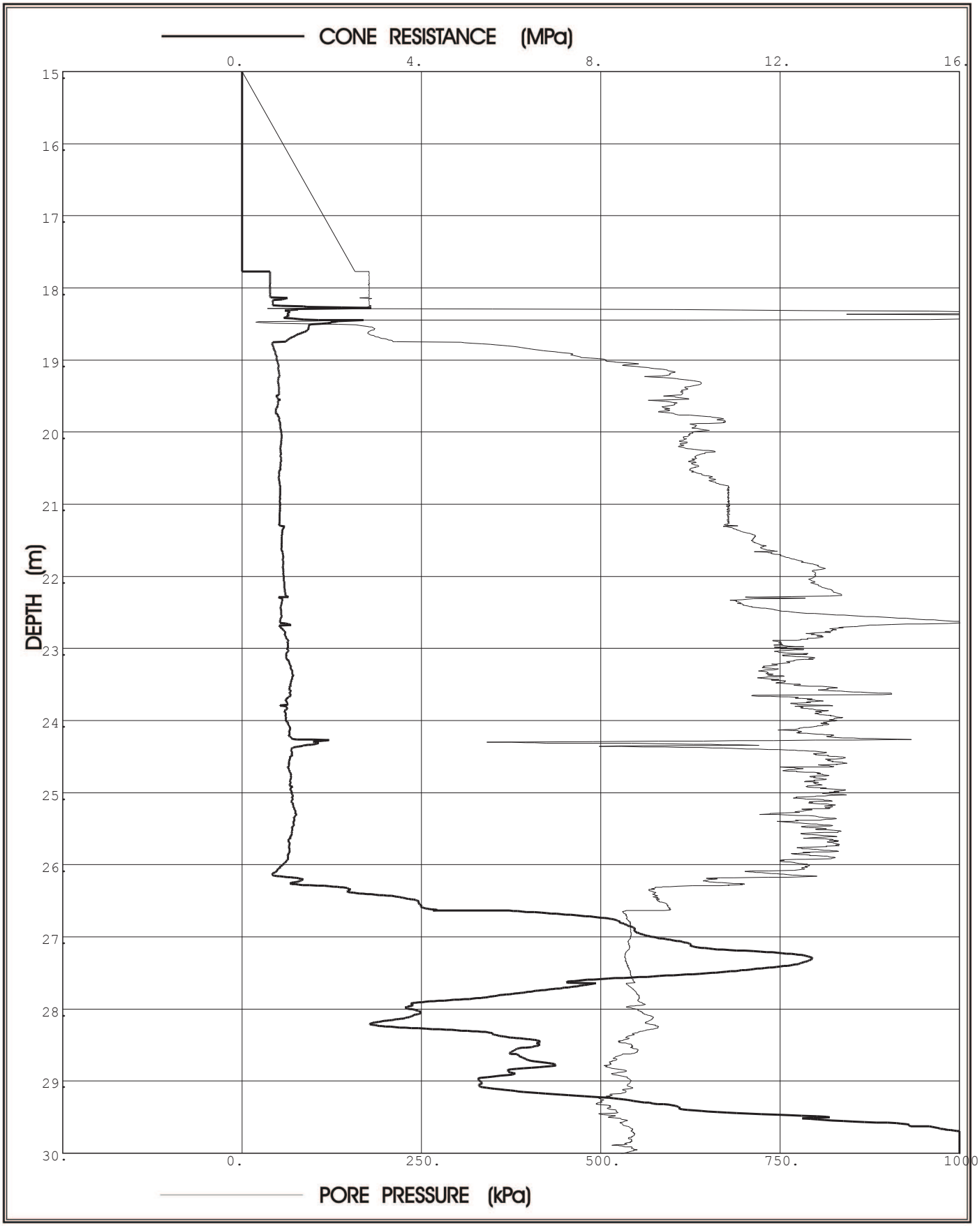
PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT01C
DATE: 2012/06/25 Probe: GHANA



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PIEZOCONE PENETRATION TEST

PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT01C
DATE: 2012/06/25 Probe: GHANA

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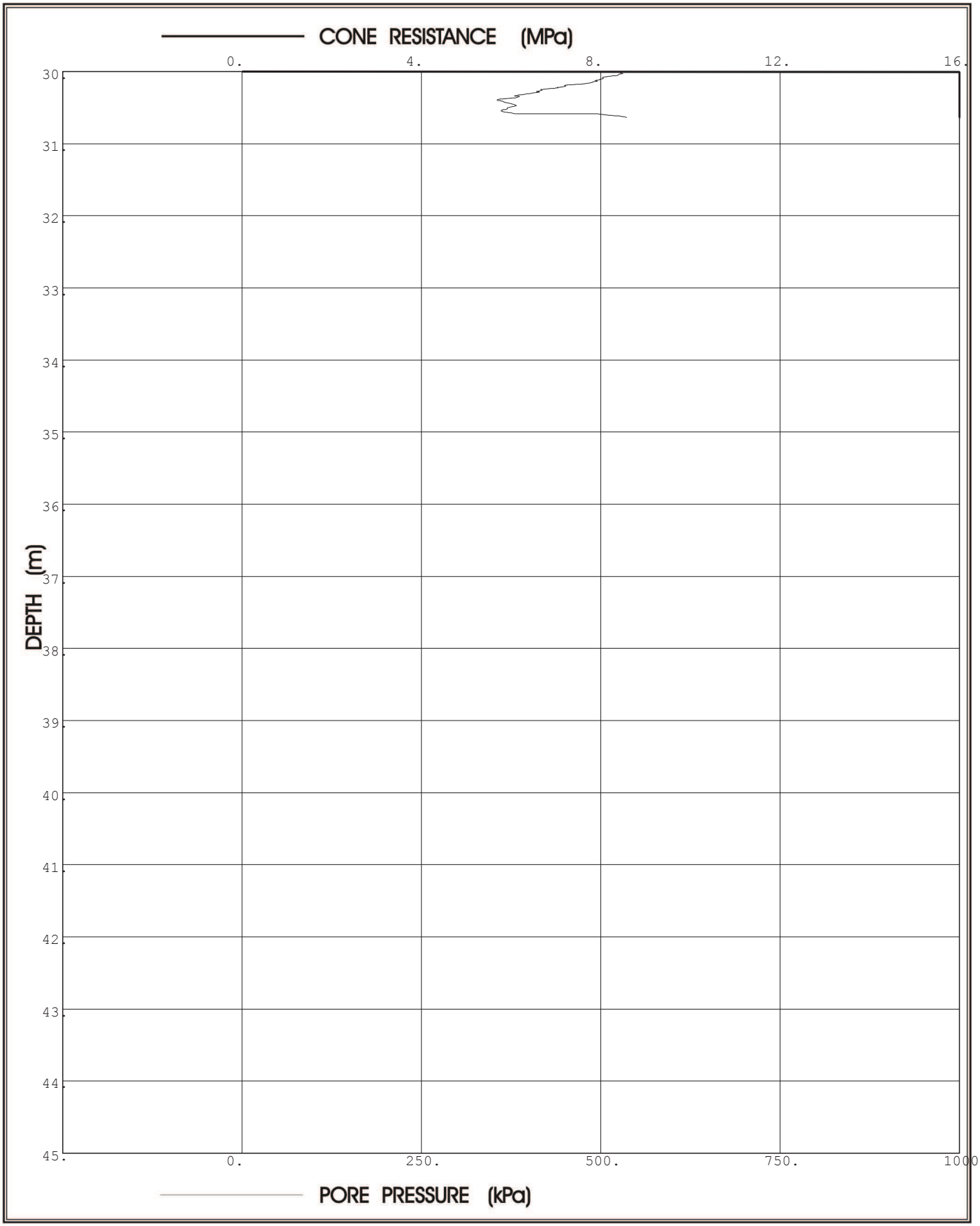

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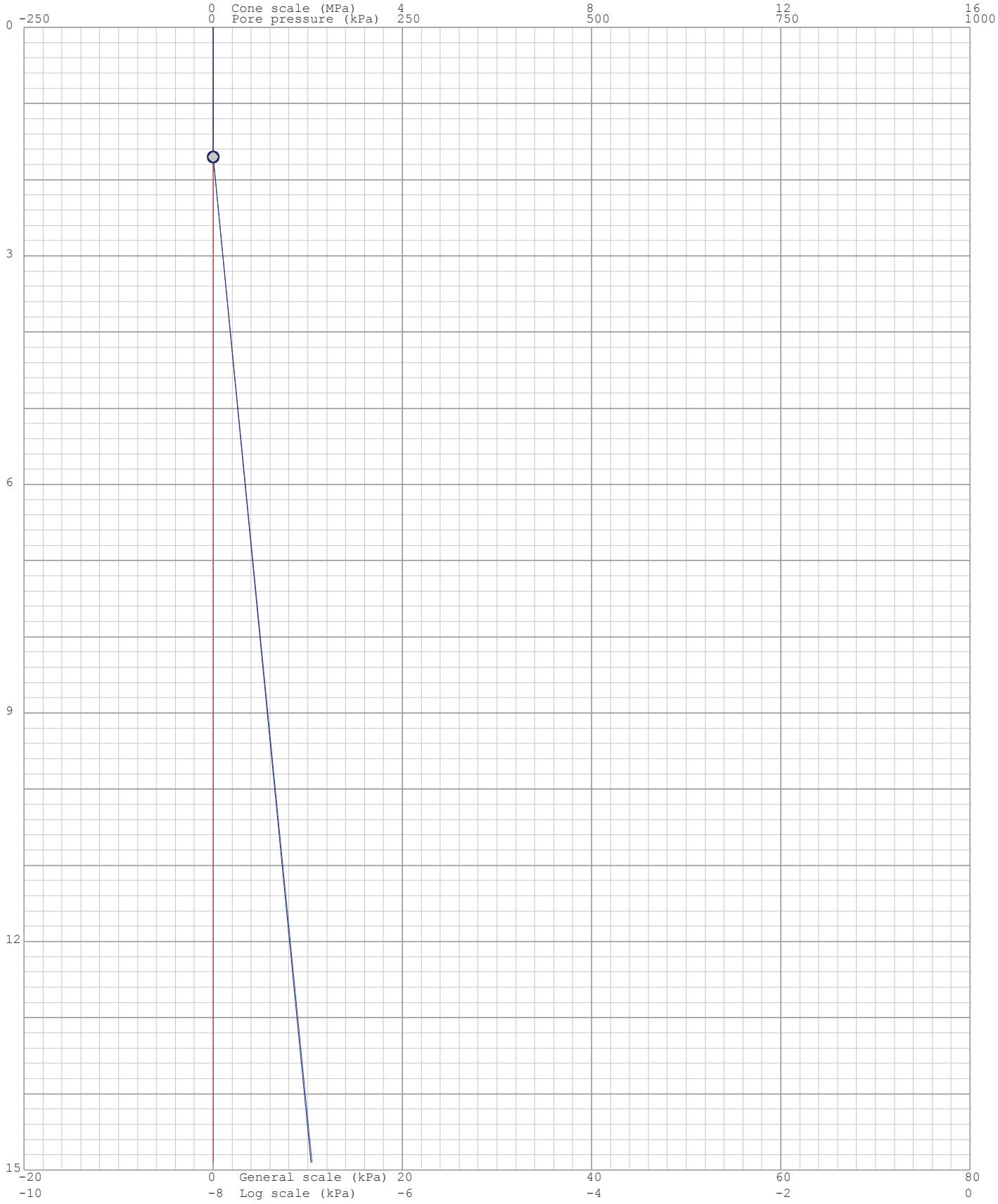
Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT01C
Date: 2012/06/25 Probe: GHANA

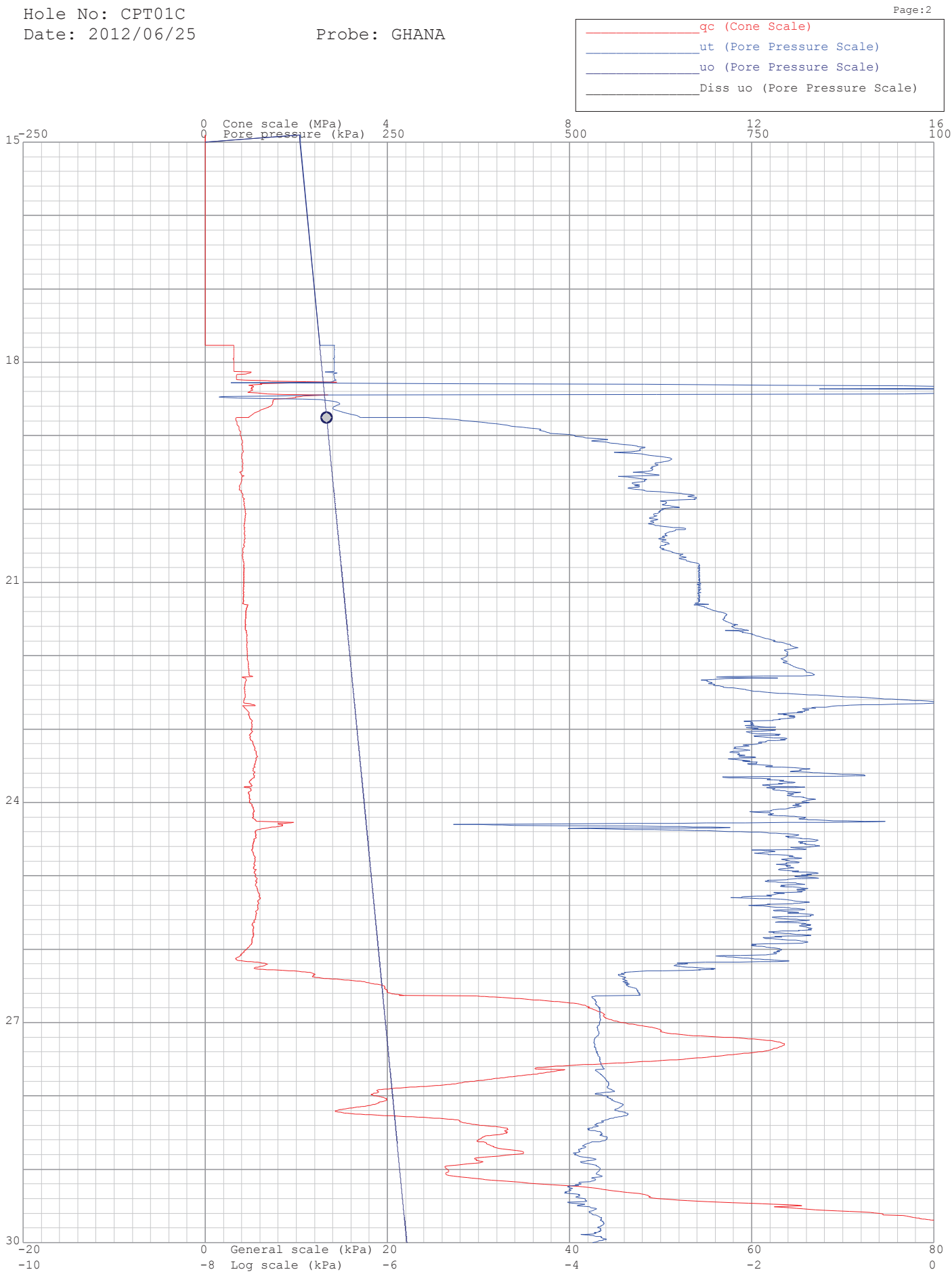
qc (Cone Scale)
ut (Pore Pressure Scale)
uo (Pore Pressure Scale)
Diss uo (Pore Pressure Scale)



Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT01C
Date: 2012/06/25 Probe: GHANA

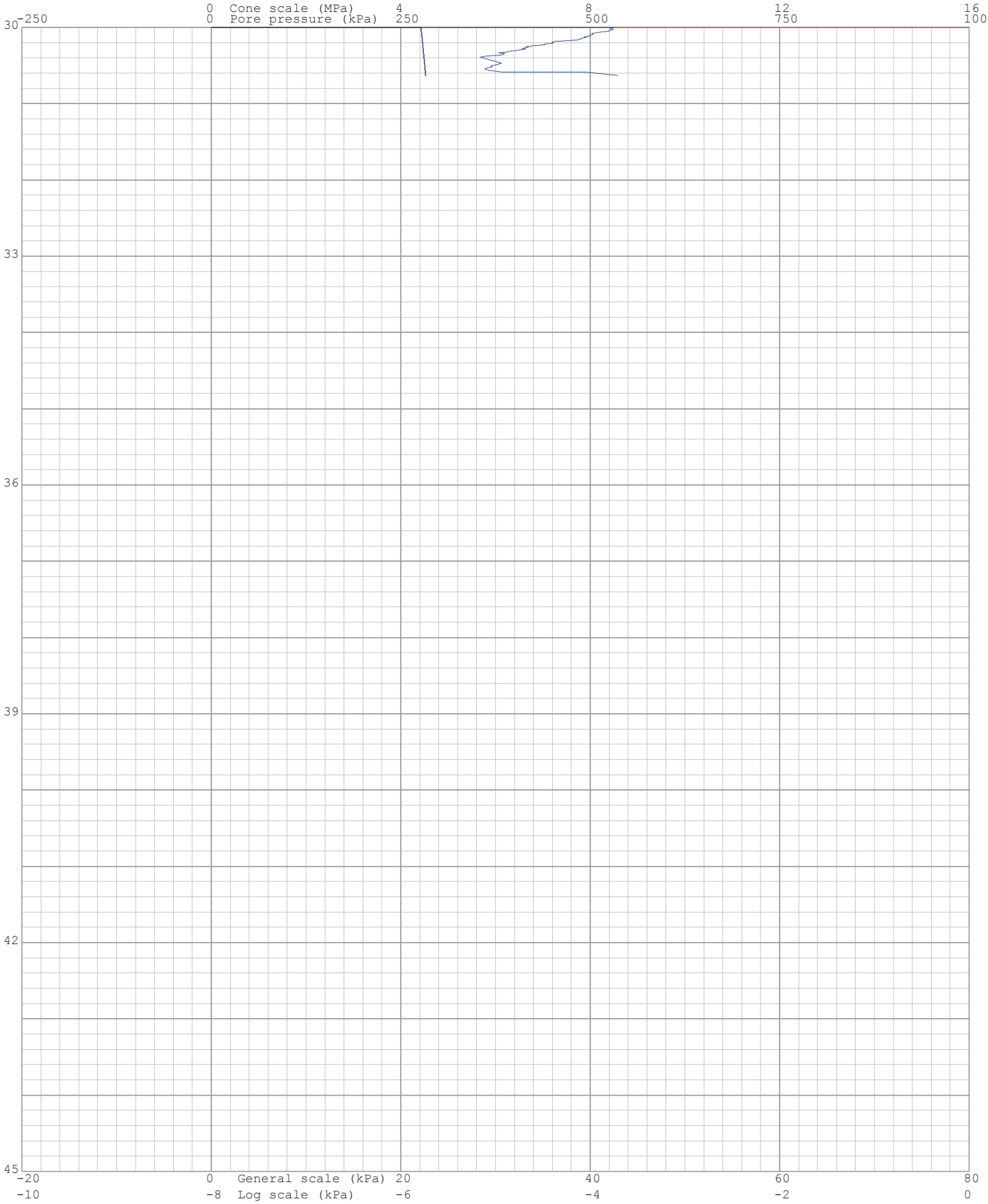


Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT01C
Date: 2012/06/25 Probe: GHANA

qc (Cone Scale)
ut (Pore Pressure Scale)
uo (Pore Pressure Scale)
Diss uo (Pore Pressure Scale)



