

BE Living Ltd

Supplementary Ground Investigation

**Phase 2C Community Centre
Dee Park
READING
Berkshire
RG30 4DD**

**Report No: 08.03.014i
December 2017**

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Client BE Living Ltd

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For and on behalf of ListersGeo, trading name of Listers Geotechnical Consultants Ltd

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EXECUTIVE SUMMARY

Project Reference	08.03.014i
Site Location	Phase 2C Dee Park, Reading, Berkshire, RG30 4DD
OS Grid Reference	468470, 173640
Development Proposals	Redevelop the site to accommodate a new Community Centre building with associated access roads, car parking and soft landscaping area in the east of the site.
Existing Buildings	Currently unoccupied.
Topography	Slopes gently down to the northeast.
Published Geology	Published geological information on the area indicates that the site is underlain by the Seaford and Newhaven Chalk Formations of Cretaceous age which is overlain by the Lambeth Group in the east
Site History	1881 - The site appears to be predominantly located within an agricultural field with an old gravel pit encroaching in to the eastern part of the site and a track crossing the south-western corner of the site. 1949 - The historical aerial photograph shows the site and immediately surrounding area are occupied by hundreds of allotments. 1971 – The site has been developed to comprise residential blocks and a playground in the southeast with a similar layout to the recently demolished buildings. 2017 - A residential block which previously encroached in to the north of the site is no longer present.
Hydrology	The nearest surface watercourse is a drain located approximately 300m to the southwest of the site.
Hydrogeology	Information obtained from the Environment Agency indicates that the site is located on a Principal Aquifer associated with the Seaford and Newhaven Chalk Formation and a Secondary A Aquifer associated with the Lambeth Group.
Geotechnical Hazards	Moderately high risk of chalk dissolution features at the site. In addition there is potential for
Ground Conditions Encountered	Made Ground down to depths of between 0.50m and 2.00m overlying relatively poor variable Lambeth Group soil comprising alternating layers of firm brown silty variably gravelly clay and loose, locally medium dense brown silty clayey sandy gravel. The Seaford and Newhaven Chalk Formations were then encountered at depths of between 2.80m and 4.80m to the full extent of this investigation at a maximum depth of 25m. The Seaford and Newhaven Chalk Formations were represented by an initial layer of firm off-white very silty clay with relic chalk structures, lithorelics and flint cobbles (grade Dm) to depths of between 5.00m and 8.80m overlying weak, low density creamy white chalk with comminuted chalk in fractures and flint cobbles (Grade C).
Groundwater Encountered	Groundwater was encountered as standing levels in the cable percussion boreholes at depths ranging from 13.20m and 13.50m below existing ground level. The depth of standing groundwater after 15 minutes monitoring was approximately 12.90m and 13.30m below existing ground level.
Ground Contamination	None of the soil contamination tests carried out as part of this investigation revealed elevated concentrations of contaminants in the soil. As such there is considered to be no significant risk of significant harm to the above referenced receptors.
Foundations	The Made Ground and Lambeth Group are considered unsuitable as a bearing stratum due to their variability, and potential for unacceptable total and differential settlement under applied foundation loadings. Piled foundations would be appropriate founded well down into the Seaford and Newhaven Chalk Formation.
Soil Gases	The infiltration results ranged between 3.6×10^{-5} m/s and 6.5×10^{-5} m/s. These results indicate soils with generally medium permeability.
Waste Soil Classification	Made Ground – Non-hazardous Lambeth Group – Inert Seaford and Newhaven Chalk Formations - Inert

Chemical Attack On Buried Concrete	Design Sulphate Class DS –1 ACEC Class AC-1
Roads & Hard Standing Design	<2%
Further work	Consideration should be given to undertaking a geophysical survey and/or rotary boreholes to further investigate the potential for voided ground associated with chalk dissolution features or shallow chalk mine workings. Laboratory testing for contaminants listed under the Waste Acceptance Criteria (WAC) can be undertaken on the Made Ground which will classify this waste soil as non-hazardous waste or inert waste. Additional confirmatory ground gas monitoring may be required by the Local Authority to confirm the findings of this report.

This executive summary should be read in conjunction with the main report.

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SUPPLEMENTARY GROUND INVESTIGATION REPORT

INTRODUCTION

A Supplementary Ground Investigation has been undertaken for a proposed new Community Centre at Phase 2C Dee Park, Reading, Berkshire, RG30 4DD. A Site Location Plan is provided in Appendix A. The Ordnance Survey National Grid reference for the centre of the site is approximately 468470, 173640.

Instructions to undertake the investigation were received from BE Living Ltd in the Deed of Appointment received on the 13th October 2017.

This report describes the desk study and intrusive site investigation activities carried out by ListersGeo in order to provide an evaluation of the ground conditions and the extent of any soil contamination present on the site. The report presents initial human health and groundwater risk assessments based on the findings of the desk study information and subsequent contamination laboratory testing. The contamination risk assessment has been carried out using the source-pathway-receptor risk assessment methodology.

The report also discusses the geotechnical implications with regard to the proposed development based on the findings of the fieldwork and subsequent laboratory testing.

The larger Dee Park site has been subject to a number of previous site investigations, these include:-

- STATS, November 2005, reference number 34847/01, on behalf of Reading Borough Council.
- Listers Geotechnical Consultants, June 2008, 08-03-014, on behalf of Inspace Partnerships.
- Listers Geotechnical Consultants, August 2009, 08-03-014a, on behalf of Inspace Partnerships.
- Listers Geotechnical Consultants, March 2010, 08-03-014b, on behalf of Willmott Dixon Housing.
- Listers Geotechnical Consultants, December 2010, 08-03-014c, on behalf of Willmott Dixon Housing
- Listers Geotechnical Consultants, November 2011, 08-03-014e, on behalf of Willmott Dixon Housing
- Listers Geotechnical Consultants, July 2013, 08-03-014f – pet.stat., on behalf of Willmott Dixon Housing
- Listers Geotechnical Consultants, November 2013, 08-03-014g on behalf of Willmott Dixon Housing
- Listers Geotechnical Consultants, August 2014, 08.03.014h, on behalf of Willmott Dixon Housing

These investigations have been reviewed and used as part of this report and relevant information has been included in the Appendices.

This current report should be read in conjunction with the previous report for full details of the investigations undertaken at the site.

This report has been prepared for the sole use of the client and their professional advisors. This report shall not be relied upon by third parties without the express written authority of ListersGeo. If an unauthorised

third party comes into possession of this report they must not rely on it and the authors owe them no duty of care and skill.

SCOPE OF THE INVESTIGATION

The scope of the investigation was to undertake an up to date site specific desk study and walkover survey, provide an assessment of the geotechnical engineering properties of the ground and the extent of any soil contamination on the site. A contaminated land risk assessment was undertaken based on the Contaminated Land Exposure Assessment (CLEA) and Environment Agency Remedial Targets Methodology (RTM) guidelines.

The investigation also includes a preliminary assessment of the feasibility of adopting a soakaway drainage solution at the site, as well as providing parameters to aid pavement design.

PROPOSALS

It is proposed to redevelop the site to accommodate a new Community Centre building with associated access roads, car parking and soft landscaping area in the east of the site. A proposed site layout plan is provided in Appendix A.

If the proposed end use or site layout should alter significantly following issue of this report, then the contents will require re-evaluation.

SITE INFORMATION AND WALKOVER SURVEY

A walkover survey of the site and its immediate surrounds was undertaken on the 26th October 2017. A selection of site photographs is presented in Appendix A along with a plan showing the recently demolished buildings.

The site lies in a predominantly residential area, and is predominantly unoccupied except for hoarding and heras fencing associated with the recent demolition works and a children's play area and playground in the east of the site.

The site consists of a rectangular parcel of land, trending approximately north to south. Measuring approximately 55m by 80m the site extends to approximately 0.4ha in area.

The general topography of the area slopes gently down to the northeast towards the River Thames. The site itself also slopes gently down towards the northeast.

The site is bordered by demolition sites or residential properties to the north, south east and west.

In the west of the site, where recent demolition of the previously existing buildings had been undertaken, several piles of earth and aggregates were noted. In addition general rubbish associated with the demolition works including metal poles, traffic cones and plastic pipes were noted.

The east of the site is separated from the west by an asphalt covered footpath with some areas of grass covered soft landscaping.

The southeast of the site is occupied by a children's play area including swings, climbing frame and roundabout with a ground surface covered with wood chippings.

The northeastern part of the site was occupied by an asphalt covered basketball court.

PREVIOUS WORK

A total of nine phases of investigation have been undertaken across the larger Dee Park site area. However, one window sample borehole and one super heavy dynamic probe were undertaken at the proposed Community Centre site by Listers Geotechnical Consultants report number 08.03.014 dated June 2008. A Window Sample Borehole was also put-down by STATS in November 2005 report reference number 34847/01, however, a copy of the STATS report was not available at the time of writing this supplementary investigation report.

The window sample borehole (WS138) and super heavy dynamic probe (SHDP238) put-down at the site by Listers Geotechnical Consultants demonstrated that the underlying soils comprised Made Ground down to 2.10m overlying Head Deposits to 3.0m which in turn overlay the Upper Chalk to the base of this borehole at 4.0m.

Of the two soil samples tested for a range of contaminants from WS138 none recorded significantly elevated concentrations.

DESK STUDY AND BACKGROUND INFORMATION

GENERAL

A desk study review of the site and its history has been undertaken to determine the former land usage and the potential for any historically derived sources of chemical contamination, as well as provide information to aid our geotechnical assessment. A copy of the desk study information obtained from Landmark is presented in Appendix F of this report.

The information provided in the desk study is obtained from independent third party sources. We have relied on this information but no guarantee can be given for the accuracy or completeness of the third party data used. It should be appreciated that such data is not exhaustive and is constantly being updated and reviewed in light of new information and procedures. Therefore improved practices, technology and new information may affect our conclusions and hence this report should be referred back to us for reassessment if new data comes to light, or changes in legislation/best practise is identified prior to development. Similarly should the development commence after expiry of one year from publication of this report, then we recommend this report is referred back to us for reassessment.

The desk study comprises a review of the following consultations and information sources:

- Environment Agency (EA)
- Natural England
- National Geoscience Information Service
- Public Health England
- Centre for Ecology & Hydrology
- British Geological Survey (BGS)
- Contemporary Trade Directories
- Historical Ordnance Survey maps
- Aerial Imagery
- Peter Brett Associates Natural Cavities Database

Information from the above referenced sources has been utilised to develop a conceptual model of the site for use in the geotechnical appraisal and source-pathway-receptor risk assessment.

GEOLOGY

Published Geology

Reference to the British Geological Survey 1:50,000 scale map, sheet 268 for Reading and other published geological information on the area indicates that the site is underlain by the Seaford and Newhaven Chalk Formations of Cretaceous age which is overlain by the Lambeth Group in the east.

The Lambeth Group strata are indicated as occurring across the far eastern parts of the larger site with a normal geological fault located up the along the eastern edge of the site trending north to south with a downthrown side to the east. As a consequence, to the west of the fault Upper Chalk strata are indicated as being exposed.

Lambeth Group strata were laid down during the Tertiary period in near shore and undulating marine conditions. As such, they alternate between sand beds and sandy clay beds with flint lenses throughout.

The Seaford and Newhaven Chalk Formations (formerly referred to as the Upper Chalk Formation) was laid down during a period of high sea level, when the average temperature was much higher than at present. As a result the sediment laid down contained high levels of calcium carbonate in the form of shells, corals and echinoderms. The resultant rock is a white, weak, fine-grained limestone called chalk that has many horizons of flint nodules.

Solution Features

Chalk, as a calcium-carbonate rich rock, is highly susceptible to dissolution by water containing carbon dioxide. This dissolution can create three common types of features within the chalk, grouped together under the generic term 'dissolution features'. These features include:

- **Sinkholes:** Depressions at the ground surface caused by the collapse of overlying chalk or superficial deposits into underground voids created by dissolution. The shape and size are dependent on the underlying void feature.
- **Solution pipes:** A feature in the surface of the chalk caused by increased dissolution in an area of closely spaced discontinuities. These features may, or may not, have a ground surface expression. They occur up to 20 metres in diameter, though are commonly much smaller.
- **Swallow Holes:** A void within the surface of the chalk where a stream is 'swallowed' by the chalk to flow underground. They often occur at the junction of impermeable strata and chalk. Infilled ancient swallow holes do exist where streams used to flow and may not have any surface expression. They can occur up to 14m in diameter, though commonly a few metres.

Ground dissolution features are documented in the area but with the closet recorded 400m away.

Further site specific information is provided in the Geotechnical Hazards section of the report.

Historical Boreholes

The British Geological Survey holds records of exploratory holes historically put down during previous investigations.

No historical borehole records are present within 300m of the site.

HISTORY OF THE SITE

The history of the site has been established by reviewing the historical Ordnance Survey maps and aerial imagery of the area, collected as part of the desk study information. This has established the following:

Time Period	Historical Usage of the Site	Historical usage of the Surrounding Area
1881 - 1917	The site appears to be predominantly located within an agricultural field with an old gravel pit encroaching in to the eastern part of the site and a track crossing the south-western corner of the site. A drain orientated from north to south appears to be present in the east of the site.	A second old gravel pit is recorded approximately 10m northeast of the site and a third is shown approximately 180m northeast of the site. Brick and tile kilns are shown 320m northwest and 450m southeast of the site. A barracks is shown approximately 640m east of the site. Possible quarries or pits are also shown 320m west and 800m southeast of the site. By 1911 housing is shown to within approximately 160m to the east of the site.
1932-1961	The gravel pit encroaching in to the east of the site is no longer labelled but the associated slope is still shown. Additional tracks are shown crossing the site from southwest to the north and east to west. The 1949 historical aerial photograph shows the site and immediately surrounding area are occupied by hundreds of allotments.	Allotment gardens are shown to the north east and southwest of the site. A large clay pit is shown to within approximately 210m south of the site. Housing is shown 240m southeast and approximately 300m northwest of the site. By 1961 housing is shown to within 60m northeast and 140m northwest of the site. The slopes associated with previously noted historical gravel pits are still shown.
1971-2006	The site has been developed to comprise residential blocks and a playground in the southeast with a similar layout to the recently demolished buildings.	The areas to the north and west have also been developed with residential blocks with a primary school to the southwest of the site and undeveloped land to the east. None of the previously noted slopes associated with former gravel pits are shown.
2017	A residential block which previously encroached in to the north of the site is no longer present.	Housing has been constructed to the immediate east of the site.

Inspection of more recent historical aerial imagery from of the site from January 2017 revealed that the buildings on the site had been fenced off and were undergoing demolition.

UNEXPLODED ORDNANCE AND BOMB SITES

An unexploded bomb risk map was obtained from Zetica, which shows that the site is located in an area where there is a low risk of unexploded ordnance. Low-risk regions are those with a bombing density of up to 10 bombs per 1000 acres. In general, further action to mitigate the risk is considered prudent, although not essential. Care is required when assessing the risk for specific sites where the risk may be higher because of local wartime activity.

HYDROLOGY

The nearest surface watercourse is a drain located approximately 300m to the southwest of the site. In this area the River Thames recorded approximately 944m north of the site has been designated as River Quality B with a flow of less than 40m³/s.

The River Quality scale is a grading system established by the Environment Agency and is based on dissolved oxygen, biological oxygen demand and ammonia content of the river. Grade A is classified as being very good, whilst Grade F is classified as being bad.

The Envirocheck data indicates that the site lies outside of any flood impact zones. However, this information does not constitute a site specific Flood Risk Assessment (FRA), as the results of a site specific FRA may differ to the information provided in the base line desk study. We therefore recommend further enquiries to determine if a site specific FRA is required to support the planning application/development at the site.

There are no current surface water abstraction licenses located within 1000m of the site.

HYDROGEOLOGY

Information obtained from the Environment Agency indicates that the site is located on a Principal Aquifer associated with the Seaford and Newhaven Chalk Formation and a Secondary A Aquifer associated with the Lambeth Group.

The aquifer designation data is based on geological mapping provided by the British Geological Survey. The maps are divided into two different types of aquifer designation:

- **Superficial (Drift)** - permeable unconsolidated (loose) deposits. For example, sands and gravels.
- **Bedrock** - solid permeable formations e.g. sandstone, chalk and limestone.

For each type there are classifications of Principal, Secondary A and Secondary B Aquifers and Unproductive Strata, each with a decreasing rank of importance.

There are four current groundwater abstraction licenses located within 1000m of the site. Two of these licences are owned by Reading Town Football Club 849m north of the site for irrigation and drinking, cooking, sanitary and washing.

