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UNIVERSITY OF CHICHESTER, BOGNOR REGIS

GROUND INVESTIGATION REPORT

CONFIDENTIAL

FEBRUARY 2016

WSP | PARSONS BRINCKERHOFF

ARUN DISTRICT COUNCIL BR/311/18/PL

UNIVERSITY OF CHICHESTER, BOGNOR REGIS

GROUND INVESTIGATION REPORT

Kier Construction Ltd.

Confidential

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1 EXECUTIVE SUMMARY

WSP | Parsons Brinckerhoff UK Ltd. (WSP) was instructed by the University of Chichester (UoC) to undertake a Ground Investigation to inform designs for a proposed Engineering and Digital Technology Park at the University of Chichester, Bognor Regis Campus. The site is located on Upper Bognor Rd, Bognor Regis, West Sussex, PO21 1HR.

This report fulfils the requirements for a Ground Investigation Report (GIR) to BS EN 1997-1:2004 +A2:2013 *Eurocode 7: Geotechnical Design* (Eurocode 7) and generally follows the format of HD 22/08 *Managing Geotechnical Risk*.

It is understood that University of Chichester has an overall development masterplan for its Bognor Regis Campus, which includes developing land currently occupied by sports fields and scrubland. The University proposes to construct a four/five storey building on the southern part of this area. It is anticipated that the building will be operational by September 2017.

The site is adjacent to Chichester University buildings fronting on to Upper Bognor Road, which forms the southern boundary of the Site. Adjacent to the eastern boundary of the site is Felpham Way. An unnamed watercourse borders the northern boundary of the Site, with recreational fields situated beyond. To the west of the Site are residential properties backing on to Brooks Lane. In addition, three Grade II listed buildings lie within the southern section of the site, including properties 67, 69 and 71 of Upper Bognor Road. The majority of the site is currently a private field, however University buildings are situated within the south west of the site and another unnamed building is located within the western portion of the site boundary. It is also noted that the site is prone to flooding and does not have any flood defences.

There are no areas of environmentally sensitive designations influencing the site and thus requires no specific or precautionary measures to be undertaken on site. The highest risks are considered to be associated with Made Ground deposits encountered under the proposed new school building footprint as well as the existing school grounds.

An intrusive ground investigation was undertaken between the dates of 2nd and 20th of November 2015 and comprised eleven dynamic sampled holes to depths of 22.20m, seven rotary cored boreholes to a maximum depth of 35m, and seven machine-excavated trial pits to depths of 3.20mbgl to 4.0mbgl. Insitu testing was undertaken during the intrusive investigation which consisted of SPT tests and Hand Shear Vane tests. Soil and groundwater samples were recovered for laboratory analysis. In general, ground conditions were found to comprise Topsoil of approximately 0.25m thickness or Made Ground from surface with thickness of 0.20m to 1.3m. Groundwater strike was encountered during drilling within four boreholes, this has been mentioned in Section 5. Furthermore, subsequent groundwater monitoring has recorded levels between 0.55mbgl (0.81m OD) and 2.54mbgl (-1.18m OD).

In order to appropriately manage the contamination constraints identified the following recommendations are made:

- A detailed review of the development design and a cost benefit analysis should be undertaken to establish whether the contaminated Made Ground can be retained / re-used on site;
- A delineation / detailed material classification assessment should be completed within areas of proposed cut to provide greater certainty and refinement of the indicative budget cost estimates and constraints to the programme from the Made Ground (landfill material);

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- A Material Management Plan; and / or an Environmental Permit will be required if contaminated materials are to be re-used or treated on-site;
- An allowances should be made for the management of contamination during and post construction, including risks from asbestos which will require management in accordance with the Control of Asbestos Regulations (CAR) 2012 and dewatering of excavations;

Given the history of the site and limited access in some areas, the potential for encountering unidentified contamination during construction should be recognised.

General limitations of the assessment are included in **Appendix A**.

2 PROJECT BACKGROUND

2.1 SCOPE AND AIMS OF REPORT

WSP | Parsons Brinckerhoff Ltd. (WSP) was instructed by University of Chichester (UoC) to undertake a Ground Investigation for a proposed development of an Engineering and Digital Technology Park Project at the University of Chichester, Bognor Regis Campus, Upper Bognor Rd, Bognor Regis, West Sussex PO21 1HR. The site layout and its location are presented in **Figure 1** and **Figure 2**.

This report fulfils the requirement for a Ground Investigation Report (GIR) to BS EN 1997-1:2004 +A2:2013 *Eurocode 7: Geotechnical Design* **(Reference 1)** and generally follows the format of Design Manual for Roads and Bridges - Managing Geotechnical Risk HD 22/08 (**Reference 2**). Soil profiles and descriptions in the report reflect the results of the current ground investigation.

The aims of this report are to:

- characterise the ground in terms of the soil composition and groundwater regime which could be used to inform design;
- identify possible geotechnical constraints in relation to the ground conditions encountered; and
- assess potential ground contamination and identify possible constraints to the proposed scheme.

In addition, a ground contamination assessment has been prepared as a separate report as a Generic Quantitative Risk Assessment (GQRA) which will be appended to this Ground Investigation Report (GIR).

This assessment was undertaken in accordance with the scope agreed between WSP | Parsons Brinckerhoff and the University of Chichester.

2.2 DESCRIPTION OF THE PROJECT

The University of Chichester wishes to develop an Engineering and Digital Technology Park, located to the north of Upper Bognor Road, adjacent to the current University Bognor campus. The Engineering and Digital Technology Park will consist of multi-storey buildings, access roads, car parks and associated infrastructure. An intrusive ground investigation is required in order to assess the ground conditions to inform the foundation design, pavement design, screen for land contaminants and also to establish the hydrogeological regime to support the drainage and Sustainable Drainage (SUDS) design.

The following ground investigation was specified by WSP in order to characterise the entire development site as shown on the Stride Treglown drawing SK_007 included in **Appendix B**.

The development site is approximately 2.2ha and located in an area of dense scrubland and on a flood plain to the north of Upper Bognor Road and west of Felpham Way at National Grid Reference 494414 099634. This is immediately east of the current University Campus. The northern extent of the proposed site is marked by Ladybrook Community Orchard. The maximum level of the site is in the west (approximately 4m Above Ordnance Datum (mOD)) and the site slopes down toward the minimum level in the southeast corner of the site (approximately 1mOD).

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The properties immediately surrounding the University campus comprise semi-detached houses. The main University buildings are located to the west of the proposed site, with halls of residence beyond the western boundary. There are recreational/sports fields covering most of the northern half of the site and a derelict field (Donkey Field) in the south region of the site (**Figure 1**).

Appendix B provides an existing site layout plan (**Figure 1**), a site location plan (**Figure 2**), an exploratory hole location plan (**Figure 3**) and a geological map of the site (**Figure 4**), as well as drawings provided by the client that show the proposed site layout and a topographical survey.

2.3 GEOTECHNICAL CATEGORY OF PROJECT

This scheme has been classified as a Geotechnical Category 2 scheme, as described within Eurocode 7. Geotechnical Category 2 projects include conventional structures and foundation forms, such as those likely to be proposed for this development, with no exceptional risk, difficult ground conditions or difficult loading conditions.

2.4 PREVIOUS REPORTS

There has been no previous ground investigation works undertaken on this site before and therefore no previous reports have been provided.

2.5 CONFIDENTIALITY STATEMENT AND LIMITATIONS

This report has been prepared for the University of Chichester in accordance with our proposal 2015 and the terms and conditions as set out therein. It has further been prepared based on the site conditions encountered at the time of the intrusive site investigations as presented. The scope of WSP's investigation and assessment is limited to that defined in our original proposals as confirmed or amended (where relevant and appropriate) within this report. Consequently this report should not be used in a different context without the express written consent of WSP.

Where relevant, any interpretation within this report refers to the condition of the site at the time of the investigation and is based on WSP's understanding of any development proposals as described. Possible future changes in the condition of the site which may occur, or alterations in any proposed development layout / design will require further assessment.

It is further noted that whilst site conditions have been recorded at the investigation locations, variations may occur in the actual conditions present in other, un-investigated areas of the site. New or amended legislation may necessitate re-assessment of the site conditions and the associated risks and liabilities.

This report is addressed to and may be relied upon by the University of Chichester. It may not be relied upon or transferred to any other parties without the express written authorisation of WSP. The report should be read and used in full. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party.

Third party information used in the production of this report has been taken in good faith as being accurate. WSP cannot and will not accept any liability for errors and / or omissions in data provided by others and WSP cannot warrant the work of others.

General limitations of the assessment are included in **Appendix A**.

This report contains British Geological Survey materials ©NERC 2015 and Environment Agency information ©Environment Agency and database right.

3 EXISTING INFORMATION

3.1 TOPOGRAPHICAL MAPS

A topographical survey of the site was undertaken by Shaw Colegate Land and Building Surveyors for the UoC in May 2015. The survey shown on the drawing enclosed in **Appendix B,** 05515_TOPO_REV_A, dated May 2015, indicates that the local topography is close to sea level across the site. The northern part of the site is generally lower with an elevation varying locally from approximately 1.14 to 1.45mOD with increasing site levels in the south of the site which varies locally from approximately 1.50 to 3.14mOD. Within the southern part of the site there is an earth bund, which runs from west to east, with a crest height of approximately 3.30mOD. The bund has been recorded within the historical maps within the Landmark Envirocheck report since 1879 as an embankment running from west to southeast outside the site boundary.

3.2 GEOLOGICAL AND HYDROGEOLOGICAL MAPS

The 1:50,000 series geology map of Chichester and Bognor (Sheet 317/332) (**Reference 3**) published by the British Geological Survey (BGS), together with information available on the BGS on-line Geology of Britain Viewer (**Reference 4**), indicate that the entire site is underlain by superficial deposits noted to comprise Raised Beach Deposits, Marine Beach Deposits and River Terrace Deposits. Lambeth Clay Formation is present within the south of the site and the White Chalk Subgroup Formation (White Chalk Subgroup) is present at depth over the entire site.

The Superficial Deposits are indicated to comprise shingle, sand, silt and clay and vary in thickness locally. The composition is dependent on the upslope source and distance from source. The Raised Beach Deposits may be bedded or chaotic and the beach deposits may be in the form of sand dunes, sheets or banks. The Raised Beach Deposits are designated as a Secondary A aquifer strata by the Environment Agency (**Reference 5**).

The Lambeth Clay Formation which comprise primarily clay, some silty or sandy, with some sands and gravel beds. The thickness can be up to approximately 39m in the west of the London Basin where Bognor Regis is inclusive of this area.

The Lambeth Clay is underlain by White Chalk Subgroup Formation (White Chalk Subgroup) which is composed of hard to very hard nodular chalks and hardgrounds with interbedded soft to medium hard chalks (some grainy). The softer chalks become more abundant towards the top of the Formation. Nodular chalks are typically lumpy and iron-stained.

Both the Lambeth Clay Formation and The White Chalk Subgroup are designated as Secondary A and Principal Aquifer respectively by the Environment Agency (EA) (**Reference 5**). The EA reports that the site is not within a Source Protection Zone or a Drinking Water Safeguard Zone. No groundwater abstractions are recorded within 1km of the site.

3.3 RECORDS OF MINES AND MINERAL DEPOSITS

On the basis of database information accessed through Envirocheck, there is no record of mining or mineral deposits within a 1km area of the site.

3.4 ARCHAEOLOGICAL AND HISTORICAL INVESTIGATIONS

On the basis of database information accessed through Envirocheck, it is identified that the main changes in land use within the site boundary have been:

- 1879 to 1967, embankment running from west to the south east continuing beyond the site boundary.
- 1932 to 1967, buildings established in the south western part of the site.
- 1975 to 2006, tress established along the eastern boundary of the site.
- 1990 to present, man-made drainage feature located mid-site running east to west.

3.5 EXISTING GROUND INVESTIGATIONS

WSP | PB are not currently aware of any previous investigation for development on the site.

3.6 CONSULTATION WITH STATUTORY BODIES AND AGENCIES

Environmental database information has been accessed through Envirocheck; no consultation was undertaken prior to any ground investigation works.

3.7 FLOOD RECORDS

With reference to the EA website (**Reference 5**), it indicates that the site is within an area of low to medium risk of flooding from surface water, however, within the Land Mark Envirocheck report, it states that the area is subject to extreme flooding from rivers or seas without defence.

3.8 GROUND CONTAMINATION

The EA website indicates that there are no sites within 500m (the subject site included) which are designated as contaminated land under Part 2A of the Environmental Protection Act 1990 (**Reference 6**). Within the Landmark Envirocheck report shows low levels of concentration of any ground contamination.

3.9 SURFACE WATER

A man-made drainage feature, which permits groundwater drainage, flows through the middle of the site from east to east.

The nearest named surface water feature is the Aldingbourne Rife River which flows to the east of the site, approximately a minimum distance of 50m from the boundary. The Environment Agency has identified that river is susceptible to flooding during heavy periods of rain mostly likely to occur during the winter months. There is also a water body (The English Channel) located approximately 500m south from the site.

3.10 UNEXPLODED ORDNANCE

As part of a Desk Study prior to the ground investigation works the site was identified by Zetica (**Reference 7**) as an area at risk of unexploded ordnance (UXO). This concluded that the site lies within an area considered to be at moderate risk of UXO due to Bognor Regis being targeted for bombing during the Second World War. The report suggested that mitigation measures should be required during development works and that an unexploded ordnance engineer should be present during intrusive works.

4 FIELD AND LABORATORY STUDIES

4.1 WALKOVER SURVEY

A site walkover was undertaken on 20th October 2015 by a WSP representative, prior to site works commencing. During the site walkover the following features were identified and recorded:

- Evidence of below ground services/utilities whilst on site there was no immediate evidence of underground services however, there were occasional manholes which are for water drainage.
- Areas of soft ground within the playing fields there were no signs of soft ground however, if there was to be a high amount of rainfall the ground would be subject to softening.
- Site topography was generally flat with a gentle sloping toward the south.
- Potential on-site sources of contamination, there was no immediate evidence for contamination directly on site.
- Accessibility to the proposed borehole locations, access to the borehole locations was easy, however there was some vegetation clearance required before entering the south part of the site (Donkey field).
- No signs of standing water present on site; and
- Overhead services/obstructions were located on the east of the site boundary between the road and the vegetation.

It was noted that the site has one access point which means tracking distances for the drill rigs are increased over what is typically ideal. Consequently, it was noted that there could be disturbance and damage to the ground and if the weather conditions are poor then the likelihood is increased.

A charged sewerage drain was noted and, in order to avoid damage to the drain, further identification and location prior to undertaking any exploratory holes was required. Due to proximity with further underground services, a number of proposed boreholes required relocation approximately 10m away from any known services.

4.2 GEOMORPHOLOGICAL/GEOLOGICAL MAPPING

No geological mapping was carried out due to the absence of outcrops across the area of investigation.

4.3 GROUND INVESTIGATION

DESCRIPTION OF FIELDWORK

WSP designed the joint geotechnical and ground contamination investigation. The objective of the geotechnical investigation was to obtain information on the ground and groundwater conditions and obtain Eurocode 7 compliant samples in order to derive information for use in design of the building for the proposed Engineering & Technology Park development.

The fieldwork was undertaken between 2nd and 20th November 2015. The investigatory boreholes were undertaken by CC Ground Investigations Ltd with the trial pitting supervised by WSP. WSP monitored the entire investigation on a full time basis to check technical compliance with the ground investigation specification. A UXO engineer from Fellows International Ltd. was present on

site on a full time basis to assess the presence of potential buried UXO during the ground investigation.

To avoid contact with existing below ground services/utilities, in advance of any intrusive works each exploratory hole location was scanned and cleared using a Cable Avoidance Tool (CAT) and Generator. In addition, inspection pits were hand dug to a depth of 1.2m bgl by CC Ground Investigations at all borehole locations prior to drilling.

Table 4-1 provides a summary of the exploratory holes completed as part of the ground investigation, along with the rationale for utilising the selected techniques. An exploratory hole location plan is provided in **Figure 3, Appendix B**.

Table 4-1: Exploratory Hole Rationale

Element of Investigation	Details	Rationale
Rotary cored boreholes	BH101 to BH111	≫ To allow inspection of soils and to allow the retrieval of samples for geotechnical and chemical laboratory testing. ≫ To derive the ground model. ≫ To assign material properties and to aid the derivation of geotechnical parameters for design purposes.
Trial pits	TP101 to TP107	≫ To allow the inspection of soils and to retrieve samples for geotechnical and chemical laboratory testing. ≫ To derive the ground model. ≫ Insitu infiltration tests were undertaken in Trial Pits TP101 and TP103 to provide information for drainage design.
Insitu testing	Standard Penetration Tests (SPTs) were undertaken at 1.5m intervals up to the surface of the chalk and at 3.0m intervals thereafter in all boreholes. TRL probes were taken up to 2.0m bgl	≫ In order to assign material properties and to aid the derivation of geotechnical parameters for design purposes. ≫ Assess ground conditions for pavement design.
Installation of groundwater and gas monitoring wells	Installed in BH101 to BH111.	≫ To provide information to characterise the groundwater conditions and quality including standing groundwater conditions and variations over a period of time post installation. ≫ To undertake ground gas monitoring to determine potential constraints to the development from soil gas generation.
Geotechnical laboratory testing	Selected soil samples were sent by CC Ground Investigations Ltd., to Professional Soils Laboratory (PSL) a UKAS accredited laboratory, for geotechnical testing	≫ To obtain material properties and to aid the derivation of geotechnical parameters for use in design.
Chemical laboratory testing	Selected soil samples were sent by CC Ground Investigations Ltd., to I2 Analytical Ltd a UKAS and	≫ To determine any potential contamination within the ground where the newly proposed buildings are to be developed.

	MCERTS accredited laboratory, for chemical testing	

The boreholes were positioned primarily within the vicinity of the proposed building footprint and to depths appropriate for the proposed four to five storey building and likely piled foundation depth requirements. Additional boreholes were located across the whole site and around the proposed car park and access roads to provide general site coverage and identify any prevalent constraints to subsequent phases of the overall development. All boreholes were commenced with a Fraste ML multipurpose drill rig utilising dynamic sampling and were extended, where possible, with rotary core boring to depths ranging from 10mbgl (BH104, BH105, BH110 and BH111) to (BH101 to BH103, and BH106 to BH109) to 35mbgl. In some instances dynamic window sampling was undertaken to termination depth due to the ground conditions being unsuitable for rotary coring methods and in this instance Class 1 sub samples could not be obtained. This is in accordance with BS EN ISO 22475-1-2006 (**Reference 8**) for sampling methods during the ground investigation.

Trial pits were located within the areas of proposed car park and roads. These were excavated using a backhoe excavator to depths ranging between 3.2 and 4.0m bgl.

Soil samples were collected for chemical laboratory testing by I2 Analytical Laboratories Ltd. All samples were taken with due regard to industry good practice and procedures were designed to minimise the potential for cross-contamination. Samples were collected into labelled containers provided by the laboratory and chain of custody documentation was completed. The samples were suitably preserved and submitted to I2 Analytical Laboratories Ltd, a UKAS and MCERTS accredited laboratory, for analysis.

GROUND INVESTIGATION REPORT

The ground conditions encountered are presented in the borehole logs and the trial pit logs which were prepared by CC Ground Investigations Ltd. The logs are included in **Appendix C** and the ground conditions are summarised in **Section 5**.

RESULTS OF IN SITU TESTS

Standard Penetration Tests (SPTs) were carried out in all the dynamic sample boreholes, BH101 to BH111. The results are shown on the borehole log sheets in the Factual Report and summary plots are included in Section 6 of this report. A calibration certificate for the hammer used for the Standard Penetration Tests is provided in **Appendix C**.

4.4 DRAINAGE STUDIES

Soil infiltration tests were undertaken in accordance with BRE 365 (**Reference 9**) within two trial pits (TP101 and TP103) to inform the proposed drainage strategy for the site. At the test locations, the trial pits encountered primarily cohesive material immediately below Topsoil level and, due to the low infiltration rate, failed to provide sufficient drainage in order to calculate permeability rates.

4.5 PILE TESTS

None undertaken.

4.6 GROUNDWATER MONITORING

Groundwater monitoring has been undertaken on three separate visits (02/12/2015, 07/12/2015 and 14/12/2015). The results are presented within the Generic Quantitative Risk Assessment Report (GQRA) which is in **Reference 10.**

4.7 SOIL GAS MONITORING

Ground gas monitoring has been undertaken on three separate visits (01/12/2015, 07/12/2015 and 14/12/2015). The results are presented within the Generic Quantitative Risk Assessment Report (GQRA) **Reference 10** and in **Appendix D.**

4.8 LABORATORY ANALYSIS

DESCRIPTION OF TESTS

The laboratory testing programme instructed by WSP was based on the soil types encountered and the relevant proposed design. Selected soil samples were submitted to a UKAS accredited laboratory for geotechnical and chemical testing in order to inform the strength and composition of the ground. The testing regime included the following:

- Soil classification tests comprising Bulk Density, Natural Moisture Content, Atterberg Limits and Particle Size Distribution;
- Saturation Moisture Content of chalk;
- Intact Dry Density (IDD) of chalk;
- Uniaxial Compressive Strength (ISRM);
- Point Load Strength testing;
- Chalk Crushing Value (CCV);
- Quick undrained triaxial testing;
- Compaction testing using 2.5 kg dynamic compaction method; and
- Chemical testing to determine acid and water soluble sulphate contents, pH, total sulphur, total potential sulphate and oxidisable sulphide.

Screening for soil contamination was undertaken on samples which are presented in the Generic Quantitative Risk Assessment Report **Reference 10** and in **Appendix D.**

TEST RESULTS

Full sets of laboratory test certificates are included together with summary tables in **Appendix E.** The data are discussed in **Section 7**.

5 GROUND SUMMARY

5.1 GENERAL

The ground conditions encountered in the exploratory holes are generally consistent with the geological sequence as detailed on the regional BGS mapping for the site and the ground conditions are described below. Exploratory hole logs for the investigation and an interpretative ground model in the form of a long section through the site, alongside the detailed geological logs for each exploratory hole are provided in **Appendix C** and **Appendix F**.

5.2 TOPSOIL

Topsoil was encountered where maintained grassed and other soft landscaped areas are present at the site. This includes the fields in the north and south. Topsoil was generally brown, slightly sandy, slightly gravelly Clay or Silt with rootlets, approximately 0.30 m in thickness and underlain typically by River Terrace Deposit or Made Ground where present.

5.3 MADE GROUND

Made Ground was encountered at twelve exploratory hole locations and generally between 0.20m and 1.3m in terms of thickness. The Made Ground included, in varying proportions across the site, fragments of brick and clinker. The matrix of the Made Ground was also found to vary across the site. In the area of the northern fields the matrix generally comprised slightly sandy slightly gravelly Clay.

Within the footprint of the proposed four to five storey building, the depth of Made Ground was between 0.3m bgl and 1.30m bgl. This contained fragments of brick flint, concrete, siliceous material, steel tubing, rare ash, clay tile fragments, porcelain fragments, and clay pipes in a matrix of slightly sandy slightly gravelly Clay.

5.4 SUPERFICIAL DEPOSITS

Superficial Deposits were encountered beneath the Made Ground or Topsoil in seventeen of the exploratory hole locations.

The Superficial Deposits comprise of three strata and vary across and near to the site, in accordance with the BGS geology map;

- Raised Marine Deposits – north of the site and within the south;
- Raised Beach Deposits – central of the site, to the south of the stream;
- Raised Terrace Deposits – south of the site, not located within site boundary.

The Superficial Deposits all comprise of firm light brown and greyish brown locally off-white slightly sandy slightly gravelly CLAY. Gravel is sub-angular to sub-rounded fine to medium of chalk and flint with rare organic material.

Note that there is some organic material with Superficial Deposits which is varies locally.

The site can be generally characterised between the north and south. The typical thickness of the Superficial Deposits within the north half of the site was between 3.20mbgl and 15.90mbgl.

In the southern part of the site the typical thickness of the Superficial Deposit was between 0.60mbgl and 3.50mbgl. This is due to the Lambeth Clay formation being present within the southern area of the site.

5.5 LAMBETH CLAY

Lambeth Clay was encountered beneath the Superficial Deposits in seven of the exploratory hole locations, and was found only within the southern area of the site where the geological boundary is located, near to the drainage outlet. The depth of the Lambeth Clay was proven to a maximum depth of 8.50mbgl, with a typical thickness of 4.30mbgl, varying locally across the site.

5.6 WHITE CHALK SUBGROUP FORMATION

White Chalk Subgroup Formation was encountered within eleven exploratory borehole locations (BH101 to BH111) due to the scheduled depth for these holes.

The Chalk can be considered to have two horizons; Structureless Chalk (weathered) and Structured Chalk (intact). The Structured Chalk was encountered beneath the structureless chalk within borehole locations BH101 to BH104, BH106 to BH109 and BH111. The structureless chalk varied in depth ranging from between 6.50mbgl to 18.90mbgl as well as the thickness which varied across the site from between 0.15mbgl to 4.80mbgl.

The structureless chalk encountered within the building footprint (BH101 to BH103) was relatively consistent in depth ranging from between 8.00mbgl to 11.30mbgl as well as thickness being consistent across the building footprint from between 0.60m to 1.40m. The structureless chalk typically comprised white stained orangish brown and yellowish brown chalk composed of slightly sandy silty gravel. Gravel is sub-angular to sub-rounded fine to coarse low density chalk. Typical grading for the structureless chalk was of Dc, this in accordance with the CIRIA C574 Chalk Grading system (**Reference 12**).

The structured chalk was encountered in BH101 to BH104, BH106 to BH109 and BH111, the thickness was not proven for this stratum; however the depth ranged between 8.90mbgl and 11.10mbgl. The structured chalk comprised very weak to weak medium density white mottled orangish brown Chalk. Discontinuities are very closely to medium spaced with minimum infill of off white comminuted chalk. The chalk typically graded a B3 chalk with strength and grade generally increased with depth.

A summary table (Table 5-1) of the thicknesses of each stratum is given below. Note the structured chalk has not been included as the thickness was not proven.

Table 5-1: Summary of Stratum Thickness

Stratum	Topsoil/ Made Ground	Superficial Deposits	Lambeth Clay	Structureless Chalk
Exploratory Hole	Thickness (m)	Thickness (m)	Thickness (m)	Thickness (m)
[1]BH101	0.3	1.3	5.8	0.6
[1]BH102	0.3	1.4	6.9	0.7
[1]BH103	0.8	0.6	8.5	1.4
BH104	0.3	6.9	*	4.8
BH105	0.3	12.4	*	2
BH106	0.4	1.1	4.2	0.8
BH107	0.4	3.5	1.7	1.9
BH108	0.1	8.3	*	2

BH109	0.7	15.9	*	2.3
BH110	0.8	6.25	*	0.15
BH111	0.2	5.4	*	4.2
TP101	1.3	*	1.9	*
TP102	0.3	1.9	1.3	*
TP103	0.2	3.8	*	*
TP104	0.3	3.7	*	*
TP105	0.3	3.4	*	*
TP106	0.4	3.2	*	*
TP107	0.4	3.2	*	*

*Strata not encountered
[1]Exploratory hole within building footprint

A summary table (Table 5-2) of the typical surface levels for each stratum is given below.

Table 5-2: Summary of Surface Levels for Stratum

Location	Typical surface levels (m OD)	Topsoil/ Made Ground	Superficial Deposit	Lambeth Clay	Structureless Chalk
		Level To (m AOD)	Level To (m AOD)	Level To (m AOD)	Level To (m AOD)
North	**Average**	1.01	-5.58	*	-10.78
South	**Average**	1.81	0.22	-3.91	-6.18

*Stratum not encountered.

5.7 ENCOUNTERED GROUNDWATER

Groundwater was encountered during the ground investigations as follows:

- BH107 2015: groundwater strike at 1.50mbgl rising and settling to 1.30mbgl after five minutes;
- BH108 2015: groundwater seepage at 1.20mbgl, no rise recorded;
- BH110 2015: groundwater strike at 1.00mbgl and remaining at 1.00mbgl after twenty minutes;
- BH111 2015: Groundwater strike at 1.50mbgl rising to 1.30mbgl after twenty minutes.

5.8 GROUNDWATER LEVEL MONITORING

Groundwater level monitoring data are presented in Table 5-3 of this report and further detailed results will be presented in a separate Generic Quantitative Risk Assessment Report (GQRA). These four wells were monitored on three occasions (2nd, 7th and 14th December 2015) for the 2015 ground investigation.

Table 5-3: Groundwater level monitoring results

Exploratory Hole	Level From (m OD)	Visit 1 (m bgl) (mOD)	Visit 2 (m bgl) (mOD)	Visit 3 (m bgl) (mOD)
BH101*	2.44	1.73 (0.71)	2.12 (0.32)	1.75 (0.69)
BH102*	2.18	1.78 (0.4)	1.72 (0.46)	1.31 (0.87)
BH103*	2.91	2.54 (0.37)	2.37 (0.54)	1.96 (0.95)
BH104	1.53	0.93 (0.6)	0.93 (0.6)	0.81 (0.72)

BH105	1.39	0.88 (0.51)	0.9 (0.49)	0.75 (0.64)
BH106*	2.24	1.60 (0.64)	1.48 (0.76)	1.44 (0.81)
BH107*	1.91	1.34 (0.57)	1.35 (0.56)	1.01 (0.9)
BH108*	1.36	0.78 (0.58)	0.8 (0.56)	0.55 (0.81)
BH109*	1.18	1.43 (-0.25)	1.16 (0.02)	0.69 (0.49)
BH110	1.42	0.78 (0.78)	0.78 (0.64)	0.62 (0.8)
BH111	1.44	0.77 (0.67)	0.79 (0.65)	0.71 (0.73)

*Boreholes within the building footprint.

5.9 GROUND GAS MONITORING

The results of the ground gas monitoring will be presented in a separate Generic Quantitative Risk Assessment Report (GQRA) (**Reference 10**) and in **Appendix D**.

6 GROUND CONDITIONS AND MATERIAL PROPERTIES

6.1 INTRODUCTION

The following chapter summarises the results of the insitu testing and laboratory testing for individual soil types encountered across the site and selects characteristic parameters. No previous ground investigations have been undertaken on this site and therefore only the information obtained from the recent (2015) ground investigation results will be used to determine the ground conditions.

This report is intended to meet the EC7 requirements for a GIR. Test data is presented and interpreted using published correlations to produce derived values. Mean and lower quartile trend lines are presented where applicable to guide the user. The selection of suitable characteristic and design values will depend on the particular location and extent of the structure and the design calculation being undertaken and as such will be selected and presented in the GDR.

6.2 TOPSOIL

Where Topsoil was present across the field areas and typically comprised grass over brown silt with low gravel content. No geotechnical assessment has been made of this material.

6.3 MADE GROUND

Made Ground was encountered in twelve of the exploratory holes with a maximum thickness of 1.3m however; typical thickness is approximately 0.46m. Due to the limited amount testing that was undertaken on the material, only Atterberg Limits can be interpreted for geotechnical assessment and it should be assessed on a case by case basis if required.

Two Atterberg Limit tests were undertaken on cohesive samples of Made Ground. The Plasticity Index (PI) of the cohesive material ranges from 30% to 33%. The two test results, when plotted on a Casagrande/A-Line Plot show that cohesive material is classified as high plasticity clay.

6.4 SUPERFICIAL DEPOSITS

Superficial Deposits were encountered below all Made Ground, where present and was predominantly found within the northern area of the site. The surface of the Superficial Deposits was recorded between 0.48mOD to 2.14mOD.

Within the Superficial Deposits numerous laboratory tests were carried out to derive characteristic values for the strata, which are as follows in this section.

Atterberg Limit tests were undertaken on forty samples from the Superficial Deposits. Plastic Limits ranged from 22% to 34% with an average of 27%. Liquid Limit ranged from 45% to 87% with an average of at 63%. Plasticity Index (PI) ranged from 23% to 53% with an average of 36%. Plasticity Index has been plotted against depth in Figure 6-1, and on a moisture content, liquid limit and plastic limit against depth below ground Figure 6-2. This shows that moisture content sits closer to the plastic limit indicating the Lambeth Clay is of a higher strength. A Casagrande/A-Line Chart has been plotted in Figure 6-3. The chart shows the Superficial Deposits to plot above the "A" line and has been classified as an intermediate to very high plasticity clay. The data presented in Figure 6-1 suggests that there is an increase in plasticity with depth, as indicated by the trend line.

Figure 6-1: Plasticity index against depth below ground

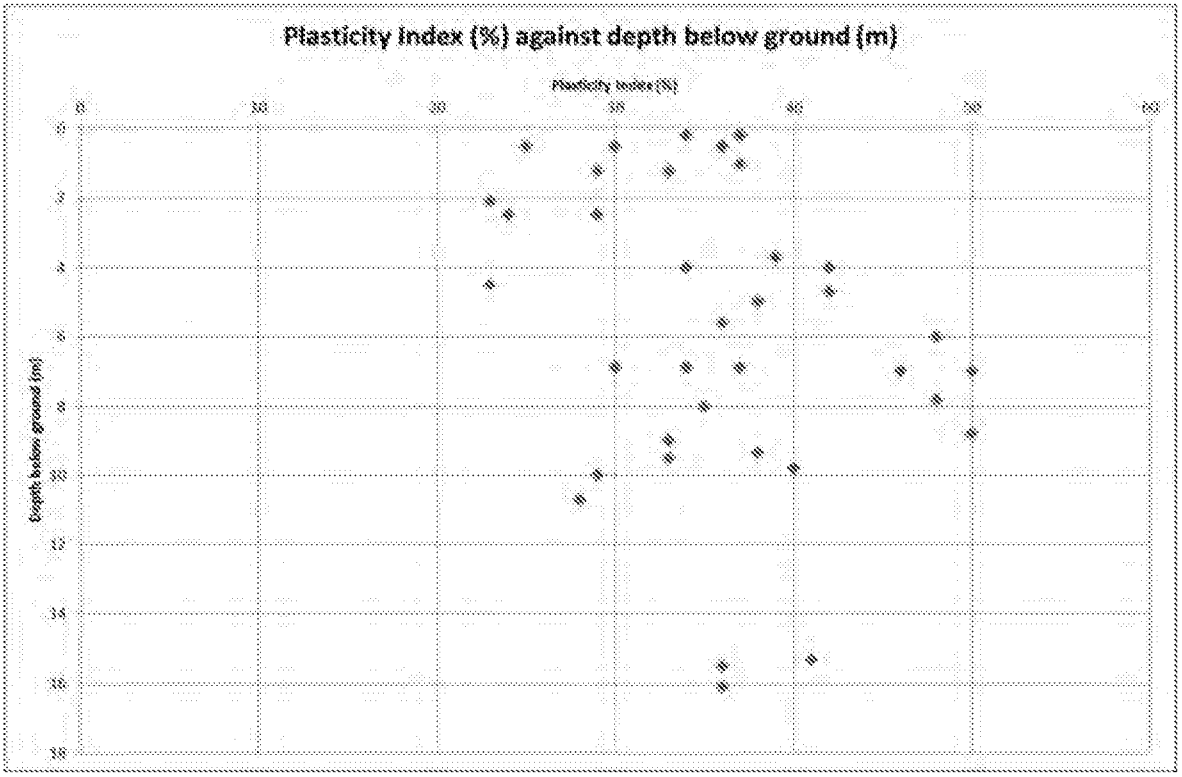


Figure 6-2: Moisture content, liquid limit and plastic limit (%) against depth below ground

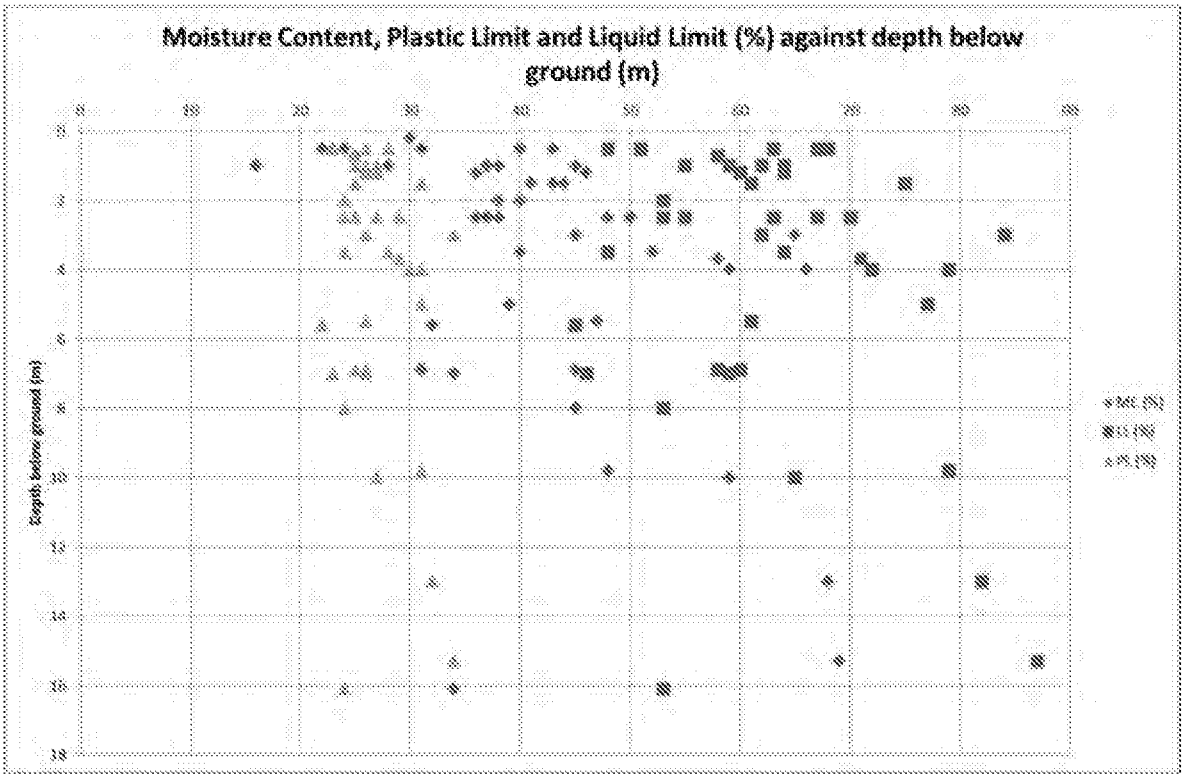
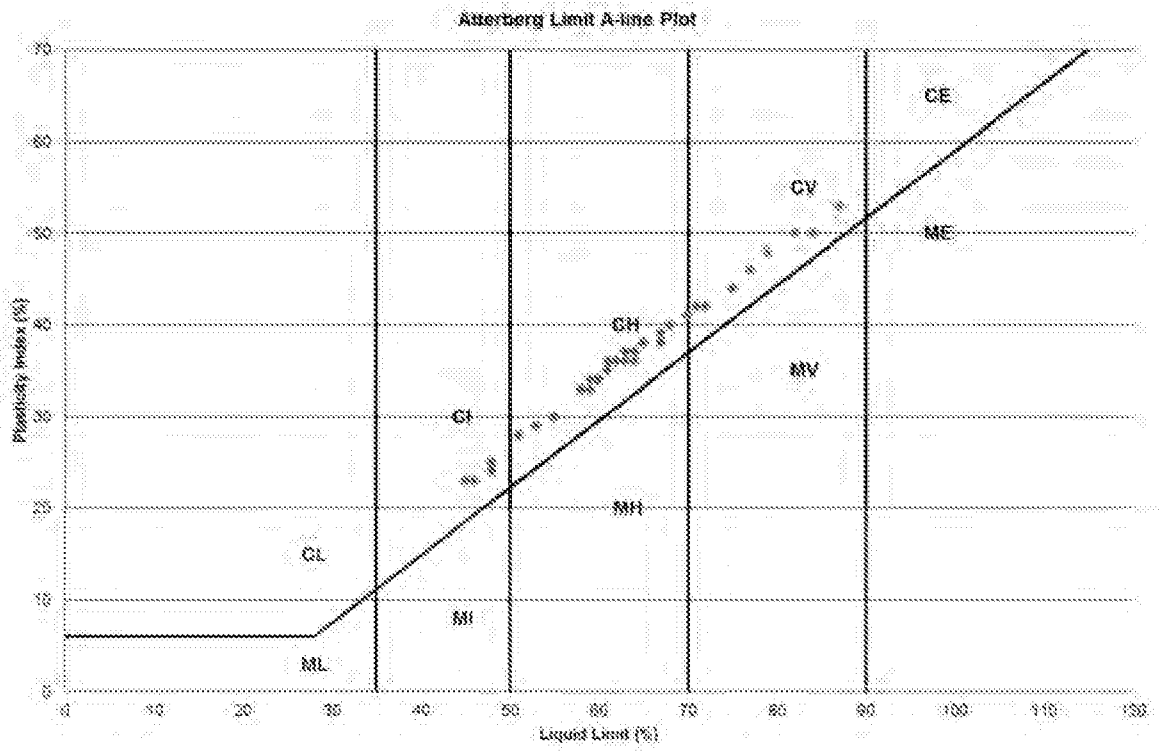
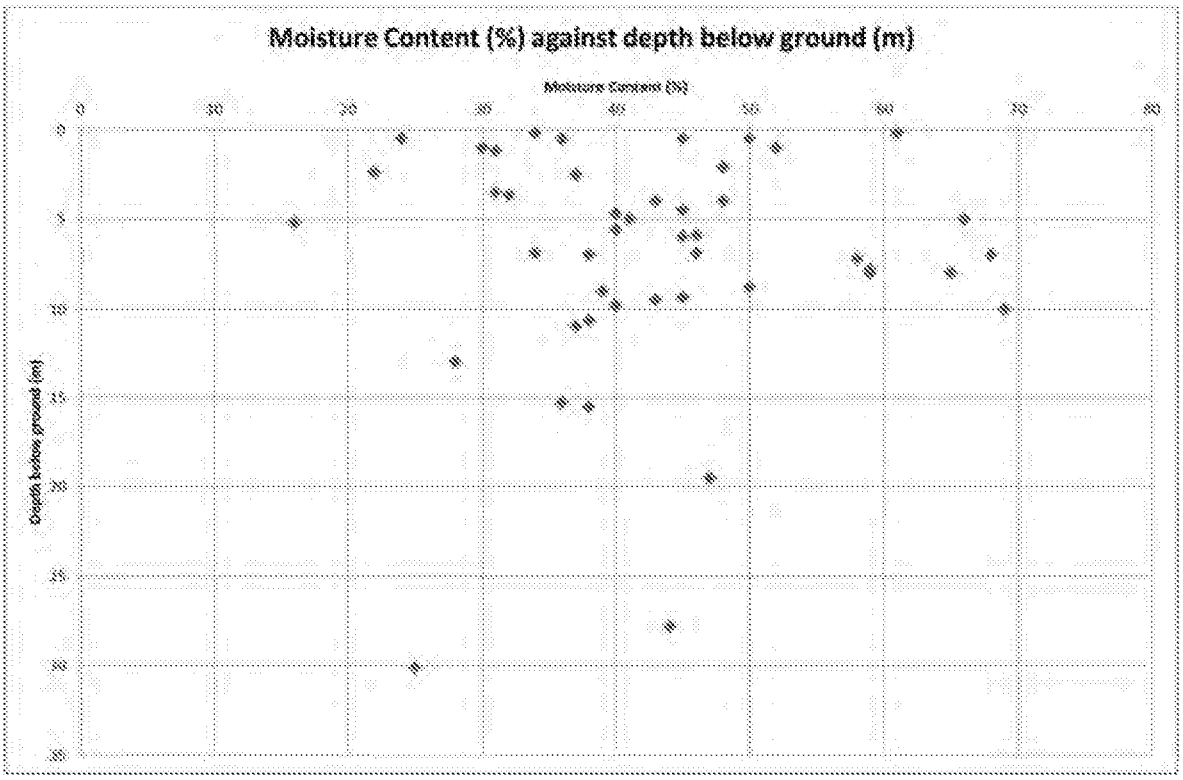


Figure 6-3: Casagrande/A-Line Chart



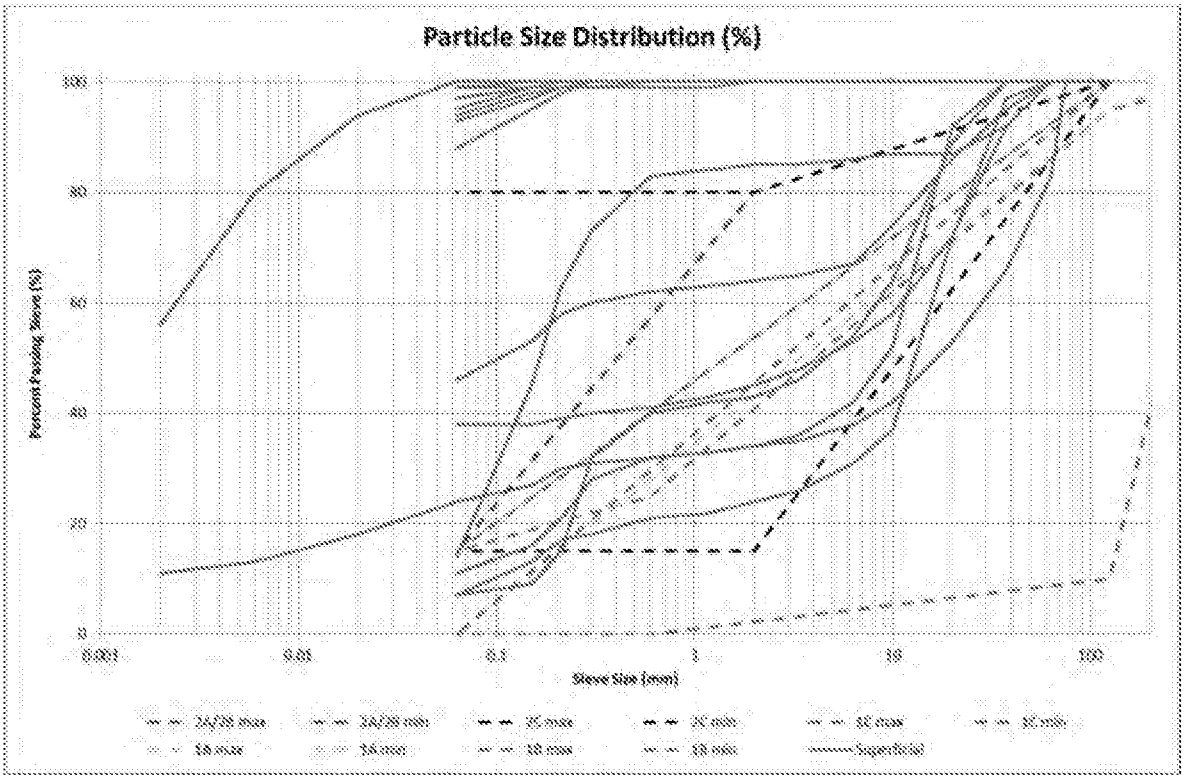
Moisture content tests were conducted on forty-six samples from the Superficial Deposits, as part of both the Atterberg limit tests and natural moisture content tests. Moisture content ranged from 16% to 69% with an average of 43%. Moisture content is plotted against depth below ground in Figure 6-4. This plot shows that there is some trend in moisture content with depth. Between ground level and 5m bgl the moisture content generally lies between values of 30% and 50%. Between 5m bgl and 10m bgl the data records show that moisture content increase from 40% to 70%.

