Tween Bridge Solar Farm

A Nationally Significant Infrastructure Project in the Energy Sector

Preliminary Environmental Information Report

Technical Appendix 9.3

Phase 1 Ground Conditions Desk Study Volume 3 – Appendices I – J

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Intégrale
Understanding Ground Conditions

Proposed Solar Energy Scheme
Land at Tween Bridge
Thorne, South Yorkshire

PHASE I GROUND CONDITIONS DESK STUDY

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VOLUME 3

APPENDIX I
TWEEN BRIDGE WIND FARM FACTUAL REPORT (2009)

APPENDIX J
HEADLAND ARCHAEOLOGY GEOARCHAEOLOGY REPORT (2015)

GEOLOGICAL • GEOTECHNICAL • ENVIRONMENTAL • ENGINEERING

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TWEEN BRIDGE WIND FARM

SITE INVESTIGATION REPORT
VOLUME 1: FACTUAL REPORT

E-on UK

JOB NO 1087

R003

JUNE 2009

Donaldson Associates Ltd
Eastfield
Church Street
Uttoxeter
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VOLUME 1: FACTUAL REPORT

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1.0 INTRODUCTION

1.1 Donaldson Associates Ltd (DAL) was instructed to undertake a site investigation on the site of the proposed Tween Bridge Wind Farm.

1.2 The scope of the investigation was to assess the sub-soils and rock conditions across the site to allow design and construction of foundation bases for proposed wind turbines (WTGs) and associated infrastructure and was carried out in 2 phases between February and April 2009.

1.3 Volume 1 of this site investigation report summarises the results of site work which was undertaken as well as subsequent laboratory testing on samples retrieved. The factual data provided by the ground investigation contractors is presented in Volume 2 as an appendix to this report.

2.0 GENERAL GEOLOGY

2.1 From the maps and memoirs of the British Geological Survey; Sheets 79 for Goole (1972), 88 for Doncaster (1969) and Sheet SE 71 SW for Yorkshire, the solid geology of the site comprises of the Triassic Sherwood Sandstone Group, a grey to red-brown sandstone with pebble beds and thin red mudstone. The sandstone is overlain by the Triassic Mercia Mudstone in the far eastern edge of the site only which generally comprises red-brown mudstone with sandstone beds.

2.2 The Sherwood Sandstone in the proposed wind farm area is approximately 350-400m thick and immediately overlies the Permian Marls and Magnesian Limestone. The Carboniferous Coal Measures are present beneath the Permian beds from around 500m depth, with the Highfield High Hazel coal seam at around 800m depth.

2.3 The superficial deposits across the site vary from alluvial silt and clay in the eastern area of the site to interbedded sand, silt and clay of the '25 foot Drift of Vale of York' covering the western site area. Some thickness of peat was expected also. From previous site investigations and old borehole logs indicated on the geological sheets, the drift in the area was expected to vary between 12 and 16m thick.

2.4 Two faults exist, which cross in the northwest of the site, very close to the site of the abandoned Thorne Colliery Shaft. The larger fault extends roughly southwest to northeast, adjacent to the route of the railway line, with the smaller fault crossing the site west to east roughly. Both faults lie outside the area where the turbines are proposed to be sited.

3.0 SITE WORK

3.1 Phase 1 of the ground investigation, undertaken by Fugro Engineering Services (Fugro), took place between 16 and 19th February 2009 with trial pitting, window sample boreholes, cone penetration tests and seismic cone penetration tests carried out.

3.2 Phase 2 of the ground investigation, undertaken by Soil Mechanics, took place between 30th March and 23rd April 2009 and comprised cable percussive boreholes with rotary follow on, further cone penetration testing, pressuremeter testing, Mostap sampling and California Bearing Ratio (CBR) tests. Laboratory testing was undertaken by Soil Mechanics also on soil and rock samples retrieved during this phase of the ground investigation.

3.3 The site work was undertaken primarily at the proposed locations of the 22 turbines, represented by the co-ordinates shown on Table 1 and the appended location plan, with the exception of the window sample boreholes and trial pitting.

3.4 The boreholes, along with logging of arisings, allowed soil and rock samples to be retrieved for detailed logging and laboratory testing. Standard Penetration Tests (SPTs) were also undertaken to give representative values of soil strength and density.

3.5 Window sample boreholes and trial pits were undertaken across the site to retrieve representative samples for contamination testing. The window sample boreholes were also for the installation of gas monitoring stand pipes.

3.6 California Bearing Ratio (CBR) tests were undertaken at numerous locations around the site along proposed access routes to enable access track design.

3.7 During the site works the proposed wind turbine reference numbers were changed by the Eon to reflect the order of wind turbines encountered from the revised wind farm access point. A decision was made to instruct all ground investigation contractors to abide by the original turbine reference numbers which would then be amended by DAL at a later stage as to avoid any confusion on site.

3.8 The original turbine reference numbers are reflected in the borehole and CPT reference numbers. These, along with the revised turbine reference numbers and a summary of the borehole and CPT details are presented in Table 1 below.

WTG No.	BH/CPT No.	Borehole depth *(Rock Head)* (m)	Groundwater (mbgl)	CPT refusal (m)	Seismic Cone max depth (m)	Mostap (M) & Pressuremeter Test (P) depths (m)
1	3	15.50 *(14.50)*	7.10	13.62	13.60	P @ 4.00 & 5.50, M @3.00-4.00 & 5.50-6.50
2	1			13.40		
3	4			12.96	13.00	P @ 5.50
4	7			12.90		P @ 4.00
5	2			11.34	11.30	P @ 4.00 & 6.00, M @ 4.00-5.00 & 6.00-7.00
6	5	22.70 *(14.40)*	8.80	10.55		
7	6			13.10		
8	8	17.94 *(13.20)*	-	10.05		
9	9			11.30	11.30	P @ 3.00 & 5.50, M @ 3.00-4.00 & 5.50-6.50
10	10	16.64 *(12.38)*	3.80	11.65		
11	11			10.79	10.80	
12	12			6.00		
13	13	15.20 *(11.20)*	2.25	6.79	6.80	
14	22	18.15 *(13.80)*	5.70	8.50		P @ 3.50 & 5.50, M @ 3.50-4.50 & 5.00-6.00
15	21			6.90		
16	14			6.50	6.50	
17	16	22.50 *(16.50)*	8.20	14.20		
18	17			15.64	15.60	P @ 4.00 & 6.50, M @ 4.00-5.00 & 6.50-7.50
19	15			6.10		
20	19			14.94		P @ 4.50 & 6.50, M @ 4.50-5.50 & 6.50-7.50
21	18	24.30 *(13.80)*	6.80	14.80		
22	20			15.23		P @ 4.50 & 7.50, M @ 4.00-5.00 & 7.00-8.00

Table 1: Turbine and ground investigation details

4.0 EXPLORATORY HOLES

4.1 CABLE PERCUSSIVE / ROTARY BOREHOLES

4.1.1 The boreholes were drilled using a Dando 175 cable percussion rig until refusal, where a rotary coring continued with a Beretta T51 rotary rig using mud flush. 8 boreholes were drilled at turbine numbers; 1(BH3), 6(BH5), 8(BH8), 10(BH10), 13(BH13), 14(BH22), 17(BH16) and 21(BH18), with depths varying from 15.20m to 24.30m (See Table 1) with the level at which the ground water was encountered being recorded and shown in Table 1 also.

4.1.2 Borehole 3, positioned at turbine location 1, shows a thin layer of topsoil, underlain by initial sandy clay to 1.80m depth over firm thinly laminated clay to 7.45m depth. These are in turn underlain by medium dense, silty, fine to medium sand grading to fine to coarse sand with depth, before the weak, weathered sandstone bedrock is encountered at 14.50m depth.

4.1.3 Borehole 5 (WTG6) shows a thin layer 0.40m of sandy clay topsoil, overlying a 1.40m thick band of loose, fine to medium sand. Below this layer lies a thin band of soft, sandy silty clay to 2.10m depth, overlying firm, thinly laminated, sandy clay to 6.90m depth. Firm, sandy clay with no distinct laminations continues to 8.80m depth, where medium dense, slightly silty, slightly gravelly sand is encountered to 10.40m depth. A medium dense, fine to medium sand grades to dense sand before bedrock is reached at 14.40m depth in the form of weak to medium strong sandstone which continues to the full depth of the borehole at 22.70m depth, with the exception of a thin band of weak mudstone between 14.87 and 14.98m.

4.1.4 Borehole 8 (WTG8) shows a thin layer (0.30m) of topsoil overlying a firm, sandy clay of 0.60m thick, below which lies a 0.50m thick clayey, fine to medium sand. At a depth of 1.45m, firm, thinly laminated, sandy clay extends to 7.00m where it is underlain by dense, silty, fine to medium sand, which becomes dense, fine to coarse sand (possibly completely weathered bedrock) at 10.75m depth. Very weak to weak, medium to coarse grained sandstone is reached at 13.20m depth which grades to medium strong with increasing depth, extending to the full depth of the borehole at 17.94m.

4.1.5 The first 3.80m of borehole 10 (WTG10) is clay, varying from soft, slightly sandy to a firm, thinly laminated, sandy clay. Beneath the clay lies a medium dense, fine to medium sand to 8.70m depth, interbedded with a thin band (0.20m) of soft, sandy clay at 7.30m.

Medium dense, clayey, fine to medium sand is encountered from 8.70m to 11.00m depth where dense, medium to coarse sand (completely weathered bedrock) is found and grades into the very weak to weak, medium to coarse grained sandstone at 12.38m. This sandstone is interbedded by a 1.56m thick band of very weak to weak, thinly laminated mudstone before a weak to medium strong, medium to coarse grained sandstone is seen to continue from 15.14m to 16.64m depth where the borehole terminates.

4.1.6 Borehole 13, positioned at turbine location 13 reaches a total depth of 15.20m, the top 0.35m consisting of topsoil underlain initially by 0.70m of soft to firm, slightly sandy clay over 1.05m of soft to firm, thinly laminated, sandy clay. At 2.10m depth medium dense, slightly silty sand is encountered to 5.20m, underlain to 6.70m depth by firm, sandy, slightly gravelly clay. Very dense, fine and medium sand is found underlying this clay and extends to 8.00m depth before grading to very dense, slightly silty, slightly gravelly sand to 11.20m where the weak to medium strong, medium to coarse grained sandstone is reached and completes the borehole log.

4.1.7 Borehole 16 (WTG17) displayed soft, sandy clay / topsoil to 1.00m. This was found to overly clayey, pseudo-fibrous peat to 2.60m depth where very soft, sandy clay continues to 3.40m depth. Firm, thinly laminated, sandy clay is shown from 3.40 to 8.20m at which medium dense; slightly silty, fine to coarse sand extends to 15.60m depth. From 15.60m dense, slightly silty, fine and medium sand overlies the very weak to medium strong, medium to coarse grained sandstone at 16.50m. Extremely weak to very weak mudstone forms a thin (0.50m) band at 20.90m between this and the medium strong sandstone beneath, extending to the base of the borehole.

4.1.8 Borehole 18 positioned at turbine location 21 shows 1.70m of peat again beneath the initial 0.20m thick topsoil layer. This is in turn underlain by 1.05m of loose, fine and medium sand and soft to firm, thinly laminated, sandy clay to 6.80m depth. Medium dense to dense, slightly silty sand extends from 6.80m to the extremely weak sandstone bedrock at 13.80m, which grades to very weak to weak, medium to coarse grained sandstone at 19.21m depth to the base of the borehole at 24.30m depth.

4.1.9 Borehole 22 (WTG14) shows a thin layer of soft to firm, sandy clay beneath the topsoil, underlain by slightly clayey, slightly gravelly sand to 1.50m depth where soft to firm, thinly laminated, sandy clay (with fine sand laminae) extends to 5.75m. Medium dense, slightly clayey, fine sand is seen to 7.00m. Medium dense, slightly clayey, slightly gravelly sand grades to dense, extending to 13.80m depth where the weak to medium strong, coarse grained sandstone bedrock is encountered and completes the borehole log at 18.15m.

4.2 MOSTAP SAMPLING

4.2.1 Pushed into the ground by the CPT rig individual 1.00m long undisturbed samples are retrieved from specific depths without having to form a borehole first. Sampling was undertaken at seven locations throughout the site (WTGs 1, 5, 9, 14, 18, 20 and 22). One of the proposed locations (location 4 for WTG3) saw no recovery from the Mostap sample and so was aborted. Two locations, namely turbine locations 1 (CPT3) and 14 (CPT22), are situated in the same locations as a counterpart borehole, thus allowing comparison to occur.

4.2.2 Two 1.00 metre samples were undertaken at each location (S1 & S2), both between 3.00 and 7.50m depth. CPT 22's sample between a depth of 3.50 and 4.50m depth shows largely soft clay, interbedded with a thin layer of soft, thinly laminated clay with occasional fine sand. The borehole for this depth and location shows the same clay with interbedded thinly laminated, sandy clay. At a depth of between 5.00 and 6.00m both the borehole and MOSTAP sampling show soft clay, showing some thinly laminated layers, with occasional areas of fine to medium sand.

4.2.3 CPT3's (WTG1) Mostap sample between the depths of 3.00 and 4.00m (S1) show layers of soft clay, with layers of clayey silt; with the borehole showing thinly laminated clay. At a depth of between 5.50 and 6.50m (S2) both the Mostap and borehole show clay, with soft, thinly laminated silty clay.

4.2.4 The further 5 Mostap locations have S1 initial depths of between 3.00 and 5.50m, and largely show these areas to consist of different grades of clay and silt, soft and thinly laminated with occasional sandy layers. S2 depths of between 5.50 and 8.00m again show areas of thinly laminated clay and silt, with occasional sandy clay and sand layers. Both the S1 and S2 samples correspond to the interpreted stratigraphy of clay with silt zones from the cone penetration tests.

4.3 WINDOW SAMPLE BOREHOLES

4.3.1 Six boreholes were drilled and logged from across the proposed wind turbine site during Phase 1 of the site investigation using a Dando Terrier (percussive) window sampler drill rig. WS1.1 and 2.1 were located at the approximate proposed position of the wind farm control building

4.3.2 The boreholes on the western side of the site, show variations in the composition to those on the eastern side. In general the boreholes have between 0.40m (WS1.1) and 0.60m

(WS5) of a mixture of top soil and made ground, consisting of a mix of soft to firm, sandy, slightly gravelly clay.

4.3.3 Those boreholes in the west, namely WS1.1, WS2.1 and WS4; show beneath the made ground layer, a 1.10m layer of a mainly clayey, very silty, fine to coarse sand, which overlies a firm, thinly laminated, clayey, sandy silt which continues until the boreholes terminate at a depth of 4.00m

4.3.4 WS5 and WS6 lie on the eastern side of the site, with the stratigraphy varying from those on the western side. Below the made ground in WS5, lies 1.10m of sandy clay, with occasional rootlets; whilst in WS6 this layer only reaches 0.40m with an underlying layer of soft, fibrous peat with a strong organic odour. Below these layers in both WS5 and WS6 lies silty, fine to coarse sand

4.3.5 WS3 was terminated at a depth of 10.00m and shows that within the western side the thinly laminated silt grades to sandy silt and onto sand at approximately 8.00m below ground level

4.3.6 A gas monitoring standpipe was installed to 4.00m depth in each window sample borehole on completion, with the exception of the 10.00m installation in WS3.

4.4 TRIAL PITS

4.4.1 The 1.20m deep hand excavated trial pits were excavated in two locations at the toe area of a colliery spoil heap, near the most northern point of the site, primarily for the retrieval of soil samples for contamination testing.

4.4.2 The first 0.20 to 0.40m of the trial pit consisting in both pits of soft to firm, slightly sandy, slightly gravelly clay. The gravel comprises subangular sandstone and mudstone, whilst the sand present is of fine to coarse grains. The clay becomes firmer with depth, whilst the colour changes from a brown near surface to an orange, brown-grey at depth.

5 IN-SITU TESTING

5.1 CONE PENETRATION TESTS

5.1.1 The cone penetration test measures the cone resistance and frictional sleeve resistance of the CPT rods as they are pushed into the ground at a constant rate of 2cm/s by use of a hydraulic ram. 11 WTG locations were logged during Phase 1 with the remaining 11 during Phase 2. A summary of the CPT details are shown in Table 1.

5.1.2 The CPT data has been used to derive assumed soil logs by Fugro and Soil Mechanics and is presented in their results (Appendix B).

5.1.3 The majority of the CPT results indicate relatively weak strata, with cone resistance typically around 1 to 2 MPa, to between 7.00 and 8.00m depth where the cone resistance rises to around 5 to 12 MPa. The interpretation of this on both the Fugro and Soil Mechanics logs is that of the predominantly soft to firm clay and silt overlying the medium dense sand which grades into the weathered bedrock where the CPTs refused (20MPa+) at between 10.00 and 13.00mbgl.

5.1.4 There are consistent ‘spikes’ in the cone resistance, generally rising from 1MPa to around 5MPa between 1.00m and 2.00m depth in many of these CPT records, which are accounted for by layers of sand or sandy, stiffer clay deposits, interbedded with the softer superficial material.

5.1.5 CPTs 12 to 15 and 21 and 22 presented a shallower cover of low cone resistance material to around 5.00m to 6.00m depth. CPT 14 and 15 showed a more gradual increase in resistance from 3 to 4m depth whereas the other CPT plots showed a sudden refusal between 6.00 and 8.00m depth as the cone resistance increased from 1 to 3MPa to 20Mpa+ over a small depth.

5.1.6 Very low cone resistance (<1MPa) at shallow depth has been considered as a possible indication of soft peat (CPT14) by Fugro in their logs. The Soil Mechanics logs identify these very low cone resistance areas as peat also or sensitive, fine grained material.

5.1.7 Sleeve friction generally mirrors the cone resistance in that it shows a marked increase from the fine grained superficial material to the coarser, denser sand and weathered sandstone with depth.

5.2 SEISMIC CONE PENTRATION TEST (SCPT)

5.2.1 Undertaken in conjunction with the CPTs, seismic cone tests were undertaken at the same 11 locations throughout the site as the Phase 1 CPTs.

5.2.2 Seismic cone penetration tests measure the vertically propagated, horizontally polarised shear waves (VS_{vh}), to allow for the determination of the shear modulus, a measure of the materials response to shear strain. All tests were undertaken using an assumed constant density of 2.00Mg/m^3.

5.2.3 Internal shear velocity for the initial 4 SCPTs (CPT 011,013,014 and 017) show an increase with depth to velocities of between 260 and 310m/s (3.8m), with initial velocities at a depth of 3.80m below ground level. The further three locations (CPT 019, 020 and 022, show no trends with the velocities ranging between 150 and 280m/s.

5.2.4 Shear Modulus values show general trends, with the shear strain increasing with depth, up to values of between 180MPa and 240MPa.

5.3 PRESSUREMETER TESTS

5.3.1 Pressure meter tests for the site were undertaken at the proposed locations for WTGs 1, 3, 5, 9, 14, 18, 20 and 22. The apparatus briefly comprises a cylindrical rubber membrane expanded against the sides of borehole created as the apparatus is pushed into the ground. The expansion of the membrane is measured directly by the apparatus producing a pressure – strain curve. Two unload-reload loops are undertaken with each test from where the Shear Modulus of the soil can be derived

5.3.2 All tests were undertaken with the superficial predominantly clay material, with some test horizons lying in more sandy clay or silt. Shears Modulus values ranged from 2.8MPa to 9.5MPa for very similar material (both firm clay) recovered from similar depths, indicating the variance across the site. See Appendix 2 for results summary.

5.4 CALIFORNIA BEARING RATIO TEST

5.4.1 California Bearing Ratio (CBR) tests were undertaken at 22 locations along the proposed route of access tracks throughout the site, as shown on the site plan included in the appendices. The CBR value was actually derived from plate load tests using a 300mm diameter plate as opposed to the standard CBR probe, the benefit of this that a greater depth of ground is tested and the larger plate allows a more even distribution of the applied load, whereas a CBR probe can hit a pebble within the soil matrix and give false high readings.

5.4.2 The load-bearing capacity of the soils at or around track formation depth was recorded with the site's CBR ratios show a split within the site, into three sections; northwest, southeast and southwest, with each area having similar CBR ratios.

5.4.3 The northwest of the area (CBR tests 1, 2, 3, 4, 5, 6, 10 and 11) show higher ratios than both the southern areas; with ratios ranging between 2.5 and 3.8%. The southeast of the site (namely CBR tests 7, 9, 12, 13, 14, 15, 16 and 17) shows low CBR ratios varying from 0.8 to 1.5%; lastly the southwest of the site (locations 18, 19, 20, 21 and 22) have mid range ratio values of between 1.9 and 2.5%.

5.4.4 CBR test location 8 is found within the southeast of the site but shows an anomaly as the ratio seen at this location is higher than the other tests undertaken in the same area.

6 GAS MONITORING & CONTAMINATION TESTING

6.1 Gas monitoring on site was undertaken by WYG, monitoring six locations across the site on multiple visits. Various gases were monitored during these visits including, methane, carbon dioxide, carbon monoxide and oxygen as well as hydrogen sulphide and volatile organic compound content.

6.2 A suite of contamination testing was undertaken by Fugro on selected samples retrieved form the window sample boreholes under the supervision of WYG.

6.3 The results of the gas monitoring and contamination testing will be included in a full environmental assessment report compiled by WYG.

7 LABORATORY RESULTS

7.1 CLASSIFICATION TESTS

7.1.1 Soil testing scheduled comprised; moisture content, Atterberg Limits, particle size distribution (PSD) analysis, and pH and sulphate tests. and pH and sulphate tests.

7.1.2 Index properties for the clay and slightly sandy clay recovered between 0.10m and 7.95m depth revealed Liquid Limits ranging from 42% to 58% and Plasticity Indices of between 22 and 34 indicating clays of intermediate to high plasticity. Silt samples were identified with Liquid Limits of 30% and Plasticity Indices of 10.

7.1.3 Particle size distribution analysis was undertaken on sand samples recovered from a number of boreholes at depths of between 3.60m and 13.00m. The particle sizes are consistent with predominantly fine to medium sand with occasional coarse sand particles. The sampled recovered from 7.50m depth in BH22 was particularly gravelly with a 25% gravel content and the sand was found to be particularly silty (10-25%) in the samples recovered from 7.50m in BH3, 9.10m in BH8 and at 6.00 and 9.00m depth in BH10.

7.1.4 Chemical testing was undertaken on various samples of sand, silt and clay retrieved from depths of between 2.50m and 16.00m across the site. pH levels from these samples were generally neutral to slightly alkaline with values ranging between 7.1 and 8.0. The exception was a slightly more acidic pH value of 5.3 from the sand sample retrieved from 3.60m in BH13. Samples retrieved from 6.00m depth in the same borehole were around a pH of 7. Sulphate tests prepared as 2:1 water to solution sample; produced sulphate levels of between 0.02 and 0.26g/L.

7.2 STRENGTH TESTS

7.2.1 Undrained triaxial compression tests and one dimensional consolidation tests were scheduled on the superficial clay samples recovered. Unconfined compressive strength (UCS) and point load (PL) tests were scheduled for various recovered rock samples also.

7.2.2 Due to the laminated nature and inclusions of silt/fine sand layers in much of the clay samples, some triaxial tests were not undertaken as the samples would be prone to splitting along these planes prior to testing. Similarly none of the UCS tests scheduled on the rock samples were undertaken as either there were no samples of sufficient length to undertake the test or the samples were disturbed during preparation prior to testing.

7.2.3 One dimensional consolidation (oedometer) tests were performed on the superficial clay samples retrieved from depths of between 3.50m and 6.00m. Four samples retrieved from depths of between 3.50 and 4.50m depth were subjected to 4 loading cycles starting at 50kPa rising to 400kPa. Two samples retrieved from 6.00m depth were subjected to 4 loading cycles from 100kPa to 800kPa. For the shallower samples the coefficient of consolidation (c_v) values (log/root) varied under 50kPa applied pressure from 1.4/1.7 m^2/year to 8.1/8.6 m^2/year. Under 400kPa before unloading was undertaken on these samples the c_v ranged from 1.0/1.1 m^2/year to 4.3/4.2 m^2/year. For the samples retrieved from 6.00mbgl the c_v values ranged from 2.8/2.9 m^2/year to 3.2/3.5 m^2/year at 100kPa pressure and 6.3/6.6 m^2/year to 42/45 m^2/year at 800kPa. The coefficient of volume compressibility (m_v) values ranged from 0.112 to 0.548m^2/MN at 50kPa to 0.104 to 0.137m^2/MN at 400kPa in the samples from between 3.50 and 4.50m depth. The m_v of the samples from 6.00m depth ranged from 0.094 to 0.370m^2/MN at 100kPa applied pressure to between 0.028 and 0.066m^2/MN at 800kPa.

7.2.4 Four clay samples recovered from depths of 1.50m to 6.55m in BHs 3, 5, 8 and 22 were subject to quick undrained triaxial compression testing. Results revealed undrained shear strengths of between 35 (soft) and 53 kPa (firm), with bulk density varying between 19 and 20 kN/m^3.

7.2.5 Two consolidated undrained triaxial compression tests were undertaken on clay samples recovered between 3.50m and 6.45m depth revealing effective angles of shearing resistance between 27.5 and 30.5 degrees.

7.2.6 In the absence of any suitable test samples to allow any unconfined compressive strength tests to be undertaken, numerous point load tests were carried out. All tests were undertaken on samples of sandstone retrieved from depths of between 12.11m and 20.75m. The point load index, Is(50), ranged from 0.02 to 0.60MPa with an average around 0.14MPa. The results are summarised in Table 3 below.

Borehole *(WTG)*	**Test Depth (m)**	**Is(50) Point Load Index (MPa)**
BH08 *(8)*	14.54	0.10
BH08 *(8)*	14.51	0.18
BH08 *(8)*	15.31	0.10
BH08 *(8)*	15.27	0.23

BH10 *(10)*	13.43	0.02
BH10 *(10)*	13.37	0.08
BH10 *(10)*	13.67	0.07
BH10 *(10)*	13.63	0.23
BH10 *(10)*	15.30	0.09
BH10 *(10)*	15.27	0.24
BH13 *(13)*	12.20	0.06
BH13 *(13)*	12.15	0.27
BH13 *(13)*	13.62	0.06
BH13 *(13)*	13.54	0.07
BH13 *(13)*	14.09	0.09
BH13 *(13)*	14.04	0.15
BH16 *(17)*	17.10	0.05
BH16 *(17)*	17.05	0.26
BH16 *(17)*	17.88	0.05
BH16 *(17)*	17.83	0.19
BH16 *(17)*	18.65	0.08
BH16 *(17)*	18.62	0.26
BH18 *(21)*	19.62	0.04
BH18 *(21)*	19.59	0.29
BH18 *(21)*	19.80	0.04
BH18 *(21)*	19.75	0.20
BH18 *(21)*	20.85	0.04
BH18 *(21)*	20.80	0.60
BH22 *(14)*	14.58	0.05
BH22 *(14)*	14.52	0.12
BH22 *(14)*	16.47	0.07
BH22 *(14)*	16.41	0.16
BH22 *(14)*	17.63	0.04
BH22 *(14)*	17.58	0.12

Table 2: Point Load Test Summary

VOLUME 2: APPENDICIES

APPENDIX A: EXPLORATORY HOLE LOGS

Method of Excavation	Hand dug
Surface Dimensions	0.50m x 0.50m
Date Excavated Start	19/02/2009
End	19/02/2009

Plan

0 °

TRIAL PIT No. TPA

Logged by	Compiled by	Checked by
IU	ren	BC
19/02/2009	23/02/2009	23/02/2009

In-situ Testing			Samples			Description of Strata	Depth (Thickness) (m)	Level	Legend
Depth (m)	Type	Result	Depth (m)	Type	No.				
			0.20-0.40	ES	1	Firm brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine of sandstone and mudstone. Sand is fine to coarse.	(0.20) 0.20		
			1.00-1.20	ES	2	Firm becoming stiff orange brown and grey brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine of mudstone and sandstone. Sand is fine to coarse.	(1.00) 1.20		
						End of Trial Pit			

Remarks (See notes & keysheets)

1 The walls of the pit were stable during excavation.
2 Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
3 On completion the trial pit was backfilled with compacted arisings.
4 Groundwater was not apparent during excavation.

Scale 1:25

FUGRO

Project	Contract No.	CPT091107
TWEEN BRIDGE WINDFARM	Figure No.	TPA (1 of 1)

302/03

Method of Excavation	Hand dug
Surface Dimensions	0.50m x 0.50m
Date Excavated Start	19/02/2009
End	19/02/2009

Plan

0 °

TRIAL PIT No. TPB

Logged by	Compiled by	Checked by
IU	ren	MZ
19/02/2009	23/02/2009	12/06/2009

In-situ Testing Depth (m)	Type	Result	Samples Depth (m)	Type	No.	Description of Strata	Depth (Thick-ness) (m)	Level	Legend
			0.30	ES	1	Soft to firm brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine of sandstone and mudstone. Sand is fine to coarse.	(0.35) 0.35		
						Firm yellow brown silty CLAY.	(0.35) 0.70		
			1.00-1.20	ES	2	Firm to stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of limestone and sandstone. Sand is fine to coarse.	(0.50) 1.20		
						End of Trial Pit			

Remarks (See notes & keysheets)
1 The walls of the pit were stable during excavation.
2 Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out.
3 On completion the trial pit was backfilled with compacted arisings.
4 Groundwater was not apparent during excavation.

Scale 1:25

FUGRO

Project	Contract No.
TWEEN BRIDGE WINDFARM	CPT091107
	Figure No. TPB (1 of 1)

302/03

Drilling Method Window Sampler
Equipment Dando Terrier
Drill Crew RU
Dates Drilled Start 16/02/2009 End 16/02/2009

Borehole Diameter 87mm to 4.00m
Casing Diameter 87mm to 2.00m

Logged by	Compiled by	Checked by
IU	ren	BC
16/02/2009	23/02/2009	23/02/2009

BOREHOLE No. WS1.1

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample Depth (m) From To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
16/02	0.00		0.10	ES	1		TOPSOIL.	(0.20) 0.20		
			0.10-0.40	B	2					
			0.30	ES	3		Firm brown sandy slightly gravelly CLAY. (Possible MADE GROUND)	(0.20) 0.40		
			0.40-1.20	B	4		Yellow brown clayey very silty fine to medium SAND.	(1.10)		
	1.20		1.20-1.50	B	5			1.50		
		(100)	1.50-3.00	B	6		Firm thinly laminated brown clayey slightly sandy to sandy SILT. Sand is fine to coarse.			
	2.00	(96)						(2.50)		
	3.00	(100)	3.00-4.00	B	7					
16/02	4.00						End of Borehole	4.00		

Remarks (See notes & keysheets)
1 Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.
2 See installation details on final sheet.
3 Groundwater was not apparent during boring.

Scale 1:25

FUGRO

Project TWEEN BRIDGE WINDFARM

Contract No. CPT091107

Figure No. WS1.1 (1 of 2)

307/03

Drilling Method Window Sampler	Borehole Diameter 87mm to 4.00m	Casing Diameter 87mm to 2.00m	BOREHOLE No. WS1.1
Equipment Dando Terrier			
Drill Crew RU Dates Drilled Start 16/02/2009 End 16/02/2009	Logged by IU 16/02/2009	Compiled by ren 23/02/2009	Checked by BC 23/02/2009

Description	Depth (m)	Level	
Concrete	0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 4.00m.
Bentonite Seal	1.00		
Gravel Filter	4.00		Base of Hole

Remarks
(See notes & keysheets)

Not to Scale

FUGRO

Project	Contract No. CPT091107
TWEEN BRIDGE WINDFARM	Figure No. WS1.1 (2 of 2)

Drilling Method Window Sampler	Borehole Diameter 87mm to 4.00m	Casing Diameter 87mm to 3.00m	BOREHOLE No. WS2.1
Equipment Dando Terrier			
Drill Crew RU	Logged by IU	Compiled by ren	Checked by BC
Dates Drilled Start 16/02/2009 End 16/02/2009	16/02/2009	23/02/2009	23/02/2009

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details Depth (m) From To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
16/02	0.00		0.10	ES	1		MADE GROUND: Composed soft to firm brown sandy slightly gravelly clay. Gravel is subangular fine of sandstone and coal. Sand is fine to coarse.	(0.40)		
			0.10-0.20	B	2					
			0.30	ES	3			0.40		
			0.80-1.00	B	4		Orange brown clayey silty fine and medium SAND.	(0.80)		
	1.20	(100)	1.20-1.80	B	5		Firm orange brown clayey SILT and fine to coarse SAND.	1.20 (0.60)		
			1.80-3.00	B	6		Firm thinly laminated brown sandy SILT. Sand is fine to coarse.	1.80		
	2.00	(100)						(2.20)		
	3.00	(100)	3.00-4.00	B	7					
16/02	4.00						End of Borehole	4.00		

Remarks (See notes & keysheets)
1 Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.
2 See installation details on final sheet.
3 Groundwater was not apparent during boring.

Scale 1:25

FUGRO

Project TWEEN BRIDGE WINDFARM

Contract No. CPT091107

Figure No. WS2.1 (1 of 2)

Drilling Method Window Sampler	Borehole Diameter 87mm to 4.00m	Casing Diameter 87mm to 3.00m	BOREHOLE No. WS2.1
Equipment Dando Terrier			
Drill Crew RU	Logged by IU 16/02/2009	Compiled by ren 23/02/2009	Checked by BC 23/02/2009
Dates Drilled Start 16/02/2009 End 16/02/2009			

Description		Depth (m)	Level	
Concrete		0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 4.00m.
Bentonite Seal		1.00		
Gravel Filter		4.00		Base of Hole

Remarks
(See notes & keysheets)

Not to Scale

FUGRO

Project	Contract No.
TWEEN BRIDGE WINDFARM	CPT091107
	Figure No. WS2.1 (2 of 2)

309/03

Drilling Method Window Sampler	Borehole Diameter 87mm to 10.00m	Casing Diameter 87mm to 6.00m	BOREHOLE No. WS3
Equipment Dando Terrier			
Drill Crew RU	Logged by IU 17/02/2009	Compiled by ren 23/02/2009	Checked by BC 23/02/2009
Dates Drilled Start 17/02/2009 End 18/02/2009			

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Depth (m) From To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
17/02	0.00		0.10	ES	1		MADE GROUND: Composed of grey brown sandy slightly gravelly clay with a little ash.	(0.40)		
			0.10-0.40	B	2					
			0.40	D	3			0.40		
			0.40-0.80	B	4		Firm brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. Sand is fine to coarse.	(0.40)		
			0.80-1.20	B	5			0.80		
							Orange brown clayey very sandy SILT. Sand is fine to coarse.	(0.40)		
	1.20		1.20-2.10	B	6			1.20		
							Orange brown very silty fine SAND.			
		(100)						(1.00)		
	2.00									
			2.20-3.10	B	7			2.20		
							Firm thinly laminated brown silty sandy CLAY with pockets of silty sand. Sand is fine to coarse.			
		(95)								
			3.00-4.00	B	8					
	3.00									
		(100)								
17/02										
18/02	4.00									
		(95)						(4.80)		

Remarks (See notes & keysheets)
1 Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.
2 See installation details on final sheet.
3 Groundwater was not apparent during boring.

Scale 1:25

FUGRO

Project	Contract No. CPT091107
TWEEN BRIDGE WINDFARM	Figure No. WS3 (1 of 3)

Drilling Method	Window Sampler	Borehole Diameter	Casing Diameter	BOREHOLE No.	WS3
Equipment	Dando Terrier	87mm to 10.00m	87mm to 6.00m		

Drill Crew: RU
Dates Drilled: Start 17/02/2009, End 18/02/2009

Logged by	Compiled by	Checked by
IU	ren	BC
17/02/2009	23/02/2009	23/02/2009

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details Depth (m) From	To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
	5.00	(60)									
	6.00	(70)									
	7.00	(80)						Soft to firm brown clayey sandy SILT with occasional pockets of silty fine sand.	7.00 (1.00)		
	8.00	(80)						Brown locally slightly silty fine and medium SAND.	8.00 (2.00)		
	9.00	(60)									
18/02	10.00							End of Borehole	10.00		

Remarks
(See notes & keysheets)

Scale 1:25

FUGRO

Project	Contract No.
TWEEN BRIDGE WINDFARM	CPT091107
	Figure No. WS3 (2 of 3)

Drilling Method Window Sampler	Borehole Diameter 87mm to 10.00m	Casing Diameter 87mm to 6.00m	BOREHOLE No. WS3
Equipment Dando Terrier			
Drill Crew RU Dates Drilled Start 17/02/2009 End 18/02/2009	Logged by IU 17/02/2009	Compiled by ren 23/02/2009	Checked by BC 23/02/2009

Description	Depth (m)	Level	
Concrete	0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 3.00m.
Bentonite Seal	1.00		
Gravel Filter	4.00		
Bentonite Seal	10.00		Base of Hole

Remarks
(See notes
& keysheets)

Not to Scale

FUGRO	Project TWEEN BRIDGE WINDFARM	Contract No. CPT091107
		Figure No. WS3 (3 of 3)

Drilling Method: Window Sampler	Borehole Diameter: 87mm to 4.00m	Casing Diameter: 87mm to 4.00m	BOREHOLE No. WS4
Equipment: Dando Terrier			
Drill Crew: RU	Logged by: IU, 16/02/2009	Compiled by: ren, 23/02/2009	Checked by: MZ, 12/06/2009
Dates Drilled: Start 16/02/2009, End 16/02/2009			

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details: Depth (m) From To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
16/02	0.00		0.10	ES	1		MADE GROUND: Composed of soft grey brown sandy slightly gravelly clay. Gravel is subangular fine of sandstone and coal. Sand is fine to coarse.	(0.40)		
			0.10-0.30	B	2					
			0.40	ES	3			0.40		
			0.50-1.20	B	4		Orange brown clayey silty fine and medium SAND.	(1.10)		
	1.20		1.20-1.50	B	5					
		(100)	1.50-3.00	B	6			1.50		
							Firm thinly laminated brown silty locally sandy CLAY. Sand is fine and medium At 1.50m: Very sandy silt.	(1.50)		
	2.00	(100)								
	3.00							3.00		
							Brown fine to medium SAND.	(0.50)		
		(55)	3.50-4.00	B	7			3.50		
							Firm brown clayey slightly sandy SILT.	(0.50)		
16/02	4.00							4.00		
							End of Borehole			

Remarks (See notes & keysheets)

1. Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.
2. See installation details on final sheet.
3. Groundwater was not apparent during boring.

Scale 1:25

FUGRO

Project: TWEEN BRIDGE WINDFARM

Contract No. CPT091107

Figure No. WS4 (1 of 2)

307/03

Drilling Method: Window Sampler	Borehole Diameter: 87mm to 4.00m	Casing Diameter: 87mm to 4.00m	BOREHOLE No. WS4
Equipment: Dando Terrier			
Drill Crew: RU	Logged by: IU, 16/02/2009	Compiled by: ren, 23/02/2009	Checked by: MZ, 12/06/2009
Dates Drilled: Start 16/02/2009, End 16/02/2009			

Description	Depth (m)	Level	
Concrete	0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 4.00m.
Bentonite Seal	1.00		
Gravel Filter	4.00		Base of Hole

Remarks
(See notes & keysheets)

Not to Scale

FUGRO

Project	Contract No.	Figure No.
TWEEN BRIDGE WINDFARM	CPT091107	WS4 (2 of 2)

Drilling Method Window Sampler	Borehole Diameter / Casing Diameter	BOREHOLE No. WS5
Equipment: Dando Terrier	87mm to 4.00m / 87mm to 4.00m	
Drill Crew: IU; Dates Drilled: Start 18/02/2009, End 18/02/2009	Logged by: IU 18/02/2009; Compiled by: ren 23/02/2009; Checked by: MZ 01/04/2009	

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Sample/Test Details: Depth (m) From To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
18/02	0.00		0.10-0.20	ES	1		Grass over MADE GROUND: Composed of firm grey sandy gravelly clay intermixed with ash. Gravel is subangular fine to coarse of sandstone, brick and concrete.	(0.50)		
			0.10-0.50	B	2					
			0.40-0.50	B	3					
			0.50-1.40	B	4			0.50		
							Firm brown silty sandy CLAY with rootlets. Sand is fine to coarse.	(0.70)		
	1.20		1.20-1.70	B	5			1.20		
							Firm brown silty CLAY.	(0.50)		
		(100)								
			1.70-3.00	B	6			1.70		
							Grey locally slightly silty fine to coarse SAND.			
	2.00	(85)						(2.30)		
	3.00		3.00-4.00	B	7					
		(60)								
18/02	4.00							4.00		
							End of Borehole			

Remarks (See notes & keysheets)

1 Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.
2 See installation details on final sheet.
3 Groundwater was not apparent during boring.

Scale 1:25

FUGRO

Project	Contract No.
TWEEN BRIDGE WINDFARM	CPT091107
	Figure No. WS5 (1 of 2)

Drilling Method Window Sampler **Equipment** Dando Terrier **Drill Crew** IU **Dates Drilled** Start 18/02/2009 End 18/02/2009	**Borehole Diameter** 87mm to 4.00m **Casing Diameter** 87mm to 4.00m **Logged by** IU 18/02/2009 **Compiled by** ren 23/02/2009 **Checked by** MZ 01/04/2009	**BOREHOLE No.** **WS5**

Description	Depth (m)	Level	
Concrete	0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 3.10m.
Bentonite Seal	0.50		
Gravel Filter	4.00		Base of Hole

Remarks
(See notes
& keysheets)

Not to Scale

FUGRO

Project	TWEEN BRIDGE WINDFARM	
Contract No.	CPT091107	
Figure No.	WS5 (2 of 2)	

309/03

Drilling Method Window Sampler	Borehole Diameter 87mm to 2.00m 75mm to 4.00m	Casing Diameter 87mm to 4.00m	BOREHOLE No. WS6
Equipment Dando Terrier			
Drill Crew RU	Logged by IU 18/02/2009	Compiled by ren 23/02/2009	Checked by BC 23/02/2009
Dates Drilled Start 18/02/2009 End 18/02/2009			

Date & Time	Run Depth (m)	Run Time (secs) (Recovery) (%)	Depth (m) From - To	Type	No.	Results	Description of Strata	Depth (Thickness) (m)	Level	Legend
18/02	0.00		0.10-0.20	ES	1		MADE GROUND: Composed of soft brown sandy gravelly clay.	(0.30)		
			0.10-0.30	B	2			0.30		
			0.40-0.70	B	3		Firm grey brown sandy slightly gravelly CLAY. Gravel is subangular fine of sandstone. Sand is fine to coarse. (Possible MADE GROUND)	(0.40)		
								0.70		
			0.70	ES	4		Soft brown fibrous PEAT with strong organic odour.	(0.80)		
			0.70-1.20	B	5					
	1.20		1.20-1.50	B	6					
		(100)	1.50-2.20	B	7			1.50		
							Brown very silty fine to coarse SAND with occasional bands of clayey silt.	(1.90)		
	2.00	(70)	2.00-3.40	B	8					
	3.00	(70)						3.40		
			3.40-4.00	B	9		Firm thickly laminated brown silty CLAY.	(0.60)		
18/02	4.00							4.00		
							End of Borehole			

Remarks (See notes & keysheets)
1 Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.
2 See installation details on final sheet.
3 Groundwater was not apparent during boring.

Scale 1:25

FUGRO

Project	Contract No.
TWEEN BRIDGE WINDFARM	CPT091107
	Figure No. WS6 (1 of 2)

Drilling Method Window Sampler	Borehole Diameter 87mm to 2.00m 75mm to 4.00m	Casing Diameter 87mm to 4.00m	BOREHOLE No. WS6
Equipment Dando Terrier			
Drill Crew RU	Logged by IU 18/02/2009	Compiled by ren 23/02/2009	Checked by BC 23/02/2009
Dates Drilled Start 18/02/2009 End 18/02/2009			

Description		Depth (m)	Level	
Concrete		0.20		Upstanding cover with gas tap. Pipe diameter 50mm to 4.00m.
Bentonite Seal		1.00		
Gravel Filter		4.00		Base of Hole

Remarks
(See notes & keysheets)

Not to Scale

FUGRO

Project	Contract No. CPT091107
TWEEN BRIDGE WINDFARM	Figure No. WS6 (2 of 2)

Borehole Log

Soil Mechanics

Drilled AH/PS Logged PM Checked RH	Start 07/04/2009 End 16/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush	Depth from / to / Diameter / Casing Depth 0.00m 14.50m 200mm 14.40m 14.50m 15.50m 146mm 15.50m	Ground Level - Coordinates National Grid E 471540.91 N 414083.84 Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.10-0.40	B 1	0.00-1.20 m Hand dug inspection pit		
0.40-1.20	B 2			
1.50-1.95	U 3	49 blows	1.50	dry
2.05	D 4			
2.50-2.95 2.50-2.95 2.50-3.00	SPT S D 5 B 6	N=9 (1,1/2,2,2,3)	2.50	dry
3.50-4.00 3.50-3.95	B 7 U NR	51 blows No recovery	3.00	dry
4.00-4.45 4.00-4.45 4.00-5.00	SPT S D 8 B 9	N=12 (2,3/2,3,3,4)	4.00	dry
5.00-5.45 5.00-6.00	U NR B 10	40 blows No recovery	4.50	dry
6.00-6.45 6.00-6.45 6.00-7.00	SPT S D 11 B 12	N=11 (1,2/3,2,2,4)	6.00	dry
			07/04/2009 6.00	dry
			08/04/2009 6.00	0800 dry
7.50-7.95 7.50-7.95 7.50-8.00	SPT S D 13 B 14	N=11 (2,3/2,3,3,3)	7.50	6.00
9.00-9.45 9.00-9.45 9.00-10.00	SPT S D 15 B 16	N=14 (2,2/2,4,3,5)	9.00	7.10

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Firm dark brown slightly sandy CLAY (TOPSOIL)	(0.40) 0.40		
Firm orange brown mottled grey sandy CLAY	(1.40) 1.80		
Firm thinly laminated brown sandy CLAY with occasional thin laminae of fine sand.	(5.65) 7.45		1
Medium dense red brown slightly silty fine to medium SAND	(1.45) 8.90		
Medium dense grey brown slightly silty fine to coarse SAND.			

Stratum continues to 14.50 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	7.10	Rose to 5.90 m after 20 minutes.	-

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No. A9057
Carried out for: Morrison Construction Limited

Borehole **BH3**

Borehole Log

Soil Mechanics

Drilled AH/PS Logged PM Checked RH	Start 07/04/2009 End 16/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush	Depth from / to / Diameter / Casing Depth 0.00m 14.50m 200mm 14.40m 14.50m 15.50m 146mm 15.50m	Ground Level - Coordinates National Grid E 471540.91 N 414083.84 Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50-10.95	SPT S	N=19 (2,4/4,5,5,5)	10.50	7.40
10.50-10.95	D 17			
10.50-11.00	B 18			
12.00-12.45	SPT S	N=22 (3,5/4,6,5,7)	12.00	8.15
12.00-12.45	D 19			
12.00-13.00	B 20			
13.50-13.95	SPT S	N=33 (5,5/7,9,8,9)	13.50	8.60
13.50-13.95	D 21			
13.50-14.00	B 22			
14.40-14.49	SPT S	50 (25 for 50mm/50 for 40mm)	08/04/2009 14.40	9.00
14.40-14.50	D 23			
			16/04/2009 13.50	0800 1.00
14.50-15.50	TCR 90 / SCR 40 / RQD 34; If NI / 90 / 200	Flush: 14.50-15.50 Mud, 85 %		
			16/04/2009 15.50	1500
15.50		D 24		

Strata

Description (Continued from Sheet 1)	Remarks	Depth, *Level* (Thickness)	Legend	Backfill/ Instruments
Medium dense grey brown slightly silty fine to coarse SAND.	10.10-10.60 m Foreman reports small pebbles 13.50-14.50 m dense	(5.60) 14.50		
Weak reddish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal closely spaced rough planar.	14.50-14.60 m AZCL 14.60-14.75 m Recovered as slightly silty, slightly gravelly sand. Gravel is subrounded coarse of various lithologies	(1.00) 15.50		
EXPLORATORY HOLE ENDS AT 15.51 m	15.31-15.37 m Weak grey mudstone 15.37-15.50 m NI 15.50 m Blowing gravel. Gravel is angular fine to medium grained of various lithologies			

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole **BH3**

Borehole Log

Soil Mechanics

Drilled AH/PS Logged PM Checked RH	Start 02/04/2009 End 05/04/2009	Equipment, Methods and Remarks Dando 175, Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m 14.40m 200mm 13.50m 14.40m 22.70m 146mm 22.70m	Ground Level - Coordinates E 471580.36 National Grid N 412892.61 Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.10-0.40	B 1	0.00-1.20 m Hand dug inspection pit		
0.40-1.20	B 2			
1.50-1.95	SPT S	N=4 (2,2/1,1,1,1)	1.50	dry
1.50-1.80	B 3			
1.80-2.00	B 4			
2.10	D 5			
2.50-2.95	U 6	42 blows	2.50	dry
3.05	D 7			
3.50-3.95	SPT S	N=12 (2,2/3,3,3,3)	3.00	dry
3.50-3.95	D 8			
3.50-4.00	B 9			
4.50-4.95	U 10	47 blows	4.50	dry
5.05	D 11			
6.00-6.45	SPT S	N=11 (3,2/2,3,3,3)	6.00	dry
6.00-6.45	D 12			
6.00-7.00	B 13			
7.50-7.95	SPT S	N=9 (1,2/2,2,2,3)	7.50	dry
7.50-7.95	D 14			
7.50-8.00	B 15			
8.80	W 15a		02/04/2009 9.00	dry
9.00-9.45	SPT C	N=15 (2,3/4,4,3,4)		
9.00	D 16		05/04/2009 9.00	0800 5.60
9.00-10.00	B 17			

Strata

Description	Depth, Level (Thickness)
Soft to firm dark brown sandy CLAY (TOPSOIL)	(0.40)
Loose brown slightly clayey fine to medium SAND	0.40 (1.40)
Soft grey brown slightly sandy silty CLAY	1.80 (0.30)
Firm thinly laminated brown sandy CLAY with occasional thin laminae of fine sand.	2.10 (4.80)
Firm red brown sandy CLAY	6.90 (1.90)
Medium dense brown slightly silty slightly gravelly SAND. Gravel is subrounded to rounded fine to coarse of various lithologies.	8.80 (1.60)
Stratum continues to 10.40 m	

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	8.80	Rose to 6.80 m after 20 minutes.	-

Depth Related Remarks

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole **BH5**

Borehole Log

Soil Mechanics

Drilled AH/PS Logged PM Checked RH	Start 02/04/2009 End 05/04/2009	Equipment, Methods and Remarks Dando 175, Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m 14.40m 200mm 13.50m 14.40m 22.70m 146mm 22.70m	Ground Level Coordinates E 471580.36 National Grid N 412892.61 Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50-10.95	SPT S	N=21 (3,4/4,6,5,6)	10.50	7.10
10.50-10.95	D 18			
10.50-11.00	B 19			
12.00-12.45	SPT S	N=31 (3,5/7,6,9,9)	12.00	7.90
12.00-12.45	D 20			
12.00-13.00	B 21			
13.50-13.70	SPT S	50 (12,13/50 for 50mm)	13.50	8.40
13.50-13.70	D 22			
14.00-14.23	SPT S	50 (15,10/50)		
14.00-14.17	D 23		05/04/2009 13.50	8.80
			09/04/2009 13.50	0800

Depth	TCR SCR RQD	If	Records/Samples
14.40-15.65	80 64 30	NI 50 80	
15.65-16.60	95 69 46		
16.60-18.10	100 95 55		
18.10-19.60	13 0 0	NI 110 350	Flush: 14.40-22.70 Mud, 80 %

Strata

Description (Continued from Sheet 1)

Description	Depth, Level (Thickness)
Medium dense brown slightly silty slightly gravelly SAND. Gravel is subrounded to rounded fine to coarse of various lithologies.	10.40
Medium dense to dense red brown fine to medium SAND.	(4.00) 14.40
Weak to medium strong reddish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal, closely spaced, planar, rough, frequently infilled up to 10mm with clayey medium to coarse sand.	(8.30)

14.40-14.65 m AZCL

14.87-14.98 m weak reddish brown mudstone

14.88-14.90 m recovered as slightly sandy clay

15.37-15.50 m subvertical fracture, drilling induced, rough planar clean

15.65-15.70 m AZCL

15.70 m orangish brown

15.70-15.85 m recovered as slightly gravelly medium to coarse SAND. Gravel is angular to subangular fine to coarse

16.25-16.75 m low cobble content. Cobbles are subrounded of sandstone

16.60-16.62 m recovered as medium to coarse sand

17.50 m reddish brown

18.06-18.10 m recovered as medium to coarse sand

18.10-19.40 m AZCL

19.40-19.60 m recovered as slightly clayey slightly gravelly medium to coarse sand. Gravel is

Stratum continues to 22.70 m

Groundwater Entries

No. | Struck (m) | Post strike behaviour | Depth sealed (m)

Depth Related Remarks

From | to (m)

Chiselling

Depths (m) | Time | Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No. A9087

Carried out for: Morrison Construction Limited

Borehole **BH5**

Borehole Log

Soil Mechanics

Drilled AH/PS Logged PM Checked RH	Start 02/04/2009 End 05/04/2009	Equipment, Methods and Remarks Dando 175, Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m 14.40m 200mm 13.50m 14.40m 22.70m 146mm 22.70m	Ground Level - Coordinates E 471580.36 National Grid N 412892.61 Chainage

Samples and Tests / Strata

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Description (Continued from Sheet 2)	Depth, Level (Thickness)	Legend	Backfill/ Instruments
19.60-21.10	30 18 0			09/04/2009 13.50		Weak to medium strong reddish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal, closely spaced, planar, rough, frequently infilled up to 10mm with clayey medium to coarse sand. :: 19.40m - subrounded fine to coarse of sandstone 20.05-21.10 m AZCL			
				14/04/2009 13.50	0800 1.76	21.10-21.90 m AZCL			
21.10-22.70	50 46 34			14/04/2009 22.70			22.70		
						EXPLORATORY HOLE ENDS AT 22.70 m			

Groundwater Entries
No. Struck (m) Post strike behaviour Depth sealed (m)

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. A9057
Carried out for Morrison Construction Limited

Borehole **BH5**

Borehole Log

Soil Mechanics

Drilled CR/PS Logged PM Checked RH	Start 07/04/2009 End 16/04/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
		Dando 175 / Berrella T51 Cable percussion boring/Rotary core drilling (GBS size) using mud flush.	0.00m 13.20m	13.20m 17.94m	200mm 146mm	12.00m 17.94m	Coordinates National Grid	E 471968.61 N 413678.89
							Chainage	

Samples and Tests / Strata

Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
		0.00-1.20 m Hand dug inspection pit			TOPSOIL	(0.30)		
0.40-0.60	B 1				Firm orange brown mottled grey sandy CLAY	0.30 (0.65)		
1.00-1.40	B 2				Brown slightly clayey fine to medium SAND	0.95 (0.50)		
1.55-2.00 1.55-2.00	B 3 U NR	14 blows No recovery	1.50	damp	Firm thinly laminated brown sandy CLAY with occasional thin laminae of fine sand.	1.45		
2.60-3.05 2.60-3.05 2.60-3.05	SPT S D 4 B 5	N=9 (1,1/2,2,2,3)	2.40	damp				
3.60-4.05	U 6	27 blows	3.40	dry				
4.20	D 7					(5.55)		
4.65-5.10 4.65-5.10 4.65-5.10	SPT S D 8 B 9	N=9 (1,2/2,2,2,3)	4.60	dry				
5.40-5.80	B 10							
6.10-6.55	U 11	28 blows	6.00	dry				
6.70	D 12							
7.00-7.40	B 13				Dense brown slightly silty fine to medium SAND	7.00		
7.60-8.05 7.60-8.05 7.60-8.05	SPT S D 14 B 15	N=33 (3,4/6,8,9,10)	7.50	4.00				
			07/04/2009 7.50	 3.50		(3.75)		
9.10-9.55 9.10-9.55 9.10-9.55	SPT S D 16 B 17	N=38 (5,7/8,10,9,11)	08/04/2009 7.50	0800 1.30				
9.60-10.20	B 18				9.70 m Foreman reports, becoming slightly gravelly			
Depth	Type & No	Records	Date Casing	Time Water	Stratum continues to 10.75 m			

Groundwater Entries

No. | Struck (m) | Post strike behaviour | Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From | to (m)

Chiselling

Depths (m) | Time | Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole **BH8**

Borehole Log

Soil Mechanics

Drilled CR/PS Logged PM Checked RH	Start 07/04/2009 End 16/04/2009	Equipment, Methods and Remarks Dando 175 / Berretta T51 Cable percussion boring/Rotary core drilling (GBS size) using mud flush.	Ground Level - Coordinates National Grid E 471968.81 N 413678.89 Chainage

Depth from	to	Diameter	Casing Depth
0.00m	13.20m	200mm	12.00m
13.20m	17.94m	146mm	17.94m

Samples and Tests

Depth	Type & No		Records	Date Casing	Time Water
10.60-10.89	SPT S		40 (4,5/5,35 for 60mm)	10.50	1.90
10.60-10.90	D 19				
10.60-10.90	B 20				
11.20-11.60	B 21				
12.10-12.30	SPT S		50 (14,11 for 35mm/ 40,10 for 15mm)	12.00	2.30
12.10-12.30	D 22				
12.10-12.30	B 23				
12.70-13.10	B 24				
13.20-13.45		NI NI 550	TCR 100, SCR 32, RQD 0	16/04/2009 12.00	0800 1.28
13.55-13.80			CS 26		
13.45-14.97	100 86 85				
14.46-14.54			CS 25		
15.22-15.31			CS 27		
14.97-16.48	100 81 74	NI 280 550	Flush; 13.20-17.94 Mud, 85 %		
16.48-17.94	100 92 82			16/04/2009	1420

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Strata

Description (Continued from Sheet 1)	Depth Related Remarks	Depth, Level (Thickness)
Dense brown slightly silty fine to medium SAND		10.75
Dense red brown fine to coarse SAND.		(2.45) 13.20
Very weak to weak reddish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal closely spaced rough planar.	13.20-13.30 m Recovered as sand 13.40-13.45 m NI 13.45-13.53 m NI Recovered as sand	(0.74) 13.94
Medium strong yellowish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal medium spaced rough planar.	14.91-14.97 m NI Recovered as gravelly sand	(1.07) 15.01
Weak to medium strong reddish brown medium to coarse grained SANDSTONE. Fractures are subhorizontal medium spaced rough planar.	15.09-15.14 m rare grey mudstone zenoliths 15.58-15.70 m grey 16.25-16.48 m NI 16.48-16.50 m Recovered as sand 17.85-17.94 m NI	(2.93) 17.94
EXPLORATORY HOLE ENDS AT 17.94 m		

Groundwater Entries
No. Struck (m) Post strike behaviour Depth sealed (m)
None observed (see Key Sheet)

Depth Related Remarks *
From to (m)

Chiselling

Depths (m)	Time	Tools used
11.20 -11.50	45 mins	
11.70 -12.00	45 mins	
12.20 -12.53	45 mins	
12.70 -12.90	45 mins	
12.90 -13.05	45 mins	
13.05 -13.20	45 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole **BH8**

Borehole Log

Soil Mechanics

Drilled	AH/PS	Start	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level	-
Logged	PM	06/04/2009	Dando 175/ Beretta T51	0.00m	12.38m	200mm	12.38m	Coordinates National Grid	E 472342.00 N 413158.00
Checked	RH	End 07/04/2009	Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	12.38m	16.64m	146mm	16.64m	Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.10-0.50	B 1	0.00-1.20 m Hand dug inspection pit		
0.50-1.20	B 2			
1.50-1.95	U 3	48 blows	1.50	dry
2.05	D 4			
2.50-2.95	SPT S	N=12 (2,3/2,3,4,3)	2.50	dry
2.50-2.95	D 5			
2.50-3.00	B 6			
3.50-3.95	U 7	40 blows	3.00	dry
3.80	W 19a			
4.05	D 8			
4.50-4.95	SPT S	N=10 (2,2/2,3,2,3)	4.50	3.70
4.50-5.00	B 10			
4.50-4.95	D 9			
6.00-6.45	SPT S	N=13 (2,3/2,4,4,3)	6.00	4.40
6.00-6.45	D 11			
6.00-7.00	B 12			
7.30	D 13			
7.50-7.95	SPT S	N=9 (1,3/2,2,2,3)	7.50	5.80
7.50-7.95	D 14			
7.50-8.00	B 15			
9.00-9.45	SPT S	N=15 (3,4/4,3,4,4)	9.00	7.00
9.00-9.45	D 16			
9.00-10.00	B 17			

Strata

Description	Depth, Level (Thickness)
Soft dark brown slightly sandy CLAY. (TOPSOIL)	(0.50)
Soft grey mottled brown sandy CLAY	0.50 (0.90)
Firm thinly laminated brown sandy CLAY	1.40 (2.40)
Medium dense light brown medium to coarse SAND	3.80 (3.50)
Soft brown sandy CLAY	7.30
Medium dense brown fine to medium SAND	7.50 (1.20)
Medium dense red dark brown clayey fine to medium SAND	8.70 (2.30)

Stratum continues to 11.00 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.80	Rose to 2.60 m after 20 minutes.	-

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole **BH10**

Borehole Log

Soil Mechanics

Drilled AH/PS Logged PM Checked RH	Start 06/04/2009 End 07/04/2009	Equipment, Methods and Remarks Dando 175/ Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m / 12.38m / 200mm / 12.38m 12.38m / 16.64m / 146mm / 16.64m	Ground Level - Coordinates E 472342.00 National Grid N 413158.00 Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50-10.95	SPT S	N=16 (2,4/3,5,4,4)	10.50	7.60
10.50-10.95	D 18			
10.50-11.00	B 19			
			06/04/2009	
12.00-12.20	SPT S	50 (11,14/50 for 50mm)	12.00	8.40
12.00-12.20	D 20			
			07/04/2009	
12.25-12.46	SPT S	50 (15,10 for 100mm/ 50 for 30mm)	12.38	5.10
12.25-12.38	D 21			
			15/04/2009	0800
12.38-12.93	100 / 15 / 0		12.38	1.26
	NI / 50 / 230			
12.93-13.58	100 / 74 / 60			
13.33-13.43		CS 22		
13.58-15.14	100 / 91 / 7	Flush: 12.38-16.64 Mud, 70 %		
	NI / 90 / 210			
15.23-15.30		CS 23		
15.14-16.64	100 / 85 / 38		15/04/2009 12.38	

Strata

Description (Continued from Sheet 1)	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Medium dense red dark brown clayey fine to medium SAND	11.00		
Dense red brown medium to coarse grained SAND. (Possible Weathered BEDROCK)	(1.38) 12.38		
Very weak to weak reddish brown grey medium to coarse grained SANDSTONE. Fractures are subhorizontal closely spaced rough planar. 12.38-12.69 m Recovered as sand. 12.93-12.98 m Recovered as slightly clayey SAND. 13.50-13.58 m NI - re	(1.20) 13.58		
Very weak to weak thinly laminated red brown locally grey MUDSTONE. Fractures are subhorizontal closely spaced rough planar. 15.02-15.14 m NI	(1.56) 15.14		
Weak to medium strong orangish brown grey medium to coarse grained SANDSTONE. Fractures are subhorizontal closely spaced rough planar. 15.30-15.45 m Recovered as sand. 16.60-16.64 m NI	(1.50) 16.64		
EXPLORATORY HOLE ENDS AT 16.64 m			

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries
No. Struck (m) Post strike behaviour Depth sealed (m)

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole **BH10**

Borehole Log

Soil Mechanics

Drilled CR/DS Logged PM Checked RH	Start 01/04/2009 End 07/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m 11.20m 200mm 11.00m 11.20m 15.20m 146mm 15.20m	Ground Level - Coordinates E 473041.00 National Grid N 412568.00 Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
		0.00-1.20 m Hand dug inspection pit		
0.60-1.00	B 1			
1.15-1.50	B 2			
1.55-2.00	B 3		1.40	
1.55-2.00	U NR	32 blows No recovery		dry
2.60-3.05	SPT S	N=13 (1,1/2,2,3,6)	2.50	2.30
2.60-3.05	D 4			
2.60-3.05	B 5			
3.60-4.05	SPT S	N=11 (1,1/2,2,3,4)	3.50	2.40
3.60-4.05	D 6			
3.60-4.05	B 7			
4.00-4.09	CS 25			
4.60-5.05	SPT S	N=6 (2,1/1,-,1,4)	4.50	2.90
4.60-5.05	D 8			
4.60-5.05	B 9			
5.30-5.65	B 10			
6.00-6.45	SPT S	N=15 (1,2/3,5,3,4)	6.00	3.50
6.00-6.45	D 11			
6.00-6.45	B 12			
6.80-7.20	B 13			
7.50-7.67	SPT S	50 (16,9 for 20mm/50)	7.50	3.80
7.50-7.65	D 14			
7.50-8.00	B 15			
			01/04/2009 7.50	3.40
			02/04/2009 7.50	0800 0.85
8.30	D 16			
8.55-8.64	SPT S	50 (25 for 50mm/50 for 40mm)	8.50	1.20
8.55-8.65	D 17			
8.55-8.65	B 18			
9.00-9.40	B 19			

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
TOPSOIL	(0.35) 0.35		
Soft to firm grey mottled brown slightly sandy CLAY	(0.70) 1.05		
Soft to firm thinly laminated brown sandy CLAY with occasional thin laminae of fine and medium sand.	(1.05) 2.10		
Medium dense becoming loose grey brown slightly silty SAND	(3.10) 5.20		1
Firm grey brown sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine and medium of sandstone.	(1.50) 6.70		
Very dense yellow brown grey fine and medium SAND	(1.30) 8.00		
Very dense brown grey slightly silty slightly gravelly SAND. Gravel is subangular fine to coarse of sandstone.	(3.20)		

Stratum continues to 11.20 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	2.25	-	-

Depth Related Remarks *

From to (m)

Chiselling

Depths (m)	Time	Tools used
6.50 -6.60	45 mins	
8.55 -8.85	45 mins	
8.90 -9.25	45 mins	
9.40 -9.75	45 mins	
9.85 -10.00	45 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No. A9057
Carried out for: Morrison Construction Limited

Borehole **BH13**

Borehole Log

Soil Mechanics

Drilled CR/DS Logged PM Checked RH	Start 01/04/2009 End 07/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m 11.20m 200mm 11.00m 11.20m 15.20m 146mm 15.20m	Ground Level Coordinates E 473041.00 National Grid N 412568.00 Chainage

Samples and Tests

Depth	Type & No		Records	Date Casing	Time Water
10.10-10.20	SPT S		50 (25 for 55mm/50 for 45mm)	10.00	1.50
10.10-10.20	D 20				
10.10-10.20	B 21				
11.10-11.19	SPT S		50 (25 for 45mm/50 for 40mm)	11.00	1.70
11.10-11.20	D 22			02/04/2009 11.00	2.00
11.10-11.20	B 23	NI		07/04/2009 11.00	0800 1.85
11.20-12.20	72 63 32	30 80 190			
12.11-12.20			CS 24		
12.20-13.70	100 85 13	NI 80 210	Flush; 11.20-15.20 Mud, 100 %		
13.70-15.20	100 94 56			07/04/2009 15.20	

Depth | TCR SCR RQD | If | Records/Samples | Date Casing | Time Water

Strata

Description (Continued from Sheet 1)	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Very dense brown grey slightly silty slightly gravelly SAND. Gravel is subangular fine to coarse of sandstone.			
Weak to medium strong grey medium to coarse grained SANDSTONE. Fractures are subhorizontal, very closely to closely spaced, rough, planar, stained orange brown, infilled with orange brown sandy up to 10mm. 11.20-11.48 m AZCL 11.48-11.54 m recovered as sand 12.27-12.29 m NI 12.59-12.62 m NI 12.75-12.80 m recovered as sandy gravel 13.07-13.34 m 1 No. subvertical undulose rough fracture, surface stained brown 13.54-13.59 m NI 15.05-15.10 m NI 15.12-15.15 m NI	11.20 (4.00)		
EXPLORATORY HOLE ENDS AT 15.20 m	15.20		

Groundwater Entries
No. | Struck (m) | Post strike behaviour | Depth sealed (m)

Depth Related Remarks *
From | to (m)

Chiselling

Depths (m)	Time	Tools used
10.35 -10.70	45 mins	
10.70 -10.90	45 mins	
10.95 -11.20	45 mins	
11.20 -11.35	45 mins	
11.35 -11.45	45 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. A9057
Carried out for Morrison Construction Limited

Borehole **BH13**

Borehole Log

Soil Mechanics

Drilled AH/DS Logged PM Checked RH	Start 31/03/2009 End 06/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary open hole drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m 16.50m 200mm 16.44m 16.50m 22.50m 146mm 22.50m	Ground Level Coordinates E 473696.94 National Grid N 412841.27 Chainage

Samples and Tests / Strata

Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level (Thickness)
0.10-1.00	B 1	0.00-1.20 m Hand dug inspection pit			Soft brown sandy CLAY (TOPSOIL)	(1.00)
1.00-1.50	B 2					1.00
					Plastic dark brown clayey pseudo-fibrous PEAT	
1.50-1.95	U 3	17 blows	1.50	dry		(1.60)
2.05	D 4					
2.50-2.95 2.50-2.95 2.50-3.00	SPT S D 5 B 6	N=4 (1,1/1,1,1,1)	2.50	dry		2.60
					Very soft brown sandy CLAY	(0.80)
3.50-3.95	U 7	35 blows	3.00	dry	Firm thinly laminated brown sandy CLAY	3.40
4.05	D 8					
4.50-4.95 4.50-5.00 4.50-4.95	SPT S B 10 D 9	N=9 (1,2/3,2,2,2)	4.50	dry		
6.00-6.45	U 11	47 blows	31/03/2009 6.00	dry		(4.80)
			01/04/2009 6.00	0800 dry		
6.55	D 12					
7.50-7.95 7.50-7.95 7.50-8.00	SPT S D 13 B 14	N=13 (2,2/3,3,4,3)	7.50	dry		
8.20	D 26a					8.20
					Medium dense becoming red brown slightly silty fine to coarse SAND	
9.00-9.45 9.00-9.45 9.00-10.00	SPT S D 15 B 16	N=16 (3,2/4,4,4,4)	9.00	6.70		
Depth	Type & No	Records	Date Casing	Time Water	Stratum continues to 15.60 m	

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	8.20	Rose to 6.40 m after 20 minutes.	-

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. A9057
Carried out for Morrison Construction Limited

Borehole **BH16**

Borehole Log

Soil Mechanics

Drilled AH/DS Logged PM Checked RH	Start 31/03/2009 End 06/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary open hole drilling (GBS size) using mud flush.	Ground Level - Coordinates E 473696.94 National Grid N 412841.27 Chainage

Depth from	to	Diameter	Casing Depth
0.00m	16.50m	200mm	16.44m
16.50m	22.50m	146mm	22.50m

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.50-10.95	SPT S	N=14 (2,4/3,4,3,4)	10.50	6.95
10.50-10.95	D 17			
10.50-11.00	B 18			
12.00-12.45	SPT S	N=26 (3,3/5,7,6,8)	12.00	7.70
12.00-12.45	D 19			
12.00-13.00	B 20			
13.50-13.95	SPT S	N=26 (5,6/5,7,7,7)	13.50	8.40
13.50-13.95	D 21			
13.50-14.00	B 22			
15.00-15.45	SPT S	N=36 (5,6/7,9,9,11)	15.00	8.50
15.00-15.45	D 23			
15.00-15.60	B 24			
15.60-16.00	B 25			
			01/04/2009 16.44	8.95
16.50-16.63	SPT S	50 (25/50 for 50mm)		
16.50-16.62	D 26		06/04/2009 16.44	0800

Depth	TCR SCR RQD	If	Records/Samples
16.50-17.00	100 18 0	NI NI 20	
17.00-18.35	100 92 55		
17.78-17.88			CS 27
18.54-18.65			CS 28
18.35-19.85	100 95 63	NI 120 280	
			Flush: 16.50-22.50 Mud, 100 %

Strata

Description (Continued from Sheet 1)

Description	Remarks	Depth, Level (Thickness)
Medium dense becoming red brown slightly silty fine to coarse SAND		(7.40) 15.60
Dense light brown slightly silty fine and medium SAND.		(0.90) 16.50
Very weak to medium strong red brown grey medium to coarse grained SANDSTONE. Fractures are subhorizontal, very closely to medium spaced, rough, planar.	16.50-16.85 m recovered as sand; 16.95-17.05 m recovered as sandy gravel; 18.30-18.35 m NI; 19.75-19.80 m recovered as	(4.40)

Stratum continues to 20.90 m

Groundwater Entries
No. Struck (m) Post strike behaviour Depth sealed (m)

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. A9057
Carried out for Morrison Construction Limited

Borehole **BH16**

Borehole Log

Soil Mechanics

Drilled AH/DS Logged PM Checked RH	Start 31/03/2009 End 06/04/2009	Equipment, Methods and Remarks	Depth from	to	Diameter	Casing Depth	Ground Level –
		Dando 175/Beretta T51 Cable percussion boring. Rotary open hole drilling (GBS size) using mud flush.	0.00m 16.50m	16.50m 22.50m	200mm 146mm	16.44m 22.50m	Coordinates National Grid E 473696.94 N 412841.27 Chainage

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
19.85-21.00	87 74 46				
		NI 50 140			
21.00-22.50	100 98 30	NI 60 120		06/04/2009 22.50	

Strata

Description (Continued from Sheet 2)		Depth, *Level* (Thickness)
Very weak to medium strong red brown grey medium to coarse grained SANDSTONE. Fractures are subhorizontal, very closely to medium spaced, rough, planar.	:: 19.75m - sand 20.00-20.05 m NI 20.26-20.28 m grey mudstone 20.47-20.62 m extremely weak	20.90
Extremely weak to very weak red brown MUDSTONE. Fractures are subhorizontal, closely spaced, planar, smooth.	20.90-20.93 m grey 21.00-21.09 m recovered as slightly clayey sand	(0.50) 21.40
Medium strong red brown grey SANDSTONE. Fractures are subhorizontal, very closely to closely spaced, rough, planar.	21.35-21.40 m grey 22.20 m 5mm bed of grey mudstone 22.45-22.50 m NI drilling induced	(1.10) 22.50
EXPLORATORY HOLE ENDS AT 22.50 m		

Legend | Backfill/Instruments

Groundwater Entries No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks * From	to (m)

Chiselling Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. A9057

Carried out for Morrison Construction Limited

Borehole **BH16**

Borehole Log

Soil Mechanics

Drilled AH/MA Logged PM Checked RH	Start 30/03/2009 End 02/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m 13.85m 200mm 13.34m 13.85m 24.30m 146mm 19.20m	Ground Level - Coordinates E 474092.00 National Grid N 413180.00 Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.20-1.20	B 1	0.00-1.20 m Hand dug inspection pit		
1.50-1.95	U 2	27 blows	1.50	dry
2.05	D 3			
2.50-2.95	SPT S	N=8 (1,2/1,2,3,2)	2.50	dry
2.50-2.95	D 4			
2.50-2.75	B 5			
2.75-3.00	B 6			
3.50-3.95	U 7	41 blows	3.00	dry
4.05	D 8			
4.50-4.95	SPT S	N=9 (1,2/2,2,2,3)	4.50	dry
4.50-5.00	B 10			
4.50-4.95	D 9			
6.00-6.45	U 11	40 blows	6.00	dry
6.55	D 12			
6.80	W 16a			
7.50-7.95	SPT S	N=13 (2,2/3,3,3,4)	7.50	5.95
7.50-7.95	D 13			
7.50-8.00	B 14			
9.00-9.45	SPT S	N=15 (2,3/4,4,3,4)	9.00	6.60
9.00-9.45	D 15			
9.00-10.00	B 16			
			30/03/2009 10.00	7.40

Strata

Description	Depth, Level/ (Thickness)
Firm brown TOPSOIL	0.20
Plastic dark brown pseudo-fibrous PEAT with occasional cobble size pockets of brown sandy clay.	(1.50) 1.70
Loose grey fine and medium SAND	(1.05) 2.75
Soft to firm thinly laminated brown mottled grey sandy CLAY	(4.05) 6.80
Medium dense becoming dense red brown slightly silty SAND	

Stratum continues to 13.80 m

Legend | Backfill/ Instruments

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	6.80	Rose to 5.10 m after 20 minutes.	-

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole **BH18**

Borehole Log

Soil Mechanics

Drilled AH/MA Logged PM Checked RH	Start 30/03/2009 End 02/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m / 13.85m / 200mm / 13.34m 13.85m / 24.30m / 146mm / 19.20m	Ground Level - Coordinates E 474092.00 National Grid N 413180.00 Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
			31/03/2009 10.00	0800 3.60
10.50-10.95 10.50-10.95 10.50-11.00	SPT S D 17 B 18	N=15 (2,3/4,4,3,4)	10.50	3.90
12.00-12.45 12.00-12.45 12.00-13.00	SPT S D 19 B 20	N=35 (3,4/6,8,10,11)	12.00	4.40
13.40-13.85 13.40-13.85	SPT S D 21	N=50 (6,5/9,14,14,13)	13.40	5.30
			31/03/2009 13.34	5.45
			01/04/2009 13.34	0800
13.85-15.30	17 / 0 / 0			
	NI			
15.30-16.80	0 / 0 / 0	Flush: 13.85-18.30 Mud, 75 %		
16.80-18.30	11 / 1 / 0			
	NI / NI / 20			
18.30-18.46		SPT S 50 (9,41/50 for 10mm)		
18.30-19.20	56 / 2 / 0	Flush: 18.30-19.20 Mud, 50 %		
			01/04/2009 19.20	
			02/04/2009 19.20	0800
19.20-19.80	150 / 83 / 18			
19.70-19.80		CS 22		

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Strata

Description (Continued from Sheet 1)

Description	Remarks	Depth, *Level* (Thickness)	Legend	Backfill/ Instruments
Medium dense becoming dense red brown slightly silty SAND		(7.00)		
Extremely weak red brown SANDSTONE	13.80-15.05 m AZCL 15.05-15.30 m recovered as gravelly sand. Gravel is rounded medium to coarse of various lithologies 16.80-18.13 m AZCL 18.13-18.28 m recovered as sand gravel. Gravel is subrounded of sandstone and quartz. 18.30-18.70 m AZCL 18.70-18.90 m recovered as sandy gravel. Gravel is subangular to subrounded fine to coarse of sandstone and quartz	13.80 (5.41)		
Very weak to weak red brown grey medium to coarse grained SANDSTONE. Fractures are subhorizontal, very closely to medium spaced, rough, planar, infilled with up to		19.21		

Stratum continues to 24.30 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	A9057
Carried out for	Morrison Construction Limited

Borehole **BH18**

Borehole Log

Soil Mechanics

Drilled AH/MA Logged PM Checked RH	Start 30/03/2009 End 02/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m 13.85m 200mm 13.34m 13.85m 24.30m 146mm 19.20m	Ground Level - Coordinates National Grid E 474092.00 N 413180.00 Chainage

Samples and Tests / Strata

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water	Description (Continued from Sheet 2)	Depth, Level (Thickness)	Legend	Backfill/ Instruments
						5mm with clay			
						:: 18.92m - 18.92-19.21 m recovered as brown slightly gravelly sand. Gravel is rounded fine to coarse of various lithologies.			
19.80-21.30	100 93 53								
20.75-20.85			CS 23						
		NI 80 240	Flush: 19.20-24.30 Mud, 80 %			21.18-21.30 m grey 21.20-21.30 m NI 21.30-21.34 m recovered as sand	(5.09)		
21.30-22.80	100 90 24								
						22.70-22.75 m recovered as sand			
22.80-24.30	100 97 41								
				02/04/2009 19.20		24.20-24.27 m recovered as sand			
						EXPLORATORY HOLE ENDS AT 24.30 m	24.30		

Groundwater Entries
No. Struck (m) Post strike behaviour Depth sealed (m)

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. A9057
Carried out for Morrison Construction Limited

Borehole **BH18**

Borehole Log

Soil Mechanics

Drilled CR/DS Logged PM Checked RH	Start 03/04/2009 End 08/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m / 13.80m / 200mm / 13.80m 13.80m / 18.15m / 146mm / 18.15m	Ground Level - Coordinates National Grid E 472198.13 N 412553.02 Chainage

Samples and Tests / Strata

Depth	Type & No	Records	Date Casing	Time Water	Description	Depth, Level (Thickness)
		0.00-1.20 m Hand dug inspection pit			TOPSOIL	(0.35)
0.35-0.65	B 1				Soft to firm grey mottled brown sandy CLAY	0.35 (0.30)
0.80-1.20	B 2				Brown slightly clayey slightly gravelly SAND. Gravel is subangular to subrounded fine to coarse of sandstone.	0.65 (0.85)
1.60-2.05	B 3				Soft to firm thinly laminated brown sandy CLAY with occasional thin laminae of fine sand.	1.50
1.60-2.05	U NR	15 blows No recovery	1.50	1.40		
2.20-2.65	SPT S	N=8 (1,1/2,2,2,2)	2.50	2.30		
2.20-2.60	B 4					
2.60-3.05	D 5					
2.60-3.05	B 6					
3.60-4.05	U 7	30 blows	3.50	damp		(4.25)
4.20	D 8					
4.60-5.05	SPT S	N=12 (1,2/2,3,3,4)	4.40	dry		
4.60-5.05	B 10					
4.60-5.05	D 9					
5.15-5.60	B 11					
					Medium dense brown slightly clayey fine SAND	5.75
6.10-6.55	SPT S	N=11 (1,2/2,2,3,4)	6.05	4.20		
6.10-6.55	D 12					
6.10-6.55	B 13					(1.25)
		Flush: 0.00-13.80 Water, 100 %				
7.00-7.40	B 14				Medium dense brown slightly clayey slightly gravelly SAND. Gravel is subangular fine to coarse of sandstone.	7.00
7.50-7.95	SPT S	N=15 (1,2/3,3,4,5)	7.50	3.90		
7.50-7.95	D 15					
7.50-7.95	B 16					
			03/04/2009 7.50	3.70		(1.75)
			06/04/2009 7.50	0800 2.30		
8.40-8.70	B 17					
					Dense red brown slightly silty slightly gravelly SAND. Gravel is subangular fine to coarse of sandstone.	8.75
9.10-9.22	SPT S	50 (25 for 65mm/50 for 55mm)	9.00	2.70		
9.10-9.25	D 18					
9.10-9.25	B 19					
9.70-10.10	B 20					
Depth	Type & No	Records	Date Casing	Time Water	Stratum continues to 13.80 m	

Legend / Backfill/Instruments

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	5.70	-	-

Depth Related Remarks *
From to (m)

Chiselling

Depths (m)	Time	Tools used
6.70 -7.05	45 mins	
9.20 -9.55	45 mins	
9.70 -10.05	45 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. A9057
Carried out for Morrison Construction Limited

Borehole **BH22**

Borehole Log

Soil Mechanics

Drilled CR/DS Logged PM Checked RH	Start 03/04/2009 End 08/04/2009	Equipment, Methods and Remarks Dando 175/Beretta T51 Cable percussion boring. Rotary core drilling (GBS size) using mud flush.	Depth from / to / Diameter / Casing Depth 0.00m 13.80m 200mm 13.80m 13.80m 18.15m 146mm 18.15m	Ground Level - Coordinates National Grid E 472198.13 N 412553.02 Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.60-10.71	SPT S	50 (25 for 60mm/50 for 50mm)	10.50	3.05
10.60-10.70	D 21			
10.60-10.70	B 22			
11.00-11.40	B 23			
12.10-12.22	SPT S	50 (25 for 70mm/50 for 45mm)	12.00	3.60
12.10-12.25	D 24			
12.10-12.25	B 25			
12.80-13.10	B 26			
13.70-13.81	SPT S	50 (25 for 65mm/50 for 40mm)	13.65	3.85
13.70-13.80	D 27			
13.70-13.80	B 28 NI		08/04/2009 13.65	4.25
14.46-14.56	61 34 16	CS 29	08/04/2009	0800 2.50
13.80-15.15				
15.15-16.65	100 99 43 NI 90 180	Flush: 13.80-18.15 Mud, 100 %		
16.65-18.15	100 90 59			
17.53-17.63		CS 30	08/04/2009	

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Strata

Description (Continued from Sheet 1)	Remarks	Depth, *Level* (Thickness)
Dense red brown slightly silty slightly gravelly SAND. Gravel is subangular fine to coarse of sandstone.		(5.05)
Weak to medium strong red brown medium to coarse grained SANDSTONE. Fractures are subhorizontal, closely spaced, rough, planar.	13.80-14.15 m AZCL 14.15-14.36 m recovered as slightly silty sand 15.05-15.15 m 1 No. subvertical rough planar fracture 16.62-16.65 m NI 17.64-17.66 m fracture infilled with grey mudstone 18.02-18.09 m 1 No. subvertical smooth planar fracture, drilling induced 18.09-18.15 m NI	13.80 (4.35)
EXPLORATORY HOLE ENDS AT 18.15 m		18.15

Groundwater Entries
No. Struck (m) Post strike behaviour Depth sealed (m)

Depth Related Remarks *
From to (m)

Chiselling

Depths (m)	Time	Tools used
10.80 -11.15	45 mins	
11.60 -11.95	45 mins	
12.35 -12.70	45 mins	
13.10 -13.40	45 mins	
13.60 -13.90	45 mins	

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. A9057
Carried out for Morrison Construction Limited

Borehole **BH22**

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT2
Sample No	1
Sample Depth, mBGL	4.00 - 5.00
Sample Type	MOSTAP

Description

4.00-4.17m
Brown slightly fine sandy SILT.

4.17-4.95m
Soft brown CLAY

4.95-5.00m
No recovery

4.00

5.00

Sampling information:

Blow Count

Recovery mm

Remarks:

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT2
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT2
Sample No	2
Sample Depth, mBGL	6.00 - 7.00
Sample Type	MOSTAP

Description

6.00-6.15
Soft brown silty CLAY

6.15-6.65m
Soft thinly laminated brown CLAY with rare partings of fine sand

6.65-6.96m
Soft thinly laminated brown CLAY

6.96-7.00m
No recovery

6.00

7.00

Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
Project No.	A9057	CPT2
Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT3
Sample No	1
Sample Depth, mBGL	3.00 - 4.00
Sample Type	MOSTAP

Description

3.00-3.53m
Soft brown CLAY

3.53-3.79m
Brown clayey SILT

3.79-3.84m
Soft brown CLAY

3.84-3.97m
Brown clayey SILT

3.97-4.00m
No recovery

3.00

4.00

Sampling information:

Blow Count

Recovery mm

Remarks:

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT3
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT3	
Sample No	2	
Sample Depth, mBGL	5.50	- 6.50
Sample Type	MOSTAP	

Description

5.50-5.64m
Soft brown CLAY

5.64-6.35m
Soft thinly laminated brown silty CLAY with occasional dustings of fine sand and silt on laminae

6.35-6.50m
No recovery

5.50

6.50

Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
Project No.	A9057	CPT3
Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT9		
Sample No	1		
Sample Depth, mBGL	3.00	-	4.00
Sample Type	MOSTAP		

Description

3.00-3.51m
Soft brown CLAY

3.51-3.60m
Soft thickly laminated brown silty CLAY

3.60-3.73m
Brown clayey SILT with rare partings of fine sand and silt

3.73-40m
Soft to firm thinly laminated brown CLAY

3.00

4.00

Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9067	CPT9
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT9		
Sample No	2		
Sample Depth, mBGL	5.50	-	6.50
Sample Type	MOSTAP		

Description

5.50-5.74m
Brown clayey SILT

5.74-6.42m
Soft thinly laminated brown CLAY with occasional dustings of silt and fine sand on laminae

6.42-6.50m
No recovery

5.50

6.50

Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT9
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT17		
Sample No	1		
Sample Depth, mBGL	4.00	-	5.00
Sample Type	MOSTAP		

Description

4.00-4.20m
Brown slightly sandy SILT

4.20-4.40m
Soft brown slightly sandy CLAY

4.40-4.45m
Brown slightly sandy SILT

4.45-4.71m
Soft brown slightly sandy CLAY. Locally speckled grey.

4.71-4.90m
Brown slightly sandy SILT

4.90-5.00m
No recovery

4.00

5.00

Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT17
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT17		
Sample No	2		
Sample Depth, mBGL	6.50	-	7.50
Sample Type	MOSTAP		

Description

6.50-7.16m
Soft brown slightly sandy CLAY with frequent thinly to thickly laminae of light brown slightly sandy silt

7.16-7.23m
Soft brown slightly sandy CLAY

7.23-7.28m
Light brown fine and medium SAND

7.28-7.35m
Soft brown slightly sandy CLAY

7.35-7.50m
No recovery

6.50

7.50

Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT17
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT19		
Sample No	1		
Sample Depth, mBGL	4.50	-	5.50
Sample Type	MOSTAP		

Description

4.50-4.83m
Soft brown slightly sandy CLAY

4.83-4.90m
Soft thinly laminated brown CLAY

4.90-5.32m
Soft brown sandy CLAY

5.32-5.37m
Soft thinly laminated brown slightly sandy CLAY

5.37-5.50m
Soft brown slightly sandy CLAY

4.50

5.50

Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	**CPT19**
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT19		
Sample No	2		
Sample Depth, mBGL	6.50	-	7.50
Sample Type	MOSTAP		

Description

6.50-6.77m
Soft brown slightly sandy CLAY

6.77-6.80m
Brown slightly sandy SILT

6.80-7.07m
Soft thinly laminated to very thinly bedded brown slightly sandy CLAY

7.07-7.13m
Soft brown slightly sandy CLAY

7.13-7.23m
Brown slightly sandy SILT

7.23-7.50m
No recovery

6.50

7.50

Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT19
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT20		
Sample No	1		
Sample Depth, mBGL	4.00	-	5.00
Sample Type	MOSTAP		

Description

4.00-4.34m
Soft brown slightly sandy CLAY grading to slightly sandy SILT. Locally speckled light grey

4.34-4.35m
Light brown slightly sandy SILT

4.35-4.68m
Soft bown slightly sandy CLAY. Locally speckled light brown

4.68-4.75m
Brown slightly sandy SILT

4.75-4.90m
Soft brown slightly sandy CLAY

4.90-5.00m
No recovery

4.00

5.00

Sampling information:

Blow Count

Recovery mm

Remarks:

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT20
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT20		
Sample No	2		
Sample Depth, mBGL	7.00	-	8.00
Sample Type	MOSTAP		

Description

7.00-7.33m
Brown slightly sandy SILT

7.33-7.79m
Brown slightly sandy CLAY with occasional thin laminae of slightly sandy silt

7.79-7.86m
Soft brown slightly sandy CLAY

7.86-8.00m
No recovery

7.00

8.00

Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT20
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT22	
Sample No	1	
Sample Depth, mBGL	3.50	- 4.50
Sample Type	MOSTAP	

Description

3.50-3.96m
Soft brown CLAY

3.96-4.11m
Soft thinly laminated brown CLAY with rare partings of fine sand

4.11-4.20m
Soft brown CLAY

4.20-4.50m
No recovery

3.50

4.50

Sampling information:

Remarks:

Blow Count

Recovery mm

Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT22
	Carried out for	Morrison Construction Limited	

Split Tube Sample Description

Soil Mechanics

Borehole No	CPT22
Sample No	2
Sample Depth, mBGL	5.00 - 6.00
Sample Type	MOSTAP

Description

5.00-5.15m
Brown fine to medium SAND

5.15-5.77m
Soft brown CLAY

5.77-5.96m
Soft thinly laminated brown CLAY with rare partings of fine sand

5.96-6.00m
No recovery

5.00

6.00

Sampling information:

Remarks:

Blow Count

Recovery mm

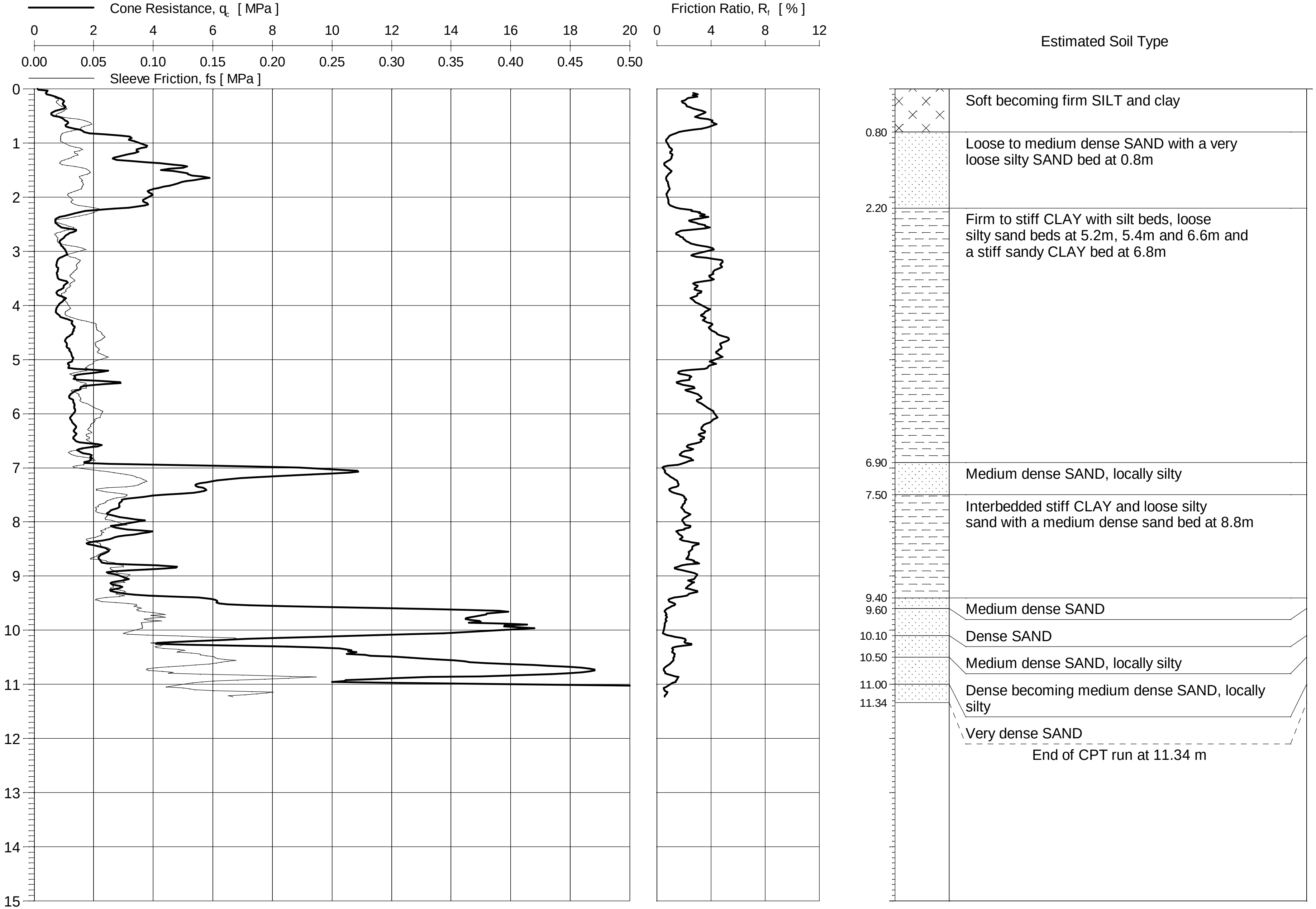
Notes:	Project	TWEEN BRIDGE WIND FARM, PHASE 2	Bh No/Depth
	Project No.	A9057	CPT22
	Carried out for	Morrison Construction Limited	

APPENDIX B: IN-SITU & LABORATORY TEST RESULTS

Checked by: Date: Approved by: Date:

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT2



Location:	CPT2	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

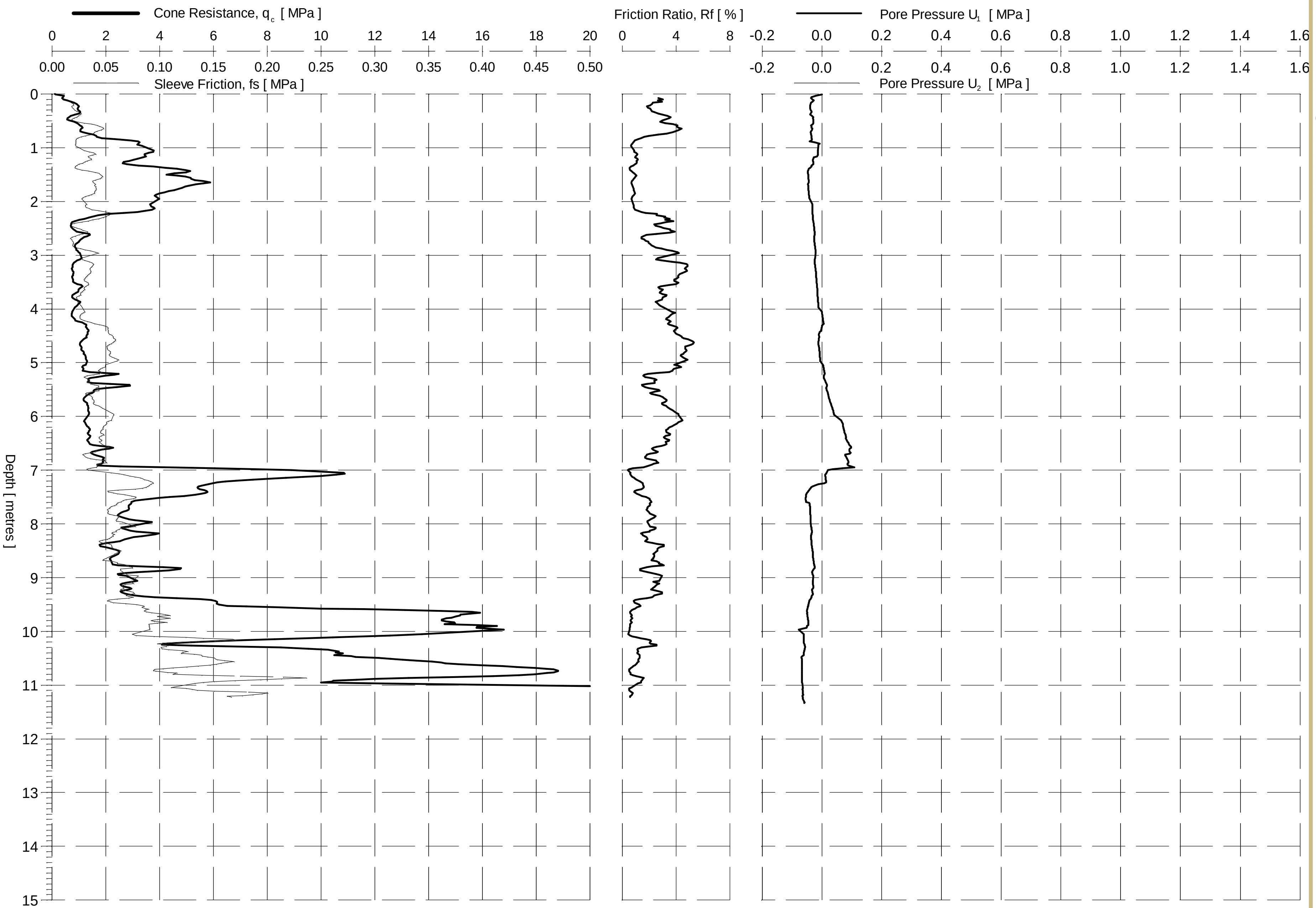
FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT2

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

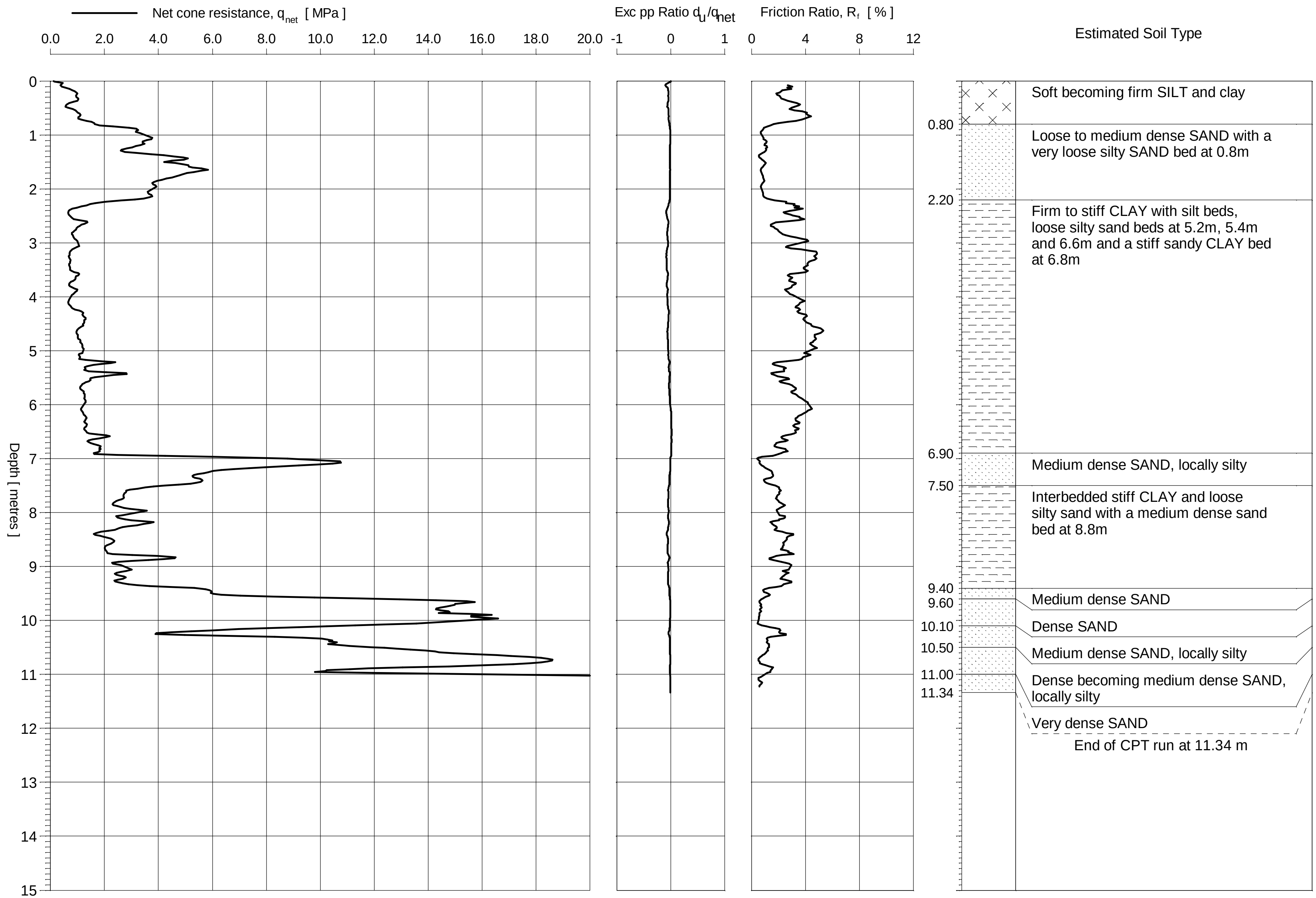
Checked by: Date: Approved by: Date:



Location:	CPT2	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT2



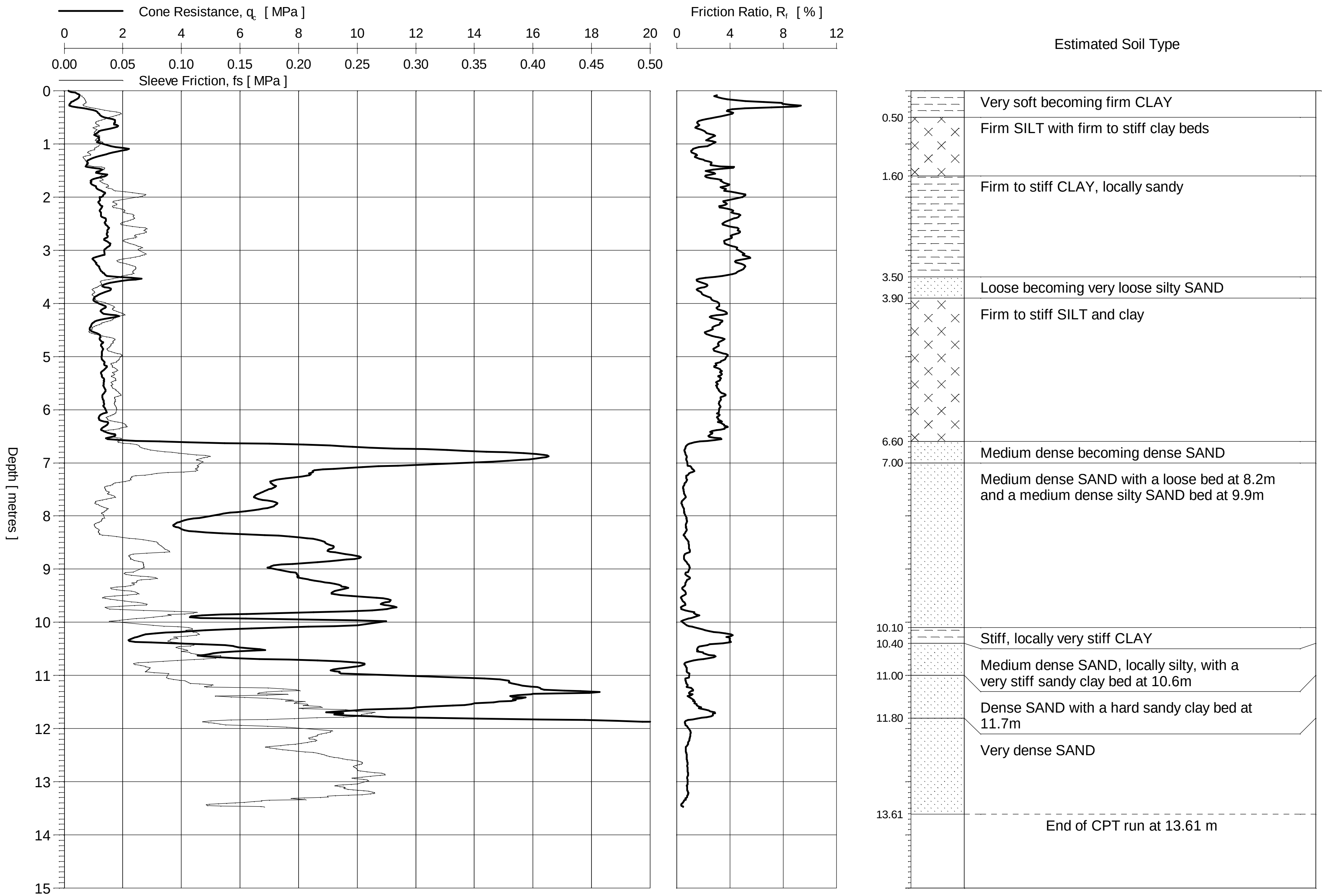
Location:	CPT2	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT3

Checked by: Date: Approved by: Date:



Location:	CPT3	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	19/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

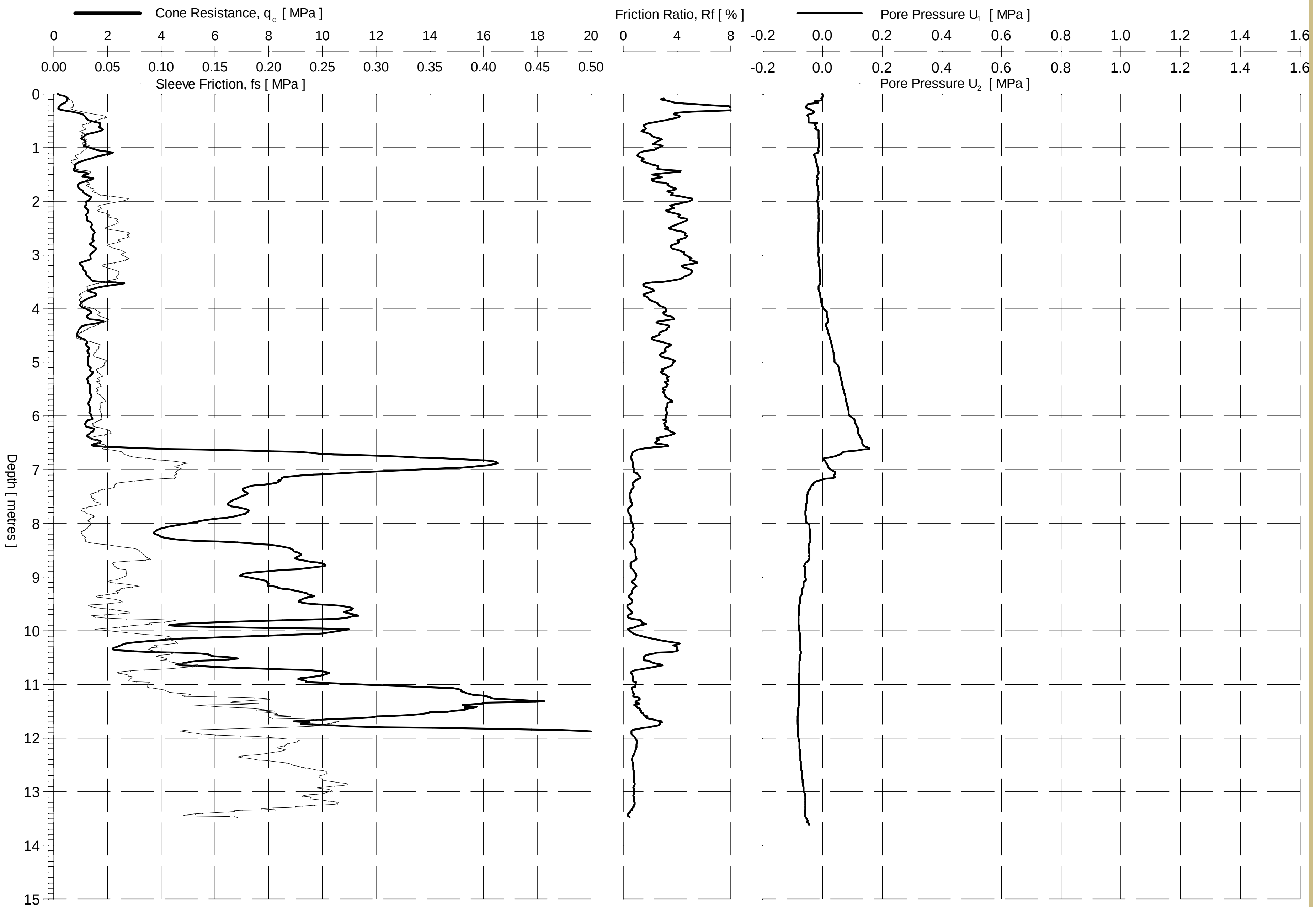
FUGRO

STATIC CONE PENETRATION TEST CPT3

Contract No:CPT091107

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:

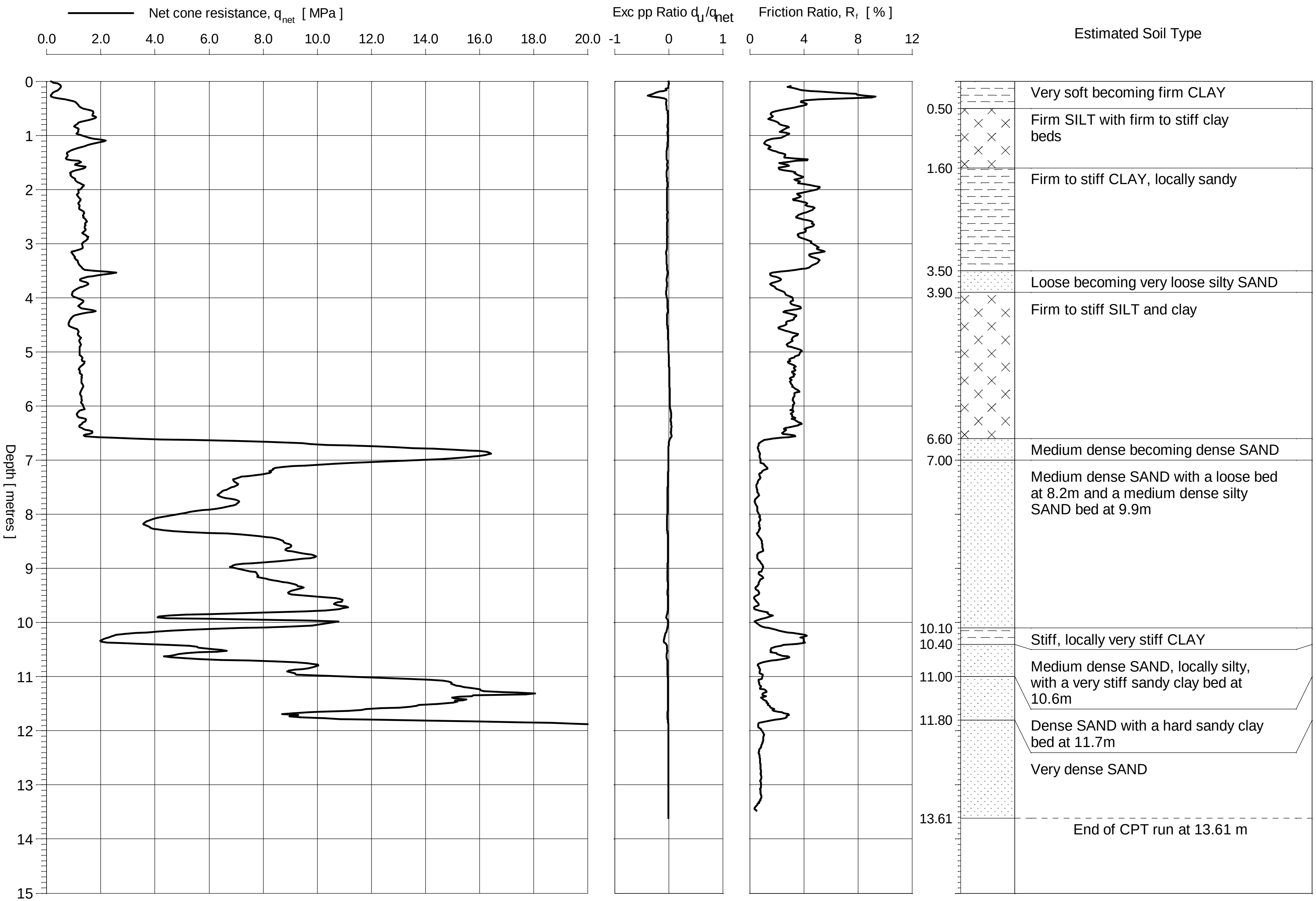


Location:	CPT3	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	19/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

STATIC CONE PENETRATION TEST CPT3

Contract No:CPT091107

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

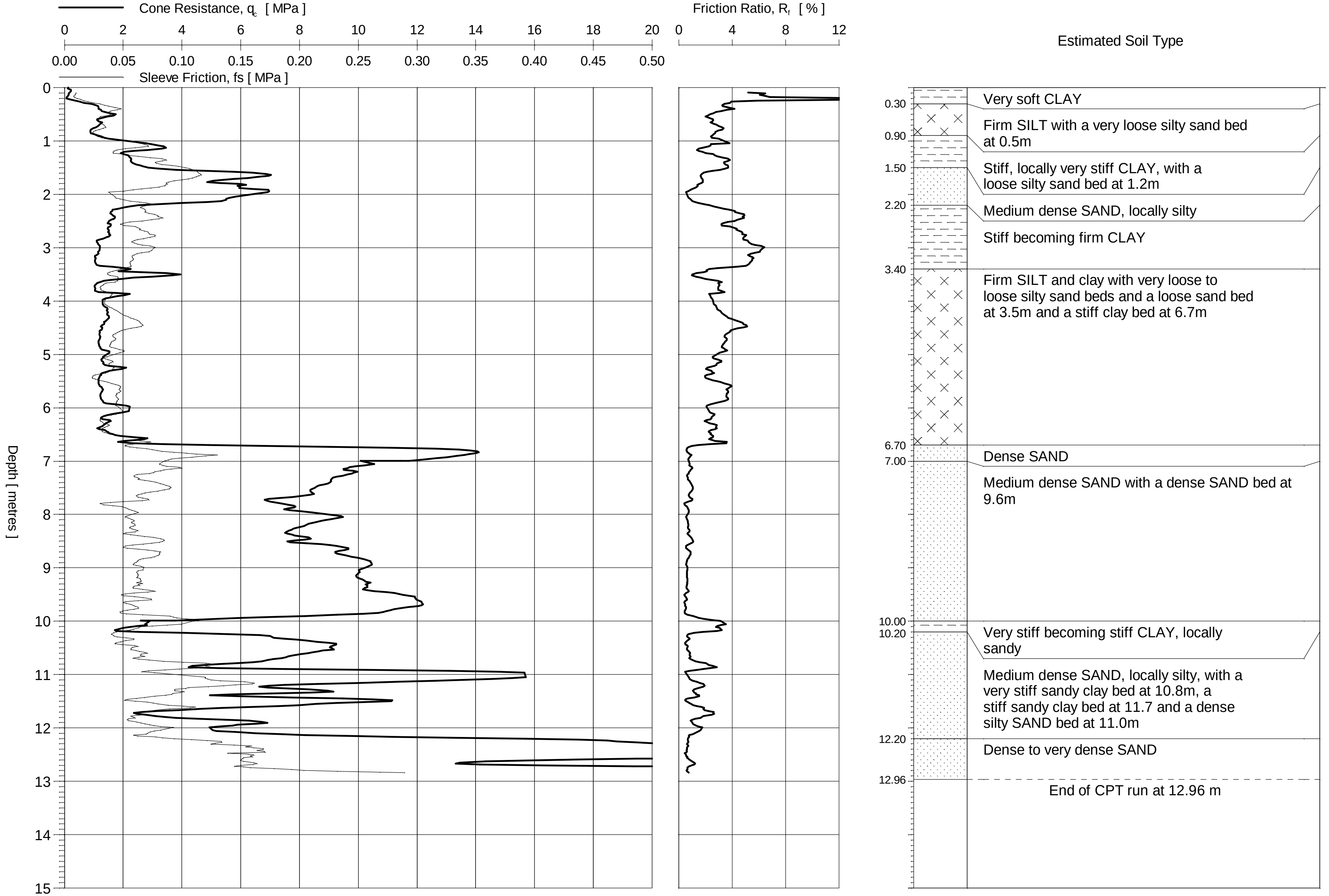


Location:	CPT3	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	19/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT4

Checked by: Date: Approved by: Date:



Location:	CPT4	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

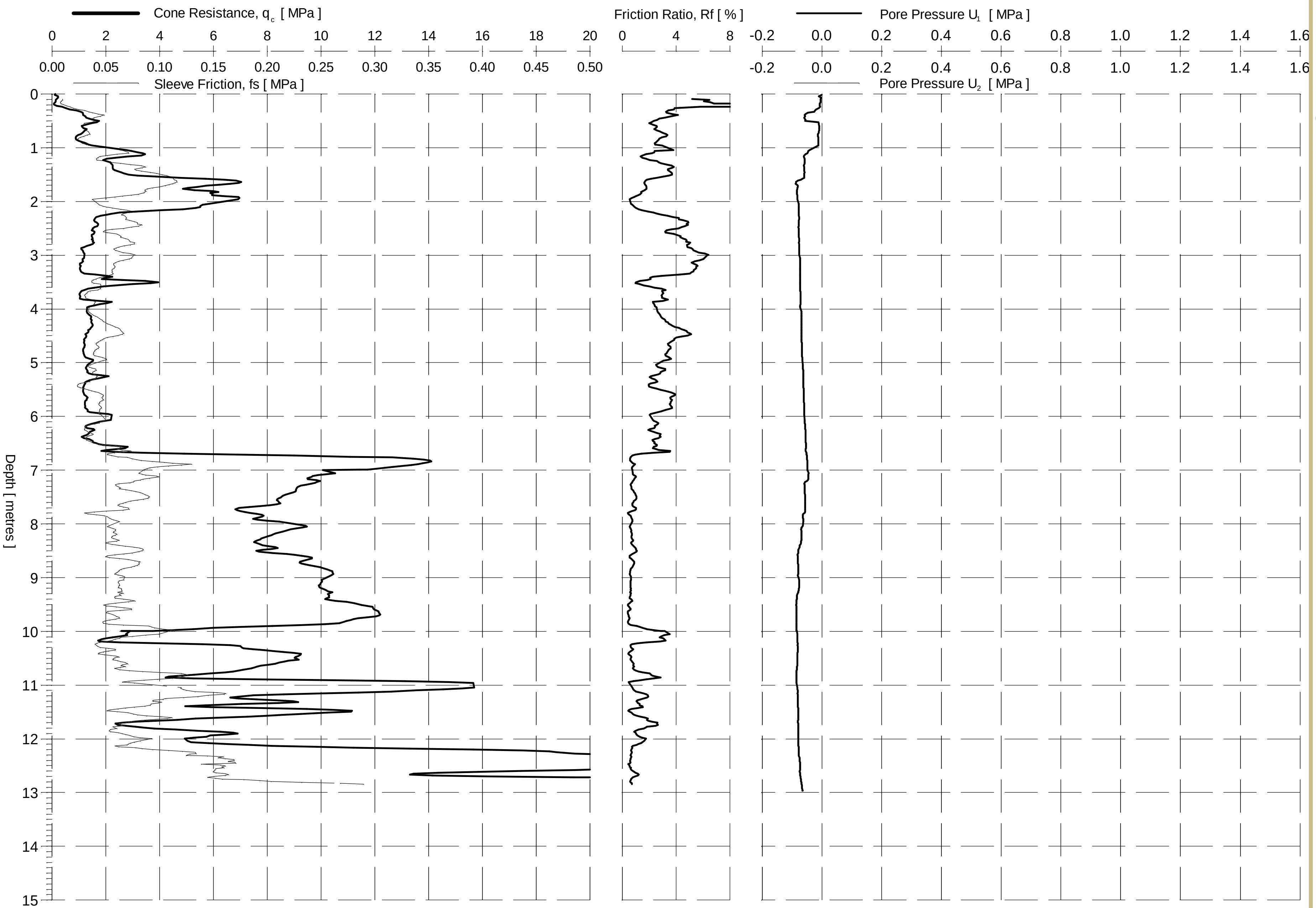
FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT4