According to information provided by the Environment Agency the site is outside of any Source Protection Zones (SPZ). An SPZ is a protection zone placed around a well or borehole that supplies groundwater of potable quality.

WASTE TREATMENT AND LANDFILL SITES

Reference to records from the BGS, the Environment Agency and the Local Authority indicates that there are four waste management facilities, no waste transfer sites and no waste treatment sites within 1000m of the site area. It is considered unlikely that any of these facilities would significantly affect the site area, as the nearest is 718m away.

Reference to records indicates that there is one historical landfill disposal sites within 1000m of the site. This landfill site is recorded 851m northwest of the site and the deposited waste included inert and industrial waste.

Given the distance it is considered unlikely this landfill site would pose a significant risk to the subject site.

ENVIRONMENTAL PERMITS, INCIDENTS AND REGISTERS

There has been one recorded pollution incident in to controlled waters within 250m of the site. This concerned unknown oils in 1994, 122m east of the site and was recorded as a Category 3 Minor Incident.

There are no current licensed discharge consents within 1000m of the site.

There are eight Integrated Pollution Control Licenses or Integrated Pollution Prevention and Control (IPPC) licenses within 2000m of the site. These are all recorded between 888m and 892m northeast of the site and are therefore unlikely to pose a significant risk to the site.

INDUSTRIAL USAGE SITES

There are three past or present trade directory entries that have been found within 250m of the site. The closest of these is an inactive boiler repair and service provider 76m north of the site. The remaining two recorded trade directory entries are both recorded 237m east of the site for sash windows.

The nearest active fuel filling station is identified as the Shell garage 549m north of the site. However an obsolete fuel filling station is recorded 137m south of the site.

WORKED OUT GROUND/MADE GROUND

There are twenty BGS Recorded Mineral Sites within 1000m of the site. The closest of these is an opencast quarry recorded 21m southeast of the site. A second opencast quarry is also recorded 29m northeast of the site. Both of these are associated with sand and gravel from the Lambeth Group. The remaining BGS Recorded Mineral Sites are in excess of 166m and all are recorded as opencast mines.

In addition to the above the quarrying of sand and clay or operation of sand and gravel pit is recorded on the site itself based on the 1883 mapping.

The potential for underground mine workings is discussed in Man Made Mining Cavities Database section of this report below.

RADON GAS

Information obtained from the BGS and the National Geoscience Information Service indicates that the site lies within an area where less than 1% of homes exceed the action level of 200Bq/m³ for radon gas. Therefore, no radon protection measures are not necessary in the construction of new dwellings or extensions, without underground rooms, on this site.

POTENTIAL GEOTECHNICAL HAZARDS

The desk study information identified that the site does not lie within an area likely to be affected by coal mining.

The risk of naturally occurring geotechnical hazards at the site is recorded in the Envirocheck report to be as follows:

Ground Stability Hazard	Hazard Potential Rating
Collapsible deposits	Very Low
Compressible deposits	No Hazard
Ground dissolution from soluble rocks	Low and Moderate
Shrinking and swelling clays	No Hazard and Moderate
Landslides	No Hazard and Low
Running sand	No Hazard and Very Low

It should be noted that a high risk of ground dissolution is recorded 151m north of the site with a similar geology to that recorded on this site.

NATURAL CAVITIES DATABASE

A factual DETR/PBA natural cavities database search was commissioned and is provided in Appendix F. The search indicated four known natural cavity locations within 1km of the centre of the site, the closest being within 400m east-southeast of the site. As such the perceived risk of the existence of dissolution features beneath the site is medium to high.

MAN MADE MINING CAVITIES DATABASE

In addition to the above a factual DETR/PBA man made cavities database search was commissioned and is also provided in Appendix F. The search indicated nine known man made cavities within 1km of the centre of the site, the closest being recorded 360m south of the site.

However, there have been several sinkhole collapses in recent years which have now been attributed to the collapse of un-recorded chalk mines associated with clay pits where lime from the chalk has been extracted for making bricks. Although no clay pits are recorded within close proximity to the site, an historical gravel pit is shown on the historical maps to encroach in to the east of the site. In addition brick and tile works including kilns are shown 320m northwest and 450m southeast of the site on the historical maps, however, no clay pits are specifically labelled on the historical maps. Therefore it is considered possible that the nearby historical gravel pits may also have been used for the extraction of clay from the Lambeth Group soils and as such consideration should be given to the potential of shallow mine chalk mine workings beneath this site.

DISSOLUTION FEATURE RISK ASSESSMENT

The site location was assessed for its susceptibility to dissolution features, using the risk assessment methodology published by Edmonds, 2001, *Predicting natural cavities in chalk*.

The geology of the site comprises the Lambeth group soils overlying the Seaford and Newhaven Chalk Formations.

The assessment provided a moderately high hazard rating for the site. This differs from the moderate hazard rating provided in the Envirocheck and in our opinion a moderately high hazard rating should be adopted at this site.

BACKGROUND SOIL CHEMISTRY

Information from the BGS regarding background levels of some heavy metals in the natural soils estimates that in the site area, rural soil has the following levels of arsenic, cadmium, chromium, lead and nickel:

Contaminant	Level in rural soil (mg/kg)
Arsenic	<15
Cadmium	<1.8
Chromium	60-90
Lead	<100
Nickel	153

These concentrations are all well below the generic environmental screening standards for a commercial site. The results are discussed further in the Contamination Risk Assessment section of this report.

POTENTIALLY SENSITIVE LAND USES

The site is not located in close proximity to any environmentally sensitive land uses, however the area is located within a nitrate vulnerable zone.

CONCEPTUAL SITE MODEL

A preliminary qualitative risk assessment has been carried out using the source-pathway-receptor principle to create a conceptual model for the site. We understand the development proposals are for new Community Centre building with associated soft landscaped areas, access roads and car parking.

As such, potential sources of contamination and potential receptors have been assessed using the Contaminated Land Exposure Assessment (CLEA) Guidelines. The fact that a pathway must exist between a potential source of contamination and a potential receptor for there to be a risk, has been taken into account.

POTENTIAL SOURCES OF CONTAMINATION

The results of the desk study and walkover indicate that the following potential sources of ground contamination are present at or in close proximity to the site:

- Made Ground is likely to be present at the site associated with previously existing buildings and the historical gravel pit which encroached in to the east of the site.
- Minor localised petroleum hydrocarbon contamination associated with vehicles including demolition plant parked or maintained on or close to the site.

Potential Ground Gas Contamination Sources

We have provisionally assessed the risk of ground gas impacting the site, by reference to guidance given in the paper “A pragmatic approach to ground gas risk assessment for the 21st Century” Card and Wilson, 2011. This is a follow up paper to the CIRIA Report C665 and is compatible with that document.

- No credible sources or pathways for landfill gas migration from an off-site landfill have been identified, however, a potential infilled historical gravel pit was recorded encroaching in to the east of the site.
- The site has not been a registered landfill.
- Any Made Ground present is not expected to be 5m deep or an average of 3m in thickness.
- Radon protection measures are not required for this site.
- The site does not lie on a potential naturally organic soil.

Therefore the following potential sources of ground gases have been identified for the site:

- Migrating soil gases.
- Explosive gases.

RECEPTORS

The following most sensitive receptors have been identified at the site:

Human Health

- End users of the site - the future staff / visitors.
- Surrounding residents.
- Construction workers.

Environmental

- Controlled Waters - the drain located approximately 300m to the south west of the site.
- Controlled Waters - the Seaford and Newhaven Chalk Formation Principal Aquifer and the Lambeth Group Secondary A Aquifer.

PATHWAYS

It is considered that a number of potential pathways exist between these potential sources and the above identified receptors.

For the human receptors these include:

- Direct soil ingestion in areas of exposed soil.
- Inhalation of indoor and outdoor vapours and dust.
- Dermal contact with contaminated soil.
- Inhalation of soil gases or vapours migrating through permeable strata into the building.

For controlled waters and the environmental receptors the pathways include:

- Migration of contaminants through the unsaturated zone.
- Migration of contaminants through the groundwater.
- Movement of contaminants through drains or services runs.

For the substructures and services the pathways include:

- Leachable or corrosive contaminants within the soil
- Leachable or corrosive contaminants within the groundwater.

EXPLORATION AND TESTING

GENERAL

A total of twenty-seven exploratory holes were formed at the site on between the 26th and 30th October 2017. These included three machine excavated trial pits, two cable percussion boreholes seven continuous tube sample boreholes, thirteen dynamic probe tests and four hand auger boreholes.

The positions of all exploratory holes undertaken at the site as part of this investigation can be seen on the Exploratory Hole Location Plans in Appendix A. The logs are provided in Appendix B and the results of the geotechnical laboratory testing are provided in Appendix C.

Gas and groundwater monitoring was undertaken on two occasions over the first few weeks following the fieldwork.

SAMPLING STRATEGY

The investigation was undertaken in general accordance with the scope of works agreed with our clients structural engineer, however some of the suggested positions of the exploratory holes were not possible due to pedestrian only access to the northern part of the site.

As the desk study and walkover survey had only identified the historical gravel pit in the east of the site specific point source of contamination BH1, CT3, CT5 and CT8 were located towards the east of the site. It should be noted however, that no test locations were permitted within the existing children's play area and basket ball court where the majority of the soft landscaping is proposed.

The other exploratory holes were positioned to create a semi-regular pattern across the site, in order to provide a spread of information.

As the desk study and walkover survey had not identified any specific point sources of potential contamination on the site, the exploratory holes were non-targeted and positioned to create a semi regular pattern across the site.

METHODOLOGY

Prior to commencement of boring/testing, and in order to minimise the dangers from/to buried services, the proposed locations were scanned using a Cable Avoidance Tool. At the borehole and probe locations, a service avoidance pit was dug, using hand tools, to a depth of around 1.2m bgl (below ground level).

The trial pits, TP1, TP2 and TP5 were excavated with an 8-tonne rubber tyred backhoe excavator to depths of between 1.7m and 2.0m below ground level, under the supervision of a geotechnical engineer, who made record of the arisings. Disturbed samples were taken at selected depths down to the base of the holes for subsequent laboratory testing and inspection. On completion, all trial pits were carefully backfilled with arisings in thin layers, ensuring that excavated material was replaced in the same order as it had been removed.

Infiltration testing was undertaken in trial pits TP5 in the south of the site in general accordance with BRE Digest 365 'Soakaway Design'. Due to insufficient access in the north of the site it was not possible to undertake a infiltration test in the north of the site.

The continuous tube sample boreholes, CT2 to CT8, were put down using an Archway Competitor Dart rig to a maximum depth of 6.0m. Boreholes were advanced using a plastic lined steel tube sampling system, driven into the ground by a top drive percussive hammer. A near continuous 87mm – 57mm diameter core sample was recovered of the sampled materials for future examination and sub-sampling. Prior to sampling, Super Heavy dynamic probing, SHDP1 to SHDP11 and SHDP CT4, SHDP CT5, SHDP CT6, was carried out adjacent to the positions of all boreholes and within the footprint of the proposed building to give an indication of the relative penetration resistance of the soils encountered. Measurements of torque are included on the probe logs.

Boreholes BH1 and BH2 were drilled utilising a standard cable percussion rig, at a diameter of 150mm, down to a maximum depth of 25m below ground level. Metal casing was extended to a maximum depth 24m, to avoid the collapse of the loose deposits within the upper part of the boreholes seal out groundwater inflows. Disturbed samples were collected at regular intervals throughout the borehole for future laboratory inspection and testing. Standard penetration tests (SPTs) and undisturbed tube samples (U100s) were taken at 1.0m intervals down to 10m depth and at 1.5m intervals thereafter.

On completion of the boring, boreholes BH1 and BH2 were utilised for the installation of a 50mm diameter slotted uPVC standpipe from 6.0m depth up to within 1.0m below existing ground level. From 1.0m depth up to ground level a plain pipe was added. The slotted section of the standpipe was surrounded with pea gravel, while expansive bentonite clay was added around the plain pipe and below the slotted section to seal the borehole. The standpipe was finished with a stopcock cover, which was then concreted flush with ground level.

Infiltration testing was also undertaken in the standpipes in general accordance with BRE 365 to provide additional indicative information regarding the permeability of the soils beneath the site.

Boreholes HA1 to HA4 were put down using a Dutch portable hand auger to a maximum depth of 1.05m below existing ground level in areas where it was not feasible to undertake machine excavated trial pits. The 55mm diameter auger head was rotated and pushed down into the soil by means of a T-handle to obtain selected disturbed soil samples at regular intervals.

Engineering and geoenvironmental conclusions given in this report are based on data obtained from these sources but it should be noted that variations, which affect these conclusions, may inevitably occur between and beyond the test locations. Also water levels may vary with time.

GROUND CONDITIONS

The intrusive investigation revealed that the general succession of strata was represented by a layer of Made Ground overlying the Lambeth Group which in turn overlies the Seaford and Newhaven Chalk Formation to the full depth of the investigation at 25m depth.

Our Ground Model for the site is as follows:

MADE GROUND

Encountered at each test location from ground level down to depths of between 0.50m and 2.00m. Represented by soft to firm and firm brown silty sandy variably gravelly clay and brown variably clayey sandy gravel and gravelly sand. Gravel is fine to coarse angular to subrounded flint, chalk, brick and concrete.

The deeper Made Ground was recorded in CT7 in the northwest of the site and therefore does not appear to be related to the historical gravel pit.

Laboratory testing revealed the following results:

Parameter	Range	Comments
Water Content (%)	6-21	Though the range is wide, the lower values are typical values for the sands and gravels layers, while the higher values are typical of the clay layers
Liquid Limit (%)	21-28	CLAY and locally SILT of medium plasticity (BS5930 Casagrande)
Plastic Limit (%)	13-19	
Plasticity Index (%)	5-14	
Modified Plasticity Index (%)	3-10	Non-shrinkable and Shrinkable soil of low Volume Change Potential (NHBC Standards)
Retained on 425µm sieve (%)	16-39	BS1377 'coarse soil' fraction
Passing 63µm sieve (%)	32-66	Fines (silt/clay) fraction

Full laboratory sieve analyses on a sample of Made Ground revealed gravel contents of 48%, sand of 32% and fines (silt/clay) of 20%.

LAMBETH GROUP

Encountered at each test location except HA1, HA3 and HA4 (where the Made Ground was not fully penetrated) from beneath the Made Ground at depths of between 0.50m and 2.00m down to depths of between 2.80m and 4.80m. Represented by alternating layers of firm brown silty variably gravelly clay and loose, locally medium dense brown silty clayey sandy gravel. Gravel is fine to coarse subangular to subrounded flint.

In the trial pits the Lambeth Group was assessed to be loose to medium dense due to the ease of excavation and the stability of the trial pit sides.

Laboratory testing revealed the following results:

Parameter	Range	Comments
Water Content (%)	5-24	Though the range is wide, the lower values correspond to the sands and gravels layers, while the higher values correspond to the clay layers
Liquid Limit (%)	21-50	Predominantly a CLAY of low plasticity (BS5930 Casagrande)
Plastic Limit (%)	14-18	
Plasticity Index (%)	4-32	
Modified Plasticity Index (%)	4-28	Non-shrinkable to Shrinkable soil of medium Volume Change Potential (NHBC Standards)
Retained on 425µm sieve (%)	3-61	BS1377 'coarse soil' fraction
Passing 63µm sieve (%)	40-72	Fines (silt/clay) fraction

The table below provides details of the 'N' values derived from standard penetration testing (SPT) and the number of blows taken to retrieve a U100 sample from the boreholes:

Parameter	Range	Comments
SPT 'N' Value	6 -19	Varying with depth

The results of the Super Heavy dynamic probing indicated that the penetration resistance of the deposit varied with depth. Interpretation of the results indicates generally variable soils of loose locally medium dense coarse grained soils and firm locally soft to firm fine grained soils.

SEAFORD & NEWHAVEN CHALK FORMATION

Encountered in each borehole from beneath the Lambeth Group at depths of between 2.80m and 4.80m down to the base of each borehole at a maximum depth of 25.00m. Represented by an initial layer of firm off-white very silty clay with relic chalk structures, lithorelics and flint cobbles (grade Dm) to depths of between 5.00m and 8.80m overlying weak, low density creamy white chalk with comminuted chalk in fractures and flint cobbles (Grade C).

