Thurrock Flexible Generation Plant

Environmental Statement Volume 6
Appendix 16.3: Team2100 Tilbury Ground Investigations

Date: July 2019

Environmental Impact Assessment

Environmental Statement

Volume 6

Appendix 16.3

Report Number: G180029U Version 02

Version: Final

Date: July 2019

This report is also downloadable from the Thurrock Flexible Generation Plant website at:
http://www.thurrockpower.co.uk

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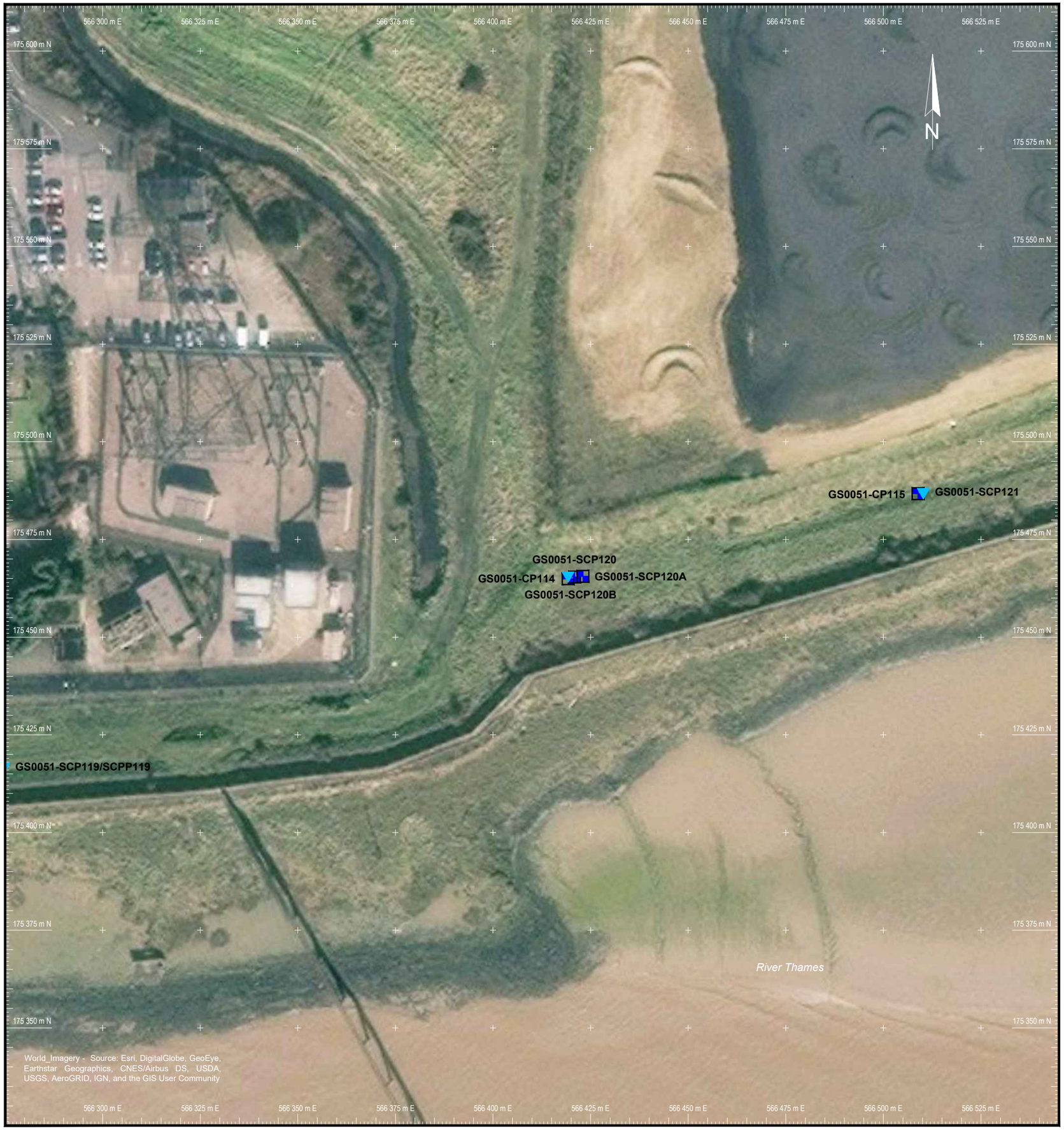
Summary

This appendix presents the results and discussion of ground investigation works undertaken for the Environment Agency (TEAM2100) by Fugro Geoservices Limited in and around zone G, the causeway and haul road construction area for Thurrock Flexible Generation Plant.

1. TEAM2100 (Fugro Geoservices Ltd) Ground Investigation Report

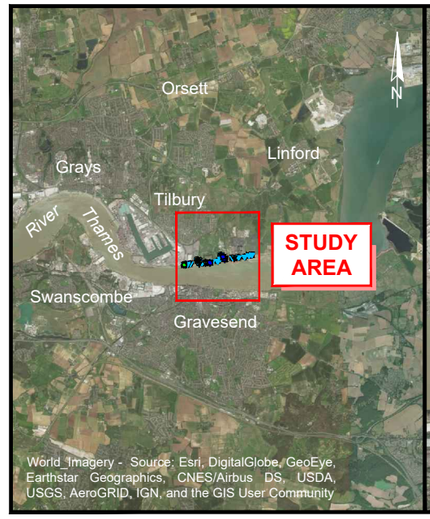


LEGEND:

CP	Cable percussion test location
CPRC	Cable percussion and rotary core test location
SCP	Cone penetration test location
SCPH	Cone penetration test & hydraulic profiling tool location
SCPP	Cone pressuremeter
IVAN	In-situ shear vane test location
	Inspection pit

NOTES:

1. Basemap is indicative only and should not be used for measurement.
2. Coordinate System: British National Grid
3. Projection: Transverse Mercator (TM)
4. Spheroid: Airy 1830
5. Datum: OSGB 1936
6. Units: Metres



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TEAM2100

TILBURY GROUND INVESTIGATIONS

DETAILED LOCATION PLAN
Sheet 9 of 9

SCALE 1 : 1 000

0 50 100 metres

0 100 200 300 feet

Vessel: N/A	Survey Date: N/A	Project Ref: G180029U

Issue:	Date:	Description:	Drawn:	Interp:	Checked:	Approved:
02	01/07/19	Final issue	DRF	-	KS	SF
01	16/02/19	Draft issue for comments	DRF	-	HB	SF

Plotted Drawing Size: A3 (420x297)	Client Ref.: -	Drawing No.: G180029U_Chart_Location.dwg	Chart: 9 of 9	Plate: B.11

C. EXPLORATORY HOLE AND FIELD RECORDS

C.1 NOTES ON EXPLORATORY HOLE RECORDS

C.1.1 General Notes

1 OPERATING PROCEDURES

The procedure used for cable percussion boring, rotary drilling, trial pitting, sampling, in situ and laboratory testing and sample descriptions are generally in accordance with BS5930:2015 'Code of practice for site investigations', BS EN ISO 14688-1:2018 'Geotechnical investigation and testing – Identification and classification of soil – Part 1 Identification and description', BS EN ISO 14689-1:2018 'Geotechnical investigation and testing – Identification and classification of rock – Part 1 Identification and description' as appropriate, and BS1377:1990 'Methods of test for soils for civil engineering purposes', unless stated otherwise. Sampling is carried out in general accordance with EN ISO 22475-1 and Standard Penetration Testing (SPT) is carried out to EN ISO 22476-3:2005.

2 GROUNDWATER

Exploratory hole water levels are recorded together with the depths at which seepages or inflows of water are detected. These observations are noted on the Records, but may be misleading for the following reasons:

a) The exploratory hole is rarely left open at the relevant depth for a sufficient time for the water level to reach equilibrium.

b) A permeable stratum may have been sealed off by the borehole casing.

c) Water may have been added to the borehole to facilitate progress.

d) The permeability may have been altered by the excavation/boring/drilling process.

Standpipes or piezometers should be installed when an accurate record of groundwater level is required, however, it should be noted that groundwater levels may vary significantly due to seasonal, climatic or man made effects. Water levels recorded during the investigation and any advice or comment made accordingly may, therefore, not be appropriate to particular foundation, geotechnical design, or temporary works solutions. Long term monitoring of standpipes or piezometers is always recommended when water levels are likely to have a significant effect on design.

3 CHISELLING

The remarks in the Borehole Records contain information on the time spent advancing the borehole by 'Chiselling Techniques', and the depth of borehole over which it was required. Such information may be affected by a wide range of variable factors, unrelated to the geotechnical properties of the strata. Such factors include, but are not restricted to: plant, equipment and operator. The data should, therefore, only be used subjectively and with extreme caution.