Figure 6-4: Moisture Content against depth below ground



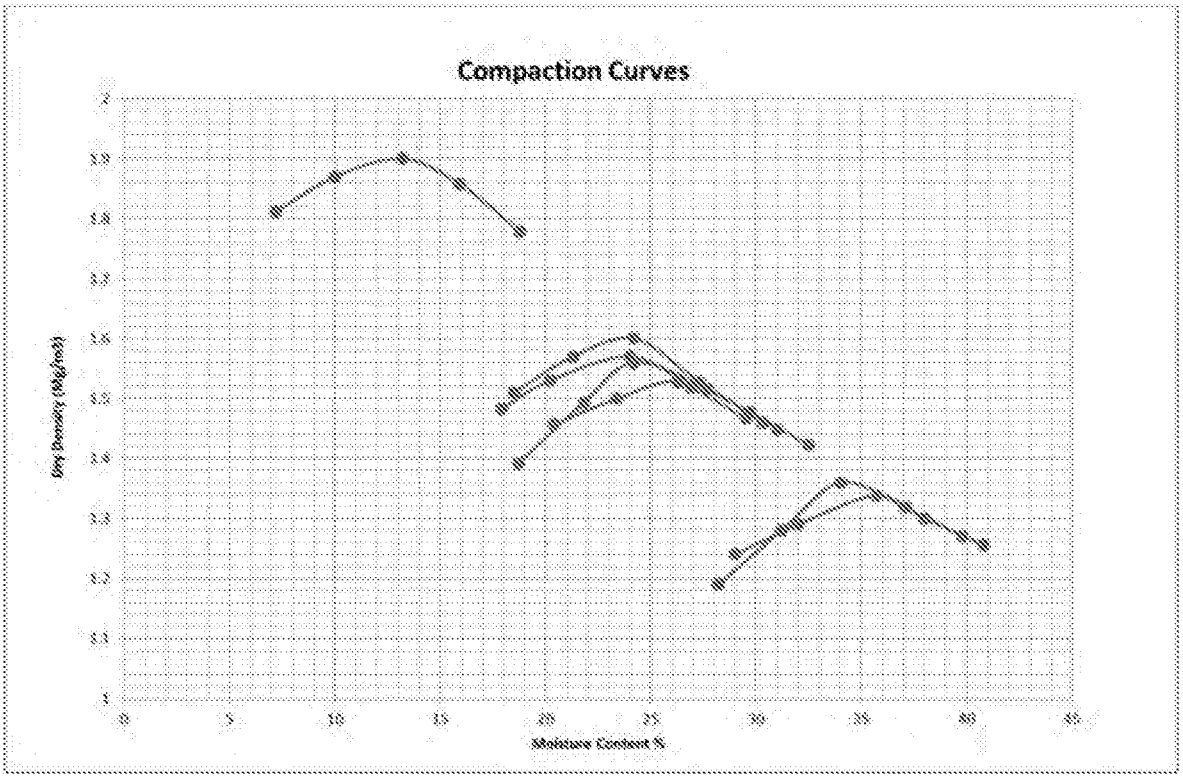
Particle Size Distribution testing was conducted on sixteen samples of Superficial Deposit. The sixteen grading curves are presented in Figure 6-5. Based on the particle sizes this stratum classifies as a Class 2 cohesive material in accordance with the Specification for Highways Works

Figure 6-5: Particle Size Distribution



Compaction testing was undertaken using a 2.5kg proctor on seven samples of Superficial Deposits. The tests reported a maximum dry density range of 1.34Mg/m^3 to 1.90Mg/m^3. The optimum moisture content range is reported as 13.2% to 35.7%. The compaction curves are presented in Figure 6-6.

Figure 6-6: Compaction Curves



6.5 LAMBETH CLAY

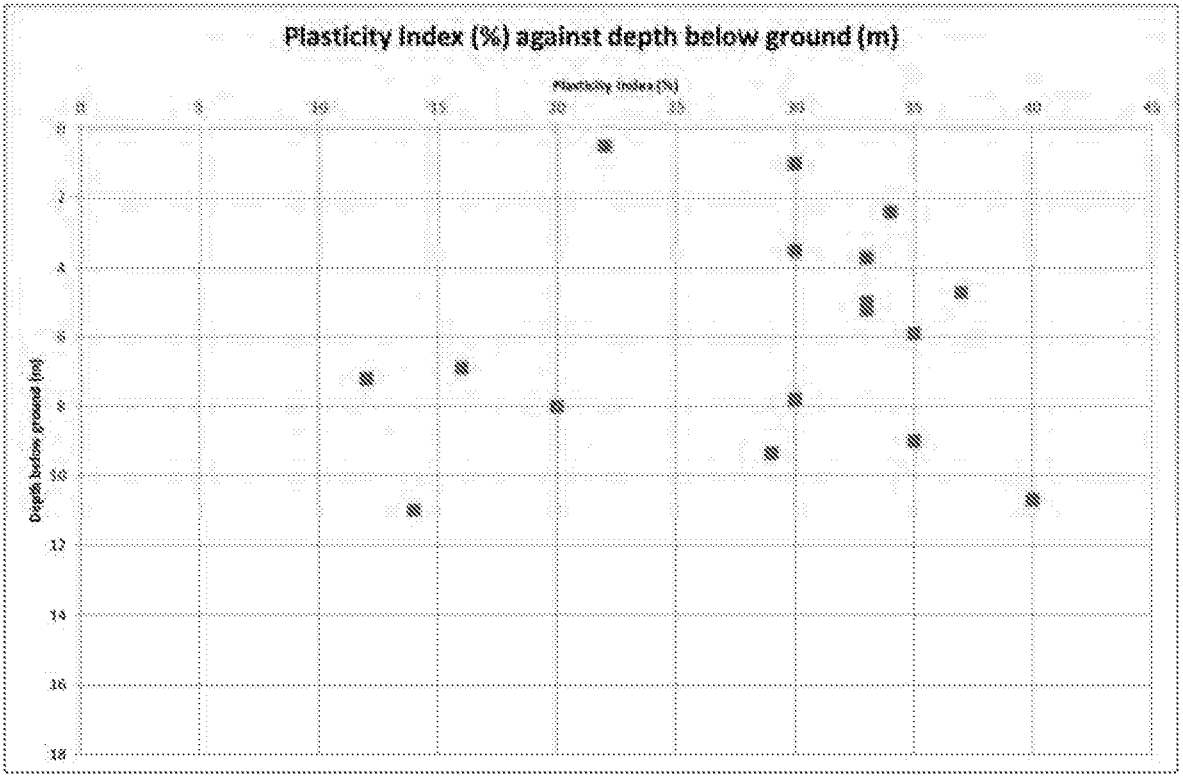
Lambeth Clay was encountered below the Made Ground and Superficial Deposits, respectively, and is generally encountered in the southern part of the site (BH101, BH102, BH103, BH106, BH107, TP101, TP102). The surface of the Lambeth Clay was recorded between 1.51mOD and 1.99mOD.

Within the Lambeth Clay numerous laboratory tests were carried out to derive characteristic values for the strata, which are as follows in this section.

Atterberg Limit tests were undertaken on seventeen samples from the Lambeth Clay. Plastic Limits ranged from 14% to 28% with an average of 23%. Liquid Limit ranged from 26% to 68% with an average of at 51.5%. Plasticity Index (PI) ranged from 12% to 40% with an average of 28%. Plasticity Index has been plotted against depth below ground in Figure 6-7 and moisture content, liquid limit and plastic limit Figure 6-8. This shows that moisture content sits closer to the plastic limit indicating the Lambeth Clay is of a higher strength. A Casagrande/A-Line Chart is presented in Figure 6-9. The chart shows the Lambeth Clay to plot above the "A" line and has been classified as a low to high plasticity clay. The data does not indicate any clear trends in order to determine the division of Lambeth Clay encountered.

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Figure 6-7: Plasticity Index of Lambeth Clay.



Plot of Plasticity Index against depth below ground level is presented in Figure 6-7. This indicates no real trend of the Plasticity Index.

Figure 6-8: Moisture content, liquid limit and plastic limit (%)against depth for Lambeth Clay

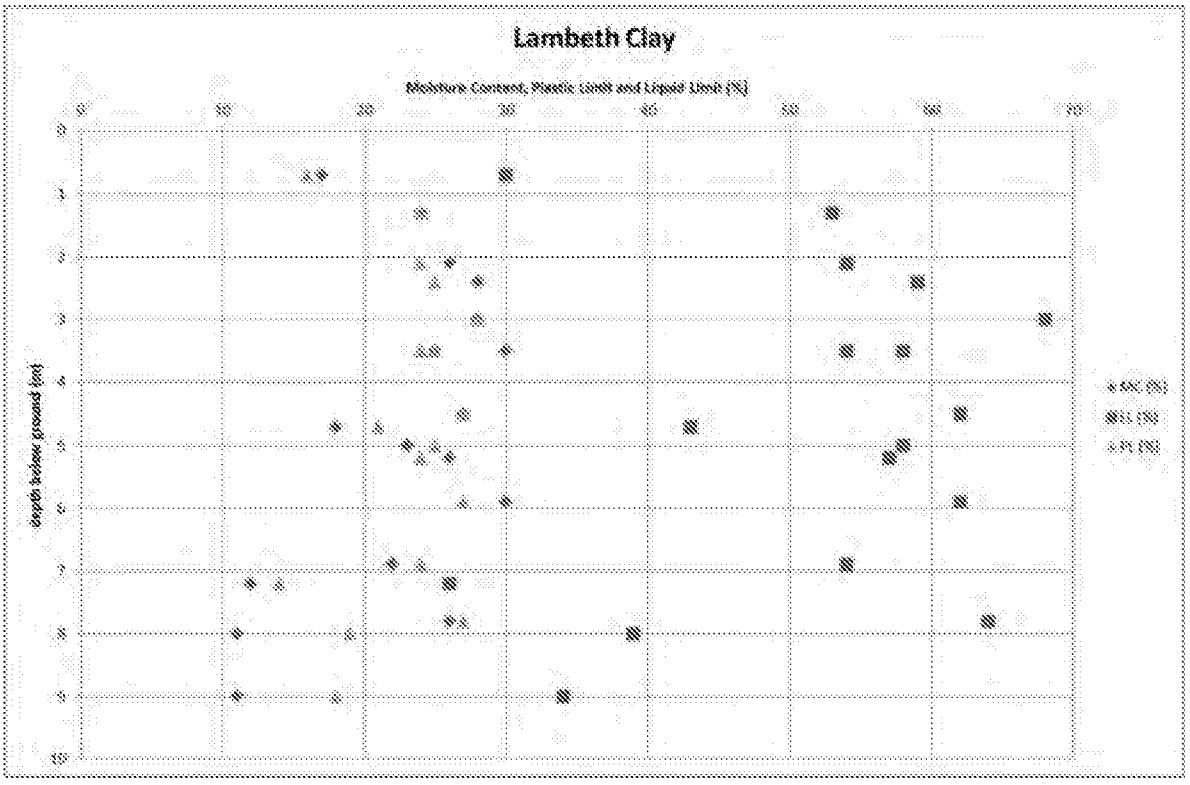
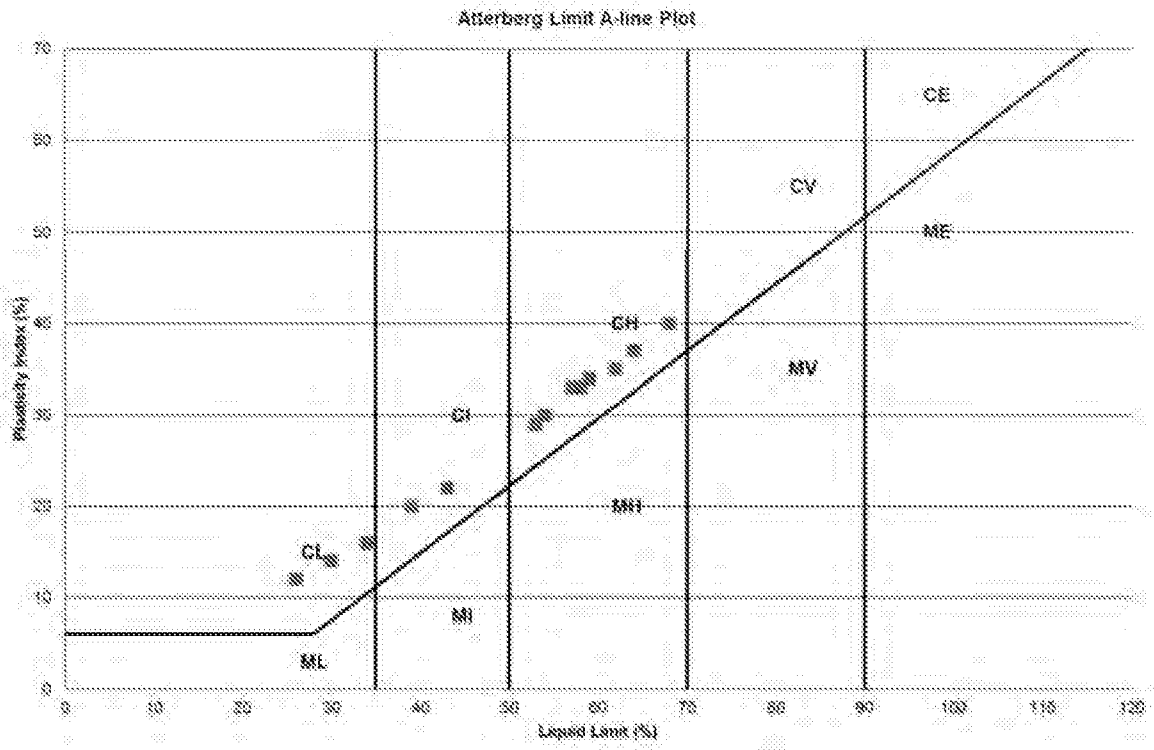
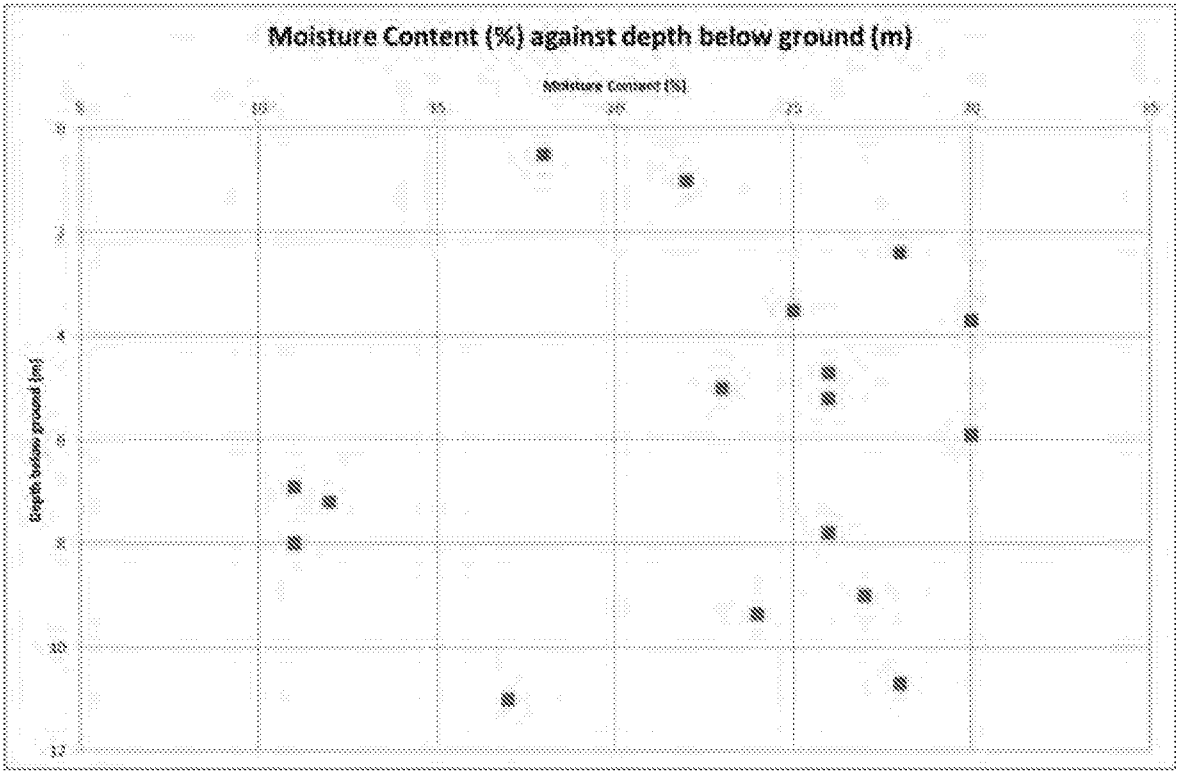


Figure 6-9: Atterberg Limit A-Line plot for Lambeth Clay.



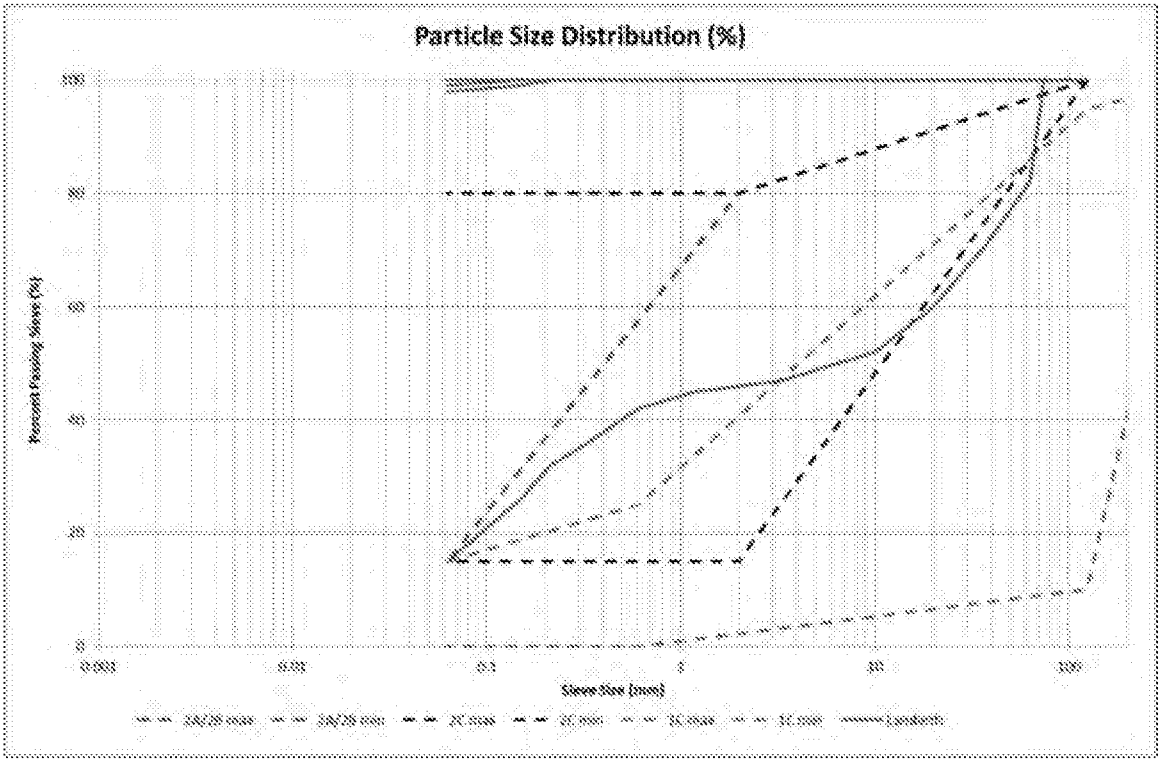
Moisture content tests were conducted on seventeen samples from the Lambeth Clay, as part of both the Atterberg limit tests. Moisture content ranged from 11% to 30% with an average of 23%. Moisture content is plotted against depth below ground in Figure 6-10. This plot shows that there is no trend in moisture content by depth and it continues to vary from around 11% to 30% throughout the depth range.

Figure 6-10: Moisture Content versus depth below ground (m) for Lambeth Clay.



Particle Size Distribution testing was conducted on four samples of Lambeth Clay. However, one of the samples comprised sand and gravel which is likely to come from the Upnor formation within the Lambeth Clay. The Upnor Formation typically is a pebble band with the Lambeth Clay and comprises fine to coarse black flint in fine to medium pale grey sand or clay, which is represented in the plot, Figure 6-11. The material is primarily comprised of silt and clay with no sand and gravel sized content and indicates a class 2A/B material, based on the particle sizes.

Figure 6-11: Particle Size Distribution Curves in Lambeth Clay.

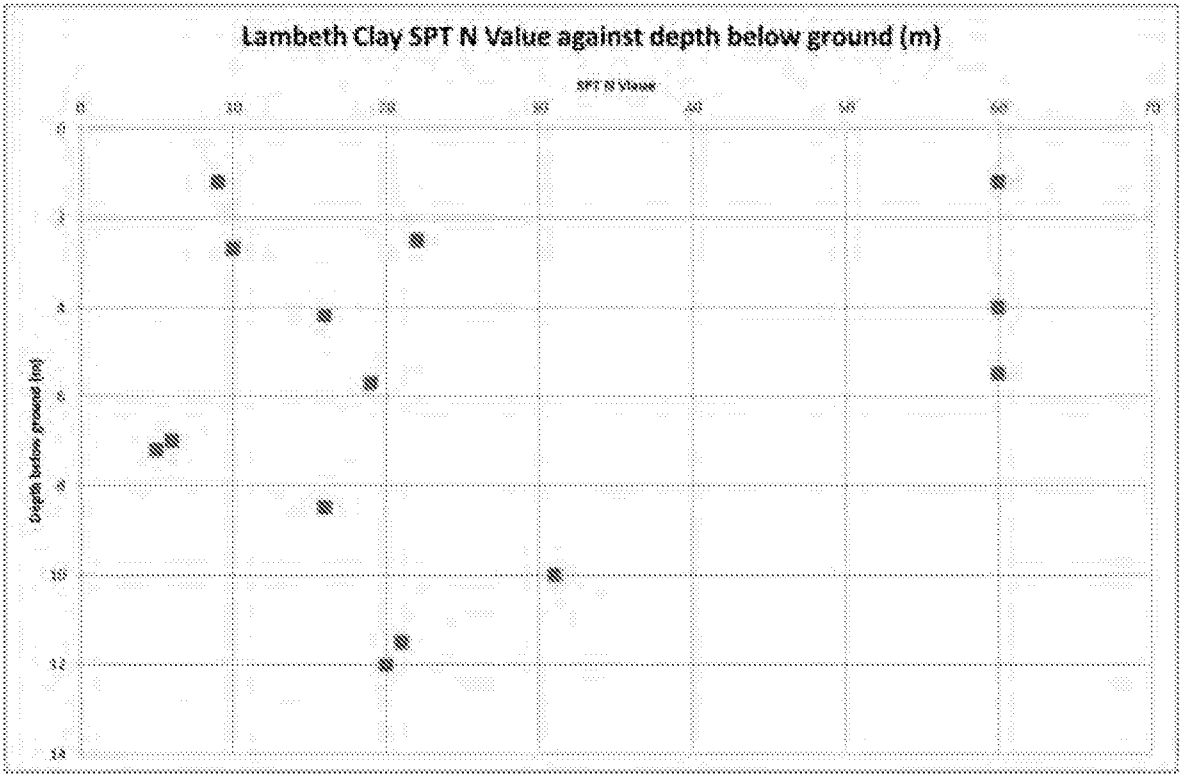


Compaction testing was undertaken on one sample of Lambeth Clay. The tests reported a maximum dry density of 1.58 Mg/m^3. The optimum moisture content is reported as 23.8%.

STRENGTH AND STIFFNESS

Standard Penetration Tests, SPTs were undertaken twenty-one times within the Lambeth Clay. The SPT N values have been limited to a maximum value of 60. The recorded SPT N values have been corrected to N_{60} values and ranged from 5 to 60, with an average of 23. Figure 6-12 presents a plot of recorded SPT N values against depth below ground level and shows an increase in SPT N value with depth. This indicates that the strength and stiffness of the material generally increases with depth which is as expected for Lambeth Clay.

Figure 6-12: SPT N60 against depth below ground level for Lambeth Clay.

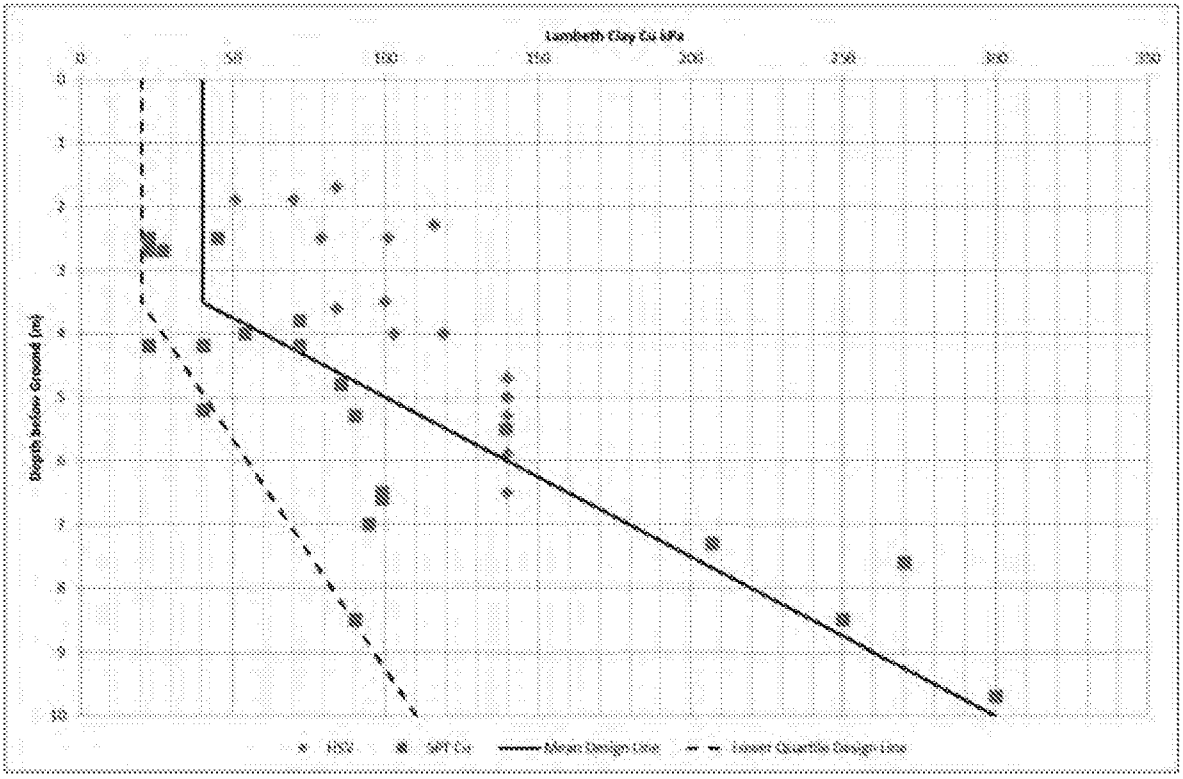


Undrained shear strength (c_u) of the clay in the Lambeth Group has been assessed using correlations with Standard Penetration Tests (Stroud, **Reference 11**). The undrained shear strength derived from the SPT blow counts (using a conversion of c_u/N = 4.2 based on the average PI in the layer of 33%) varies between 22.5kPa and 300kPa (average = 102kPa).

Results from Hand Shear Vane testing undertaken during the logging process on the core, within the liner, were at depths ranging from 1.7m bgl to 6.5m bgl. The results show a trend that strength generally increases with depth. However, results from this testing method are usually disregarded due to the low reliability of the method when undertaken on core samples and the 140kPa limiting maximum value.

The results of both the SPT correlation and HSV testing are plotted against depth below ground surface in Figure 6-12 and show that undrained shear strength generally increases with depth.

Figure 6-13: SPT and HSV correlation against depth below ground.



A mean design line and lower quartile design line are plotted on Figure 6-13 in order to arrive at recommended values for undrained shear strength at various depths. The use of mean values or lower quartile values depends upon the design application being considered and should be selected by the design engineer. The trend lines are summarised below:

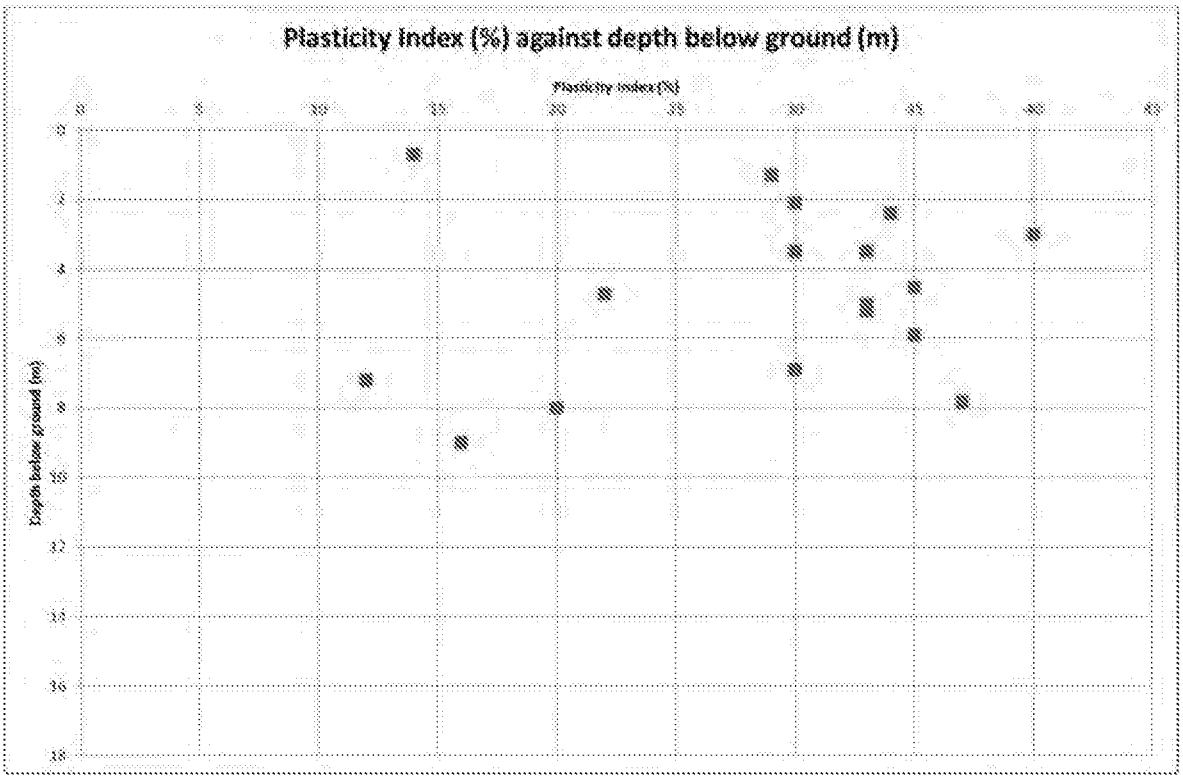
The average design line gives a strength profile of:

→ c_u = 40kPa + 40z, where z is depth below 3.5m bgl.

The lower quartile design line gives a strength profile of:

→ c_u = 20kPa + 13.85z, where z is depth below 3.5m bgl.

Figure 6-14: Undrained Shear Strength (Cu) against depth below surface (m) of Lambeth Clay.



Drained internal angle of friction (ϕ') has been estimated from PI (BS6031:2007). The range of PI is 12% to 40%, corresponding to an internal angle of friction (ϕ') of 23° to 27°. The average PI is 28% corresponding to an average ϕ' of 25°. This is represented in Figure 6-14.

A summary of the in situ field testing and laboratory geotechnical testing undertaken in the Lambeth Clay is provided in Table 6-1.

Table 6-1: Lambeth Clay test results

	Atterberg Limits (%)			Moisture Content (%)	SPT N_{60} Value	c_u correlated from SPT (kPa)
	LL	PL	PI			
No. of tests	17	17	17	17	21	21
Maximum	68	28	40	30	60	300
Minimum	26	14	12	11	5	22.5
Average	51	23	28	23	23	102
Rec' Value	-	-	-	-	-	Lower quartile: 20kPa + 13.85z[1] Mean: 40kPa + 40z[1]

[1] Where z is depth below 3.50m

6.6 WHITE CHALK SUBGROUP

White Chalk Subgroup was encountered below all Superficial Deposits and Lambeth Clay, respectively. The surface of the White Chalk Subgroup was recorded from between -3.46mOD to -17.72mOD and extended beyond the termination of all exploratory holes. There is a clear zone of

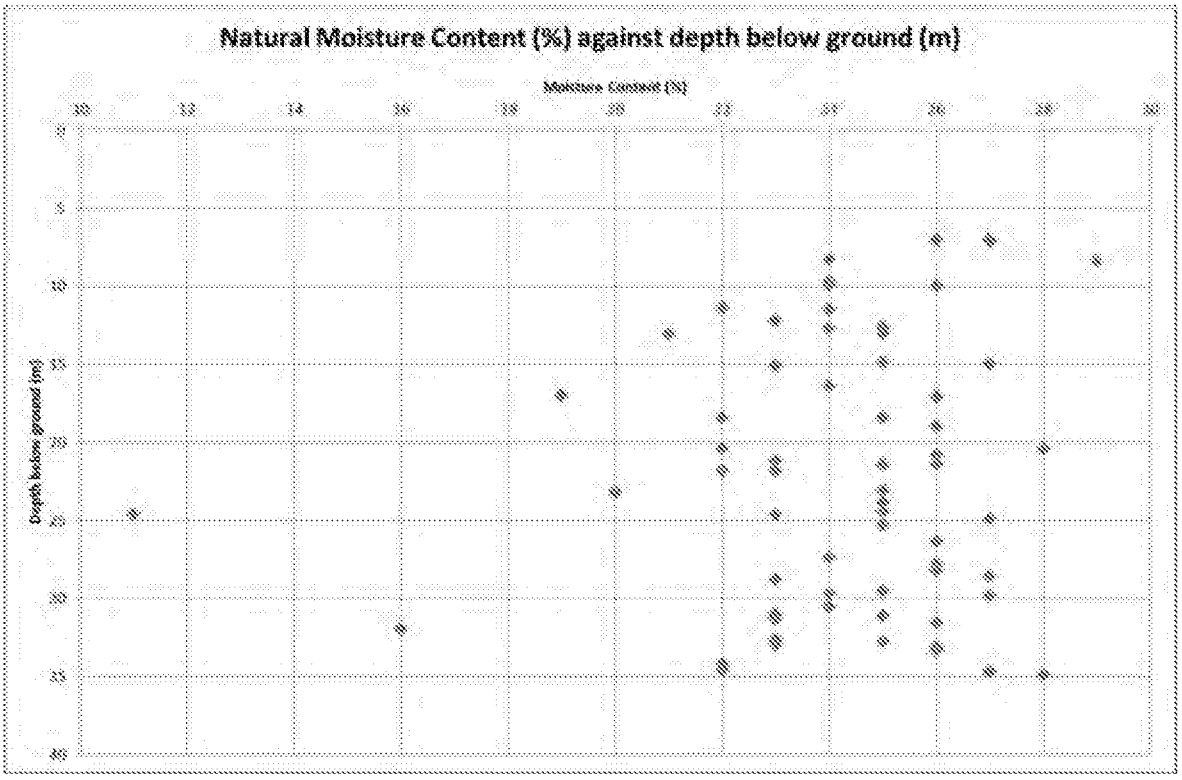
weathered chalk which is present within most boreholes. For the purposes of this report and analysis of parameters, this weathered zone is included.

Within the White Chalk Subgroup numerous laboratory tests were carried out to derive characteristic values for the strata, which are as follows in this section.

Atterberg Limit tests were recorded on three samples of chalk. The Liquid Limit ranges from 36% to 57% and the average is 46%. The Plastic Limit ranges from 21% to 25% and the average is 23.6%. Plasticity Index (PI) ranges from 11% to 32% and the average is 22%.

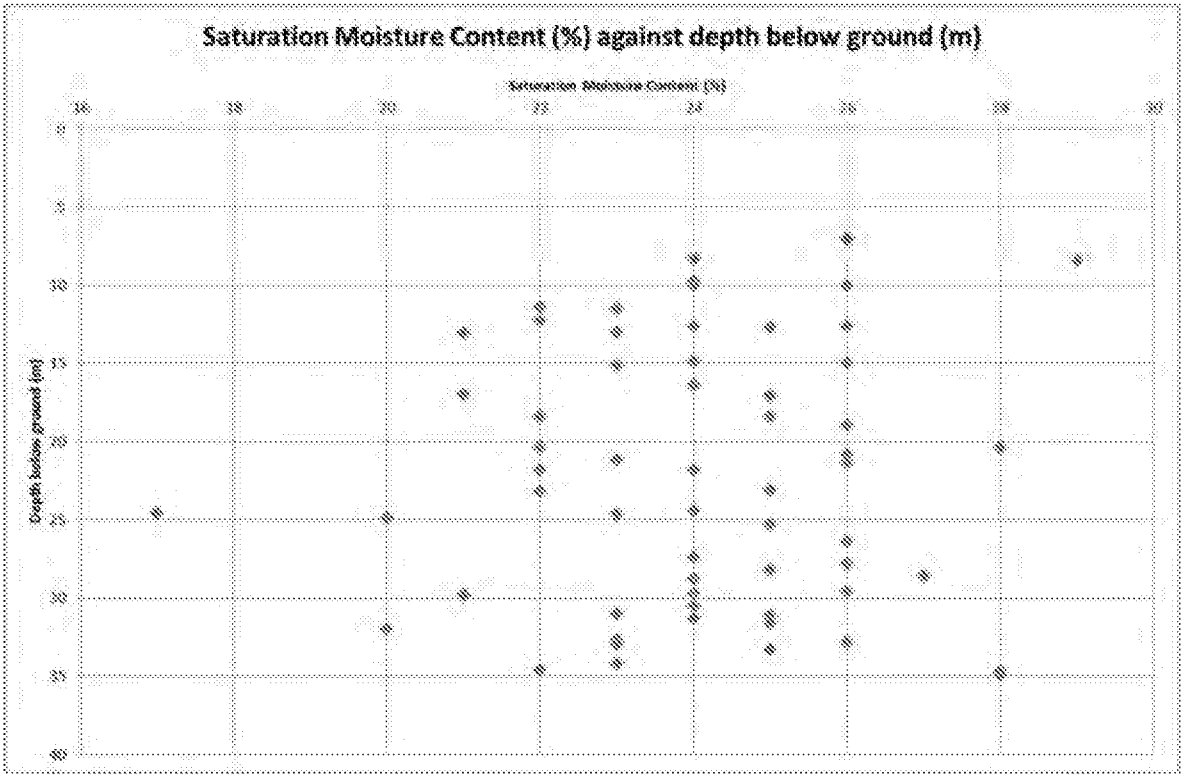
Natural moisture content tests were conducted on sixty-two samples of the White Chalk Subgroup. Results ranged from 11% to 29% with an average of 24%. Natural moisture content is plotted against depth below ground level in Figure 6-15. This plot shows that moisture content generally increases with depth and the majority of values range from between 22% to 26%.

Figure 6-15: Natural Moisture Content against depth below ground level



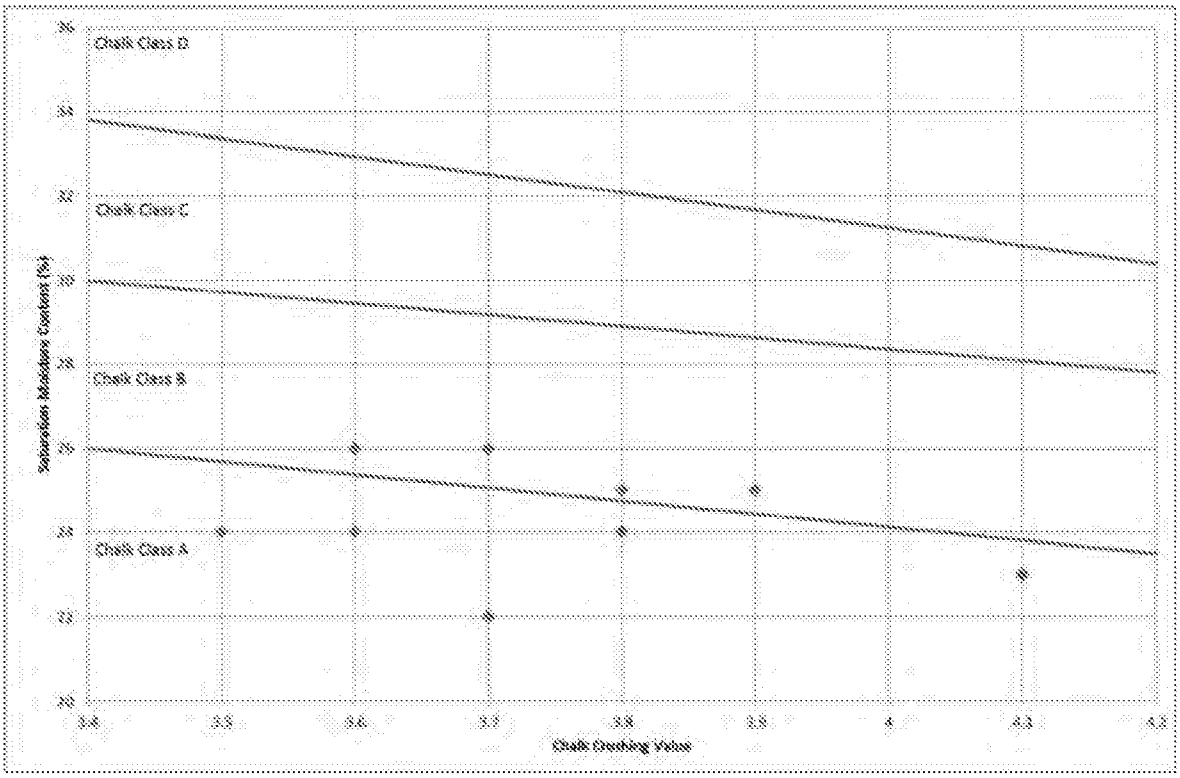
Saturation moisture content (SMC) tests were conducted on sixty-two samples of the structured White Chalk Subgroup. Results ranged from 17% to 29% with an average of 24%. Saturation moisture content is plotted against depth below ground level in Figure 6-16. This plot shows that saturation moisture content ranges between 22% and 26% with some outliers above and below this range.

Figure 6-16: Saturation Moisture Content against depth below ground level



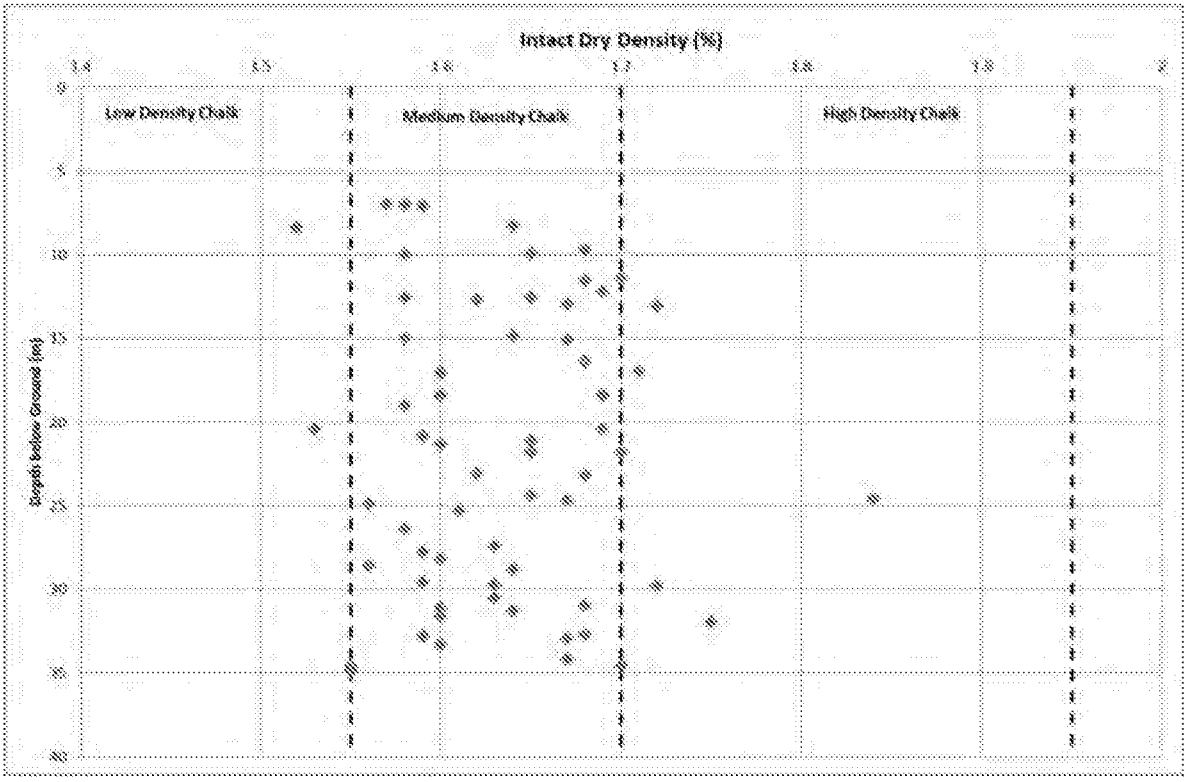
Thirteen chalk crushing value (CCV) samples have been undertaken on the structured chalk and can be used in conjunction with the saturation moisture content to classify the chalk in accordance with CIRIA C574 (**Reference 12**). The CCV ranged between 3.5 and 4.1, and have been plotted against Saturation Moisture Content (SMC) in Figure 6-17, that records the chalk as being a Earthwork Class A/B chalk, in accordance with Figure 5.1(b) Modified chalk classification chart (from Departmental Advice Note HA44/91 DTp 1991), in CIRIA C574.

Figure 6-17: Chalk Earthwork Classification based on Saturation Moisture Content against Chalk Crushing Value



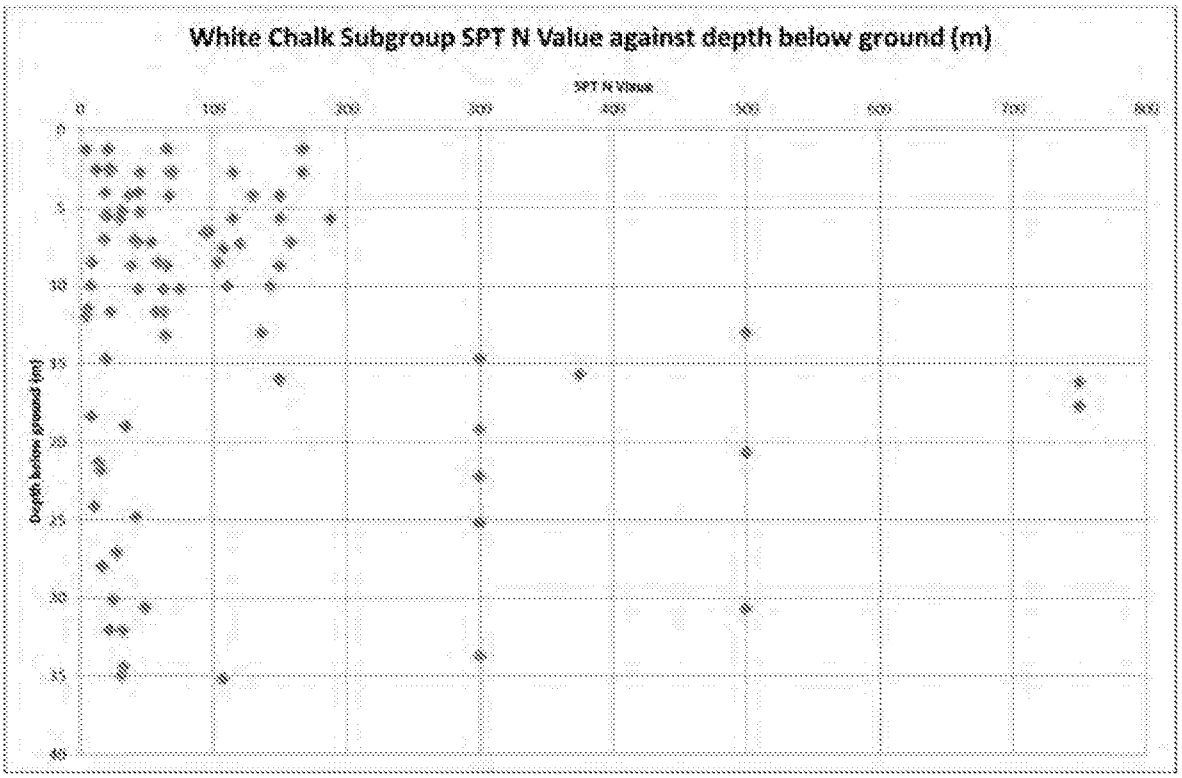
Intact dry density testing was undertaken on sixty-two samples of structured chalk from the ground investigation. Results ranged from 1.52% to 1.84% with an average of 1.63%. These values indicate the chalk is generally classified as a medium density chalk. This correlates with the data from the ground investigation factual report and borehole logs.