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



Location: CPT4

Cone Used: F7.5CKEH3SW2/B 1701-1274

Ground Level (metres) : 0.000

Operator: NF/BR

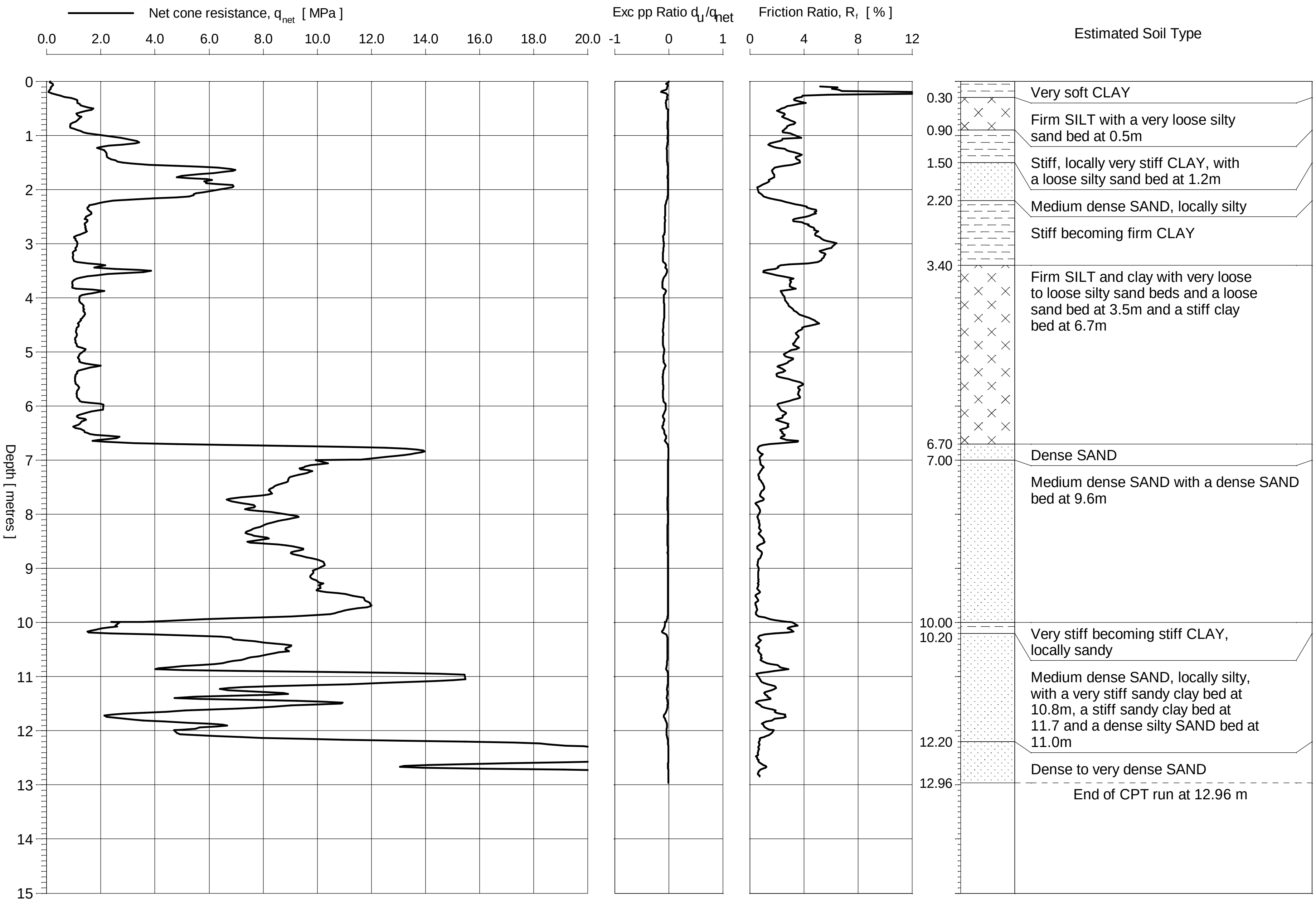
Date of Test: 18/02/2009

CPT Rig: GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT4

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM



Location:	CPT4	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

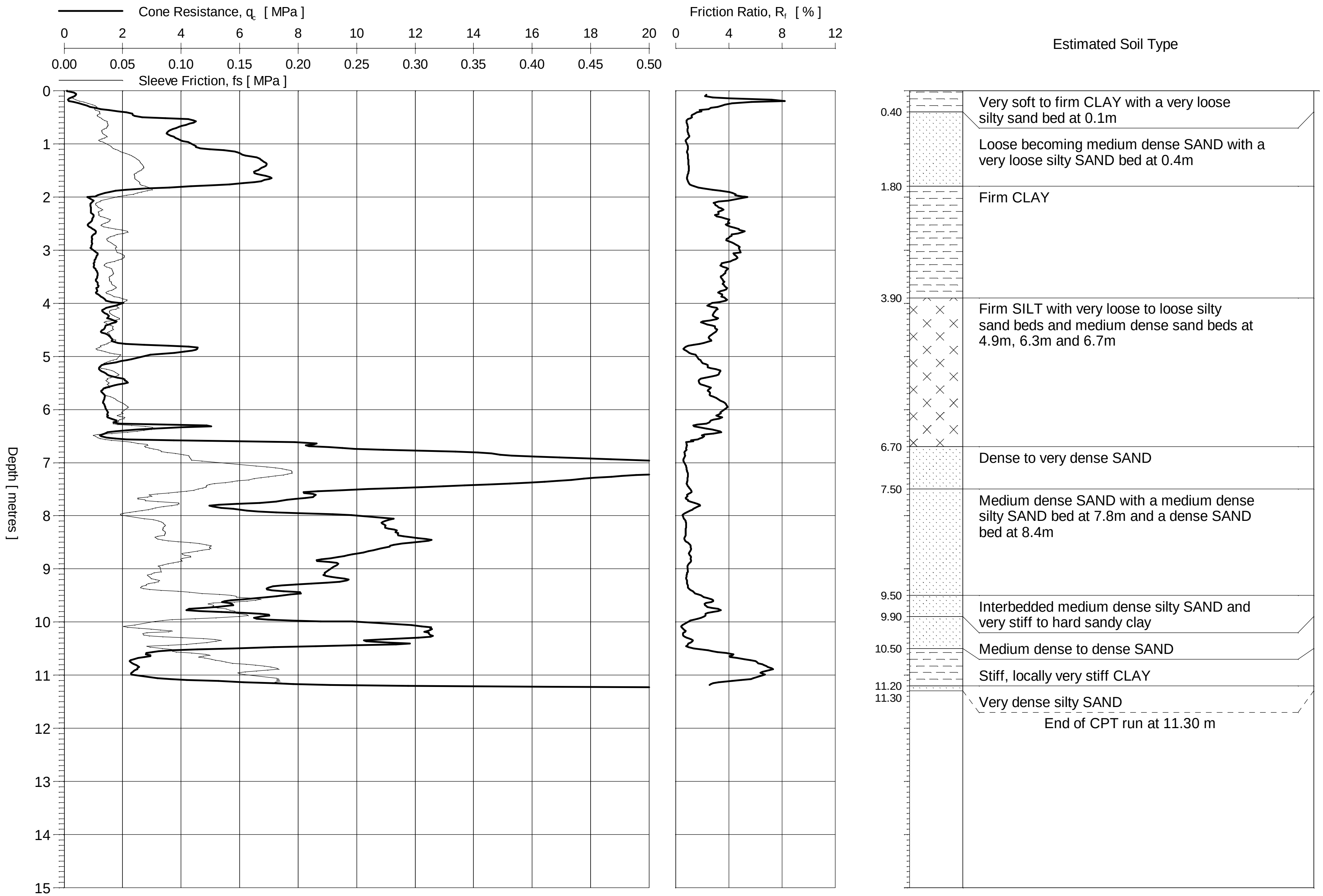
FUGRO

Checked by: Date: Approved by: Date:

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT9

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM



Location:	CPT9	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

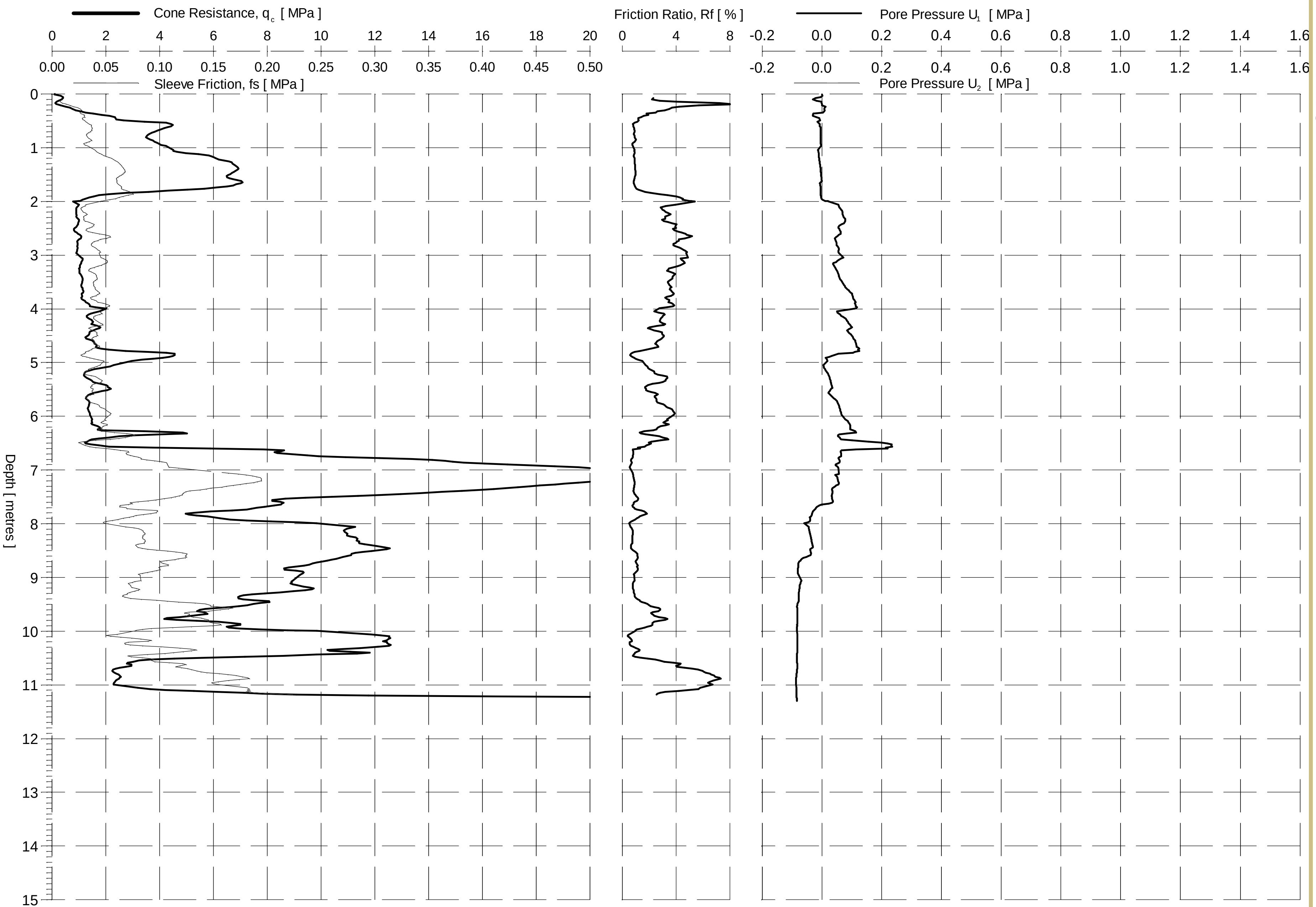
FUGRO

Checked by: Date: Approved by: Date:

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT9

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

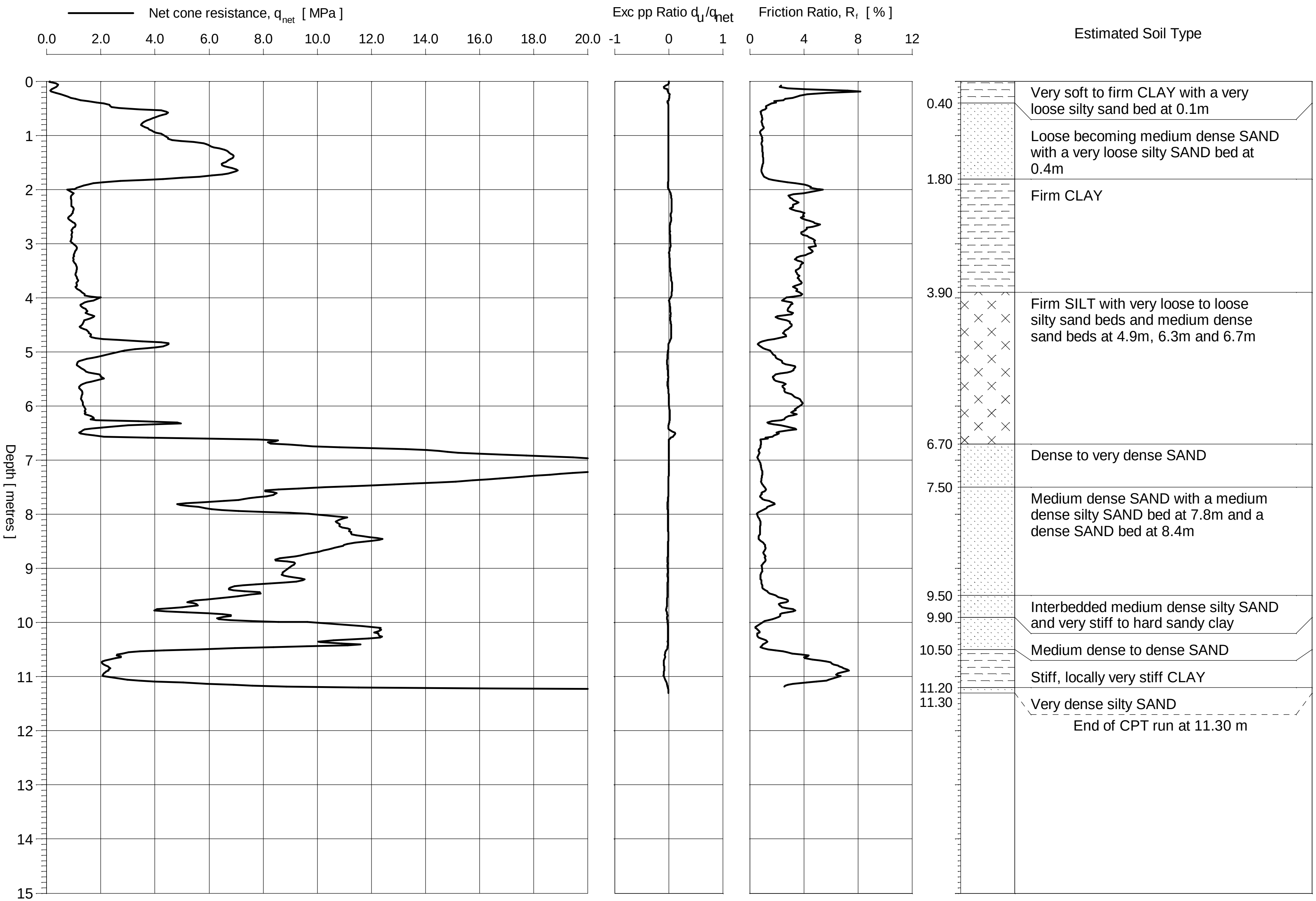


Location:	CPT9	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

FUGRO

STATIC CONE PENETRATION TEST CPT9

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM



Location:	CPT9	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

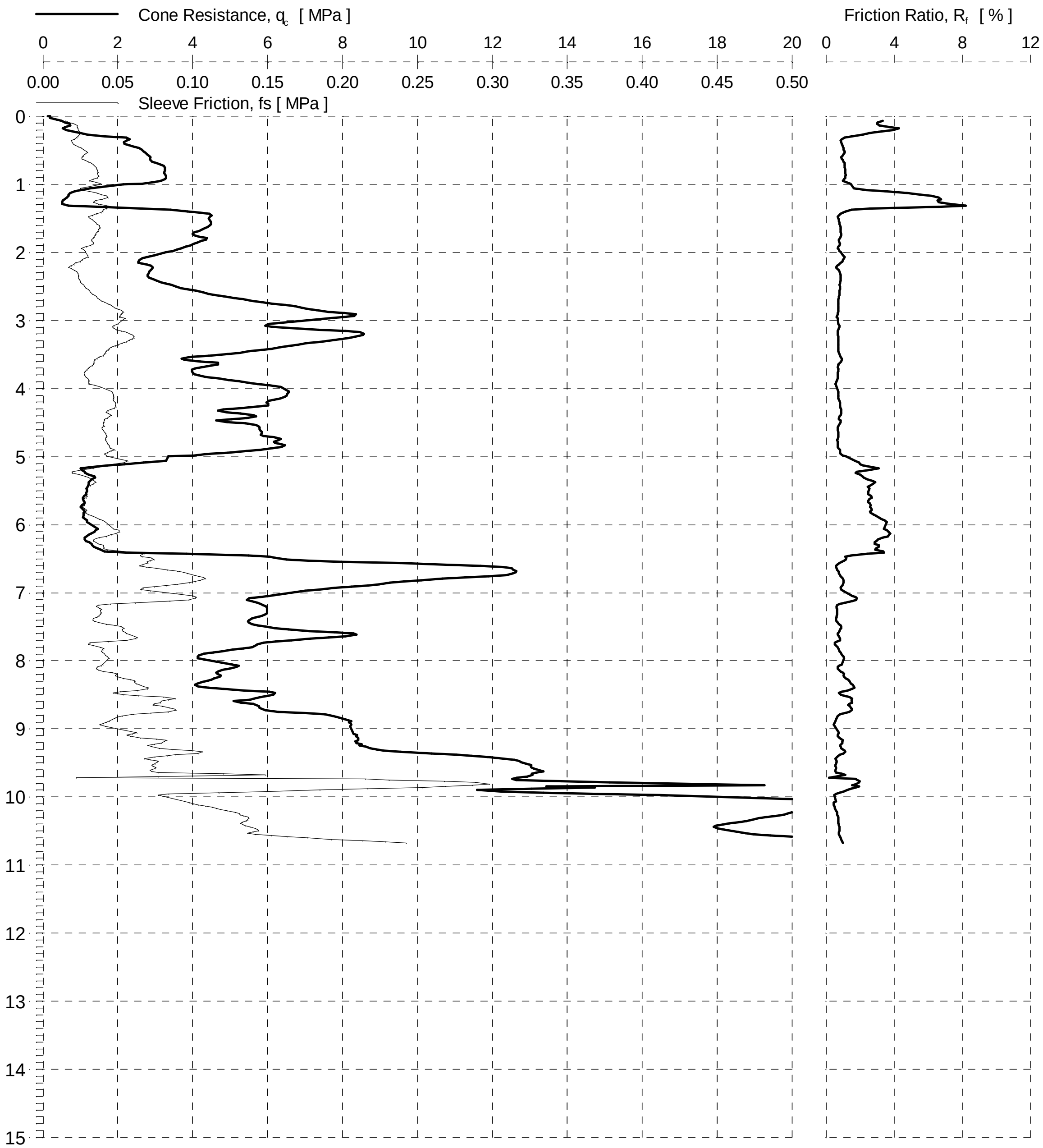
FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT11

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



Estimated Soil Type

Depth (m)	Estimated Soil Type
0.30	Soft, locally firm CLAY, locally sandy
1.10	Very loose becoming loose SAND
1.40	Soft to firm CLAY
1.90	Medium dense SAND with a loose to medium dense SAND bed at 1.7m
2.60	Loose SAND
5.10	Medium dense SAND with a loose SAND bed at 3.6m and a loose silty SAND bed at 5.1m
6.40	Firm SILT with clay beds
9.40	Medium dense SAND, locally silty, with a dense SAND bed at 6.7m
10.00	Dense SAND, locally silty, with a dense gravel bed at 9.7m and a medium dense SAND bed at 9.9m
10.79	Dense to very dense SAND

End of CPT run at 10.79 m

Location:	CPT11	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

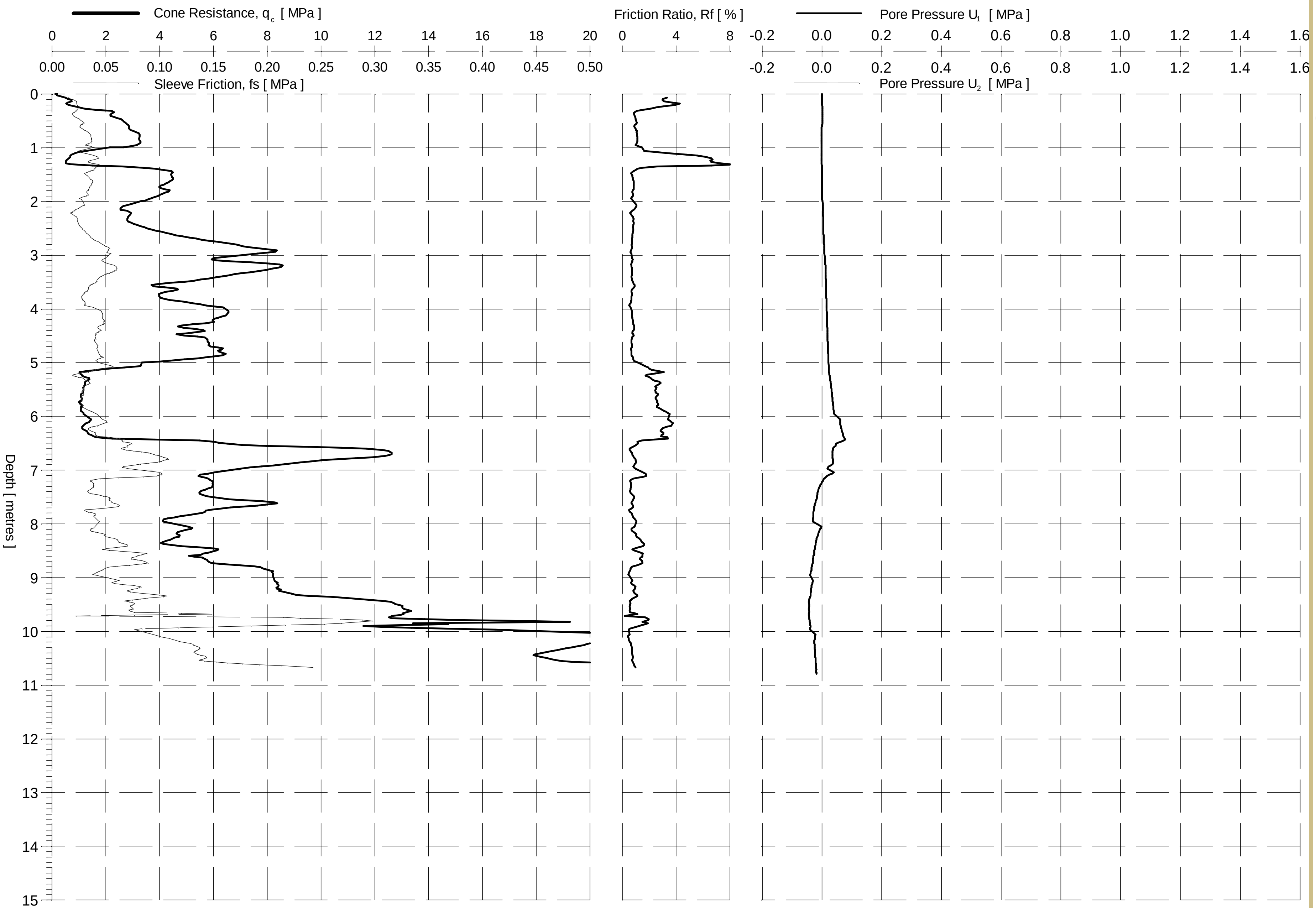
FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT11

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:

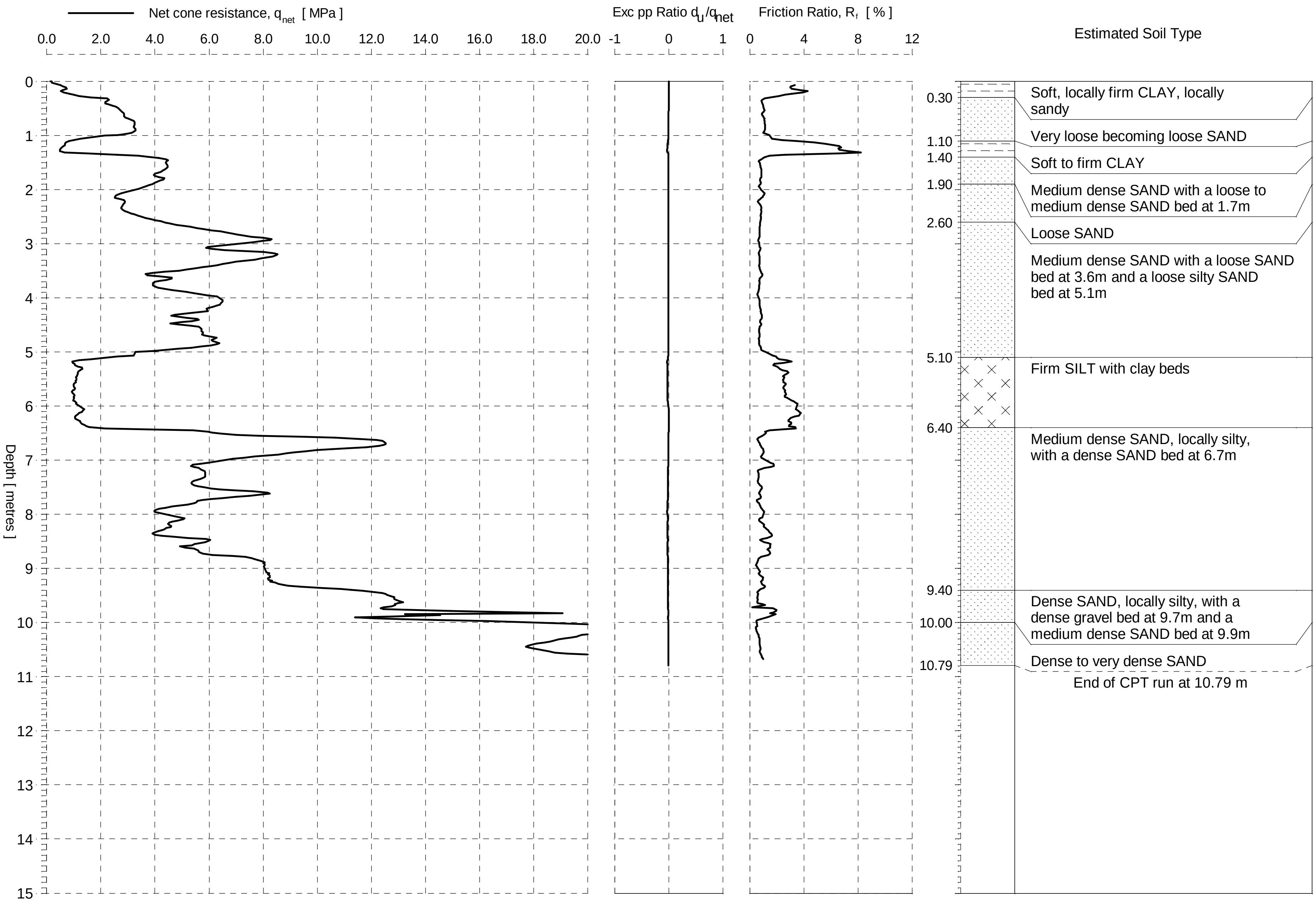


Location:	CPT11	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT11



Location:	CPT11	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

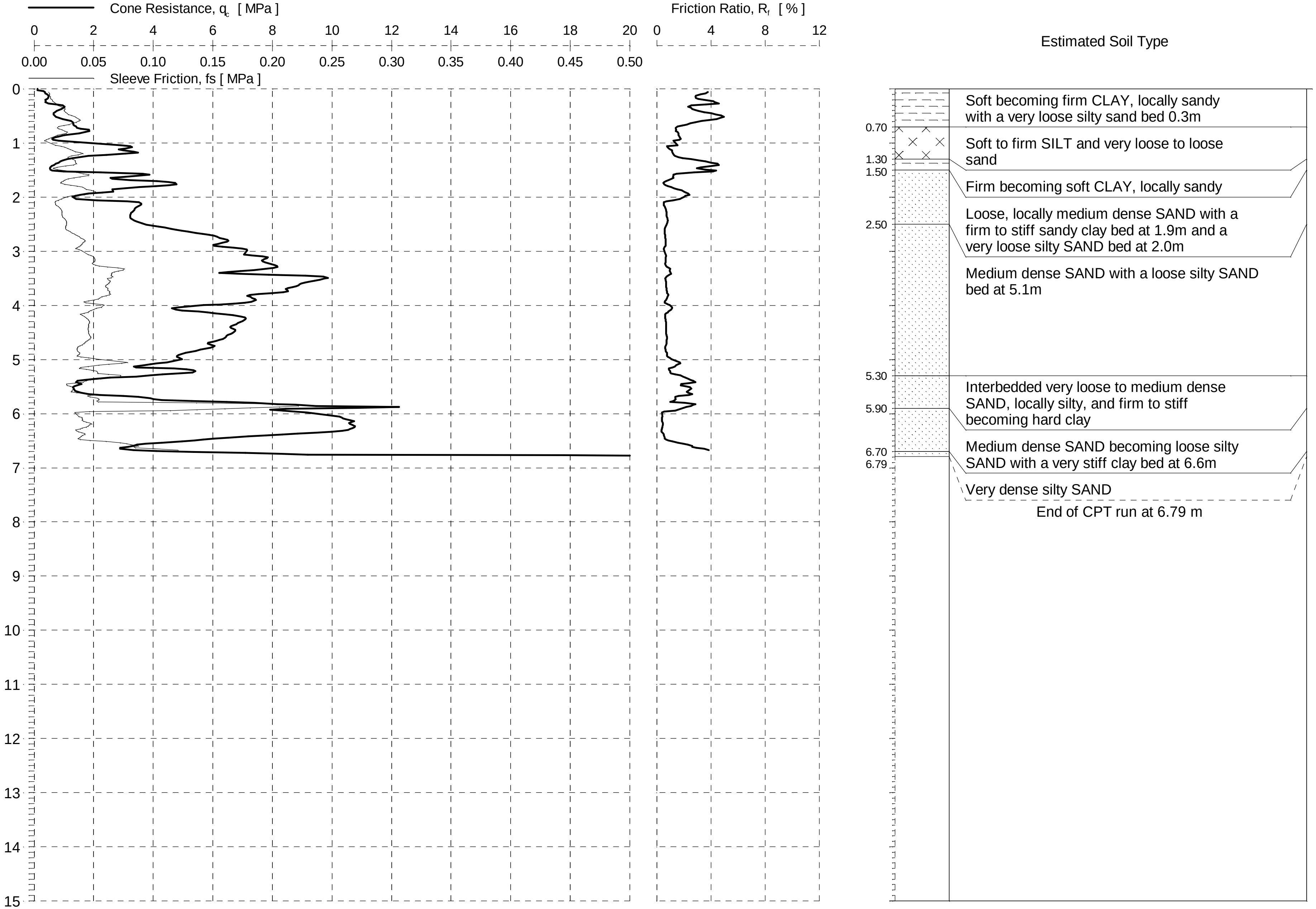
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

FUGRO

Checked by: Date: Approved by: Date:

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT13



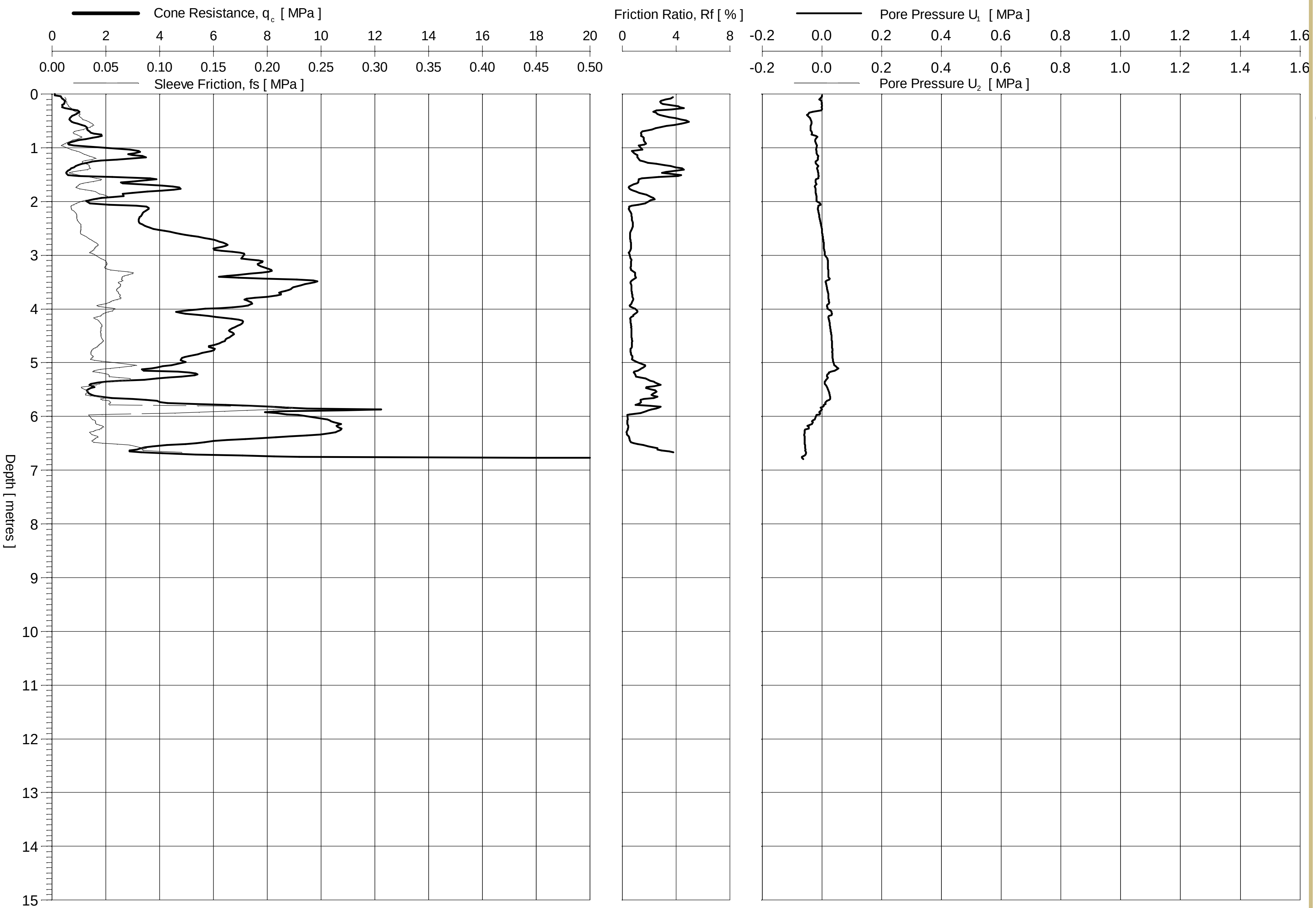
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Location:	CPT13	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT13

Checked by: Date: Approved by: Date:



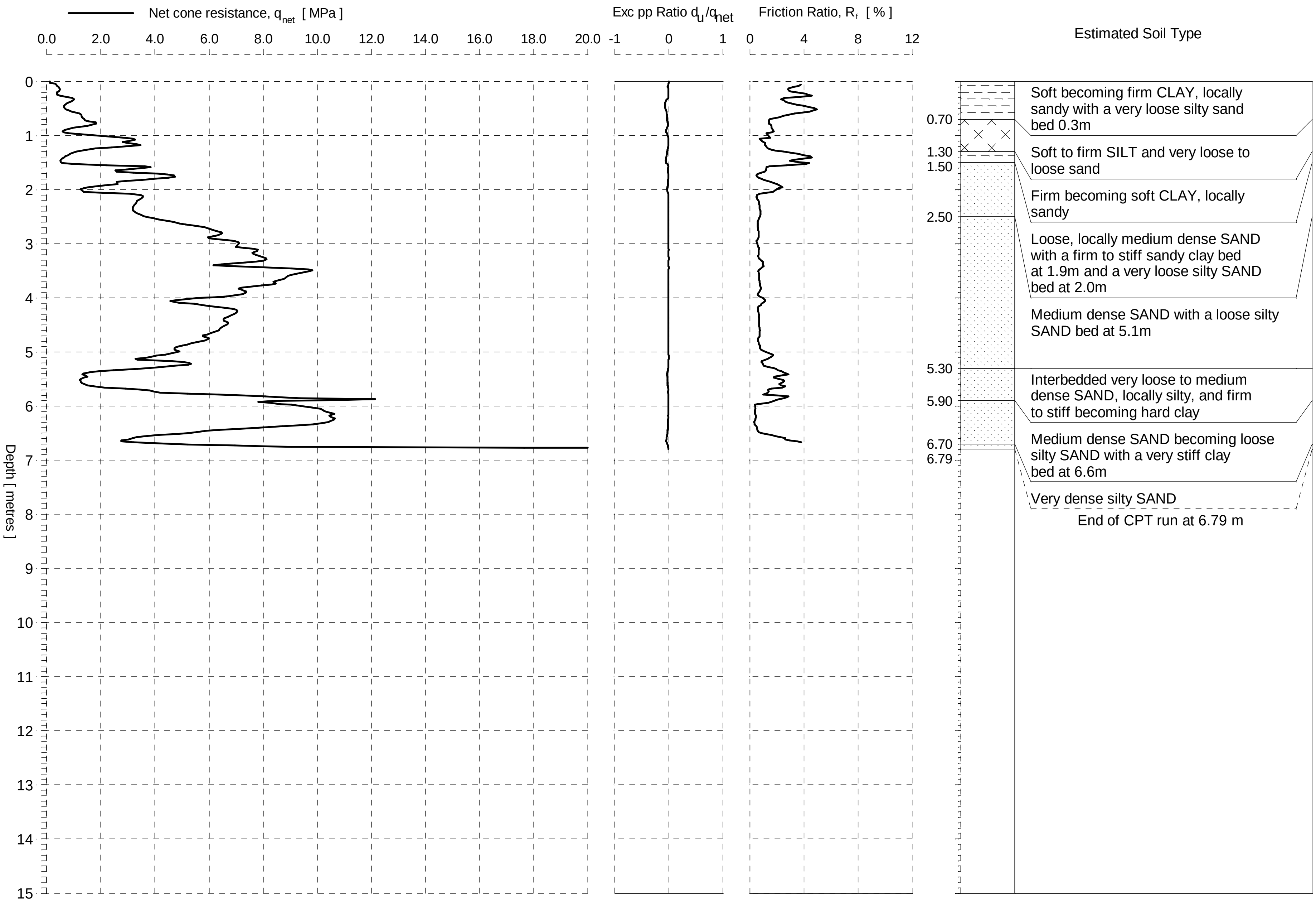
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Location:	CPT13	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

STATIC CONE PENETRATION TEST CPT13

Contract No:CPT091107



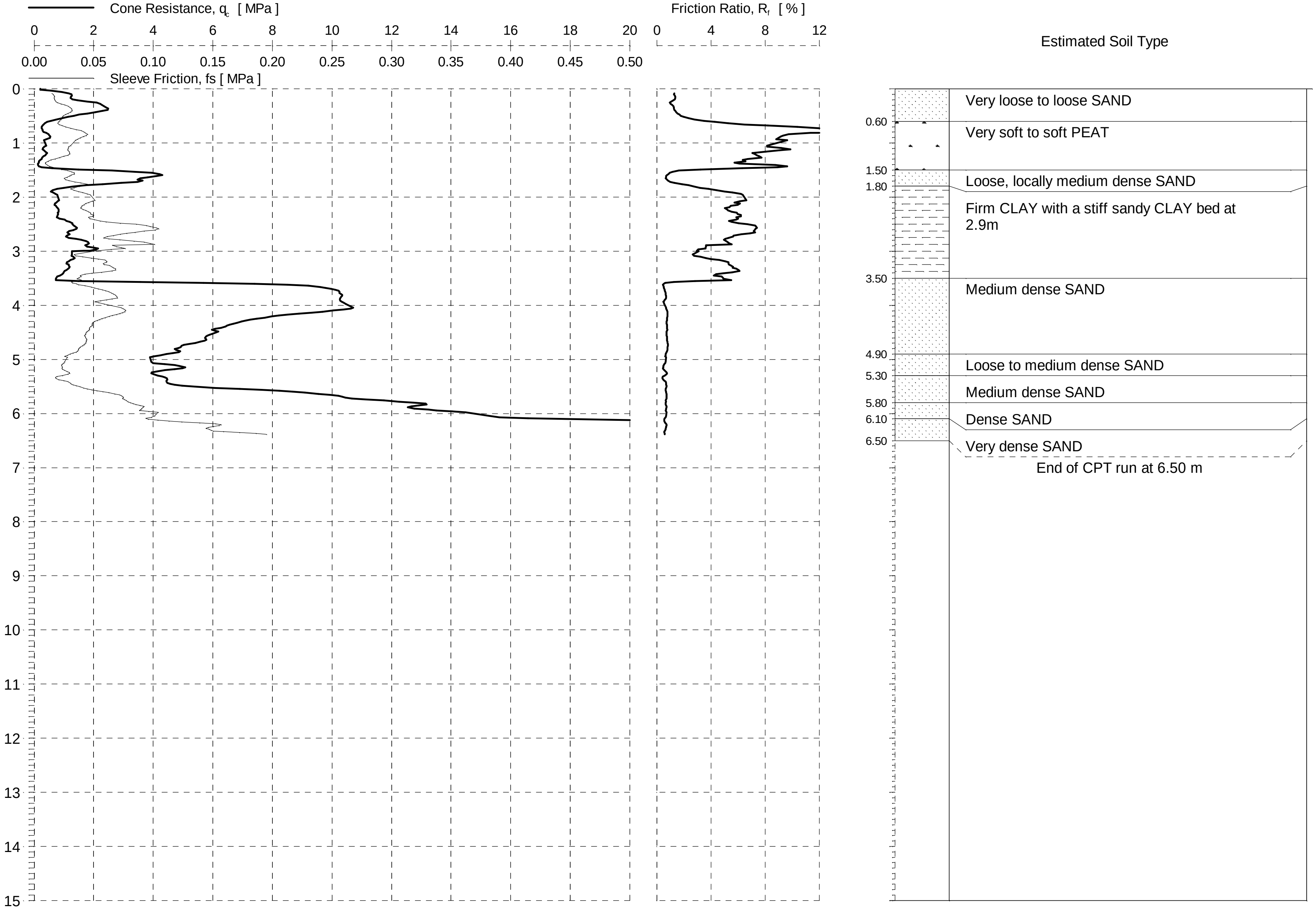
Location:	CPT13	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	18/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT14

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



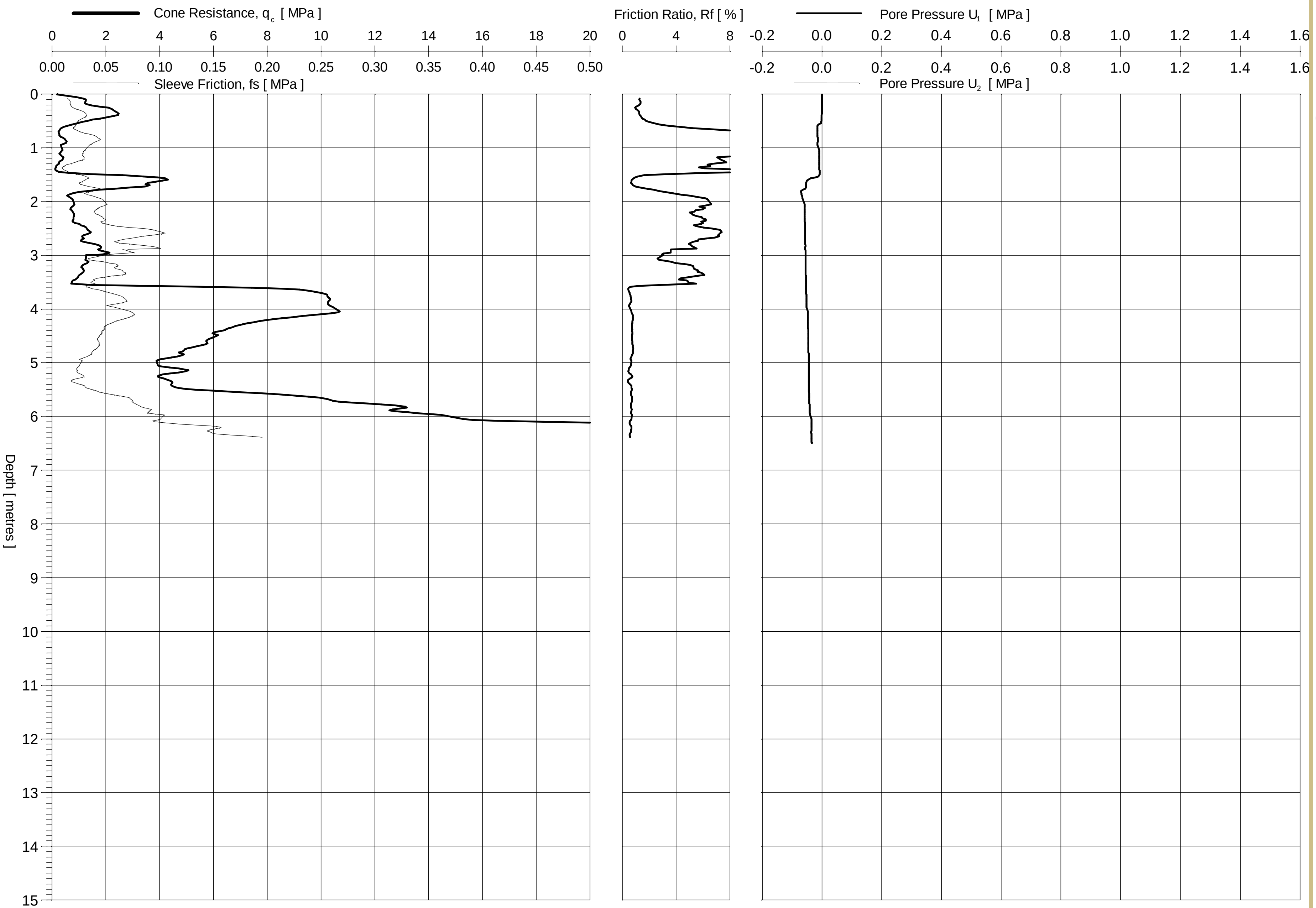
Location:	CPT14	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT14

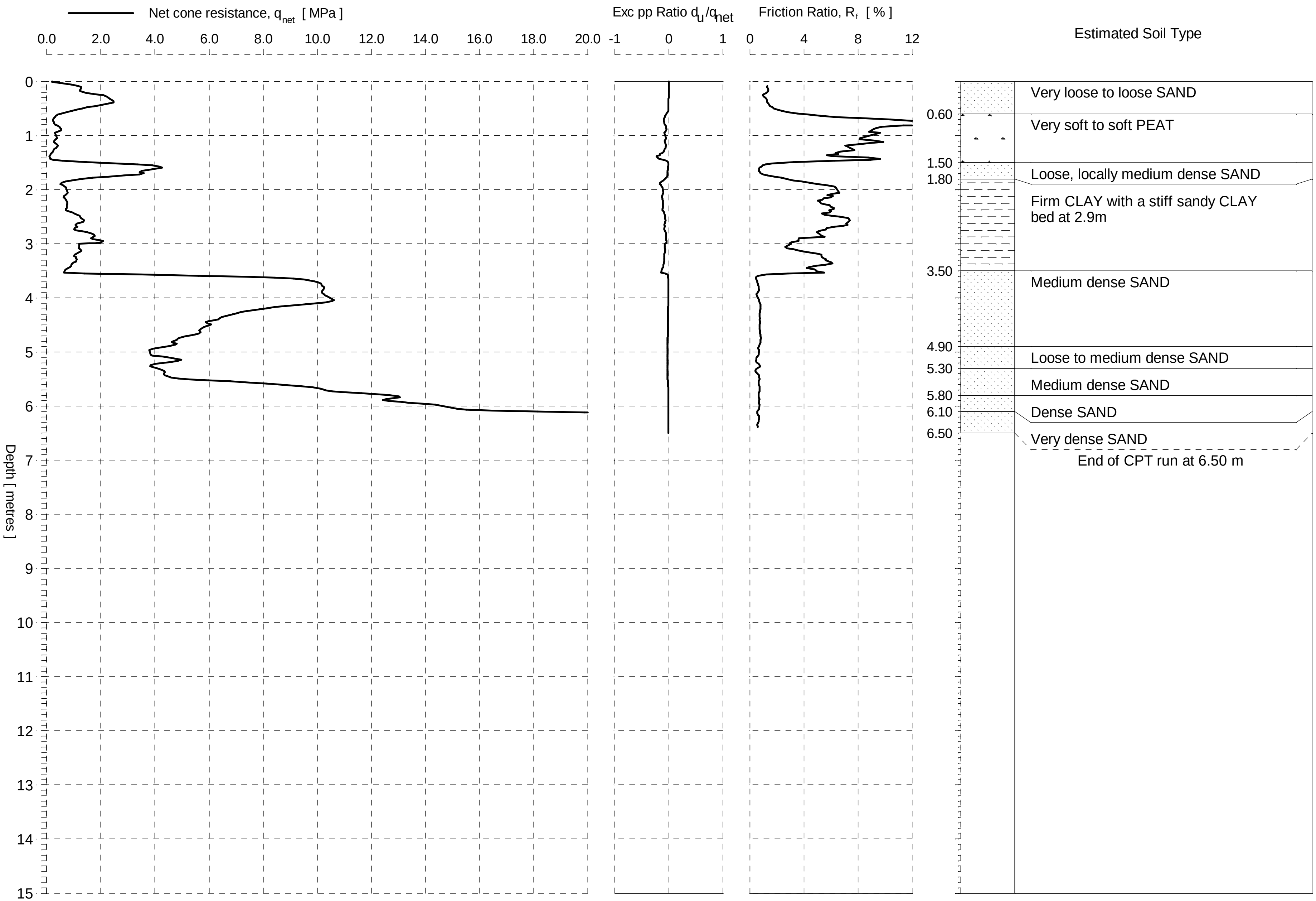
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



Location:	CPT14	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

STATIC CONE PENETRATION TEST CPT14



Location:	CPT14	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

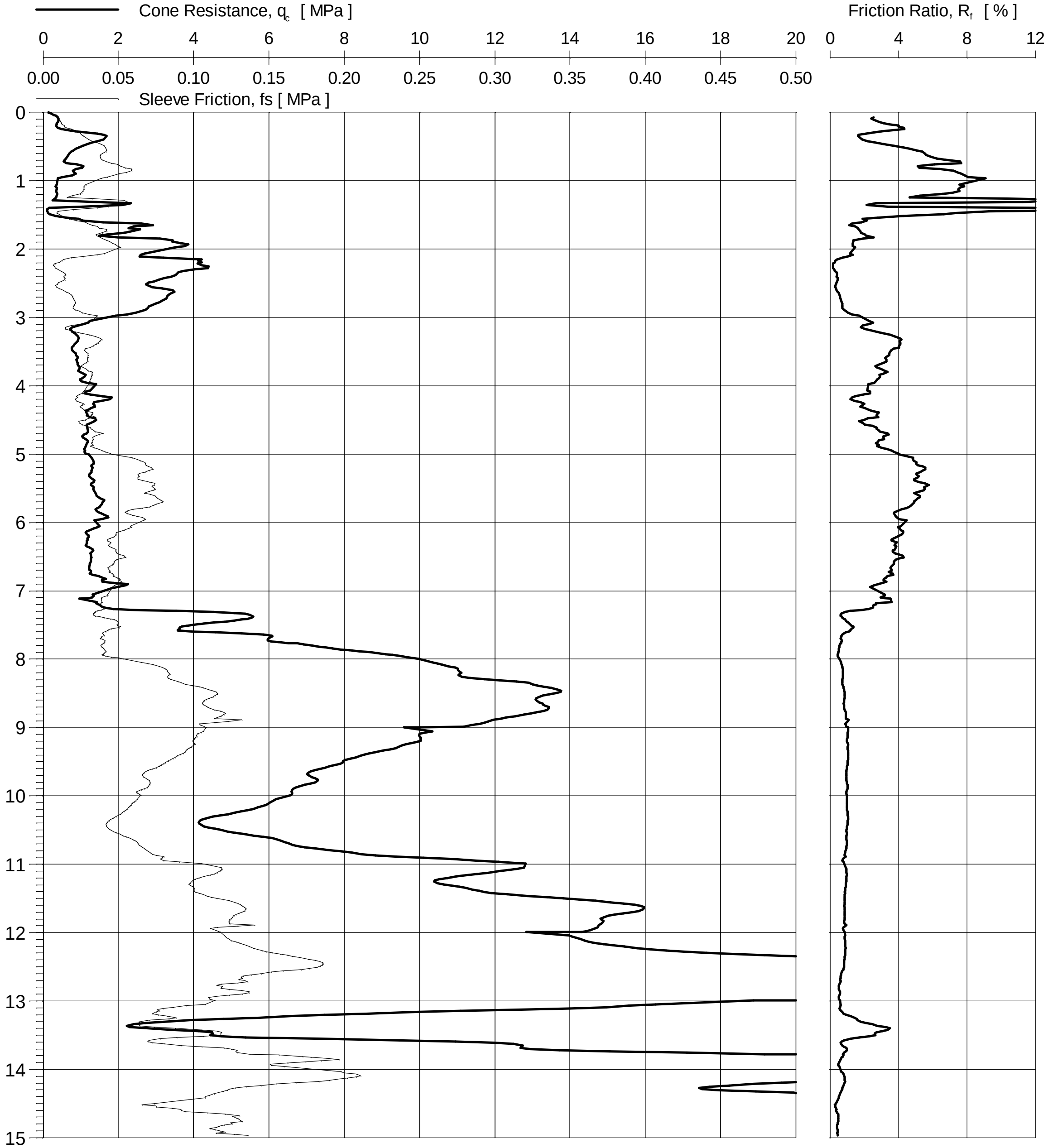
FUGRO

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

STATIC CONE PENETRATION TEST CPT17

Contract No:CPT091107

Checked by: Date: Approved by: Date:



Estimated Soil Type

Depth (m)	Description
0.50	Very loose silty SAND with a soft clay bed at 0.3m
1.50	Firm becoming very soft organic CLAY and peat with a loose silty sand bed at 1.4m
2.10	Very loose to loose SAND, locally silty
3.00	Loose to medium dense GRAVEL and sand
5.00	Firm SILT with very loose silty sand beds
7.30	Firm to stiff CLAY, locally sandy with a loose silty sand bed at 7.0m
8.30	Medium dense SAND with a loose silty SAND bed at 7.5m
8.90	Dense SAND
11.40	Medium dense SAND with a dense SAND bed at 11.0m
12.40	Dense SAND
13.30	Very dense SAND becoming medium dense silty SAND
13.50	Stiff becoming very stiff sandy CLAY
14.40	Dense to very dense SAND

Continued next sheet

Location:	CPT17	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

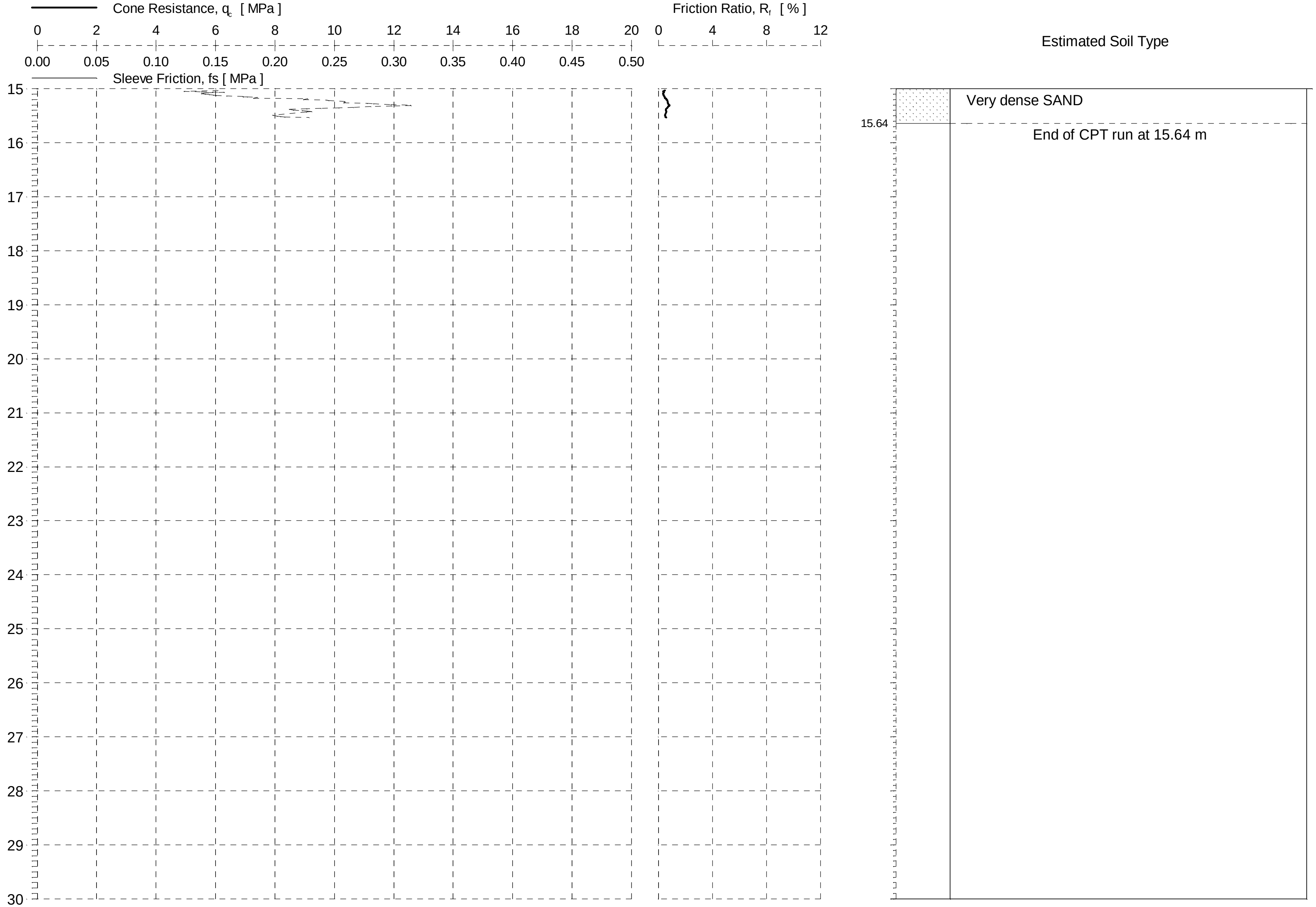
FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT17

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



Location:	CPT17	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

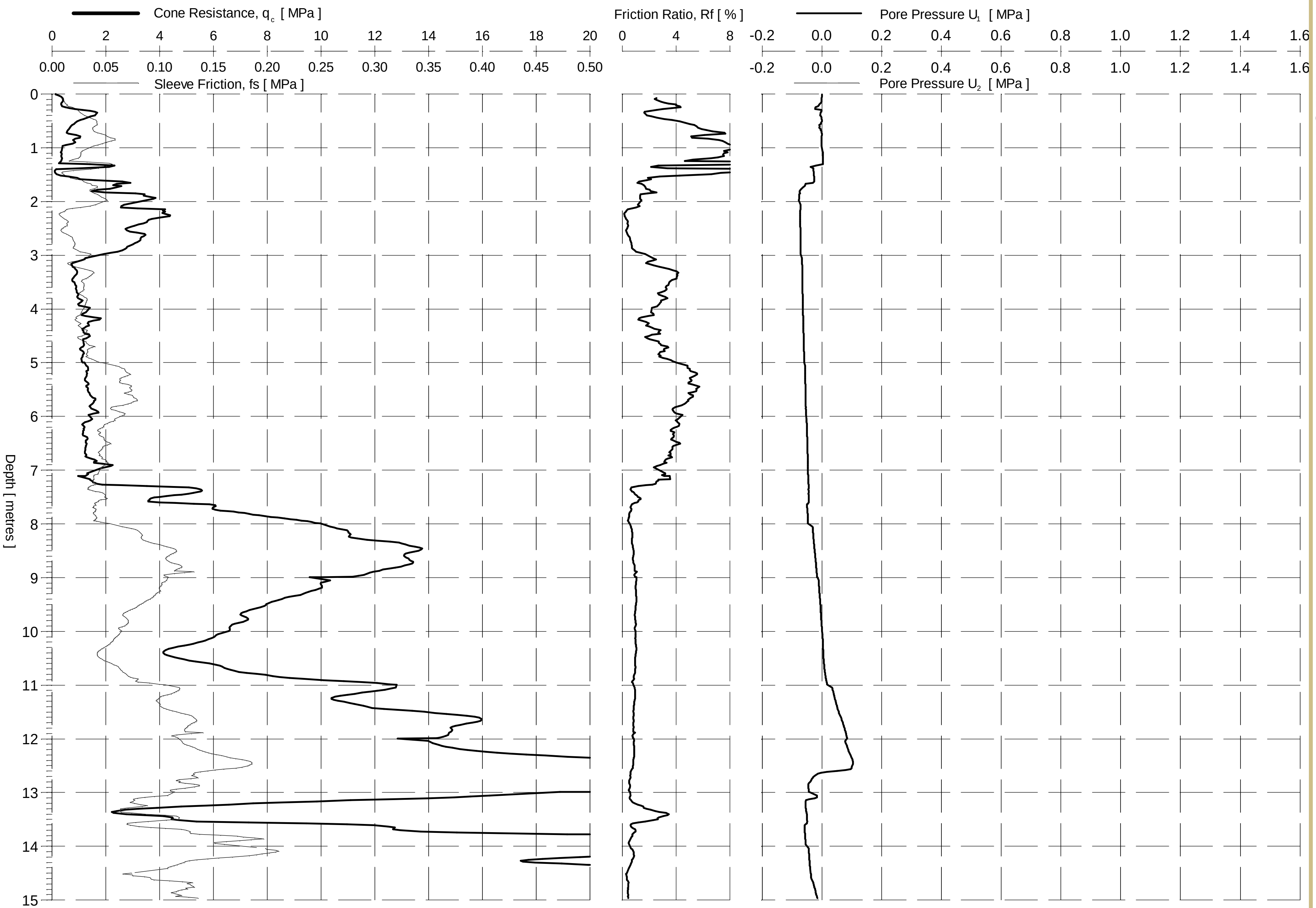
FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT17

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:

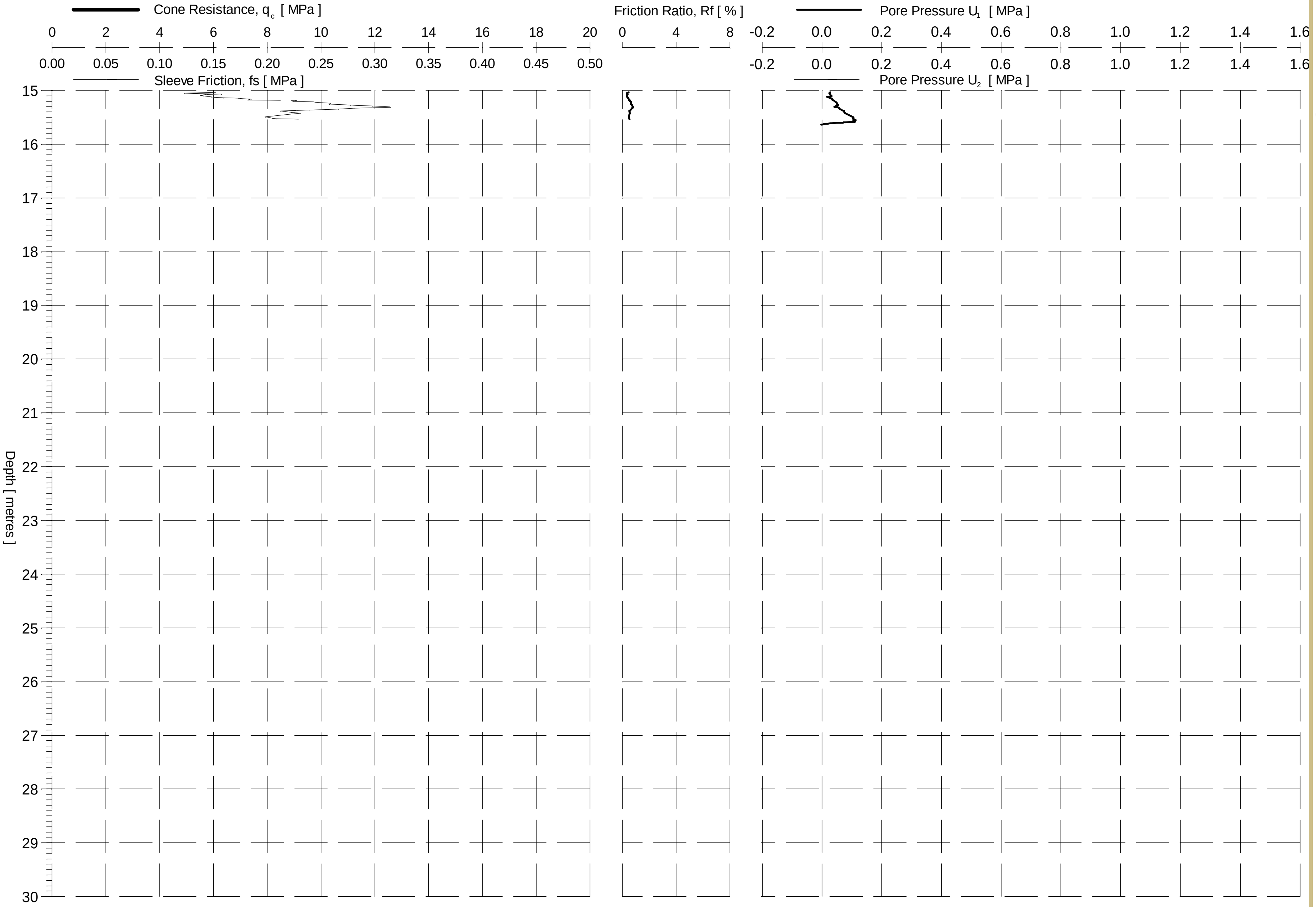


Location:	CPT17	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT17

Checked by: Date: Approved by: Date:



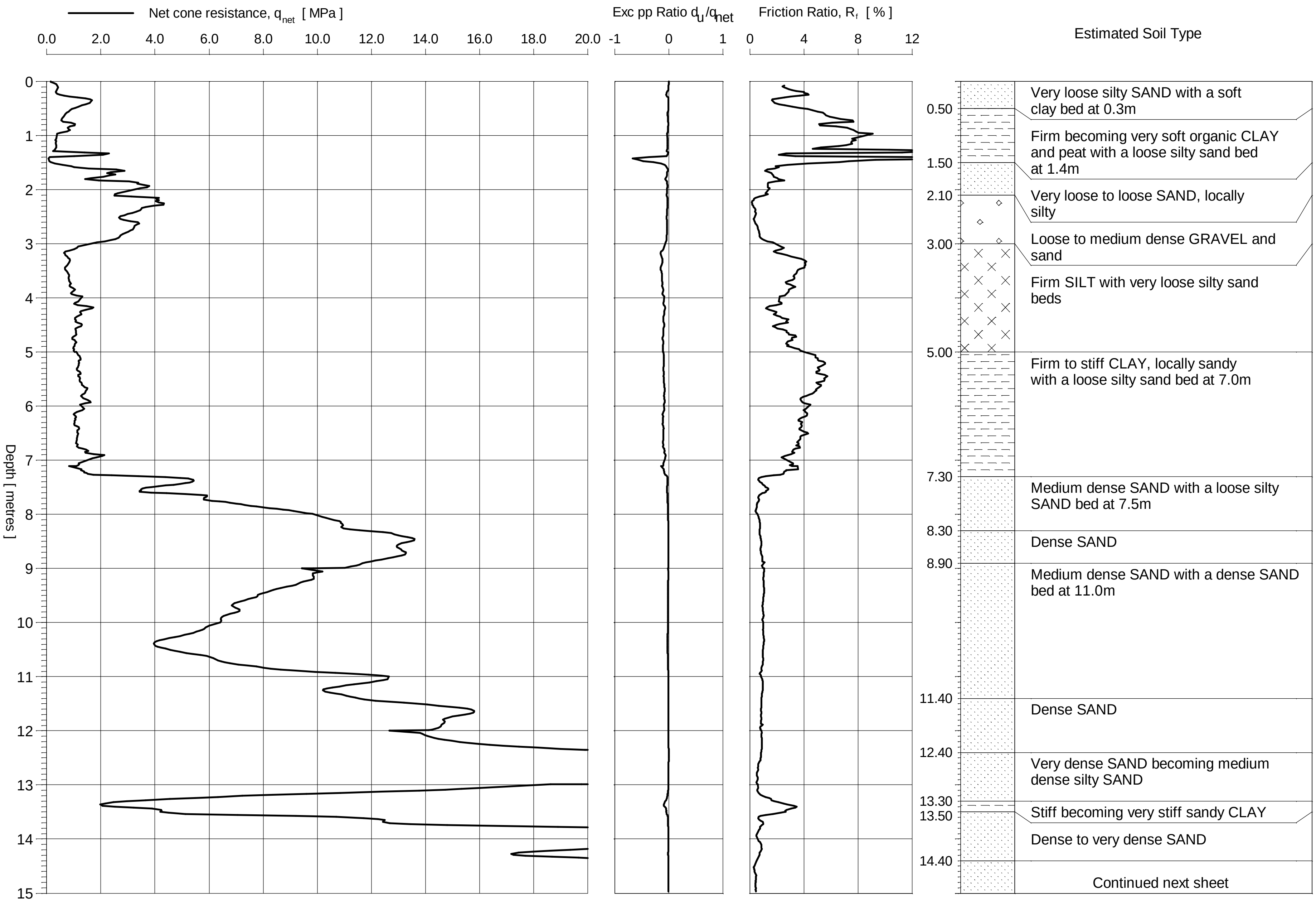
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Location:	CPT17	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT17



Location:	CPT17	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

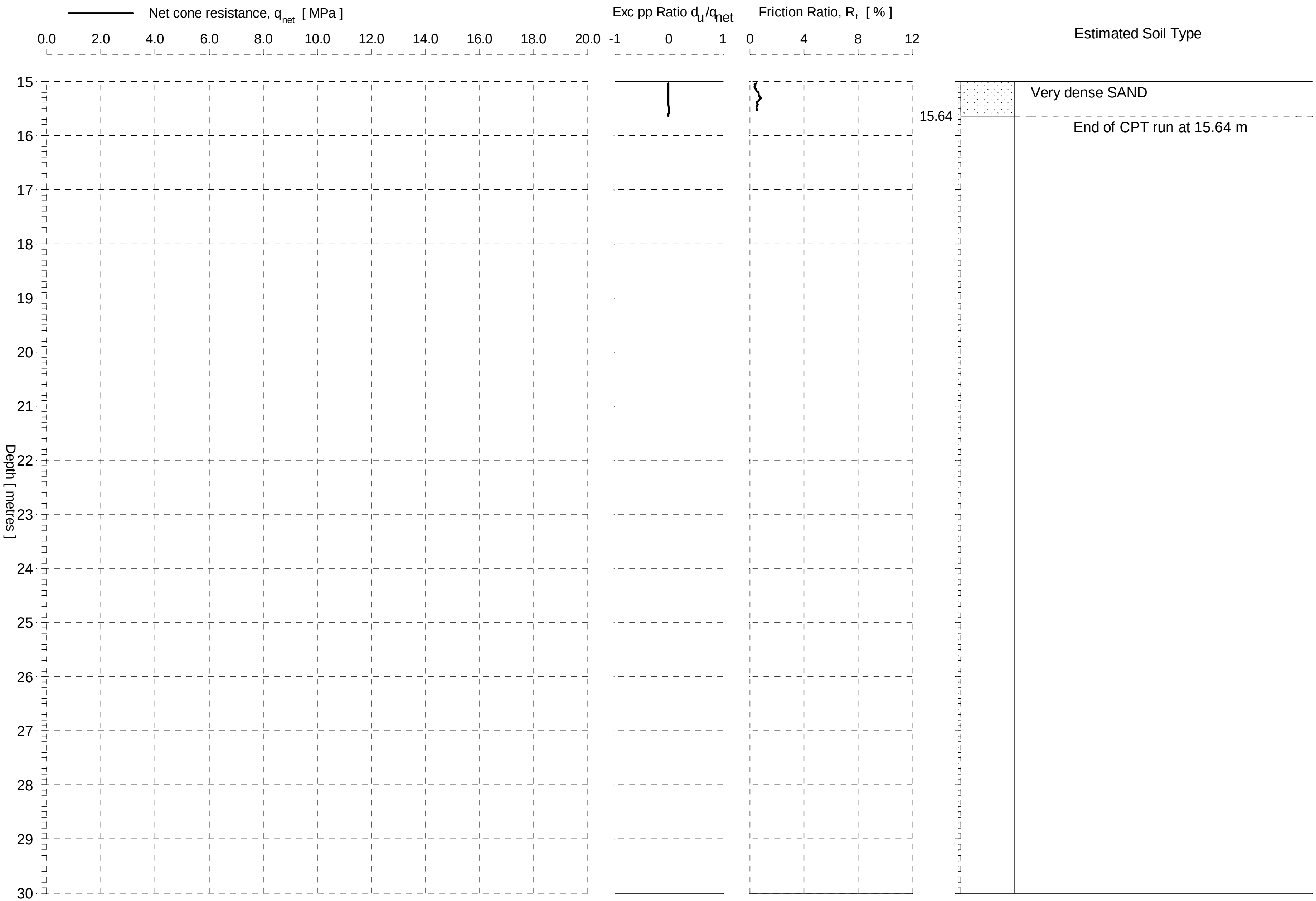
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

FUGRO

STATIC CONE PENETRATION TEST CPT17

Contract No:CPT091107

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM



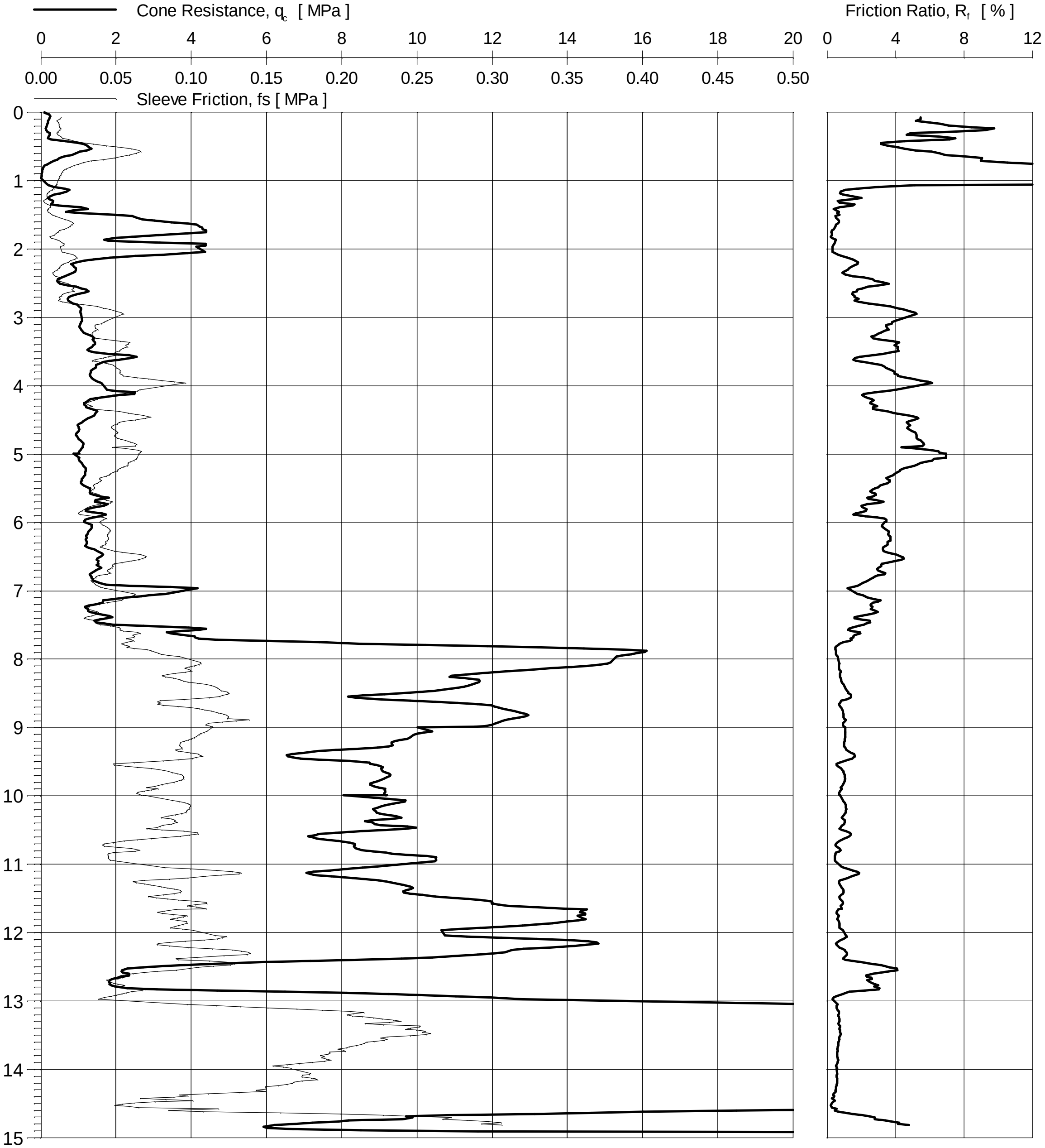
Location:	CPT17	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT19

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



Estimated Soil Type

Depth (m)	Estimated Soil Type
	Very soft to soft CLAY with a firm CLAY bed at 0.5m
1.10	Soft becoming firm SILT
1.50	Loose to medium dense SAND, locally gravelly, with a very loose SAND bed at 1.9m
2.10	Firm, locally soft SILT
2.80	Firm, locally stiff CLAY, locally sandy with firm silt beds at 3.3m and 4.3m and loose silty sand beds at 3.6m and 4.1m
4.40	Firm CLAY
5.50	Interbedded firm SILT and stiff clay with very loose silty sand beds at 5.7m and 5.9m and a medium dense sand bed at 7.0m
7.50	Loose becoming medium dense silty SAND
7.80	Medium dense to dense SAND
9.00	Medium dense SAND with silty SAND beds at 9.5m and 11.1m
11.50	Medium dense to dense SAND
12.40	Very stiff becoming stiff CLAY, locally sandy, with a loose silty sand bed at 12.7m
12.80	Very dense SAND, locally gravelly, with a medium dense SAND bed at 12.9m
14.60	Continued next sheet
14.94	

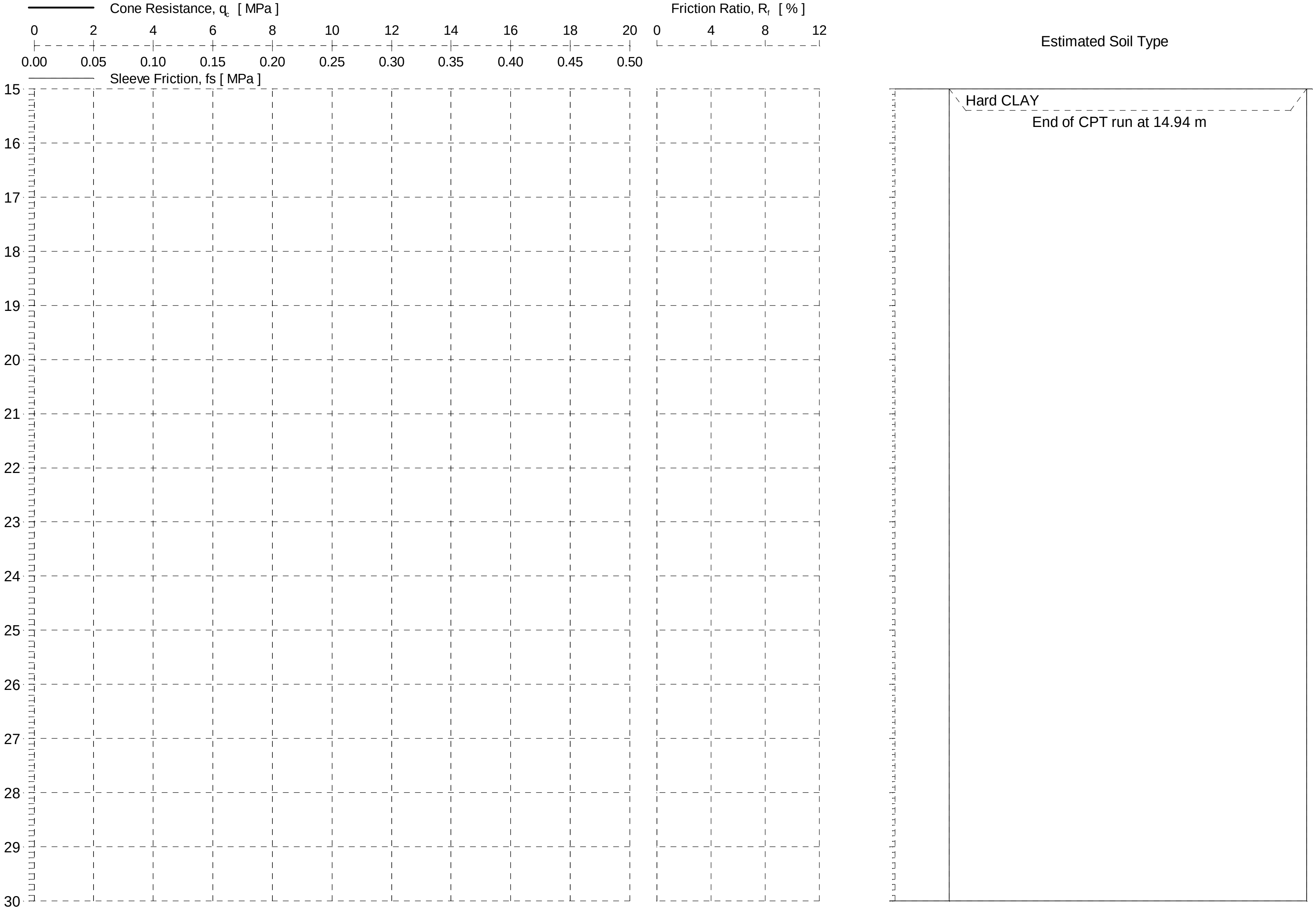
Location:	CPT19	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT19

Checked by: Date: Approved by: Date:



Location:	CPT19	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

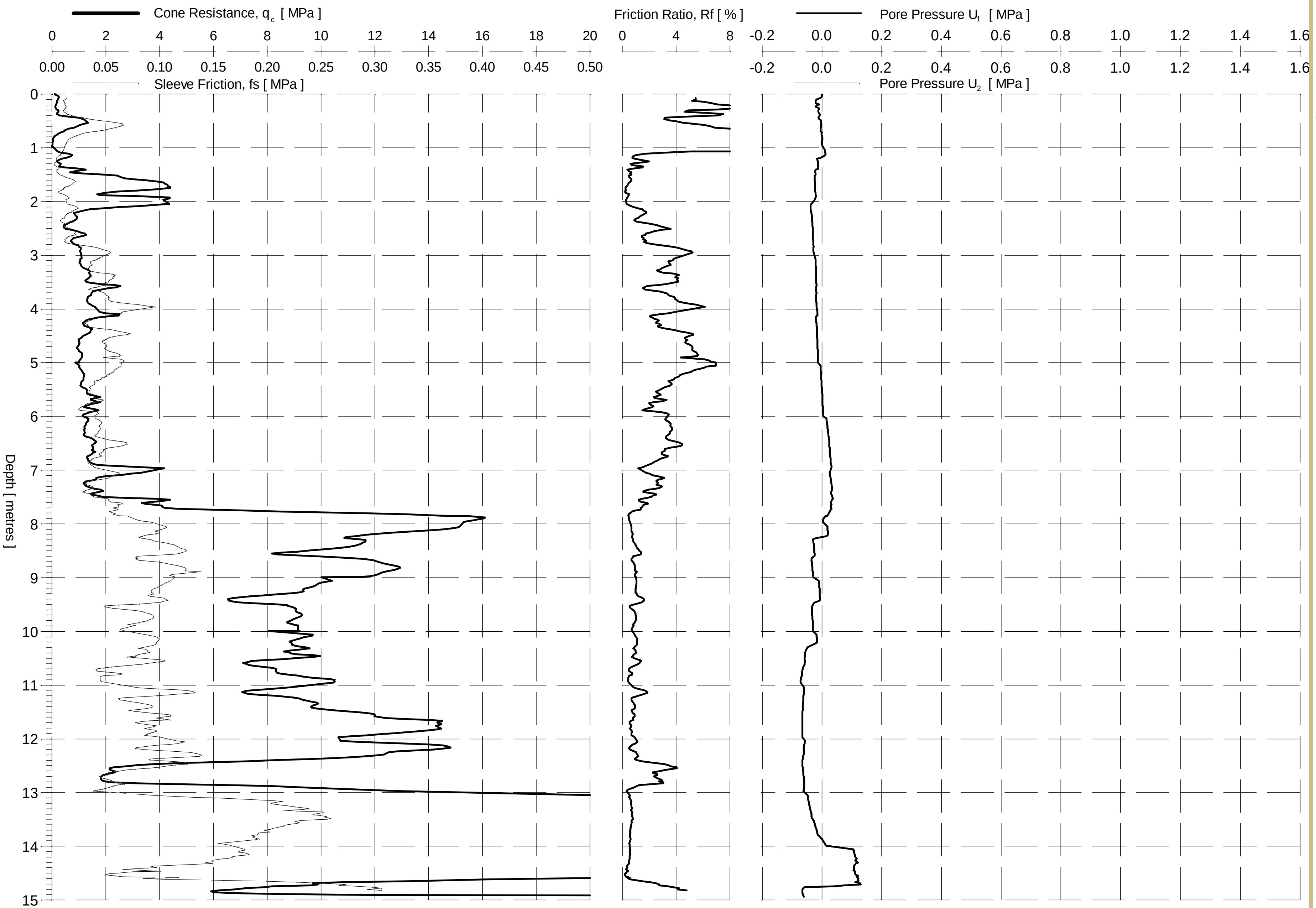
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT19

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:

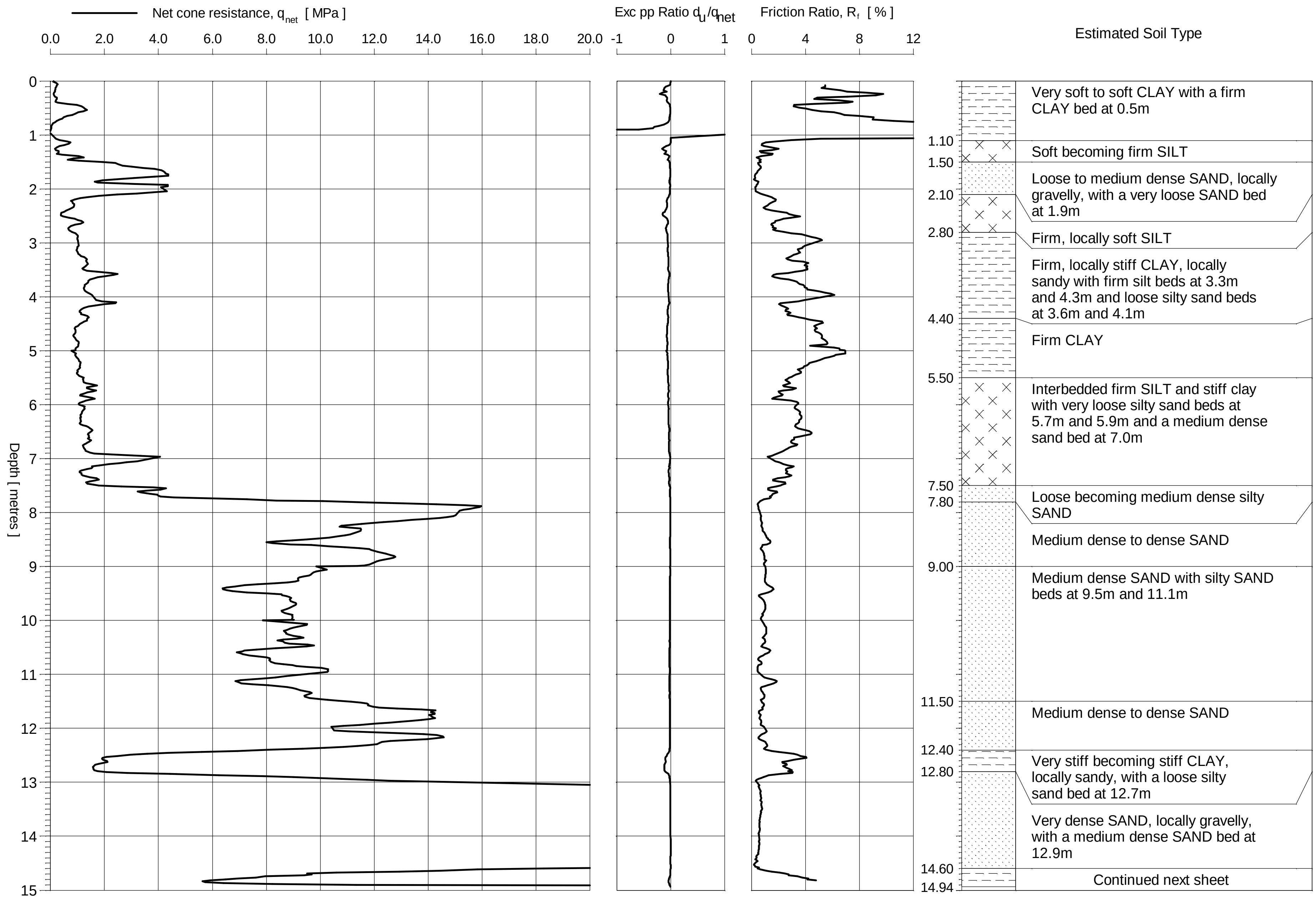


Location:	CPT19	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT19

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM



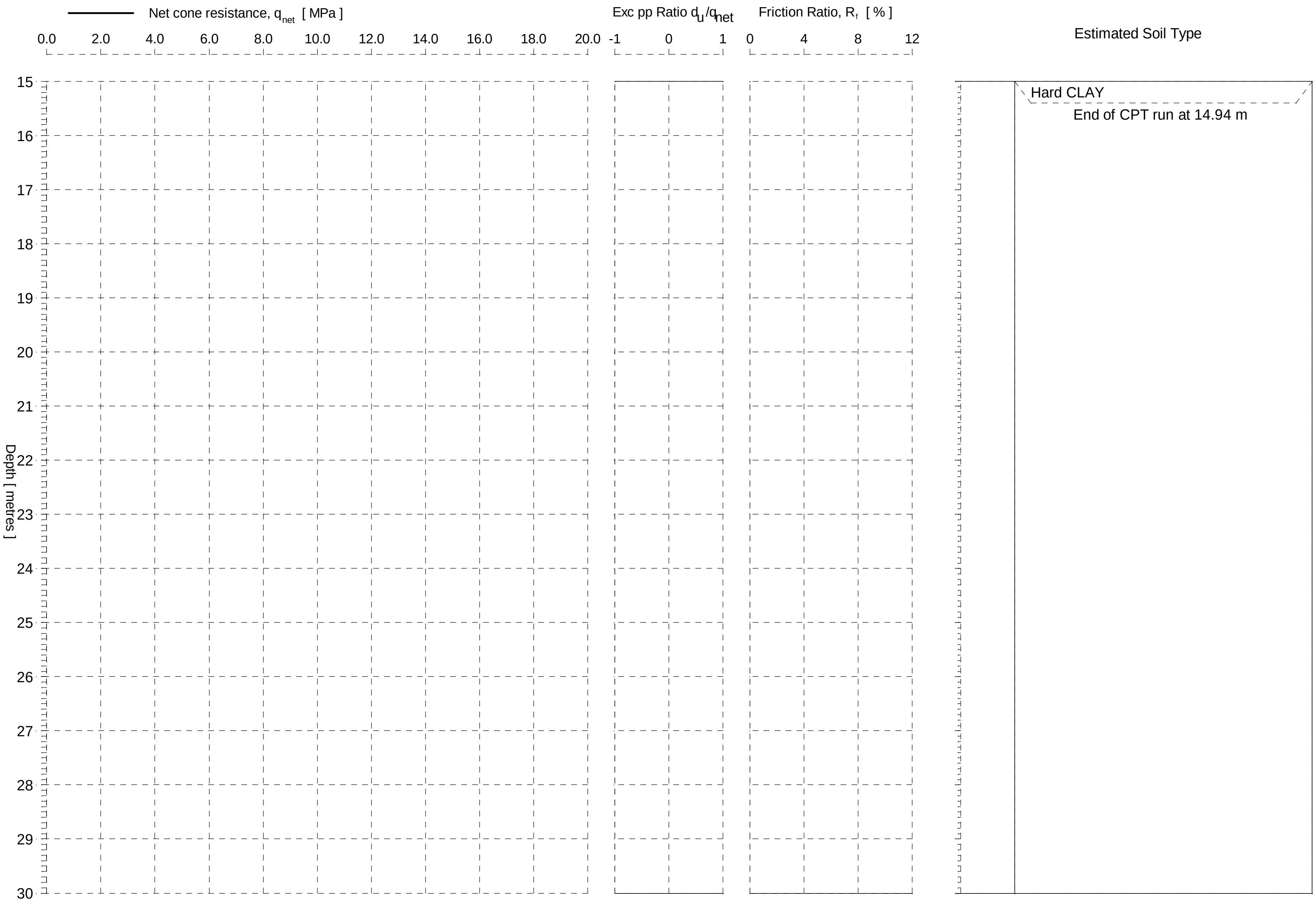
Location:	CPT19	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT19

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM



Location:	CPT19	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

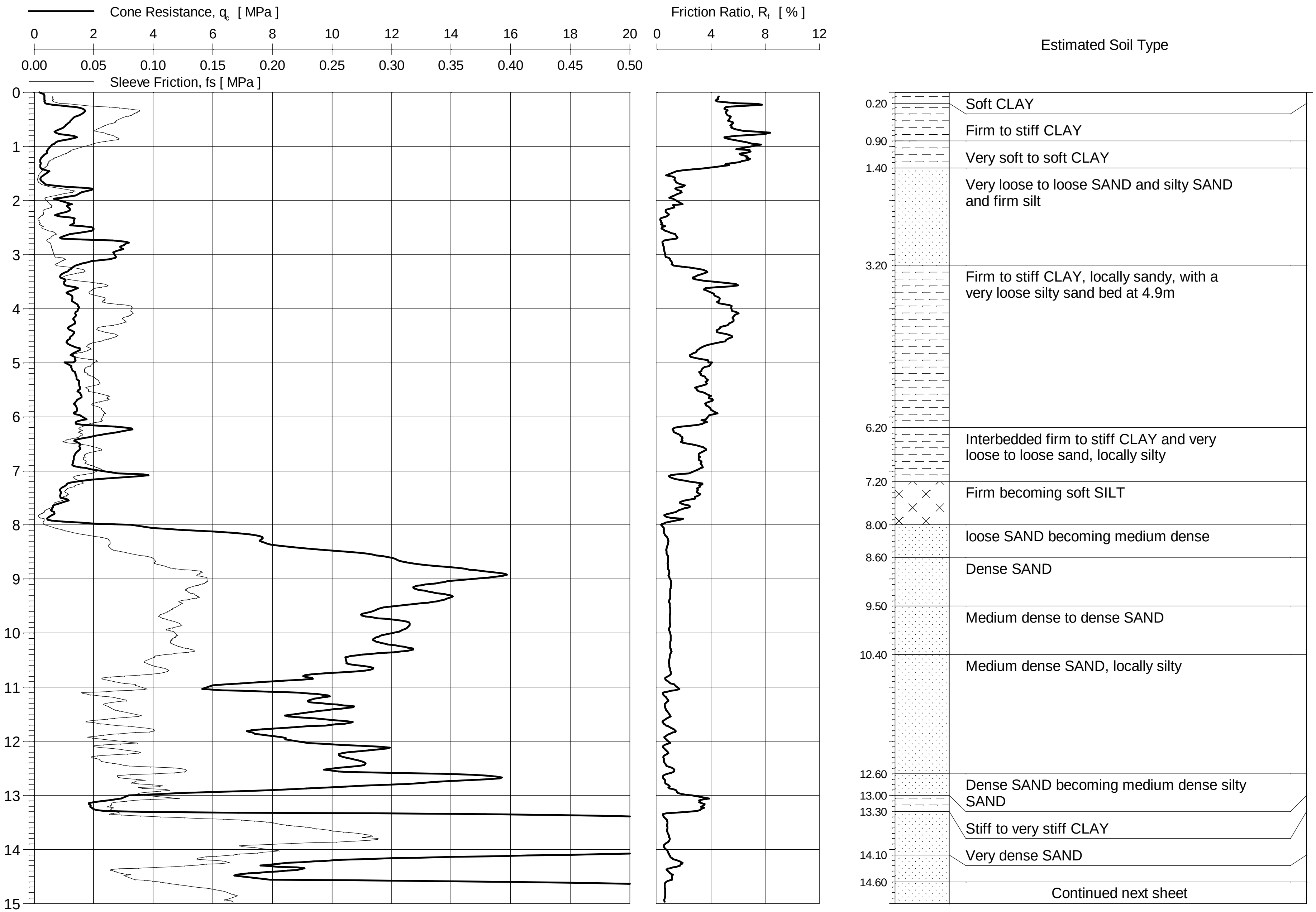
FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT20

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



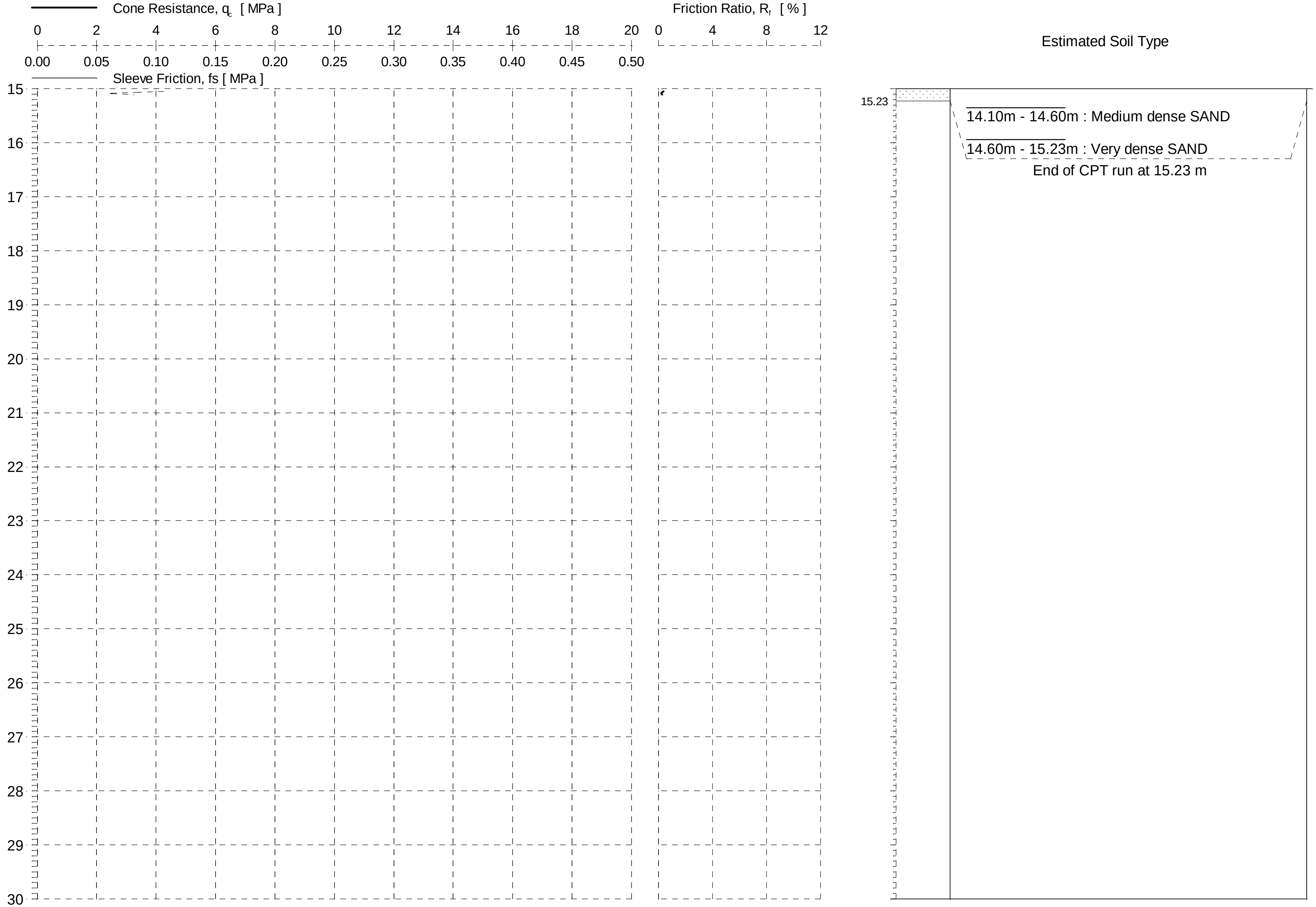
Location:	CPT20	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT20

Checked by: Date: Approved by: Date:



Location:	CPT20	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

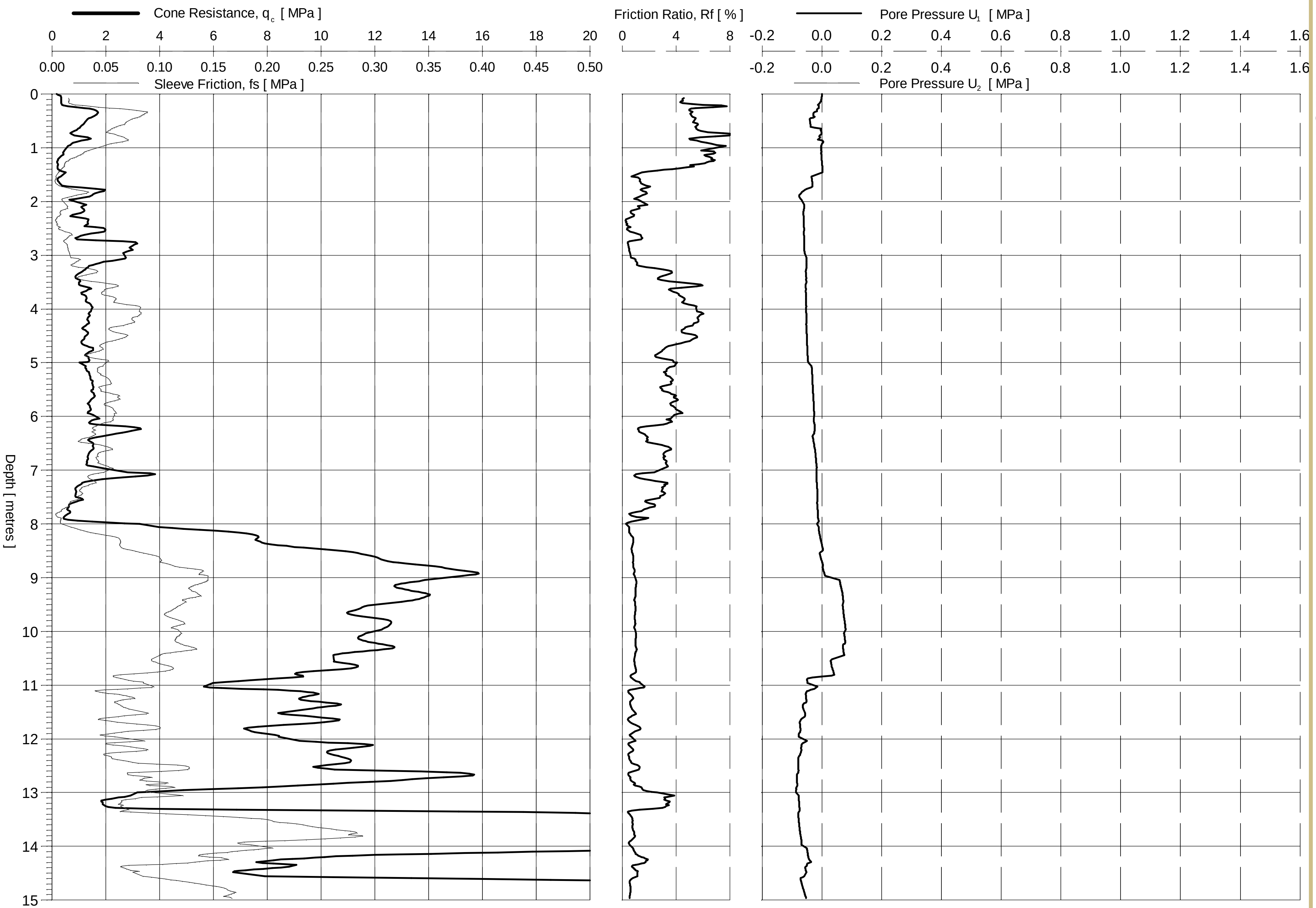
MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT20

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



Location:	CPT20	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

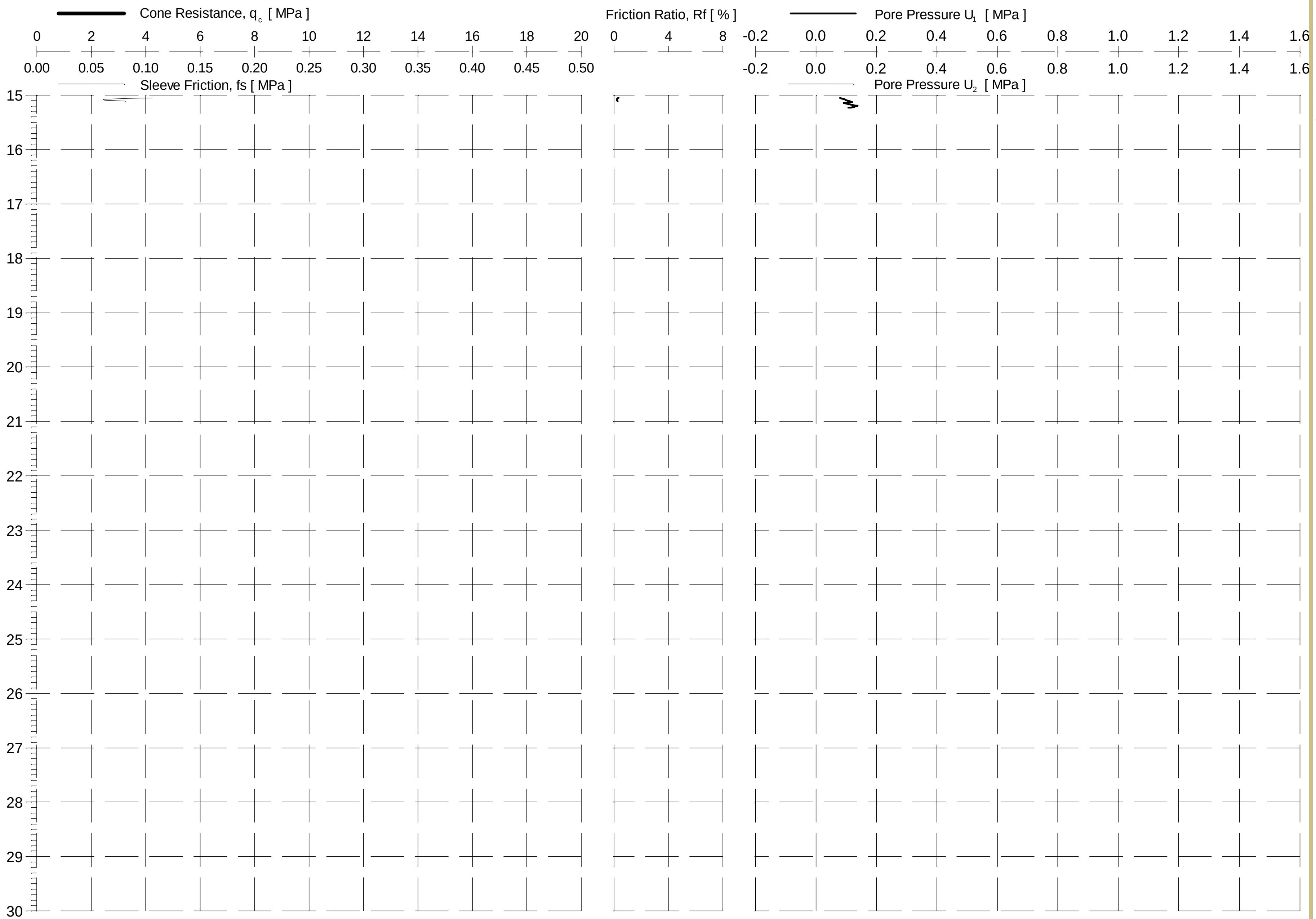
FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT20

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:

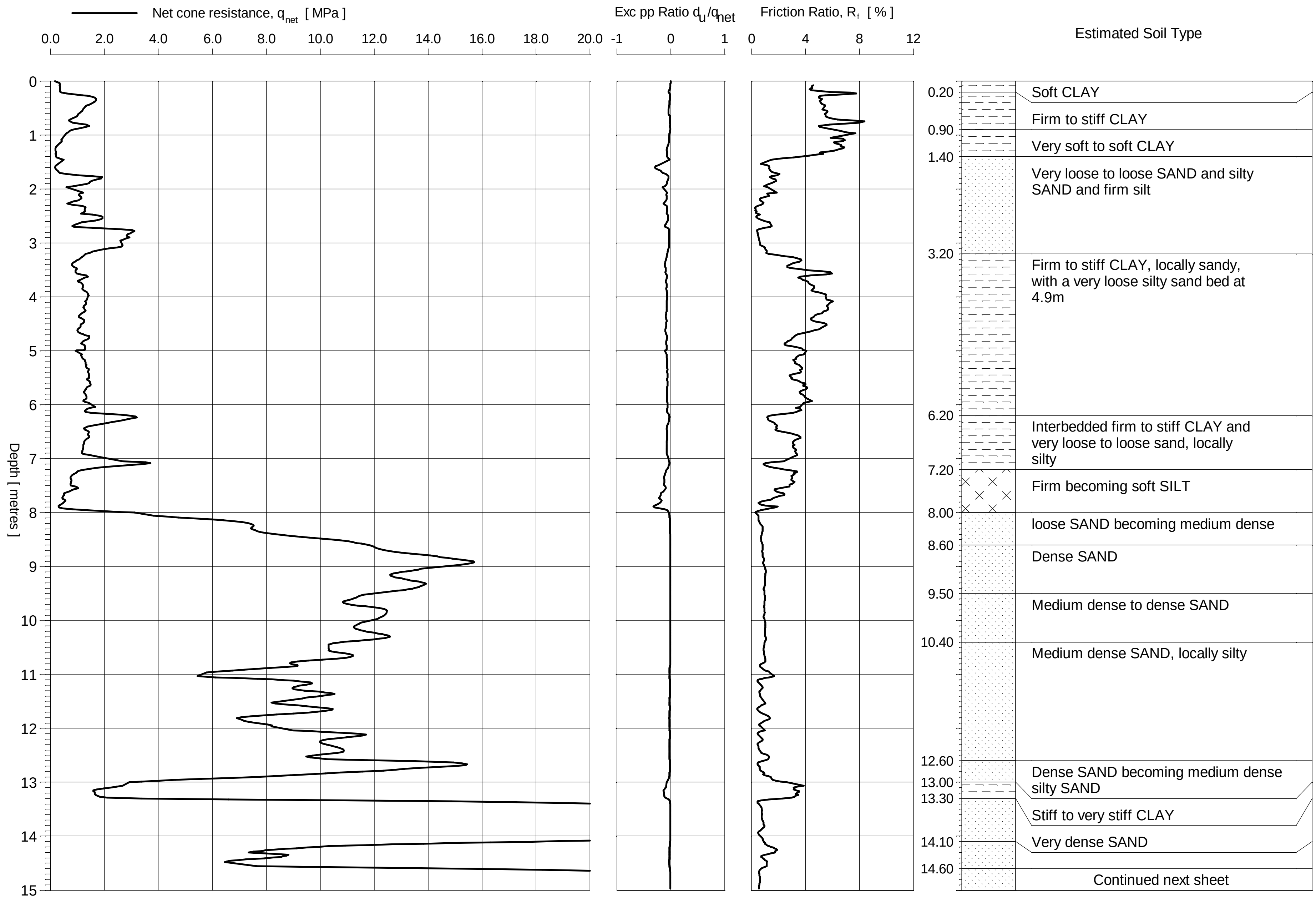


Location:	CPT20	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

STATIC CONE PENETRATION TEST CPT20

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Contract No:CPT091107



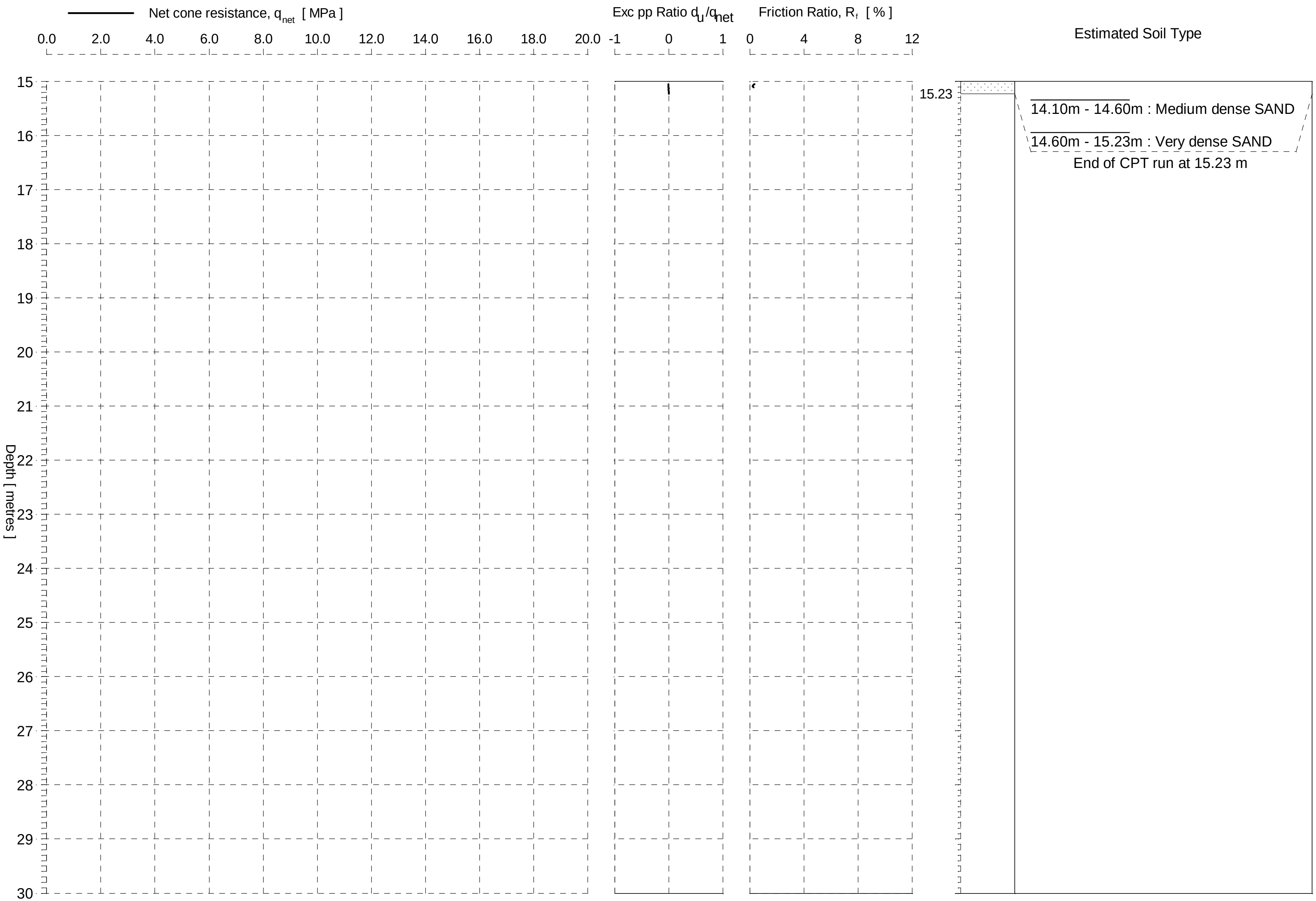
Location:	CPT20	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT20

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM



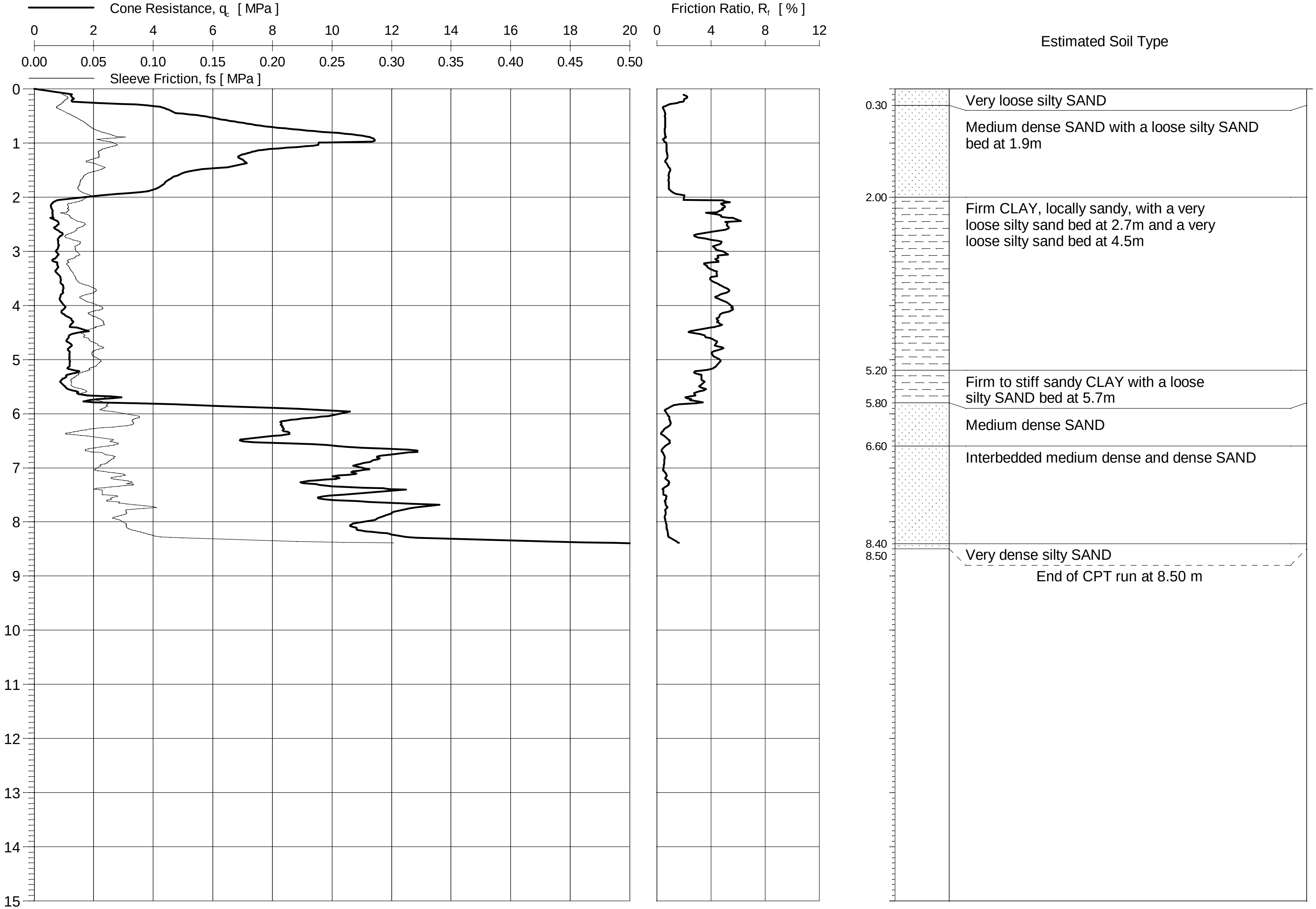
Location:	CPT20	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	17/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT22

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Checked by: Date: Approved by: Date:



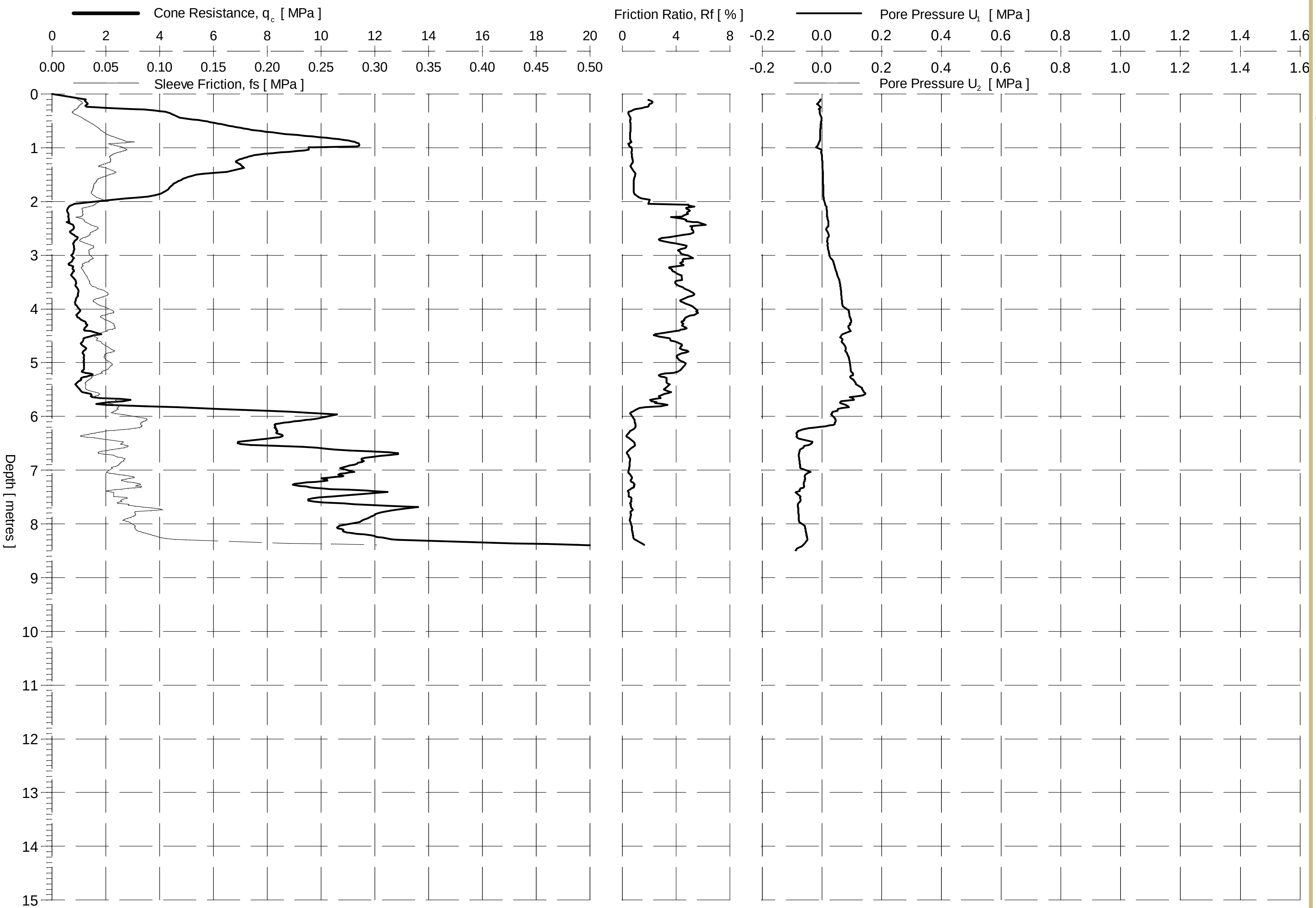
Location:	CPT22	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	16/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

FUGRO

Contract No:CPT091107

STATIC CONE PENETRATION TEST CPT22

Checked by: Date: Approved by: Date:

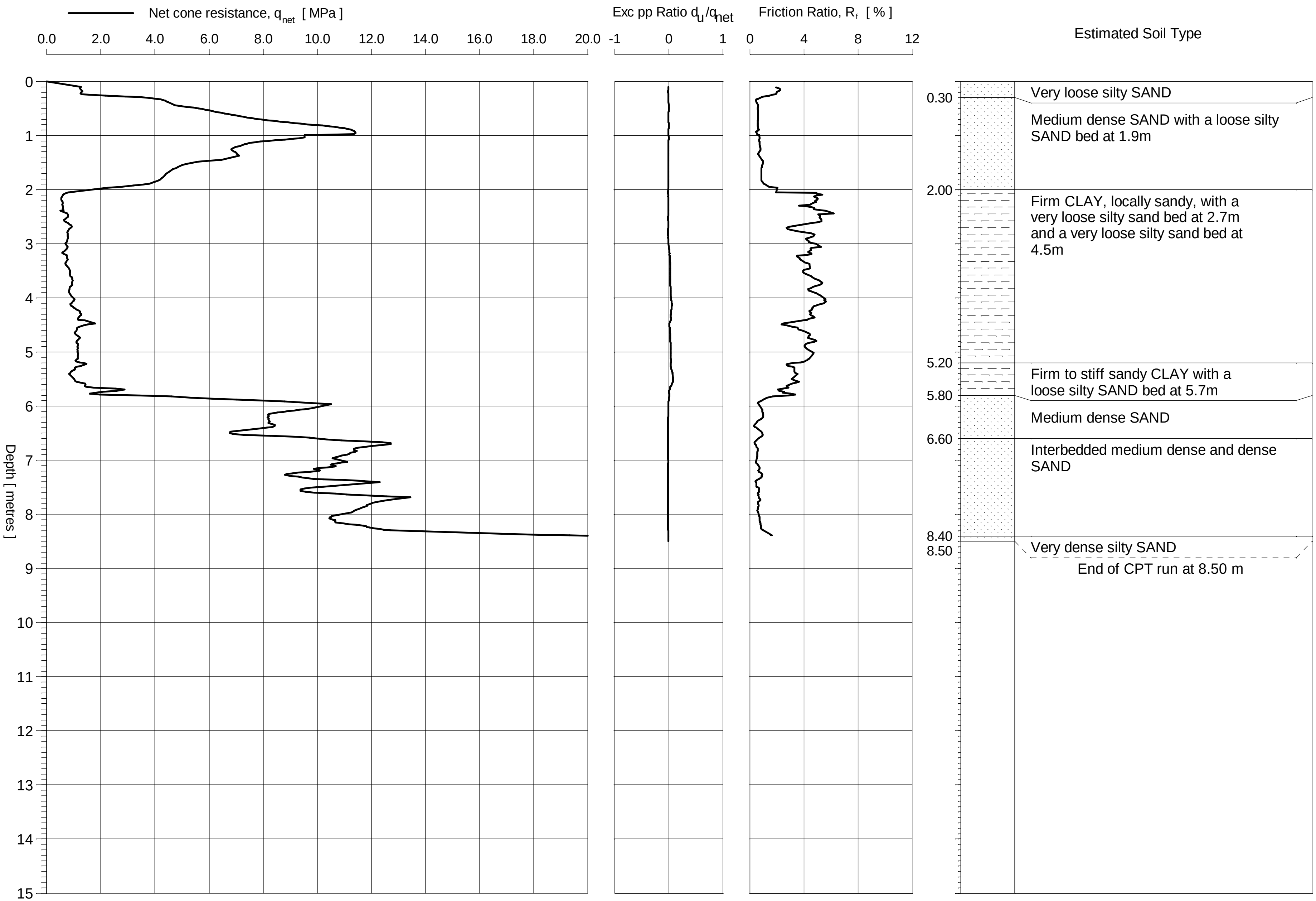


MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

Location:	CPT22	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	16/02/2009
Ground Level (metres) :	0.000	CPT Rig:	GB12