4 IDENTIFICATION AND DESCRIPTION OF SOILS - SEE SEPARATE SHEET

The identification system follows the Company's Engineering: Geotechnical Procedures Manual which is based on BS EN ISO 14688-1:2018 and appropriate clarifications in the National Foreword, BS 5930:2015 and BS EN ISO 14689-1:2018.

Relative density terms are given where supported by SPT N values, with the exception of Made Ground. The field assessment of compactness or relative density for coarse grained soils is only given on trial pit records where appropriate assessment of the soils has been undertaken.

Where the terms 'soft to firm', 'firm to stiff' etc. are used they indicate a strength which is close to the borderline between the two terms and cannot be precisely defined by inspection only, and/or which is indicated as borderline or ranging between the two terms after consideration also of in situ and laboratory test results. Consistencies may have been amended in the light of test results.

Where 'to' links two terms, as in 'slightly sandy to sandy' this again represents a borderline case or a range, where the precise proportions cannot be determined as outlined previously.

The name of the geological formation is only given where this has been requested and can be determined with confidence (see Clause 41.5 of BS 5930:2015).

5 INTERPRETATION OF THE RESULTS OF THE INVESTIGATION

The description of ground conditions encountered and any engineering interpretation included in the report are based on the results of the boreholes and trial pits and the field and laboratory testing carried out. There may be ground conditions at the site which have not been revealed by the investigation and consequently have not been taken into account.

Any interpolation or extrapolation of strata between exploratory holes shown on any cross sections or site plans is an estimate only of the likely stratification based on general experience of the ground conditions and is subject to the interpretation of the reader.

The term "TOPSOIL" is used in this report to describe the surface, usually organic rich, layer including turf, subsoil and weathered material with roots. The use of this term may not imply that the soil satisfies the requirements of Clause 3 of BS 3882:1994, 'Specification for topsoil', or is suitable for general horticultural and agricultural purposes.

Laboratory test results in this report give the soil properties of individual specimens tested under specified conditions. Individual results or groups of results may not be appropriate for use as design parameters for some geotechnical analyses. The samples may be non-representative, disturbed internally, or prepared and tested under conditions suited for different geotechnical applications. Unless the selection of design parameters is discussed in this report, it is recommended that the advice of a Geotechnical Specialist is sought.

C.1.2 In Situ Testing and Sampling

STANDARD PENETRATION TESTS

S( )&C( ) Standard Penetration Test (SPT). S( ) denotes a 50mm diameter split barrel sampler, normally undertaken in cohesive and mixed soils and C( ) indicates the test was carried out using a 50mm diameter, 60 degree apex, solid cone normally used in coarse granular soils and weak rock. The tests are carried out in accordance with EN ISO 22476-3:2005

The distance that the SPT assembly sinks into the ground prior to the start of the test is measured and reported as Static Weight Penetration (SWP). The sampler or cone is driven up to 450mm into the soil using a 63.6kg hammer with a 760mm drop. An initial seating drive of 150mm (or 25 blows whichever is less) is undertaken to penetrate through any ground which may be disturbed at the base of the borehole. For the test drive, the number of blows required to obtain an additional 300mm penetration (or penetration for 50 / 100 blows) is recorded as the penetration resistance (also known as the 'N' value). The test is usually completed when the test drive attains the 300mm penetration or the number of blows recorded during the 'test drive' only reaches 50 in soils or 100 in weak rock.

If the sampler advances below the bottom of the borehole under the static weight of the drive rods with the hammer assembly on top, the corresponding penetration is not included as seating drive but the information is reported separately as SWP. The test is terminated in all cases before the non return valve reaches the level of the material at the base of the borehole, in effect about 600mm total penetration. If SWP (Static Weight Penetration) is greater than 150mm then test increments of 75mm are undertaken with the final increment being completed at less than 600mm total penetration including SWP.

If a sample is not recovered in the sampler, or the cone is used, a disturbed sample of appropriate size for the material is taken on completion of the test over the depth of the test zone. The sample is given the same depth as the top of the Standard Penetration Test drive.

The depth on the Borehole Record at the left hand side of the 'Depth' column is that at the start of the test. Where full penetration of the test drive is obtained, the penetration resistance ('N' value) is reported in the 'SPT Blows/N' column. If full penetration in the test drive is not obtained, then the length of drive (test length in mm) and the penetration resistance (number of blows) are both reported. Full results, including the cone or barrel type, static weight penetration, blows and penetration of each of the Seating Drive and Test Drive increments, the calibration reference number for the SPT hammer assembly, the energy ratio and the 'N' value, as well as start and end depths and water and casing levels are given on the separate Standard Penetration Test Summary

* in the 'Test Length' column denotes that the blows and penetration include the initial Seating Drive blows.

OTHER IN SITU TESTS

The following in situ tests are reported on the **Exploratory Hole Records**, in the 'Test' or 'Type' and 'Results' columns where appropriate.

k In situ Permeability Test - refer to detailed test results for permeability values

PMT Pressuremeter Test - refer to detailed test results for modulus values, etc.

FV/FVR Borehole Shear Vane Test (undrained shear strength - c_u - in kPa) - refer also to detailed test results, N - 'Natural' or peak shear strength, R - Remoulded shear strength

HV/HVR Hand Shear Vane Test (Direct reading of undrained shear strength in kPa). 'N' and 'R' as above. The values are indicative and should not be taken as being equivalent to laboratory test results. The Pilcon vane results have a factor varying from about a sixth for the 33mm vane to a third for the 19mm vane which reduces the BS1377 shear vane value. The values presented are therefore approximate and should be treated with great caution if used for design purposes

PP Pocket Penetrometer. Unconfined Strength (UCS) reported in kg/cm^2 to the nearest 0.25 kg/cm^2 or kPa with the same accuracy. Equivalent c_u in kPa is very approximately UCS x 50. Pocket Penetrometers are an aid to logging of cohesive soils, the results are indicative and should not be relied upon. The equipment used is not calibrated

CBR California Bearing Ratio Test (CBR%) - refer also to detailed test results

PID Photo-Ionisation Detector Readings in headspace of small disturbed chemical samples. Result given in ppm by volume

C.1.3 In Situ Testing and Sampling

UNDISTURBED SAMPLES

All samples recovered are recorded and handled in accordance with EN ISO 22475-1.

U/UT General purpose open tube sample. Sample normally taken with open tube sampler approximately 0.1m diameter and 0.45m long and driven with an 80kg sinker bar and 56kg sliding hammer, unless noted otherwise. "XX" in U100 blows column denotes the number of hammer blows. The height of hammer drop can be variable depending on operator technique. Depths are given of the top of the sample if full penetration and recovery are achieved, otherwise actual lengths of penetration and recovery are given in the appropriate columns.

'U' denotes steel or plastic liner sample in general use up to year 2010 designated OS/TKW in accordance with BS EN ISO 22475-1 with an area ratio greater than 25%. 'UT' denotes thin wall open tube sampler designated OS/TW with an area ratio less than 15%, available from 2010.

U/UT(X) General purpose open tube sample (X) mm diameter

TW(X) Thin wall (push) sample (X) mm diameter

P(X) Piston sample (X) mm diameter

DISTURBED AND CORE SAMPLES

CBR	Sample taken in CBR Mould
D	Small disturbed sample (plastic tub or jar with air tight lid)
B	Bulk disturbed sample (polythene bag, tied at neck - size dependent on purpose)
LB	Large Bulk disturbed sample (normally several bulk samples of the same material - size dependent on purpose)
W	Water sample
C	Core sample
CS	Short core, generally about 100mm
CL	Long core, generally 250mm to 300mm
#	Sample not recovered

ENVIRONMENTAL SAMPLES

CD	Sample for chemical analysis in a plastic tub
K	Sample for chemical analysis in an amber glass jar
V	Sample for chemical analysis in a glass vial
CDKV	Set of samples for chemical analysis as above
WAC	Sample for Waste Acceptance Criteria
ES	Environmental Soil Sample
EW	Environmental Water Sample

C.1.4 Key to Borehole and Trial Pit Records

Soil Types

Coarse grained, Non cohesive

- Boulders
- Cobbles
- Gravel
- Sand

Fine grained, Cohesive

- Silt
- Clay

Other Soil Types

- Topsoil
- Peat
- Made Ground

Note: Composite soil types may be signified by combined symbols.