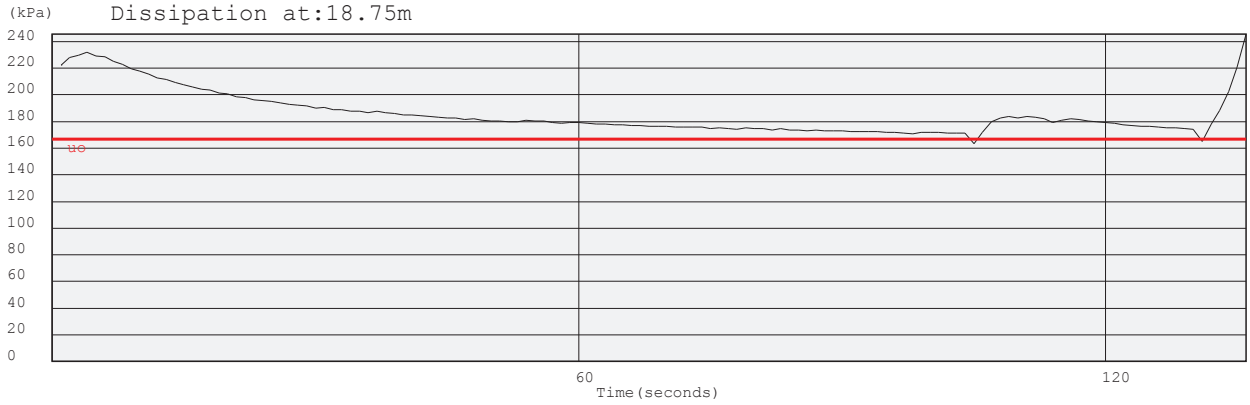
Project:Durban Harbour Over Water

Site: Pier2

Hole: CPT01C Date: 2012/06/25 Probe: GHANA

Dissipation at:1.7m

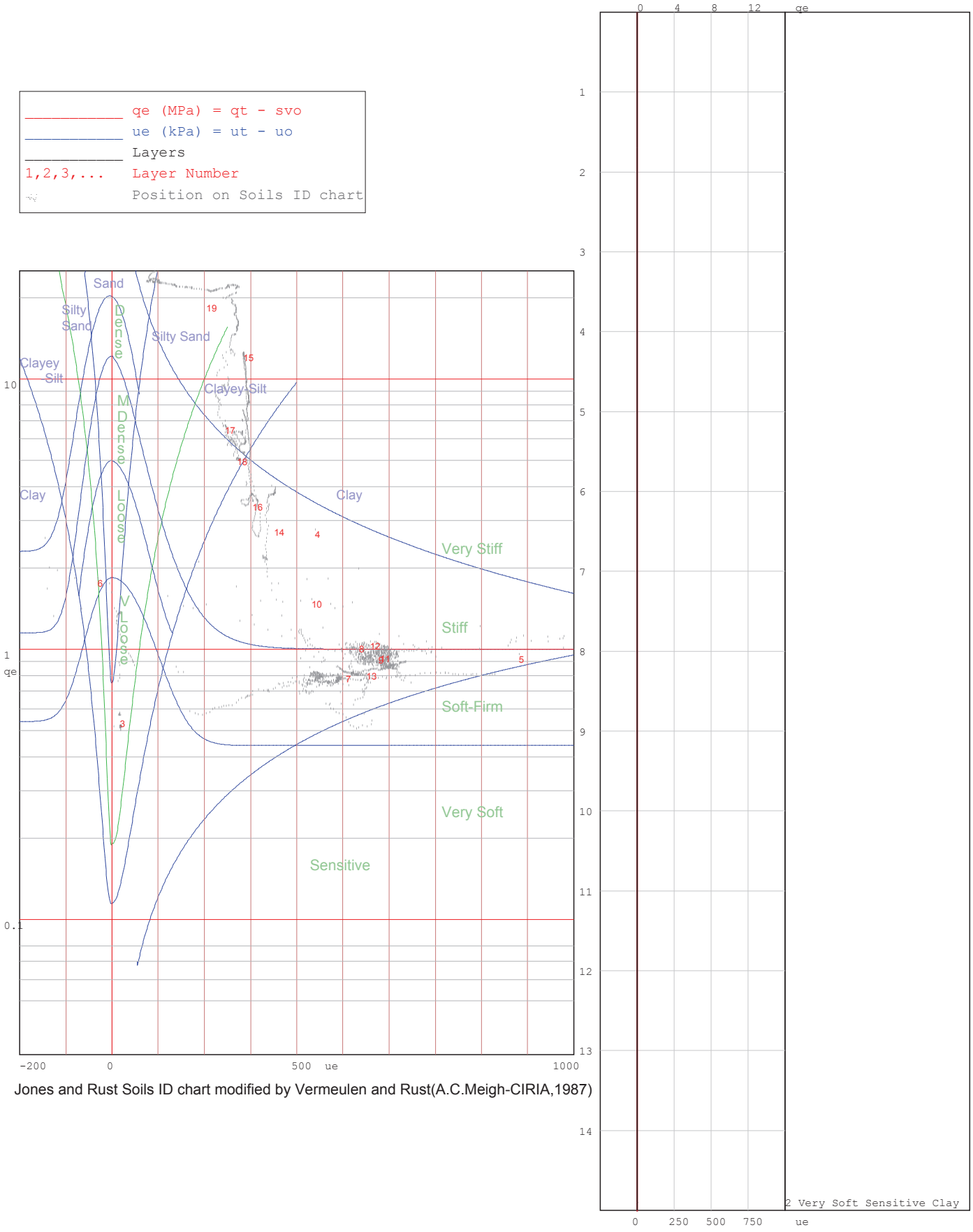
Dissipation at:18.75m



Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT01C
Date: 2012/06/25 Probe: GHANA

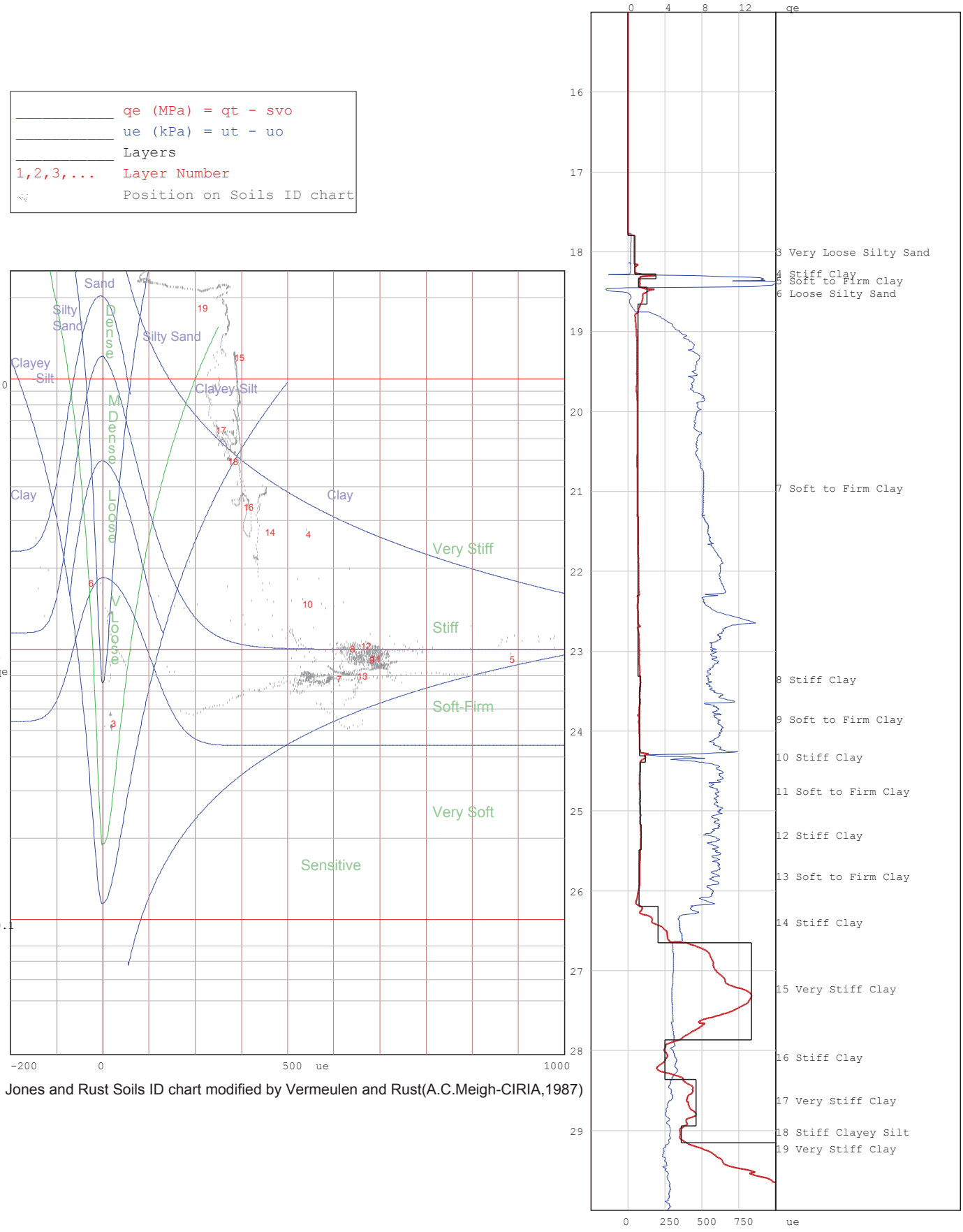


Jones and Rust Soils ID chart modified by Vermeulen and Rust(A.C.Meigh-CIRIA,1987)

Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT01C
Date: 2012/06/25 Probe: GHANA

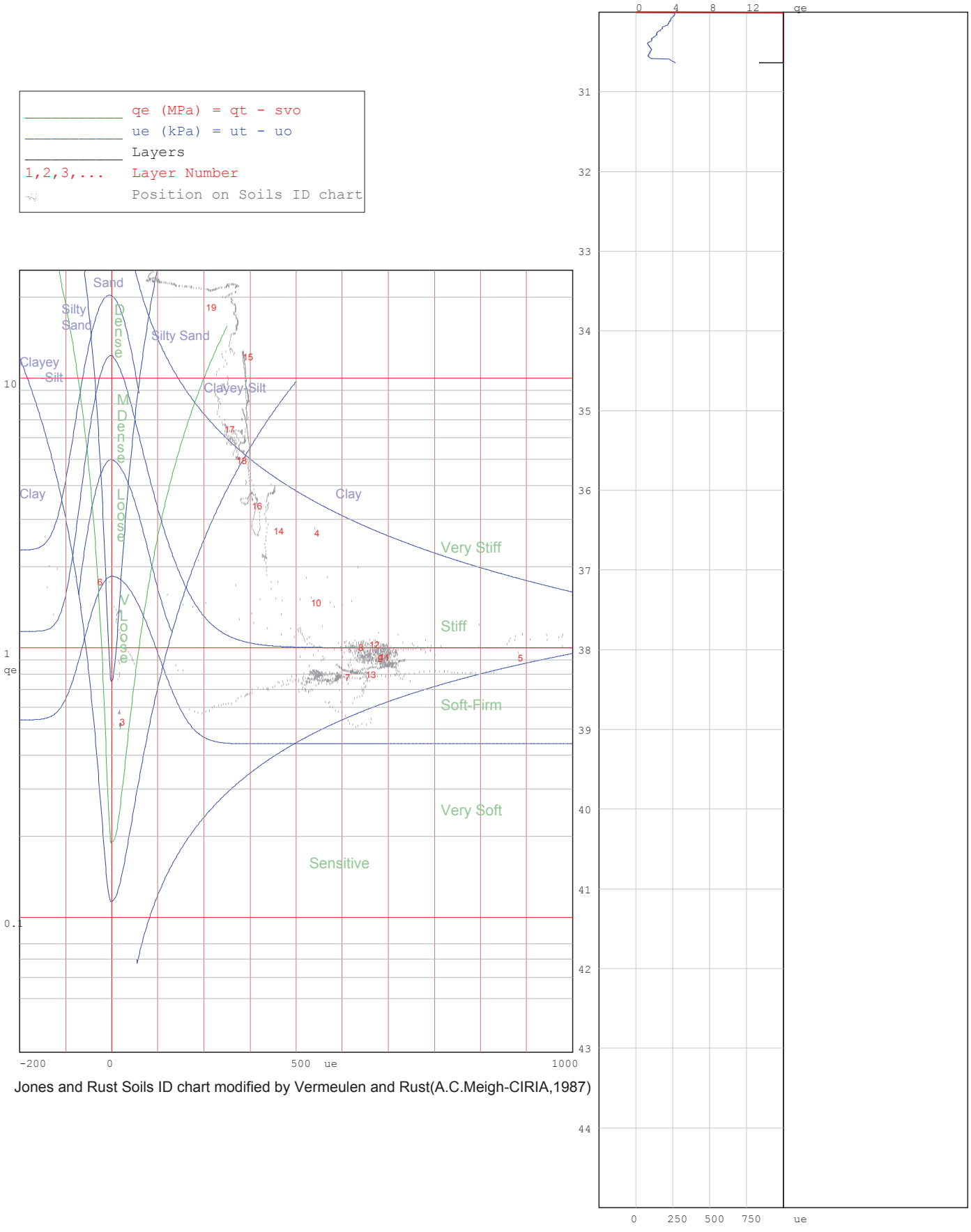


Jones and Rust Soils ID chart modified by Vermeulen and Rust(A.C.Meigh-CIRIA,1987)

Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT01C
Date: 2012/06/25 Probe: GHANA

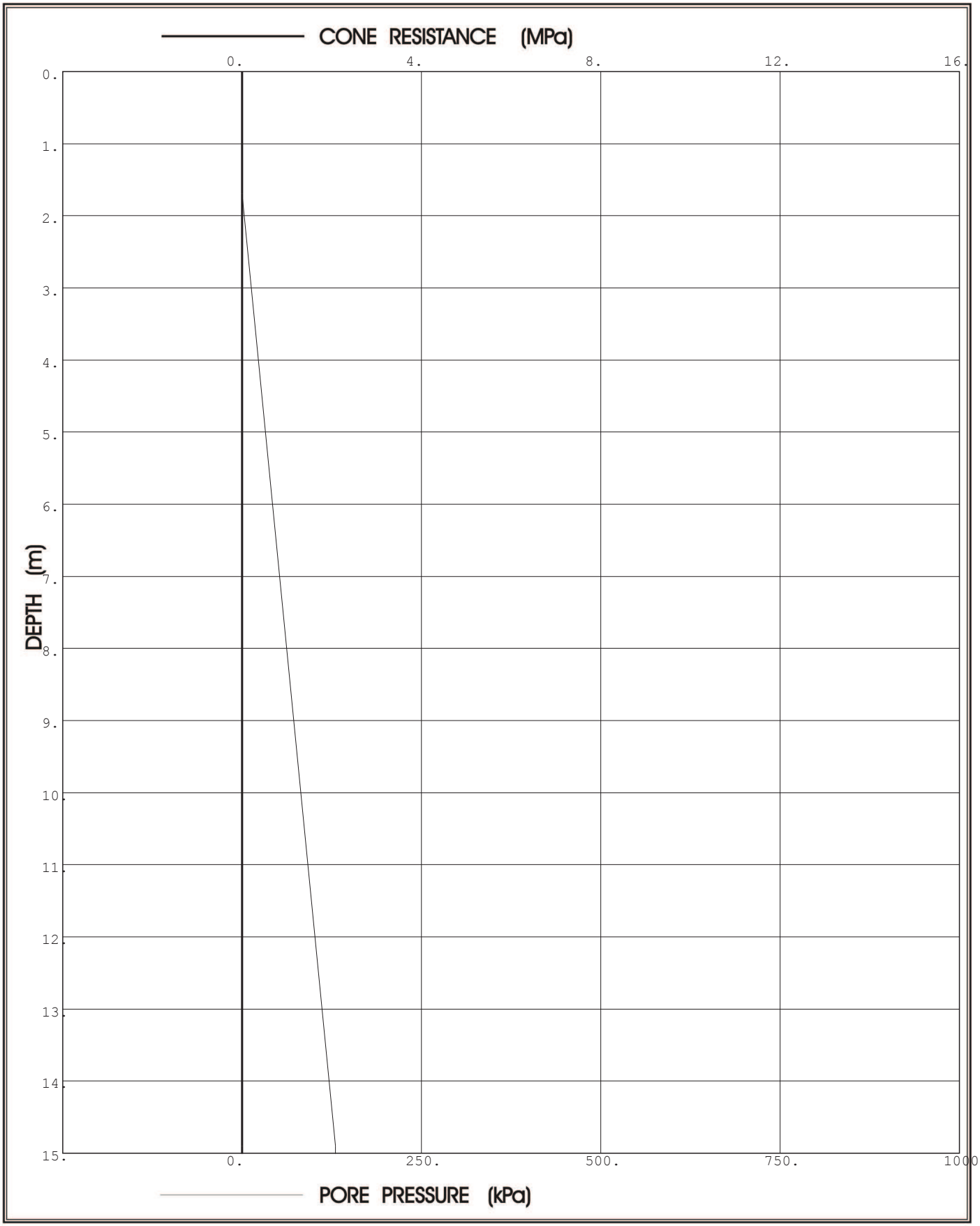


Jones and Rust Soils ID chart modified by Vermeulen and Rust(A.C.Meigh-CIRIA,1987)

PIEZOCONE PENETRATION TEST

PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT02
DATE: 2012/06/20 Probe: GHANA