Laboratory testing revealed the following results:

Parameter	Range	Comments
Water Content (%)	14-57	-
Liquid Limit (%)	30-76	CLAY of low to high plasticity and locally a silt of low plasticity (BS5930 Casagrande)
Plastic Limit (%)	20-35	
Plasticity Index (%)	5-41	
Modified Plasticity Index (%)	5-37	Ranges from Non-shrinkable to Shrinkable soil of medium Volume Change Potential (NHBC Standards)
Retained on 425µm sieve (%)	7-27	BS1377 'coarse soil' fraction
Passing 63µm sieve (%)	58-88	Fines (silt/clay) fraction

The table below provides details of the 'N' values derived from standard penetration testing (SPT) and the number of blows taken to retrieve a U100 sample from the boreholes:

Parameter	Range	Comments
SPT 'N' Value	5 to greater than 50	Generally increasing with depth

Saturation moisture content testing on selected chalk blocks recorded dry density between 1.4Mg/m³ and 1.55Mg/m³, indicating chalk with low density.

The results of the Super Heavy dynamic probing indicated that the penetration resistance of the fine grained layer varied with depth.

California Bearing Ratio (CBR) Tests

CBR tests were undertaken on two bulk soil samples remoulded using a 2.5kg compactive effort at natural water content. The samples were from the Made Ground soils encountered at the site. Results of the testing are shown in the table below:

Location	Stratum	Depth (m)	CBR (%)
TP02	Made Ground	0.5	4.5
BH2C/02	Made Ground	0.5	1.5

Sulphate and pH Tests

Soluble sulphate tests and pH tests were carried out on twenty-three soil samples recovered from the exploratory holes across the site. These recorded values as shown in the table below:

Parameter	Range
Soluble Sulphate (g/l)	0.04-0.38
pH units	7.3-8.9

GROUNDWATER

Groundwater was encountered as standing levels in the cable percussion boreholes at depths ranging from 13.20m and 13.50m below existing ground level. The depth of standing groundwater after 15 minutes monitoring was approximately 12.90m and 13.30m below existing ground level.

Groundwater monitoring carried out as part of the project has revealed the borehole standpipes were dry down to a depth of 6.0m below existing ground level.

OBSERVED SOIL CONTAMINATION

No obvious evidence of potential contamination was recorded during the site work.

INFILTRATION TESTING

Infiltration testing was carried out in the Lambeth Group strata encountered at the site, at a depth of between 0.95m and 2.0m depth in TP5 in general accordance with BRE Digest 365 'Soakaway Design'. The infiltration results ranged between 3.6×10^{-5} m/s and 6.5×10^{-5} m/s.

The results of the infiltration tests are included in Appendix C.

GROUND GAS

Ground gas monitoring was carried out in boreholes BH1 and BH2 as a part of this investigation, on two occasions, using a calibrated Geotech GA 5000 gas analyser.

The results are shown in the table below:

Parameter	Range
Oxygen (%v/v)	20.8-20.9
Carbon Dioxide (%v/v)	0.2-0.4
Methane (%v/v)	0.1
Flow rate (l/h)	0.4-0.5

Weather reports for the time preceding the testing was referred to and falling pressure conditions were encountered prior to the testing undertaken on the 30th December 2017.

The results are provided in Appendix B.

GROUND CONTAMINATION ASSESSMENT

SOIL TESTING

Six samples of the Made Ground soils collected on site during this investigation were tested for a range of contaminants.

The suite of testing carried out on the samples was decided upon following consultation of R&D CLR Publications, published as part of the Contaminated Land Exposure Assessment (CLEA), a joint venture between the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency.

The test suite included a range of:

- Metals and inorganic substances.
- Speciated Polyaromatic Hydrocarbons (PAH).
- Total Petroleum Hydrocarbons (TPH), with eight band split.
- Asbestos screening.

The soil samples were tested to obtain 'Total' values within the soil.

The results of the tests from this investigation are included in Appendix C.

LEACHATE TESTING

Four soil samples collected as part of the investigation were tested from a solution obtained using the NRA R&D301 leachate procedure, simulating contaminant leachability to underlying groundwater.

The test suite included the range of metals and inorganic substances targeted in the soil sample testing suite.

RISK ASSESSMENT GUIDELINES – HUMAN HEALTH

The human health risk assessment has been undertaken using the guidance provided in the Environment Agency's publication CLR11, Model Procedures for the Management of Contaminated Land, published in September 2004. Human health assessment criteria used are based upon the proposed final land use of the site. The site is to be redeveloped to accommodate a new Community Centre.

Therefore, the guidelines for 'Commercial' have been used.

If the proposed site use should alter from the above, then the human health risk assessment will require re-evaluation for the new end use scenario.

Currently in the UK, no statutory limits for the presence of contaminants in soils or groundwater exist. Therefore, the results of the soil samples tested are compared to the following environmental quality standards:

Category 4 Screening Levels (C4SLs)

Published in March 2014 by DEFRA, C4SLs were primarily produced to support the revised Statutory Guidance to support Part 2A of the Environmental Protection Act 1990, which was published in April 2012. This Guidance introduced a new four-category system for classifying land under Part 2A for cases of a Significant Possibility of Significant Harm to human health, where Category 1 includes land where the level of risk is clearly unacceptable and Category 4 includes land where the level of risk posed is acceptably low.

With regards to using the C4SLs for planning purposes the DEFRA letter of 3rd September 2014 from Lord de Mauley established that they are also suitable for use in planning situations, as does the DCLGs 'Planning Portal' document 2014.

Suitable 4 Use Levels (S4ULs)

As well as the limited number of C4SLs (and where C4SLs are not available), the set of S4ULs produced by Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) in 2015 using the Contaminated Land Exposure Assessment (CLEA) software, version 1.06 released in 2009, are used as a screening tool.

The CLEA software is a deterministic exposure model with altered exposure data to the original model. The model allows the creation of a generic assessment criteria database with which to screen laboratory testing results. These generic assessment criteria are conservative and based upon common assumptions.

RISK ASSESSMENT GUIDELINES – GROUNDWATER

The procedures set out in Environment Agency's Remedial Targets Methodology (RTM) *Hydrogeological risk assessment for contaminated land* (2006), have been followed.

The leachate test results are compared to the UK Drinking Water Standards (UKDWS) set out in The Water Supply (Water Quality) Regulations 2016. Where the environmental setting is sensitive, results are also compared to the Environmental Quality Standards (EQS) as set out in the EC Dangerous Substances Directive (76/464/EEC).

Several of the EQS contaminants are dependent on the hardness of the receiving watercourse. In this area chalk deposits are present and Thames Water indicates water hardness in the region in the order of 318CaCO₃ mg/l and hard water conditions are present based on the local geology. This information has been used to aid our assessment.

The EQS refer to limits of contaminants permitted in waters discharged directly into a surface watercourse.

RESULTS OF TOTAL SOIL TESTS

Screening for the presence of asbestos did not reveal any asbestos containing material (ACM) or fibres in the samples of Made Ground soils tested.

Of all the remaining contaminants tested for, none recorded values higher than their relevant environmental standard value for human health for a commercial setting. The elevated contaminants are discussed further below.

RESULTS OF LEACHATE TESTS

Of the four samples tested none recorded values in excess of their respective UK Drinking Water Standard (UKDWS) and shown in the table below.

HUMAN HEALTH RISK ASSESSMENT

The following quantitative risk assessment has been carried out using the source-pathway-receptor principle. As such, potential sources of contamination have been assessed using the CLEA Guidelines. The fact that a pathway must exist between a potential source and potential receptor for there to be a risk, has been taken into account. The potential human receptors evaluated for their individual risk are:

- End users of the site – the future staff/visitors.
- Surrounding residents.
- Construction workers.

If the proposed site use or layout should alter significantly, then the human health risk assessment will require re-evaluation.

GENERAL

None of the soil contamination tests carried out as part of this investigation revealed elevated concentrations of contaminants in the soil. As such there is considered to be no significant risk of significant harm to the above referenced receptors.

The above conclusion should be agreed with the relevant regulator prior to construction to avoid any possible delays.

CONSTRUCTION WORKERS

The exposure route of primary concern for the contamination is 'direct soil ingestion'. For the construction workers there is a direct link to the soil when they undertake the site work and therefore different measures should be taken to manage the short-term exposure risk of coming into contact with contaminated soil.

To reduce the risk to as low as reasonably practicable for the construction workers it is recommended that appropriate health and safety measures be implemented along with the use of Personal Protective Equipment (PPE). All personnel coming into contact with the soil, ground workers in particular, should be instructed to use gloves when on site to avoid dermal contact and restrict inadvertent hand-to-mouth ingestion. Washing facilities should be provided for the site staff to use, and should be used prior to eating or smoking. Reference should be made to the HSE Document, "Protection of Workers and the General Public during Development of Contaminated Land".

Although no asbestos was identified in the soils at the site, the presence of ACM and fibres within Made Ground at any site cannot be ruled out. Groundworkers should be made aware of potential risks of asbestos during the groundworks prior to beginning work.

GROUNDWATER RISK ASSESSMENT

The following risk assessment has, again, been carried out using the source-pathway-receptor principle. The procedures set out in the Environment Agency's Remedial Targets Methodology *Hydrogeological risk assessment for contaminated land* (2006), have been followed.

Results have been compared to the UK Drinking Water Standards and to the available Environmental Quality Standards (EQS). The potential environmental receptors considered during this risk assessment were:

- Controlled Waters - the drain located approximately 300m to the south west of the site.
- Controlled Waters - the Seaford and Newhaven Chalk Formation Principal Aquifer and the Lambeth Group Secondary A Aquifer.

GENERAL

None of the metal and inorganic contaminants tested for within the leachate samples recorded values significantly higher than the UKDWS or EQS values.

It is therefore considered that neither of the two above recognised environmental receptors will be at significant risk from groundwater pollution at the site.

However, the Environment Agency is the regulatory body charged with protection of controlled waters and are likely to be a consultee in the planning process. As such we strongly recommend that the conclusions of this report are agreed with the Agency, at the earliest stage, to reduce any potential delays to the development should they require further clarification of this report or further testing.

GEOTECHNICAL ENGINEERING CONCLUSIONS

GENERAL

We understand the proposed re-development comprises the construction of a new Community Centre building with associated access roads, car parking and soft landscaping area in the east of the site.

The exploratory work from this investigation has proven the expected general strata sequence comprising Made Ground down to depths of between 0.50m and 2.00m overlying relatively poor variable Lambeth Group soil comprising alternating layers of firm brown silty variably gravelly clay and loose, locally medium dense brown silty clayey sandy gravel. The Seaford and Newhaven Chalk Formations were then encountered at depths of between 2.80m and 4.80m to the full extent of this investigation at a maximum depth of 25m. The Seaford and Newhaven Chalk Formations were represented by an initial layer of firm off-white very silty clay with relic chalk structures, lithorelics and flint cobbles (grade Dm) to depths of between 5.00m and 8.80m overlying weak, low density creamy white chalk with comminuted chalk in fractures and flint cobbles (Grade C).

Groundwater was encountered as standing levels in the cable percussion boreholes at depths ranging from 13.20m and 13.50m below existing ground level. The depth of standing groundwater after 15 minutes monitoring was approximately 12.90m and 13.30m below existing ground level. Groundwater monitoring carried out as part of the project has revealed the borehole standpipes were dry down to a depth of 6.0m below existing ground level.

The laboratory testing shows the finer grained layers of the Made Ground and Lambeth Group as well as the upper layers of the Seaford and Newhaven Chalk Formations to have a predominantly medium volume change potential as defined by NHBC Building Standards, Chapter 4.2.

Groundwater was encountered as standing levels in the cable percussion boreholes at depths ranging from 13.20m and 13.50m below existing ground level. The depth of standing groundwater after 15 minutes monitoring was approximately 12.90m and 13.30m below existing ground level.

Groundwater monitoring carried out as part of the project has revealed the borehole standpipes were dry down to a depth of 6.0m below existing ground level.

The site location was assessed for its susceptibility to dissolution features, using the risk assessment methodology published by Edmonds, 2001, *Predicting natural cavities in chalk*. The assessment provided a moderately high hazard rating for the site.

Additionally consideration should be given to the potential of shallow mine chalk mine workings beneath this site due to the potential the chalk may have been mined in this area for brick making.

The probing at the site indicates that the Lambeth Group soils are weaker/looser than normally expected. It is possible that this could be attributed to the faulting recorded to the immediate east of the site, associated with possible infilling of the historical gravel pit, infilled chalk dissolution features or loosening of soils overlying historical chalk mines. Whilst the Lambeth Group soils are weaker than expected the probing and

drilling has not indicated any voiding which may be associated with chalk dissolution features or mine working although this does not discount the possibility of voids at depth or in areas that have not been investigated. Therefore consideration should be given to the potential for such features to occur beneath this site and mitigation measures should be incorporated in to the design of the proposed new Community Centre.

It may be considered prudent to undertake a geophysical survey and/or rotary boreholes to further assess the potential of shallow mine workings or chalk dissolution features at the site.

No obvious evidence of the fault marked on the geological map was encountered during the site work.

SITE EXCAVATION

Conventional hydraulic plant should be satisfactory for excavating foundation and service trenches within the Made Ground, Lambeth Group, and Seaford and Newhaven Chalk Formations

In line with HSE guidelines, all excavations requiring personnel access should be adequately supported to avoid the risk of collapse. Consideration should also be given to the stability of open trenches where personnel are working in close proximity. During the fieldwork, excavations within the Made Ground and Lambeth Group remained stable for the short time that the trial pits/boreholes were open.

Groundwater is expected to be encountered at depths greater than about 13m. It should be appreciated, however, that seasonal variations may exist and hence groundwater entries may occur particularly during wetter months or after periods of inclement weather.

FOUNDATION SOLUTIONS

Shallow Foundations

The Made Ground and Lambeth Group are considered unsuitable as a bearing stratum due to their variability, and potential for unacceptable total and differential settlement under applied foundation loadings.

Ground Improvement

Ground improvement using vibro stone columns or vibro concrete columns could be considered as an alternative to shallow foundations with stone columns being constructed onto the more competent Seaford and Newhaven Chalk Formations at depth.

The advice of a specialist ground improvement contractor should be obtained.

Pile Foundations

Piled foundations may be appropriate founded well down into the Seaford and Newhaven Chalk Formation. For preliminary pile design unit values of ultimate shaft and end bearing resistance are given in Appendix D. Settlements of piled foundations should be acceptably small.

Due to the potential presence of dissolution features and shallow chalk mine workings, it is recommended that end-bearing piles are not adopted as they may be underlain by further weak soils. The piles should have an adequate factor of safety based on the shaft resistance alone, so that the base does not carry a

disproportionate amount of the working load. It should also be noted that uncertainty about the integrity of the pile shaft should voids or loose material be encountered both cfa and driven cast-in-place piles would be unsuitable. Such problems would not occur with driven pre-formed piles.

The contribution from the base resistance should not be included unless pile load testing is undertaken. Then, if $N > 25$, an allowable pile working load should not exceed 1000-1800kPa. Where $N < 25$, then the allowable pile working load should not exceed 600-800kPa.

An appropriate factor of safety and working load limits should be adopted, to limit pile settlement to acceptable levels as detailed in CIRIA C574. Limitations of pile concrete crushing strength/maximum permitted concrete stress should also be taken into consideration along with group settlement for pile groups.

GROUND FLOOR SLABS

Given the potential for chalk dissolution features or shallow chalk mines at the site we would recommend that suspended floor slabs are adopted.

Should a suspended floor slab not be considered practical for the proposed building, then provided all the Topsoil and Made Ground is stripped off, ground bearing floor slabs could be constructed placed on a layer of well compacted granular fill. However, reinforcement measures should be incorporated in to the ground floor slab to bridge voids of up to 5m should these occur in the future. Additionally a high tensile geotextile could be placed beneath a ground bearing floor slab.

However, where Made Ground is too thick to be removed the NHBC states that suspended slabs must be used. In addition, where foundations depths are greater than 1.50m bgl due to the existence of nearby vegetation then suspended floors will also be required.

It should be noted that a suspended floor slab will be required in soils with a volume change potential in accord with NHBC guidelines, even in the absence of trees and shrubs, but where the soil is seasonally desiccated. Under those circumstances the adoption of a suspended slab is only likely to be avoided if construction of the floor slab takes place during the wetter times of the year. A void should be left below the floor slab to accommodate future soil movements. This may be achieved by use of a proprietary compressible material such as Clay board or Cellcore.

ADDITIONAL MITIGATION MEASURES FOR POTENTIAL SINKHOLES

For drainage systems, flexible jointed pipes should be used wherever possible and particular care should be taken for the avoidance of leaks in both water supply and drainage pipe work.

In addition underground drainage and water pipes should be regularly checked for leaks or damage. Prompt repair of any leaking water pipes, surface water drains or associated underground services should then be undertaken.