Figure 6-18: Intact Dry Density against depth below ground level



Standard Penetration Tests, (SPTs) were undertaken on eighty-three samples within the chalk. The recorded SPT N values have been corrected to N^{60} values which are between 5 and 750 with an average of 114. However, it should be noted that twenty-four tests present high values of 120 to 750; these values have been extrapolated during the in-situ testing. Figure 6-19 presents SPT N Value plotted against depth below ground level.

Figure 6-19: SPT N Value against depth below ground level



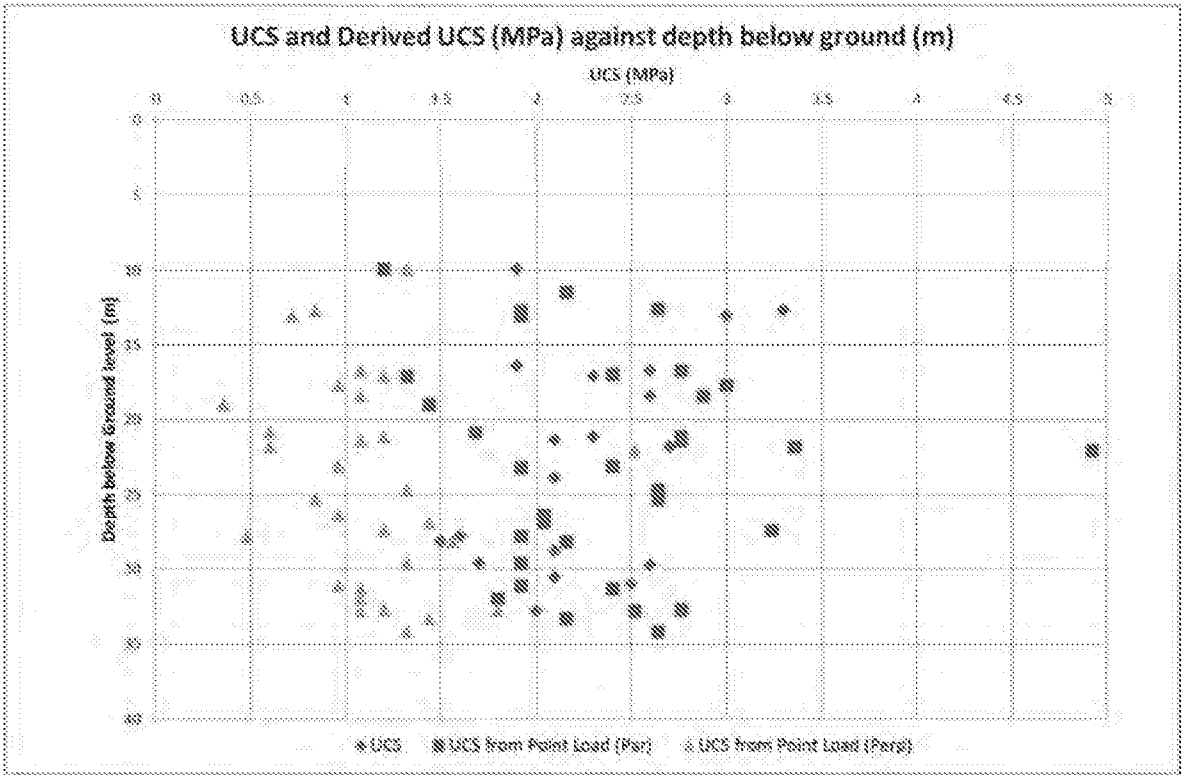
Thirty-two samples of the chalk were subject to a Point Load Strength Index Test which was split between two orientations, parallel and perpendicular, to give sixty-four results and gave an Is_{50} of between 0.05MPa and 0.41MPa, with an average of 0.15MPa. The tests that were in the parallel orientation gave a range of results between 0.10MPa and 0.41MPa with an average of 0.20MPa. The results undertaken in the perpendicular orientation have given a range between 0.03MPa and 0.21MPa with an average of 0.09MPa.

Nineteen Unconfined Compressive Strength (UCS) tests were undertaken recording a range of between 1.5MPa and 3.3MPa, with an average of 2.26MPa. UCS values have been plotted along with UCS derived from Is_{50} results[1], against depth below ground level (m bgl), in Figure 6-20.

[1] UCS can be taken as 10 times (range 16 – 25 times) the Point Load Index (Is_{50}) – David Norbury Limited 2008

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Figure 6-20: UCS and Derived UCS vs Depth below Ground Level



The results of the UCS and Point Load testing provide values typically lower than 3MPa, identifying the chalk as low density (CIRIA C574). This does not agree with the results of the saturation moisture content, intact dry density and chalk crushing value testing which all identify the material as a medium density chalk. A reason for this is that saturation moisture content, intact dry density and chalk crushing value tests require an intact lump of chalk, and often the chalk lump selected represents the best part of the sample (i.e. the only good lump available) thus the results reflect the upper end of the quality for the chalk material. It may therefore be that the UCS better reflects the chalk mass.

A summary of the laboratory geotechnical testing undertaken in the White Chalk Subgroup is provided in Table 6-2.

Table 6-2: White Chalk Subgroup test results

	Atterberg Limits (%)			Moisture Content (%)	Saturation Moisture Content (%)	Chalk Crushing Value (%)	Unconfined Compressive Strength testing (MPa)	Point Load Index Is_{50} (MPa)	Intact Dry Density (Mg/^{3})
	LL	PL	PI						
No. of tests	3	3	3	65	62	13	19	64	62
Maximum	57	25	32	29	29	4.1	3.3	0.41	1.84
Minimum	36	21	11	11	17	3.5	1.5	0.03	1.52
Average	45	23	22	24.2	24	3.8	2.3	0.15	1.63

[1] Where z is depth below surface of White Chalk Subgroup

6.7 GROUNDWATER/CHEMISTRY

GROUNDWATER

Standpipe piezometers were installed in BH101 to BH111; these boreholes were included in a programme of groundwater level monitoring. These eleven wells were monitored on three occasions (2nd, 7th and 14th December 2015). The results are tabulated in Table 5-3.

BURIED CONCRETE

In accordance with the assessment methodology outlined in British Research Establishment (BRE) Special Digest 1: Concrete in Aggressive Ground (**Reference 13**), chemical testing was undertaken on soil samples obtained during the ground investigation. The results have been utilised to determine the Design Sulphate Class of the strata present and the Aggressive Chemical Environment for Concrete (ACEC). This is summarised in Table 6-3 below:

Table 6-3: Summary of Sulphate Calculations

Exploratory Hole	Top Depth (m)	Strata [1, 2]	pH	Total Sulphur (%)	Water Soluble 2:1 (mg/l)	Water Soluble 2:1 (g/l)	Total Sulphate Content (%)	Sulphate Class	ACEC Class	Total Potential Sulphate (%)
BH102	1.9	LMBE	8.8	0.04	350	0.35	0.09	DS5	AC-2	0.38
TP102	2.5	LMBE	7.3	0.05	220	0.22	0.1	DS5	AC-2	0.42
BH106	3.5	LMBE	8.3	0.02	150	0.15	0.06	DS5	AC-2	0.25
BH101	3.9	LMBE	8.2	0.02	120	0.12	0.03	DS5	AC-2	0.13
TP101	3	LMBE	8.4	0.01	120	0.12	0.04	DS5	AC-2	0.17
BH103	5.3	LMBE	8.2	<0.01	83	0.083	0.03	DS5	AC-2	0.13
BH103	1.9	LMBE	8.3	0.02	81	0.081	0.04	DS5	AC-2	0.17
BH107	5	LMBE	8.8	0.02	50	0.05	0.04	DS5	AC-2	0.17
TP101	1.3	LMBE	8.2	0.02	32	0.032	0.02	DS5	AC-2	0.08
BH109	4	SUPD	8.2	0.64	520	0.52	0.21	DS5	AC-2	0.88
BH108	6.3	SUPD	8.8	0.46	520	0.52	0.17	DS5	AC-2	0.71
BH108	1.65	SUPD	8.3	0.39	490	0.49	0.19	DS5	AC-2	0.80
BH109	15.5	SUPD	8	1.8	340	0.34	2.2	DS5	AC-2	9.24
BH104	5.2	SUPD	9	0.21	270	0.27	0.1	DS5	AC-2	0.42
TP104	1.5	SUPD	8.7	0.08	170	0.17	0.08	DS5	AC-2	0.34
TP106	2	SUPD	8.5	0.02	82	0.082	0.04	DS5	AC-2	0.17
TP107	1.5	SUPD	8.2	0.01	32	0.032	0.02	DS5	AC-2	0.08
TP103	1	SUPD	7.4	<0.01	31	0.031	0.02	DS5	AC-2	0.08

[1] LMBE - Lambeth Clay

[2] SUPD - Superficial Deposits

Eighteen samples were obtained for sulphate testing, from both the Superficial Deposits and Lambeth Clay. The mean of the highest 20% of the values recorded provides a characteristic value for the total potential sulphate of 2.91%, water soluble sulphate of 468 mg/l with a pH value of 8.3. These values correspond to a Design Sulphate Class of DS-5.

However, it is anticipated that the proposed building foundations are likely to be piled and therefore there will be no excavation/disturbance of the ground which prohibits oxidation of the

pyrite. This is based on the following extract from (BRE) Special Digest 1: Concrete in Aggressive Ground (**Reference 13**) stating '*Concrete in pyritic ground which is initially low in soluble sulphate does not have to be designed to withstand a high potential sulphate class unless it is exposed to ground which has been disturbed to the extent that contained pyrite might oxidise and the resultant sulphate ions reach the concrete. This may prompt redesign of the structure or change to the construction process to avoid ground disturbance; for example, by using precast or cast-in-situ piles instead of constructing a spread footing within an excavation.*'

Therefore it is suggested that the design sulphate class is reduced to DS-2, taking account of the water soluble sulphate content. This corresponds to concrete class of AC-2.

6.8 GROUND CONDITIONS FOR PROPOSED STRUCTURES

The following sub-sections use the findings of the ground investigation and laboratory testing to provide some general guidance on likely ground engineering solutions for the proposed development.

FOUNDATION SOLUTIONS – MAIN BUILDING

Column loadings for the four- to five-storey building are anticipated to be in the order of 4000kN (unfactored) / 4400kN (factored). It is expected that the bearing resistance of the Superficial Deposits and Lambeth Clay would not be sufficient to accommodate the anticipated column loads. Furthermore, it is also anticipated that potential differential settlements could occur due to the variability in the thickness of the Superficial Deposits. It is therefore likely that a piled foundation solution and a suspended ground floor slab would be required. Provisional pile lengths are provided in Table 6-4 for the anticipated building loads. Note these are indicative, and not to be used for detailed design. It is recommended that a Geotechnical Design Report (GDR) is produced at detailed design stage. It is noted that the pile lengths for the northern area of the site are likely to be significantly longer.

Table 6-4: Preliminary Pile Lengths for building footprint.

EUROCODE 7	PROVISIONAL REQUIRED PILE LENGTH (M)		
Pile Diameter (mm)	4 Pile Grouping	3 Pile Grouping	Single Pile
450	13	16	34
600	11	13	26
750	10	11	22

FOUNDATION EXCAVATIONS

The stability of any foundation trenches will need to be inspected and monitored as the upper materials may be unstable, especially in the presence of groundwater. Where ground is unstable or there is a need to leave steep sided excavations open for longer periods, there may be a need for excavations to be supported.

Groundwater may be encountered in the deeper foundation excavations and an appropriate method of groundwater management, such as draining to a sump and pumping out, may be required.

PRELIMINARY PAVEMENT DESIGN

The California Bearing Ratio (CBR) for pavement design has been estimated using Table 5.1 of IAN 73/06 Rev 1 (2009) (**Reference 14**). This estimates the equilibrium subgrade CBR based on the soil type and Plasticity Index. For this project it is assumed that any Made Ground will be removed and therefore all pavements will be founded upon the Superficial Deposits. The Plasticity

Index of the Superficial Deposits range from 23% to 53%. Taking a conservative preliminary design value corresponds to an equilibrium subgrade CBR of 2%. This assumes thin construction of 300mm from pavement surface to subgrade. To increase the preliminary design value, it is likely capping or a geosynthetic layer will be required to enable a cost effective design.

7 LAND CONTAMINATION RISK ASSESSMENT

7.1 LAND CONTAMINATION ASSESSMENT

Introduction

It is understood that the Client is proposing to construct an Engineering and Digital Technology Park (comprising teaching facilities) in the south-eastern area of the Bognor Regis Campus and associated student accommodation, access roads, car parking and landscaping adjacent to the north.

A land contamination assessment was undertaken alongside the geotechnical ground investigation, the aims of which were to build upon findings of the WSP 'Phase 1 Land Contamination Assessment, University of Chichester, Bognor Regis Campus, Digital Technology Park', (Ref. 70014375-001, dated August 2015) (**Reference 15**).

This current assessment was carried out in order to further quantify potential ground contamination liabilities associated with historical and current site use; and to advise on potential options for mitigating potential contamination risks associated with the development.

A summary of the contamination assessment undertaken and is provided in the following section. A full Preliminary Land Quality Assessment has been produced under a separate cover (Ref: 70013264-300, February 2016) (**Reference 10**) and should be read in conjunction with this report.

7.2 CONTAMINATION ASSESSMENT APPROACH

The contamination assessment comprised the following elements which are summarised within this section:

- Review of previous Phase 1 Land Contamination Assessment and publicly available information in order to establish potential sources of contamination which required assessment;
- Analysis of soil, groundwater and gas samples to enable a generic quantitative risk assessment to be completed to assess potential risks to human health and controlled water receptors;
- Development of a conceptual site model summarising potential contaminant linkages; and
- Provision of recommendations with respect to the management / mitigation of potential contaminated land development constraints.

7.3 POTENTIAL SOURCES OF CONTAMINATION

Potential sources of contamination identified from the previous report and publicly available data sources prior to the investigation included the following:

- Electrical substation and pump house within 50m of the site, to the north of Barbara Smith Halls;
- Current embankment (approx. 1m high spanning width of the site) in the south eastern area of the site;
- Felpham Way (A259), Upper Bognor Road and allotments adjacent to the east of the site; and
- Fly tipping to the south of Barbara Smith Halls.

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Based on the above information, the current assessment scope was designed to target the above areas of concerns, whilst also providing general site coverage to enable an assessment of contamination risks to be completed.

The rationale and scope of the contamination assessment is summarised in Table 7-1:

Table 7-1: Exploratory Hole Rationale

Potential Area of Concern (PAOC)	Proposed Location (s)	Rationale
PAOC 1 – Made Ground	All locations	→ HP101 – 102 undertaken in earth bund to determine nature and composition of materials → All further locations to determine possible presence of Made Ground
PAOC 2 – Ground gas assessment	All BHs	→ BH106 installed as a shallow ground gas monitoring well to determine potential shallow ground gas generation → Further monitoring locations installed in superficial deposits and chalk to determine potential gas generation from sources including organic matter and carbonates
PAOC 3 – migration of contaminants from off-site	BH101 – BH103, BH106 – 109, TP102 – TP103 and TP107	→ BH101 – 103, BH106 – 109, TP102 and TP107 located adjacent to eastern and southern boundaries to investigate migration from adjacent road and allotments → BH107 and TP102 – 103 are located on-site adjacent to the pump house and electrical substation
Assessment of the groundwater regime / groundwater quality	All BHs	→ BH109 and BH110 installed as groundwater wells in shallow superficial deposits to determine hydraulic connectivity with underlying chalk aquifer. → BH101 installed as groundwater well in the Lambeth Group bedrock to determine hydraulic connectivity with chalk aquifer beneath → BH102 – BH105, BH107, BH108 and BH111 installed as groundwater wells in chalk bedrock deposits, triangulated to infer flow direction and possible contaminant migration

7.4 CONTAMINATION ASSESSMENT

The following section represents a summary of the Generic Quantitative Risk Assessment (GQRA) (**Reference 10**) for potential risk to human health and controlled water receptors. Details of the full assessment methodology are provided in **Appendix G**.

7.5 HUMAN HEALTH – SOIL

It has been assumed for the basis of the assessment that the land to the south of the on-site drainage ditch will be used for a commercial / teaching building and the land to the north of the ditch will be utilised for high-rise student accommodation flats and car parking. As such the results of the analysis have been compared to WSP Generic Assessment Criteria (GACs) for a residential end use, with no consumption of home grown produce and 1% soil organic matter, which is based on laboratory analysis of soils and represents a conservative approach to the assessment.

Human health receptors considered as part of this assessment are:

- Future students and teaching/support staff in the teaching building;
- Maintenance workers;
- Residents in student accommodation; and
- Future site visitors.

Construction and maintenance works have been discounted from the assessment, as risks to these will be mitigated by the implementation of good environmental practices and health and safety measures during future construction and maintenance works.

A total of thirty soil samples were submitted for chemical analysis and compared to WSP GACs. The following observations were made:

- Exceedances of the GAC for benzo(a)pyrene (1mg/kg) was recorded in two locations, in BH104 at 0.1m bgl (3.2mg/kg) and BH105 at 0.1m bgl (1.3mg/kg). Both samples were collected from Made Ground and are located immediately to the adjacent to the north of the drainage ditch (BH104) and in the central northern boundary (BH105). No further analytes exceeded their respective screening criteria;
- No Asbestos Containing Materials (ACM) was recorded in all sixteen soil samples screened; and
- No pesticides, herbicides or volatile organic compounds (VOCs) were recorded greater than the laboratory limits of detection.

7.6 CONTROLLED WATERS ASSESSMENT

The controlled waters risk assessment was conducted in accordance with the principles of EA 'Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination' 2006 (EA 2006) and on the 'prevent and limit' approach of the Water Framework Directive (2000/60/EC). Level 1 (leachate) and level 2 (groundwater) assessments were undertaken, which allows a direct comparison of results against appropriate assessment criteria.

Controlled water receptors considered as part of this assessment were:

- The underlying Chalk Principal Aquifer;
- Secondary A Aquifers within the Lambeth Group and River Terrace Deposits;
- The on-site drainage ditch;
- Aldingbourne Rife to the east; and
- The English Channel approximately 300m south of the site.

One surface water abstraction is recorded within 1km of the site, 170m south at Butlins Holiday Village. No groundwater abstractions are recorded within 1km of the site.

Due to the potential for risks to a Principal Aquifer and surface water, contaminant concentrations have been screened against both the UK Drinking Water Quality Standards (DWQS) 2000 (Amended 2004) and the Water Framework Directive (WFD) standards and groundwater threshold values for surface waters and transitional and coastal waters.

Based on groundwater conditions encountered, it is considered that groundwater within the chalk aquifer is flowing in a southern / easterly direction. It is considered that groundwater within the chalk bedrock is in vertical hydraulic continuity with the overlying superficial deposits and Lambeth Group.

7.7 LEVEL 1 ASSESSMENT – LEACHATE

A total of twelve soil samples were submitted for leachate analysis. The following observations were made:

- Copper concentrations within leachate from three soil samples (BH102 at 0.1m bgl, 7.5µg/l; BH107 at 0.2m bgl, 7.1µg/l and TP104 at 0.1m bgl, 6.1µg/l) marginally exceeded the WFD criteria for coastal waters (5µg/l). All samples were collected from Made Ground, except BH102 at 0.1m bgl which comprised Topsoil;
- Lead concentrations within leachate from four soil samples (BH102 at 0.1m bgl, 10µg/l; BH107 at 0.2m bgl, 9.3µg/l; BH109 at 0.5m bgl, 7.4µg/l and BH110 at 0.2m bgl, 8.5µg/l) marginally exceeded the WFD standard for coastal waters (7.2µg/l). All samples were collected from Made Ground except BH102 0.1m bgl which comprised Topsoil; and
- No petroleum hydrocarbons were detected in any samples and PAHs were only detected in low concentrations not exceeding their respective screening criteria in BH102 at 1.3m bgl (Lambeth Group).

7.8 LEVEL 2 ASSESSMENT – GROUNDWATER

A total of ten groundwater samples were collected from all the boreholes with the exception of BH106 (which was dry at the time of sampling) and were submitted for laboratory chemical analysis. The following observations were made:

- No PAHs, petroleum hydrocarbons or VOCs were present above limits of detection;
- Mercury concentrations in all samples (in the range of 0.12 to 0.4µg/l), exceeded the WFD coastal and freshwater standards (0.05µg/l). Samples were taken from the Lambeth Group, chalk bedrock and superficial deposits in the north of the site; and
- Selenium concentrations exceeded the DWS (10µg/l) in four samples (BH101 27µg/l, BH103 16µg/l, BH105 14µg/l and BH107 10µg/l). Of these, BH103, BH105 and BH107 were screened in the chalk bedrock and BH101 was screened in the Lambeth Group.

7.9 GAS ASSESSMENT

Ground gas monitoring was undertaken on three occasions in December 2015. Utilising guidance presented in CIRIA C665 (**Reference 16**) and taking a worst case gas concentration of 3.7% CO_2, 0.5% CH_4 and a maximum flow of 18.0l/hr, a worst case GSV of 0.67 l/hr for carbon dioxide and 0.09 l/hr for methane is calculated.

The results indicate the Site to be classified as Characteristic Gas Situation 2 (CS2). CIRIA C665 states a typical source for CS2 to be 'natural soil, high peat/ organic content', which is typical of the superficial deposits encountered in the northern portion of the site. This should be confirmed with the Local Planning Authority prior to development.

The WSP Phase 1 Land Contamination Assessment indicated that the site is located within an intermediate probability radon area, as between 1 and 3% of homes are above the action level for radon gas.

Full details of the ground gas monitoring and ground gas assessment are provided in **Appendix D**.

7.10 CONTAMINATION CONCLUSIONS & RECOMMENDATIONS

Based on available data to date, it is considered that contamination risks to the proposed development are low. Whilst localised marginal contaminant exceedances were observed in soil,

leachate and groundwater samples collected during this assessment, they are not considered to represent a potential significant risk to human health or controlled water receptors.

Spatial distribution of analyte exceedances in soil and leachate samples was attributed to the location of Made Ground. Of the two soil samples that exceeded the screening criteria (1mg/kg) for benzo(a)pyrene, BH105 at 0.1m bgl (1.3mg/kg) is situated beneath the proposed car park and it is considered that this will limit exposure of any potential contamination by breaking the direct contact exposure pathways to human health.

The minor exceedance of benzo(a)pyrene in BH104 at 0.1m bgl (3.2mg/kg) is located in an area of soft landscaping adjacent to the south of the proposed student accommodation block. Whilst the risk of significant exposure to human health is considered low, given the sensitive land use (accommodation), it is considered prudent to delineate and install a suitable thickness of clean cover to mitigate the potential risk. If site levels do not allow the installation of a clean cover layer, then impacted material may require excavation and re-use under areas of hard-standing / building footprint. It is understood that the proposed site layout is not confirmed for the northern portion of the site and should the layout change, this may impact on potential remedial options and further assessment may be necessary.

Fly tipping observed to the south of Barbara Smith Halls was discounted as a potential source of contamination, as no soil samples collected from BH103 and TP101 adjacent to the off-site fly tipping indicated soil contamination. Furthermore, no fly tipping was observed in the southern portion of the site following vegetation clearance. Asbestos was discounted as a potential source of contamination, as no visual or laboratory evidence of this was recorded.

Marginal exceedances of copper and lead were recorded in leachates; and selenium and mercury in groundwater from all strata. No discernible soil source or off-site sources of contamination has been identified. Given the marginal exceedances and the development proposals to install areas of hard-standing it is considered that the risks to groundwater are low. However, it is considered prudent to undertake a further round of confirmatory groundwater and surface water sampling.

8 GEOTECHNICAL RISK REGISTERS

The geotechnical risk registers identify geotechnical hazards / risks associated with the various ground related aspects of the proposed development and associated structures.

Risk is taken as the possibility of adverse consequences such as danger, loss, injury or other arising from a hazard, the hazard being something with the potential to cause harm. The geotechnical risk is assessed as the risk is created by the site ground conditions which can adversely affect the scheme cost, completion time, health and safety, environment and quality of product.

The risk register is intended as a live document and is included on the following pages, Table 8-1.

Table 6-1: Geotechnical Risk Register

ITEM	DATE RAISED	DESIGN / CONSTRUCTION RISK	CONSEQUENCE	QUALITATIVE RISK LEVEL HIGH / MEDIUM / LOW	POSSIBLE MITIGATION(S)
1	February 2016	Limited groundwater monitoring data.	Incorrect assumptions in groundwater and geotechnical designs.	Low	Assume conservative groundwater profiles.
2	February 2016	Change in ground conditions at depth which will change in strength profile and subject to settlement and over consolidation. If organic material this may cause ground gas.	Structural damage. Cost of repairs. Long term performance. Reputational damage	High	Consider issues in design of temporary and permanent works. Additional monitoring during the construction phase of the development.
3	February 2016	Geological strata encountered at formation are different to design.	Unsuitable construction methods. Cost of redesign. Reputational damage.	Medium	Data gaps to be determined at detail design stage. Carry out additional ground information if necessary.
4	February 2016	Settlement of underlying strata due to consolidation settlement in compressible soils/made ground.	Unacceptable settlement of foundations. .	Medium	Design to consider this and site inspections needed to make sure design assumptions met.
5	February 2016	Sulphate attack on buried concrete.	Structural damage. Cost of repairs. Long term performance. Reputational damage.	Low	Use test results from ground investigation to select concrete class from BRE Special Digest 1.
6	February 2016	Unexploded Ordnance.	Risk to human life. Structural damage.	High	Attendance of Unexploded Ordnance Engineer on site to provide a watching brief during construction works and mitigate risk.
7	February 2016	Buried services and utilities.	Structural damage. Health and safety of workforce. Reputational damage. Financial and programme implications.	Medium	Service clearance to be undertaken to identify buried services and utilities prior to any intrusive works. Risk assessments and permit to dig issued before intrusive works. Following these procedures will reduce risk to low.
8	February 2016	Desiccated ground in the Superficial Deposits	Potential for heave also high strength shouldn't be used in design as it will reduce when desiccation reduces/reaches equilibrium	Medium	A shallow foundation solution has not been proposed due to potential heave, and therefore a piled solution is recommended.
9	February 2016	This report constitutes a Ground Investigation Report (GIR) and not a Geotechnical Design report (GDR).	Outline recommendations presented in this report are used for construction and	High	Detailed design should be carried out at the appropriate time with the insitu and laboratory test information presented within this report used as the baseline. The preliminary geotechnical

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ITEM	DATE RAISED	DESIGN / CONSTRUCTION RISK	CONSEQUENCE	QUALITATIVE RISK LEVEL HIGH / MEDIUM / LOW	POSSIBLE MITIGATION(S)
			detailed design not carried out.		foundation recommendations presented within this report should not be solely relied upon and WSP shall not accept liability if designs are carried out on this report alone.

REFERENCES

1 BSI: BS EN 1997-1:2004 Eurocode 7: Geotechnical Design – Part 1: General Rules.

2 Highways Agency: Design Manual for Roads and Bridges, Volume 4, Part 2, HD 22/08, Managing Geotechnical Risk, 2008

3 British Geological Survey: Sheet 317/332, Chichester & Bognor Regis (Solid and Drift edition) 1:50,000 Series, 1996

4 British Geological Survey: Geology of Britain Viewer website, accessed 23/11/2015 http://mapapps.bgs.ac.uk/geologyofbritain/home.html

5 Environment Agency: What's In Your Backyard website accessed 23/11/2015 http://watermaps.environment-agency.gov.uk/

6 Part 2A, Environmental Protection Act 1990

7 Zetica UXO, Regional Unexploded Bomb Risk Map for West Sussex, 2015

8 BSI: BS EN ISO 22475-1:2006 Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution

9 Building Research Establishment: Digest 365 Soakaway Design, 2003

10 WSP, Generic Quantitative Risk Assessment, 2016

11 Stroud, M.A.: The Standard Penetration Test, Its Application and Interpretation. Penetration Testing in the UK, pp. 29-46, 1989

12 CIRIA C574, Engineering in Chalk, London 2002

13 Building Research Establishment: BRE Special Digest 1, Concrete in Aggressive Ground 2005

14 Highways Agency: Interim Advice Note 73/06 Revision 1 Design Guidance for Road Pavement Foundations, 2009

15 WSP 'Phase 1 Land Contamination Assessment, University of Chichester, Bognor Regis Campus, Digital Technology Park', (Ref. 70014375-001, dated August 2015)

16 CIRIA C665, Assessing Risks posed by Hazardous Ground Gases to Buildings, London 2007

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Appendix A

REPORT LIMITATIONS

Appendix B

SITE PLANS & MAPS

Appendix C

EXPLORATORY HOLE LOGS & FACTUAL REPORT

Appendix D

GAS MONITORING RESULTS

Appendix E

LABORATORY RESULTS

Appendix F

GROUND MODEL

Appendix G

HUMAN HEALTH RISK ASSESSMENT

Appendix A

REPORT LIMITATIONS

General Limitations

Limitations for WSP Land Restoration and Ground Engineering Division

General

WSP has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report. Unless explicitly agreed otherwise, in writing, this report has been prepared under WSP Standard Terms and Conditions, as included within our proposal to the Client.

Project specific appointment documents may be agreed on a project by project basis, at our discretion. A charge may be levied for both the time to review and finalise appointments documents and also for associated changes to the appointment terms. WSP reserve the right to amend the fee should any changes to the appointment terms create an increase risk to WSP.

The report needs to be considered in the light of the WSP proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report. The report is only valid for its originally intended purpose as set out in either our report or the proposal.

Phase 1 Geo Environmental Preliminary Risk Assessments

The works undertaken to prepare this report comprise a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. It is not standard, due to the timescales, to visit archives and local libraries as part of these works. WSP cannot be held responsible for any disclosures that are provided post production of our report and will not automatically update our report.

The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, WSP reserves the right to review such information and, if warranted, to modify the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the Site.

WSP does not warrant work / data undertaken / provided by others.

This section covers reports with the following titles or combination of titles: Phase 1; Desk Top Study; Geo-Environmental Assessment; Development Appraisal; Preliminary Environmental Risk Assessment; Constraints Report; Due Diligence Report; Geotechnical Development Review; Environmental Statement; Environmental Chapter; Geotechnical Development Risk Register or Baseline Environmental Assessment. These limitations associated with preliminary works also apply when they are reported within an intrusive investigation report.

Intrusive Investigation Reports

The investigation has been undertaken to provide information concerning the type and degree of contamination present at the Site in order to allow a generic risk assessment to be undertaken or identification of the soil properties to allow for geotechnical development constraints to be identified.

The objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters. For geotechnical investigations the purpose is to broadly identify the development constraints associated with the physical property of the soils underlying the site.

The amount of exploratory work, soil property and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site

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usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the Site, and as such can only provide a general indication of conditions. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of localised "hotspots" of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report. For example these include spatial variations in soil properties; the varying thickness and physical nature of the strata identified and changes in groundwater levels or flow rates.

The inspection; testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. WSP has interpreted between these points based upon assumptions to develop our interpretation and conclusions. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation.

On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 2 became the mandatory baseline standard for geotechnical ground investigations.

In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. A GDR can strictly only be prepared following confirmation of all structural loads and serviceability requirements. The design process requires close co-operation between the geotechnical engineer and the structural engineer and is iterative. Where a GDR is prepared using preliminary or assumed loadings and/or serviceability limits it should only be considered as an interim report and should not be relied upon for the procurement or construction of the works it describes. A GDR will be a standalone specifically entitled report.

During any build programme WSP should be consulted if alternative ground conditions are encountered. It assumes during any site works that the contractor will use their best endeavours to manage and control groundwater and other unforeseen ground conditions. WSP will not be liable for actions taken prior to consultation.

The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.

The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated with the WSP risk assessment process have been outlined within the body or associated appendix of the report.

Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.

If costs have been included in relation to additional site works, and / or site remediation works these must be considered as indicative only and must, be confirmed by a qualified quantity surveyor.

The following report titles (or combination) may cover this category of work: geo environmental site investigation; geotechnical assessment; GIR (Ground Investigation reports); preliminary environmental and geotechnical risk assessment; geotechnical risk register.

Detailed Quantitative Risk Assessments and Remedial Strategy Reports

These reports either use primary data or build upon previous report versions and associated notes. The scope of the investigation; further testing and monitoring and associated risk assessments were selected on the basis of the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination

concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.

The outputs of the Detailed Quantitative Risk Assessments are based upon WSP manipulation of standard risk assessment models. Models are simulations based on the available data set and should not be used as predictions.

Where a remediation strategy is proposed, this is based on our interpretation of the risk assessment criteria and is specific to a particular location and a particular intended land use and configuration / layout. Prior to adoption they will need discussing and agreeing with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatory Authority engagement are not within the control of WSP. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.

Monitoring (including Remediation Monitoring reports)

These reports are factual in nature and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of an earthworks or remedial works.

The data is presented and will be compared with assessment criteria.

Asbestos in soils

Unless explicitly included for in our proposal, our investigation does not include for a formal asbestos assessment and the inspection for asbestos, either as asbestos containing materials (ACMs) lying on the surface or as ACMs and/or as loose asbestos fibres within made ground/stockpiles is excluded. Our report will include only the factual reporting of any laboratory asbestos soil screening results, if completed. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and/or trace loose asbestos fibres within the soil matrix at the site.

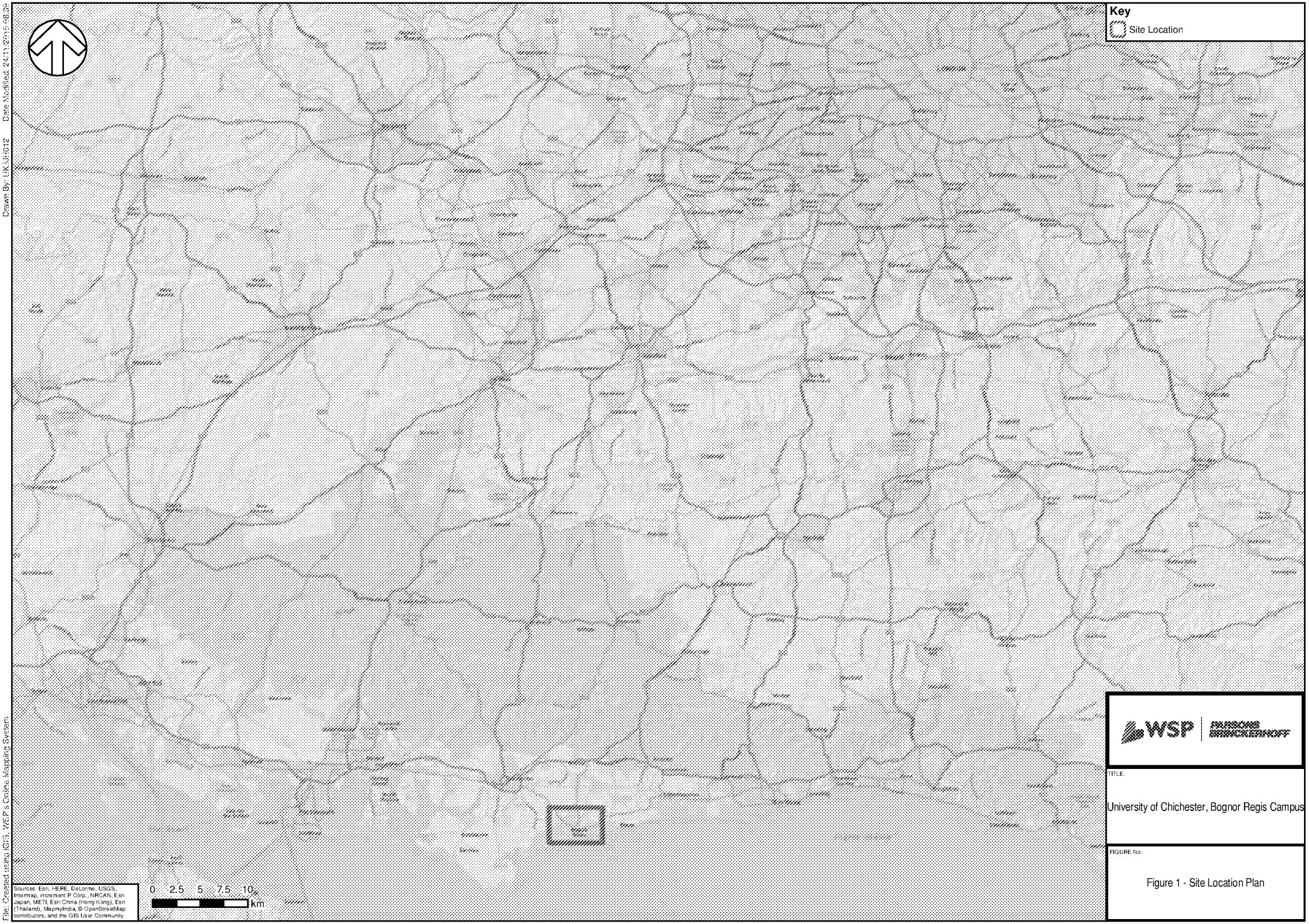
Where we indicate in our proposal that we will consider asbestos we will undertake screening of representative soil samples for the presences / absence of loose asbestos fibres. If these are found a further and more detailed specific investigation into asbestos in soils will need to be undertaken, which will include asbestos quantification testing. These investigations are associated with more rigorous monitoring of asbestos and health and safety provisions.

Appendix B

SITE PLANS & MAPS

ARUN DISTRICT COUNCIL BR/311/18/PL

Drawn By: UK Jul 2012 Date Modified: 24/11/2015 08:39



WSP | Parsons Brinckerhoff

TITLE:

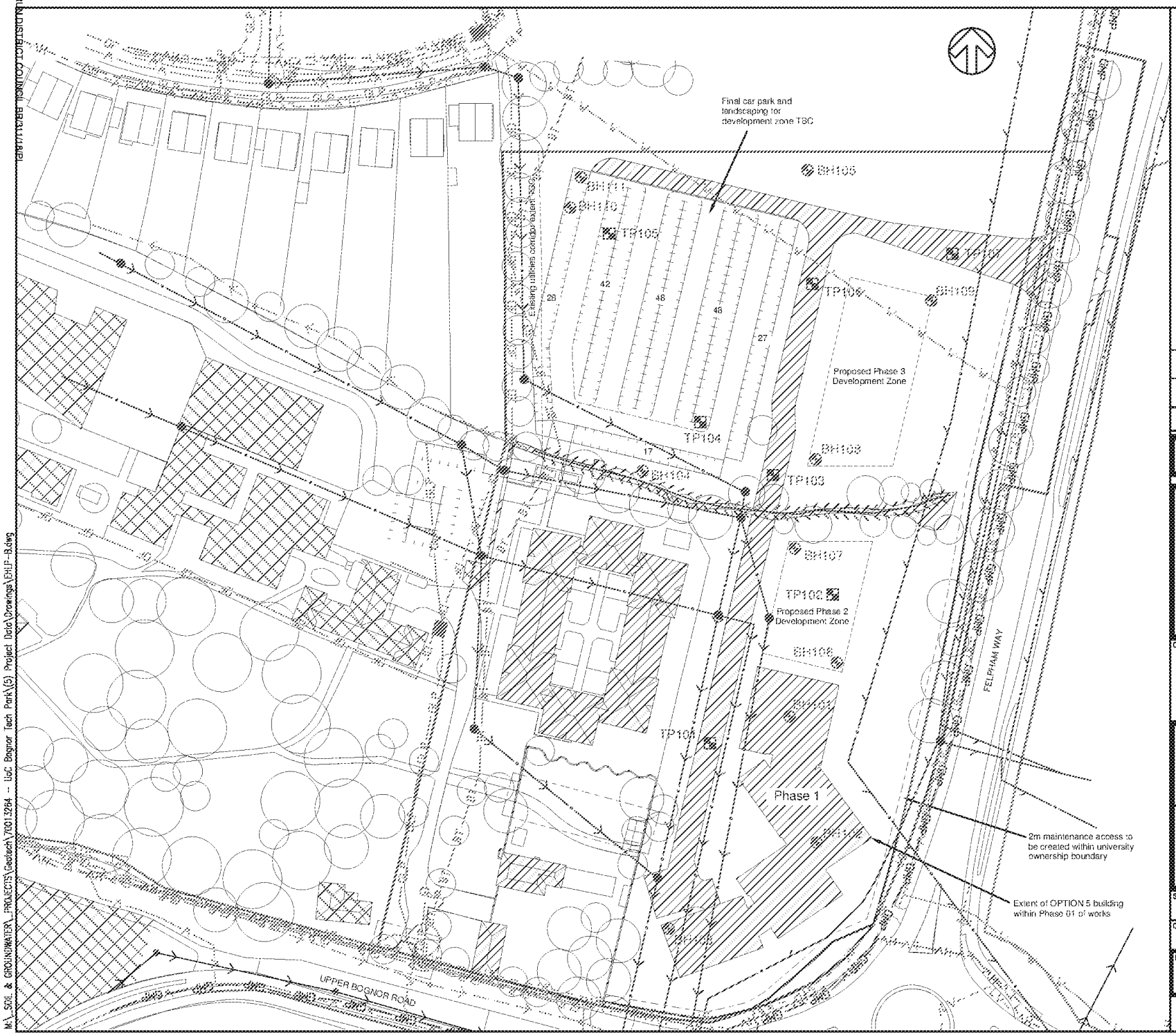
University of Chichester, Bognor Regis Campus

FIGURE No:

Figure 1 - Site Location Plan

File: Created using iGIS, WSP's Online Mapping System

File: Created using GIS, WSP's Online Mapping System Drawn By: UK:UH012 Date Modified: 24/11/2015 08:52



M:_SOIL & GROUNDWATER_PROJECTS\Geotech\70013264 - UoC Bognor Tech Park\(5) Project Data\Drawings\EHLP-B.dwg

ARUN DISTRICT COUNCIL 08/11/18/PL

DO NOT SCALE

REV	DATE	BY	DESCRIPTION	CHK	APD
B	29.10.2015	PRE	UPDATED WITH NEW MASTERPLAN AND SERVICES INFORMATION	JH	PMC
A	24.07.2015	PRE	ISSUED WITH GROUND INVESTIGATION SPECIFICATION	JH	PMC

DRAWING STATUS: FOR INFORMATION ONLY

WSP | PARSONS BRINCKERHOFF
Mountbatten House, Basing View, Basingstoke, Hampshire RG21 4HJ
Tel: +44 (0)1256 318800 Fax: +44 (0)1256 318700
www.wspgroup.com - www.pbworld.com

CLIENT: University of Chichester

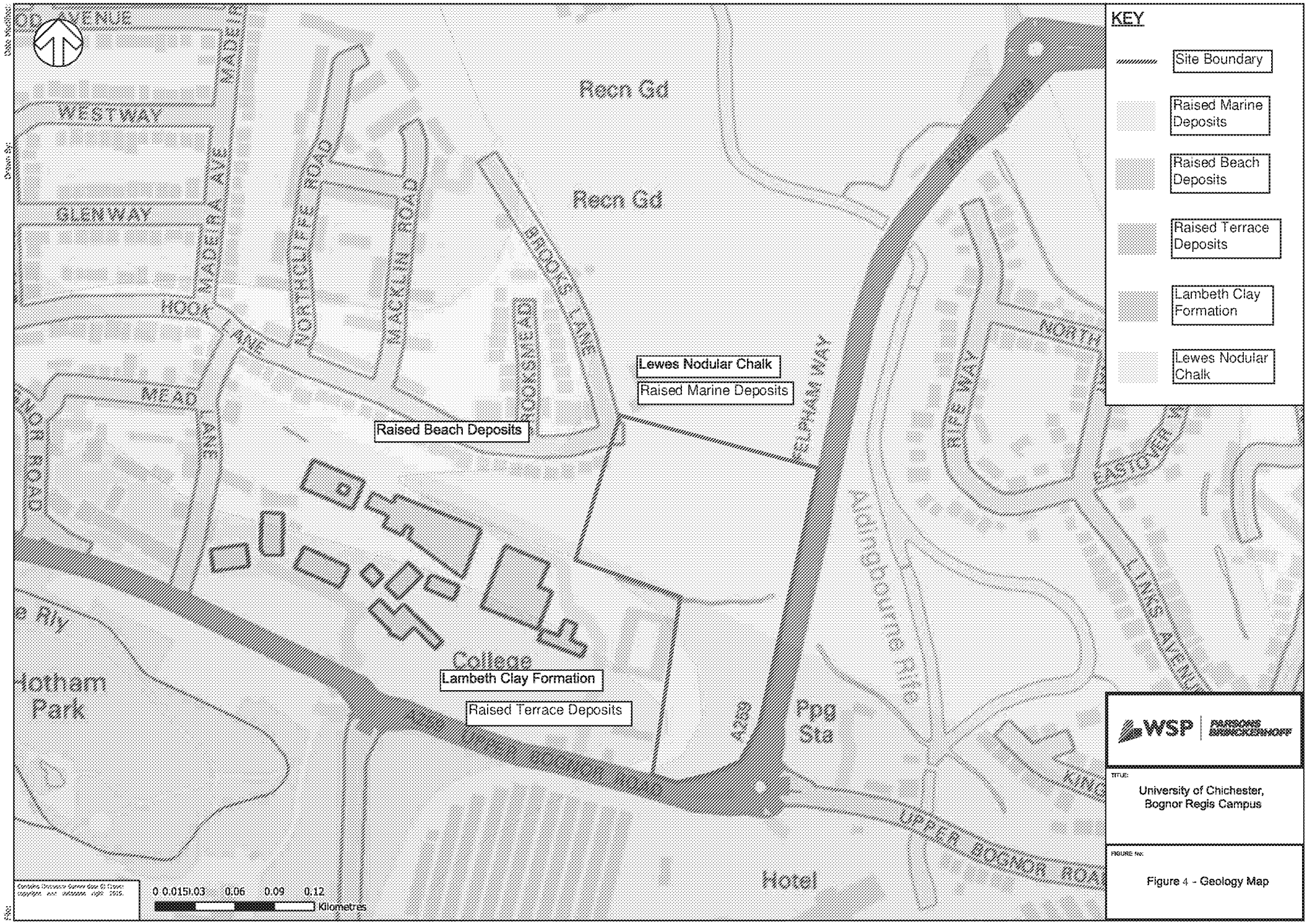
PROJECT: UNIVERSITY OF CHICHESTER
EDT PARK
BOGNOR REGIS

TITLE: EXPLORATORY HOLE LOCATION PLAN

SCALE @ A3:	CHECKED:	APPROVED:
NTS	JH	PC
CAD FILE:	DESIGN DRAWN:	DATE:
EHLP-B.dwg	PRE	24 July 2015
PROJECT No:	DRAWING No:	REV:
70010938	FIGURE 3	B

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ARUN DISTRICT COUNCIL BR/31/18/PL



ARUN DISTRICT COUNCIL BR/311/18/PL



Proposed Site Plan
1 : 500

Responsible is not permitted to undertake or allow to undertake any scaling from this drawing. All dimensions must be taken from figured dimensions only.