Contract No:CPT091107

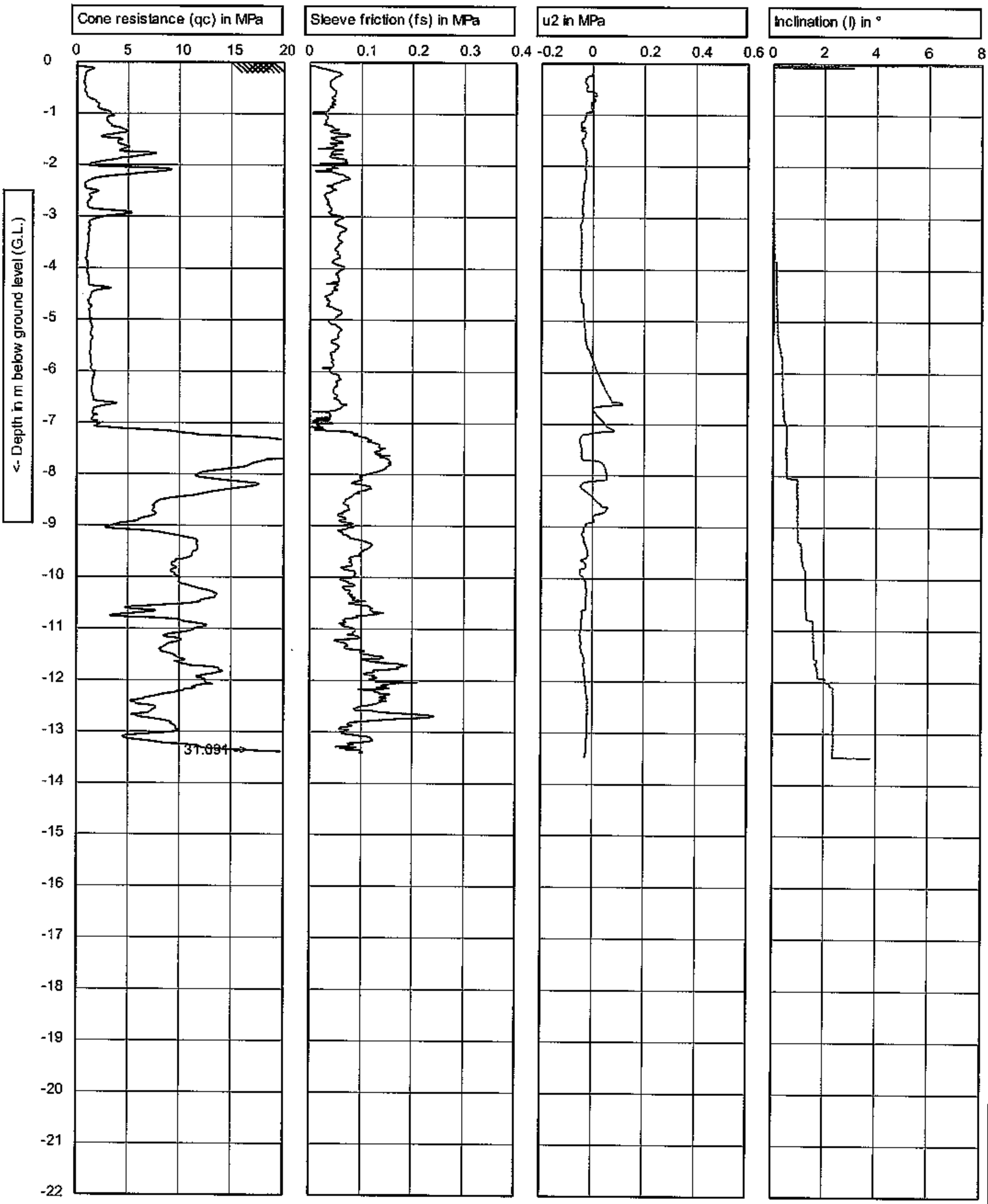
STATIC CONE PENETRATION TEST CPT22



Location:	CPT22	Operator:	NF/BR
Cone Used:	F7.5CKEH3SW2/B 1701-1274	Date of Test:	16/02/2009
		Interpretation checked by:	
Ground Level (metres) :	0.000	CPT Rig:	GB12

MORRISON CONSTRUCTION
TWEEN BRIDGE WINDFARM

FUGRO



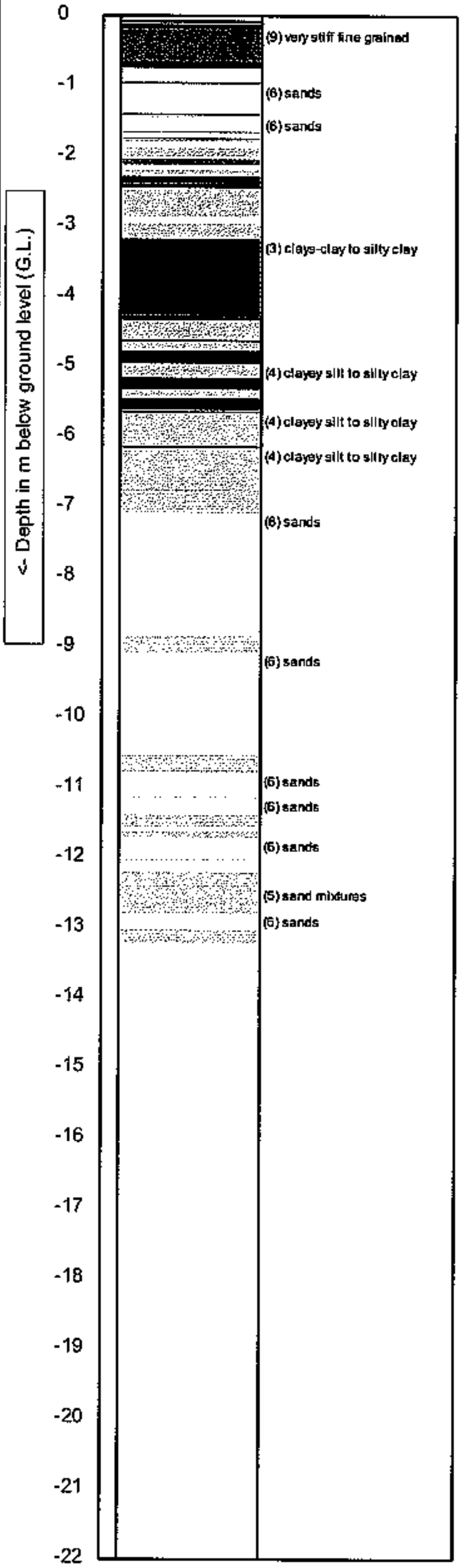
Preliminary Data

SM Geocone

u2; 150 cm²; 10 cm²	Test method BS 1377 : Part 9 : 1990 : 3.1	Pre drill :	**0**
G.L. : **0**	W.L. : **0**	Date :	**06/04/2009**
Project : **Client : Morrison Construction**		Cone no. :	**S10CFIP.361**
Location : **TWEEN BRIDGE WIND FARM, PHASE 2**		Project no. :	**M9015**
Position :		CPT no. :	**cpt_01** 1/3

CPTask V1.13

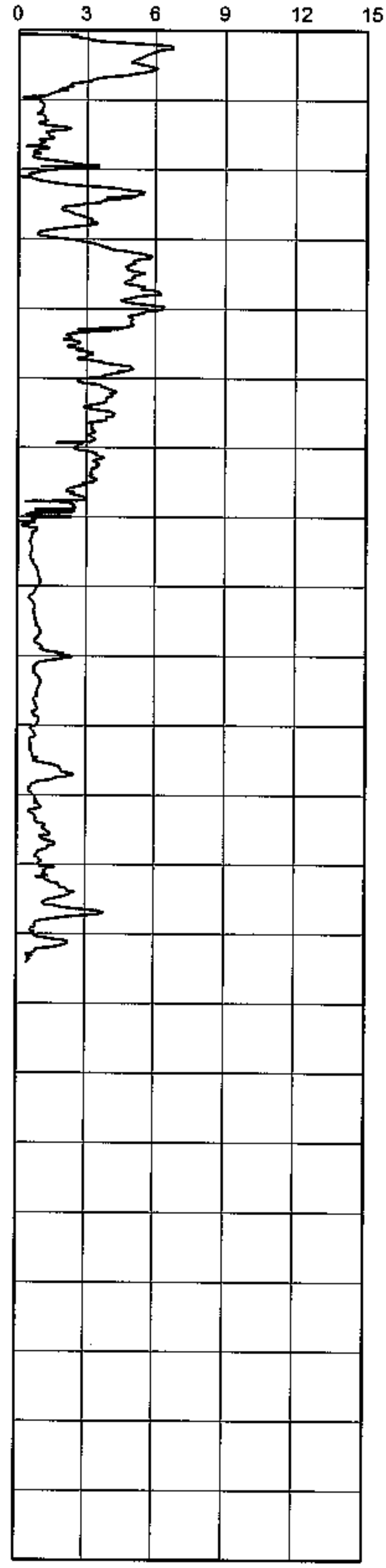
Soil Classification (using Fr)



(0) not defined
(1) sensitive, fine grained
(2) organic soils-peats
(3) clays-clay to silty clay
(4) clayey silt to silty clay
(5) sand mixtures

(7) gravelly sand to sand
(8) very stiff sand to clayey sand
(9) very stiff fine grained

Friction ratio (Rf) in %

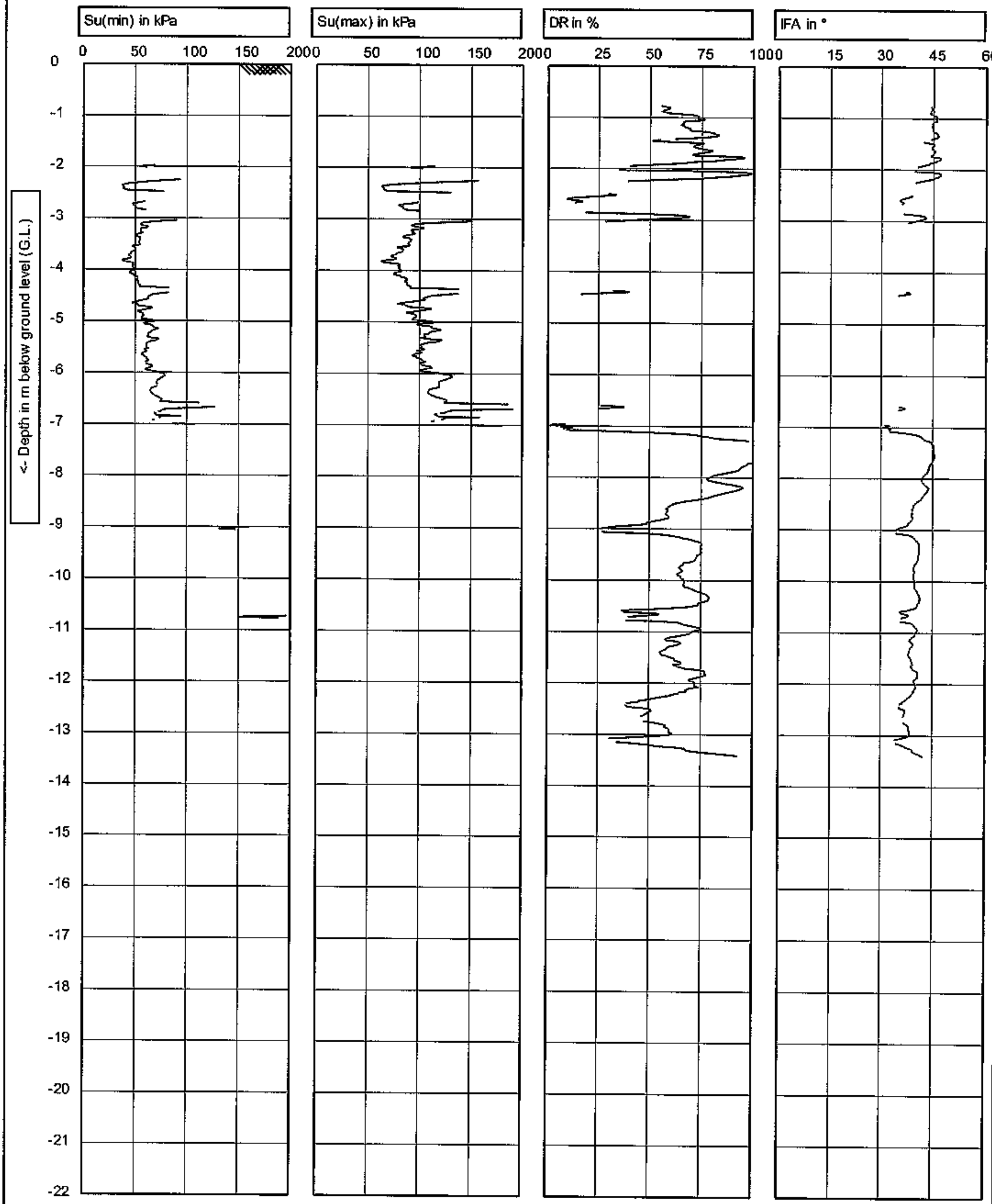


Preliminary Data

SM Geocone

u2 150 cm² 10 cm²	Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
	G.L. : 0	W.L. : 0	Date :	06/04/2009
Project :	Client : Morrison Construction		Cone no. :	S10CFIP.361
Location :	TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :			CPT no. :	cpt_01 2/3

CPTask V1.13

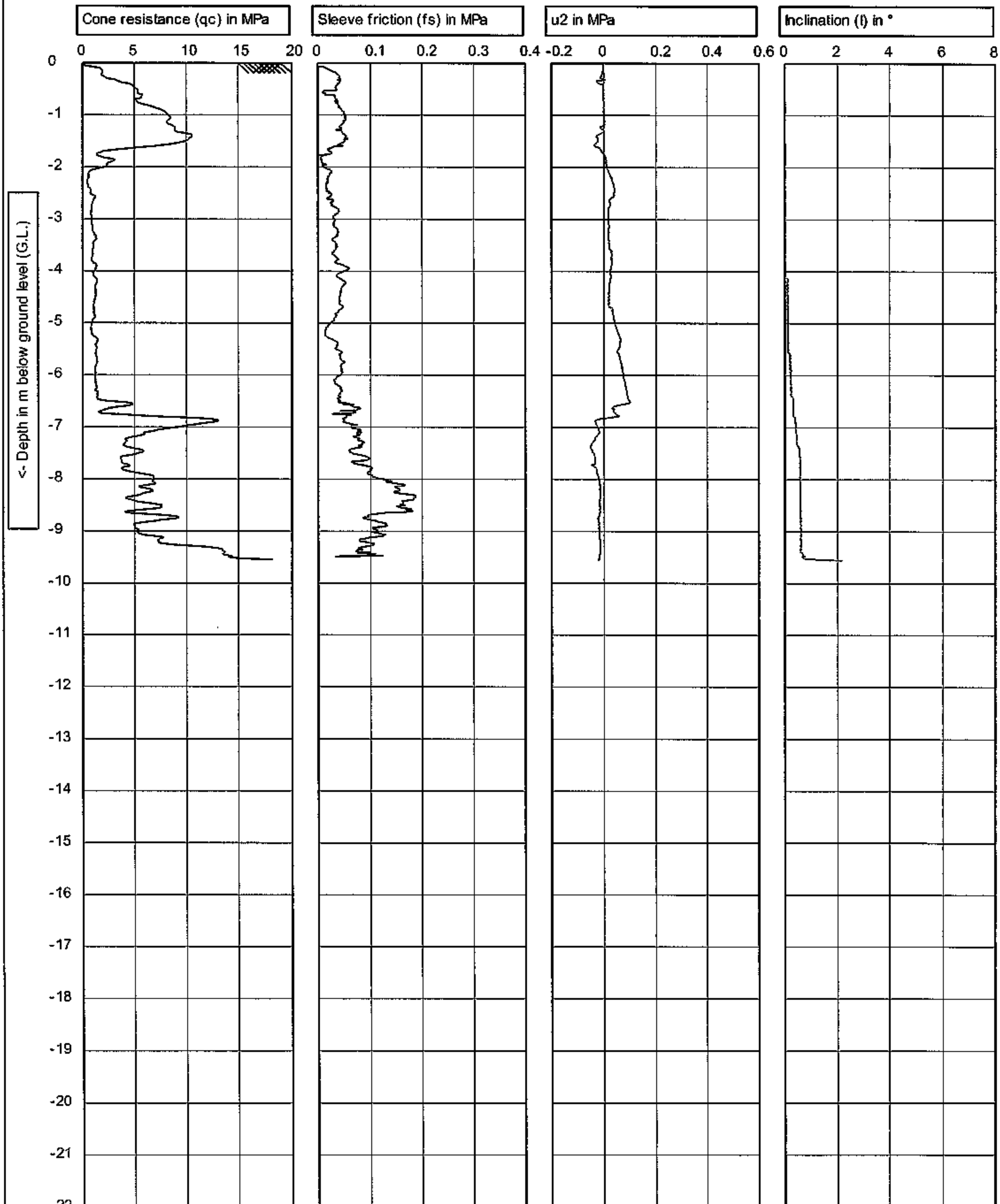


Preliminary Data

SM Geocone

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
G.L. : 0	W.L. : 0	Date :	06/04/2009
Project : Client : Morrison Construction		Cone no. :	S10CFIP.361
Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :		CPT no. :	cpt_01 3/3

CPTask V1.13



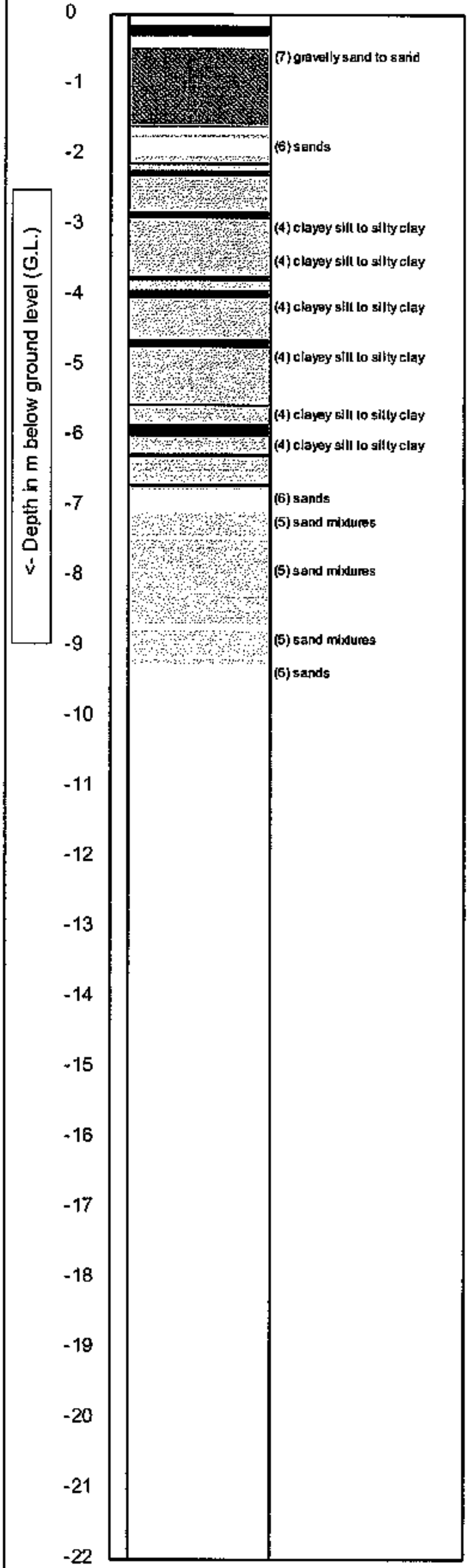
Preliminary Data

SM Geocone

Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0	
G.L. : **0**	W.L. : **0**	Date :	**06/04/2009**	
Project : **Client : Morrison Construction**		Cone no. :	**S10CFIP.361**	
Location : **TWEEN BRIDGE WIND FARM, PHASE 2**		Project no. :	**M9015**	
Position :		CPT no. :	**cpt_05**	**1/3**

CPTask V1.13

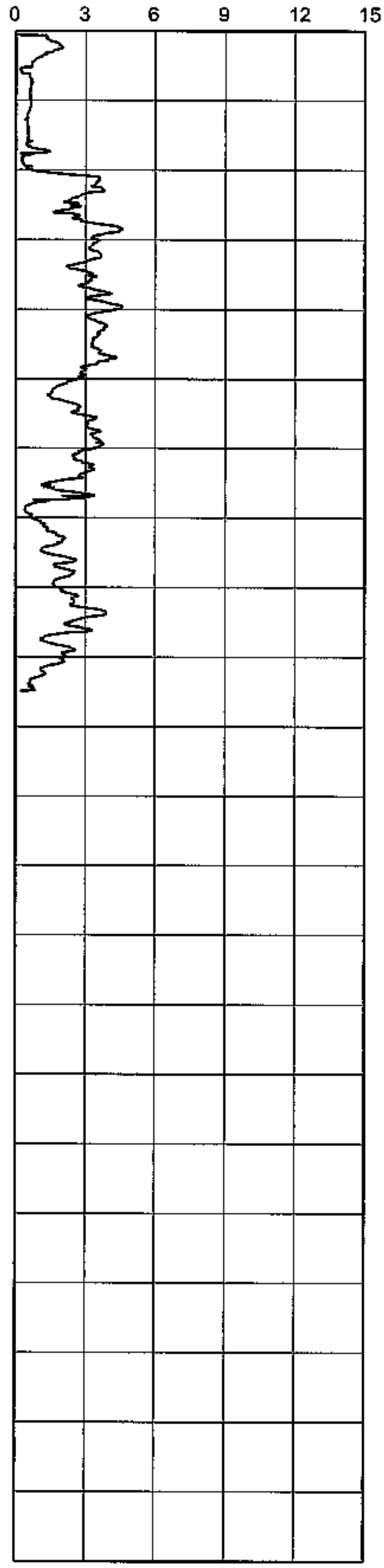
Soil Classification (using Fr)



(0) not defined
(1) sensitive, fine grained
(2) organic soils-peats
(3) clays-clay to silty clay
(4) clayey silt to silty clay
(5) sand mixtures

(7) gravelly sand to sand
(8) very stiff sand to clayey sand
(9) very stiff fine grained

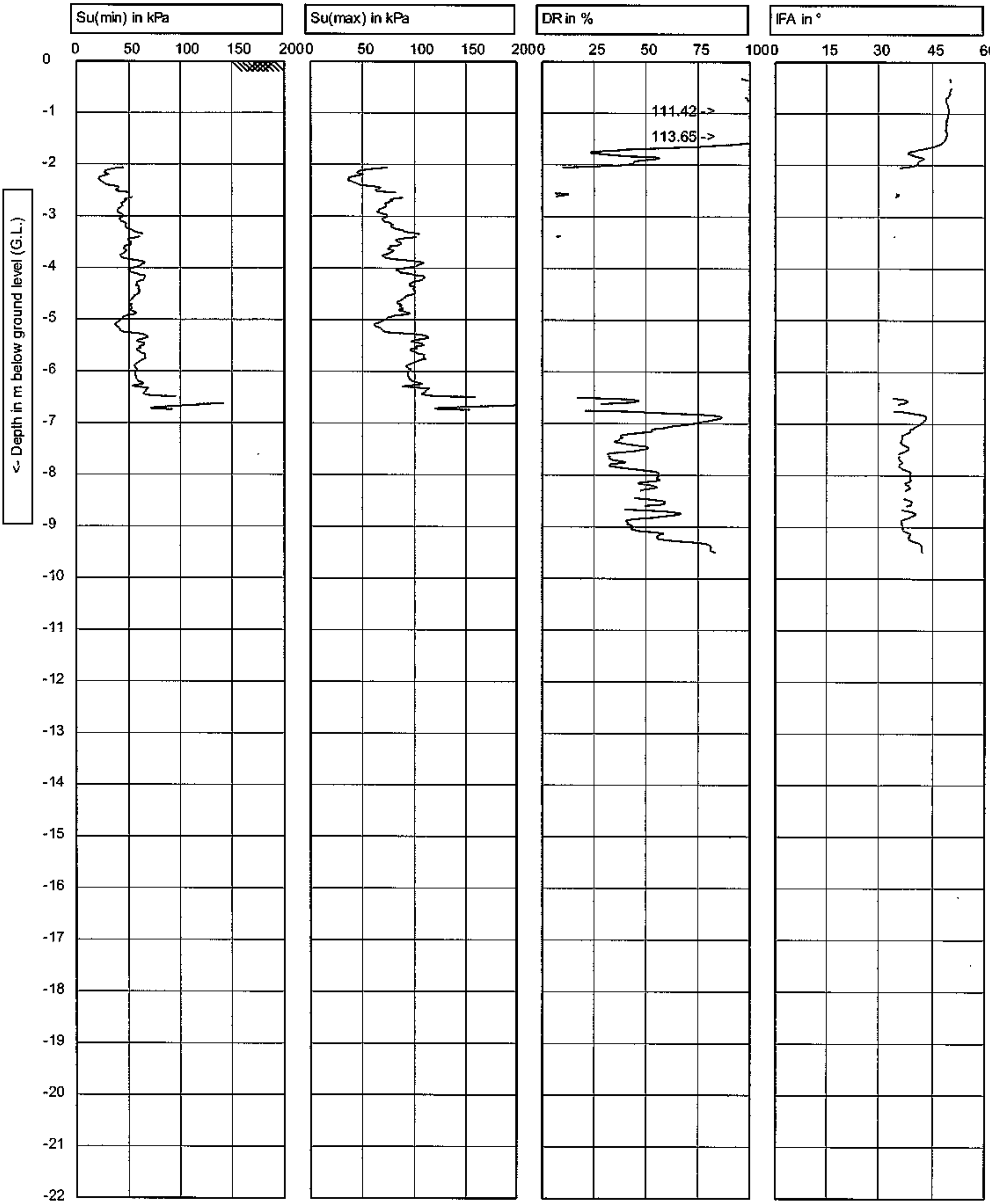
Friction ratio (Rf) in %



Preliminary Data

SM Geocone	u2 150 cm² 10 cm²	Test method BS 1377 : Part 9 : 1990 : 3.1	Pre drill :	0
		G.L. : **0** W.L. : **0**	Date :	**06/04/2009**
	Project :	**Client : Morrison Construction**	Cone no. :	**S10CFIP.361**
	Location :	**TWEEN BRIDGE WIND FARM, PHASE 2**	Project no. :	**M9015**
	Position :		CPT no. :	**cpt_05** 2/3

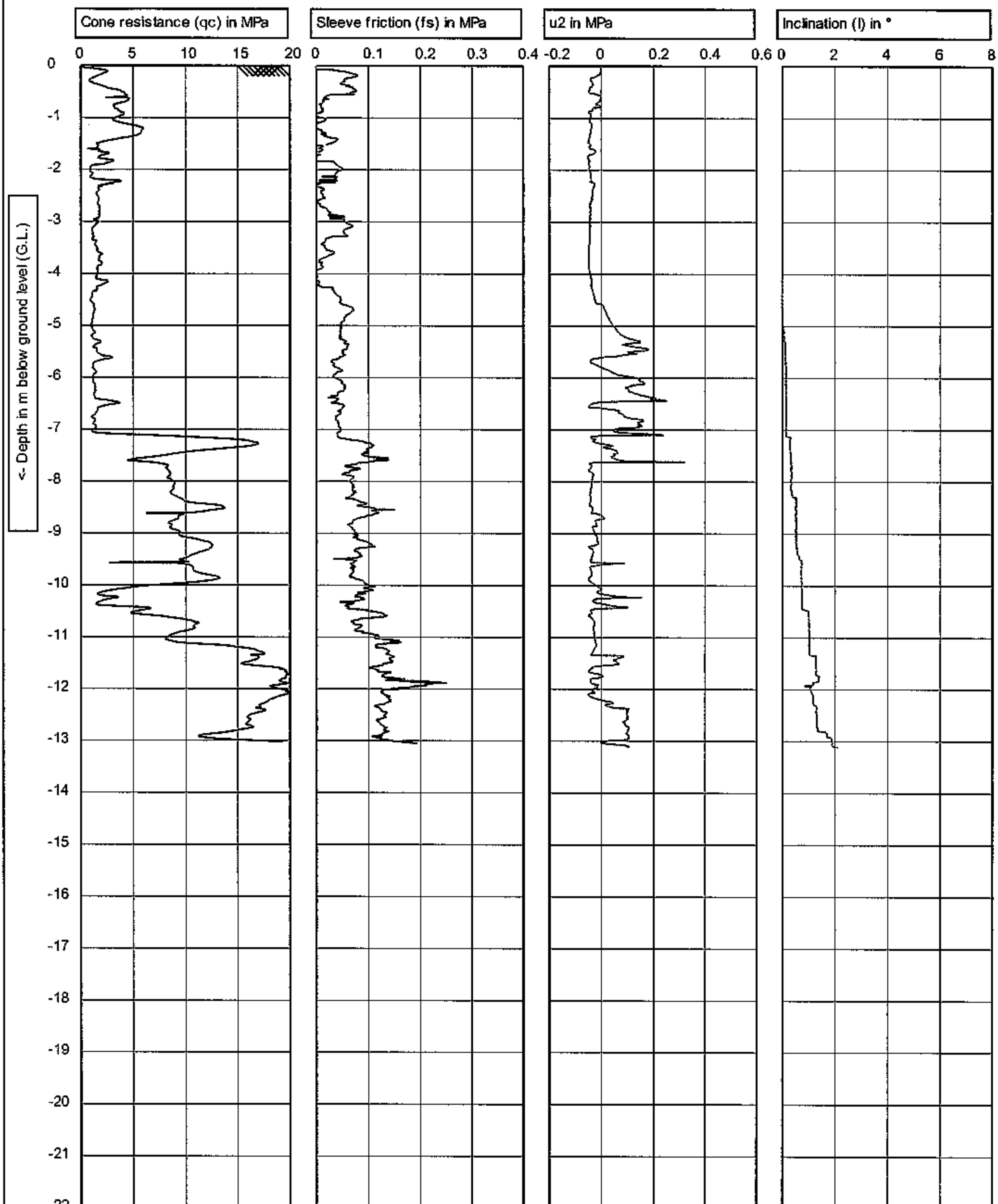
CPTask V1.13



Preliminary Data

SM Geocone	u2 150 cm² 10 cm²	Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0	
		G.L. : 0	W.L. : 0	Date :	06/04/2009	
	Project : Client : Morrison Construction			Cone no. :	S10CFIP.361	
	Location : TWEEN BRIDGE WIND FARM, PHASE 2			Project no. :	M9015	
	Position :			CPT no. :	cpt_05	3/3

CPTask V1.13

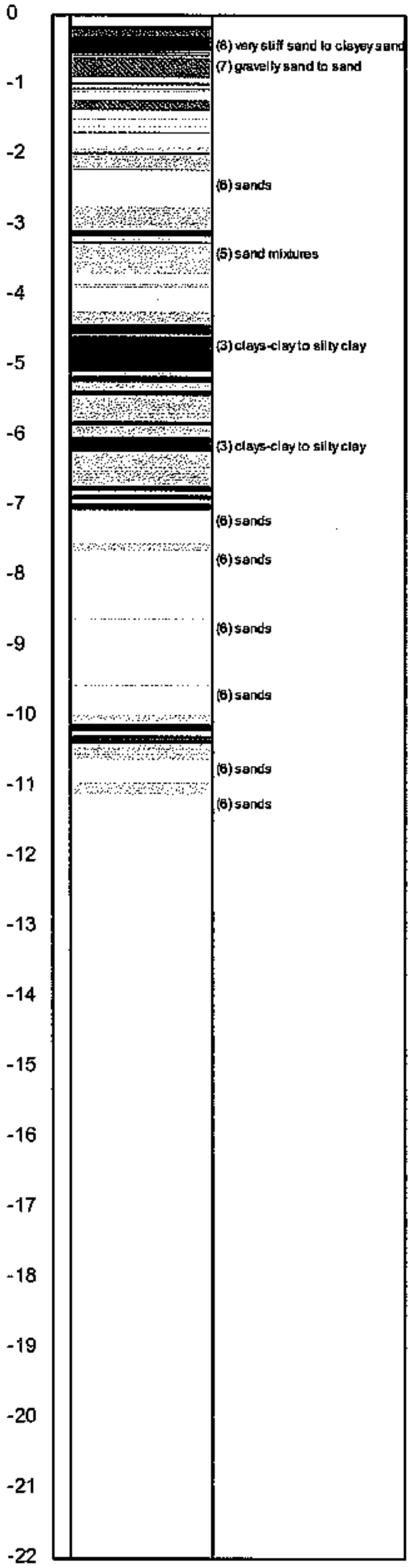


Preliminary Data

SM Geocone	Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0	
r u2 150 cm² 10 cm²	G.L. : 0	W.L. : 0	Date :	06/04/2009	
Project : **Client : Morrison Construction**			Cone no. :	S10CFIP.361	
Location : **TWEEN BRIDGE WIND FARM, PHASE 2**			Project no. :	M9015	
Position :			CPT no. :	cpt_06	1/3

CPTask V1.13

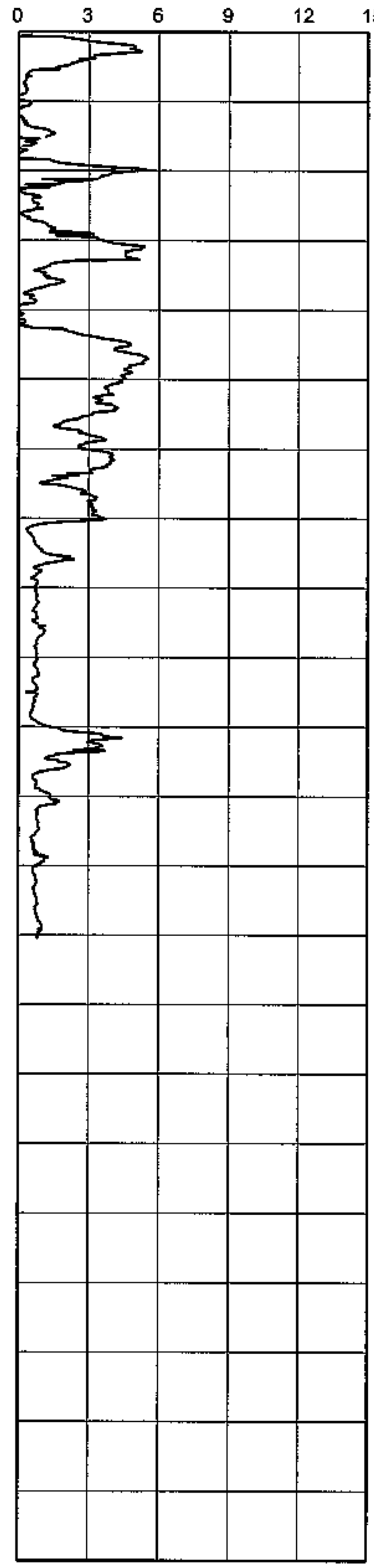
Soil Classification (using Fr)



(0) not defined
(1) sensitive, fine grained
(2) organic soils-peats
(3) clays-clay to silty clay
(4) clayey silt to silty clay
(5) sand mixtures

(7) gravelly sand to sand
(8) very stiff sand to clayey sand
(9) very stiff fine grained

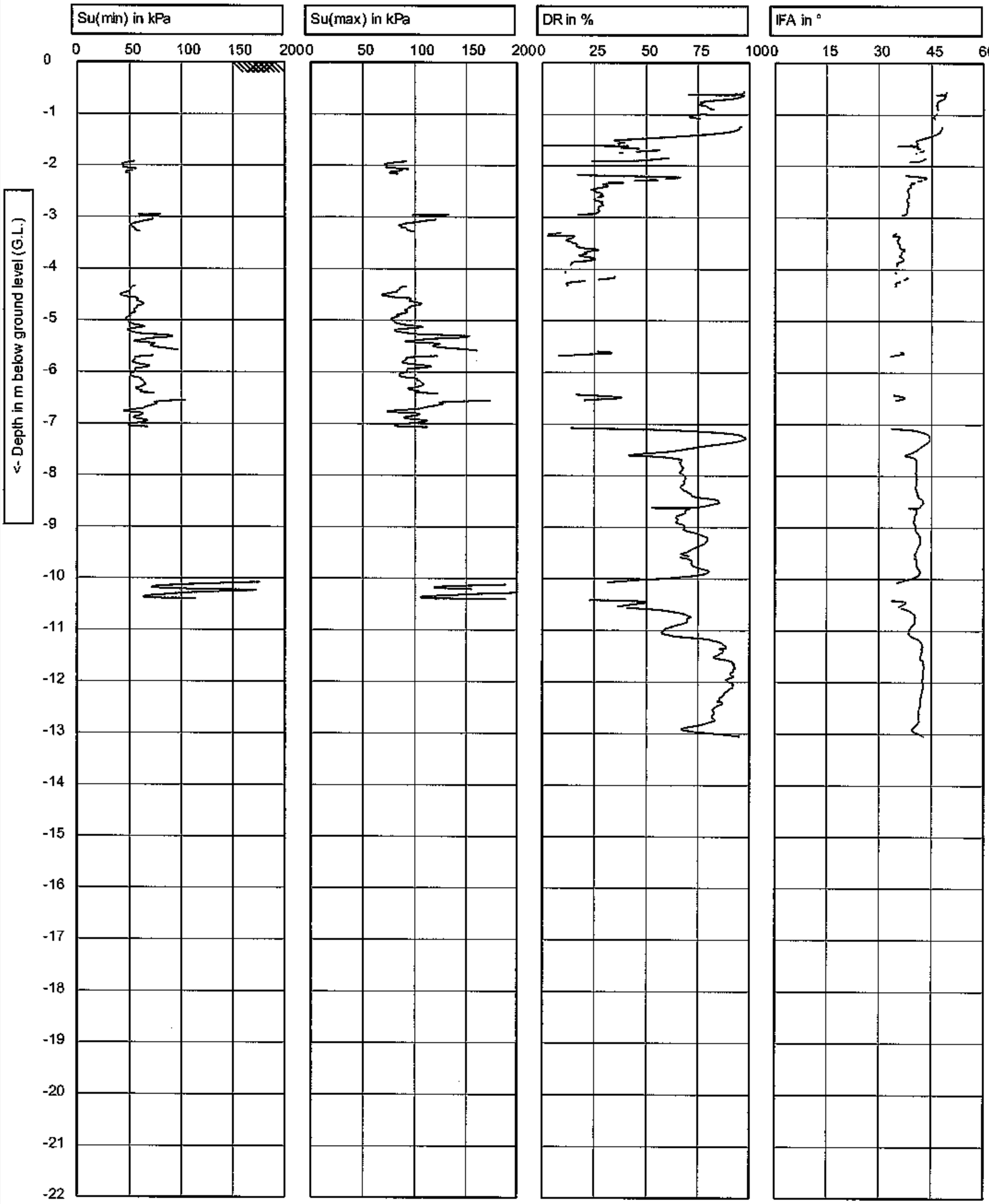
Friction ratio (Rf) in %



Preliminary Data

SM Geocone	u2 150 cm² 10 cm²	Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0	
		G.L. : 0	W.L. : 0	Date :	06/04/2009	
	Project :	Client : Morrison Construction		Cone no. :	S10CFIP.361	
	Location :	TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015	
	Position :			CPT no. :	cpt_06	2/3

CPTask V1.13

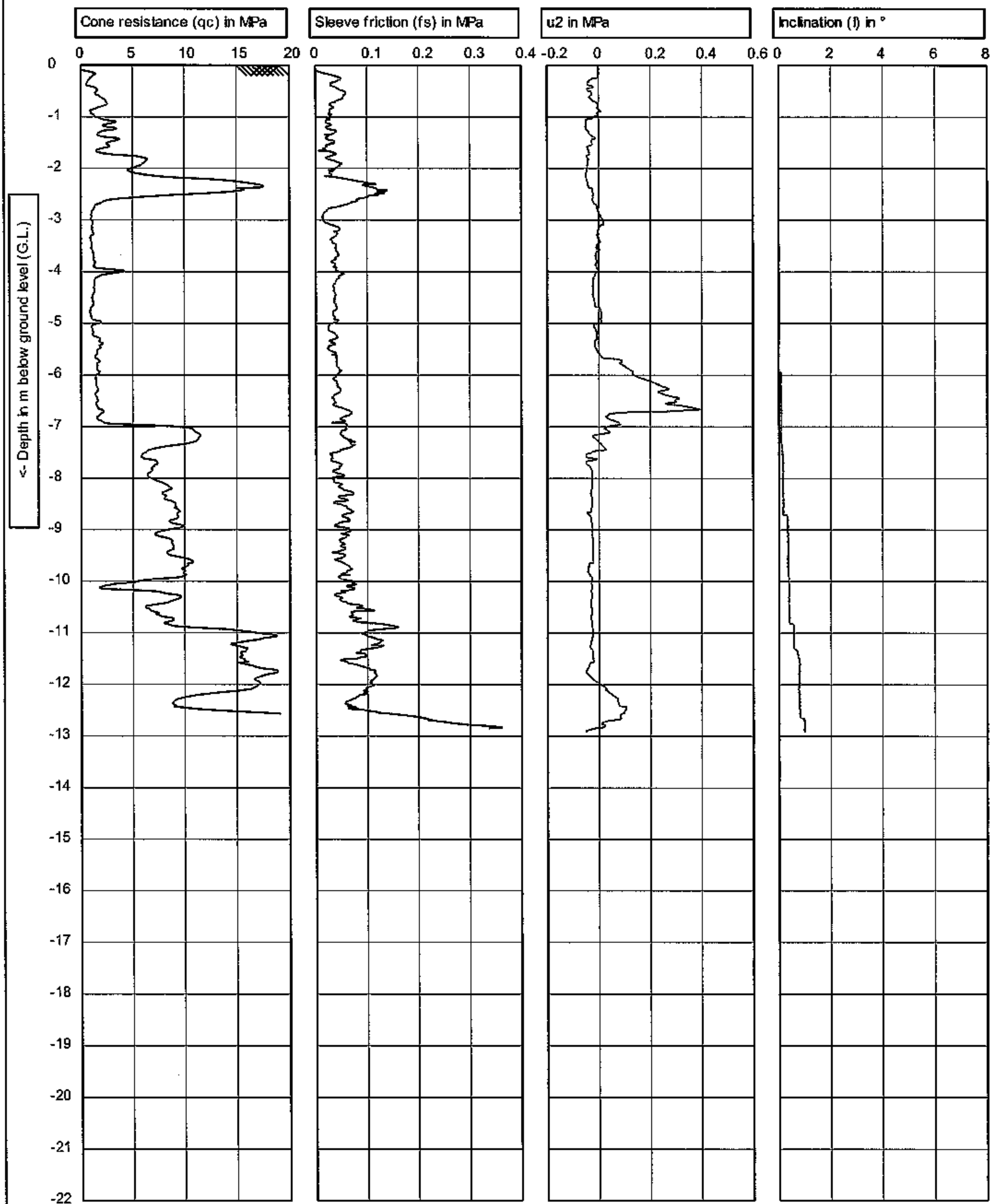


Preliminary Data

SM Geocone

u2 150 cm² 10 cm²	Test method BS 1377 : Part 9 : 1990 : 3.1		Pre drill :	0
	G.L. : 0	W.L. : 0	Date :	06/04/2009
Project :	Client : Morrison Construction		Cone no. :	S10CFIP.361
Location :	TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :			CPT no. :	cpt_06 3/3

CPTask V1.13

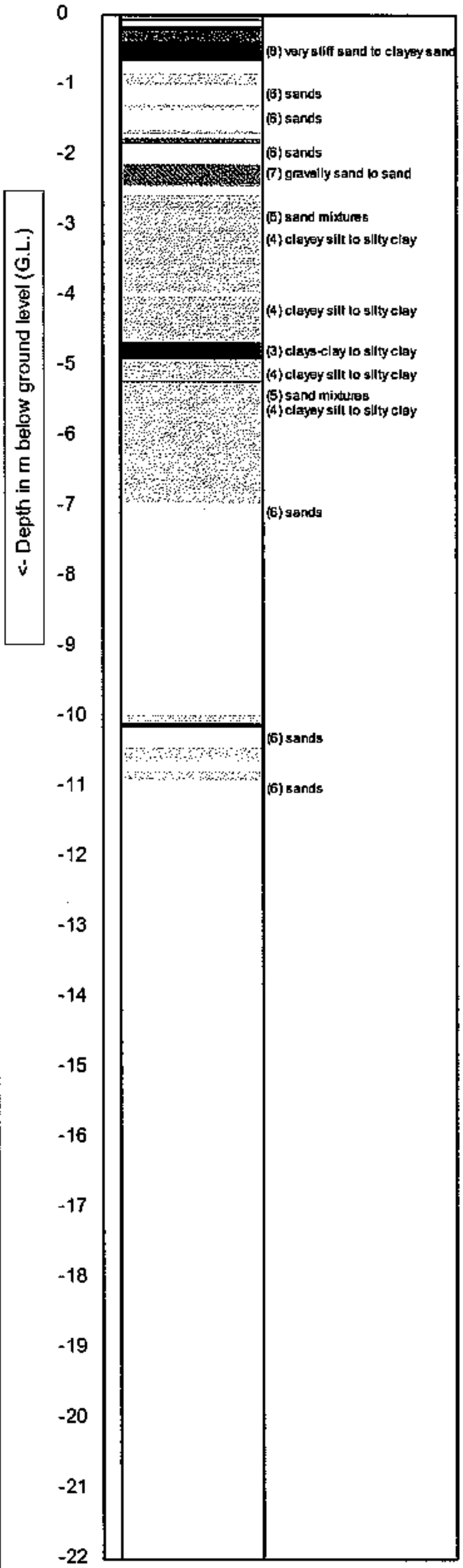


Preliminary Data

SM Geocone	u2 150 cm² 10 cm²	Test method BS 1377 : Part 9 : 1990 : 3.1	Pre drill :	0
	G.L. : 0	W.L. : 0	Date :	07/04/2009
	Project : **Client : Morrison Construction**		Cone no. :	**S10CFIP.361**
	Location : **TWEEN BRIDGE WIND FARM, PHASE 2**		Project no. :	**M9015**
	Position :		CPT no. :	**cpt_07** 1/3

CPTask V1.13

Soil Classification (using Fr)



(0) not defined
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(5) sand mixtures

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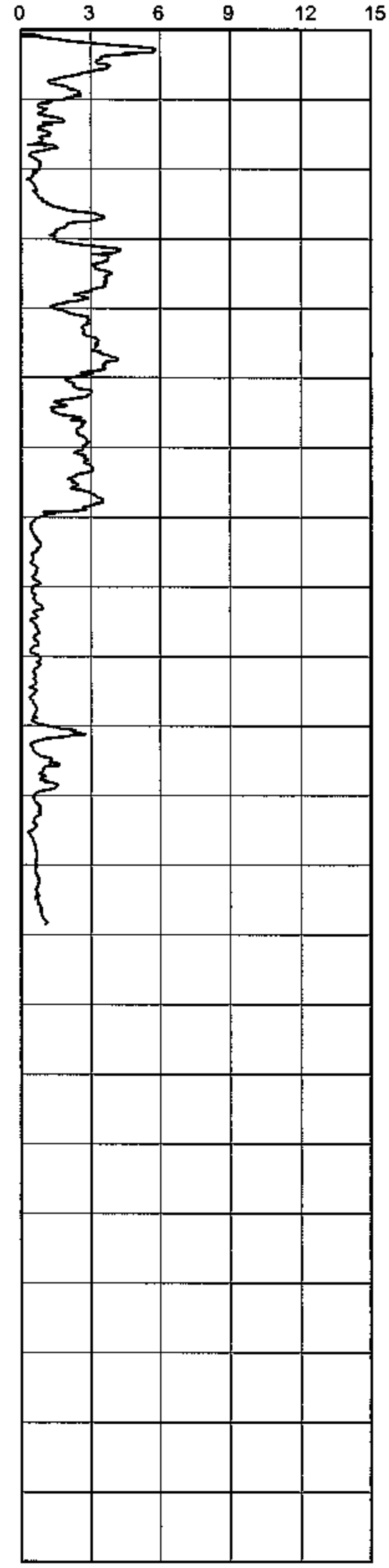
Friction ratio (Rf) in %



Preliminary Data

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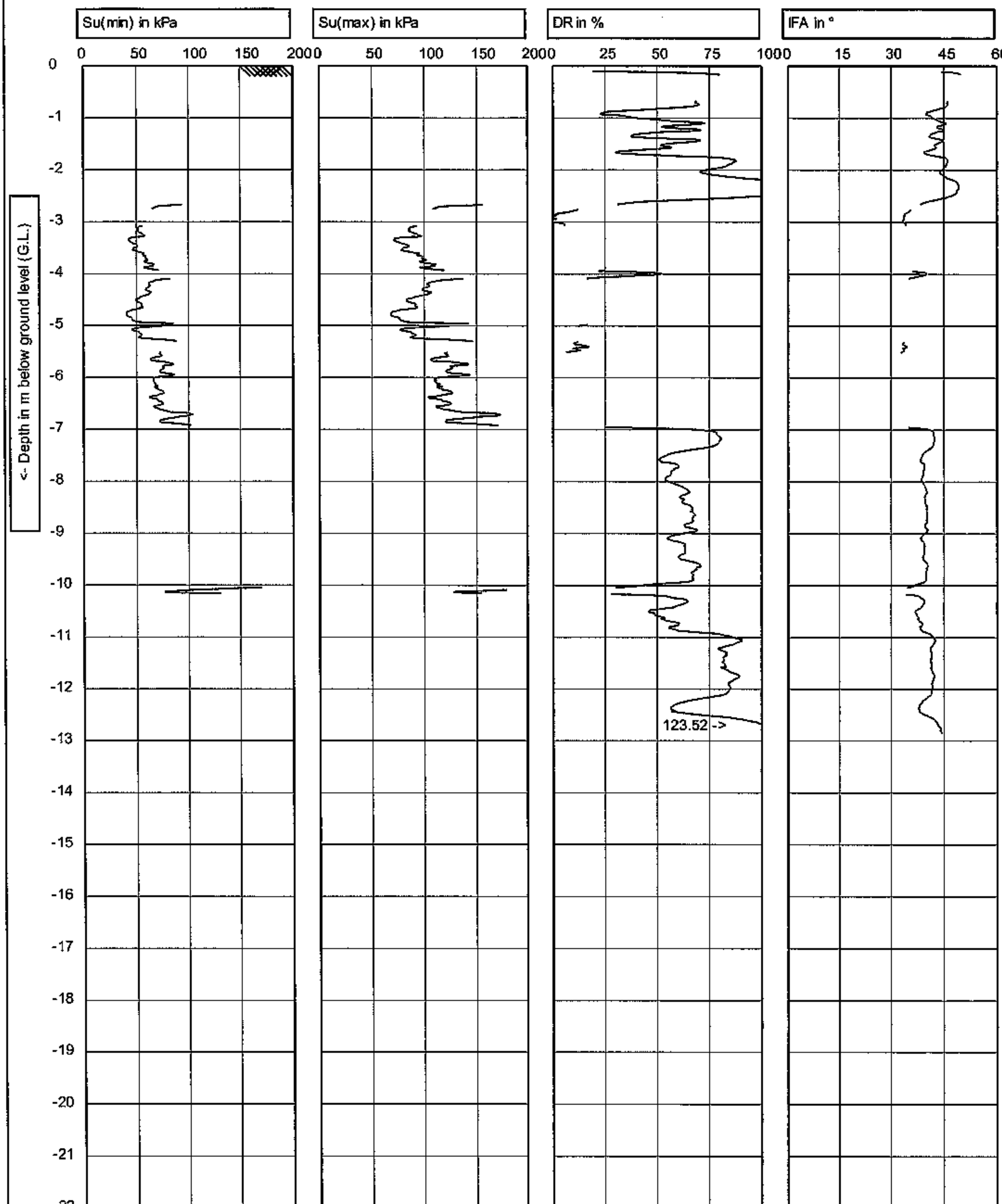
		Project : **Client : Morrison Construction**		Cone no. :	**S10CFIP.361**	
		Location : **TWEEN BRIDGE WIND FARM, PHASE 2**		Project no. :	**M9015**	
		Position :		CPT no. :	**cpt_07**	**2/3**

CPTask V1.13



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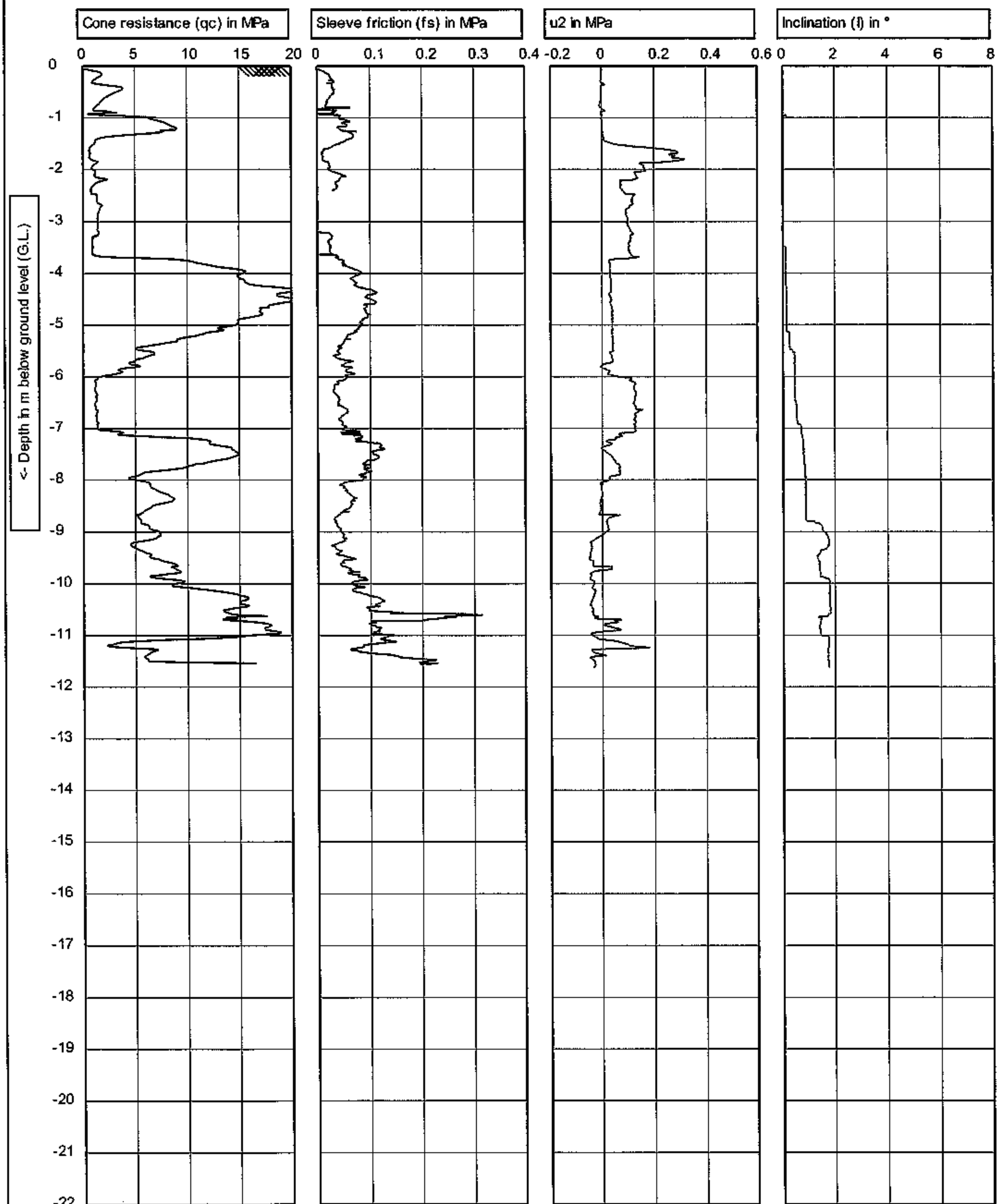
CPTask V1.13



Preliminary Data

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Location : **TWEEN BRIDGE WIND FARM, PHASE 2**			Project no. :	**M9015**
Position :			CPT no. :	**cpt_10** 1/3

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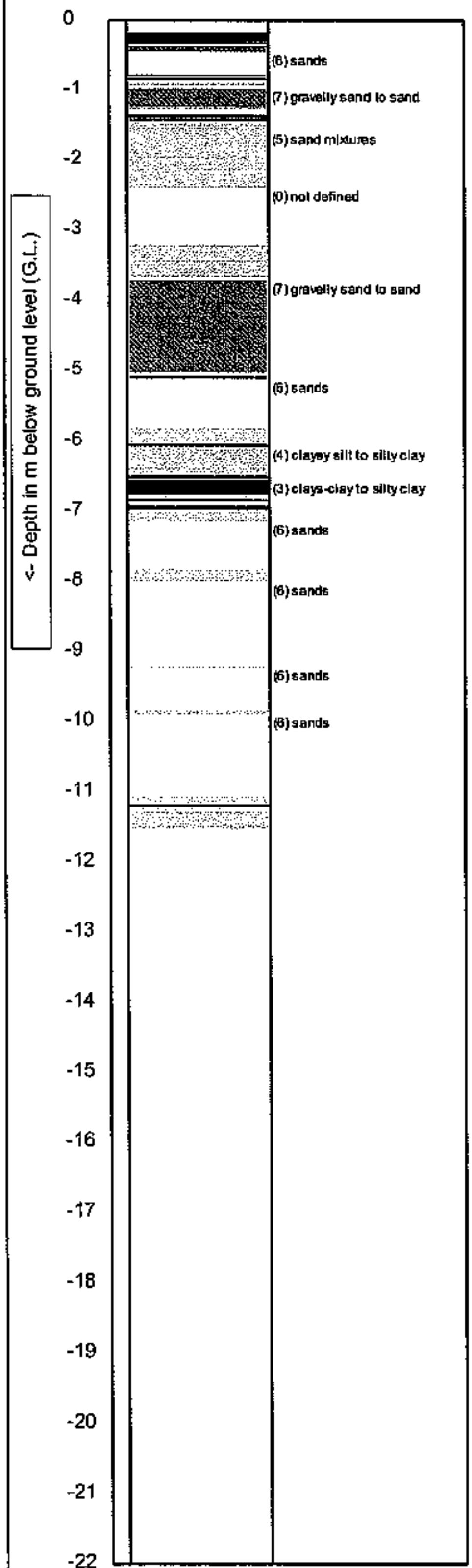

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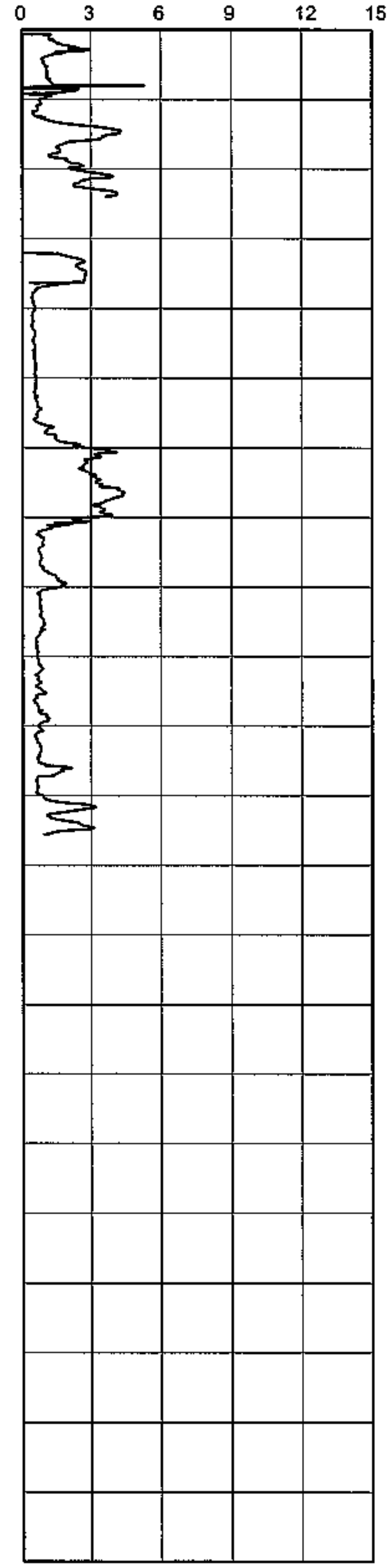

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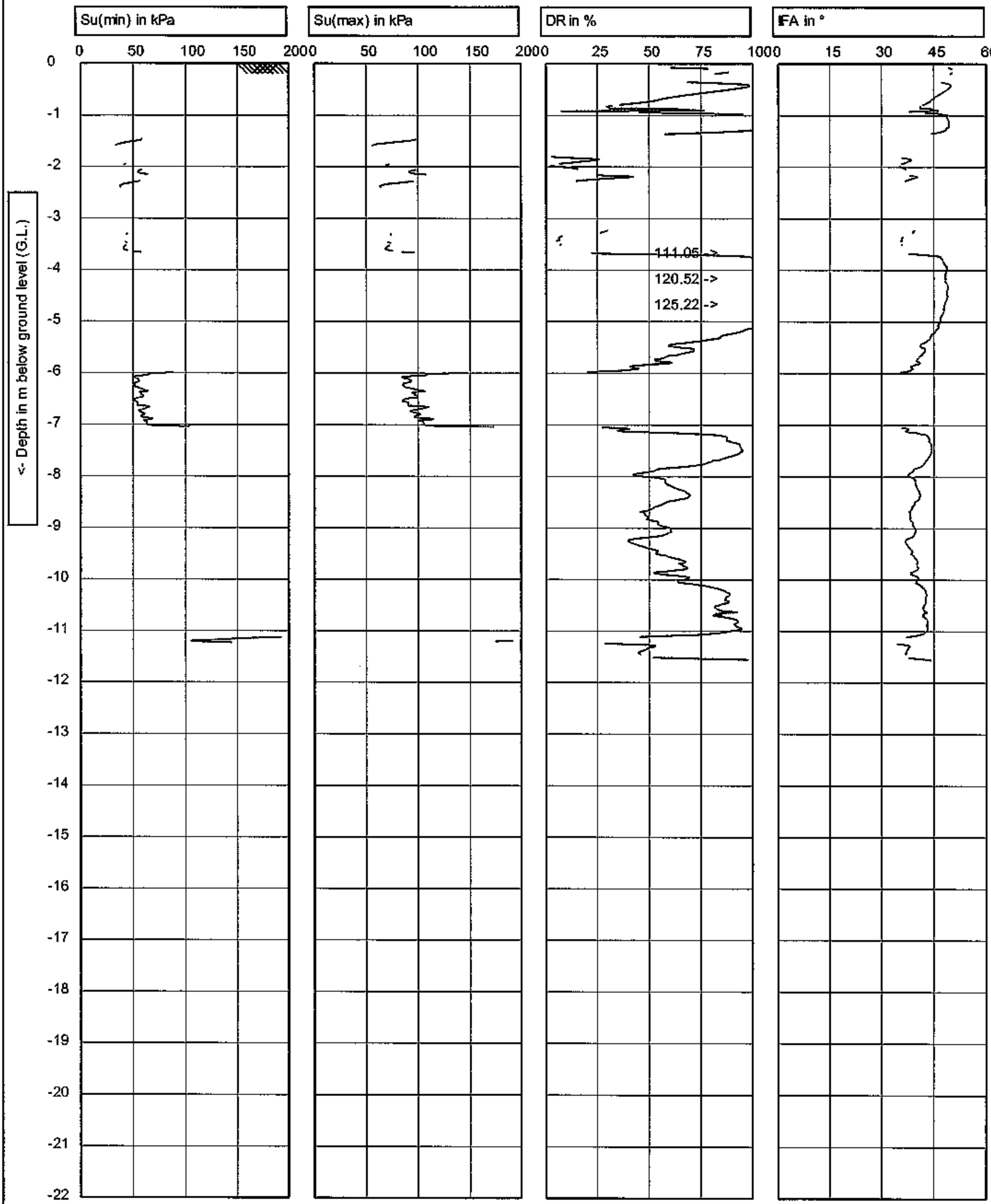
	Position :		CPT no. :	cpt_10 2/3

CPTask V1.13



Preliminary Data

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Location : TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
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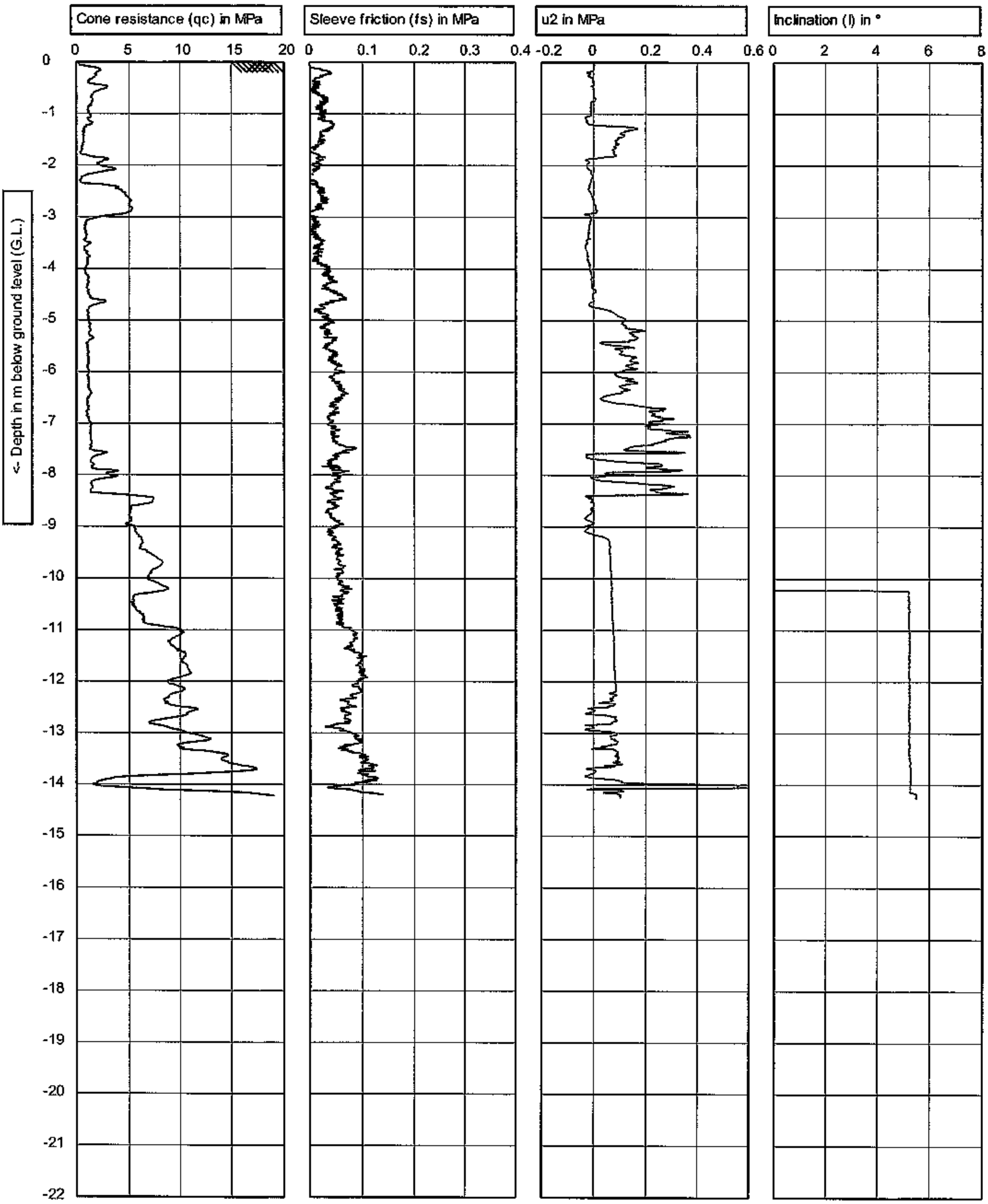
CPTask V1.13



Preliminary Data

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Location :	TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
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CPTask V1.13

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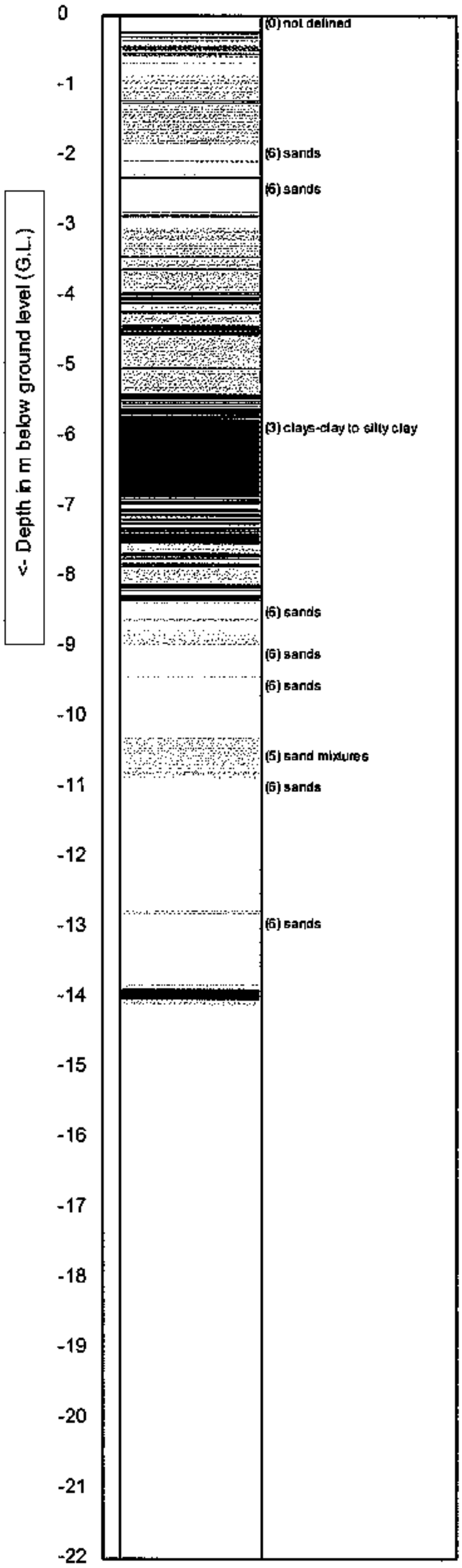

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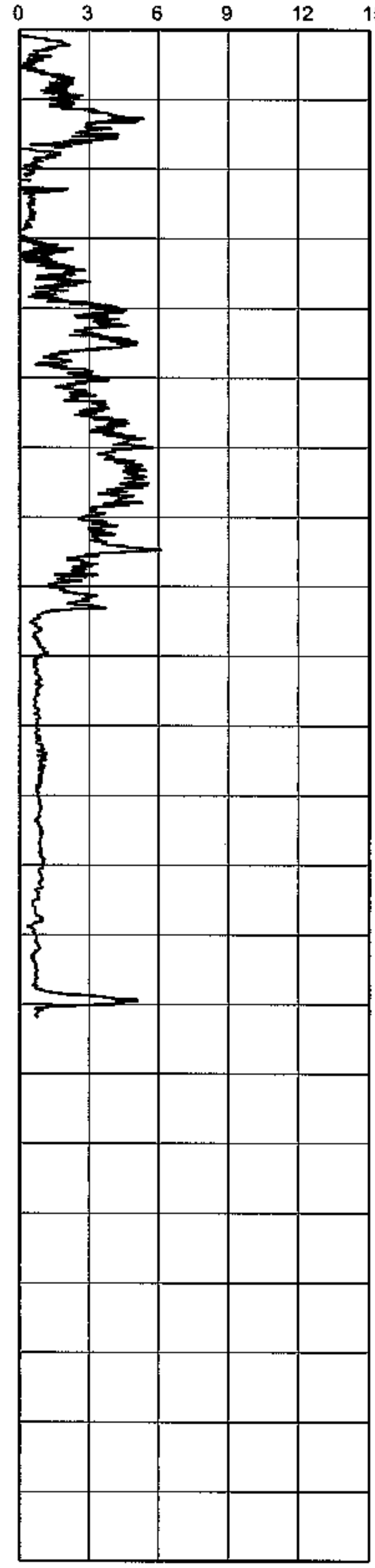
Friction ratio (Rf) in %



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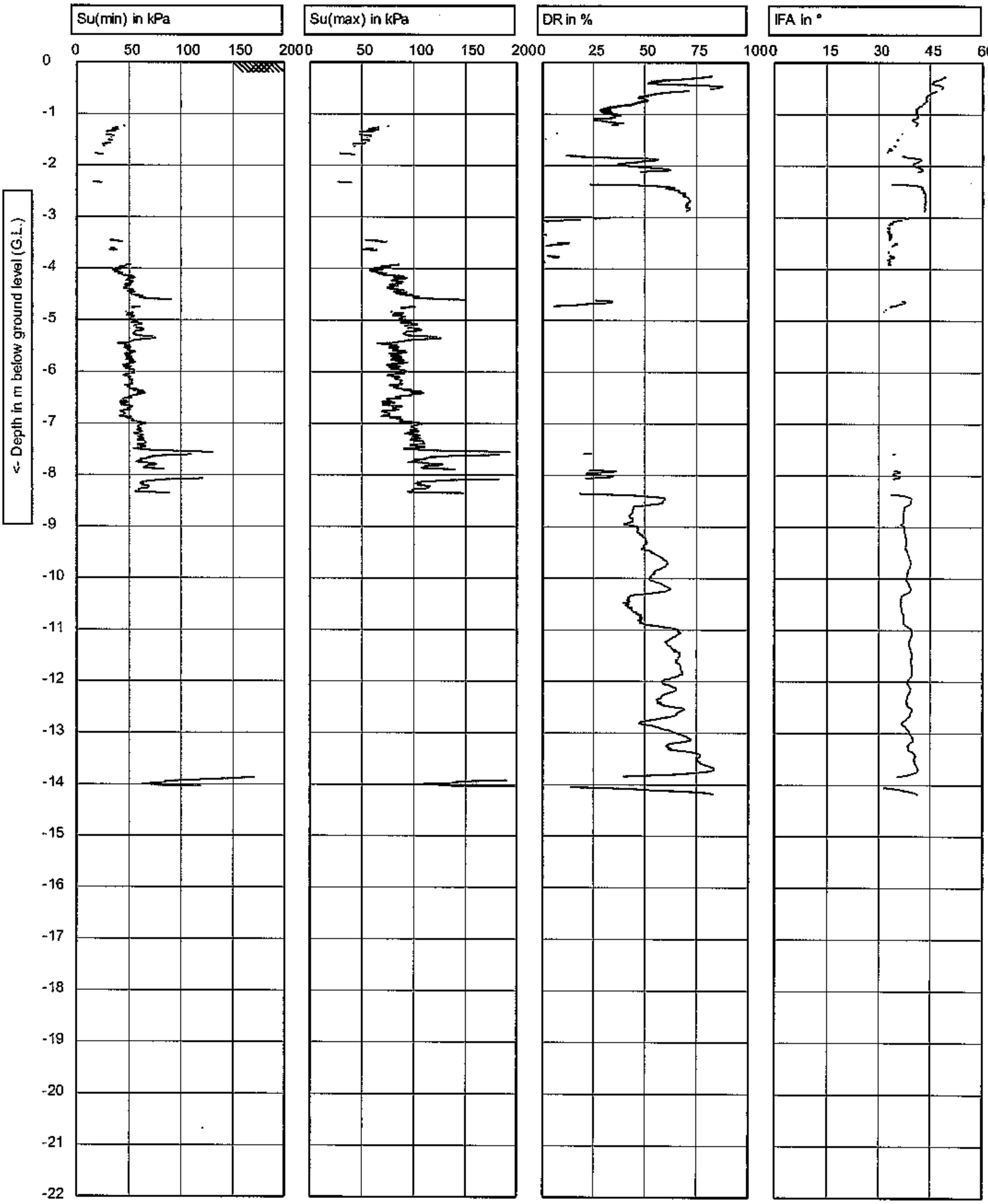
CPTask V1.13



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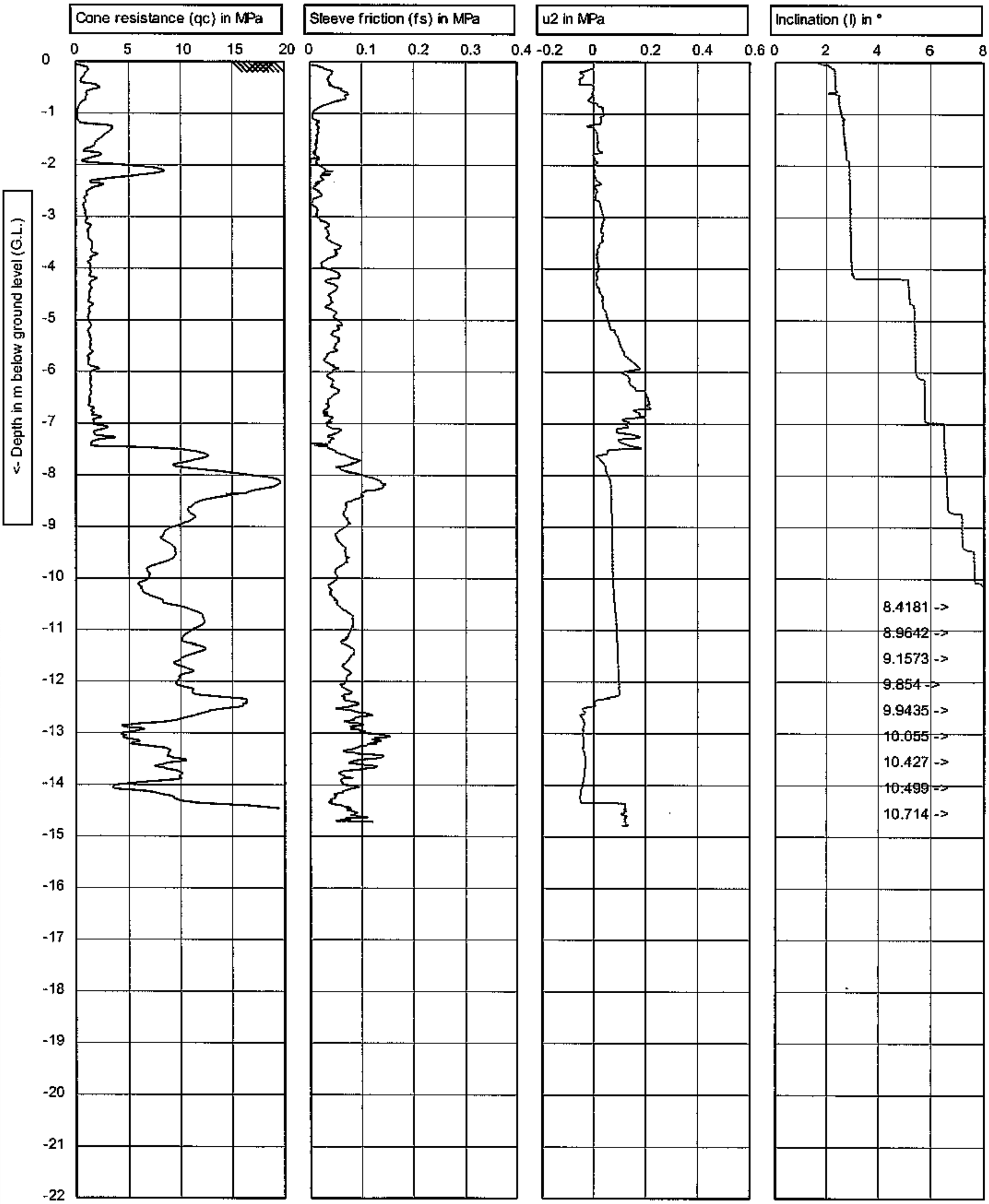
CPTask V1.13



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Project : **Client : Morrison Construction**		Cone no. :	**S10CFIP.361**
Location : **TWEEN BRIDGE WIND FARM, PHASE 2**		Project no. :	**M9015**
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CPTest V1.13

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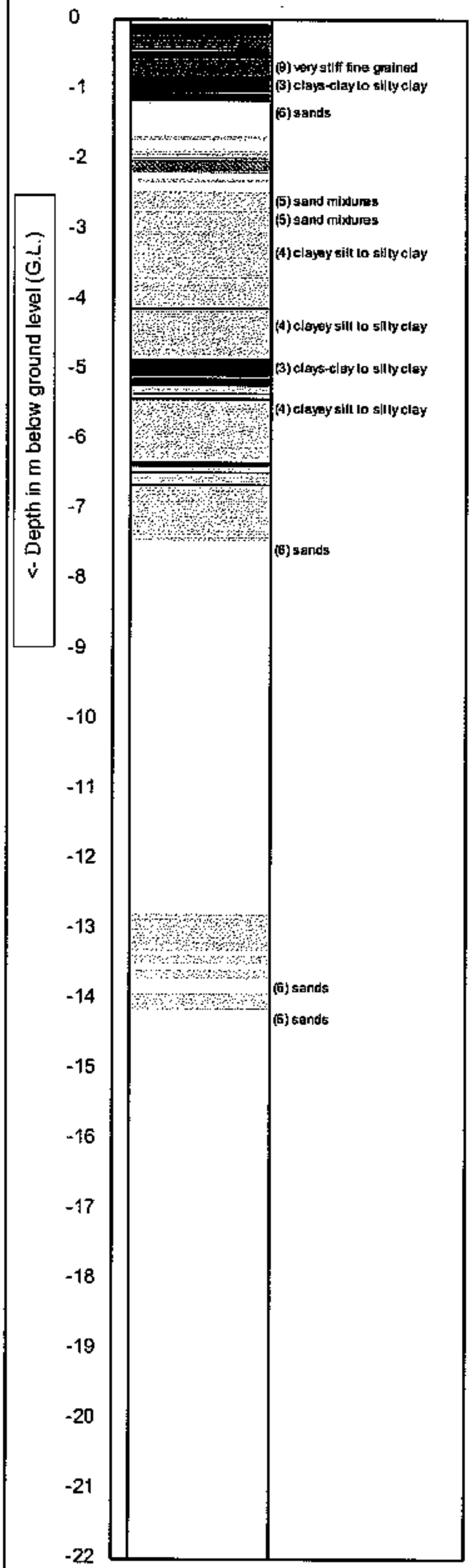

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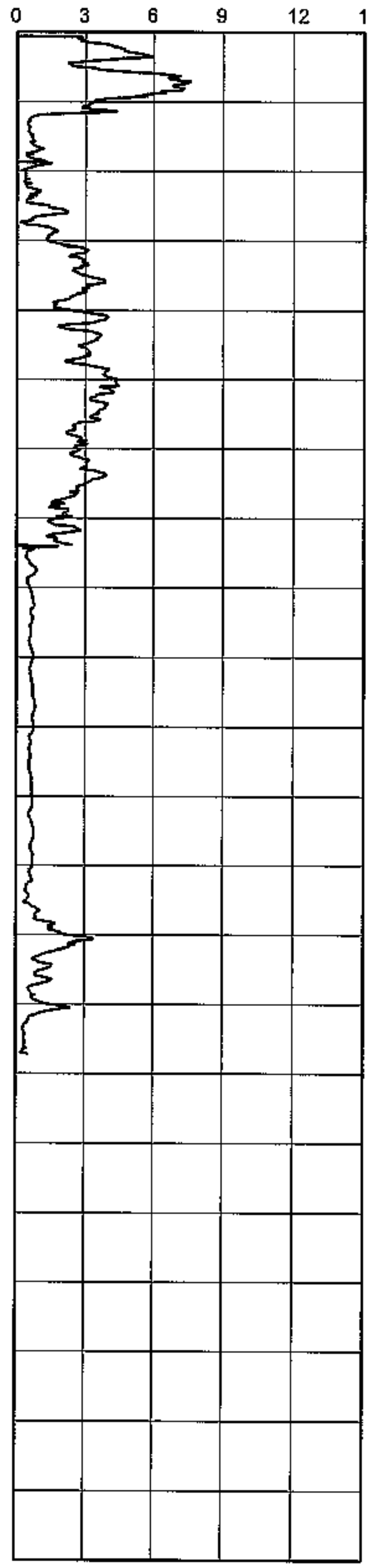

Preliminary Data

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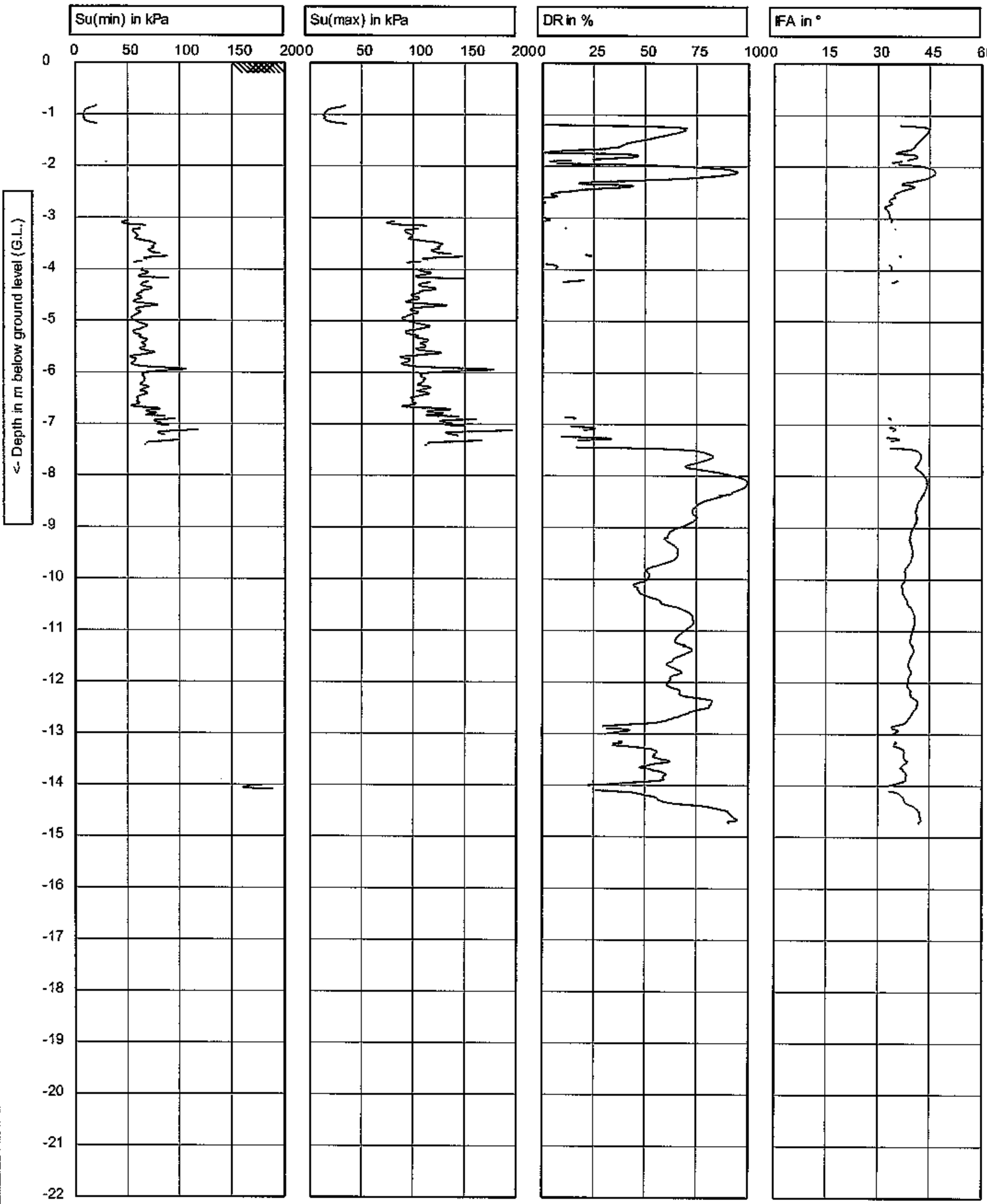
Project :	Client : Morrison Construction		Cone no. :	S10CFIP.361
Location :	TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :			CPT no. :	cpt_18 2/3

CPTask V1.13



Preliminary Data

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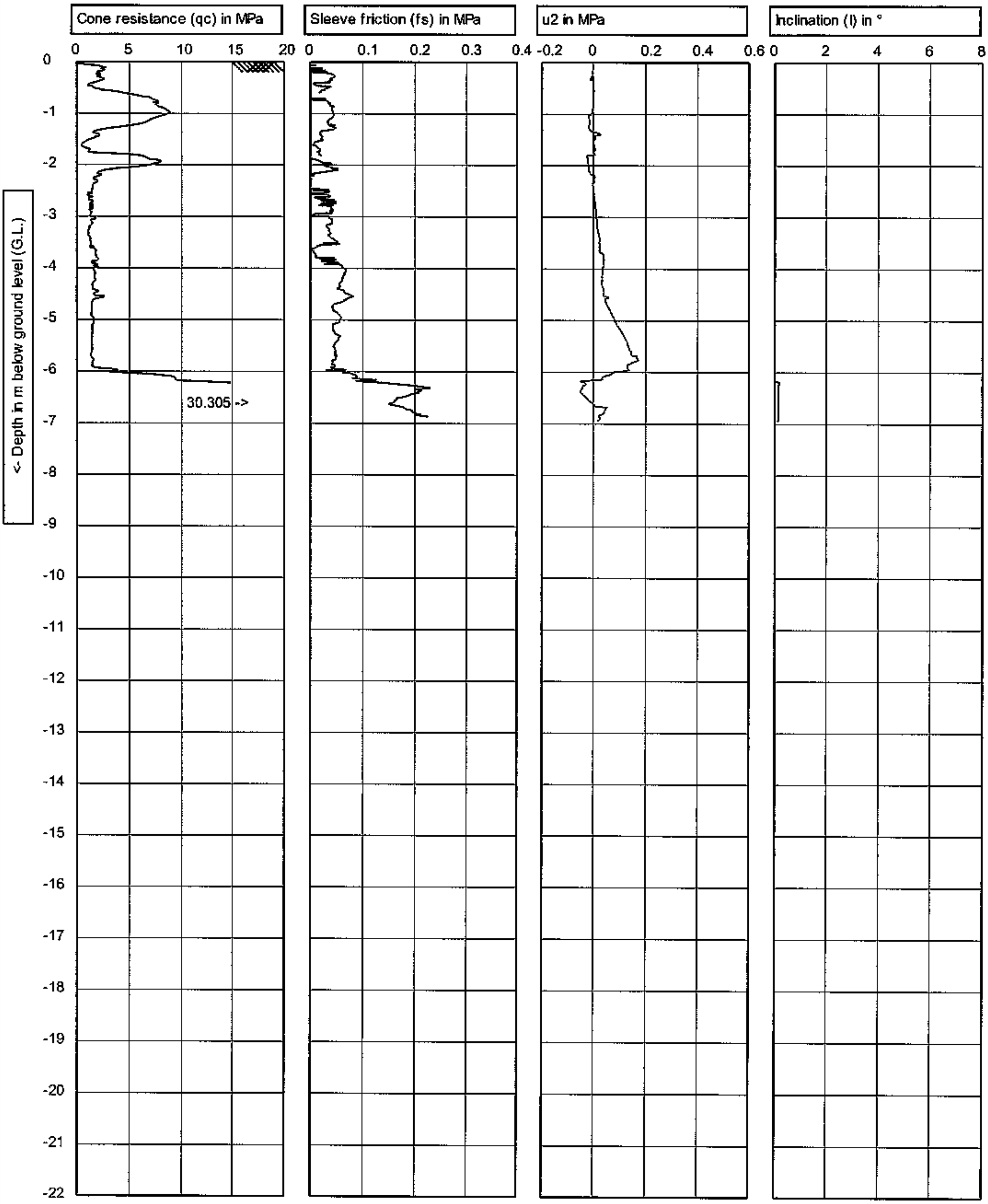
CPTask V1.13



Preliminary Data

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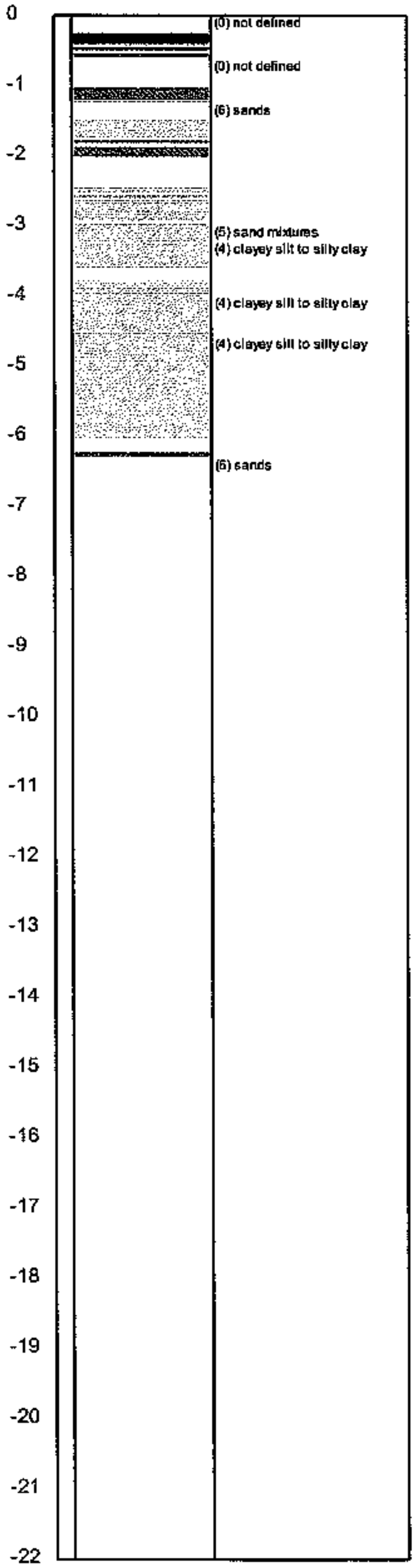
Project :	Client : Morrison Construction		Cone no. :	S10CFIP.361
Location :	TWEEN BRIDGE WIND FARM, PHASE 2		Project no. :	M9015
Position :			CPT no. :	cpt_21 1/3

CPTask V1.13

Soil Classification (using Fr)



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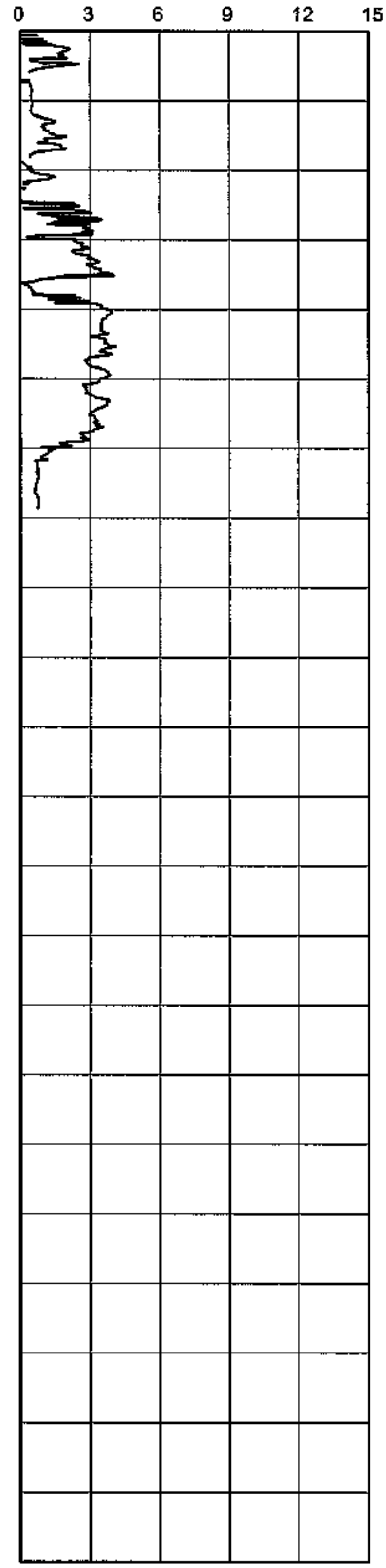

Preliminary Data

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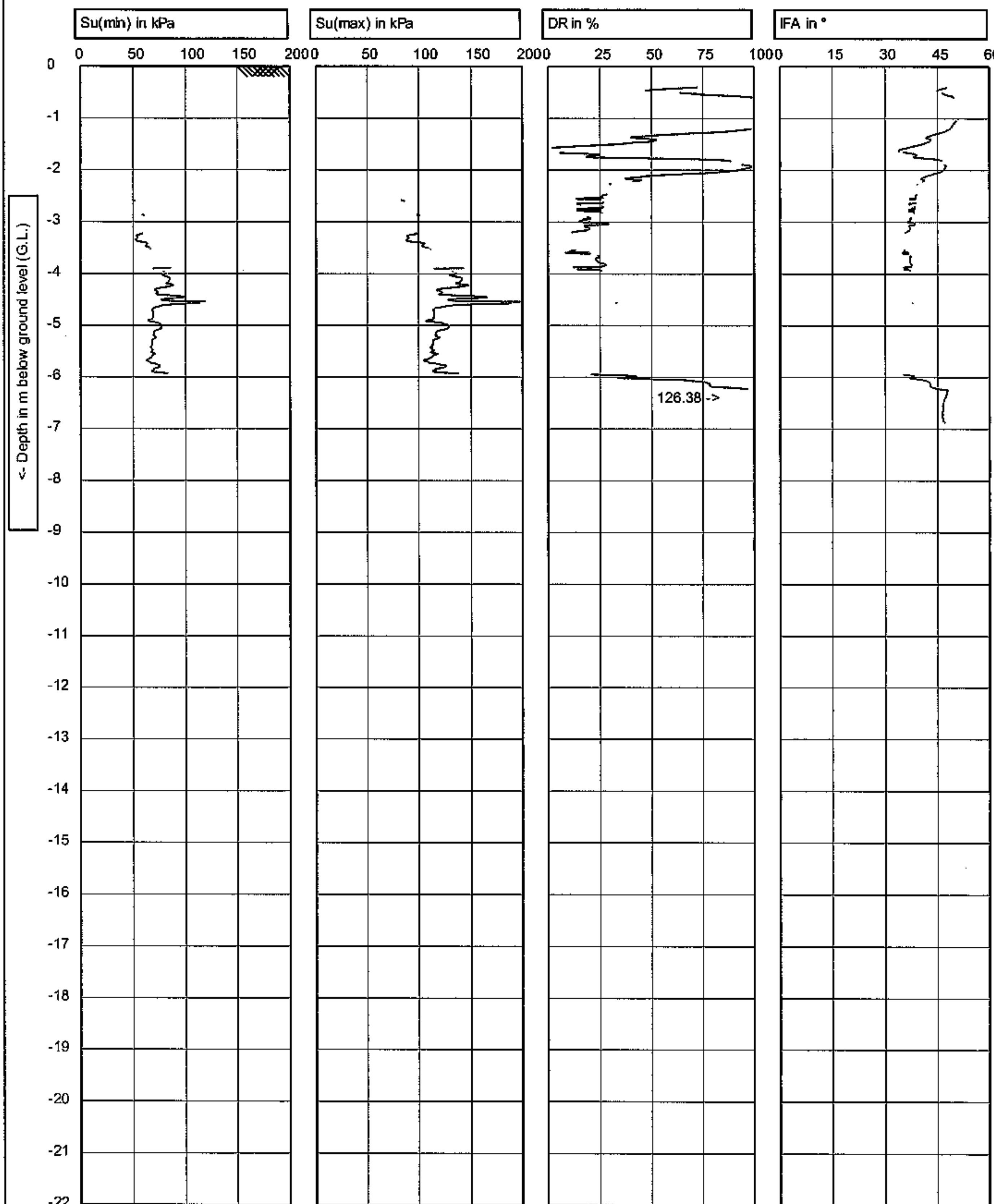
Project :	**Client : Morrison Construction**		Cone no. :	**S10CFIP.361**
Location :	**TWEEN BRIDGE WIND FARM, PHASE 2**		Project no. :	**M9015**
Position :			CPT no. :	**cpt_21** 2/3

CPTask V1.13



Preliminary Data

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Project :	**Client : Morrison Construction**		Cone no. :	**S10CFIP.361**
Location :	**TWEEN BRIDGE WIND FARM, PHASE 2**		Project no. :	**M9015**
Position :			CPT no. :	**cpt_21** **3/3**

CPTask V1.13

CLIENT: MORRISON CONSTRUCTION
ENGINEER: DONALSON ASSOCIATES

TWEEN BRIDGE WIND FARM SI

SEISMIC CPT REPORT

FES Contract Number: CPT0911074

Fugro Aperio Project Number: J3379

REPORT ISSUE STATUS

02	06/03/09	**Final Report**	OG	DK	D. Kilcoyne	
01	03/03/09	**Digital Draft**	OG	AD	D. Kilcoyne	
Issue	**Date**	**Description**	**Prepared**	**Checked**	**Approved (Printed)**	**Approved (Signature)**

O. Gibson	
OLIVER GIBSON	DAVID KILCOYNE
GEOPHYSICIST	**DIVISION HEAD**

EXECUTIVE SUMMARY

- This report documents the results of the field work undertaken as part of the Tween Bridge Wind Farm geophysical investigation.
- The overall brief was to provide an analysis of seismic cone penetration test (SCPT) data at eleven CPT locations.
- Specific objectives were to provide a commentary on the acquisition of SCPT measurements, calculate shear wave velocities for each measurement and derive values of shear modulus.
- The seismic source utilised for the SCPT tests produced horizontally polarised, vertically propagating shear waves, therefore, all dynamic moduli derived from measurements taken on site are confined to this plane only.
- No assessment of anisotropic stiffness can be made using the data acquired by SCPT methods.
- Seismic data quality was generally sufficient to provide estimates of shear wave velocity as a function of depth.

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Figure 6: Interval Shear Velocity versus Depth – SCPT13

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Figure 15: Interval Shear Modulus versus Depth – SCPT09

Figure 16: Interval Shear Modulus versus Depth – SCPT11

Figure 17: Interval Shear Modulus versus Depth – SCPT13

Figure 18: Interval Shear Modulus versus Depth – SCPT14

Figure 19: Interval Shear Modulus versus Depth – SCPT17

Figure 20: Interval Shear Modulus versus Depth – SCPT19

Figure 21: Interval Shear Modulus versus Depth – SCPT20

Figure 22: Interval Shear Modulus versus Depth – SCPT22

APPENDIX B1 - Service Constraints

APPENDIX B2 - Tabulated Values of Velocities and Moduli

1. INTRODUCTION

1.1 General

1.1.1 This report documents the acquisition, processing and interpretation of geophysical data (SCPT measurements) that formed part of the Tween Bridge Wind Farm site investigation, undertaken between 16th – 19th February, 2009.

1.2 The Brief

1.2.1 The overall brief was to acquire and provide an analysis of SCPT data in the vicinity of eleven test locations.

1.2.2 Specific objectives were to:

- provide a commentary on the acquisition of seismic measurements
- calculate shear wave velocities for each measurement
- derive values of shear modulus

1.3 Definitions

1.3.1 A list of abbreviations and acronyms used in this report are provided below:

Vs_{vh}	=	Vertically propagating, horizontally polarised shear velocity
G_{vh}	=	Shear modulus (derived from Vs_{vh} data)
ρ_b	=	Bulk density

1.3.2 Measurements obtained during SCPT investigations are considered to exert very small strains. For this reason, all moduli mentioned here within should be taken to be small strain moduli.

1.4 Service Constraints

1.4.1 Appendix B1 “Service Constraints”, outlines the limitations of this report, in terms of a range of considerations including, but not limited to, its purpose, its scope, the data on which it is based, its use by Third Parties, possible future changes in design procedures and possible changes in the conditions at the site with time. The Appendix represents a clear exposition of the constraints, which apply to all reports issued by Fugro Aperio Limited. It should be noted that the Service Constraints do not in any way supersede the terms and conditions of the contract between Fugro Engineering Services Limited and the Client.

1.4.2 The findings presented within this report are the result of the measurement and interpretation of acoustic signals. As such any results derived from the geophysical investigation should be taken in the context of and in reference to the complete ground investigation.

1.4.3 Additionally with specific reference to seismic data and respective derived parameters, the following constraints apply. Engineering properties are derived from seismic velocity calculations resulting from the identification of appropriate seismic waveforms and their time of travel along a source-receiver path from surface to downhole. The shape and phase characteristics of a received compressional or shear-type waveform and associated arrival time selection may be influenced by frequency-selective attenuation, dispersion, reflection, refraction, scattering , mode conversion processes and source and receiver coupling effects dependent on variations in ground conditions along the corresponding source-receiver travel path. In the derivation of elastic parameters or engineering properties such as shear modulus, apparent variations arising from both the relative and absolute influence of these processes along a particular source-receiver path may not be known or be calculable.

2. SITE WORK

2.1 General

2.1.1 Data was acquired from eleven positions as tabulated in table 1 below. The site was located to the east of Thorne near Doncaster, UK off Moor Edges Road.

2.2 SCPT Data

2.2.1 SCPT data were acquired at eleven test locations.

Test Location Reference	Eastings (m)	Northings (m	Refusal depth bgl (m)
CPT02	471367	413113	11.34
CPT03	471540	414854	13.62
CPT04	471589	413526	12.96
CPT09	472223	413457	11.30
CPT11	472543	413009	10.79
CPT13	473041	412588	6.79
CPT14	473332	412877	6.50
CPT17	473714	412511	15.64
CPT19	474133	412891	14.94
CPT20	474232	418589	15.23
CPT22	472208	412571	8.50

Table 1: Location of SCPT

2.2.2 The location of the test holes are presented in the main geotechnical report.

2.2.3 SCPT data were collected using a source that produced vertically propagated, horizontally polarised shear waves (Vs_{vh}).

2.2.4 Shear wave energy was generated by a shear hammer source that produced shear stress at the ground surface to propagate shear wave energy into the formation with particle motion largely in a vertical plane.

2.2.5 A wooden plank was placed on the ground surface and was loaded using the hydraulic legs of the CPT truck. The source was activated at a horizontal distance of 2.86 m from the CPT location, at a surface position perpendicular to the plane containing the CPT cone. This was carried out at depths between 1 m and the refusal depth of the CPT cone (table 1).

2.2.6 The term ‘horizontally polarised’ describes a decomposition of the shear wave motion A real seismic source will produce both SV and SH motions unless the source polarisation angle (defined as the angle between the SV vector and the resultant of the SV and SH vectors) is zero to produce purely SV motion or $\pi/2$ radians to produce purely SH motion.

2.2.7 In practice, the source will produce a component of shear wave energy that can be considered orthogonal to the primary polarisation direction. The most likely cause of the additional component is that no seismic source is capable of producing particle motion that is restricted to vertical or horizontal planes. In addition receiving geophones are unlikely to have measurement axes precisely co-planar with the dominant polarisation directions and will measure a degree of off-axis particle motion.

2.2.8 The seismic source was actuated in two opposing directions in order to produce shear wave arrivals with first break particle motions in opposing directions.

2.2.9 A single triaxial geophone was close to the cone tip to measure two orthogonal horizontal components and a single vertical component.

2.2.10 Each measurement comprised stacked (summed) data that were recorded to improve the signal to noise ratio. Due to the relatively low levels of ambient noise, three stacks were generally recorded to achieve a satisfactory signal-noise ratio.

2.2.11 The seismograph used was set up using the following acquisition parameters:

- Record length - 200 ms
- Delay - none
- Sample interval - 50 µs
- Acquisition filters - out

2.3 Verticality

2.3.1 No quantitative measure of the verticality of the one path was recorded. For this reason, the ray-paths calculated to be used in derivation of velocities will have an uncertain error introduced into them.

2.3.2 The cone that contains the geophones is capable of measuring the angle from the vertical to its centre line. The value recorded is a scalar quantity and therefore can not be used to calculate absolute position. It is noted that during the course of the SCPT test, the angle of the cone was relatively low and hence the cone pushed into the ground approximately vertically.

2.4 Data quality

2.4.1 Data quality was typically good throughout the acquisition with the shear wave arrival easily identified below 2 m bgl for most CPTs. Typically it was not possible to identify the shear wave at 1 m bgl due to a low signal to noise ratio.

2.4.2 SCPT022 exhibited low signal to noise ratios down to 3 m bgl. As such it was not possible to pick the shear wave above this depth.

3. DATA ANALYSIS

3.1 SCPT Data

3.1.1 Direct arrivals (of earliest detectable shear wave energy) were visually picked from shot records at each 1 m depth interval.

3.1.2 Shear wave energy, subject to signal-to-noise characteristics, was identified based upon polarity reversal between shots from reversed source activation and amplitude/frequency characteristics expected of shear wave arrivals.

3.1.3 Shear wave velocities were determined from pick times and distances between source and associated receiver locations determined from measurements of the offset from hole to source taken on site and the depth of the cone penetrometer.

3.1.4 Quality control of the identified pick times was conducted by comparing calculated interval shear wave velocities from picks of different parts of the shear wave including the first break and first positive maximum. Typically variations in calculated shear velocities at coincident depth intervals were < 10 % within individual tests.

3.2 Engineering Parameters

3.2.1 Shear modulus was derived from calculated shear wave velocities using the equation listed below:

$$G_{vh} = \rho_b * Vs_{vh}^2$$

3.2.2 For the purpose of calculating elastic parameters, the density assumed was 2.00 Mg/m^3. Whilst it is considered that variations in density of these layers will exist, the magnitude will have a minimal effect on derived elastic parameters.

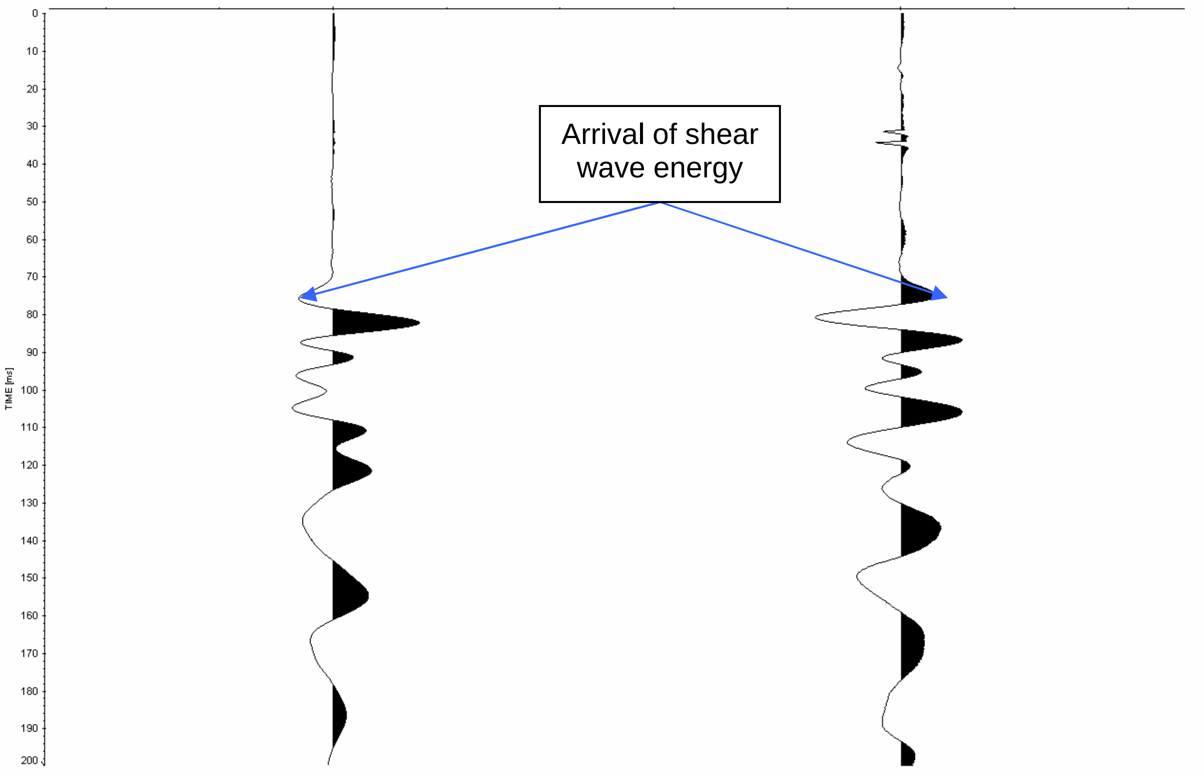
4. FINDINGS

4.1 General Comments

4.1.1 The findings of this investigation are presented on Figures 1-22. Tabulated values of all derived parameters are provided in Appendix B2.

4.1.2 The quality of the seismic signals was examined and post acquisition processing was undertaken where appropriate. High and low pass filters were applied to attempt to remove any unwanted noise that was present in the data. Any processing undertaken was consistent throughout the test to minimise time picking errors that could have arisen from signal phase changes.

4.1.3 Minimal seismic noise was present in all traces collected. The example traces below show the two horizontal components collected by the receivers mounted behind the cone.



Example data from 9.6 m below ground level at CPT20.

4.2 SCPT Testing

4.2.1 Profiles of derived shear wave velocities (Vs_{vh}) are provided on Figures 1-11.

4.2.2 Inspection of the shear wave profiles indicated Vs_{vh} values varied between ~100 m/s at ~2 m depth to up to ~300 m/s at the refusal depth across the site. Large increases in shear velocity are observed in CPT 2, 14, 17, 19 & 22 at the refusal depths that are probably associated with variations in geology at this point.

4.2.3 Profiles of interval shear modulus are provided on Figures 12-22. It should be noted that a constant density of 2 Mg/m^3 has been assumed when calculating these values.

4.2.4 Variations in measurements of Vs_{vh} / shear modulus as a function of depth are generally consistent.

4.2.5 The velocity profile exhibits some scatter in the data, particularly at greater depths. This is thought to be in part due to the effect of calculating interval velocities from non-common ray-paths.

4.2.6 It should also be appreciated that the temporal resolution of identifiable seismic arrivals reduces with increasing depth. The Earth acts as a natural filter to seismic energy, with the result that higher frequency components of seismic energy are removed from deeper propagating waves. Measurement of seismic velocity over an interval of 1m requires precision time picking of first arrival events (i.e. a time picking error of +/- 0.1 ms in 400 m/s media will result in a velocity error of approximately +/- 5%).

4.2.7 For deeper investigation the temporal resolution problem at depth may be mitigated by appropriate use of cross-borehole seismic methods. For this particular investigation the use of SCPT data for velocity calculation is considered to be appropriate.

5. CONCLUSIONS

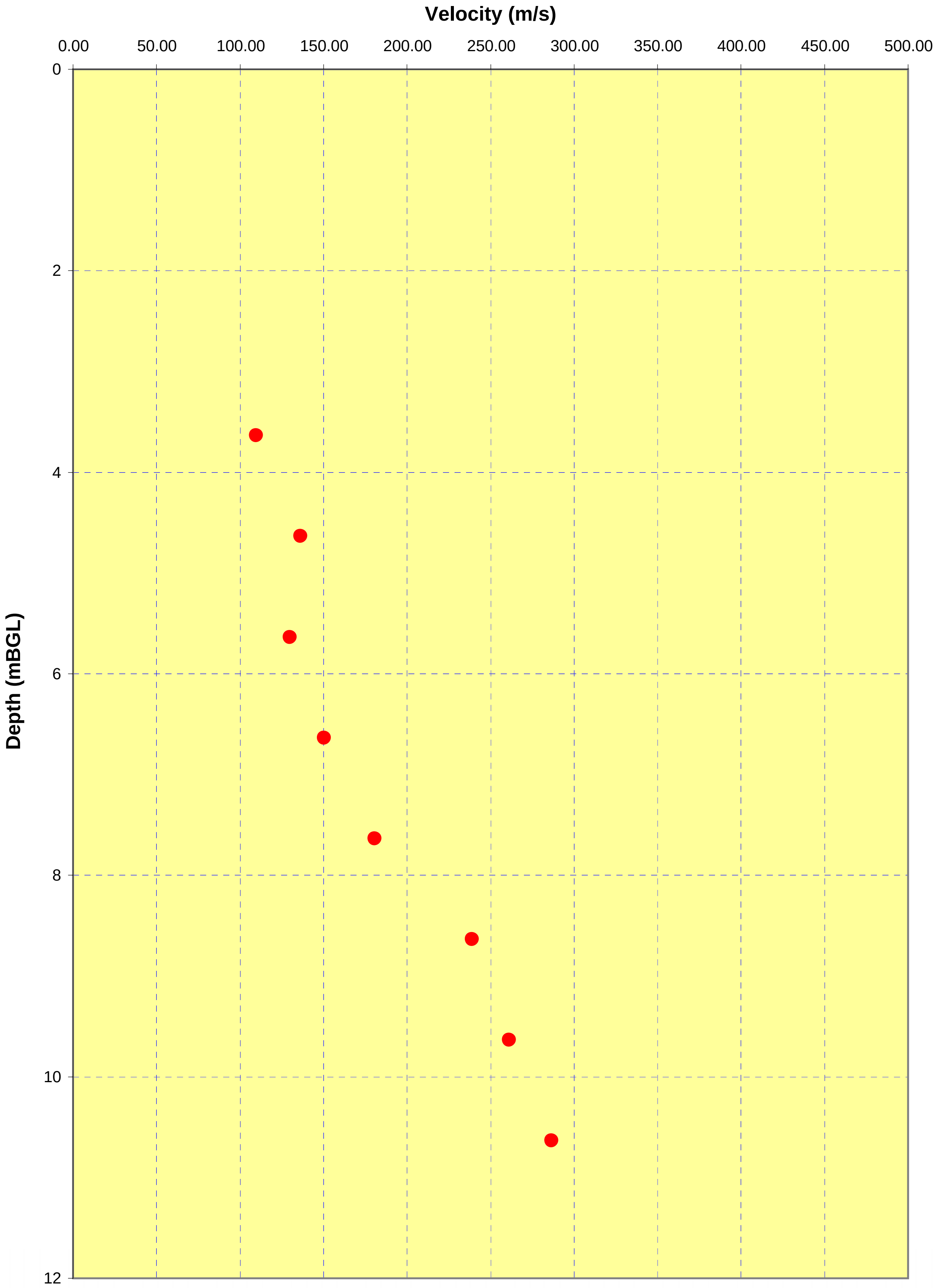
5.1.1 SCPT data acquired at the Tween Bridge Wind Farm site were generally of sufficient quality to provide an estimate of shear-wave velocity as a function of depth.

5.1.2 Determination of shear modulus was made using Vs_{vh} values and an assumed constant density value of 2.00 Mg/m^3.

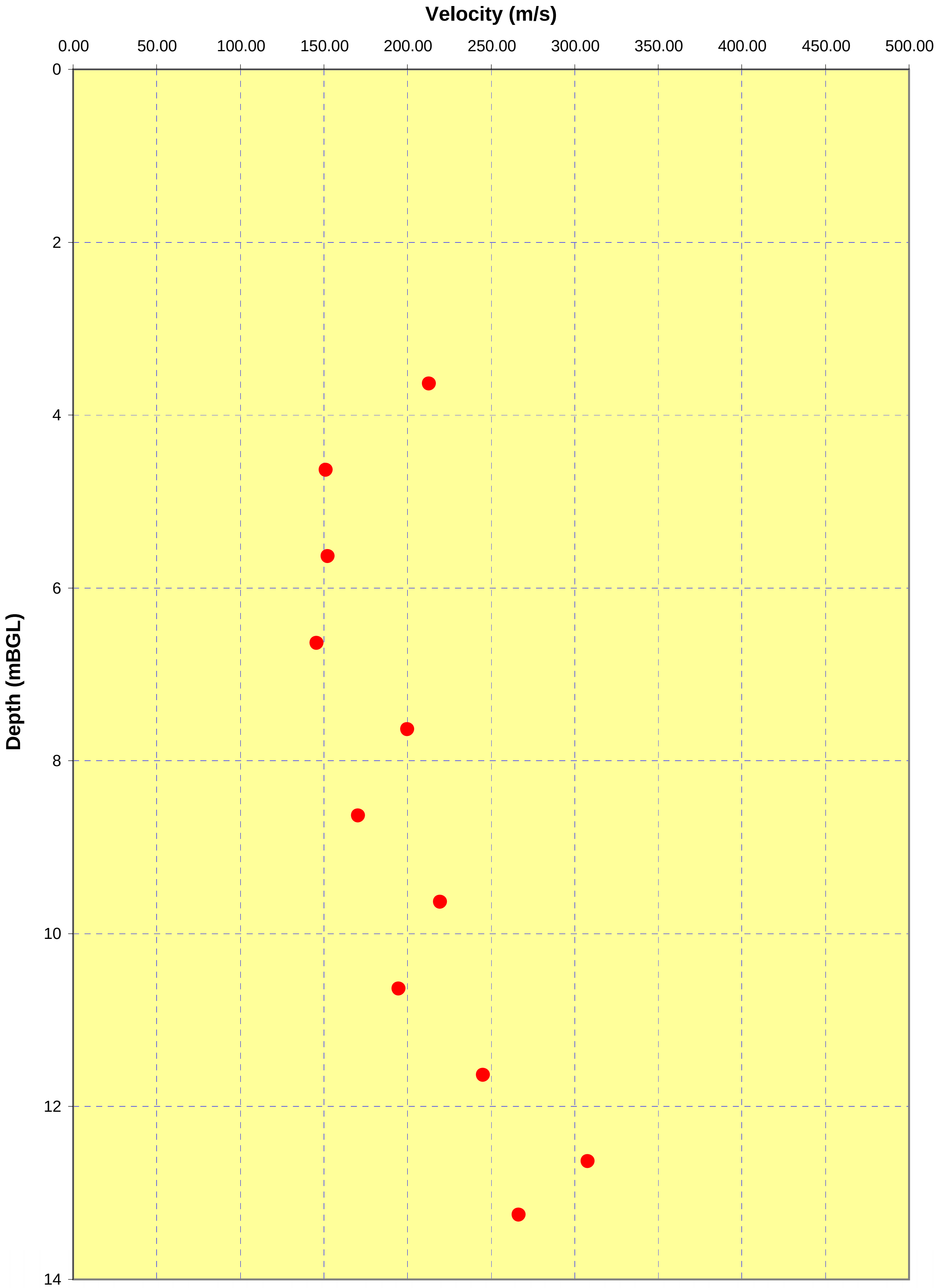
5.1.3 All velocity estimates and subsequent parameter calculations relate to small strain dynamic measurements taken in a vertical plane. Potential anisotropic stiffness behaviour of ground material at this site cannot be ascertained from the data within this report.