Furthermore it may be prudent to adopt high tensile geotextiles in areas of parking, access roads and pathways at the site to reduce to potential for collapse should instability occur in the future.

GAS PROTECTION

In consideration of the source-pathway-receptor methodology for ground gas risk assessment set out in CIRIA C665, the sensitivity of the development is considered to be moderate. The generation potential of the source is considered to be moderate due to the a potential infilled historical gravel pit which was recorded encroaching in to the east of the site.

The results of the gas monitoring have revealed that low levels of carbon dioxide gas up to 0.4% and methane gas of up to 0.1% is being produced in the ground. Flows rates between 0.4l/hr and 0.5l/hr were recorded.

The low flow rates show that no significant volumes of gas being produced in the ground. There was no organic rich soil and no significant thickness of Made Ground at the site.

The results have been evaluated with reference to Code of practice for the characterization and remediation from ground gas in affected developments, BS8485:2015.

Using the maximum carbon dioxide reading of 0.4% with the highest recorded flow rate of 0.5l/hr, the maximum gas screening value is 0.0016l/hr. There were no carbon dioxide levels above 5% and no methane levels above 1%. This classifies the site as Characteristic Situation 1.

Therefore, for this commercial development it is considered that no gas protection is necessary with regard to methane or carbon dioxide gas.

However, additional confirmatory ground gas monitoring may be required by the Local Authority to confirm the findings of this report given the proximity of a potentially infilled historical gravel pit..

The BGS advises that no radon gas protection measures are necessary for buildings without underground rooms at this site.

The above conclusions should be agreed with the relevant local Regulatory Authority as soon as possible prior to development, to reduce any potential delays to the development should they require further clarification of this report or further ground gas monitoring.

WORKING PLATFORMS FOR TRACKED PLANT

If construction on the site requires the use of heavy tracked plant then reference will need to be made to the most recent guide for the design of 'Working Platforms for Tracked Plant', 2004, produced by the BRE.

Use of such plant will require construction of either a working platform or an adequate running surface if the subgrade is determined as being already adequate to support the anticipated plant loadings.

The subgrade down to 2.00m depth will vary across the site. Accordingly the following soil characteristics should be used for preliminary Working Platform design in accord with the most recent guidance given by the Building Research Establishment.

Cohesive (clay) Soils down to 2.00m	
Undrained Shear Strength C_u	50kN/m ²
Effective unit weight of subgrade material	18kN/m ²

Granular (sand) Soils down to 2.00m	
Angle of shearing resistance of granular subgrade ϕ' s	30°
Effective unit weight of subgrade material	17kN/m ²

It should be noted that soft spots and zones of weaker soil may exist on any site at shallow depth that will have a significant influence on the instability of tracked plant. The location of such features will not readily be determined by a general ground investigation for foundation design and more specific investigation at shallow depth may be required before the design of a working platform can be completed.

The advice of a specialist contractor should be sought to determine the most suitable size and thickness of platform required for their specific plant. This will take into account the size of the plant and anticipated loadings imposed on the working platform.

CLASSIFICATION OF WASTE MATERIAL

The excavations on site from foundation and services trenches will produce a considerable amount of arisings. Under current waste management legislation if these arisings are surplus to requirements they will be classified as waste and need disposing of at a licensed facility.

Any soil classified as waste requires classification of the chemical constituents prior to leaving site in accordance with the European Waste Catalogue.

If it is decided that the surplus arisings will be disposed of at a landfill facility, the implementation of the Landfill Directive means that the waste soil requires additional classification under the Waste Acceptance Criteria (WAC).

Some of the soil may be able to be re-used on-site as described in the RE-USE OF MATERIAL ON SITE section below.

European Waste Catalogue Determination

The 'Total' soil contamination test results from this investigation have been used in conjunction with the HazWasteOnline spreadsheets and the Technical Guidance WM3 published by the Environment Agency.

This has established that all of the soil has been classified as non-hazardous waste.

The assessment report is provided in Appendix E.

With regard to European Decision 1999/31/EC, EWC 17 05 04 'Stone and soils from uncontaminated sites' should be classified as inert. Therefore, it is considered that the Lambeth Group and Seaford and Newhaven Chalk Formations soils from this site should be classified as such.

Asbestos

No obvious visual evidence of asbestos containing material (ACM) was noted in the soils during the fieldwork and no Asbestos was detected in the four samples screened.

However, the presence of asbestos containing material (ACM) and fibres within Made Ground at any site cannot be ruled out. Should visible pieces of asbestos be encountered in the soils at the site, this soil should be considered as mixed waste and must be separated whenever possible and each separate waste stream classified accordingly.

Waste Classification

From the results of the HazWasteOnline spreadsheets, currently, the waste soil on this site is classified as follows:

- Made Ground – Non-hazardous
- Lambeth Group – Inert
- Seaford and Newhaven Chalk Formations - Inert

Uncontaminated soil and stones, including naturally occurring sands and clays, may be accepted in an inert landfill without testing, provided that it is not topsoil or peat and excludes soil from contaminated sites. Inert waste should not undergo change, will not burn, react, biodegrade or adversely affect human health or the environment. It should not contain metals or plastics.

It should be noted that in May/June 2012 HMR&C issued Briefs 15/12 and 18/12 clarifying how construction spoil and excess soils will be assessed for landfill tax purposes. Detailed accurate descriptions of waste are required for all wastes to support the landfill tax assessment. Uncontaminated naturally occurring soils will remain inert by default and eligible for the lower rate of landfill tax. Similarly 'reworked soils' and demolition 'stone' comprising ONLY materials listed in the Schedule of the Landfill Tax (Qualifying Material) Order 2011 (SI 2011/1017) will also be eligible for the lower rate of landfill tax.

Analytical results relevant to the materials being disposed of should be provided to the landfill operators or waste management contractors to confirm whether it meets their license agreements and to confirm tipping costs.

Laboratory testing for contaminants listed under the Waste Acceptance Criteria (WAC) can be undertaken on the Made Ground which will classify this waste soil as non-hazardous waste or inert waste.

The Landfill Regulations dictate that all waste must be treated before going to landfill. This treatment should fulfil all of the following three criteria:

- Physical, thermal, chemical or biological process including sorting.

- Change the characteristics of the waste.
- Reduce the volume, reduce the hazardous nature, facilitate its handling or enhance its recovery.

The most basic method of pre-treatment is sorting of the waste and re-cycling any possible materials, many waste disposals companies will have on-site recycling facilities that will be able to undertake this process at the landfill site. However, if treatment would not reduce its quantity or the hazards it poses to human health or the environment, then all three steps may not be necessary. The exception is inert waste for which treatment is not technically feasible.

The Environment Agency expect all landfill operators to obtain written evidence that the waste they accept has been pre-treated. We recommend that a signed certificate should be obtained describing the treatment to give to the receiving landfill. Further testing may be required after the treatment before the soil is accepted by the relevant landfill.

RE-USE OF MATERIAL ON SITE

Currently, if surplus arisings are 'fit for re-use' on the site and have not been treated, its re-use is allowed within the planning law. If it needs treating prior to re-use, exemptions can be sought from the Environment Agency to allow this activity.

A recent voluntary code of practice published by CL:AIRE, in conjunction with the EA, (the Definition of Waste: Development Industry Code of Practice, Version 2) endorses the re-use of arisings on and off the site of origin without the need for exemptions from the EA, dependent on whether it is "fit for purpose". It also supports the use of "Hub and Cluster" sites (to enable surplus soil to be used on agreed sites in the local vicinity, dependent on the soil being 'fit for purpose').

Based upon the human health and groundwater risk assessments, the soils on this site are considered to be suitable to be re-used on site for landscaping purposes, dependent on the agreement of the Local Authority.

SUBSURFACE CONCRETE

The concrete design mix recommendations for subsurface concrete have been assessed in terms of BRE Special Digest 1.

The site has no known history of industrial development and may therefore be considered as natural ground.

The groundwater beneath the site should be considered as mobile.

Chemical tests have recorded a characteristic soil soluble sulphate concentration of 40mg/l.

These results correspond to a Design Sulphate Class of DS-1.

Testing indicates a characteristic pH of 7.3 pH units.

The above assessment provides an Aggressive Chemical Environment for Concrete (ACEC) class of AC-1.

ACCESS ROADS AND PARKING

CBR tests were undertaken on two bulk soil samples remoulded using a 2.5kg compactive effort at natural water content. The samples were from the Made Ground soils encountered at the site. Results of the testing are shown in the table below:

Location	Stratum	Depth (m)	CBR (%)
TP02	Made Ground	0.5	4.5
BH2C/02	Made Ground	0.5	1.5

The structural design of a road or hardstanding is based on the strength of the subgrade, which is assessed on the California Bearing Ratio (CBR) scale. Laboratory CBR tests undertaken in Made Ground provided a CBR values of between 1.5% and 4.5% and we recommend a value of <2% is adopted for design.

Deep Made Ground was encountered over the whole of the site. Pavement construction may be considered on this existing Made Ground, subject to similar considerations as the casting of ground bearing floor slabs. Where deep Made Ground is encountered beneath the area of proposed pavement it is recommended that geogrids or similar soil reinforcement techniques be employed to provide a subgrade with a known CBR value. Reinforcement measures will also mitigate lateral and vertical displacement from traffic loadings and differential settlement over variable ground. Discussions should be held with a soil reinforcement company (such as Tensar) who would design a subgrade to a specified CBR value.

As the Made Ground and natural soils are likely to be frost susceptible a pavement thickness of not less than 450mm should be used.

The following should also be taken into consideration:

- Inspection of the formation and removal of any surface areas of soft, organic or other unsuitable materials.
- 'Heavy' proof rolling of the resultant formation, to compact loose coarse materials and locate any soft spots at shallow depth beneath the formation for subsequent removal.
- Removal of intact or loose obstructions where noted at surface, or known based on the investigation, to a depth of at least 600mm beneath the formation to prevent the creation of hard spots or voiding.
- Backfilling of any excavation with well-compacted inert coarse material.
- Adopt a pavement design based upon an equilibrium CBR of less than 2%.

It may be prudent to adopt high tensile geotextiles in areas of parking, access roads and pathways at the site to reduce to potential for collapse should instability occur in the future.

INFILTRATION MEASURES

Appropriately designed sustainable drainage systems (SuDS) are more sustainable than using piped drainage to local sewer systems. However, infiltration measures close to buildings may result in undermining of foundations and softening of soils leading to instability. Attenuation measures should be located at suitable distances from foundations and infrastructure.

Infiltration testing was carried out in the Lambeth Group strata encountered at the site, at a depth of between 0.95m and 2.0m depth in TP5 in general accord with BRE Digest 365 'Soakaway Design'. The infiltration results ranged between 3.6×10^{-5} m/s and 6.5×10^{-5} m/s.

These results indicate soils with generally medium permeability.

In chalk deposits soakaways can initiate new dissolution voids, or reactivate existing features, and in areas where dissolution features are known to be prevalent, soakaways should be avoided if possible, but if unavoidable, should be sited at least 20m away from any foundations.

UNDERGROUND SERVICES

Low levels of heavy metals and hydrocarbons were recorded in the made ground/soil at the site. These contaminants could potentially affect services pipes. For instance, organic contaminants, such as petroleum or polyaromatic hydrocarbons, may attack plastic pipes and these would need to be protected by sleeving with another material.

It should be noted that the utility companies often have their own local guidelines and standards on levels of shallow soil contamination in the ground that may or may not be acceptable for the installation of below ground services. These standards may be different to those specified for assessing risks to human health and groundwater.

FURTHER WORK/RECOMMENDATIONS

No elevated concentrations of contaminants were recorded by this investigation and whilst there is considered to be a low risk of contamination at this site, some areas of the site have not been investigated. A watching brief should therefore be maintained during demolition and groundworks, and should suspicious soils be encountered, work should cease immediately and the soils be assessed by a suitably qualified engineer.

Soil is a heterogeneous material and variations, which affect our conclusions, may inevitably occur between and beyond the test locations. The risk of significant variations to our Ground Model is considered to be low however should ground conditions vary noticeably from our Ground Model, then we recommend further assessment by a suitably qualified person.

Based on our investigation, the risk from chalk dissolution features is considered to be moderately high. As such, we recommend a watching brief is prepared during groundworks and should any evidence of loosened or weak zones of soil be encountered, then we recommend further advice is sought from a specialist.

Consideration should be given to undertaking a geophysical survey and/or rotary boreholes to further investigate the potential for voided ground associated with chalk dissolution features or shallow chalk mine workings.

Laboratory testing for contaminants listed under the Waste Acceptance Criteria (WAC) can be undertaken on the Made Ground which will classify this waste soil as non-hazardous waste or inert waste.

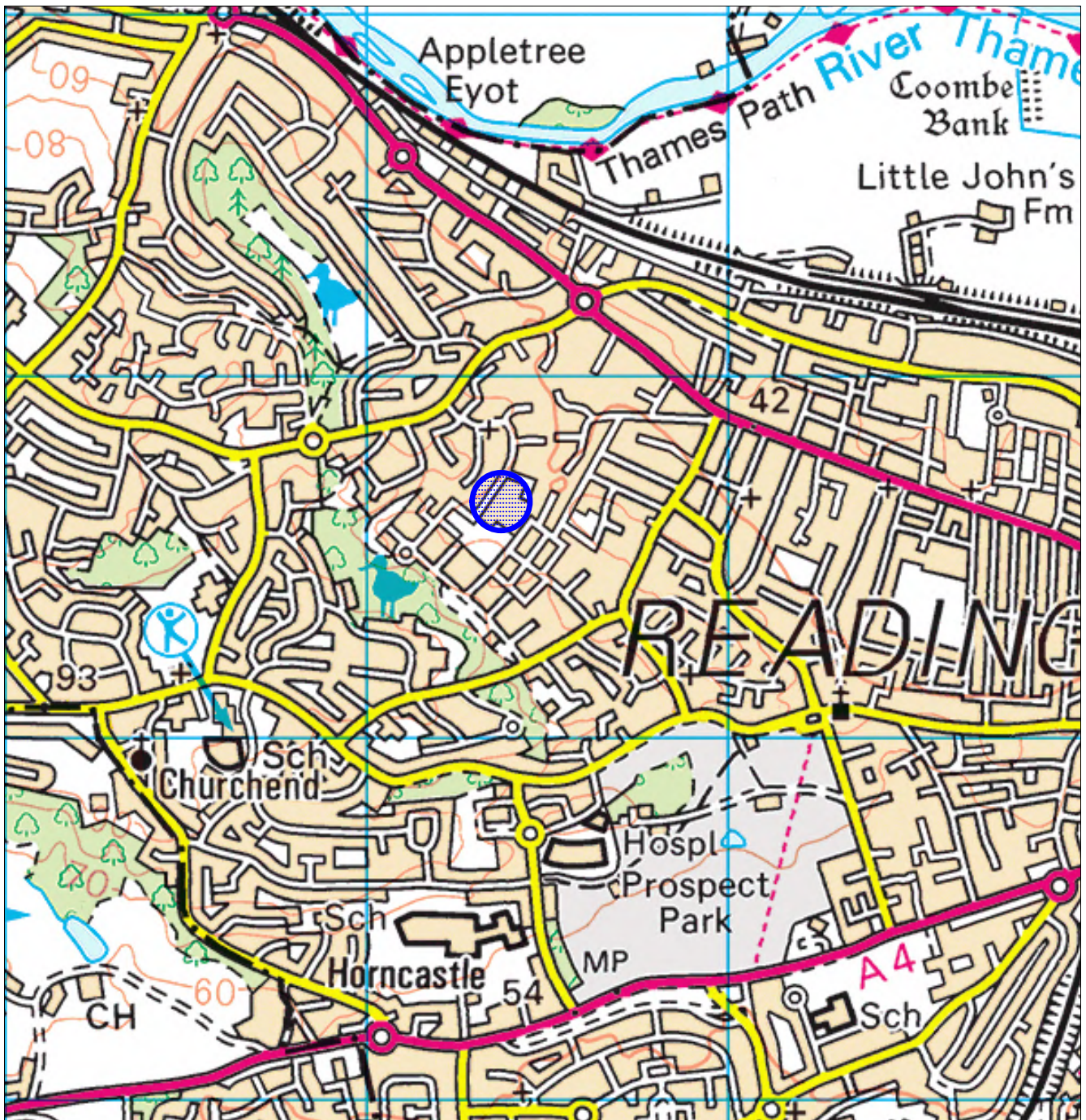
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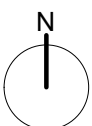
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APPENDIX A PLANS AND PHOTOGRAPHS

Extract of 1:50,000 Ordnance Survey Explorer Map



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Key:



Approximate Site Location



LISTERS GEO

Geotechnical and Geoenvironmental Consultants

Listers Geotechnical Consultants Ltd www.listersgeotechnics.co.uk Tel: 01327 860060

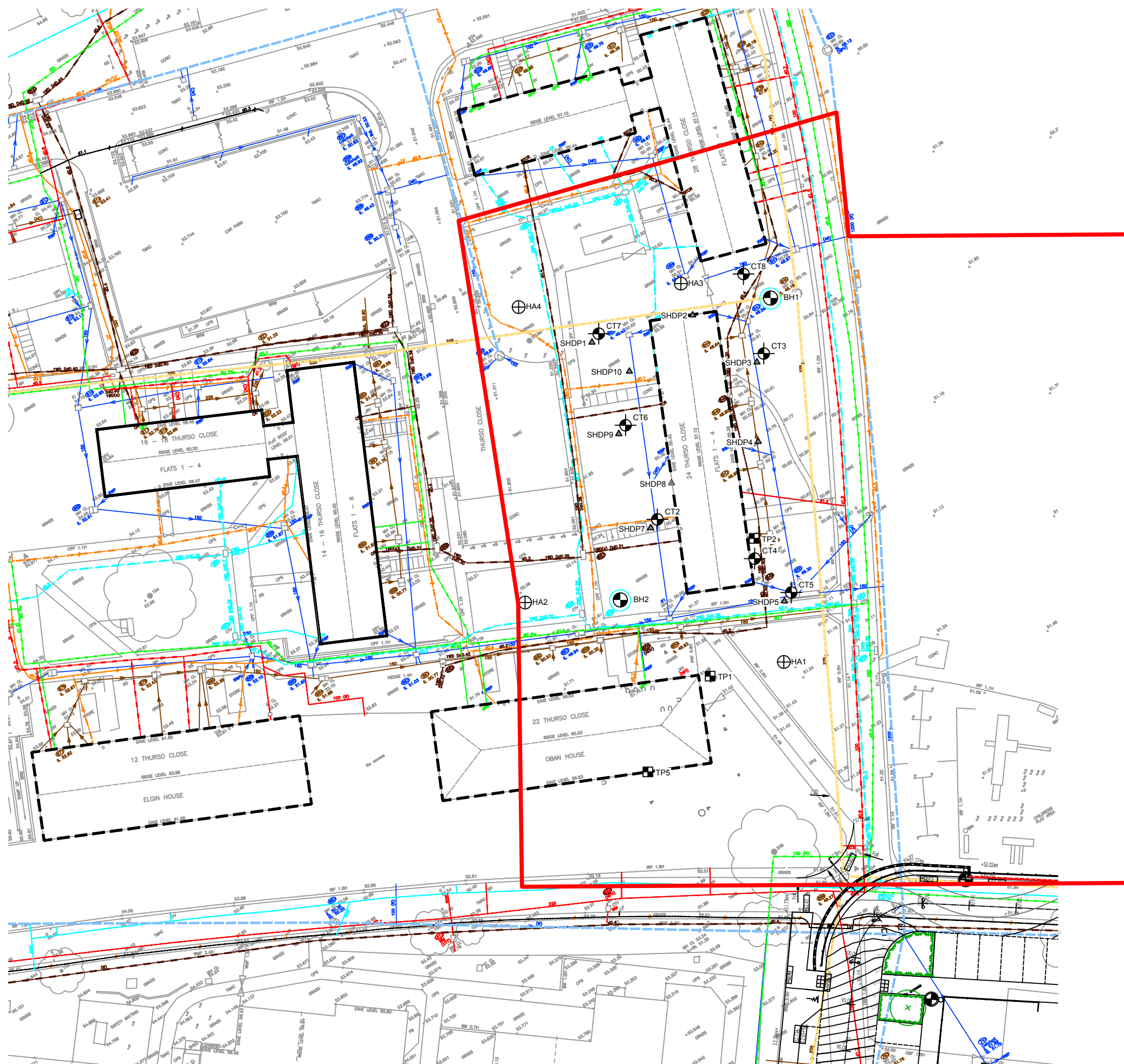
Title: Site Location Plan

Site: Phase 2C, Dee Park, Reading, RG30 4DD

Scale: NTS

Job No: 08.03.014i

Drawn By: HC



Key:

- Continuous Tube Sampler Borehole
- Super Heavy Dynamic Probe
- Cable Percussive Borehole
- Hand Auger Borehole
- Machine Excavated Trial Pit
- Install
- Approximate Site Boundary

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Listers Geotechnical Consultants Ltd www.listersgeotechnics.co.uk Tel: 01327 860060

Title: Exploratory Hole Location Plan - Existing Site Layout

Site: Phase 2C, Dee Park, Reading, RG30 4DD

Scale: NTS Job No: 08.03.014i Drawn By: HC



Photo 1



Photo 2

SITE PHOTOGRAPHS

Report:
08.03.014i



Photo 3



Photo 4

SITE PHOTOGRAPHS

Report:
08.03.014i



Photo 5



Photo 6

SITE PHOTOGRAPHS

Report:
08.03.014i



Photo 7



Photo 8

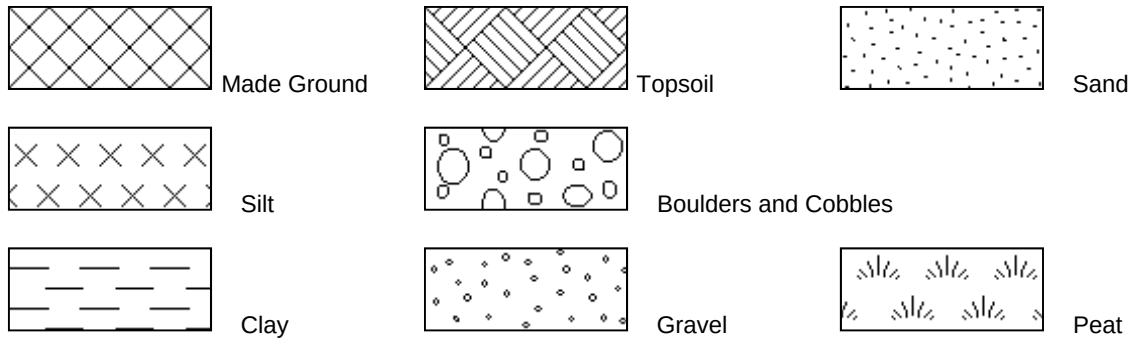
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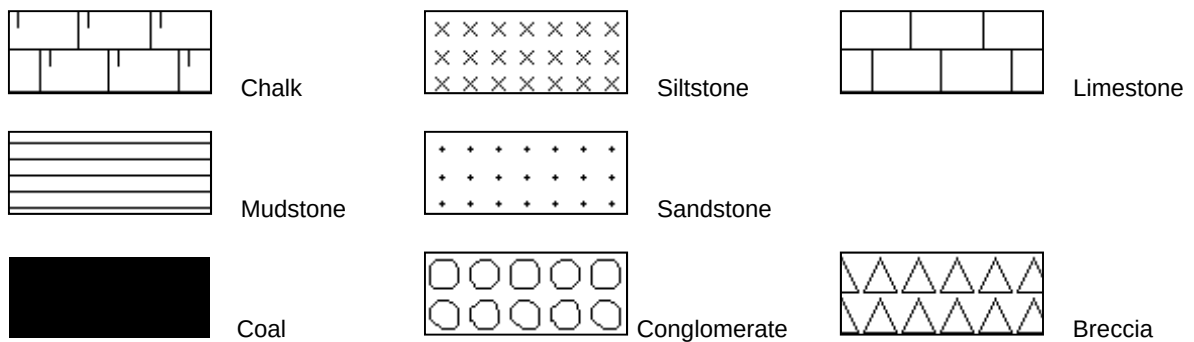
APPENDIX B

FIELDWORK AND TESTING

LEGEND - Soils



LEGEND - Rocks (Sedimentary)



LOG ABBREVIATIONS

W	Water Sample		Water Strike
B	Bulk Sample		Water (Standing Level)
D	Disturbed Sample	PP	Pocket Penetrometer
J	Jar Sample	HV	Hand Vane
U	Undisturbed Sample	SPT	Standard Penetration Test
(No. of blows shown in brackets for U100 samples)		CPT	Cone Penetration Test
WAC	Waste Acceptance criteria Sample	CBR	California Bearing Ratio
		*	Extrapolated Value

Pocket penetrometer testing provides values of unconfined compressive strength. The results have been converted to an approximate equivalent shear strength which should be used with due circumspection. As the pocket penetrometer tends to overestimate shear strength, we have used an appropriate reduction factor.

LOG KEY

Trial Pit Log

Trial Pit No.

TP 01
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level:
Dates: 26/10/2017

Project Number:
08.03.014i

Logged By:
Matthew Johnston
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	(kPa)					
	0.20	D					MADE GROUND Brown very clayey silty sandy GRAVEL with medium to high cobble content. Gravel and cobbles are fine to coarse angular of flint, brick and concrete (loose/medium dense)	
	0.50	D						
	0.80	D						
	1.00	D		0.90			MADE GROUND/IMPORTED NATURAL Firm dark grey silty very sandy slightly gravelly CLAY. Gravel is fine to coarse angular to sub-angular flint	1
				1.20				
	1.50	D					LAMBETH GROUP Firm orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded flint	
				1.70			End of Trial Pit at 1.70m	2
								3
								4

Method of excavation: Mini digger

Stability: Sides Stable

Groundwater: None encountered

Trial Pit Dimensions: 0.70m x 2.10m x 1.70m

Remarks: Uncovered black pipe at 0.70m - avoided and undamaged


Trial Pit Log

Trial Pit No.

TP 02
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level:
Dates: 26/10/2017

Project Number:
08.03.014i

Logged By:
Matthew Johnston
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	(kPa)					
	0.20	D					MADE GROUND Loose brown very clayey very sandy GRAVEL with medium to high cobble content. Gravel and cobbles are fine to coarse, angular flint and concrete with rare metal and copper pipe	
	0.50 0.50 - 1.00	D CBR						
	1.00	D		1.00			LAMBETH GROUP Firm orangish brown very sandy slightly gravelly CLAY. Gravel is fine to coarse, sub-rounded flint	1
				1.20			LAMBETH GROUP (Loose to medium dense) orangish brown very clayey sandy GRAVEL. Gravel is fine to coarse, rounded flint	
	1.50	D		1.70			LAMBETH GROUP Firm orangish brown very sandy slightly gravelly CLAY. Gravel is fine to coarse sub-rounded flint	
	2.00	D		2.00			End of Trial Pit at 2.00m	2
								3
								4

Method of excavation: Mini digger

Stability: Unstable below 1.20m

Groundwater: None encountered

Trial Pit Dimensions: 0.80m x 1.90m x 2.0m

Remarks:


Trial Pit Log

Trial Pit No.
TP 05
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level:
Dates: 26/10/2017

Project Number:
08.03.014i

Logged By:
Matthew Johnston
to BS 5930:2015

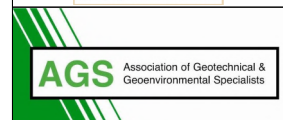
Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	(kPa)					
	0.20	D		0.20			MADE GROUND Soft dark brown very sandy slightly gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded flint, concrete and clinker with occasional roots	
	0.50	D		0.55			HEAD Firm brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded flint with occasional glass	
	1.00	D					HEAD Dark brown slightly clayey slightly gravelly SAND. Gravel is fine to medium sub-angular to sub-rounded flint	1
	1.50	D					- becoming slightly orange brown	
	2.00	D		2.00			End of Trial Pit at 2.00m	2
								3
								4

Method of excavation: Mini digger

Stability: Sides Stable

Groundwater: None encountered

Trial Pit Dimensions: 0.70m x 2.40m x 2.00m

Remarks: Visible roots to 0.30m depth


Cable Percussive Borehole Log

Borehole No.

BH2C/01

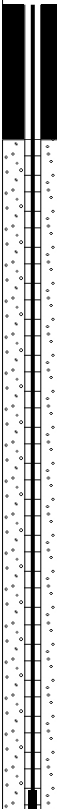
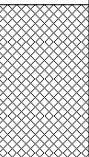
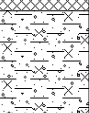
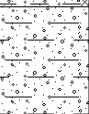
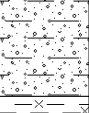
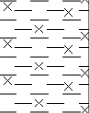
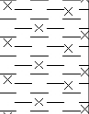
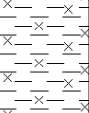
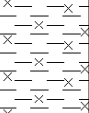
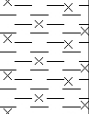
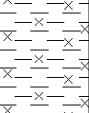
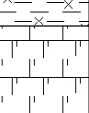
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Co-ords: 468478E - 173666N

Project Number:
08.03.014i

Level:
Logged By:
Dates: 26/10/2017 to 27/10/2017

 Matthew Johnston
to BS 5930:2015

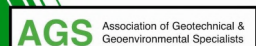
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Result					
		0.50	D		1.20			MADE GROUND Firm brown silty, sandy very gravelly CLAY. Gravel is fine to coarse sub-angular flint, chalk and brick, occasional cobble-sized flint, brick and ceramic water pipe	1
		0.50 - 1.00	B						
		1.20	D		2.00			LAMBETH GROUP Soft brown silty sandy slightly gravelly CLAY. Gravel is fine to coarse flint and quartzite	2
		1.20 - 1.70	B						
		1.20	SPT(S)	N=7 (4/1,2,2,2)	2.00			LAMBETH GROUP Medium dense brown clayey sandy GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded flint	3
		1.70	D						
		2.00	D		3.50			SEAFOORD & NEWHAVEN CHALK FORMATIONS Firm off-white and white very silty CLAY with relic chalk structure and lithorelics (Grade Dm)	4
		2.00 - 2.50	B						
		2.00	SPT(S)	N=19 (9/5,5,5,4)	3.50			SEAFOORD & NEWHAVEN CHALK FORMATIONS Firm off-white and white very silty CLAY with relic chalk structure and lithorelics (Grade Dm)	5
		2.50	D						
		3.00	D		4.50			SEAFOORD & NEWHAVEN CHALK FORMATIONS Firm off-white and white very silty CLAY with relic chalk structure and lithorelics (Grade Dm)	6
		3.00	SPT(S)	N=6 (4/2,1,2,1)					
		3.50	D		5.50			SEAFOORD & NEWHAVEN CHALK FORMATIONS Firm off-white and white very silty CLAY with relic chalk structure and lithorelics (Grade Dm)	7
		3.50 - 4.00	B						
		4.00	D		6.50			SEAFOORD & NEWHAVEN CHALK FORMATIONS Firm off-white and white very silty CLAY with relic chalk structure and lithorelics (Grade Dm)	8
		4.00	SPT(S)	N=5 (3/2,1,1,1)					
		4.50	D		7.50			SEAFOORD & NEWHAVEN CHALK FORMATIONS Firm off-white and white very silty CLAY with relic chalk structure and lithorelics (Grade Dm)	9
		5.00	D						
		5.00	SPT(S)	N=6 (4/1,2,2,1)	8.80			SEAFOORD & NEWHAVEN CHALK FORMATIONS Firm off-white and white very silty CLAY with relic chalk structure and lithorelics (Grade Dm)	10
		5.50	D						
		6.00	D		9.50			SEAFOORD & NEWHAVEN CHALK FORMATIONS Weak, low density creamy white CHALK with comminuted chalk in fractures (Grade C)	11
		6.00	SPT(S)	N=7 (2/2,1,2,2)					
		6.50	D		10.00			SEAFOORD & NEWHAVEN CHALK FORMATIONS Weak, low density creamy white CHALK with comminuted chalk in fractures (Grade C)	12
		7.00	D						
		7.00	SPT(S)	N=7 (3/2,2,1,2)					
		7.50	D						
		8.00	D						
		8.00	SPT(S)	N=8 (4/1,2,2,3)					
		8.50	D						
		9.00	D						
		9.00	SPT(S)	N=16 (6/4,4,4,4)					
		9.50	D						
		10.00	D						

Borehole Diameter: 150mm

Borehole Casing Depth: 19.50m

Chiselling:
Instrumentation: Standpipe installed to 6.00m depth

Groundwater: Groundwater struck at 13.20m, rising to 12.90m

Remarks: Inspection pit excavated to 1.20m


Cable Percussive Borehole Log

Borehole No.