Rock Types

Sedimentary

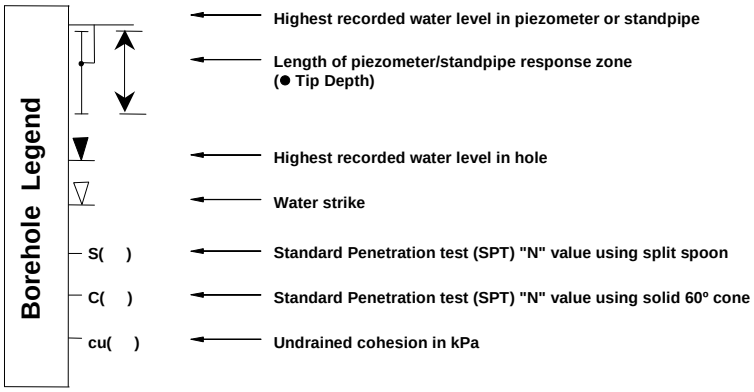
- Sandstone
- Siltstone
- Conglomerate
- Chalk
- Limestone
- Breccia
- Coal
- Mudstone/Claystone/Shale

Metamorphic

- Coarse/Medium grained
- Fine grained

Igneous

- Coarse grained
- Medium grained
- Fine grained



C.1.5 Description of Rock Cores

DESCRIPTIVE ORDER

Strength, Structure, Colour, Texture, Grain Size, ROCK NAME. Minor constituents and additional information. (Geological formation - see comments under identification and description of soils). Mass characteristics - factual description of weathering state (if appropriate) and description of discontinuities and fracture state (if appropriate).

Term	Field identification	Strength (MPa)
Extremely weak	Scratched by thumbnail. Gravel sized lumps crush between finger and thumb.	0.6 to 1
Very weak	Scratched by thumbnail, lumps can be broken by heavy hand pressure, can be peeled easily by a pocket knife, crumbles under firm blows with point of geological hammer.	1 to 5
Weak	Thin slabs, corners or edges can be broken off with hand pressure, can be peeled by a pocket knife with difficulty, easily scratched by pocket knife, shallow indentations made by firm blow with point of geological hammer.	5 to 12.5
Moderately weak	Thin slabs, corners or edges can be broken off with heavy hand pressure, can be scratched with difficulty by pocket knife, hand-held specimen can be broken with single firm blow of geological hammer	12.5 to 25
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen on a solid surface can be fractured with single firm blow of geological hammer.	25 to 50
Strong	Specimen requires more than one blow of geological hammer to fracture it.	50 to 100
Very strong	Specimen requires many blows of geological hammer to fracture it.	100 to 250
Extremely strong	Specimen can only be chipped with geological hammer.	Greater than 250

DISCONTINUITIES

Bedding Spacing & Planar Structures *	Spacing (mm)	Discontinuity Spacing
	>6000	Extremely widely spaced
Very thickly bedded	>2000 2000-6000	Very widely spaced
Thickly bedded	600 - 2000	Widely spaced
Medium bedded	200 - 600	Medium spaced
Thinly bedded	60 - 200	Closely spaced
Very thinly bedded	20 - 60	Very closely spaced
Thickly laminated (Sedimentary) narrow (Metamorphic & Igneous)	6 – 20 <20	Extremely closely spaced
Thinly laminated (Sedimentary) Very narrow (Metamorphic & Igneous)	<6	

* For igneous and metamorphic rocks the appropriate descriptive term for planar structure should be used
e.g. medium foliated gneiss, very narrowly cleaved slate, very thickly flow banded diorite.

NOTES ON DISCONTINUITY RECORDS

Types of Discontinuities	B Bedding fracture	J Rock joint,	C Cleavage	FS Fault/shear	D Discontinuity
Units	mOD metres Ordnance Datum	m metres	mm millimetres		

WEATHERING

Standard descriptions of weathered rocks for engineering purposes should always include comments on the degree, extent and nature of any weathering effects at material or mass scales. This may allow subsequent classification and provide information for separating rock into zones of like character. Indications of weathering include

- changes in colour
- changes in fracture state
- reduction in strength
- presence, character and extent of weathering products

If a systematic classification following the guidelines given in the Standard can be applied unambiguously, this is described in the text of the report. Otherwise, the rocks are not classified in terms of weathering beyond the approach described above.

Weathering terms that may be used for description of rock material and these terms may be qualified or combined.
Discoloured - The degree and type of colour change from original is described, and if for mass or particular mineral constituents
Disintegrated - Fragmentation by physical weathering, bonding lost but material fabric intact. Material friable, not decomposed
Decomposed - Chemical alteration of mineral grains so material fabric is intact but some or all grains are decomposed

For rock mass weathering the following terms may be used
Slightly - Discolouration on surfaces and / or of material
Moderately - Less than half of mass decomposed/disintegrated. Fresh/discoloured rock as continuous material or corestones
Highly - More than half decomposed/disintegrated. Fresh/discoloured rock as discontinuous framework or corestones
Completely - All rock material decomposed and/or disintegrated. Original mass structure largely intact
Residual Soil - All material converted to soil, structure and fabric destroyed, may be volume change but material not moved
The term 'Fresh' is used to indicate that there is no visible weathering or alteration, except possibly slight discolouration on major surfaces.

ROCK CORE SIZES

The core barrels commonly used by the Company in site investigations are as follows:

Core Barrel Type	Borehole Diameter (mm)	Standard Core Size (mm)	Core Size using Rigid Plastic Liner (mm)	Casing Size or Type	Casing O.D (mm)	Casing I.D (mm)
STANDARD BRITISH SIZES						
NWM	75.7	54.7	51	NX	88.9	76.2
HWF	98.8	76.2	72	HX	114.3	100.0
HWAF	99.5	70.9	-	HX	114.3	100.0
PWF	120.0	92.1	87	PX	139.7	122.3
SWF	145.4	112.8	107	SX	168.3	147.7
UWF	173.7	139.8	132	UX	193.7	176.2
WIRELINE SIZES						
BQ	59.9	36.4	35			
NQ	75.7	47.6	45			
HQ	96.1	63.5	61			
PQ	122.7	85.0	82			
GEOBOR S	146.0	102.0	102	SX	168.3	147.7
THINWALL SIZES						
TNX	75.7	60.8	-	NX	88.9	76.2
T2 66	66.1	51.9	-	74	74.3	67.3
T2 76	76.1	61.9	-	84	84.3	77.3
T2 86	86.1	71.9	68	98	98.0	89.0
T2 101	101.1	83.9	80	113	113.0	104.0
T6 116	116.1	92.9	89	128	128.0	118.0
T6 131	131.1	107.9	104	143	143.0	133.3
NON STANDARD BARRELS						
4.12F TRIEFUS	105.2	74.7	72	PX	139.7	122.3
5.5x4C SINGLE TUBE	139.7	101.6	-	SX	168.3	147.7
B116	116	102	-	PX	139.7	122.3
B146	146	132	-	SX	168.3	147.7

Note: Core diameters may vary when different lining systems are in use.

ROCK CORE CHARACTERISTICS

TCR **Total Core Recovery.** The length of the total amount of core sample recovered, expressed as a percentage of the length of the core run.

SCR **Solid Core Recovery.** The length of solid core recovered, expressed as a percentage of the length of the core run. Solid core is defined as that length of core which has a full diameter, but not necessarily a full circumference. Only natural fractures are considered. Drilling or handling induced fractures are ignored.

RQD **Rock Quality Designation.** The length of solid core recovered in pieces each more than 100mm long as a percentage of the core run length.

FI **Fracture Index.** The number of discontinuities expressed as 'fractures per metre', measured over any convenient length of consistent fracture characteristics. Fracture index is normally measured axial along the core.

If Fracture Spacing. The minimum, average and maximum spacing of discontinuities in mm, measured over any convenient length of consistent fracture characteristics. Fracture spacing is normally measured perpendicular to the discontinuity plane unless indicated otherwise.

I_s Corrected **Point Load Strength Index** $I_{s(50)}$ which is given in MPa

Zones of atypical fracturing of restricted extent which occur within a rock unit of uniform fracture characteristics are identified within the Description of Strata, but not given a separate $_{If / FI}$.

AZCL Assumed Zone of Core Loss

NI Not Intact

NR No Recovery

NA Not Applicable

DI Drilling Induced

C.1.6 Identification and Description of Soils

	Basic Soil Type	Particle Size (mm)		Visual Identification
VERY COARSE SOILS	BOULDERS		200	Large Boulders >630mm. These soils only seen complete in pits or exposures. Often difficult to recover from boreholes.
	COBBLES		63	
COARSE SOILS (Typically over 65% Sand and Gravel Sizes)	GRAVEL	coarse	20	Easily visible to naked eye; particle shape can be described, grading can be described. Well graded: wide range of grain sizes, well distributed. Poorly graded: not well graded. (May be uniform: size of most particles lies between narrow limits; or gap graded; an intermediate size of particle is markedly under represented).
		medium	6.3	
		fine	2	
	SAND	coarse	0.63	Visible to naked eye; no cohesion when dry; grading can be described. Well graded and poorly graded: as above
		medium	0.2	
		fine	0.063	
FINE SOILS (Typically over 35% Silt and Clay Sizes)	SILT	coarse	0.02	Only coarse silt visible with hand lens; exhibits little plasticity and marked dilatancy; slightly granular or silky to touch. Disintegrates in water; lumps dry quickly; possesses cohesion but powders easily between fingers. Term "SILT" or "CLAY" must be used, "SILT/CLAY" not allowed. Dry lumps can be broken but not powdered between the fingers; they also disintegrate under water but more slowly than silt; smooth to the touch; exhibits plasticity but no dilatancy; sticks to the fingers and dries slowly; shrinks appreciably on drying usually showing cracks. Intermediate and high plasticity clays show these properties to a moderate and high degree, respectively.
		medium	0.0063	
		fine	0.002	
	CLAY			
ORGANIC SOILS	ORGANIC CLAY, SILT or SAND	Varies		Contains varying amounts of organic vegetable matter - defined by colour: grey - slightly organic; dark grey – organic; black – very organic.