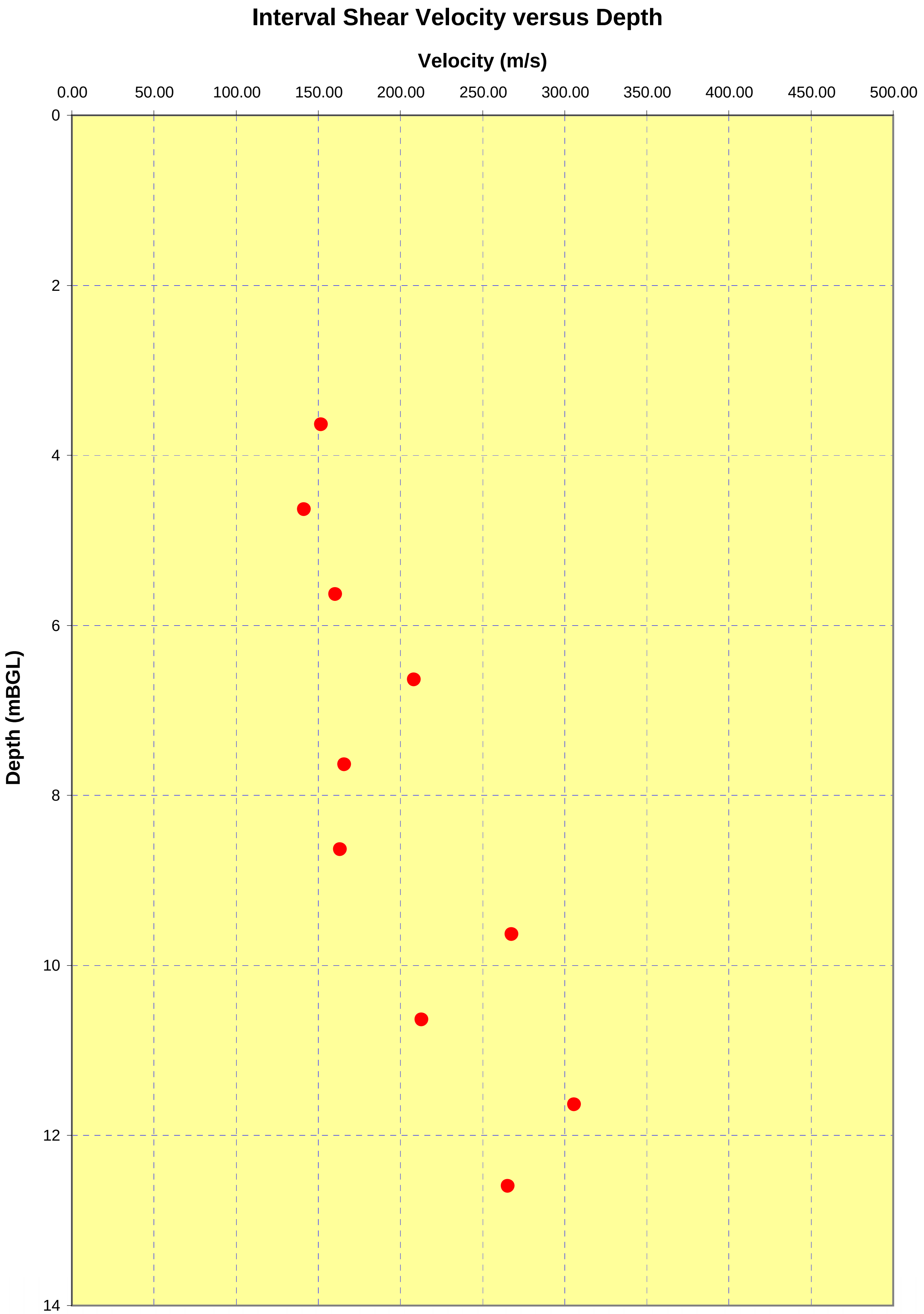
FIGURES

Interval Shear Velocity versus Depth

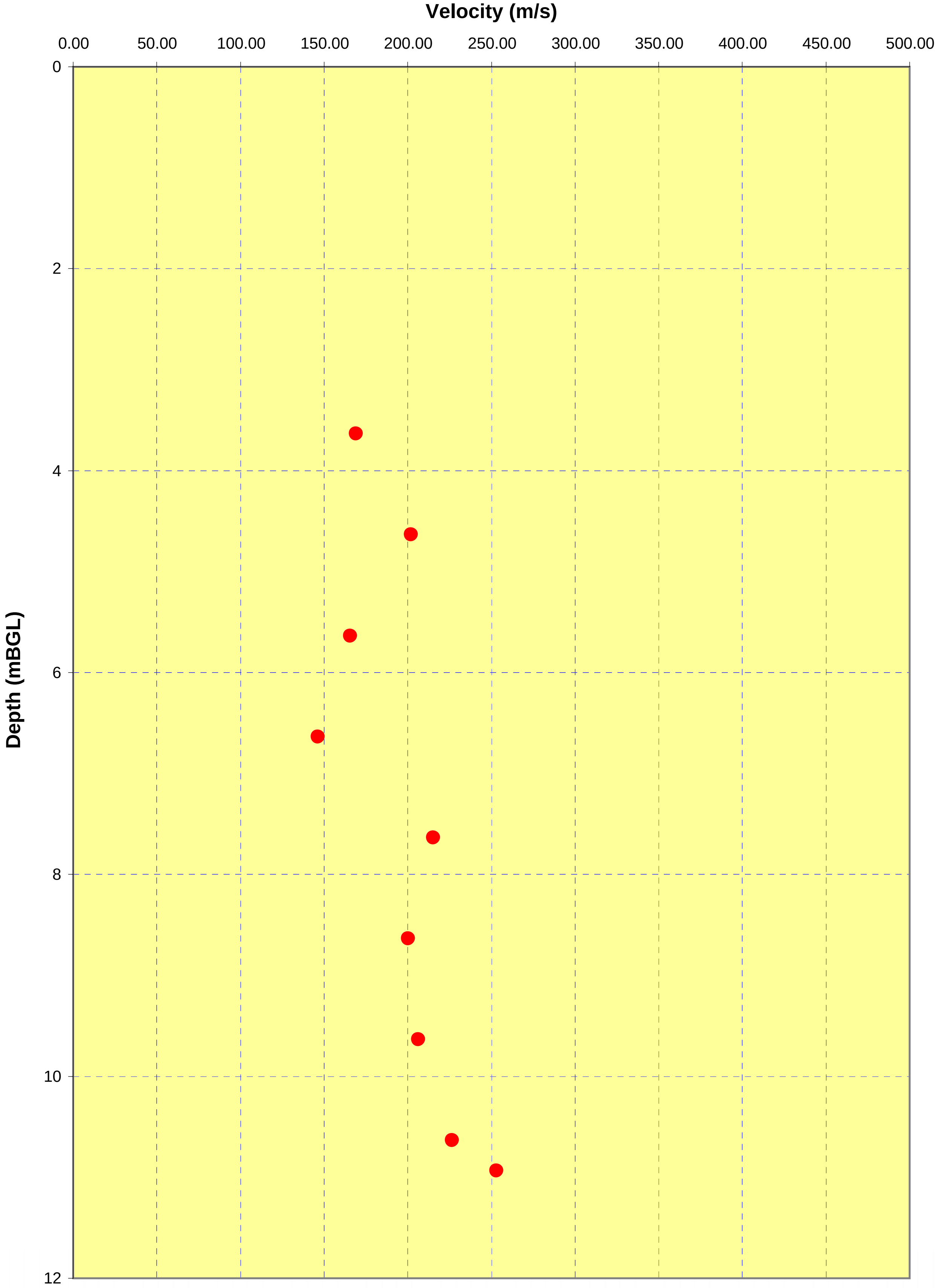


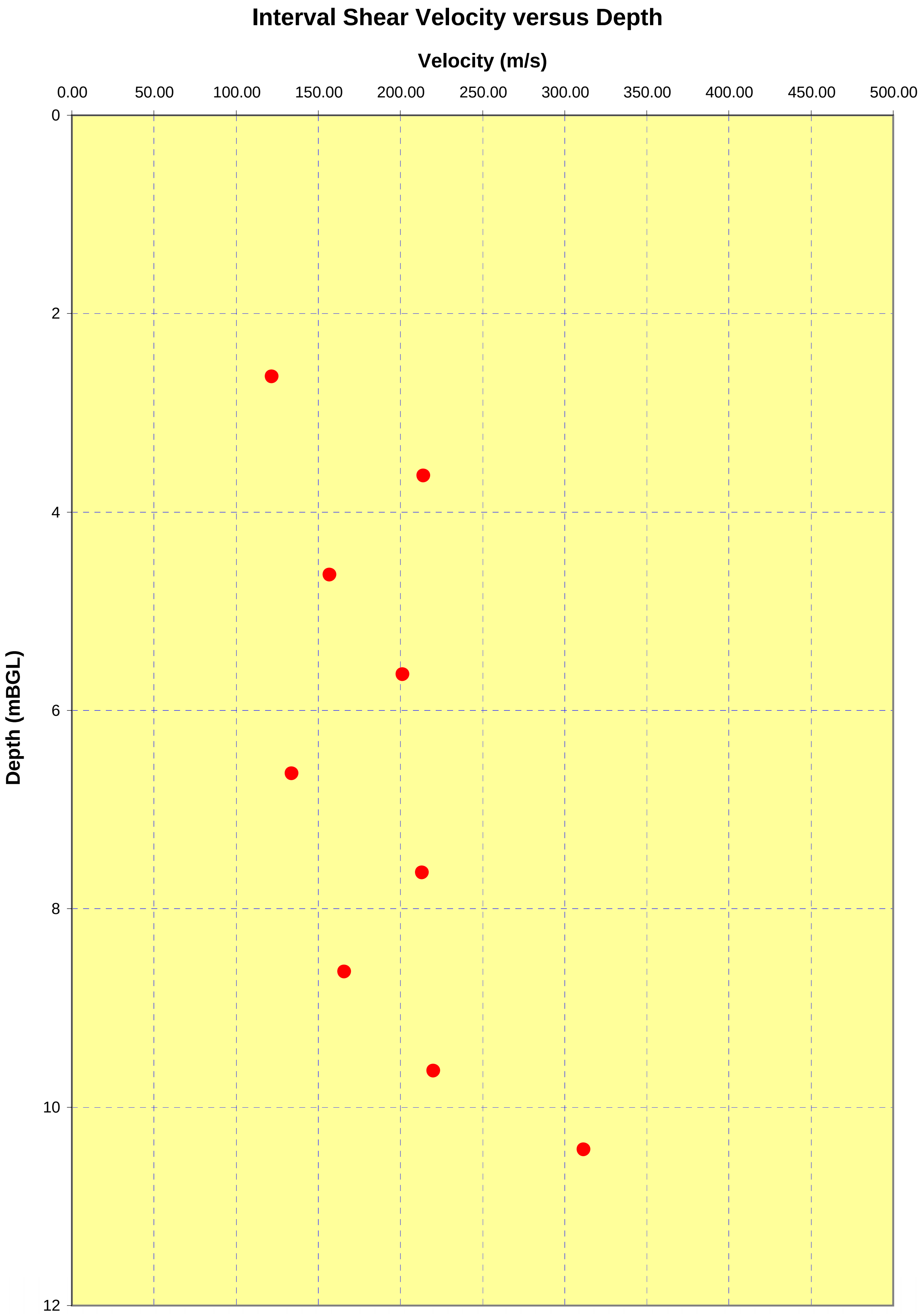
Interval Shear Velocity versus Depth

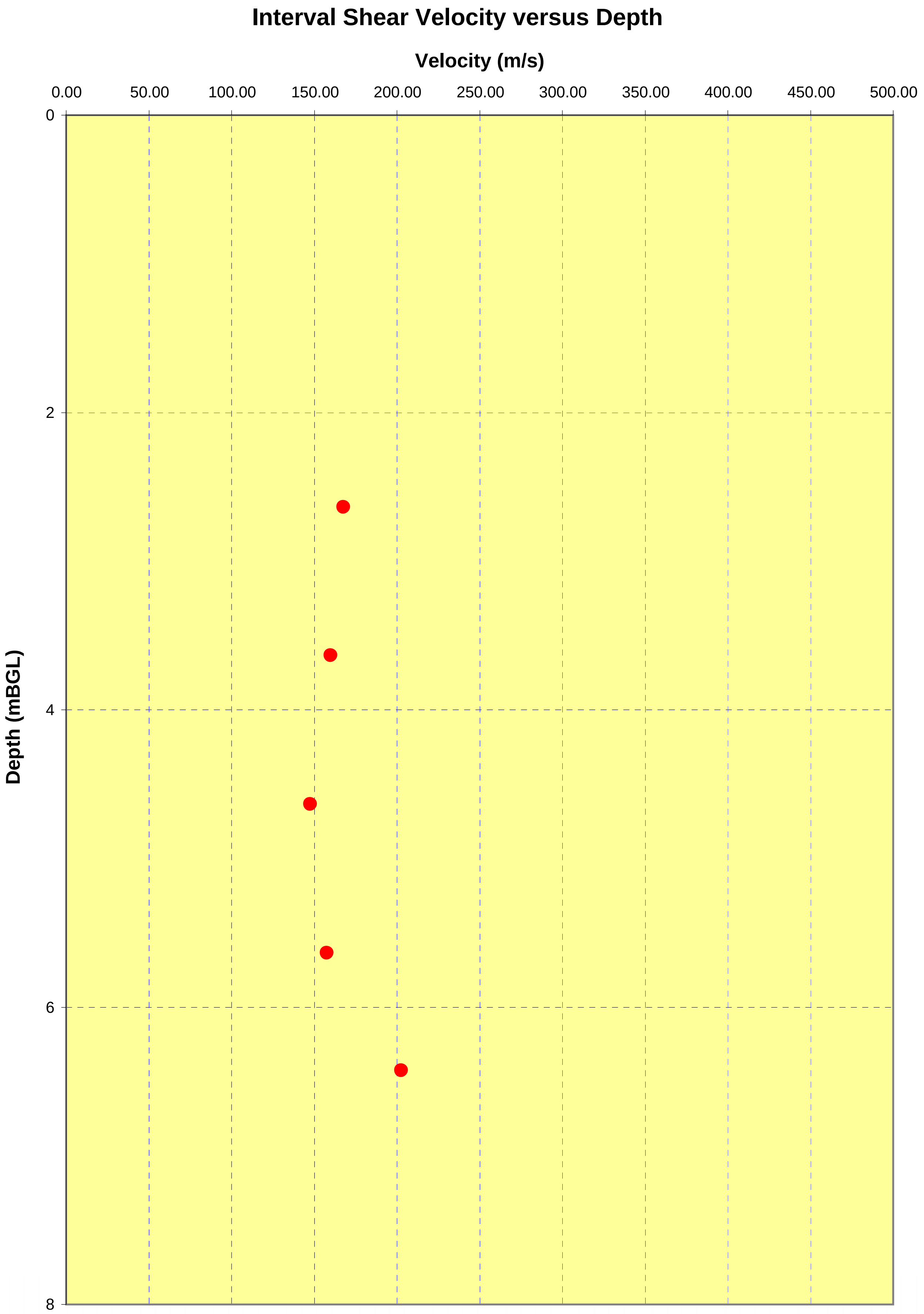


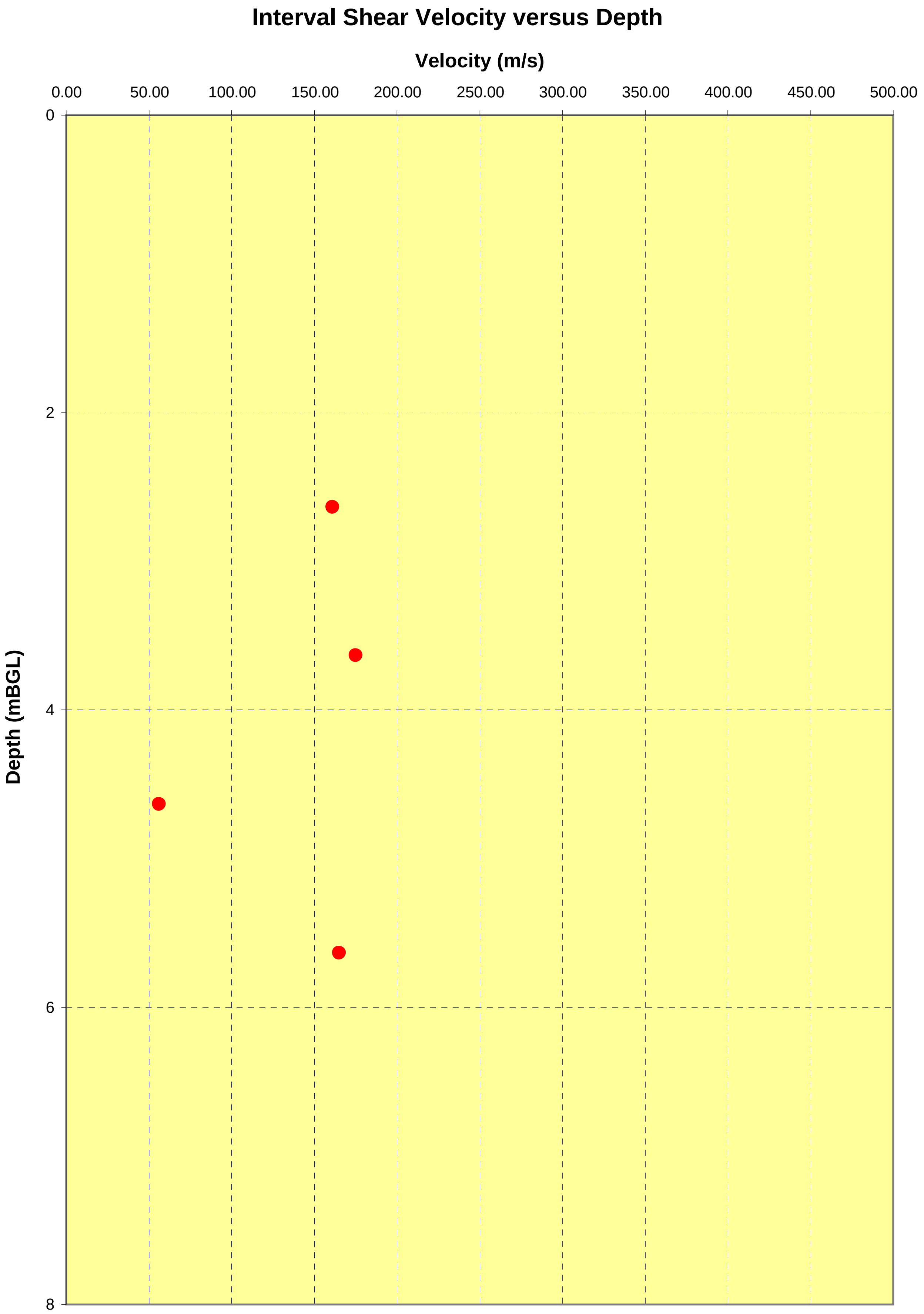

Interval Shear Velocity versus Depth
Velocity (m/s)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
Depth (mBGL)
0
2
4
6
8
10
12
14

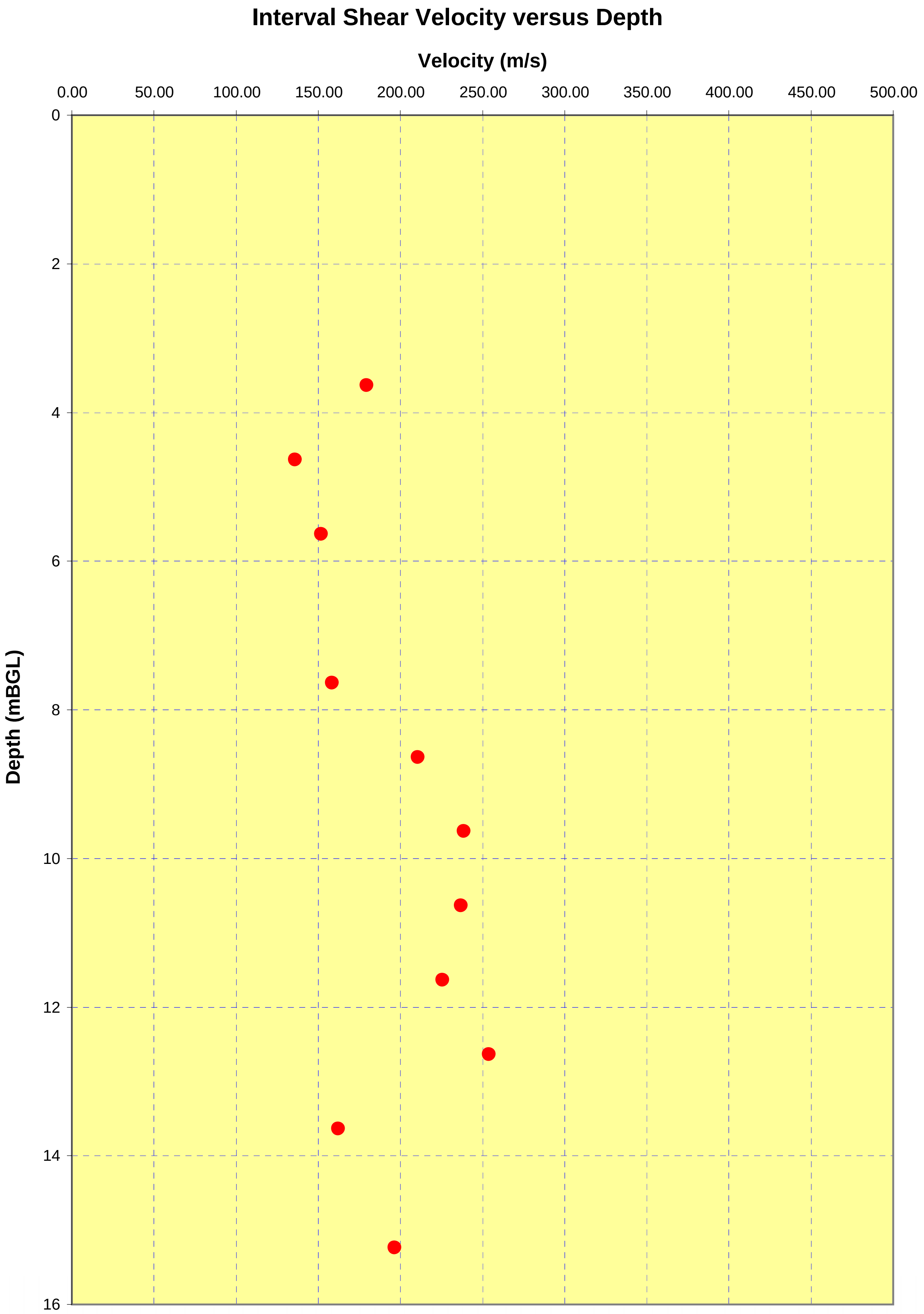
Interval Shear Velocity versus Depth




Interval Shear Velocity versus Depth
Velocity (m/s)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
Depth (mBGL)
0
2
4
6
8
10
12


Interval Shear Velocity versus Depth
Velocity (m/s)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
Depth (mBGL)
0
2
4
6
8


Interval Shear Velocity versus Depth
Velocity (m/s)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
Depth (mBGL)
0
2
4
6
8


Interval Shear Velocity versus Depth
Velocity (m/s)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
Depth (mBGL)
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2
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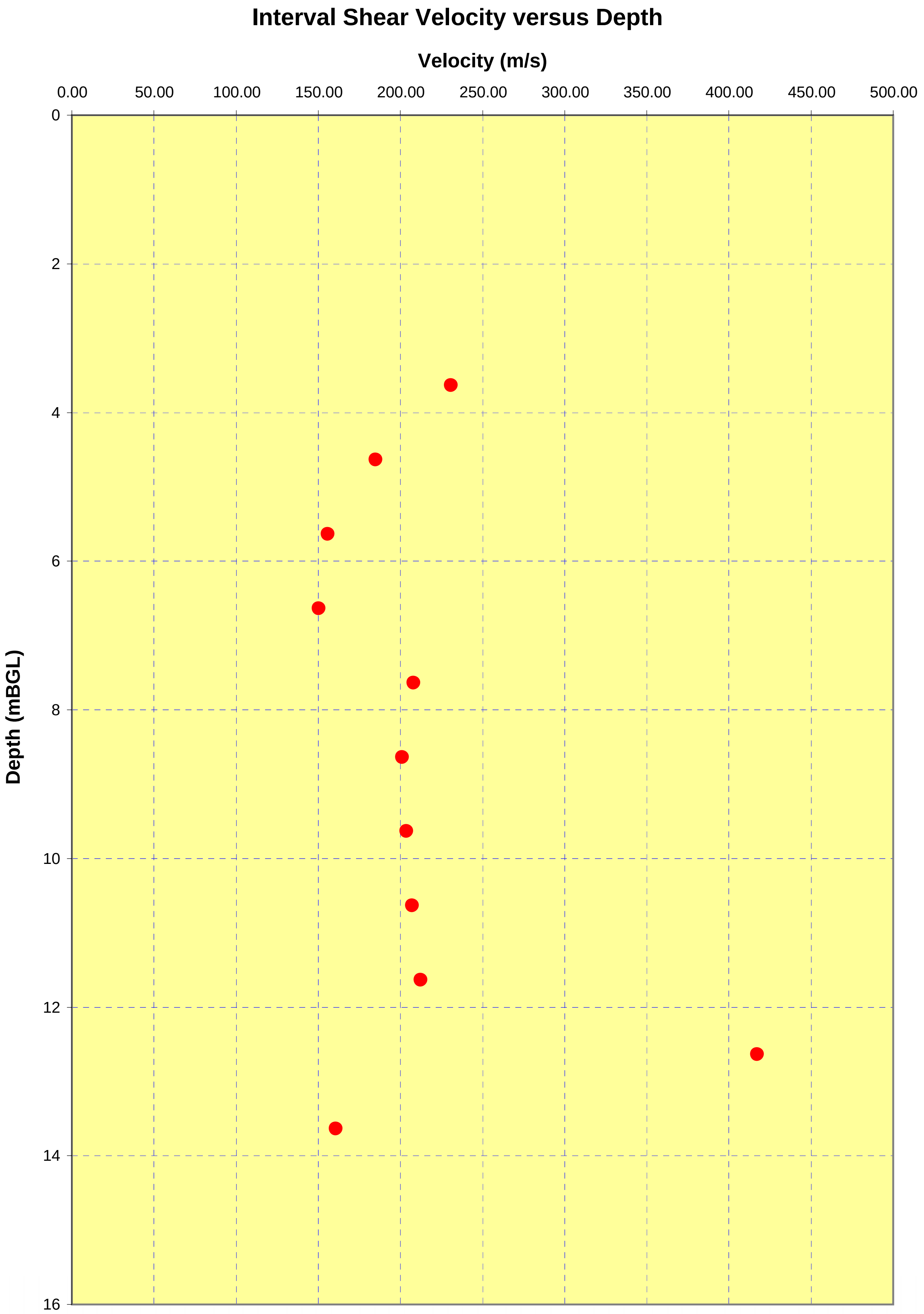
14
16


Interval Shear Velocity versus Depth
Velocity (m/s)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
Depth (mBGL)
0
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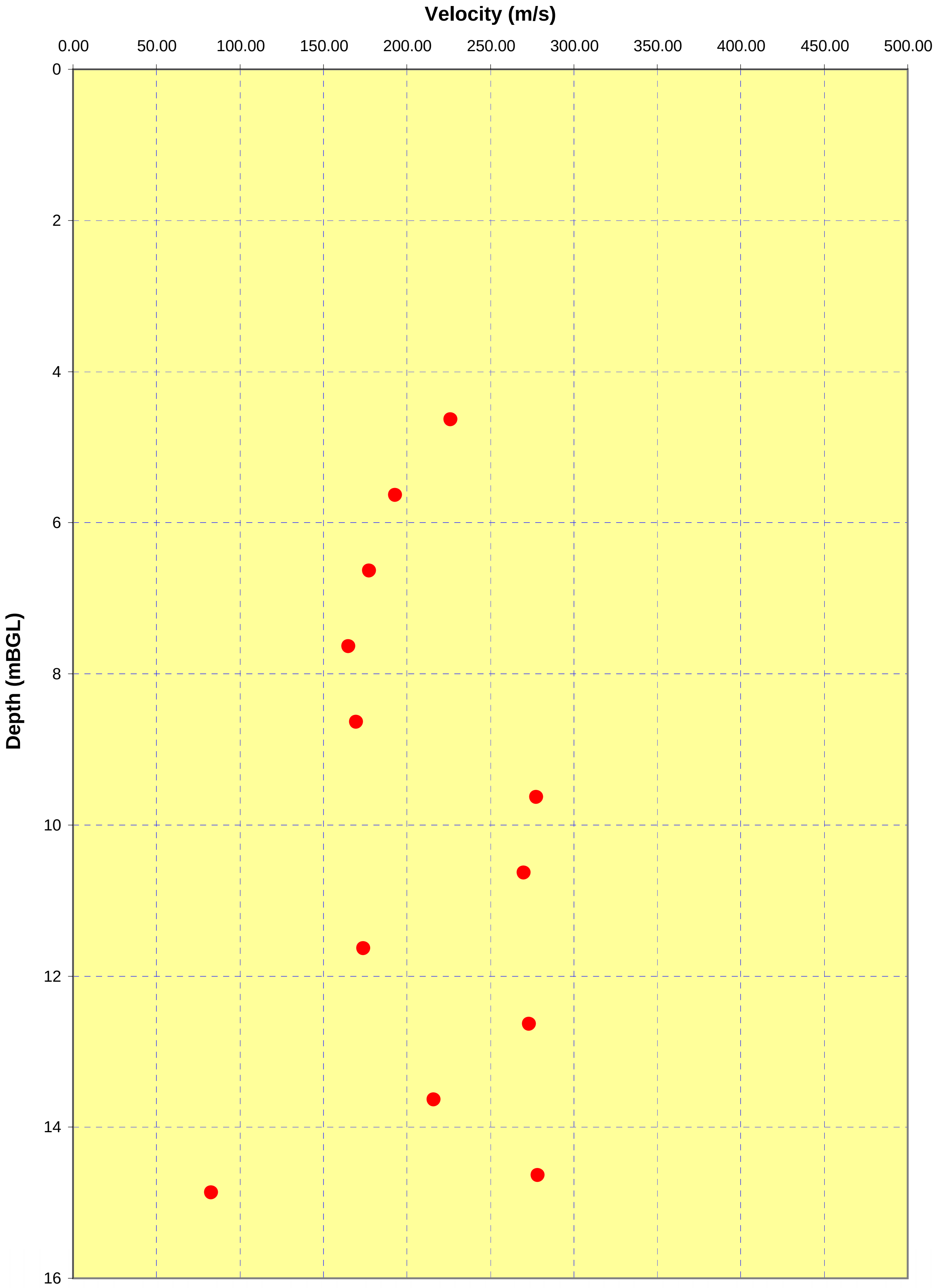
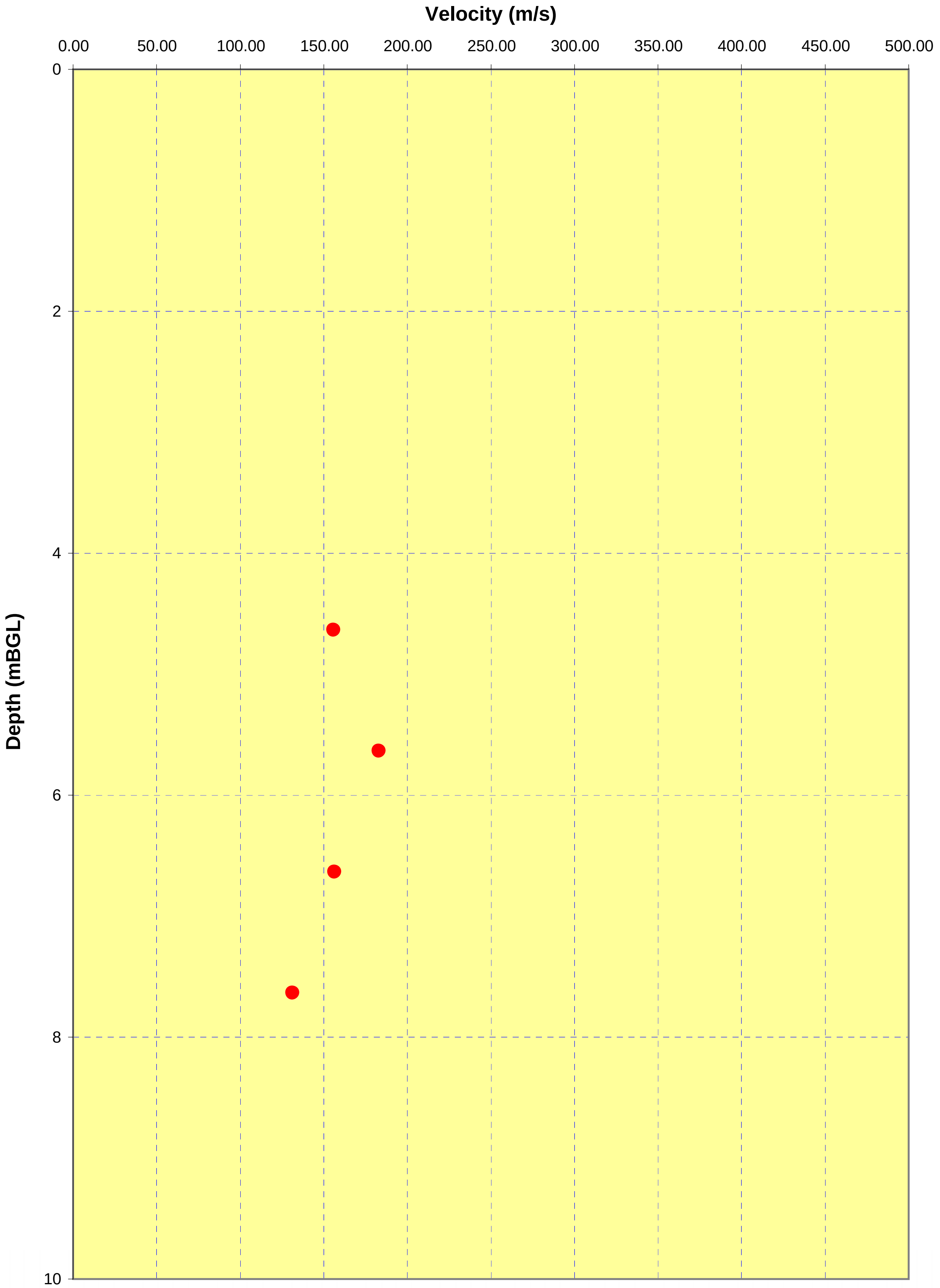
14
16

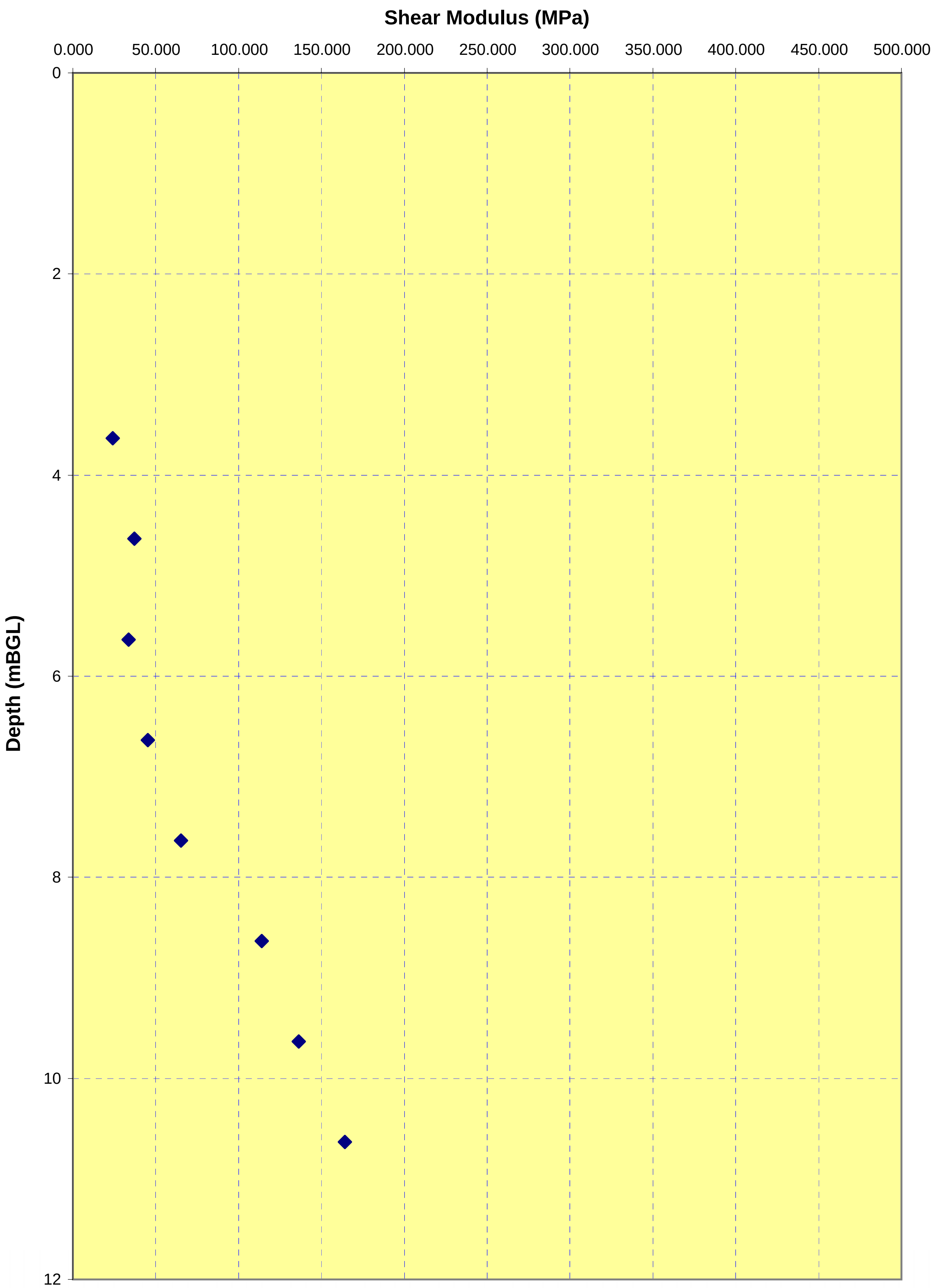
Interval Shear Velocity versus Depth

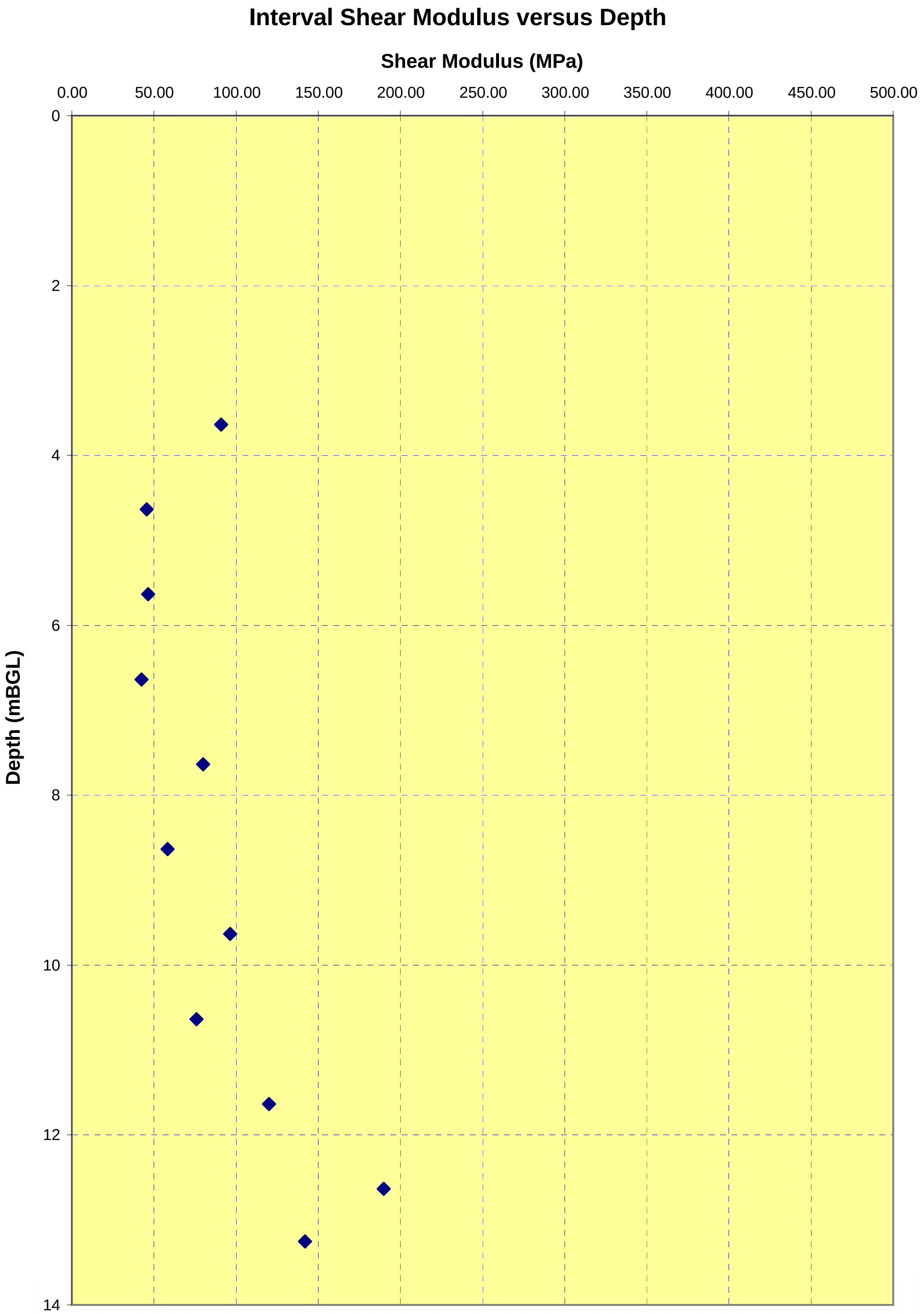


Interval Shear Velocity versus Depth



Interval Shear Modulus versus Depth




Interval Shear Modulus versus Depth
Shear Modulus (MPa)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
Depth (mBGL)
0
2
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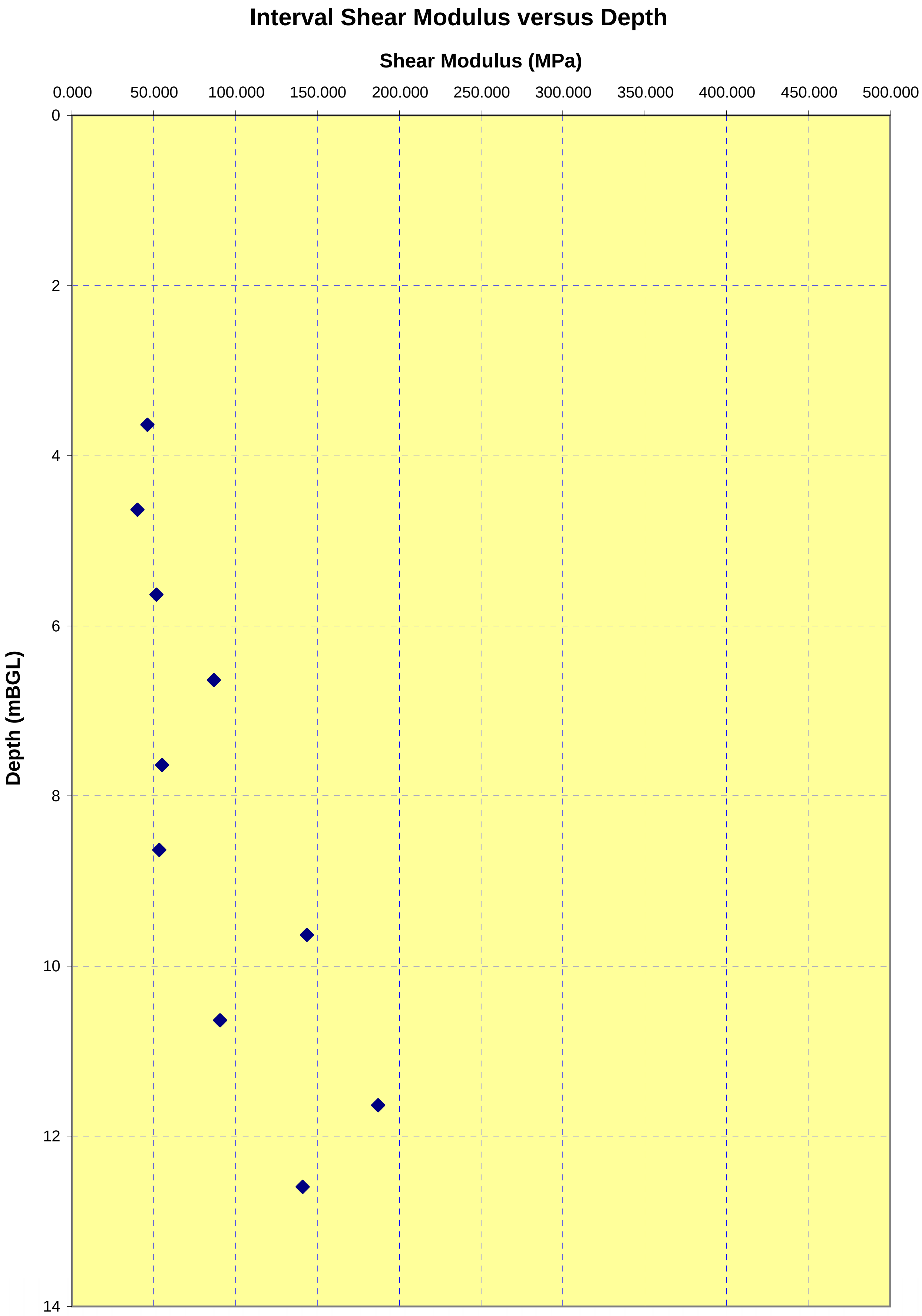
Interval Shear Modulus versus Depth
Shear Modulus (MPa)
0.000
50.000
100.000
150.000
200.000
250.000
300.000
350.000
400.000
450.000
500.000
Depth (mBGL)
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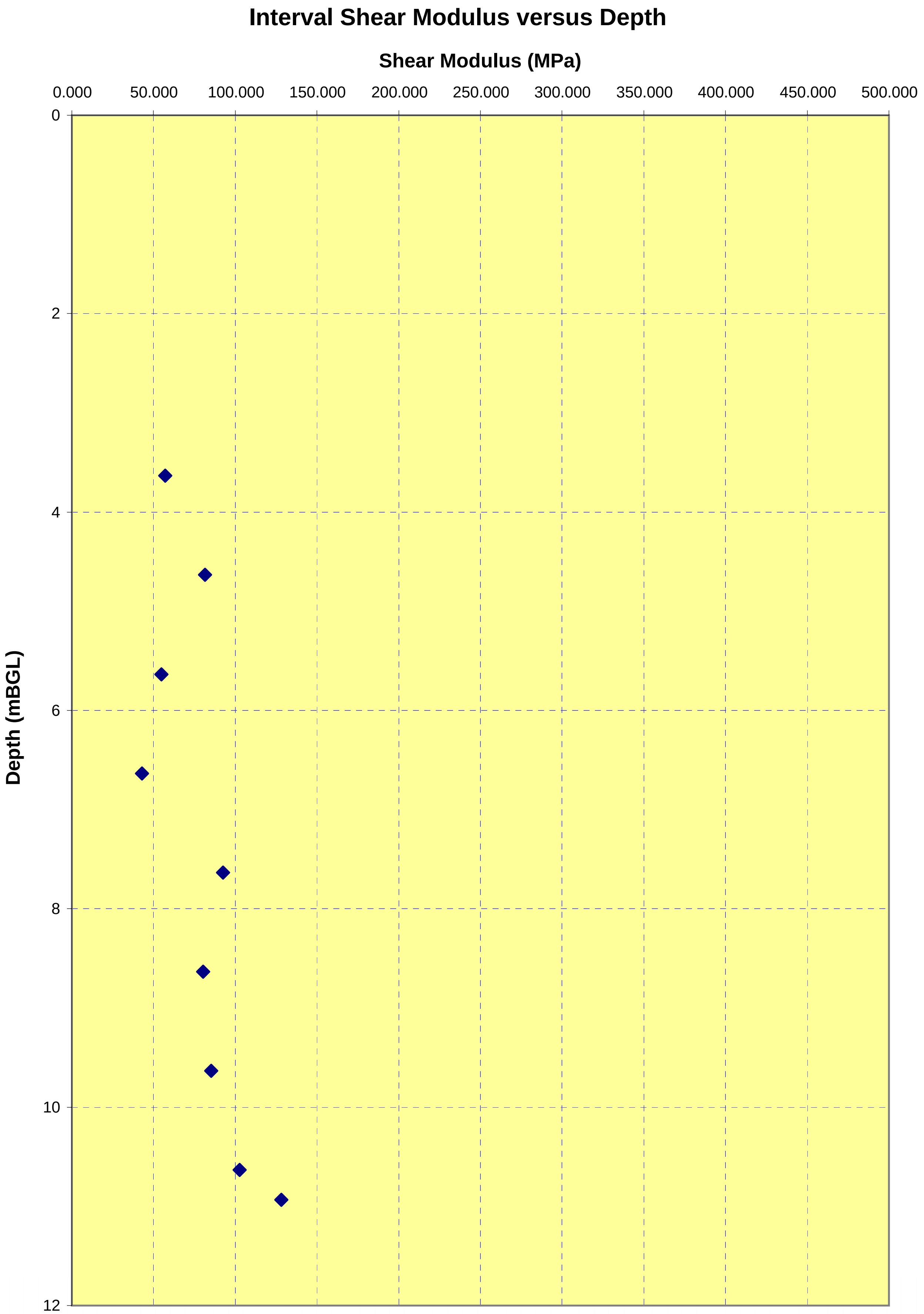
Interval Shear Modulus versus Depth
Shear Modulus (MPa)
0.000
50.000
100.000
150.000
200.000
250.000
300.000
350.000
400.000
450.000
500.000
Depth (mBGL)
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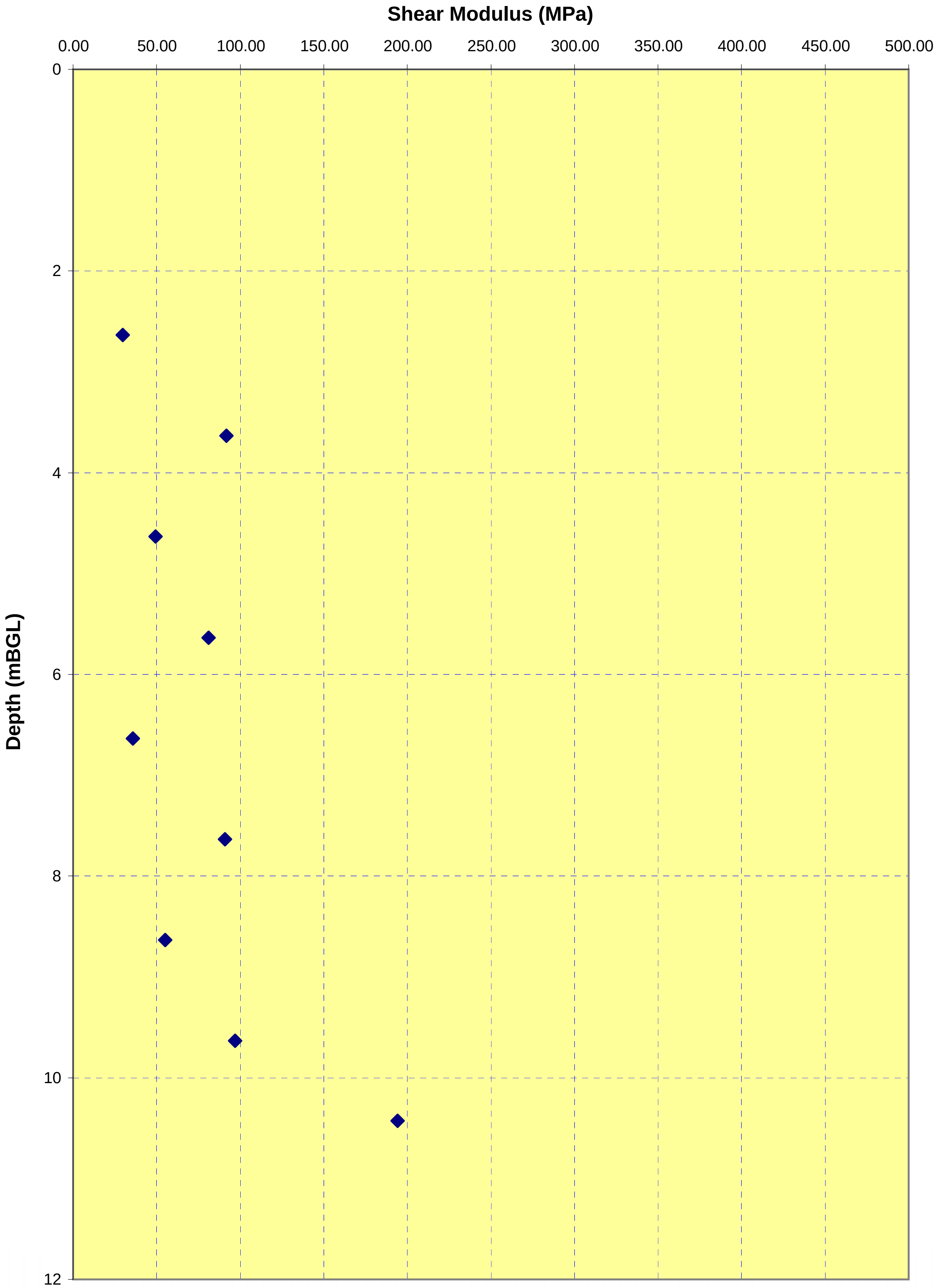
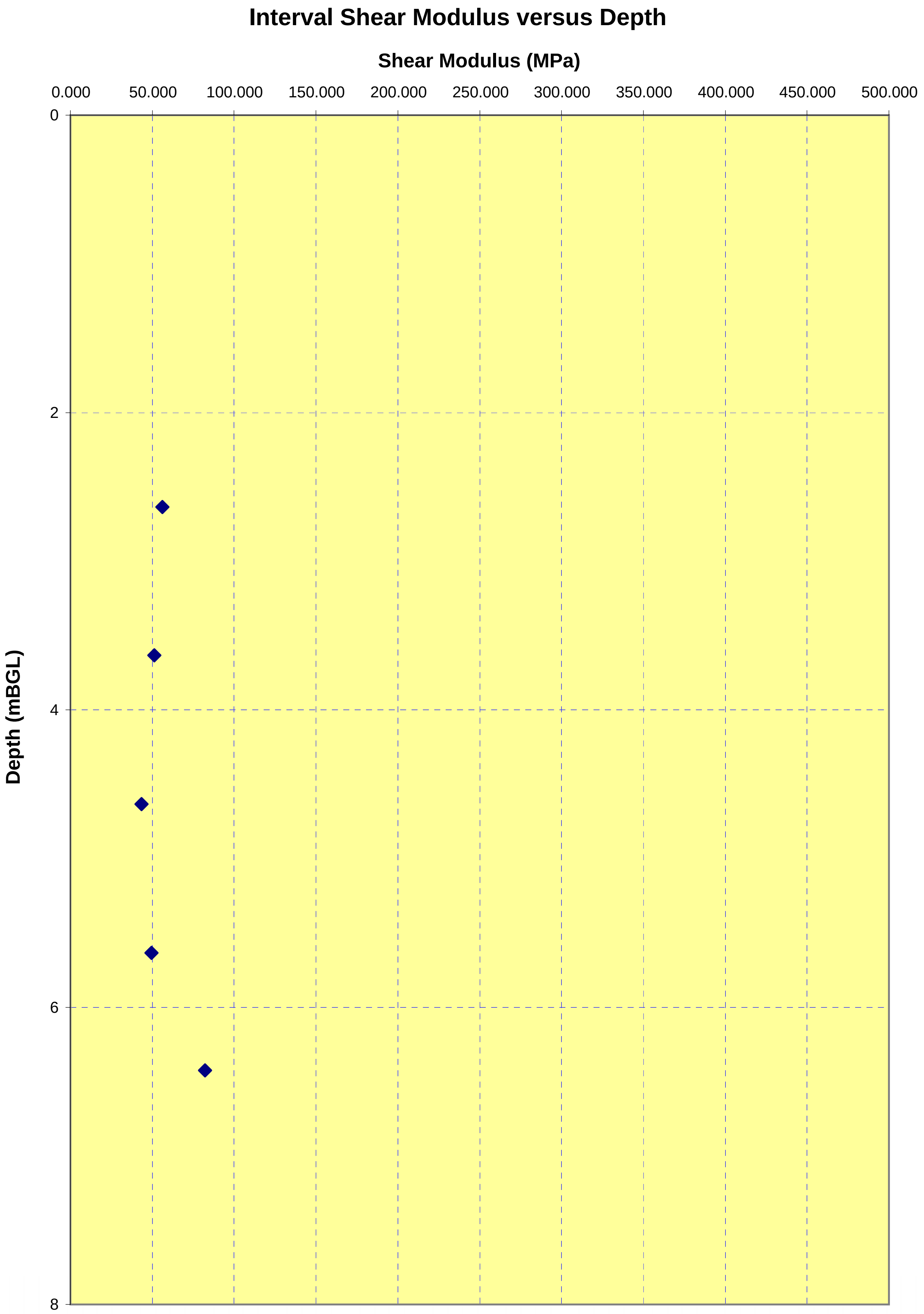
12

Interval Shear Modulus versus Depth




Interval Shear Modulus versus Depth
Shear Modulus (MPa)
0.000
50.000
100.000
150.000
200.000
250.000
300.000
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400.000
450.000
500.000
Depth (mBGL)
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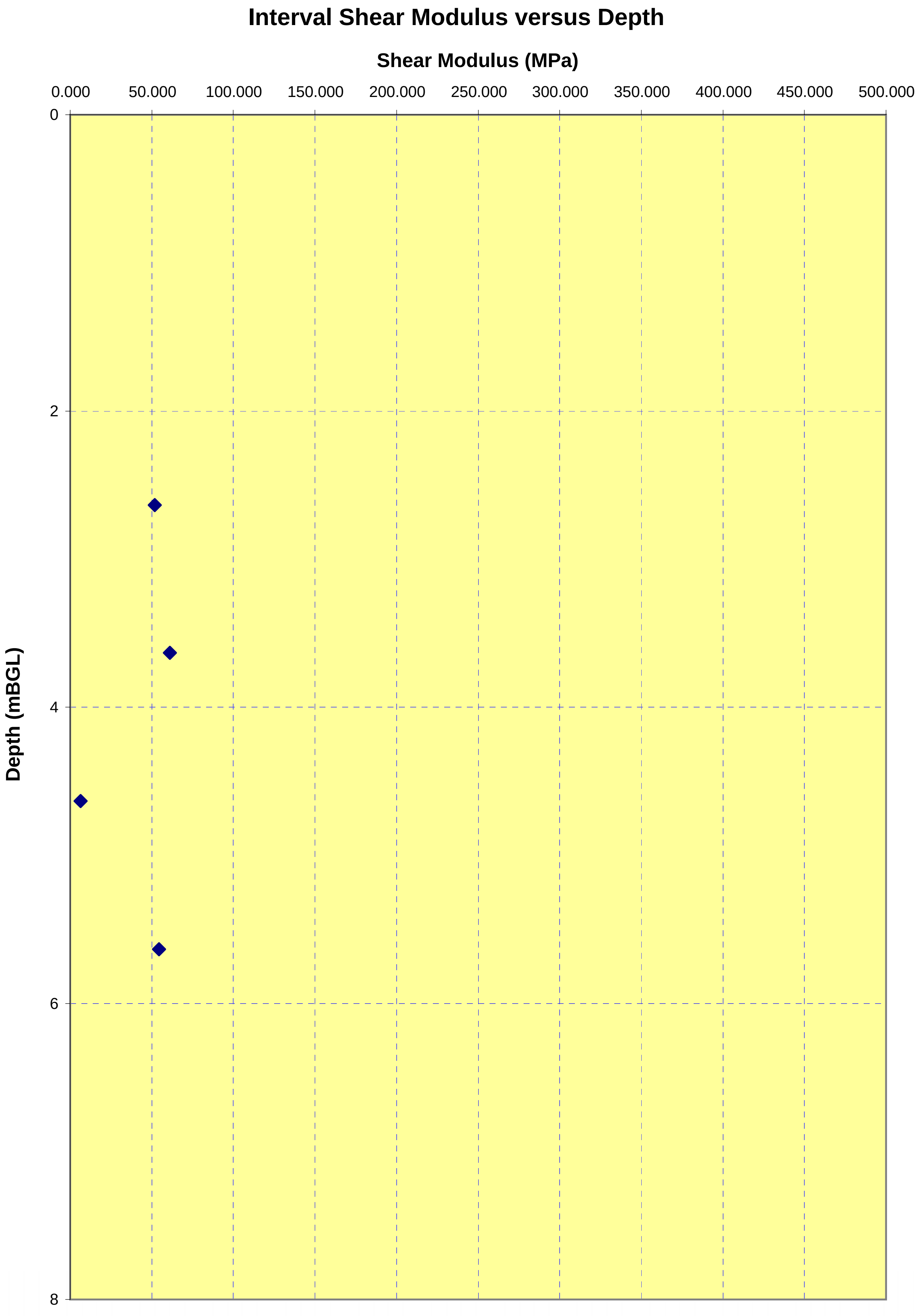
Interval Shear Modulus versus Depth
Shear Modulus (MPa)
0.000
50.000
100.000
150.000
200.000
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450.000
500.000
Depth (mBGL)
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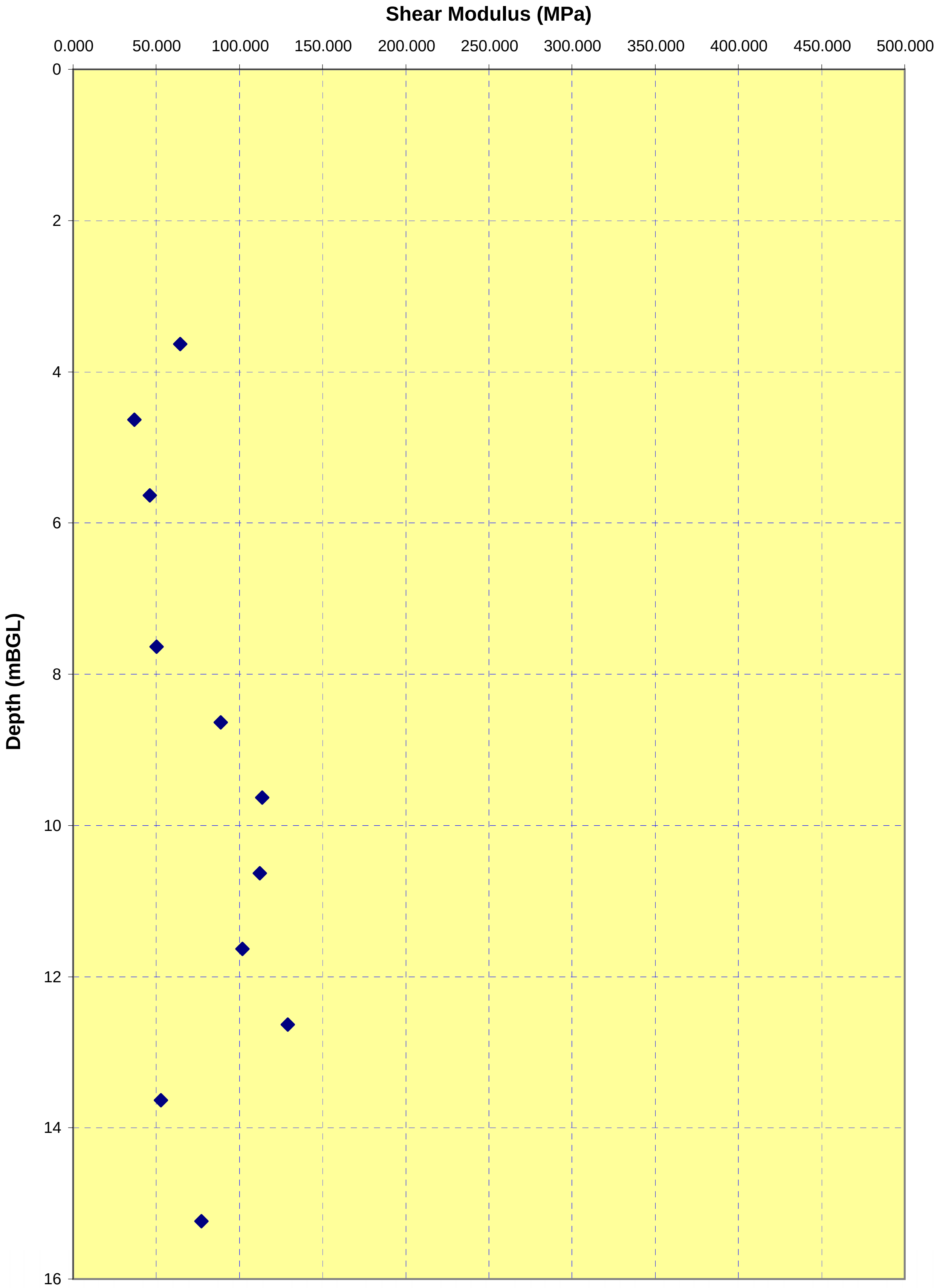
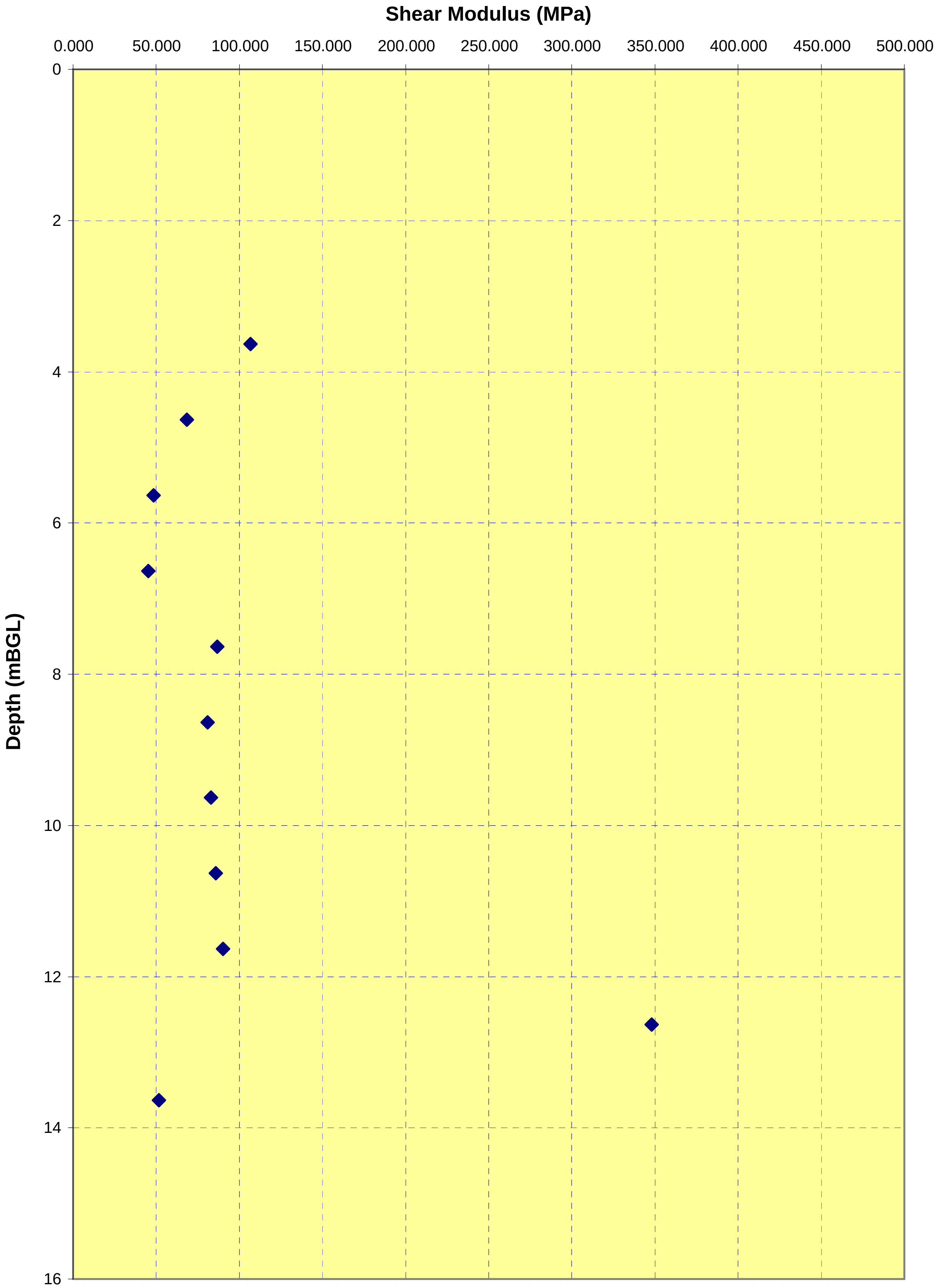
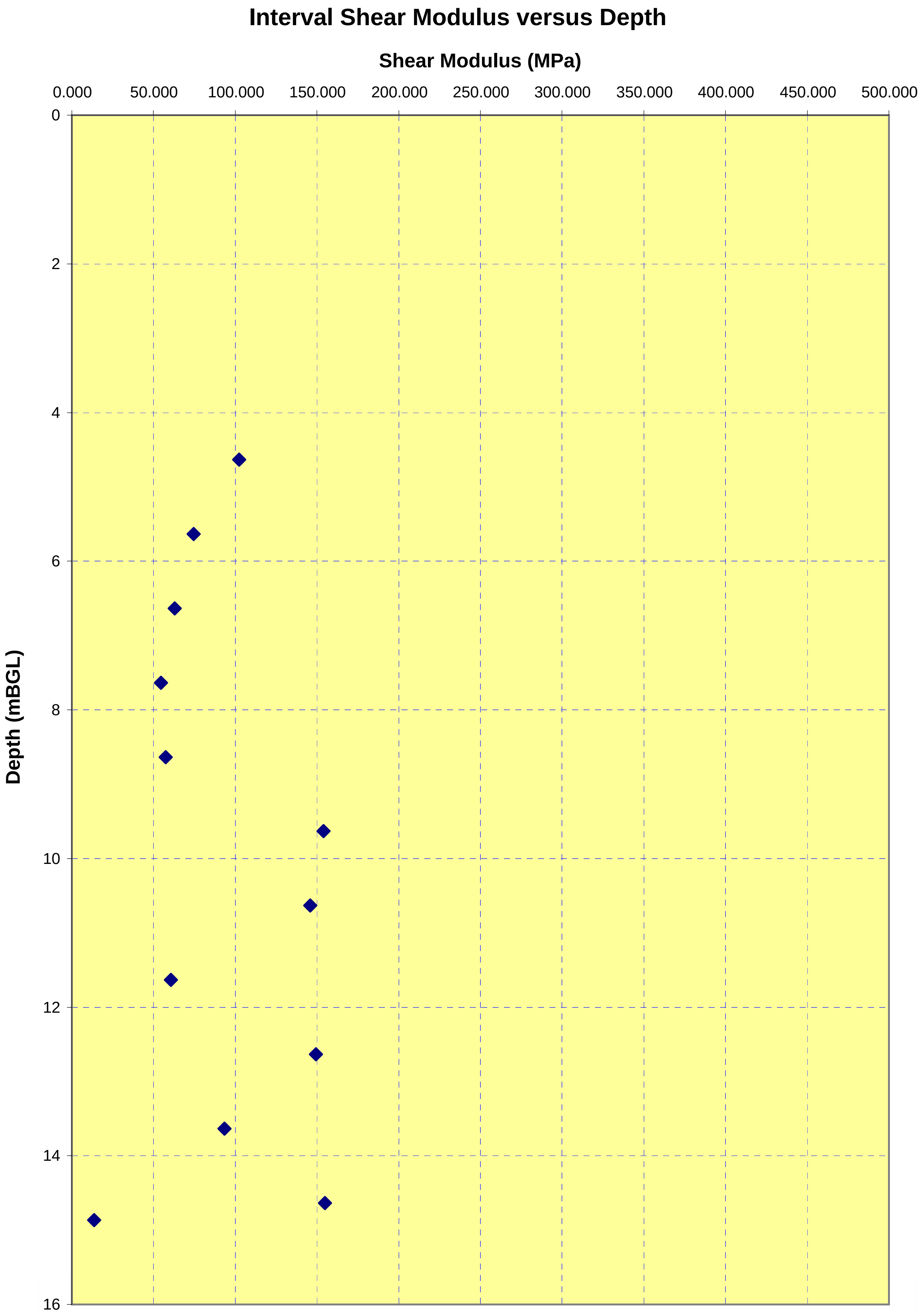
8

Interval Shear Modulus versus Depth



Interval Shear Modulus versus Depth




Interval Shear Modulus versus Depth
Shear Modulus (MPa)
0.000
50.000
100.000
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Depth (mBGL)
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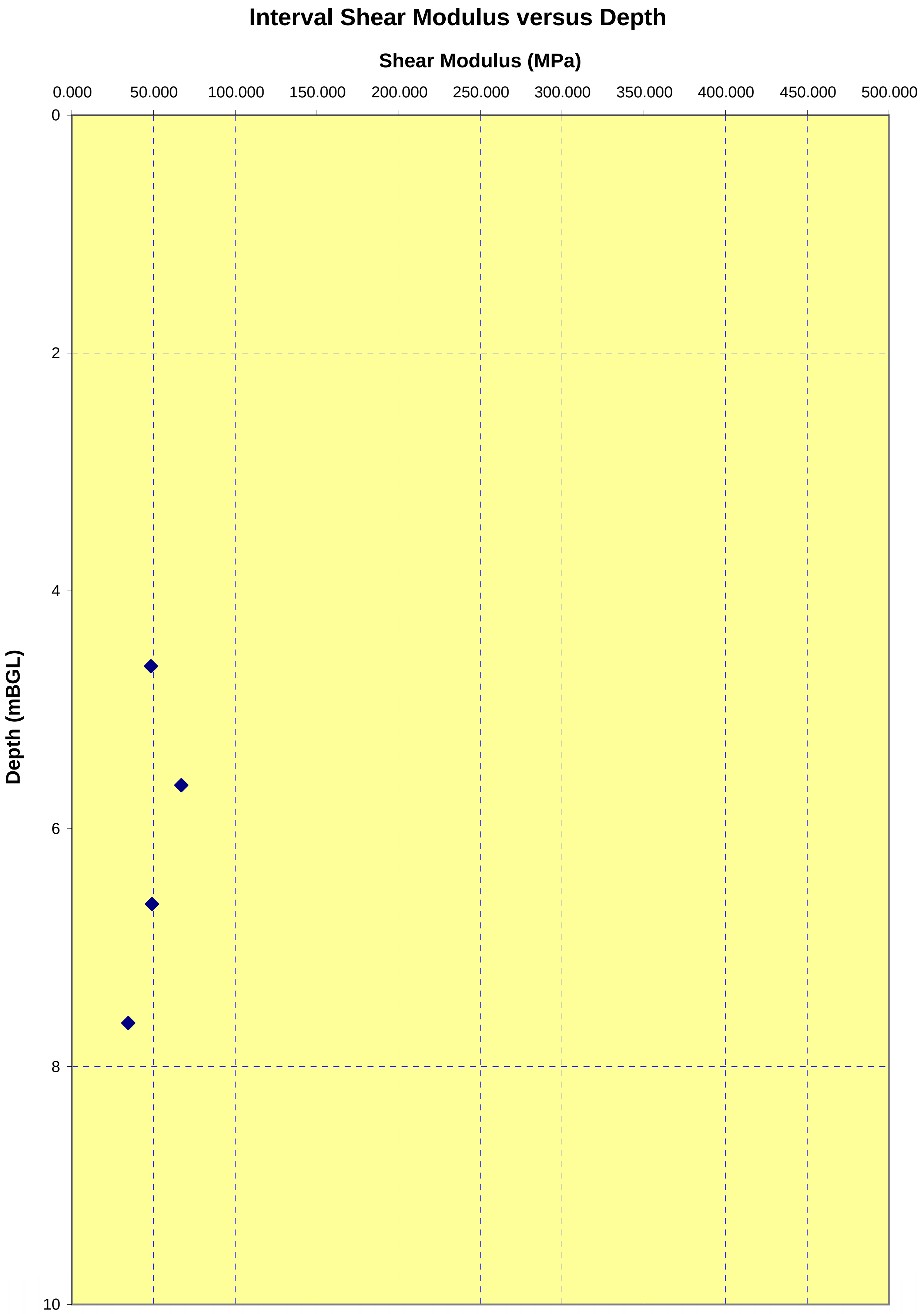
Interval Shear Modulus versus Depth
Shear Modulus (MPa)
0.000
50.000
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450.000
500.000
Depth (mBGL)
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APPENDIX B1 - SERVICE CONSTRAINTS

APPENDIX B1

SERVICE CONSTRAINTS

1. This report and the assessment carried out in connection with the report (together the "Services") were compiled and carried out by Fugro Aperio Limited ("FAPL") on behalf of Fugro Engineering Services (the "Client") for Donalson Associates (the "Engineer") and Morrison Construction (the "Clients") in accordance with the terms of a contract between FES and the Client dated January 2009. The Services were performed by FAPL with the skill and care ordinarily exercised by a reasonable geotechnical specialist at the time the Services were performed. Further, and in particular, the Services were performed by FAPL taking into account the limits of the scope of works required by the Client, the time scale involved and the resources, including financial and manpower resources, agreed between FAPL and the Client.

2. Other than that expressly contained in paragraph 1 above, FAPL provides no other representation or warranty whether express or implied, in relation to the Services.

3. The Services were performed by FAPL exclusively for the purposes of the Client. FAPL is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, FAPL does not authorise, consent or condone any party other than the Client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and FAPL disclaims any liability to such party. Any such party would be well advised to seek independent advice from a competent geotechnical specialist and / or lawyer.

4. It is FAPL's understanding that this report is to be used for the purpose described in Section 1 - "Introduction" of this report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, and/or should the Client's proposed development or use of the site change (including in particular any change in any design and/or specification relating to the proposed use or development of the site), this report may no longer be valid or appropriate and any further use of or reliance upon the report in those circumstances by the Client without FAPL's review and advice shall be at the Client's sole and own risk. Should FAPL be requested, and FAPL agree, to review the report after the date hereof, FAPL shall be entitled to additional payment at the then existing rates or such other terms as may be agreed between FAPL and the Client.

5. The passage of time may result in changes (whether man-made or otherwise) in site conditions and changes in regulatory or other legal provisions, technology, methods of analysis, or economic conditions which could render the report inaccurate or unreliable. The information, recommendations and conclusions contained in this report should not be relied

upon if any such changes have taken place or after a period of 2 years from the date of this report or such other period as maybe expressly stated in the report, without the written agreement of FAPL. In the absence of such written agreement of FAPL, reliance on the report after any such changes have occurred or after the period of 2 years has expired shall be at the Client's own and sole risk. Should FAPL agree to review the report after the period of 2 years has expired, FAPL shall be entitled to additional payment at the then existing rates or such other terms as may be agreed between FAPL and the Client.

6. The observations, recommendations and conclusions in this report are based solely upon the Services, which were provided pursuant to the contract between the Client and FAPL. FAPL has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the Client and FAPL. FAPL is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services.

7. Where the Services have involved FAPL's interpretation and/or other use of any information (including documentation or materials, analysis, recommendations and conclusions) provided by third parties (including independent testing and/or information services or laboratories) or the Client and upon which FAPL was reasonably entitled to rely or involved FAPL's observations of existing physical conditions of any site involved in the Services, then the Services clearly are limited by the accuracy of such information and the observations which were reasonably possible of the said site. Unless otherwise stated, FAPL was not authorised and did not attempt to independently verify the accuracy or completeness of such information, received from the Client or third parties during the performance of the Services. FAPL is not liable for any inaccuracies (including any incompleteness) in the said information, the discovery of which inaccuracies required the doing of any act including the gathering of any information which it was not reasonably possible for FAPL to do including the doing of any independent investigation of the information provided to FAPL save as otherwise provided in the terms of the contract between the Client and FAPL.

8. The soil and ground conditions information provided in the Services are based solely on evaluations of soil and ground condition samples and in-situ tests at determined sample test locations and elevations. That information cannot be extrapolated to any area or elevation outside those locations and elevations unless specifically so stated in the report. In the light of the information available to FAPL, the soil and ground conditions information are considered appropriate for use in relation to the geotechnical design and installation aspects of the structures addressed in the report, but they may not be appropriate for the design of other structures.

APPENDIX B2 – TABULATED RESULTS

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	28.05				2.00	
3.0	2.6	3.89	0.59	35.16	28.05	7.11		2.00	
4.0	3.6	4.63	0.74	41.88	35.16	6.72	109.61	2.00	24.030
5.0	4.6	5.45	0.82	47.90	41.88	6.03	136.25	2.00	37.129
6.0	5.6	6.32	0.87	54.62	47.90	6.72	129.95	2.00	33.772
7.0	6.6	7.23	0.91	60.64	54.62	6.03	150.34	2.00	45.203
8.0	7.6	8.15	0.93	65.78	60.64	5.14	180.65	2.00	65.271
9.0	8.6	9.10	0.94	69.73	65.78	3.95	238.77	2.00	114.022
10.0	9.6	10.05	0.95	73.38	69.73	3.66	261.05	2.00	136.294
11.0	10.6	11.01	0.96	76.74	73.38	3.36	286.56	2.00	164.237
11.3	11.0	11.34	0.33	77.23	76.74	0.49	666.66	2.00	888.861

Tabulated SCPT results – SCPT002

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	27.85				2.00	
3.0	2.6	3.89	0.59	31.70	27.85	3.85		2.00	
4.0	3.6	4.63	0.74	35.16	31.70	3.46	213.01	2.00	90.747
5.0	4.6	5.45	0.82	40.59	35.16	5.43	151.10	2.00	45.661
6.0	5.6	6.32	0.87	46.32	40.59	5.73	152.36	2.00	46.427
7.0	6.6	7.23	0.91	52.54	46.32	6.22	145.58	2.00	42.385
8.0	7.6	8.15	0.93	57.19	52.54	4.64	199.88	2.00	79.902
9.0	8.6	9.10	0.94	62.72	57.19	5.53	170.52	2.00	58.153
10.0	9.6	10.05	0.95	67.06	62.72	4.35	219.54	2.00	96.399
11.0	10.6	11.01	0.96	72.00	67.06	4.94	194.87	2.00	75.950
12.0	11.6	11.98	0.97	75.95	72.00	3.95	245.12	2.00	120.165
13.0	12.6	12.96	0.97	79.11	75.95	3.16	307.99	2.00	189.717
13.6	13.3	13.56	0.61	81.38	79.11	2.27	266.45	2.00	141.989

Tabulated SCPT results – SCPT003

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	30.5				2.00	
3.0	2.6	3.89	0.59	33.7	30.49	3.26		2.00	
4.0	3.6	4.63	0.74	38.6	33.75	4.85	151.66	2.00	46.001
5.0	4.6	5.45	0.82	44.4	38.60	5.81	141.23	2.00	39.894
6.0	5.6	6.32	0.87	49.9	44.42	5.44	160.50	2.00	51.522
7.0	6.6	7.23	0.91	54.2	49.85	4.35	208.39	2.00	86.850
8.0	7.6	8.15	0.93	59.8	54.20	5.59	165.96	2.00	55.085
9.0	8.6	9.10	0.94	65.6	59.79	5.77	163.43	2.00	53.422
10.0	9.6	10.05	0.95	69.1	65.56	3.56	267.83	2.00	143.469
11.0	10.6	11.01	0.96	73.6	69.12	4.52	212.86	2.00	90.617
12.0	11.6	11.98	0.97	76.8	73.64	3.17	305.83	2.00	187.068
13.0	12.6	12.92	0.93	80.3	76.81	3.52	265.35	2.00	140.823

Tabulated SCPT results – SCPT004

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	28.77037				2.00	
3.0	2.6	3.89	0.59	32.77031	28.77	4.00		2.00	
4.0	3.6	4.63	0.74	37.12441	32.77	4.35	169.07	2.00	57.172
5.0	4.6	5.45	0.82	41.19175	37.12	4.07	201.83	2.00	81.470
6.0	5.6	6.32	0.87	46.45759	41.19	5.27	165.73	2.00	54.934
7.0	6.6	7.23	0.91	52.64499	46.46	6.19	146.39	2.00	42.861
8.0	7.6	8.15	0.93	56.95742	52.64	4.31	215.15	2.00	92.582
9.0	8.6	9.10	0.94	61.66568	56.96	4.71	200.32	2.00	80.253
10.0	9.6	10.05	0.95	66.29061	61.67	4.62	206.30	2.00	85.122
11.0	10.6	11.01	0.96	70.54054	66.29	4.25	226.42	2.00	102.534
11.3	10.9	11.30	0.29	71.68636	70.54	1.15	253.06	2.00	128.080

Tabulated SCPT results – SCPT009

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
1.0	0.6	2.93	2.93	19.91635				2.00	
2.0	1.6	3.30	0.36	23.1663	19.92	3.25		2.00	
3.0	2.6	3.89	0.59	28.04122	23.17	4.87	121.88	2.00	29.709
4.0	3.6	4.63	0.74	31.47866	28.04	3.44	214.16	2.00	91.730
5.0	4.6	5.45	0.82	36.70775	31.48	5.23	156.99	2.00	49.291
6.0	5.6	6.32	0.87	41.04101	36.71	4.33	201.40	2.00	81.124
7.0	6.6	7.23	0.91	47.81174	41.04	6.77	133.78	2.00	35.794
8.0	7.6	8.15	0.93	52.16583	47.81	4.35	213.09	2.00	90.818
9.0	8.6	9.10	0.94	57.85324	52.17	5.69	165.83	2.00	54.999
10.0	9.6	10.05	0.95	62.18651	57.85	4.33	220.19	2.00	96.966
10.8	10.4	10.81	0.76	64.62397	62.19	2.44	311.65	2.00	194.250

Tabulated SCPT results – SCPT011

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
1.0	0.6	2.93	2.93	46.85342				2.00	
2.0	1.6	3.30	0.36	49.16588	46.85	2.31		2.00	
3.0	2.6	3.89	0.59	52.70749	49.17	3.54	167.76	2.00	56.288
4.0	3.6	4.63	0.74	57.31158	52.71	4.60	159.89	2.00	51.132
5.0	4.6	5.45	0.82	62.874	57.31	5.56	147.58	2.00	43.561
6.0	5.6	6.32	0.87	68.41557	62.87	5.54	157.49	2.00	49.604
6.8	6.4	7.03	0.71	71.93635	68.42	3.52	202.64	2.00	82.126

Tabulated SCPT results – SCPT013

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
1.0	0.6	2.93	2.93	34.14529				2.00	
2.0	1.6	3.30	0.36	34.5	34.15	0.35		2.00	
3.0	2.6	3.89	0.59	38.18689	34.50	3.69	161.15	2.00	51.939
4.0	3.6	4.63	0.74	42.39516	38.19	4.21	174.93	2.00	61.203
5.0	4.6	5.45	0.82	57.01992	42.40	14.62	56.13	2.00	6.302
6.0	5.6	6.32	0.87	62.3115	57.02	5.29	164.93	2.00	54.401
6.5	6.1	6.77	0.45	62.9	62.31	0.59	763.94	2.00	1167.212

Tabulated SCPT results – SCPT014

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	45.54				2.00	
3.0	2.6	3.89	0.59	58.87	45.54	13.33		2.00	
4.0	3.6	4.63	0.74	62.98	58.87	4.10	179.37	2.00	64.350
5.0	4.6	5.45	0.82	69.02	62.98	6.04	135.88	2.00	36.925
6.0	5.6	6.32	0.87	74.77	69.02	5.75	151.78	2.00	46.074
8.0	7.6	8.15	1.83	86.35	74.77	11.58	158.30	2.00	50.118
9.0	8.6	9.10	0.94	90.83	86.35	4.48	210.57	2.00	88.675
10.0	9.6	10.05	0.95	94.83	90.83	4.00	238.54	2.00	113.801
11.0	10.6	11.01	0.96	98.89	94.83	4.06	236.87	2.00	112.217
12.0	11.6	11.98	0.97	103.19	98.89	4.29	225.66	2.00	101.848
13.0	12.6	12.96	0.97	107.02	103.19	3.83	253.90	2.00	128.926
14.0	13.6	13.93	0.98	113.04	107.02	6.02	162.28	2.00	52.669
15.0	14.6	14.91	0.98	114.75	113.04	1.71	573.72	2.00	658.304
15.6	15.2	15.50	0.59	117.75	114.75	3.00	196.43	2.00	77.167

Tabulated SCPT results – SCPT017

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	59.96				2.00	
3.0	2.6	3.89	0.59	61.54	59.96	1.58		2.00	
4.0	3.6	4.63	0.74	64.73	61.54	3.19	230.96	2.00	106.683
5.0	4.6	5.45	0.82	69.17	64.73	4.44	185.00	2.00	68.448
6.0	5.6	6.32	0.87	74.77	69.17	5.60	155.73	2.00	48.503
7.0	6.6	7.23	0.91	80.79	74.77	6.02	150.44	2.00	45.267
8.0	7.6	8.15	0.93	85.25	80.79	4.46	208.12	2.00	86.624
9.0	8.6	9.10	0.94	89.94	85.25	4.69	201.21	2.00	80.968
10.0	9.6	10.05	0.95	94.62	89.94	4.69	203.55	2.00	82.867
11.0	10.6	11.01	0.96	99.27	94.62	4.65	207.13	2.00	85.806
12.0	11.6	11.98	0.97	103.83	99.27	4.56	212.27	2.00	90.116
13.0	12.6	12.96	0.97	106.16	103.83	2.33	417.11	2.00	347.968
14.0	13.6	13.93	0.98	112.25	106.16	6.08	160.61	2.00	51.592
14.9	14.6	14.85	0.92	113.12	112.25	0.87	1052.82	2.00	2216.874

Tabulated SCPT results – SCPT019

Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
2.0	1.6	3.30	3.30	50.19				2.00	
3.0	2.6	3.89	0.59	55.55	50.19	5.37		2.00	
5.0	4.6	5.45	1.56	62.44	55.55	6.88	226.26	2.00	102.386
6.0	5.6	6.32	0.87	66.96	62.44	4.52	193.05	2.00	74.535
7.0	6.6	7.23	0.91	72.06	66.96	5.10	177.46	2.00	62.986
8.0	7.6	8.15	0.93	77.69	72.06	5.62	164.95	2.00	54.418
9.0	8.6	9.10	0.94	83.25	77.69	5.56	169.56	2.00	57.498
10.0	9.6	10.05	0.95	86.69	83.25	3.44	277.57	2.00	154.093
11.0	10.6	11.01	0.96	90.25	86.69	3.56	270.12	2.00	145.927
12.0	11.6	11.98	0.97	95.81	90.25	5.56	174.11	2.00	60.627
13.0	12.6	12.96	0.97	99.37	95.81	3.56	273.20	2.00	149.274
14.0	13.6	13.93	0.98	103.89	99.37	4.52	216.12	2.00	93.418
15.0	14.6	14.91	0.98	107.41	103.89	3.52	278.37	2.00	154.982
15.2	14.9	15.14	0.23	110.14	107.41	2.73	82.73	2.00	13.689

Tabulated SCPT results – SCPT020

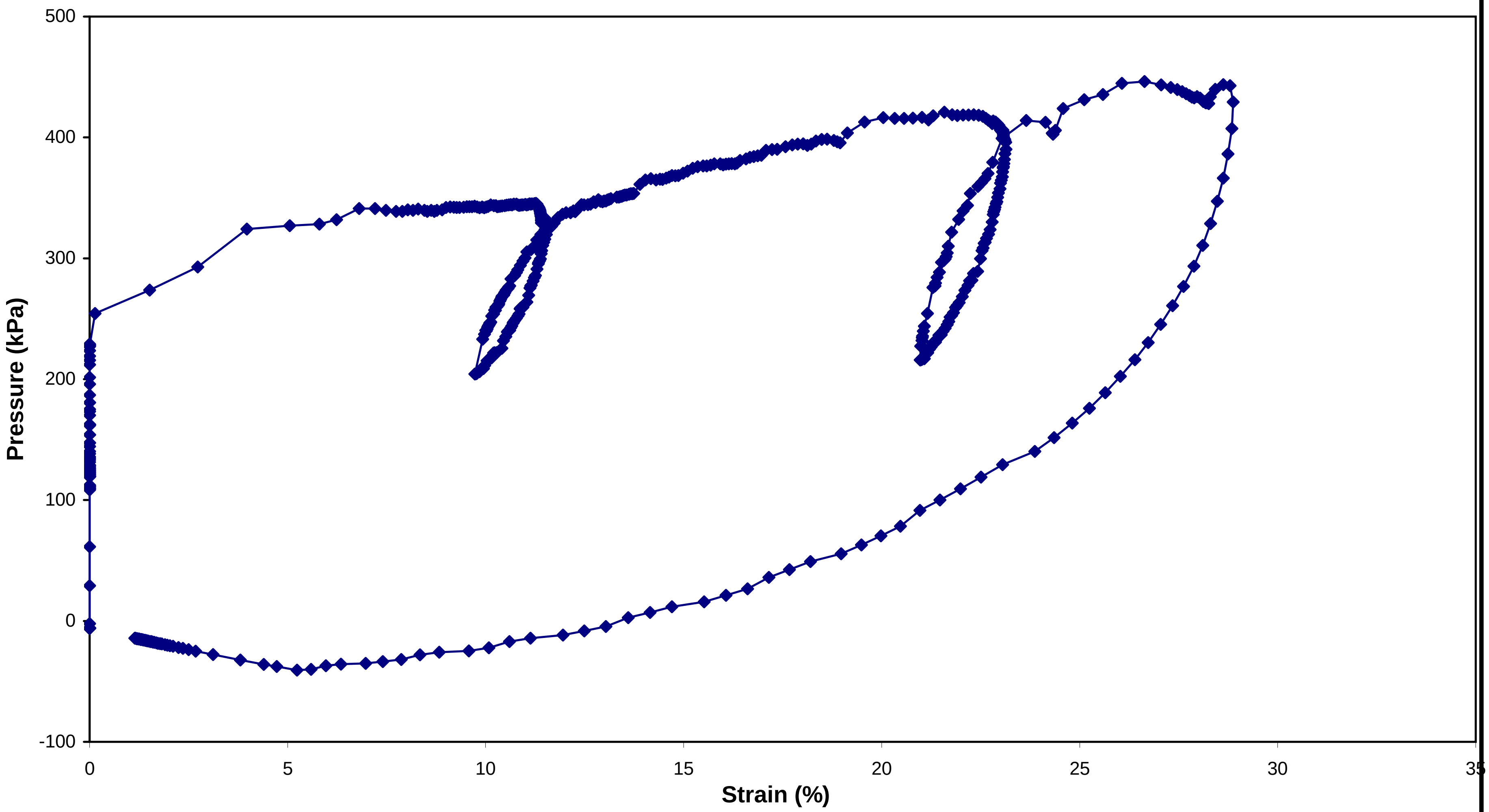
Cone Depth (mBGL)	Receiver Depth (mBGL)	Direct Distance (m)	Interval Distance (m)	S-Wave Arrival(x) Bottom (ms)	S-Wave Arrival(x) Top (ms)	S-Wave Diff (ms)	Interval Velocity (m/s)	Density (Mg/m^3)	Interval Gmax (MPa)
3.0	2.6	3.89	3.89	40.46				2.00	
4.0	3.6	4.63	0.74	43.21	40.46	2.75		2.00	
5.0	4.6	5.45	0.82	48.48	43.21	5.27	155.75	2.00	48.515
6.0	5.6	6.32	0.87	53.25	48.48	4.77	182.93	2.00	66.928
7.0	6.6	7.23	0.91	59.04	53.25	5.79	156.40	2.00	48.920
8.0	7.6	8.15	0.93	66.10	59.04	7.06	131.38	2.00	34.520
8.5	8.1	8.62	0.47	66.80	66.10	0.70	673.32	2.00	906.708

Tabulated SCPT results – SCPT022

Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction



Borehole Number	**cpt_02**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

Remarks

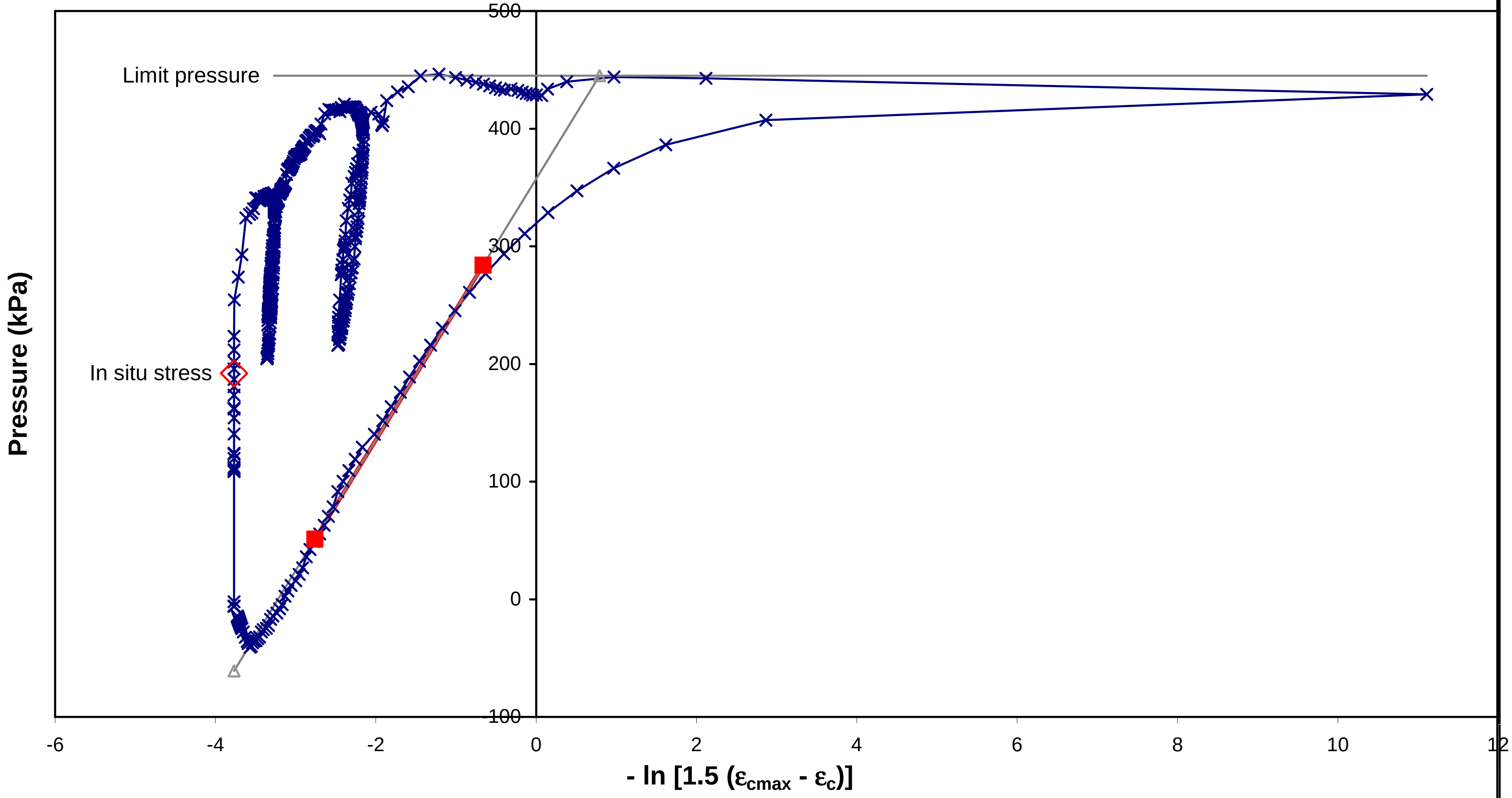
Figure
DPM cpt_02 T1

Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Shear strength analysis



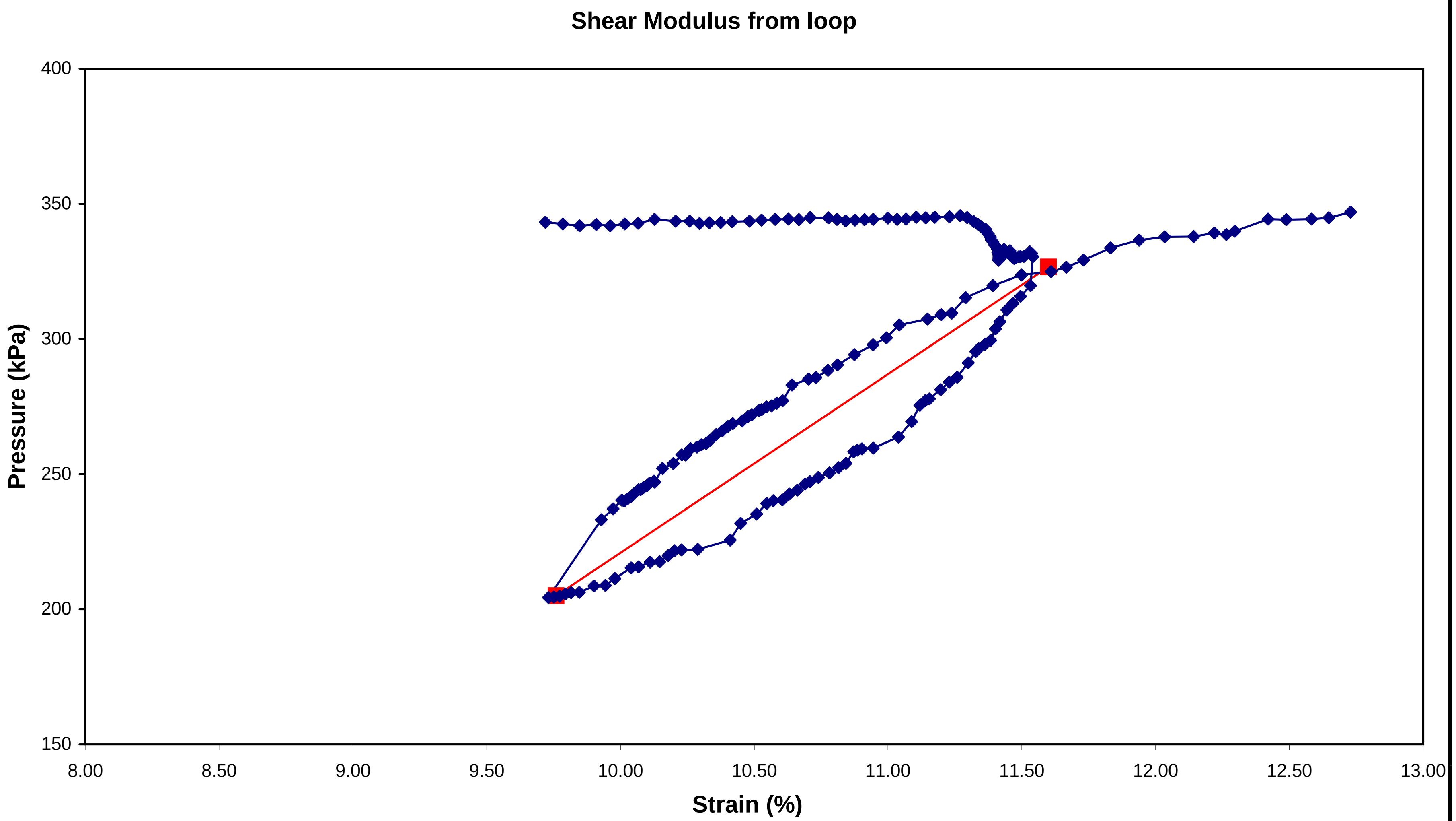
Borehole Number	**cpt_02**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

Shear strength analysis	
δε	δπ
−0.66	284
−2.76	51
Gradient	110.95
Su (kPa)	**55**

In situ stress analysis	
δε	P
-3.77	-60.90
0.79	445.00
σm (kPa)	**192**

Figure
DPM cpt_02 T1

Driven Pressuremeter Test Results



Borehole Number	**cpt_02**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

Calculating Shear Modulus

Loop 1	
$\delta\varepsilon$	dp
9.76	205
11.60	326.6
1.84 %	122 kPa

Unload reload modulus, Gur **3.3** **MPa**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

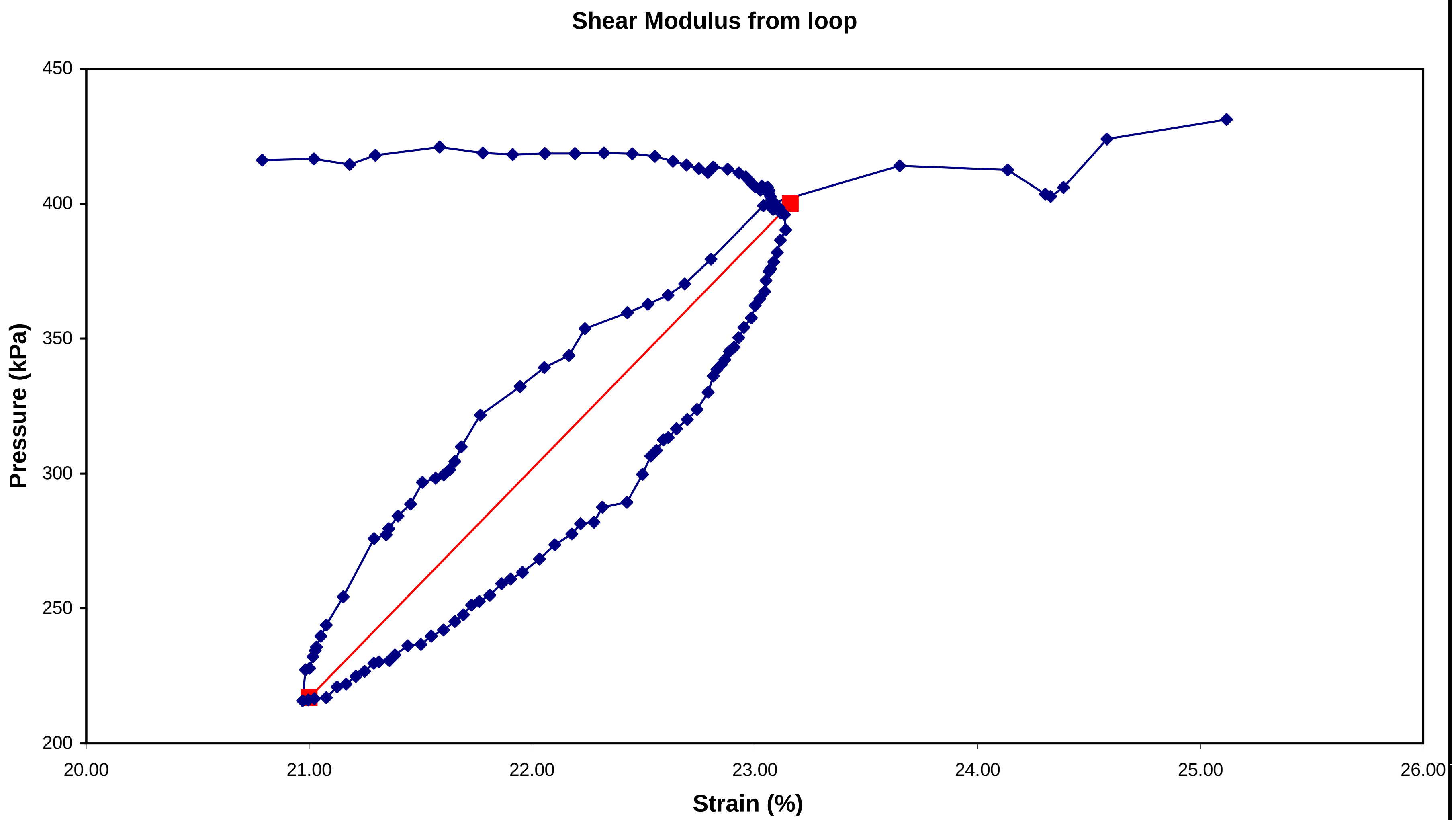
Project No. M9015

Carried out for Morrison Construction

Figure **DPM cpt_02 T1**

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	cpt_02
Test Number	1
Depth(m)	4.00
Installation Method	CPT
Operator	TH DB
Test Date	09 April 2009

Calculating Shear Modulus

Loop 2	
δε	dp
21.00	217
23.16	400
2.16 %	183 kPa

Unload reload modulus, Gur **4.2** **MPa**

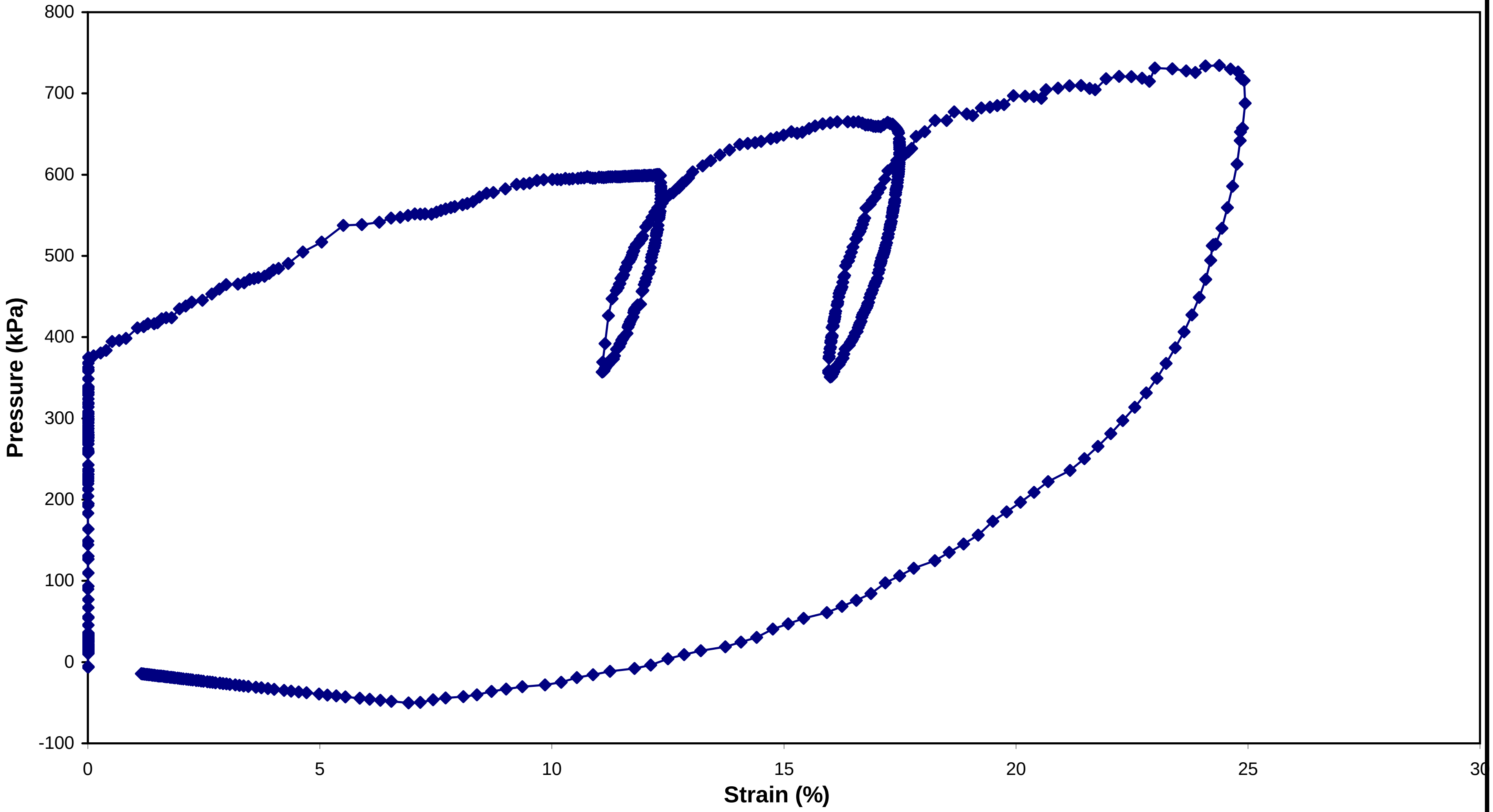
Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure **DPM cpt_02 T1**

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	**cpt_02**
Test Number	**2**
Depth(m)	**6.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

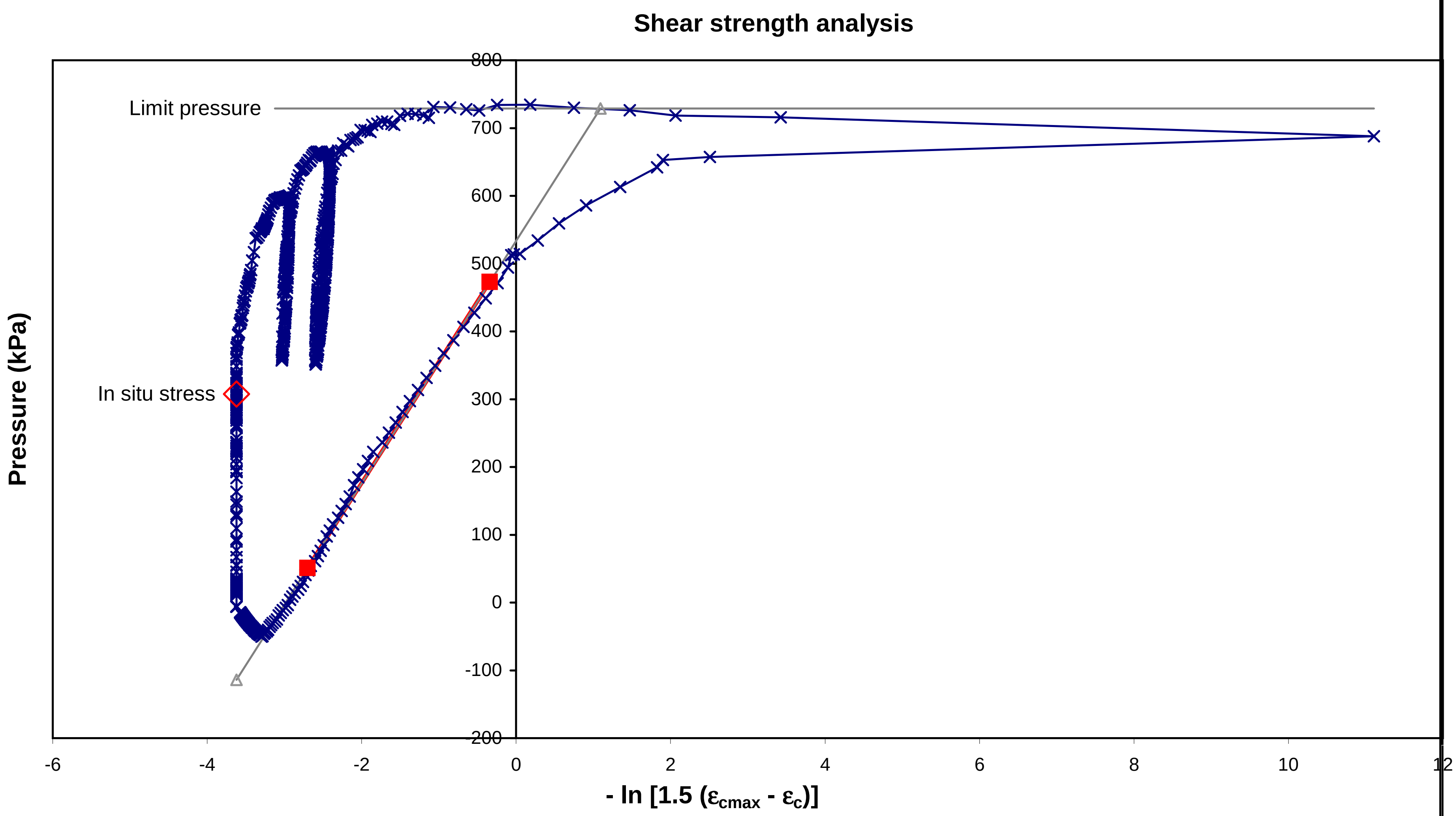
DPM cpt_02 T2

Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Figure: DPM cpt_02 T2



Borehole Number	**cpt_02**
Test Number	**2**
Depth(m)	**6.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

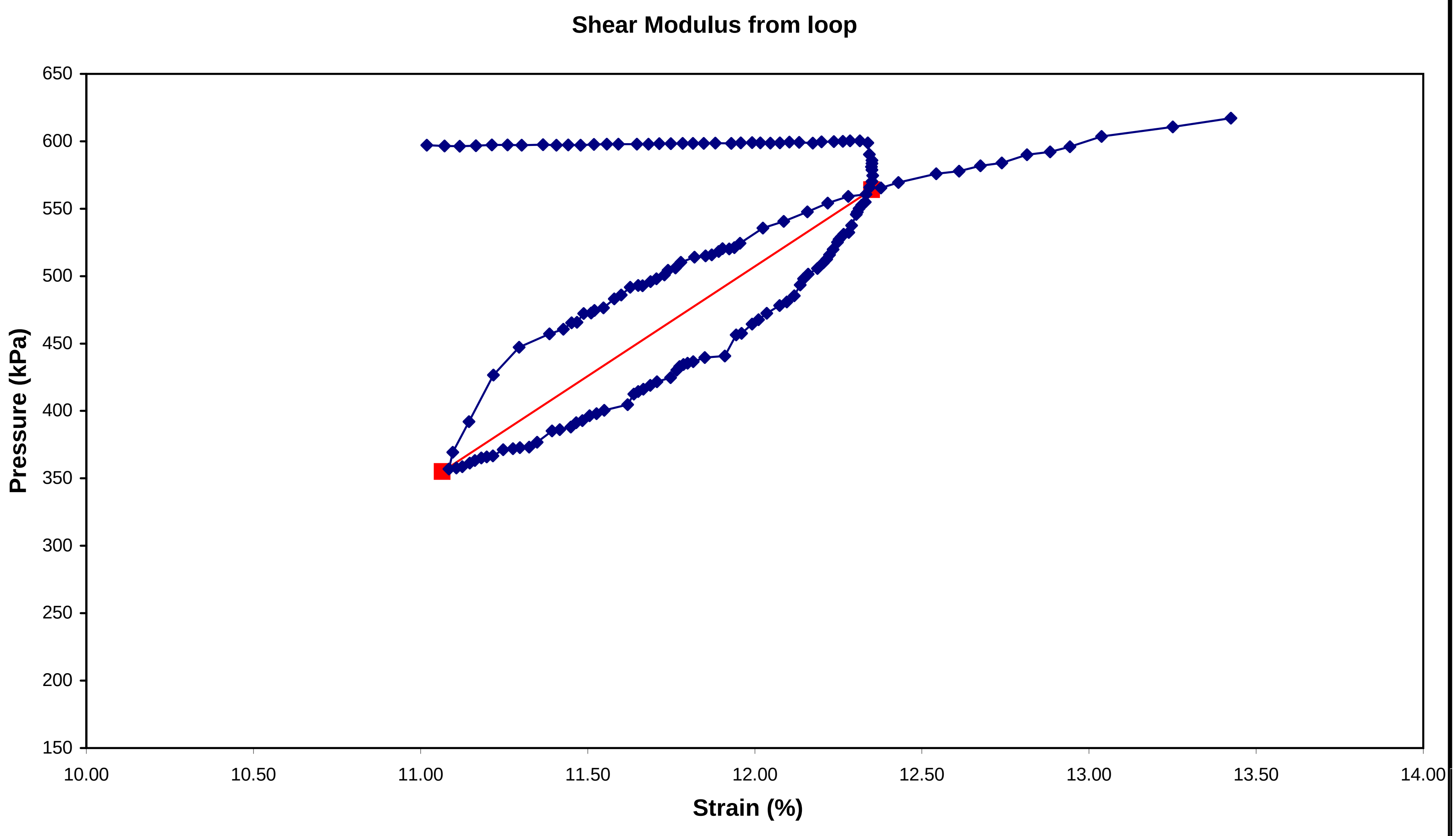
Shear strength analysis	
δε	δπ
–0.34	473
–2.7	51
Gradient	178.81
Su (kPa)	**89**

In situ stress analysis	
δε	P
-3.62	-113.85
1.09	729.00
σm (kPa)	**308**

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction



x
strain

Borehole Number	**cpt_02**
Test Number	**2**
Depth(m)	**6.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

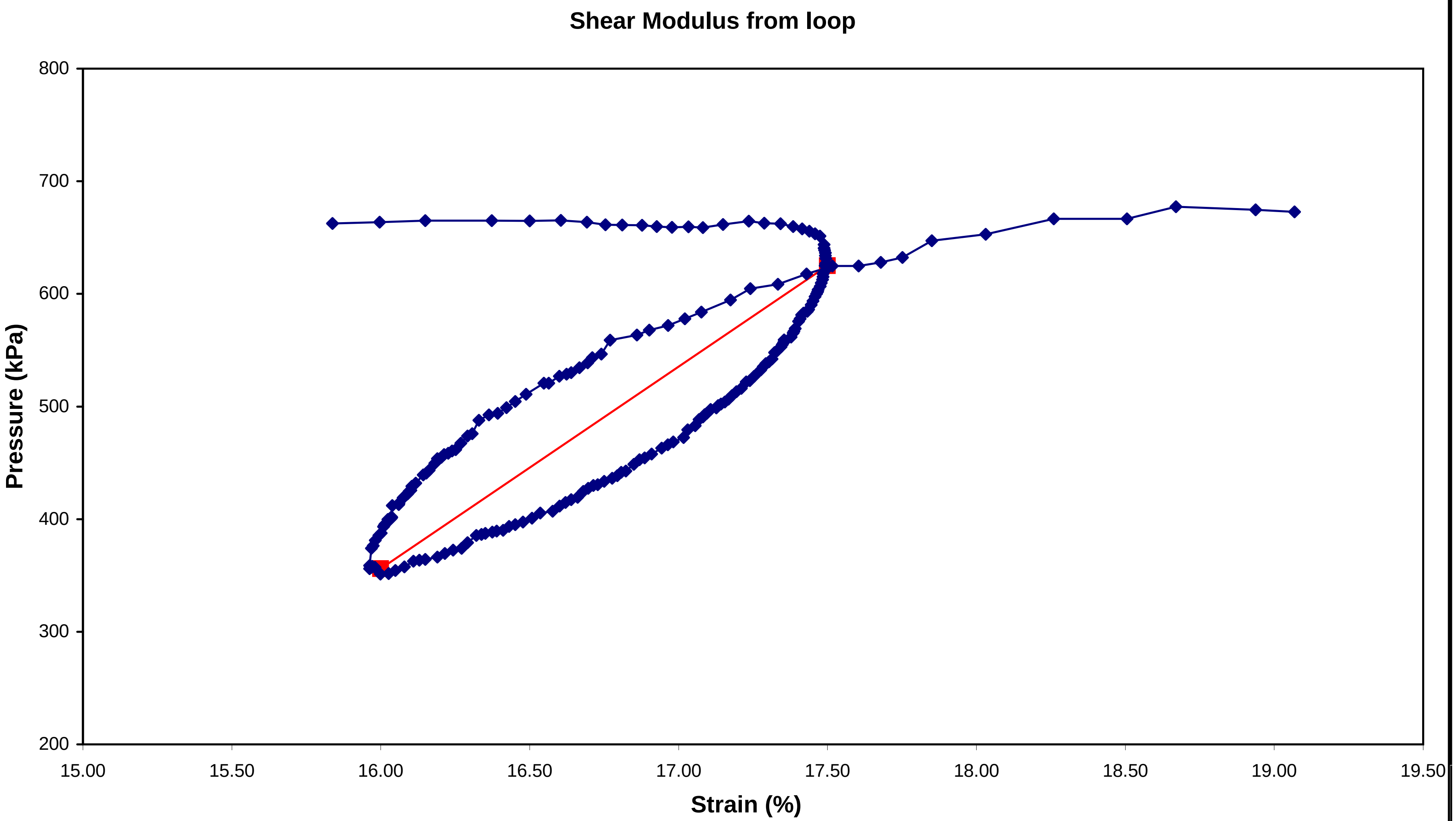
Calculating Shear Modulus

Loop 1	
$\delta\varepsilon$	dp
11.07	355
12.35	564
1.29 %	209 kPa

Unload reload modulus, Gur **8.1** **MPa**

Figure
DPM cpt_02 T2

Driven Pressuremeter Test Results



x
strain

Borehole Number	**cpt_02**
Test Number	**2**
Depth(m)	**6.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

Calculating Shear Modulus

Loop 2	
δε	dp
16.00	356
17.50	625
1.50 %	269 kPa

Unload reload modulus, Gur **9.0** **MPa**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