A1 Original Sheet Size

University Ownership Boundary

Proposed Development Zone

3.25 hectares
8.03 acres

Proposed Phase 1 Development Zone

0.47 hectares
1.16 acres

Conservation Area

Rev	Date	By	Chk	Description
F	30/08/18	MN	RC	Proposed Phase 1 Development Zone amended
E	30/08/18	MN	RC	Proposed Phase 1 Development Zone amended
D	30/08/18	MN	RC	Proposed Phase 1 Development Zone amended
C	30/08/18	MN	RC	Proposed Phase 1 Development Zone amended
B	30/08/18	MN	RC	Proposed Phase 1 Development Zone amended
A	30/08/18	MN	RC	Proposed Phase 1 Development Zone amended

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Project
University of Chichester
Bognor Regis Campus - Engineering and Digital Technology Park

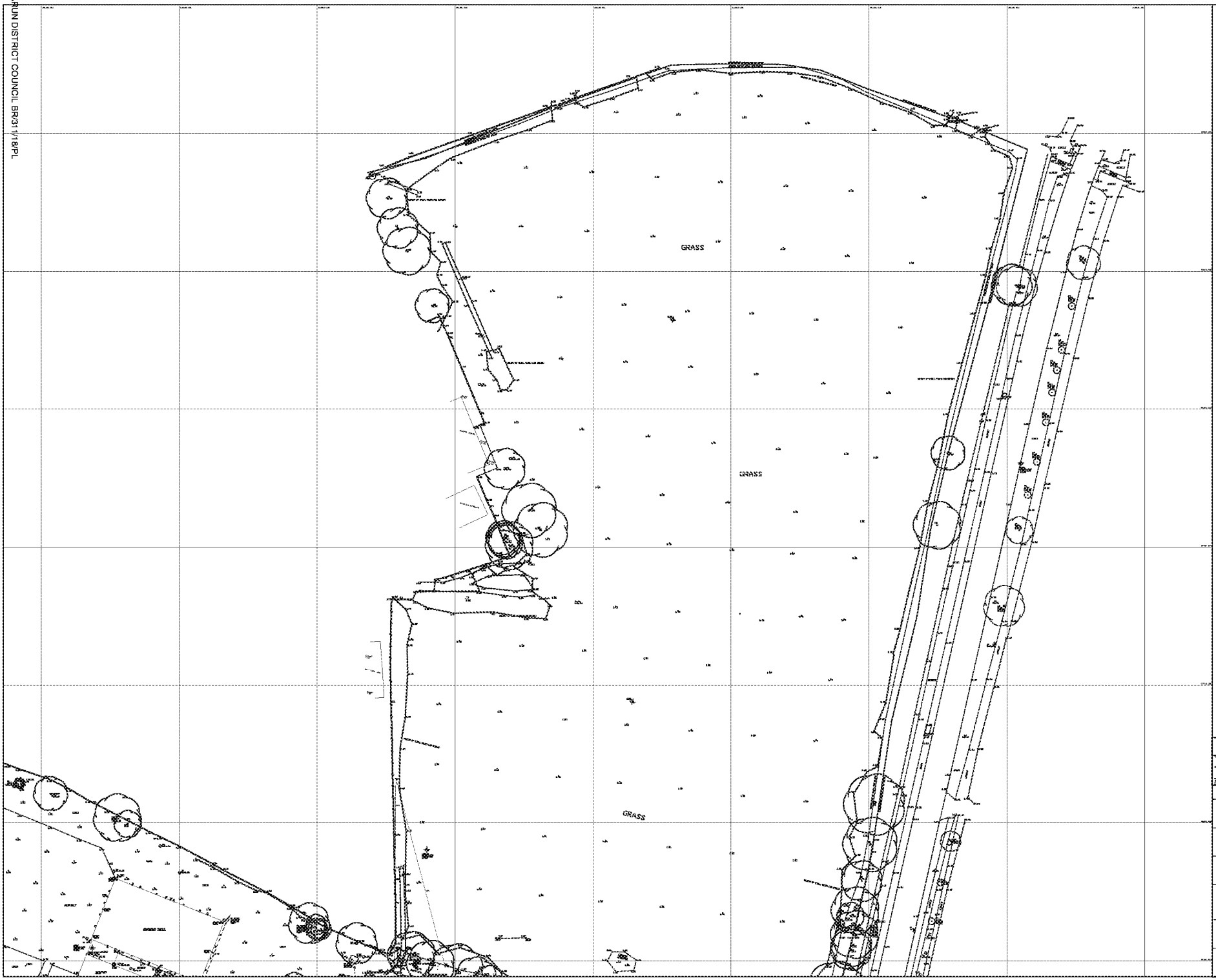
Drawing Title
Proposed Site Plan

Status
SKETCH

Scale	Date	Drawn	Checked
1 : 500	30/08/18	MN	RC

Project Number	Drawing Number	Revision
50136	SK_007	E

ARUN DISTRICT COUNCIL BR/31/18/PL



NOTES :

ALL LEVELS RELATIVE TO O.S. DATUM (NEW) USING SURVEY CONTROL STATION TO BE CONFIRMED

WHILE ALL POSSIBLE EFFORT HAS BEEN MADE TO IDENTIFY SERVICES, WE ARE UNABLE TO ENTIRE COVERS NOTED OR RECORDED AT THE TIME OF SURVEY.

ALL LEVELS AND DIMENSIONS SHOULD BE CHECKED ON SITE PRIOR TO THE COMMENCEMENT OF WORKS

TREES SHOWN IDENTIFIED TO BEST OF SURVEYORS ABILITY, BOTANICAL CONFIRMATION IF SPECIES CRITICAL

KEY :

BB	- BELOW BENCH	OHW	- OVERHEAD WIRE
BSK	- LITTER BIN	OCH	- OVERHEAD
BL	- BOX LEVEL	PIL	- PILLAR
BOLL	- BOLLARD	PL	- PAVEMENT LIGHT
BRK	- BRICK WALL	POT	- POLYTHEN
BS	- BUS STOP	SLEVE	- SERVICE EYE
CATV	- CABLE TELEVISION	SE	- SOUND BOX
CL	- COVER LEVEL	RTW	- RETAINING WALL
CONC	- CONCRETE	RWP	- RAIN WATER PIPE
ELEC	- ELECTRIC	SAN	- SANITARY
EP	- ELECTRICITY POLE	SB	- STOCK BOARD
FB	- FLOWER BED	SL	- SOIL LEVEL
FFL	- FINISHED FLOOR LEVEL	SU	- SPECIES UNKNOWN
FH	- FIRE HYDRANT	SVP	- SOIL VENT PIPE
FP	- FLAG POLE	TBM	- TEMPORARY BENCH MARK
G	- GULLY	TCB	- TELEPHONE CALL BOX
GL	- GROUND LEVEL	TF	- TOP OF FENCE
GV	- GAS VALVE	TH	- TOP OF HEDGE
HY	- HYDRANT	TL	- TOP OF LEDGE
IC	- INSPECTION COVER	TP	- TELEGRAPH POLE
KL	- KERBT LEVEL	TT	- TOP OF TREE
LB	- LETTER BOX	TW	- TOP OF WALL
LP	- LAMP POST	UGR	- UNDERGROUND DRAINS
LT	- LIGHT	UTL	- UNABLE TO LIFT
MH	- MANHOLE	WL	- WATER LEVEL
MKR	- MARKER	WV	- WATER VALVE

FENCE TYPES :

BWF	- BARBED WIRE	SB	- BRICK BALING
CVN	- CLOSE BOARD	PVR	- POST & RAIL
CHL	- CHAIN LINK	PVW	- POST & WIRE
CVP	- CHESTNUT PALING		

STN/A — SURVEY STATION

ANCILLARY BUILDING

SLOPE INDICATION

GATE

KERB LEVELS

TREE SPREAD (WITH Reference) SPREAD Radius

FENCE
WALL
BANK/PATH
OVERHEAD
MANHOLE/IP
BUILDING
LOW WIRE
BOTTOM
KERB
TRACK/
DEEP KERB

DRAINAGE :

FOUL DRAINAGE

STORM DRAINAGE/ WATER DRAINAGE

150Ø - 225mm DIAMETER PIPE

N

ISO 9001 REGISTERED FIRM

0m 1 2 3 4 5 6 7 8 9 10m
SCALE BAR

Shaw|Colegate
LAND & BUILDING SURVEYORS

Unit 9B, The Old Flour Mill, Queen Street, Emsworth, Hants. PO10 7BT
Tel : (01243) 371472 Email : mail@shawcolegate.com
Fax: (01243) 378940 Web : www.shawcolegate.com

Title : UNIVERSITY OF CHICHESTER - BOGNOR CAMPUS
TOPOGRAPHIC SURVEY - UPDATED

Job No. : 05515_TOPO_REV A
Original Scale : 1:200
Sheet Size : OVERSIZED

Surveyed By : Various Date : 2009 / 2010 / May 2015
Drawn By : Various Date : 2009 /2010 / May 2015

Client: University of Chichester
Bishop Otter Campus, College Lane, Chichester
West Sussex, PO19 6PE



ARUN DISTRICT COUNCIL PART 1/18/PL

NOTES :

ALL LEVELS RELATIVE TO O.S. DATUM (NEW) SCALE
SURVEY GRID (BOGNOR) TO IS GRIDNORTH, GRID

WHILE ALL POSSIBLE EFFORT HAS BEEN MADE
TO IDENTIFY SERVICES, WE ARE UNABLE TO
ENTIRE, COVERS NOTED OR OBSERVED AT THE
TIME OF SURVEY.

ALL LEVELS AND DIMENSIONS SHOULD BE CHECKED ON SITE
PRIOR TO THE COMMENCEMENT OF WORKS

TREES SHOWN DIAMETRICS TO BEST OF SURVEYORS ABILITY, SEEK
CONFIRMATION IF SPECIES CRITICAL

KEY :

BB	- BELOW BOARD	OHW	- OVERHEAD WIRE
BSK	- LITTER BIN	OCH	- OVERHEAD
BL	- BOX LEVEL	PIL	- PILLAR
BOLL	- BOLLARD	PL	- PAVEMENT LIGHT
BRK	- BRICK WALL	POT	- POLYTHEN
BS	- BUS STOP	SLEVE	- SLEEVING EYE
CWTV	- CABLE TELEVISION	SE	- SOUND EDGE
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CONC	- CONCRETE	RWP	- RAIN WATER PIPE
ELEC	- ELECTRIC	SAW	- SAWING
EP	- ELECTRICITY POLE	SCB	- STONE BOARD
FB	- FLOWER BED	SL	- SILT LEVEL
FFL	- FINISHED FLOOR LEVEL	SP	- SPECIES UNKNOWN
FH	- FIRE HYDRANT	SVP	- SOIL VENT PIPE
FP	- FLAG POLE	TBM	- TEMPORARY BENCH MARK
G	- GULLY	TCP	- TELEPHONE CALL BOX
GL	- GROUND LEVEL	TF	- TOP OF FENCE
GV	- GAS VALVE	TH	- TOP OF HEDGE
HY	- HYDRANT	TL	- TOP OF LOW WALL
IC	- INSPECTION COVER	TP	- TELEGRAPH POLE
GL	- GRAVEL LEVEL	TT	- TOP OF TREE
LB	- LETTER BOX	TW	- TOP OF WALL
LP	- LAMP POST	UGR	- UNDERGROUND DRAINAGE
LT	- LIGHT	UTL	- CABLES TO LEFT
MH	- MANHOLE	WL	- WATER LEVEL
MKR	- MARKER	WV	- WATER VALVE

FENCE TYPES :

BRW	- BARBED WIRE	SB	- SEEK RAILING
CLB	- CLOSE BOARD	PWR	- POST & RAIL
CHL	- CHAIN LINK	PW	- POST & WIRE
CVP	- CHESTNUT PALING		

STN/HT SURVEY STATION

ANCILLARY BUILDING

SLOPE INDICATION

KERB LEVELS

TREE SPREAD (WITH diameter/s) SPECIES (radius)

FENCE
WALL
BANK/PATH
OVERHEAD
MANHOLE/SF
BUILDING
LOW WIRE
GATE
BOTTOM
KERB
TRACK/
DROP KERB

DRAINAGE :

FOUL DRAINAGE

STORM DRAINAGE

150Ø = 150mm DIAMETER PIPE

N

ISO 9001
REGISTERED FIRM

SCALE BAR

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Client : University of Chichester
Bishop Otter Campus, College Lane, Chichester
West Sussex, PO19 6PE

Appendix C

EXPLORATORY HOLE LOGS & FACTUAL REPORT

CC Ground Investigations Ltd

DRAFT

FACTUAL REPORT

SITE: University of Chichester – Bognor Regis Campus

CLIENT: University of Chichester

ORDER No: **3010066 dated 06/ 10/ 2015**

DATE: 21 January 2016

REPORT No: C4872

[redacted]

ARUN DISTRICT COUNCIL

CONTENTS

REPORT

1.		INTRODUCTION	1
2.		SITE DESCRIPTION AND GEOLOGY	3
	2.1	Site Description	3
	2.2	Geology	3
3.		GROUND INVESTIGATION	4
	3.1	Fieldwork	4
	3.2	In Situ Testing	6
	3.3	Logging	7
	3.4	Laboratory Testing	8
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Appendix A – Site Plan

Appendix B – Exploratory Hole Data

Appendix C – Laboratory Test Results

Appendix D – SPT Calibration Data

ARUN DISTRICT COUNCIL BR/311/18/PL

1. INTRODUCTION

This investigation was carried out by CC Ground Investigations Ltd (CCGI) on the instruction and on behalf of The University of Chichester (The Client) under the technical direction of WSP | Parsons Brinckerhoff (the Engineer)

The purpose of the ground investigation was to determine geotechnical properties, ground contamination status and groundwater regime to facilitate the design of access roads, car parks and multi-storey buildings associated with the proposed Engineering and Digital Technology Park at the University of Chichester Bognor Regis Campus

The scope of the ground investigation was defined in the Engineer's specification, reference: Report No 70013264-P01.

This report describes the work carried out by CC Ground Investigations Ltd and presents the findings.

All information, comments and opinions given in this report are based on the ground conditions encountered during the site work, and on the results of laboratory and field tests performed during the investigation. There may however be conditions at or adjacent to the site which have not been taken into account, such as unpredictable soil strata and water conditions between or below exploratory holes. A careful watch should be maintained during any future groundworks and the comments of this report reviewed as necessary.

ARUN DISTRICT COUNCIL BR/311/18/PL

This report has been prepared for The University of Chichester and WSP | Parsons Brinckerhoff. This report shall not be relied upon or transferred to other parties without the written consent of CC Ground Investigations Ltd. Should any information contained within this report be used by any unauthorised third party it is done so at their own risk and shall not be the responsibility of CC Ground Investigations Ltd.

ARUN DISTRICT COUNCIL BR/311/18/PL

2. SITE DESCRIPTION AND GEOLOGY

2.1 Site Description

The site is located in an area of dense scrubland and a flood plain to the north of Upper Bognor Road and west of Felpham Way at National Grid Reference 494414 099634. The proposed Engineering and Digital Technology Park will be located east of the current University Campus.

2.2 Geology

Geological Records (British Geological Survey (BGS), England and Wales sheet 332 1:50,000 scale) indicate the site is underlain by superficial geology comprising of raised marine and raised beach deposits (silt, sand and gravel). Underlying solid geology comprising the Lambeth Group and White Chalk Subgroup is recorded.

ARUN DISTRICT COUNCIL BR/311/18/PL

3. GROUND INVESTIGATION

3.1 Fieldwork

Eighteen exploratory holes were carried out between 2nd and 20th November 2015. All exploratory hole locations are shown on the site plan (Appendix A). The exploratory hole locations were set out by CCGI as directed by the Client on site.

The fieldwork was carried out in general accordance with BS5930, Amendment 2 (2010).

Eleven boreholes, referenced BH101 to BH111 (Exploratory Hole Data – Appendix B) were formed using a track mounted Comacchio MC300 or Fraste PL(G) multi-purpose rig. Following CAT scanning hand tools were used to excavate an inspection pit to a depth of 1.20m to check for buried services. Bulk and environmental soil samples were taken and retained from the inspection pits. The boreholes were then advanced using percussive sampling techniques to produce continuous disturbed samples of 112mm diameter.

On refusal of percussive sampling the boreholes were continued by rotary core drilling techniques utilising a water flush. A double-tube swivel core barrel with a semi-rigid plastic liner was utilised to recover continuous cores of 123mm diameter.

Soil and rock samples were retained in semi-rigid plastic liners, which were capped on site to prevent moisture loss.

ARUN DISTRICT COUNCIL BR/311/18/PL

Undisturbed samples of 100mm nominal diameter were taken in suitable cohesive material using an open drive sampler (U(T)100). The samples were wax sealed on site to prevent moisture loss.

Boreholes were monitored for groundwater ingress as they were advanced. Upon encountering water, sampling was temporarily stopped to allow the level to stabilise. Water levels were also recorded at the start and finish of each shift and on completion of the borehole. Water levels are presented on the relevant log.

On completion combined gas and water monitoring standpipes were installed in all boreholes. Each installation consisted of a 50mm ID HDPE slotted tube set in a filter response zone of limestone free gravel. The installation was sealed above (and below in the case of BH101, BH106, BH107, BH109 and BH110) with a bentonite pellet seal and accessed via a valve assembly. The installations were protected at the surface by a lockable, galvanised steel borehole helmet. Installation details are given on the relevant borehole log.

Following CAT scanning, seven trial pits, referenced TP101 to TP107, (Exploratory Hole Data – Appendix B) were excavated using a JCB 3CX mechanical excavator with a 0.45m wide backactor bucket.

Representative disturbed samples were taken and retained in sealed plastic bags and airtight containers to retain moisture content.

On completion all trial pits were backfilled with arisings. The ground surface was left slightly mounded to accommodate future settlement.

ARUN DISTRICT COUNCIL BR/311/18/PL

Subsequent to fieldwork, all exploratory hole positions were surveyed and National Grid co-ordinates and levels are presented on the relevant log.

On completion of fieldwork all samples were brought to CCGI's office for storage.

3.2 In Situ Testing

Standard penetration tests (SPT) were carried out in general accordance with BS EN ISO 22476-3:2005. A split barrel or a solid cone was used depending upon the materials encountered and the split barrel samples retained as small disturbed samples. The SPT N value was taken as the number of blows to penetrate the 300mm test drive following a 150mm seating drive. Where low penetration was recorded the seating drive was terminated at 25 blows and the test drive completed after a further 50 blows. SPT results are summarised as uncorrected N values on the borehole logs. SPT hammer calibration data is presented in Appendix D.

Insitu hand shear vane tests were carried out in accordance with BS1377: Part 9:1990:4.4. Different vane sizes were used depending on the consistency of the soil encountered. The results are presented in on the exploratory hole logs (Appendix B).

Two infiltration tests were carried out in trial pits in accordance with BRE 365. The results and calculated infiltration rate are included in Appendix B following the relevant exploratory hole log.

ARUN DISTRICT COUNCIL BR/311/18/PL

Six TRL DCP tests, referenced DCP-101, DCP-102, DCP-104 to DCP-107, (Exploratory Hole Data – Appendix B), were carried out by driving a 60°; 20mm diameter steel cone into the ground using an 8kg weight dropped 575mm. The rate of penetration of the cone is recorded used to estimate the material CBR value through published empirical relationships.

The number of blows and depth of penetration are recorded throughout the test and are presented graphically. CBR values can be calculated for predetermined increments of penetration (usually 10mm) using the following equation: $\log_{10}(CBR) = 2.48 - 1.057 * \log_{10}(mm/blow)$.

3.3 Logging

Soil and rock samples from the exploratory holes were logged by an Engineering Geologist in general accordance with BS5930, Amendment 2 (2010) and Ciria 574 (2002) Bulk, small disturbed, core and environmental soil samples were taken retained at a range of depths. Environmental soil samples were stored on site in temperature controlled conditions. Soil and rock descriptions are presented in the borehole logs together with details of sampling, in situ testing and relevant comments on drilling techniques.

ARUN DISTRICT COUNCIL BR/311/18/PL

3.4 Laboratory Testing

The following laboratory tests were carried out by Professional Soils Laboratory (UKAS No. 4043) in accordance with BS1377:1990, Parts 1 to 8, unless otherwise stated. The results are presented in Appendix C.

Test Type	No. of Tests	Remarks
Natural Moisture Content	157	The results are shown on the summary of soil classification and chalk tests.
Liquid and Plastic Limits	66	The results are shown on the plasticity chart and summary of soil classification tests.
Particle Size Distribution (wet sieving method)	26	The fine fractions of 3 of these tests were further analysed using the pipette method.
Optimum Moisture Content (compaction test)	9	2.5kg test
Bulk Density	4	Determined using the linear measurement method.
California Bearing Ratio	3	Carried out on remoulded bulk samples
Chalk Crushing value	17	
Intact Dry Density	65	
Saturated Moisture Content	65	
Quick Undrained Triaxial Test	3	Multi stage tests
Uniaxial Compressive Strength	19	ISRM Part 2
Point Load Strength	64	ISRM RTH 325-89 SR12
BRE SD1 chemical testing suite for soil	21	Testing carried out by Chemical Testing Laboratories in accordance with BRE Special Digest 1.

ARUN DISTRICT COUNCIL BR/311/18/PL

A range of chemical tests were carried out on soil and water samples by i2 Analytical (UKAS No. 4041). Testing was carried out in accordance with ISO 17025. The results are tabulated and presented in Appendix C.

CC GROUND INVESTIGATIONS LIMITED

Christopher Scrivens BSc (Hons) FGS Rob Clarke. BSc (Hons) M Sc (Eng) FGS
Senior Engineering Geologist **Director**

ARUN DISTRICT COUNCIL BR/311/18/PL

4. REFERENCES

British Geological Society, Solid and Drift Sheet 332, Bognor Regis, 1:50,000 scale

BRE Special Digest 1:2003: Concrete in aggressive ground. Part 1.

BRE Digest 365 (2007), Soakaway Design.

BS 5930+A2:1999 (2010), Code of Practice for Site Investigations

BS 1377: Parts 1 to 9 (1990), Methods of Tests of Soils for Civil Engineering Purposes

BS EN ISO 14688: Part 1: (2002), Identification and description of soil.

BS EN ISO 14688: Part 2: (2004), Principles for a classification of soil.

BS EN ISO 14689: Part 1: (2003), Identification and description.

BS EN ISO 22475: Part 1: (2006), Technical principles for execution.

BS EN ISO 22476: Part 3: (2005), Standard penetration test.

CIRIA 574 (2002): Engineering in Chalk

ISRM (International Society for Rock Mechanics), Part 2, Suggested Methods Uniaxial Compressive Strength of Rock Material.

ISRM RTH 325-89 SR12, Suggested Method for Determining Point Load Strength.

ARUN DISTRICT COUNCIL BR/311/18/PL

APPENDIX A

Appendix A – Site Plan

APPENDIX B

Appendix B – Exploratory Hole Data

CC Ground Investigations Ltd

KEY TO EXPLORATORY HOLE LOGS

Logging

The logging of soils and rocks has been carried out in general accordance with BS 5930:1999 (Amendment No.2, 2010).

Sample no/type

C	Core run / sample
X	Dynamic sample
D	Small disturbed sample
B	Large disturbed sample
U	Undisturbed sample
UT	Thin walled undisturbed sample
W	Water sample
ES	Environmental
SPT	Standard Penetration Test carried out
CPT	Solid Cone Penetration Test carried out

Water levels

Initial Water Strike

Level after monitoring

3.00m Standing Level

Insitu Tests

S 30	Split spoon sampler (SPT) followed by N Value (EN ISO 22476-3:2005)
C 30	Solid cone (CPT) followed by N Value (EN ISO 22476-3:2005)
*240	Where full test drive not completed, linearly extrapolated N value reported.
**	No effective penetration
H 30	Hand Vane – direct reading in kPa. Re* denotes refusal (i.e. >140 kPa)

Sample range

Undisturbed sample

Core run

U(T)100 Undisturbed sample

Rotary core sub-sample

Installation Details

Porous Tip

Screened Standpipe

Bentonite seal

Plain standpipe

Granular response zone

Concrete

Grout

Arisings backfill

Soils	Rocks		
	Sedimentary	Metamorphic	Igneous
Made ground	Chalk	Coarse-grained	Coarse-grained
Boulders and cobbles	Limestone	Medium-grained	Medium-grained
Gravel	Conglomerate	Fine-grained	Fine-grained
Sand	Breccia		
Silt	Sandstone		
Clay	Siltstone		
Peat	Mudstone		
NOTE: Composite soil types will be signified by combined symbols, e.g.,	Shale		
Silty sand	Coal		
	Pyroclastic (volcanic ash)		
	Gypsum, Rocksalt etc.		

Arenaceous

Rudaceous

Argillaceous

CC GROUND INVESTIGATIONS LTD

ROTARY BOREHOLE LOG

Telephone: 01452 739165 , Fax: 01452 739220 , Email: info@ccground.co.uk

Borehole No. **BH101**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494426 N 99580	Hole Type DS+RC
Location: Bognor Regis		Level: 2.44mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 17/11/2015 End: 20/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		ES	0.10					TOPSOIL: Very soft brown mottled orangish brown and grey slightly sandy slightly gravelly silty CLAY with frequent rootlets. Gravel is sub-angular fine and medium flint. (Topsoil)	(0.30)		
		B	0.20						0.30	2.14	
		B	0.50					Soft orangish brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is angular and sub-angular fine to coarse flint. (Superficial Deposits)			
		ES	0.60								
1		B	1.00						(1.30)		1
		SPT	1.20 - 1.65	S 1							
								Firm grey mottled orangish brown, yellowish brown and reddish brown slightly sandy silty CLAY. (Superficial Deposits)	1.60	0.84	
2											2
		D	2.40								
		ES	2.50	S 5							
		SPT	2.50 - 2.95								
3											3
		D	3.90						(4.65)		
4		ES	4.00	S 12							4
		SPT	4.00 - 4.45								
5								4.90-6.25m: Becoming stiff.			5
		D	5.20								
		SPT	5.30 - 5.75	S 20							
6								5.80-6.25m: Becoming yellowish brown mottled grey and orangish brown.			6

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REMARKS:

EQUIPMENT: Hand digging tools. Fraste PL multi purpose track mounted rig.
METHOD: Hand dug inspection pit: 0.00-1.20m. Continuous dynamic sampled (128mm diam) 1.20-6.50m. Waterflush rotary core drilled (146mm diam) 6.50-35.00m.
CASING: SW to 8.80m.
GROUNDWATER: None encountered prior to using water flush to advance casing to 5.30m.
INSTALLATION: Bentonite pellet seal: 7.00-35.00m, 50mm ID HDPE slotted pipe with washed gravel response zone: 2.00-7.00m, plain pipe with washed gravel response zone: 1.90-2.00m; and with bentonite pellet seal: 0.20-1.90m, raised borehole helmet set in concrete 0.00-0.20m. Gas valve fitted.
REMARKS: Dynamic sampled (128mm) to recover dropped core: 8.60-10.00m.

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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ROTARY BOREHOLE LOG

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Borehole No. **BH101**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494426 N 99580	Hole Type DS+RC
Location: Bognor Regis		Level: 2.44mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 17/11/2015 End: 20/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								Stiff grey locally silty CLAY. (Superficial Deposits) 6.35-6.60m: Frequent light yellowish brown silty sand lenses (<50mm).	6.25 (0.35)	-3.81	
		D C SPT	6.40 6.50 - 7.30 6.50 - 6.95	S 22		100% 0% 0%		Medium dense yellowish brown silty SAND. (Superficial Deposits)	6.60 (0.30)	-4.16	
7								Soft grey mottled yellowish brown and orangish brown slightly sandy gravelly CLAY with low cobble content. Gravel is angular to sub-rounded fine to coarse flint. Cobbles are sub-angular to sub-rounded flint. (Superficial Deposits)	6.90 (0.50)	-4.46	7
		D C SPT	7.20 7.30 - 8.80 7.30 - 7.75	S 46		99% 9% 9%		Structureless white stained orangish brown and yellowish brown CHALK composed of slightly sandy silty GRAVEL. Gravel is sub-angular to sub-rounded fine to coarse low density chalk. (White Chalk Subgroup Grade Dc)	7.40 (0.60)	-4.96	
8								Very weak and weak medium density white mottled orangish brown CHALK locally structureless. Discontinuities are randomly orientated very closely and closely spaced infilled with comminuted chalk (<12mm) stained orangish brown and grey. (White Chalk Subgroup Grade C4-Dc)	8.00	-5.56	8
		D	8.30								
		C	8.80 - 9.50			79% 0% 0%		8.80-10.00m: Drilling disturbed. Limited recovery. Recovered as slightly sandy silty gravel. 8.80-8.85m: Band of angular to sub-angular fine to coarse rinded flint gravel and sub-angular cobble.	(2.45)		
9		D	9.30								9
		C	9.50 - 10.00			70% 0% 0%					
10		C SPT	10.00 - 11.50 10.00 - 10.45	S 32		100% 41% 35%		10.00-10.45m: Drilling disturbed. Recovered as slightly sandy silty gravel.			10
								Very weak and weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal closely spaced infilled with comminuted chalk (<3mm). (White Chalk Subgroup Grade B3)	10.45	-8.01	
11								10.90-11.20m: Drilling disturbed. Recovered as slightly sandy silty gravel. 11.00-11.05m: Band of angular to sub-angular fine to coarse rinded flint gravel and sub-angular cobble.			11
		D C	11.40 11.50 - 13.00			93% 61% 39%		11.50-11.75m: Discontinuities are sub-horizontal to horizontal extremely closely to very closely spaced infilled with comminuted chalk (<1mm). [Grade B4-B5] 11.75-13.00m: Discontinuities are sub-horizontal to horizontal closely to medium spaced infilled with comminuted chalk (<1mm). [Grade B2-B3] 12.10-12.20m: Band of angular to sub-angular fine to coarse rinded flint gravel and sub-angular cobble. 12.20-12.40m: Drilling disturbed. Recovered as slightly sandy silty gravel.	(3.75)		
12											12
		D CS	12.60 12.70 - 13.00								
13		C SPT	13.00 - 14.50 13.00 - 13.45	S 33		89% 13% 13%		13.00-14.20m: Discontinuities are randomly orientated extremely closely and very closely spaced infilled with			13

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
17/11/2015	7.30	5.30	1.10
18/11/2015	7.30	5.30	1.25

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ROTARY BOREHOLE LOG

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Borehole No. **BH101**

Sheet 3 of 6

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494426 N 99580	Hole Type DS+RC
Location: Bognor Regis		Level: 2.44mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 17/11/2015 End: 20/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								comminuted chalk (<3mm). Very weak and weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal closely spaced infilled with comminuted chalk (<3mm). (White Chalk Subgroup Grade B3) *(continued from previous sheet)*			
14								13.43-13.45m: Band of angular to sub-angular fine to coarse rinded flint gravel. 13.70-14.10m: Discontinuity is sub-vertical infilled with comminuted chalk (<1mm) stained orangish brown and grey. 14.10-14.15m: Band of angular to sub-angular fine to coarse rinded flint gravel.	14.20	-11.76	14
		D	14.30								
		C	14.50 - 16.00			100% 75% 55%					
		D	14.70								
15								Very weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal closely to medium spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade A2-B3) 14.83-14.87m: Band of angular to sub-angular fine to coarse rinded flint gravel. 15.30-15.35m: Band of angular to sub-angular fine to coarse rinded flint gravel.			15
16		C	16.00 - 17.50	S*65		80% 52% 38%		16.00-16.05m: Band of angular to sub-angular fine to coarse rinded flint gravel.			16
		SPT	16.00 - 16.40								
17		D	17.00					17.00-17.10m: Flint cobble (cored). 17.10-17.50m: Drilling disturbed. Recovered as slightly sandy silty gravel.			17
		C	17.50 - 19.00			73% 35% 33%		17.60-17.62m: Band of angular to sub-angular fine to coarse rinded flint gravel.			
18								18.20-18.35m: Band of angular to sub-angular fine to coarse rinded flint gravel.			18
		D	18.50					18.45-19.00m: Discontinuities stained orangish brown.			
19		C	19.00 - 20.30	S*70		108% 55% 28%		19.00-19.60m: Drilling disturbed. Recovered as slightly sandy silty gravel.	(9.45)		19
		SPT	19.00 - 19.40								
								19.65-19.70m: Discontinuity is 45° infilled with grey silty clay (<5mm) (possible marl). 19.70-20.30m: Mottled grey and orangish brown.			
20											20
		D	20.20					20.24-20.25m: 10mm horizontal band of grey Marl. 20.25-20.30m: Indistinctly thinly laminated.			
		C	20.30 - 21.80			100% 88%					

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
18/11/2015	20.30	8.80	1.50
19/11/2015	20.30	8.80	1.55

CC ROTARY LOG C4872.GPJ GINT STD AGS 3_1.GDT 21/1/16

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ROTARY BOREHOLE LOG

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Borehole No. **BH101**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494426 N 99580	Hole Type DS+RC
Location: Bognor Regis		Level: 2.44mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 17/11/2015 End: 20/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
						79%		Very weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal closely to medium spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade A2-B3) *(continued from previous sheet)*			
21		CS	21.15 - 21.40		C			20.90-20.97m: Discontinuities are very closely spaced.			21
		D	21.70					21.60-21.64m: Discontinuities are extremely closely spaced.			
		C	21.80 - 23.30	S*130		97%					
22		SPT	21.80 - 22.25		C	83% 78%					22
23		D	23.20					23.00-23.20m: Indistinctly thickly laminated, mottled grey.			23
		C	23.30 - 24.80			94% 83% 39%					
								Weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal very closely to medium spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade B2-B4)	23.65	-21.21	
24					C			23.66-23.68m: 20mm band of grey Marl. 24.15-24.65m: Discontinuities are vertical to sub-vertical extremely closely to very closely spaced infilled with comminuted chalk (<1mm).			24
		D	24.70								
		C	24.80 - 26.30	S*115		40%		24.80-26.30m: Drilling disturbed. Recovered as slightly sandy silty gravel locally mottled orangish brown. 24.80-24.82m: Band of angular to sub-angular fine to coarse rinded flint gravel.			
25		SPT	24.80 - 25.00			0% 0%		25.30-25.32m: Band of angular to sub-angular fine to coarse rinded flint gravel.	(3.20)		25
					C						
26		C	26.30 - 28.00			88% 65% 58%		26.30-26.40m: Band of angular to sub-angular fine to coarse rinded flint gravel.			26
								26.85-26.87m: Band of angular to sub-angular fine to coarse rinded flint gravel.	26.85	-24.41	
27					C			Very weak to weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal closely spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade B3)			27
		D	27.30								
		D	27.50								

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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ROTARY BOREHOLE LOG

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Borehole No. **BH101**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494426 N 99580	Hole Type DS+RC
Location: Bognor Regis		Level: 2.44mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 17/11/2015 End: 20/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
28		CS	27.80 - 28.00					Very weak to weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal closely spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade B3) *(continued from previous sheet)*			
		C	28.00 - 29.50	S*54		97% 51% 39%					
		SPT	28.00 - 28.43								
		D	28.50					28.00-28.40m: Drilling disturbed. Recovered as slightly sandy silty gravel. 28.55-28.75m: Drilling disturbed. Recovered as slightly sandy silty gravel mottled orangish brown. 28.65-28.75m: Band of angular to sub-angular fine to coarse rinded flint gravel and sub-angular cobble.	(3.75)		
29								29.25-29.30m: Flint cobble (cored). 29.35-29.65m: Mottled orangish brown.			
		C	29.50 - 30.60			100% 15% 0%		29.50-30.60m: Drilling disturbed. Recovered as slightly sandy silty gravel. 29.55-29.65m: Band of angular to sub-angular fine to coarse rinded flint gravel.			
30		D	30.10					30.00-30.30m: Mottled grey.			
		C	30.60 - 32.10	S*65		97% 55% 44%		Very weak to weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal closely to medium spaced. No infill. (White Chalk Subgroup Grade A2-A3)	30.60	-28.16	
		SPT	30.60 - 31.00								
31		CS	31.00 - 31.30								
		D	31.70					31.60-31.70m: Drilling disturbed. Recovered as slightly sandy silty gravel. 31.60-31.65m: Band of angular to sub-angular fine to coarse rinded flint gravel.	(2.80)		
32		C	32.10 - 33.60	S*63		100% 84% 79%					
		SPT	32.10 - 32.50								
		CS	32.80 - 33.10					32.73-32.77m: Discontinuity is sub-horizontal stained grey. No infill. 32.77-33.15m: Mottled grey.			
33								33.13-33.35m: Drilling disturbed. Recovered as slightly sandy silty gravel. 33.15-33.25m: Band of angular to sub-angular fine to coarse rinded flint gravel. 33.30-33.35m: Band of angular to sub-angular fine to coarse rinded flint gravel.	33.40	-30.96	
		C	33.60 - 35.00			100% 71% 49%		Very weak to weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal very closely to closely spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade A3-B4)			
34		D	34.40						(2.00)		
								34.50-34.55m: Band of angular to sub-angular fine to coarse rinded flint gravel.			
35		SPT	35.00 - 35.40	S*63							

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
19/11/2015	30.60	8.80	1.60
20/11/2015	30.60	8.80	1.65

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Borehole No. **BH101**

Sheet 6 of 6

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494426 N 99580	Hole Type DS+RC
Location: Bognor Regis		Level: 2.44mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 17/11/2015 End: 20/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								Borehole completed at 35.40m	35.40	-32.96	

36 37 38 39 40 41 42

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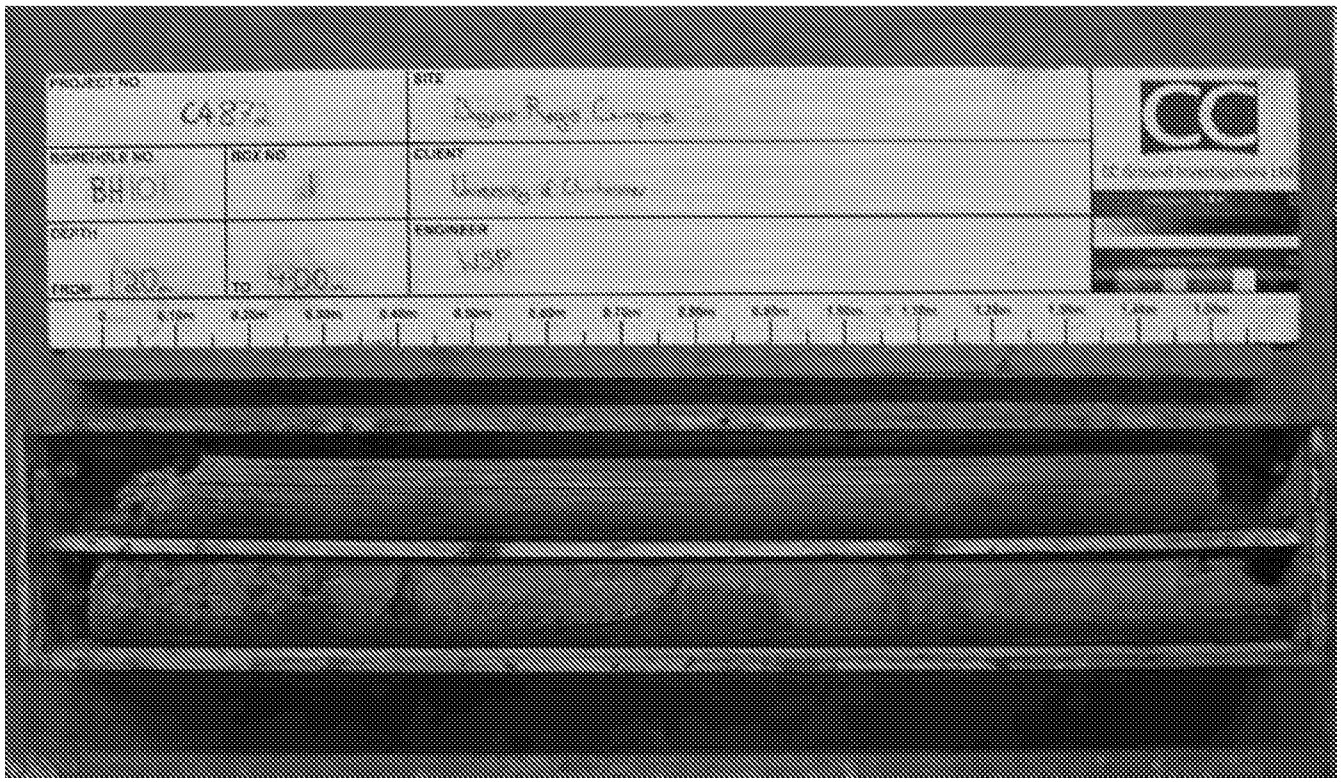
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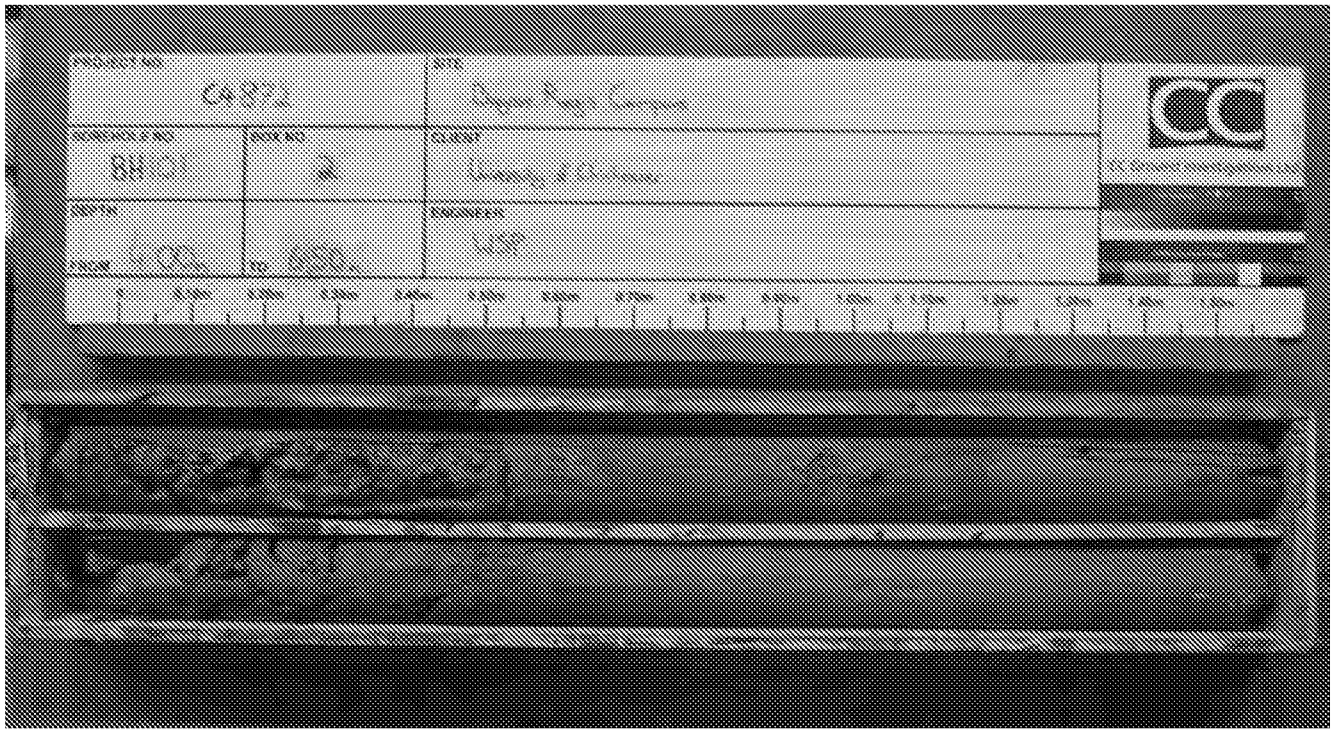
Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
20/11/2015	35.40	8.80	1.55

Borehole Photograph



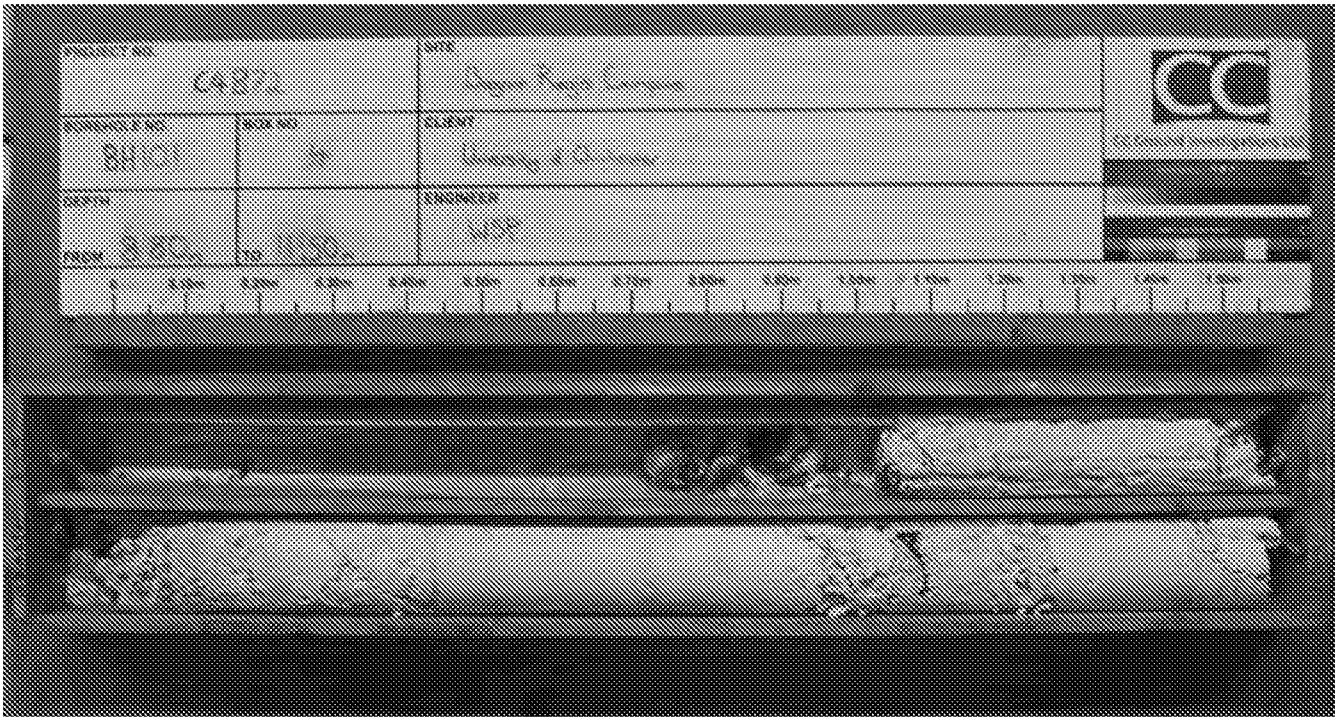


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Contract Name:	University of Chichester
Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH101