Composite Soil Types
(Mixtures of basic soil types)

Scale of secondary constituents with coarse and very coarse soils. Term before, description after principal

Term before (term in ' [ ] ' may be used for 2nd'ry parts, matrix etc)	Principal Soil Type	Description after	Approx % 2nd'ry soil type
Slightly (sandy*) [occasional / little]	SAND, GRAVEL; (COBBLES or BOULDERS See Notes)	Used to describe components of secondary constituents. e.g. Gravel is fine and medium subangular fine sandstone and mudstone.	<5
--(sandy*) [some]			5 – 20
Very (sandy*) [much / many]			20 to 40†
--		and (sand*) or and (cobbles+)	50†

* Fine or coarse soil type as appropriate
\+ Very coarse soil type – see Notes
† described as fine soil depending on behaviour

Scale of secondary constituents with fine soils. Terms before, description after principal constituent.

Term before	Principal Soil Type	Description after	Approx % 2nd'ry soil type
Slightly (sandy*)	CLAY or SILT	Used to describe components of secondary constituents e.g. sandy gravelly CLAY. Gravel is coarse rounded quartzite	<35
-- (sandy*)			35 to 65†
Very (sandy*)			>65†

* Coarse soil type as appropriate
† or described as coarse soil depending on mass behaviour

EXAMPLES OF COMPOSITE TYPES
(indicating preferred order for description)

Loose brown very sandy subangular coarse GRAVEL with many pockets (<5mm across) of soft grey clay.

Firm thinly interlaminated brown SILT and CLAY.

Dense light brown clayey fine and medium SAND.

Density / Consistency / Peat Condition

For very coarse soils qualitative description by inspection of voids and particle packaging.

Standard Penetration Test in Boreholes for Coarse Soils

No of blows	Relative Density
<4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
>50	Very Dense
Slightly cemented	Visual Examination: pick removes soil in lumps which can be abraded.

Silty CLAY or clayey SILT – use prefix only when secondary constituent has significant effect on material characteristics. Terms 'slightly' or 'very' not applicable.

Consistency

Very soft	Finger easily pushed in up to 25mm. Exudes between fingers
Soft	Finger pushed in up to 10mm. Moulded by fingers
Firm	Thumb makes impression easily. Rolls to thread
Stiff	Can be indented slightly by thumb. Crumbles if rolled
Very Stiff	Indented by thumbnail. Cannot be moulded
Hard	Can be scratched by thumb nail
Firm Peat	Fibres compressed together
Spongy Peat	Very compressible, open
Plastic Peat	Moulded in hand, smears

Structure

Term	Field Identification
Homo-geneous	Deposit consists essentially of one type
Interbedded or interlaminated	Alternating layers of varying types. Pre-qualified by thickness term if in equal proportions. Otherwise thickness of, and spacing between, subordinate layers defined
Hetero-geneous	A mixture of types
Weathered (granular)	Particles may be weakened and may show concentric layering
Weathered (cohesive)	Usually has crumb or columnar structure
Fissured	Breaks into blocks along unpolished discontinuities
Sheared	Breaks into blocks along polished discontinuities
Intact	No fissures
Fibrous Peat	Plant remains recognisable and retain some strength. When squeezed only water, no solids
Pseudo-fibrous Peat	Plant remains recognisable, strength lost. Partial decomposition. Turbid water when squeezed, <50% solids
Amorphous Peat	Recognisable plant remains absent, full decomposition. When squeezed only paste with >50% solids
Gyttja	Decomposed plant & animal remains, maybe inorganic constituents
Humus	Plant remains, living organisms & inorganic constituents in topsoil

Interval Scales

Scale of Bedding Spacing	Mean Spacing (mm)	Scale of Spacing of Other Discontinuities / [Blocks]
Very thickly bedded	over 2000	Very widely spaced / [Very large]
Thickly bedded	2000-600	Widely spaced / [Large]
Medium bedded	600-200	Medium spaced / [Medium]
Thinly bedded	200-60	Closely spaced / [Small]
Very thinly bedded	60-20	Very closely / [Very small]
Thickly laminated	20-6	Extremely closely spaced
Thinly laminated	under 6	

Spacing terms may also be used for distance between partings, isolated beds or laminae, desiccation cracks, rootlets etc. Terms such as partings or dustings may be used for laminae less than 2mm and less than 0.6mm respectively.

Discontinuity Shape (See Standard for Persistence/Openness)	Small scale (mm's) rough, smooth Medium scale (cm's) planar, stepped, undulating Large scale (m's) wavy, curved, straight

Particle Nature

Particle Shape & Form

Very angular
(Sub) angular
(Sub) rounded
Well rounded

Low Sphericity
Flat or Elongate

High Sphericity
Cubic

Particle Surface Texture

Rough

Smooth

Polished

NOTES Identification and descriptive method, and descriptions, generally in accordance with BS5930:2015 Section 6 clauses 41 and 43 and BS EN ISO 14688-1:2018
Additional notes relating to BS EN ISO 14688-2:2018 – modified terms for content of secondary fraction given in Annex B Table B1 are not comparable to 5930 and are not be used.
Organic Content: - Low – 2 to 6%; Medium - 6 to 20%; High - >20%. Terms not used on borehole records
Carbonate content :- Only noted if field test with dilute HCl undertaken – Carbonate free if no effervescence; Calcareous if slight effervescence; Highly calcareous if strong reaction
Undrained shear strength: - terms from laboratory or in situ tests not given on borehole records.
Very Coarse Soils – described by initially removing very coarse materials and describing residue before adding back the very coarse soils. If residue is cohesive then described as '…….(COBBLES / BOULDERS) with low (cobble / boulder) content with (some / much etc) matrix of …..' If residue is granular then described as ' with matrix of ' or as a coarse soil.
Cobbles :- <10% - low cobble content; 10 to 20% - medium content; >20% - high content; **Boulders** <5% - low boulder content; 5 to 20% - medium content; >20% - high content

C.1.7 Method of Middle and Upper Chalk Description

The cable percussion boring technique, particularly in Chalk, destroys much of the texture and structure of the material. "Disturbed" samples tend to be of use only to indicate the occurrence of non-Chalk materials, such as clays and flint, within the Chalk mass and occasionally to show staining and hard grounds. General purpose U100 driven open tube samples also display an amount of disturbance with a tendency to remoulding on the periphery of the sample and partial disturbance and fracturing of the material throughout the sample. Higher quality samples tend to be recovered from rotary coring. Actual description of the Chalk in situ, such as afforded by trial pits or exposures, is the most satisfactory method.

A Chalk "Grade" system for describing Chalk in situ was devised by Ward, Burland and Gallois[1] for a site at Mundford in Norfolk, in 1968 (generally known as the "Mundford" scheme). Wakeling[2] has subsequently slightly extended the scheme and published a tentative correlation between SPT 'N' values and "Grade" for Middle and Upper Chalk at the Mundford site. This tentative correlation of Chalk "Grade" to SPT 'N' value is based on a single specific site and must be used with extreme caution at any other location. Nonetheless, SPT 'N' values may be used to give a relative indication of the variations in Chalk quality within a site, and SPT 'N' values are used for many empirical or semi-empirical methods of foundation design in Chalk. A discussion on the applicability and use of the SPT 'N' value to determine "Grade" of Chalk is given in the Proceedings of the 1989 International Chalk Symposium, pages 1 to 4, 109 to 132 and 137 to 152.

A more recent system for the engineering description of Chalk and the allocation of Chalk "Grades" was proposed by Spink and Norbury[3] at the International Chalk Symposium in 1989, an outline of which is given in the Notes. The Mundford and the Spink and Norbury "Grades" (I to VI) are broadly equivalent when based on material description. The most recent grading system for Chalk to be widely used, which can be taken from Spink and Norbury type descriptions, has been given in CIRIA Project Report 11[44] in 1994 and further revised in CIRIA Report C574[5]. The CIRIA system is summarised in the accompanying notes together with a correlation between the CIRIA system and the Mundford/Spink and Norbury systems.