Osimo CC
P O Box 39108
Moreleta Park
0044



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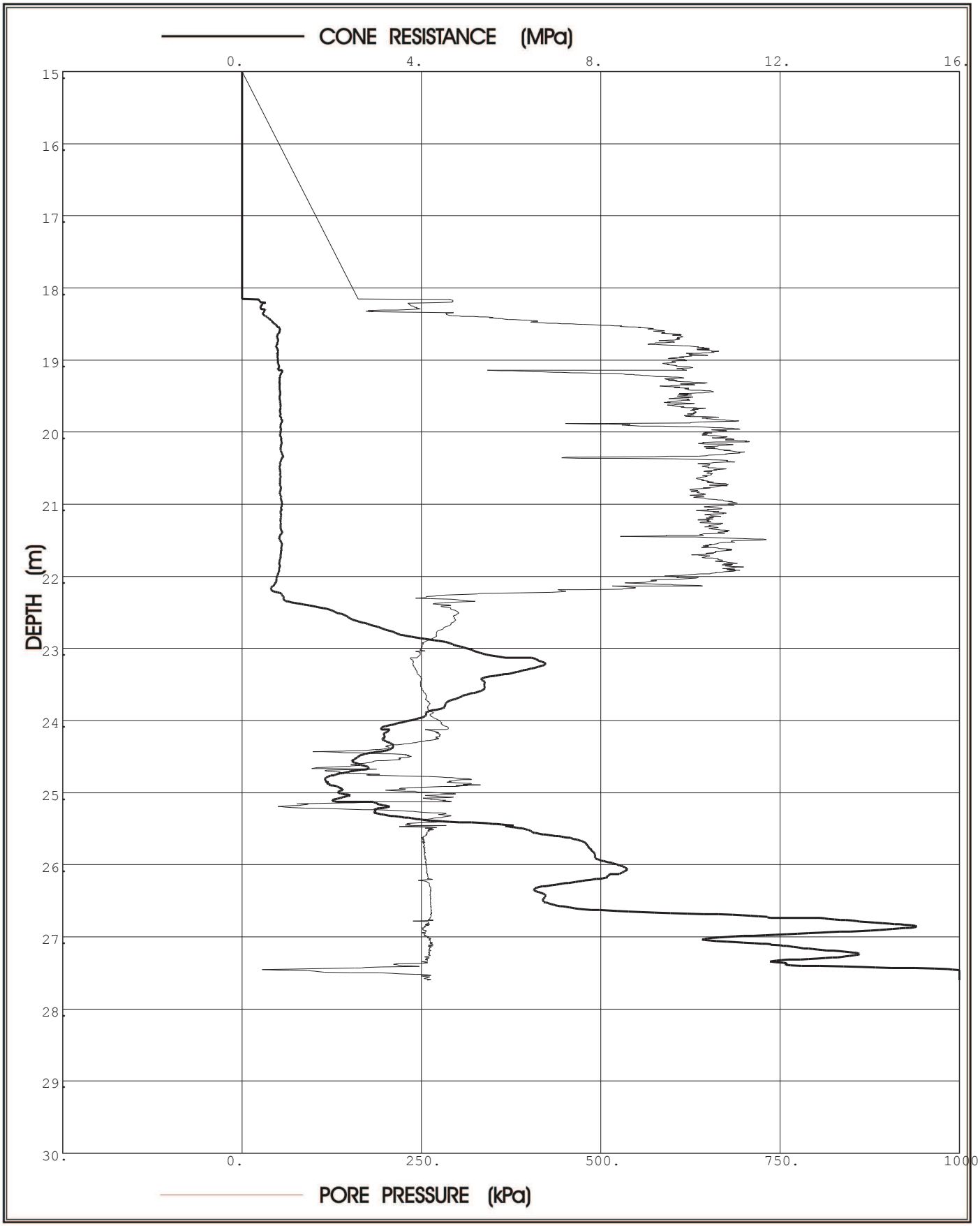
PIEZOCONE PENETRATION TEST

PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT02
DATE: 2012/06/20 Probe: GHANA

Osimo CC
P O Box 39108
Moreleta Park
0044



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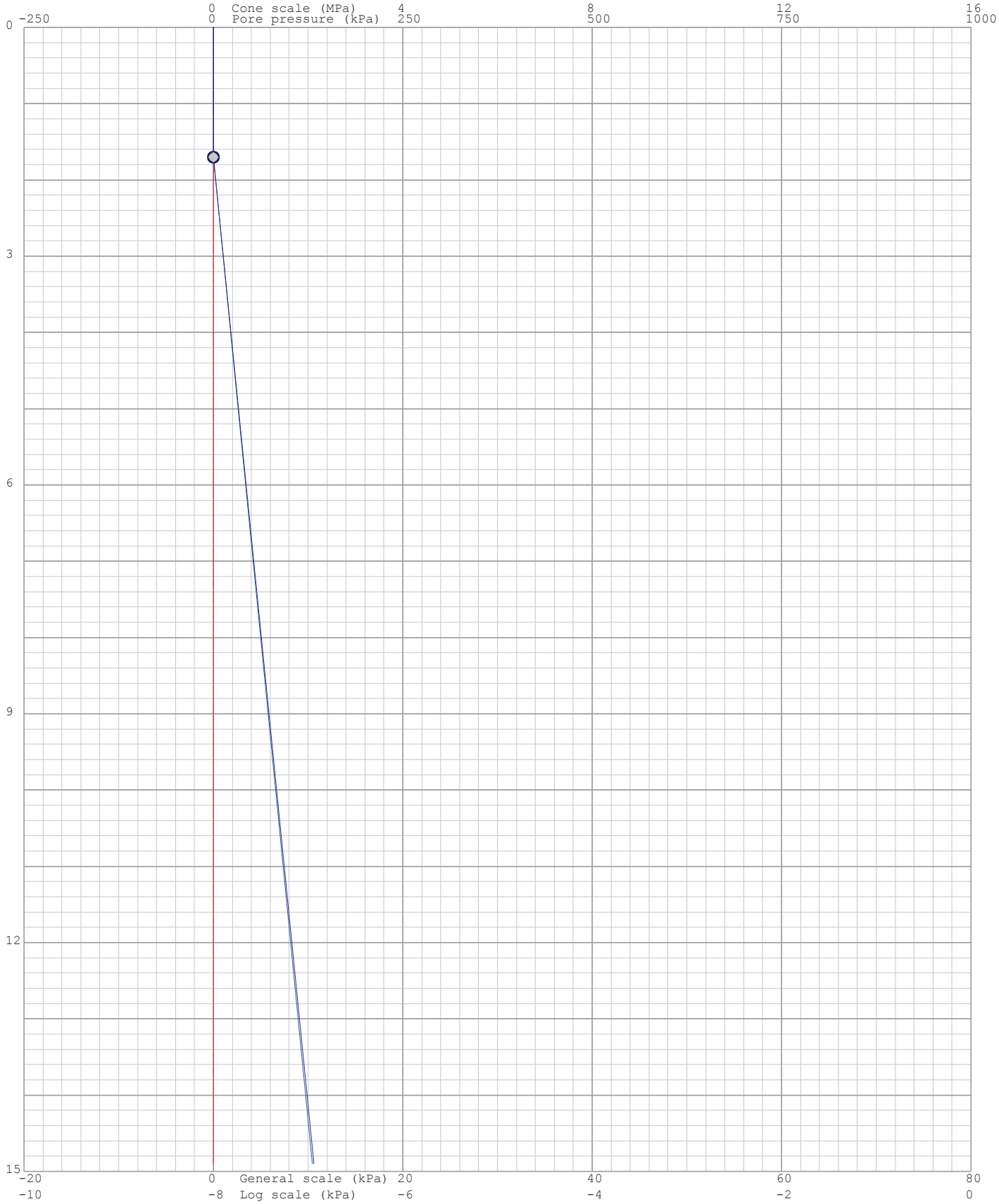
Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT02
Date: 2012/06/20 Probe: GHANA

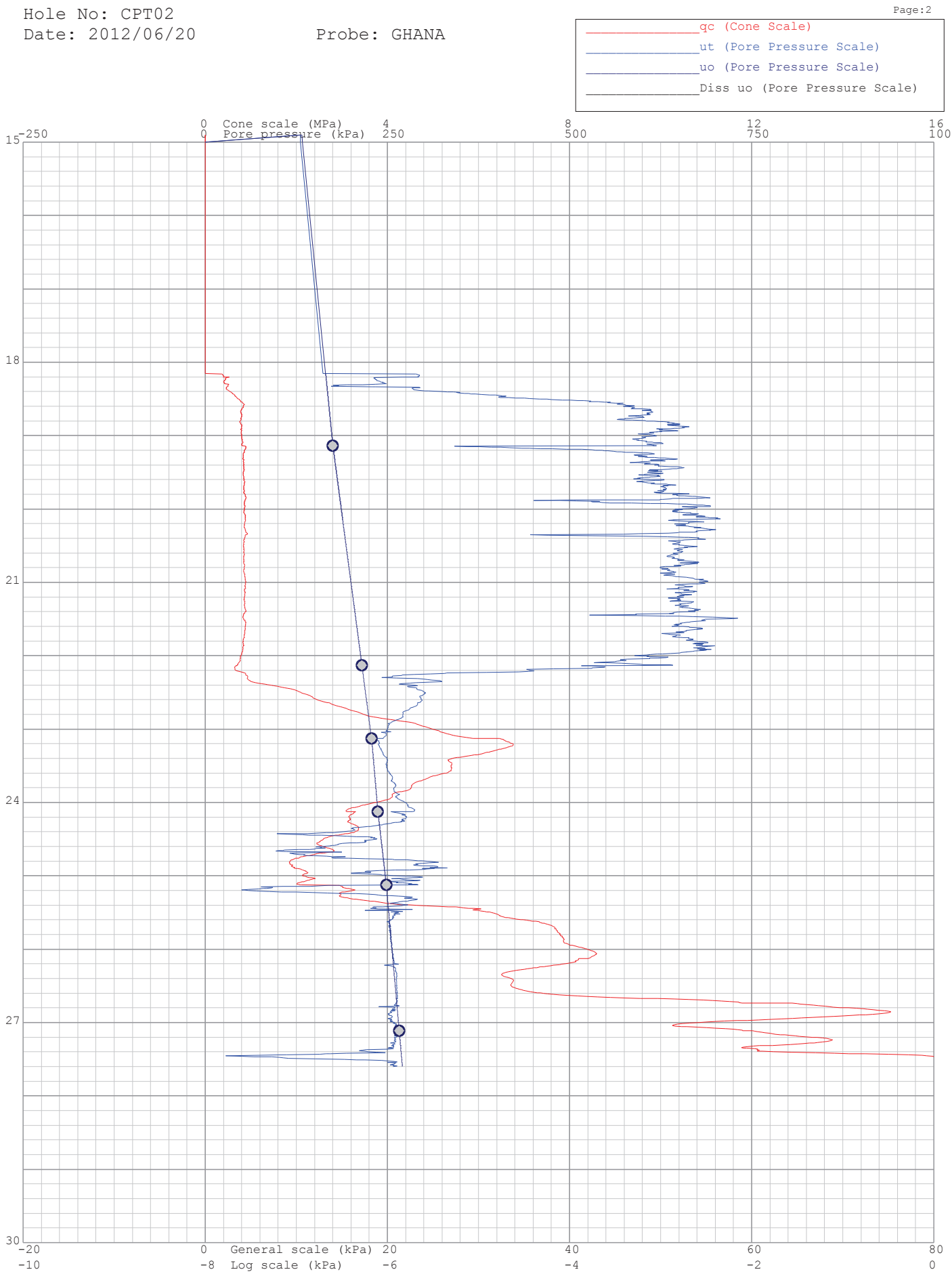
qc (Cone Scale)
ut (Pore Pressure Scale)
uo (Pore Pressure Scale)
Diss uo (Pore Pressure Scale)



Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT02
Date: 2012/06/20 Probe: GHANA



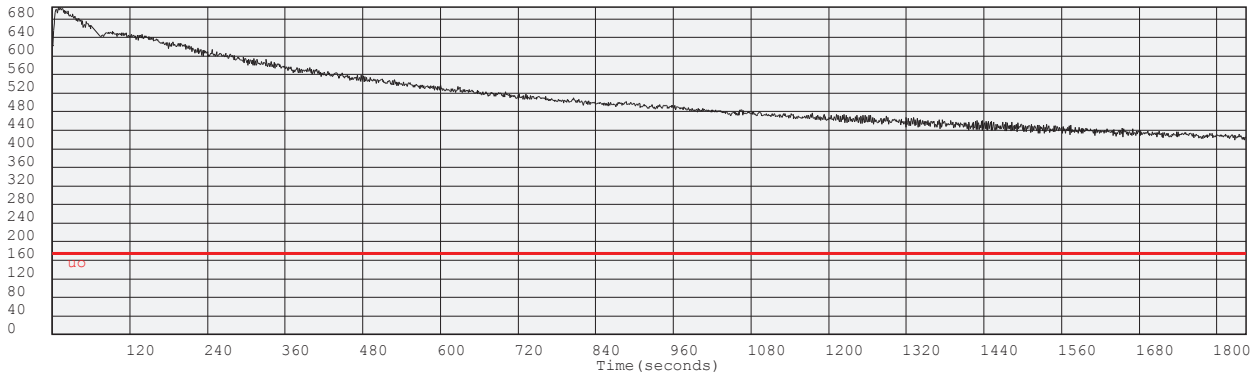
Project:Durban Harbour Over Water

Site: Pier2

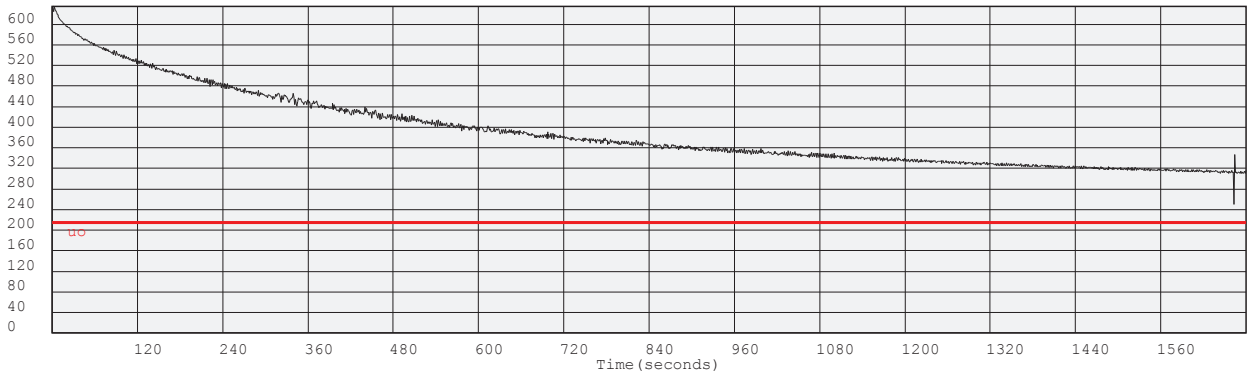
Hole: CPT02 Date: 2012/06/20 Probe: GHANA