Borehole Photograph

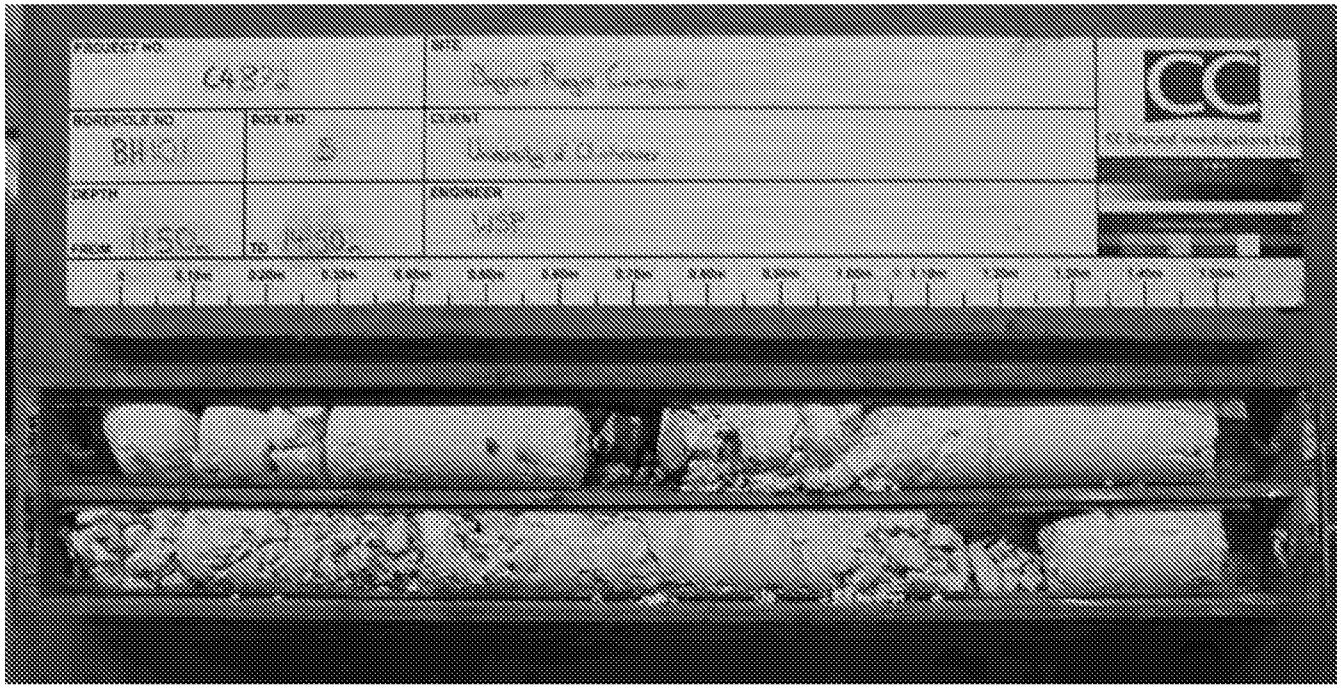


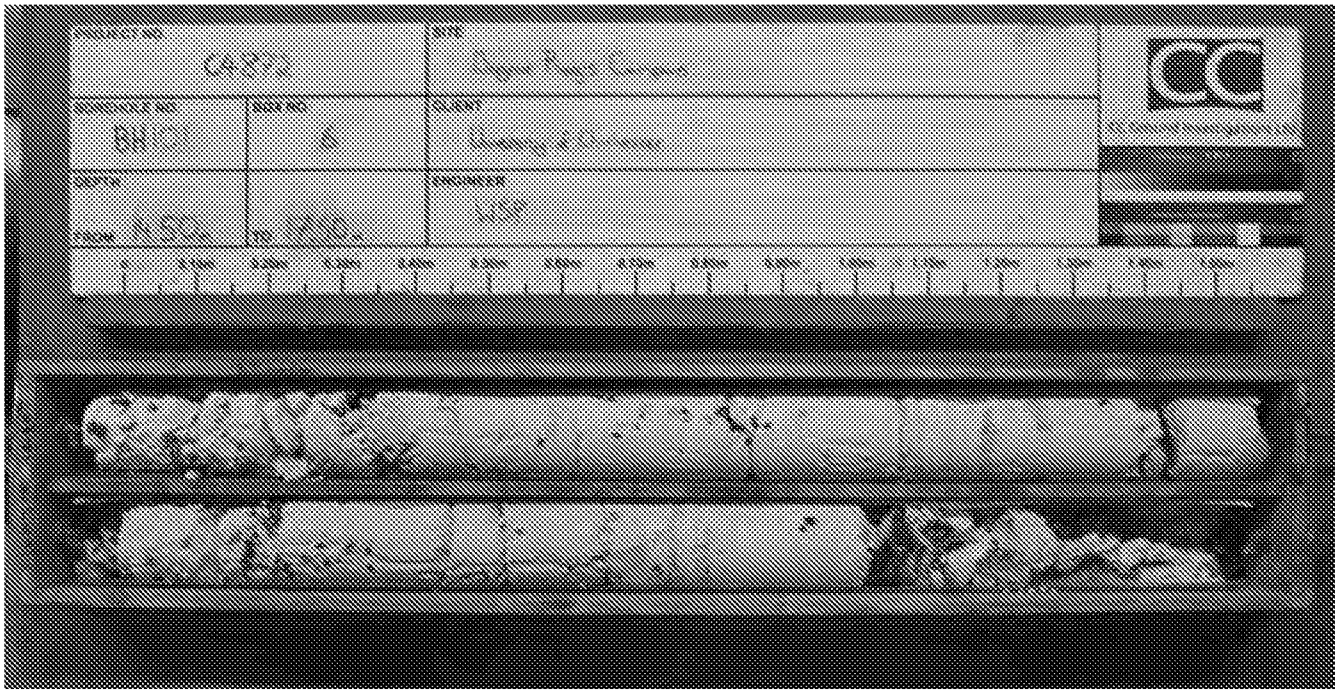


Contract Name:	University of Chichester
Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH101

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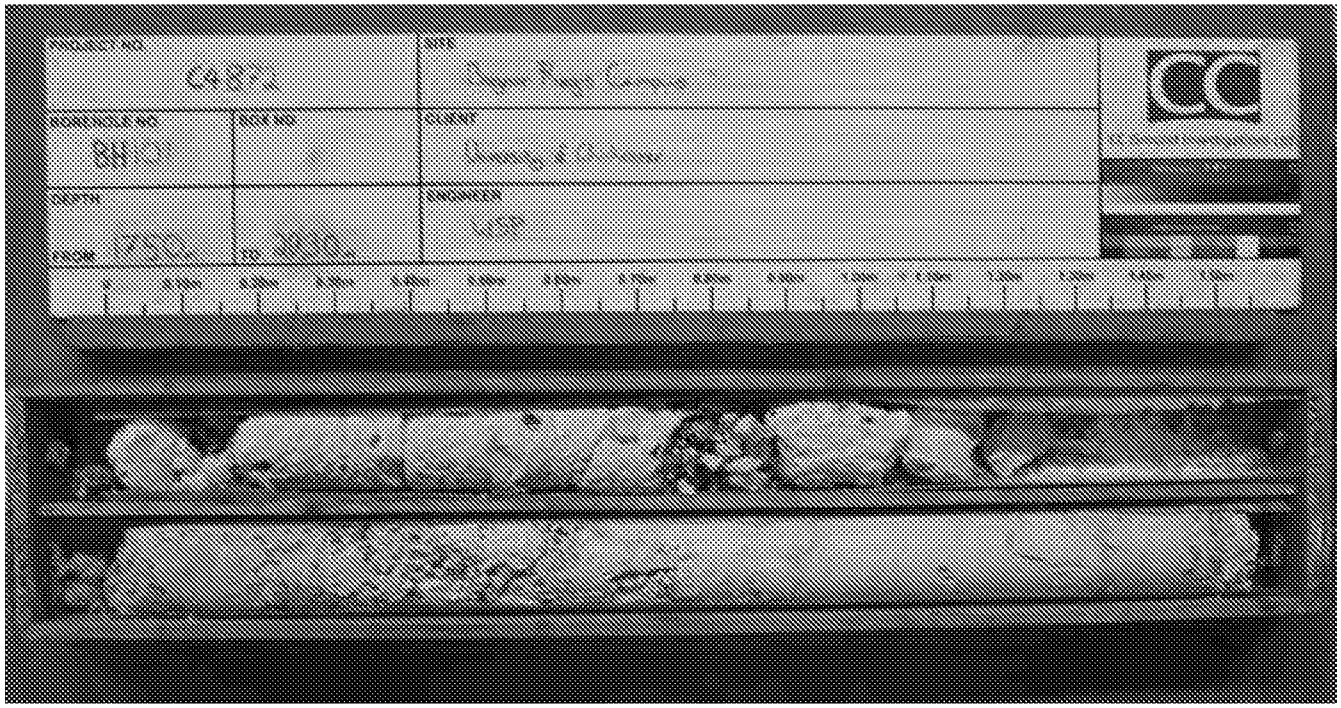
Borehole Photograph

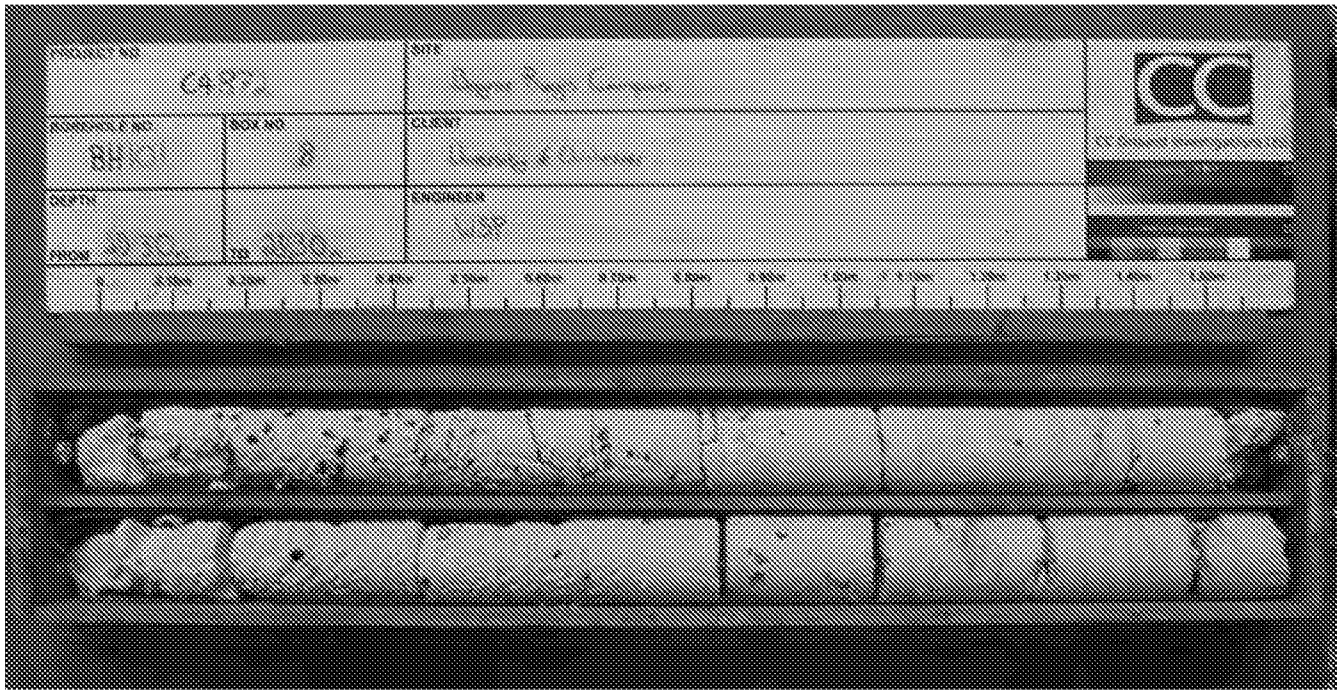




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Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH101

Borehole Photograph

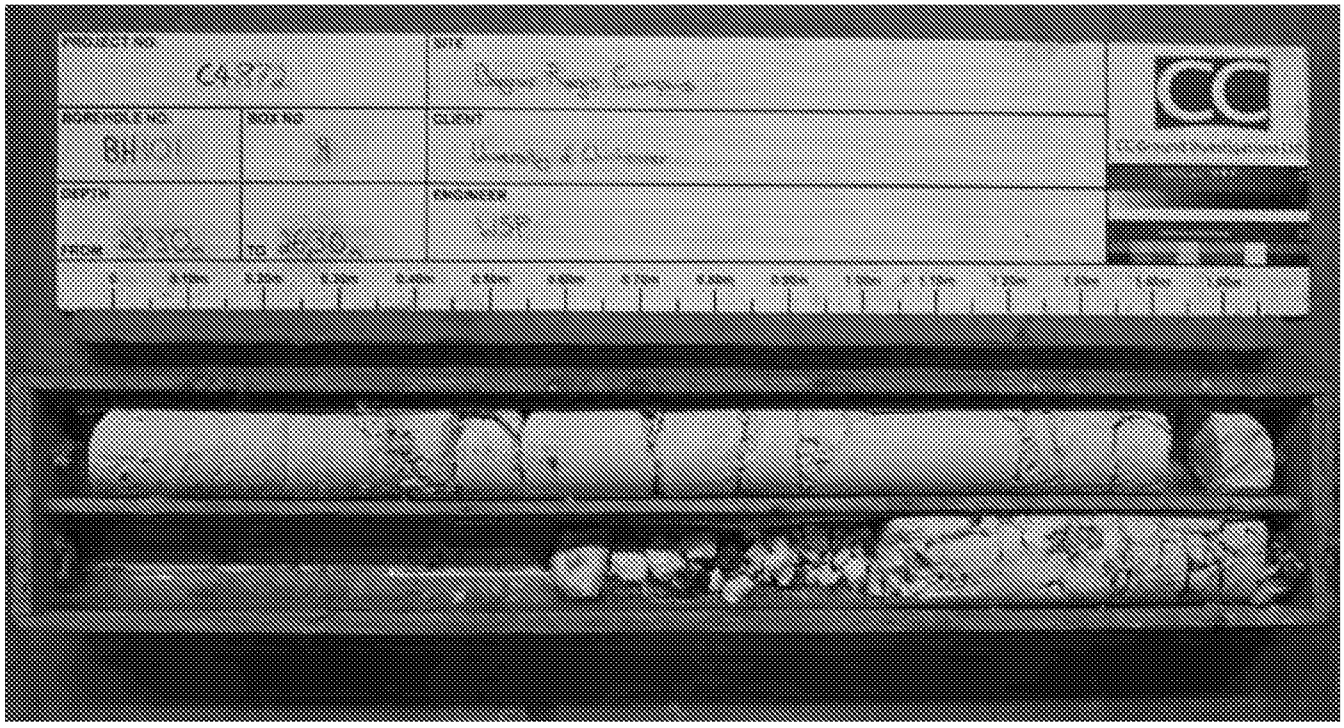


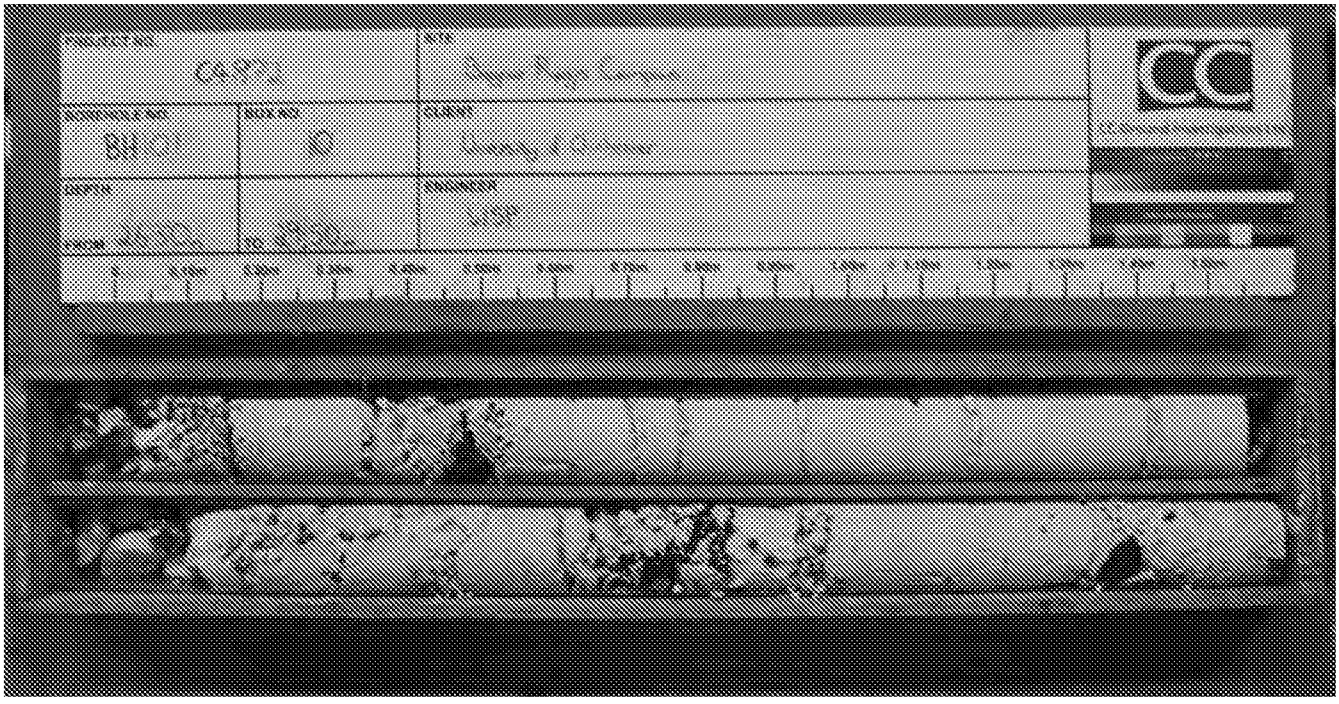


Contract Name:	University of Chichester
Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH101

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Borehole Photograph

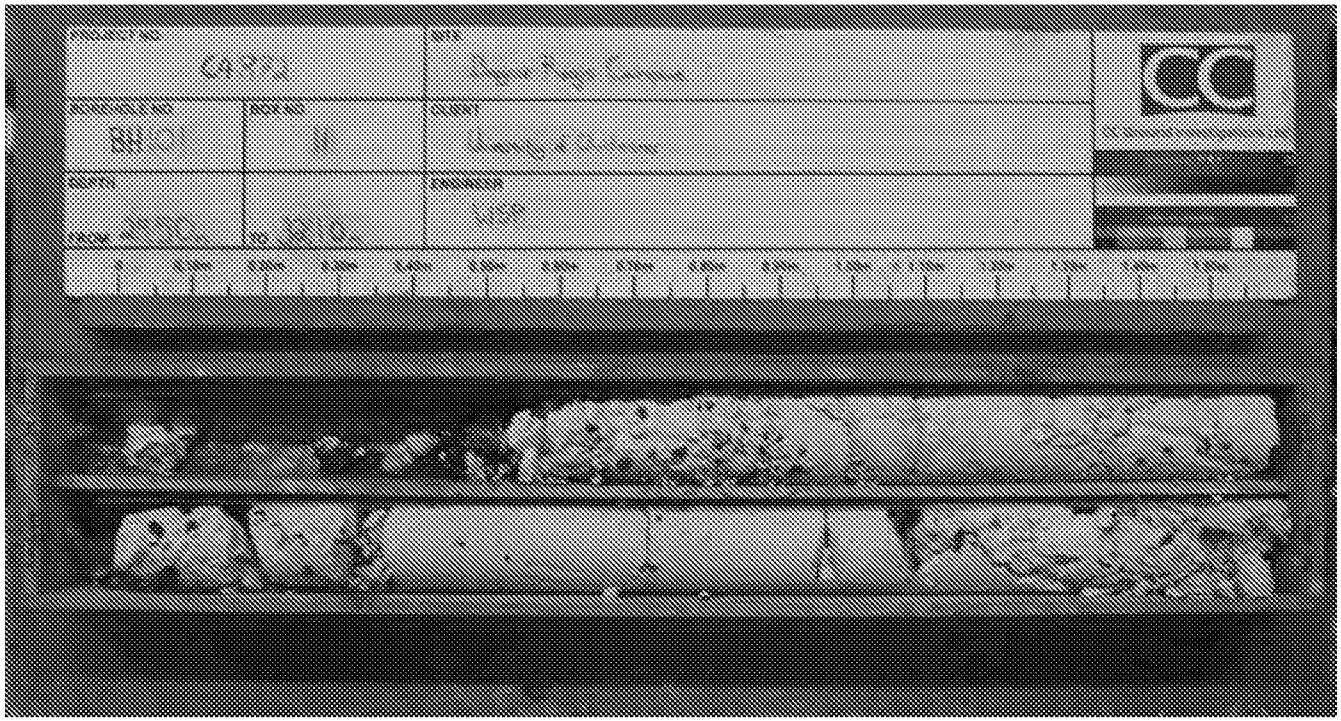


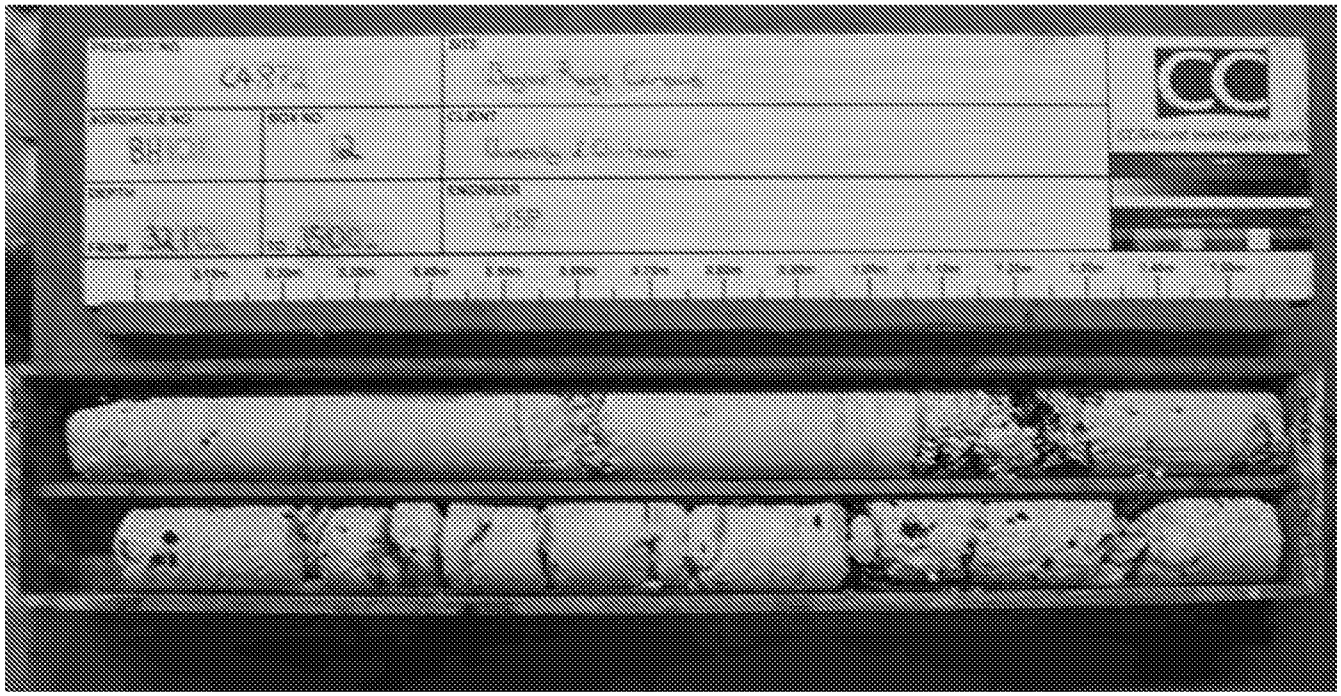


Contract Name:	University of Chichester
Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH101

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Borehole Photograph





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Contract Name:	University of Chichester
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Client:	University of Chichester
Hole ID:	BH101

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ROTARY BOREHOLE LOG

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Borehole No. **BH102**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494421 N 99543	Hole Type DS+RC
Location: Bognor Regis		Level: 2.18mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 16/11/2015 End: 19/11/2015	Logged By RS/SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		ES	0.10					TOPSOIL: Very soft brown mottled orangish brown and grey slightly sandy slightly gravelly silty CLAY with frequent rootlets. Gravel is subangular fine and medium flint. (Topsoil)	(0.30)		
		B	0.30						0.30	1.88	
		B	0.50					Soft orangish brown mottled grey slightly sandy slightly gravelly silty CLAY. Gravel is angular and subangular fine to coarse flint. (Superficial Deposits)			
1		B	1.00						(1.40)		1
		ES	1.20	S 3							
		SPT	1.20 - 1.65								
								Firm orangish brown and light grey mottled reddish brown slightly sandy silty CLAY. (Lambeth Group)	1.70	0.48	
2		D	1.90	H 70					(0.60)		2
		H									
								Stiff reddish brown mottled orangish brown and light grey slightly sandy silty CLAY. (Lambeth Group)	2.30	-0.12	
		D	2.50	H 101							
		H									
		SPT	2.70 - 3.15	S 5							
3									(2.20)		3
		D	3.50	H 100							
		H									
4		D	4.00	H 119				4.00-4.20m: Slightly gravelly. Gravel is sub-rounded fine and medium sandstone.			4
		H									
		SPT	4.20 - 4.65	S 9							
								Stiff and very stiff reddish brown light greenish grey and orangish brown slightly sandy silty CLAY. (Lambeth Group)	4.50	-2.32	
5		D	5.00								5
		SPT	5.20 - 5.65	S 9							
6		D	5.90								6

DRAFT

REMARKS:

EQUIPMENT: Hand digging tools. Fraste ML/PL multi purpose track mounted rig.
METHOD: Hand dug inspection pit: 0.00-1.20m. Continuous dynamic sampled (126mm diam) 1.20-7.60m. Waterflush rotary core drilled (146mm diam) 7.60-35.00m.
CASING: SW to 12.00m.
GROUNDWATER: None encountered prior to using water flush to advance casing.
INSTALLATION: 50mm ID HDPE slotted pipe with washed gravel response zone: 10.50-33.50m, plain pipe with bentonite pellet seal: 0.20-10.50m, raised borehole helmet set in concrete 0.00-0.20m. Gas valve fitted.

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

CC GROUND INVESTIGATIONS LTD

ROTARY BOREHOLE LOG

Telephone: 01452 739165 , Fax: 01452 739220 , Email: info@ccground.co.uk

Borehole No. **BH102**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494421 N 99543	Hole Type DS+RC
Location: Bognor Regis		Level: 2.18mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 16/11/2015 End: 19/11/2015	Logged By RS/SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								Stiff and very stiff reddish brown light greenish grey and orangish brown slightly sandy silty CLAY. (Lambeth Group) *(continued from previous sheet)*			
		D SPT	6.50 6.60 - 7.05	S 22					(3.90)		
7		D	7.40								7
		C SPT	7.60 - 8.50 7.60	S*61		100% 10% 0%		7.50-7.90m: Slightly gravelly. Gravel is sub-angular to sub-rounded fine to medium low density chalk.			
8		D	8.00					7.90-8.30m: Gravelly. Gravel is angular to sub-angular fine to coarse flint.			8
								8.30-8.40m: Yellowish brown calcareous cobble. (possible cored boulder).	8.40	-6.22	
		C CPT	8.50 - 10.00 8.50	C*300		97% 30% 0%		Stiff bluish grey mottled yellowish brown slightly sandy slightly gravelly sandy CLAY. Gravel is angular to sub-rounded fine to medium low density chalk and flint. (Lambeth Group)	8.60	-6.42	
9								Structureless white stained orangish brown and yellowish brown CHALK composed of slightly sandy silty GRAVEL. Gravel is sub-angular to sub-rounded fine to coarse low density chalk. (White Chalk Subgroup Grade Dc)	(0.70)		9
								9.00-9.20m: Locally indistinctly structured. Discontinuities are extremely closely spaced randomly orientated infilled with comminuted chalk (<10mm). [Grade C5]	9.30	-7.12	
		D C	9.90 10.00 - 11.50			100% 56% 51%		Very weak and weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal very closely and closely spaced infilled with comminuted chalk (<5mm). (White Chalk Subgroup Grade C4-C5)			
10								9.30-10.40m: Discontinuities are sub-vertical and vertical extremely closely and very closely spaced stained orangish brown locally infilled with comminuted chalk (<1mm).			10
								10.00-10.55m: Drilling disturbed. Recovered as slightly sandy silty cobbly gravel. Gravel is sub-angular to sub-rounded fine to coarse. Cobbles are sub-rounded.			
11								10.40-10.42m: Band of angular and sub-angular fine to coarse rinded flint gravel.			11
								10.50-10.55m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-angular cobble.	(3.90)		
		D C CPT	11.40 11.50 - 13.00 11.50	C*300		97% 38% 22%		10.90-11.90m: Discontinuities are sub-vertical and vertical very closely and closely spaced locally infilled with comminuted chalk (<1mm).			
12								11.50-11.55m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-angular cobble.			12
								11.90-12.30m: Discontinuities are sub-vertical to 45° closely spaced infilled with grey silty clay (<10mm).			
								12.30-13.80m: Discontinuities are sub-vertical and vertical very closely and closely spaced locally stained orangish brown. No infill.			
								12.50-12.52m: Band of angular and sub-angular fine to coarse rinded flint gravel.			
								12.65-12.67m: Band of angular and sub-angular fine to coarse rinded flint gravel.			
13		D C	12.90 13.00 - 14.50			85% 75% 71%		13.10-13.15: Band of angular and sub-angular fine to	13.20	-11.02	13

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
16/11/2015	7.60	4.20	0.80
17/11/2015	7.60	4.20	2.30

CC GROUND INVESTIGATIONS LTD

ROTARY BOREHOLE LOG

Telephone: 01452 739165 , Fax: 01452 739220 , Email: info@ccground.co.uk

Borehole No. **BH102**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494421 N 99543	Hole Type DS+RC
Location: Bognor Regis		Level: 2.18mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 16/11/2015 End: 19/11/2015	Logged By RS/SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								coarse rinded flint gravel and sub-angular cobble (<100mm). Weak medium density white locally mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal closely to medium spaced infilled with comminuted chalk (<3mm). (White Chalk Subgroup Grade B3-A2) *(continued from previous sheet)*	(1.60)		
14		D CS	13.80 13.86 - 14.30								
		C CPT	14.50 - 16.00 14.50	C*750		100% 21% 21%			14.80	-12.62	
15		D	14.90					Weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal very closely and closely spaced infilled with comminuted chalk (<3mm). (White Chalk Subgroup Grade B4-B5) 15.10-15.12m: Band of angular and sub-angular fine to coarse rinded flint gravel. 15.65-15.70m: Band of angular and sub-angular fine to coarse rinded flint gravel. 15.80-15.82m: Band of angular and sub-angular fine to coarse rinded flint gravel. 16.40-16.45m: Band of angular and sub-angular fine to coarse rinded flint gravel.	(1.90)		
16		C	16.00 - 17.50			100% 77% 61%			16.70	-14.52	
		CS	16.75 - 17.15					Weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal medium spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade A2-B2)			
17		D	17.40								
		C CPT	17.50 - 19.00 17.50	C*750		68% 55% 40%		17.50-17.55m: Band of angular and sub-angular fine to coarse rinded flint gravel. 17.55-17.80m: Drilling disturbed. Recovered as slightly sandy silty gravel. 17.65-17.70m: Band of angular and sub-angular fine to coarse rinded flint gravel. 17.90-18.20m: Mottled grey. 18.10-18.12m: Band of angular and sub-angular fine to coarse rinded flint gravel. 18.12-18.25m: Discontinuities are sub-horizontal to horizontal very closely and closely spaced infilled with comminuted chalk (<1mm). [Grade B3-B4]			
18		D	18.50								
19		C	19.00 - 20.50			93% 86% 73%		19.15-19.20m: Band of angular and sub-angular fine to coarse rinded flint gravel. 19.27-19.30m: Band of angular and sub-angular fine to coarse rinded flint gravel.			
		CS	19.50 - 19.85					19.82-19.85m: Discontinuity infilled with comminuted chalk stained brown (30mm).			
20		D	20.40					20.10-20.25m: Indistinctly thinly laminated mottled grey.			

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
17/11/2015	19.00	4.20	0.80
18/11/2015	19.00	4.20	1.20

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ROTARY BOREHOLE LOG

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Borehole No. **BH102**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494421 N 99543	Hole Type DS+RC
Location: Bognor Regis		Level: 2.18mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 16/11/2015 End: 19/11/2015	Logged By RS/SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
21		C CPT	20.50 - 22.00 20.50	C*300		99% 85% 81%		Weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal medium spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade A2-B2) *(continued from previous sheet)* 20.87-20.90m: Discontinuity infilled with comminuted chalk stained grey (30mm).	(8.30)		
		CS	21.40 - 21.77								
22		D C	21.90 22.00 - 23.50			100% 73% 68%		22.10-22.15m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-angular cobble. 22.40-22.60m: Drilling disturbed. Recovered as angular to sub-angular fine to coarse rinded flint and chalk gravel and sub-angular cobble.			
23		CS	22.85 - 23.25								
		D C CPT	23.40 23.50 - 25.00 23.50	C*500		93% 80% 61%		23.50-23.55m: Band of angular and sub-angular fine to coarse rinded flint gravel.			
24		CS	23.93 - 24.20					24.15-24.50m: Indistinctly thinly laminated mottled grey. 24.30-24.50m: Discontinuity is sub-vertical and vertical stained grey infilled with comminuted chalk (<5mm).			
25		D C	24.90 25.00 - 26.50			85% 51% 36%		Weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal very closely and closely spaced infilled with comminuted chalk (<3mm). (White Chalk Subgroup Grade B3-B4) 25.30-25.32m: Band of angular and sub-angular fine to coarse rinded flint gravel.	25.00 (0.80)	-22.82	
26								Weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal very closely and closely spaced infilled with comminuted chalk (<3mm). (White Chalk Subgroup Grade B4-B5) 25.80-25.82m: Band of angular and sub-angular fine to coarse rinded flint gravel. 26.00-26.10m: Drilling disturbed. Recovered as sub-angular slightly sandy silty gravel. 26.05-26.07m: Band of angular and sub-angular fine to coarse rinded flint gravel.	25.80 (1.00) 26.80	-23.62 -24.62	
		D C CPT	26.40 26.50 - 28.00 26.50	C*300		99% 65% 55%					
27		CS	26.90 - 27.22					Weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal medium spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade A2-B3) 27.60-27.64m: Flint cobble (cored).			

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
18/11/2015	23.50	12.00	0.80
19/11/2015	23.50	12.00	1.40

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Borehole No. **BH102**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494421 N 99543	Hole Type DS+RC
Location: Bognor Regis		Level: 2.18mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 16/11/2015 End: 19/11/2015	Logged By RS/SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
28		D C	27.90 28.00 - 29.50			91% 51% 37%		Weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal medium spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade A2-B3) *(continued from previous sheet)* 26.30-28.45m: Drilling disturbed. Recovered as slightly sandy silty gravel and cobbles.			
									(3.85)		
29								28.90-29.25m: Drilling disturbed. Recovered as slightly sandy silty gravel.			
		D C CPT CS	29.40 29.50 - 31.00 29.50 29.80 - 30.15	C*300		100% 63% 63%		29.50-29.60m: Flint cobble (cored). 29.60-29.80m: Drilling disturbed. Recovered as slightly sandy silty gravel and cobbles.			
30								30.15-30.35m: Drilling disturbed. Recovered as slightly sandy silty gravel and cobbles. 30.35-30.37m: Band of angular and sub-angular fine to coarse rinded flint gravel. 30.60-30.65m: Drilling disturbed. Recovered as sub-angular slightly sandy silty gravel.	30.65	-28.47	
31		D C	30.90 31.00 - 32.50			100% 81% 68%		Weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal medium spaced. No infill. (White Chalk Subgroup Grade A2-A3) 31.10-31.15m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-angular cobble.			
									(2.10)		
32		D C CPT CS	32.40 32.50 - 34.00 32.50 32.75 - 33.29	C*500		97% 83% 66%		32.40-32.60m: Discontinuities are sub-vertical and vertical very closely and extremely closely spaced locally infilled with comminuted chalk (<1mm). 32.55-32.57m: Band of angular and sub-angular fine to coarse rinded flint gravel.	32.75	-30.57	
33								Weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal medium spaced. No infill. (White Chalk Subgroup Grade A2)	(0.55) 33.30	-31.12	
34		D C	33.90 34.00 - 35.00			80% 45% 41%		Weak medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal closely to medium spaced locally infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade A2-B3) 33.40-33.45m: Flint cobble (cored).			
									(1.78)		
35		D CPT	34.90 35.00 - 35.08	C*300				34.35-34.45m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-angular cobble.			

Borehole completed at 35.08m

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
19/11/2015	35.08	12.00	0.80

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ROTARY BOREHOLE LOG

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Borehole No. **BH102**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494421 N 99543	Hole Type DS+RC
Location: Bognor Regis		Level: 2.18mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 16/11/2015 End: 19/11/2015	Logged By RS/SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
									35.08	-32.90	

36 37 38 39 40 41 42

DRAFT

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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ROTARY BOREHOLE LOG

Telephone: 01452 739165 , Fax: 01452 739220 , Email: info@ccground.co.uk

Borehole No. **BH103**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494386 N 99532	Hole Type DS+RC
Location: Bognor Regis		Level: 2.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 13/11/2015 End: 18/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		B ES	0.50					MADE GROUND: Soft and firm greyish brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is sub-angular fine to coarse brick flint and concrete. 0.25m: Concrete boulder.	(0.80)		
									0.80	2.11	
1		B ES SPT ES	1.00 1.20 - 1.65 1.30	 S 1 				Firm orangish brown mottled white and grey slightly sandy gravelly CLAY. Gravel is sub-angular and sub-rounded fine to coarse flint. (Lambeth Group)	(0.40)		1
									1.20	1.71	
								Soft light grey mottled orangish brown slightly sandy silty CLAY. (Lambeth Group)	1.40	1.51	
								Firm light grey mottled orangish brown and reddish brown slightly sandy silty CLAY. (Lambeth Group)	(0.90)		
2		D H	1.90	H 51							2
									2.30	0.61	
		D H SPT	2.50 2.70 - 3.15	H 79 S 6				Stiff light grey, orangish brown and reddish brown slightly sandy silty CLAY. (Lambeth Group)			
3											3
		D H	3.60	H 84					(2.70)		
4		D H ES SPT	4.00 4.20 4.20 - 4.65	H 103 S 16 							4
		D	4.70								
5									5.00	-2.09	5
								Very stiff light grey reddish brown and orangish brown slightly sandy silty CLAY. (Lambeth Group)			
		D	5.30								
		C SPT	5.50 - 7.00 5.50 - 5.95	S 31 		100% 0% 0%					
6											6

DRAFT

REMARKS:

EQUIPMENT: Hand digging tools. Comacchio MC300 multi purpose track mounted rig.
METHOD: Hand dug inspection pit: 0.00-1.20m. Continuous dynamic sampled (128mm diam) 1.20-5.50m. Waterflush rotary core drilled (146mm diam) 5.50-35.00m.
CASING: SW to 5.50m.
GROUNDWATER: None encountered prior to using water flush to advance casing.
INSTALLATION: Arisings: 30.00-35.00m. 50mm ID HDPE slotted pipe with washed gravel response zone and geosock: 30.00-13.00m. Plain 50mm ID HDPE pipe with gravel surround: 12.80-13.00m and bentonite pellet seal: 0.20-12.80m. Raised 150mm steel cover set in concrete: 0.00-0.20m. Gas valve fitted.

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
13/11/2015	5.00	4.20	3.20
16/11/2015	5.00	4.20	2.20

CC GROUND INVESTIGATIONS LTD

ROTARY BOREHOLE LOG

Telephone: 01452 739165 , Fax: 01452 739220 , Email: info@ccground.co.uk

Borehole No. **BH103**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494386 N 99532	Hole Type DS+RC
Location: Bognor Regis		Level: 2.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 13/11/2015 End: 18/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		D	6.20					Very stiff light grey reddish brown and orangish brown slightly sandy silty CLAY. (Lambeth Group) *(continued from previous sheet)*	(2.50)		
7		D C SPT	6.90 7.00 - 8.50 7.00 - 7.45	S 21		100% 0% 0%			7.50	-4.59	7
		D	7.80					Hard friable reddish brown locally light grey and orangish brown slightly sandy slightly gravelly silty CLAY. Gravel is sub-angular and sub-rounded fine and medium sandstone. (Lambeth Group)	(1.50)		
8		C SPT	8.50 - 9.70 8.50 - 8.95	S 20		100% 0% 0%			9.00	-6.09	8
9		B	9.00 - 9.35					Hard light grey mottled orangish brown slightly gravelly sandy CLAY. Gravel is sub-angular fine to coarse flint. Locally tending to gravelly very clayey fine and medium sand. (Lambeth Group)	(0.35)		
		B	9.35 - 9.70					Orangish brown and grey clayey very sandy GRAVEL. Gravel is angular to sub-rounded fine to coarse flint. Low cobble content of angular flint. (Lambeth Group)	9.35 (0.55)	-6.44	9
		C CPT ES	9.70 - 11.20 9.70 - 9.91 9.70	C*250		97% 45% 26%			9.90	-6.99	
10		ES	10.50					Strong white LIMESTONE with sub-horizontal very closely and closely spaced undulating rough discontinuities with a little brown staining on discontinuity surfaces. (Lambeth Group)	(1.40)		10
		B	10.70								
11		D	11.00					10.90-11.10m: Sub-vertical undulating rough discontinuity.			11
		C	11.20 - 12.60			100% 59% 23%			11.30	-8.39	
		D	11.40					Very weak and weak medium density white with occasional orangish brown staining CHALK. Discontinuities are extremely and very closely spaced (20/40/60) locally infilled with (0/0/1) white comminuted chalk, moderately orangish brown stained. (White Chalk Subgroup Grade B4-5)	(0.35)		
12		B	12.20					Very weak medium and high density white CHALK. Discontinuities are closely and medium spaced locally very closely spaced (50/200/430) locally infilled with (0/0/1) white comminuted chalk, slightly orangish brown stained. (White Chalk Subgroup Grade A2-3) 12.20-12.47m: Sub-vertical undulating rough discontinuity with orangish brown staining on discontinuity surface.	11.65	-8.74	12
		D C CPT	12.50 12.60 - 13.90 12.60 - 12.89	C*107		98% 68% 51%					
13		CS	13.06 - 13.31								13

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
16/11/2015	11.20	5.50	1.80
17/11/2015	11.20	5.50	2.40

CC ROTARY LOG C4872.GPJ GINT STD AGS 3_1.GDT 21/1/16

ARUN DISTRICT COUNCIL BR/311/18/PL

CC GROUND INVESTIGATIONS LTD

ROTARY BOREHOLE LOG

Telephone: 01452 739165 , Fax: 01452 739220 , Email: info@ccground.co.uk

Borehole No. **BH103**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494386 N 99532	Hole Type DS+RC
Location: Bognor Regis		Level: 2.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 13/11/2015 End: 18/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		B	13.50					Very weak medium and high density white CHALK. Discontinuities are closely and medium spaced locally very closely spaced (50/200/430) locally infilled with (0/0/1) white comminuted chalk, slightly orangish brown stained. (White Chalk Subgroup Grade A2-3) *(continued from previous sheet)*	(3.75)		
		D	13.80								
14		C	13.90 - 15.20			96% 81% 15%		13.70-13.80m: Band of angular and sub-angular fine to coarse rinded flint gravel.			14
		CS	14.25 - 14.64					14.20-14.23m: Band of angular and sub-angular fine to coarse rinded flint gravel.			
15		D	15.00								15
		B	15.10								
		C	15.20 - 16.60	C*115		100% 39% 20%					
		CPT	15.20 - 15.48						15.40	-12.49	
								Weak low and medium density white locally orangish brown stained CHALK. Discontinuities are extremely closely and very closely spaced (10/30/60) and sub-vertical closely spaced locally infilled with (1/2/3) white comminuted chalk, slightly orangish brown stained (White Chalk Subgroup Grade B4/B5)	(0.30)		
									15.70	-12.79	
16								Weak medium density white CHALK. Discontinuities are closely and medium spaced locally very closely spaced (50/200/430) locally infilled with (0/0/1) white comminuted chalk, slightly orangish brown stained. (White Chalk Subgroup Grade A2-3)			16
		D	16.40								
		C	16.60 - 18.00			100% 41% 37%		15.70-16.00m: Sub-vertical undulating rough discontinuity with orangish brown staining on fracture surface.			
17		B	17.02					16.00-16.00m: 2 no. parallel very closely spaced sub-vertical undulating rough discontinuities with orangish brown staining on fracture surface.			17
		D	17.47					16.00-16.18m: 60° undulating rough discontinuity. 16.50-16.92m: Sub-vertical undulating rough discontinuity with orangish brown staining on discontinuity surface. 16.80-16.85m: Band of sub-angular coarse rinded flint gravel. 16.93-17.02m: Band of angular and sub-angular fine to coarse rinded flint gravel.			
18		C	18.00 - 19.50	C*150		92% 69% 54%		17.02-17.45m: Sub-vertical undulating rough discontinuity with orangish brown staining on discontinuity surface.			18
		CPT	18.00 - 18.25					17.45-17.47m: Band of angular and sub-angular fine to coarse rinded flint gravel.			
		CS	18.40 - 18.65					17.47-18.60m: Sub-vertical and randomly orientated extremely and very closely spaced intersecting discontinuities.			
19		D	19.00					18.00-18.40m: Sub-vertical undulating rough discontinuity with orangish brown staining on discontinuity surface. 18.65-18.95m: Sub-horizontal and randomly orientated extremely closely and very closely spaced intersecting discontinuities.			19
		C	19.50 - 20.80			100% 38% 0%					
		CS	19.70 - 19.95								
20								20.22-20.35m: Band of angular and sub-angular coarse rinded flint gravel and cobbles. 20.40-20.45m: Band of angular and sub-angular fine to			20

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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Borehole No. **BH103**

Sheet 4 of 6

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494386 N 99532	Hole Type DS+RC
Location: Bognor Regis		Level: 2.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 13/11/2015 End: 18/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								coarse rinded flint gravel. Weak medium density white CHALK. Discontinuities are closely and medium spaced locally very closely spaced (50/200/430) locally infilled with (0/0/1) white comminuted chalk, slightly orangish brown stained. (White Chalk Subgroup Grade A2-3) *(continued from previous sheet)*			
		C	20.80 - 22.20	C*167		100%		20.56-20.61m: Band of angular and sub-angular fine to coarse rinded flint gravel.			
21		CPT	20.80 - 21.04			72% 63%		21.35-21.47m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-rounded cobbles.			21
		CS	21.80 - 22.10								
22		D	22.00								22
		C	22.20 - 23.60			89% 85% 73%		22.40-22.65m: Mottled grey. 22.49-22.51m: Discontinuity is sub-horizontal infilled with comminuted chalk (possible Marl).			
23											23
		D	23.50								
		C	23.60 - 25.00	C*167		100%		23.95-24.10m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-rounded cobbles.			
		CPT	23.60 - 23.84			81% 51%		24.05-24.65m: Discontinuities are vertical and sub-vertical extremely closely and very closely spaced infilled with comminuted chalk (<1mm) locally stained orangish brown.			
24								24.39-24.40m: Discontinuity is subhorizontal infilled with grey sandy clay (10mm) (possible Marl).			24
		D	24.60					24.80-27.00m: Mottled grey.			
		CS	24.68 - 25.00								
25		C	25.00 - 26.40			100% 68% 54%					25
									(19.30)		
								25.65-25.83m: Indistinctly thinly laminated mottled grey (probable Marl).			
26											26
		D	26.30								
		C	26.40 - 27.40	C*150		100%					
		CPT	26.40 - 26.65			74% 61%					
27											27
		D	27.10								
		CS	27.13 - 27.40								
		C	27.40 - 28.90			95% 71% 53%		27.55-27.60m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-rounded cobbles.			