Chalk descriptions in the report have been made generally to the method outlined by Spink and Norbury and revised by the CIRIA recommendations. Rotary core, U100 sample and trial pit strata descriptions given in the report also have an assessment of the CIRIA Chalk grade. Chalk descriptions included on the cable percussion borehole records are generally for the materials as recovered, and Chalk grade is not normally given due to the difficulties outlined in the first two paragraphs of this note. However, U100 Chalk grades and SPT 'N' values are given so that the reader may make their own assessment of the Chalk grade as necessary. The CIRIA grading scheme has been used for any engineering assessment in this report as this is considered to be current best practice; and the CIRIA recommendations have been used for foundation design. The Mundford SPT 'N' grading scheme has not been used in this report.

[1] W.H. WARD, J.B. BURLAND and R.W. GALLOIS, 1968. Geotechnical assessment of a site at Mundford, Norfolk for a large proton accelerator. Geotechnique, 18 (No 4), pp 399-431.
[2] T.R.M WAKELING, 1969. A comparison of the results of a standard site investigation methods against the results of a detailed geotechnical investigation in the Middle Chalk at Mundford, Norfolk. Proc. Conf. In situ Investigations in soils and rocks. British Geotechnical Society, London, pp 17-22.
[3] T.W. SPINK and D.R. NORBURY, 1989. The engineering geological description of Chalk. Proc. Int. Chalk Symp., Brighton. Thomas Telford, London, pp 153-160.
[4] CIRIA PROJECT REPORT 11, Foundations in chalk, January 1994, CIRIA, London.
[5] CIRIA Report C574, Engineering in chalk, 2002, CIRIA, London

GEOLOGICAL DESCRIPTION AND GRADING OF MIDDLE & UPPER CHALK FOR ENGINEERING PURPOSES AFTER SPINK AND NORBURY

<table>
<tr><th>Grade</th><th colspan="3">Definitions of Grade</th><th>Typical Features of Grade</th><th>Word Order For Descriptions</th></tr>
<tr><td colspan="6">STRUCTURELESS (or reworked) CHALK</td></tr>
<tr><td>Grade</td><td>% Comminuted Chalk Matrix</td><td>% Clasts [i] (>0.06mm)</td><td>Weathering of Clasts</td><td>Strength of Clasts [vii]</td><td rowspan="3">Structureless CHALK composed of:
matrix (soil strength, colour, nature eg "firm white silt and sand sized comminuted Chalk") and clasts (angularity, size, colour, weathering, strength eg "subangular 5 to 15mm fragments of white highly weathered very weak chalk")
Matrix first in cohesive matrix-dominated (Grade VI) Chalk, clasts first in granular clast- dominated (Grade V) Chalk.
Give proportion of matrix to clasts. Presence type and size of flints, clay pockets, etc</td></tr>
<tr><td>VI</td><td>> about 35%</td><td>< about 65%</td><td>Moderately to completely</td><td>Very weak or weak</td></tr>
<tr><td>V</td><td>< about 35%</td><td>> about 65%</td><td>Moderately or highly</td><td>Very weak or weak</td></tr>
<tr><td colspan="6">STRUCTURED CHALK</td></tr>
<tr><td>Grade</td><td>Fracture Spacing mm</td><td>Fracture Width mm</td><td>Material Weathering</td><td>Material Strength [vii]</td><td rowspan="5">Colour, rock material weathering, CHALK, rock material strength.

Discontinuity - type, spacing (minimum/mean/maximum), orientation: dip direction [in situ observation only] / dip, openness / width, nature of infill, stainings.

Presence and nature (size, shape) of flints. Other features (marl layers, fossils, etc)</td></tr>
<tr><td>IV</td><td>Extremely to very closely <60</td><td>Open or infilled 5</td><td>Moderately or highly</td><td>Very weak or weak</td></tr>
<tr><td>III</td><td>Closely 60-200</td><td>Open or infilled up to 3</td><td>Slightly or moderately</td><td>Weak or Moderately weak</td></tr>
<tr><td>II</td><td rowspan="2">At least medium >200</td><td rowspan="2">Tight and clean</td><td rowspan="2">Fresh or slightly</td><td>Moderately weak</td></tr>
<tr><td>I</td><td>Moderately weak or mod. Strong</td></tr>
</table>

Weathering	**Rock Mass (from Geological Society Engineering Group Working Party Report on Engineering Geological Maps and Plans 1972)**
Fresh	No visible sign of weathering, no discolouration or loss of strength
Slightly	Discolouration along discontinuities, which may be open. Intact rock not weaker than fresh rock.
Moderately	Discolouration through mass, intact rock weaker, alteration on discontinuities
Highly	As moderately; but deeper alteration, fabric altered/disturbed near discontinuities, many lithorelicts
Completely	Mass entirely discoloured and changed to soil, structure still visible, occasional lithorelicts
Residual	Entirely decomposed, no original structure visible

Weathering	**Fragments**
Slightly	Slight discolouration/speckling. No apparent weakness
Moderately	Discolouration/speckling throughout with slight weakening
Highly	Discolouration/speckling throughout with obvious weakening

Field Definition of Rock Strength [vii]	
Term	Field Definition
Very Weak	Lumps crumble easily in hand
Weak	Thin slabs broken easily by hand
Moderately Weak	Thin slabs broken by heavy hand pressure
Moderately Strong	Core broken by light hammer blows
Strong	Core broken with heavy hammer blows
Very Strong	Chipped with heavy hammer blows

Grade	Term	% of secondary constituents	
		Matrix	Clasts
VI	with a little		< about 35
VI	with some		about 35-65
V or VI	with much	about 35	about 65
V	with much	about 20-35	
V	with some	about 5-20	
V	with a little	< about 5	

NOTES

i "Clasts" are coarse fragments generally gravel size or greater (>2mm), also termed lithorelicts. They may also be sand sized if the material as a whole behaves as a granular soil.

ii Intermediate grades may be assigned, but not IV/V. Grade V/VI should not be assigned unless engineering behaviour cannot be assessed.

iii Grade IV and V based on material behaviour. Grade VI - (cohesive) matrix-dominated, V - (granular) clast-dominated.

iv Grade I to IV determined by assessing average or typical fracture spacing, width and aperture

v Typical strength ranges given. Others may occur and if significantly different then grade may be changed accordingly.

vi For a full account of the description and grading scheme, reference should be made to: T.W. SPINK and D.R. NORBURY, 1989. The engineering geological description of Chalk. Proc. Int. Chalk Symp., Brighton. Thomas Telford, London, pp 153-160.

vii Material strengths those of BS5930 prior to issue of BS5930:1999 Amendment 1

CIRIA CHALK GRADING SCHEME
From CIRIA Report C574, Engineering in Chalk, CIRIA, London 2002

The method of grading is based principally on the definition of material behaviour as follows:
Is the material structureless (Grade D) or structured (Grade A to C)?
If structureless - is it a cohesive type material (cohesive-matrix dominated - Dm) or is it a granular type material (granular clast-dominated or rarely granular clast-matrix dominated - Dc). In most materials the matrix will be up to sand sized and cohesive and the clasts generally gravel size or greater and granular. The material's engineering behaviour is the most important defining factor.
Example description: Structureless CHALK: firm off white slightly gravelly sandy SILT. Gravel is very weak low density off white chalk locally stained brown, speckled black. Occasional nodular flint <40mm. Rare trace of brown clay (Grade Dm)
Alternative: Structureless CHALK: firm off white comminuted sandy SILT chalk with about 25% angular fragments <25mm of weak …..
If structured - then first assess intact dry density (low, medium, high or very high). Then define discontinuity aperture/infill (prefix A to C) and then discontinuity spacing (suffix 1 to 5). Each discontinuity set should be described separately.
Example description: Very weak medium density fractured off white unstained CHALK. Fractures/ discontinuities typically subhorizontal and subvertical very closely spaced (10/40/70) planar closed or open locally infilled (0/2/4) with comminuted chalk rarely with brown clay veneer with local brown staining and black speckling on surfaces. Rare nodular flint up to 60mm. (Grade Medium Density B4)

STRUCTURELESS CHALK			
CIRIA Grade	**Mundford Grade**	**Comminuted (Cohesive) Chalk Matrix**	**Coarser Fragments (>2mm)**
Dm	VI	Greater than about 35%	Less than about 65%
Dc	V	Less than about 35%	Greater than about 65%