(kPa) Dissipation at:1.7m

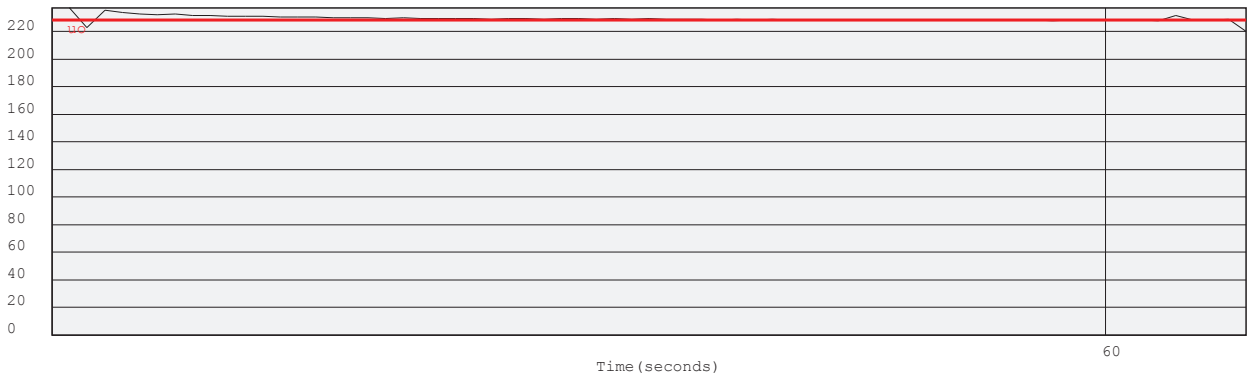
(kPa) Dissipation at:19.14m



(kPa) Dissipation at:22.132m



(kPa) Dissipation at:23.126m

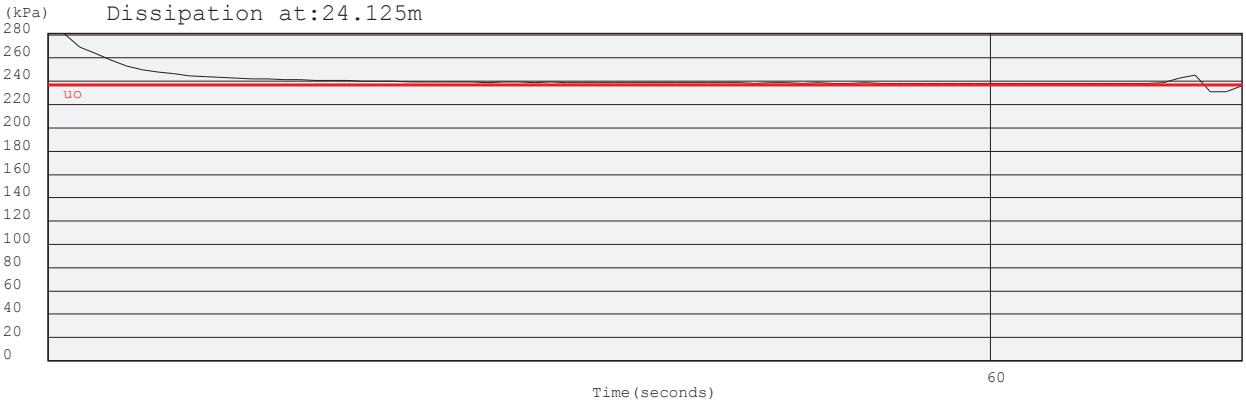


Project:Durban Harbour Over Water

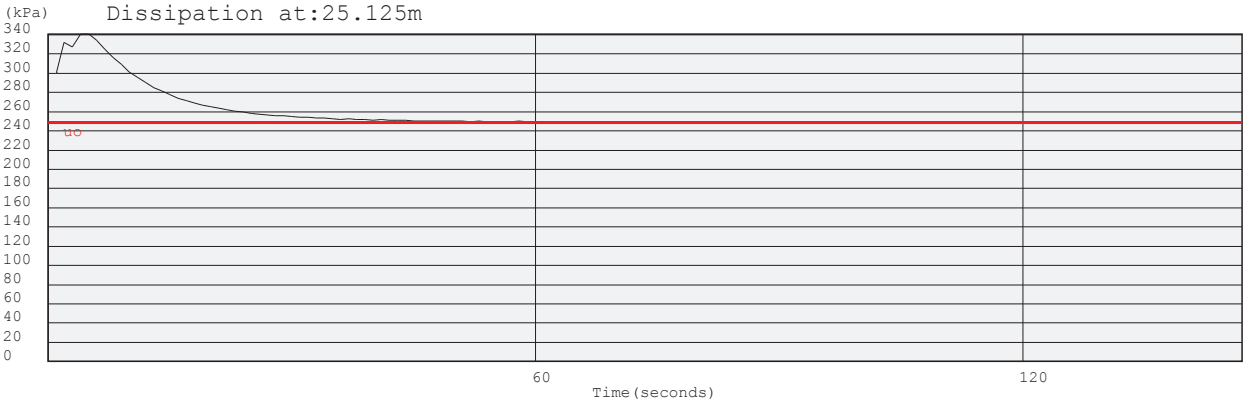
Site: Pier2

Hole: CPT02 Date: 2012/06/20 Probe: GHANA

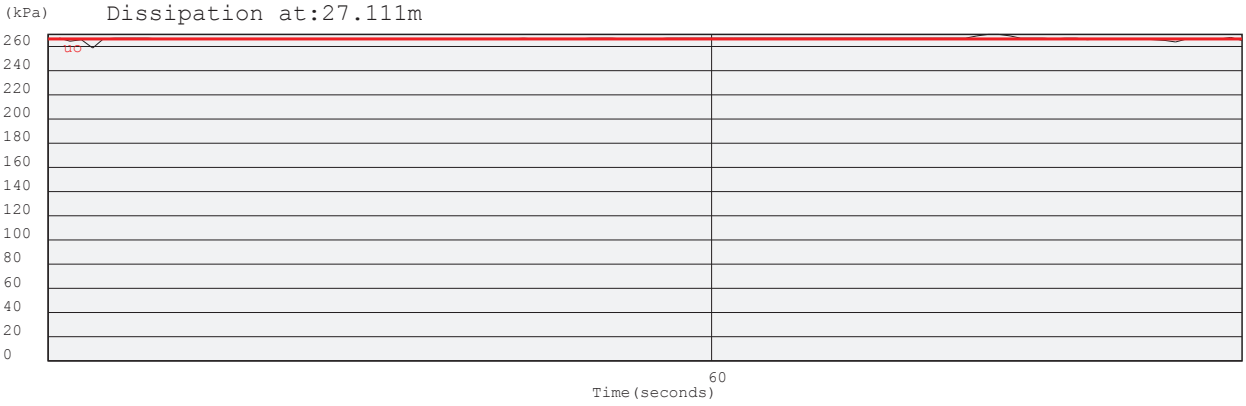
Dissipation at:24.125m



Dissipation at:25.125m



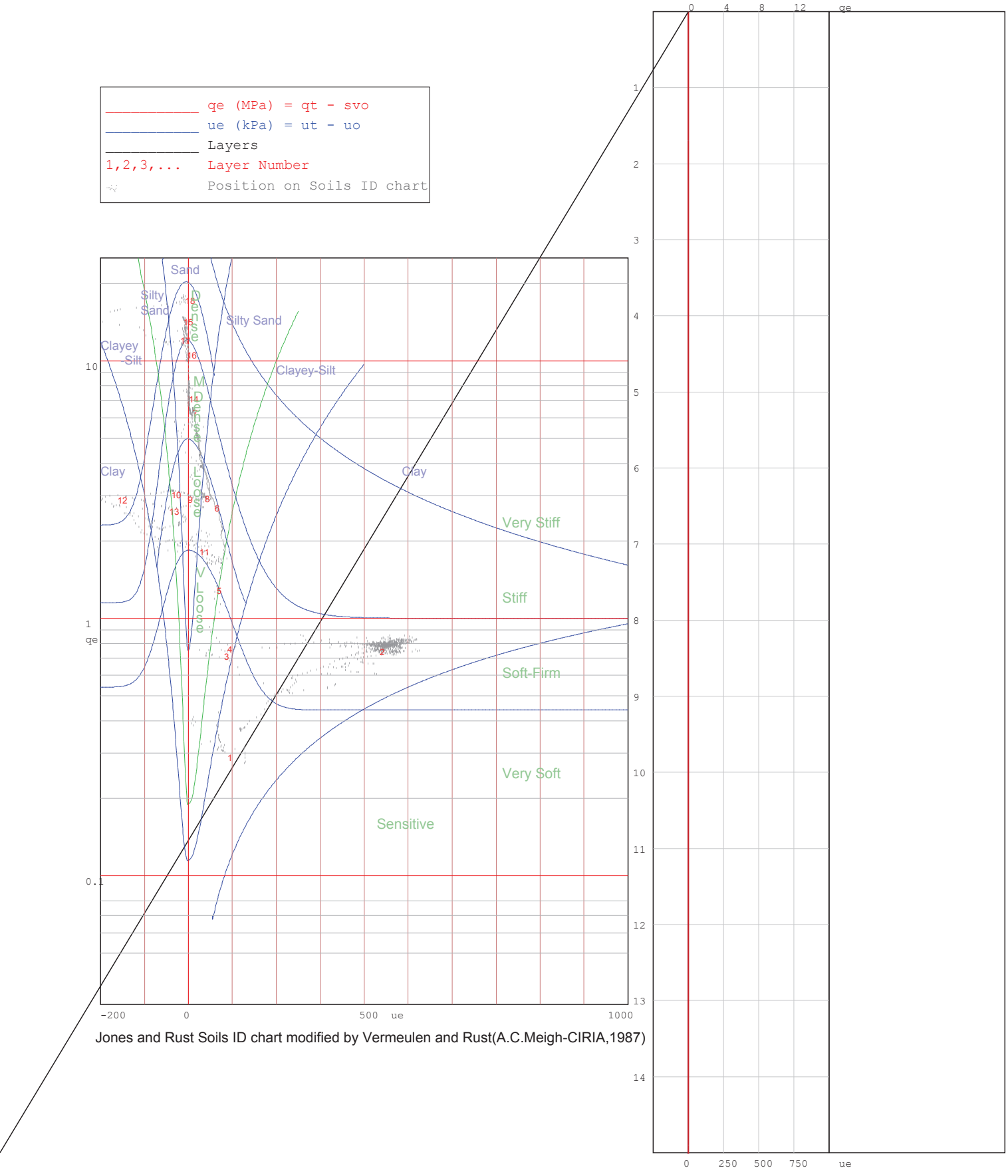
Dissipation at:27.111m



Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT02
Date: 2012/06/20 Probe: GHANA



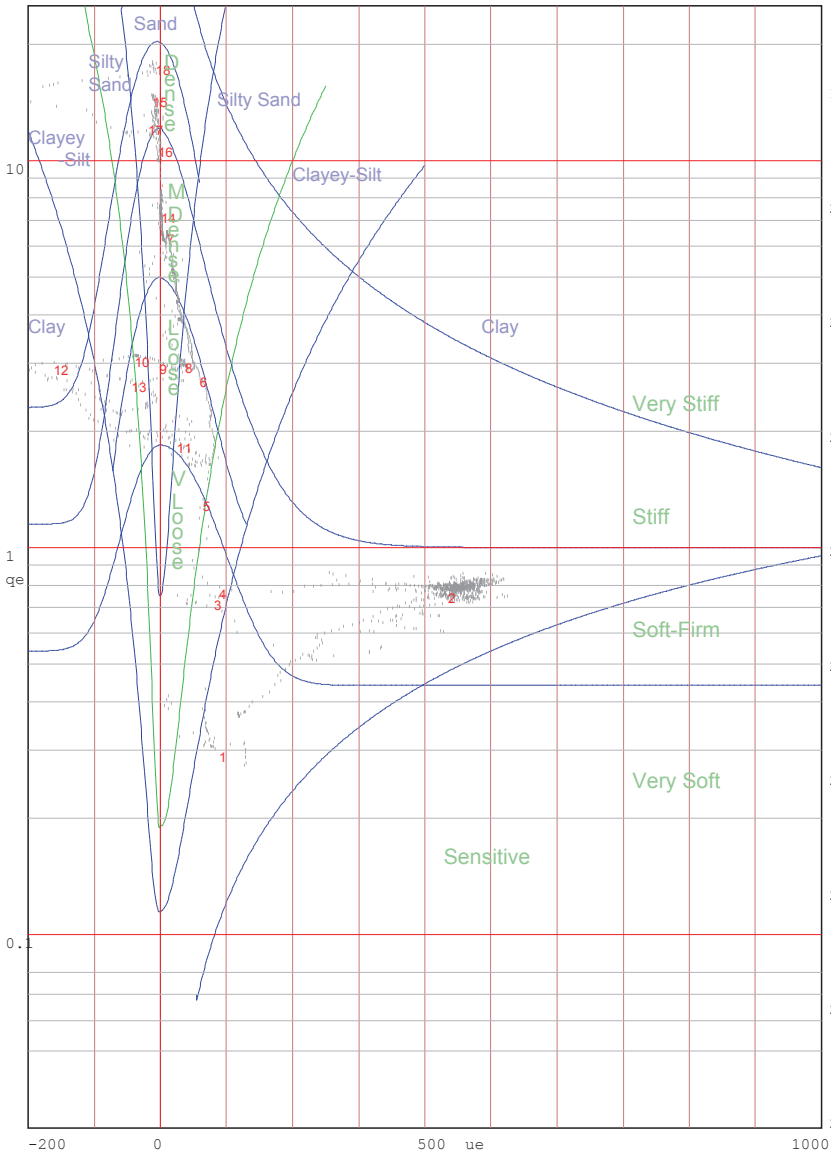
Jones and Rust Soils ID chart modified by Vermeulen and Rust(A.C.Meigh-CIRIA,1987)

Project: Durban Harbour Over Water

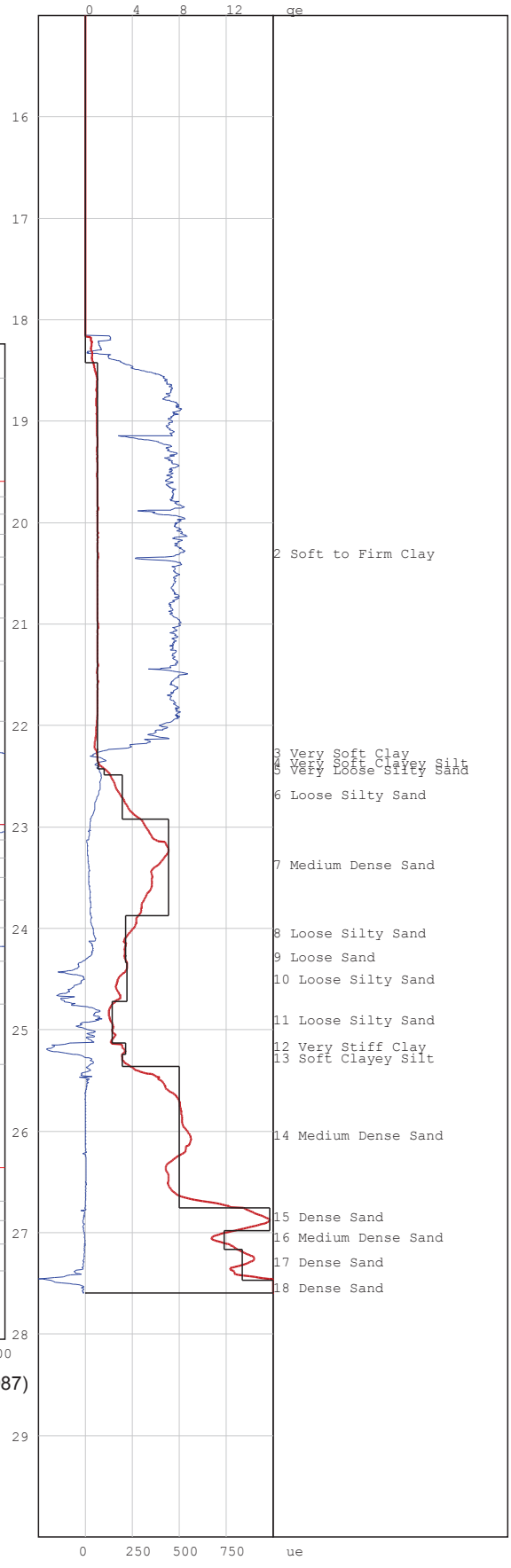
Site: Pier2

Hole No: CPT02
Date: 2012/06/20 Probe: GHANA

qe (MPa) = qt - svo
ue (kPa) = ut - uo
Layers
1,2,3,... Layer Number
Position on Soils ID chart



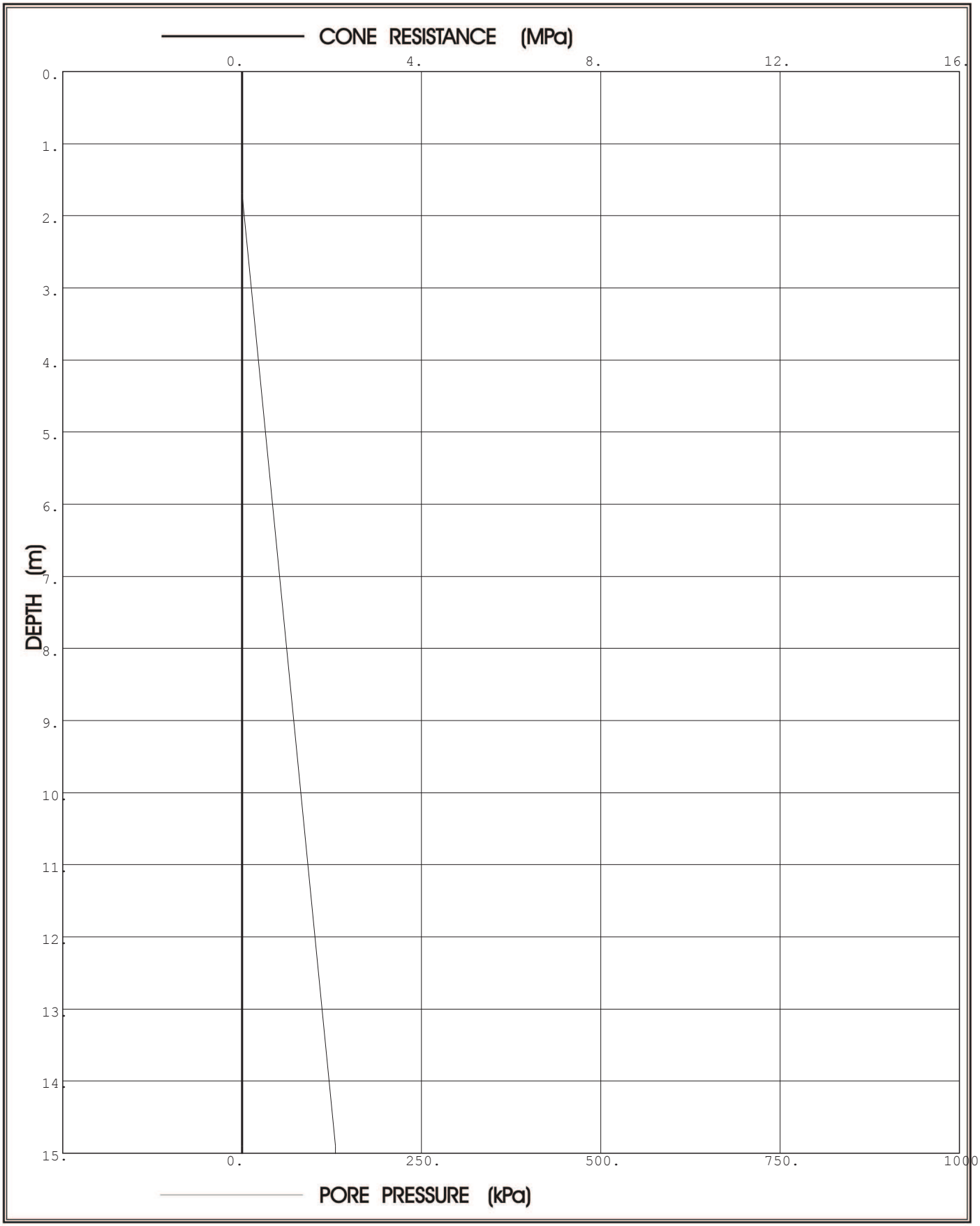
Jones and Rust Soils ID chart modified by Vermeulen and Rust(A.C.Meigh-CIRIA,1987)



PIEZOCONE PENETRATION TEST

PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT03
DATE: 2012-06-18 Probe: GHANA

Osimo CC
P O Box 39108
Moreleta Park
0044



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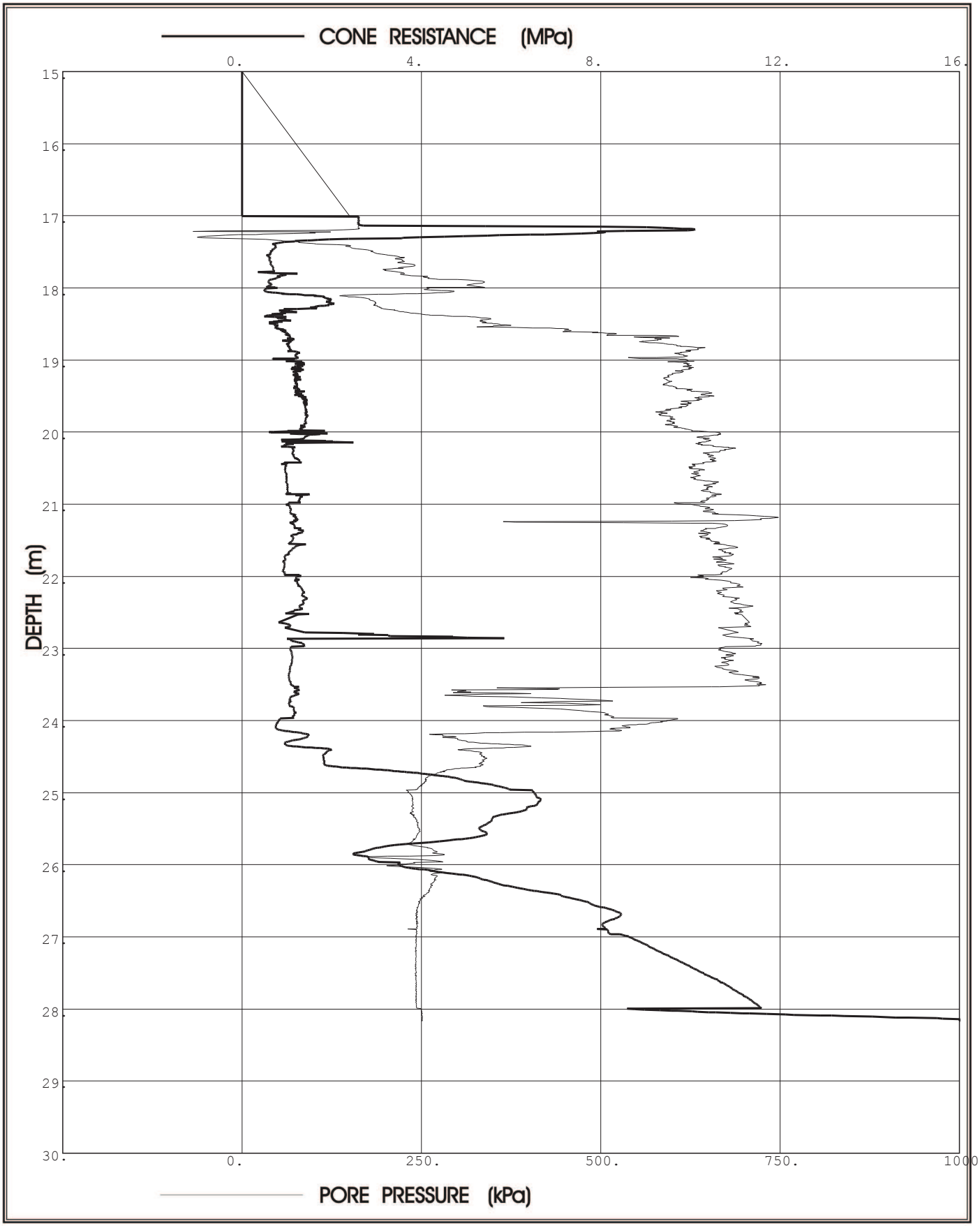
PIEZOCONE PENETRATION TEST

Osimo CC
P O Box 39108
Moreleta Park
0044

PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT03
DATE: 2012-06-18 Probe: GHANA