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
17/11/2015	26.40	5.50	2.30
18/11/2015	26.40	5.50	2.40

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Borehole No. **BH103**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494386 N 99532	Hole Type DS+RC
Location: Bognor Regis		Level: 2.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 13/11/2015 End: 18/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
28								27.70-27.72m: Band of angular and sub-angular fine to coarse rinded flint gravel. 27.80-27.95m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-rounded cobbles. Weak medium density white CHALK. Discontinuities are closely and medium spaced locally very closely spaced (50/200/430) locally infilled with (0/0/1) white comminuted chalk, slightly orangish brown stained. (White Chalk Subgroup Grade A2-3) *(continued from previous sheet)*			28
		D	28.80					28.20-28.90m: Discontinuity is vertical and sub-vertical infilled with comminuted chalk (<1mm) locally stained orangish brown.			
29		C CPT	28.90 - 29.40 28.90 - 29.13	C*188		60% 60% 46%		28.50-28.55m: Band of angular and sub-angular fine to coarse rinded flint gravel. 28.70-28.90m: Chalk recovered non-intact as silty gravel.			29
		C	29.40 - 30.90			98% 79% 62%		29.14-29.22m: Rinded flint cobble or boulder (cored through). 29.22-29.40m: Drilling disturbed. Recovered as sub-angular rinded flint and chalk gravel. 29.60-32.40m: Discontinuities are sub-horizontal and horizontal closely to medium spaced locally infilled with comminuted chalk (<5mm). [Grade A2-B3]			
30		D B	30.40 30.50								30
								30.63-30.72m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-rounded cobbles.			
31		C CPT	30.90 - 32.30 30.90 - 31.15	C*158		96% 74% 51%					31
								31.65-31.72m: Band of angular and sub-angular fine to coarse rinded flint gravel and sub-rounded cobbles.			
32											32
		D C	32.20 32.30 - 33.80			97% 86% 88%		32.15-32.23m: Sub-angular to sub-rounded rinded flint cobble. 32.40-35.00m: Discontinuities are sub-horizontal to horizontal medium spaced locally closely spaced with no infill. [Grade A2-A3] 32.40-34.70m: Mottled grey.			
33											33
		D CS	33.20 33.30 - 33.65								
		C CPT	33.80 - 35.00 33.80 - 34.05	C*150		100% 80% 54%		33.80-33.90m: Band of angular and sub-angular fine to coarse rinded flint gravel.			
34											34
								34.70-34.72m: Band of angular and sub-angular fine to coarse rinded flint gravel.			
35		D	34.90					34.80-34.85m: Band of angular and sub-angular fine to	35.00	-32.09	35

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
18/11/2015	35.00	5.50	2.80

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Borehole No. **BH103**

Sheet 6 of 6

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494386 N 99532	Hole Type DS+RC
Location: Bognor Regis		Level: 2.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 13/11/2015 End: 18/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								coarse rinded flint gravel.			
								Borehole completed at 35.00m			

36 37 38 39 40 41 42

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Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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Borehole No. **BH104**

Sheet 1 of 2

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494380 N 99657	Hole Type DS
Location: Bognor Regis		Level: 1.53mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 10/11/2015 End: 10/11/2015	Logged By SM

(m)	Water Levels	Samples & In Situ Testing No/Type	Depth (m)	Result	Sample	Install	Description	Depth (m)	Level (mAD)	Legend
		ES	0.10				MADE GROUND: Very soft dark brown mottled black and yellowish brown slightly gravelly silty CLAY with frequent roots and rootlets (<3mm). Gravel is angular to sub-angular fine to medium brick.	(0.30)		
		B	0.20					0.30	1.23	
		B	0.50				Soft grey mottled orangish brown, yellowish brown and brown slightly sandy silty CLAY. (Superficial Deposits)			
							0.70-1.80m: Tending to orangish brown mottled grey.			
1		B	1.00					(1.50)		1
		ES								
		SPT	1.20 - 1.65	S 1						
								1.80	-0.27	
2							Very soft grey slightly sandy silty CLAY locally tending to clayey silt with frequent orangish brown stained root traces and occasional part decomposed plant remains (<3mm). (Superficial Deposits)			2
		D	2.20							
		H	2.40	H 11						
		SPT	2.50 - 2.95	S<1						
3		H	3.00	H 11			3.00-7.20m: Locally with black mottling.			3
		H	3.50	H 12						
		D	3.70							
4		SPT	4.00 - 4.45	S<1						4
								(5.00)		
5		H	5.00	H 7						5
		D	5.20							
		SPT	5.50 - 5.95	S 5						
6							5.90-6.80m: Slightly gravelly. Gravel is angular to sub-rounded			6

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REMARKS:

EQUIPMENT: Hand digging tools. Fraste PL multi purpose track mounted rig.
METHOD: Hand dug inspection pit: 0.00-1.20m. Continuous dynamic sampled (126mm diam) 1.20-12.00m.
GROUNDWATER: None encountered prior to using water flush to advance casing to 5.50m.
CASING: SW to 8.50m.
INSTALLATION: 50mm ID HDPE slotted pipe with washed gravel response zone: 9.00-12.00m. 50mm ID HDPE plain pipe with washed gravel response zone: 8.90-9.00m, and bentonite pellet seal: 0.30-8.90m, and flush 150mm steel cover set in concrete: 0.00-0.30m Gas valve fitted.

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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Borehole No. **BH104**

Sheet 2 of 2

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494380 N 99657	Hole Type DS
Location: Bognor Regis		Level: 1.53mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 10/11/2015 End: 10/11/2015	Logged By SM

(m)	Water Levels	Samples & In Situ Testing No/Type	Depth (m)	Result	Sample	Install	Description	Depth (m)	Level (mAD)	Legend
							fine to medium flint. Very soft grey slightly sandy silty CLAY locally tending to clayey silt with frequent orangish brown stained root traces and occasional part decomposed plant remains (<3mm). (Superficial Deposits) *(continued from previous sheet)*			
							Yellowish grey and light grey slightly sandy very gravelly SILT. Gravel is sub-angular to sub-rounded fine to coarse chalk. (Superficial Deposits)	6.80 (0.40)	-5.27	
7		D SPT	6.90 7.00 - 7.45	S 5			Structureless CHALK composed of white mottled grey slightly sandy silty GRAVEL. Gravel is sub-angular to rounded fine to coarse medium density chalk and flint. (White Chalk Subgroup Grade Dc)	7.20	-5.67	7
8							8.20-8.50m: Locally tending to structured chalk [Grade C5].			8
		D SPT	8.40 8.50 - 8.95	S 12			8.50-11.50m: Limited recovery of structureless chalk [Grade Dm].			
9		D	9.10							9
								(5.25)		
10		SPT	10.00 - 10.45	S 19			10.00-10.10m: Sub-angular to sub-rounded rinded flint cobble (~130mm).			10
		D	10.70							
11										11
		SPT	11.50 - 11.95	S 19			11.50-12.00m: Locally tending to structured chalk [Grade C4-C5].			
12		D SPT	11.95 12.00 - 12.45	S 18						12
							Borehole completed at 12.45m	12.45	-10.92	
13										13

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

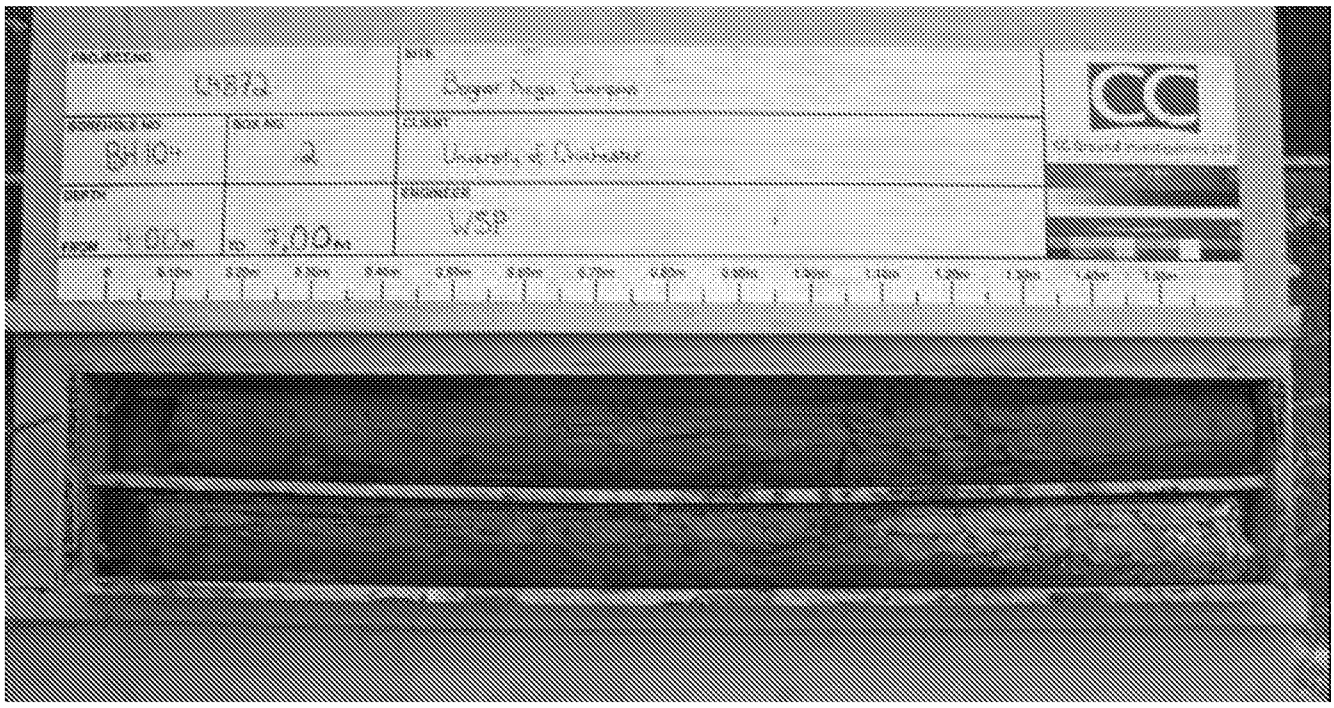
Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
10/11/2015	12.45	8.50	1.00

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Borehole Photograph

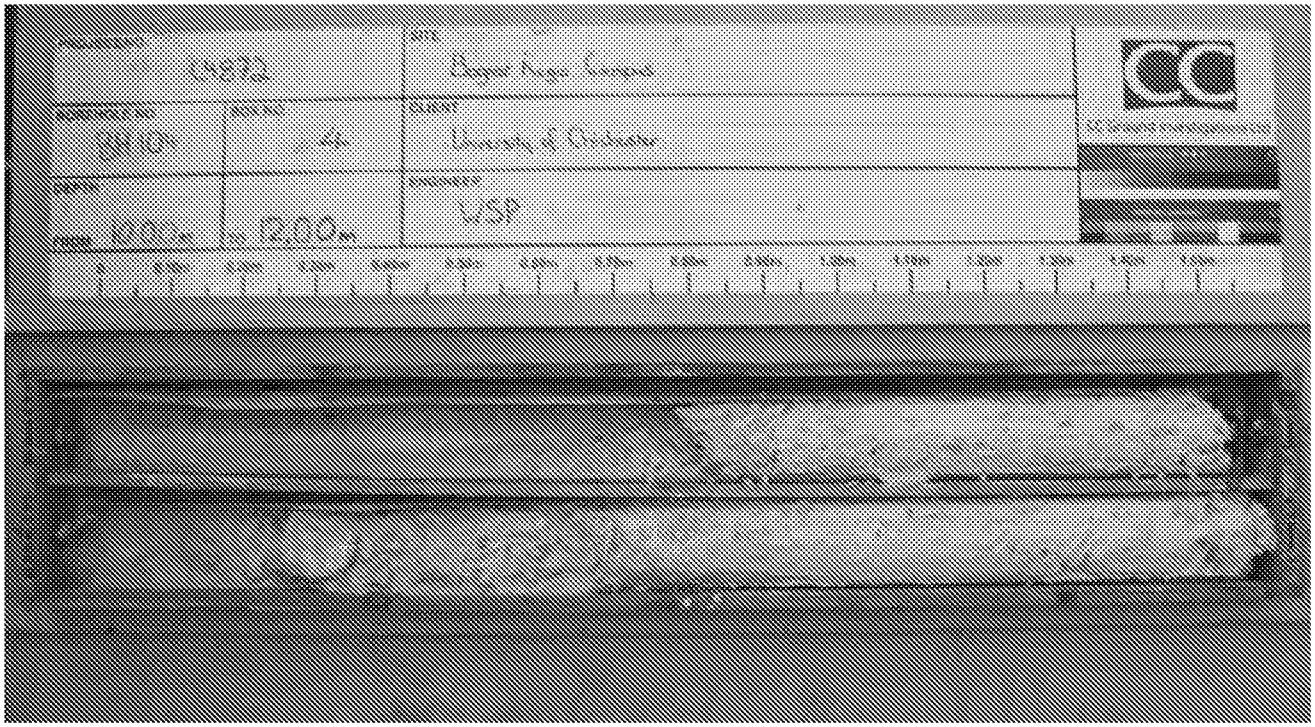




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Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH104

Borehole Photograph





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Client:	University of Chichester
Hole ID:	BH104

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Borehole No. **BH105**

Sheet 1 of 3

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494427 N 99736	Hole Type DS
Location: Bognor Regis		Level: 1.39mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 04/11/2015 End: 05/11/2015	Logged By RS

(m)	Water Levels	Samples & In Situ Testing No/Type	Depth (m)	Result	Sample	Install	Description	Depth (m)	Level (mAD)	Legend
		B	0.30				MADE GROUND: Stiff friable orangish brown mottled dark grey and reddish brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is sub-angular fine and medium brick.	0.20	1.19	
		B	0.50				MADE GROUND: Stiff orangish brown mottled reddish brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is sub-angular fine brick.	(0.60)		
								0.80	0.59	
1		B	1.00				Firm orangish brown slightly sandy silty CLAY. (Superficial Deposits)	(0.30)		1
		SPT	1.20 - 1.65	S<1			Very soft light grey and orangish brown silty CLAY. (Superficial Deposits)	1.10	0.29	
		D	1.70					(1.10)		
2		H	2.00	H 17						2
								2.20	-0.81	
		D	2.50	H 16			Very soft light grey silty CLAY with frequent 1mm diameter vertical dead rootlets. (Superficial Deposits)	(0.50)		
		H SPT	2.70 - 3.15	S<1			Very soft grey silty CLAY with rare sub-angular fine gravel sized and 1mm diameter partially decomposed organic fragments and dead rootlets. (Superficial Deposits)	2.70	-1.31	
3										3
		H	3.40	H 12				(2.10)		
4		D H SPT	4.00 4.20 - 4.65	H 16 S 1						4
							Very soft grey silty CLAY. (Superficial Deposits)	4.80	-3.41	
5										5
		D H SPT	5.50 5.70 - 6.15	H 13 S 1				(1.60)		
6										6

REMARKS:

EQUIPMENT: Hand digging tools. Fraste PL multi purpose track mounted rig.
METHOD: Hand dug inspection pit: 0.00-1.20m. Continuous dynamic sampled (126mm diam) 1.20-14.70m.
GROUNDWATER: None encountered prior to use of water flush to advance casing to 4.20m..
CASING: 160mm diam casing to 14.70m.
INSTALLATION: 50mm ID HDPE slotted pipe with washed gravel response zone: 13.20-14.70m. 50mm ID HDPE plain pipe with bentonite pellet seal: 0.20-13.20m and flush 150mm steel cover set in concrete: 0.00-0.20m Gas valve fitted.

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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Borehole No. **BH105**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494427 N 99736	Hole Type DS
Location: Bognor Regis		Level: 1.39mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 04/11/2015 End: 05/11/2015	Logged By RS

(m)	Water Levels	Samples & In Situ Testing No/Type	Depth (m)	Result	Sample	Install	Description	Depth (m)	Level (mAD)	Legend
							Very soft grey silty CLAY. (Superficial Deposits) *(continued from previous sheet)*			
		H	6.40	H 9				6.40	-5.01	
							Very soft indistinctly thinly laminated dark grey slightly sandy silty CLAY. (Superficial Deposits)			
7		D	7.00	H 9						7
		H								
		SPT	7.20 - 7.65	S 2				(2.00)		
8										8
							Very soft grey silty CLAY. (Superficial Deposits)	8.40	-7.01	
		D	8.50	H 10						
		H								
		SPT	8.70 - 9.15	S 2						
9										9
10		D	10.00	H 12						10
		H								
		SPT	10.20 - 10.65	S 4						
								(4.30)		
11										11
		SPT	11.70 - 12.15	S 12						
12										12
							Structureless CHALK composed of white gravelly SILT. Gravel is extremely weak and very weak low and medium density white fine to coarse with occasional black specks. (White Chalk Subgroup Grade Dm)	12.70	-11.31	
								(0.30)		
13		D	13.00					13.00	-11.61	13
							(continued on next sheet)			

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Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
04/11/2015	11.70	10.20	0.60
05/11/2015	11.70	10.20	2.60

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Borehole No. **BH105**

Sheet 3 of 3

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494427 N 99736	Hole Type DS
Location: Bognor Regis		Level: 1.39mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 04/11/2015 End: 05/11/2015	Logged By RS

(m)	Water Levels	Samples & In Situ Testing No/Type	Depth (m)	Result	Sample	Install	Description	Depth (m)	Level (mAD)	Legend
		SPT	13.20 - 13.65	S 9			Structureless CHALK composed of silty angular and sub-angular fine to coarse GRAVEL. Clasts are very weak, low and medium density white with occasional black specks. (White Chalk Subgroup Grade Dc) *(continued from previous sheet)*	(2.15)		
		D	14.50							
		SPT	14.70 - 15.15	S 8						
							Borehole completed at 15.15m	15.15	-13.76	

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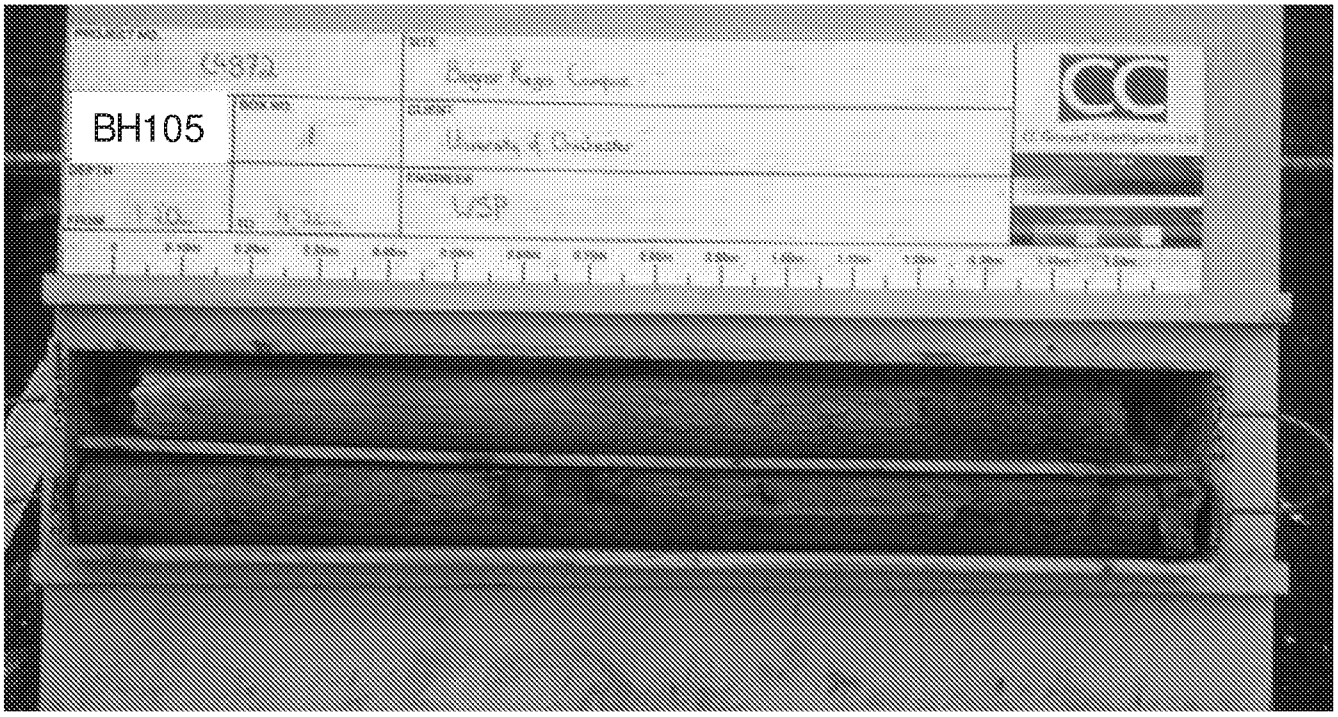
Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
05/11/2015	15.15	14.70	0.60

Borehole Photograph



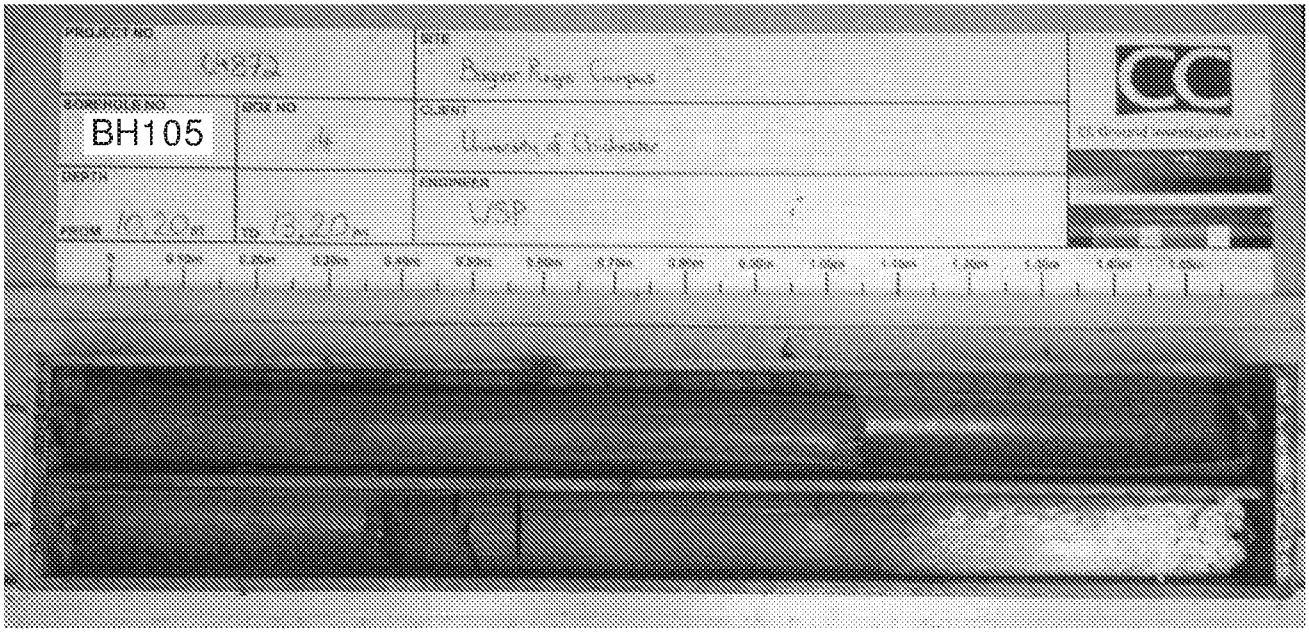


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Client:	University of Chichester
Hole ID:	BH105

Borehole Photograph

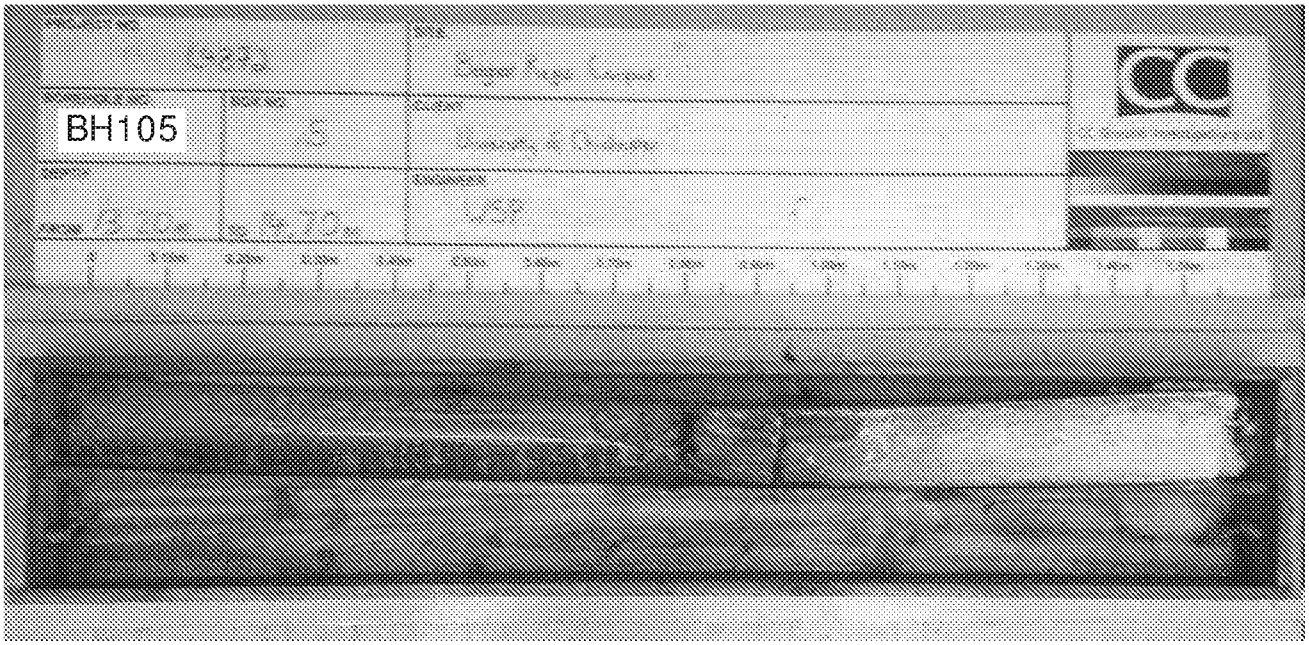




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Borehole No. **BH106**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494433 N 99598	Hole Type DS+RC
Location: Bognor Regis		Level: 2.24mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 11/11/2015 End: 17/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		B	0.20					MADE GROUND: Rough vegetation over very soft brown slightly sandy slightly gravelly silty CLAY with frequent roots and rootlets (<5mm). Gravel is angular to sub-rounded fine to coarse brick, sandstone, flint and siliceous material.	(0.40)		
		B	0.50						0.40	1.84	
								Soft yellowish brown mottled orangish brown and grey slightly sandy silty CLAY. (Lambeth Group)	(0.30)		
									0.70	1.54	
1		B	1.00					Soft yellowish brown mottled grey, orangish brown and reddish brown slightly sandy slightly gravelly silty CLAY with frequent orangish brown stained root traces and occasional partially decomposed roots and rootlets (<2mm). Gravel is sub-rounded to rounded fine to coarse flint and siliceous material. (Lambeth Group)	(0.80)		1
		SPT	1.20 - 1.65	S 4							
									1.50	0.74	
		H	1.70	H 84				Firm locally becoming stiff indistinctly thinly laminated slightly sandy silty CLAY with frequent orangish brown stained root traces. (Lambeth Group) 1.50-5.60m: Firm locally tending to stiff. Indistinctly laminated. Gravel absent.			
2		D	2.10								2
		H	2.30	H 116							
		ES	2.40								
		SPT	2.50 - 2.95	S 10							
3											3
		D	3.50						(4.10)		
		SPT	3.80 - 4.25	S 16							
4								4.00-5.60m: Occasional silty sand lenses (<30mm). 4.05-4.80m: Locally slightly gravelly. Gravel is sub-rounded to rounded fine to coarse chalk and flint.			4
		D	4.50								
		SPT	4.80 - 5.25	S 19							
5											5
									5.60	-3.36	
								Firm grey silty CLAY. (Lambeth Group)	5.70	-3.46	
		D	5.80					*(continued on next sheet)*			
6											6

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REMARKS:

EQUIPMENT: Hand digging tools. Fraste PL multi purpose track mounted rig.
METHOD: Hand dug inspection pit: 0.00-1.20m. Continuous dynamic sampled (128mm diam) 1.20-15.70m. Waterflush rotary core drilled (146mm diam) 15.70-34.40m.
GROUNDWATER: None encountered prior to using water flush to advance casing.
CASING: SW casing to 6.00m.
INSTALLATION: Bentonite pellet backfill: 1.60-35.00m. 50mm ID HDPE slotted pipe with washed gravel response zone: 0.60-1.60m, plain pipe with washed gravel response zone: 0.50-0.60m, and bentonite pellet seal: 0.20-0.50m, raised borehole helmet set in concrete 0.00-0.20m. Gas valve fitted.

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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ROTARY BOREHOLE LOG

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Borehole No. **BH106**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494433 N 99598	Hole Type DS+RC
Location: Bognor Regis		Level: 2.24mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 11/11/2015 End: 17/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		C SPT	6.00 - 7.50 6.00 - 6.28	S*75		100% 0% 0%		Structureless CHALK composed of yellowish brown mottled grey and orangish brown slightly sandy slightly gravelly SILT. Gravel is sub-angular to sub-rounded fine to coarse extremely weak and very weak low density chalk and rinded flint. (White Chalk Subgroup Grade Dm) *(continued from previous sheet)* 6.25-6.45m: Sub-angular flint cobbles (<110mm). 6.45-6.50m: Weak medium density sub-rounded chalk cobble.	(0.80)		
									6.50	-4.26	
7		D	7.30					Extremely weak and very weak low to medium density white mottled grey CHALK. Discontinuities are sub-horizontal and horizontal locally randomly orientated extremely closely spaced infilled with comminuted chalk (<30mm) locally stained orangish brown. (White Chalk Subgroup Grade C5-Dc) 7.00-7.60m: White mottled orangish brown.	(1.10)		7
		C	7.50 - 9.00			97% 77% 0%			7.60	-5.36	
8								Extremely weak and very weak low to medium density white mottled orangish brown CHALK. Discontinuities are sub-horizontal to horizontal very closely to closely spaced infilled with comminuted chalk (<3mm). (White Chalk Subgroup Grade B3-B4) 8.35-12.80m: Widely spaced thin beds of rinded flint cobbles and gravel (<130mm). Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.			8
		D	8.80								
9		C SPT	9.00 - 10.50 9.00 - 9.45	S 23		82% 38% 26%					9
10		CS	9.95 - 10.25					9.80-10.10m: Discontinuities are horizontal extremely closely and very closely spaced infilled with comminuted chalk (<1mm). [Grade B4-B5]	(5.25)		10
		D	10.30								
		C	10.50 - 12.00			92% 43% 13%					
11								11.00-11.20m: Discontinuities are randomly orientated extremely closely spaced infilled with comminuted chalk (<5mm). Possibly drilling disturbed. [Grade C5-Dc] 11.40-11.50m: Discontinuities are randomly orientated extremely closely spaced infilled with comminuted chalk (<5mm). Possibly drilling disturbed. [Grade C5-Dc] 11.50-12.00m: Discontinuities are horizontal closely spaced infilled with comminuted chalk (<1mm). [Grade B3]			11
		D	11.80								
12		C SPT	12.00 - 12.50 12.00 - 12.45	S 21		100% 16% 0%		11.80-11.85m: Indistinctly thinly laminated, mottled grey. 12.00-12.85m: Discontinuities are randomly orientated extremely closely spaced infilled with comminuted chalk (<5mm). Possibly drilling disturbed. [Grade C5-Dc]			12
		C	12.50 - 14.00			99% 52% 31%					
13								*(continued on next sheet)*	12.85	-10.61	13

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
11/11/2015	12.00	6.00	1.80
12/11/2015	12.00	6.00	1.50

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Borehole No. **BH106**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494433 N 99598	Hole Type DS+RC
Location: Bognor Regis		Level: 2.24mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 11/11/2015 End: 17/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		D	13.50					Very weak low to medium density white locally mottled brown and orangish brown CHALK. Discontinuities are sub-horizontal to horizontal very closely to closely spaced infilled with comminuted chalk (<1mm) stained orangish brown. (White Chalk Subgroup Grade B3-B3) *(continued from previous sheet)*			
14		C SPT	14.00 - 14.30 14.00 - 14.45	S 23		83% 50% 0%		13.30-14.20m: Closely to medium spaced thin beds of rinded flint cobbles and gravel (<70mm). Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.			14
		C	14.30 - 15.80			89% 50% 8%		13.50-13.60m: Discontinuities are randomly orientated extremely closely spaced infilled with comminuted chalk (<3mm). Possibly drilling disturbed. [Grade B5-Dc] 13.80-13.85m: Discontinuities are randomly orientated extremely closely spaced infilled with comminuted chalk (<3mm) stained orangish brown and yellowish brown. Possibly drilling disturbed. [Grade B5-Dc] 13.85-14.30m: Discontinuity is sub-vertical, clean stained orangish brown. 14.30-15.70m: Discontinuities are sub-vertical and sub-horizontal extremely closely and very closely spaced infilled with comminuted chalk (<1mm). [Grade B4-B5]			
15		D	15.00								15
		C	15.80 - 17.30			88% 37% 29%		15.95-23.70m: Medium to widely spaced thin beds of rinded flint cobbles and gravel (<100mm). Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.			
16		D	16.50					16.60-16.70m: Discontinuities are sub-horizontal extremely closely spaced infilled with comminuted chalk (<3mm). [Grade B5] 16.70-17.90m: Discontinuities are vertical to sub-vertical very closely spaced infilled with comminuted chalk (<1mm).	(7.20)		16
17		C SPT	17.30 - 18.80 17.30 - 17.75	S 44		100% 43% 33%		17.30-17.60m: Locally with brown mottling.			17
18		D	18.00					18.00-19.20m: Discontinuities are sub-horizontal and horizontal closely to medium spaced infilled with comminuted chalk (<1mm). [Grade B2-B3] 18.10-18.50m: Indistinctly thinly laminated locally mottled grey.			18
		CS	18.40 - 18.64								
		C	18.80 - 20.30			99% 42% 33%		18.90-19.20m: Discontinuity is sub-vertical to 45°, with infill of comminuted chalk (<1mm) locally stained orangish brown.			
19		D	19.50					19.50-19.75m: Discontinuities are vertical to sub-vertical extremely closely and very closely spaced infilled with comminuted chalk (<1mm) stained yellowish brown.			19
20		C SPT	20.30 - 21.80 20.30 - 20.75	S 45		100% 67%		19.90-20.10m: Discontinuities are randomly orientated extremely closely spaced infilled with comminuted chalk (<1mm) stained orangish brown and yellowish brown. Possibly drilling disturbed. [Grade B5-Dc] *(continued on next sheet)*	20.05	-17.81	20

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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Borehole No. **BH106**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494433 N 99598	Hole Type DS+RC
Location: Bognor Regis		Level: 2.24mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 11/11/2015 End: 17/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
21						44%		Very weak to weak medium density white locally mottled orangish brown CHALK. Discontinuities are sub-horizontal and horizontal closely spaced infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade B3) *(continued from previous sheet)*			21
		D	20.90					20.40-20.65m: Very closely spaced thin beds of rinded flint cobbles and gravel (<140mm). Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.	(2.05)		
		CS	21.35 - 21.70					21.00-21.80m: Discontinuities are sub-horizontal to horizontal medium spaced infilled with comminuted chalk (<3mm). [Grade B2]			
		C	21.80 - 23.30			100% 81% 76%					
22		CS	22.05 - 22.45						22.10	-19.86	22
								Weak medium density white locally mottled orangish brown CHALK. Discontinuities are sub-horizontal and horizontal medium spaced infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade B2-B3)			
								22.40-22.50m: Mottled grey.			
								22.50-22.60m: Discontinuities infilled with very soft indistinctly thinly laminated grey clayey silt. [Marl]			
								22.54m: Sub-horizontal discontinuity infilled with yellowish brown sand (<2mm).			
23								22.87m: Sub-horizontal discontinuity infilled with yellowish brown sand (<5mm).			23
		D	23.20								
		C	23.30 - 24.60	S*97		71% 6% 6%		23.30-23.70m: Drilling disturbed.			
		SPT	23.30 - 23.65								
								23.70-23.80m: Locally mottled orangish brown and reddish brown.	(3.20)		
24								24.00-24.20m: Discontinuities are randomly orientated extremely closely and very closely spaced infilled with comminuted chalk (<3mm). [Grade B4-Dc]			24
		D	24.40					24.05-25.35m: Closely spaced thin beds of rinded flint cobbles and gravel (<100mm). Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.			
		C	24.60 - 26.10								
25						107% 53% 28%			25.30	-23.06	25
								Very weak to weak medium density white locally mottled orangish brown CHALK. Discontinuities are sub-horizontal and horizontal closely spaced to medium spaced infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade B2-B3)			
								25.75-26.10m: Discontinuities are randomly orientated extremely closely and very closely spaced infilled with comminuted chalk (<5mm).			
26		D	26.00					26.10-28.95m: Very closely to closely spaced thin beds of rinded flint cobbles and gravel (<100mm) locally mottled orangish brown. Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.			26
		C	26.10 - 27.60			86% 51% 41%					
27											27
		CS	27.40 - 27.60								
		C	27.60 - 28.70	S*120		95% 27%		27.60-27.75m: Drilling disturbed recovered as slightly gravelly silty sand. Gravel is angular to sub-angular fine			
		D	27.60								

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
12/11/2015	23.30	6.00	1.60
13/11/2015	23.30	6.00	1.55

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Borehole No. **BH106**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494433 N 99598	Hole Type DS+RC
Location: Bognor Regis		Level: 2.24mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 11/11/2015 End: 17/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
28		SPT	27.60 - 27.85			18%		to medium chalk and flint. Very weak to weak medium density white locally mottled orangish brown CHALK. Discontinuities are sub-horizontal and horizontal closely spaced to medium spaced infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade B2-B3) *(continued from previous sheet)* 27.90-28.20m: Discontinuity is sub-vertical infilled with comminuted chalk (<1mm). 28.10-28.20m: 1no. sub-rounded rinded flint cobble (<140mm). 28.90-31.50m: Closely to medium spaced thin beds of rinded flint cobbles and gravel (<140mm). Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.			
		D	28.60								
		C	28.70 - 30.20			97% 66% 27%					
29											
30		D	30.10								
		C	30.20 - 31.70	S*111		100% 73% 65%			(9.85)		
		SPT	30.20 - 30.46								
		CS	30.55 - 30.85								
31											
		D	31.60								
		C	31.70 - 33.20			97% 91% 83%					
32		CS	32.00 - 32.25					32.20-34.70m: Closely to medium spaced thin beds of rinded flint gravel. Gravel is sub-angular to rounded fine to coarse. 32.65-32.70m: Discontinuity is sub-horizontal infilled with comminuted chalk (50mm). Discontinuity surfaces mottled grey.			
33		D	33.10								
		C	33.20 - 34.70	S*136		100% 35% 32%					
		SPT	33.20 - 33.37								
34											
		D	34.60								
		C	34.70 - 35.00			0% 0% 0%					
35		SPT	35.00 - 35.15	S*150							

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Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
13/11/2015	33.20	6.00	1.60
17/11/2015	33.20	6.00	1.65

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Borehole No. **BH106**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494433 N 99598	Hole Type DS+RC
Location: Bognor Regis		Level: 2.24mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 11/11/2015 End: 17/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								Borehole completed at 35.15m	35.15	-32.91	

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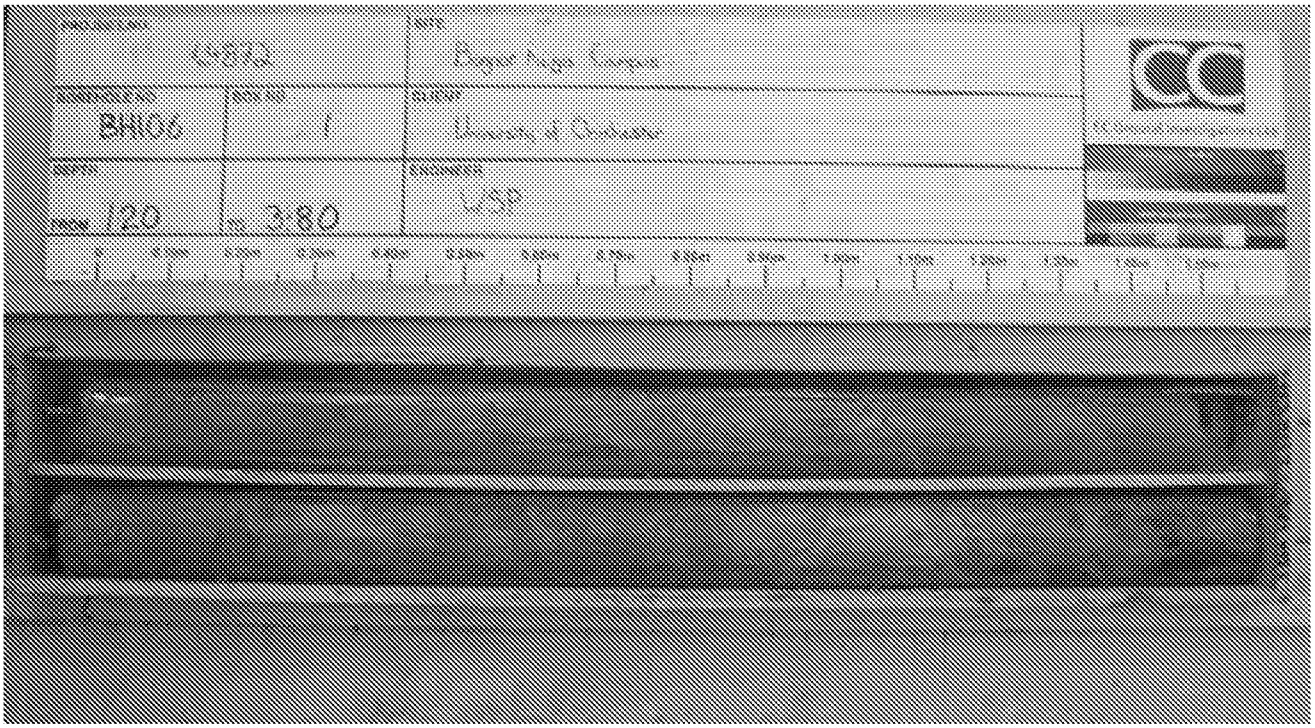
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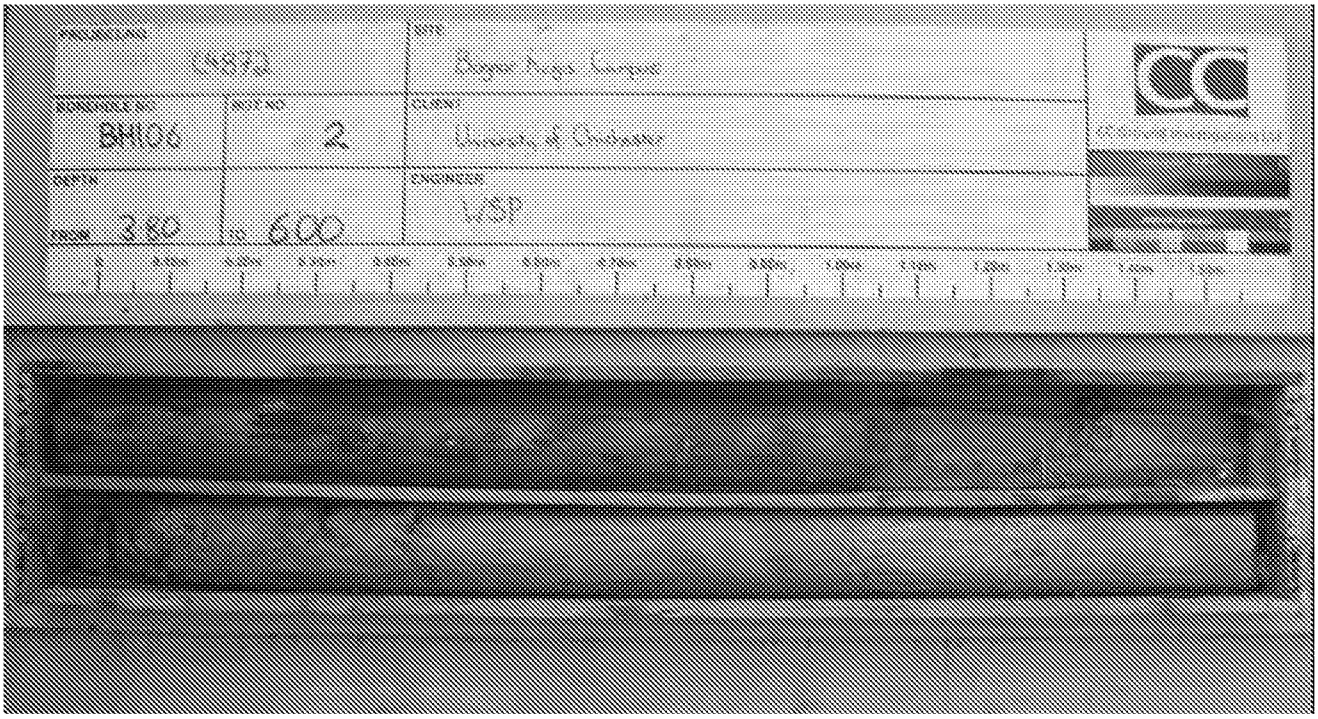
Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
17/11/2015	35.15	6.00	1.70

Borehole Photograph



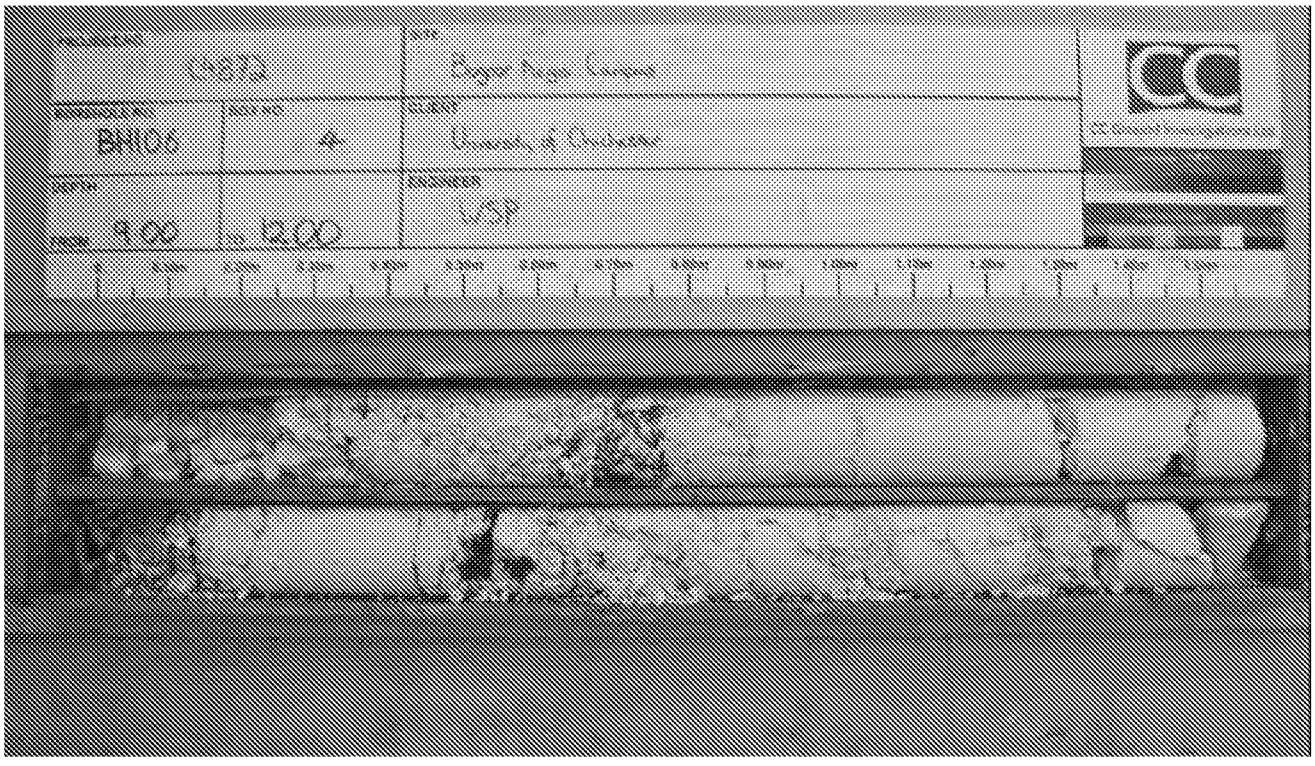


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Contract Name:	University of Chichester
Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH106