STRUCTURED CHALK				
Typical discontinuity spacing (mm)	**Typical discontinuity aperture/infill**			**Grade**
	Open or infill >3mm	**Open or infill <3mm**	**Closed clean**	
<20mm Extremely close	IV C5	- (B5)	- (A5)	Mundford CIRIA
20-60mm Very close	IV C4	III/IV* B4	- (A4)	Mundford CIRIA
60-200mm Close	III/IV* C3	III B3	II/III* A3	Mundford CIRIA
200-600mm Medium	- C2	II/III* B2	II or I# A2	Mundford CIRIA
>600mm Wide or greater	- C1	- B1	II or I# A1	Mundford CIRIA
Mundford Grades : * undefined ; # for very high density chalk; CIRIA GRADES : () Not Common				

ASSESSMENT OF DRY DENSITY						
FIELD IDENTIFICATION	**FIELD TEST PENETRATION (mm)**			**LABORATORY TEST (Mg/m^3)**	**DENSITY DESCRIPTION**	**EQUIVALENT STRENGTH** BS5930:1999 Amendment 1
	150mm Nail	**Used Pick**	**New Pick**			
30-40mm thick clasts crushed by finger pressure and remoulded to form "putty"	>25	>30	>35	<1.55	Low	To Very Weak (<3MN/m^2)
30-40mm thick clasts will not crush with finger pressure, but broken with both hands. Part fractured and part crushed when struck with hammer.	15-25	11-30	18-35	1.55 -1.70	Medium	Upper end Very Weak (3-5MN/m^2)
Small clasts broken with great difficulty by hand cannot break 30-40mm clasts. Lumps fracture as a whole after several heavy hammer blows.	6-15	2-11	6-18	1.70 – 1.95	High	Lower end Weak (5-12.5MN/m^2)
Will not break by hand. 100mm dia clasts held in hand broken by single hammer blow.	<6	<2	<6	>1.95	Very High	Upper end weak to Medium Strong (>12.5MN/m^2)

C.2 EXPLORATORY HOLE RECORDS

C.2.1 Schedule of Exploratory Holes

Exploratory Hole ID	Method of Construction	Grid Coordinates		Ground Level [m OD]	Hole Depth [m BGL]	Remarks and Instrumentation Details Diameter: Type: Slotted Section or Tip (Response Zone) [m BGL]	Field Testing
		Easting [m]	Northing [m]				
GRF151-SCPH001	IP+SCP	564761.10	175299.82	1.95	19.50	-	CPT, HPT
GRF151-SCPH004	IP	564742.75	175298.57	2.38	1.20	-	
GRF151-SCPH005	IP+SCP	564758.14	175295.28	2.00	17.11	-	CPT, HPT
GRF151-SCPH013	IP+SCP	564766.67	175320.23	1.65	16.66	-	CPT, HPT
GRF151-SCPP001	IP+SCP	564761.01	175298.88	1.94	17.63	-	CPT, CPM, Diss
GRF151-SCPP005	IP+SCP	564756.98	175296.22	1.98	17.11	-	CPT, CPM
GRF151-SCPS009	IP	564763.62	175307.36	1.70	1.20	-	
GS0051-CP111	IP	*565626.00**	*175348.00**		1.20	Coordinates used for GS0051-CP11A to nearest whole metre	
GS0051-CP111A	CP	565625.67	175347.53	3.33	23.00	2 x EPIE; to 6.50m (6.00m to 7.00m) and 19.00m 918.50m to 19.00m)	SPT
GS0051-CP111B	IP	*565626.00**	*175348.00**		1.20	Coordinates used for GS0051-CP11A to nearest whole metre	
GS0051-CP112	CP	566081.69	175403.93	3.11	25.00	1 x EPIE; to 7.50m (7.00m to 8.00m)	HV, SPT, PID
GS0051-CP113	CP	566273.58	175416.63	2.97	27.60	2 x EPIE; to 12.00m (11.50m to 12.50m) and 25.00m (24.50m to 25.50m)	SPT, VHT
GS0051-CP114	IP	566419.25	175464.96	4.12	1.20	-	
GS0051-CP115	IP	566508.86	175486.73	2.89	1.40	-	
GS0051-IVAN115	IP	565630.07	175348.06	3.32	1.20	-	IVAN
GS0051-IVAN117	IP	565933.52	175386.27	2.59	0.55	-	
GS0051-IVAN117A	IP	565934.01	175386.13	2.58	1.20	-	IVAN
GS0051-SCP114	IP	*565575.00**	*175420.00**		0.80	Coordinates assessed from site notes.	
GS0051-SCP115	IP+SCP	565628.05	175348.17	3.30	19.66	-	CPT, Diss
GS0051-SCP116	IP+SCP	565885.85	175389.21	2.59	17.65	-	HV, CPT
GS0051-SCP116A	IP	565887.84	175389.61	2.57	1.20	-	HV, PID, CPT
GS0051-SCP117	IP+SCP	565932.85	175386.17	2.60	19.23	-	CPT, Diss
GS0051-SCP118	IP+SCP	566081.75	175402.78	3.08	20.03	-	HV, PID, CPT
GS0051-SCP119	IP+SCP	566274.65	175416.90	3.01	18.04	-	HV, PID, CPT, Diss

Exploratory Hole ID	Method of Construction	Grid Coordinates		Ground Level [m OD]	Hole Depth [m BGL]	Remarks and Instrumentation Details Diameter: Type: Slotted Section or Tip (Response Zone) [m BGL]	Field Testing
		Easting [m]	Northing [m]				
GS0051-SCP120	IP	566420.91	175465.38	4.16	0.40	-	HV, PID
GS0051-SCP120A	IP	566423.04	175465.56	4.12	0.60	-	
GS0051-SCP120B	IP+SCP	566419.23	175465.81	4.14	19.57	-	CPT
GS0051-SCP121	IP+SCP	566510.23	175487.16	2.88	18.80	-	CPT
GS0051-SCPP115	IP	565627.30	175347.86	3.33	0.55	-	
GS0051-SCPP115A	IP+SCP	565629.05	175348.23	3.34	16.53	-	CPT
GS0051-SCPP117	IP+SCP	565933.77	175385.24	2.59	16.26	-	CPT
GS0051-SCPP119	IP+SCP	566274.65	175416.90	3.01	11.63		CPT
GW0051-CP108	CP	565481.84	175355.6	3.54	25.00	-	HV, SPT
GW0051-CP109	CP	565504.21	175479.38	3.84	30.00	2 x EPIE; to 2.80m (2.00m to 3.00m) and 14.50m (14.00m to 15.00m)	SPT
GW0051-CPRC102	CP+RC	565391.59	175280.17	3.61	30.50	2 x EPIE; to 15.00m (14.50m to 15.50m) and 26.50m (26.00m to 27.00m)	SPT, VHT
GW0051-SCP111	IP+SCP	565403.74	175285.33	4.81	1.22	-	HV, PID, CPT
GW0051-SCP111A	IP+SCP	565405.01	175286.06	4.92	1.25	-	CPT
GW0051-SCP111B	IP+SCP	565393.10	175280.06	3.66	20.22	-	CPT
GW0051-SCP112	IP+SCP	565484.04	175354.64	3.69	18.13	-	HV, PID, CPT, Diss
GW0051-SCP113	IP+SCP	565505.27	175479.92	3.84	16.03	-	HV, PID, CPT
GW0051-SCPP113	IP+SCP	565505.89	175481.24	3.86	12.13	-	CPM, CPT
GX0051-CP104	CP	564797.53	175200.34	3.49	25.00	-	SPT
GX0051-CP105	CP	565001.58	175230.32	3.45	26.45	-	HV, SPT, VHT
GX0051-CP106	CP	565146.75	175230.67	4.36	29.95	2 x EPIE; to 6.50m (6.00m to 7.00m) and 21.50m (21.00m to 22.00m)	HV, SPT, VHT
GX0051-CPRC101	CP+RC	564889.23	175216.68	3.36	30.65	2 x EPIE; to 5.50m (5.00m to 6.00m) and 10.00m (9.60m to 10.40m)	SPT, VHT
GX0051-IVAN106	IP	564797.66	175198.29	3.53	1.20	-	IVAN
GX0051-IVAN109	IP	565146.75	175230.67	4.36	1.25	-	
GX0051-SCP106	IP+SCP	564797.51	175199.27	3.54	18.71	-	CPT, Diss

Exploratory Hole ID	Method of Construction	Grid Coordinates		Ground Level [m OD]	Hole Depth [m BGL]	Remarks and Instrumentation Details Diameter: Type: Slotted Section or Tip (Response Zone) [m BGL]	Field Testing
		Easting [m]	Northing [m]				

Abbreviations:

IP	Inspection Pit
RC	Rotary Coring
CP	Cable Percussion
TP	Trial Pit
SCP	Cone Penetration Testing
IVAN	Penetrating Shear Vane Test

m	Metres
mm	Millimetres
m OD	Metres Ordnance Datum
m BGL	Metres below Ground Level
SP	Slotted Standpipe
SPIE	Standpipe Piezometer
EPIE	Vibrating Wire Piezometer

PID	Photo-ionisation Detector Screening
SPT	Standard Penetration Testing
HV	Hand Shear Vane Testing
VHT	Variable Head Permeability Testing
CPT	Cone Penetration Test
Diss	Dissipation Testing
CPM	Cone Pressuremeter Testing
HPT	Hydraulic Profiling Tool

Notes: Geodetic Parameters; OSGB 1936 / British National Grid
Where survey details are not available, locations shown in italics with * and remark. Ground elevations have not been included.