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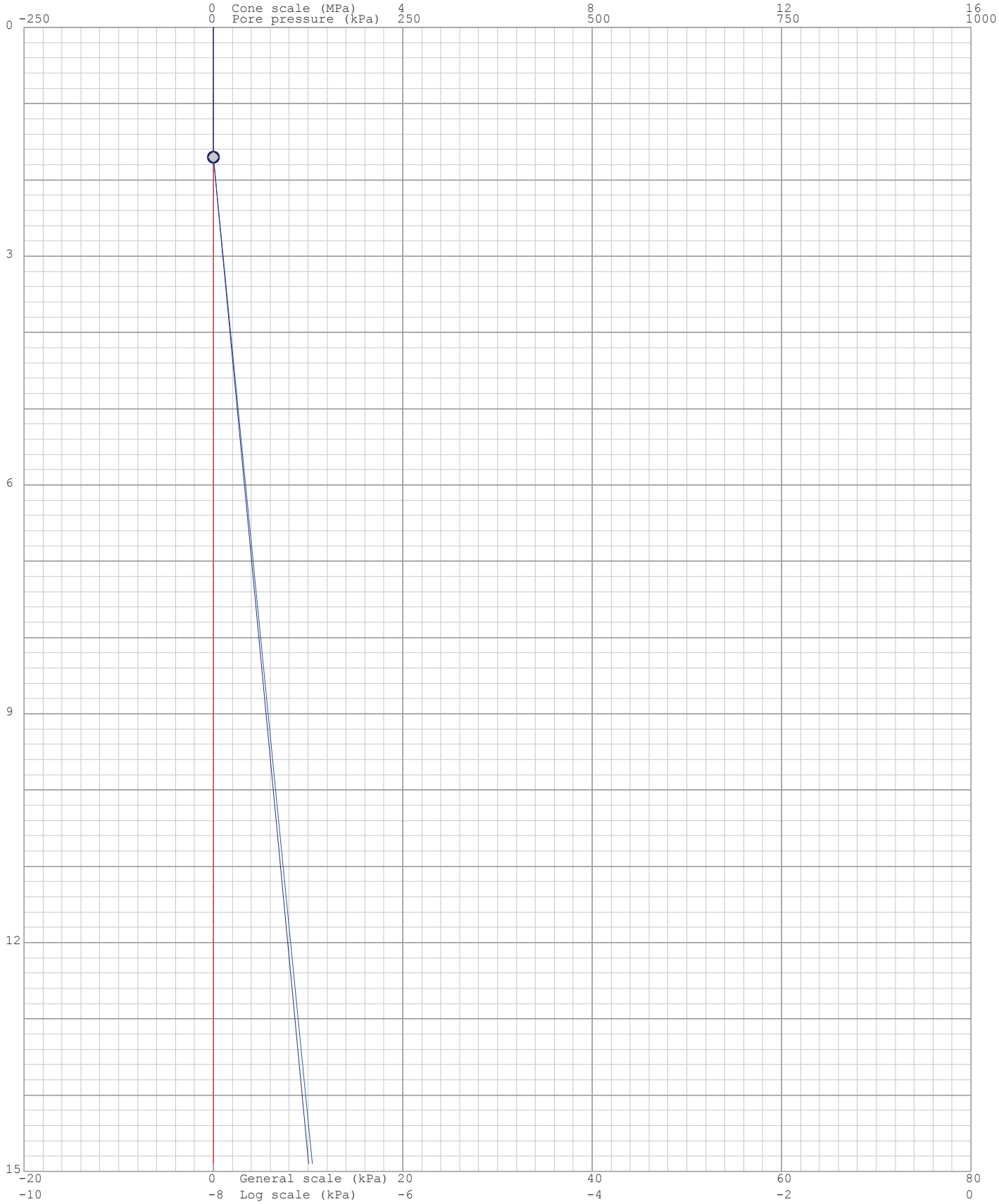
Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT03
Date: 2012-06-18 Probe: GHANA

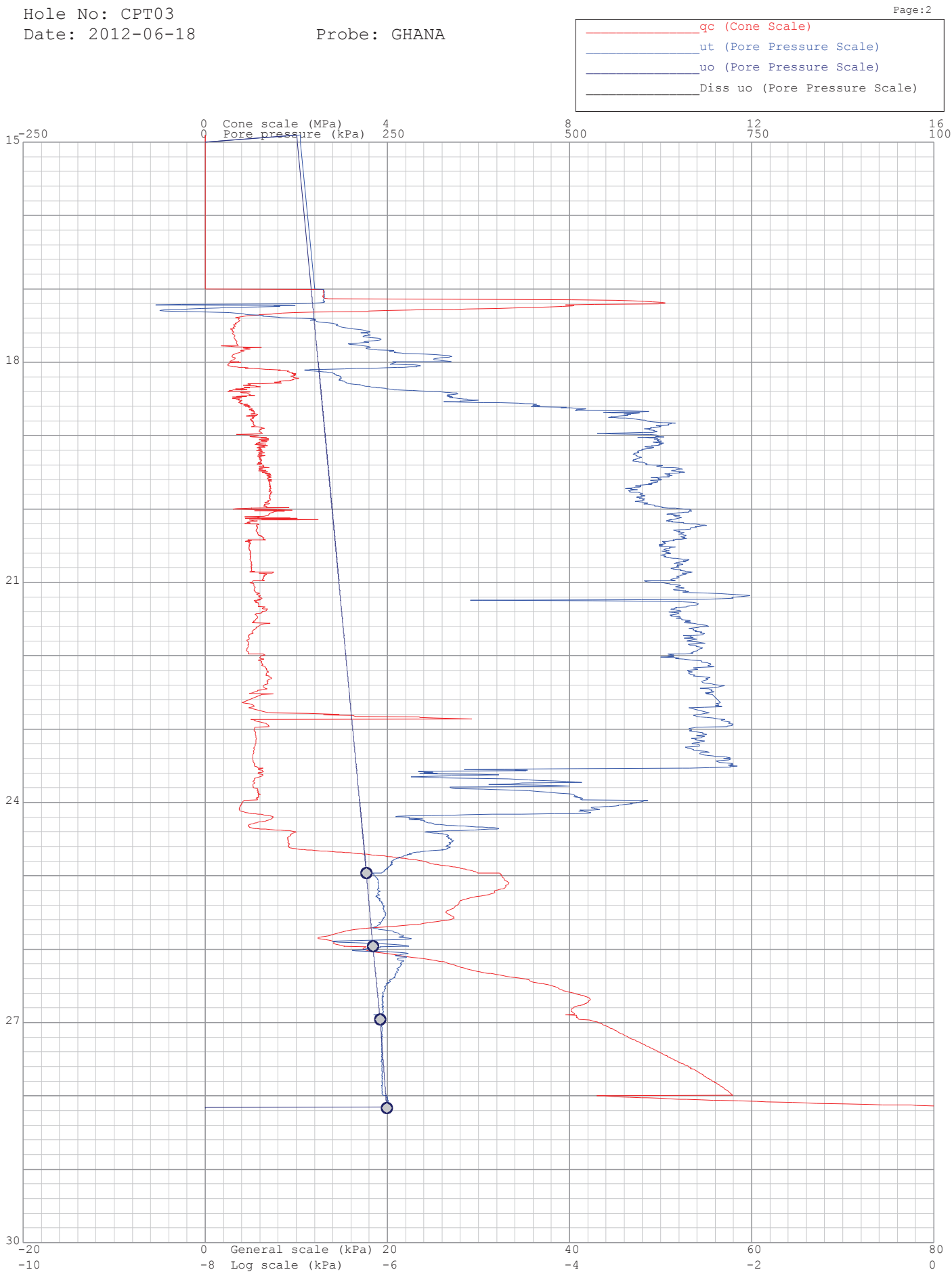
qc (Cone Scale)
ut (Pore Pressure Scale)
uo (Pore Pressure Scale)
Diss uo (Pore Pressure Scale)



Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT03
Date: 2012-06-18 Probe: GHANA



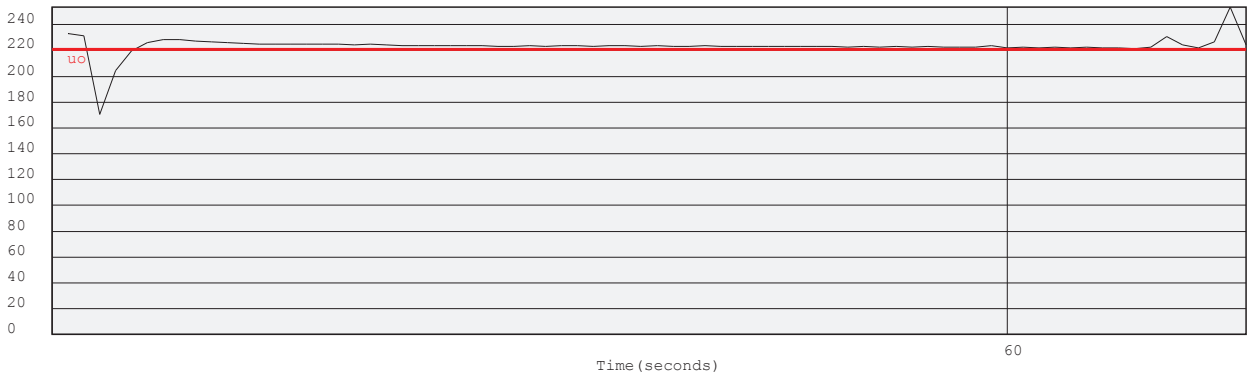
Project:Durban Harbour Over Water

Site: Pier2

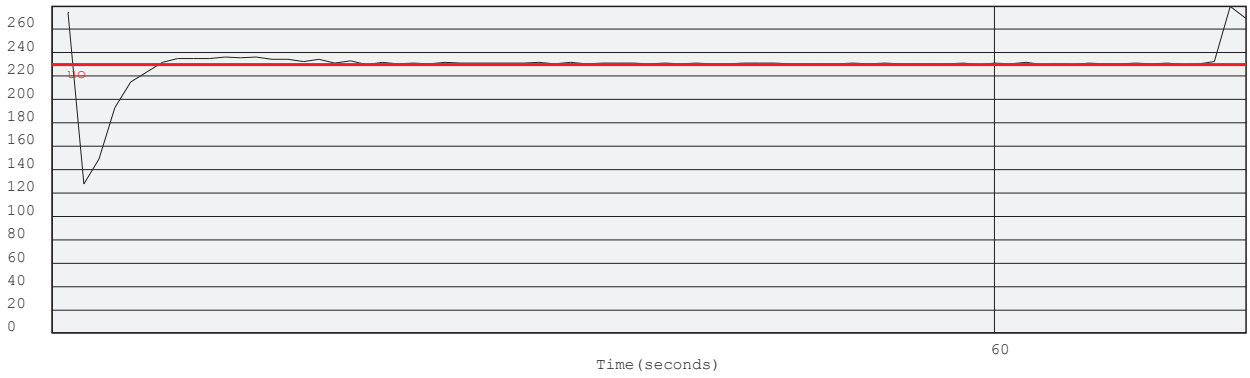
Hole: CPT03 Date: 2012-06-18 Probe: GHANA

(kPa) Dissipation at:1.7m

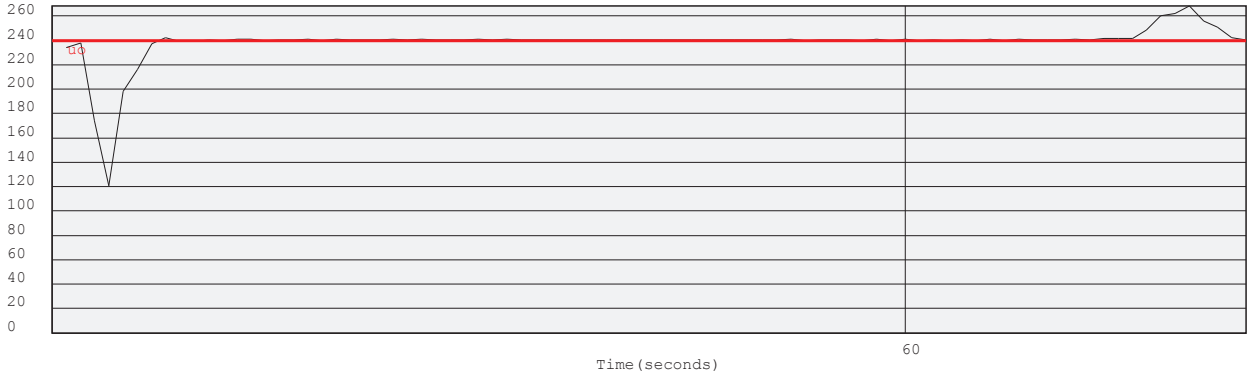
(kPa) Dissipation at:24.96m



(kPa) Dissipation at:25.963m



(kPa) Dissipation at:26.96m

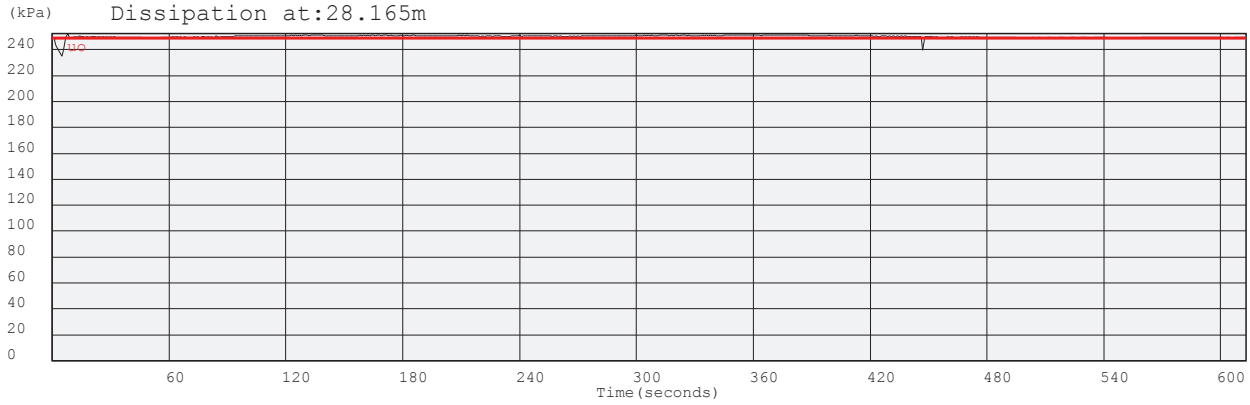


Project:Durban Harbour Over Water

Site: Pier2

Hole: CPT03 Date: 2012-06-18 Probe: GHANA

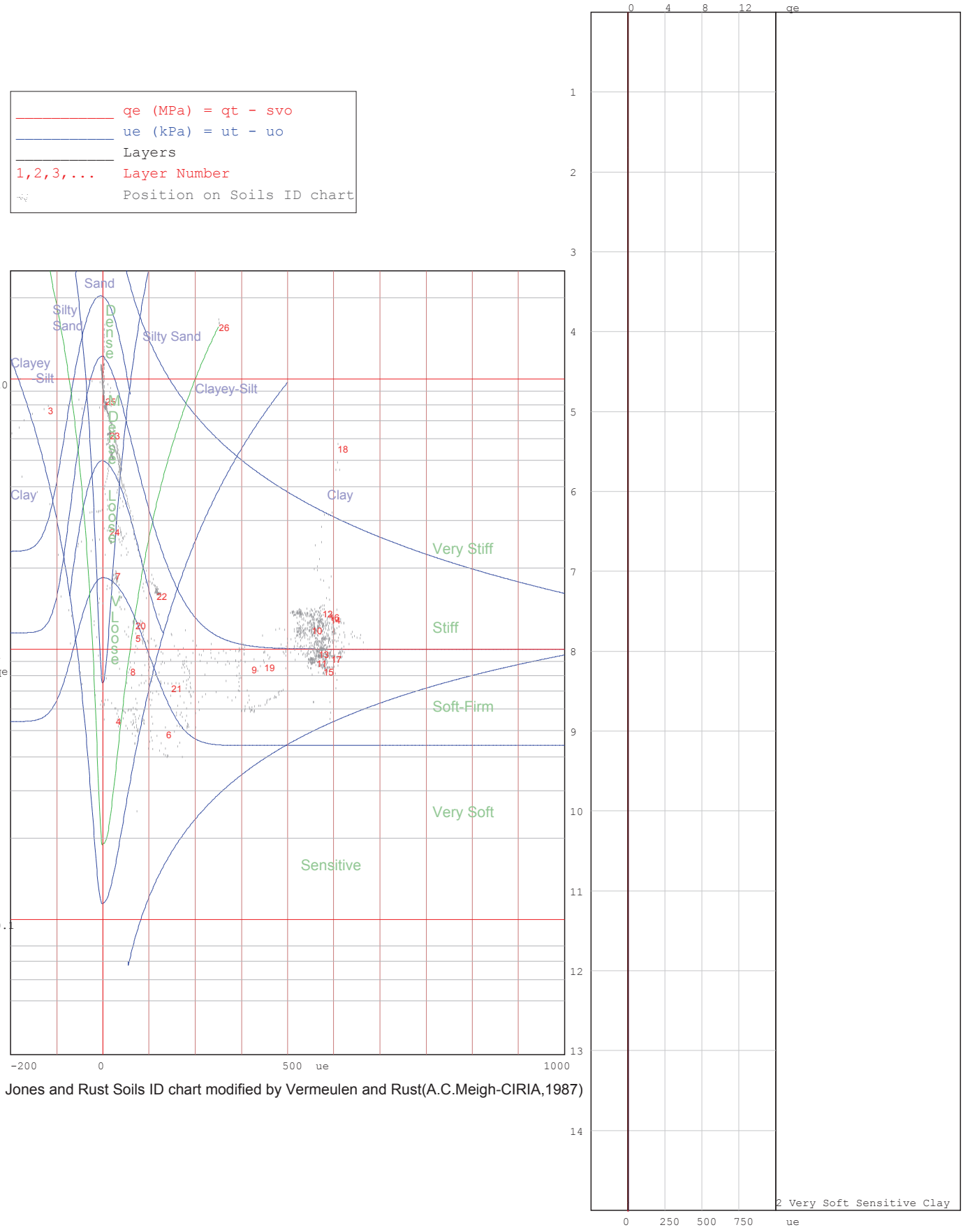
Dissipation at:28.165m



Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT03
Date: 2012-06-18 Probe: GHANA