Borehole Photograph



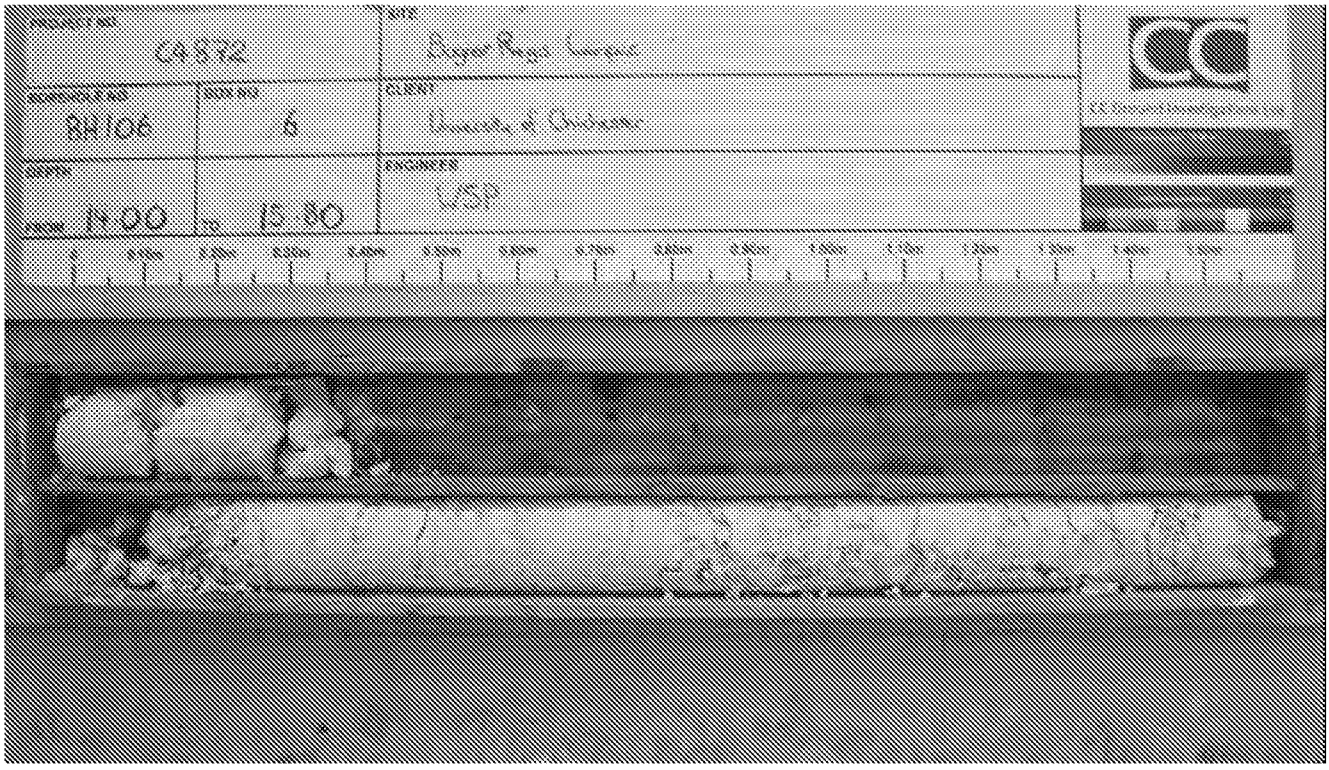


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Contract Name:	University of Chichester
Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH106

Borehole Photograph





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Contract Name:	University of Chichester
Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH106

Borehole Photograph

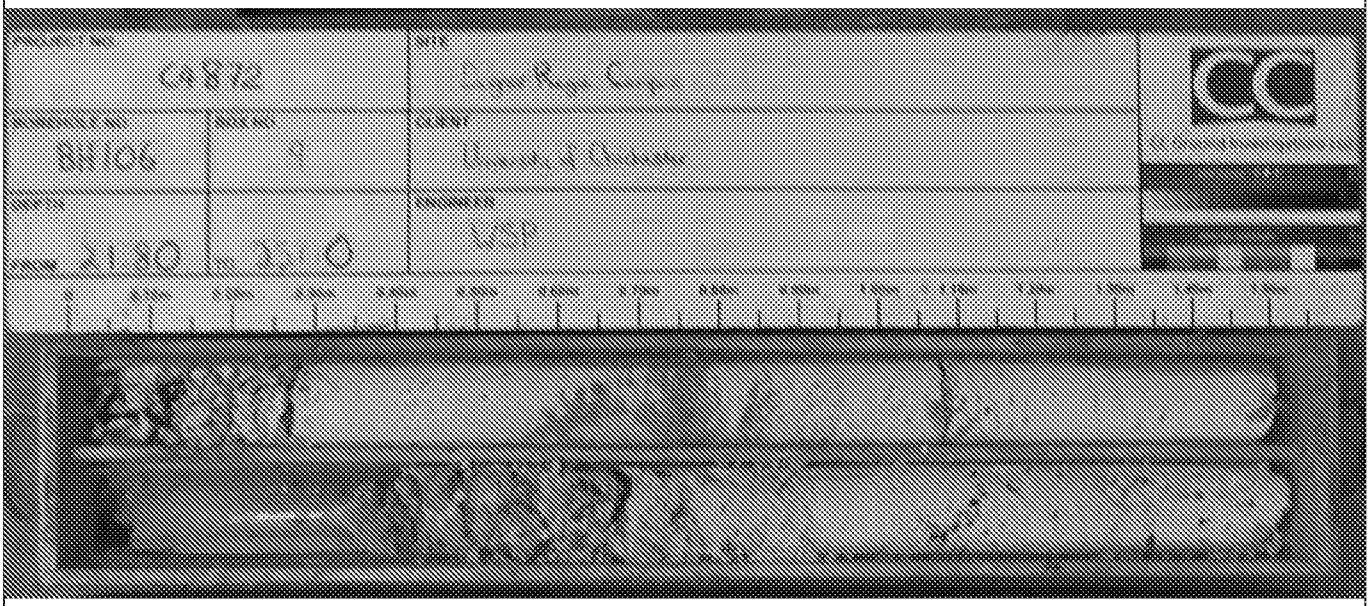


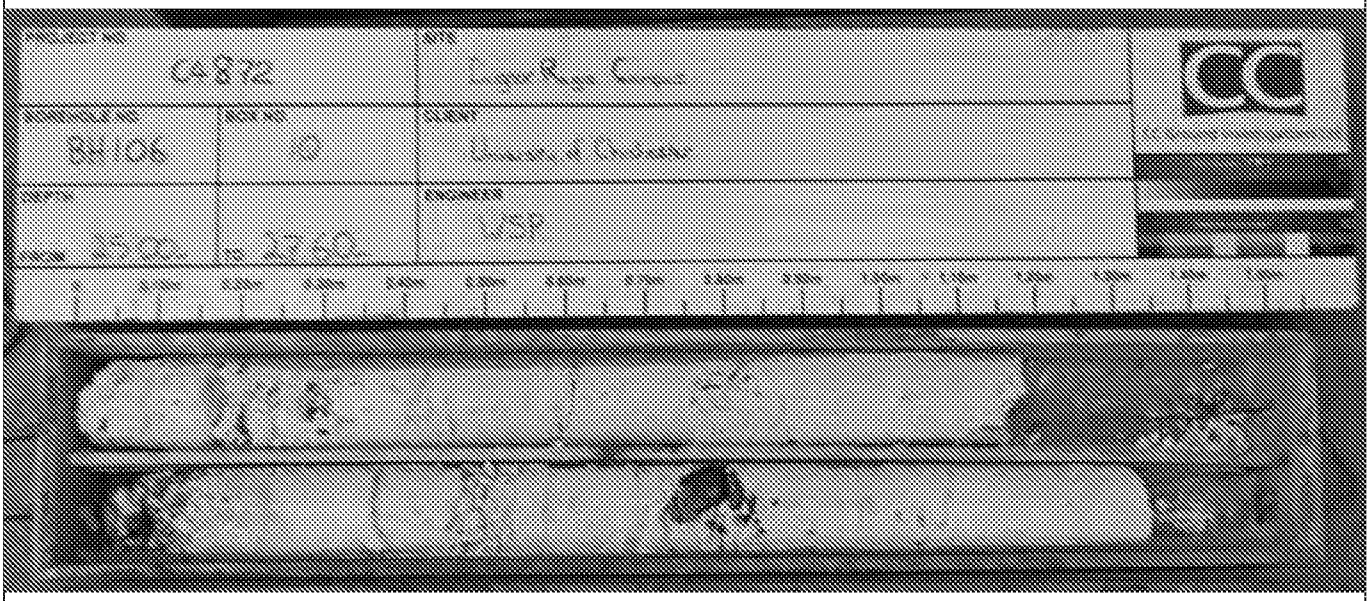


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Contract Name:	University of Chichester
Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH106

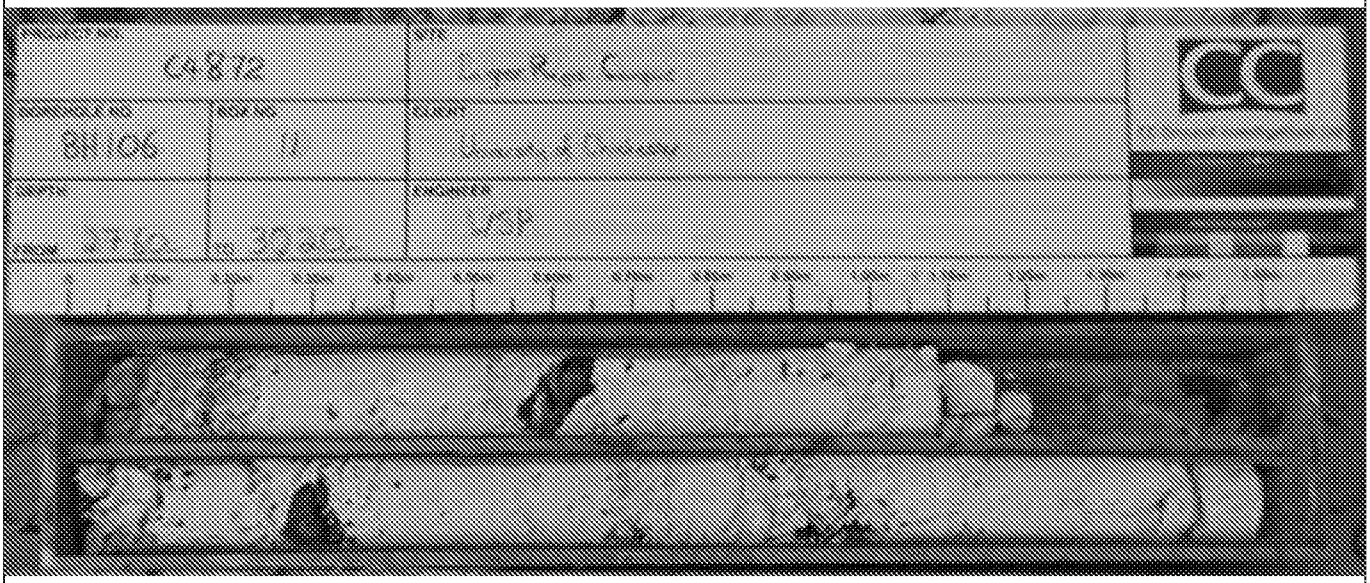
Borehole Photograph

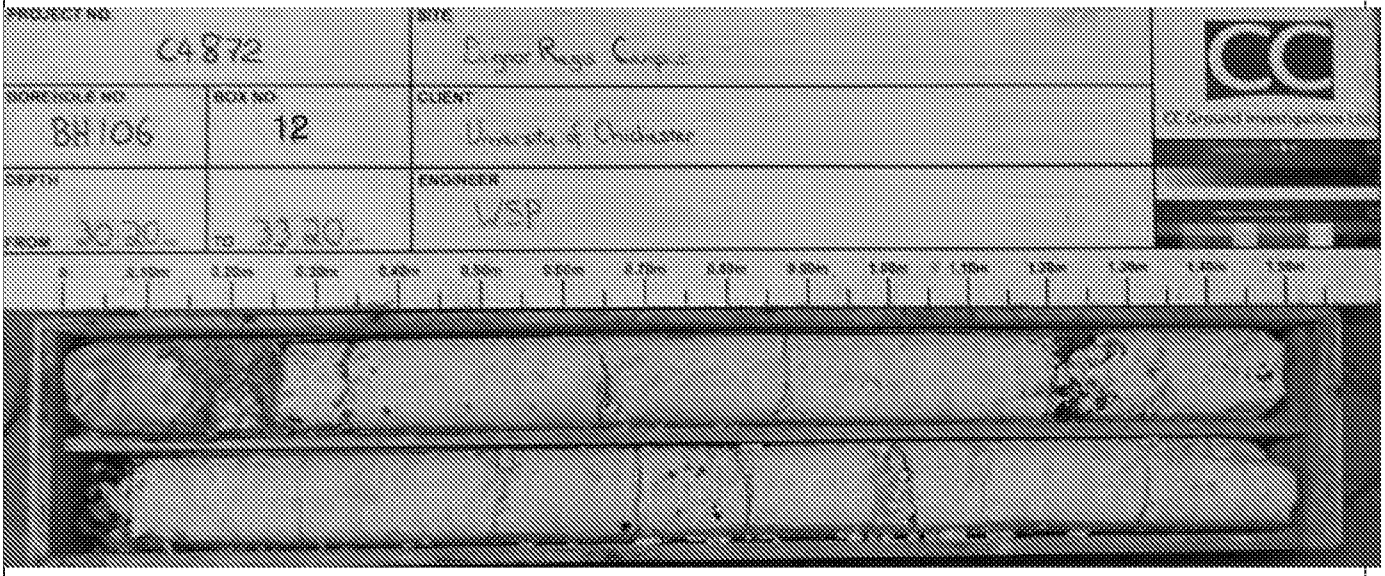




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Client:	University of Chichester
Hole ID:	BH106

Borehole Photograph

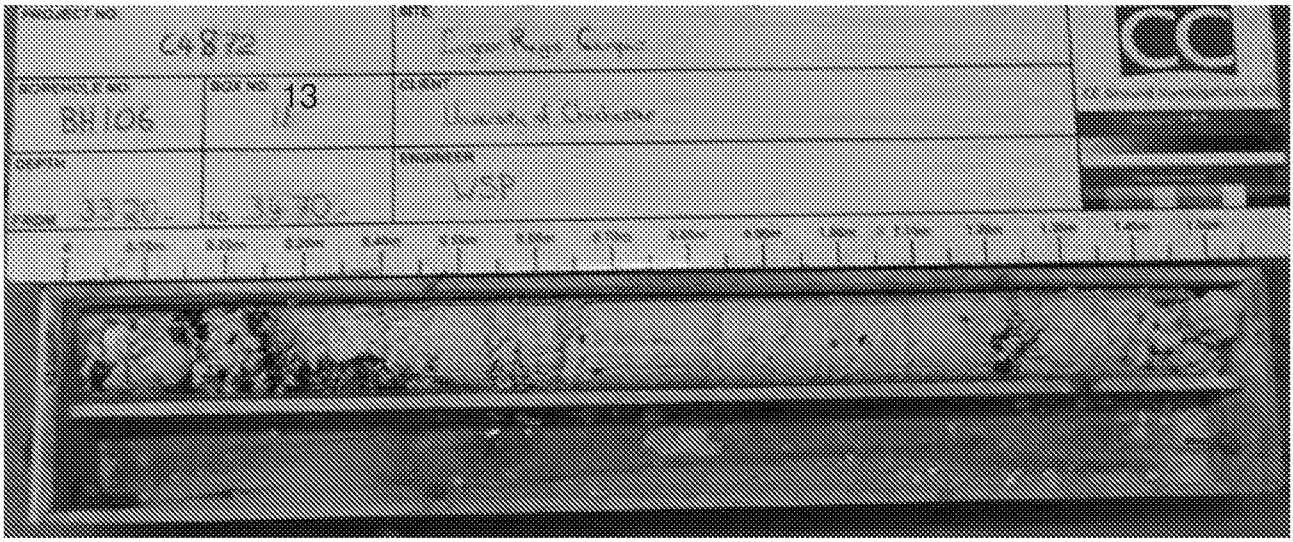




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Borehole Photograph



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Hole ID:	BH106

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Borehole No. **BH107**

Sheet 1 of 5

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494418 N 99623	Hole Type DS+RC
Location: Bognor Regis		Level: 1.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 09/11/2015 End: 12/11/2015	Logged By DM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		B	0.20					MADE GROUND: Grass over soft brown mottled orangish brown slightly sandy slightly gravelly silty CLAY with frequent rootlets (<1mm). Gravel is angular to sub-rounded fine to medium brick, sandstone, mudstone and siliceous material.	(0.40)		
		ES							0.40	1.51	
		B	0.50					Soft grey mottled yellowish brown and orangish brown slightly sandy silty CLAY. (Superficial Deposits)	(0.50)		
		ES	0.60						0.90	1.01	
1		B	1.00					Grey mottled orangish brown clayey sandy GRAVEL with occasional pockets of clay (<10mm). Gravel is sub-rounded to rounded fine to coarse flint. (Superficial Deposits)	(0.30)		1
		ES	1.10						1.20	0.71	
	1	B	1.20 - 2.20	S 18				Medium dense brown and reddish brown slightly silty slightly sandy GRAVEL. Gravel is sub-rounded to rounded fine to coarse of flint. (Superficial Deposits)	(1.00)		
	1	SPT	1.20 - 1.65								
2									2.20	-0.29	2
		B	2.20 - 2.50					Light greenish grey silty gravelly SAND. Gravel is sub-angular to sub-rounded fine to coarse of flint (Superficial Deposits)	(0.30)		
									2.50	-0.59	
		SPT	2.70 - 3.15	S 35				Dense brown, reddish brown and light greenish grey silty sandy GRAVEL. Gravel is sub-rounded to rounded fine to coarse of flint. (Superficial Deposits)	(1.00)		
3		B	3.00 - 3.50								3
		D	3.50 - 3.55					Orange brown silty slightly gravelly SAND. Gravel is sub-rounded to rounded fine to coarse of flint. (Superficial Deposits)	3.50	-1.59	
		D	3.55 - 3.60						3.55	-1.64	
		B	3.60 - 3.90						3.60	-1.69	
		D	3.90 - 4.10					Light bluish grey sandy slightly gravelly clayey SILT with rootlets (Superficial Deposits)	(0.55) 3.90	-1.99	
4		H	4.10	H 45				Brown, reddish brown and light greenish grey silty very sandy GRAVEL. Gravel is sub-rounded to rounded fine to coarse of flint. (Superficial Deposits)			4
		SPT	4.20 - 4.65	S 5							
		H	4.50	H 65				Soft to firm dark reddish brown CLAY. (Lambeth Group)	(1.10)		
		H	4.80	H 40				4.70m: Becoming mottled reddish brown. 4.80m: Becoming grey.			
		H	4.90	H 60							
5		D	5.00 - 5.15					Stiff orangish brown mottled grey and brown slightly sandy slightly gravelly silty CLAY. Gravel is sub-rounded to rounded fine to coarse of flint. (Lambeth Group)	5.00	-3.09	5
		SPT	5.20 - 6.15	S 34					5.15	-3.24	
								Orangish brown, reddish brown and white slightly sandy gravelly to gravelly CLAY with occasional cobbles. Gravel is sub-angular to sub-rounded fine to coarse of chalk and flint. Cobbles are sub-angular to sub-rounded of chalk.	(0.45)		
		D	5.65						5.60	-3.69	
								(continued on next sheet)	(0.60)		
6											6

REMARKS:

EQUIPMENT: Hand digging tools. Fraste PL multi purpose track mounted rig.
METHOD: Hand dug inspection pit: 0.00-1.20m. Continuous dynamic sampled (128mm diam) 1.20-15.50m. Water flush rotary coring using T6-146 coring barrel: 15.50-35.00m.
GROUNDWATER: Standing at 1.50m following sample run 1.20-2.70m. Rising and settling at 1.30m following five minute monitoring period.
CASING: 160mm diameter casing to 16.00m.
INSTALLATION: Bentonite pellet seal: 34.75-35.00m. 50mm ID HDPE slotted pipe with washed gravel response zone: 6.75-34.75m. 50mm ID HDPE plain pipe with bentonite pellet seal: 0.20-6.75m. Flush 150mm steel cover set in concrete 0.00-0.20m Gas valve fitted.

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)
09/11/15	1.50	Nil	1.30

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
09/11/2015	5.10	4.20	2.20
10/11/2015	5.10	4.20	1.50

CC ROTARY LOG C4872.GPJ GINT STD AGS 3_1.GDT 21/1/16

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ROTARY BOREHOLE LOG

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Borehole No. **BH107**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494418 N 99623	Hole Type DS+RC
Location: Bognor Regis		Level: 1.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 09/11/2015 End: 12/11/2015	Logged By DM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								Structureless CHALK composed of firm to stiff white mottled light orange brown slightly sandy slightly gravelly to gravelly SILT. Clasts are extremely weak low density. (White Chalk Subgroup Grade Dm) *(continued from previous sheet)*	6.20	-4.29	
								Structureless CHALK composed of white mottled light yellow and light orangish brown silty to very silty very sandy angular to sub-angular fine to coarse GRAVEL with occasional sub-angular cobbles. Flints are dark brown to very dark brown sub-rounded to rounded coarse gravel size nodular (White Chalk Subgroup Grade Dc)	(1.30)		
7		D	7.00								7
		SPT	7.20 - 7.65	S 16							
									7.50	-5.59	
8								Extremely weak low density locally very weak low to medium density white CHALK. Discontinuities are randomly orientated extremely closely spaced rough undulating and stepped tight to moderately wide with comminuted silt infill within open to moderately wide discontinuities. Flints are very dark brown coarse gravel size nodular medium to widely spaced. (White Chalk Subgroup Grade C4/5) 7.70m: Light orangish brown staining with slight sand smear along discontinuity. 8.15m: Soft light brown clayey silt (<5mm) around very dark brown with light grey rinded nodular flint.			8
		D	8.40								
		SPT	8.60 - 9.05	S 42							
9											9
		D	9.70					9.70m: <10mm comminuted silt infill around very dark brown / black nodular flint. 9.80m: <10mm comminuted silt infill around very dark brown / black nodular flint.			
10		SPT	9.90 - 10.35	S 17							10
								10.20m: Light grey marl lens and some orange brown discolouration along discontinuity.			
11		D	11.10								11
		SPT	11.30 - 11.75	S 49					(6.00)		
								11.50-11.70m: Very closely to closely spaced coarse gravel size very dark brown / black nodular flints.			
12											12
								12.20m: Very dark brown / black with light grey / white rinded coarse gravel size flint. 12.20m: Flints becoming very widely spaced.			
		D	12.60								
13		SPT	12.70 - 13.15	S 22							13

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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ROTARY BOREHOLE LOG

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Borehole No. **BH107**

Sheet 3 of 5

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494418 N 99623	Hole Type DS+RC
Location: Bognor Regis		Level: 1.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 09/11/2015 End: 12/11/2015	Logged By DM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								Extremely weak low density locally very weak low to medium density white CHALK. Discontinuities are randomly orientated extremely closely spaced rough undulating and stepped tight to moderately wide with comminuted silt infill within open to moderately wide discontinuities. Flints are very dark brown coarse gravel size nodular medium to widely spaced. (White Chalk Subgroup Grade C4/5) *(continued from previous sheet)*			
14		D SPT	14.00 14.10 - 14.55	S 31							14
15											15
		D C SPT	15.40 15.50 - 17.00 15.50 - 15.74	S*167		100% 57% 42%		15.40m: Very dark brown / black nodular flint (recovered as fine to coarse gravel size fragments - drilling induced fracturing).	15.50	-13.59	
16		C CS	16.20 - 17.00 16.40 - 16.59		C C			Very weak medium density white CHALK with medium spaced flints. Bedding discontinuities are sub-horizontal closely to medium spaced (110/210/380) rough undulating tight to partly open predominantly clean with occasional silt smear. Flints are very dark brown with light grey rind coarse gravel size to cobble size nodular. (White Chalk Subgroup Grade B2/3). 15.50-15.95m: Non-intact. Disturbed by SPT. 16.10-16.22m: Locally discontinuities are extremely to very closely spaced rough stepped and undulating with comminuted silt infill >3mm around coarse gravel size flint. (Locally Grade C5) 16.35m: Light brown discolouration along 30° discontinuity. 16.85m: Light grey brown discolouration along sub-horizontal discontinuity.	(1.98)		16
17		D C	16.95 - 17.00 17.00 - 18.50			100% 68% 27%					17
		CS	17.70 - 17.90		S			17.00m-17.10m: Locally extremely weak low density with extremely closely spaced thin marl laminations of light grey marl. 17.00m-17.48m: Sub-vertical to 80° rough undulating and stepped closed discontinuity. From 17.30m: Discontinuity becoming tight with light brown discolouration along surface. 17.30m-17.35m: White calcite mineralisation (<2mm thick) along discontinuity.	17.48 17.70	-15.57 -15.79	
18		D	18.19 - 18.26								18
		C CPT	18.50 - 20.00 18.50 - 18.87	S*68		93% 21% 7%		Extremely weak to very weak low to medium density white CHALK with extremely closely spaced thin light grey marl laminations and very closely spaced fossil shell fragments. Discontinuities are sub-horizontal very closely spaced (50/150) rough undulating tight to moderately wide with light grey silt infill (degraded marl) <10mm. (White Chalk Subgroup Grade C3/4) 17.48m: White calcite mineralisation (<2mm thick) along sub-horizontal discontinuity.	(2.82)		
19		CS	18.97 - 19.14		C			Very weak medium density white CHALK with very closely spaced very light grey marly lenses. Bedding discontinuities are sub-horizontal closely to medium spaced (80/210/380) rough undulating predominantly tight clean with occasional silt smear. Flints are very dark brown with white rind nodular recovered as medium to coarse gravel size and cobble size fragments. (White Chalk Subgroup Grade B2/3) 17.90-18.00m: Discontinuities are sub-horizontal to sub-vertical very closely spaced (30/40/50) rough stepped tight clean (probably drilling induced). 18.20-19.65m: Sub-vertical rough undulating closed to			19
		D	19.60 - 19.65								
20		C	20.00 - 21.50		C	100% 43% 7%					20

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
10/11/2015	15.50	15.10	1.50
11/11/2015	15.50	15.10	1.50

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ROTARY BOREHOLE LOG

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Borehole No. **BH107**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494418 N 99623	Hole Type DS+RC
Location: Bognor Regis		Level: 1.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 09/11/2015 End: 12/11/2015	Logged By DM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		CS	20.52 - 20.67					tight discontinuity with light brown and dark brown mottled discolouration along joint surface. 18.50-18.95m: Non-intact. Disturbed by SPT. 18.85-19.00m: Locally extremely weak low density with comminuted infill (<10mm) around flint cobble. 19.40-19.70m: Locally very weak with extremely closely to very closely spaced randomly orientated discontinuities with some comminuted silt infill (10mm) around flint cobble. (Locally grade C4/5) 19.80-20.00m: Light yellow brown discolouration along sub-horizontal discontinuities. 20.00-20.15m: Locally extremely weak to very weak around coarse gravel size fragments of flint. Discontinuities are randomly orientated extremely closely to very closely spaced tight with silt smear and occasional dark brown discolouration. 20.25-20.52m: 70° rough to smooth undulating discontinuity with light grey and dark brown surface discolouration. 20.40m: Orange brown discolouration along sub-horizontal discontinuity. 20.51-20.52m: Orange brown discolouration along sub-horizontal discontinuity.	20.52	-18.61	
21		D	21.45 - 21.50	S*67		100%			(1.28)		21
		C	21.50 - 23.00			39%					
		CPT	21.50 - 21.88			26%					
		CS	21.80 - 22.10						21.80	-19.89	
22		D	22.30								22
23		C	23.00 - 24.50			100%		Very weak medium density locally extremely weak to very weak low to medium density preferentially along bedding discontinuities white CHALK with close to medium spaced thin marl laminations. Bedding discontinuities are sub-horizontal closely spaced (90/120/200) rough undulating tight to partly open with some comminuted infill (<3mm). (White Chalk Subgroup Grade B3) *(continued from previous sheet)* 20.68-21.10m: Sub-vertical to 80° rough undulating discontinuity with light brown staining. 21.00-21.10m: 45° rough striated discontinuity with light grey and dark brown staining. 21.20-21.35m: Locally extremely weak low density with extremely closely spaced thin marl laminations. Discontinuities are randomly orientated extremely closely spaced. 21.35m: Dark orangish brown staining. 21.50-21.80m: Non-intact. Disturbed by SPT.			23
		CS	23.10 - 23.30			65%			(2.85)		
		D	23.40			25%					
24		D	24.40								24
		C	24.50 - 26.00	S.31		87%					
		CPT	24.50 - 24.95			8%					
						0%			24.65	-22.74	
25		D	25.00					Very weak medium density white CHALK with closely spaced very light grey thin to thick marl lenses and medium spaced flints. Bedding discontinuities are sub-horizontal predominantly closely spaced (60/120/150) rough undulating partly open with silt smear. Flints are very dark brown with white rind <50mm thick nodular. (White Chalk Subgroup Grade B3) 21.80-22.15m: Medium spaced discontinuities. 22.65-23.00m: Sub-vertical rough undulating and stepped discontinuity with slight silt smear. Preferentially very weak with extremely closely to very closely spaced discontinuities along joint. 23.30-23.75m: Closely spaced very dark brown flint bands (<30mm thick). 24.15m: Extremely closely spaced discontinuities around flint. 24.65-25.00m: Non-intact. Disturbed by SPT.	(1.35)		25
26		D	25.95 - 26.00						26.00	-24.09	26
		C	26.00 - 27.50			100%					
						75%					
		CS	26.40 - 26.71			54%					
27								Very weak medium density white CHALK with closely spaced very light grey thin to thick marl lenses and medium spaced flints. Bedding discontinuities are sub-horizontal predominantly closely spaced (60/100/200) rough undulating. (White Chalk Subgroup Probable Grade B3) 25.40-25.90m: Sub-vertical rough undulating discontinuity with extremely closely spaced dark brown specs.	(1.50)		27
		C	27.50 - 29.00	S*94		97%			27.50	-25.59	
		CPT	27.50 - 27.81			45%					
						21%		Very weak medium density white CHALK with very closely to closely spaced thin light grey laminations and			

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
11/11/2015	27.50	16.00	3.40
12/11/2015	27.50	16.00	1.50

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Borehole No. **BH107**

Sheet 5 of 5

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494418 N 99623	Hole Type DS+RC
Location: Bognor Regis		Level: 1.91mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 09/11/2015 End: 12/11/2015	Logged By DM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								lenses. Discontinuities are closely to medium spaced (65/280/350) rough undulating wide (<40mm) infilled with slightly silty slightly sandy angular to sub-angular fine to coarse gravel of chalk and flint. (White Chalk Subgroup GradeC2/3)	(0.67)		
28					C			26.00-26.10m: Non-intact. Recovered as slightly silty sandy fine to coarse gravel of chalk and flint (probable drilling induced disturbance).	28.17	-26.26	28
		B	28.70					26.50-26.75m: 45° rough undulating discontinuity with very pale brown silt smear. Preferentially fractured (extremely closely spaced) around joint.	(1.09)		
		D	28.90					26.80m: Becoming Grade A2/3. Discontinuities becoming tight to partly open clean.			
29		C	29.00 - 30.50			100% 97% 75%		27.50-27.58m: Drilling disturbed; chalk cobble recovered.	29.26	-27.35	29
								27.58-27.76m: Band of sub-angular and sub-rounded fine to coarse gravel and cobbles of flint.			
								Very weak medium density white with occasional orangish brown staining CHALK. Discontinuities are very closely and closely spaced spaced (20/40/80) infilled with (1/2/5) white comminuted chalk, lightly orangish brown stained. (White Chalk Subgroup Grade C4-5) *(continued from previous sheet)*			
		CS	29.75 - 30.10		C			28.12-28.17m: Band of structureless grade Dc chalk.			
30								Weak medium density white CHALK. Discontinuities are very closely and closely spaced (NI/60/130) locally infilled (0/3/20) with white comminuted chalk. (White Chalk Subgroup Grade B2-3)			30
		C	30.50 - 32.00	S*107		97%		28.38-28.40m: Band of sub-angular coarse flint gravel.			
		CPT	30.50 - 30.79			73% 58%		Very weak medium density white CHALK. Discontinuities are closely and medium spaced locally extremely closely and very closely spaced (10/120/340) rarely locally infilled (0/0/2) with white comminuted chalk. (White Chalk Subgroup Grade A2-3)			
		D	30.90					30.22-30.35m: Band of sub-rounded fine and medium flint gravel.			
31					C			30.50-30.55m: Band of sub-rounded fine and medium flint gravel.			31
		CS	31.30 - 31.56					30.60-30.80m: sub-vertical to 60° undulating rough fracture.			
		B	31.56					31.18-31.30m: Band of low and medium density grade B4-5 chalk.			
		C	32.00 - 33.50			87% 67% 39%		31.60-31.80m: With occasional sub-angular and sub-rounded fine to coarse gravel sized light grey staining.	(5.74)		
32								31.85-31.90m: Band of sub-angular and sub-rounded medium and coarse flint gravel.			32
		D	32.50					32.10-32.20m: Band of sub-angular and sub-rounded fine to coarse flint gravel.			
					C			32.68-32.75m: Drilling disturbed; recovered non intact as sub-angular fine to coarse gravel sized fragments.			
33		CS	32.97 - 33.15								33
		B	33.18					33.20-33.25m: Band of angular and sub-angular fine to coarse flint gravel.			
		C	33.50 - 35.00	S*103		92%		33.38-33.50m: Band of angular and sub-angular fine to coarse flint gravel.			
		CPT	33.50 - 33.79			57% 51%		33.55-33.60m: Band of sub-angular and sub-rounded fine to coarse flint gravel.			
								33.75-33.80m: Band of sub-angular and sub-rounded fine to coarse flint gravel.			
34								34.12-34.21m: Band of medium density grade B5 chalk.			34
		CS	34.20 - 34.53		C						
		B	34.67					34.62-34.66m: sub-rounded coarse gravel sized flint nodule.			
		D	34.90					34.82-35.00m: 2 no. sub-vertical very closely spaced parallel undulating rough Discontinuities.	35.00	-33.09	
35								Borehole completed at 35.00m			35

Groundwater:

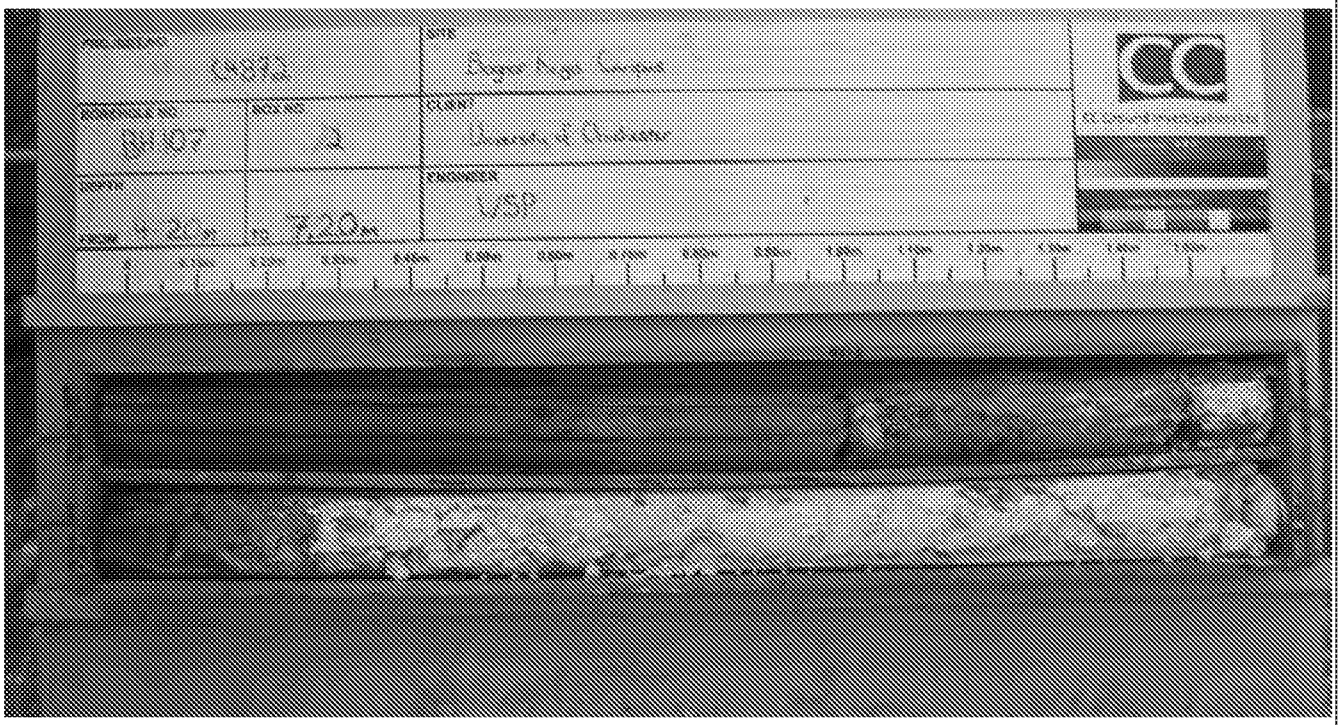
Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
12/11/2015	35.00	16.00	3.70

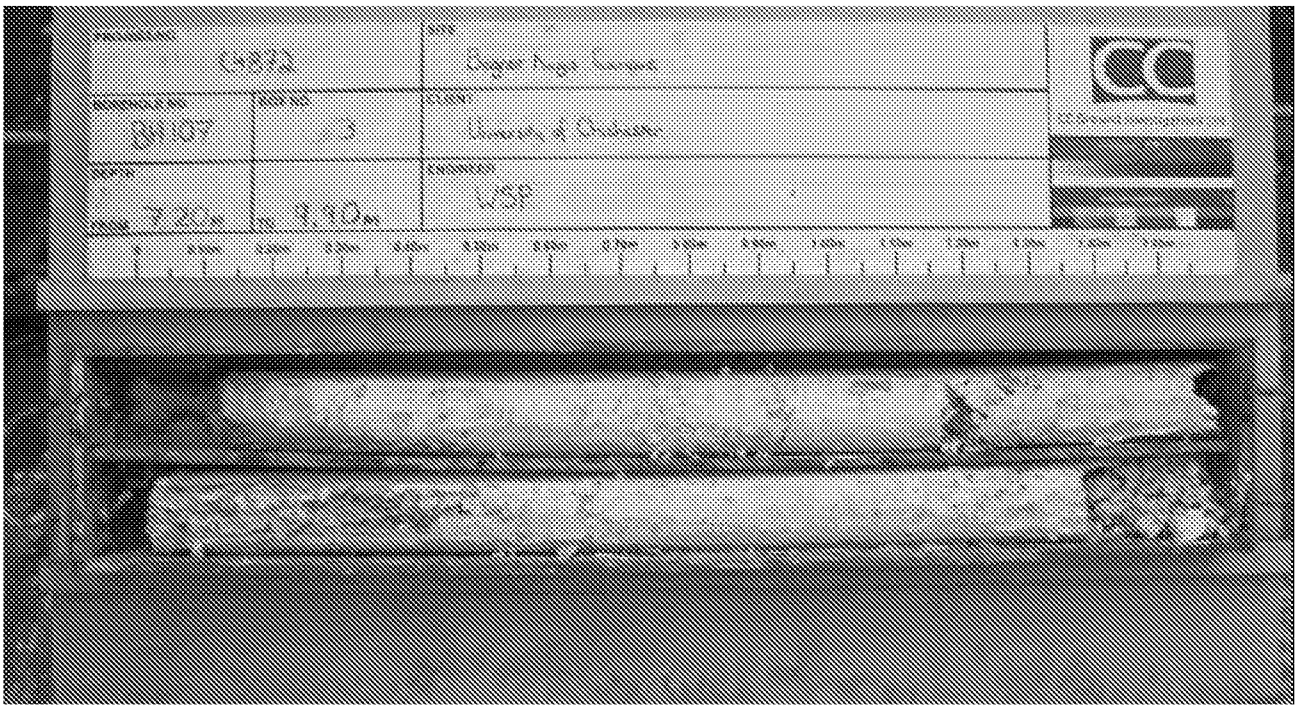
Borehole Photograph





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Contract ID:	C4872
Client:	University of Chichester
Hole ID:	BH107

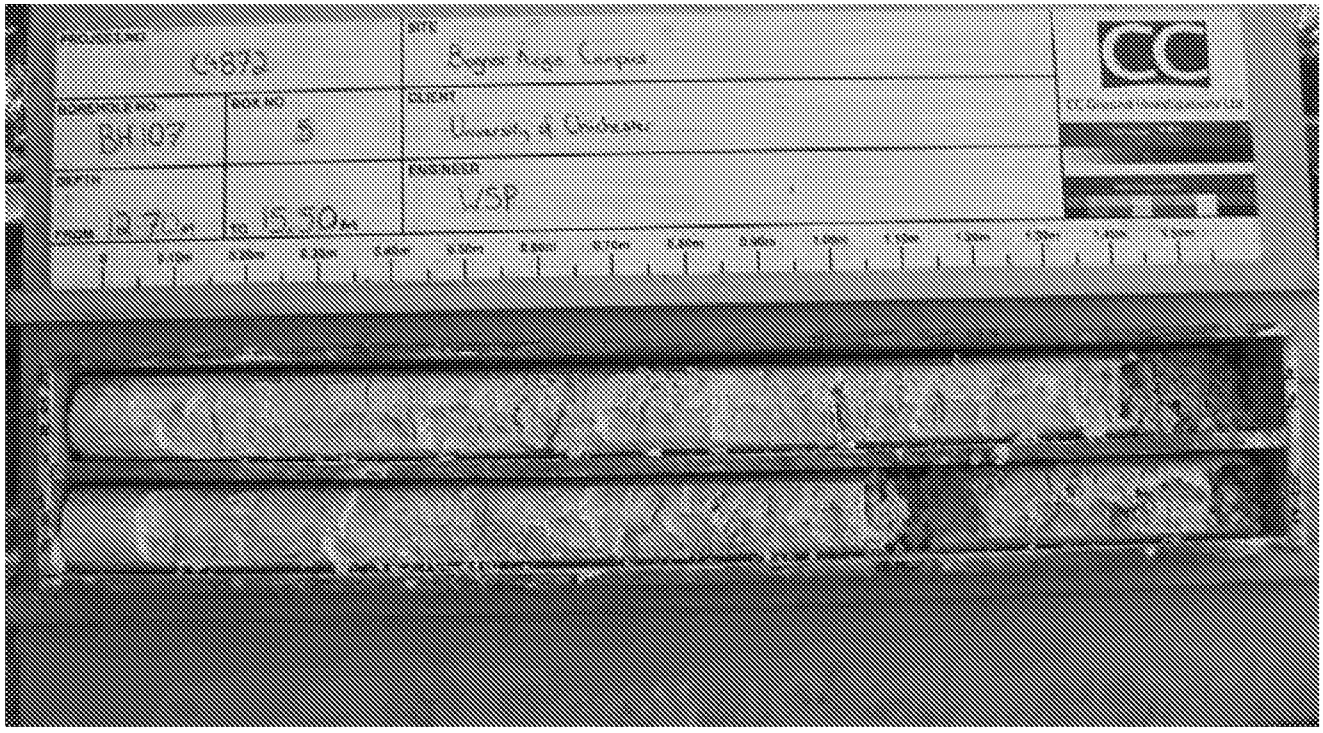
Borehole Photograph

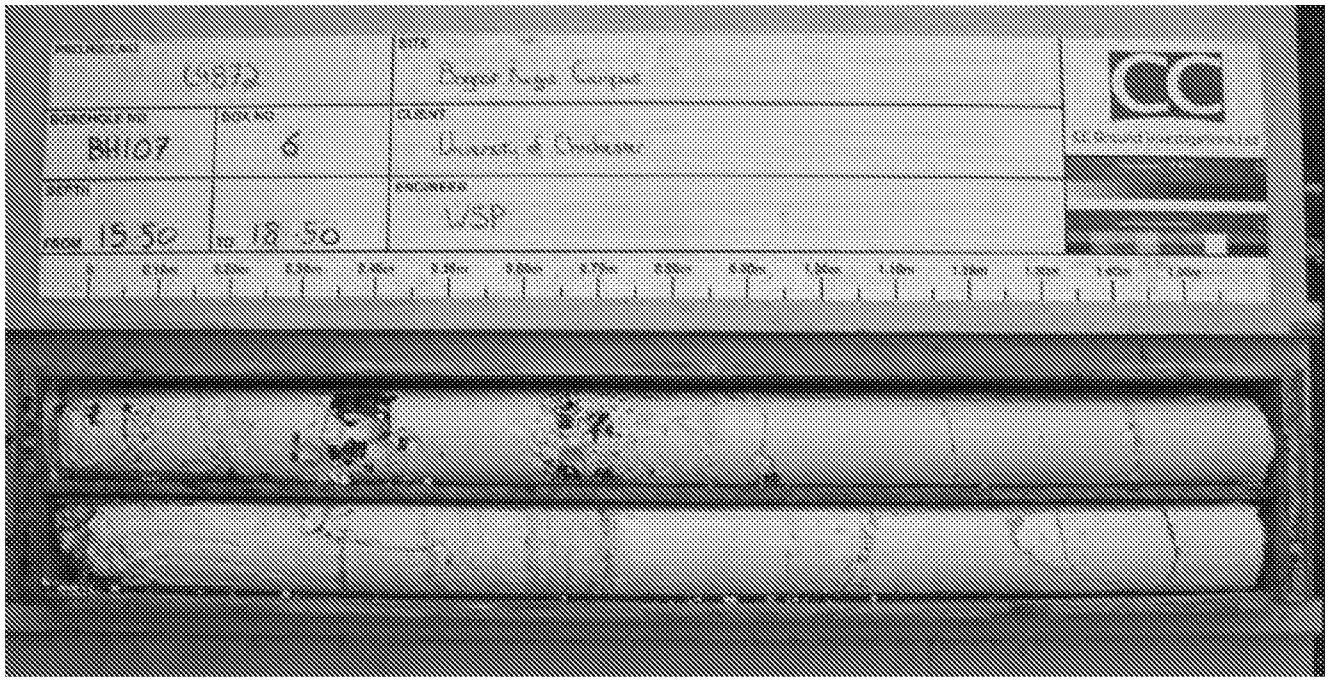




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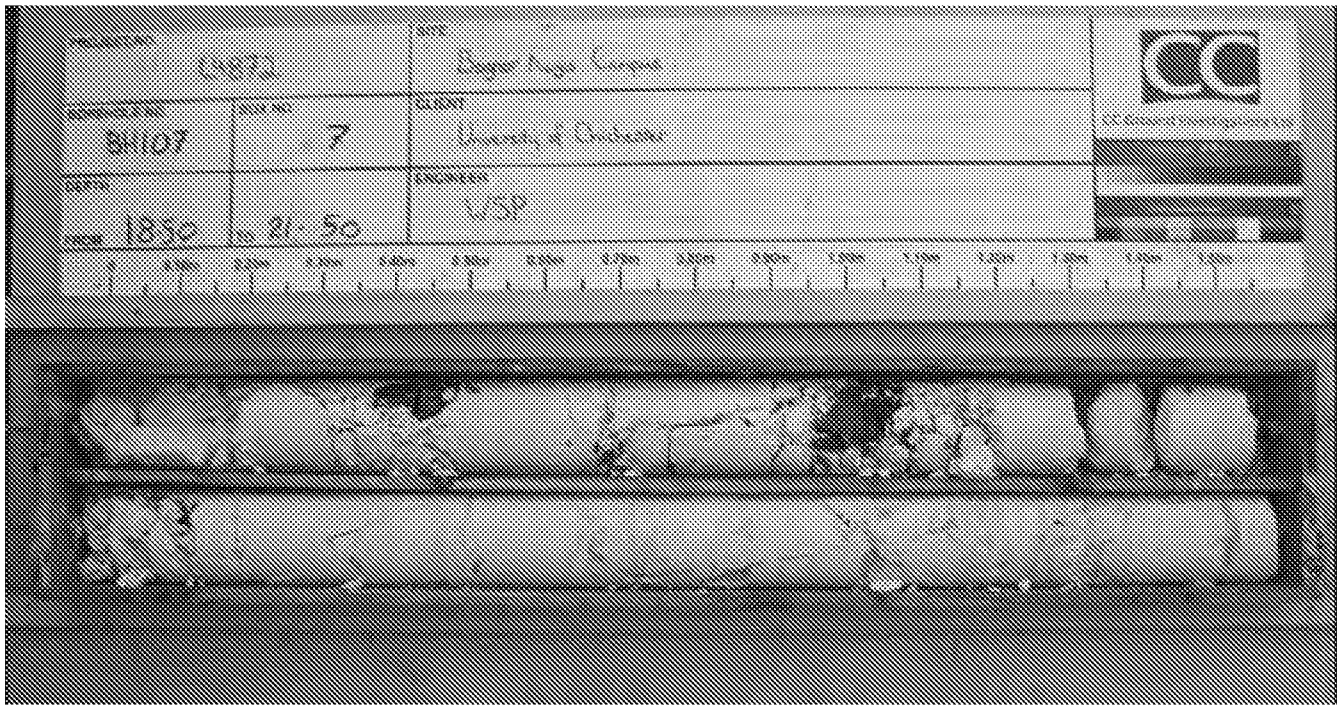
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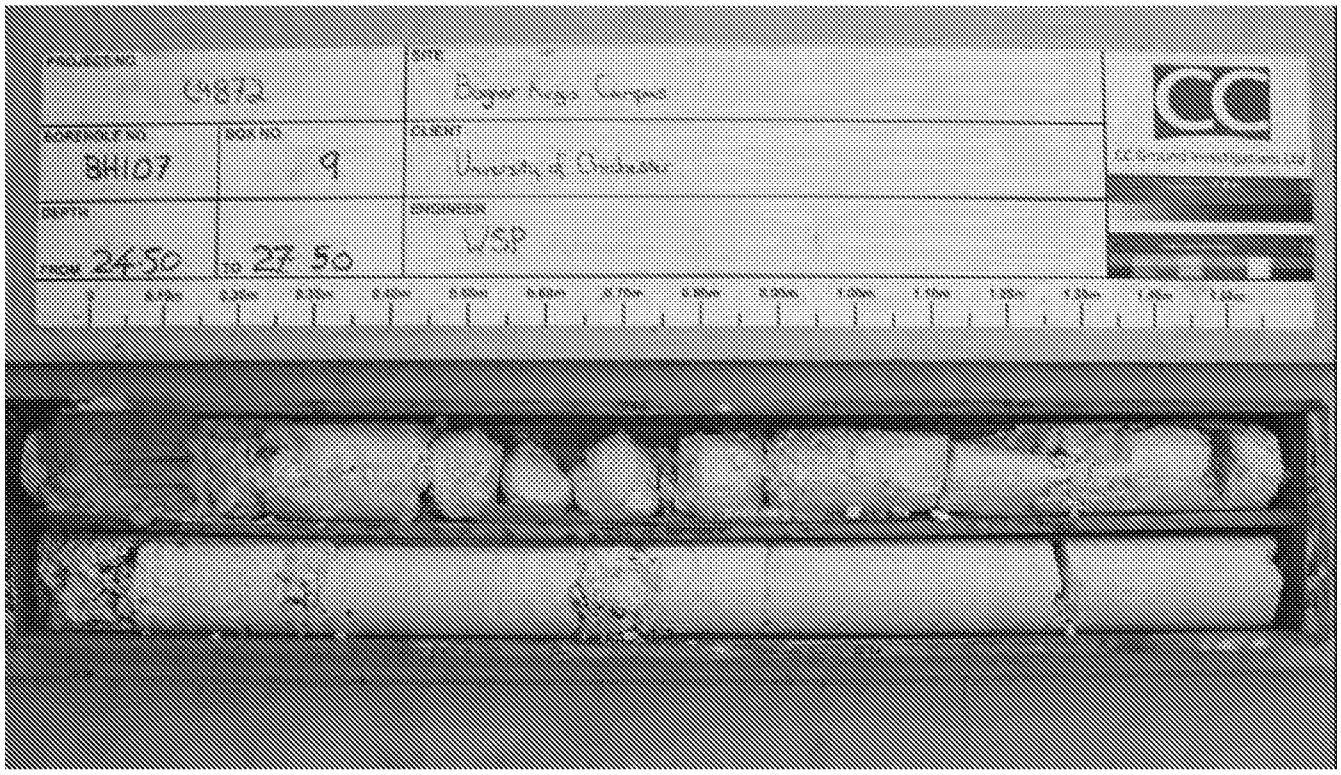