BH2C/01

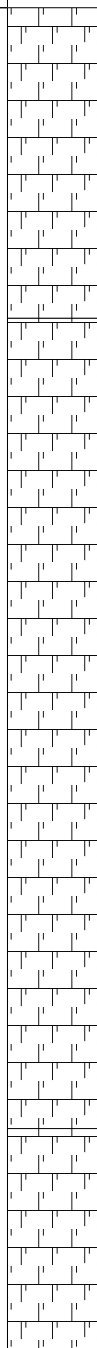
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 Matthew Johnston
to BS 5930:2015

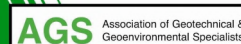
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Result					
		10.00 - 10.50	B	N=23 (9/4,6,7,6)	12.30		SEAFORD & NEWHAVEN CHALK FORMATIONS Weak, low density creamy white CHALK with comminuted chalk in fractures and flint cobbles (Grade C)	11	
		10.00	SPT(S)						
		11.00	D						
		11.50	D						
		11.50	SPT(S)	N=26 (10/6,8,6,6)					12
		12.50	D						
		13.00	D						
		13.00	SPT(S)	N=45 (13/7,12,12,14)			13		
		14.00	D						
		14.50	D						
		14.50	SPT(S)	N=41 (23/12,7,10,12)				15	
		15.50	D						
		16.00	D						
		16.00	SPT(S)	N=40 (24/12,10,8,10)			16		
		17.00	D						
		17.50	D						
		17.50	SPT(S)	N=49 (25/12,12,14,11)				18	
		18.50	D						
		19.00	D						
		19.00	SPT(S)	50 for 275mm (25 for 120mm/12,13,15,10 for 50mm)	19				
20.00	D								
20.00		20.00		End of Borehole at 20.00m		20			

Borehole Diameter: 150mm

Borehole Casing Depth: 19.50m

Chiselling:
Instrumentation: Standpipe installed to 6.00m depth

Groundwater: Groundwater struck at 13.20m, rising to 12.90m

Remarks: Inspection pit excavated to 1.20m


Cable Percussive Borehole Log

Borehole No.

BH2C/02

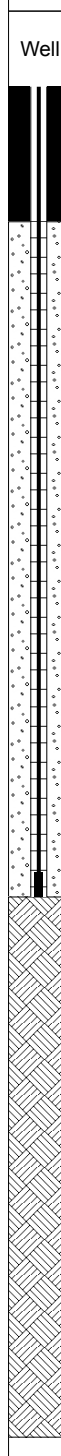
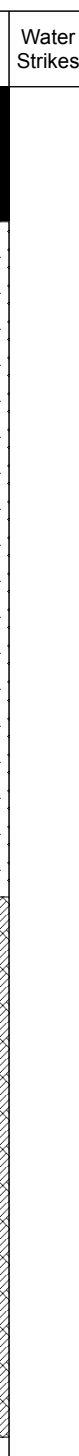
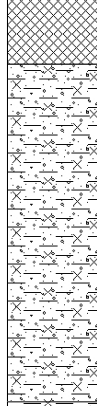
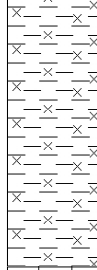
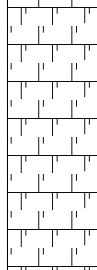
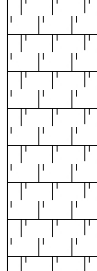
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords: 468450E - 173651N

Project Number:
08.03.014i

Level:
Logged By:
Dates: 27/10/2017 to 30/10/2017

 Matthew Johnston
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Result					
		0.50	D		0.50			MADE GROUND Soft to firm brown silty sandy gravelly CLAY. Gravel is fine to coarse sub-rounded to sub-angular flint and rare brick	
		0.50 - 1.00	B						
		1.20	D					LAMBETH GROUP Soft to firm brown silty sandy gravelly CLAY. Gravel is fine to coarse sub-rounded to sub-angular flint	1
		1.20	SPT(S)	N=6 (3/1,2,2,1)					
		1.70	D						
		2.00	D						
		2.00	SPT(S)	N=11 (4/3,2,3,3)					
		2.50	D						
		3.00	D						
		3.00	SPT(S)	N=8 (3/2,3,2,1)	3.00				
		3.50	D						
		3.50 - 4.00	B						
		4.00	D						
		4.00	SPT(S)	N=10 (4/2,3,3,2)					
		4.50	D						
		4.50 - 5.00	B						
		5.00	D		5.00			SEAFORD & NEWHAVEN CHALK FORMATIONS Firm off-white and white very silty CLAY with relic chalk structure and lithorelics and flint cobbles (Grade Dm)	3
		5.00	SPT(S)	N=20 (6/4,4,6,6)					
		5.50	D						
		6.00	D						
		6.00	SPT(S)	N=20 (7/4,4,5,7)					
		6.50	D						
		7.00	D						
		7.00	SPT(S)	N=20 (6/4,5,5,6)					
		7.50	D					SEAFORD & NEWHAVEN CHALK FORMATIONS Weak, low density creamy white CHALK with comminuted chalk in fractures and flint cobbles (Grade C)	4
8.00	D								
8.00	SPT(S)	N=7 (3/2,2,1,2)							
8.50	D								
9.00	D								
9.00 - 9.50	B								
9.00	SPT(S)	N=13 (4/3,2,4,4)					5		
9.50	D								
							6		
							7		
							8		
							9		
							10		

Borehole Diameter: 150mm

Borehole Casing Depth: 24.00m

Chiselling:
Instrumentation: Standpipe installed to 6.00m depth

Groundwater: Groundwater struck at 13.50m, rising to 13.30m

Remarks: Inspection pit excavated to 1.20m


Cable Percussive Borehole Log

Borehole No.

BH2C/02

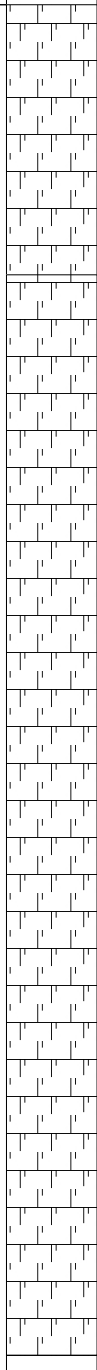
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords: 468450E - 173651N

Project Number:
08.03.014i

Level:
Logged By:
Dates: 27/10/2017 to 30/10/2017

 Matthew Johnston
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Result					
		10.00	SPT(S)	N=21 (8/4,7,6,4)	12.00			SEAFORD & NEWHAVEN CHALK FORMATIONS Weak, low density creamy white CHALK with comminuted chalk in fractures and flint cobbles (Grade C)	11
		11.00	D						
		11.50	D						
		11.50	SPT(S)	N=25 (9/5,6,8,6)					
		12.50	D					SEAFORD & NEWHAVEN CHALK FORMATIONS Strong, high density white CHALK with flint cobbles	12
		13.00	D						
		13.00	SPT(S)	N=39 (12/7,10,10,12)					
		14.00	D						
		14.50	D						
		14.50	SPT(S)	N=43 (21 for 13mm/10,12,12,9)					
		15.50	D						
		16.00	D						
		16.00	SPT(S)	N=40 (23/12,10,10,8)					
		17.00	D						
		17.50	D						
		17.50	SPT(S)	N=48 (24/12,12,13,11)					
		18.50	D						
		19.00	D						
		19.00	SPT(S)	N=49 (25/12,12,13,12)					
		20.00	D						20

Borehole Diameter: 150mm

Borehole Casing Depth: 24.00m

Chiselling:
Instrumentation: Standpipe installed to 6.00m depth

Groundwater: Groundwater struck at 13.50m, rising to 13.30m

Remarks: Inspection pit excavated to 1.20m


Cable Percussive Borehole Log

Borehole No.

BH2C/02

Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords: 468450E - 173651N

Project Number:
08.03.014i

Level:
Logged By:
Dates: 27/10/2017 to 30/10/2017

 Matthew Johnston
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Result					
		20.50	D					SEAFORD & NEWHAVEN CHALK FORMATIONS Strong, high density white CHALK with flint cobbles	
		20.50	SPT(S)	50 for 265mm (25 for 120mm/13,15,15,7 for 40mm)					21
		21.50	D						
		22.00	D						22
		22.00	SPT(S)	50 for 245mm (25 for 130mm/15,14,16,5 for 20mm)					
		23.00	D						23
		23.50	D						
		23.50	SPT(S)	50 for 225mm (25 for 100mm/15,15,18,2 for 0mm)					24
		24.50	D						
		25.00	D						25
		25.00	SPT(S)	50 for 180mm (25 for 90mm/15,18,17 for 30mm)	25.00			End of Borehole at 25.00m	
									26
									27
									28
									29
									30

Borehole Diameter: 150mm

Borehole Casing Depth: 24.00m

Chiselling:
Instrumentation: Standpipe installed to 6.00m depth

Groundwater: Groundwater struck at 13.50m, rising to 13.30m

Remarks: Inspection pit excavated to 1.20m


Continuous Tube Sampler Log

Borehole No.

CT 02
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 26/10/2017

Project Number:
08.03.014i

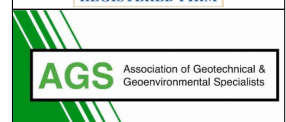
Logged By:
Matthew Johnston
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	(kPa)					
		1.00 - 1.50	C		1.00			MADE GROUND Crushed brick rubble	1
		1.50 - 2.00	C		1.20			MADE GROUND Firm brown and red brown very silty sandy gravelly CLAY. Gravel is fine to coarse angular flint, chalk and brick	
		2.00 - 2.50	C					LAMBETH GROUP Firm brown silty sandy gravelly CLAY. Gravel is fine to coarse sub-angular flint and occasional chalk	2
		2.50 - 3.00	C						
		3.00 - 3.50	C		3.00				3
		3.50 - 4.00	C					SEAFORD AND NEWHAVEN CHALK FORMATIONS Soft to firm off-white silty sandy CLAY with relic chalk structure, lithorelics and flint cobbles (Grade Dm)	
		4.00 - 4.50	C						4
		4.50 - 5.00	C						
		5.00 - 5.50	C						5
		5.50 - 6.00	C						
					6.00			End of Borehole at 6.00m	6
									7

Borehole Diameter: 87-57mm

Groundwater: None encountered

Instrumentation: Backfilled with arisings

Remarks: Inspection pit excavated to 1.20m


Continuous Tube Sampler Log

Borehole No.

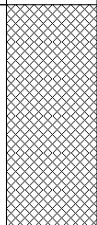
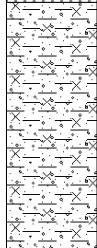
CT 03
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 26/10/2017

Project Number:
08.03.014i

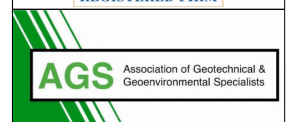
Logged By:
Matthew Johnston
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	(kPa)					
		0.00 - 0.70	D		1.20			MADE GROUND Soft to firm brown very silty very sandy gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded flint and occasional red brick	1
		0.70 - 1.00	D						
		1.00 - 1.50	C						
		1.50 - 2.00	C						
		2.00 - 2.50	C		2.50			LAMBETH GROUP Soft to firm brown and grey silty sandy gravelly CLAY. Gravel is fine to coarse sub-angular flint	2
		2.50 - 3.00	C						
		3.00 - 3.50	C						
		3.50 - 4.00	C						
		4.00 - 4.80	C						
		4.80 - 5.00	C						
					4.80			SEAFORD AND NEWHAVEN CHALK FORMATIONS Soft to firm off-white silty sandy CLAY with occasional lithorelics and flint cobbles (Grade Dm)	5
					5.00				
								End of Borehole at 5.00m	
									6
									7

Borehole Diameter: 87-57mm

Groundwater: None encountered

Instrumentation: Backfilled with arisings

Remarks: Inspection pit excavated to 1.20m


Continuous Tube Sampler Log

Borehole No.

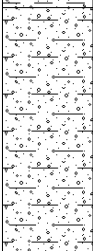
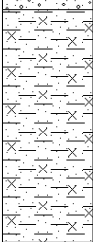
CT 04
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 26/10/2017

Project Number:
08.03.014i

Logged By:
Matthew Johnston
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	(kPa)					
		0.00 - 0.20	D		0.20 0.30			MADE GROUND Grey brown silty sandy clayey GRAVEL. Gravel is fine to coarse angular flint, red brick and concrete	1
		0.20 - 0.30	D					MADE GROUND Concrete	
		0.30 - 1.00	D					MADE GROUND Brown very silty GRAVEL of fine to medium angular flint	
		1.00 - 1.50	C				LAMBETH GROUP Firm to stiff brown silty sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular flint		
		1.50 - 2.00	C					LAMBETH GROUP Brown clayey very sandy GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded flint	
		2.00 - 2.50	C						
		2.50 - 2.80	C					SEAFORD AND NEWHAVEN CHALK FORMATIONS Firm off-white silty sandy CLAY with occasional lithorelics and flint cobbles	
		2.80 - 3.00	C						
		3.00 - 3.50	C						
		3.50 - 4.00	C						
					4.00		End of Borehole at 4.00m		4
									5
									6
									7

Borehole Diameter: 87-57mm

Groundwater: None encountered

Instrumentation: Backfilled with arisings

Remarks: Inspection pit excavated to 1.20m


Continuous Tube Sampler Log

Borehole No.

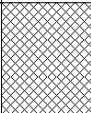
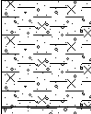
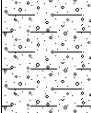
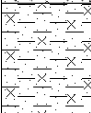
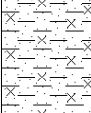
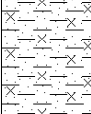
CT 05
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 26/10/2017

Project Number:
08.03.014i

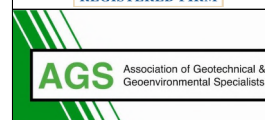
Logged By:
Matthew Johnston
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	(kPa)					
		0.00 - 0.60	D		0.60			MADE GROUND Firm brown silty sandy gravelly CLAY. Gravel is fine to medium sub-angular flint	1
		0.60 - 1.00	D					MADE GROUND Brown very sandy very gravelly CLAY. Gravel is fine to coarse sub-angular flint and concrete	
		1.00 - 1.50	C		1.20			LAMBETH GROUP Firm brown silty very sandy gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded flint	2
		1.50 - 1.75	C					LAMBETH GROUP Loose becoming medium dense brown very clayey sandy GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded flint	
		1.75 - 2.00	C		1.75				3
		2.00 - 2.50	C						
		2.50 - 3.00	C		4.00				4
		3.00 - 3.35	C						
		3.50 - 4.00	C		4.00				5
		4.00 - 4.50	C						
		4.50 - 5.00	C		6.00				6
		5.00 - 5.50	C						
		5.50 - 6.00	C						
					6.00			End of Borehole at 6.00m	7

Borehole Diameter: 87-57mm

Groundwater: None encountered

Instrumentation: Backfilled with arisings

Remarks: Inspection pit excavated to 1.20m


Continuous Tube Sampler Log

Borehole No.

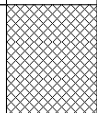
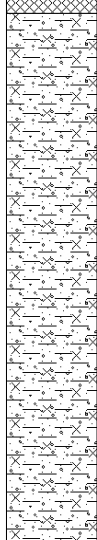
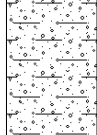
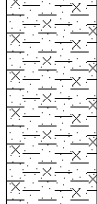
CT 06
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 26/10/2017

Project Number:
08.03.014i

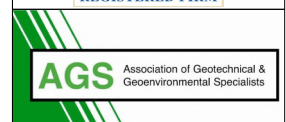
Logged By:
Matthew Johnston
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	(kPa)					
		0.00 - 0.60	D		0.60			MADE GROUND Soft brown very sandy gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded flint and red brick	1
		0.60 - 1.00	D					MADE GROUND Brown clayey GRAVEL. Gravel is fine to coarse sub-angular flint and chalk	
		1.00 - 1.50	C		1.20			LAMBETH GROUP Firm brown very silty very sandy gravelly CLAY. Gravel is fine to coarse angular to sub-rounded flint	2
		1.50 - 2.00	C						
		2.00 - 2.50	C						
		2.50 - 3.00	C						
		3.00 - 3.50	C		4.00				3
		3.50 - 4.00	C						
		4.00 - 4.50	C						
		4.50 - 5.00	C						
		5.00 - 5.50	C		4.80			LAMBETH GROUP Loose to medium dense brown clayey sandy GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded flint	4
		5.50 - 6.00	C					SEAFORD AND NEWHAVEN CHALK FORMATIONS Firm off-white silty sandy CLAY with relic chalk structure and flint cobbles (Grade Dm)	
					6.00			End of Borehole at 6.00m	6
									7

Borehole Diameter: 57-87mm

Groundwater: None encountered

Instrumentation: Backfilled with arisings

Remarks: Inspection pit excavated to 1.20m


Continuous Tube Sampler Log

Borehole No.