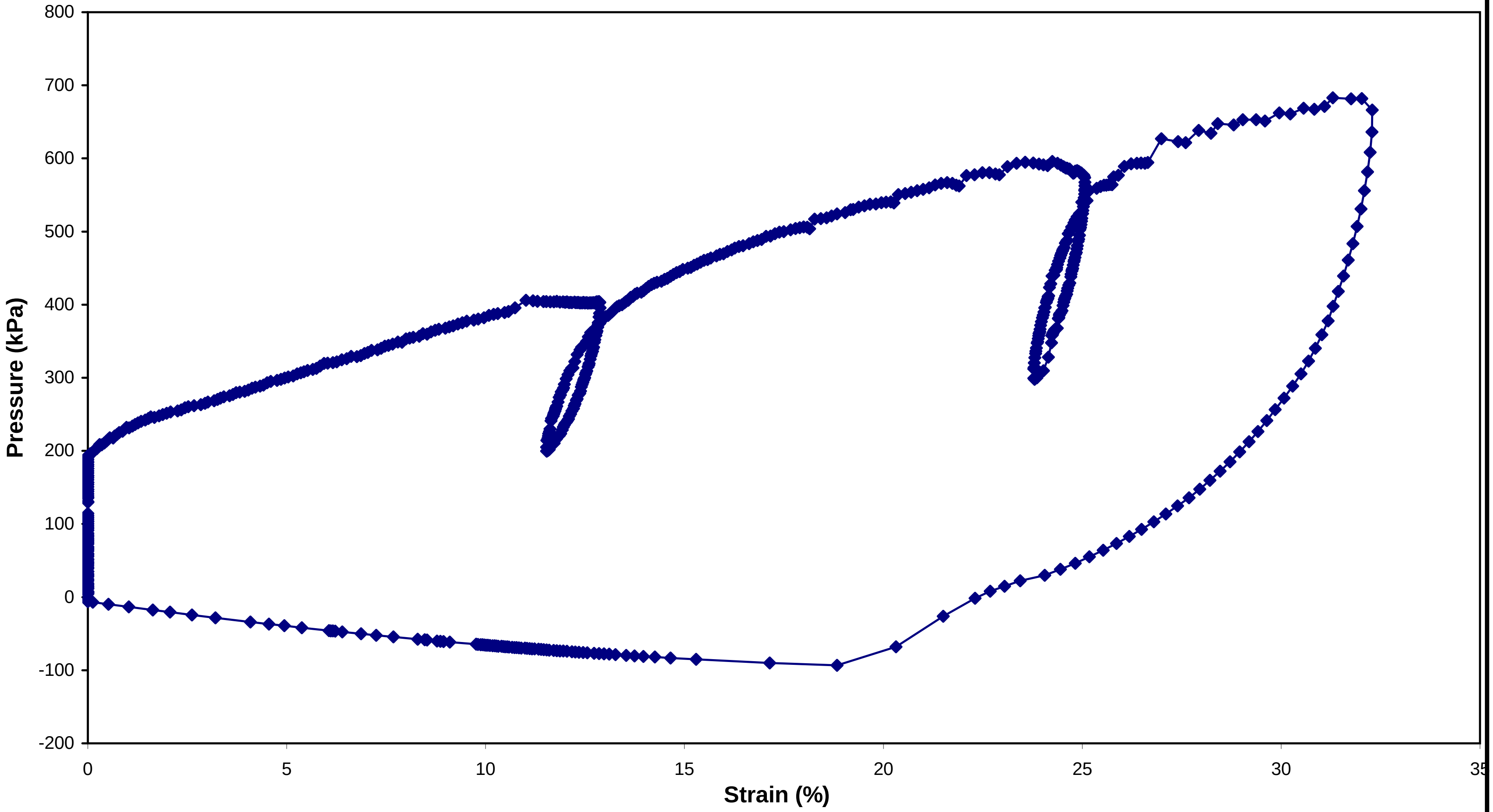
Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_02 T2

Driven Pressuremeter Test Results



Borehole Number	**cpt_03**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**14 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

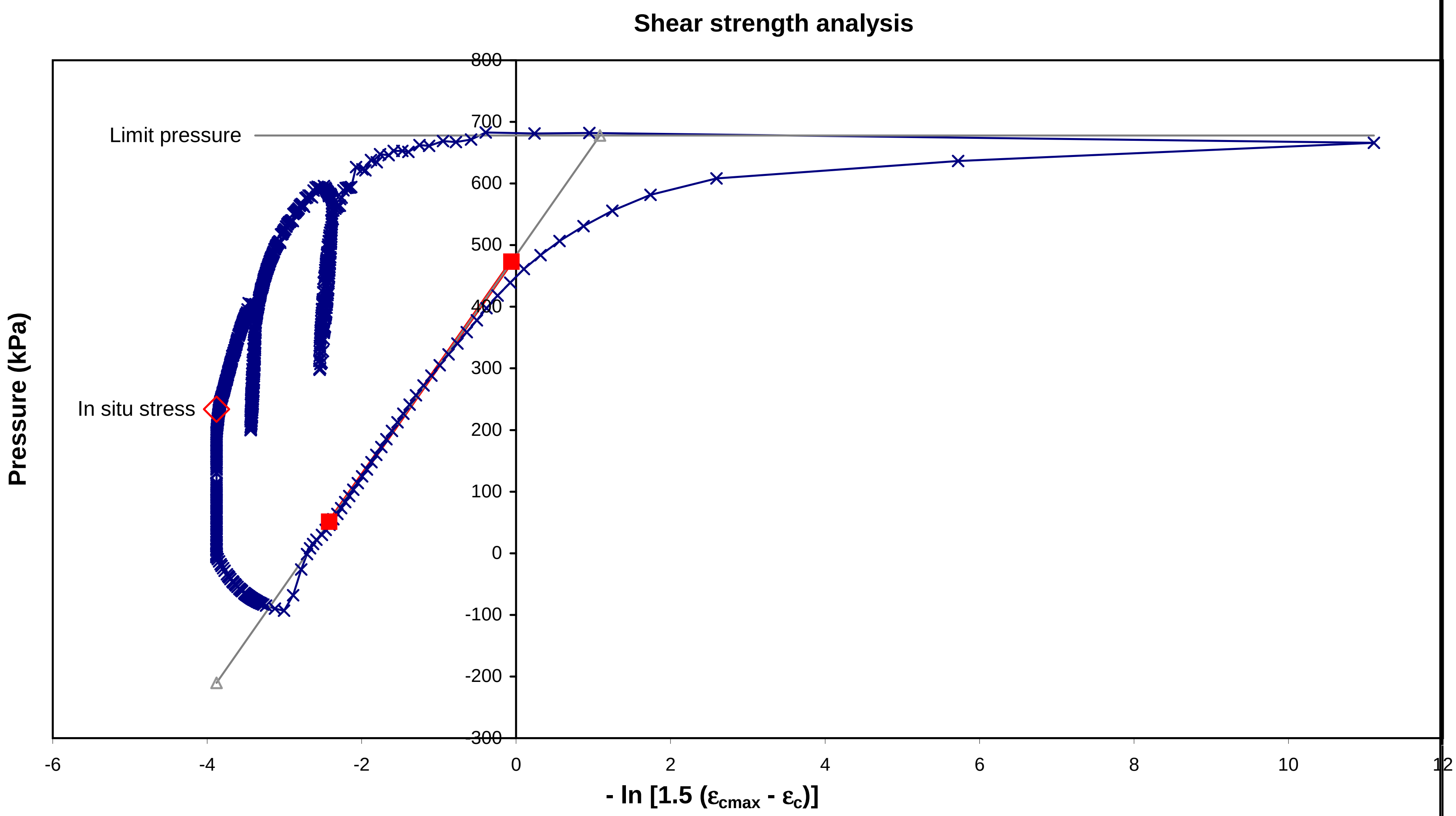
Figure
DPM cpt_03 T1

Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Figure: DPM cpt_03 T1

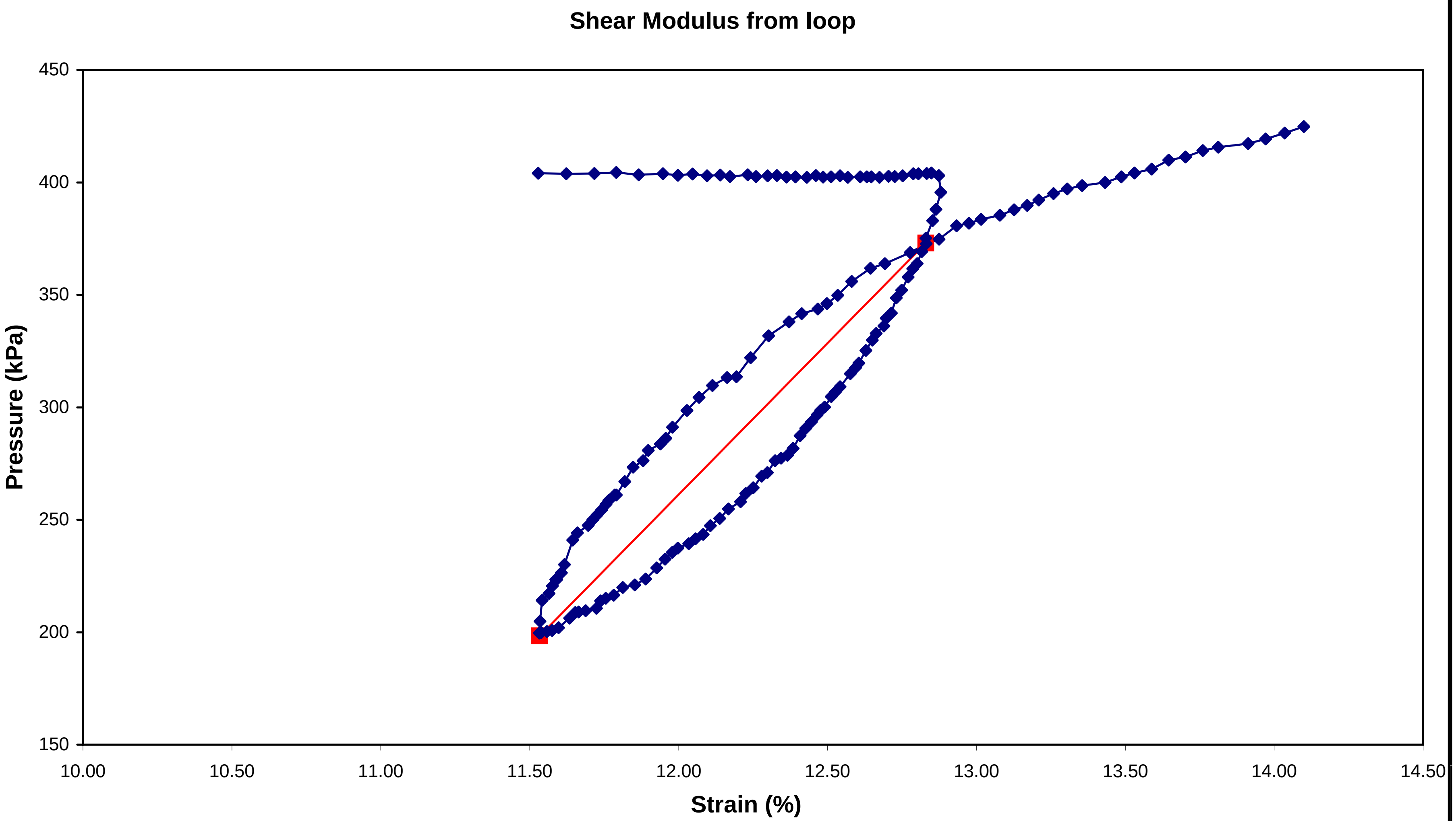


Borehole Number	**cpt_03**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**14 April 2009**

Shear strength analysis	
$\delta\varepsilon$	$\delta\pi$
–0.06	473
–2.42	51
Gradient	178.81
Su (kPa)	**89**

In situ stress analysis	
$\delta\varepsilon$	P
-3.88	-210.10
1.09	678.00
σm (kPa)	**234**

Driven Pressuremeter Test Results



x
strain

Borehole Number	**cpt_03**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**14 April 2009**

Calculating Shear Modulus

Loop 1	
δε	dp
11.53	198
12.83	373
1.30 %	175 kPa

Unload reload modulus, Gur **6.7** **MPa**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

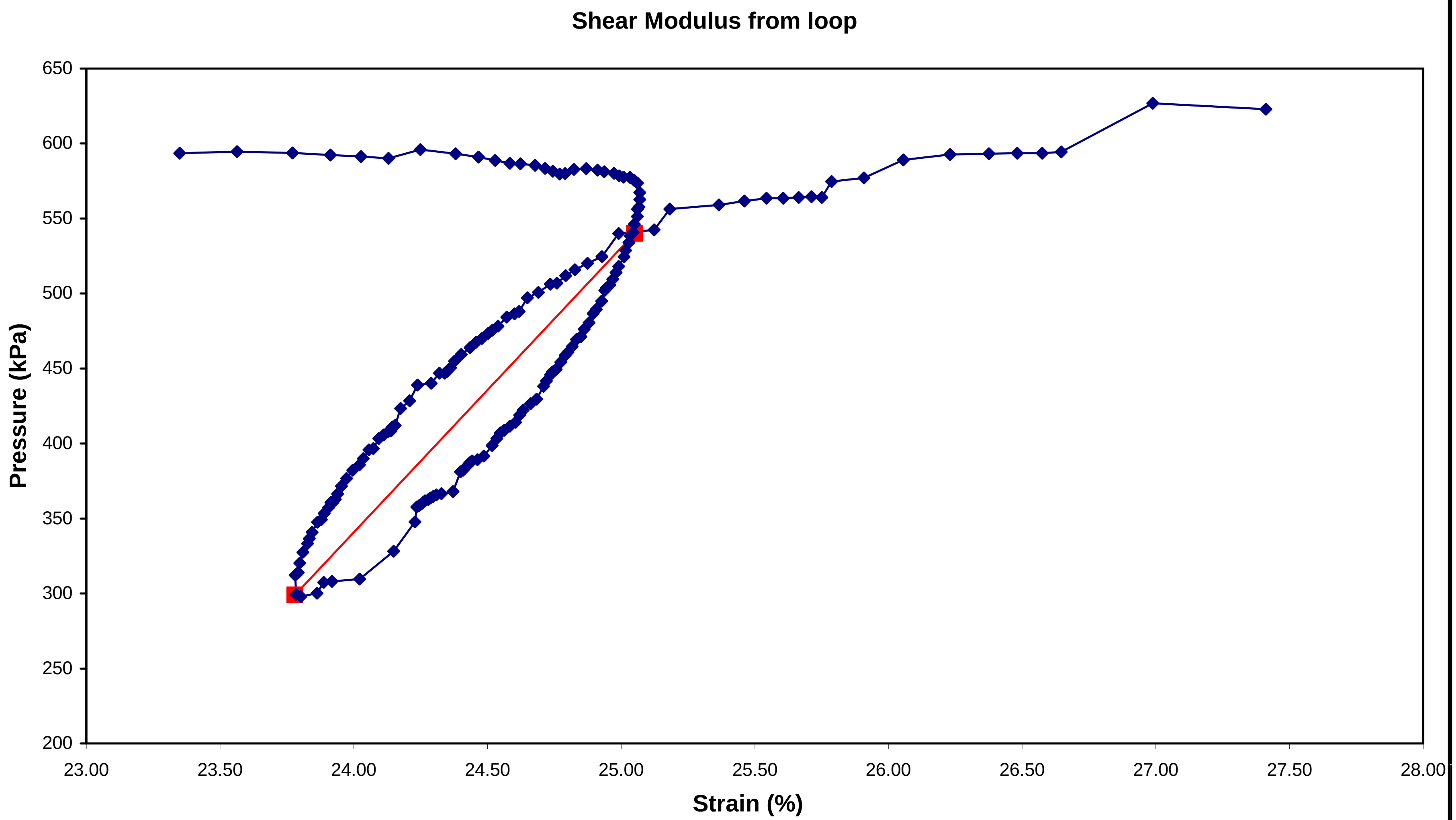
Carried out for Morrison Construction

Figure

DPM cpt_03 T1

GEOCONE

Driven Pressuremeter Test Results



x
strain

Borehole Number	**cpt_03**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**14 April 2009**

Calculating Shear Modulus

Loop 2	
δε	dp
23.78	299
25.05	540
1.27 %	241 kPa

Unload reload modulus, Gur **9.5** **MPa**

Notes:

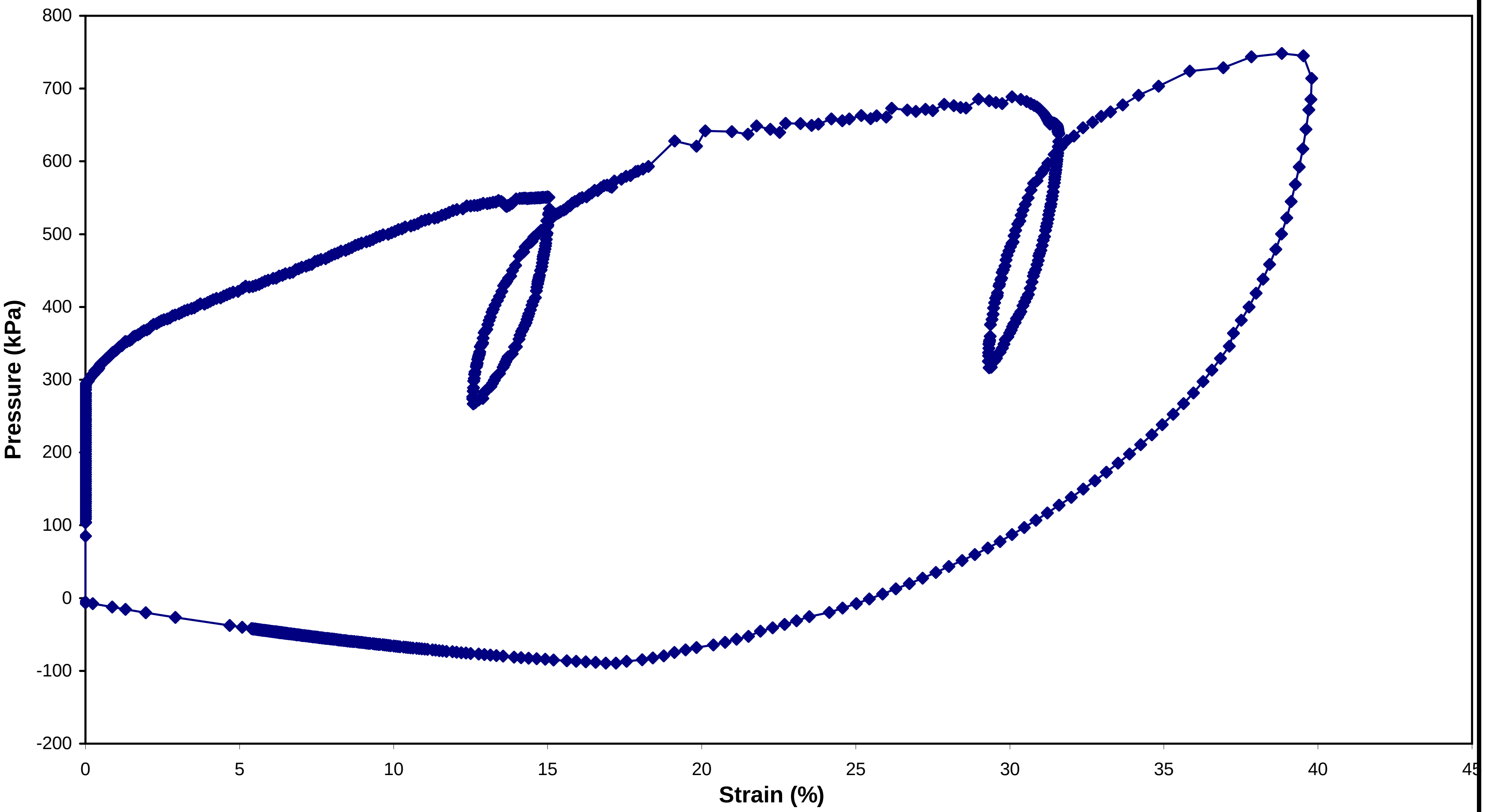
Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure
DPM cpt_03 T1

Driven Pressuremeter Test Results

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction



Borehole Number	**cpt_03**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Remarks

GEOCONE

Figure

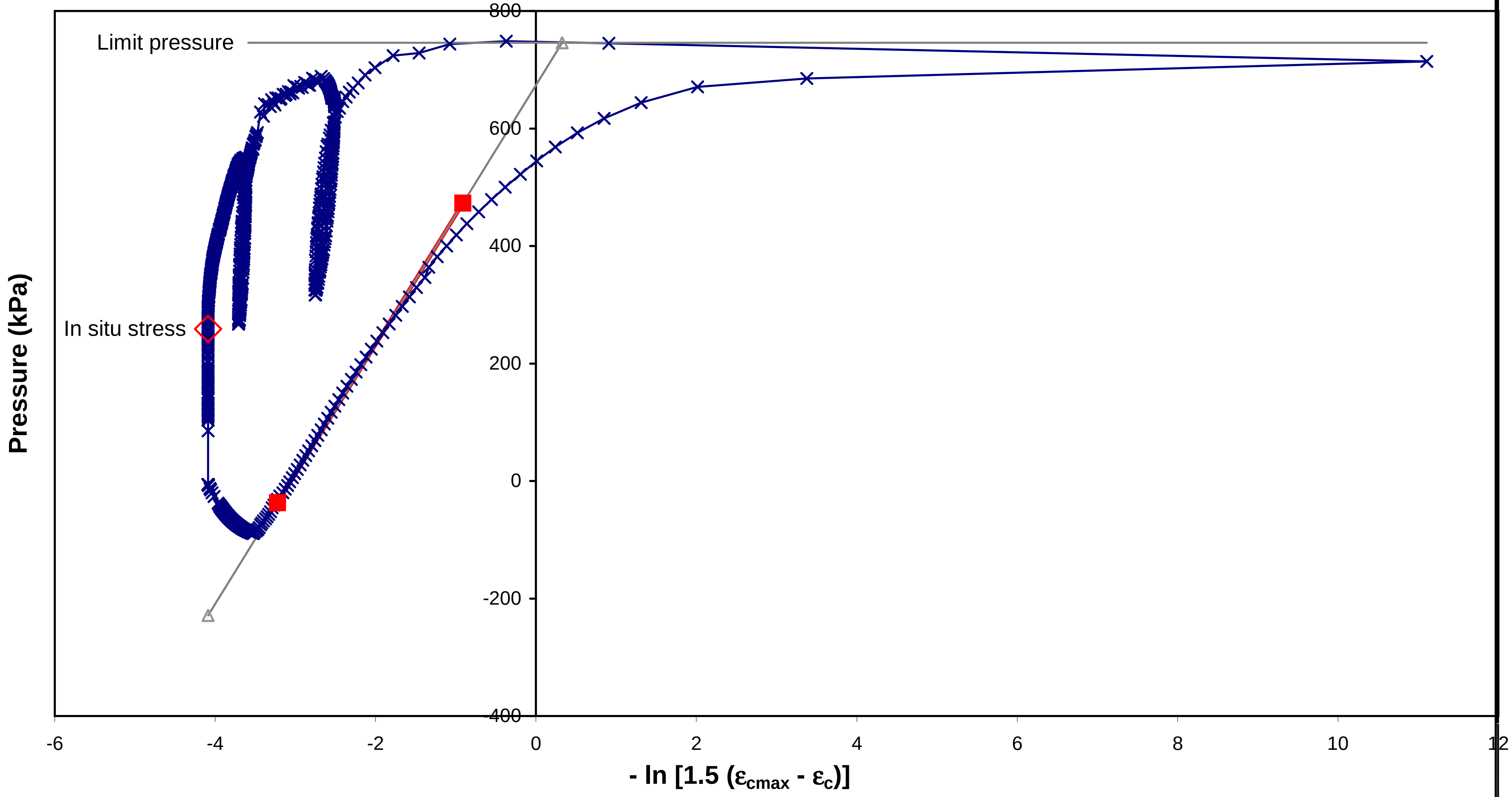
DPM cpt_03 T2

Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Shear strength analysis



Borehole Number	**cpt_03**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Shear strength analysis	
δε	δπ
–0.91	473
–3.22	–37
Gradient	220.78
Su (kPa)	**110**

In situ stress analysis	
δε	P
-4.09	-228.89
0.33	746.00
σm (kPa)	**259**

Figure
DPM cpt_03 T2

Driven Pressuremeter Test Results

Notes:

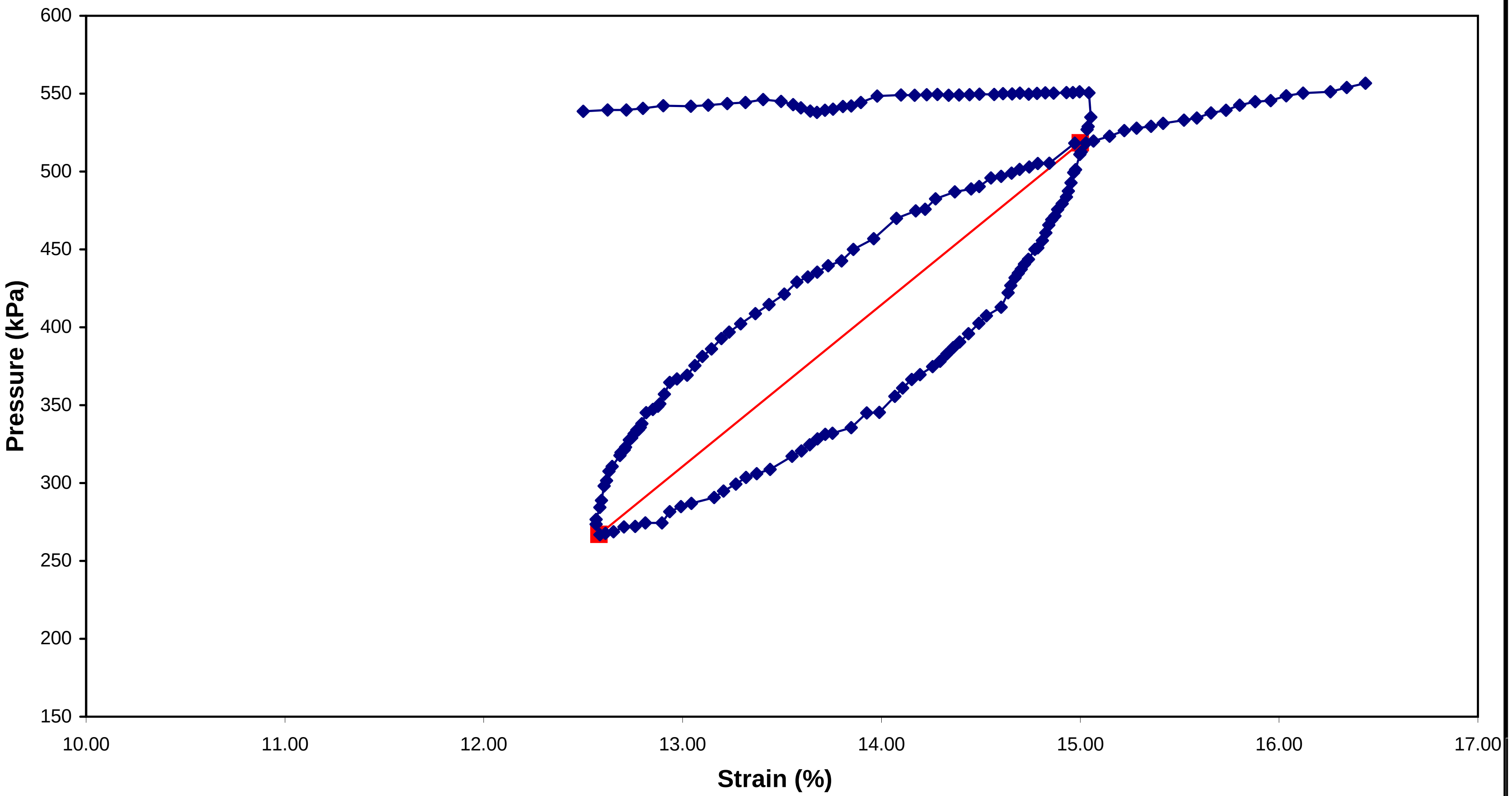
Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure **DPM cpt_03 T2**

Shear Modulus from loop



x
strain

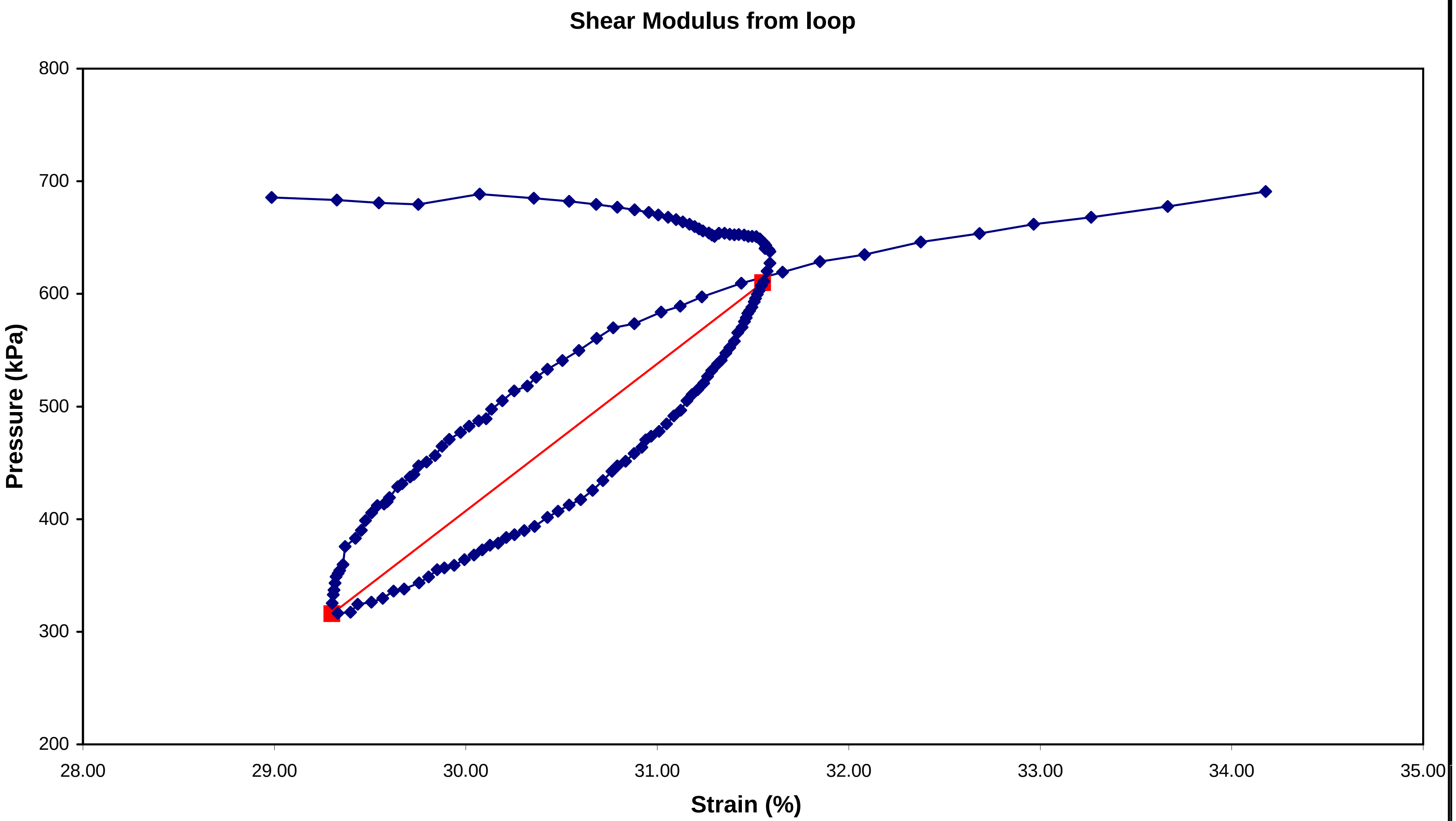
Borehole Number	**cpt_03**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Calculating Shear Modulus

Loop 1	
δε	dp
12.58	267
15.00	518.4
2.42 %	251 kPa

Unload reload modulus, Gur **5.2** **MPa**

Driven Pressuremeter Test Results



Borehole Number	**cpt_03**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Calculating Shear Modulus

Loop 2	
δε	dp
29.30	316
31.55	610
2.25 %	294 kPa

Unload reload modulus, Gur **6.5** **MPa**

x
strain

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

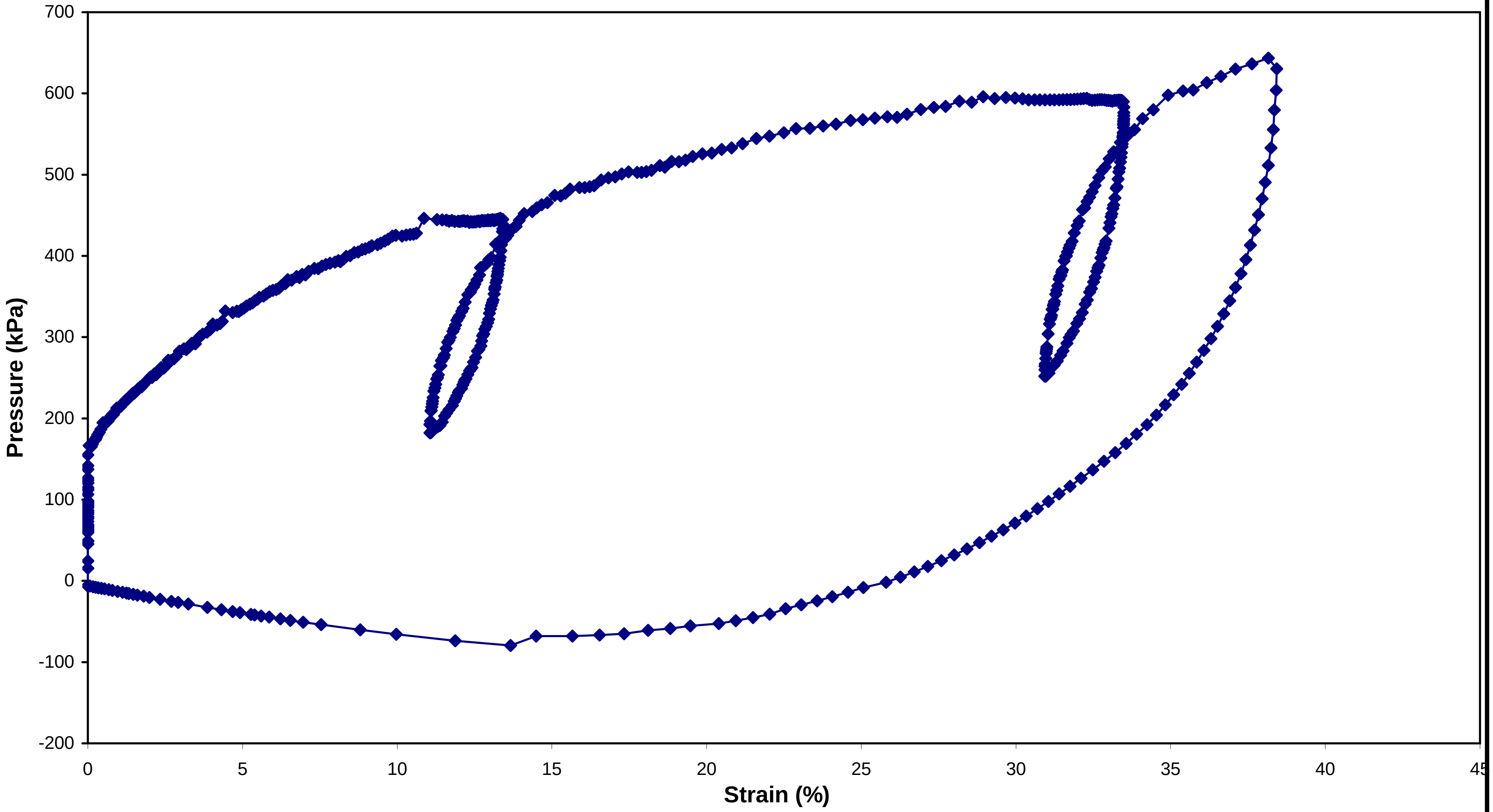
Carried out for Morrison Construction

Figure

DPM cpt_03 T2

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	**cpt_04**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_04 T1

GEOCONE

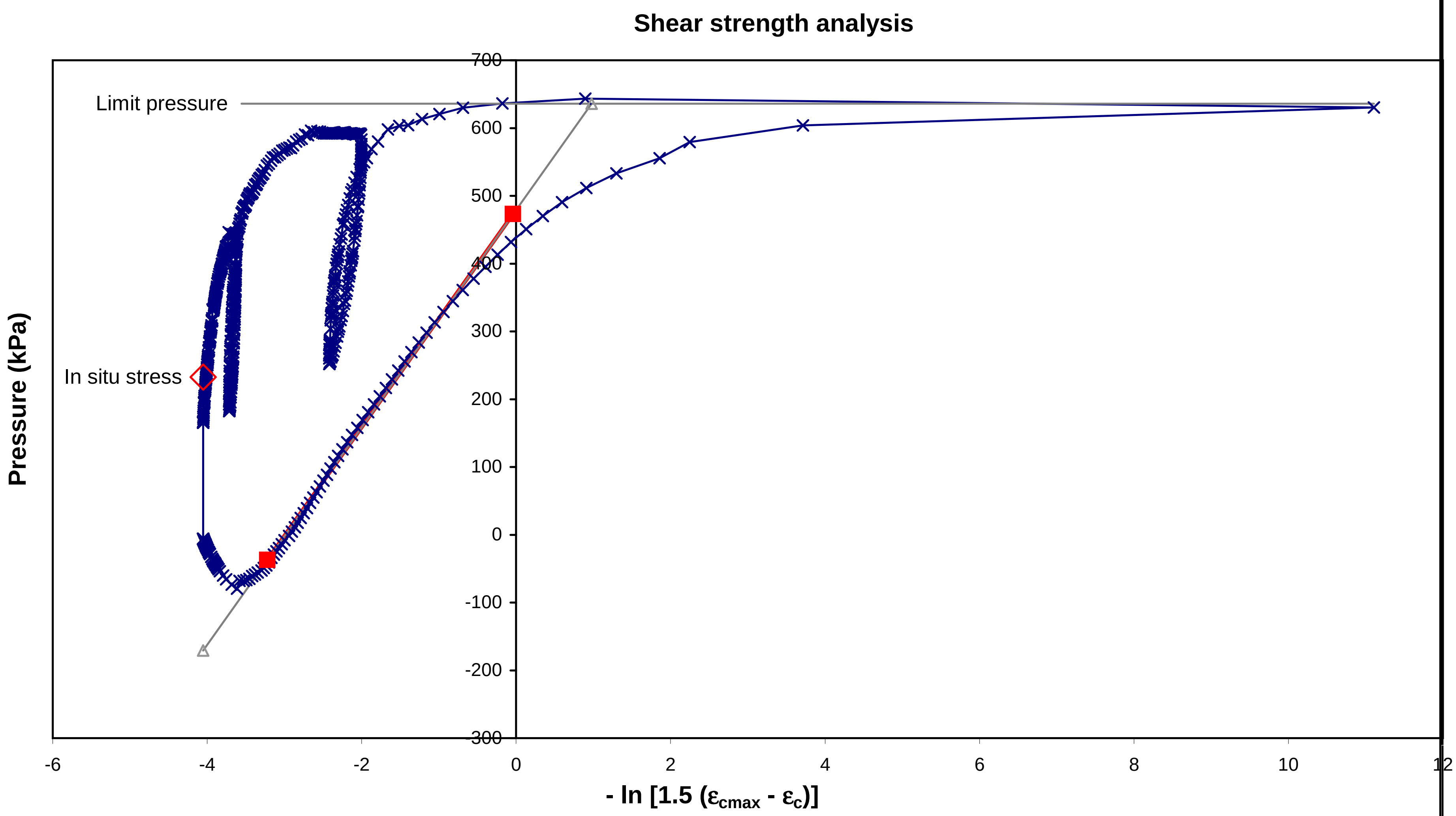
Driven Pressuremeter Test Results

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_04 T1



Borehole Number	**cpt_04**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Shear strength analysis	
$\delta\varepsilon$	$\delta\pi$
−0.04	473
−3.22	−37
Gradient	160.38
Su (kPa)	**80**

In situ stress analysis	
$\delta\varepsilon$	P
-4.05	-170.79
0.98	636.00
σm (kPa)	**233**

Driven Pressuremeter Test Results

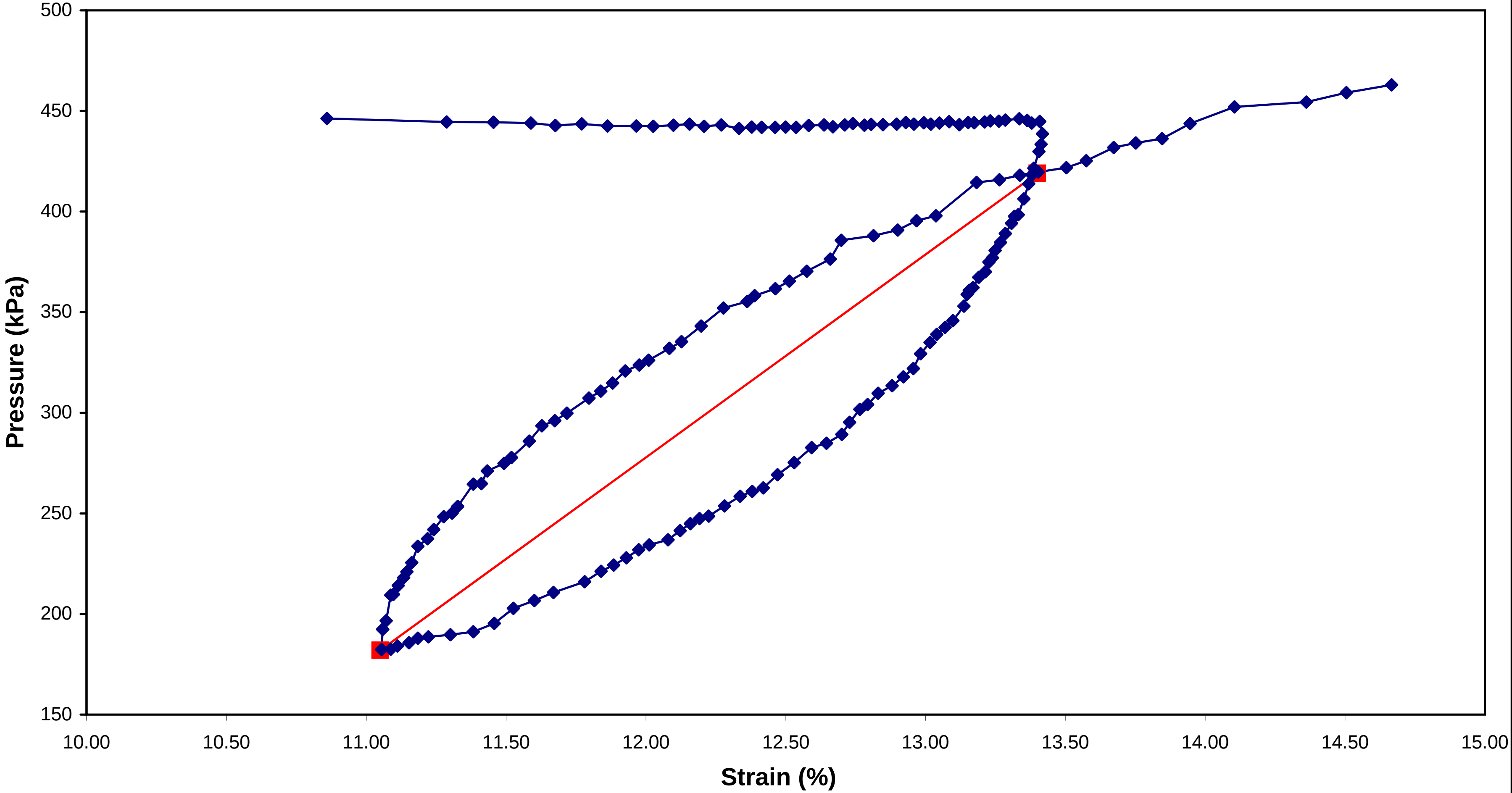
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_04 T1

Shear Modulus from loop



Borehole Number	**cpt_04**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Calculating Shear Modulus

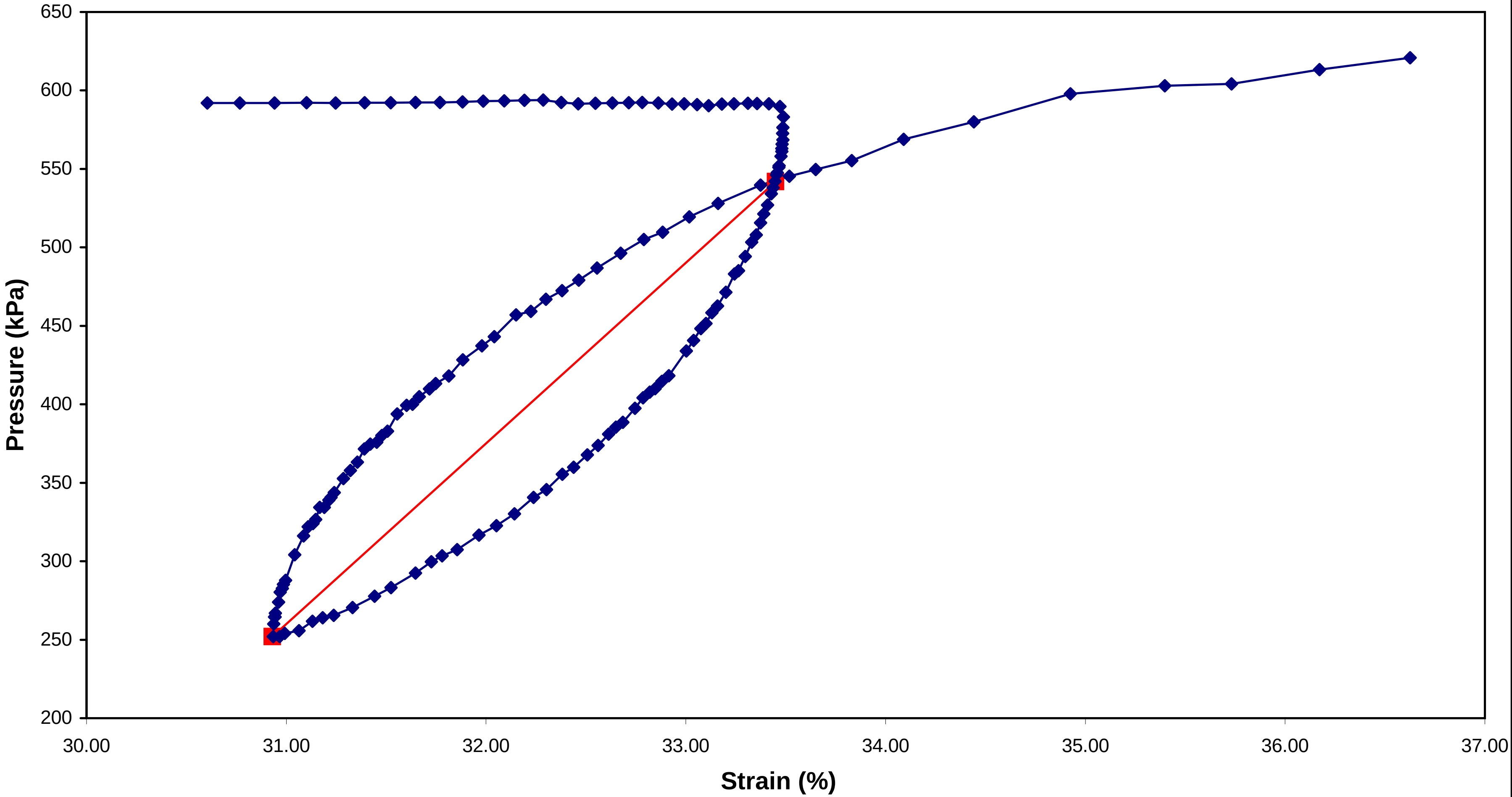
Loop 1	
δε	dp
11.05	182
13.40	419
2.35 %	237 kPa

Unload reload modulus, Gur **5.0** **MPa**

x
strain

Driven Pressuremeter Test Results

Shear Modulus from loop



Borehole Number	**cpt_04**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Calculating Shear Modulus

Loop 2	
$\delta\varepsilon$	dp
30.93	252
33.45	542
2.52 %	290 kPa

Unload reload modulus, Gur **5.8** **MPa**

x
strain

Notes:

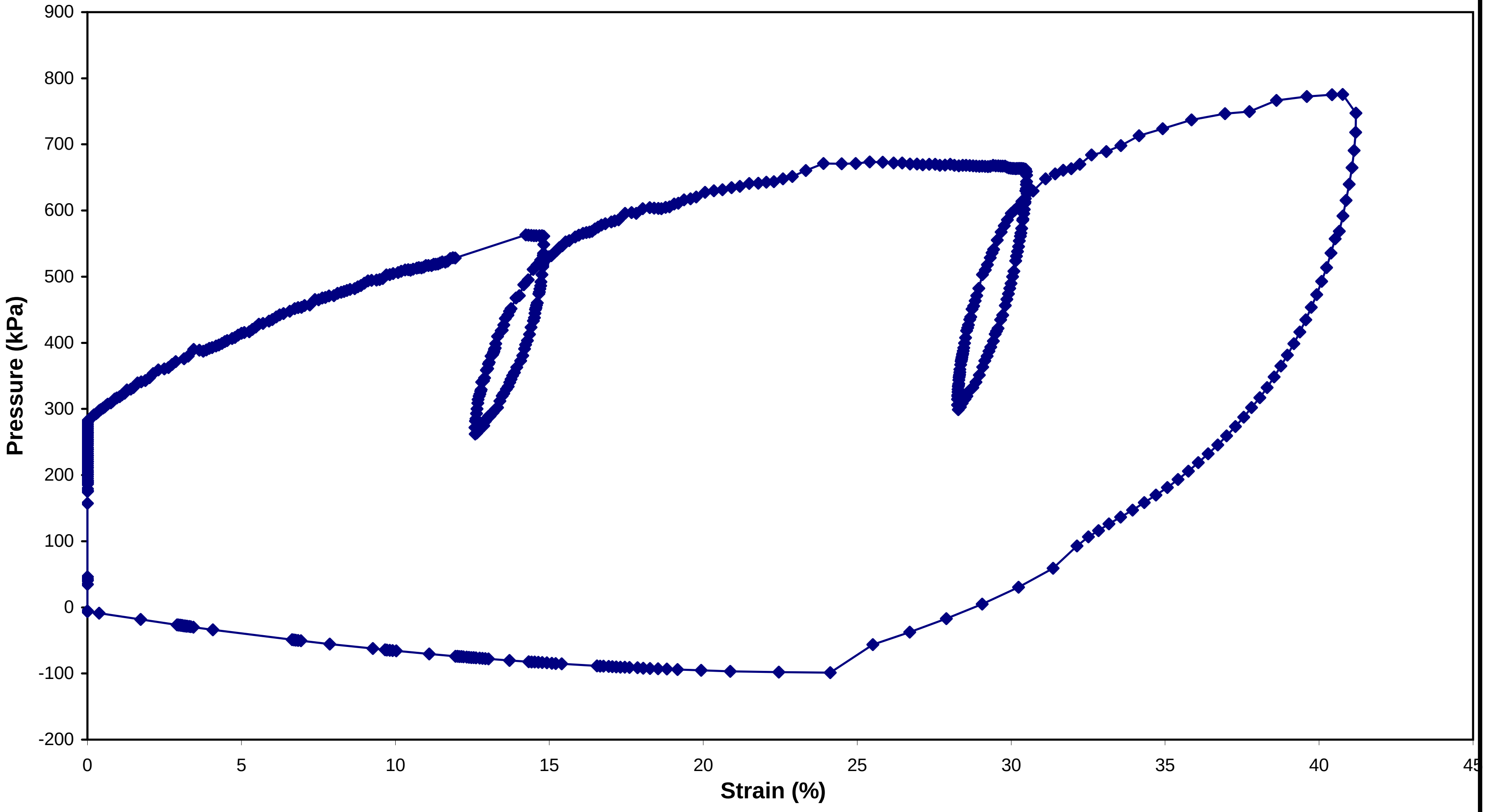
Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure
DPM cpt_04 T1

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction



Borehole Number	**cpt_04**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Remarks

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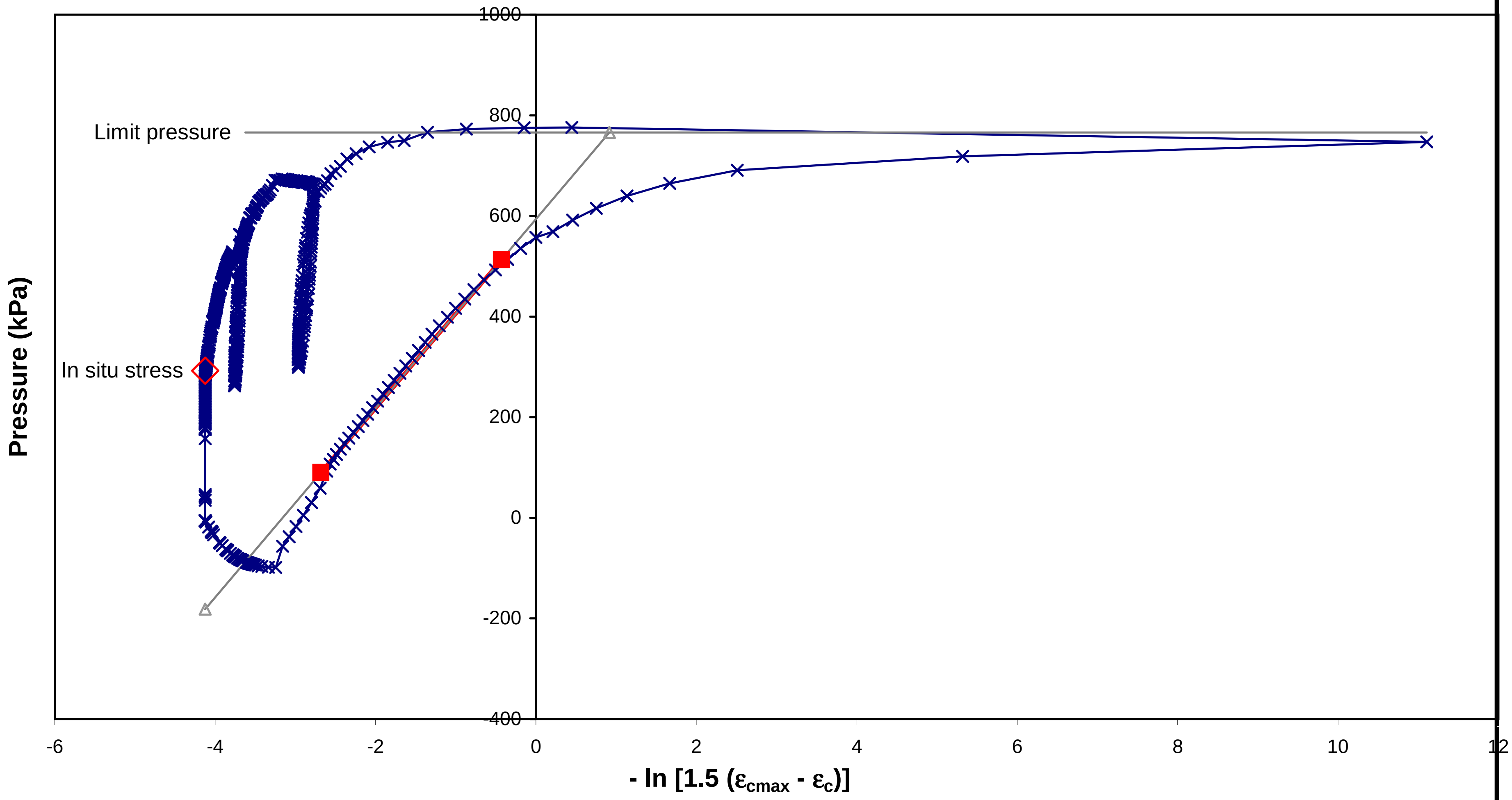
Figure DPM cpt_04 T2

Driven Pressuremeter Test Results

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Shear strength analysis



Borehole Number	**cpt_04**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Shear strength analysis	
$\delta\varepsilon$	$\delta\pi$
−0.43	513
−2.68	90
Gradient	188.00
Su (kPa)	**94**

In situ stress analysis	
$\delta\varepsilon$	P
-4.12	-181.42
0.92	766.00
σm (kPa)	**292**

Figure

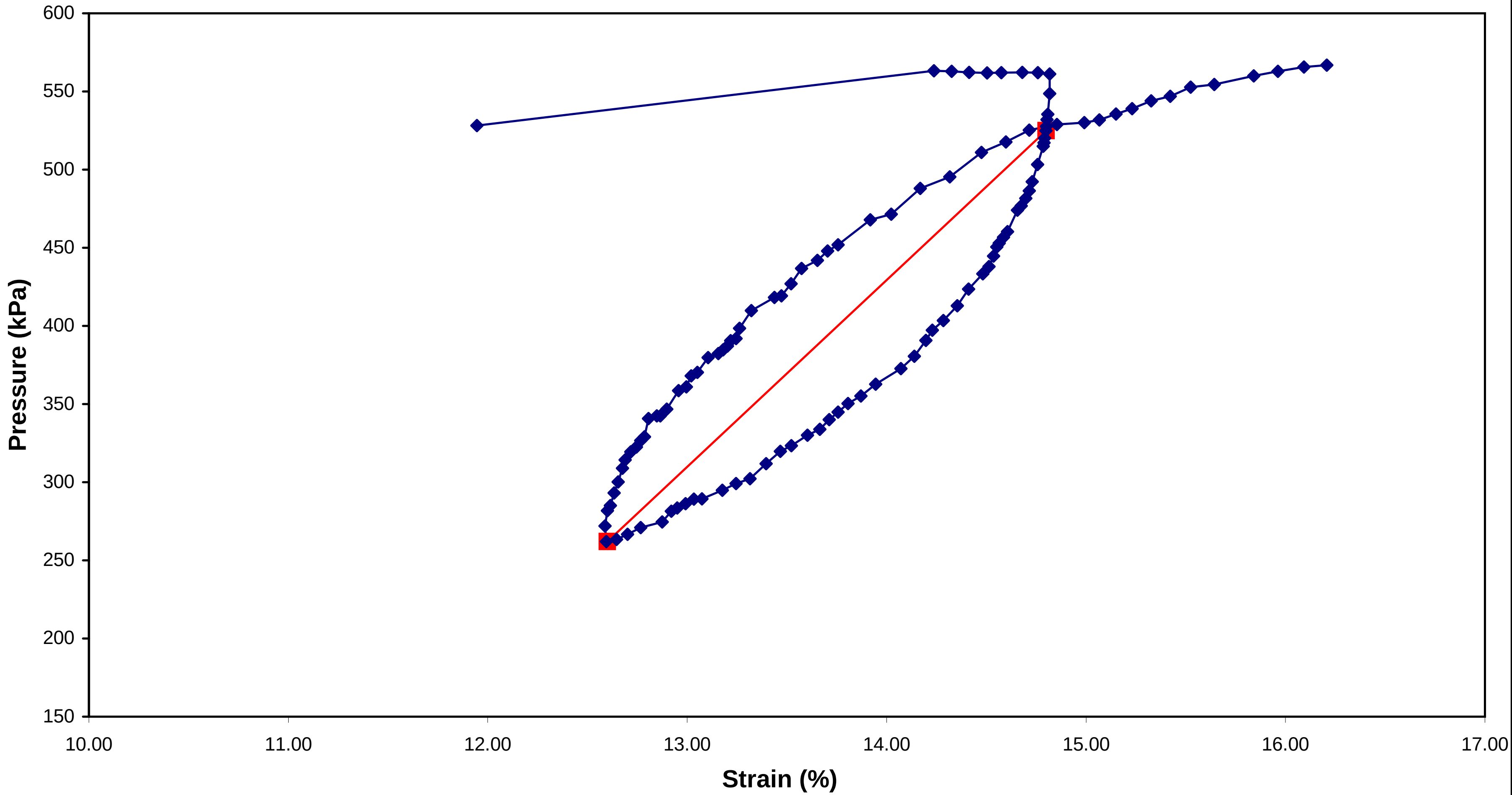
DPM cpt_04 T2

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Shear Modulus from loop



x
strain

Borehole Number	**cpt_04**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Calculating Shear Modulus

Loop 1	
δε	dp
12.60	262
14.80	525
2.20 %	263 kPa

Unload reload modulus, Gur **6.0** **MPa**

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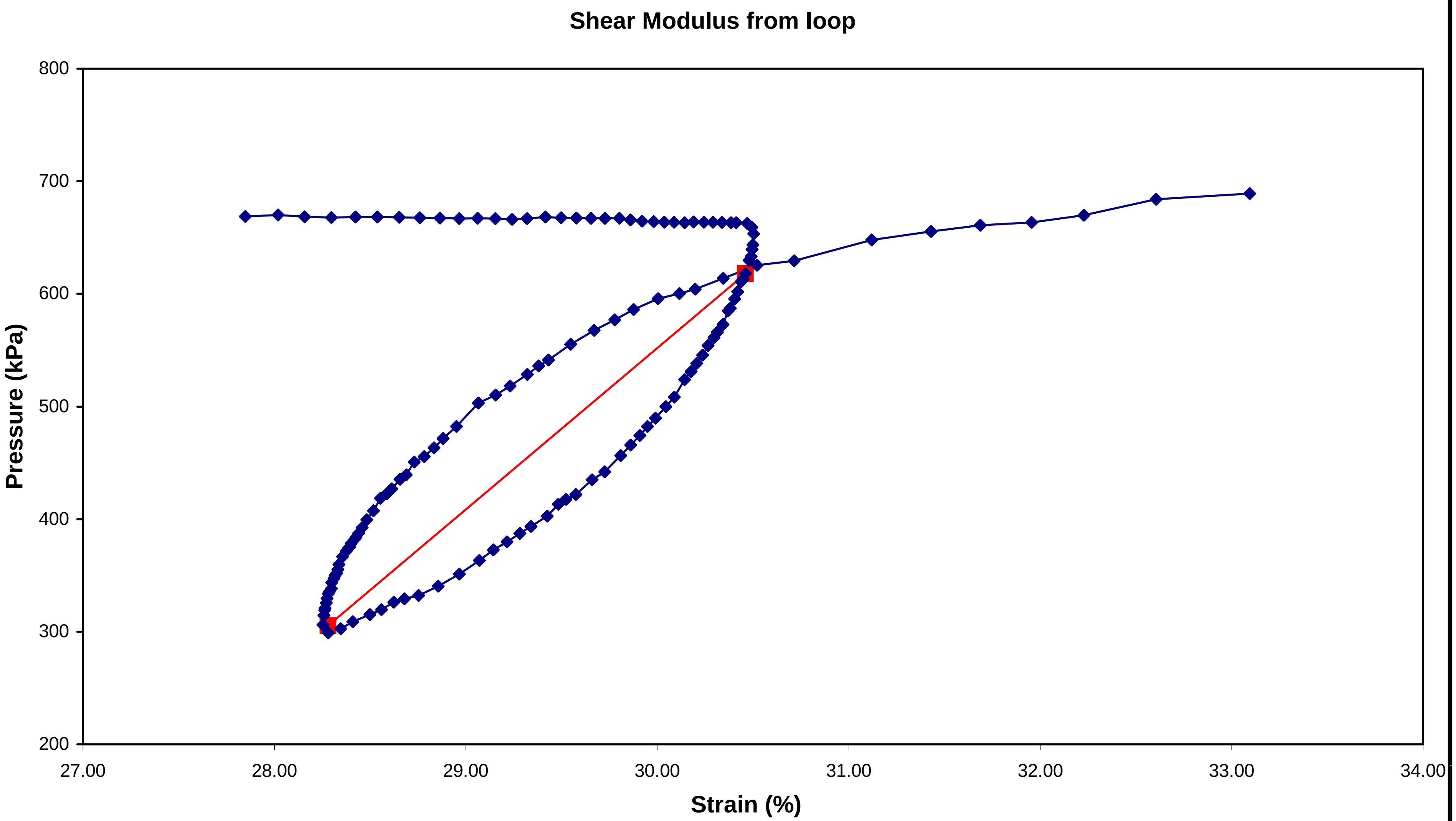
Figure **DPM cpt_04 T2**

Driven Pressuremeter Test Results

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction



x
strain

Borehole Number	**cpt_04**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Calculating Shear Modulus

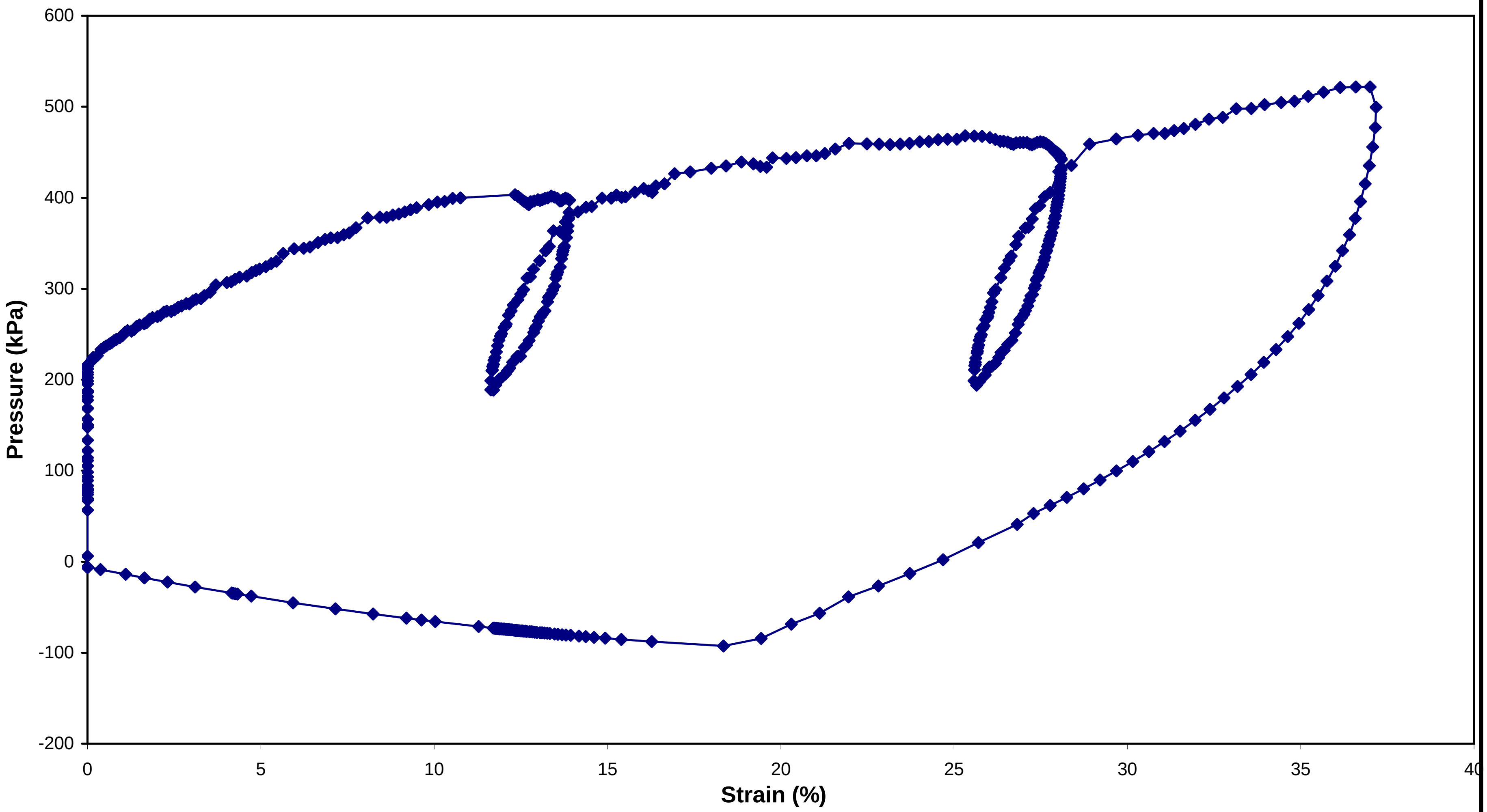
Loop 2	
δε	dp
28.28	306
30.46	618
2.18 %	313 kPa

Unload reload modulus, Gur **7.2** **MPa**

Figure

DPM cpt_04 T2

Driven Pressuremeter Test Results



Borehole Number	**cpt_09**
Test Number	**1**
Depth(m)	**3.00**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_09 T1

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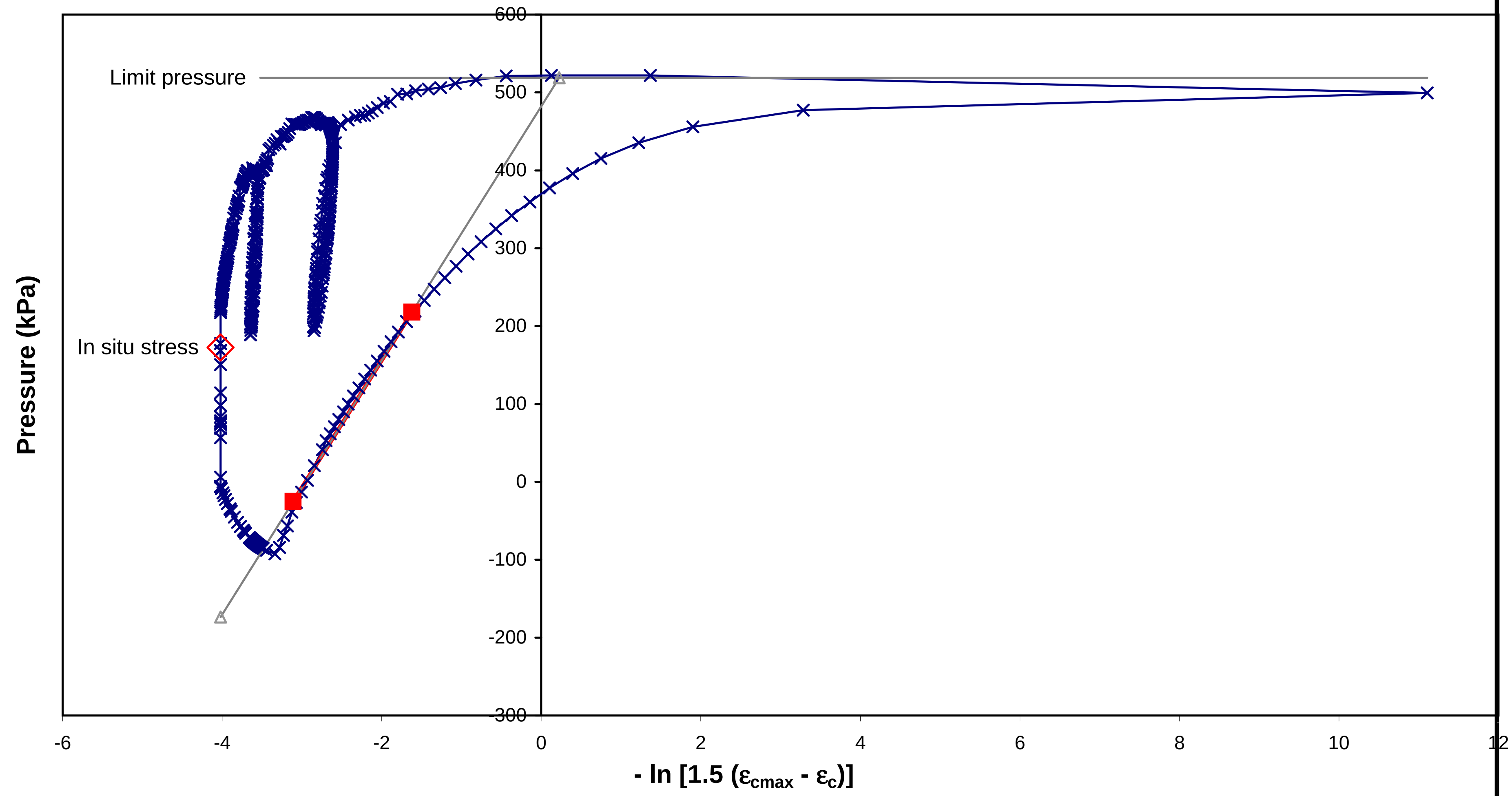
Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Figure: DPM cpt_09 T1

Shear strength analysis



Borehole Number	**cpt_09**
Test Number	**1**
Depth(m)	**3.00**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Shear strength analysis	
$\delta\varepsilon$	$\delta\pi$
−1.62	218
−3.11	−25
Gradient	163.09
Su (kPa)	**82**

In situ stress analysis	
$\delta\varepsilon$	P
-4.02	-173.58
0.23	519.00
σm (kPa)	**173**

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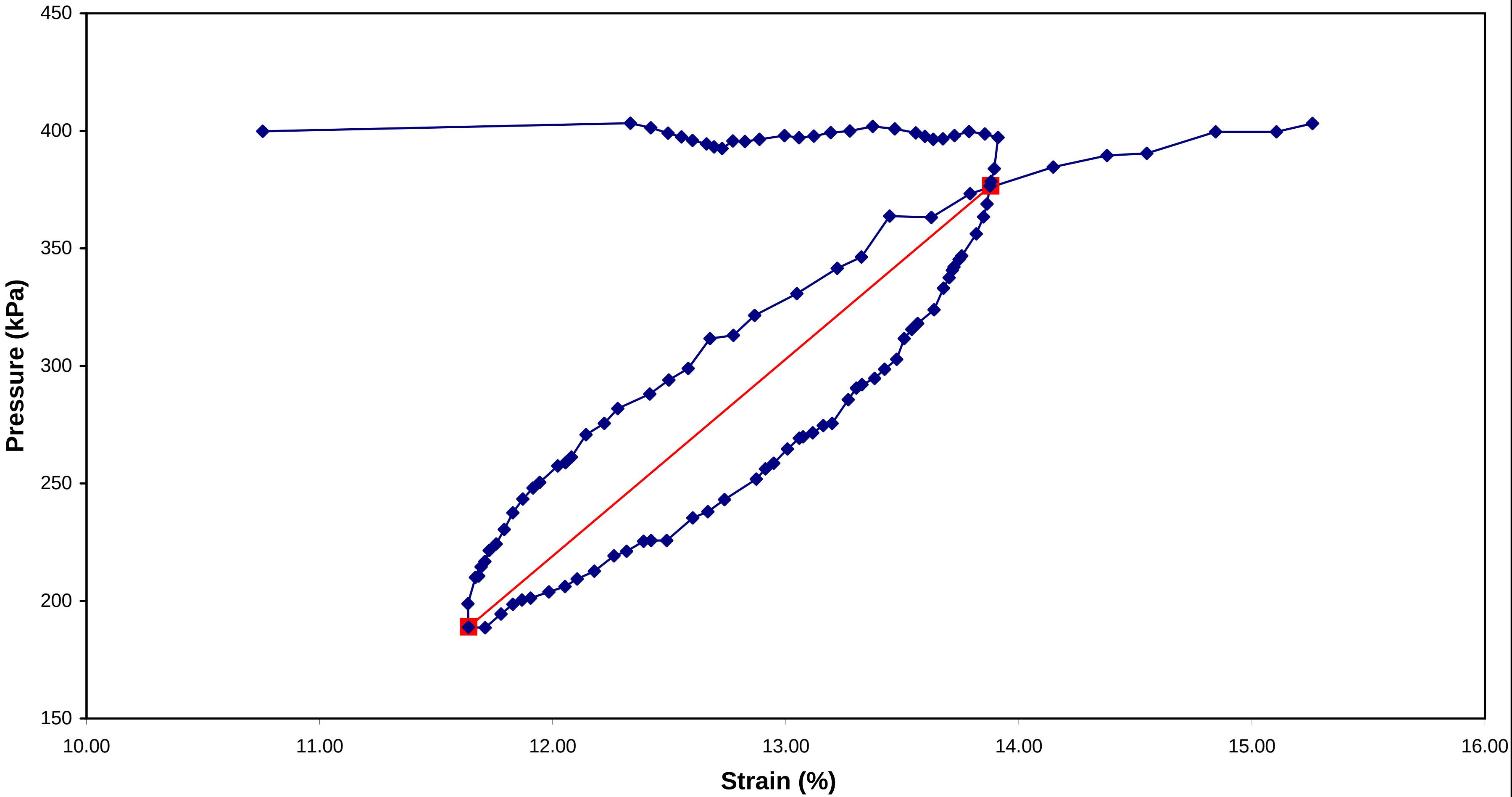
Driven Pressuremeter Test Results

Shear Modulus from loop



Borehole Number	**cpt_09**
Test Number	**1**
Depth(m)	**3.00**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Calculating Shear Modulus

Loop 1	
δε	dp
11.64	189
13.88	376.6
2.24 %	188 kPa

Unload reload modulus, Gur **4.2** **MPa**

x
strain

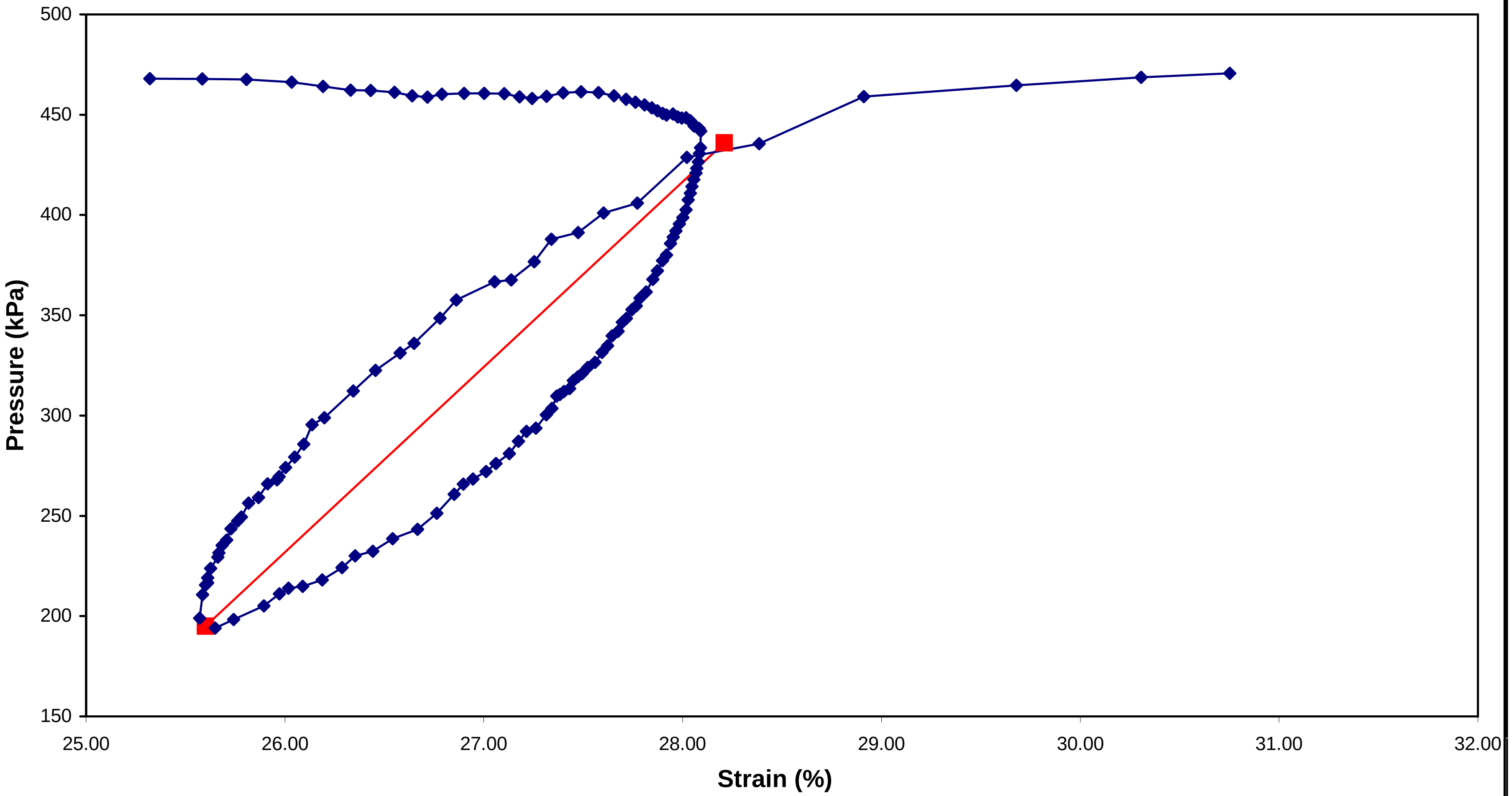
Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure
DPM cpt_09 T1

Driven Pressuremeter Test Results

Shear Modulus from loop



Borehole Number	**cpt_09**
Test Number	**1**
Depth(m)	**3.00**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Calculating Shear Modulus

Loop 2	
$\delta\varepsilon$	dp
25.60	195
28.21	436
2.61 %	241 kPa

Unload reload modulus, Gur **4.6** **MPa**

x
strain

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure
DPM cpt_09 T1

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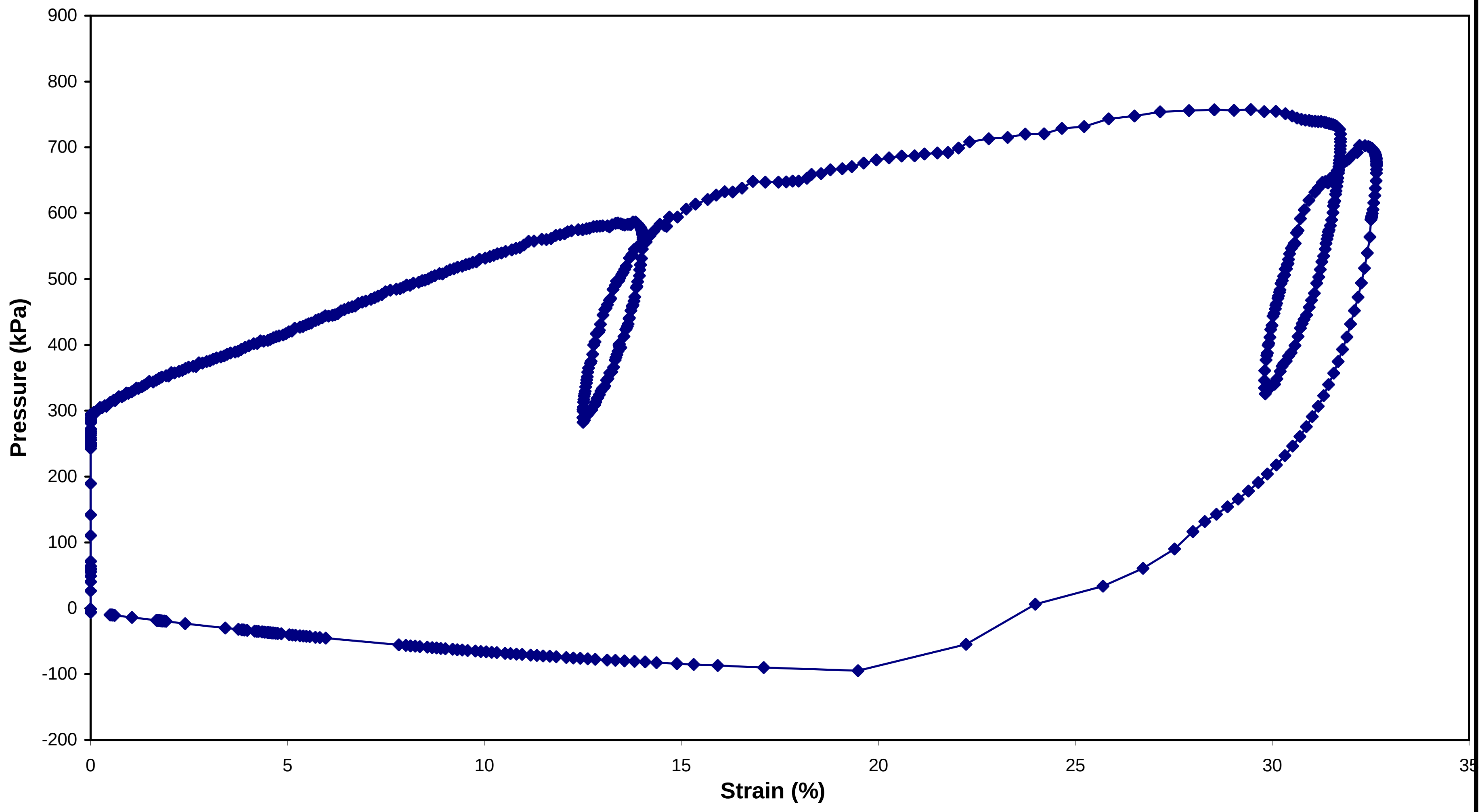
Driven Pressuremeter Test Results



Borehole Number	**cpt_09**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_09 T2

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Driven Pressuremeter Test Results

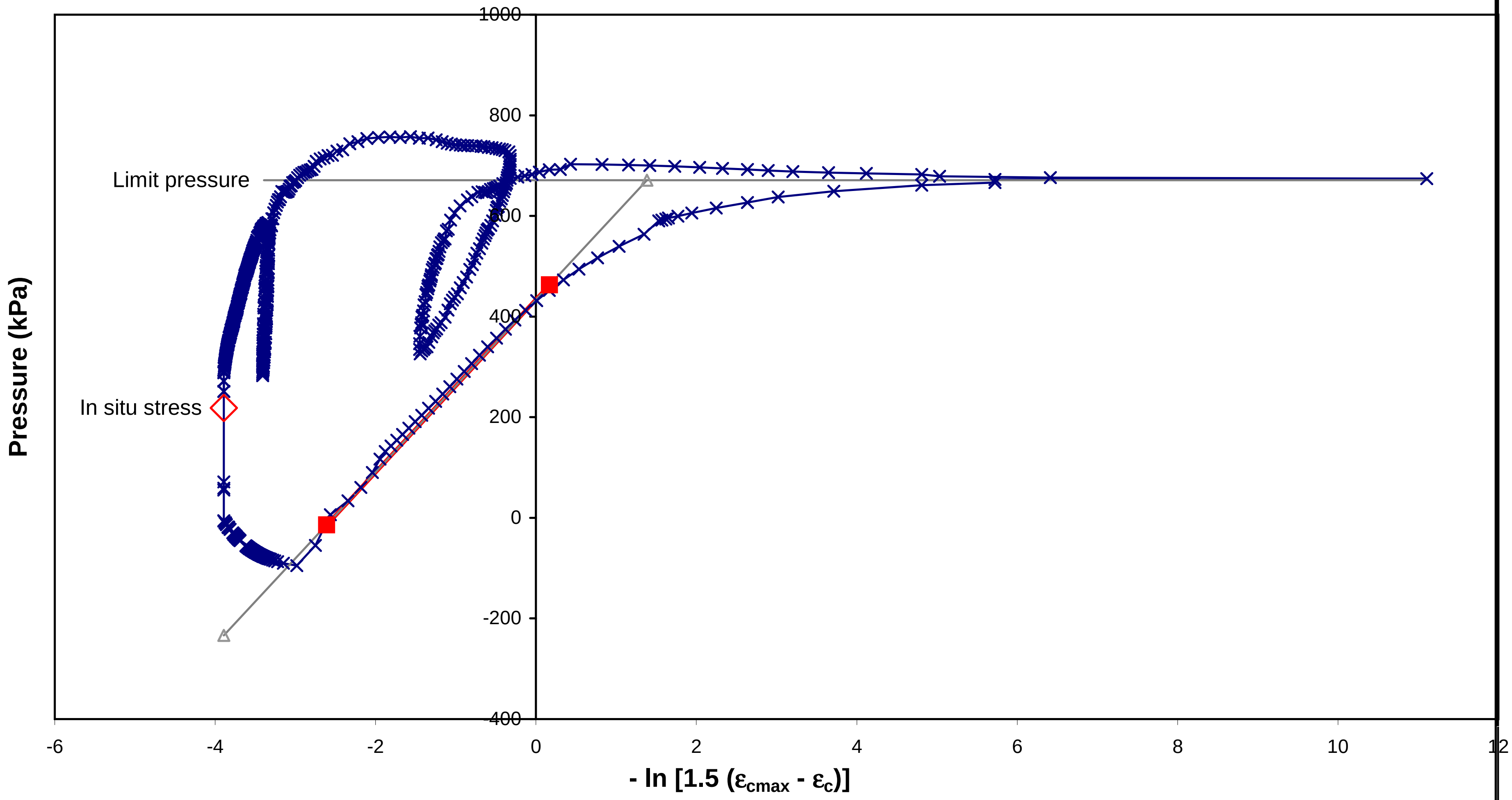
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_09 T2

Shear strength analysis



Borehole Number	**cpt_09**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Shear strength analysis	
$\delta\varepsilon$	$\delta\pi$
0.17	463
–2.61	–14
Gradient	171.58
Su (kPa)	**86**

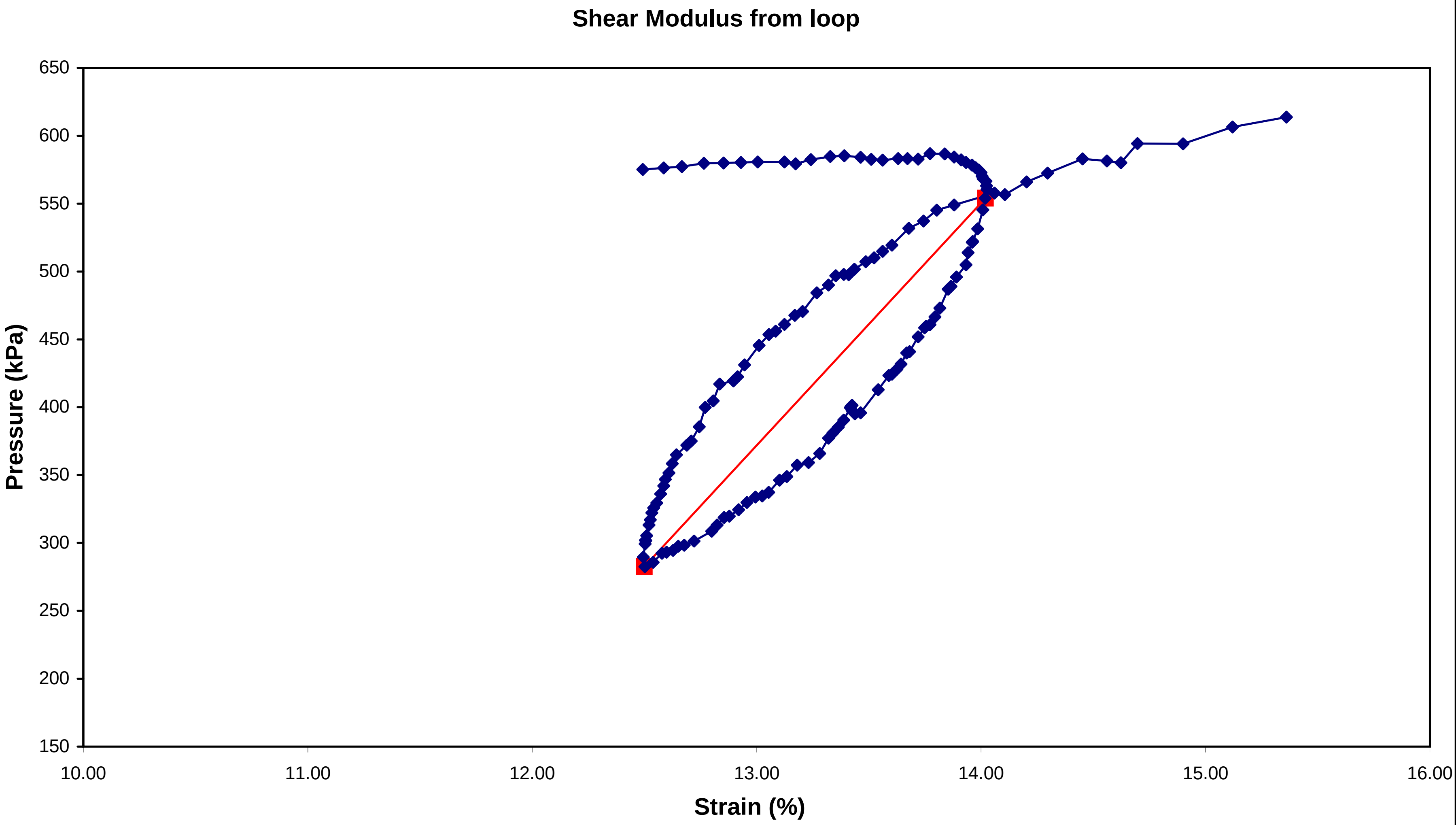
In situ stress analysis	
$\delta\varepsilon$	P
-3.89	-233.86
1.38	671.00
σm (kPa)	**219**

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure DPM cpt_09 T2



x
strain

Borehole Number	**cpt_09**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Calculating Shear Modulus

Loop 1	
$\delta\varepsilon$	dp
12.50	283
14.02	554
1.52 %	271 kPa

Unload reload modulus, Gur **8.9** **MPa**

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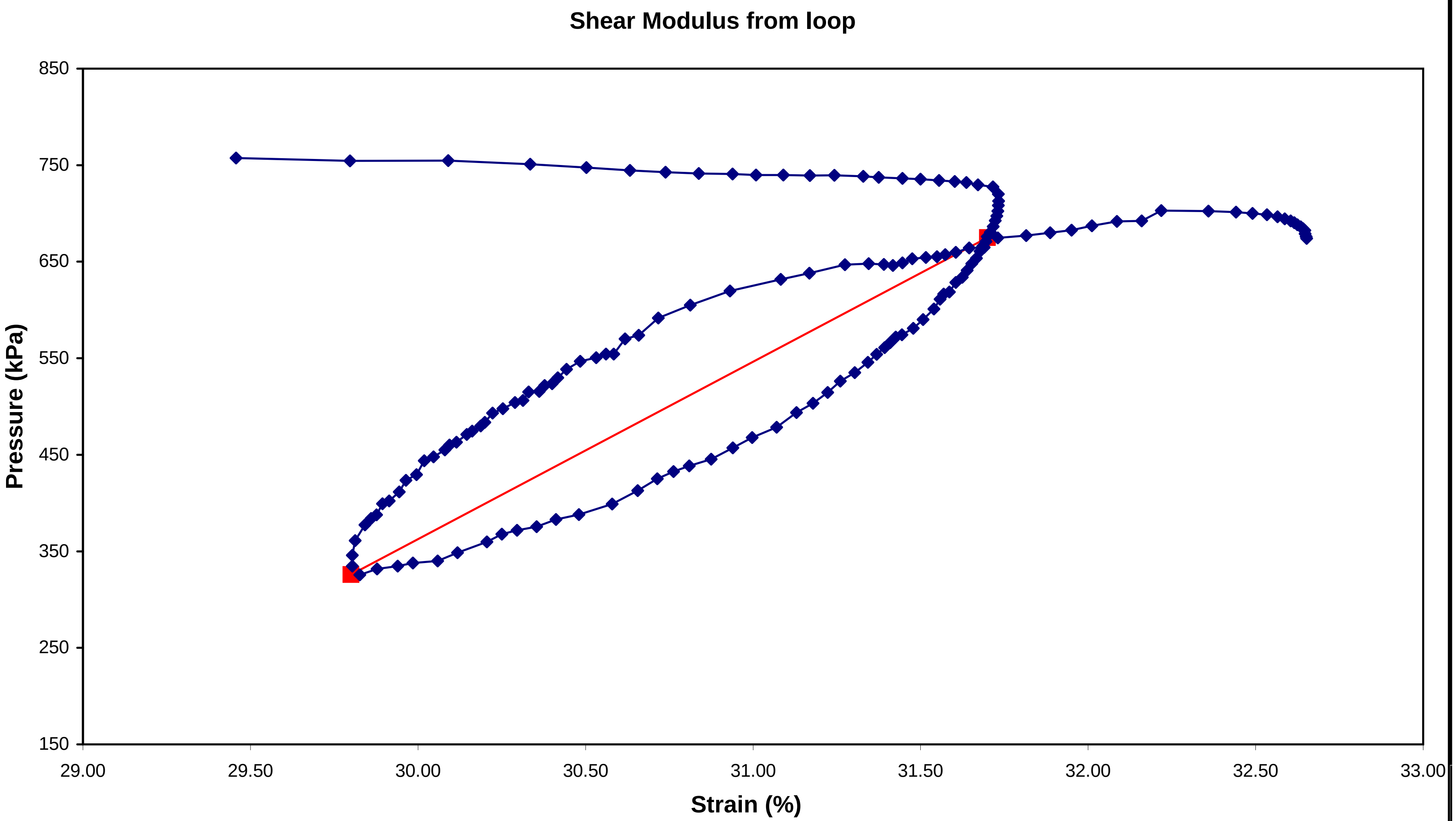
Driven Pressuremeter Test Results



x
strain

Borehole Number	**cpt_09**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**14 April 2009**

Calculating Shear Modulus

Loop 2	
δε	dp
29.80	326
31.70	675
1.90 %	349 kPa

Unload reload modulus, Gur **9.2** **MPa**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

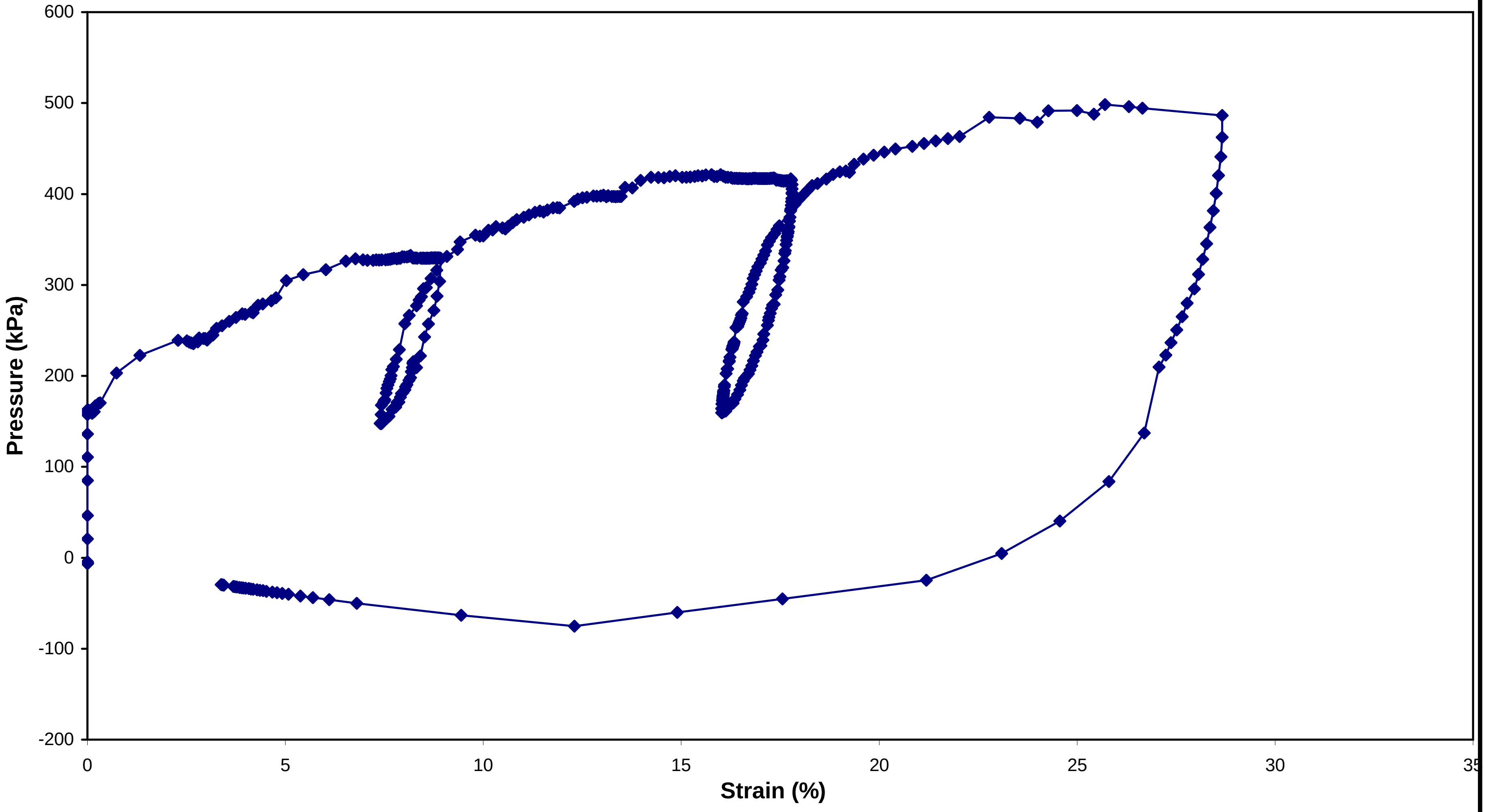
Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_09 T2

Driven Pressuremeter Test Results



Borehole Number	**cpt_17**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**02 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

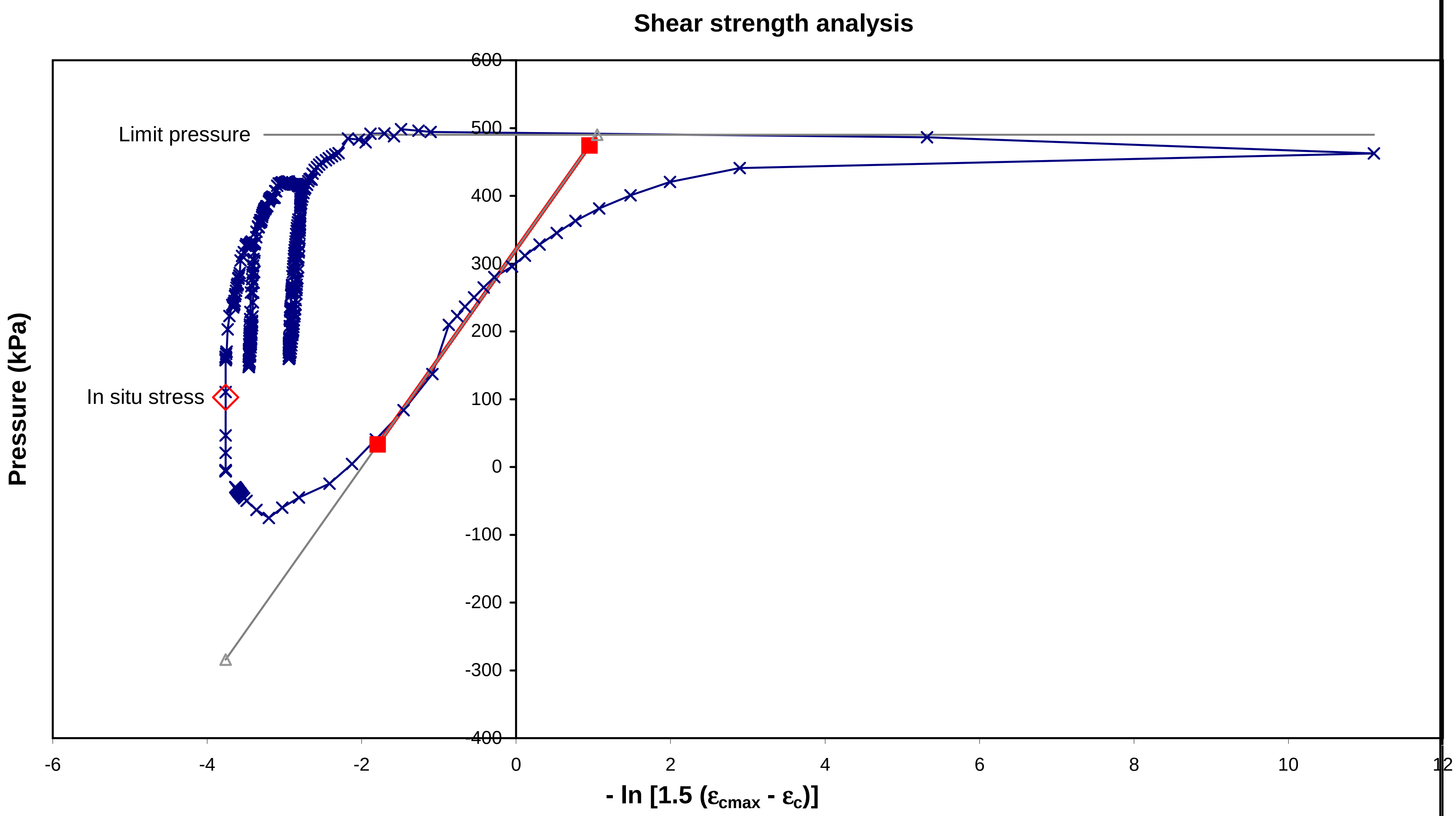
Figure

DPM cpt_17 T1

Driven Pressuremeter Test Results

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction



Borehole Number	**cpt_17**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**02 April 2009**

Shear strength analysis	
$\delta\varepsilon$	$\delta\pi$
0.95	474
−1.79	33
Gradient	160.95
Su (kPa)	**80**

In situ stress analysis	
$\delta\varepsilon$	P
-3.76	-284.25
1.05	490.00
σm (kPa)	**103**

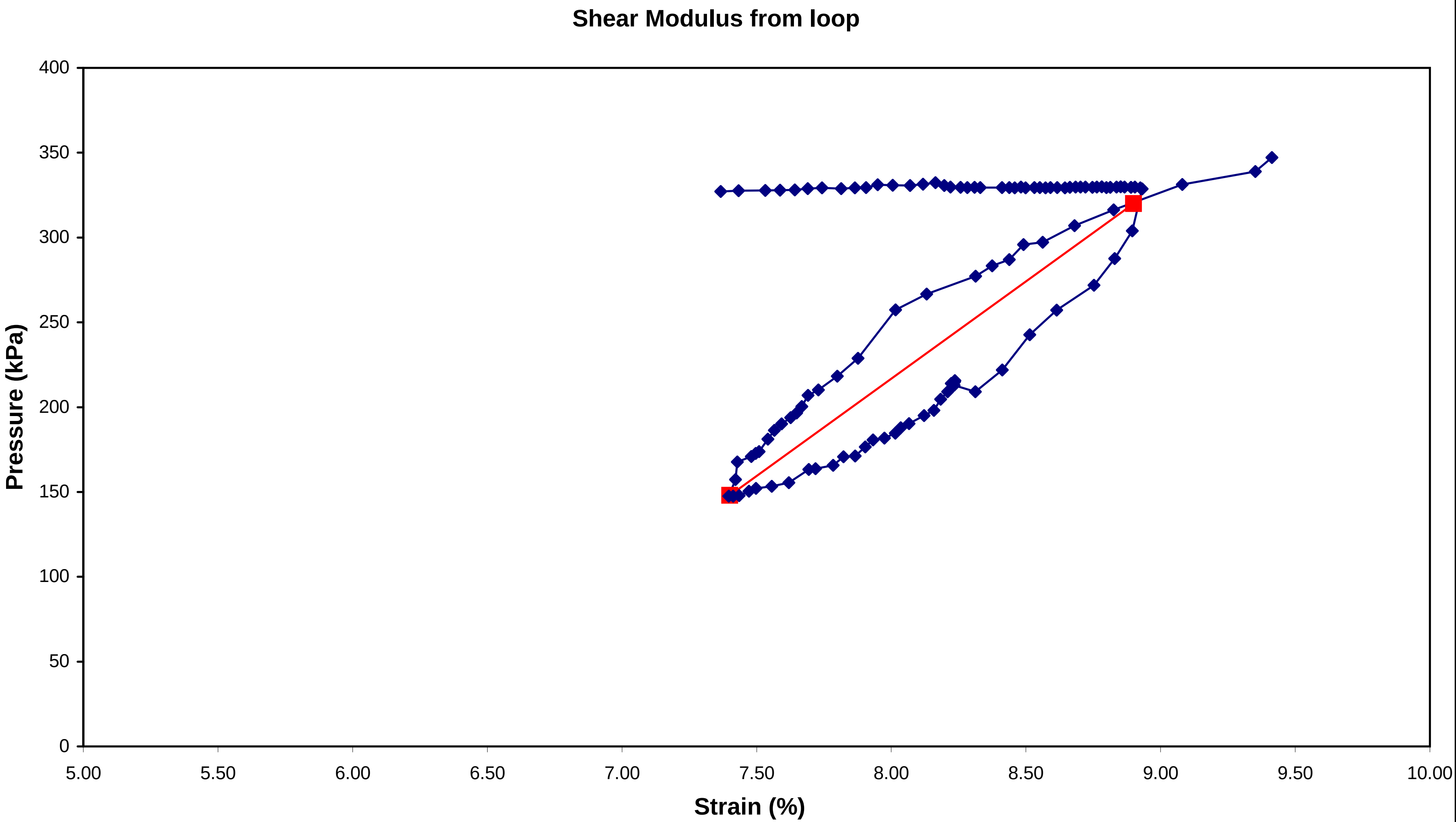
Figure

DPM cpt_17 T1

Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction



x
strain

Borehole Number	**cpt_17**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**02 April 2009**

Calculating Shear Modulus

Loop 1	
$\delta\varepsilon$	dp
7.40	148
8.90	320
1.50 %	172 kPa

Unload reload modulus, Gur **5.7** **MPa**

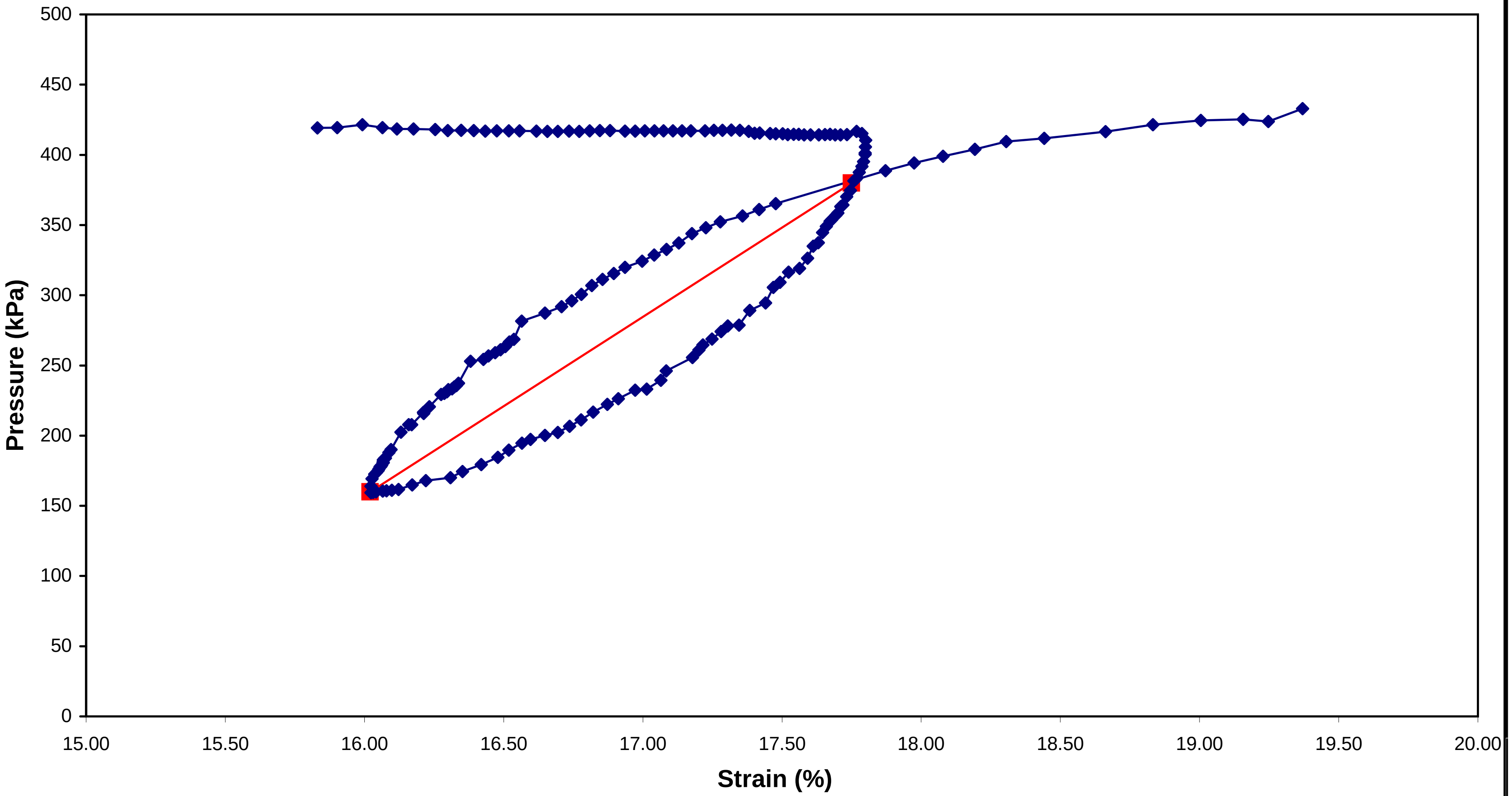
Figure
DPM cpt_17 T1

Driven Pressuremeter Test Results

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction
Figure	**DPM cpt_17 T1**

Shear Modulus from loop



x
strain

Borehole Number	**cpt_17**
Test Number	**1**
Depth(m)	**4.00**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**02 April 2009**

Calculating Shear Modulus

Loop 2	
δε	dp
16.02	160
17.75	380
1.73 %	220 kPa

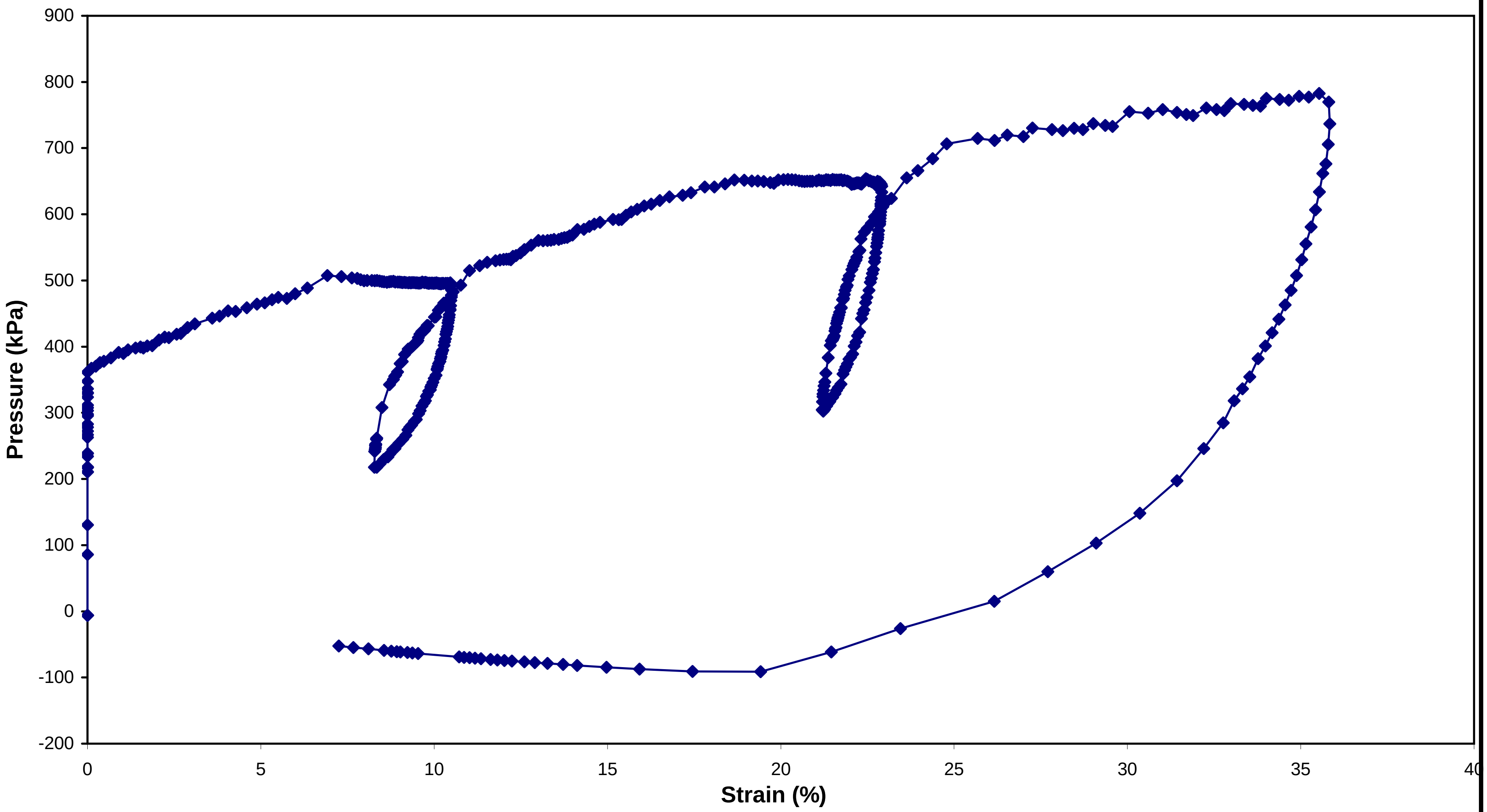
Unload reload modulus, Gur **6.4** **MPa**

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure
DPM cpt_17 T2



Borehole Number	**cpt_17**
Test Number	**2**
Depth(m)	**6.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**02 April 2009**

Remarks

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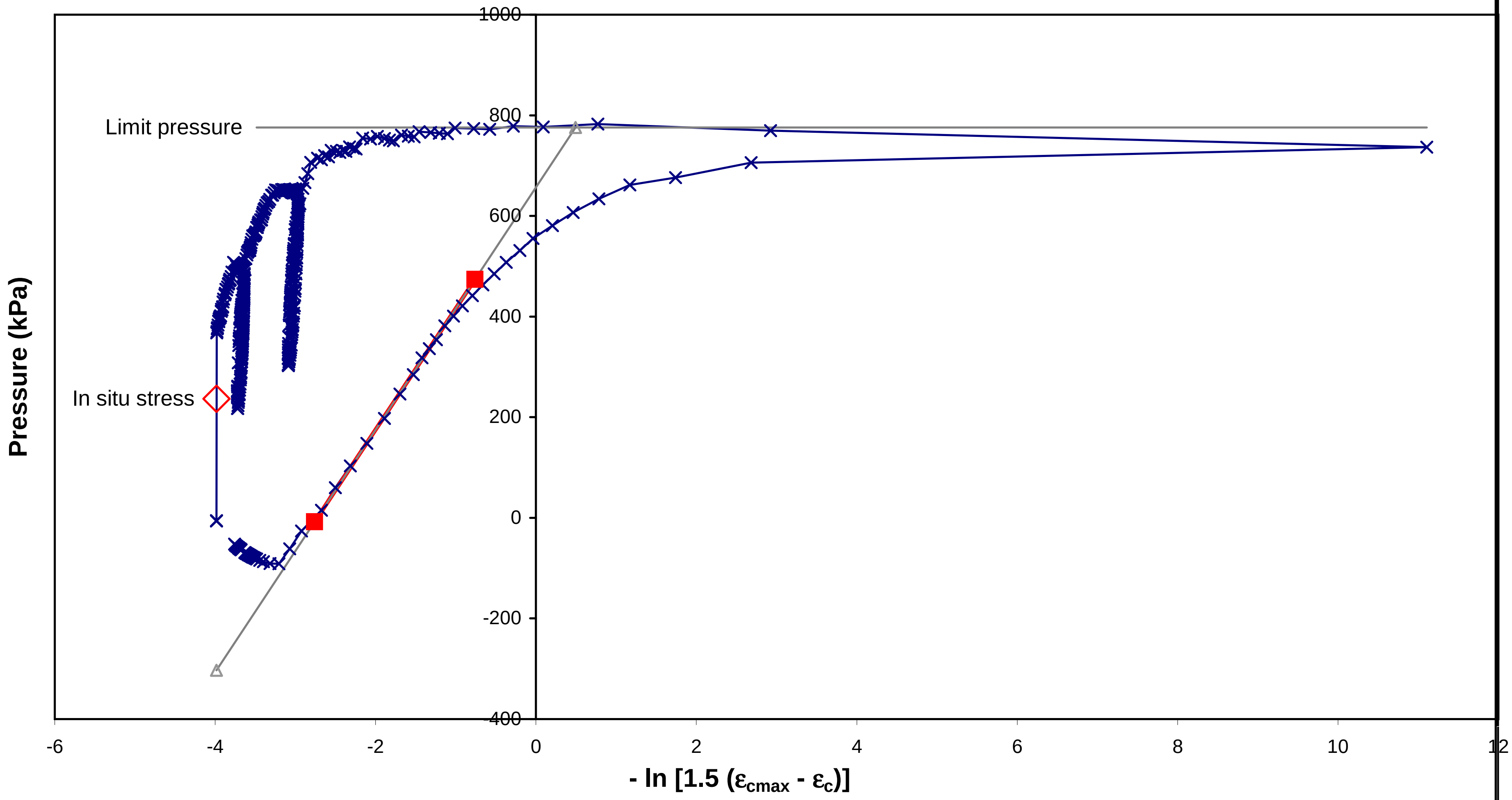
Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Shear strength analysis



Borehole Number	**cpt_17**
Test Number	**2**
Depth(m)	**6.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**02 April 2009**

Shear strength analysis	
$\delta\varepsilon$	$\delta\pi$
–0.76	474
–2.76	–8
Gradient	241.00
Su (kPa)	**121**

In situ stress analysis	
$\delta\varepsilon$	P
-3.98	-303.13
0.49	776.00
σm (kPa)	**236**

Figure
DPM cpt_17 T2

Driven Pressuremeter Test Results

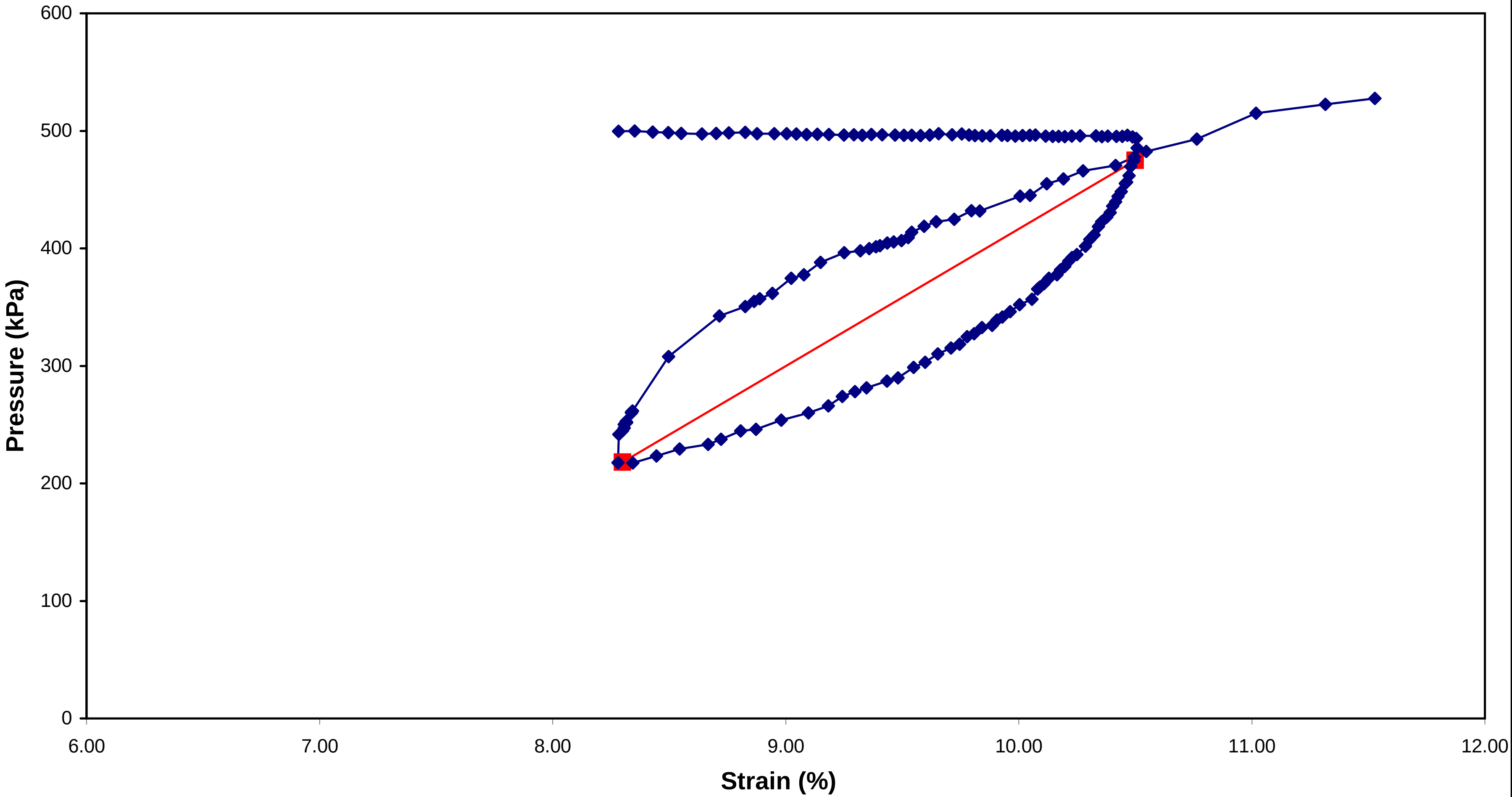
Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Figure