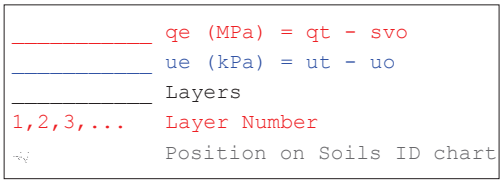


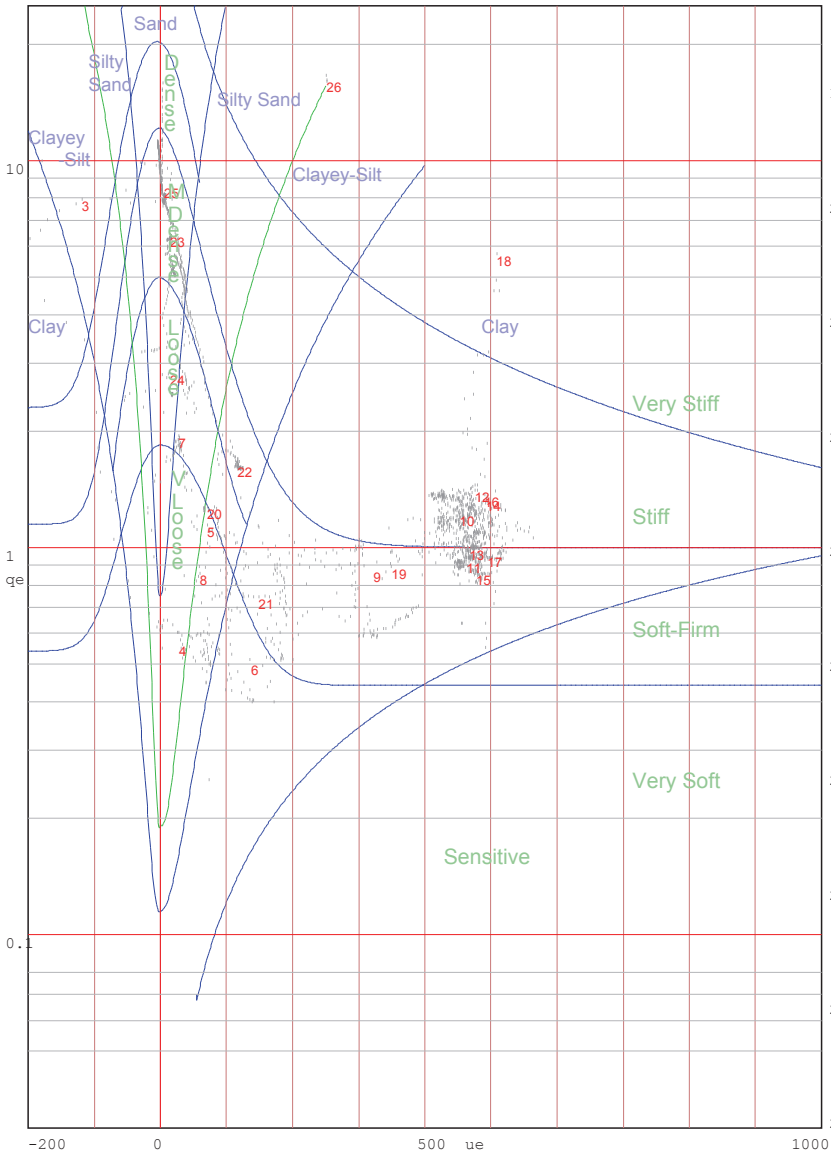
Jones and Rust Soils ID chart modified by Vermeulen and Rust(A.C.Meigh-CIRIA,1987)

Project: Durban Harbour Over Water

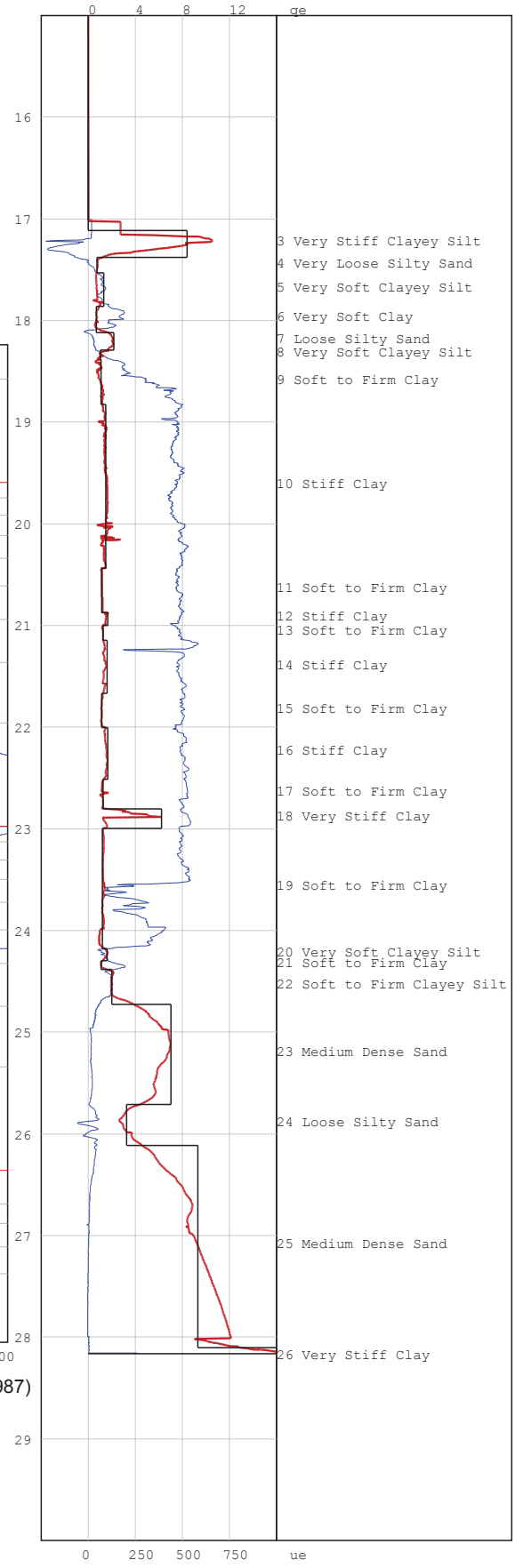
Site: Pier2

Hole No: CPT03
Date: 2012-06-18 Probe: GHANA





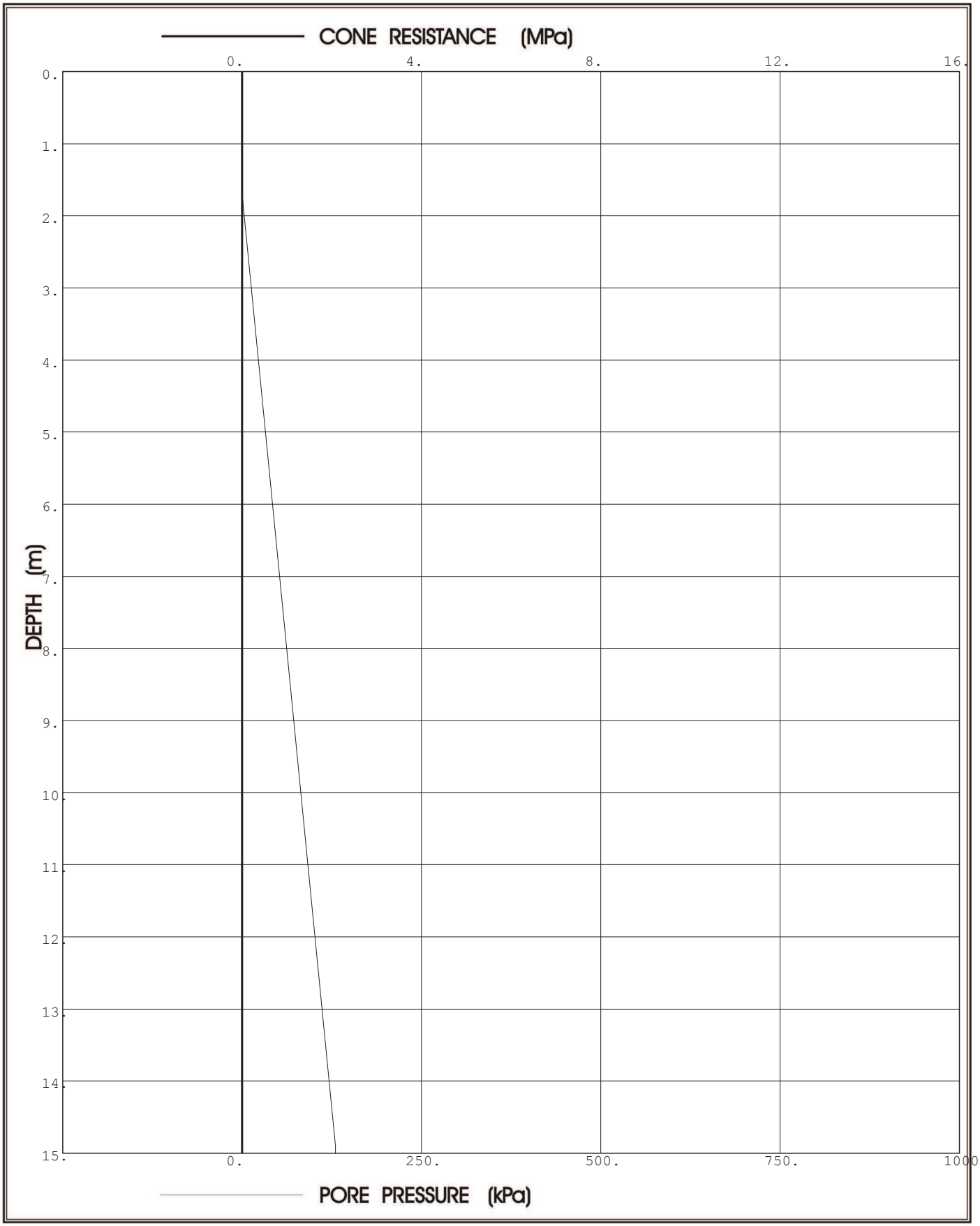
Jones and Rust Soils ID chart modified by Vermeulen and Rust(A.C.Meigh-CIRIA,1987)



PIEZOCONE PENETRATION TEST

PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT04
DATE: 2012-06-21 Probe: GHANA

Osimo CC
P O Box 39108
Moreleta Park
0044



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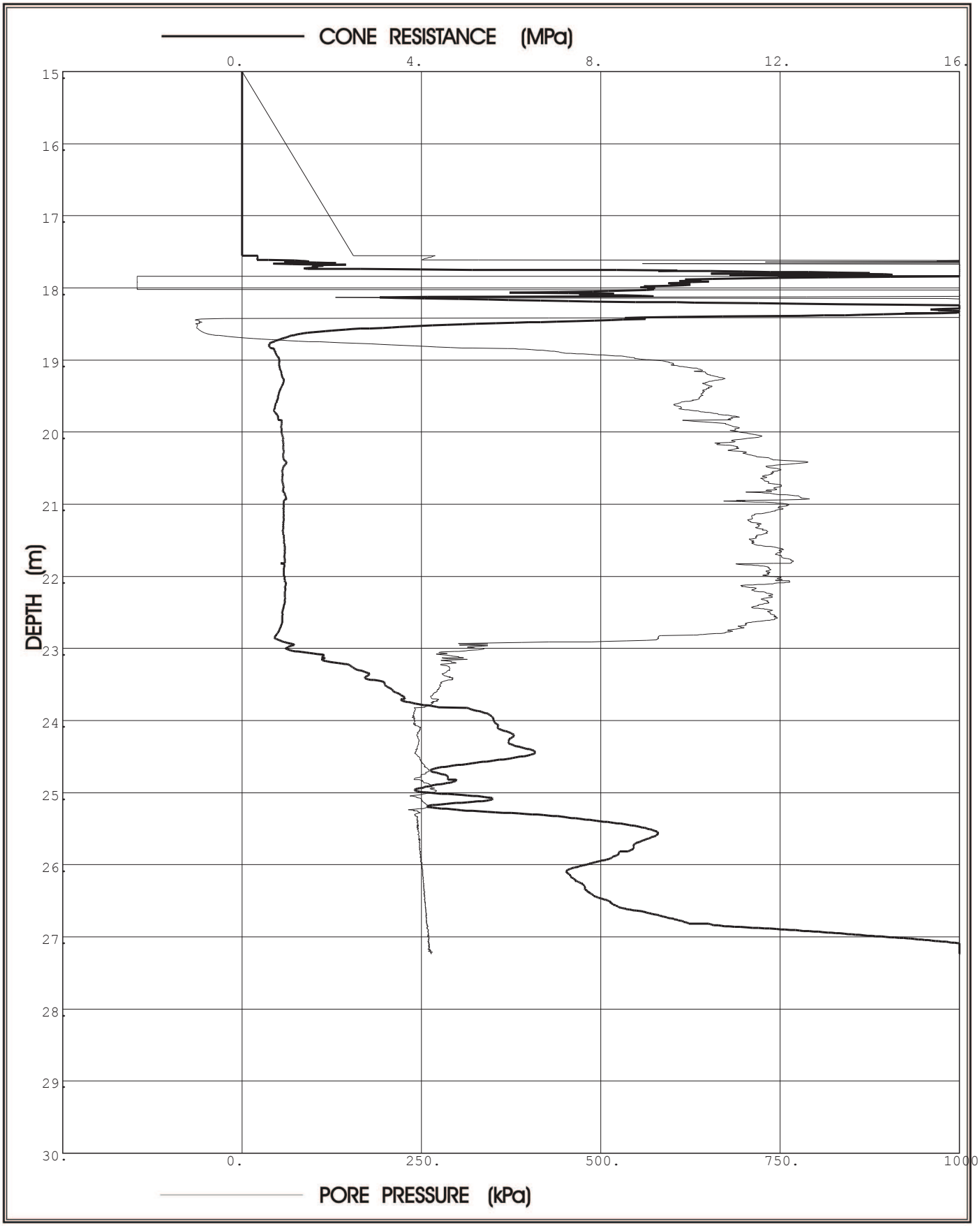
PIEZOCONE PENETRATION TEST

PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT04
DATE: 2012-06-21 Probe: GHANA

Osimo CC
P O Box 39108
Moreleta Park
0044



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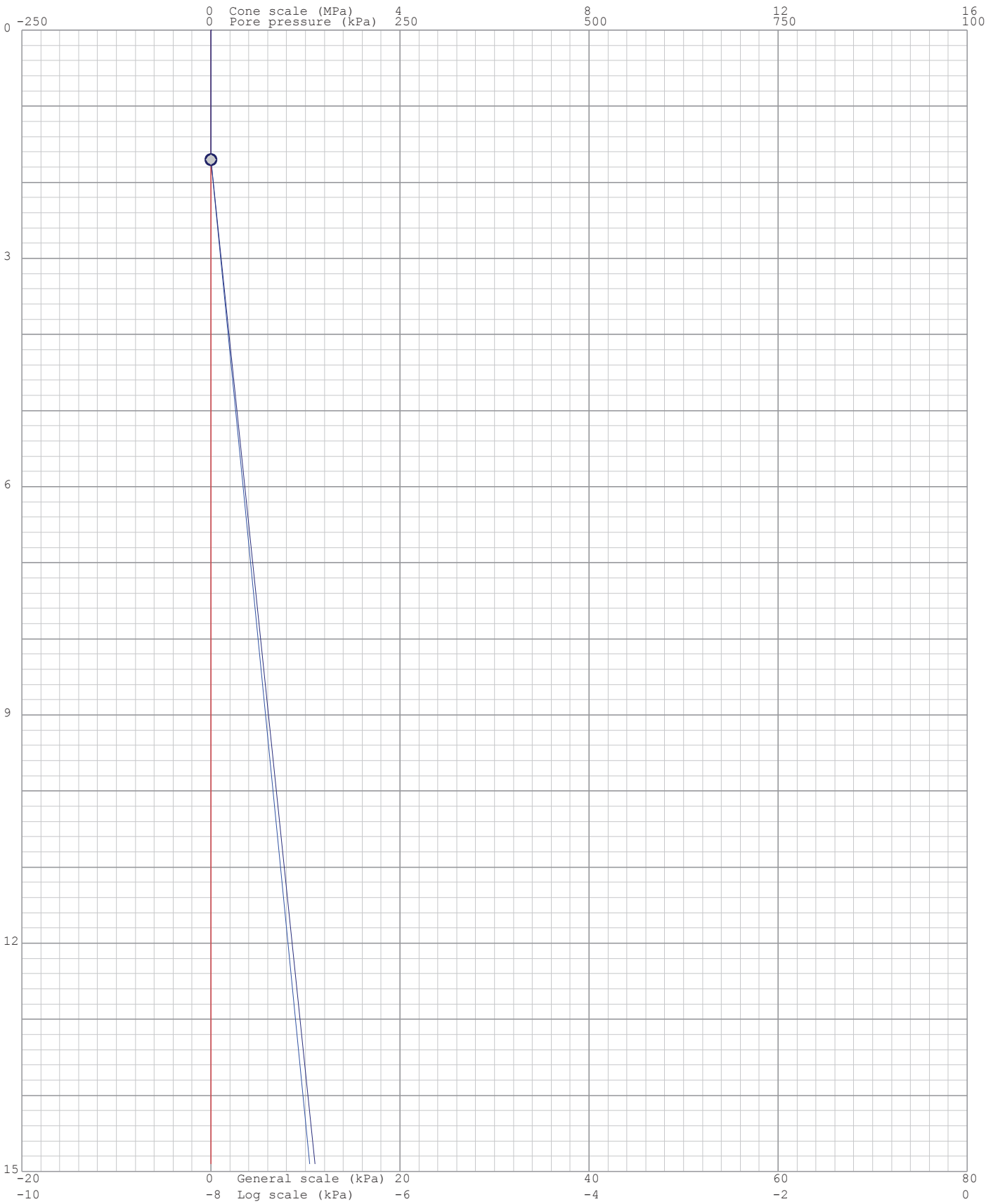
Project: Durban Harbour Over Water

Site: Pier2

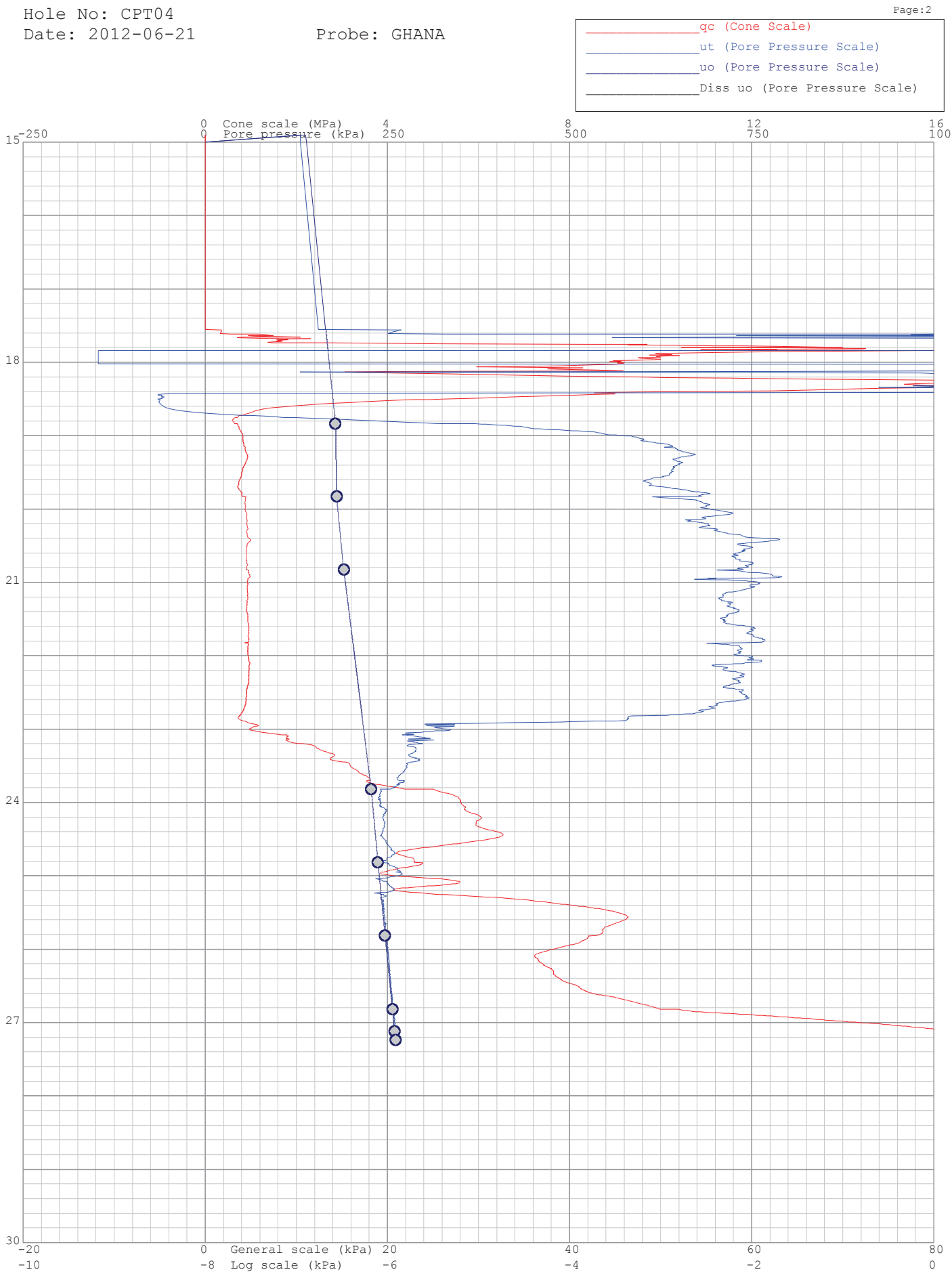
Hole No: CPT04
Date: 2012-06-21 Probe: GHANA



Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT04
Date: 2012-06-21 Probe: GHANA



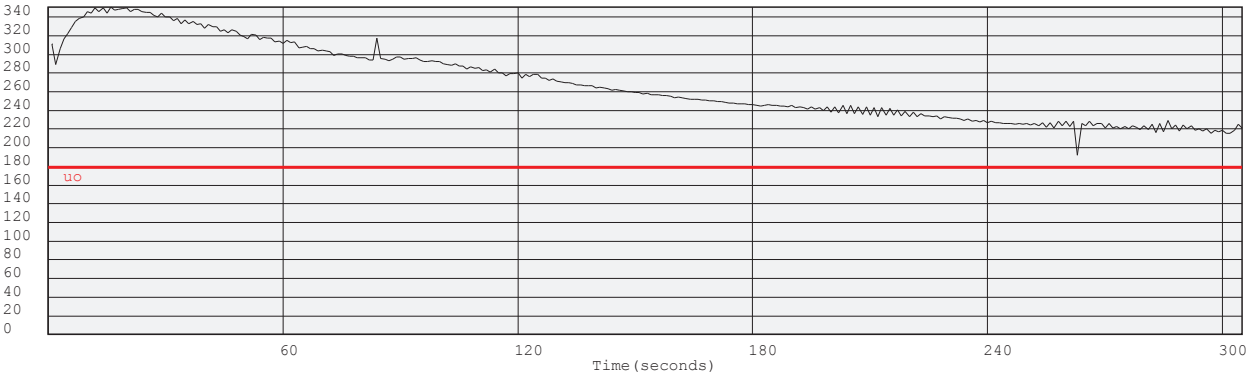
Project:Durban Harbour Over Water

Site: Pier2

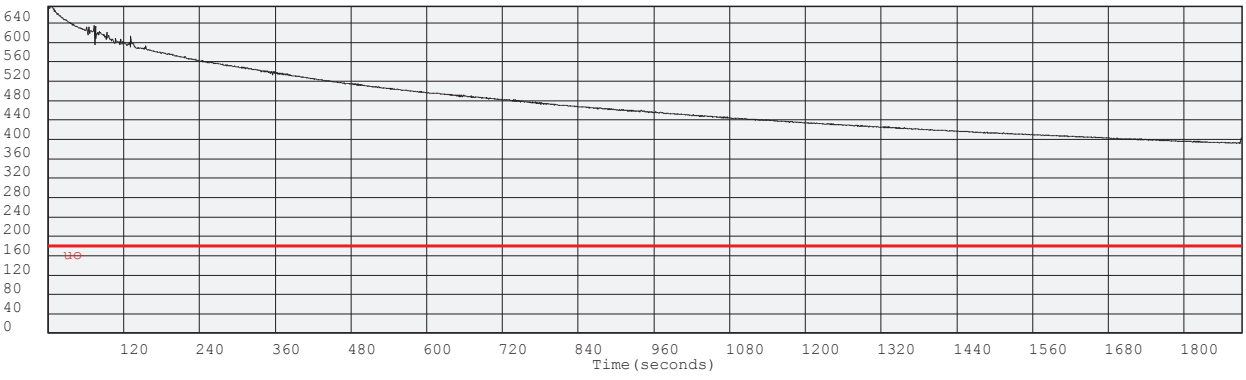
Hole: CPT04 Date: 2012-06-21 Probe: GHANA

Dissipation at:1.7m

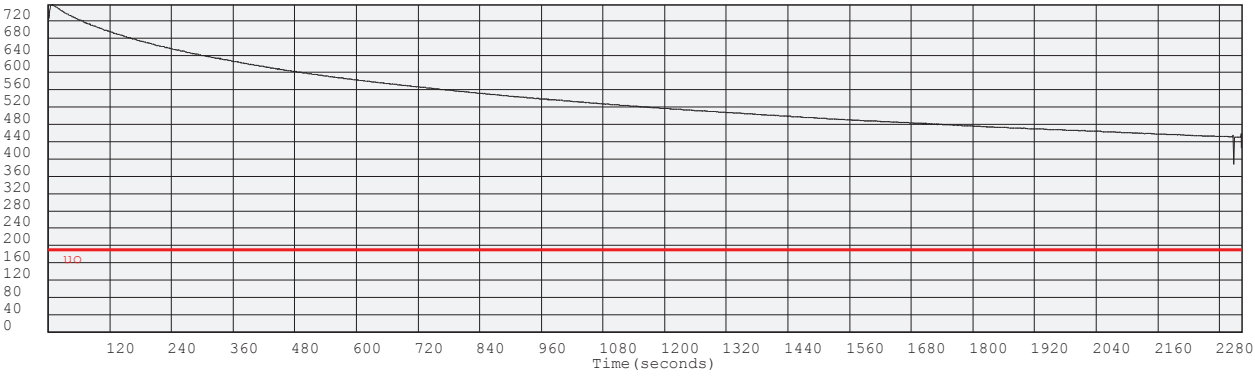
Dissipation at:18.834m



Dissipation at:19.828m



Dissipation at:20.827m

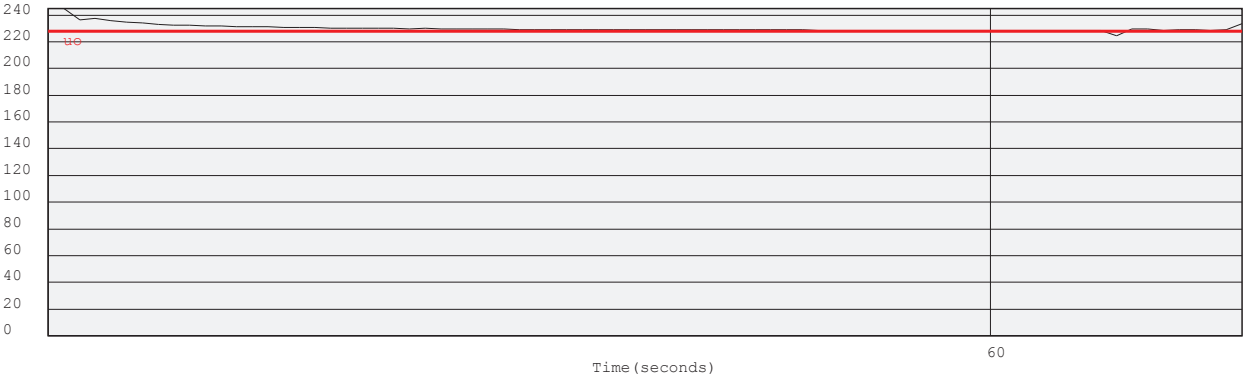


Project:Durban Harbour Over Water

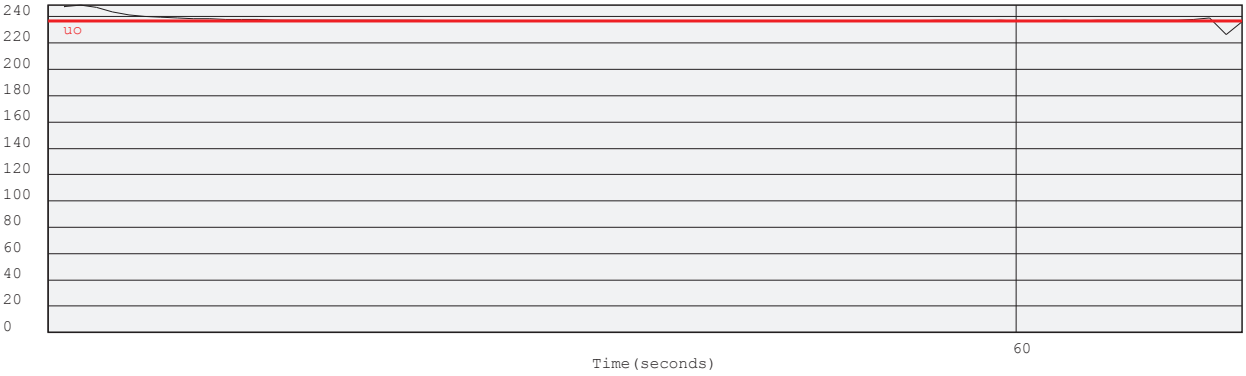
Site: Pier2

Hole: CPT04 Date: 2012-06-21 Probe: GHANA

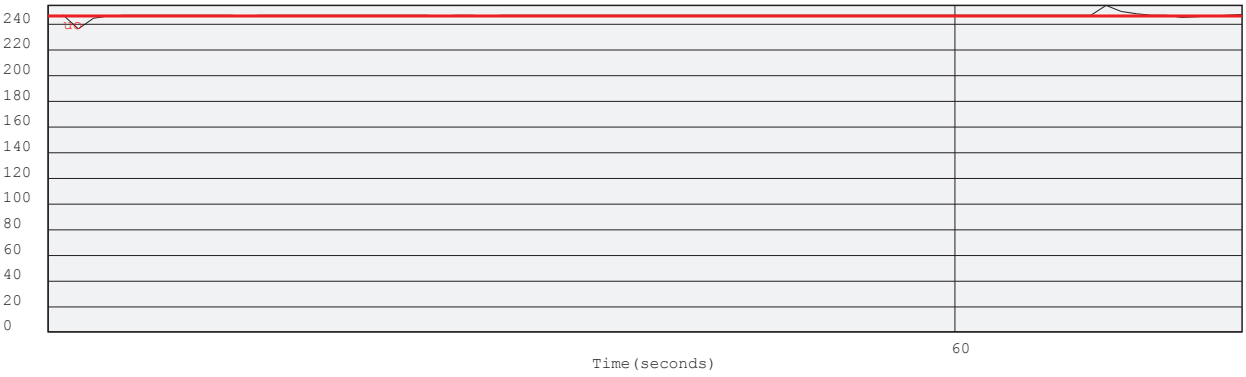
Dissipation at:23.819m



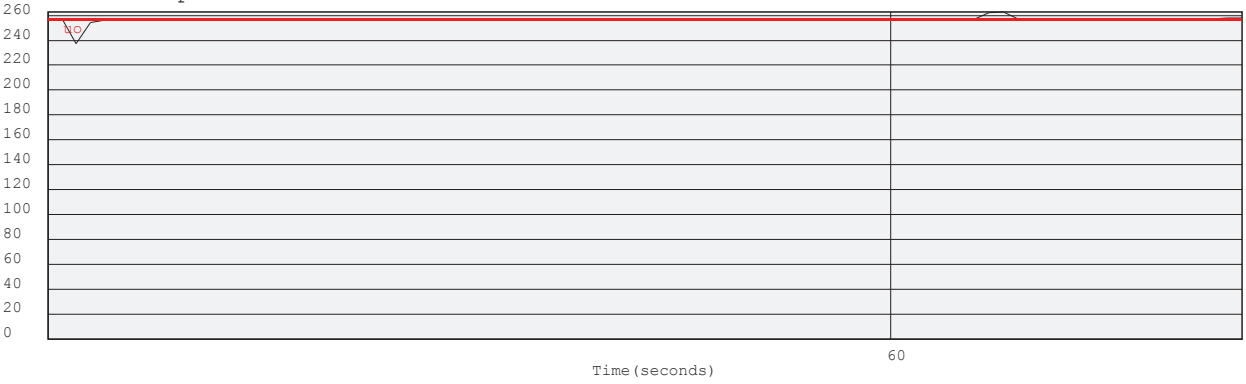
Dissipation at:24.817m



Dissipation at:25.815m



Dissipation at:26.817m

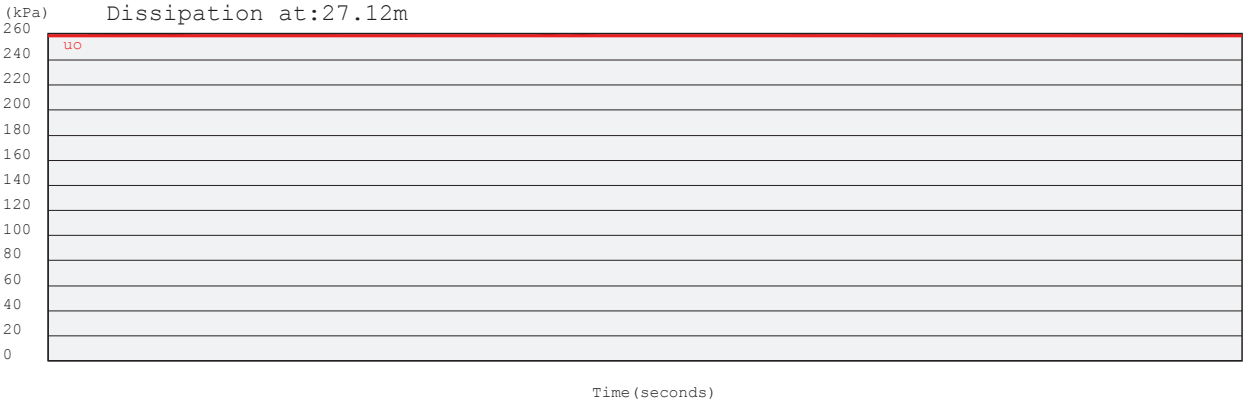


Project:Durban Harbour Over Water

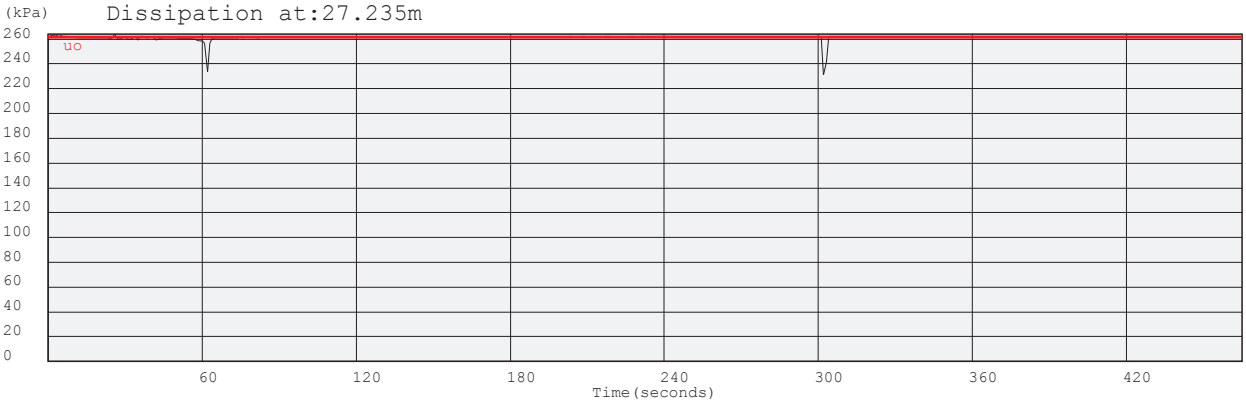
Site: Pier2

Hole: CPT04 Date: 2012-06-21 Probe: GHANA

Dissipation at:27.12m



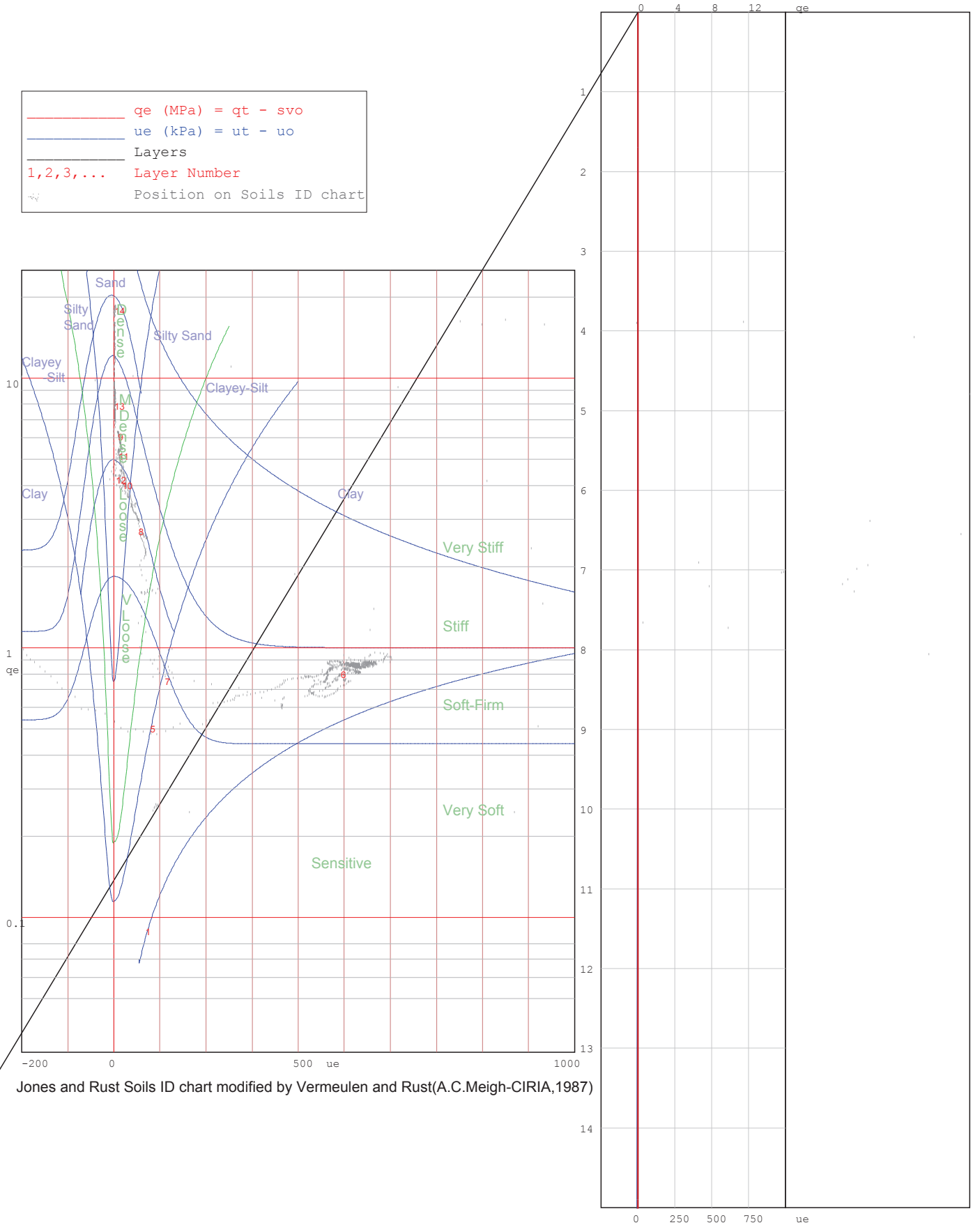
Dissipation at:27.235m



Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT04
Date: 2012-06-21 Probe: GHANA