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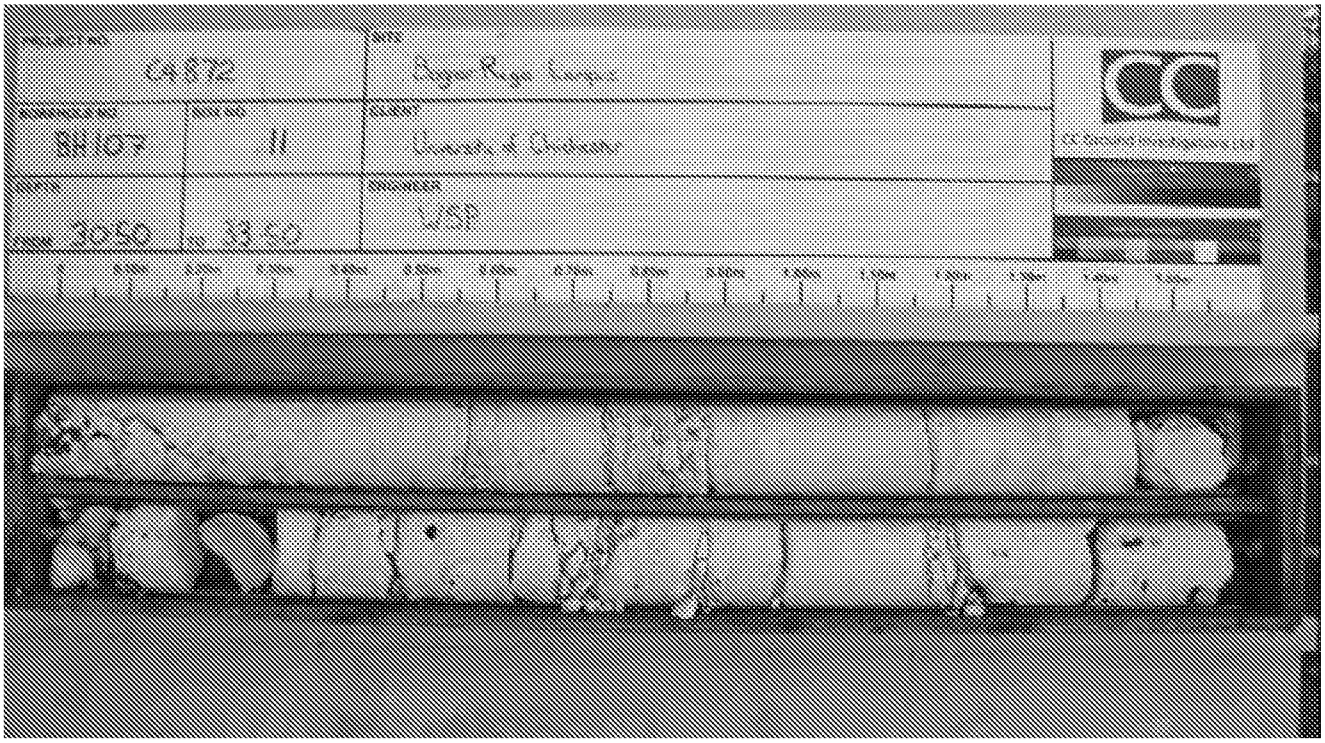




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Borehole Photograph





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Hole ID:	BH107

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ROTARY BOREHOLE LOG

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Borehole No. **BH108**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494417 N 99666	Hole Type DS+RC
Location: Bognor Regis		Level: 1.36mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 02/11/2015 End: 09/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		B	0.20					MADE GROUND: Grass over soft brown mottled yellowish brown, orangish brown and grey slightly sandy slightly gravelly silty CLAY with frequent rootlets (<1mm). Gravel is angular to sub-rounded fine to coarse brick and siliceous material.	0.10	1.26	
		ES	0.40						(0.30)		
		B	0.50						0.40	0.96	
1		B	1.00					Soft becoming firm yellowish brown mottled orangish brown and grey slightly gravelly silty CLAY with occasional rootlets (<1mm). Gravel is angular to sub-rounded fine to coarse siliceous material. (Superficial Deposits)			1
		UT100	1.20 - 1.65					Soft grey mottled orangish brown and yellowish brown slightly sandy silty CLAY. (Superficial Deposits) 0.40-1.00m: Locally firm.	(1.35)		
		D	1.65 - 1.75						1.75	-0.39	
2		D	2.00	H 14				Very soft grey mottled black slightly sandy silty CLAY. (Superficial Deposits) 1.90-4.00m: Sand absent.			2
		H						2.20-2.70m: Frequent black partially decomposed roots and rootlets (<3mm).			
		SPT	2.50 - 2.95	S 1							
3									(2.25)		3
		D	3.50	H 12							
		H									
4		UT100	4.00 - 4.45						4.00	-2.64	4
		D	4.45 - 4.55					Very soft to soft grey slightly sandy locally sandy silty CLAY. (Superficial Deposits)			
								4.80-6.40m: Occasional shell fragments (<50mm).			
5		D	5.00	H 13							5
		H									
		SPT	5.50 - 5.95	S 5							
6											6

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REMARKS:

EQUIPMENT: Hand digging tools. Fraste PL multi purpose track mounted rig.
METHOD: Hand dug inspection pit: 0.00-1.20m. Continuous dynamic sampled (128mm diam) 1.20-15.70m. Waterflush rotary core drilled (146mm diam) 15.70-34.40m.
GROUNDWATER: Water seepage at 1.20m. No rise recorded.
CASING: SW casing to 15.70m.
INSTALLATION: 50mm ID HDPE slotted pipe with washed gravel response zone: 10.00-34.40m, plain pipe with washed gravel response zone: 9.90-10.00m, and bentonite pellet seal: 0.30-9.90m, flush 150mm steel cover set in concrete 0.00-0.30m. Gas valve fitted.

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)
03/11/15	1.20		1.20

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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ROTARY BOREHOLE LOG

Telephone: 01452 739165 , Fax: 01452 739220 , Email: info@ccground.co.uk

Borehole No. **BH108**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494417 N 99666	Hole Type DS+RC
Location: Bognor Regis		Level: 1.36mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 02/11/2015 End: 09/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
		D	6.30					Very soft to soft grey slightly sandy locally sandy silty CLAY. (Superficial Deposits) *(continued from previous sheet)*	(4.40)		
								6.40-7.00m: Limited recovery.			
7		SPT	7.00 - 7.45	S 2							7
								7.40-7.80m: Occasional wood fragments (<20mm).			
								7.80-8.40m: Frequent wood fragments (<50mm).			
8		D	8.00								8
								8.20-8.40m: Slightly gravelly. Gravel is angular to sub-rounded fine to coarse flint and charcoal.	8.40	-7.04	
		SPT	8.50 - 8.95	S 6				Structureless CHALK composed of yellowish brown mottled grey and white slightly sandy gravelly SILT. Gravel is sub-angular to sub-rounded fine to coarse, very weak, low density chalk. (White Chalk Subgroup Grade Dm)	(0.40)		
									8.80	-7.44	
9								Structureless CHALK composed of white mottled grey slightly sandy silty GRAVEL with a strong sulphurous odour. Gravel is sub-angular to sub-rounded fine to coarse, very weak, low density chalk. (White Chalk Subgroup Grade Dc)	(0.30)		9
									9.10	-7.74	
		D	9.50					Structureless locally indistinctly structured CHALK composed of white mottled grey slightly sandy silty GRAVEL with slight sulphurous odour. Gravel is sub-angular to sub-rounded fine to coarse, very weak, low density chalk. (White Chalk Subgroup Grade Dc locally tending to C5)	(1.30)		
10		SPT	10.00 - 10.45	S 5							10
									10.40	-9.04	
		D	10.70					Extremely weak to very weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal extremely closely and very closely spaced infilled with comminuted chalk (<20mm). (White Chalk Subgroup Grade C4-C5)			
11								10.90-13.90m: Widely spaced very thin to thin beds of rinded flint gravel and cobbles. Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.			11
								11.00-11.30m: Structureless. Recovered as slightly sandy gravelly silt. Possibly drilling disturbed.			
12											12
								12.25-12.40m: Discontinuity surfaces locally stained orangish brown.			
		D	12.50								
		B	12.60 - 13.00								
13		SPT	13.00 - 13.45	S 21				12.90-13.30m: Discontinuity surfaces locally stained orangish brown.			13

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
04/11/2015	11.50	11.50	1.10

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ROTARY BOREHOLE LOG

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Borehole No. **BH108**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494417 N 99666	Hole Type DS+RC
Location: Bognor Regis		Level: 1.36mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 02/11/2015 End: 09/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
								Extremely weak to very weak medium density white CHALK. Discontinuities are sub-horizontal and horizontal extremely closely and very closely spaced infilled with comminuted chalk (<20mm). (White Chalk Subgroup Grade C4-C5) *(continued from previous sheet)*	(6.30)		
								13.60-15.10m: Extremely weak low to medium density chalk.			
14		D	14.00					14.00-15.10m: Discontinuities are sub-horizontal to horizontal very closely spaced stained orangish brown infilled with comminuted chalk (<15mm). [Grade C4]			14
								14.20-14.50m: Limited recovery.			
								14.50-14.80m: Structureless. Recovered as slightly sandy silty gravel. Possibly drilling disturbed.			
15								15.10-15.40m: Locally mottled orangish brown and grey.			15
								15.40-15.60m: Discontinuities are sub-horizontal to horizontal extremely closely spaced stained grey infilled with comminuted chalk (<5mm). [Grade C5]			
		C	15.70 - 16.80	S 45		100%					
		SPT	15.70 - 16.15			6% 0%		15.85-15.90m: Mottled grey.			
16								16.10-16.15m: Mottled orangish brown.			16
		D	16.50					16.50-16.65m: Rinded flint gravel and cobbles (<70mm). Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.	16.70	-15.34	
		C	16.80 - 18.30			100% 43% 26%		Extremely weak to very weak medium density white locally mottled grey and orangish brown CHALK. Discontinuities are sub-vertical to sub-horizontal very closely to closely spaced clean or infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade A3-B4)	(1.30)		
17		CS	17.10 - 17.35					16.80-17.45m: Closely to medium spaced very thin to thin beds of rinded flint gravel and cobbles. Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.			17
								17.00-17.08m: Possibly drilling disturbed.			
								17.30-17.45m: Possibly drilling disturbed.	18.00	-16.64	
18		CS	18.10 - 18.30					Extremely weak to very weak medium density white locally mottled orangish brown and grey CHALK. Discontinuities are 45° to sub-horizontal closely spaced infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade B3)			18
		C	18.30 - 19.80	S 37		100%					
		SPT	18.30 - 18.75			51% 35%		18.65-18.70m: Possibly drilling disturbed.			
		CS	18.80 - 19.10					18.80-19.10m: Discontinuities are sub-horizontal medium spaced (300mm) with smear of comminuted chalk (<1mm). [Grade B2]			
19								19.10-21.30m: Discontinuities are sub-horizontal and horizontal closely and very closely spaced locally infilled with comminuted chalk (<1mm). [Grade A3-B4]			19
		D	19.50								
		C	19.80 - 21.30			100% 52% 24%		19.80-21.50m: Closely to medium spaced very thin to thin beds of rinded flint gravel and cobbles. Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.			
20											20

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)

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ROTARY BOREHOLE LOG

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Borehole No. **BH108**

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494417 N 99666	Hole Type DS+RC
Location: Bognor Regis		Level: 1.36mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 02/11/2015 End: 09/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
21		CS	20.82 - 21.00		C			Extremely weak to very weak medium density white locally mottled orangish brown and grey CHALK. Discontinuities are 45° to sub-horizontal closely spaced infilled with comminuted chalk (<1mm). (White Chalk Subgroup Grade B3) *(continued from previous sheet)*	(6.30)		21
		C SPT	21.30 - 22.80 21.30 - 21.75	S 30	C	96% 53% 21%					
22					C			21.90-22.80m: Discontinuities are sub-horizontal and horizontal closely spaced infilled with comminuted chalk (<1mm). [Grade B3]			22
		D	22.30					22.30-22.85m: Closely to medium spaced very thin to thin beds of rinded flint gravel and cobbles. Gravel is sub-angular to rounded fine to coarse. Cobbles are sub-rounded.			
		CS	22.60 - 22.80		C						
		C	22.80 - 24.10			98% 39% 31%		22.85-23.50m: Discontinuities are randomly orientated very closely and extremely closely spaced infilled with comminuted chalk (<1mm). [Grade B4-B5]			
23		D	23.40		C			23.50-24.30m: Discontinuities are sub-horizontal and horizontal medium and closely spaced locally infilled with comminuted chalk (<1mm). [Grade B2-B3]			23
		CS	23.85 - 24.10		C						
24		C SPT	24.10 - 25.60 24.10 - 24.55	S 43		100% 43% 29%		24.25-24.75m: Possibly drilling disturbed. Discontinuities are randomly orientated extremely closely and very closely spaced infilled with comminuted chalk (<5mm) with occasional sub-angular to sub-rounded fine to coarse flint gravel. [Grade C4-C5]	24.30	-22.94	24
					C			Very weak to weak medium density white mottled yellowish brown and orangish brown CHALK. Discontinuities are sub-horizontal closely spaced locally infilled with comminuted chalk (<1mm). Very widely and widely spaced rinded flints recovered as angular to sub-rounded gravel and cobbles (<300mm). (White Chalk Subgroup Grade B3-A3)			
25		D	25.10					24.75-25.00m: Discontinuities are sub-vertical to sub-horizontal closely spaced infilled with comminuted chalk (<1mm). [Grade B3]			25
		CS	25.30 - 25.50		C			25.00-25.15m: Possibly drilling disturbed. Discontinuities are randomly orientated extremely closely and very closely spaced infilled with comminuted chalk (<5mm). [Grade C4-C5]			
		C	25.60 - 27.10			100% 85% 67%		25.25-25.30m: Possibly drilling disturbed. Discontinuities are randomly orientated extremely closely and very closely spaced infilled with comminuted chalk (<5mm). [Grade C4-C5]			
26					C			25.30-31.60m: Discontinuities are sub-horizontal to horizontal closely to medium spaced with smear of comminuted chalk (<1mm). [Grade B2-B3]			26
		D	26.60					25.85-26.20m: Discontinuity is sub-vertical to 45° clean.			
		CS	26.85 - 27.10		C			26.30-26.40m: Possibly drilling disturbed. Discontinuities are randomly orientated extremely closely and very closely spaced infilled with comminuted chalk (<5mm). [Grade C4-C5]			
27		C SPT	27.10 - 28.60 27.10 - 27.55	S 39		100% 97% 97%		27.60-31.40m: Occasional grey mottling.			27

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
04/11/2015	24.10	15.70	1.00
05/11/2015	24.10	15.70	1.10

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ROTARY BOREHOLE LOG

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Borehole No. **BH108**

Sheet 5 of 5

Project Name: University of Chichester	Project No: **C4872**	Co-ords: E 494417 N 99666	Hole Type DS+RC
Location: Bognor Regis		Level: 1.36mAOD	Scale 1 : 37.50
Client: University of Chichester		Dates: Start: 02/11/2015 End: 09/11/2015	Logged By SM

(m)	Water Levels	Core Run, Samples & Testing: No/Type	Depth (m)	Result	Core Run & Sample	TCR SCR RQD	Install	Description	Depth (m)	Level (mAD)	Legend
28		D	27.80					Very weak to weak medium density white mottled yellowish brown and orangish brown CHALK. Discontinuities are sub-horizontal closely spaced locally infilled with comminuted chalk (<1mm). Very widely and widely spaced rinded flints recovered as angular to sub-rounded gravel and cobbles (<300mm). (White Chalk Subgroup Grade B3-A3) *(continued from previous sheet)*			
		CS	28.30 - 28.60		C						
		C	28.60 - 30.10			95% 81% 63%					
		CS	28.80 - 29.20								
29					C			29.20-29.25m: Possibly drilling disturbed. Discontinuities are randomly orientated extremely closely and very closely spaced infilled with comminuted chalk (<5mm). [Grade C4-C5]	(10.50)		
								29.70-29.80m: Possibly drilling disturbed. Discontinuities are sub-horizontal extremely closely and very closely spaced infilled with comminuted chalk (<3mm). [Grade B4-B5]			
30		D	30.00								
		C	30.10 - 30.60	S 44		98%					
		SPT	30.10 - 30.55			94%					
		D	30.20		C	60%					
		C	30.60 - 32.10			100% 67% 47%					
31								31.15-31.60m: Possibly drilling disturbed. Discontinuities are sub-horizontal to horizontal locally randomly orientated extremely closely and very closely spaced infilled with comminuted chalk (<3mm). [GradeB4-B5] 31.30-31.35m: Possibly drilling disturbed. Discontinuities are randomly orientated extremely closely spaced infilled with comminuted chalk (<1mm). [Grade B4-B5] 31.60-31.70m: Possibly drilling disturbed. Discontinuities are randomly orientated extremely closely spaced infilled with comminuted chalk (<1mm). [Grade B4-B5] 32.10-32.30m: Discontinuity is sub-vertical to 45° clean, striated and mottled grey. 32.30-34.40m: Indistinctly thinly laminated.			
		CS	31.30 - 31.50		C						
32		D	31.90								
		C	32.10 - 33.60	S*57		85%					
		SPT	32.10 - 32.50			57% 49%					
		CS	32.70 - 33.00		C						
33		D	33.00								
		C	33.60 - 34.40			100% 66% 41%					
34					C			33.90-34.20m: Discontinuities are sub-vertical to 45° very closely to closely spaced infilled with comminuted chalk (<1mm), striated and mottled grey.			
		D	34.20								
		SPT	34.40 - 34.80	S*64							
								Borehole completed at 34.80m	34.80	-33.44	
35											

Groundwater:

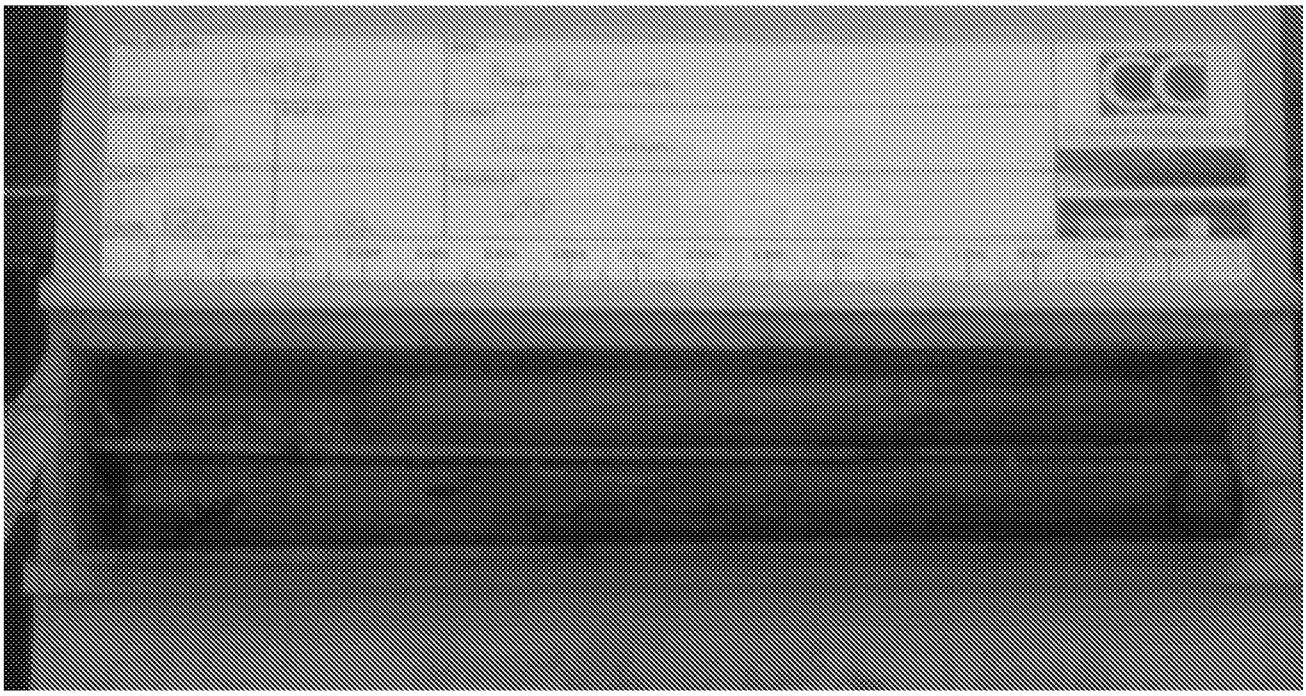
Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

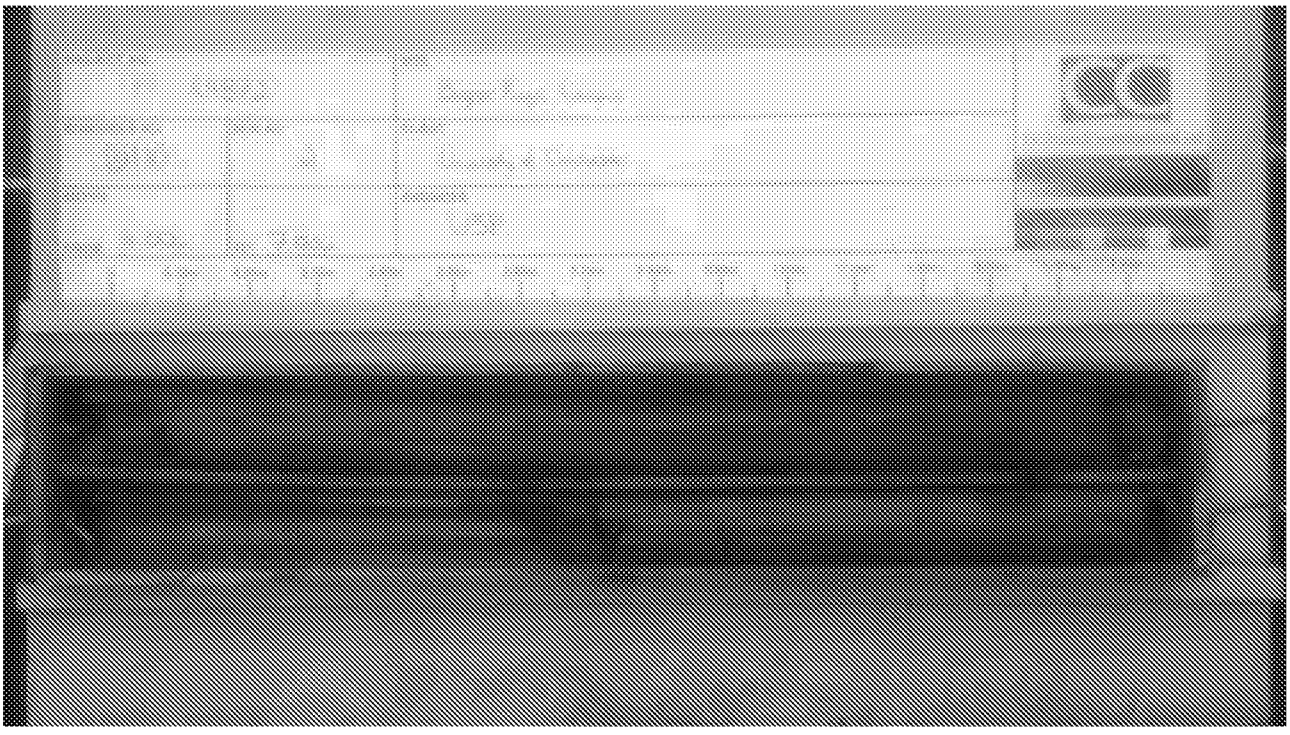
Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
05/11/2015	34.80	15.70	1.00

DRAFT

Borehole Photograph

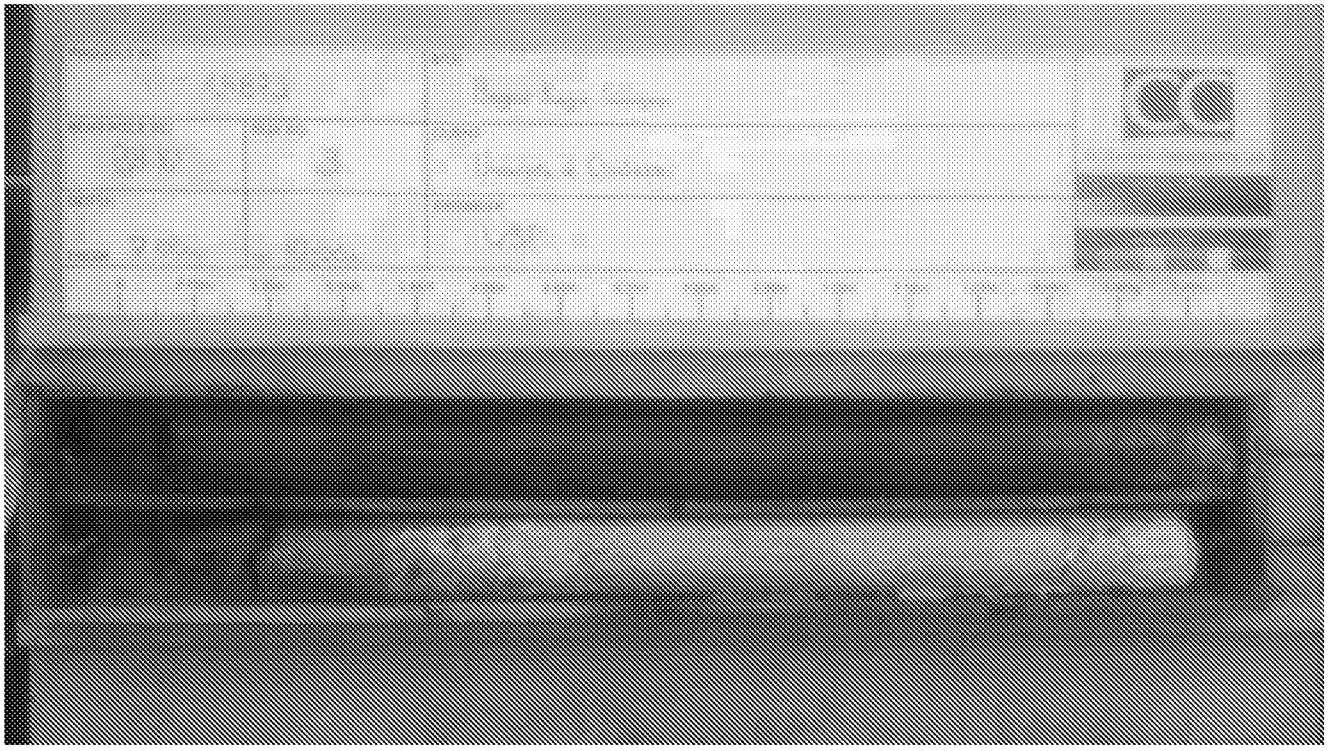




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Client:	University of Chichester
Hole ID:	BH108

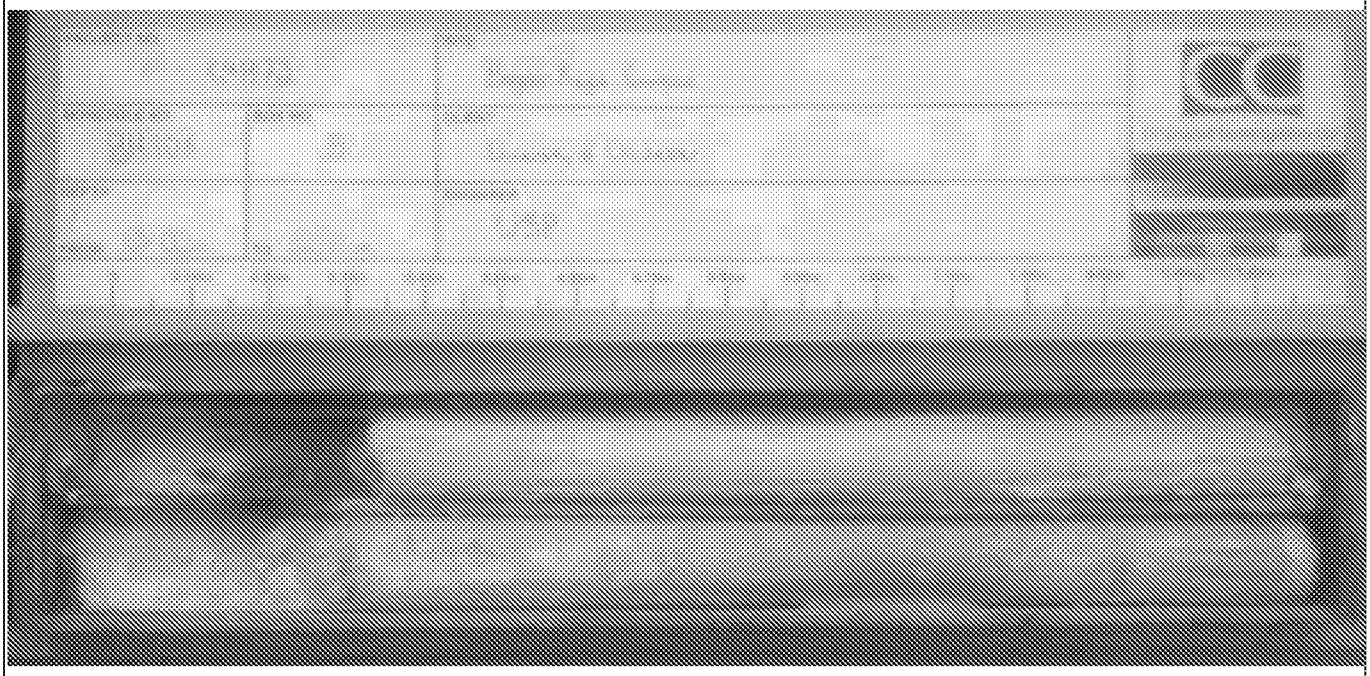
Borehole Photograph

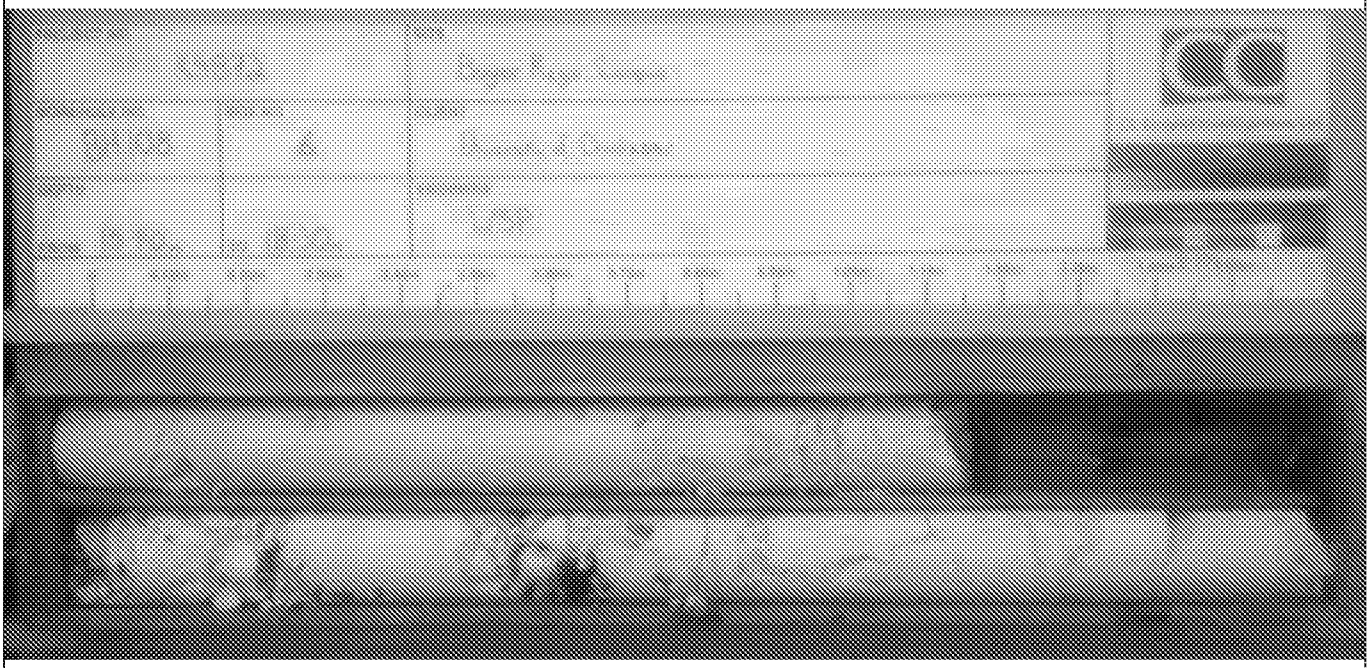




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Borehole Photograph

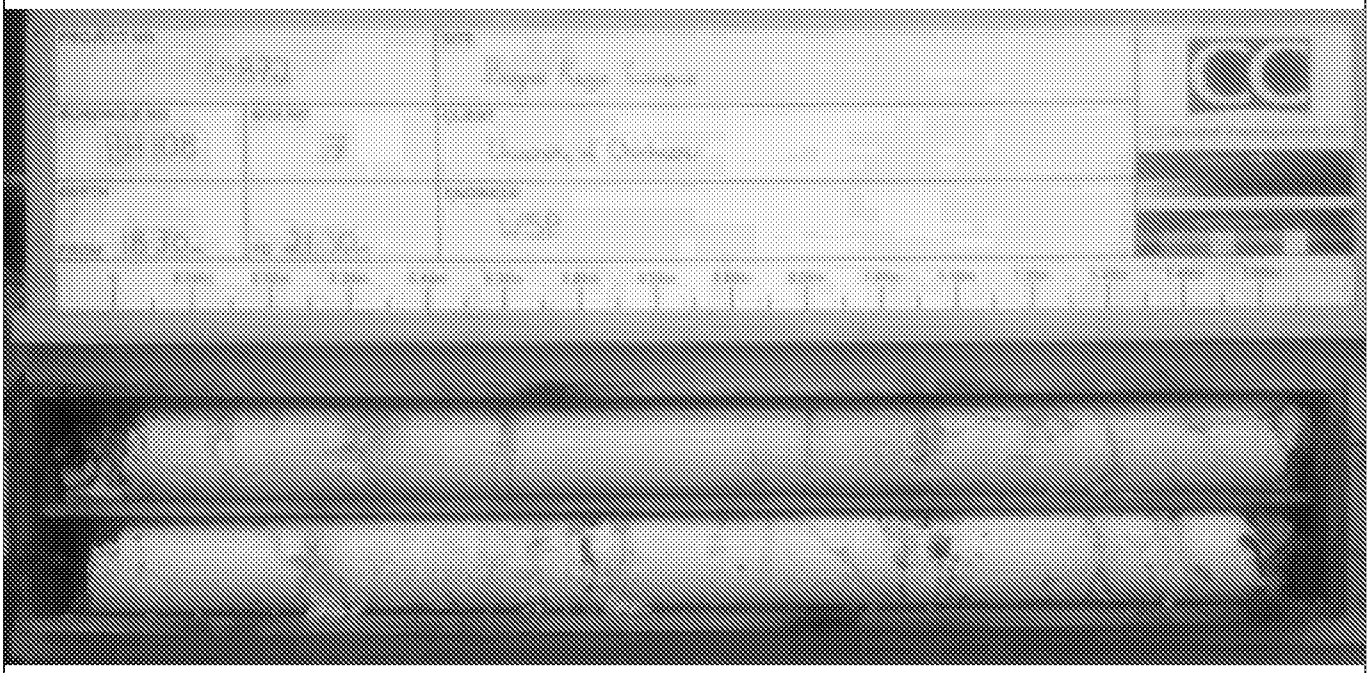


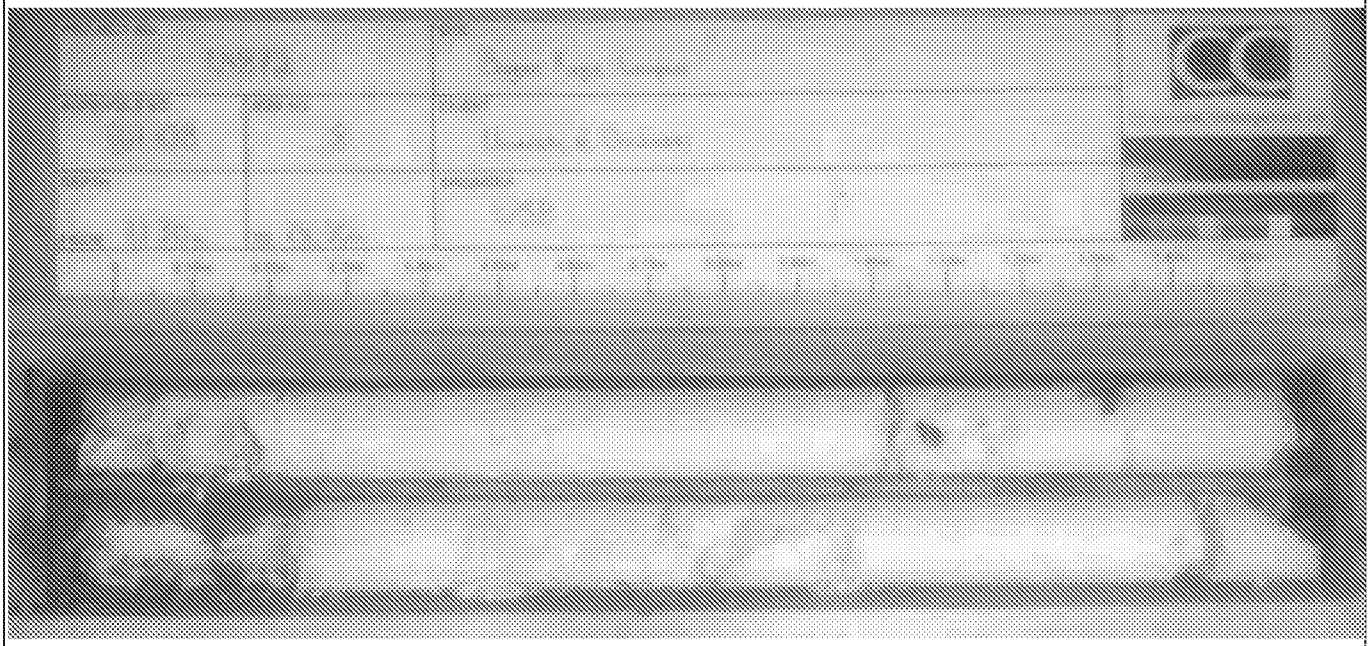


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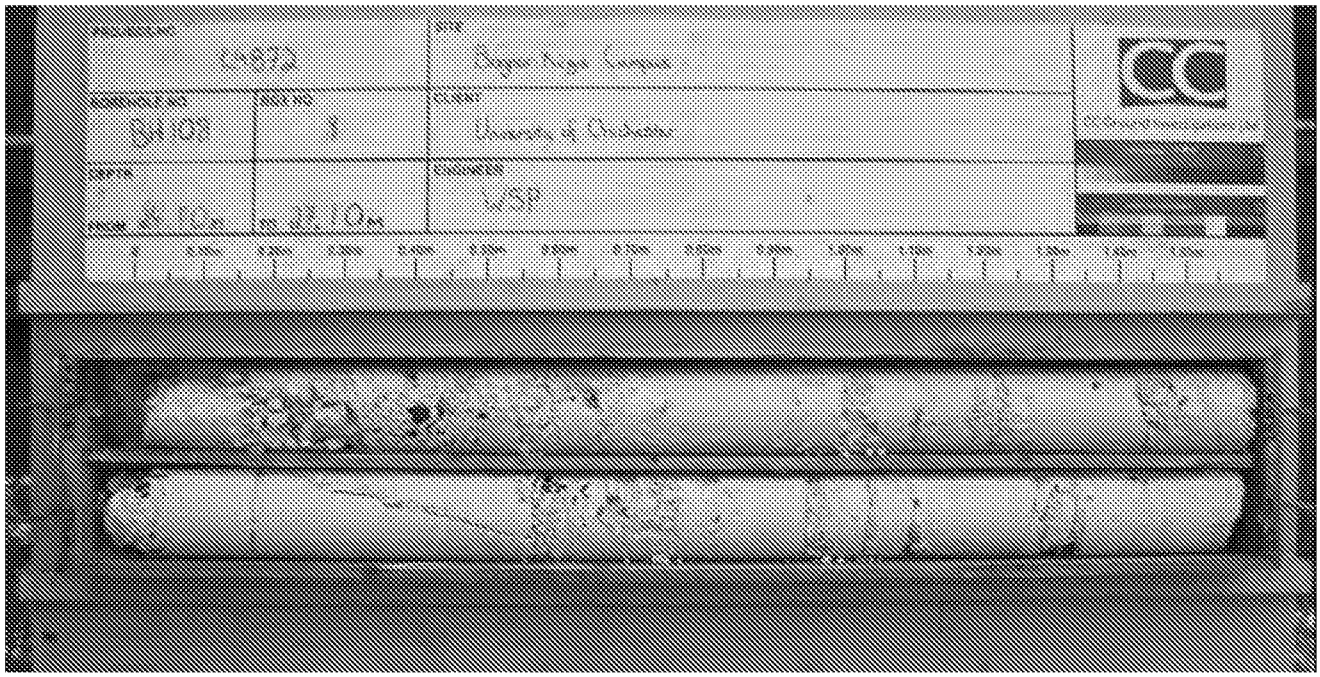


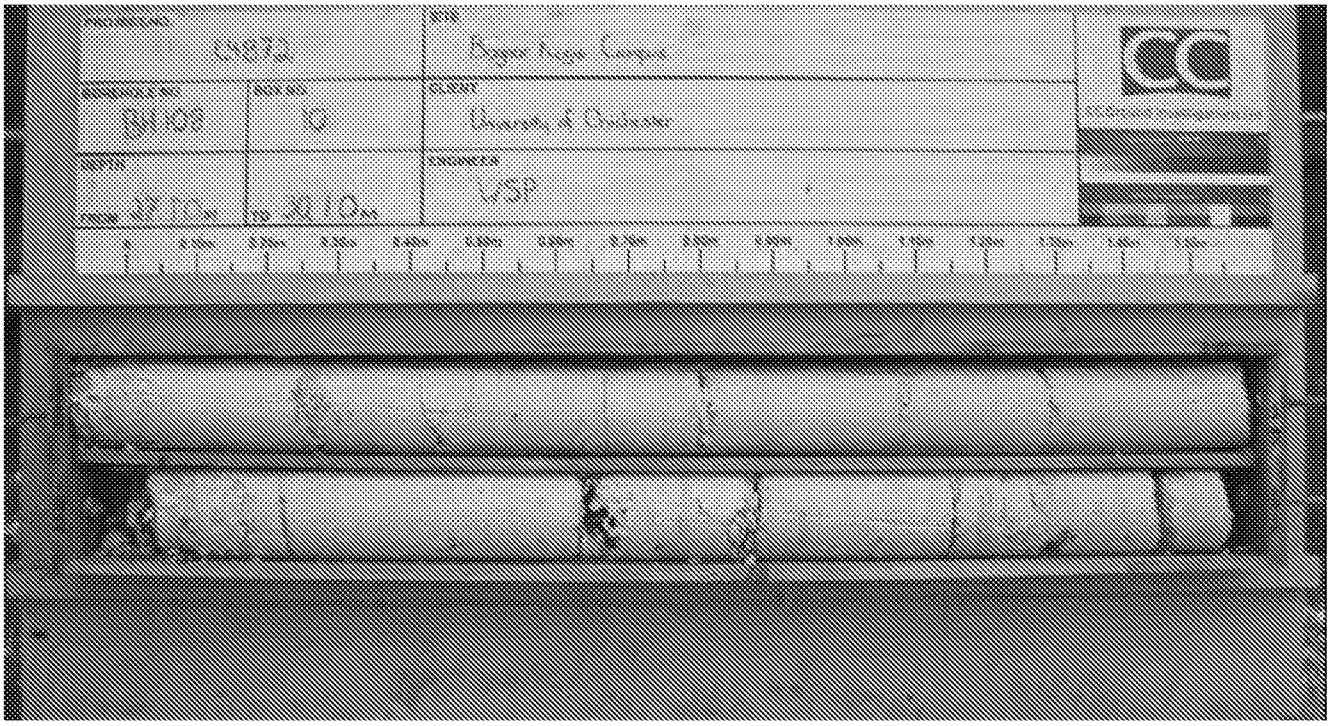


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Borehole Photograph





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