DPM cpt_17 T2

Shear Modulus from loop



x
strain

Borehole Number	**cpt_17**
Test Number	**2**
Depth(m)	**6.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**02 April 2009**

Calculating Shear Modulus

Loop 1	
$\delta\varepsilon$	dp
8.30	218
10.50	475
2.20 %	257 kPa

Unload reload modulus, Gur **5.8** **MPa**

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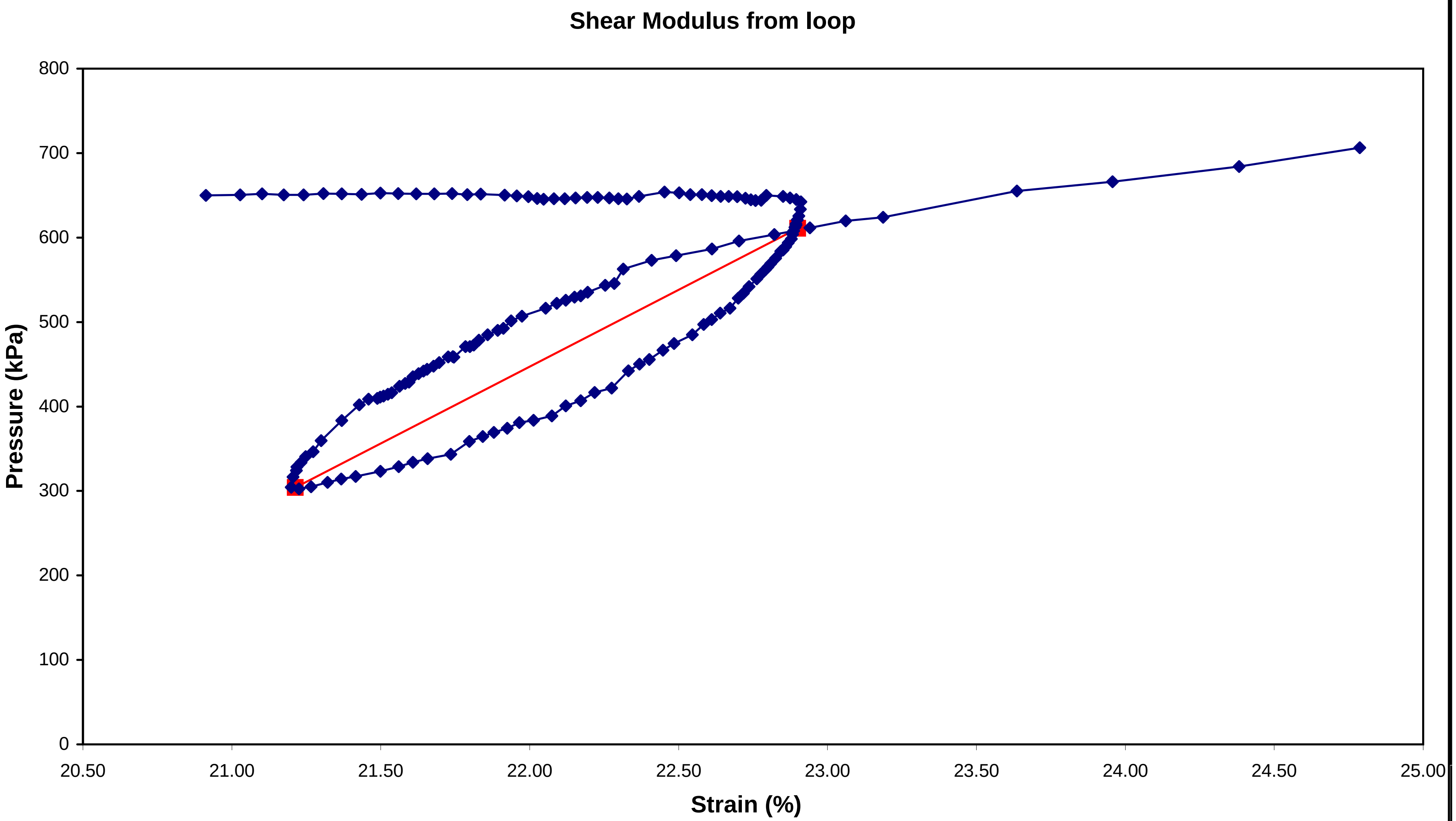
Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction



x
strain

Borehole Number	**cpt_17**
Test Number	**2**
Depth(m)	**6.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**02 April 2009**

Calculating Shear Modulus

Loop 2	
δε	dp
21.21	304
22.90	611
1.69 %	307 kPa

Unload reload modulus, Gur **9.1** **MPa**

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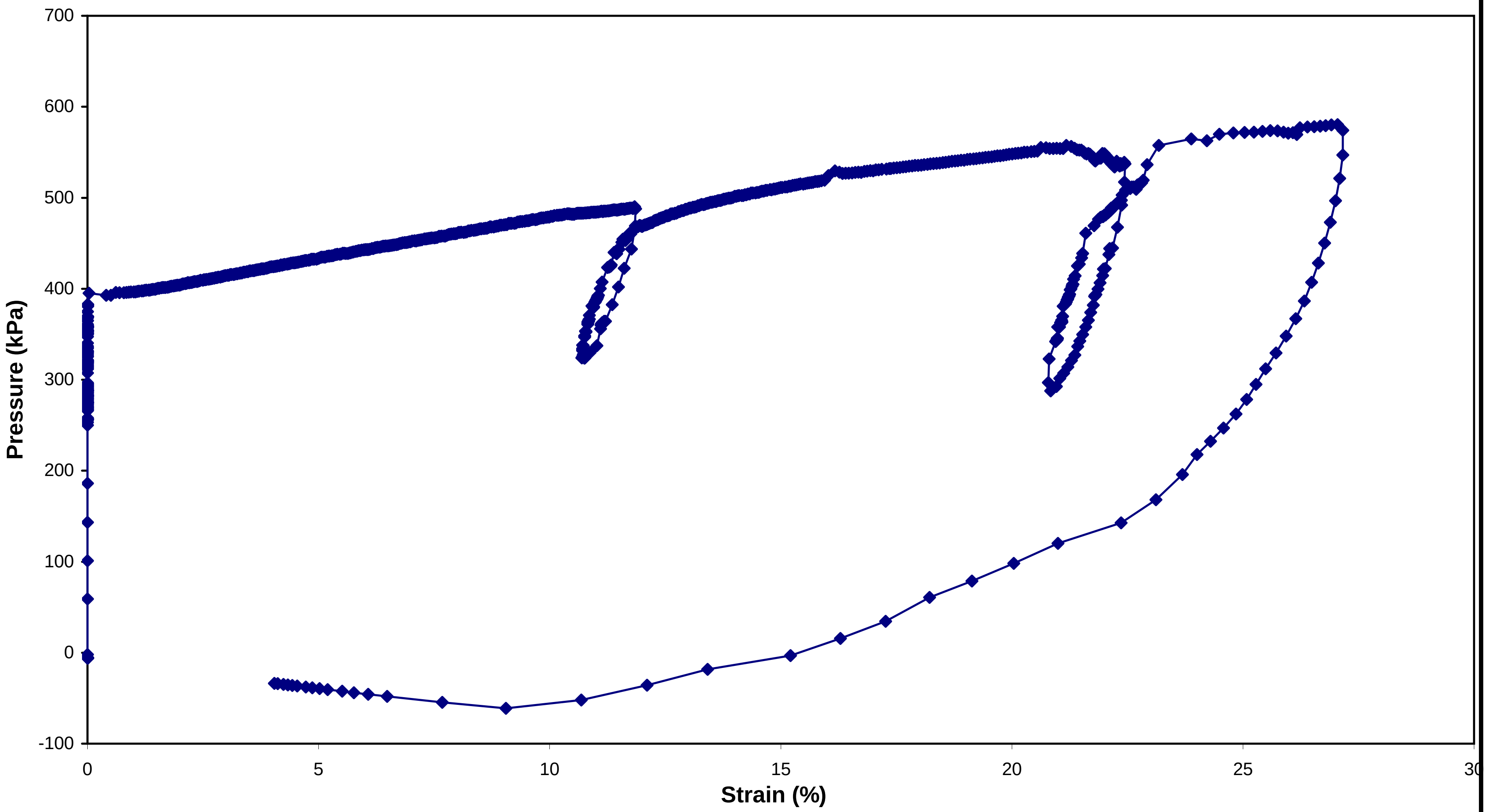
Figure

DPM cpt_17 T2

Driven Pressuremeter Test Results



Borehole Number	**cpt_19**
Test Number	**1**
Depth(m)	**4.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**01 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

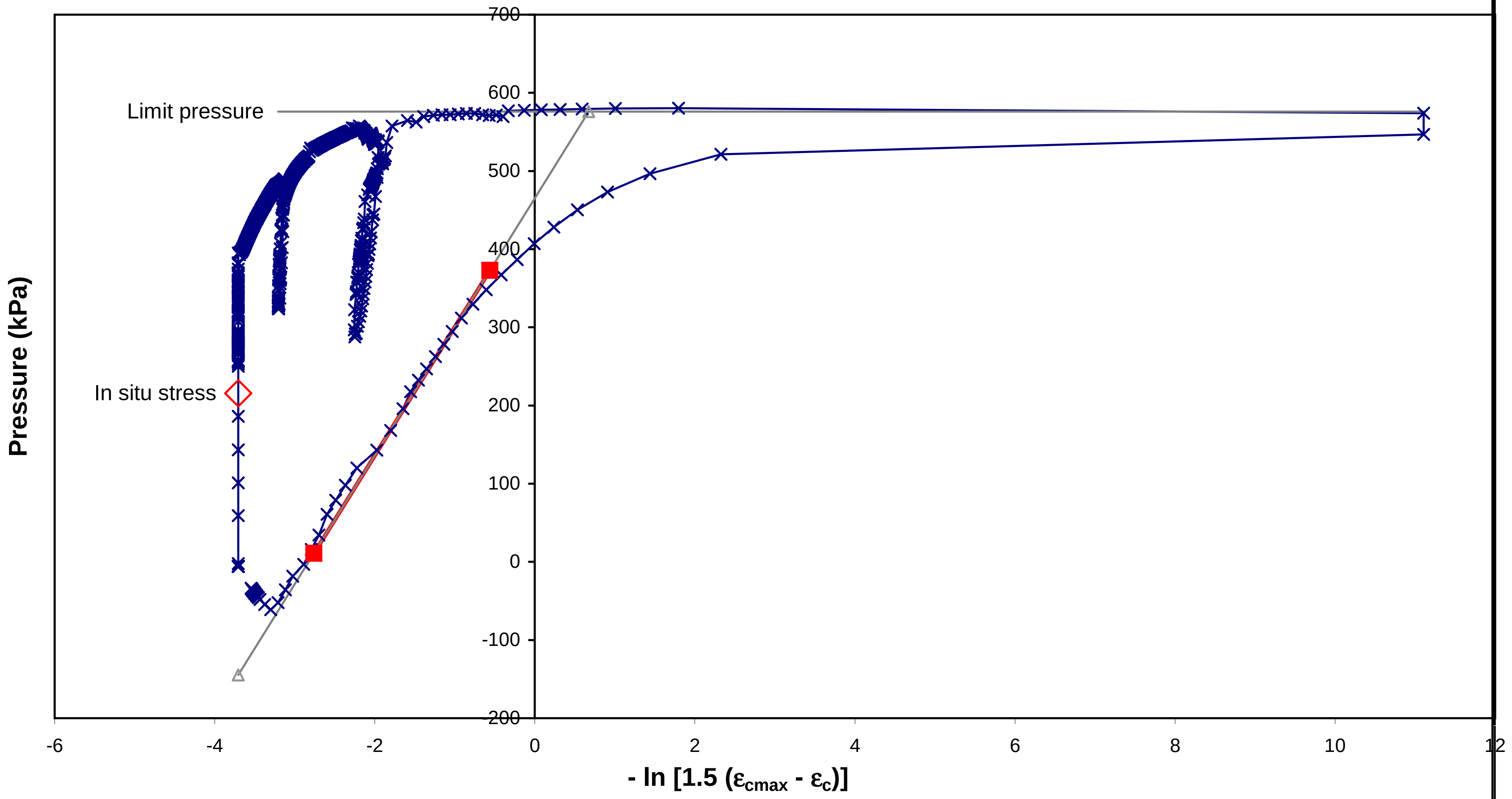
DPM cpt_19 T1

Driven Pressuremeter Test Results

Notes:

Project	TWEEN BRIDGE WIND FARM, PHASE 2
Project No.	M9015
Carried out for	Morrison Construction

Shear strength analysis



Borehole Number	**cpt_19**
Test Number	**1**
Depth(m)	**4.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**01 April 2009**

Shear strength analysis	
$\delta\varepsilon$	$\delta\pi$
–0.56	373
–2.76	11
Gradient	164.55
Su (kPa)	**82**

In situ stress analysis	
$\delta\varepsilon$	P
-3.71	-144.85
0.67	576.00
σm (kPa)	**216**

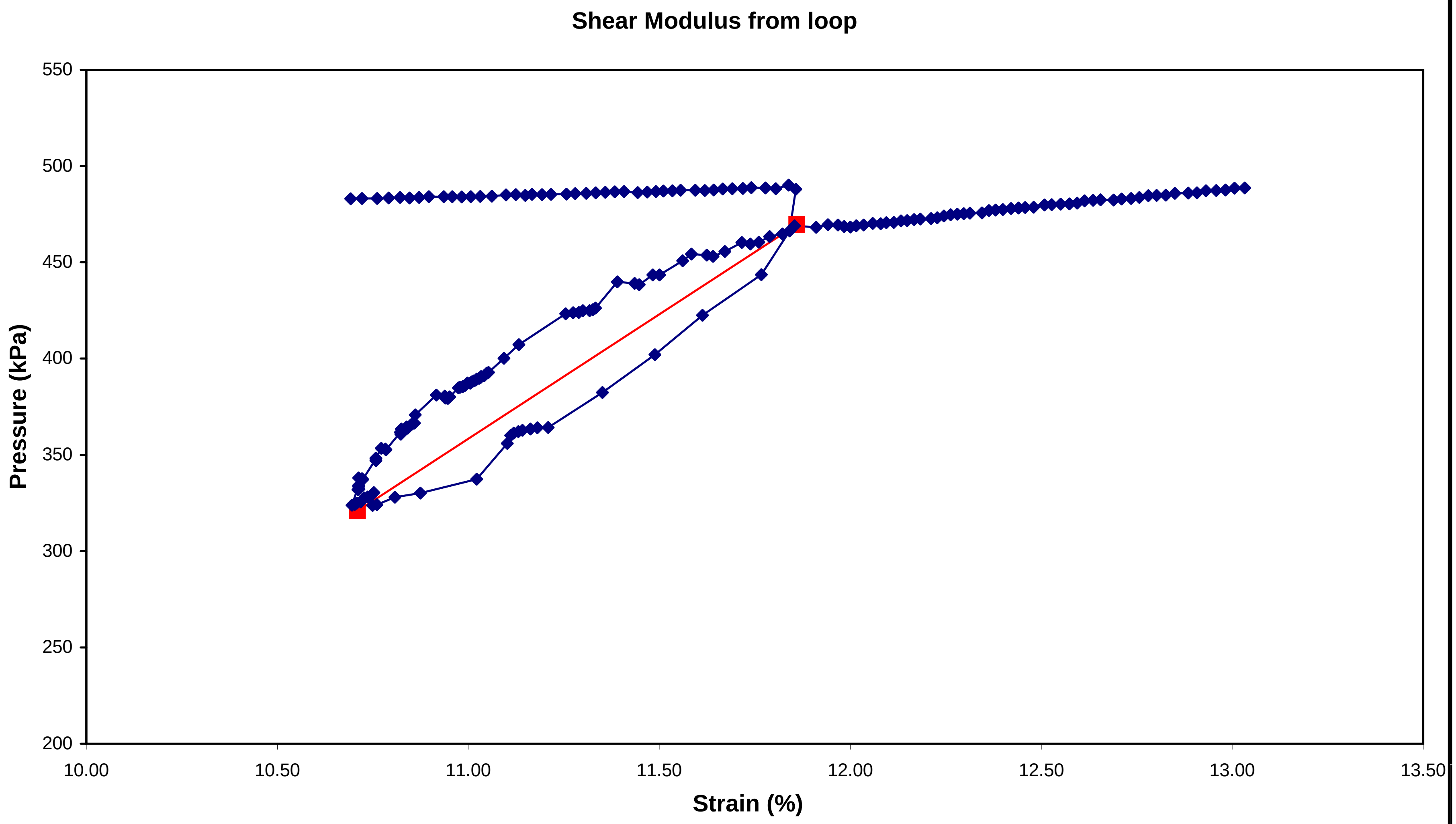
Figure
DPM cpt_19 T1

Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Figure: DPM cpt_19 T1



x
strain

Borehole Number	**cpt_19**
Test Number	**1**
Depth(m)	**4.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**01 April 2009**

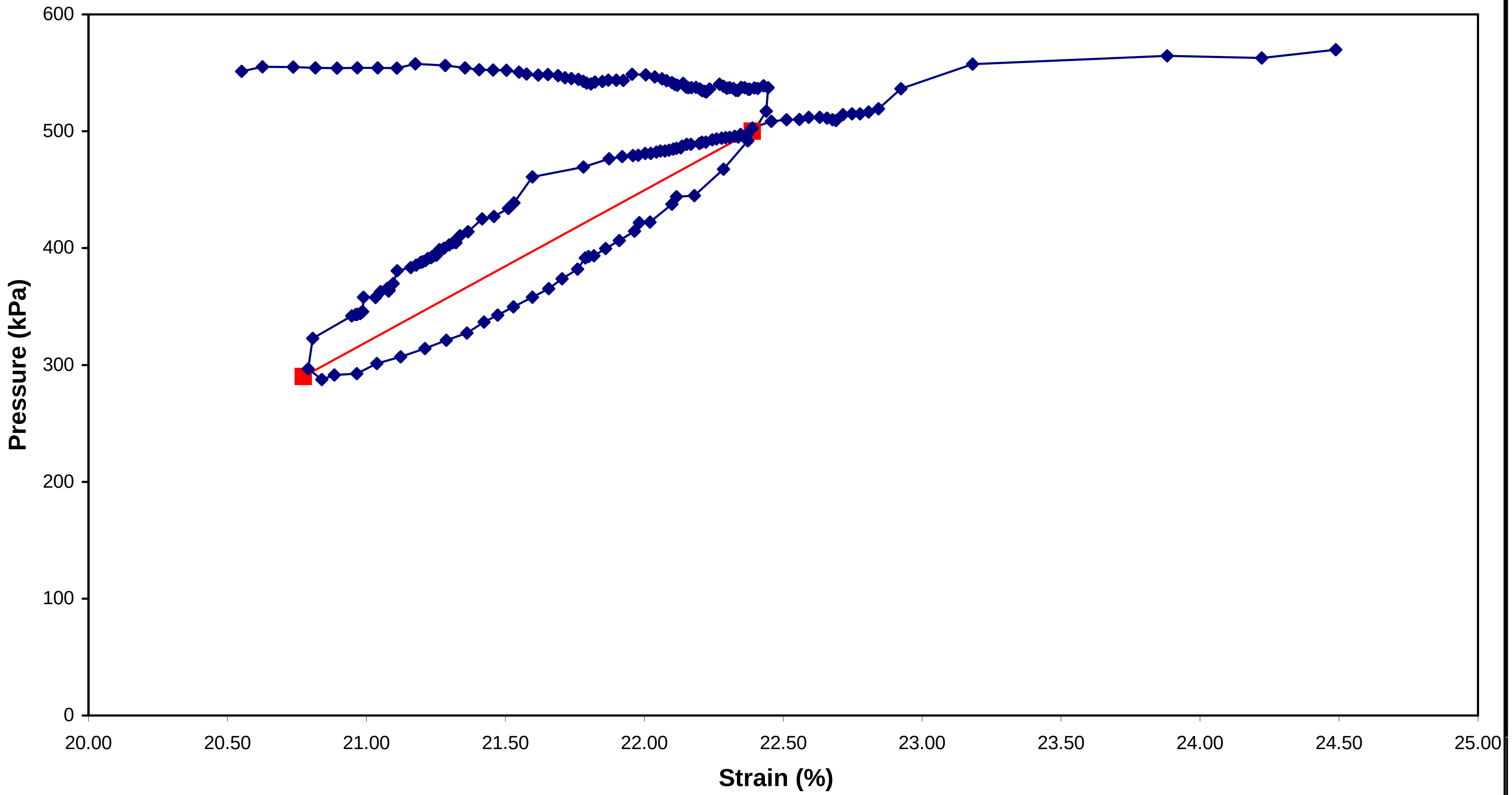
Calculating Shear Modulus

Loop 1	
$\delta\varepsilon$	dp
10.71	321
11.86	469.5
1.15 %	149 kPa

Unload reload modulus, Gur **6.5** **MPa**

Driven Pressuremeter Test Results

Shear Modulus from loop



Borehole Number	**cpt_19**
Test Number	**1**
Depth(m)	**4.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**01 April 2009**

Calculating Shear Modulus

Loop 2	
δε	dp
20.77	290
22.39	500
1.62 %	210 kPa

Unload reload modulus, Gur **6.5** **MPa**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

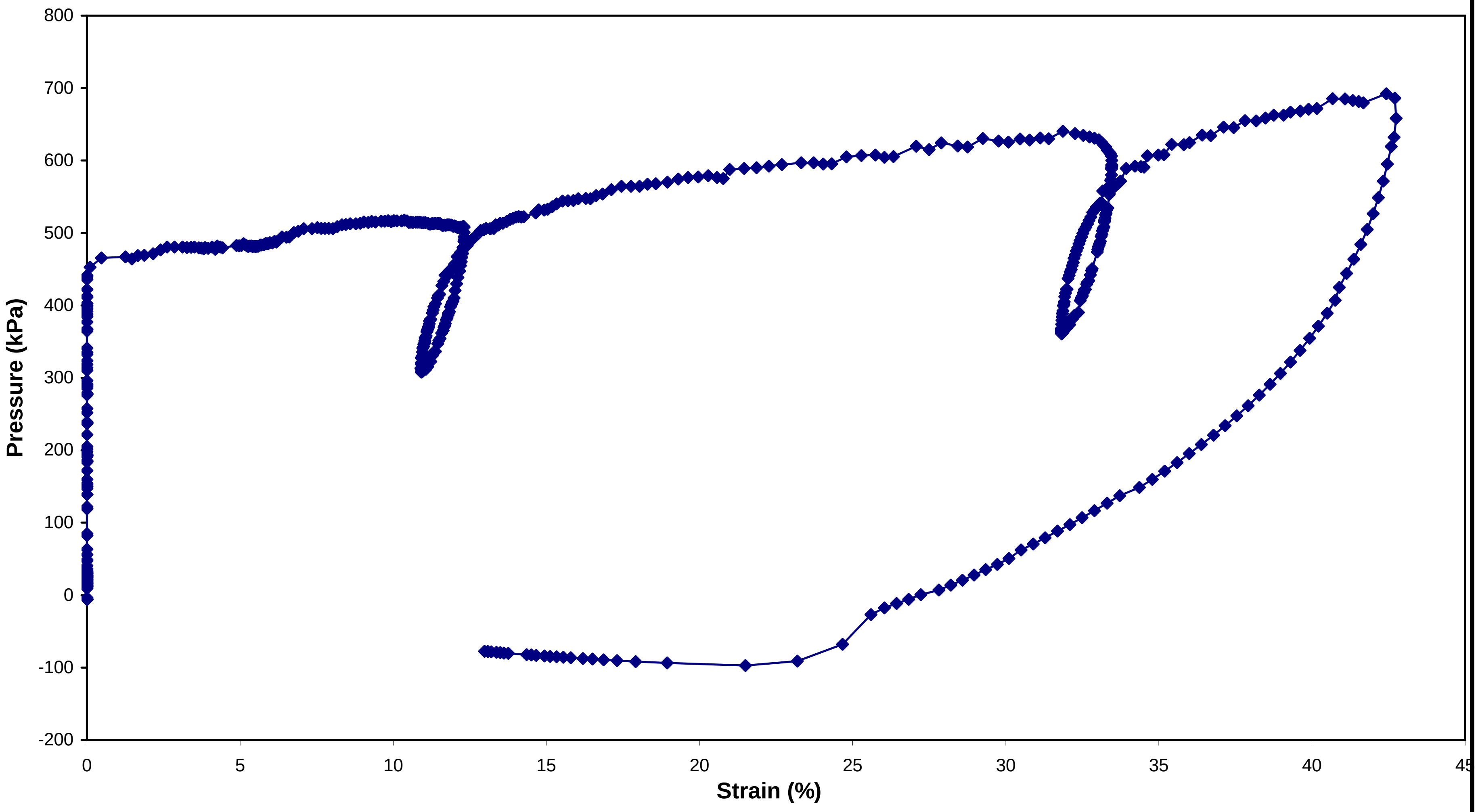
Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_19 T1

Driven Pressuremeter Test Results



Borehole Number	**cpt_19**
Test Number	**2**
Depth(m)	**6.50**
Installation Method	**CPT**
Operator	**Th DB**
Test Date	**01 April 2009**

Remarks

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Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_19 T2

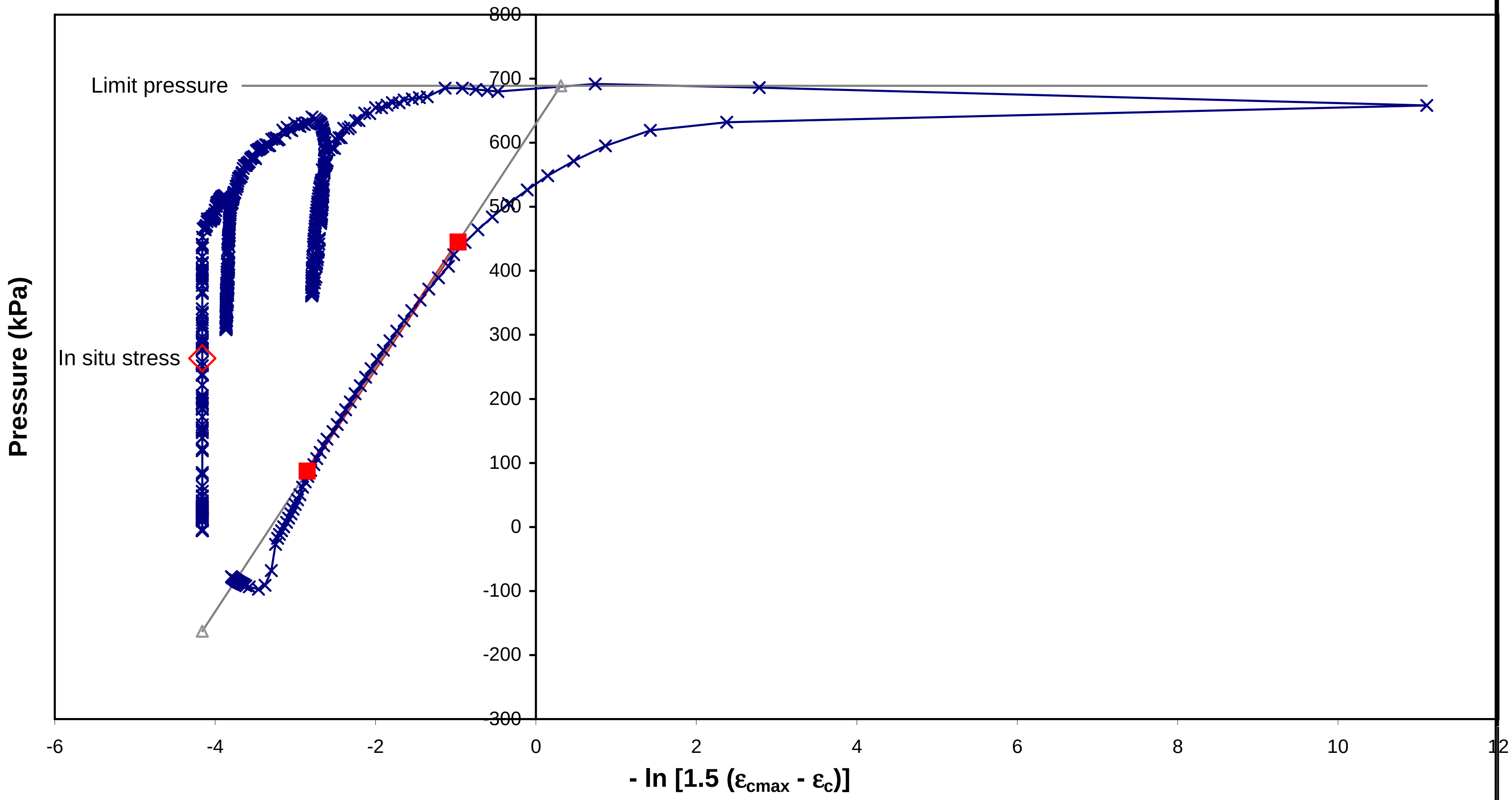
Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Figure: DPM cpt_19 T2

Shear strength analysis



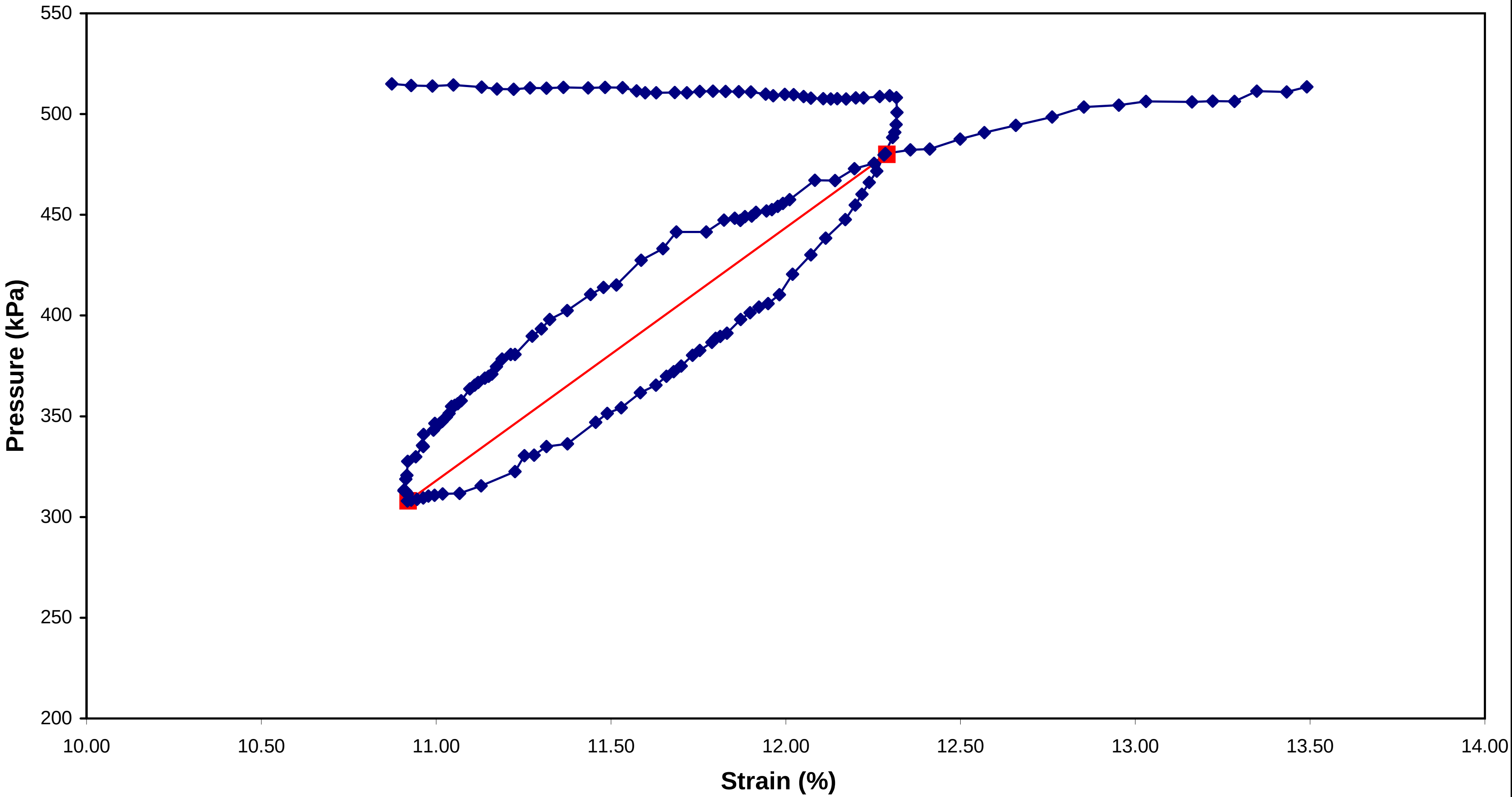
Borehole Number	**cpt_19**
Test Number	**2**
Depth(m)	**6.50**
Installation Method	**CPT**
Operator	**Th DB**
Test Date	**01 April 2009**

Shear strength analysis	
δε	δπ
−0.97	445
−2.85	87
Gradient	190.43
Su (kPa)	**95**

In situ stress analysis	
δε	P
-4.16	-162.59
0.31	689.00
σm (kPa)	**263**

Driven Pressuremeter Test Results

Shear Modulus from loop



Borehole Number	**cpt_19**
Test Number	**2**
Depth(m)	**6.50**
Installation Method	**CPT**
Operator	**Th DB**
Test Date	**01 April 2009**

Calculating Shear Modulus

Loop 1	
δε	dp
10.92	308
12.29	480
1.37 %	172 kPa

Unload reload modulus, Gur **6.3** **MPa**

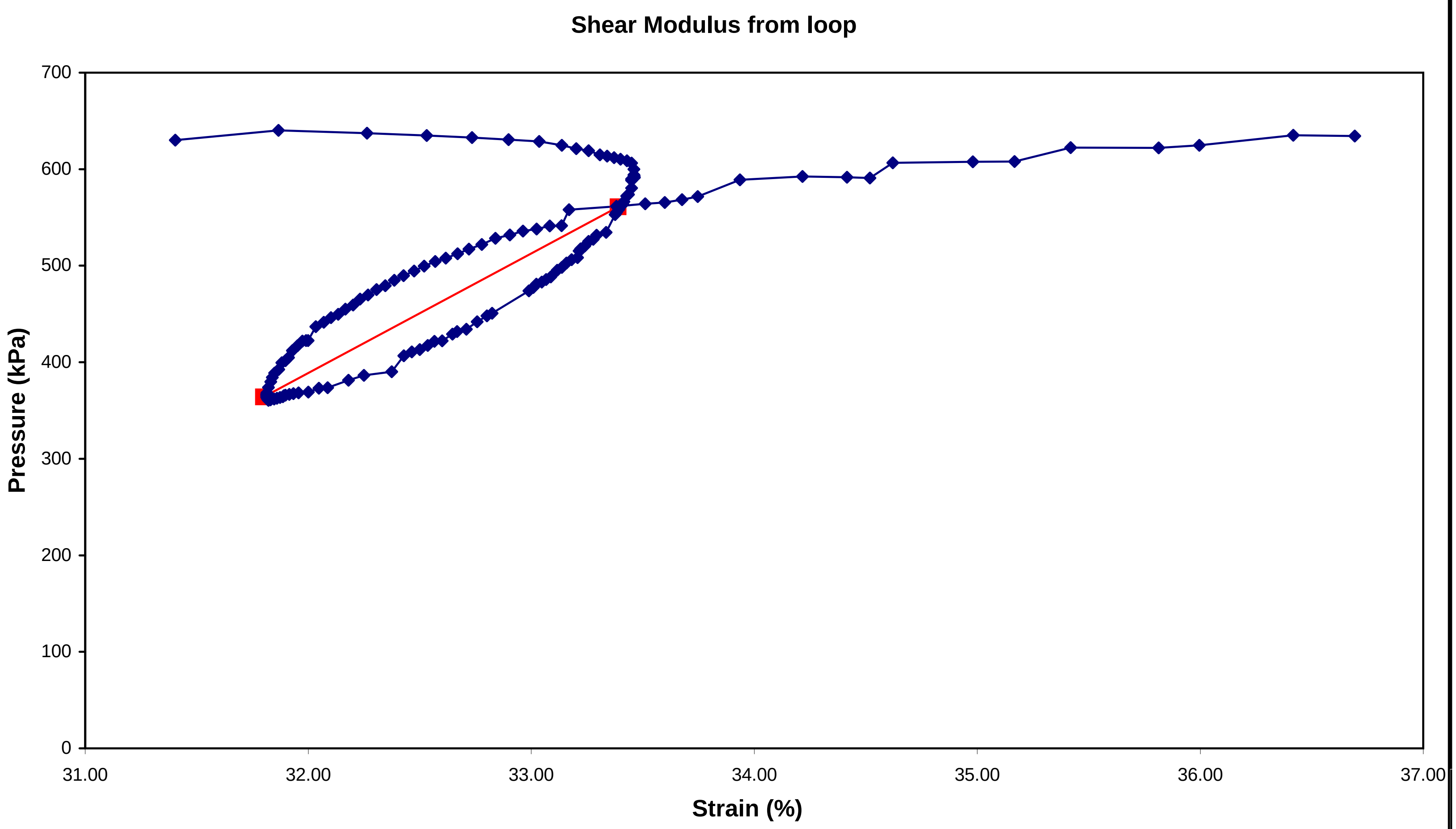
x
strain

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure
DPM cpt_19 T2

Driven Pressuremeter Test Results



Borehole Number	**cpt_19**
Test Number	**2**
Depth(m)	**6.50**
Installation Method	**CPT**
Operator	**Th DB**
Test Date	**01 April 2009**

Calculating Shear Modulus

Loop 2	
δε	dp
31.80	364
33.39	561
1.59 %	197 kPa

Unload reload modulus, Gur **6.2** **MPa**

x
strain

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

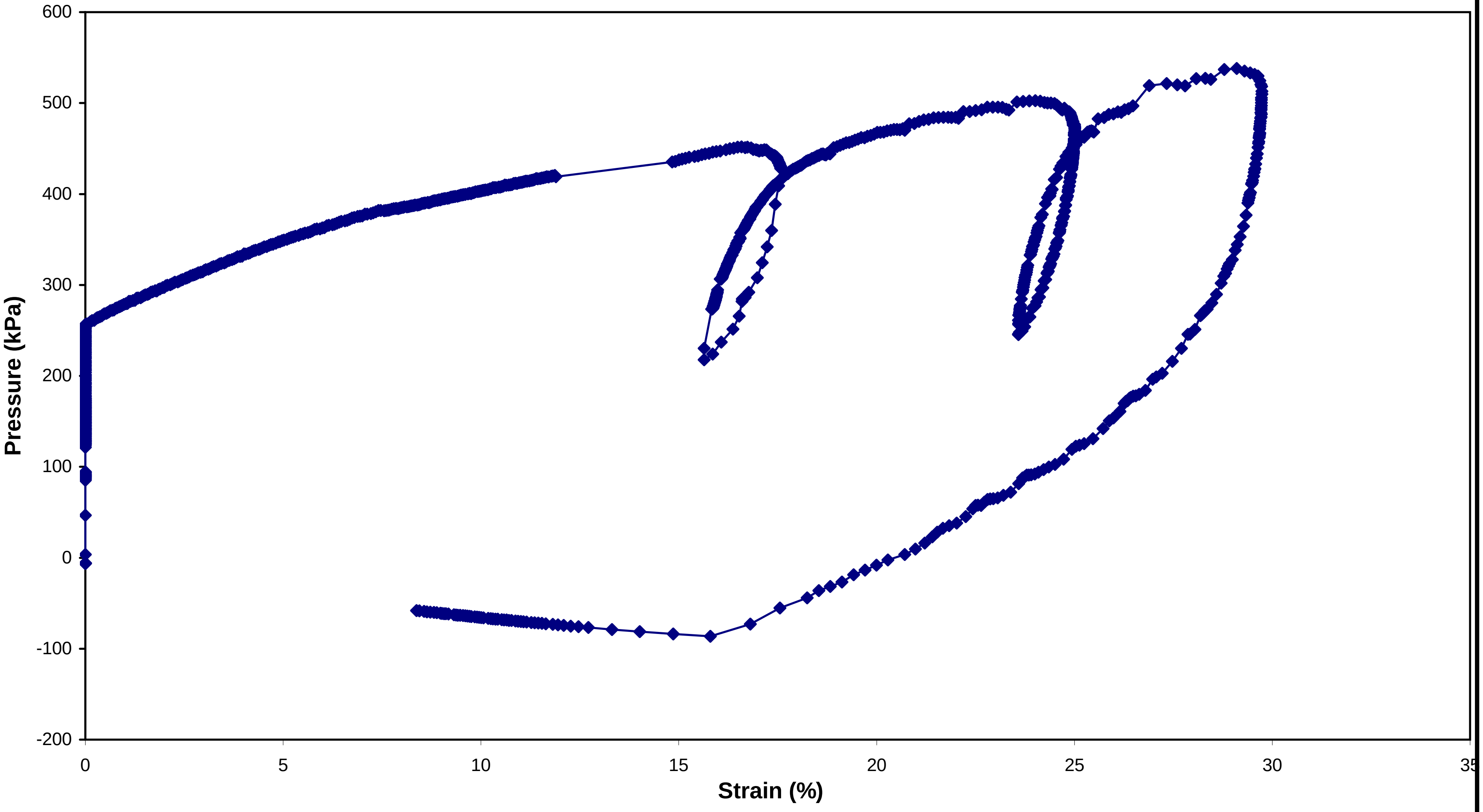
Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_19 T2

Driven Pressuremeter Test Results



Borehole Number	**cpt_20**
Test Number	**1**
Depth(m)	**4.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**01 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_20 T1

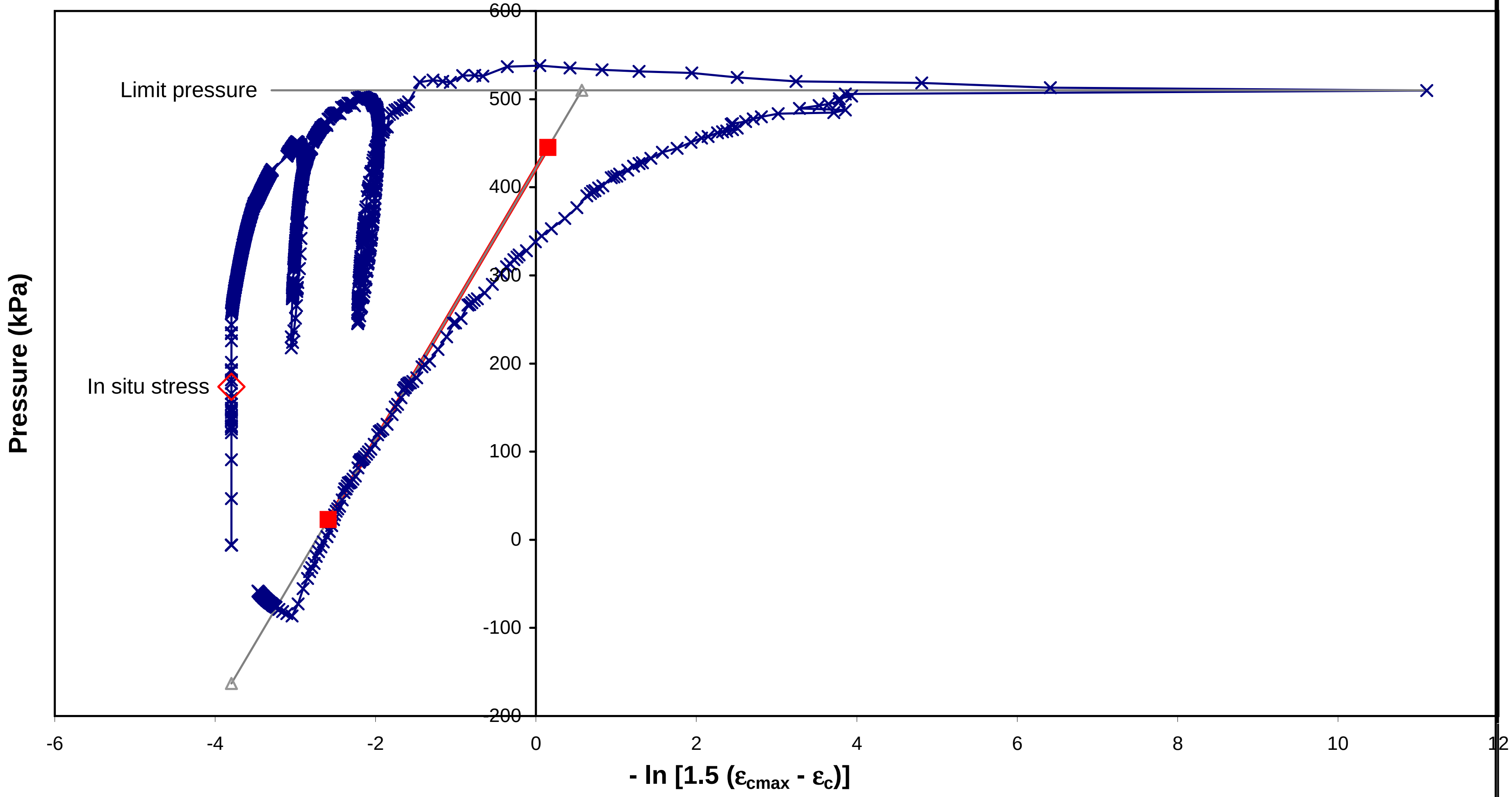
GEOCONE

Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Shear strength analysis



Borehole Number	**cpt_20**
Test Number	**1**
Depth(m)	**4.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**01 April 2009**

Shear strength analysis	
δε	δπ
0.15	445
–2.59	23
Gradient	154.01
Su (kPa)	**77**

In situ stress analysis	
δε	P
-3.80	-163.03
0.57	510.00
σm (kPa)	**173**

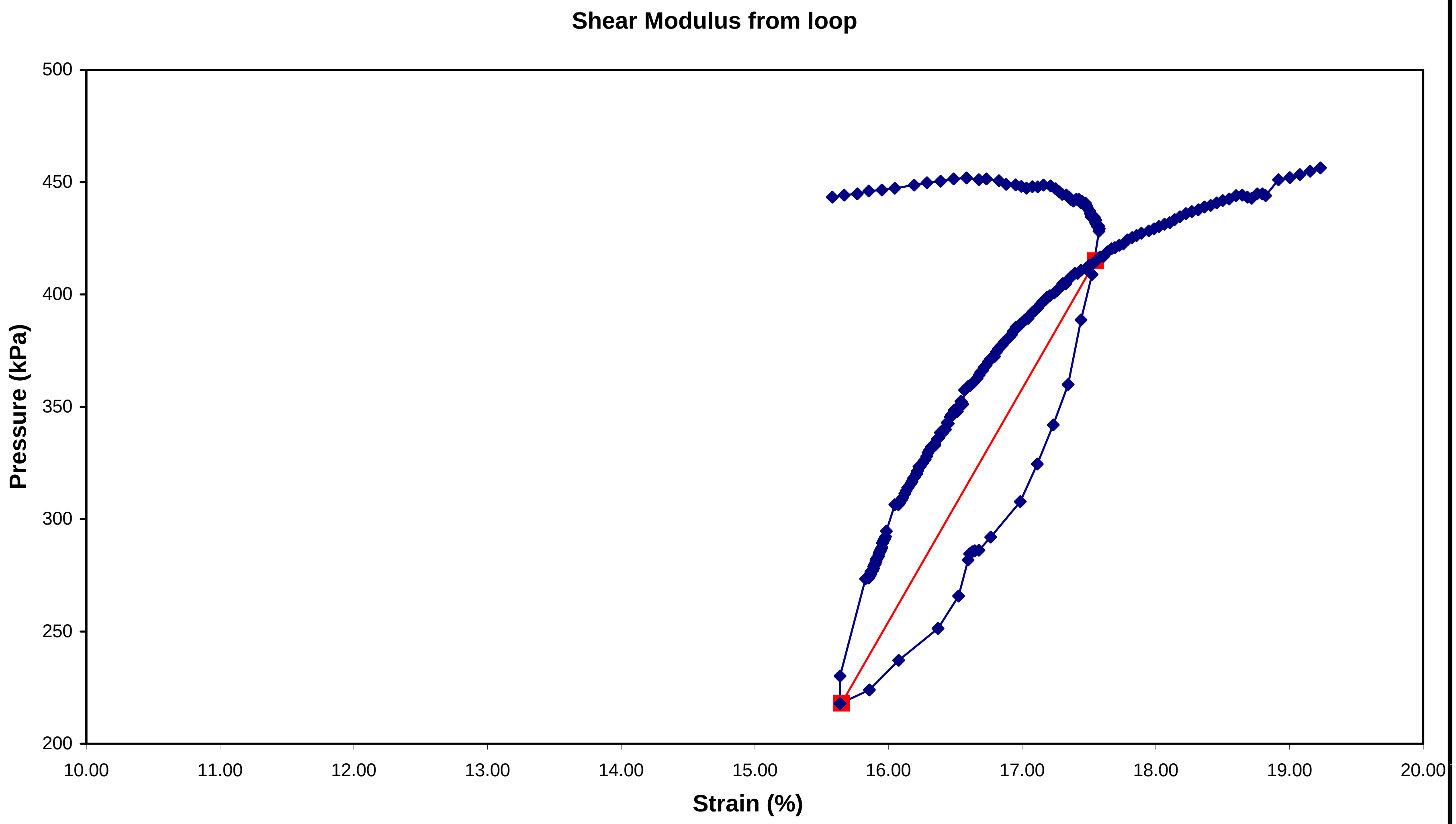
Figure
DPM cpt_20 T1

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure DPM cpt_20 T1



x
strain

Borehole Number	**cpt_20**
Test Number	**1**
Depth(m)	**4.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**01 April 2009**

Calculating Shear Modulus

Loop 1	
δε	dp
15.65	218
17.55	415
1.90 %	197 kPa

Unload reload modulus, Gur **5.2** **MPa**

GEOCONE

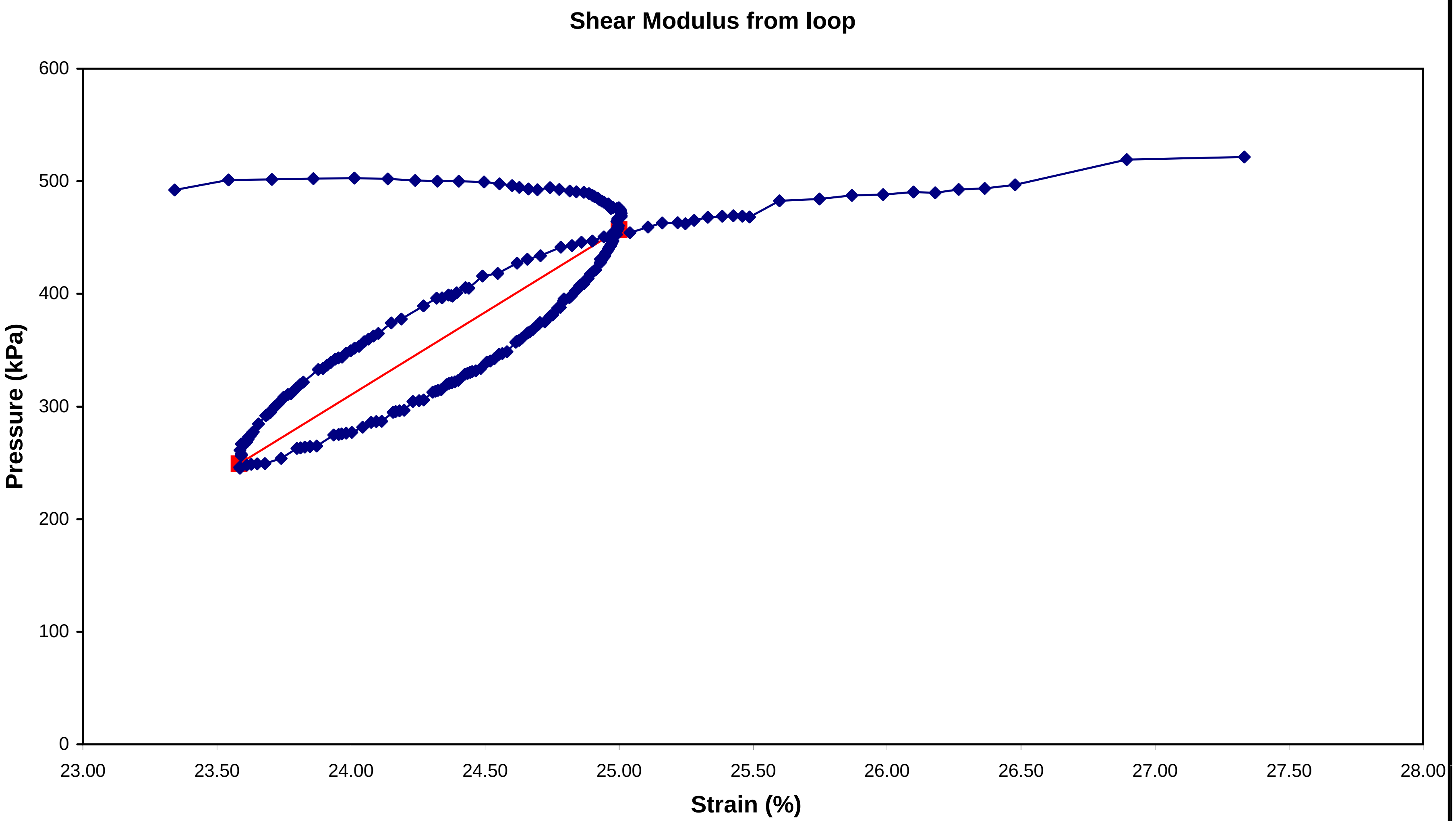
Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure DPM cpt_20 T1

Shear Modulus from loop



Borehole Number	**cpt_20**
Test Number	**1**
Depth(m)	**4.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**01 April 2009**

Calculating Shear Modulus

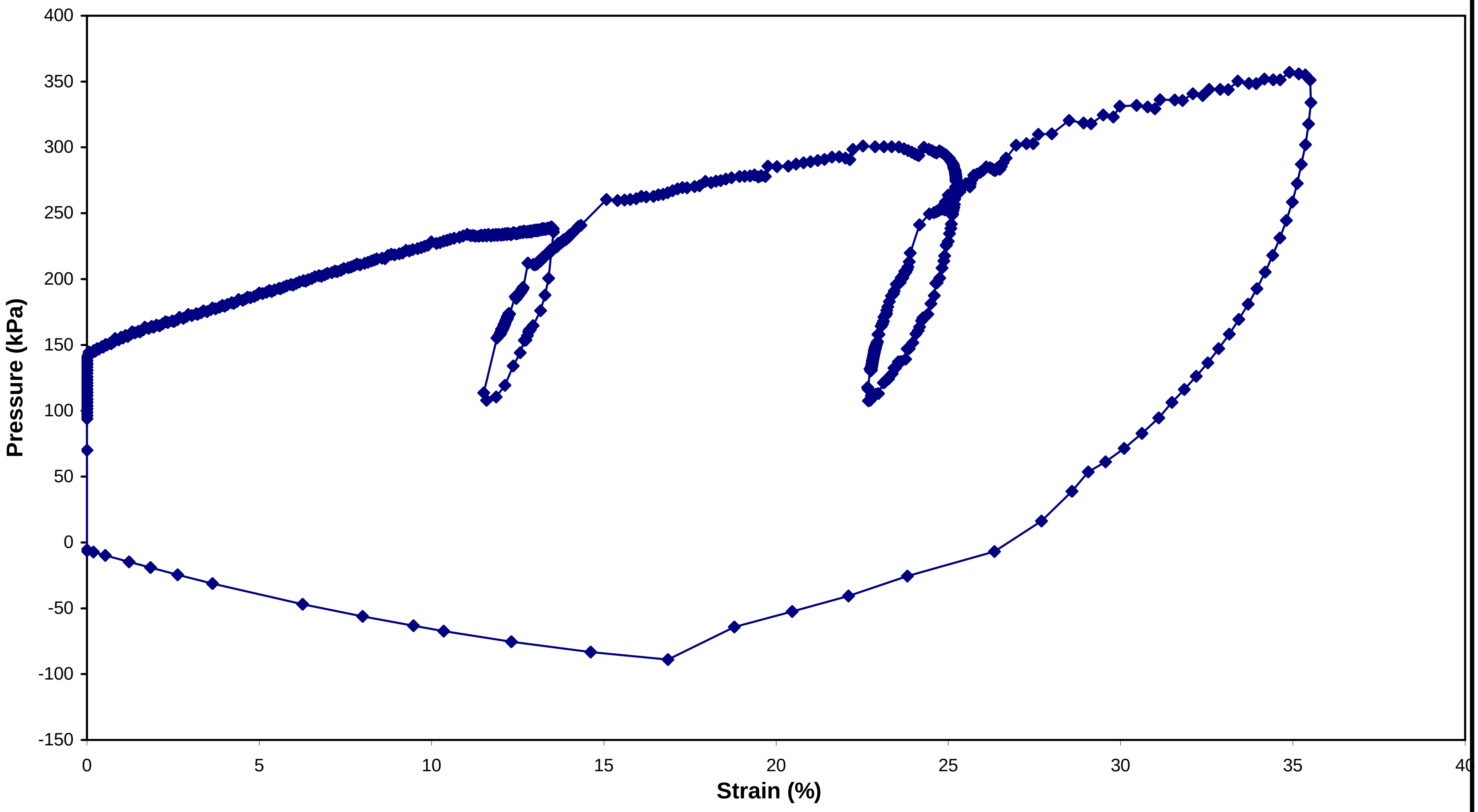
Loop 2	
δε	dp
23.58	249
25.00	457
1.42 %	208 kPa

Unload reload modulus, Gur **7.3** **MPa**

x
strain

GEOCONE

Driven Pressuremeter Test Results



Borehole Number	**cpt_20**
Test Number	**2**
Depth(m)	**7.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**01 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure
DPM cpt_20 T2

GEOCONE

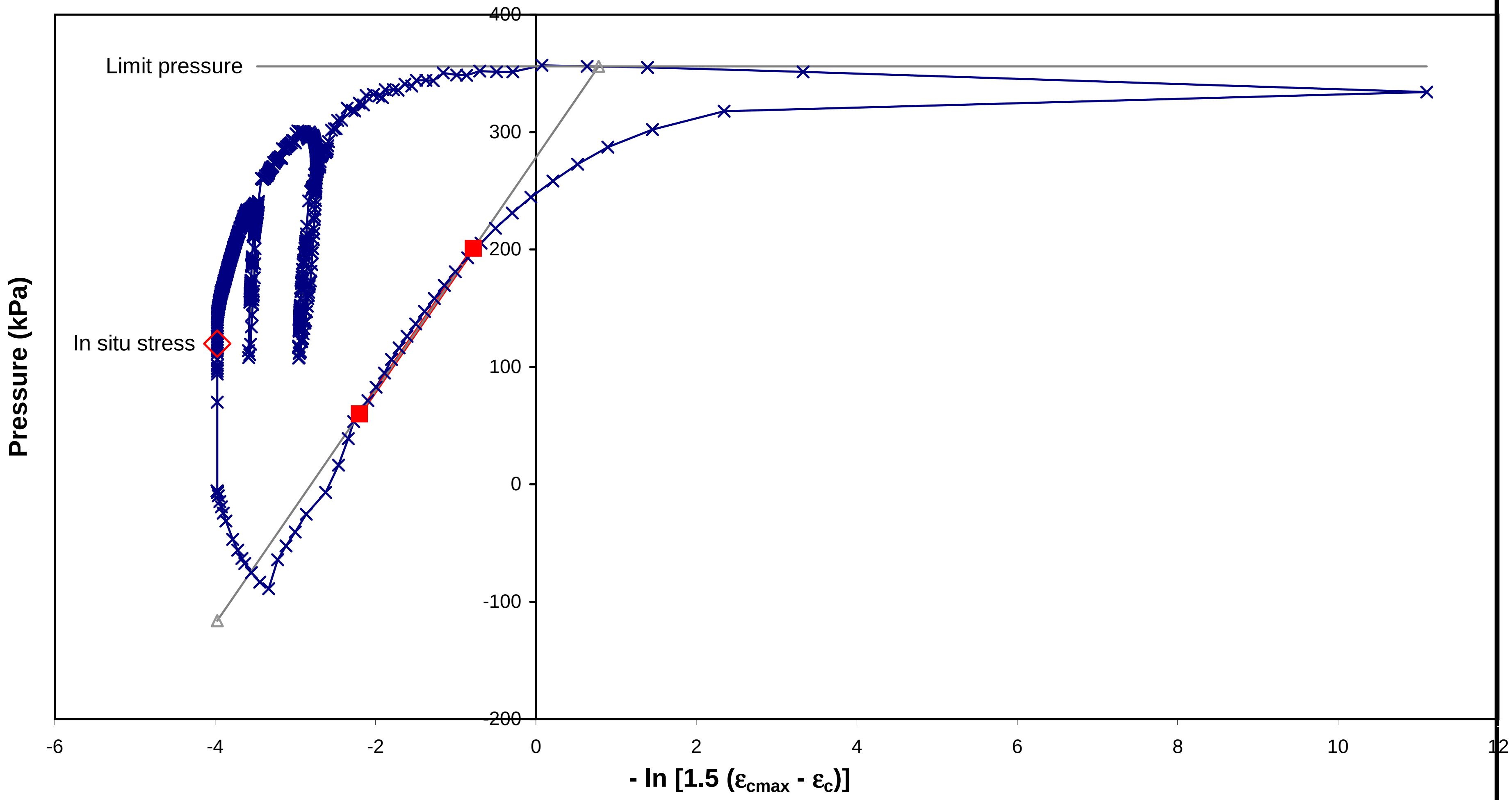
Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Figure: DPM cpt_20 T2

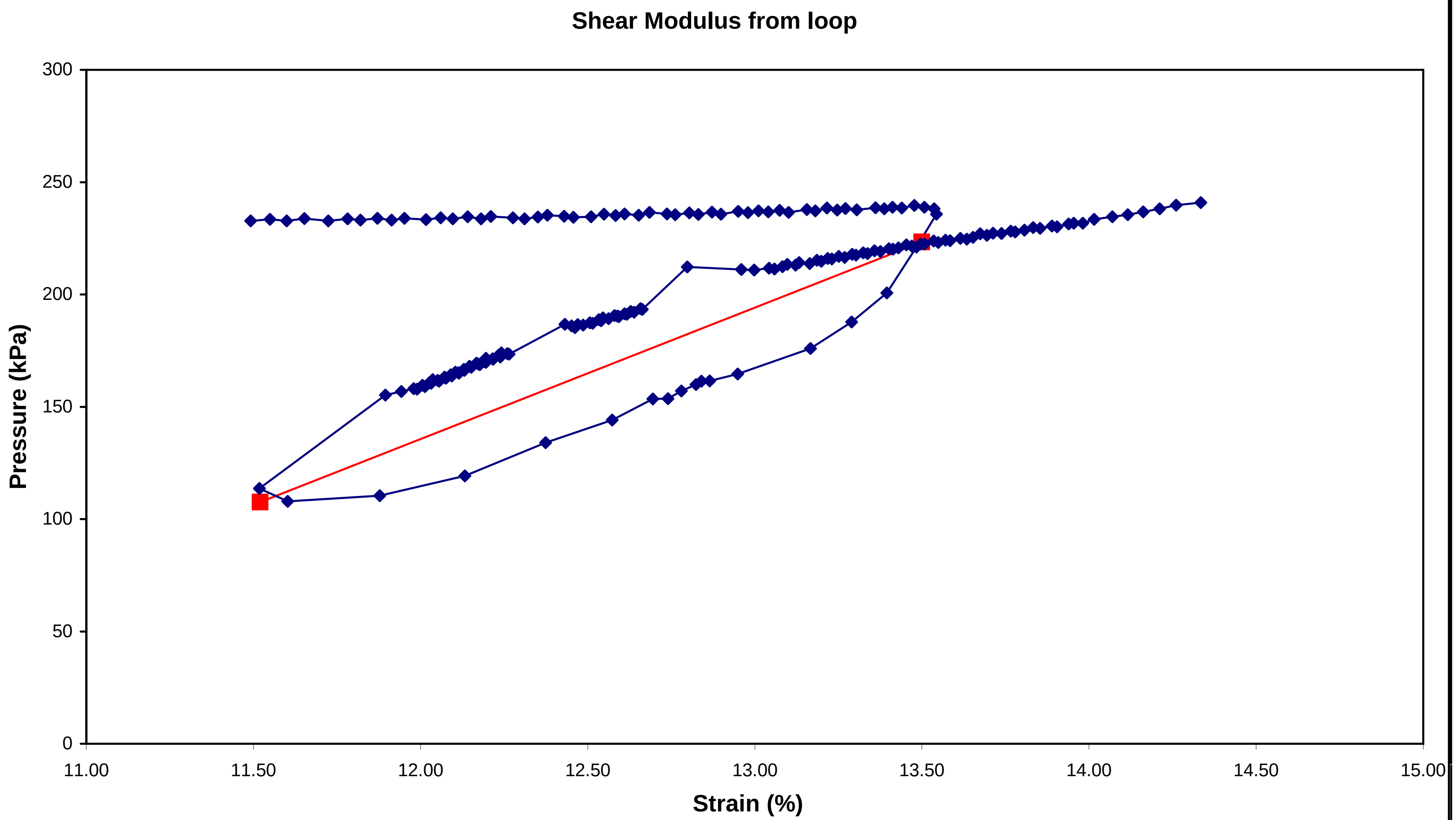
Shear strength analysis



Borehole Number	cpt_20
Test Number	2
Depth(m)	7.50
Installation Method	CPT
Operator	Th Db
Test Date	01 April 2009

Shear strength analysis	
δε	δπ
−0.78	201
−2.2	60
Gradient	99.30
Su (kPa)	**50**

In situ stress analysis	
δε	P
-3.98	-116.31
0.78	356.00
σm (kPa)	**120**



Borehole Number	**cpt_20**
Test Number	**2**
Depth(m)	**7.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**01 April 2009**

Calculating Shear Modulus

Loop 1	
$\delta\varepsilon$	dp
11.52	108
13.50	223.4
1.98 %	116 kPa

Unload reload modulus, Gur **2.9** **MPa**

x
strain

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

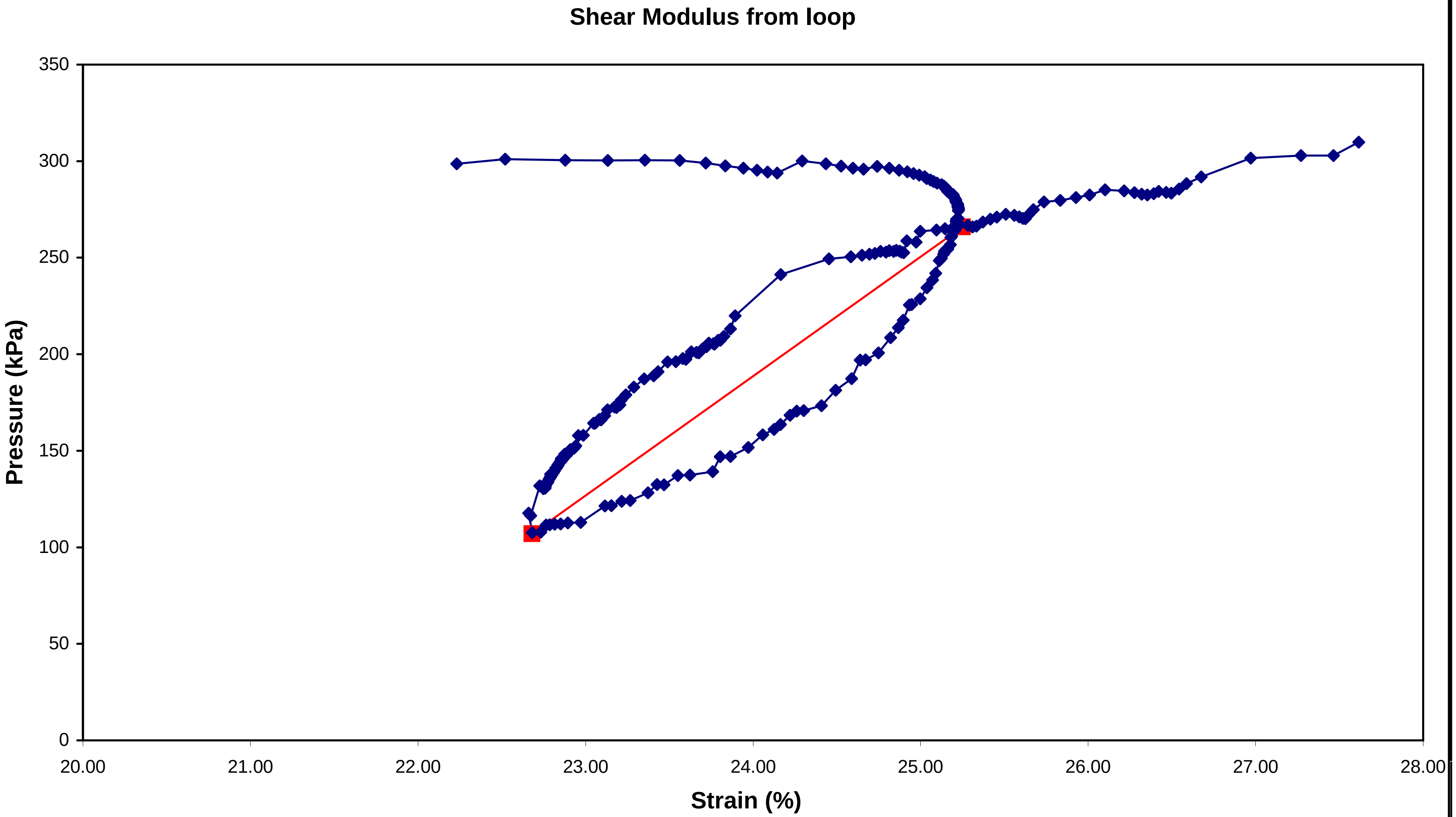
Figure
DPM cpt_20 T2

GEOCONE

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction



x
strain

Borehole Number	**cpt_20**
Test Number	**2**
Depth(m)	**7.50**
Installation Method	**CPT**
Operator	**Th Db**
Test Date	**01 April 2009**

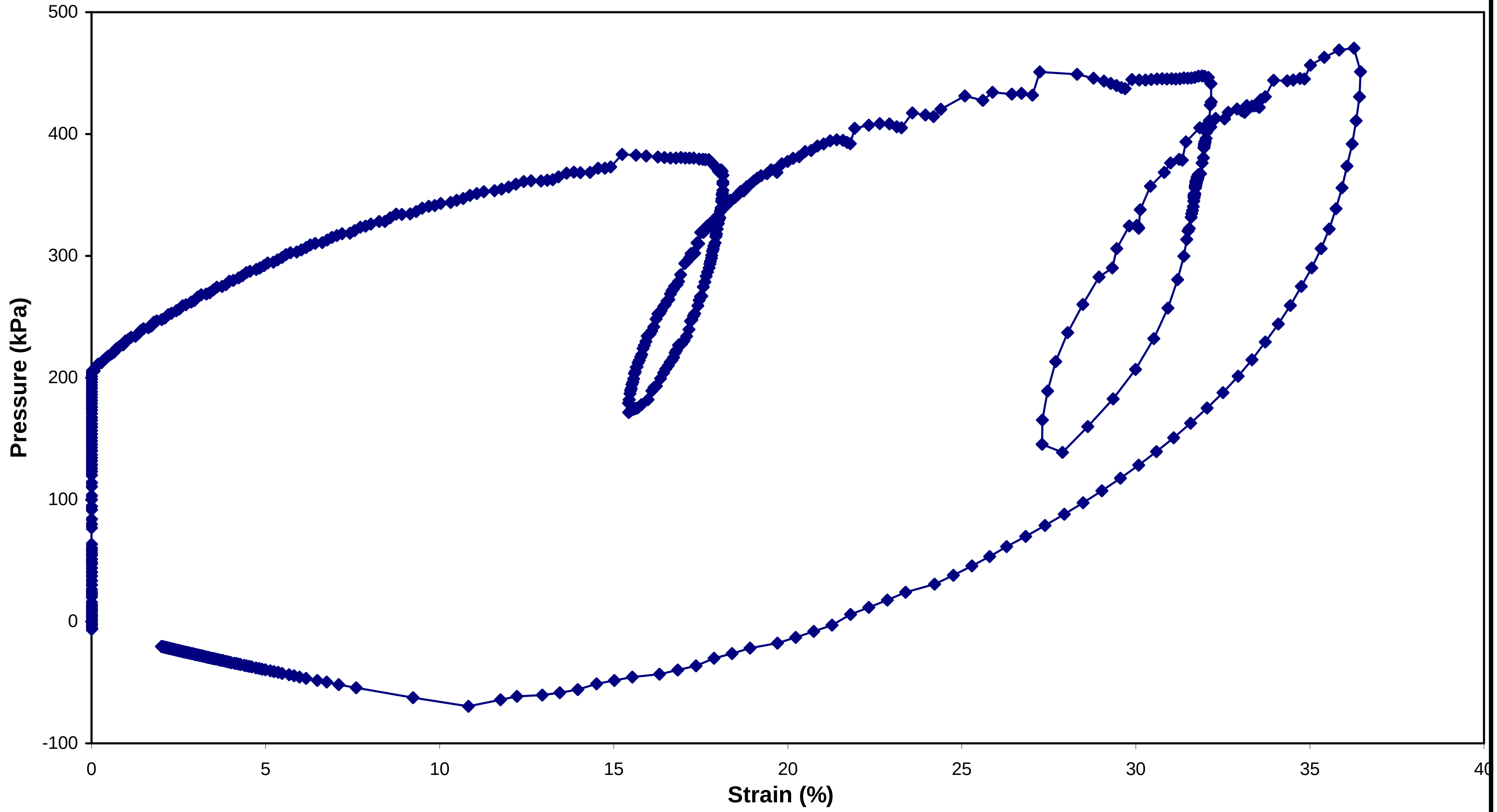
Calculating Shear Modulus

Loop 2	
δε	dp
22.68	107
25.25	266
2.57 %	159 kPa

Unload reload modulus, Gur **3.1** **MPa**

Figure
DPM cpt_20 T2

Driven Pressuremeter Test Results



Borehole Number	**cpt_22**
Test Number	**1**
Depth(m)	**3.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

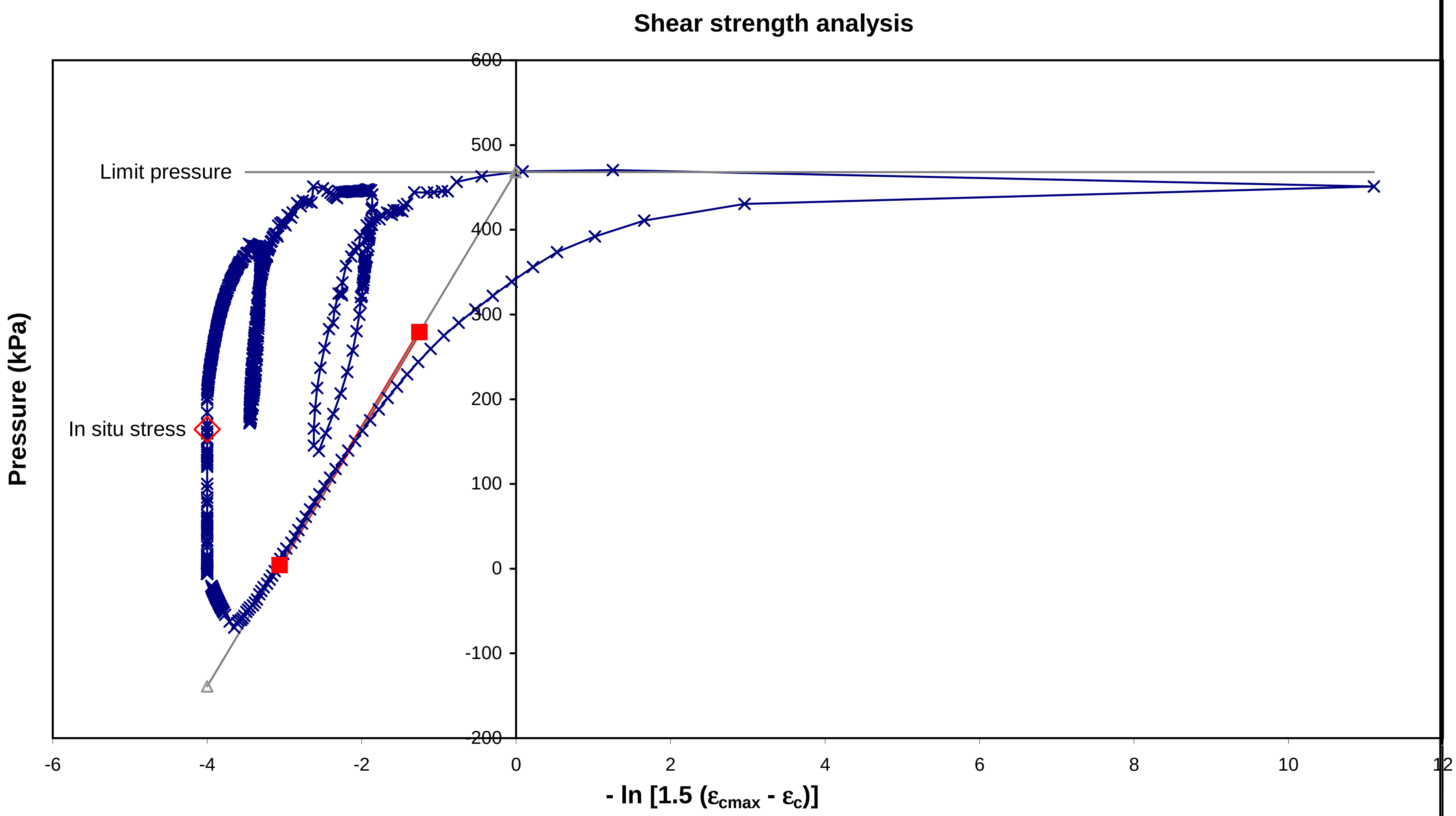
Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_22 T1

Driven Pressuremeter Test Results



Borehole Number	**cpt_22**
Test Number	**1**
Depth(m)	**3.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

Shear strength analysis	
δε	δπ
−1.25	279
−3.06	4
Gradient	151.93
Su (kPa)	**76**

In situ stress analysis	
δε	P
-4.00	-139.05
-0.01	468.00
σm (kPa)	**164**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Figure
DPM cpt_22 T1

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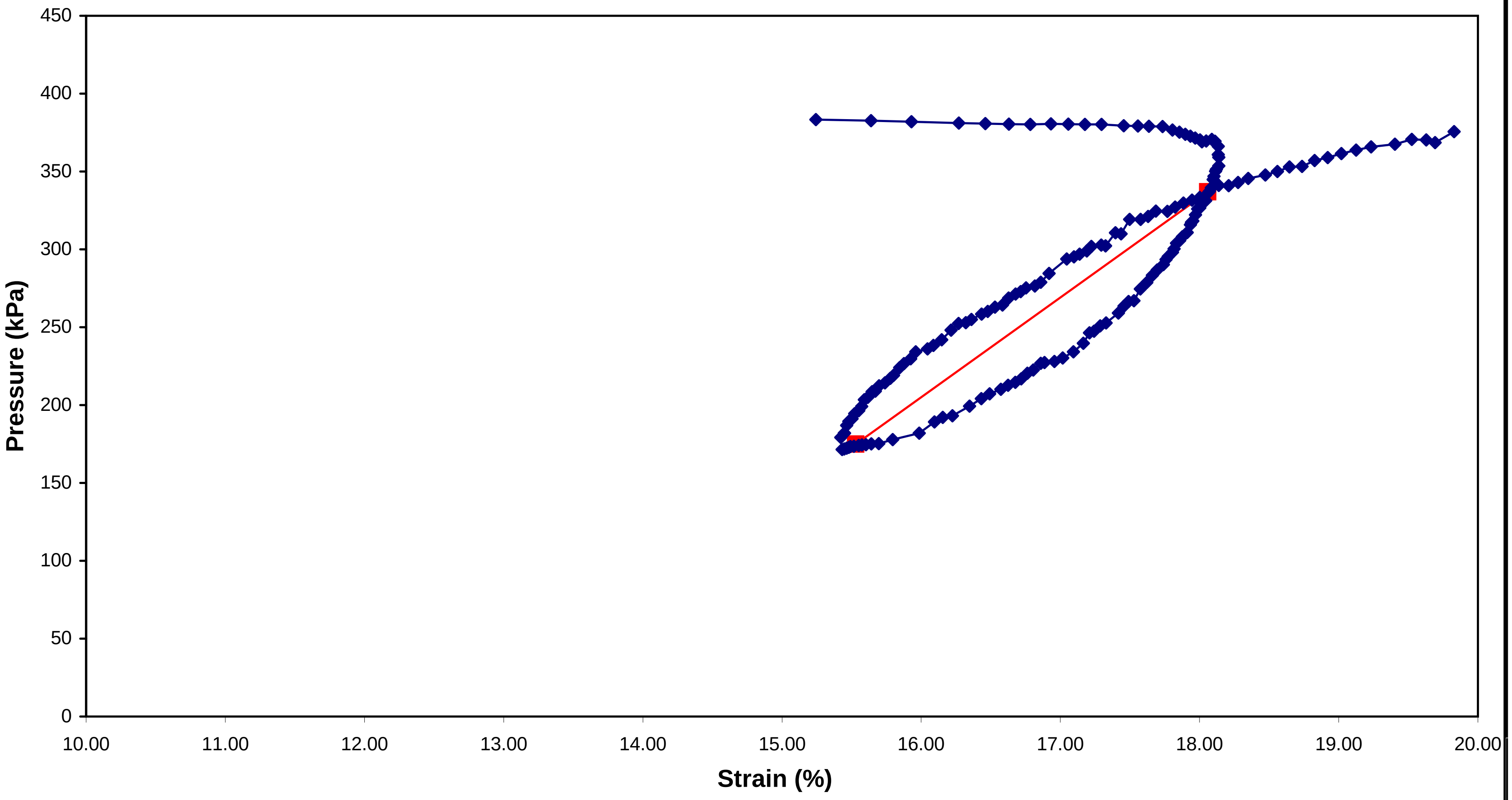
Driven Pressuremeter Test Results

Shear Modulus from loop



x
strain

Borehole Number	**cpt_22**
Test Number	**1**
Depth(m)	**3.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

Calculating Shear Modulus

Loop 1	
δε	dp
15.53	175
18.06	337
2.53 %	162 kPa

Unload reload modulus, Gur **3.2** **MPa**

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

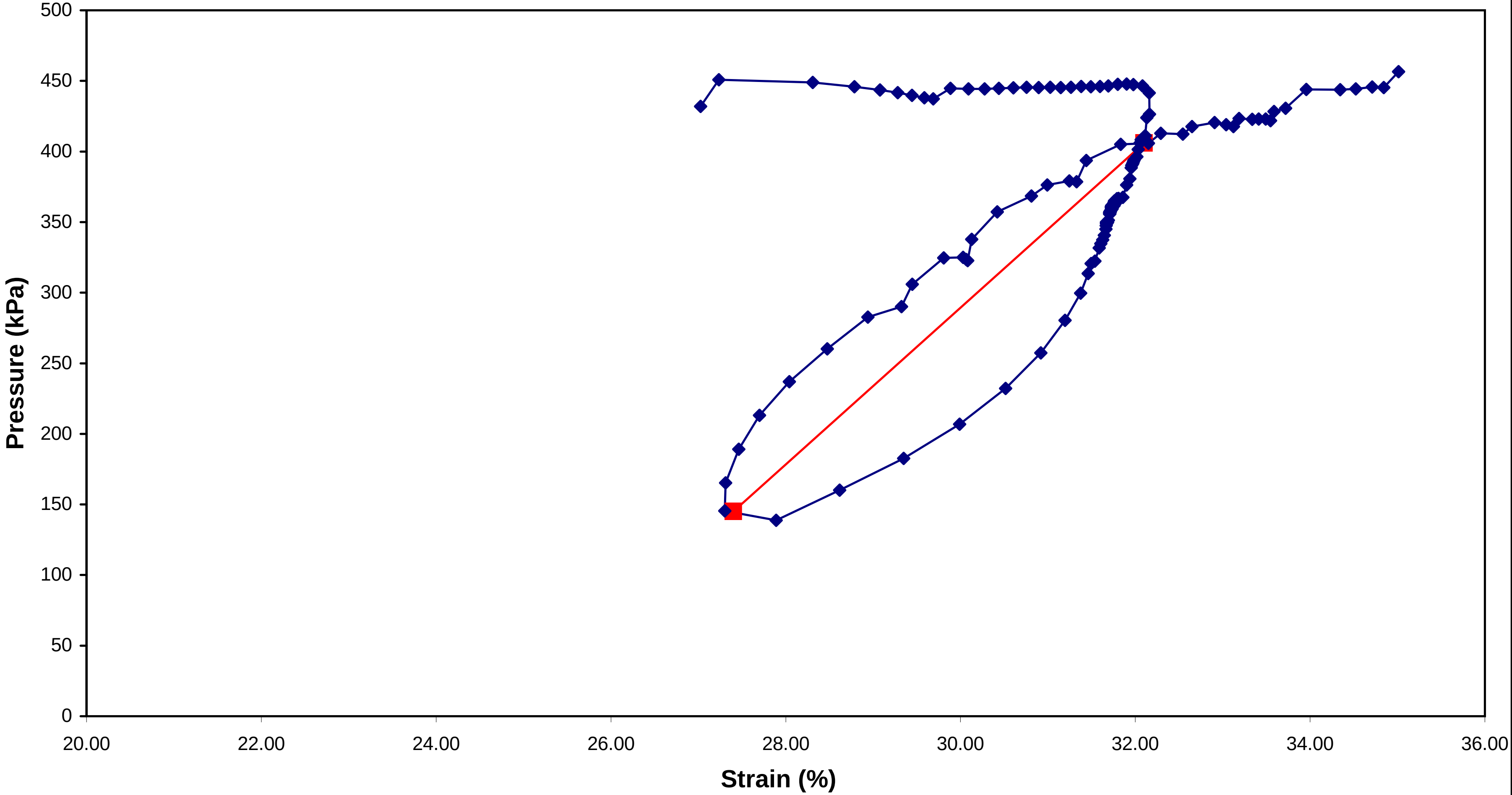
Figure
DPM cpt_22 T1

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Shear Modulus from loop



x
strain

Borehole Number	**cpt_22**
Test Number	**1**
Depth(m)	**3.50**
Installation Method	**CPT**
Operator	**TH DB**
Test Date	**09 April 2009**

Calculating Shear Modulus

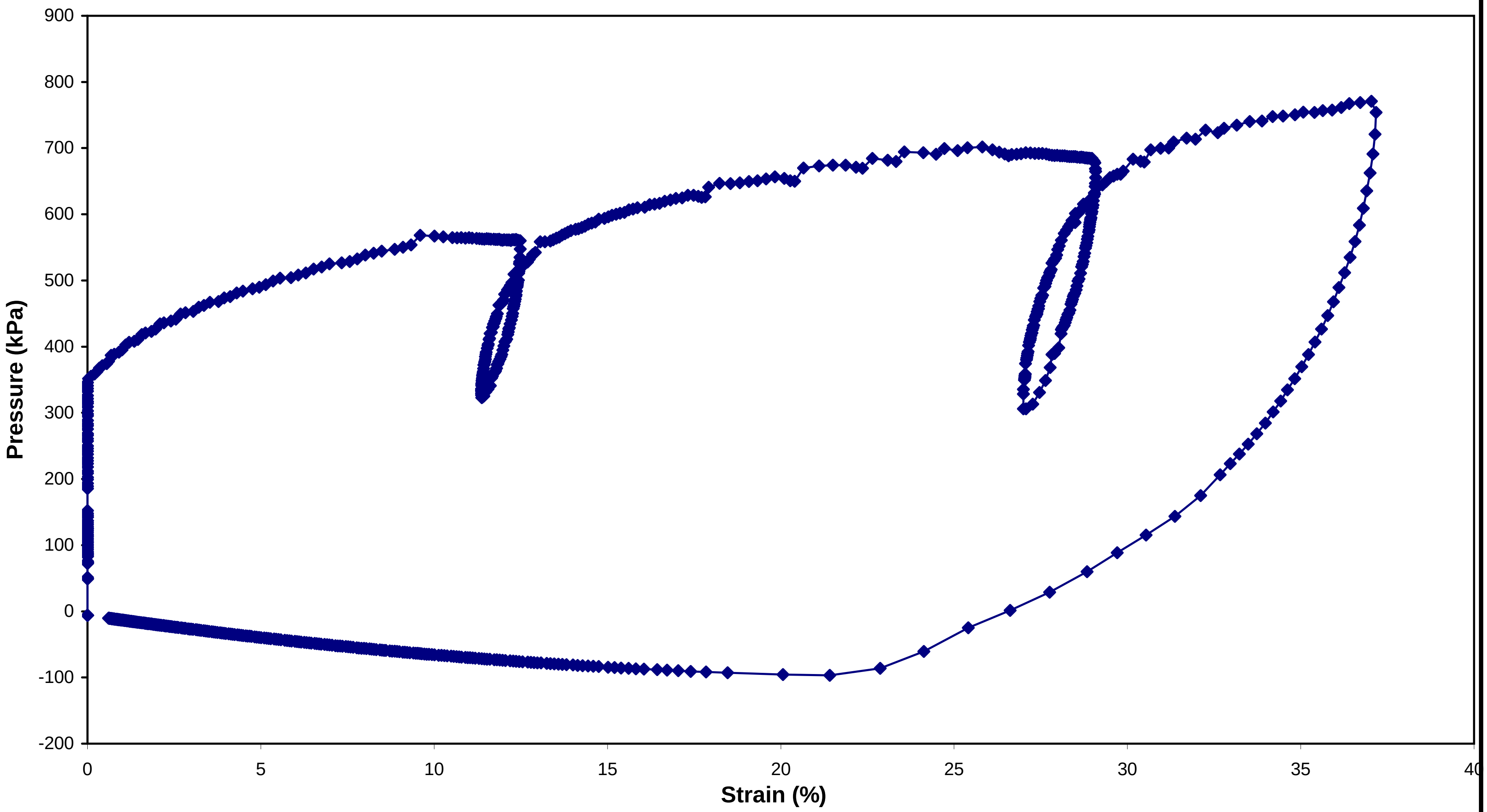
Loop 2	
δε	dp
27.40	145
32.10	406
4.70 %	261 kPa

Unload reload modulus, Gur **2.8** **MPa**

GEOCONE

Figure **DPM cpt_22 T1**

Driven Pressuremeter Test Results



Borehole Number	**cpt_22**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th DB**
Test Date	**09 April 2009**

Remarks

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2

Project No. M9015

Carried out for Morrison Construction

Figure

DPM cpt_22 T2

GEOCONE

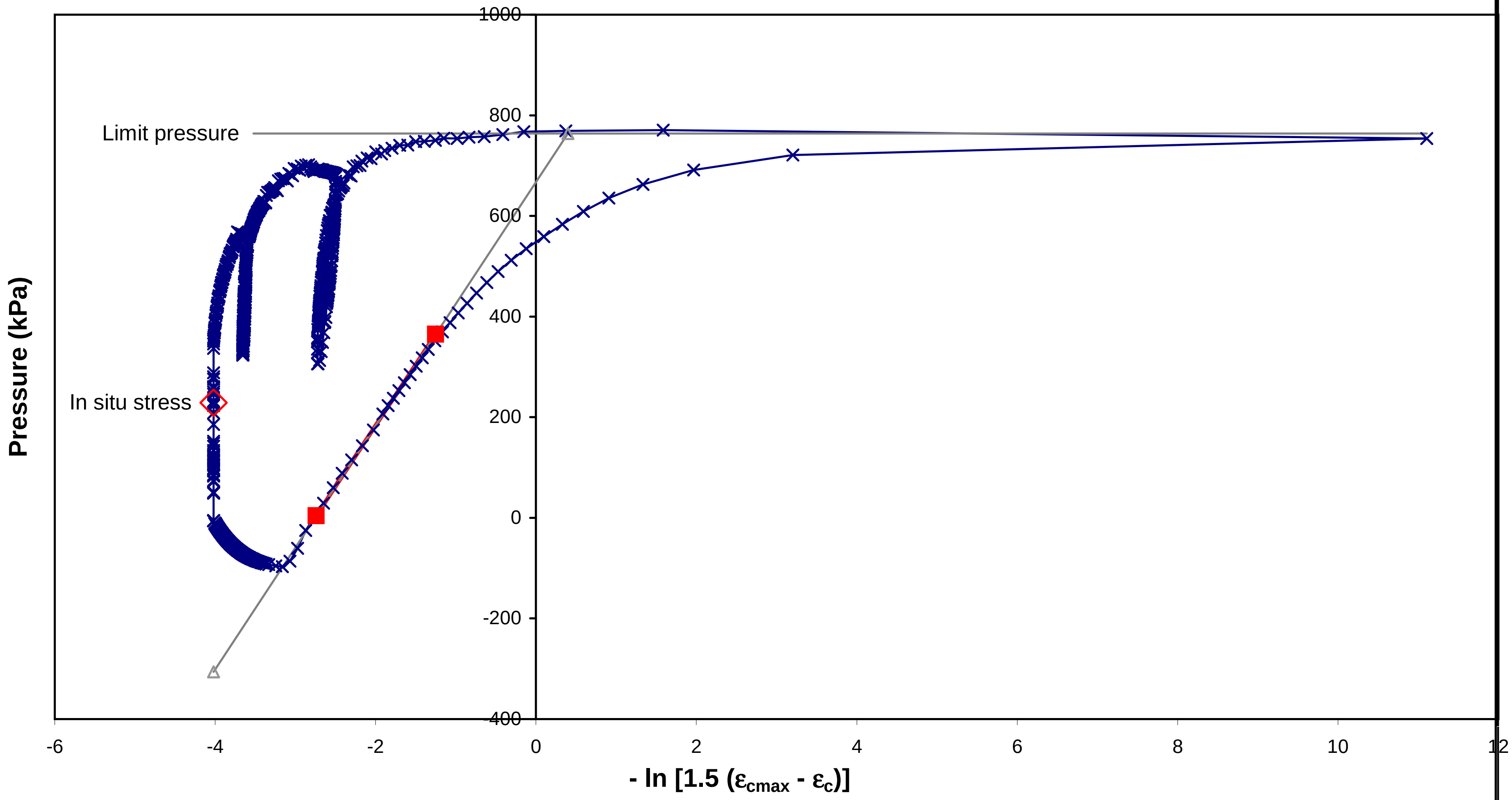
Driven Pressuremeter Test Results

Notes:

Project: TWEEN BRIDGE WIND FARM, PHASE 2
Project No.: M9015
Carried out for: Morrison Construction

Figure: **DPM cpt_22 T2**

Shear strength analysis



Borehole Number	**cpt_22**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th DB**
Test Date	**09 April 2009**

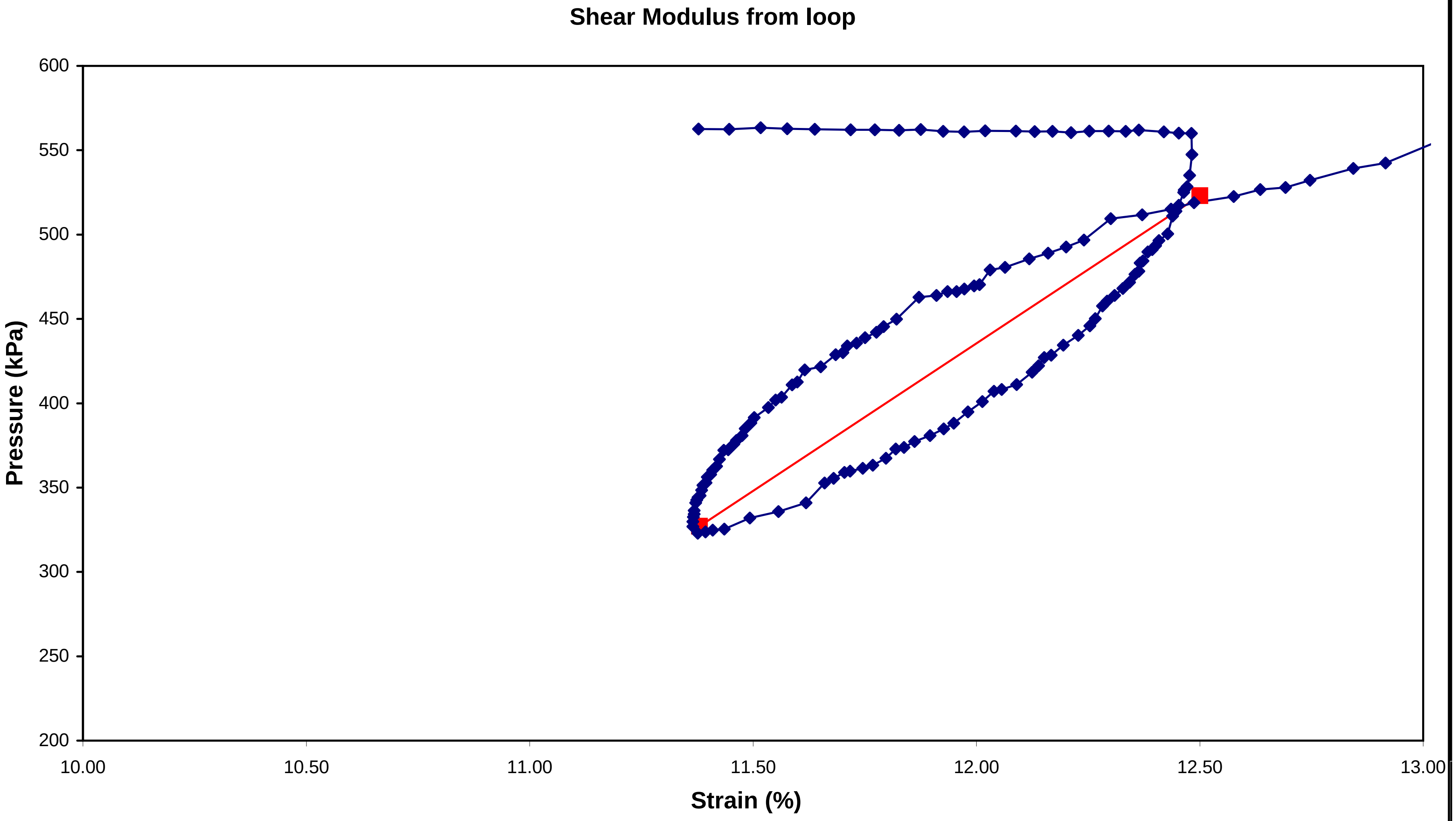
Shear strength analysis	
$\delta\varepsilon$	$\delta\pi$
−1.25	365
−2.74	4
Gradient	242.28
Su (kPa)	**121**

In situ stress analysis	
$\delta\varepsilon$	P
-4.02	-306.38
0.40	764.00
σm (kPa)	**229**

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction



x
strain

Borehole Number	**cpt_22**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th DB**
Test Date	**09 April 2009**

Calculating Shear Modulus

Loop 1	
δε	dp
11.38	327
12.50	523
1.12 %	196 kPa

Unload reload modulus, Gur **8.8** **MPa**

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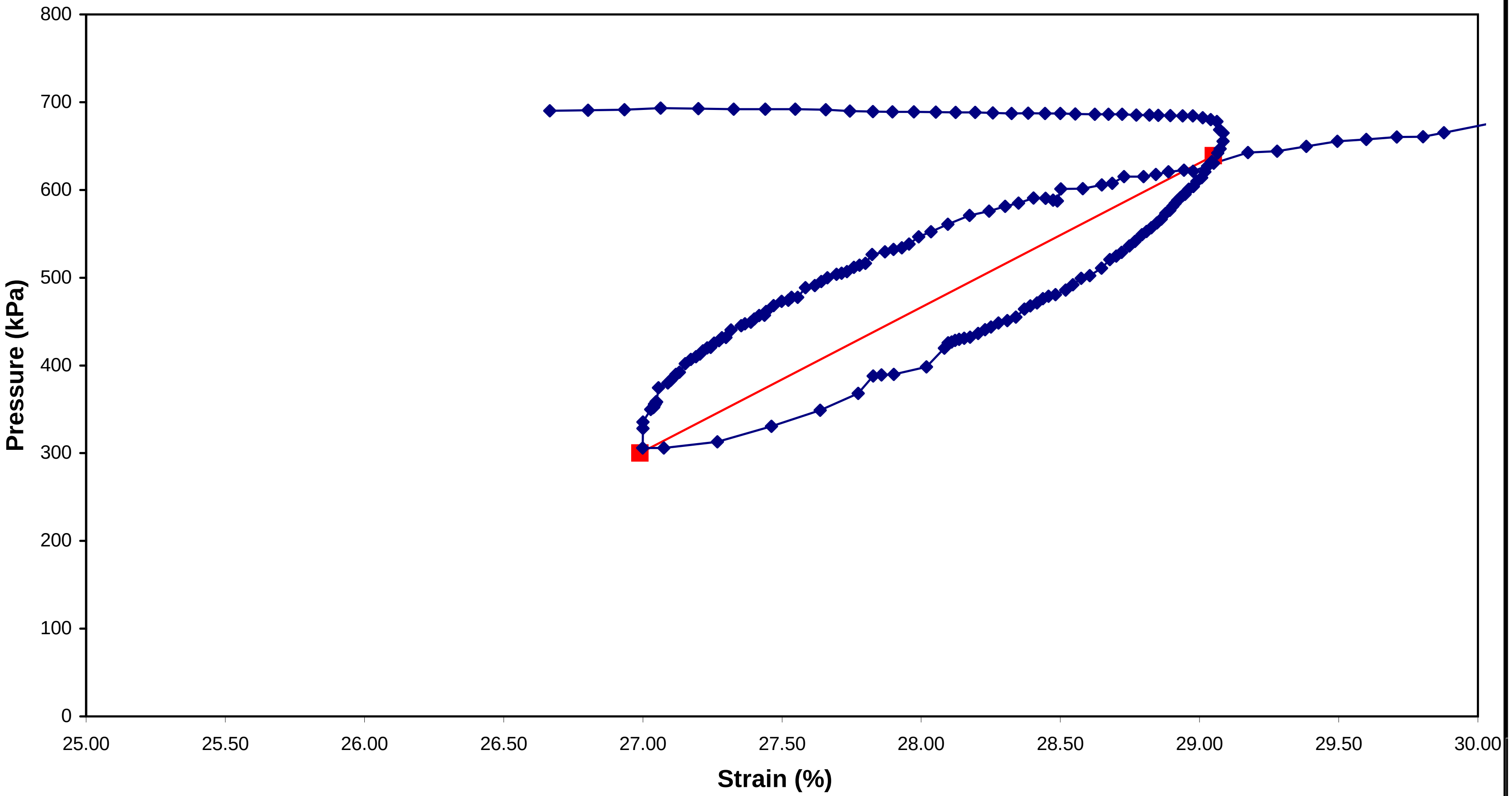
Figure
DPM cpt_22 T2

Driven Pressuremeter Test Results

Notes:

Project TWEEN BRIDGE WIND FARM, PHASE 2
Project No. M9015
Carried out for Morrison Construction

Shear Modulus from loop



x
strain

Borehole Number	**cpt_22**
Test Number	**2**
Depth(m)	**5.50**
Installation Method	**CPT**
Operator	**Th DB**
Test Date	**09 April 2009**

Calculating Shear Modulus

Loop 2	
δε	dp
26.99	300
29.05	639
2.06 %	339 kPa

Unload reload modulus, Gur **8.2** **MPa**

Figure

DPM cpt_22 T2

Soil Mechanics

CERTIFICATE OF TEST

UKAS TESTING
4330

Authorised signatories:

D. Swindells–Operations Manager[ ]
S. Grayson–Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

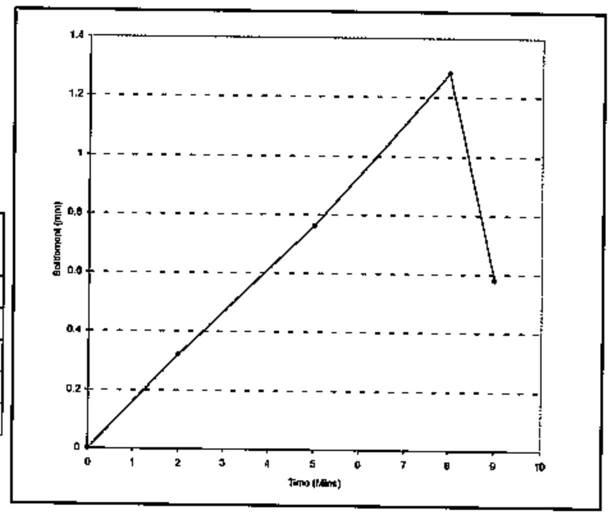
Date 08/04/2009
Report Ref: 09FW0331

Lab Ref No.	**09FW0331.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**1**	Client Reference	**1**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Orangish brown sandy SILT**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**29.8**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
30	2	0.32
60	5	0.76
90	8	1.28
0	9	0.58



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.28	**54.7**	**3.8**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

Client Name	**Soil Mechanics** **Askern Road** **Carcroft** **Doncaster** **South Yorkshire** **DN5 8DG**
FAO	**Paul McMann**

Issuing laboratory:
Soil Mechanics

Unit 11b, Provincial Park
Nether Lane
Ecclesfield
Sheffield, S35 9ZX
Tel: 0114 240 1901
Fax: 0114 240 1744

Authorised By:

Soil Mechanics

CERTIFICATE OF TEST

UKAS TESTING 4330

Authorised signatories:

D. Swindells–Operations Manager[ ]
S. Grayson–Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

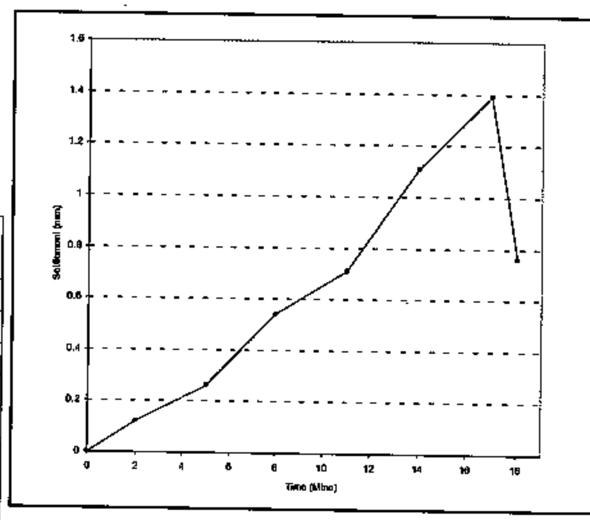
Date 08/04/2009
Report Ref: 09FW0332

Lab Ref No.	09FW0332.1	Date Tested	01/04/2009
Scheme / Site	Causeway Farm, Thorne		
Test Location	2	Client Reference	2
Technician	GB	Weather	Overcast
Soil Description	Dark brown slightly sandy CLAY		

TEST RESULTS

Depth of Test (mm)	400
Distance from excavation wall (mm)	100
Reaction Load Used	JCB
Plate Size (mm)	300
Test Method	Incremental
Moisture Content (%) (If Requested)	26.9

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.12
30	5	0.26
45	8	0.54
60	11	0.71
75	14	1.11
90	17	1.39
0	18	0.76



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.39	45.3	3.3

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

Client Name

Soil Mechanics
Askern Road
Carcroft
Doncaster
South Yorkshire
DN5 8DG

FAO **Paul McMann**

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Authorised By:

Soil Mechanics

CERTIFICATE OF TEST

UKAS TESTING
4330

Authorised signatories:

D. Swindells–Operations Manager[✓]
S. Grayson–Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

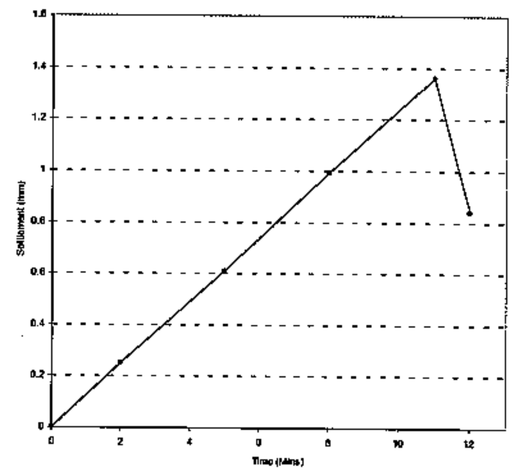
Date 08/04/2009
Report Ref: 09FW0333

Lab Ref No.	**09FW0333.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**3**	Client Reference	**3**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**32.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
20	2	0.25
40	5	0.61
60	8	0.99
80	11	1.36
0	12	0.84



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.36	**38.2**	**2.7**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

Issuing laboratory:
Soil Mechanics

Unit 11b, Provincial Park
Nether Lane
Ecclesfield
Sheffield, S35 9ZX
Tel: 0114 240 1901
Fax: 0114 240 1744

Client Name	**Soil Mechanics** **Askern Road** **Carcroft** **Doncaster** **South Yorkshire** **DN5 8DG**
FAO	**Paul McMann**

Authorised By: DM

Soil Mechanics

CERTIFICATE OF TEST

UKAS TESTING
4330

Authorised signatories:

D. Swindells–Operations Manager[✓]
S. Grayson–Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

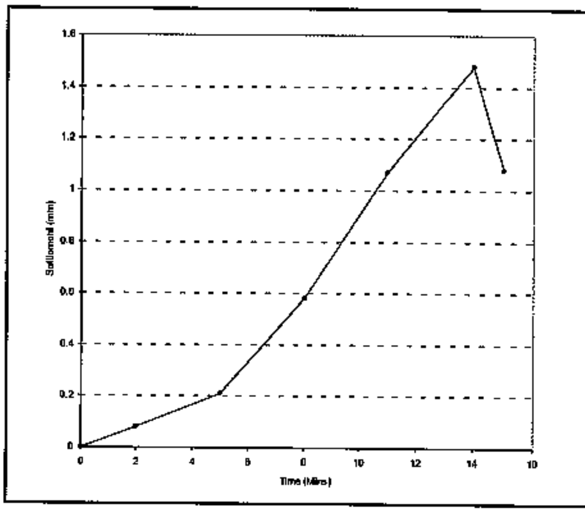
Date 08/04/2009
Report Ref: 09FW0334

Lab Ref No.	**09FW0334.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location		Client Reference	**4**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**31.0**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.08
30	5	0.21
45	8	0.58
60	11	1.07
75	14	1.48
0	15	1.08



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.48	**27.0**	**2.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

Client Name **Soil Mechanics**
Askern Road
Carcroft
Doncaster
South Yorkshire
DN5 8DG

FAO **Paul McMann**

Issuing laboratory:
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Unit 11b, Provincial Park
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Tel: 0114 240 1901
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Authorised By:

Soil Mechanics

CERTIFICATE OF TEST

4330

Authorised signatories:

D. Swindells–Operations Manager[✓]
S. Grayson–Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

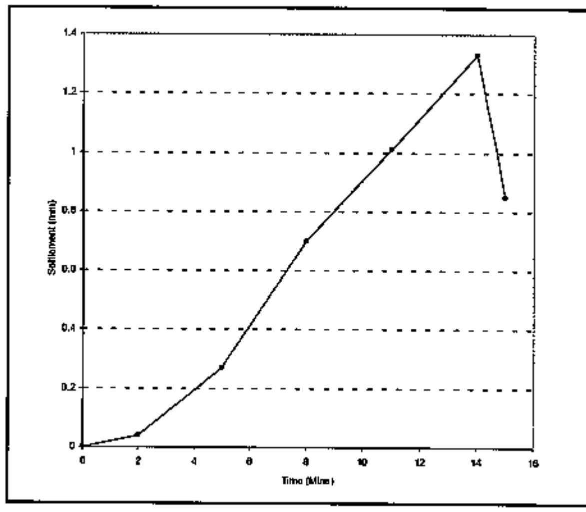
Date 08/04/2009
Report Ref: 09FW0335

Lab Ref No.	**09FW0335.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**5**	Client Reference	**5**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Brown/orange slightly sandy SILT**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**17.6**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.04
30	5	0.27
45	8	0.70
60	11	1.01
75	14	1.33
0	15	0.85



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.33	**36.1**	**2.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

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UKAS TESTING 4330

CERTIFICATE OF TEST

Authorised signatories:

D. Swindells–Operations Manager[✓]
S. Grayson–Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

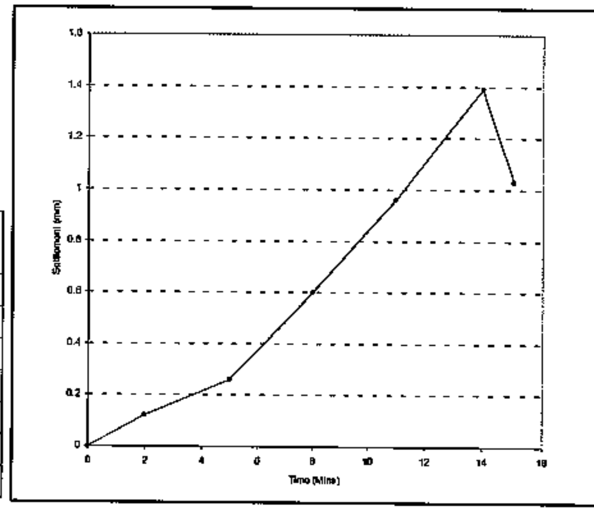
Date 08/04/2009
Report Ref: 09FW0336

Lab Ref No.	**09FW0336.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**6**	Client Reference	**6**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Brown/orange slightly sandy SILT**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**22.1**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.12
30	5	0.26
45	8	0.60
60	11	0.96
75	14	1.39
0	15	1.03



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.39	**25.9**	**2.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

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S. Grayson–Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

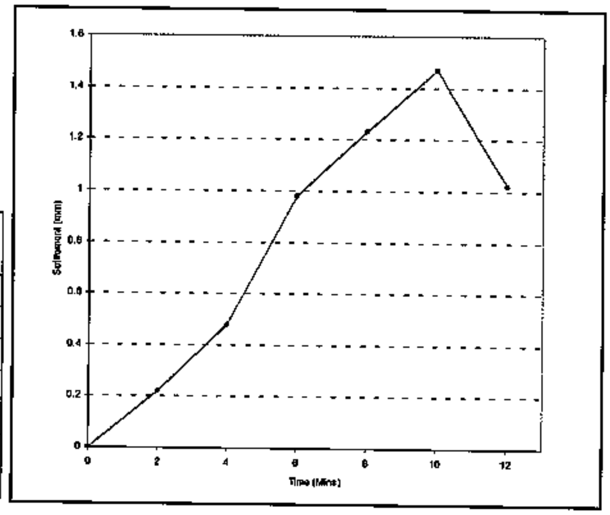
Date 07/04/2009
Report Ref: 09FW0338

Lab Ref No.	**09FW0338.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**7**	Client Reference	**CBR 7**
Technician	**JF**	Weather	**Dry**
Soil Description	**Brown slightly silty sandy CLAY with streak inclusions**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**19.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.22
20	4	0.48
30	6	0.98
40	8	1.23
50	10	1.47
0	12	1.02



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.47	**30.6**	**1.0**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

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Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

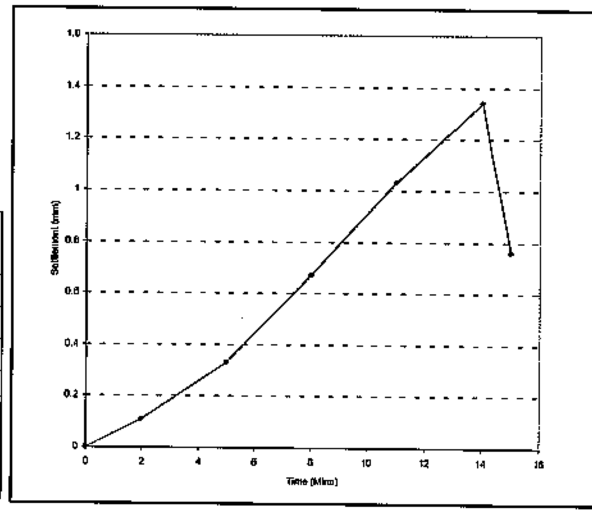
Date 08/04/2009
Report Ref: 09FW0346

Lab Ref No.	**09FW0346.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**8**	Client Reference	**8**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Orangish brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**20.8**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.11
30	5	0.33
45	8	0.67
60	11	1.03
75	14	1.34
0	15	0.76



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.34	**43.3**	**2.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

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S. Grayson–Lab Team Leader[✓]

Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

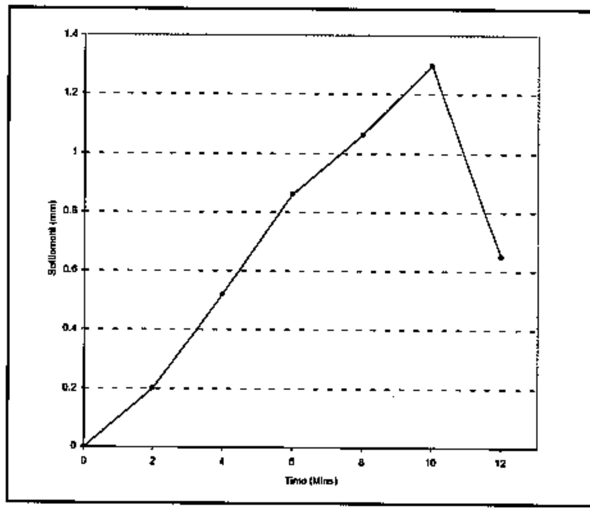
Date 07/04/2009
Report Ref: 09FW0339

Lab Ref No.	**09FW0339.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**9**	Client Reference	**CBR 9**
Technician	**JF**	Weather	**Dry**
Soil Description	**Brown slightly silty sandy CLAY with streak inclusions**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**19.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.20
20	4	0.52
30	6	0.86
40	8	1.06
50	10	1.30
0	12	0.65



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.30	**50.0**	**1.3**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

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Authorised signatories:

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Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

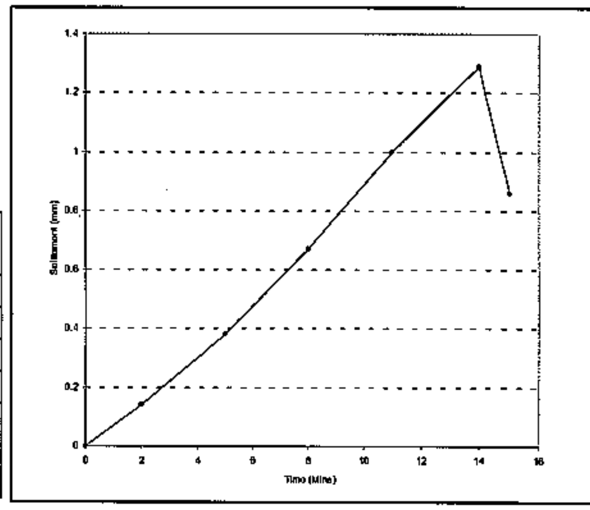
Date 08/04/2009
Report Ref: 09FW0337

Lab Ref No.	**09FW0337.1**	Date Tested	**01/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**10**	Client Reference	**10**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Brown/orange slightly sandy SILT**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**24.6**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.14
30	5	0.38
45	8	0.67
60	11	1.00
75	14	1.29
0	15	0.86



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.29	**33.3**	**2.6**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

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Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

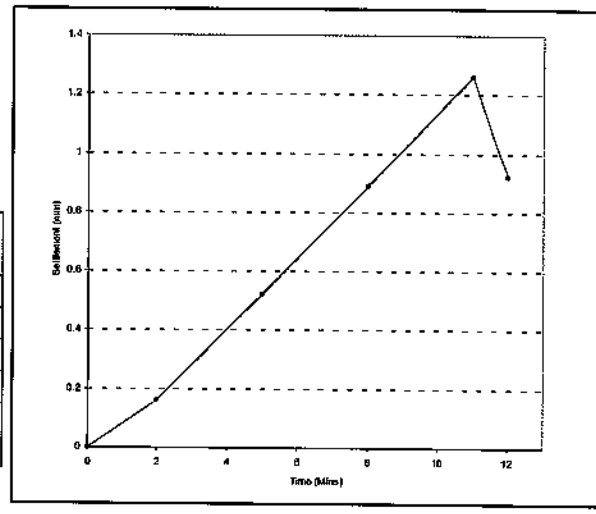
Page 1 of 1
Date 08/04/2009
Report Ref: 09FW0347

Lab Ref No.	**09FW0347.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**11**	Client Reference	**11**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Orangish Brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**21.7**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.16
30	5	0.52
45	8	0.89
60	11	1.26
0	12	0.92



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.26	**27.0**	**1.9**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

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Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

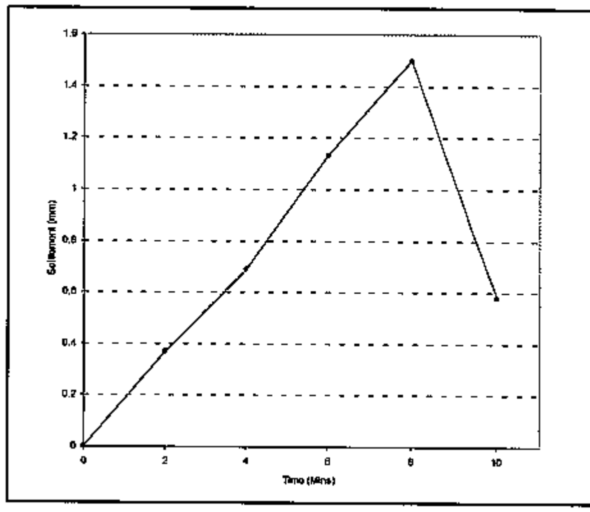
Page 1 of 1
Date 07/04/2009
Report Ref: 09FW0340

Lab Ref No.	**09FW0340.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**12**	Client Reference	**CBR 12**
Technician	**JF**	Weather	**Dry**
Soil Description	**Dark brown sandy CLAY with rootlets**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**35.9**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.37
20	4	0.69
30	6	1.13
40	8	1.50
0	10	0.58



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.50	**61.3**	**1.1**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

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CERTIFICATE OF TEST

Authorised signatories:

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S. Grayson–Lab Team Leader[✓]

Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

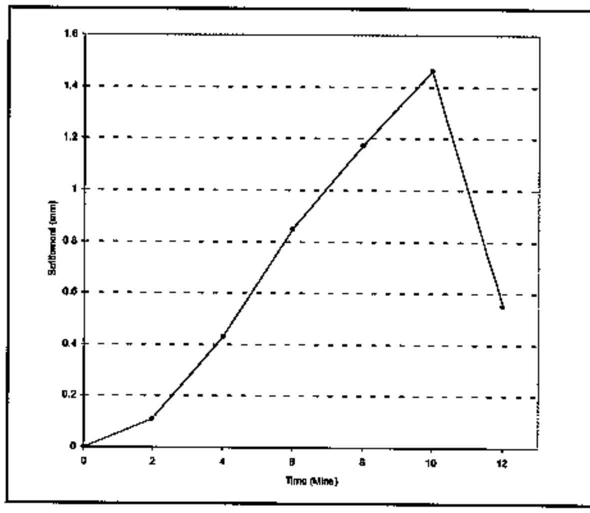
Date 07/04/2009
Report Ref: 09FW0341

Lab Ref No.	**09FW0341.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**13**	Client Reference	**CBR 13**
Technician	**JF**	Weather	**Dry**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**345.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.11
20	4	0.43
30	6	0.85
40	8	1.17
50	10	1.46
0	12	0.55



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.46	**62.3**	**1.0**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

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Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

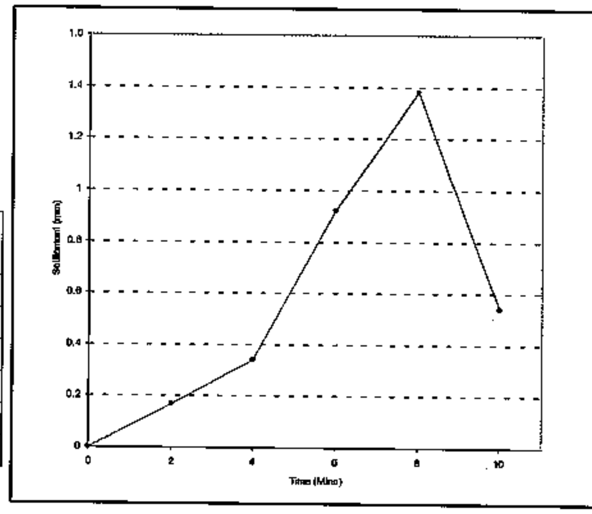
Date 07/04/2009
Report Ref: 09FW0342

Lab Ref No.	09FW0342.1	Date Tested	02/04/2009
Scheme / Site	Causeway Farm, Thorne		
Test Location	14	Client Reference	CBR 14
Technician	JF	Weather	Dry
Soil Description	Light brown slightly silty SAND with rootlets		

TEST RESULTS

Depth of Test (mm)	400
Distance from excavation wall (mm)	1000
Reaction Load Used	JCB
Plate Size (mm)	300
Test Method	Incremental
Moisture Content (%) (If Requested)	17.9

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.17
20	4	0.34
30	6	0.92
40	8	1.38
0	10	0.54



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.38	60.9	0.8

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

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Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

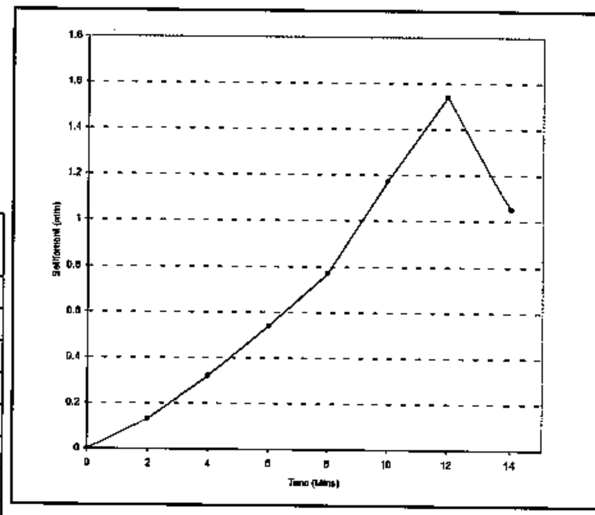
Date 07/04/2009
Report Ref: 09FW0343

Lab Ref No.	09FW0343.1	Date Tested	02/04/2009
Scheme / Site	Causeway Farm, Thorne		
Test Location	15	Client Reference	CBR 15
Technician	JF	Weather	Dry
Soil Description	Greyish brown sandy CLAY with fine gravel		

TEST RESULTS

Depth of Test (mm)	400
Distance from excavation wall (mm)	1000
Reaction Load Used	JCB
Plate Size (mm)	300
Test Method	Incremental
Moisture Content (%) (If Requested)	12.9

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.13
20	4	0.32
30	6	0.54
40	8	0.77
50	10	1.17
60	12	1.54
0	14	1.05



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.54	31.8	1.5

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

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Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

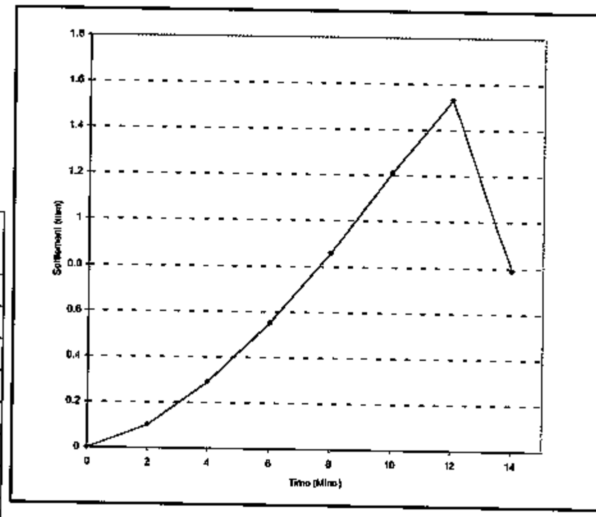
Date 07/04/2009
Report Ref: 09FW0344

Lab Ref No.	09FW0344.1	Date Tested	02/04/2009
Scheme / Site	Causeway Farm, Thorne		
Test Location	16	Client Reference	CBR 16
Technician	JF	Weather	Dry
Soil Description	Brown clayey SAND with rootlets		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**18.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.10
20	4	0.29
30	6	0.55
40	8	0.86
50	10	1.21
60	12	1.53
0	14	0.79



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.53	**48.4**	**1.4**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

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Vertical Deformation of Soil by Plate Load Test
BS 1377: Part 9: 1990

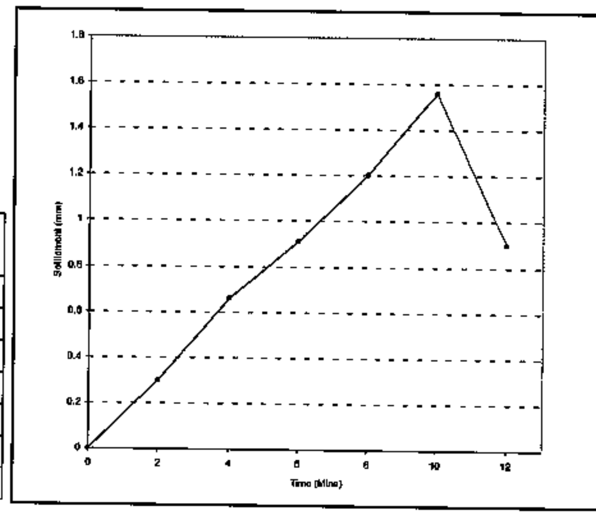
Date 07/04/2009
Report Ref: 09FW0345

Lab Ref No.	**09FW0345.1**	Date Tested	**02/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**17**	Client Reference	**CBR 17**
Technician	**JF**	Weather	**Dry**
Soil Description	**Greyish brown sandy CLAY with rootlets**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**1000**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**21.1**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
10	2	0.30
20	4	0.66
30	6	0.91
40	8	1.20
50	10	1.56
0	12	0.90



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.56	**42.3**	**1.0**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

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Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

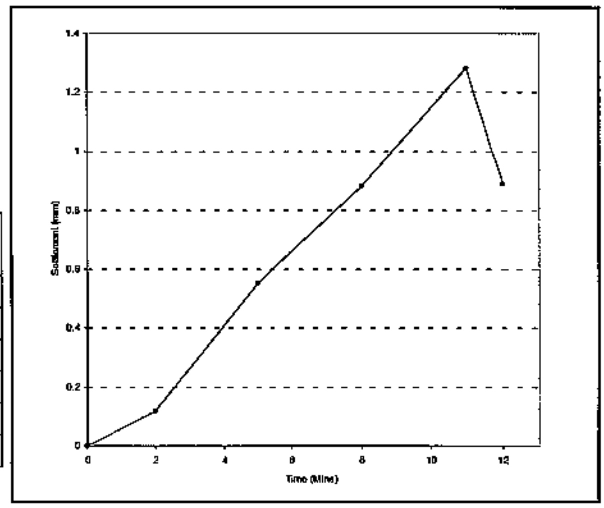
Date 08/04/2009
Report Ref: 09FW0348

Lab Ref No.	**09FW0348.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**18**	Client Reference	**18**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**39.9**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.12
30	5	0.55
45	8	0.88
60	11	1.28
0	12	0.89



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.28	**30.5**	**1.9**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

Issuing laboratory:
Soil Mechanics
Unit 11b, Provincial Park
Nether Lane
Ecclesfield
Sheffield, S35 9ZX
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Fax: 0114 240 1744

Client Name **Soil Mechanics**
Askern Road
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FAO **Paul McMann**

Authorised By: DL

Soil Mechanics

CERTIFICATE OF TEST

UKAS TESTING
4330

Authorised signatories:

D. Swindells–Operations Manager[ ]
S. Grayson–Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

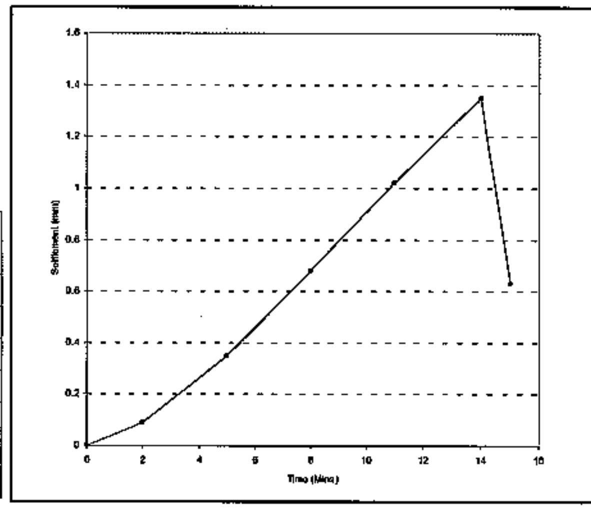
Date 08/04/2009
Report Ref: 09FW0349

Lab Ref No.	**09FW0349.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**19**	Client Reference	**19**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY mixed with black peat**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**32.1**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.09
30	5	0.35
45	8	0.68
60	11	1.02
75	14	1.35
0	15	0.63



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.35	**53.3**	**2.5**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

Issuing laboratory:
Soil Mechanics
Unit 11b, Provincial Park
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Client Name **Soil Mechanics**
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FAO **Paul McMann**

Authorised By:

Soil Mechanics

4330

CERTIFICATE OF TEST

Authorised signatories:

D. Swindells–Operations Manager[ ]
S. Grayson–Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

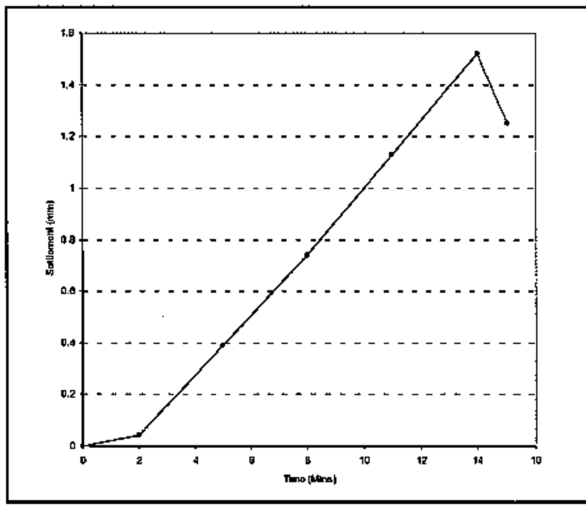
Date 08/04/2009
Report Ref: 09FW0350

Lab Ref No.	**09FW0350.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**20**	Client Reference	**20**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Light brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**200**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**32.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.04
30	5	0.39
45	8	0.74
60	11	1.13
75	14	1.52
0	15	1.25



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.52	**17.8**	**2.2**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

Issuing laboratory:
Soil Mechanics

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CERTIFICATE OF TEST

UKAS TESTING 4330

Authorised signatories:

D. Swindells-Operations Manager[ ]
S. Grayson-Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

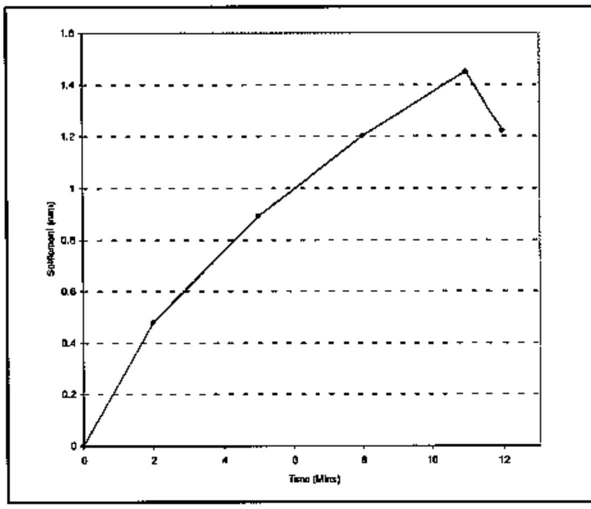
Date 08/04/2009
Report Ref: 09FW0351

Lab Ref No.	**09FW0351.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**21**	Client Reference	**21**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY mixed with black peat**		

TEST RESULTS

Depth of Test (mm)	**400**
Distance from excavation wall (mm)	**100**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**40.6**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.48
30	5	0.89
45	8	1.20
60	11	1.45
0	12	1.22



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.45	**15.9**	**2.0**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

Issuing laboratory:
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Client Name **Soil Mechanics**
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FAO **Paul McMann**

Authorised By: DM

Soil Mechanics

UKAS TESTING 4330

CERTIFICATE OF TEST

Authorised signatories:

D. Swindells–Operations Manager[ ]
S. Grayson–Lab Team Leader[ ]

Vertical Deformation of Soil by Plate Load Test

BS 1377: Part 9: 1990

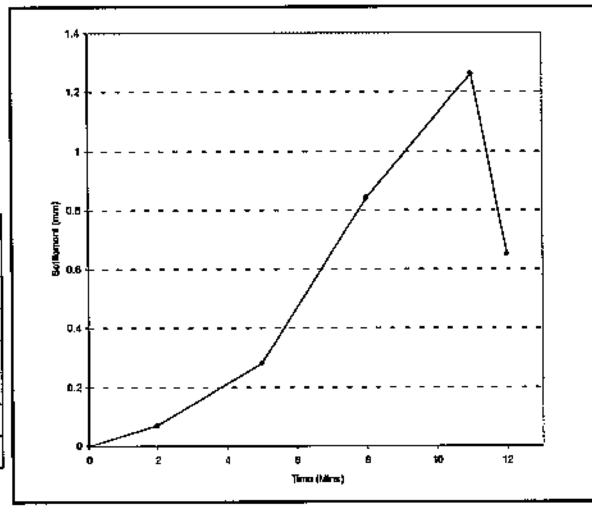
Date 08/04/2009
Report Ref: 09FW0352

Lab Ref No.	**09FW0352.1**	Date Tested	**03/04/2009**
Scheme / Site	**Causeway Farm, Thorne**		
Test Location	**22**	Client Reference	**22**
Technician	**GB**	Weather	**Overcast**
Soil Description	**Dark brown slightly sandy CLAY**		

TEST RESULTS

Depth of Test (mm)	**500**
Distance from excavation wall (mm)	**400**
Reaction Load Used	**JCB**
Plate Size (mm)	**300**
Test Method	**Incremental**
Moisture Content (%) (If Requested)	**36.3**

Applied Load (kN/m^2)	Time (Mins)	Mean Deflection (mm)
0	0	0.00
15	2	0.07
30	5	0.28
45	8	0.84
60	11	1.26
0	12	0.65



Maximum Deflection (mm)	Recovery (%)	%CBR* (If Requested)
1.26	**48.4**	**1.9**

*Note: %CBR values calculated using methods given in Design Manual for Roads and Bridges – Volume 7.