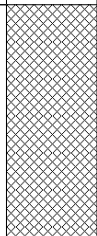
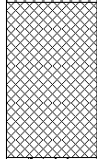
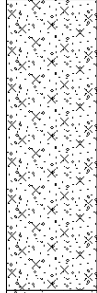
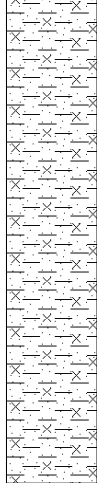
CT 07
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 26/10/2017

Project Number:
08.03.014i

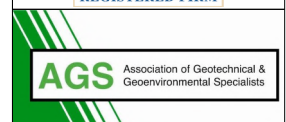
Logged By:
Matthew Johnston
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	(kPa)					
		0.00 - 0.30	D		1.20			MADE GROUND Brown very clayey gravelly SAND. Gravel is fine to coarse sub-angular to sub-rounded flint	1
		0.30 - 0.80	D						
		0.80 - 1.00	D						
		1.00 - 1.50	C						
		1.50 - 2.00	C		2.00			MADE GROUND Firm brown silty sandy very gravelly CLAY. Gravel is fine to coarse angular to sub-rounded flint and pottery	2
		2.00 - 2.50	C						
		2.50 - 3.00	C						
		3.00 - 3.50	C						
		3.50 - 4.00	C		3.50			LAMBETH GROUP Loose brown silty very gravelly SAND. Gravel is fine to coarse sub-angular flint	3
		4.00 - 4.50	C						
		4.50 - 5.00	C						
		5.00 - 5.50	C						
		5.50 - 6.00	C		6.00			SEAFORD AND NEWHAVEN CHALK FORMATIONS Firm off-white silty sandy CLAY with relic chalk structures and flint cobble	4
								End of Borehole at 6.00m	6
									7

Borehole Diameter: 87-57mm

Groundwater: None encountered

Instrumentation: Backfilled with arisings

Remarks: Inspection pit excavated to 1.20m


DPH and SHDP DYNAMIC PROBING

This is a simple test consisting of driving a rod with an oversize point at its base into the ground. A uniform, regular, hammer blow is used. The blow count is recorded for every 100mm of driving (N_{100}) and the results presented as a plot of blow count against depth.

Outside the UK this type of testing has been used extensively in a wide range of formats (ie. various hammer weights, hammer drops, point sizes, etc.) for many years. Since 1985 Dynamic Probing has become widely accepted in this country and the first British Standard for this test was published in 1990.

The standard equipment is a petrol powered unit using a 50kg hammer dropping through 0.50m 32mm diameter rods and a 15cm² area cone. This is the Heavy Dynamic Probe (DPH) and the equipment has been selected for general use as giving a good compromise between sensitivity in loose materials and penetration rates in denser materials. A sacrificial cone is used for each probing. A damper is used between the hammer and anvil.

The Super Heavy Dynamic Probe (DPSH) is a heavier version, using a 63.5kg hammer dropping through 0.75m, 32mm diameter rods and a 20cm² area cone.

The hammer operation is automated and driving is carried out as a continuous operation from ground level without a borehole. The test therefore not only provides a continuous record for the full depth penetration but also avoids many of the problems associated with poor operator technique when carrying out SPTs in boreholes.

Dynamic Probing provides an excellent method for locating boundaries between strata of differing density and driving resistance as well as comparative assessments of a single strata across a site. Comparisons between Dynamic probing results, SPT values and other soil parameters are given in DIN4094. Information on UK practice and correlation data in UK soils was published at the ICE Conference on Penetration Testing in 1988.

The complete machine weighs 140kg stands 2.5m high and measures 750mm wide x 850mm deep when erected. For movement between positions the mast is lowered and the machine wheeled on an integral axle. Probing can be carried out within 300mm of a vertical wall.

References:

1. Subsoil; exploration by penetration tests -DIN4094. December 1990 (Standard and supplement)
2. Soils for civil engineering purposes. In-situ tests. - BS1377 Part 9 1990
3. Penetration testing in the UK. (Proceedings of the geotechnology conference organised by the Institution of Civil Engineers and held in Birmingham 6-8 July 1988)
4. Code of Practice for Site Investigations – BS5930:2015 Section 4

DPH and SHDP DYNAMIC PROBING INFORMATION

Super Heavy Dynamic Probe

Borehole No.

SHDP 01
Project Location: Phase 2c, Dee Park, Reading, Bershire, RG30 4DD.

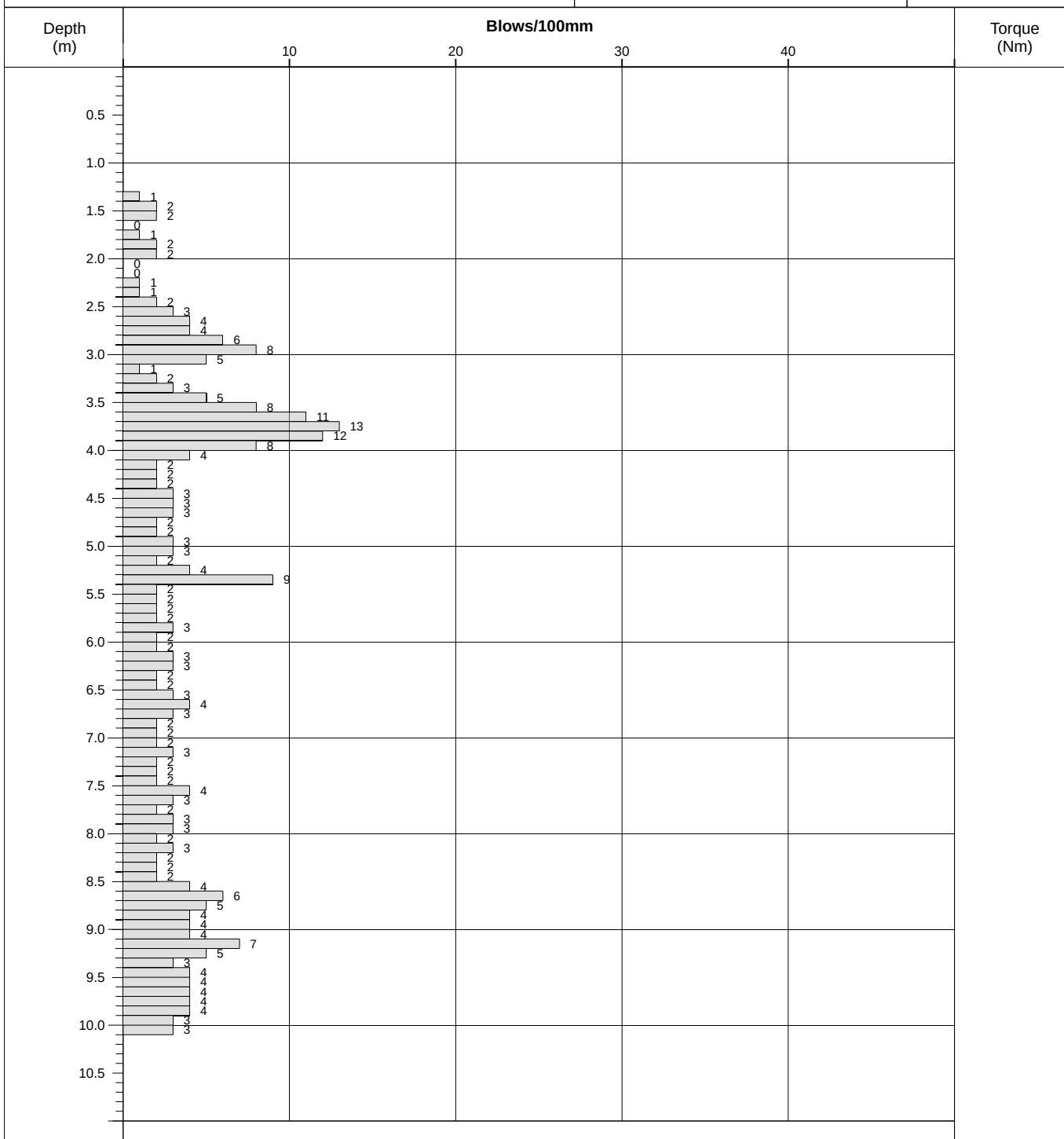
Co-ords:
Level:
Dates: 26/10/2017

Project Number:

08.03.014i

Hole Type:

SHDP - B


Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



Super Heavy Dynamic Probe

Borehole No.

SHDP 02
Project Location: Phase 2c, Dee Park, Reading, Bershire, RG30 4DD.

Co-ords:
Level:
Dates: 26/10/2017

Project Number:

08.03.014i

Hole Type:

SHDP - B

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0.5					50
1.0					
1.5					
1.6	2	4	7	8	
2.0					
2.5					
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					
6.0					
6.5					
7.0					
7.5					
8.0					
8.5					
9.0					
9.5					
10.0					
10.5					

Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



Super Heavy Dynamic Probe

Borehole No.

SHDP 03
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

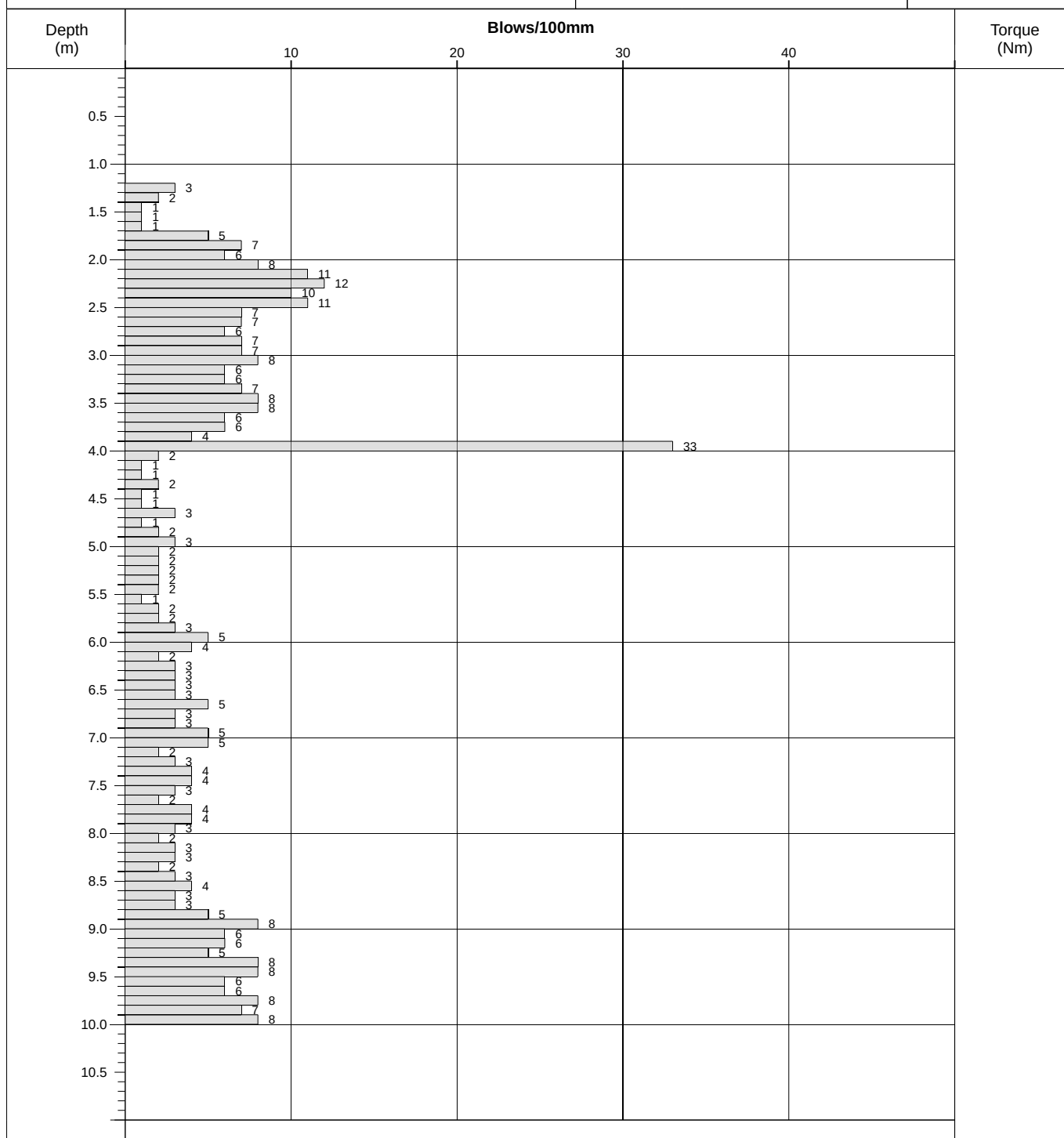
Dates: 26/10/2017

Project Number:

08.03.014i

Hole Type:

SHDP - B


Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



Super Heavy Dynamic Probe

Borehole No.

SHDP 04
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

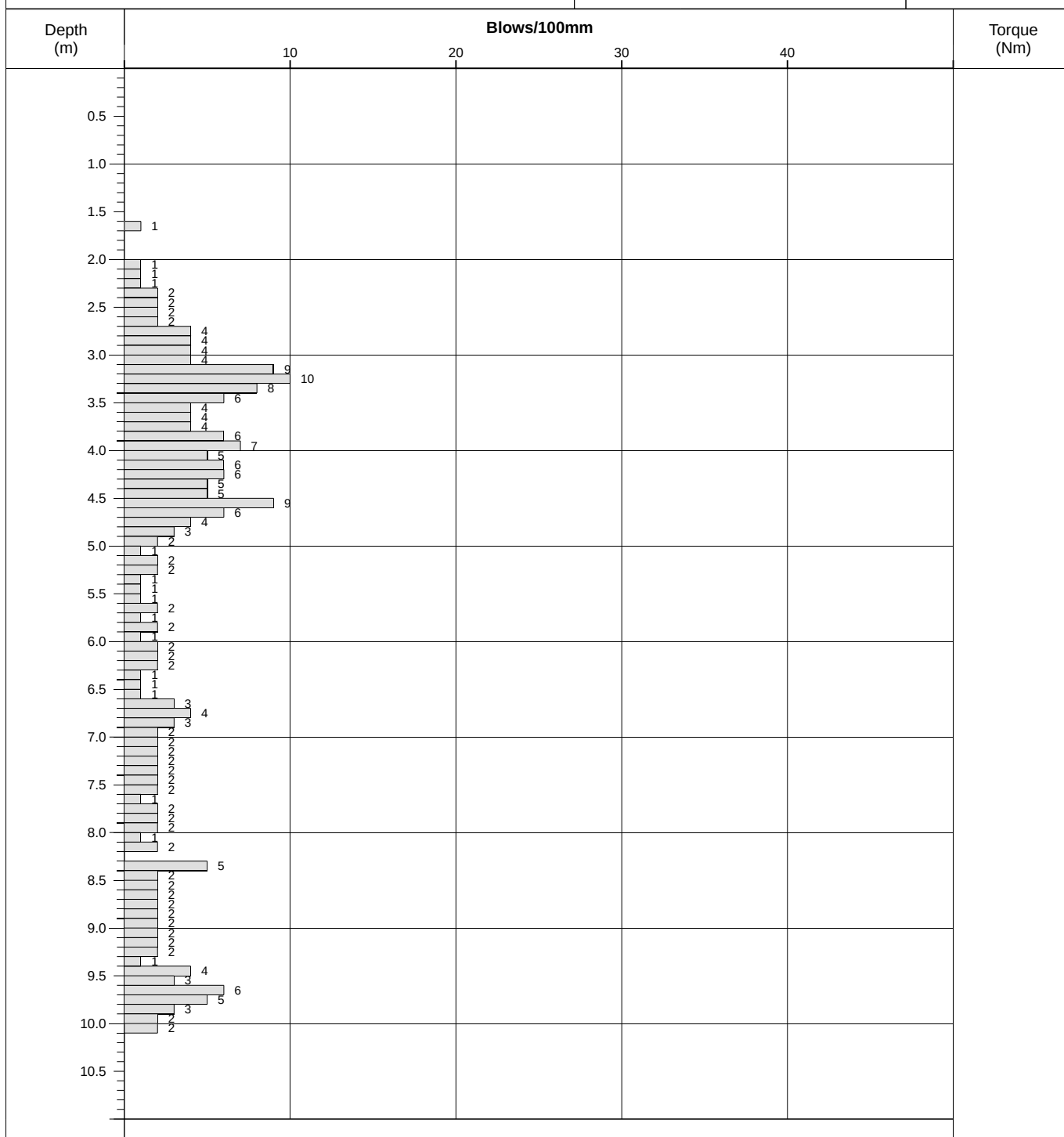
Dates: 26/10/2017

Project Number:

08.03.014i

Hole Type:

SHDP - B


Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



Super Heavy Dynamic Probe

Borehole No.