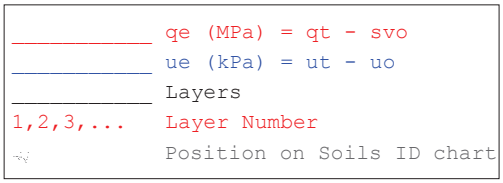


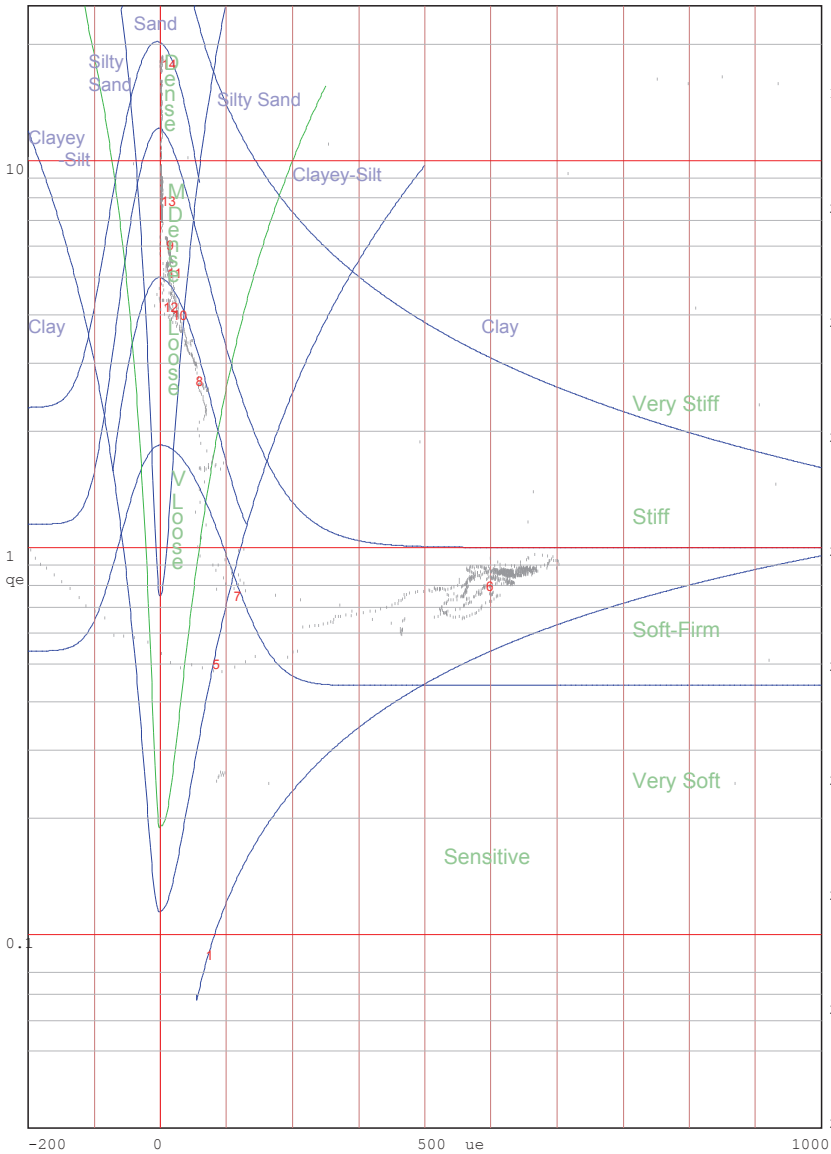
Jones and Rust Soils ID chart modified by Vermeulen and Rust(A.C.Meigh-CIRIA,1987)

Project: Durban Harbour Over Water

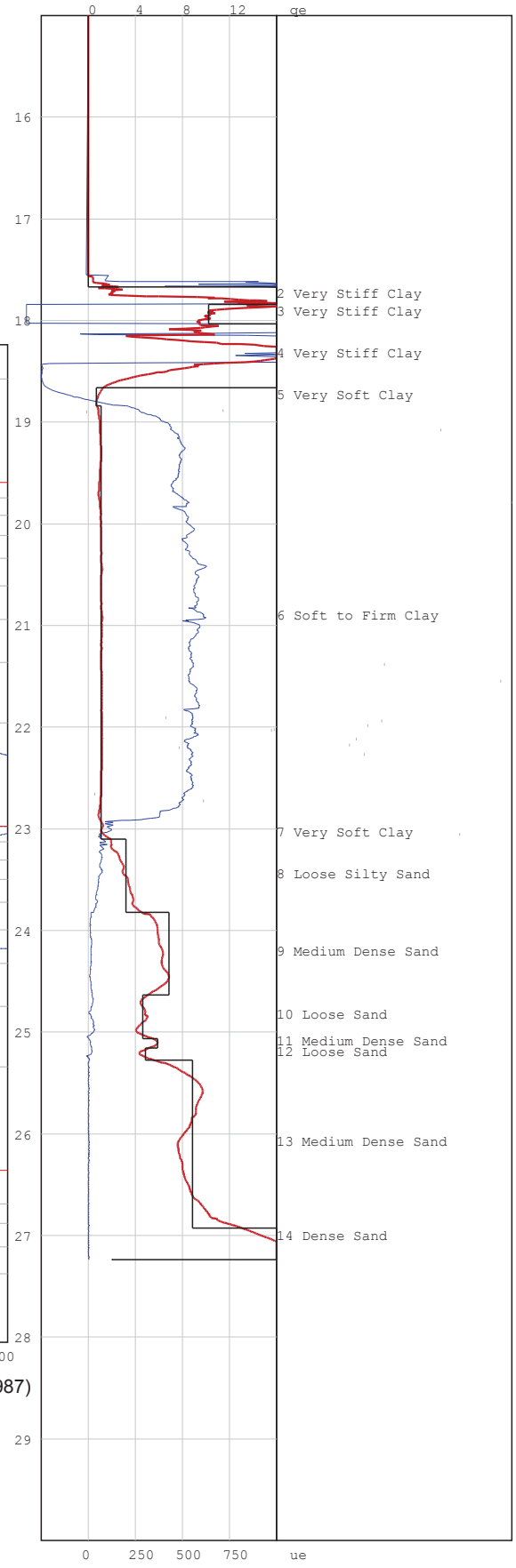
Site: Pier2

Hole No: CPT04
Date: 2012-06-21 Probe: GHANA





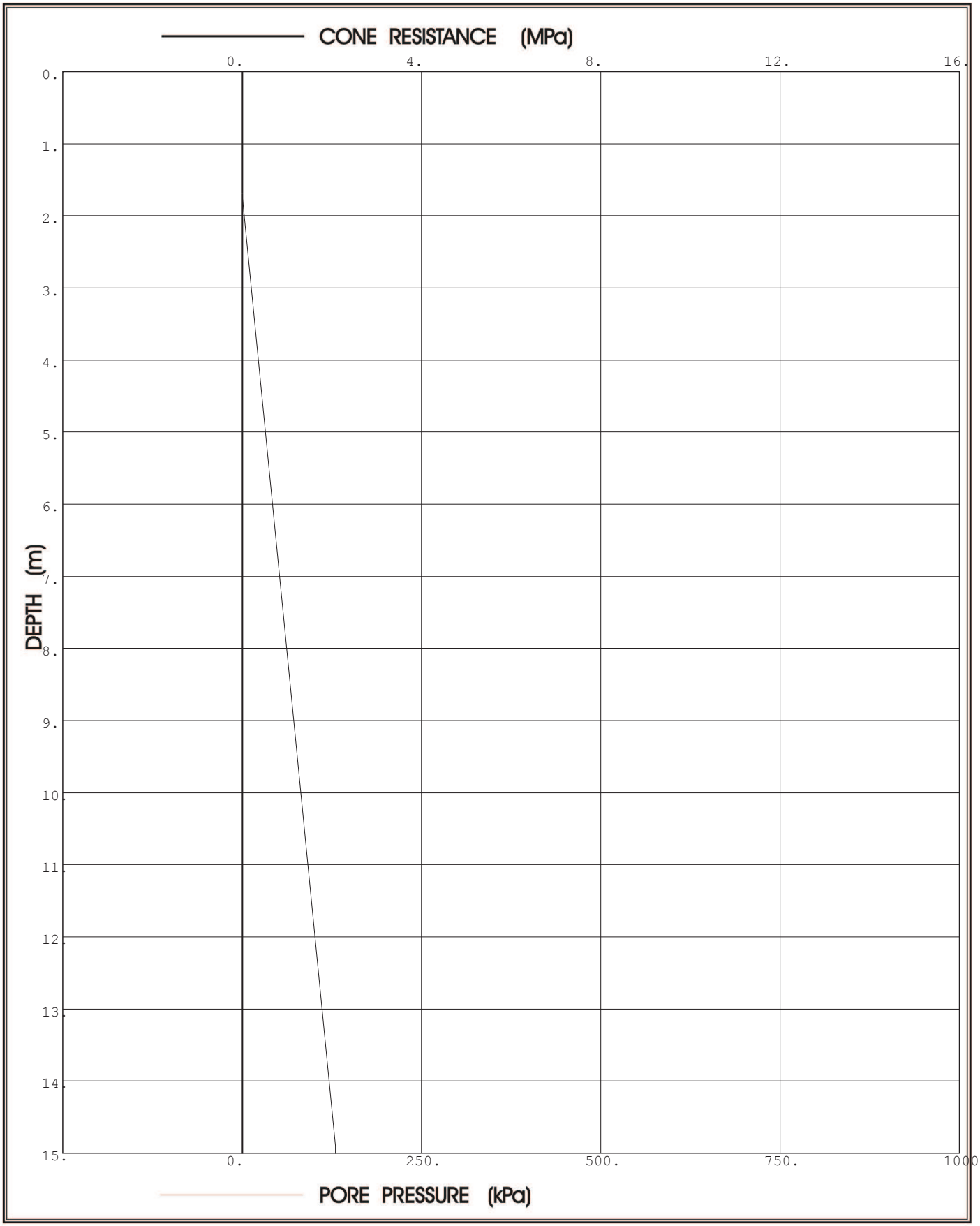
Jones and Rust Soils ID chart modified by Vermeulen and Rust(A.C.Meigh-CIRIA,1987)



PIEZOCONE PENETRATION TEST

PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT05
DATE: 2012/06/26 Probe: GHANA

Osimo CC
P O Box 39108
Moreleta Park
0044



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PIEZOCONE PENETRATION TEST

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PROJECT: Durban Harbour Over Water
SITE: Pier2
CPTU (RE): CPT05
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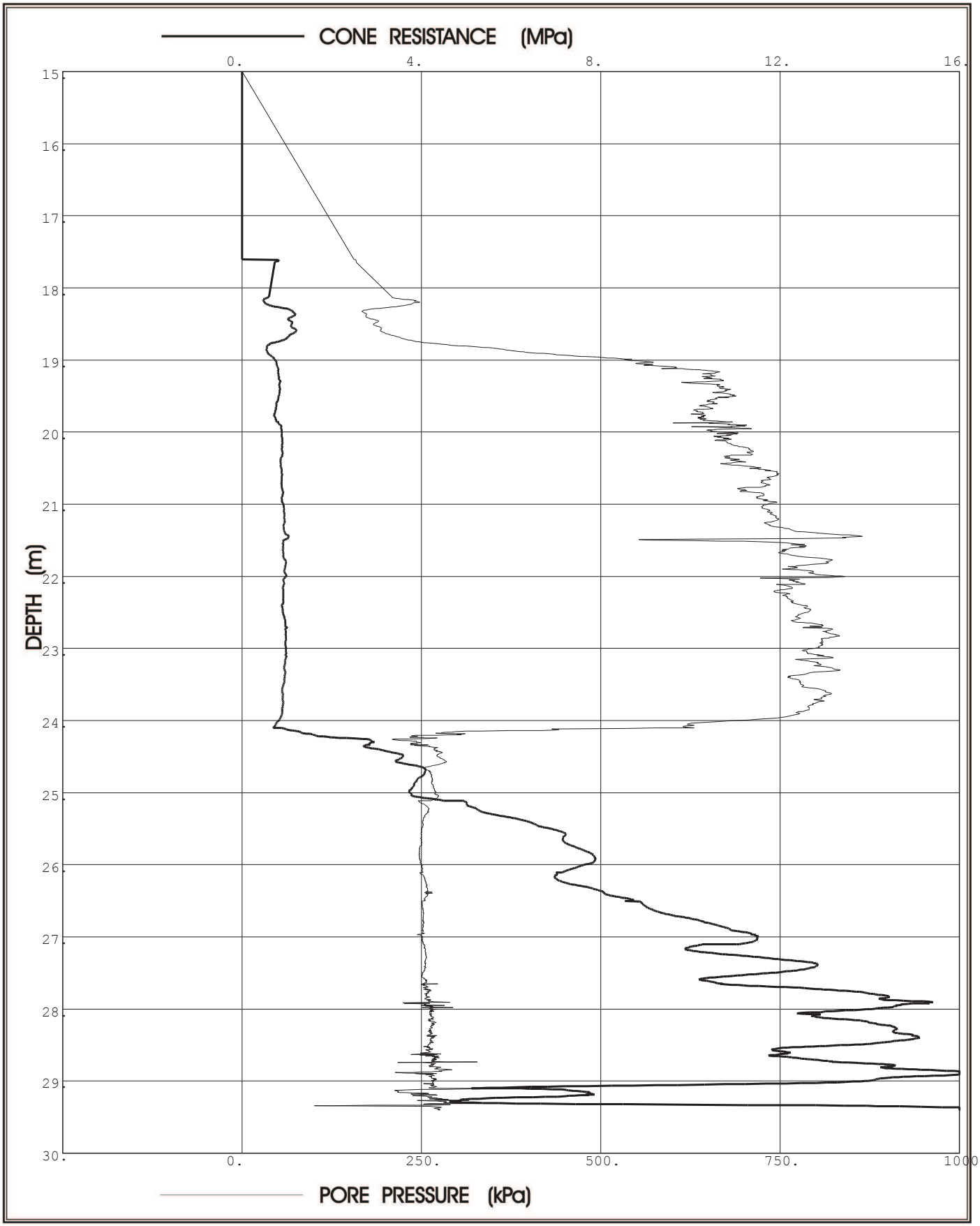

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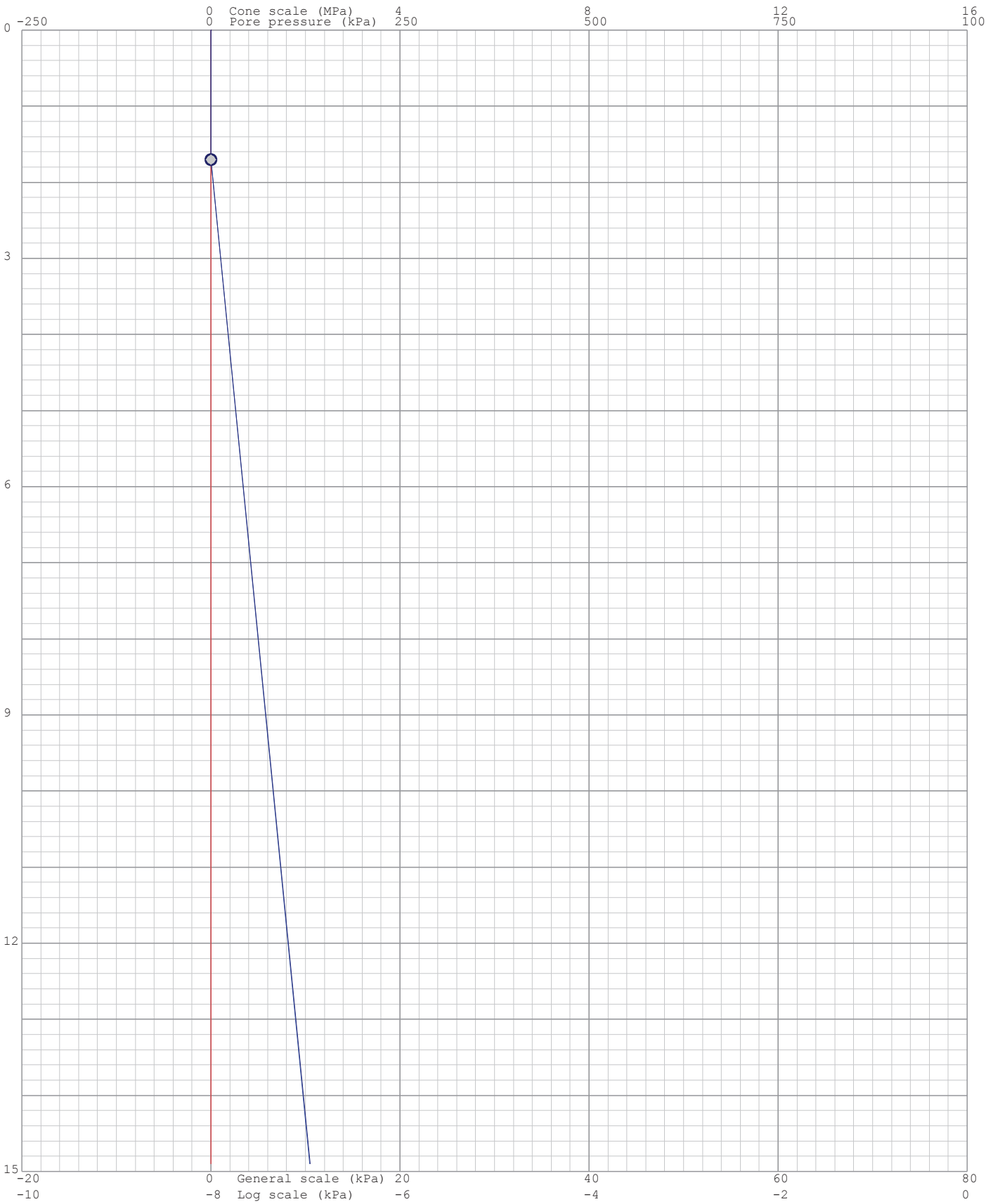
Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT05
Date: 2012/06/26 Probe: GHANA



Project: Durban Harbour Over Water

Site: Pier2

Hole No: CPT05
Date: 2012/06/26 Probe: GHANA