Remarks:

Issuing laboratory:
Soil Mechanics

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Nether Lane
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Client Name **Soil Mechanics**
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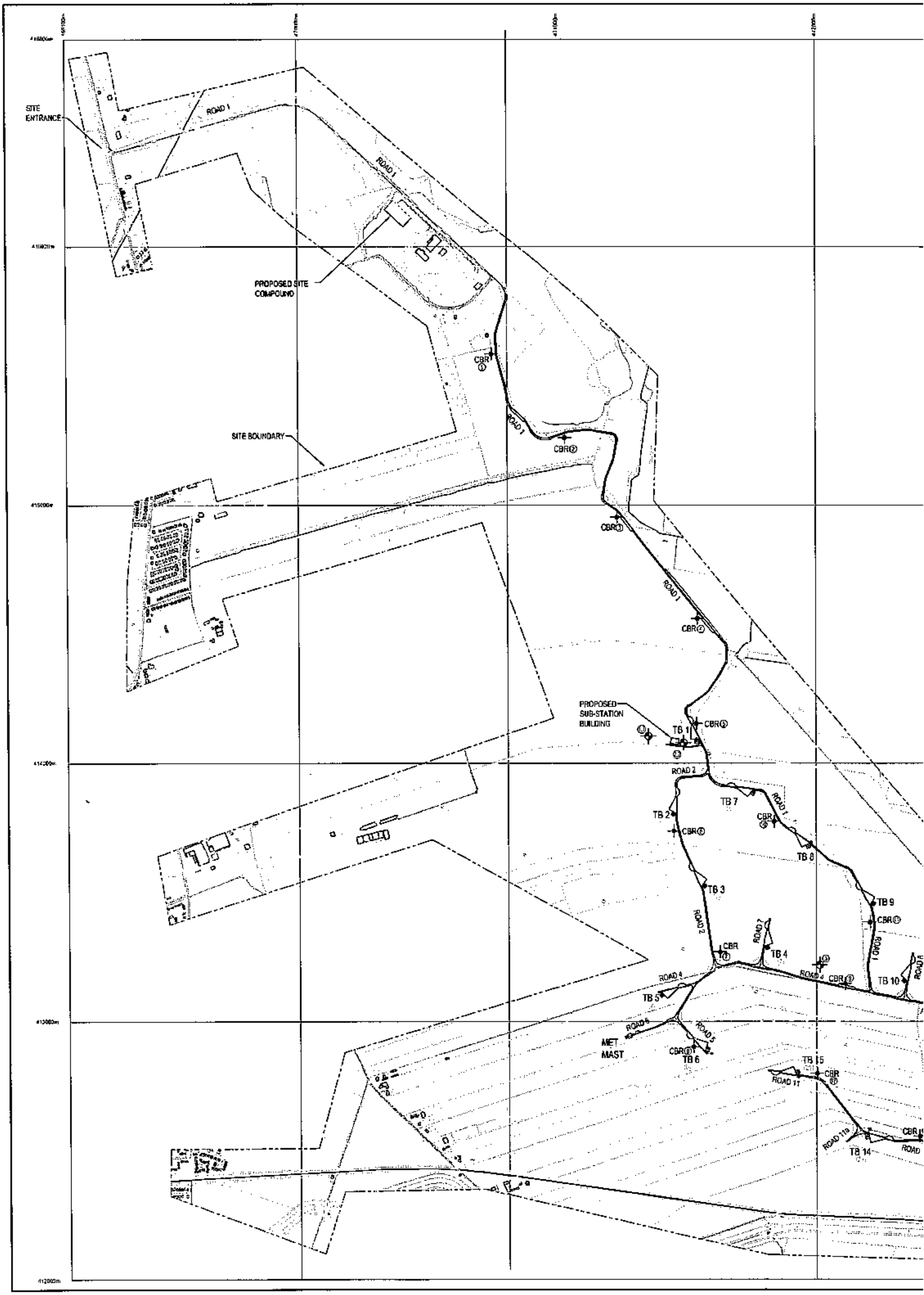
FAO **Paul McMann**

Authorised By: DM


SITE ENTRANCE
ROAD 1
PROPOSED SITE COMPOUND
CBR ①
CBR ②
SITE BOUNDARY
CBR ③
CBR ④
PROPOSED SUB-STATION BUILDING
TB 1
CBR ⑤
ROAD 2
TB 7
TB 2
CBR ⑥
TB 8
TB 3
TB 9
ROAD 7
TB 4
ROAD 4
CBR ⑨
TB 10
ROAD 1
TB 5
ROAD 6
MET MAST
ROAD 5
CBR ⑧
TB 6
TB 15
ROAD 11
ROAD 11a
TB 14
ROAD

INDEX PROPERTIES - SUMMARY OF RESULTS

Project No	Project Name
A9057	TWEEN BRIDGE WIND FARM, PHASE 2

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	ρ (Mg/m³)	ρ_d (Mg/m³)	W (%)	< 425 µm sieve (%)	W_L (%)	W_P (%)	I_P	ρ_s (Mg/m³)	Remarks
BH3	1	0.10	0.40	B	Greyish brown slightly sandy CLAY.			21	100 n	45 a	23	22		
BH3	8	4.00	4.45	D	Brown slightly sandy CLAY.			17	100 s	48 b	21	27		
BH3	11	6.00	6.45	D	Brown slightly sandy CLAY.			19	100 n	54 a	21	33		
BH5	1	0.10	0.40	B	Brownish grey clayey sandy SILT.			22	99 n	30 a	20	10		
BH5	11	5.05	5.05	D	Brown silty CLAY.			27	100 n	49 a	22	27		
BH5	14	7.50	7.95	D	Brown silty SAND.			21	94 s	22 b	NP			
BH8	8	4.65	5.10	D	Brown silty CLAY.			22	100 n	42 a	20	22		
BH10	1	0.10	0.50	B	Brown and light brown slightly sandy clayey SILT.			17	100 n	30 a	20	10		
BH13	11	6.00	6.45	D	Light brown SAND with occasional pockets of clay.			19	100 n	24 b	NP			
BH16	1	0.10	1.00	B	Brown slightly sandy CLAY.			37	100 n	58 a	24	34		
BH16	9	4.50	4.95	D	Brown slightly sandy CLAY.			19	100 n	47 a	22	25		
BH16	13	7.50	7.95	D	Brown CLAY.			26	100 n	43 a	21	22		
BH18	9	4.50	4.95	D	Brown slightly sandy CLAY.			32	100 n	44 a	19	25		
BH22	9	4.60	5.05	D	Greyish brown silty CLAY.			28	100 s	50 b	22	28		

General notes: All above tests carried out to BS1377 : 1990 definitive method in all cases unless annotated otherwise. See individual test reports for further details.

Key :
- ρ bulk density, linear
- ρ_d dry density
- w moisture content
- W_L Liquid limit
- a 4 point cone test
- b 1 point cone test
- W_P Plastic limit
- NP non - plastic
- I_P Plasticity Index
- <425um preparation
- n from natural soil
- s sieved specimen
- ρ_s particle density
- -g = gas jar
- -p = small pyknometer

CHEMICAL TESTS - SUMMARY OF RESULTS

Project No	Project Name
A9057	TWEEN BRIDGE WIND FARM, PHASE 2

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	Org %	LOI %	pH	Preparation/test *	Sulphate as SO_4 2:1 water sol. g/L	Sulphate as SO_4 ground water g/L	Sulphate as SO_4 acid sol. %	SD1 options TS %	SD1 options Mg mg/L, NO_3 mg/L, NH_4	CO_2 %	Chloride, Cl water sol. %	Chloride, Cl acid sol. %	<2 mm %	Remarks
BH3	6	2.50	3.00	B	Greyish brown silty CLAY.			7.2	1+3	0.07								100	
BH3	14	7.50	8.00	B	Greyish brown very sandy SILT.			7.3	1+3	0.07								100	
BH3	20	12.00	13.00	B	Dark brownish grey slightly gravelly SAND.			7.3	1+3	0.26								100	
BH5	9	3.50	4.00	B	Greyish brown slightly sandy CLAY.			7.3	1+3	0.10								100	
BH5	15	7.50	8.00	B	Greyish brown silty SAND.			7.4	1+3	0.09								100	
BH5	21	12.00	13.00	B	Brown SAND.			7.5	1+3	0.07								100	
BH8	9	4.65	5.10	B	Greyish brown slightly sandy CLAY.			7.6	1+3	0.16								100	
BH8	15	7.60	8.05	B	Greyish brown slightly sandy SILT.			7.5	1+3	0.04								100	
BH8	21	11.20	11.60	B	Greyish brown slightly sandy SILT.			7.4	1+3	0.08								100	
BH10	6	2.50	3.00	B	Greyish brown slightly sandy CLAY.			7.5	1+3	0.09								100	
BH10	12	6.00	7.00	B	Greyish brown silty SAND.			7.6	1+3	0.11								100	
BH10	19	10.50	11.00	B	Greyish brown slightly sandy SILT.			7.3	1+3	0.07								100	
BH13	7	3.60	4.05	B	Greyish brown SAND with rare clay pockets.			5.3	1+3	0.12								100	
BH13	12	6.00	6.45	B	Light brown and light grey clayey SAND.			7.1	1+3	0.11								100	
BH13	19	9.00	9.40	B	Light brown clayey SAND.			7.2	1+3	0.09								100	
BH16	14	7.50	8.00	B	Brown slightly sandy CLAY.			7.7	1+3	0.09								100	
BH16	18	10.50	11.00	B	Brown SAND.			7.8	1+3	0.07								100	
BH16	25	15.60	16.00	B	Brown slightly gravelly SAND.			8.0	1+3	0.07								100	
BH18	10	4.50	5.00	B	Brown slightly sandy CLAY.			7.7	1+3	0.02								100	

BS 1377 : definitive method unless stated :
- Org Organic matter content (s-sulphides, c-chlorides identified)
- LOI Mass loss on ignition at 440°C
- CO_2 Carbonate content (rapid titration)
- Cl Chloride content

* Sulphate tests preparation / test methods :
1. BS 1377:Part 3:1990:clause 5.3
2. BS 1377:Part 3:1990:clause 5.4
3. BS 1377:Part 3:1990:clause 5.5
4. TRL447 - 1 water soluble sulphate
5. TRL447 - 2 acid soluble sulphate
6. BR279 - groundwater sulphate

< 2mm material passing 2mm sieve

BRE Special Digest SD1, dependent options :
- TS Total Sulphur to BR279 / EN ISO15178
- Mg Soluble Magnesium to BR279, colorimetric
- NO3 Soluble Nitrate to BR279, colorimetric
- NH_4 qualitative

QA Ref			Table
SLR 3 Rev 91 Jan 09	Soil Mechanics	Printed:22/06/2009 12:08	CHEM 1

CHEMICAL TESTS - SUMMARY OF RESULTS

Project No	Project Name
A9057	TWEEN BRIDGE WIND FARM, PHASE 2

Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	Org %	LOI %	pH	Sulphate as SO_4 Preparation/test *	Sulphate 2:1 water sol. g/L	Sulphate ground water g/L	Sulphate acid sol. %	SD1 options TS %	SD1 options Mg mg/L, NO_3 mg/L, NH_4	CO_2 %	Chloride, Cl water sol. %	Chloride, Cl acid sol. %	<2 mm %	Remarks
BH18	14	7.50	8.00	B	Brown silty SAND.			7.9	1+3	0.07								100	
BH18	20	12.00	13.00	B	Brown SAND.			7.7	1+3	0.02								100	
BH22	10	4.60	5.05	B	Greyish brown slightly sandy CLAY.			7.2	1+3	0.03								100	
BH22	16	7.50	7.95	B	Greyish brown silty very gravelly SAND.			7.6	1+3	0.07								75	
BH22	26	12.80	13.10	B	Brown sandy CLAY.			7.7	1+3	0.05								100	

BS 1377 : definitive method unless stated :
- Org Organic matter content (s-sulphides, c-chlorides identified)
- LOI Mass loss on ignition at 440°C
- CO_2 Carbonate content (rapid titration)
- Cl Chloride content

* Sulphate tests preparation / test methods :
1. BS 1377:Part 3:1990:clause 5.3
2. BS 1377:Part 3:1990:clause 5.4
3. BS 1377:Part 3:1990:clause 5.5
4. TRL447 - 1 water soluble sulphate
5. TRL447 - 2 acid soluble sulphate
6. BR279 - groundwater sulphate

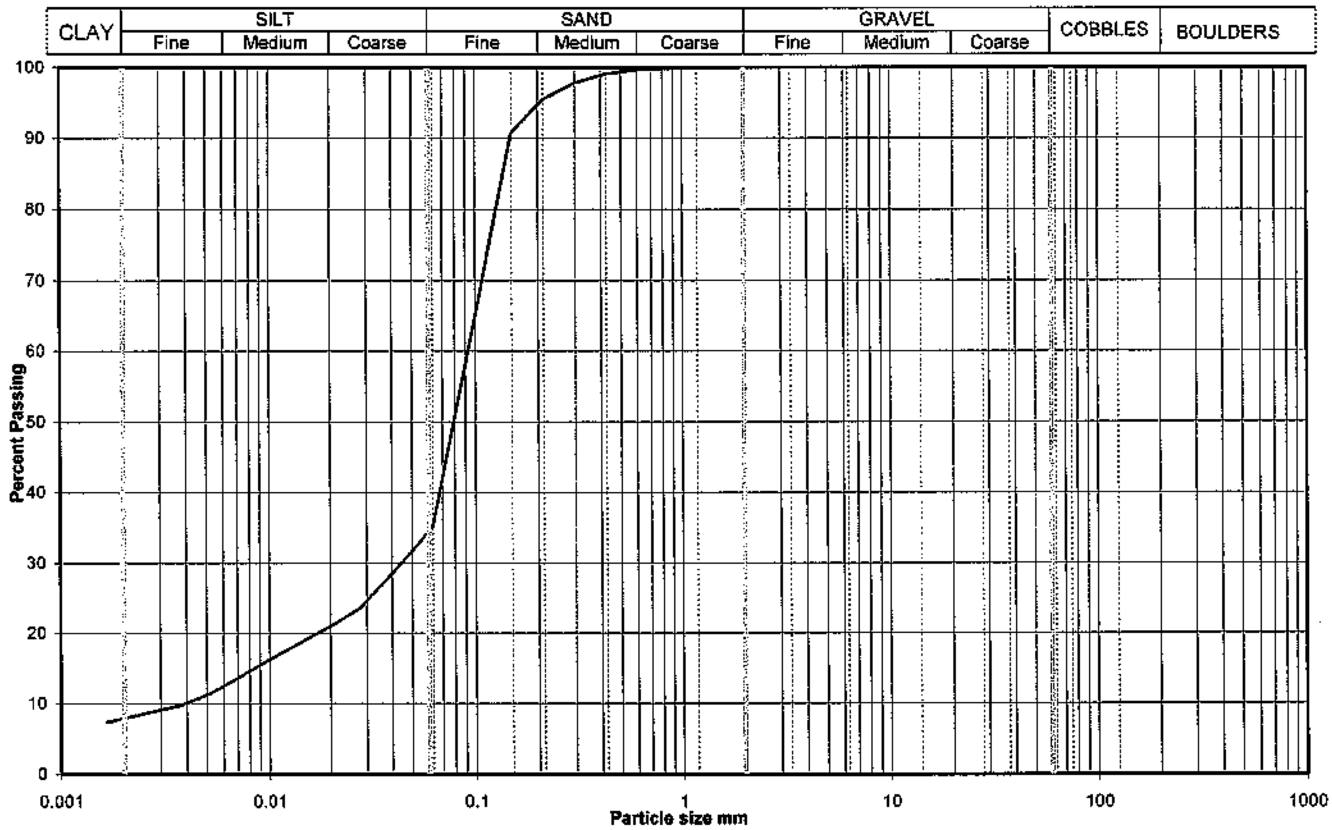
< 2mm material passing 2mm sieve

BRE Special Digest SD1, dependent options :
- TS Total Sulphur to BR279 / EN ISO15178
- Mg Soluble Magnesium to BR279, colorimetric
- NO3 Soluble Nitrate to BR279, colorimetric
- NH_4 qualitative

QA Ref			Table
SLR 3 Rev 91 Jan 09	Soil Mechanics	Printed:22/06/2009 12:08	CHEM 2

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH3
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	7.50
			Samp No	14 Type B
			ID	ESGA905720090414000000162
			Spec Ref	



Sieving Particle Size mm	Sieving % Passing	Sedimentation Particle Size mm	Sedimentation % Passing
125	100	0.0630	35
90	100	0.0534	33
75	100	0.0384	28
63	100	0.0276	23
50	100	0.0197	21
37.5	100	0.0103	16
28	100	0.0052	11
20	100	0.0037	10
14	100	0.0017	7
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100	Particle density, Mg/m3	
0.600	100		
0.425	99	2.65 assumed	
0.300	98	Dry mass of sample, kg	
0.212	95		
0.150	91	13.1	
0.063	35		

Soil description	Greyish brown very sandy SILT.
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377
Remarks	

Sample Proportions		Whole	*<60mm
*<60mm values to aid description only	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	65	65
	Silt	27	27
	Clay	8	8

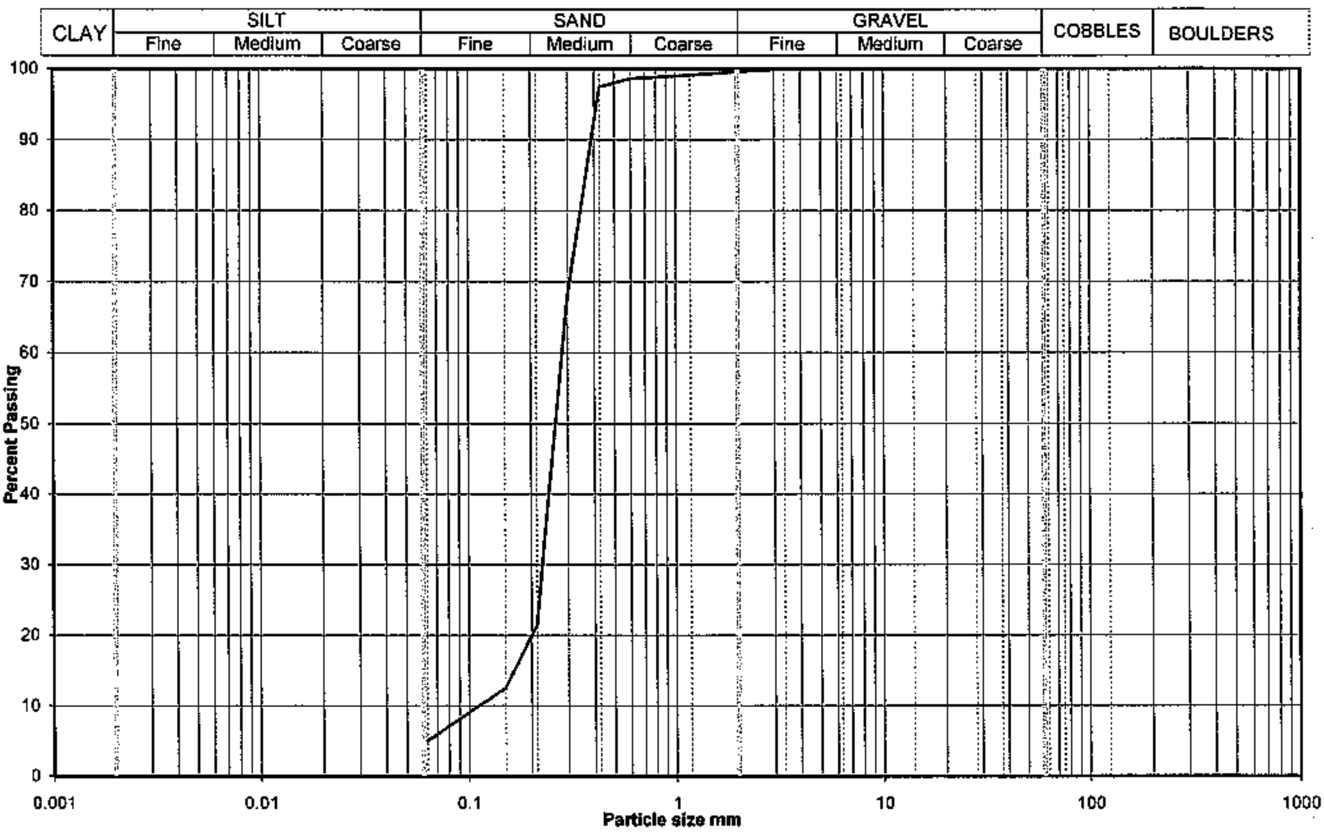
Uniformity Coefficient	D_{60} / D_{10}	23

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	Printed:22/06/2009 12:10	**Figure** **PSD 1**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH3
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	10.50
			Samp No	18 Type B
			ID	ESGA905720090414000000166
			Spec Ref	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	99		
0.600	99		
0.425	97		
0.300	68	Dry mass of sample, kg	
0.212	21		
0.150	12	10.2	
0.063	5		

Soil description	Greyish brown SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions *<60mm values to aid description only		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	95	95
	Silt	silt+clay =	
	Clay	5	5

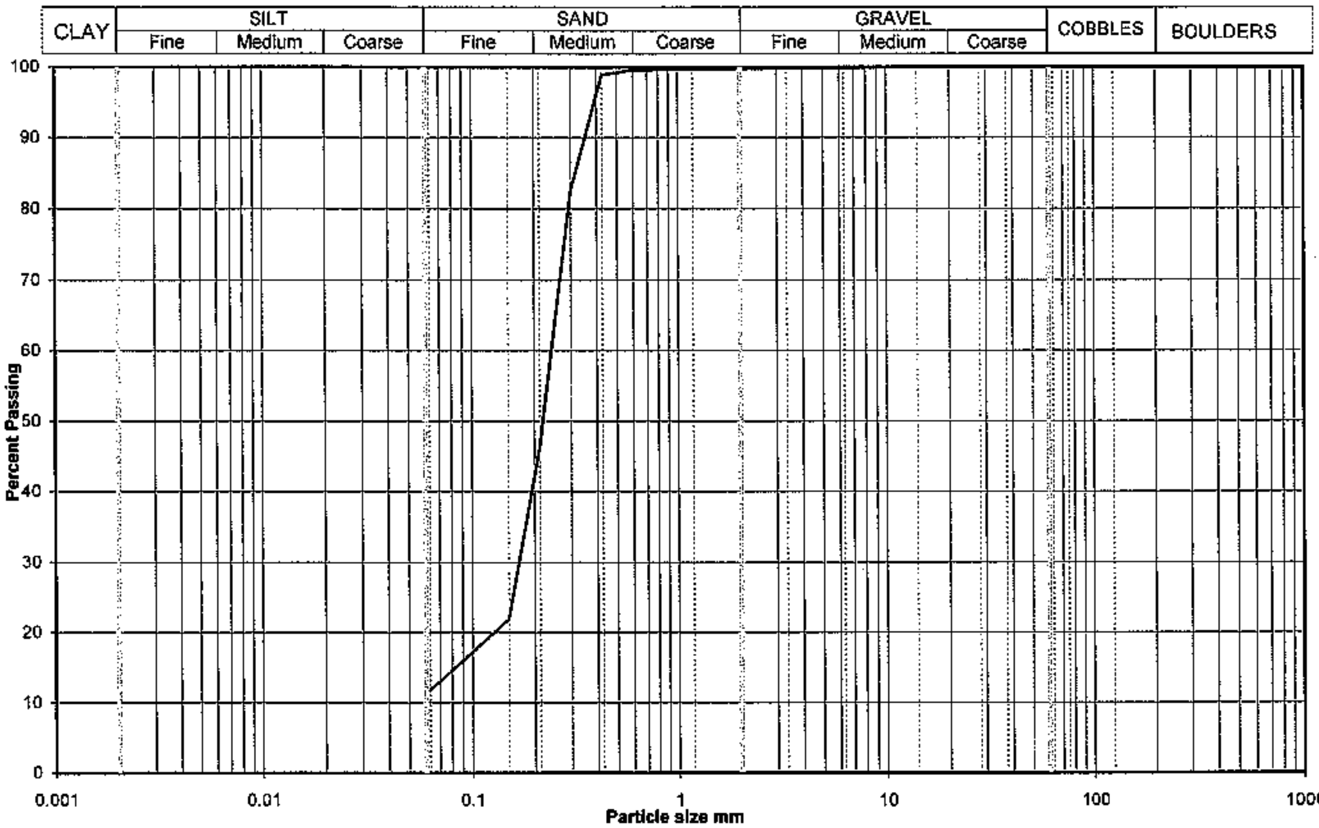
Uniformity Coefficient	D_{60} / D_{10}	3

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	Printed:22/06/2009 12:10	**Figure** **PSD 2**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH5		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	12.00		
			Samp No	21	Type	B
			ID	ESGA905720090408000000142		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	100		
0.425	99		
0.300	82	Dry mass of sample, kg	
0.212	46		
0.150	22	10.4	
0.063	12		

Soil description	Brown SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
		Whole	*<60mm
Sample Proportions	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	88	88
*<60mm values to aid description only	Silt	silt+clay =	
	Clay	12	12

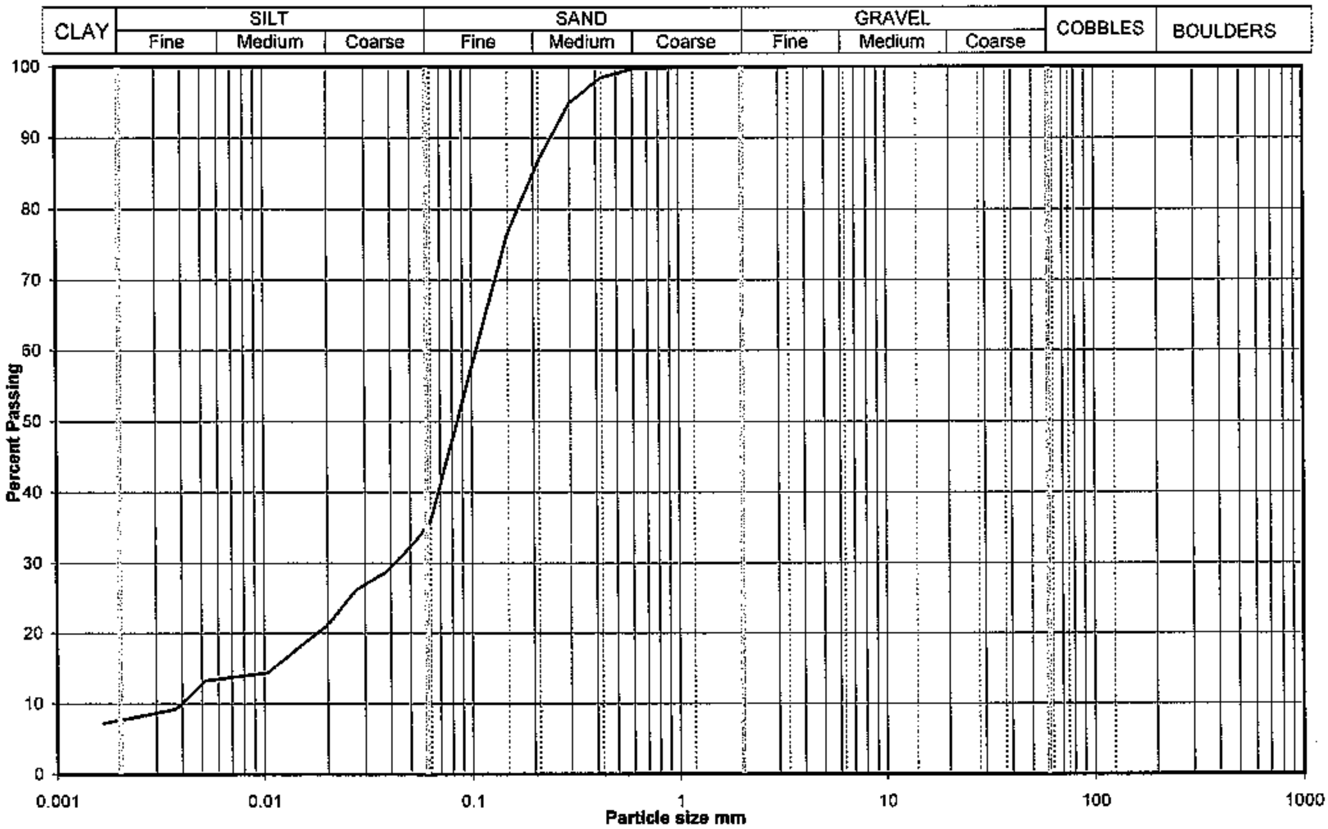
Uniformity Coefficient D_{60} / D_{10}	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	Printed:22/06/2009 12:10	**Figure** **PSD 3**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH8		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	9.10		
			Samp No	17	Type	B
			ID	ESGA905720090414000000188		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	36
90	100	0.0531	33
75	100	0.0382	29
63	100	0.0273	26
50	100	0.0197	21
37.5	100	0.0104	14
28	100	0.0052	13
20	100	0.0037	9
14	100	0.0017	7
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100	Particle density, Mg/m3	
0.600	100		
0.425	98	2.65 assumed	
0.300	95	Dry mass of sample, kg	
0.212	87		
0.150	76	10.4	
0.063	36		

Soil description	Greyish brown very sandy SILT.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	65	65
*<60mm values to aid description only	Silt	27	27
	Clay	8	8

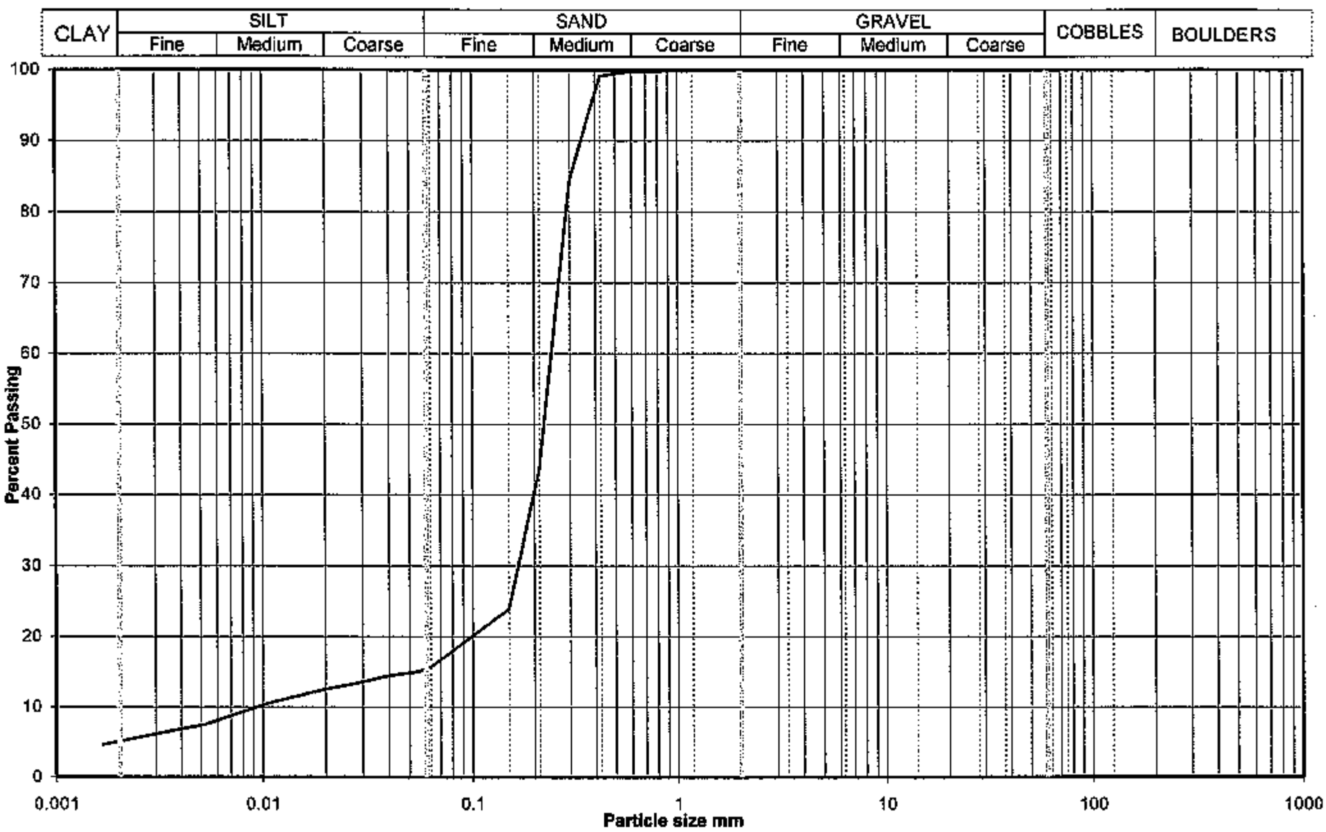
Uniformity Coefficient D_{60} / D_{10}	26

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	Printed:22/06/2009 12:11	**Figure** **PSD 4**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH10		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	6.00		
			Samp No	12	Type	B
			ID	ESGA9057200904080000000013		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	16
90	100	0.0556	15
75	100	0.0395	14
63	100	0.0280	13
50	100	0.0199	13
37.5	100	0.0104	10
28	100	0.0053	8
20	100	0.0037	7
14	100	0.0017	5
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100	Particle density, Mg/m3	
0.600	100		
0.425	99	2.65	assumed
0.300	84	Dry mass of sample, kg	
0.212	44		
0.150	24	9.0	
0.063	16		

Soil description	Greyish brown silty SAND.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	85	85
*<60mm values to aid description only	Silt	10	10
	Clay	5	5

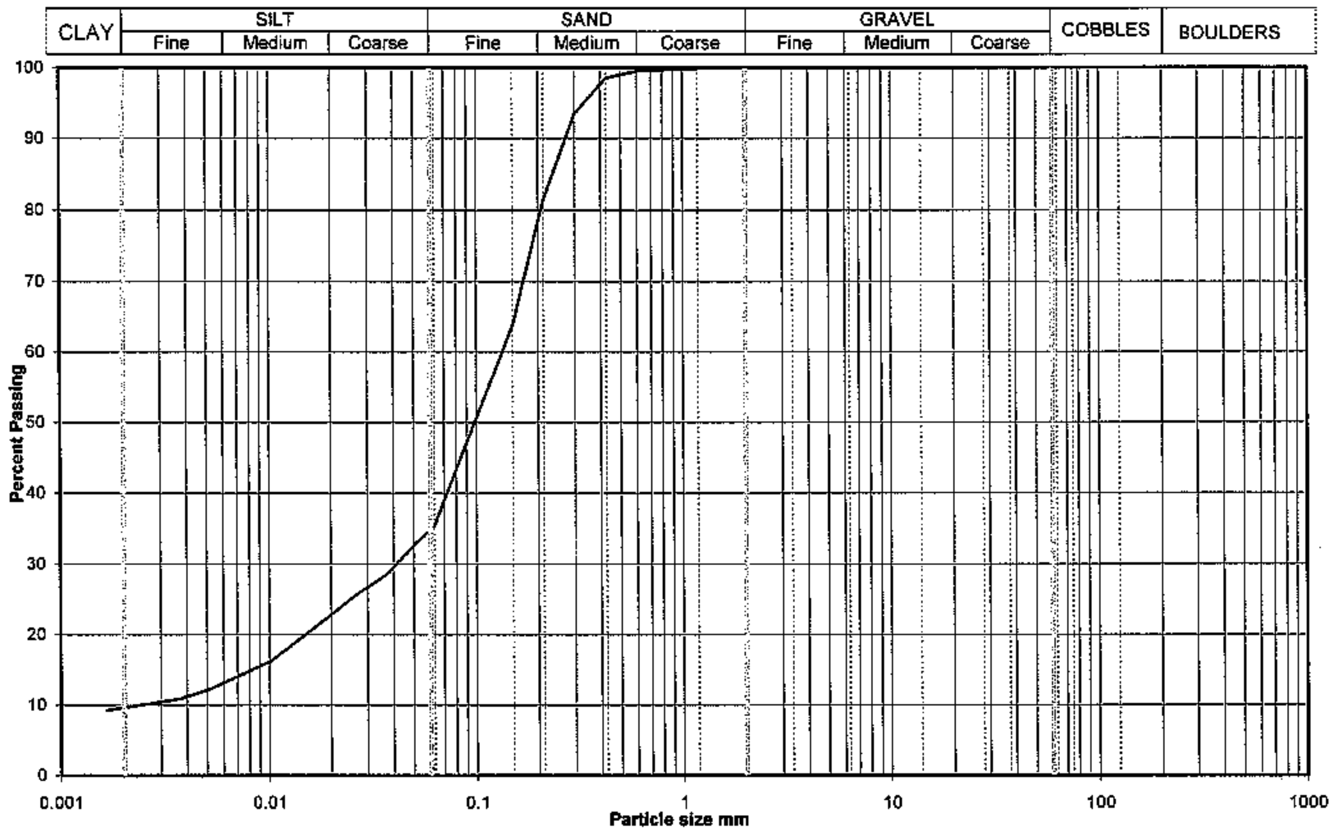
Uniformity Coefficient D_{60} / D_{10}	26

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	Printed:22/06/2009 12:11	**Figure** **PSD 5**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No		BH10	
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)		9.00	
			Samp No	17	Type	B
			ID	ESGA9057200904080000000018		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	35
90	100	0.0516	33
75	100	0.0373	29
63	100	0.0267	26
50	100	0.0192	22
37.5	100	0.0102	16
28	100	0.0052	12
20	100	0.0037	11
14	100	0.0016	9
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100	Particle density, Mg/m3	
0.600	99		
0.425	98	2.65	assumed
0.300	93	Dry mass of sample, kg	
0.212	81		
0.150	64	10.5	
0.063	35		

Soil description	Greyish brown very sandy SILT.		
Preparation / Pretreatment	Sieve: natural material Hydro: as BS1377		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	65	65
*<60mm values to aid description only	Silt	25	25
	Clay	10	10

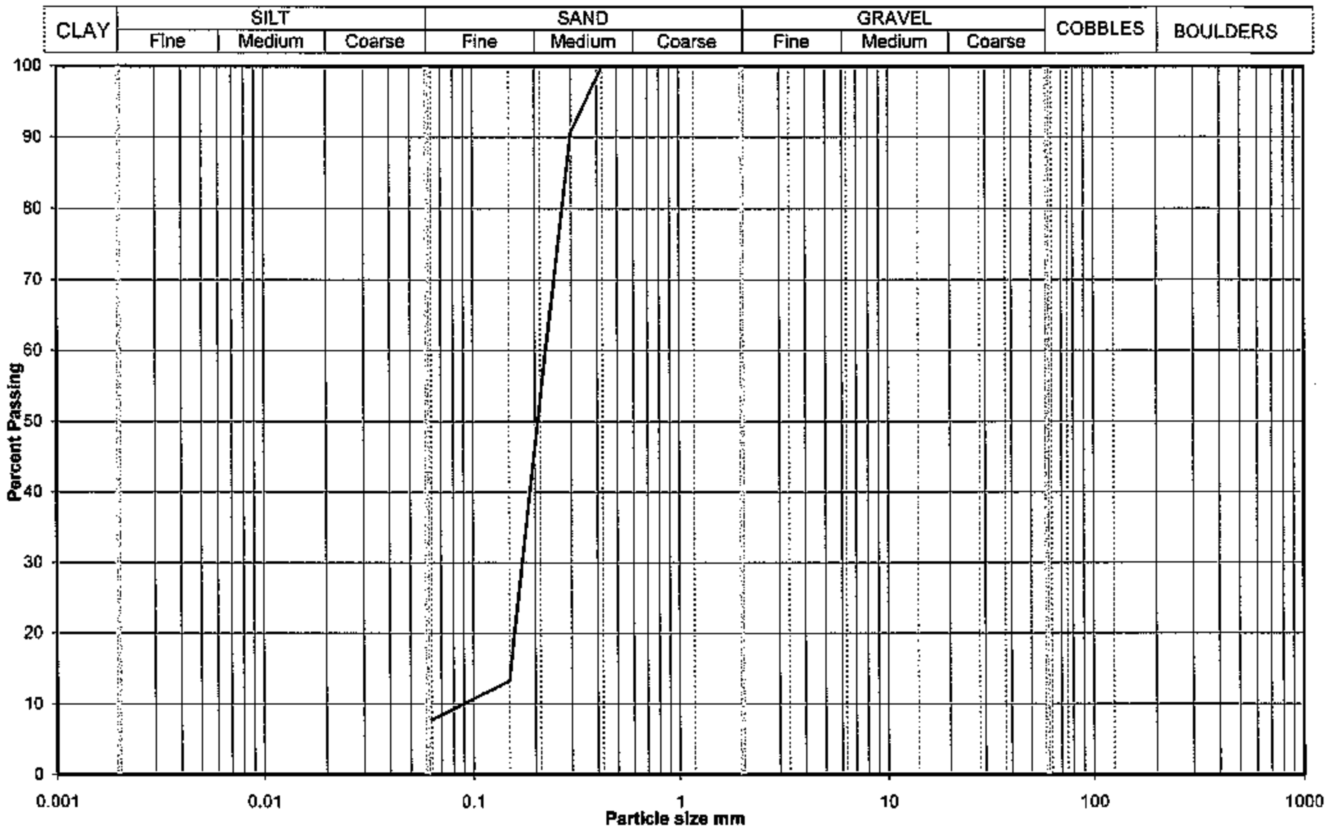
Uniformity Coefficient	D_{60} / D_{10}	55

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	9.5 hydrometer

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	Printed:22/06/2009 12:11	Figure **PSD 6**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH13		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	3.60		
			Samp No	7	Type	B
			ID	ESGA90572009040800000000027		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	100		
0.425	100		
0.300	91	Dry mass of sample, kg	
0.212	53		
0.150	13	12.9	
0.063	8		

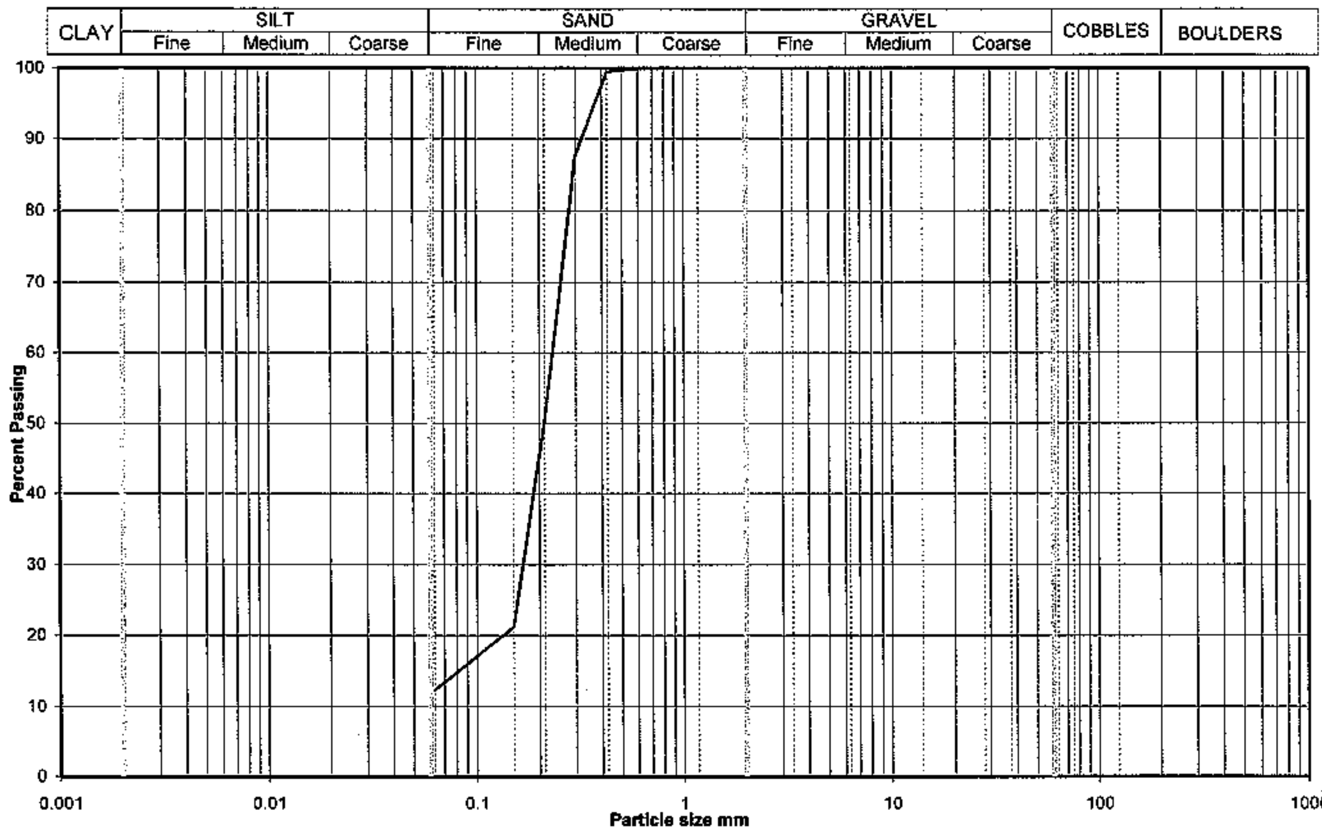
Soil description	Greyish brown SAND with rare clay pockets.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions *<60mm values to aid description only		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	92	92
	Silt	silt+clay =	
	Clay	8	8

Uniformity Coefficient D_{60} / D_{10}	3

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH13			
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	9.00			
			Samp No	19	Type	B	
			ID	ESGA9057200904080000000039			
			Spec Ref				



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	100		
0.425	99		
0.300	88	Dry mass of sample, kg	
0.212	50		
0.150	21		
0.063	12	11.4	

Soil description	Light brown clayey SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	88	88
*<60mm values to aid description only	Silt	silt+clay =	
	Clay	12	12

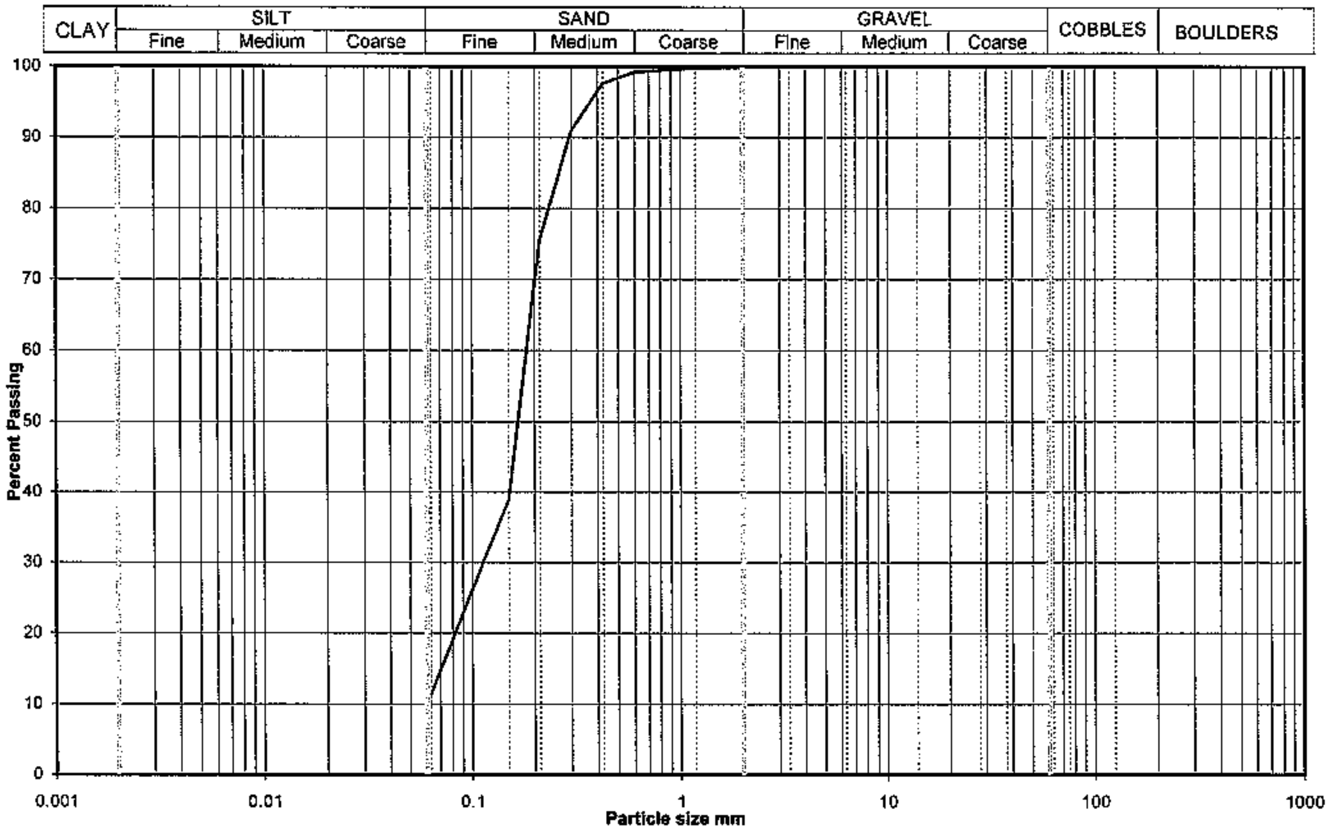
Uniformity Coefficient D_{60} / D_{10}	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	Printed:22/06/2009 12:11	**Figure** **PSD 8**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH16		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	9.00		
			Samp No	16	Type	B
			ID	ESGA905720090406000000060		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	99		
0.425	98		
0.300	91	Dry mass of sample, kg	
0.212	76		
0.150	39	12.4	
0.063	11		

Soil description	Brown silty SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
		Whole	*<60mm
Sample Proportions	Cobbles / boulders	0	0
*<60mm values to aid description only	Gravel	0	0
	Sand	89	89
	Silt	silt+clay =	
	Clay	11	11

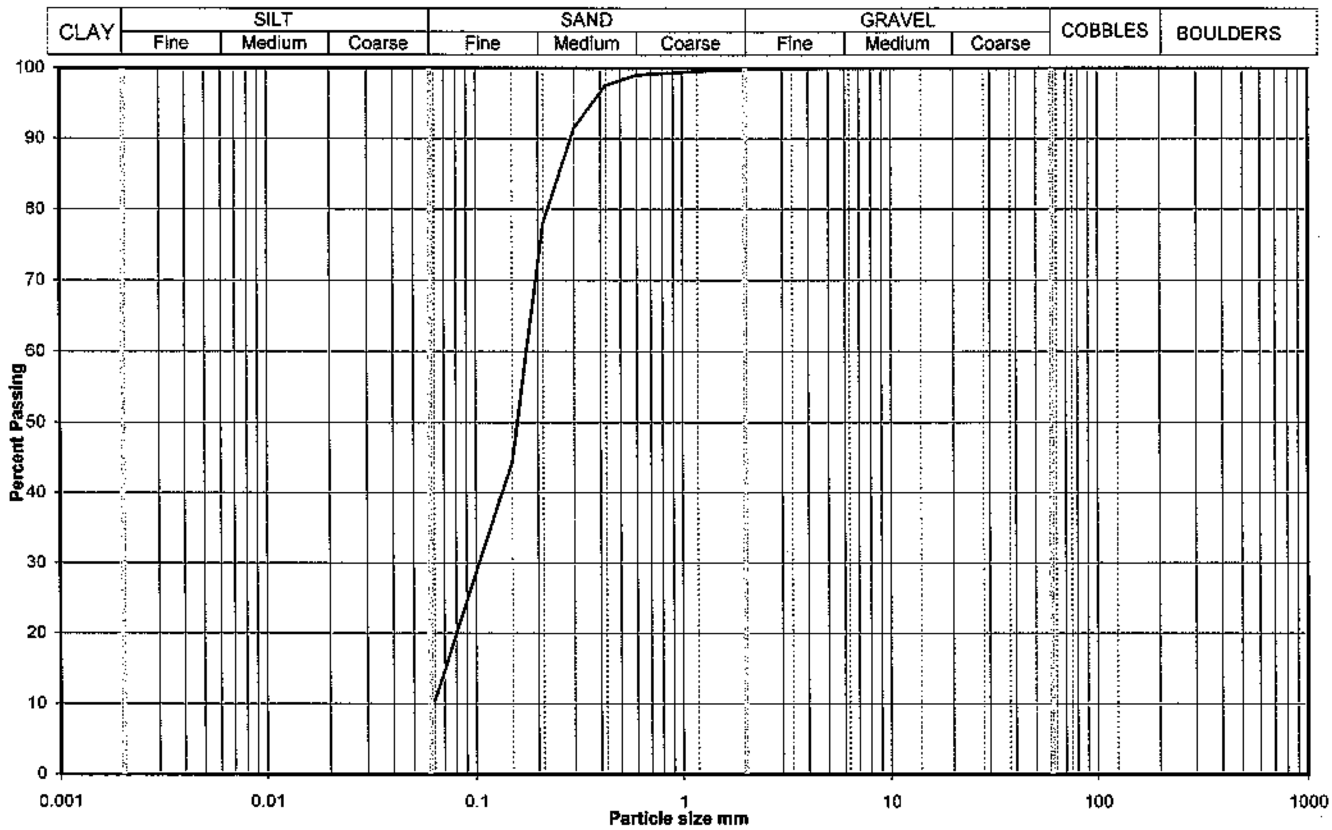
Uniformity Coefficient D_{60} / D_{10}	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	Printed:22/06/2009 12:11	**Figure** **PSD 9**

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH16		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	12.00		
			Samp No	20	Type	B
			ID	ESGA90572009040800000000064		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	99		
0.425	98		
0.300	91	Dry mass of sample, kg	
0.212	78		
0.150	44	14.5	
0.063	10		

Soil description	Brown silty SAND.		
Preparation / Pretreatment	Sieve: natural material		
Remarks			
		Whole	*<60mm
Sample Proportions	Cobbles / boulders	0	0
	Gravel	0	0
*<60mm values to aid description only	Sand	89	89
	Silt	silt+clay =	
	Clay	11	11

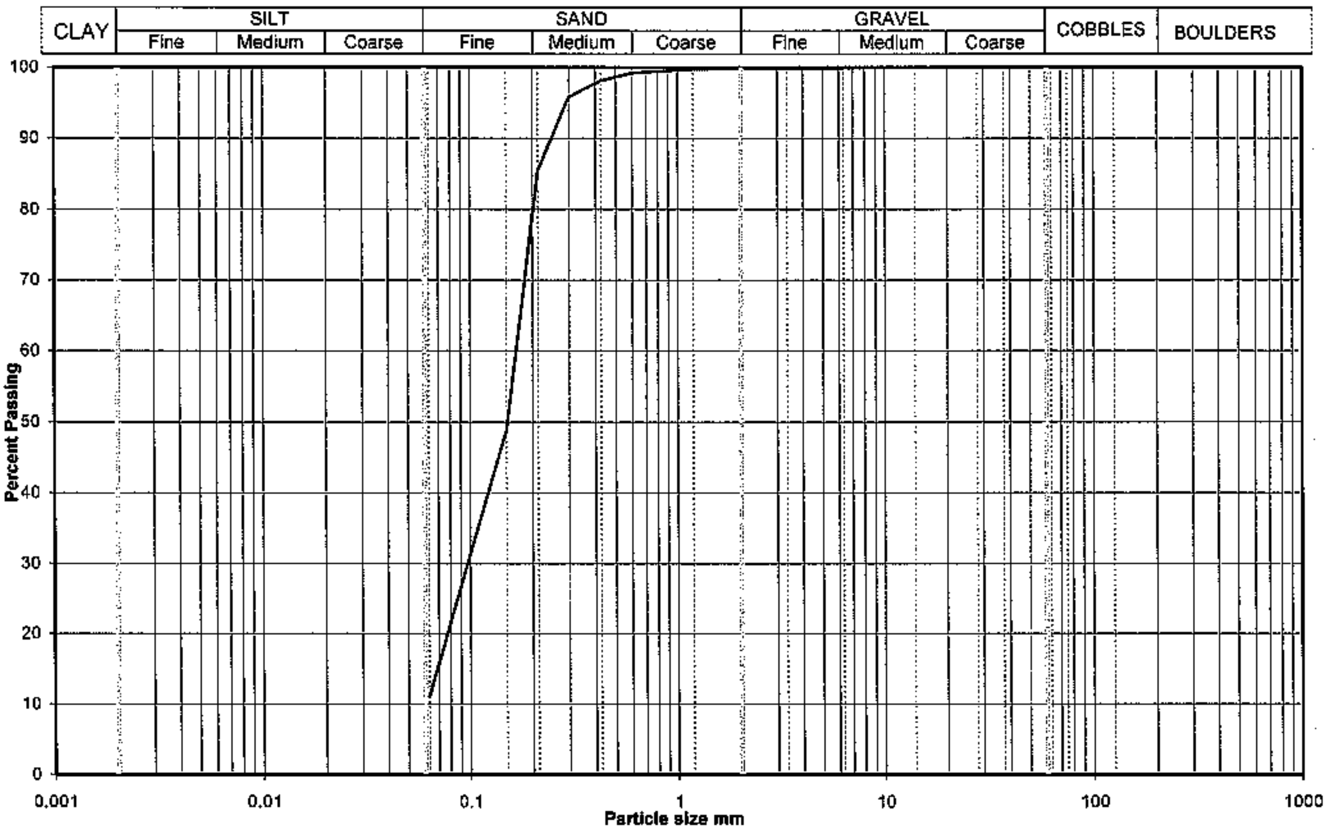
Uniformity Coefficient D_{60} / D_{10}	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref SLR 2,9 Rev 84 Sept 08	Soil Mechanics	Printed:22/06/2009 12:11	Figure PSD 10

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH18			
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	7.50			
			Samp No	14	Type	B	
			ID	ESGA9057200904080000000085			
			Spec Ref				



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5.0	100		
3.35	100		
2.00	100		
1.18	100		
0.600	99		
0.425	98		
0.300	96	Dry mass of sample, kg	
0.212	85		
0.150	49		
0.063	11	11.8	

Soil description	Brown silty SAND.
Preparation / Pretreatment	Sieve: natural material
Remarks	

Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	0	0
	Sand	89	89
*<60mm values to aid description only	Silt	silt+clay =	
	Clay	11	11

Uniformity Coefficient	D_{60} / D_{10}	Not applicable

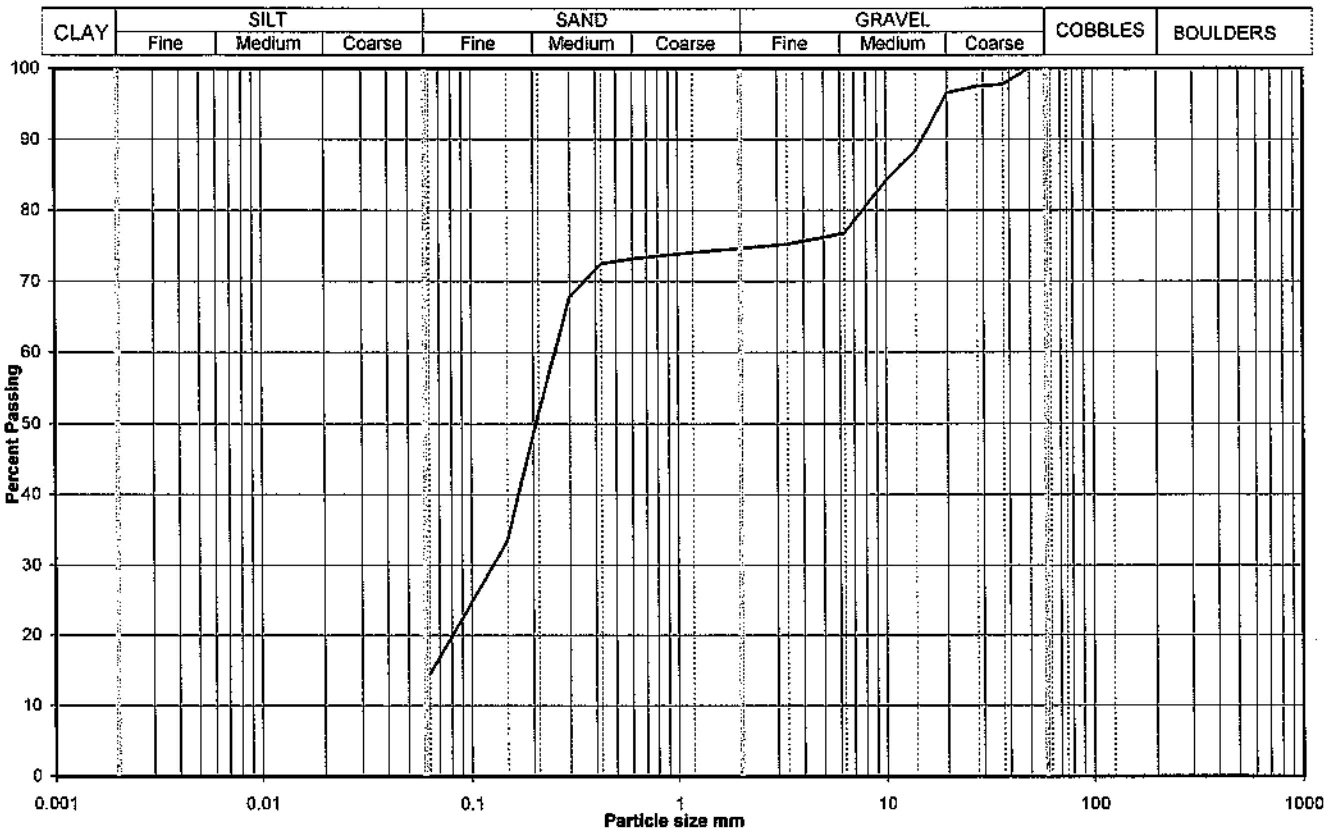
Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref			Figure
SLR 2,9 Rev 84 Sept 08	Soil Mechanics	Printed:22/06/2009 12:11	**PSD 11**

UKAS TESTING 1157

Particle Size Distribution Analysis

Project No	A9057	Sample Details:	Hole No	BH22		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	7.50		
			Samp No	16	Type	B
			ID	ESGA90572009040800000108		
			Spec Ref			



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	98		
28	97		
20	97		
14	88		
10	84		
6.3	77		
5.0	76		
3.35	75		
2.00	75		
1.18	74		
0.600	73		
0.425	72		
0.300	68	Dry mass of sample, kg	
0.212	52		
0.150	33	11.6	
0.063	14		

Soil description	Greyish brown silty very gravelly SAND.
Preparation / Pretreatment	Sieve: natural material
Remarks	

Sample Proportions		Whole	*<60mm
	Cobbles / boulders	0	0
	Gravel	25	25
*<60mm values to aid description only	Sand	60	60
	Silt	silt+clay =	
	Clay	15	15

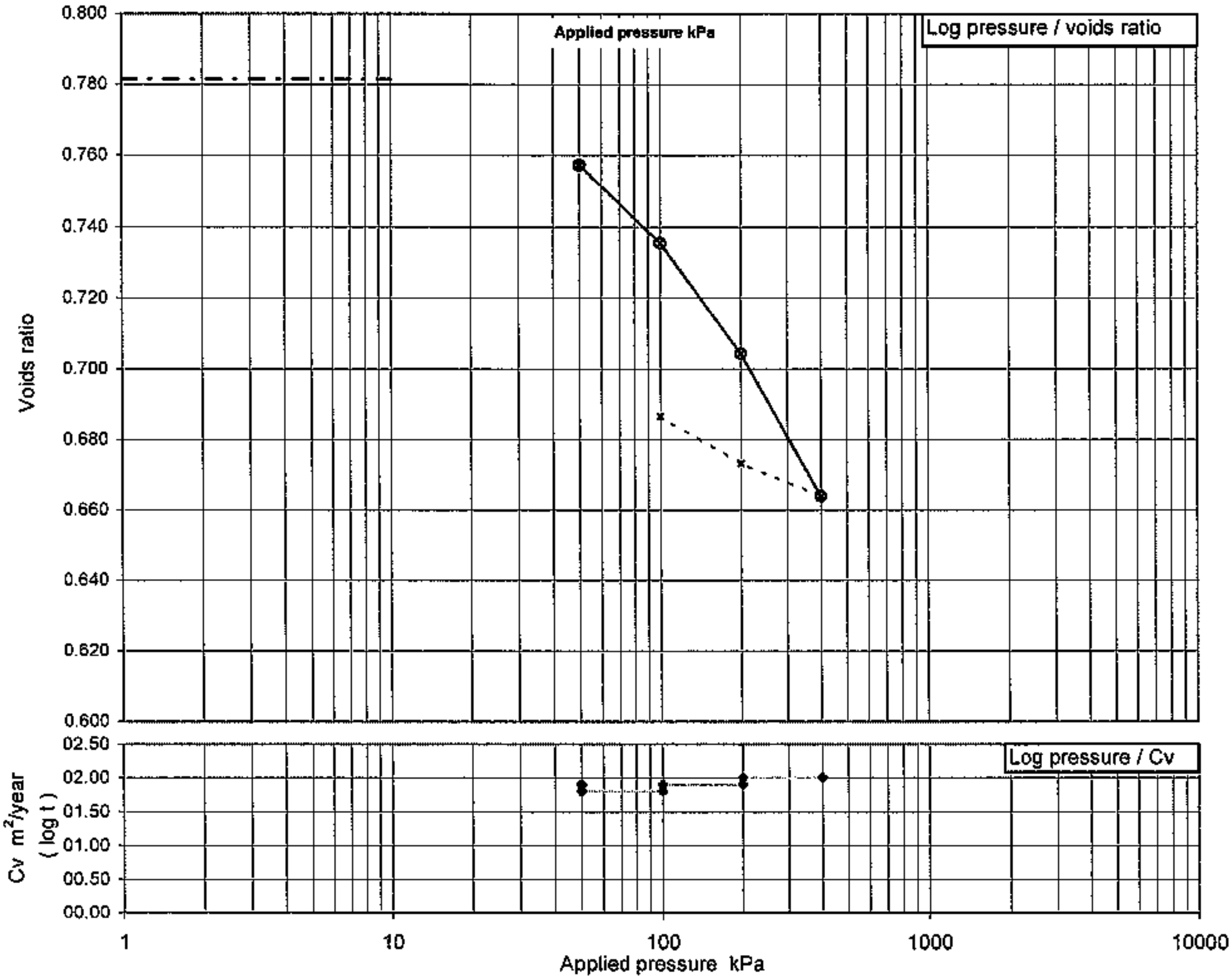
Uniformity Coefficient	D_{60} / D_{10}	Not applicable

Test Method	BS 1377 : Part 2 : 1990	
	Sieving	9.2 wet sieve
	Sedimentation	none

QA Ref				Figure
SLR 2,9 Rev 84 Sept 08	Soil Mechanics	UKAS TESTING 1157	Printed:22/06/2009 12:11	PSD 12

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No		BH5	
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)		4.50	
			Samp No	10	Type	U
			ID	ESGA9057200904080000000130		
			Spec Ref			



Soil description	Firm brown laminated CLAY with occasional silt pockets.			
Preparation	Undisturbed			
Index properties (if available)	Liquid limit %		Plastic limit %	

Specimen details	Initial	Final	
Particle density	2.70	assumed	Mg/m³
Diameter	74.85		mm
Height	19.05	18.04	mm
Voids ratio	0.781	0.687	
Moisture content	30	27	%
Bulk density	1.97	2.03	Mg/m³
Dry density	1.52	1.60	Mg/m³
Saturation	103	105	%
Average temperature for test	23		°C

Swelling pressure: not measured kPa

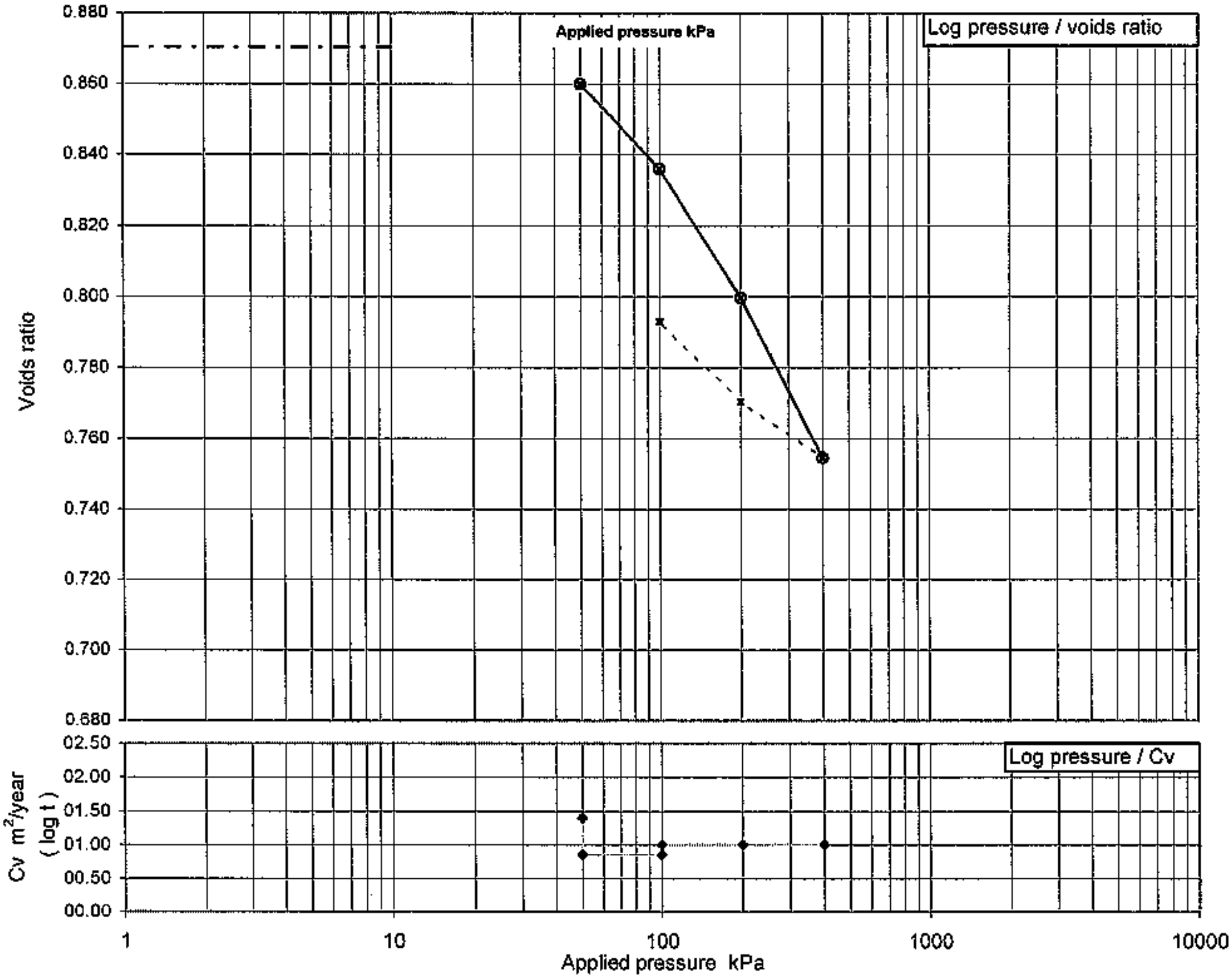
Notes :

Specimen taken 80 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m^2/MN	C_v ($t_{50,\ log}$) $m^2/year$	C_v ($t_{90,\ root}$) $m^2/year$	
0	0.7815				
50	0.7572	0.273	1.9	1.9	
100	0.7355	0.247	1.8	1.8	
200	0.7042	0.180	1.9	2	
400	0.6639	0.118	2	2.1	
200	0.6732	0.028	-	-	
100	0.6866	0.080	-	-	

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH8		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	3.60		
			Samp No	6	Type	U
			ID	ESGA90572009041400000000177		
			Spec Ref			



Soil description	Soft brown silty CLAY.			
Preparation	Undisturbed			
Index properties (if available)	Liquid limit %		Plastic limit %	

Specimen details	Initial	Final	
Particle density	2.75	assumed	Mg/m³
Diameter	74.62		mm
Height	19.06	18.27	mm
Voids ratio	0.870	0.793	
Moisture content	33	30	%
Bulk density	1.95	2.00	Mg/m³
Dry density	1.47	1.53	Mg/m³
Saturation	103	105	%
Average temperature for test	23		°C

Swelling pressure: not measured kPa

Notes :

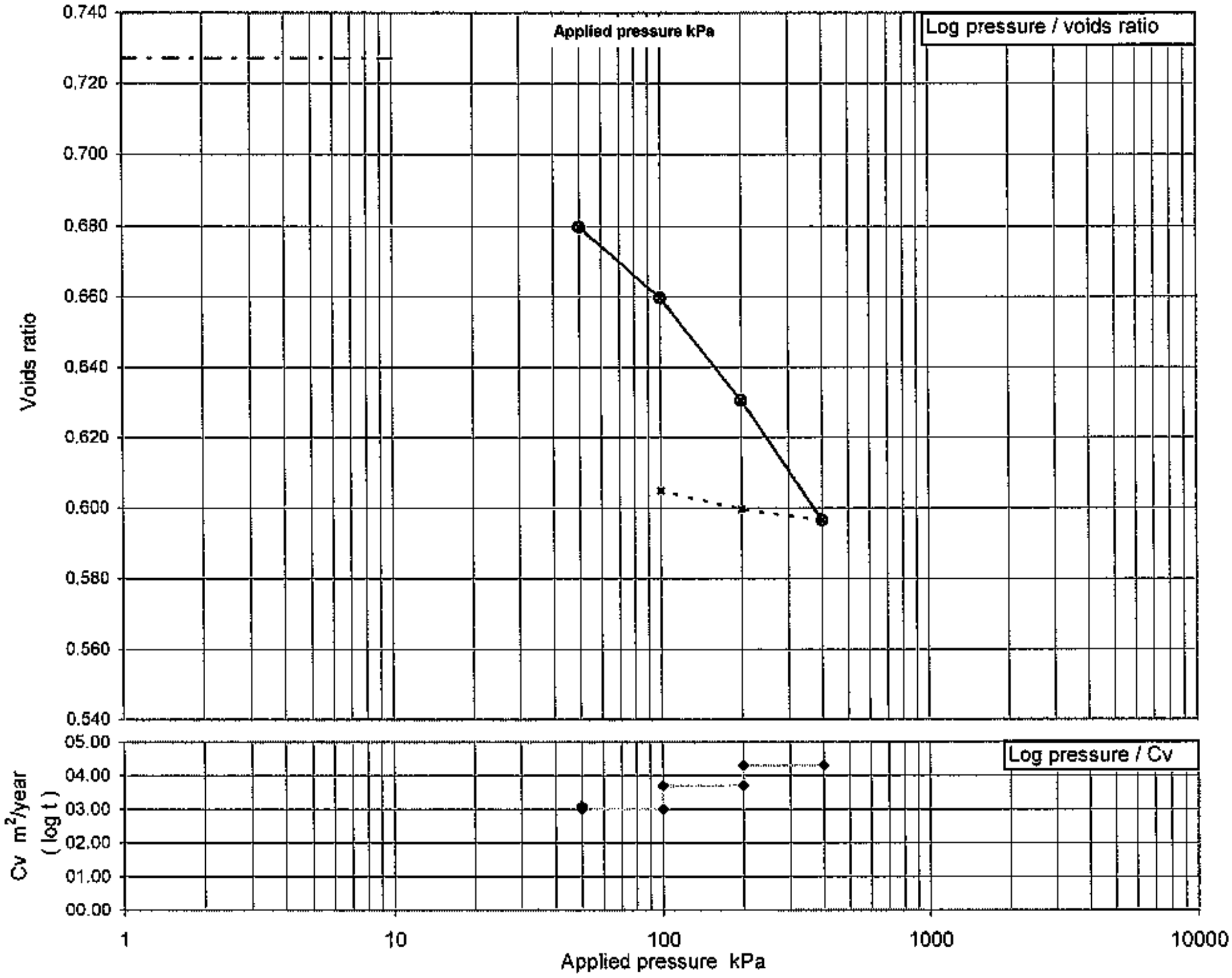
Specimen taken 100 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m^2/MN	C_v ($t_{50, log}$) m^2/year	C_v ($t_{90, root}$) m^2/year	
0	0.8704				
50	0.8599	0.112	1.4	1.7	
100	0.8359	0.257	0.85	0.88	
200	0.7996	0.198	1	1.1	
400	0.7545	0.125	1	1.1	
200	0.7704	0.045	-	-	
100	0.7929	0.127	-	-	

QA Ref SLR 5.3 Rev 115 Jan 09	Soil Mechanics	UKAS TESTING 1157	Printed:22/06/2009 12:09	Figure **OED 2**

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH10			
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	3.50			
			Samp No	7	Type	U	
			ID	ESGA90572009040800000000007			
			Spec Ref				



Soil description	Soft brown sandy CLAY.			
Preparation	Undisturbed			
Index properties (if available)	Liquid limit %		Plastic limit %	

Specimen details	Initial	Final	
Particle density	2.70	assumed	Mg/m^3
Diameter	74.90		mm
Height	19.17	17.81	mm
Voids ratio	0.727	0.605	
Moisture content	27	24	%
Bulk density	1.99	2.08	Mg/m^3
Dry density	1.56	1.68	Mg/m^3
Saturation	101	105	%
Average temperature for test	23		°C

Swelling pressure: not measured kPa

Notes :

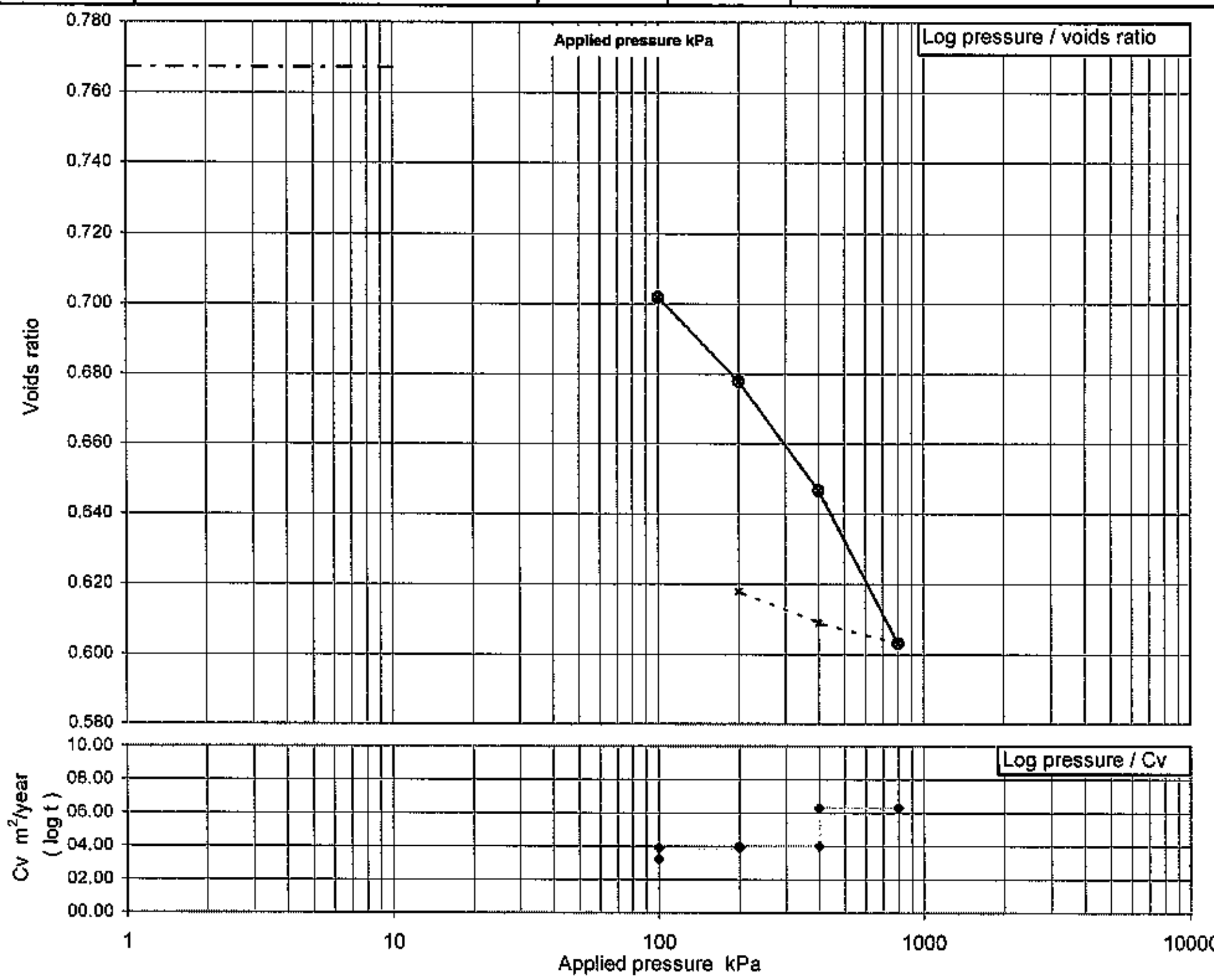
Specimen taken 340 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m^2/MN	C_v ($t_{50, log}$) $m^2/year$	C_v ($t_{90, root}$) $m^2/year$	
0	0.7271				
50	0.6798	0.548	3.1	3.3	
100	0.6597	0.239	3	3.2	
200	0.6305	0.176	3.7	4	
400	0.5965	0.104	4.3	4.2	
200	0.5995	0.009	-	-	
100	0.6048	0.033	-	-	

QA Ref SLR 5.3 Rev 115 Jan 09	Soil Mechanics	UKAS TESTING 1157	Printed:22/06/2009 12:09	Figure **OED 3**

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH16		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	6.00		
			Samp No	11	Type	U
			ID	ESGA90572009040800000000054		
			Spec Ref			



Soil description	Firm to stiff greyish brown thinly laminated CLAY with silt and sand dusting on laminae.		
Preparation	Undisturbed		
Index properties (if available)	Liquid limit %		Plastic limit %

Specimen details	Initial	Final	
Particle density	2.70	assumed	Mg/m³
Diameter	75.00		mm
Height	19.12	17.50	mm
Voids ratio	0.767	0.618	
Moisture content	29	24	%
Bulk density	1.97	2.07	Mg/m³
Dry density	1.53	1.67	Mg/m³
Saturation	101	104	%
Average temperature for test	22		°C

Swelling pressure: not measured kPa

Notes :

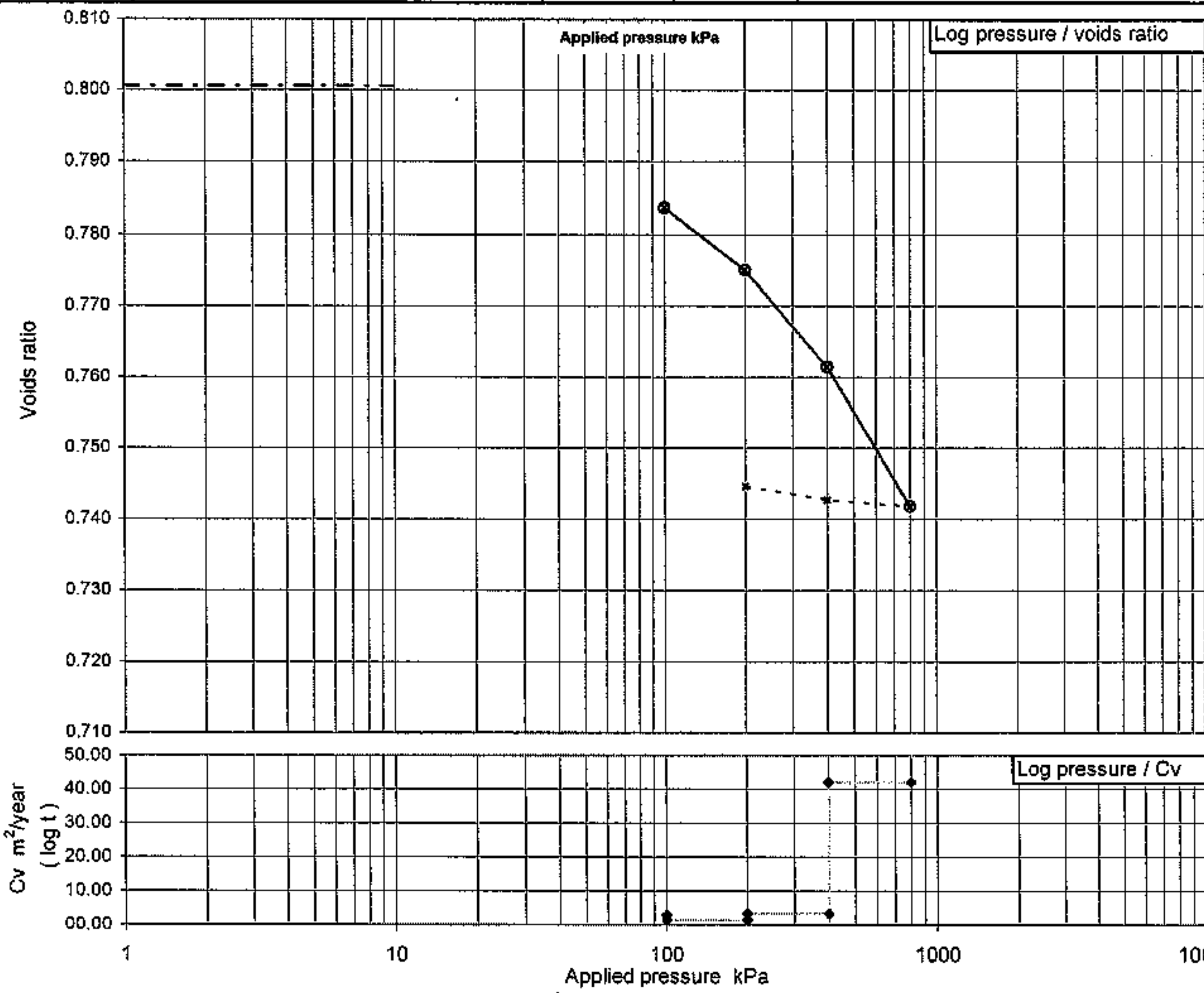
Specimen taken 10 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m²/MN	C_v ($t_{50, log}$) m²/year	C_v ($t_{90, root}$) m²/year	
0	0.7672				
100	0.7019	0.370	3.2	3.5	
200	0.6778	0.141	3.9	4.3	
400	0.6466	0.093	4	4.2	
800	0.6031	0.066	6.3	6.8	
400	0.6090	0.009	-	-	
200	0.6179	0.028	-	-	

QA Ref SLR 5.3 Rev 115 Jan 09	Soil Mechanics	Printed:22/06/2009 12:09	Figure **OED 4**

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH18		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	6.00		
			Samp No	11	Type	U
			ID	ESGA905720090408000000081		
			Spec Ref			



Soil description	Greyish brown very silty SAND with occasional gravel sized clay pockets.
Preparation	Undisturbed
Index properties (if available)	Liquid limit %	Plastic limit %

Specimen details	Initial	Final	
Particle density	2.65	assumed	Mg/m³
Diameter	74.96		mm
Height	19.02	18.42	mm
Voids ratio	0.801	0.745	
Moisture content	31	29	%
Bulk density	1.92	1.97	Mg/m³
Dry density	1.47	1.52	Mg/m³
Saturation	102	105	%
Average temperature for test	22		°C

Swelling pressure: not measured kPa

Notes :

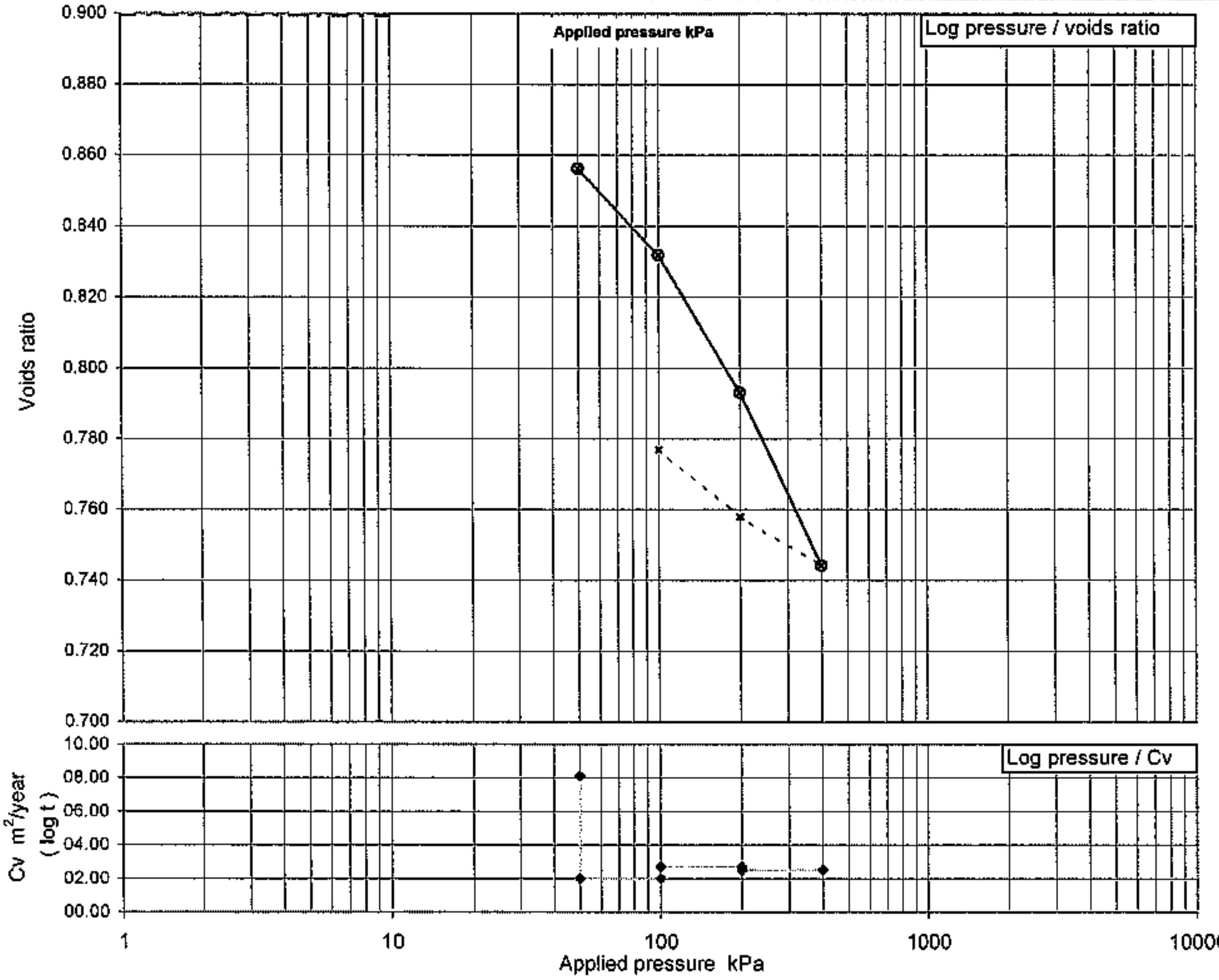
Specimen taken 10 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m²/MN	C_v ($t_{50, log}$) m²/year	C_v ($t_{90, root}$) m²/year	
0	0.8005				
100	0.7837	0.094	2.8	2.9	
200	0.7751	0.048	1.4	1.5	
400	0.7614	0.038	3.3	3.6	
800	0.7417	0.028	42	45	
400	0.7427	0.001	-	-	
200	0.7446	0.005	-	-	

QA Ref				Figure
SLR 5.3 Rev 115 Jan 09	Soil Mechanics	UKAS TESTING 1157	Printed:22/06/2009 12:09	OED 5

ONE DIMENSIONAL CONSOLIDATION TEST
BS 1377 : Part 5 : 1990 : clause 3

Project No	A9057	Sample Details:	Hole No	BH22		
Project Name	TWEEN BRIDGE WIND FARM, PHASE 2		Depth (m BGL)	3.60		
			Samp No	7	Type	U
			ID	ESGA90572009040800000000099		
			Spec Ref			



Soil description	Firm brown CLAY with silt laminations.			
Preparation	Undisturbed			
Index properties (If available)	Liquid limit %		Plastic limit %	

Specimen details	Initial	Final	
Particle density	2.75	assumed	Mg/m³
Diameter	74.87		mm
Height	19.23	17.99	mm
Voids ratio	0.899	0.777	
Moisture content	33	30	%
Bulk density	1.92	2.01	Mg/m³
Dry density	1.45	1.55	Mg/m³
Saturation	100	105	%
Average temperature for test	23		°C

Swelling pressure: not measured kPa

Notes :

Specimen taken 80 mm from base of sample

Applied Pressure kPa	Voids ratio	M_v m^2/MN	C_v ($t_{50, log}$) $m^2/year$	C_v ($t_{90, root}$) $m^2/year$	
0	0.8994				
50	0.8562	0.455	8.1	8.6	
100	0.8317	0.264	2	2.2	
200	0.7931	0.211	2.7	2.9	
400	0.7441	0.137	2.5	2.7	
200	0.7578	0.039	-	-	
100	0.7768	0.108	-	-	

QA Ref			Figure
SLR 5.3 Rev 115 Jan 09	Soil Mechanics	Printed:22/06/2009 12:10	OED 6

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TESTS WITHOUT MEASUREMENT OF PORE PRESSURE - SUMMARY OF RESULTS

Project No	Project Name
A9057	TWEEN BRIDGE WIND FARM, PHASE 2

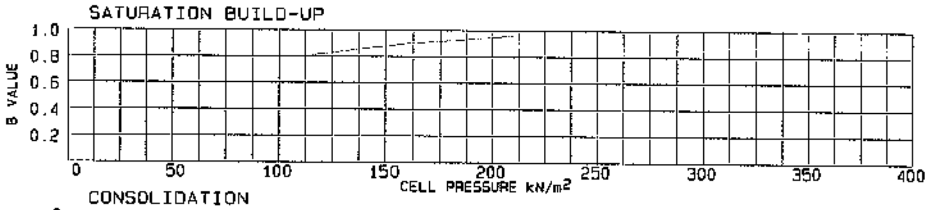
Hole No.	Sample No.	Depth (m) from	Depth (m) to	type	Soil Description	Density bulk Mg/m³	Density dry Mg/m³	w %	Test type	Dia. mm	σ_3 kPa	At failure / end of stage: Axial strain %	$\sigma_1 - \sigma_3$ kPa	c_u kPa	MODE	Remarks
BH3	3	1.50	1.95	U	Firm brown CLAY with silt partings.	1.97	1.55	27	UU	103.3	30	19.6	106	53	P	
BH5	10	4.50	4.95	U	Firm brown laminated CLAY with occasional silt pockets.	1.98	1.53	29	UU	103.1	90	11.3	102	51	B	
BH8	11	6.10	6.55	U	Firm brown CLAY with sand partings.	1.91	1.45	31	UU	103.4	120	19.7	70	35	P	
BH22	7	3.60	4.05	U	Firm brown CLAY with silt laminations.	1.95	1.51	29	UU	103.3	70	18.2	80	40	C	

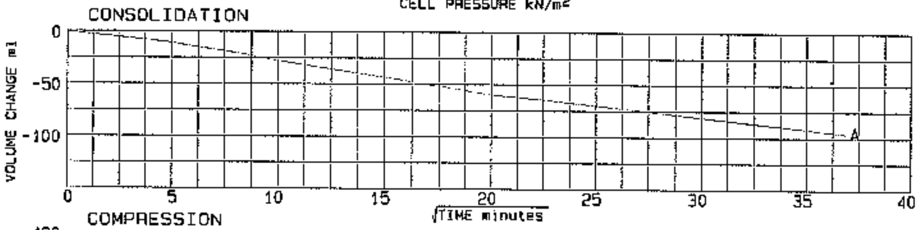
General notes: Tests carried out in accordance with BS1377: Part 7: 1990, clause 8 for single stage, clause 9 for multistage tests. Specimens nominally 2:1 height diameter ratio and tested at a rate of strain of 2%/minute, unless annotated otherwise. See individual test reports for further details.

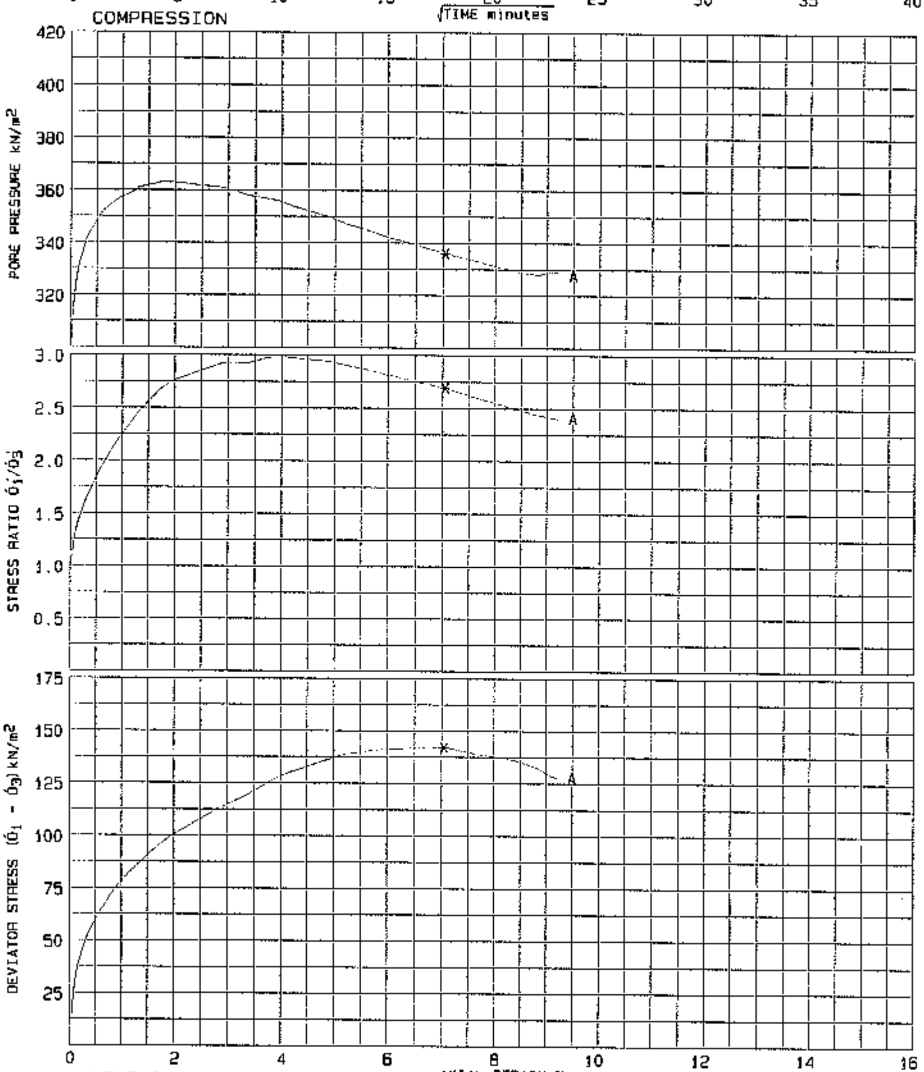
Legend:

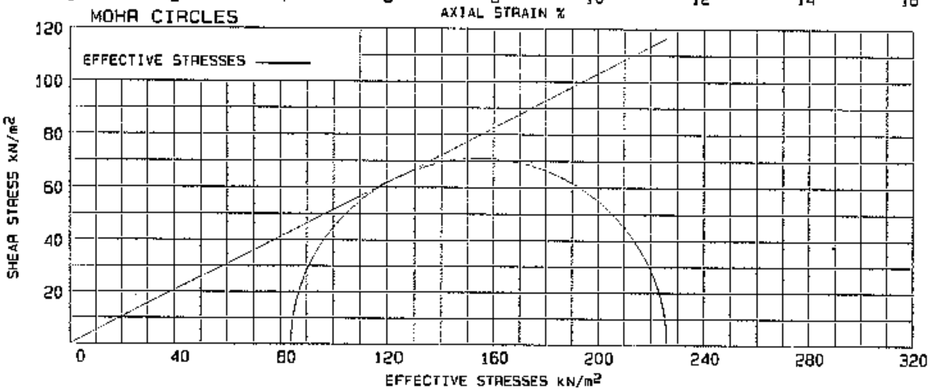
UU - single stage test (may be in sets of specimens)	σ_3 cell pressure	Mode of failure	P	plastic
UUM - multistage test on a single specimen	$\sigma_1 - \sigma_3$ deviator stress		B	brittle
suffix R - remoulded or recompacted	c_u undrained shear strength		C	compound

QA Ref			Table
SLR 2 Rev 63 Jul 07	Soil Mechanics	Printed:22/06/2009 12:08	UUSUM 1









	SPECIMEN		A	B	C
INITIAL	Density Mg/m3		2.03		
	Moisture %		29		
	Dry Density Mg/m3		1.58		
AFTER CONSOLIDATION	Density Mg/m3		2.08		
	Moisture %		26		
	Dry Density Mg/m3		1.65		
SATURATION STAGE	Initial pwp	kN/m2	0		
	Saturated pwp		150		
	Final cell pressure		210		
	B value		0.96		
CONSOLIDATION STAGE	Cell Pressure	kN/m2	420		
	Back Pressure		300		
	Initial pwp		410		
	Final pwp		303		
	σ_3'		120		
	pwp dissipation %		97		
COMPRESSION STAGE	Cell Pressure	kN/m2	420		
	Initial pwp		300		
	Inital σ_3'		120		
	Rate of strain % per hour		0.35		
FAILURE CONDITIONS AT PEAK DEVIATOR STRESS	Axial Strain %		7.0		
	$(\sigma_1 - \sigma_3)_f$	kN/m2	142		
	u_f		336		
	$\sigma_3'_f$		84		
	$\sigma_1'_f$		226		
	A_f		0.23		
	(σ_1' / σ_3')		2.692		
	MODE OF FAILURE				

SHEAR STRENGTH PARAMETERS C' ASSUMED ZERO	C'	Ø'
	0 kN/m2	27½°

NOTES

Saturation by application of cell/back pressure increments of 50 kN/m2 with a differential of 10 kN/m2.

Drainage during consolidation to top with Vertical side drains fitted

Stress/strain curves corrected for area change, side drains and .45 mm thick membrane

SOIL DESCRIPTION
Firm to stiff greyish brown thinly laminated CLAY with silt and sand dusting on laminae.

TYPE OF SPECIMEN UNDISTURBED

SPECIMEN DIMENSIONS 102.3mm dia x 203.1 mm long

Test carried out to BS 1377 : Part 8 : 1990 : Test 7

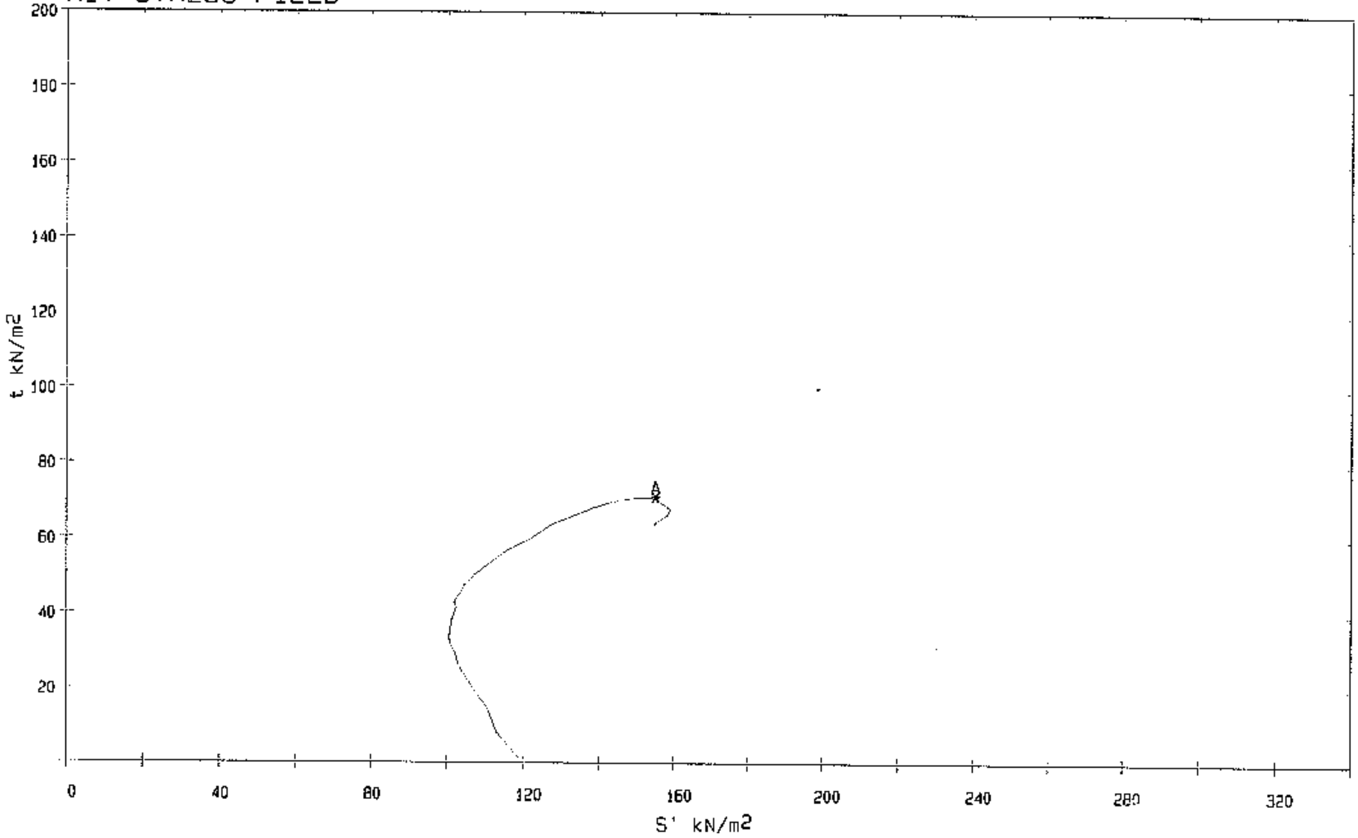
Consolidated Undrained Triaxial Compression Test with measurement of Pore Pressure

Borehole No. BH16 Depth 6.00-6.45m
Sample No. U11

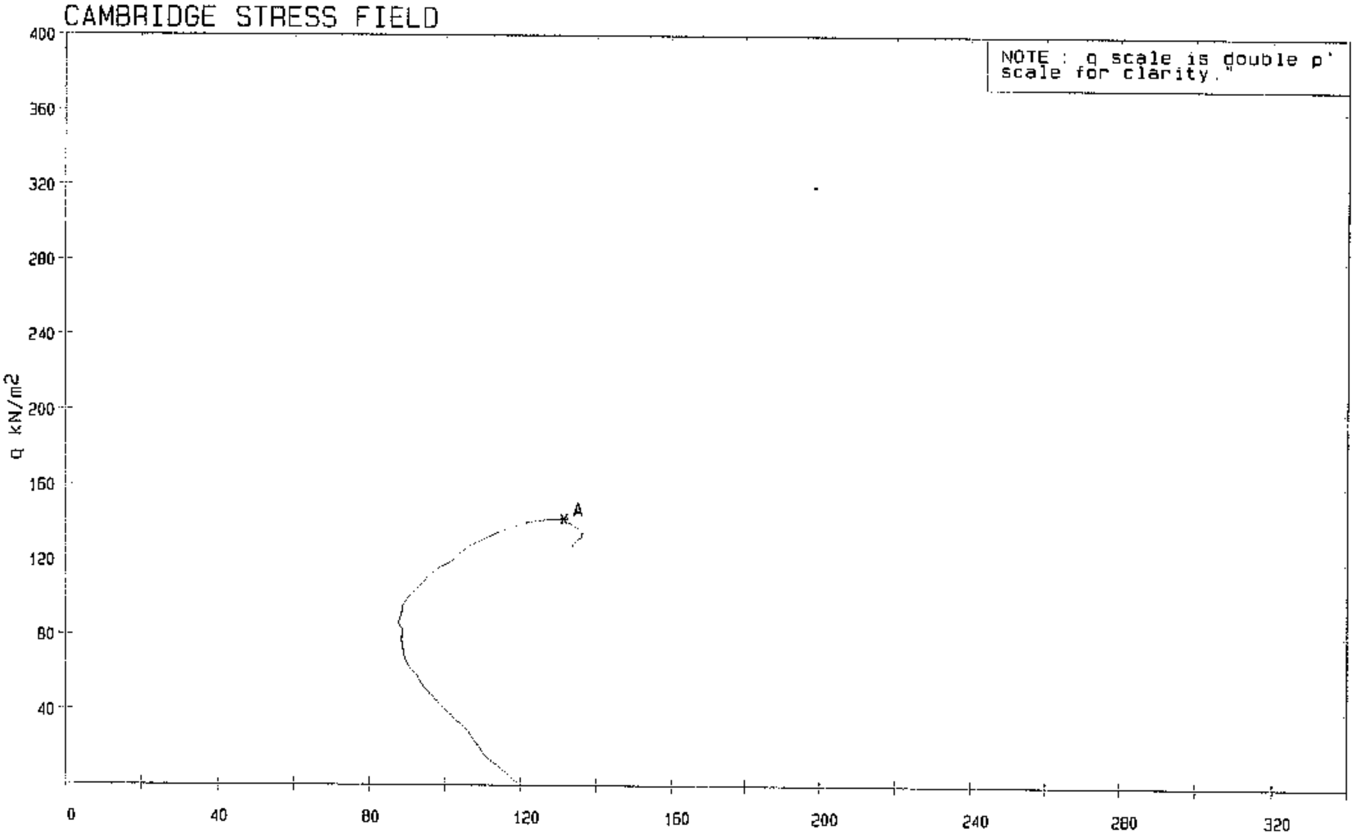
SLR 8.7A	Soil Mechanics	Location TWEEN BRIDGE WIND FARM, PHASE 2	Loc. No. A9057	Fig.