Contract Name	Tilbury Ground Investigations			Location ID
Client	TEAM2100			**GS0051-CP114**
Fugro Reference	G180029U			
Coordinates (m)	E566419.25 N175464.96	Ground Elevation (m Datum)	4.12	Sheet 1 of 1
Hole Type	Inspection Pit			Status: Final

Equipment

Depth From (m)	Depth To (m)	Hole Type	Date From	Date To	Equipment	Core Barrel	Core Bit	Drilling Crew	Logged By	Remarks
0.00	1.20	IP	03/12/2018	03/12/2018	Hand dug				JB	

Progress

Date (dd/mm/yyyy)	Time (hh:mm:ss)	Hole Depth (m)	Casing Depth (m)	Water Depth (m)	Weather
03/12/2018	08:00:00	0.00			
03/12/2018	18:00:00	1.20		Dry	

Rotary Details

Depth From (m)	Depth To (m)	Flush Type	Flush Return (%)	Flush Colour	Run Time (hh:mm)

Core Details

Depth From (m)	Depth To (m)	Diameter (mm)

Hole and Casing

Depth To (m)	Hole Diameter (mm)	Depth To (m)	Casing Diameter (mm)

Chiselling / Slow Progress

Depth From (m)	Depth To (m)	Duration (hh:mm)	Tool / Remark

Water Strike

Strike At (m)	Rise To (m)	Time Elapsed (mins)	Casing Depth (m)	Depth Sealed (m)

Water Added

Depth From (m)	Depth To (m)

Water Strike Remarks

General Remarks

1. Initially a PAS128B survey was undertaken. Prior to excavation, a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was then hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located. 2. UXO clearance carried out. 3. Inspection pit walls remained stable and vertical. 4. Samples not taken from inspection pit. 5. Borehole not drilled.

Installation

Type	ID	Response Zone Top (m)	Response Zone Base (m)	Installation Date

Pipe

ID	Top Depth (m)	Base Depth (m)	Diameter (mm)	Type

Backfill

Depth From (m)	Depth To (m)	Backfill Material	Date
0.00	1.20	Arisings	03/12/2018

Notes

- Abbreviations and results data defined on 'Notes on Exploratory Position Records'

Checked By	JI	Elevation Datum	Local Datum Not Defined	Grid Coordinate System	National Grid Ref Not Defined

Template: FGSL/HBSI/FGSL BH Summary.hbt/Config Fugro Rev5/12/03/2019/TS — Print Date: 09/07/2019

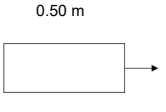
FUGRO	Contract Name	Tilbury Ground Investigations		Location ID
	Client	TEAM2100		**GS0051-CP114**
	Fugro Reference	G180029U		
	Coordinates (m)	E566419.25 N175464.96	Ground Elevation (m Datum) 4.12	Sheet 1 of 1
	Hole Type	Inspection Pit		Status: Final

Sampling and In Situ Testing				Strata Details					Groundwater	
Depth (m)	Type	No.	Test Results	Depth (m)	Strata Descriptions	Depth (Thickness) (m)	Level (m Datum)	Legend	Water Strike	Backfill / Installation
					MADE GROUND. Dark greyish brown slightly gravelly clayey fine and medium SAND with frequent rootlets (<1mm). Gravel is subangular and subrounded fine and medium of flint. [MADE GROUND]	(0.05) 0.05 (0.25)	4.07			
					MADE GROUND. Orangish brown SAND and GRAVEL. Sand is fine to coarse. Gravel is subangular to well rounded fine to coarse of flint. [MADE GROUND]	0.30 (0.20)	3.82			
					MADE GROUND. Grey weakly cemented PULVERISED FUEL ASH (PFA). Recovered as sand and gravel sized fragments. [MADE GROUND]	0.50	3.62			
				1	MADE GROUND. Off white silty sandy GRAVEL with low cobble content and occasional to frequent pockets (20mm x 8mm) of grey ashy sand. Gravel is angular to subrounded fine to coarse of chalk and occasional flint. Cobbles (100mm x 110mm x 90mm) are angular of flint and angular of chalk (140mm x 110mm x 70mm). [MADE GROUND]	(0.70)				
					Below 0.70m; occasional pockets (14mm x 7mm) orangish brown clay. 1.00m to 1.10m; bed of fine and medium ashy sand.	1.20	2.92			
					End of Inspection Pit at 1.20 m					
				2						
				3						
				4						

Notes

- Abbreviations and results data defined on 'Notes on Exploratory Position Records'

Plan



Contract Name	Tilbury Ground Investigations			Location ID
Client	TEAM2100			**GS0051-SCP120**
Fugro Reference	G180029U			
Coordinates (m)	E566420.91 N175465.38	Ground Elevation (m Datum)	4.16	Sheet 1 of 1
Hole Type	Inspection Pit			Status: Final

Equipment

Depth From (m)	Depth To (m)	Hole Type	Date From	Date To	Equipment	Core Barrel	Core Bit	Drilling Crew	Logged By	Remarks
0.00	0.40	IP	25/10/2018	25/10/2018	Hand dug				PC	

Progress

Date (dd/mm/yyyy)	Time (hh:mm:ss)	Hole Depth (m)	Casing Depth (m)	Water Depth (m)	Weather
25/10/2018	08:00:00	0.00			
25/10/2018	18:00:00	0.40		Dry	

Rotary Details

Depth From (m)	Depth To (m)	Flush Type	Flush Return (%)	Flush Colour	Run Time (hh:mm)

Core Details

Depth From (m)	Depth To (m)	Diameter (mm)

Hole and Casing

Depth To (m)	Hole Diameter (mm)	Depth To (m)	Casing Diameter (mm)

Chiselling / Slow Progress

Depth From (m)	Depth To (m)	Duration (hh:mm)	Tool / Remark

Water Strike

Strike At (m)	Rise To (m)	Time Elapsed (mins)	Casing Depth (m)	Depth Sealed (m)

Water Added

Depth From (m)	Depth To (m)

Water Strike Remarks

General Remarks

1. Initially a PAS128B survey was undertaken. Prior to excavation, a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was then hand-dug to 0.40m. 2. UXO clearance carried out. 3. Inspection pit walls remained stable and vertical. 4. No samples taken. 5. Inspection pit terminated at 0.40m due to concrete obstruction. Relocated as GX0051-SCP120A.

Installation

Type	ID	Response Zone Top (m)	Response Zone Base (m)	Installation Date

Pipe

ID	Top Depth (m)	Base Depth (m)	Diameter (mm)	Type

Backfill

Depth From (m)	Depth To (m)	Backfill Material	Date
0.00	0.40	Arisings	25/10/2018

Notes

- Abbreviations and results data defined on 'Notes on Exploratory Position Records'

Checked By	JI	Elevation Datum	Local Datum Not Defined	Grid Coordinate System	National Grid Ref Not Defined

Template: FGSL/HBSI/FGSL BH Summary.hbt/Config Fugro Rev5/12/03/2019/TS — Print Date: 09/07/2019

	Contract Name	Tilbury Ground Investigations		Location ID
	Client	TEAM2100		**GS0051-SCP120**
	Fugro Reference	G180029U		
	Coordinates (m)	E566420.91 N175465.38	Ground Elevation (m Datum) 4.16	Sheet 1 of 1
	Hole Type	Inspection Pit	Status	Final

Sampling and In Situ Testing				Strata Details					Groundwater	
Depth (m)	Type	No.	Test Results	Depth (m)	Strata Descriptions	Depth (Thickness) (m)	Level (m Datum)	Legend	Water Strike	Backfill / Installation
0.10	HVane		53 kPa		MADE GROUND. (Firm) brown slightly sandy slightly gravelly CLAY with frequent roots and rootlets (<2mm). Sand is fine. Gravel is subangular fine and medium of flint. [MADE GROUND]	(0.10) 0.10	4.06			
0.20	PID		< 0.1 ppm		MADE GROUND. Dark greyish/black slightly gravelly fine SAND (PFA). Gravel is angular to subrounded fine to coarse of ash. [MADE GROUND]	(0.30) 0.40	3.76			
					At 0.40m; inspection terminated due to smooth concrete at base.					
				1	End of Inspection Pit at 0.40 m					
				2						
				3						
				4						

Notes

- Abbreviations and results data defined on 'Notes on Exploratory Position Records'