NOTE : Tested at a rate of strain based on pore pressure equalisation at failure only

MIT STRESS FIELD

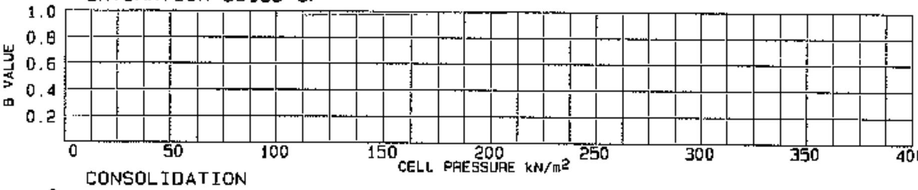


CAMBRIDGE STRESS FIELD

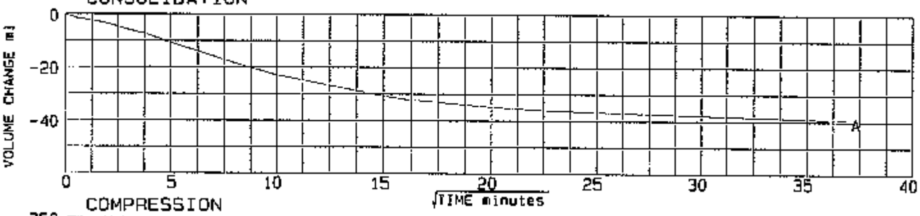


Consolidated Undrained Triaxial Compression Test with measurement of Pore Pressure		Borehole No. BH16 Sample No. U11		Depth 6.00-6.45m
SLR 8.7B	Soil Mechanics	Location TWEEN BRIDGE WIND FARM, PHASE 2	Loc. No. A9057	Fig.

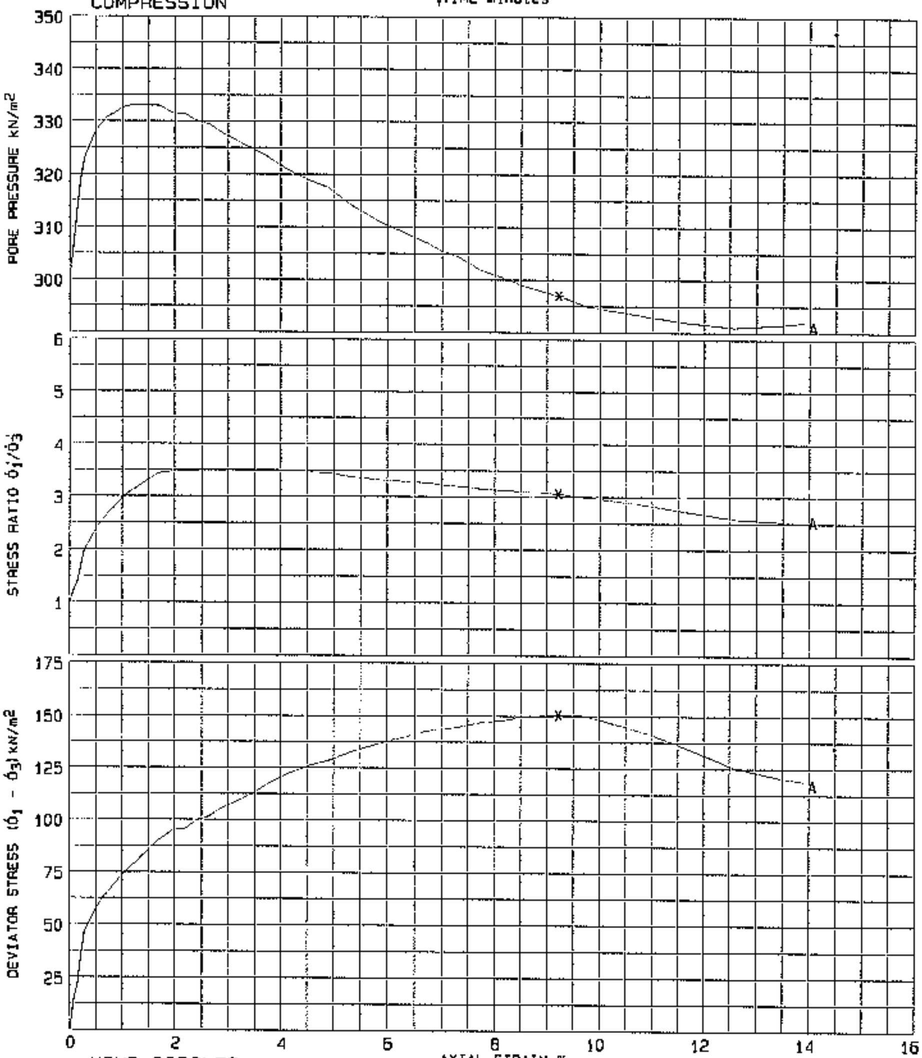
SATURATION BUILD-UP



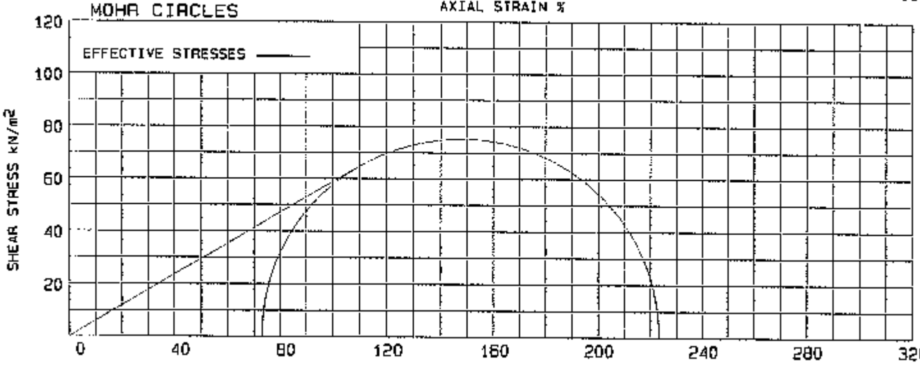
CONSOLIDATION



COMPRESSION



MOHR CIRCLES



	SPECIMEN		A	B	C
INITIAL	Density Mg/m³		2.03		
	Moisture %		26		
	Dry Density Mg/m³		1.61		
AFTER CONSOLIDATION	Density Mg/m³		2.04		
	Moisture %		25		
	Dry Density Mg/m³		1.64		
SATURATION STAGE	Initial pwp	kN/m²	0		
	Saturated pwp	kN/m²	150		
	Final cell pressure	kN/m²	210		
	B value		1.00		
CONSOLIDATION STAGE	Cell Pressure	kN/m²	370		
	Back Pressure	kN/m²	300		
	Initial pwp	kN/m²	356		
	Final pwp	kN/m²	300		
	σ_3'	kN/m²	70		
	pwp dissipation %		100		
COMPRESSION STAGE	Cell Pressure	kN/m²	370		
	Initial pwp	kN/m²	300		
	Inital σ_3'	kN/m²	70		
	Rate of strain % per hour		1.27		
FAILURE CONDITIONS AT PEAK DEVIATOR STRESS	Axial Strain %		9.2		
	$(\sigma_1 - \sigma_3)_f$	kN/m²	150		
	u_f	kN/m²	297		
	$\sigma_3'_f$	kN/m²	73		
	$\sigma_1'_f$	kN/m²	223		
	A_f		-0.02		
	(σ_1' / σ_3')		3.060		
	MODE OF FAILURE				

SHEAR STRENGTH PARAMETERS C' ASSUMED ZERO	C'	Ø'
	0 kN/m²	30½°

NOTES

Saturation by application of cell/back pressure increments of 50 kN/m2 with a differential of 10 kN/m2.

Drainage during consolidation to top with Vertical side drains fitted

Stress/strain curves corrected for area change, side drains and .45 mm thick membrane

SOIL DESCRIPTION
Firm greyish brown thinly laminated CLAY with silt and sand dusting on laminae.

TYPE OF SPECIMEN UNDISTURBED

SPECIMEN DIMENSIONS 103.1 mm dia x 202.8 mm long

Test carried out to BS 1377 : Part 8 : 1990 : Test 7

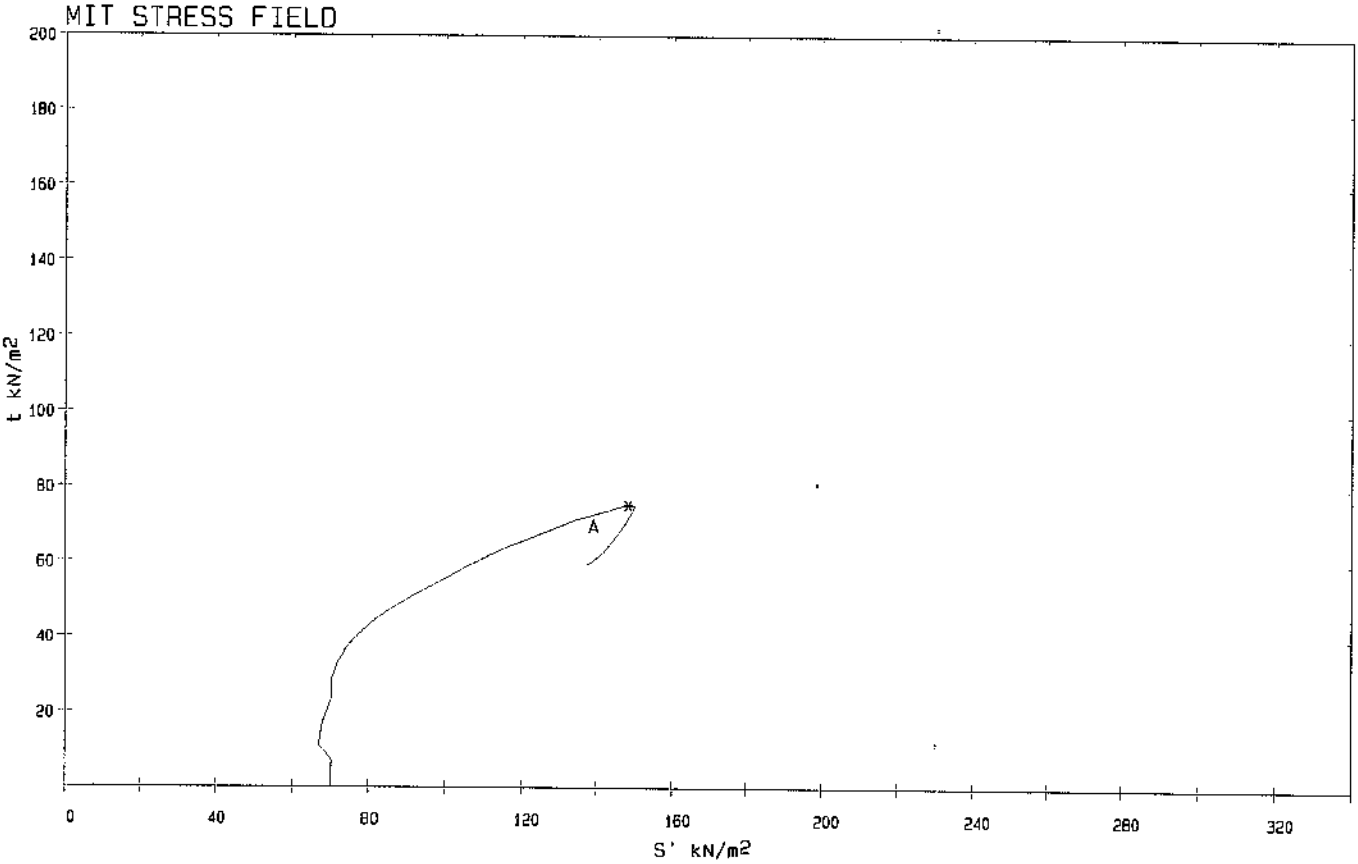
Consolidated Undrained Triaxial Compression Test with measurement of Pore Pressure

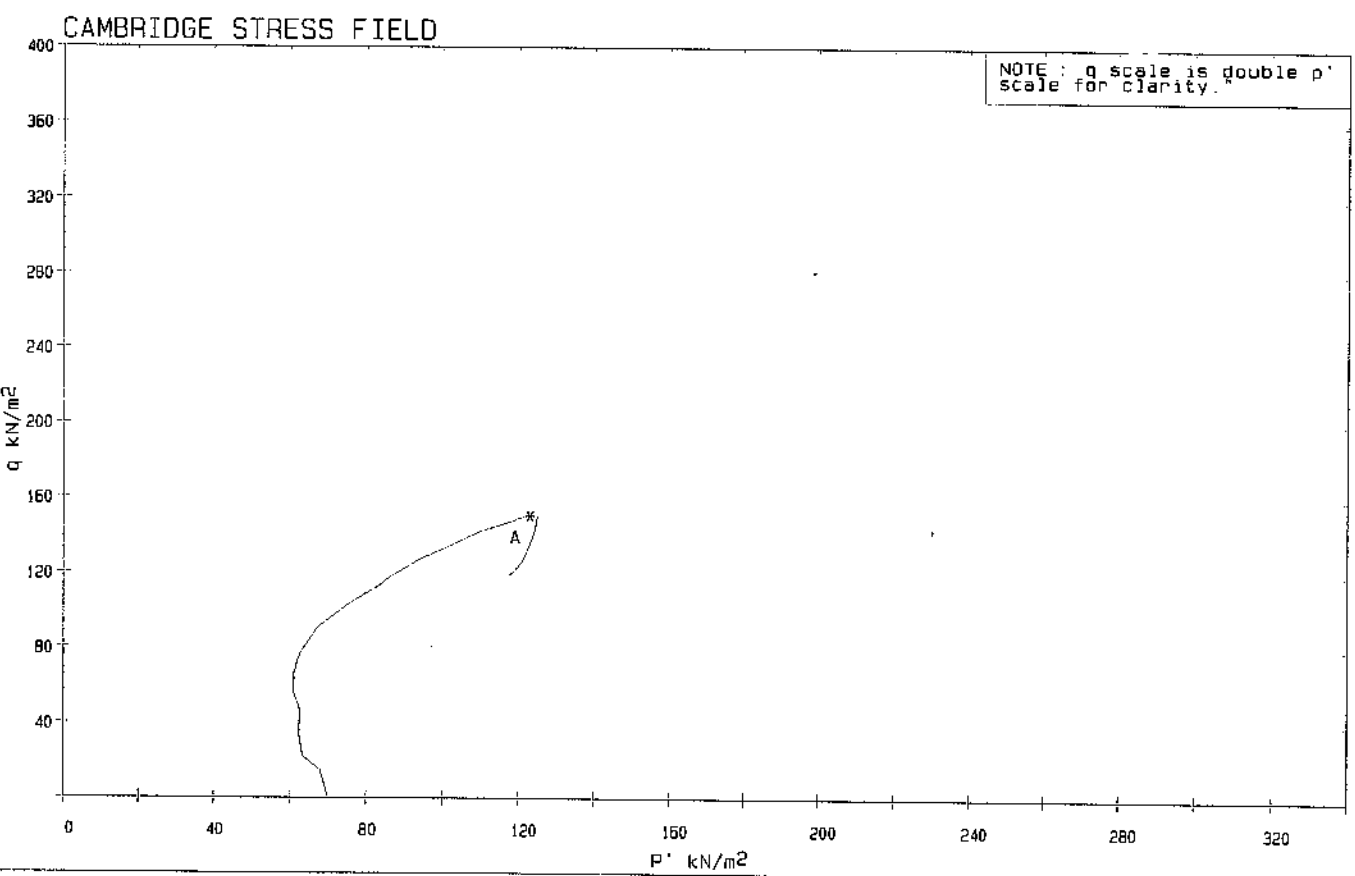
Borehole No. BH18 Depth 3.50-3.95m

Sample No. U7

SLR 8.7A	Soil Mechanics	Location TWEEN BRIDGE WIND FARM, PHASE 2	Loc. No. A9057	Fig.

NOTE : Tested at a rate of strain based on pore pressure equalisation at failure only





Consolidated Undrained Triaxial Compression Test with measurement of Pore Pressure		Borehole No. BH18 Sample No. U7	Depth 3.50-3.95m
SLR 8.7B	Soil Mechanics	Location TWEEN BRIDGE WIND FARM, PHASE 2	Loc. No. A9057	Fig.

Soil Mechanics

Project: TWEEN BRIDGE WIND FARM, PHASE 2

Project No: A9057

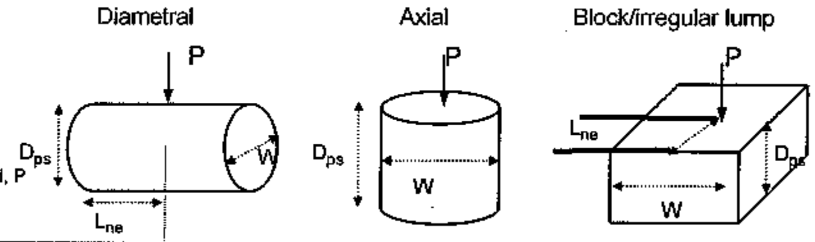
Carried out by: EM

Date: 06 May 2009

Test Type
D - Diametral, A - Axial, I - Irregular Lump
Direction (U = unknown or random)
L - parallel to planes of weakness
P - perpendicular to planes of weakness
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P

Machine Ram Area, cm^2 14.426

Point Load Test Results



Borehole	Top, m BGL	Ref	Type	Test No	Test Depth, m BGL	Description	Test Type see ISRM Fig 5 and 8: Type (D, A, I)	Direction (L/P)	Failure Valid (Y/N)	Dimensions: L mm	Dps', mm	W mm	Gauge reading, MPa	P Failure Load, kN	P Failure Load, kN	De equivalent diameter, mm	Is MPa	Is(50) point load index, MPa	Remarks
BH8	14.46	25	CS	1	14.54	SANDSTONE	D	L	Y	35	97	100	0.48	0.69		98.5	0.07	0.10	
BH8	14.46	25	CS	2	14.51	SANDSTONE	A	P	Y		38	100	0.51	0.74		69.6	0.15	0.18	
BH8	15.22	27	CS	1	15.31	SANDSTONE	D	L	Y	40	97	100	0.52	0.75		98.5	0.08	0.10	
BH8	15.22	27	CS	2	15.27	SANDSTONE	A	P	Y		31	100	0.56	0.81		62.8	0.20	0.23	
BH10	13.33	22	CS	1	13.43	SANDSTONE	D	L	Y	50	100	100	0.08	0.12		100.0	0.01	0.02	
BH10	13.33	22	CS	2	13.37	SANDSTONE	A	P	Y		54	100	0.29	0.42		82.9	0.06	0.08	
BH10	15.23	23	CS	1	15.30	SANDSTONE	D	L	Y	40	100	100	0.44	0.63		100.0	0.06	0.09	
BH10	15.23	23	CS	2	15.27	SANDSTONE	A	P	Y		36	100	0.67	0.97		67.7	0.21	0.24	
BH13	12.11	24	CS	1	12.20	SANDSTONE	D	L	Y	50	99	100	0.28	0.40		99.5	0.04	0.06	
BH13	12.11	24	CS	2	12.15	SANDSTONE	A	P	Y		40	100	0.80	1.15		71.4	0.23	0.27	
BH13	14.00	25	CS	1	14.09	SANDSTONE	D	L	Y	45	99	100	0.44	0.63		99.5	0.06	0.09	
BH13	14.00	25	CS	2	14.04	SANDSTONE	A	P	Y		47	100	0.52	0.75		77.4	0.13	0.15	
BH16	17.78	27	CS	1	17.88	SANDSTONE	D	L	Y	50	95	100	0.26	0.38		97.5	0.04	0.05	
BH16	17.78	27	CS	2	17.83	SANDSTONE	A	P	Y		42	100	0.60	0.87		73.1	0.16	0.19	
BH16	18.54	28	CS	1	18.65	SANDSTONE	D	L	Y	50	98	100	0.42	0.61		99.0	0.06	0.08	
BH16	18.54	28	CS	2	18.62	SANDSTONE	A	P	Y		31	100	0.64	0.92		62.8	0.23	0.26	
BH18	19.70	22	CS	1	19.80	SANDSTONE	D	L	Y	50	99	100	0.20	0.29		99.5	0.03	0.04	
BH18	19.70	22	CS	2	19.75	SANDSTONE	A	P	Y		46	100	0.68	0.98		76.5	0.17	0.20	
BH18	20.75	23	CS	1	20.85	SANDSTONE	D	L	Y	55	100	100	0.22	0.32		100.0	0.03	0.04	
BH18	20.75	23	CS	2	20.80	SANDSTONE	A	P	Y		34	100	1.60	2.31		65.8	0.53	0.60	
BH22	14.46	29	CS	1	14.58	SANDSTONE	D	L	Y	60	100	100	0.24	0.35		100.0	0.03	0.05	
BH22	14.46	29	CS	2	14.52	SANDSTONE	A	P	Y		69	100	0.56	0.81		93.7	0.09	0.12	
BH22	17.53	30	CS	1	17.63	SANDSTONE	D	L	Y	50	100	100	0.20	0.29		100.0	0.03	0.04	
BH22	17.53	30	CS	2	17.58	SANDSTONE	A	P	Y		41	100	0.36	0.52		72.3	0.10	0.12	

Soil Mechanics

Point Load Test Results

Project: TWEEN BRIDGE WIND FARM, PHASE 2

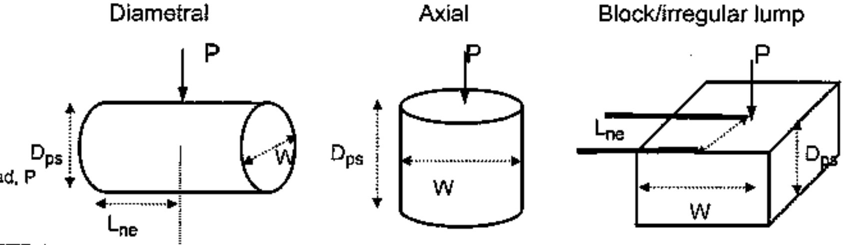
Project No: A9057

Carried out by: EM

Date: 07 May 2009

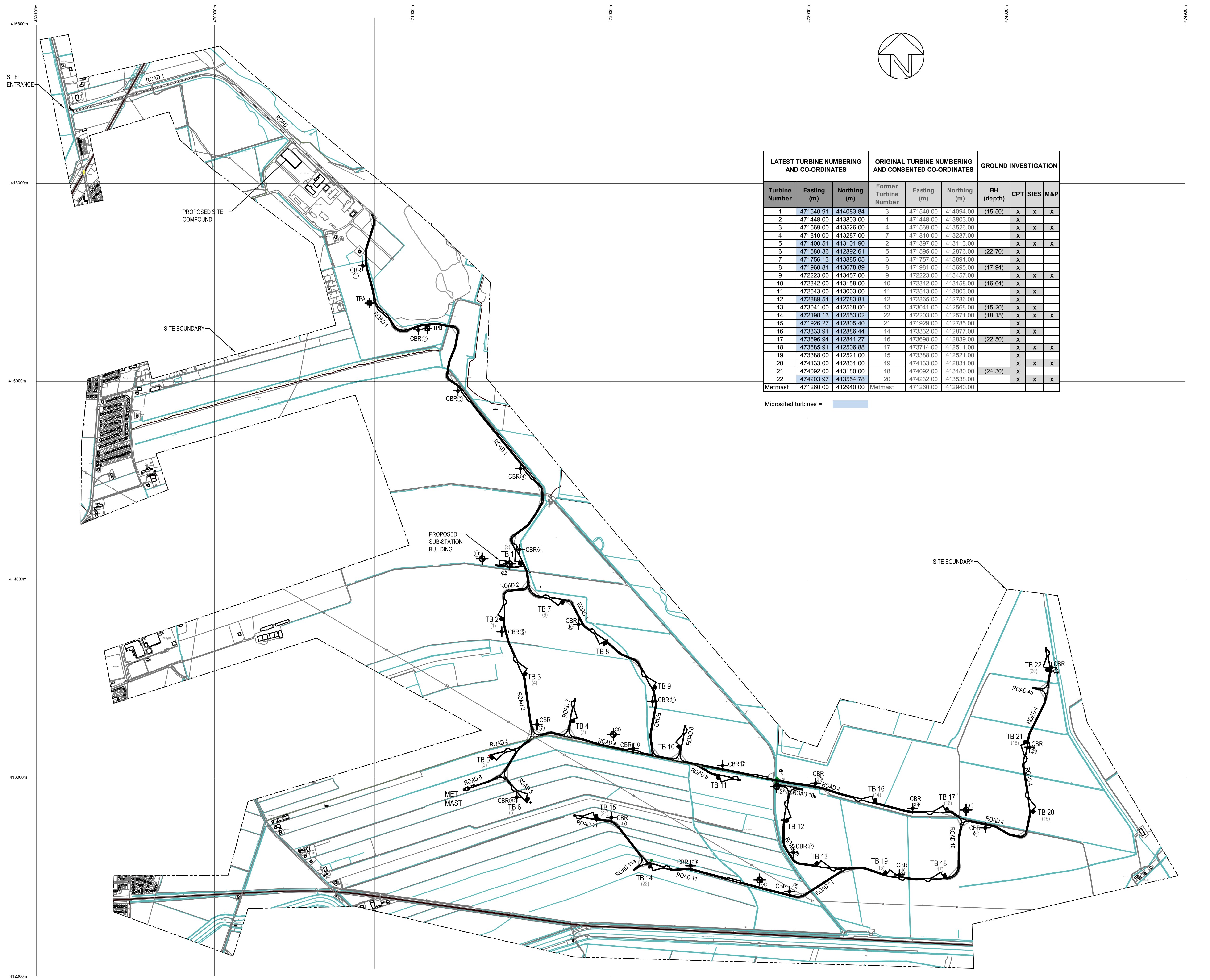
Test Type
D - Diametral, A - Axial, I - Irregular Lump
Direction (U = unknown or random)
L - parallel to planes of weakness
P - perpendicular to planes of weakness
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P

Machine Ram Area, cm^2 14.426



Borehole	Top, m BGL	Ref	Type	Test No	Test Depth, m BGL	Description	Test Type see ISRM Fig 5 and 8: Type (D, A, I)	Test Type see ISRM Fig 5 and 8: Direction (L/P)	Failure Valid (Y/N)	Dimensions: L mm	Dimensions: Dps', mm	Dimensions: W mm	Gauge reading, MPa	P Failure Load, kN	P Failure Load, kN	De equivalent diameter, mm	Is MPa	Is(50) point load index, MPa	Remarks
BH10	13.58	CS24		1	13.67	SANDSTONE	D	L	Y	40	74	100	0.29	0.42		86.0	0.06	0.07	
BH10	13.58	CS24		2	13.63	SANDSTONE	A	P	Y		15	100	0.32	0.46		43.7	0.24	0.23	
BH13	13.50	CS26		1	13.62	SANDSTONE	D	L	Y	60	98	100	0.28	0.40		99.0	0.04	0.06	
BH13	13.50	CS26		2	13.54	SANDSTONE	A	P	Y		64	100	0.30	0.43		90.3	0.05	0.07	
BH16	17.00	CS29		1	17.10	SANDSTONE	D	L	Y	40	100	100	0.24	0.35		100.0	0.03	0.05	
BH16	17.00	CS29		2	17.05	SANDSTONE	A	P	Y		41	100	0.80	1.15		72.3	0.22	0.26	
BH18	19.52	CS24		1	19.62	SANDSTONE	D	L	Y	50	97	100	0.20	0.29		98.5	0.03	0.04	
BH18	19.52	CS24		2	19.59	SANDSTONE	A	P	Y		28	100	0.67	0.97		59.7	0.27	0.29	
BH22	16.35	CS31		1	16.47	SANDSTONE	D	L	Y	60	99	100	0.36	0.52		99.5	0.05	0.07	
BH22	16.35	CS31		2	16.41	SANDSTONE	A	P	Y		44	100	0.51	0.74		74.8	0.13	0.16	

APPENDIX C: GROUND INVESTIGATION AND ROAD LAYOUT PLAN



LATEST TURBINE NUMBERING AND CO-ORDINATES			ORIGINAL TURBINE NUMBERING AND CONSENTED CO-ORDINATES			GROUND INVESTIGATION			
Turbine Number	Easting (m)	Northing (m)	Former Turbine Number	Easting (m)	Northing (m)	BH (depth)	CPT	SIES	M&P
1	471540.91	414083.84	3	471540.00	414094.00	(15.50)	x	x	x
2	471448.00	413803.00	1	471448.00	413803.00		x		
3	471569.00	413526.00	4	471569.00	413526.00		x	x	x
4	471810.00	413287.00	7	471810.00	413287.00		x		
5	471400.51	413101.90	2	471397.00	413113.00		x	x	x
6	471580.36	412892.61	5	471595.00	412876.00	(22.70)	x		
7	471756.13	413885.05	6	471757.00	413891.00		x		
8	471968.81	413678.89	8	471981.00	413695.00	(17.94)	x		
9	472223.00	413457.00	9	472223.00	413457.00		x	x	x
10	472342.00	413158.00	10	472342.00	413158.00	(16.64)	x		
11	472543.00	413003.00	11	472543.00	413003.00		x	x	
12	472889.54	412783.81	12	472865.00	412786.00		x		
13	473041.00	412568.00	13	473041.00	412568.00	(15.20)	x	x	
14	472198.13	412553.02	22	472203.00	412571.00	(18.15)	x	x	x
15	471926.27	412805.40	21	471929.00	412785.00		x		
16	473333.91	412886.44	14	473332.00	412877.00		x	x	
17	473696.94	412841.27	16	473698.00	412839.00	(22.50)	x		
18	473685.91	412506.88	17	473714.00	412511.00		x	x	x
19	473388.00	412521.00	15	473388.00	412521.00		x		
20	474133.00	412831.00	19	474133.00	412831.00		x	x	x
21	474092.00	413180.00	18	474092.00	413180.00	(24.30)	x		
22	474203.97	413554.78	20	474232.00	413538.00		x	x	x
Metmast	471260.00	412940.00	Metmast	471260.00	412940.00				

Microsited turbines =

TURBINE LOCATION GROUND INVESTIGATION KEY

BH BOREHOLE
CPT CONE PENETRATION TEST
SIES SEISMIC CONE TEST
M&P MOSTAP SAMPLE & PRESSUREMETER TEST

OTHER GROUND INVESTIGATION LOCATIONS

WINDOW SAMPLE BOREHOLE WITH GAS MONITORING INSTALLATION

CBR① CALIFORNIA BEARING RATIO TEST LOCATION

TB 20 (19) CURRENT WTG POSITION (FORMER WTG REFERENCE No.)

TPA TRIAL PIT LOCATIONS

Rev.	Revision Description	Drn	Chkd	Appd	Date
A	ISSUED FOR TENDER PURPOSES	RD	DJL	WT	12.06.09

Status:

FOR TENDER PURPOSES

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Project: TWEEN BRIDGE WINDFARM ECI STAGE 1

Title: GROUND INVESTIGATION & SITE TRACK LAYOUT

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RD	DJL	DJL
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ORDE/03

OLD RIVER DON WIND FARM

Geoarchaeological Report

commissioned by REG Windpower

February 2015

HEADLAND ARCHAEOLOGY

REGISTERED CIfA ORGANISATION

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project info

HA JOB NO.	ORDE/03
HAS NO.	HAS1095
NGR	SE 74760 12300
PARISH	Crowle
LOCAL AUTHORITY	North Lincolnshire

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REGISTERED CIfA ORGANISATION

Old River Don Wind Farm
Geoarchaeological Report

SUMMARY

An auger survey was undertaken on land at Medge Hall, Crowle, as part of a programme of evaluation required as Supplementary Environmental Information further to the cultural heritage assessment presented in an Environmental Statement for the Old River Don Wind Farm, a development of six wind turbines and associated infrastructure. The survey consisted of 7 auger transects, sampling turbine base micro-siting zones and compound area. The aim of the survey was to record the presence or absence of peat deposits across the areas of deep construction impacts, and to investigate the cultural and palaeoenvironmental potential of the area. A further facet was the ground-truthing of a previous geophysical survey, in order to determine the topography of the basement sands and the potential of this deposit as a former occupation horizon.

The coring demonstrated the presence of organic rich deposits at turbines 1-4, comprising a peat deposit of a reasonably uniform 1m thickness, which was overlain by 1m+ of deliberately introduced tidal silts ('warp'). At turbine 5 peat cover appeared reduced or absent. At turbine 6 a raised island or levee rose above the peat and river channel deposits. At the proposed compound area a former channel of the Old River Don was detected.

The peat sequences detected are not considered to be of particular palaeoenvironmental interest, in comparison to other previously studied sequences in the locality. Any archaeological remains in the turbine 1-4 locations would most likely be associated with pre-peat levels, at an average depth of 2m below ground level (average elevation -0.17m OD). Turbine 6 may have some archaeological potential at shallower depths associated with the higher ground. Turbine 5 appears to have limited cover of warp and peat, which may relate to former peat cutting activity. The compound area has limited archaeological potential due to the presence of river channel deposits.

The previous conductivity survey appears to have provided generally reliable information about the thickness of superficial cover at turbines 1-5, but did not directly detect the presence of peat.

INTRODUCTION

REG Windpower has submitted an Environmental Statement in support of a planning application for the construction of six wind turbines with associated infrastructure at Old River Don Wind Farm, Medge Hall, near Crowle, North Lincolnshire. The proposed development area (PDA) sits within an area of potential archaeological significance which has already been subject to limited investigation by the Humber Wetlands Project (Van de Noort and Ellis 1997). A key aspect of this is in relation to multiperiod activity (Mesolithic to the 20^{th} century) and the palaeoenvironmental potential of peat deposits across the PDA. In order to understand the potential impacts on sub-surface heritage assets, the archaeological advisor to the planning authority requested that a programme of evaluation be carried out prior to determination of the planning application.

REG Windpower commissioned Headland Archaeology to agree and undertake a programme of field evaluation, comprising geophysical survey, palaeoenvironmental coring and fieldwalking.

A geophysical survey using an EM-31 conductivity meter was undertaken by Headland Archaeology in September 2014 (Mayes 2014). The objective of the survey was to map the sub-peat topography of turbine bases 1-5, by attempting to differentiate between areas of conductive - presumed wet – ground, and areas of resistant – and presumed drier – ground. The survey demonstrated variations in the conductivity of the deposits across the survey areas but concluded that ground-truthing of the results was needed in order to determine the extent to which variations in peat thickness had influenced the conductivity results.

This component of the pre-determination work comprised targeted hand-auger survey of the turbine base micro-siting zones and compound area (Illus 1). This was designed to provide further information about the presence and thickness of peat deposits and the depth of the sub-peat topography in order to assist in establishing the archaeological potential of the proposed development area. A project design covering the work was agreed with the archaeological advisor to the planning authority (Kimber 2014).

Site Description

The site is located c.2km to the west of Crowle (centred at NGR 474964 413217). The majority of the site comprises Grade 2 agricultural land with a small area of Grade 3 located at the site access from Marsh Road. It is currently managed for arable production. A strip of woodland, aligned roughly northeast-southwest, dissects the centre of the site; however the majority lies outside of the site boundary. The site is drained by numerous drains and ditches.

Thorne Moor Special Areas of Conservation (SAC) and part of the Thorne and Hatfield Moors Special Protection Areas (SPA) border the site on the north-east and north-west. A further four international sites, i.e. Special Areas of Conservation, Special Protection Areas and Ramsar sites are located within 10km of the Site.

The site is located within the Humberhead Levels region of the Humber wetlands, a low-lying region to the southwest of the Humber estuary. The land profile is generally flat, with ground levels lying between 3m Above Ordnance Datum (OD) and 0.7m OD. The old course of the River Don, made redundant by artificial drainage, passes through the south-eastern part of the development area in a broad alluvial floodplain. To the east of the Old River Don, Crowle sits at the northern tip of the Isle of Axholme, an area of higher ground bounded by the former wetlands of the Trent valley to the east and the Don, Idle and Torne to the west. The north-west half of the site lies within Thorne Moors, an area of raised mire wetland which has been considerable reduced and degraded by peat extraction and agricultural drainage.

OBJECTIVES

The objectives of the auger survey were:

- To determine the thickness of any superficial deposits of low archaeological/palaeoenvironmental potential;
- To target particular high-conductivity anomalies/trends and check whether they correspond to buried areas of deep peat;
- To target particular low-conductivity anomalies/trends and check whether they correspond to areas of raised ground within the buried raised mire;
- In the Turbine 6 and compound area; check whether buried ground surfaces with archaeological potential could occur at depths greater than can be detected by a gradiometer survey (0.5-1m);
- In the Turbine 6 and compound areas; locate if possible any former river channels;
- To thereby check the interpretation of the geophysical survey against actual ground conditions and produce a sub-surface deposit model with a high confidence rating;
- To use this information to inform the siting of the proposed wind turbines and other site infrastructure away from areas of archaeological and/or palaeoenvironmental potential;

- To produce and deposit a satisfactory archive and disseminate the results of the work via grey-literature reporting and publication as appropriate.

METHODOLOGY

Fieldwork

The fieldwork methodology was set out fully in the Project Design (Kimber 2014), but in brief, provision was made for the drilling of 70 auger points across the development zone. At several points in Turbines 1-6 the highly compacted nature of the warp deposits hindered borehole recovery. At these locations the resolution of the transects was reduced to target the principal variations in conductivity. These modifications were undertaken in discussion with the monitoring archaeologist. It was rapidly determined that the Compound Area was located within a zone previously occupied by a substantial palaeochannel of the Old River Don, and resolution was reduced here on the recommendation of the palaeoenvironmental specialist as significant sedimentary variation across the channel was unlikely. In total 41 points were drilled on transects across the turbine micro-siting localities. The remaining 3 points were in the compound area. All drilling was undertaken using a Dutch Auger and 6cm gouge auger.

All auger points were located using a Trimble GPS, allowing the construction of a Digital Elevation Model (DEM) and subsurface relief map in a Geographic Information System (SURFER10) representing thickness and depth of the peat deposit.

RESULTS

The auger survey will be discussed in two parts. The first will consist of a characterisation of the sedimentary units found across the site. The Compound Area, Turbine 5 and Turbine 6 will be discussed individually, while the remaining Turbines will be discussed together, due to the relatively homogeneity of the deposits found in these areas. The second part will provide comment on the relationship of the geophysical survey to the depth of the stratigraphy and sedimentology observed at the site.

Full details of all augers taken are given in Appendix 1.

Turbines 1-4

The basement varied across the site: at Turbines 1 (Illus 2 & 3), 2 (Illus 4 & 5) and 3 (Illus 6 & 7) this consisted of clay or a silty, clay rich sand, whilst at Turbine 4 (Illus 8 & 9) the basement deposit was sand. The depth at which this deposit was reached varied between -1.08m OD (Turbine 1) and +0.37m OD (Turbine 2). This disparity probably represents the buried topography of the basement. Overall, the basement depth was generally below sea level, although there were indications of a slight rise at Turbine 2 (Table 1). Deeper measurements, possibly representing topographically significant variations occurred at Turbine 1 (Borehole 70; d=-1.08m OD) and Turbine 4 (Boreholes 39 & 40; d=-0.83 & -0.76m OD).

Where the basement consisted of clay or sandy clay, a sandy deposit overlay the primary unit. This was capped in some areas by further deposits of sand and clay, most notably borehole 65 and 68, Turbine 1; borehole 52, Turbine 2; and boreholes 41 and 43, Turbine 3. Boreholes 52 and 65 were particularly complex with several intercalated layers of sand and clay.

The subsequent unit, which variously consisted of fibrous peat was found across all four turbines, and whilst the base of this deposit varied across them, the overall thickness of the deposit did not often significantly exceed 1m; although at Borehole 70 it was 1.64m thick. In nearly all cases, the peat gave way to further bands of intercalated sands and clays, before giving way to loamy topsoil.

Turbine 5 (Illus 10 & 11)

The basement deposit here was sandy, and generally slightly above sea level, with a maximum elevation of 0.18m OD. Across Profile 10 at Turbine 5 (boreholes 29, 27 25 & 22), the peat was almost entirely absent except at Borehole 27, where a grainy organic peat lay directly beneath the topsoil.

Borehole 21 identified a large hollow, the base of which lay at -1.14m OD. The hollow was filled with 0.67m of organic silt and peat and sealed by approximately 1m of silty clays, sandy silts and topsoil.

In general this location seems to have lost (or never had) peat cover like at Turbines 1-4; and does not seem to have had significant warp cover either.

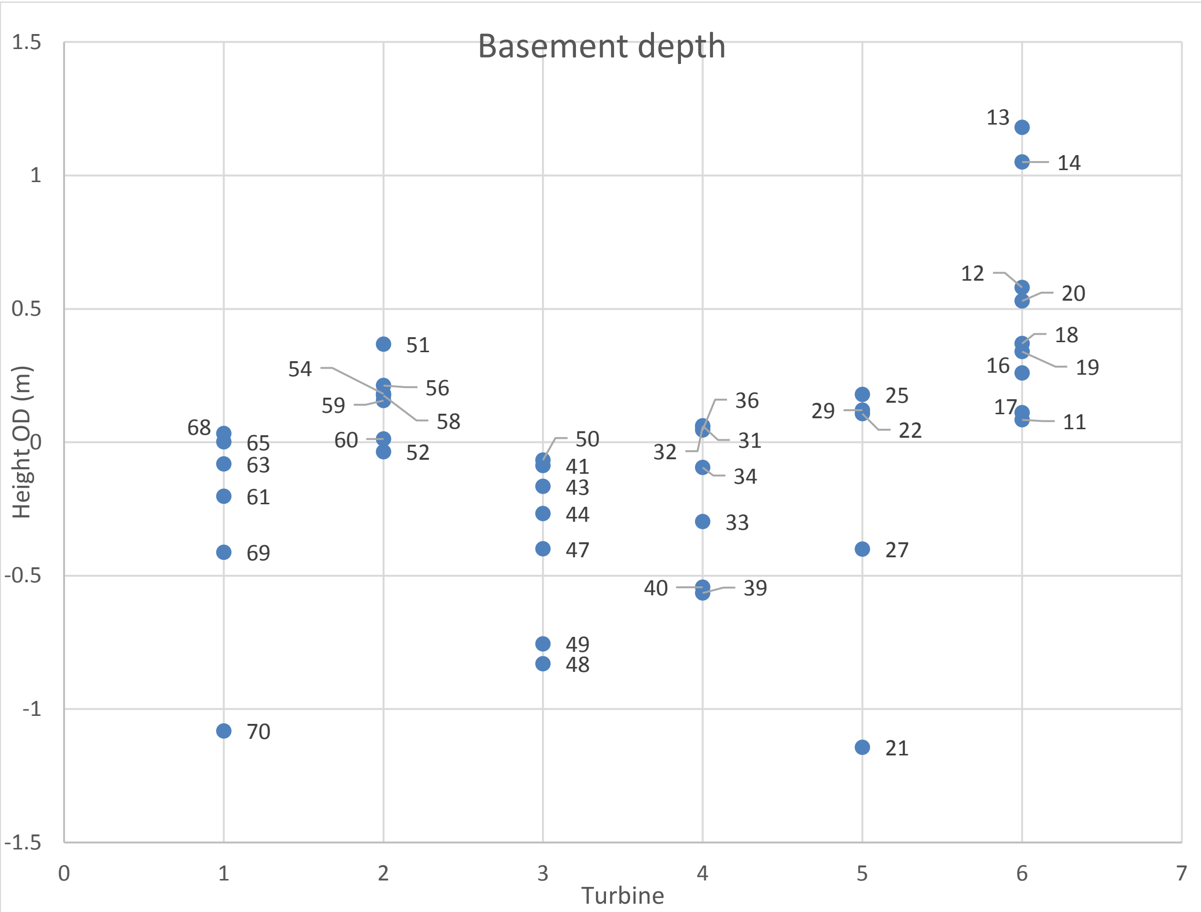


Table 1: Basement depth at Turbines 1-6

Turbine 6 (Illus 12 & 13)

In contrast to Turbines 1-5, the stratigraphy associated with Turbine 6 was relatively shallow and consisted predominantly of basal sand, in some cases sandy clay or clay silt which is overlain variously by silty clays before finally giving way to a clay-rich topsoil. Thin lenses of organic matter were present at some of the borehole locations – notably boreholes 11, 16, 17 & 18 - however these sediments did not seem to represent extensive peat cover, in particular the centre of this area appears clear of peat. The basement topography rose in this area, to 1.18m OD (borehole 13), where a noticeable topographic rise was present.

Compound (Illus 14 & 15)

The stratigraphic sequence in the area of the compound was relatively simple, consisting of a tripartite or bipartite sequence of grey clay, peat and a sandy, clay rich topsoil. Borehole 2 was the deepest found at the site, exceeding four metres and containing in excess of 1.5m of peat. Fragments of wood were also noted within this deposit; borehole 7 was abandoned due to the presence of a large impenetrable piece of wood, whether floodplain detritus or the more substantial remains of an *in situ* tree.

COMPARISON WITH GEOPHYSICAL INTERPRETATION

Turbine 1

The auger transect across Profile 01 in this area supports the suggestion from the conductivity of a wetter or deeper area within the underlying landscape. Overall, the top of the peat in this area was found between 0.77 and 1.58m below ground level (1.05-0.56m OD) with thickness increasing slightly from 0.92-1.64m to the north in line with increased conductivity. The overlying warp also increased in thickness, and the level of the basement sands also fell away towards the north, from -0.20m to -1.08m OD. The geophysics appears to have accurately mapped a buried topographic variation in this area. A similar trend was not observed in Profile 02. The absolute depth of the basement layer and the thickness of the warp and underlying peat did not vary significantly in this area. The general consistency in deposit thicknesses along this transect appears consistent with the low variability in the conductivity readings.

Turbine 2

The peat deposits in this area were less thick than those in Turbine 1. The deeper peat deposits found in boreholes 52 and 58 were associated with reduced conductivity readings compared to the thinner peat deposits in boreholes 56 & 59, when the opposite was expected from the geophysical interpretation. It is likely that there were other influences on the conductivity reading from superficial or bedrock deposits that have overwhelmed any signal from the peat.

In general there was little significant variation in warp cover, peat thickness or basement depth, and this appears to be reflected in the low variation of the conductivity readings. The thickness of total cover was shallowest at Borehole 51 (d=1.16m) and this point was both elevated compared to the other basement levels (0.37m OD) and associated with a reading of reduced conductivity.

Turbine 3

The sedimentology in this area corresponded occasionally with the interpretation of the geophysical survey, particularly in the case of borehole 49, which had 1.5m thick peat within an apparent basin and high conductivity; the evidence at borehole 48 - with very similar stratigraphy but low conductivity – was contradictory of the model. The remaining boreholes in this sequence 41 and 43 are also anomalous, in particular borehole 50 revealed only 0.1m of peat but had a high conductivity. Variation in the thickness of the superficial deposits appears to have been more influential on the conductivity readings.

Turbine 4

Whilst areas of thicker peat were associated with high conductivity values in boreholes 32, 33 & 39, other areas of peat with almost the same thickness were associated with lower conductivity values (e.g. boreholes 34, 36 & 40). There was no clear correlation between peat thickness and conductivity at this location.

Turbine 5

The borehole data at this turbine base supported the geophysical interpretation in part. The variation in conductivity across Profile 10 was reflected in the apparent presence of a peat filled channel. The increased conductivity in the area of borehole 21 was associated with thicker peat than elsewhere at this location, but also with a thicker superficial deposit of warp.

DISCUSSION

The area surrounding the proposed DA and indeed the DA itself has been subject to significant archaeological and environmental investigation since the 1970s (e.g. Buckland, 1979; van de Noort and Ellis, 1997, 1998). It is, nonetheless, the first time predictive modelling has been applied in this area. Such methods have already been applied in a number of areas in the Trent Valley (Brown *et al*. 2007; Carey *et al.* 2006; Challis *et al.* 2007; Gearey and Chapman, 2002).

Auger Survey

The most significant results of this survey are:

- The relatively shallow depth of the peat deposit across the site;
- The presence of a topographic rise or 'island' in the area of Turbine 6;
- The possible location of a former channel of the River Don at the compound area.

When compared to the data from the Adlingfleet transect (Van de Noort and Ellis 1998) the boreholes from Crowle are substantially shallower. Nonetheless, overall, the stratigraphy is strikingly similar: a base of blue grey alluvium, associated with early Holocene sea level rise, overlain by a fine to medium sand of aeolian provenance (Van de Noort and Ellis 1998). These units are overlain by the peat deposit which in most cases is less than 1.2m thick, once again in comparison to the Adlingfleet boreholes, this is relatively shallow.

Peat formation and succession is well understood as a result of the substantial corpus of analytical work undertaken by the Humber Wetlands Project in the mid-1990s. Organic deposition commenced *c*. 5200-2650BP and is indicative of flooding of the lower lying ground and subsequent paludification (Van de Noort and Ellis 1998). In the wider area pollen analysis in the area broadly indicates a succession of reed (*Phragmites)* swamp, mixed Alder (*Alnus)* dominated fen carr woodland before giving way to a further reed dominated episode (Van de Noort and Ellis 1998). In the immediate vicinity of Crowle, previous work suggests a backswamp or riparian mire (Dinnin 1997).

These organic deposits are overlain by the alluvium and sands of warp which was deposited during the 19th century.

Archaeologically, the area of most interest identified by both the auger survey and the geophysics is the raised area, which occupies the footprint of Turbine 6. This feature is expressed as a low, domed topographic rise within the landscape. It is composed of sands and gravels, consistent with an in-channel bar or levee capped by sand and may be associated with the early/mid Holocene proto Don. It is the most likely area to contain any evidence of prehistoric or Romano-British activity in the area.

The location of Turbine 5 may also be of archaeological potential, because of the apparent absence of peat from much of this area. The sub-peat ground surface is at a similar level to that at Turbines 1-4, and it is possible that any peat cover in this area was fully removed by peat cutters and that the area was not subsequently warped.

Finally, within the compound area, it is possible that the boreholes in this area have identified deeper areas of alluvium and organics associated with a palaeochannel of the Old River Don. In the borehole 2 location it seems that a backswamp area similar to that at turbines 1-4 was overlain by later alluvial sedimentation deriving from the channel. A southern channel of the Don at Crowle was subject to intensive palaeoenvironmental investigation by Dinnin (1997). After the development of a carr woodland and floodplain mire 7500-5000BP, this was also replaced by tranquil backswamp or floodplain mire (Dinnin 1997).

Geophysics and the stratigraphic sequence

The auger survey has revealed a relatively homogeneous band of peat which varies from approximately 0.6-1.6m in thickness at Turbines 1-4, but was absent from Turbines 5 & 6. In several areas, most notably Turbines 1, 4 & 5, high conductivity areas were associated with real features of substantial depth and containing a more significant peat deposit than observed across the rest of the area. In contrast, the results for Turbine 2 indicated reduced conductivity, even where the sedimentology clearly indicated a substantial depth of peat (e.g. boreholes 59 and 60).

It was originally hoped that the geophysics would indicate the overall thickness of the peat across the site. However, there was only a slight correlation between peat thickness and conductivity readings (Table 2). There does appear to be a stronger correlation between the thickness of superficial cover and increased conductivity (Table 3). This suggests that the properties of the overlying warp deposits exerted a dominant effect on the readings taken by the conductivity meter, save in areas of gross variation in the sub-peat topography. This may be because the marine derived warp deposits contain a higher concentration of dissolved salts than the groundwater fed peat, which could lead to higher conductivity readings where thicker deposits of warp are present (A Boucher pers comm).

The base of the warp also appears to reflect the solid geology of the basement itself. This is likely to be a result of peat compression across the site, the weight of the warp and overlying sediments, which will be highly variable, causing downward movement in the peat where the basement is deeper. This effect will be enhanced by the composition of the peat itself, for example, in areas where the peat is composed of a tougher material such as wood, the effects of compression will be less. In areas of less resistant material, such as sedges, reeds or even areas which may once have been open water, this effect will be enhanced. This effect and the associated problems and the ramifications for archaeology and palaeoenvironmental analysis, particularly chronological issues has been well documented by a number of authors, e.g. Allen 1999, 2004; Haslett *et al*. 1998; Long *et al*. 2006. Whilst these are examples exploring intertidal environments, when warp formation is considered, such examples provide ideal parallels.

A further consideration, which may explain the nature of the stratigraphy and its relationship to the geophysical results, particularly in the case of Turbine 2, is the depth of the water table and its effects on the moisture content of the peat. The geophysical survey was undertaken during the early autumn of 2014, at the end of one of the driest summers in recent years. This would have had a direct effect on the water table in the area, which could be assumed to be lower than usual and also the moisture content of the peat, which could be considered to be reduced. Other factors may include better drainage in this particular area, greater permeability of the bedrock or subtle variations in the depth of the peat itself.

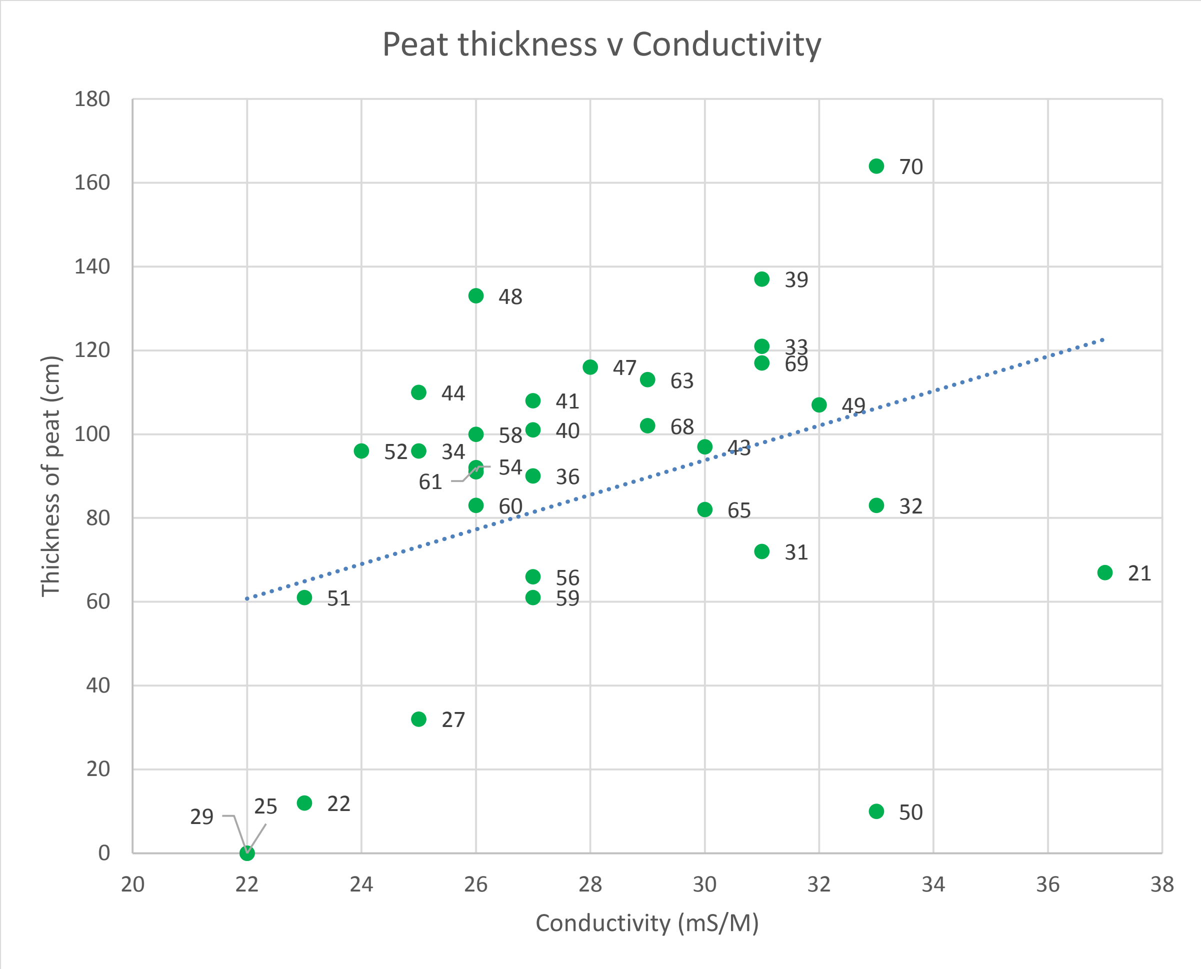


Table 2: Peat thickness versus conductivity

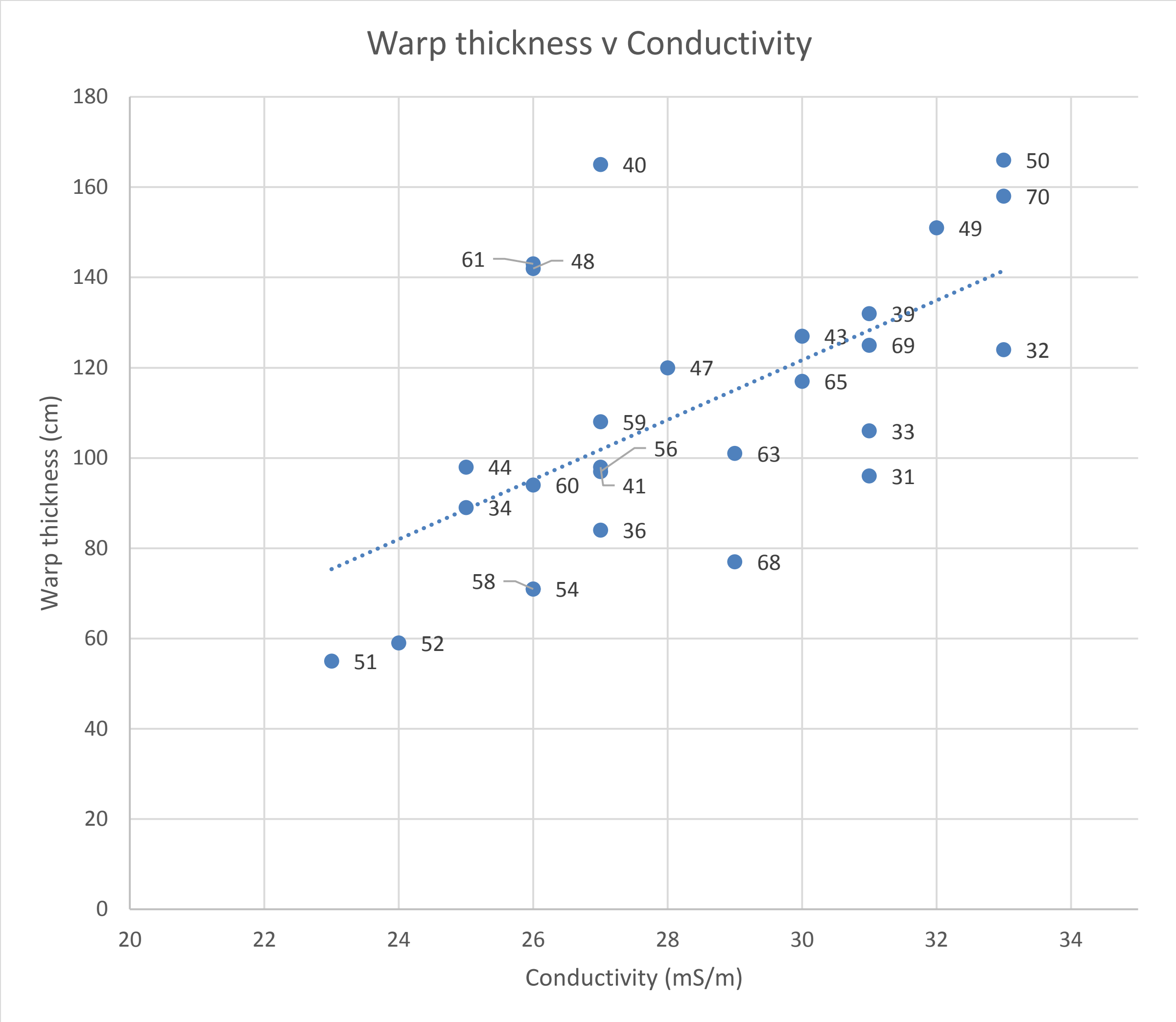


Table 3: Warp thickness versus conductivity

CONCLUSIONS

The auger survey has demonstrated that there is generally no more than a 1m undulation in the level of the sub-peat topography across Turbines 1-5, at or around 0m OD. At each turbine site the undulation is generally limited within a range of 0.5m. This suggests a relatively level flood-plain landscape existed prior to peat formation. In general the variations in the sub-peat topography seem to be too minor to have registered on the conductivity survey, having been generally swamped by the responses from the overlying warp deposits.

The gross exceptions to this – deeper basin features at Turbine 1 (borehole 70); Turbine 3 (borehole 49) and Turbine 5 (borehole 21) appear to have been detected as conductive responses by the geophysical survey, although the readings appear to reflect the thicker warp within these hollows, rather than thick peat. Their presence is suggestive of low points in the pre-peat landscape. The gradient of these features is not steep – being around 0.5m deeper than their next-nearest auger points – and they are likely to simply represent a slight exaggeration in the general topographic undulation rather than indicating substantial landscape features such as river channels.

The auger survey was successful in mapping the stratigraphic sequence at the survey locations. The evidence from this survey supports the previous evidence that the floodplain was covered by a mire or backswamp during the Neolithic and Bronze Age. This evidence reduces the likelihood of human activity in the immediate area of Turbine 1, 2, 3, 4 & 5; it is well recognised that for much of prehistory, human occupation was associated with the drier periphery of the floodplain (Van de Noort and Ellis 1998 p 292). In this case, this area of the floodplain of the Old

River Don during much of Neolithic/Bronze age was dominated by fluvial wetlands and would have been too wet for permanent or prolonged human activity. The exception is Turbine 6 which appears to occupy a former island or area of higher ground within the floodplain.

The compound area appears to be within a former channel of the Old River Don. This channel may have become inactive by the later prehistoric period. Gradiometer survey of this area did not indicate the presence of any archaeological remains.

In terms of palaeoenvironmental potential, the peat does not represent a particularly substantial deposit when considering the rest of this part of the Humberhead Levels and the extensive nature of previous work. If further work was required post-consent, the most productive method of analysis would be the acquisition of material for radiocarbon dating from the top and bottom of the deposit. This would constrain the period of formation and place the deposit within the existing chronology and model for vegetative succession/development, providing a minor addition to the existing body of data.

BIBLIOGRAPHY

Allen, J.R.L. 1999. Geological impacts on coastal wetland landscapes: some general effects of sediment autocompaction in the Holocene of northwest Europe. *The Holocene* 9, 1-12

Brown, A. G., Carey, C. R., Challis, K., Howard, A. J., Kincey, M., Tetlow, E. and Cooper, L. 2007. *Predictive m modeling of multi-period geoarchaeological resources at a river confluence. PNUM 3357*. University of Exeter

Allen, J.R.L. 2004. Annual textual banding in Holocene estuarine silts, Severn Estuary Levels (SW Britain): patterns, cause and implications. *The Holocene* 4, 536-552.

Buckland, P. C. 1972. *Thorne Moors: a palaeoecological study of a Bronze Age site*. Department of Geography, University of Birmingham

Carey, C., Brown, A.G., Challis, K., Howard, A. J. and Cooper, L. 2006. Predictive modelling of multiperiod geoarchaeological resources at a river confluence: a case study from the Trent–Soar, UK. *Archaeological Prospection*, 13, 4. 241-250

Chapman, H. P., and Gearey, B. R., 2002. Archaeological Predictive Modelling in Raised Mires – concerns and approaches for their interpretation and future management. Journal of Wetland Archaeology 2, 77-88

Challis, K., Howard, A. J., Moscrop, D. and Tetlow, E. A. 2006. *Assessing the Geoarchaeological Development of the Catchment Tributaries and their Impact on the Holocene Evolution of the River Trent*. Trent Valley Geoarchaeology.

Dinnin M. 1997. The palaeoenvironmental survey of the Rivers Idle, Torne and Old River Don, *in* Van de Noort, R and Ellis, S 1997 *Wetland Heritage of the Humberhead Levels*. Hull: Humber Wetlands Project, 81-156

Gearey, B. R. 2005. *Palaeoenvironmental Investigations at Thorne and Hatfield Moors: Research in Mitigation of Continued Peat Extraction*. Wetland Archaeology and Environments Research Centre (WAERC), University of Hull, unpublished client report for English Nature/The Scotts Company (UK) Ltd

Gaunt, G. D. 1994. *Geology of the country around Goole, Doncaster and the Isle of Axholme: memoir for one-inch sheets 79 and 88 (England and Wales)*. HMSO: London

Haslett, S.K., Davies, P., Curr, R.H.F., Davies, C.F.C., Kennington, K., King, C.P., Margets, A.J., 1998. Evaluating late-Holocene relative sea-level changes in the Somerset Levels, southwest Britain. *The Holocene* 8, 197-207.

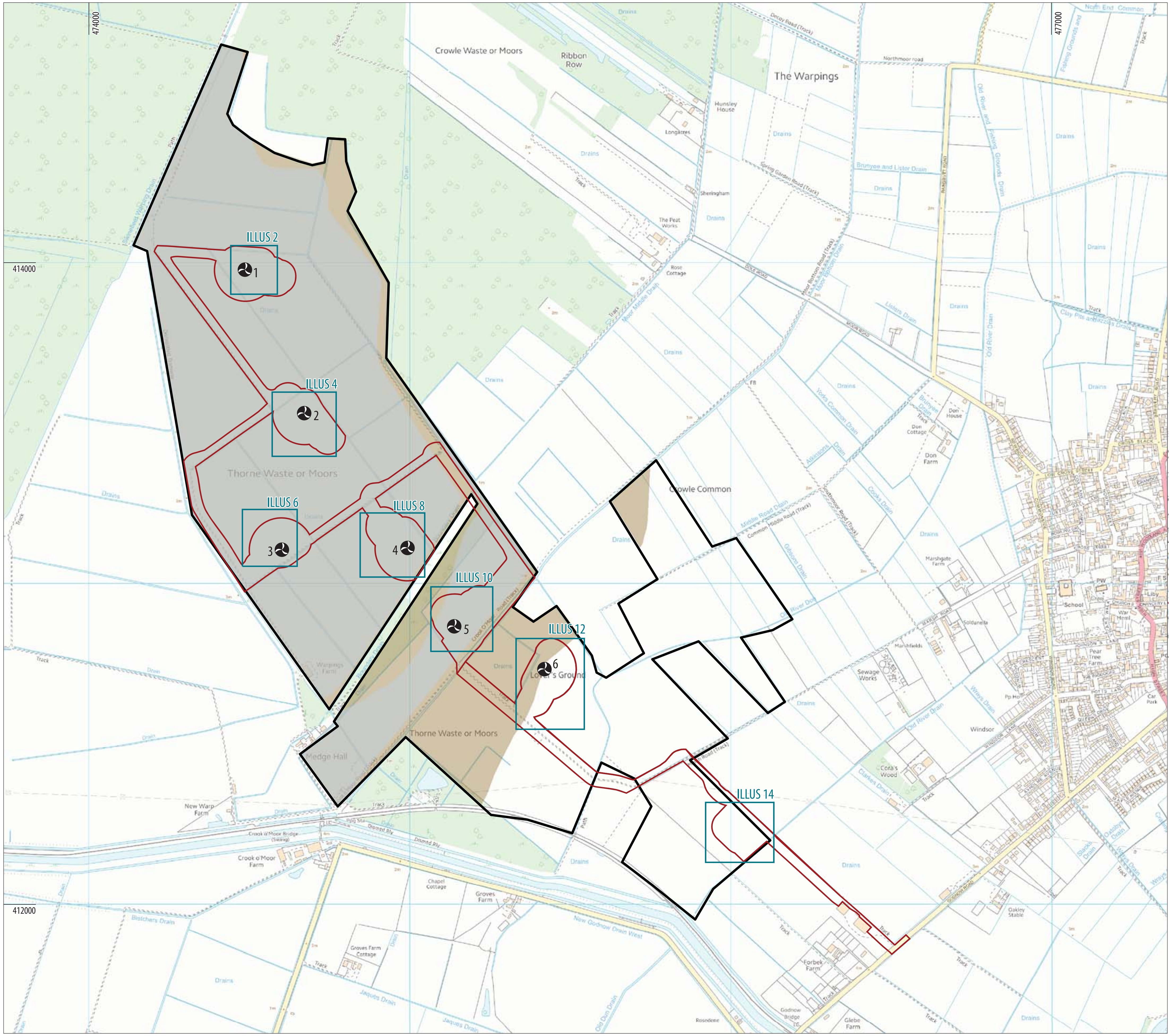
Head, R, Fenwick, H, Chapman, H, Van de Noort, R and Dinnin, M. 1997. The archaeological survey of the Rivers Idle, Torne and Old River Don *in* Van de Noort, R and Ellis, S. *Wetland Heritage of the Humberhead Levels*. Hull: Humber Wetlands Project. 267-367.

Long, A.J., Waller, M.P. & Stupples, P. 2006.Driving mechanisms of coastal change: Peat compaction and the destruction of late Holocene coastal wetlands. *Marine Geology*. 25:63-84.

Van de Noort, R. and Ellis, S. 1997 (eds.) *Wetland Heritage of the Humberhead Levels*. Hull: Humber Wetlands Project

Van de Noort, R., Chapman, H., Head, R. and Dinnin, M. 1997. The archaeological survey of West, Hatfield and Thorne Moors. *in* Van de Noort, R. and Ellis, S. *Wetland Heritage of the Humberhead Levels*. Hull: Humber Wetlands Project 368-381.

Van de Noort, R. and Ellis, S. (eds.) 1998 *Wetland Heritage of the Ancholme and lower Trent Valleys*. Hull: Humber Wetlands Project



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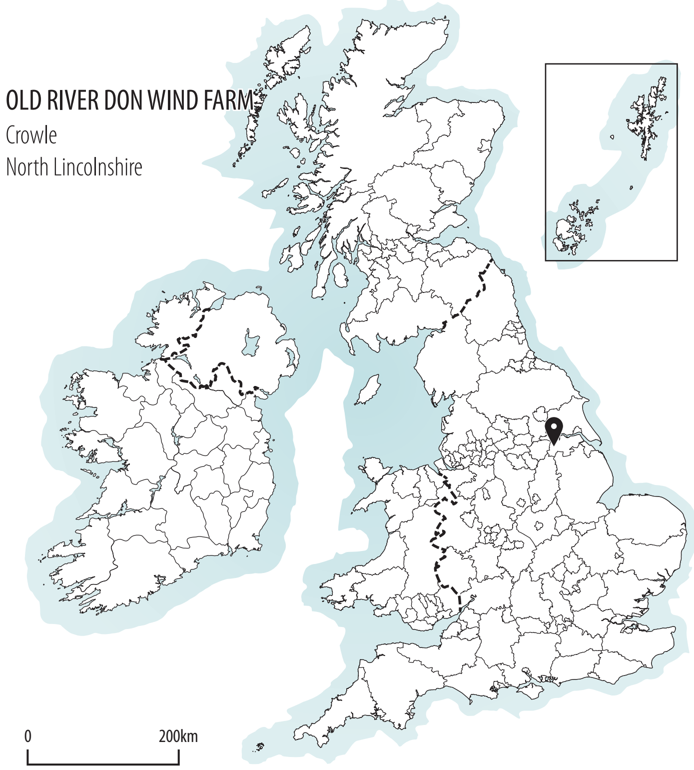
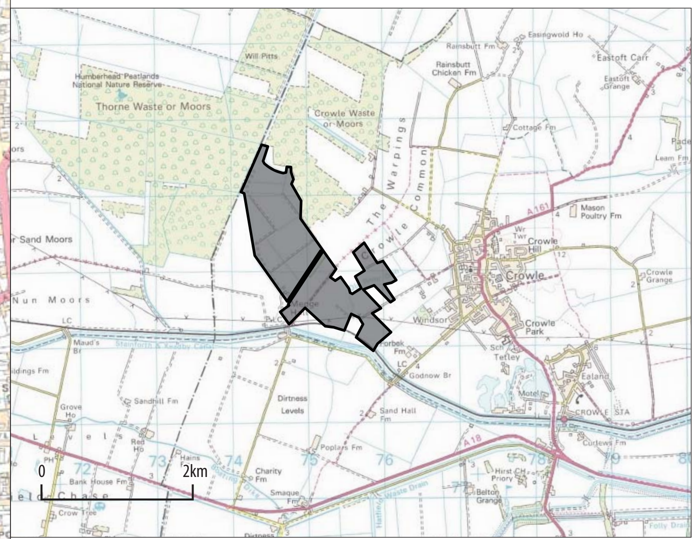
Crowle
North Lincolnshire





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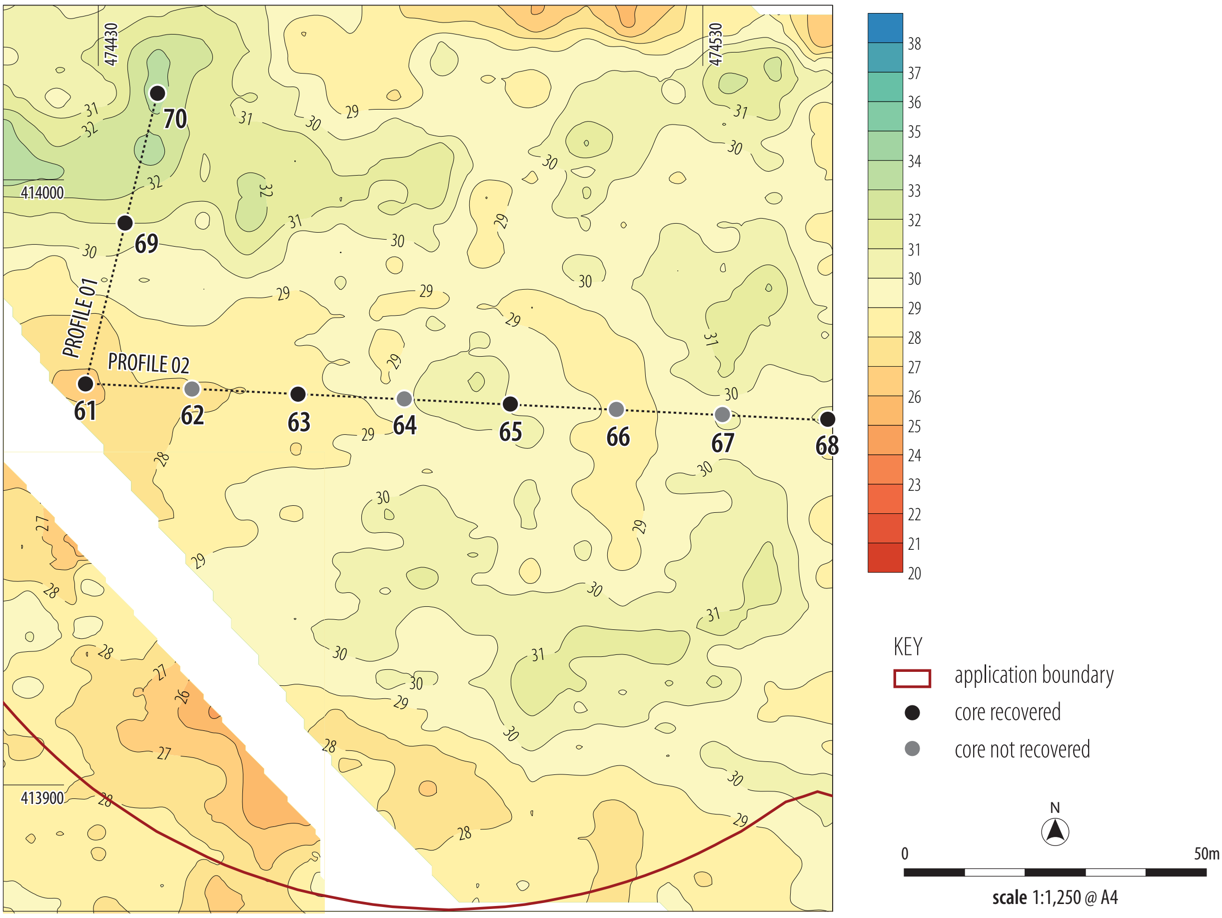
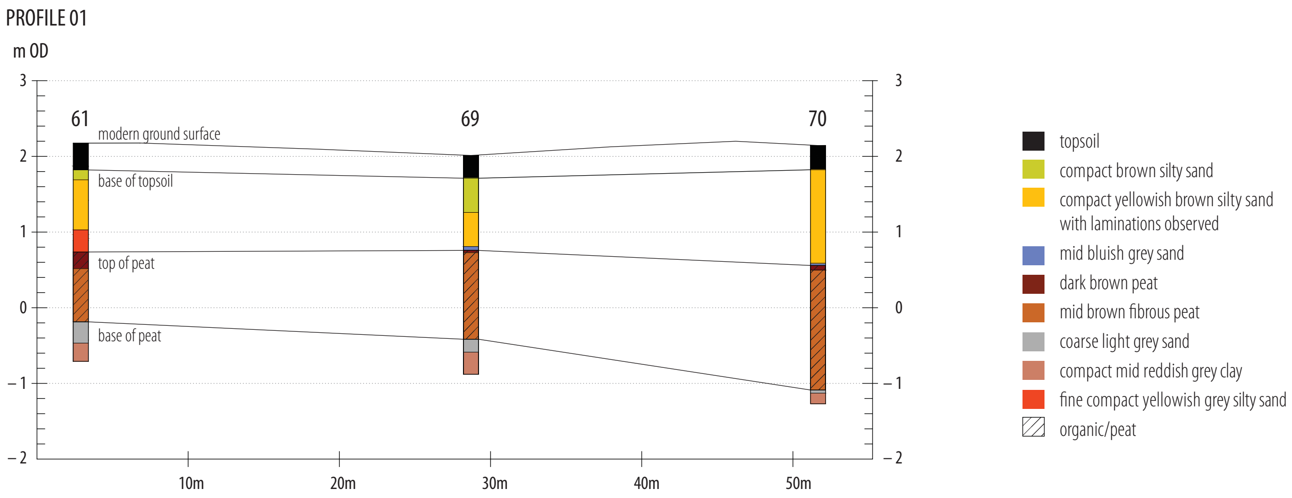
KEY
- application boundary
- inner study area
- proposed turbine location

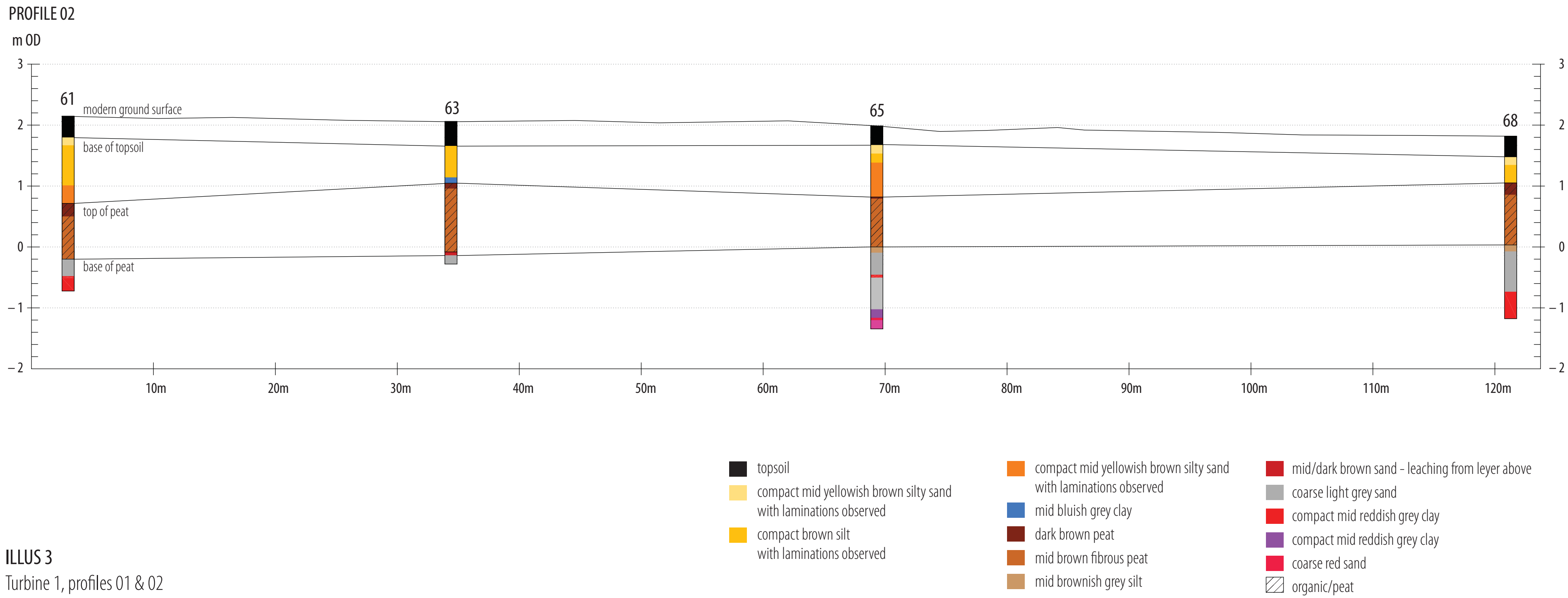
0 500m
scale 1:12,500 @ A3

ILLUS 1
Site location



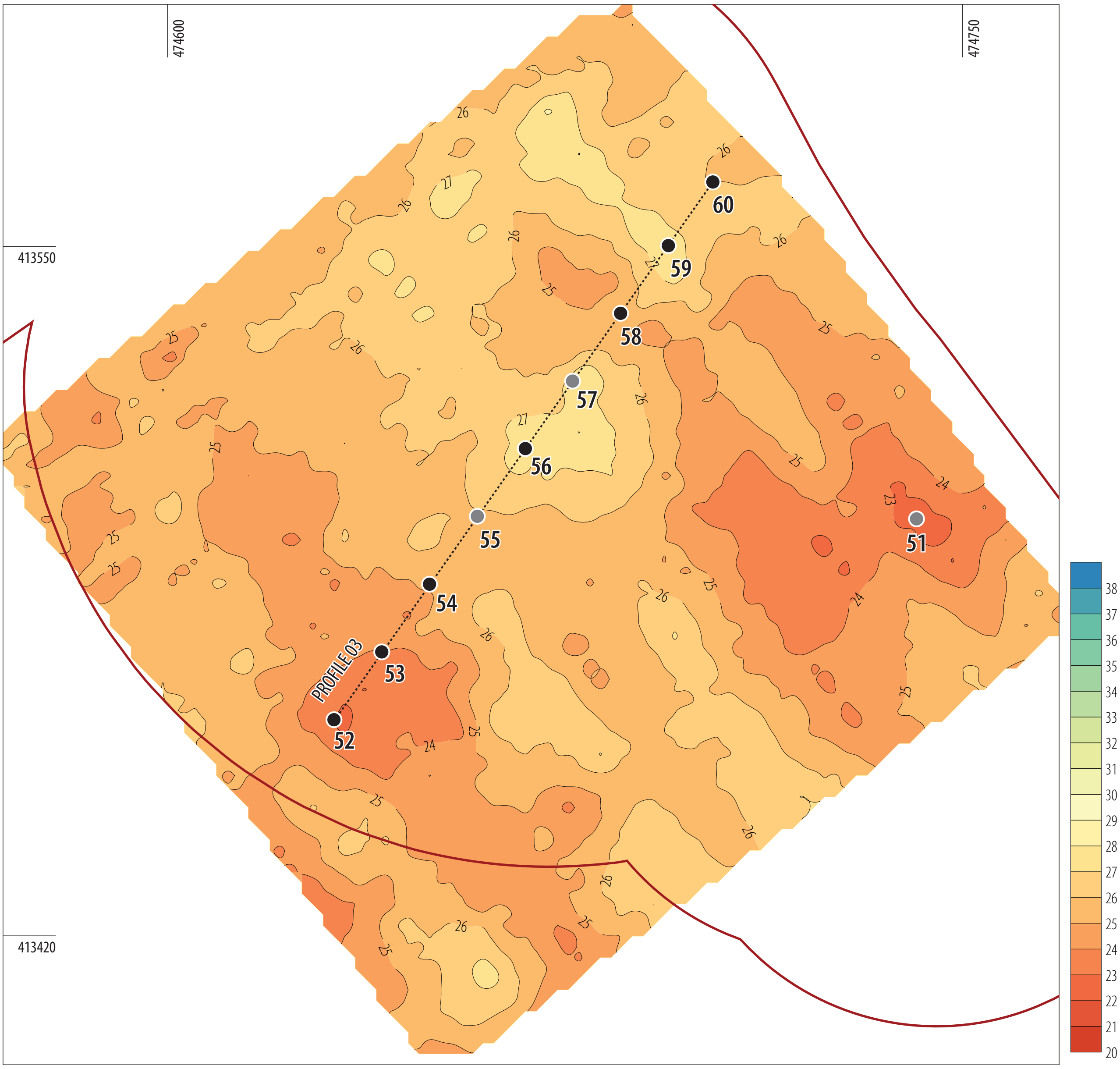
ILLUS 2
Turbine 1, core locations





ILLUS 3

Turbine 1, profiles 01 & 02



KEY

application boundary

core recovered

core not recovered

N

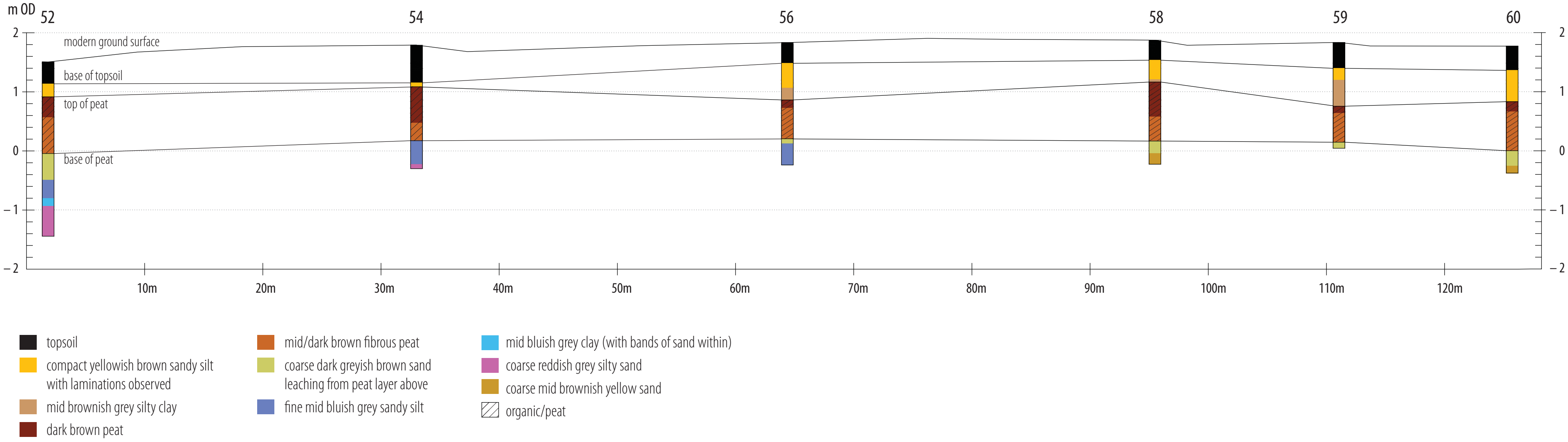
0 50m

scale 1:1,250 @ A4

ILLUS 4

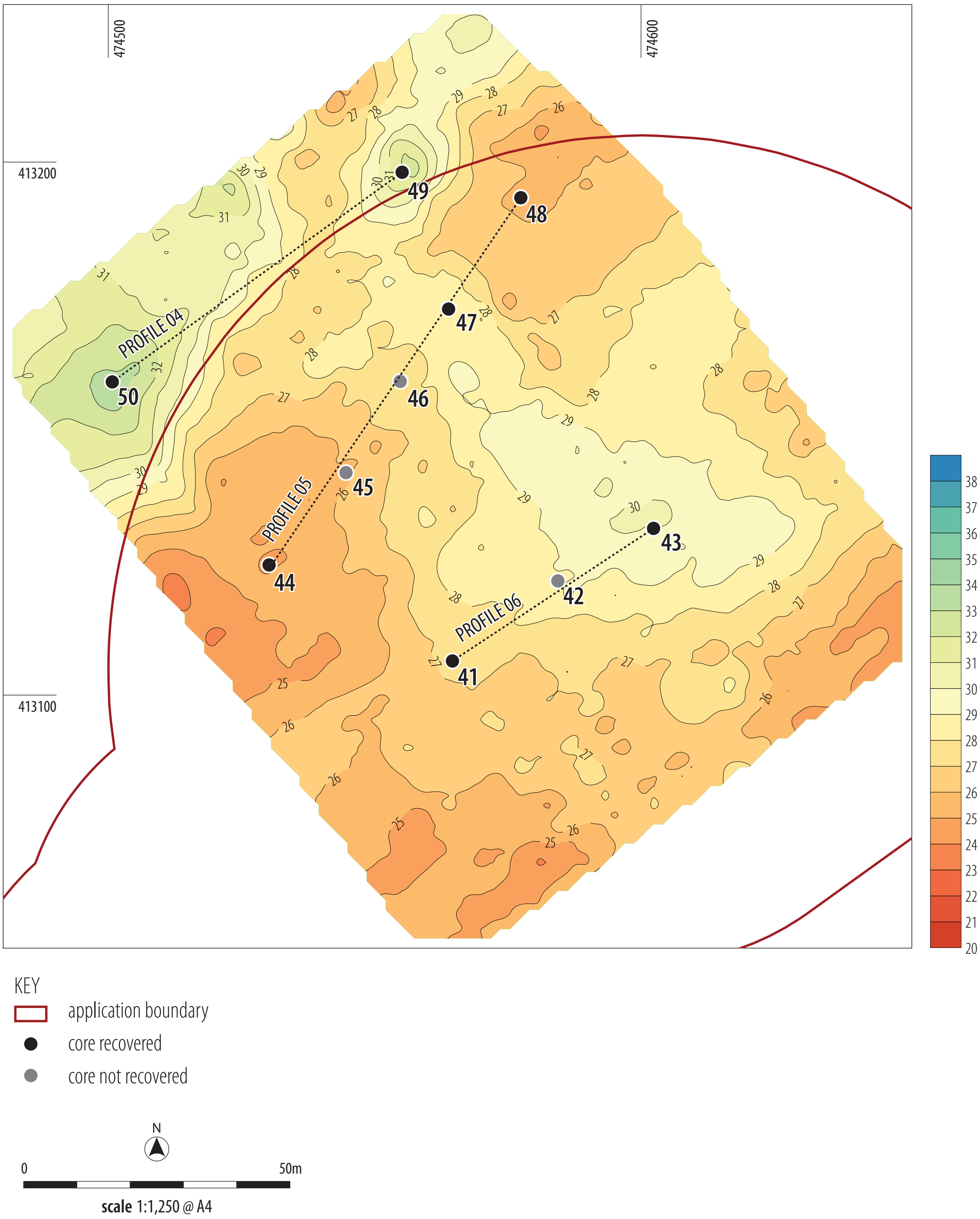
Turbine 2, core locations

PROFILE 03



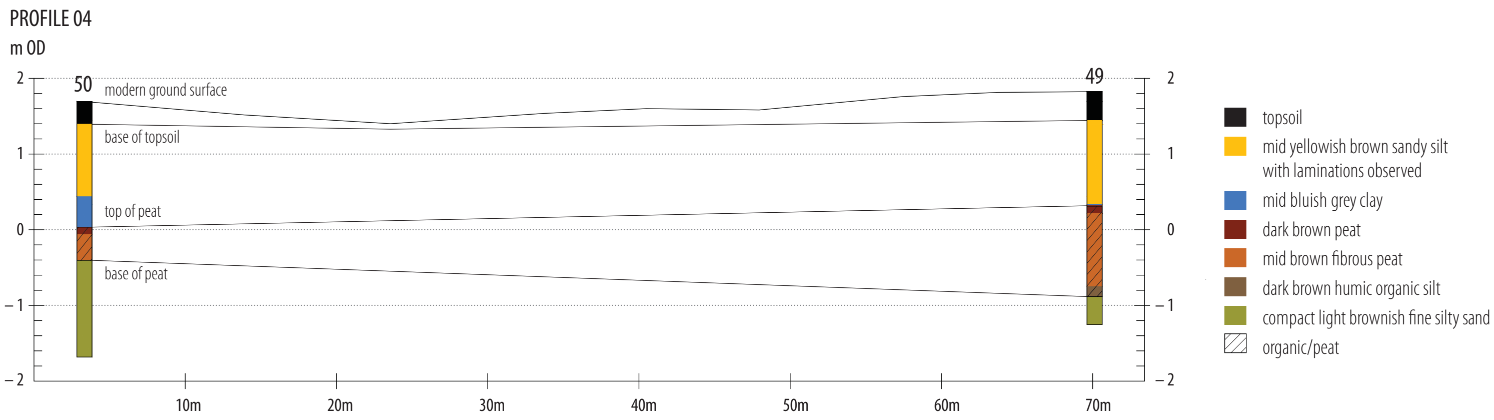
ILLUS 5

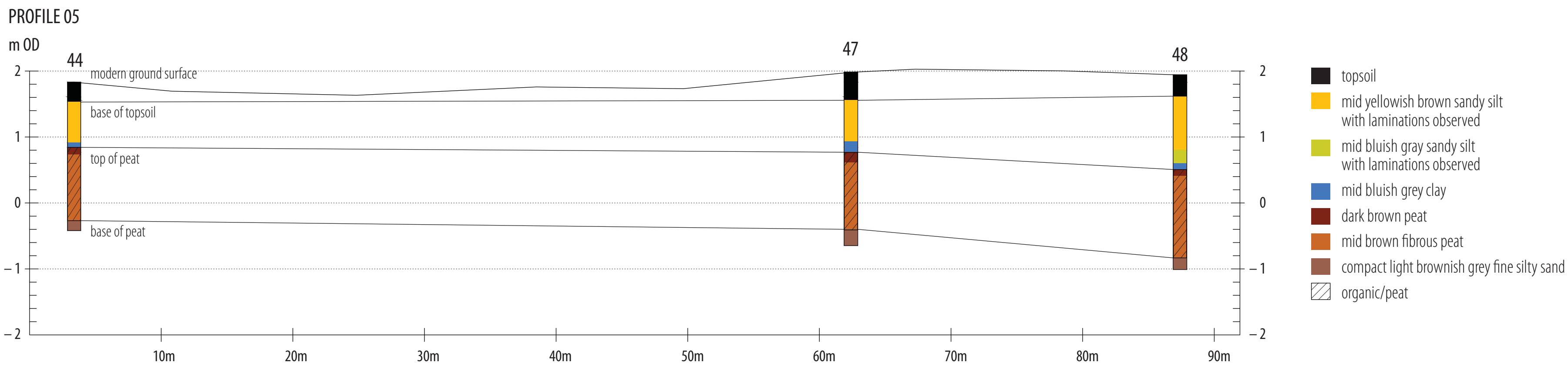
Turbine 2, profile 03

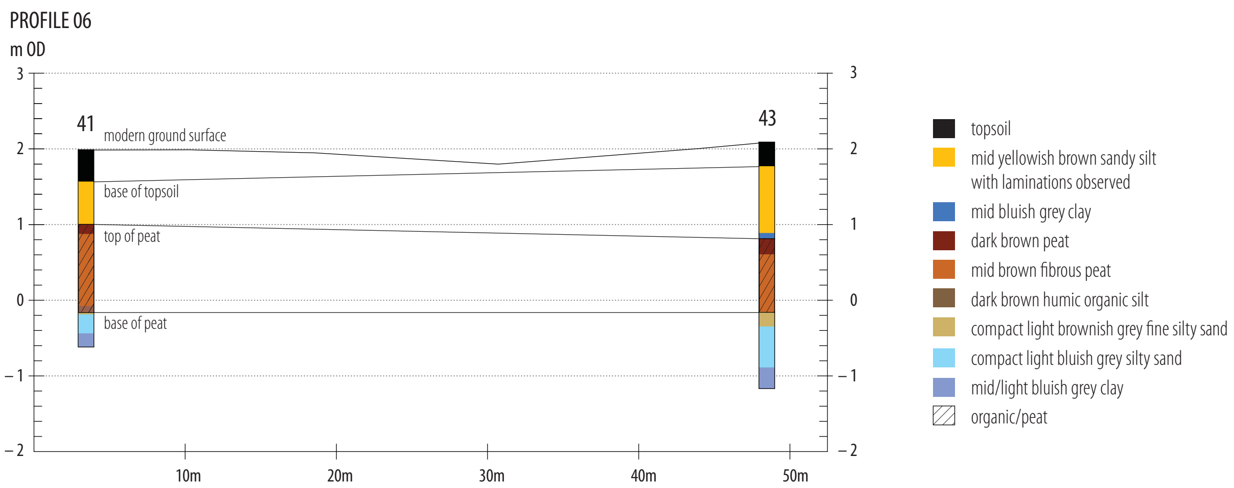


ILLUS 6

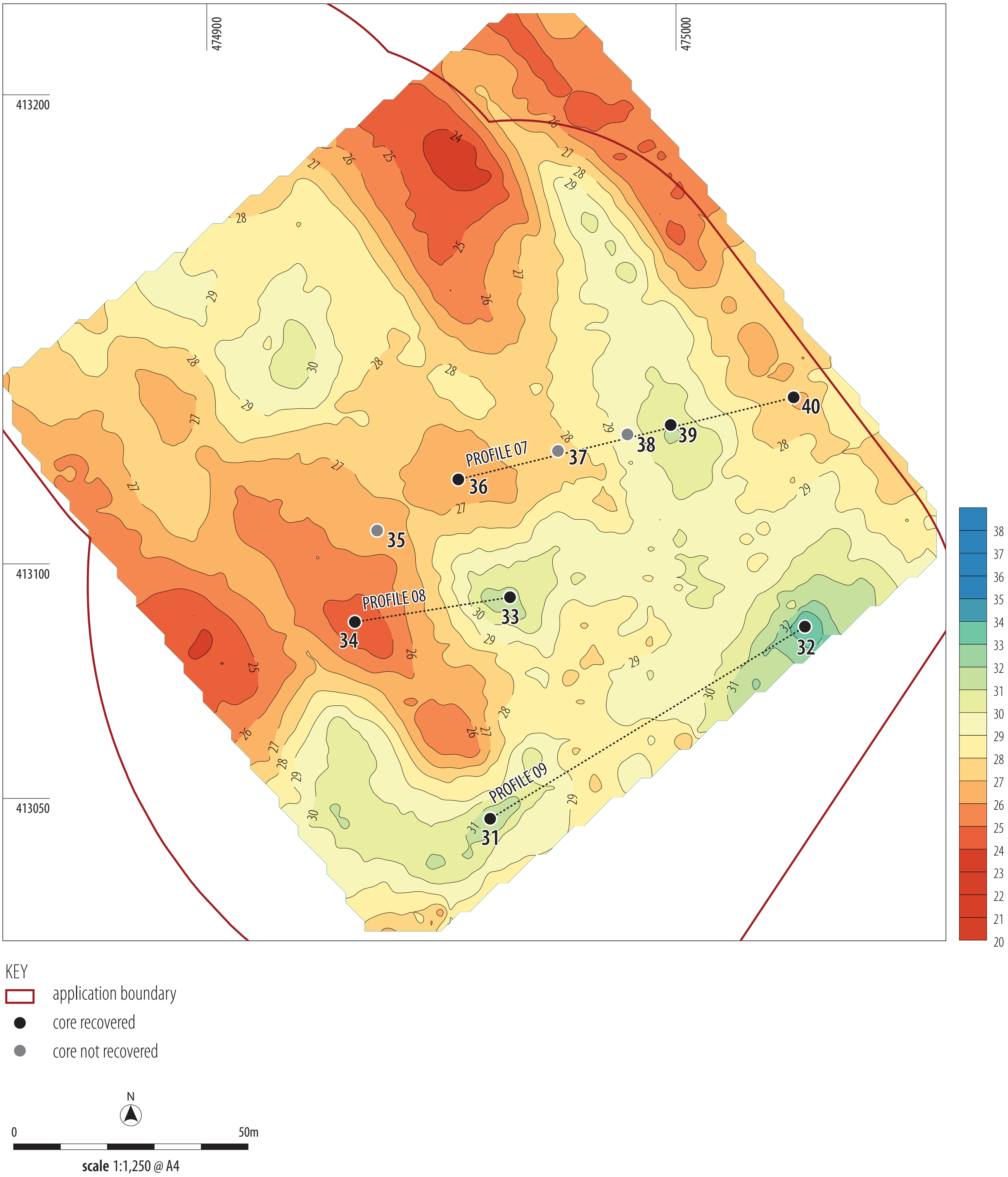
Turbine 3, core locations



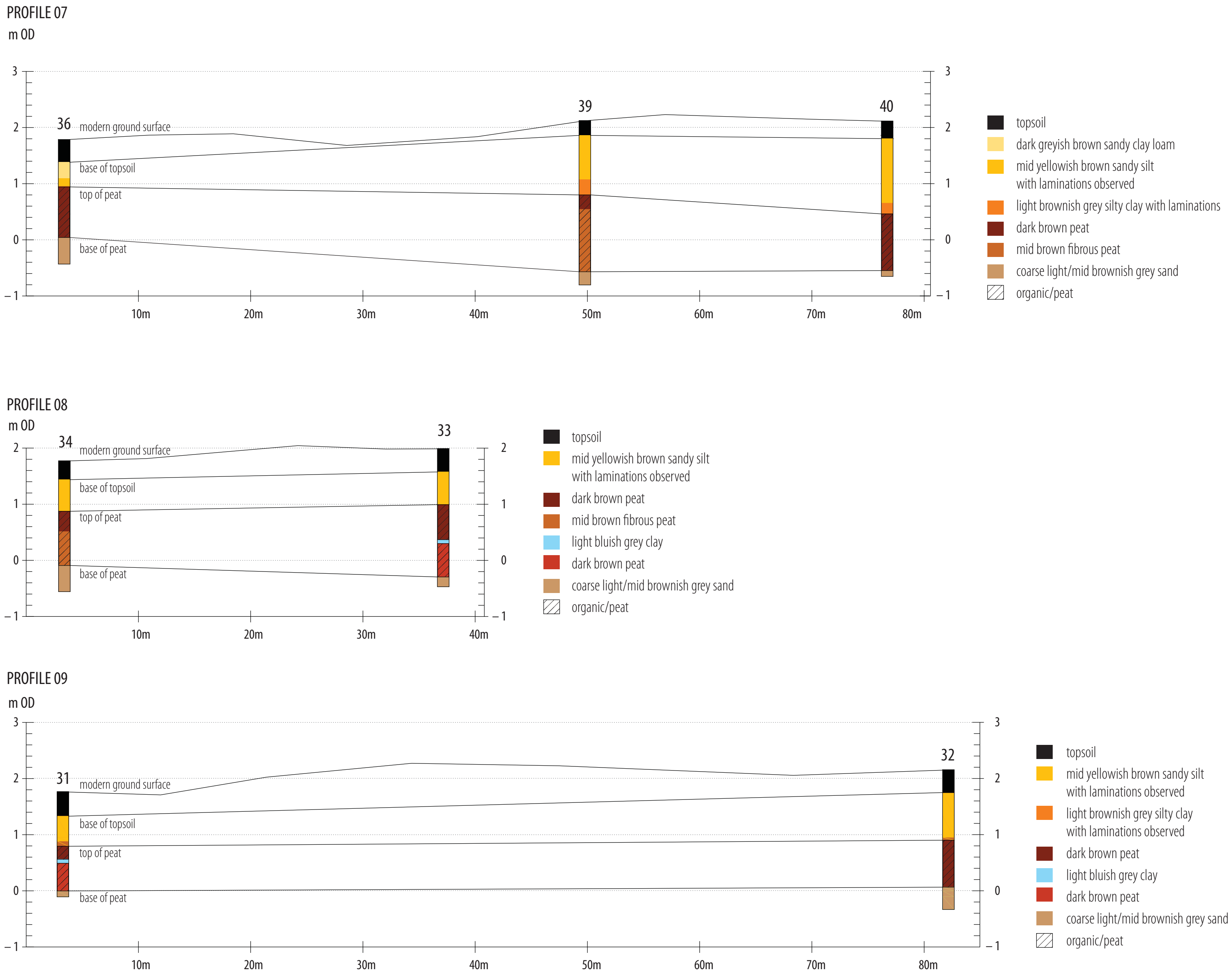




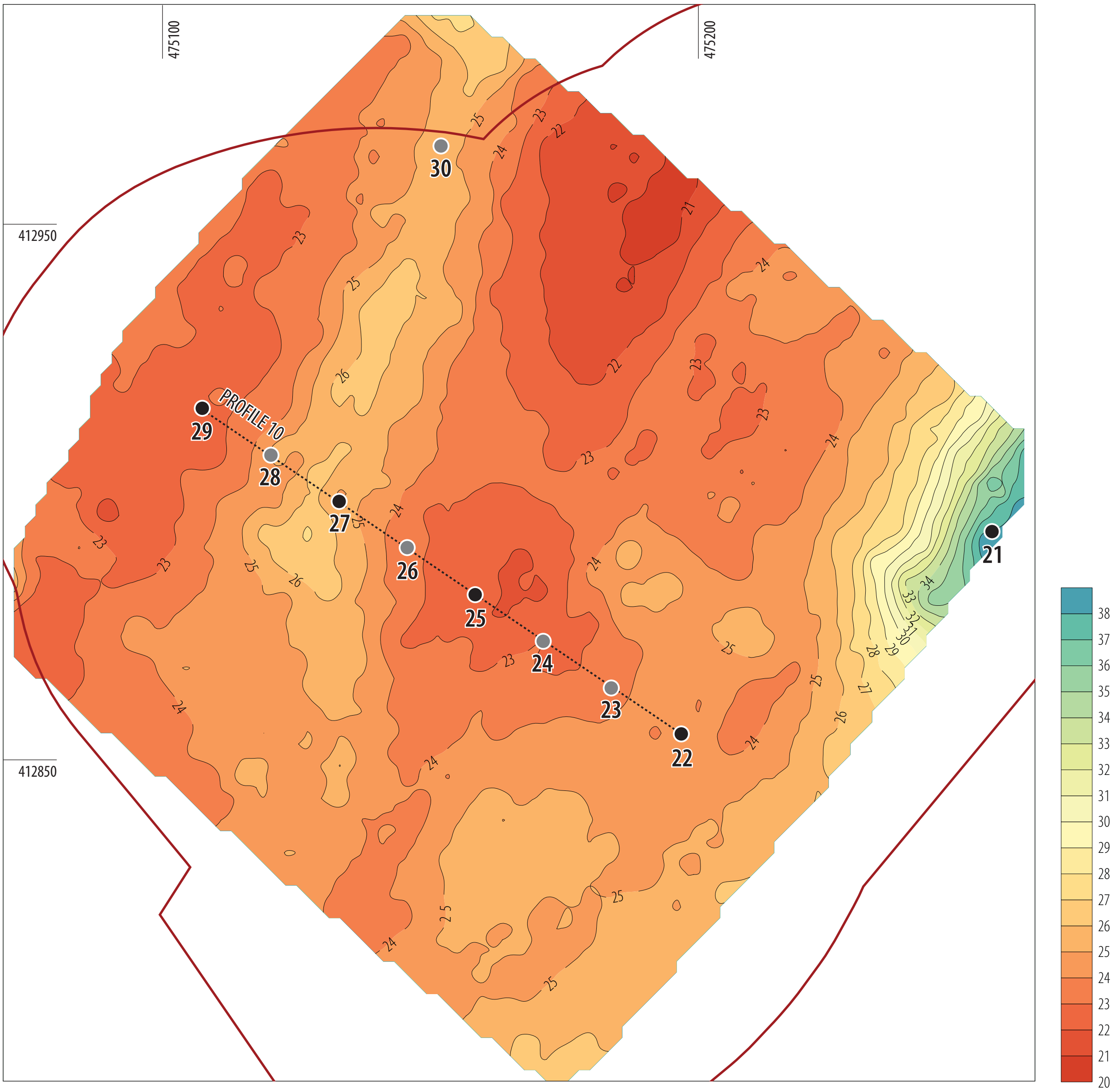
ILLUS 7
Turbine 3, profiles 04, 05 & 06



ILLUS 8
Turbine 4, core locations



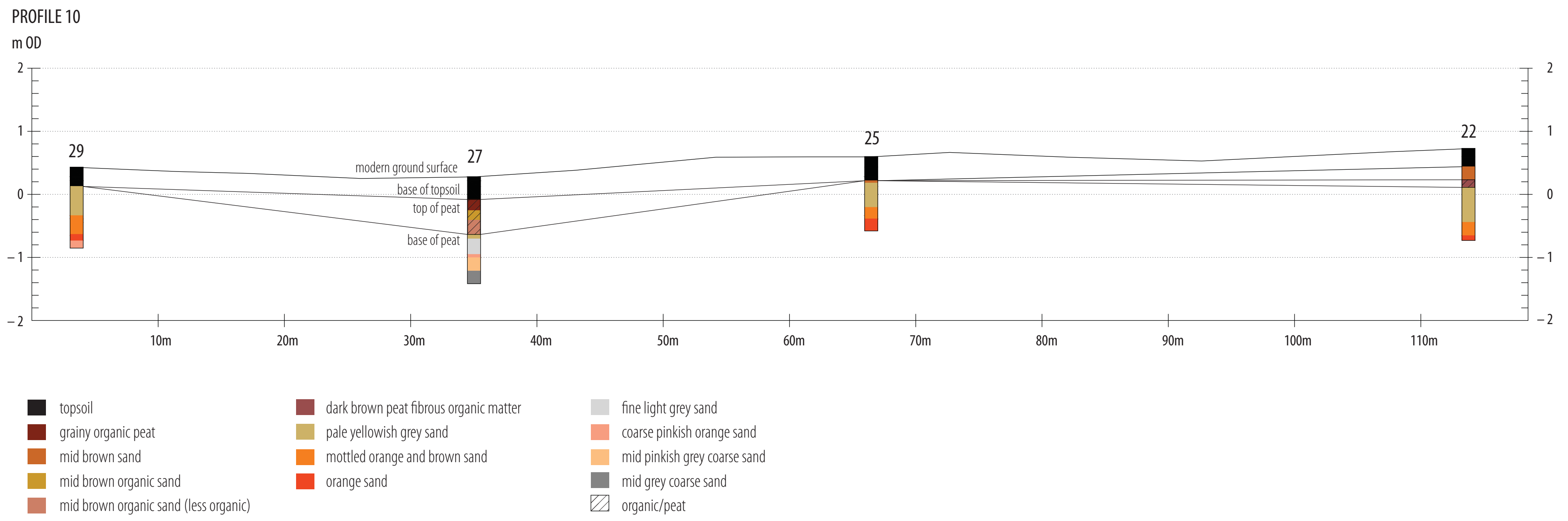
ILLUS 9
Turbine 4, profiles 07, 08 & 09



KEY
application boundary
core recovered
core not recovered

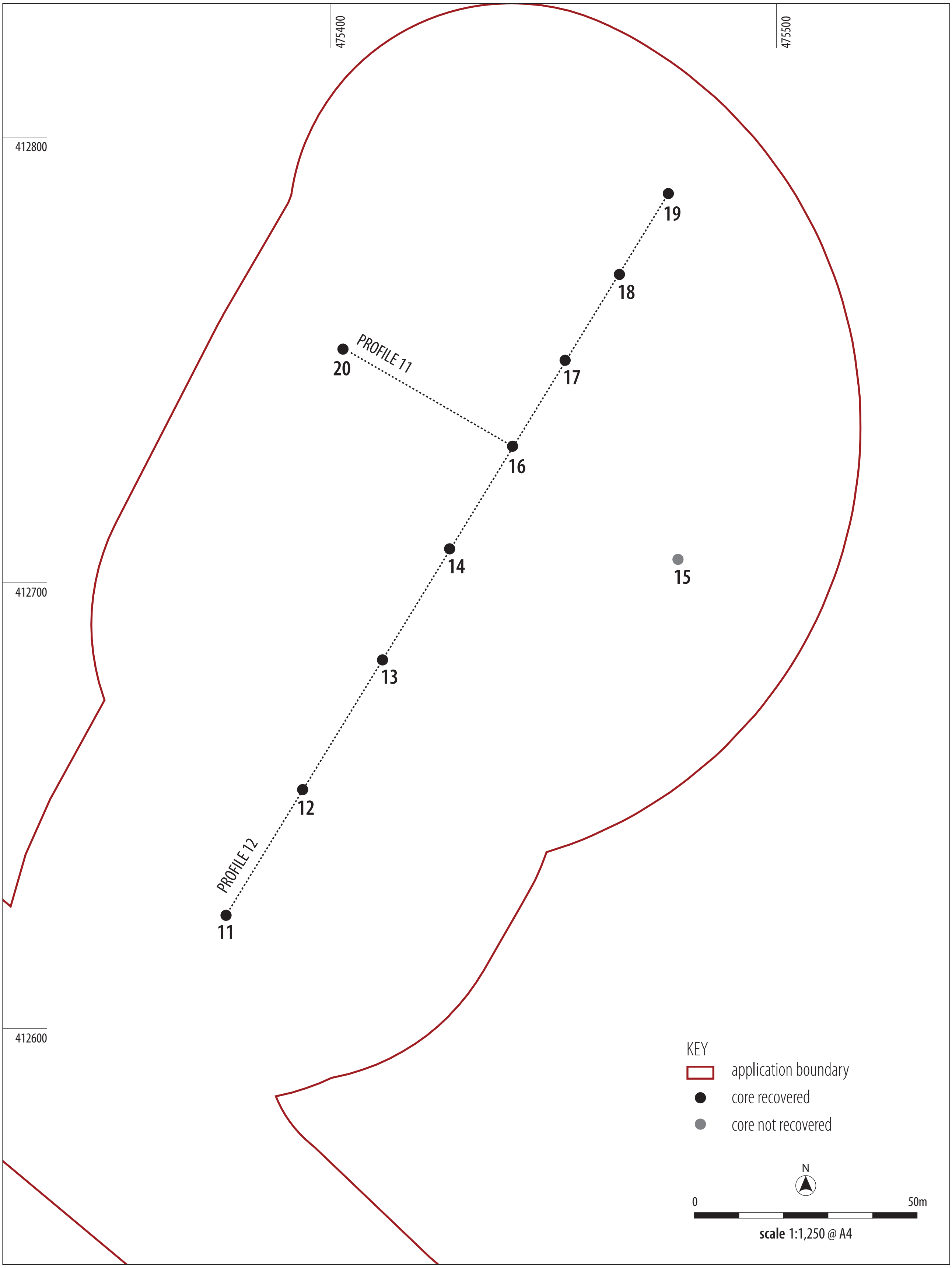
N
0
50m
scale 1:1,250 @ A4

ILLUS 10
Turbine 5, core locations



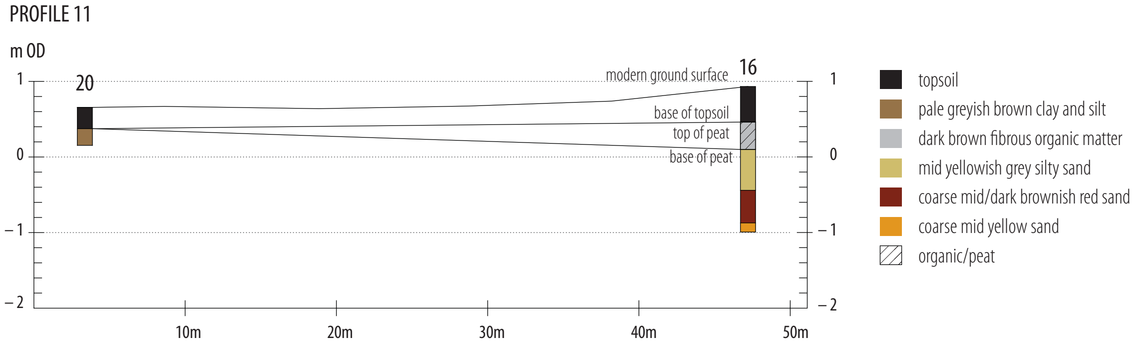
ILLUS 11

Turbine 5, profile 10

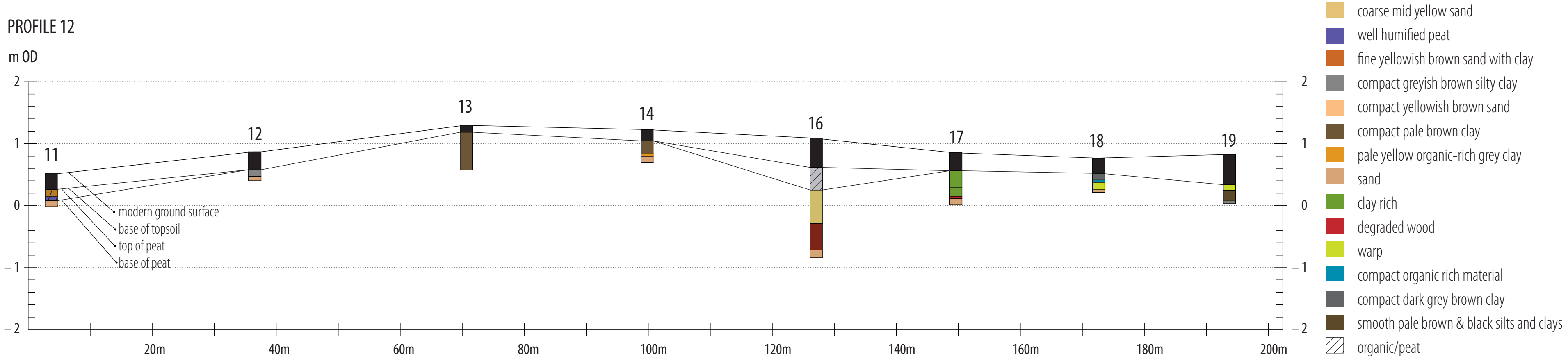


ILLUS 12
Turbine 6, core locations

PROFILE 11

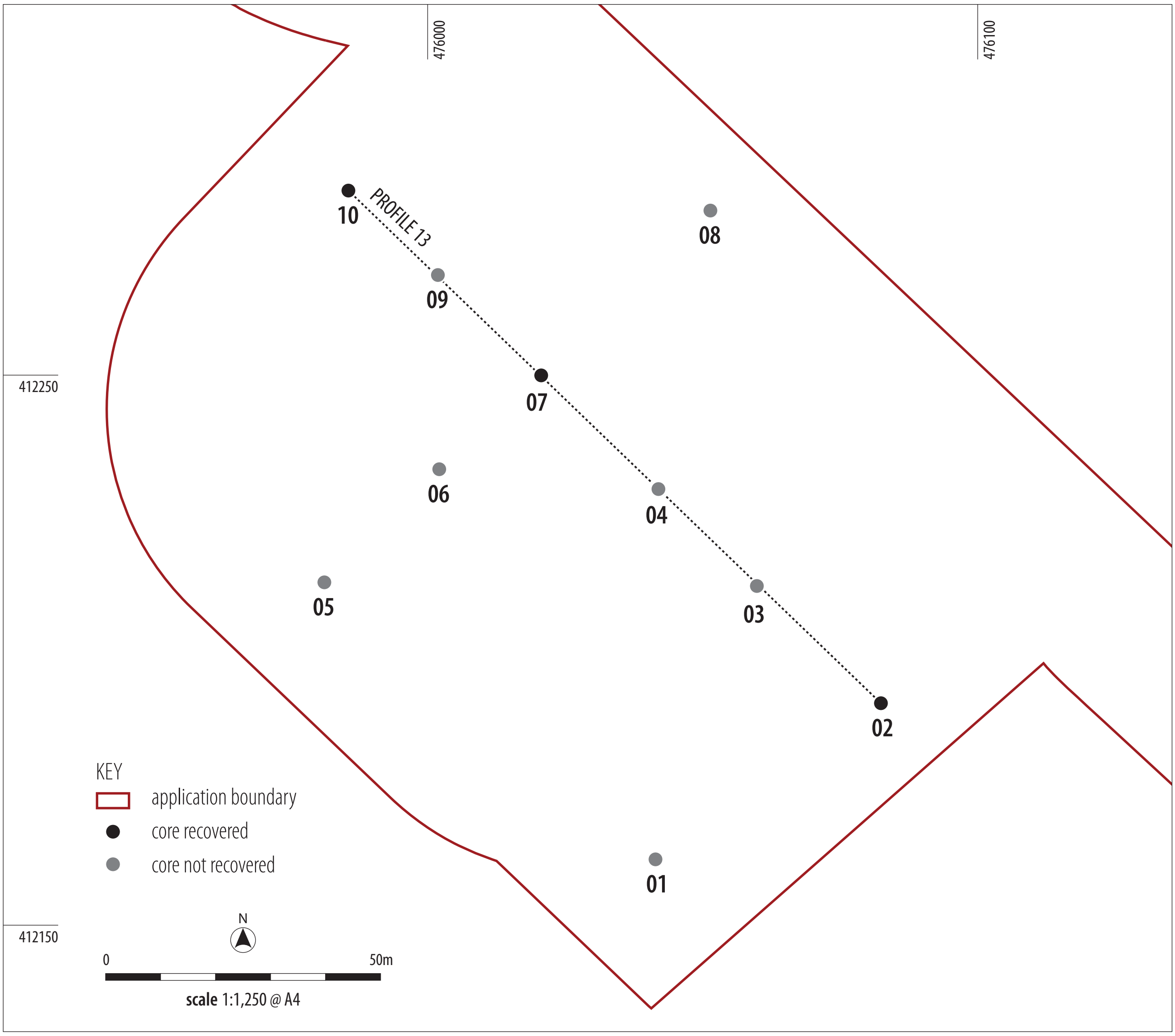


PROFILE 12

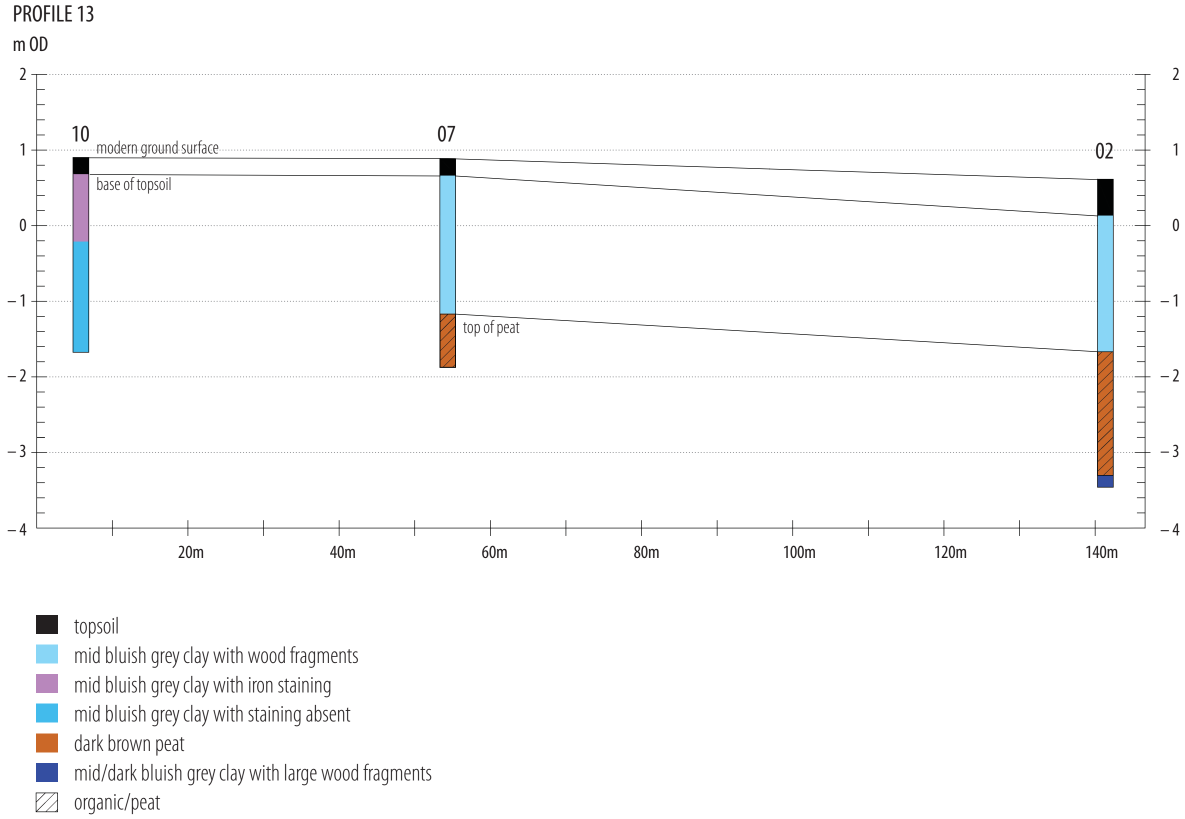


ILLUS 13

Turbine 6, profiles 11 & 12



ILLUS 14
Compound, core locations



ILLUS 15
Compound, profile 13

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