Plan

Contract Name	Tilbury Ground Investigations			Location ID **GS0051-SCP120A**
Client	TEAM2100			
Fugro Reference	G180029U			
Coordinates (m)	E566423.04 N175465.56	Ground Elevation (m Datum)	4.12	Sheet 1 of 1
Hole Type	Inspection Pit			Status: Final

Equipment

Depth From (m)	Depth To (m)	Hole Type	Date From	Date To	Equipment	Core Barrel	Core Bit	Drilling Crew	Logged By	Remarks
0.00	0.60	IP	06/11/2018	06/11/2018	Hand dug				JB	

Progress

Date (dd/mm/yyyy)	Time (hh:mm:ss)	Hole Depth (m)	Casing Depth (m)	Water Depth (m)	Weather
06/11/2018	08:00:00	0.00			
06/11/2018	18:00:00	0.60		Dry	

Rotary Details

Depth From (m)	Depth To (m)	Flush Type	Flush Return (%)	Flush Colour	Run Time (hh:mm)

Core Details

Depth From (m)	Depth To (m)	Diameter (mm)

Hole and Casing

Depth To (m)	Hole Diameter (mm)	Depth To (m)	Casing Diameter (mm)

Chiselling / Slow Progress

Depth From (m)	Depth To (m)	Duration (hh:mm)	Tool / Remark

Water Strike

Strike At (m)	Rise To (m)	Time Elapsed (mins)	Casing Depth (m)	Depth Sealed (m)

Water Added

Depth From (m)	Depth To (m)

Water Strike Remarks

General Remarks

1. Initially a PAS128B survey was undertaken. Prior to excavation, a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was then hand-dug to 0.60m depth. 2. UXO clearance carried out. 3. Inspection pit walls remained stable and vertical. 4. No samples taken. 5. Inspection pit terminated at 0.60m due to concrete obstruction. Relocated as GS0051-SCP120B.

Installation

Type	ID	Response Zone Top (m)	Response Zone Base (m)	Installation Date

Pipe

ID	Top Depth (m)	Base Depth (m)	Diameter (mm)	Type

Backfill

Depth From (m)	Depth To (m)	Backfill Material	Date
0.00	0.60	Arisings	06/11/2018

Notes

- Abbreviations and results data defined on 'Notes on Exploratory Position Records'

Checked By	JI	Elevation Datum	Local Datum Not Defined	Grid Coordinate System	National Grid Ref Not Defined

Template: FGSL/HBSI/FGSL BH Summary.hbt/Config Fugro Rev5/12/03/2019/TS — Print Date: 09/07/2019

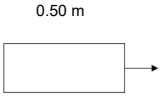
	Contract Name	Tilbury Ground Investigations			Location ID
	Client	TEAM2100			**GS0051-SCP120A**
	Fugro Reference	G180029U			
	Coordinates (m)	E566423.04 N175465.56	Ground Elevation (m Datum)	4.12	Sheet 1 of 1
	Hole Type	Inspection Pit			Status: Final

Sampling and In Situ Testing				Strata Details					Groundwater	
Depth (m)	Type	No.	Test Results	Depth (m)	Strata Descriptions	Depth (Thickness) (m)	Level (m Datum)	Legend	Water Strike	Backfill / Installation
					MADE GROUND. (Soft) dark greyish brown slightly gravelly sandy CLAY with frequent rootlets (<1mm). Sand is fine and medium. Gravel is subangular to subrounded fine to coarse flint. [MADE GROUND]	(0.15) 0.15	3.97			
					MADE GROUND. Orangish brown slightly clayey very sandy GRAVEL with low cobble content. Sand is fine to coarse. Gravel is subangular to well rounded fine to coarse of flint and occasional brick. Cobbles are very angular of concrete (110mm x 180mm x 200mm) and angular brick (70mm x 90mm x 180mm). [MADE GROUND]	(0.15) 0.30 (0.30)	3.82			
					MADE GROUND. Grey weakly cemented ash (PFA) recovered as sand and gravel sized fragments with rare fragments of brick, concrete and timber (20mm x 50mm x 70mm) and intact masonry (90mm x 150mm x 220mm). [MADE GROUND] 0.50m to 0.60m; concrete obstructions.	0.60	3.52			
				1	End of Inspection Pit at 0.60 m					
				2						
				3						
				4						

Notes

- Abbreviations and results data defined on 'Notes on Exploratory Position Records'

Plan



Contract Name	Tilbury Ground Investigations			Location ID
Client	TEAM2100			**GS0051-SCP120B**
Fugro Reference	G180029U			
Coordinates (m)	E566419.23 N175465.81	Ground Elevation (m Datum)	4.14	Sheet 1 of 1
Hole Type	Static Cone Penetrometer			Status: Final

Equipment

Depth From (m)	Depth To (m)	Hole Type	Date From	Date To	Equipment	Core Barrel	Core Bit	Drilling Crew	Logged By	Remarks
0.00	1.50	IP	06/11/2018	06/11/2018	Hand dug				JB	
0.00	19.97	SCP	13/11/2018	13/11/2018	GB2			CD		

Progress

Date (dd/mm/yyyy)	Time (hh:mm:ss)	Hole Depth (m)	Casing Depth (m)	Water Depth (m)	Weather
06/11/2018	08:00:00	0.00			
06/11/2018	18:00:00	1.50		Dry	

Rotary Details

Depth From (m)	Depth To (m)	Flush Type	Flush Return (%)	Flush Colour	Run Time (hh:mm)

Core Details

Depth From (m)	Depth To (m)	Diameter (mm)

Hole and Casing

Depth To (m)	Hole Diameter (mm)	Depth To (m)	Casing Diameter (mm)

Chiselling / Slow Progress

Depth From (m)	Depth To (m)	Duration (hh:mm)	Tool / Remark

Water Strike

Strike At (m)	Rise To (m)	Time Elapsed (mins)	Casing Depth (m)	Depth Sealed (m)

Water Added

Depth From (m)	Depth To (m)

Water Strike Remarks

General Remarks

1. Initially a PAS128B survey was undertaken. Prior to excavation, a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was then hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located. 2. UXO clearance carried out. 3. Inspection pit walls remained stable and vertical. 4. Cone Penetration Testing carried out. Results presented separately.

Installation

Type	ID	Response Zone Top (m)	Response Zone Base (m)	Installation Date

Pipe

ID	Top Depth (m)	Base Depth (m)	Diameter (mm)	Type

Backfill

Depth From (m)	Depth To (m)	Backfill Material	Date
0.00	1.20	Arisings	06/11/2018

Notes

- Abbreviations and results data defined on 'Notes on Exploratory Position Records'

Checked By	JI	Elevation Datum	Local Datum Not Defined	Grid Coordinate System	National Grid Ref Not Defined

Template: FGSL/HBSI/FGSL BH Summary.hbt/Config Fugro Rev5/12/03/2019/TS — Print Date: 09/07/2019

FUGRO	Contract Name	Tilbury Ground Investigations			Location ID
	Client	TEAM2100			**GS0051-SCP120B**
	Fugro Reference	G180029U			
	Coordinates (m)	E566419.23 N175465.81	Ground Elevation (m Datum)	4.14	Sheet 1 of 1
	Hole Type	Inspection Pit			Status: Final

Sampling and In Situ Testing				Strata Details					Groundwater	
Depth (m)	Type	No.	Test Results	Depth (m)	Strata Descriptions	Depth (Thickness) (m)	Level (m Datum)	Legend	Water Strike	Backfill / Installation
					MADE GROUND. Dark greyish brown clayey gravelly fine and medium SAND with frequent rootlets (<1mm). Gravel is subangular and subrounded fine and medium of flint. [MADE GROUND]	(0.05) 0.05	4.09			
0.20	D	2-BRE				(0.25)				
0.20	D	3								
0.20	ES	1			MADE GROUND. Orangish brown very sandy GRAVEL. Gravel is subangular to well rounded fine to coarse of flint. [MADE GROUND]	0.30	3.84			
0.40	D	5-BRE				(0.20)				
0.40	D	6								
0.40	ES	4			MADE GROUND. Grey weakly cemented ash (PFA) recovered as sand and gravel sized fragments. [MADE GROUND]	0.50	3.64			
0.40 - 0.50	B	7								
					MADE GROUND. Off white silty sandy GRAVEL with rare to occasional pockets (40mm x 60mm) of greyish brown clay. Gravel is very angular to subrounded fine to coarse of chalk. [MADE GROUND]	(0.70)				
1.00	D	10		1						
1.00	D	9-BRE								
1.00	ES	8								
1.00 - 1.20	B	11			At 1.15m; 1 No. subangular cobble (60mm x 170mm x 200mm) of rinded black flint.	1.20	2.94			
					End of Inspection Pit at 1.20 m					
				2						
				3						
				4						

Notes

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Plan