SHDP 05
Project Location: Phase 2c, Dee Park, Reading, Bershire, RG30 4DD.

Co-ords:
Level: mAOD

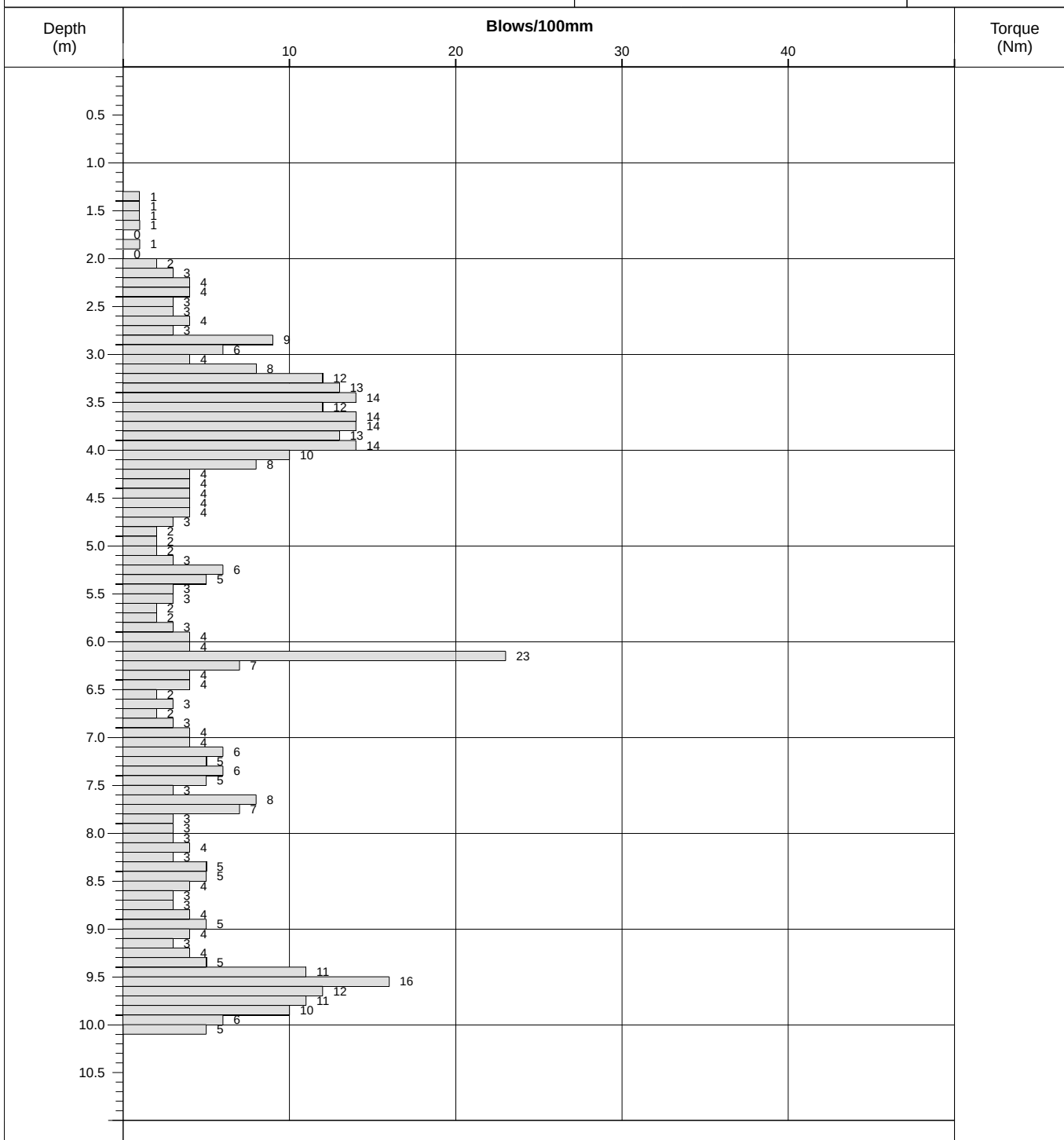
Dates: 26/10/2017

Project Number:

08.03.014i

Hole Type:

SHDP - B


Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



Super Heavy Dynamic Probe

Borehole No.

SHDP 07
Project Location: Phase 2c, Dee Park, Reading, Bershire, RG30 4DD.

Co-ords:
Level: mAOD

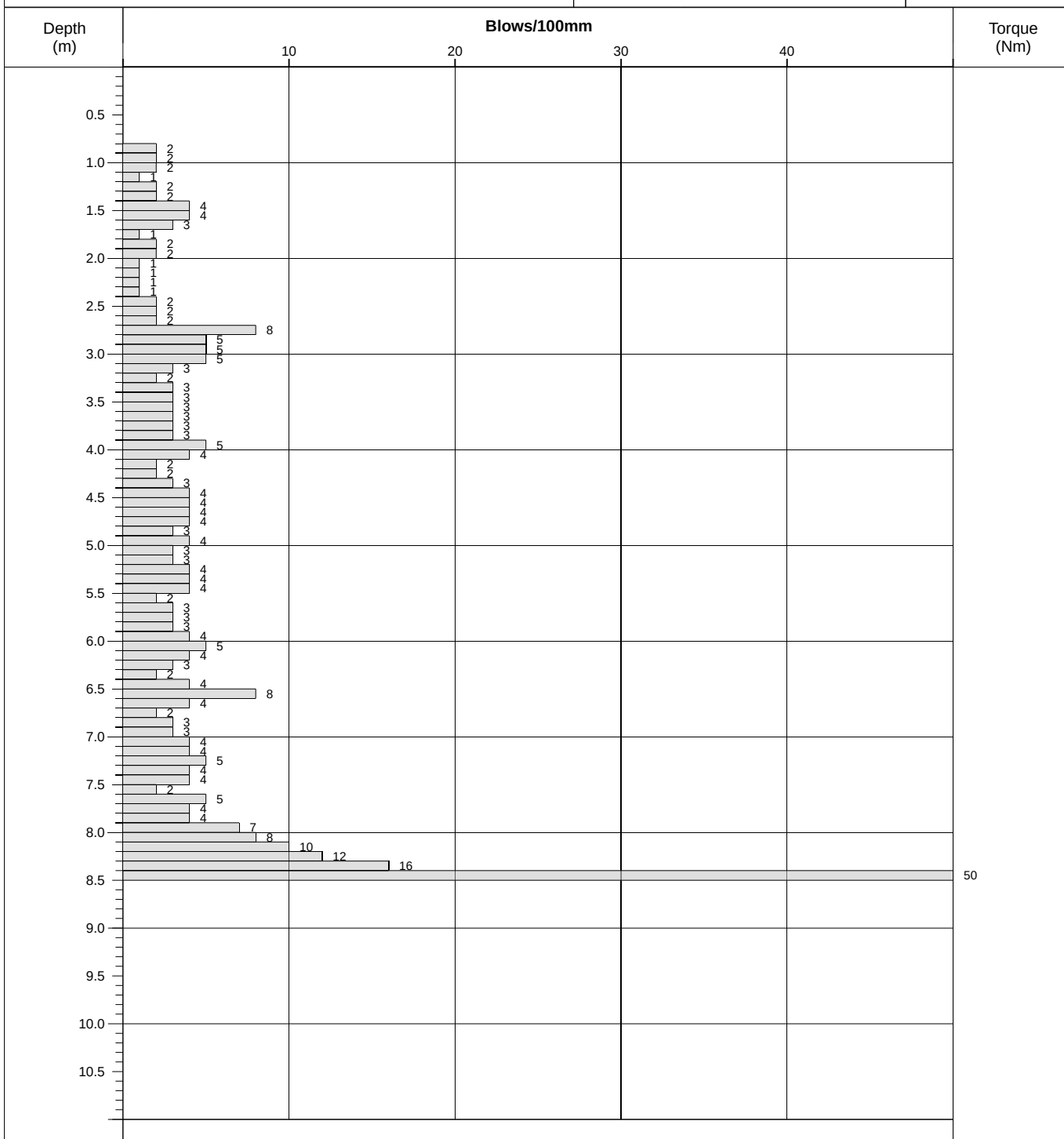
Dates: 26/10/2017

Project Number:

08.03.014i

Hole Type:

SHDP - B


Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



Super Heavy Dynamic Probe

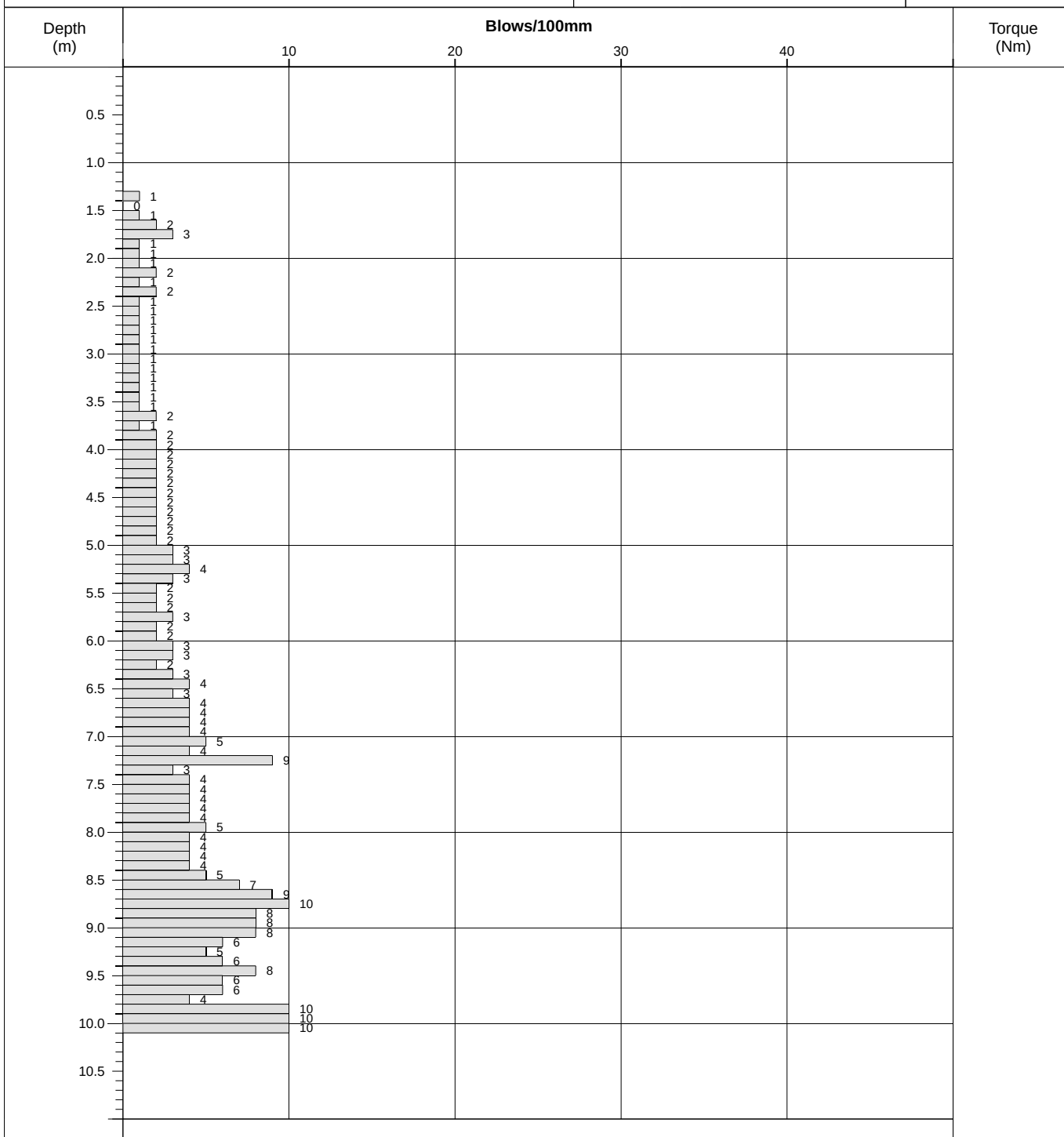
Borehole No.

SHDP 08
Project Location: Phase 2c, Dee Park, Reading, Bershire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 26/10/2017

Project Number:
08.03.014i

Hole Type:
SHDP - B

Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



Super Heavy Dynamic Probe

Borehole No.

SHDP 09
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

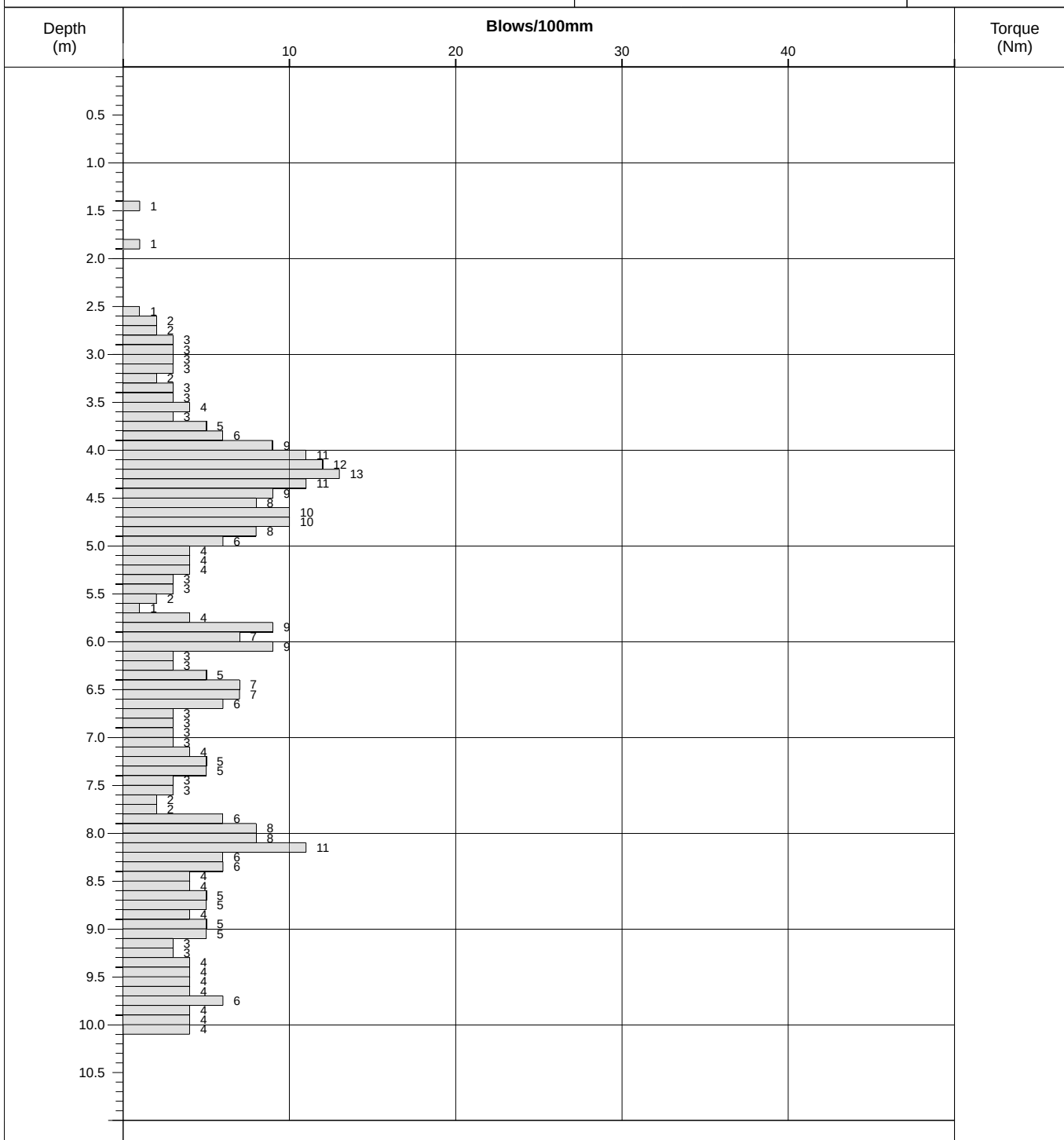
Dates: 26/10/2017

Project Number:

08.03.014i

Hole Type:

SHDP - B


Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



Super Heavy Dynamic Probe

Borehole No.

SHDP 11
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

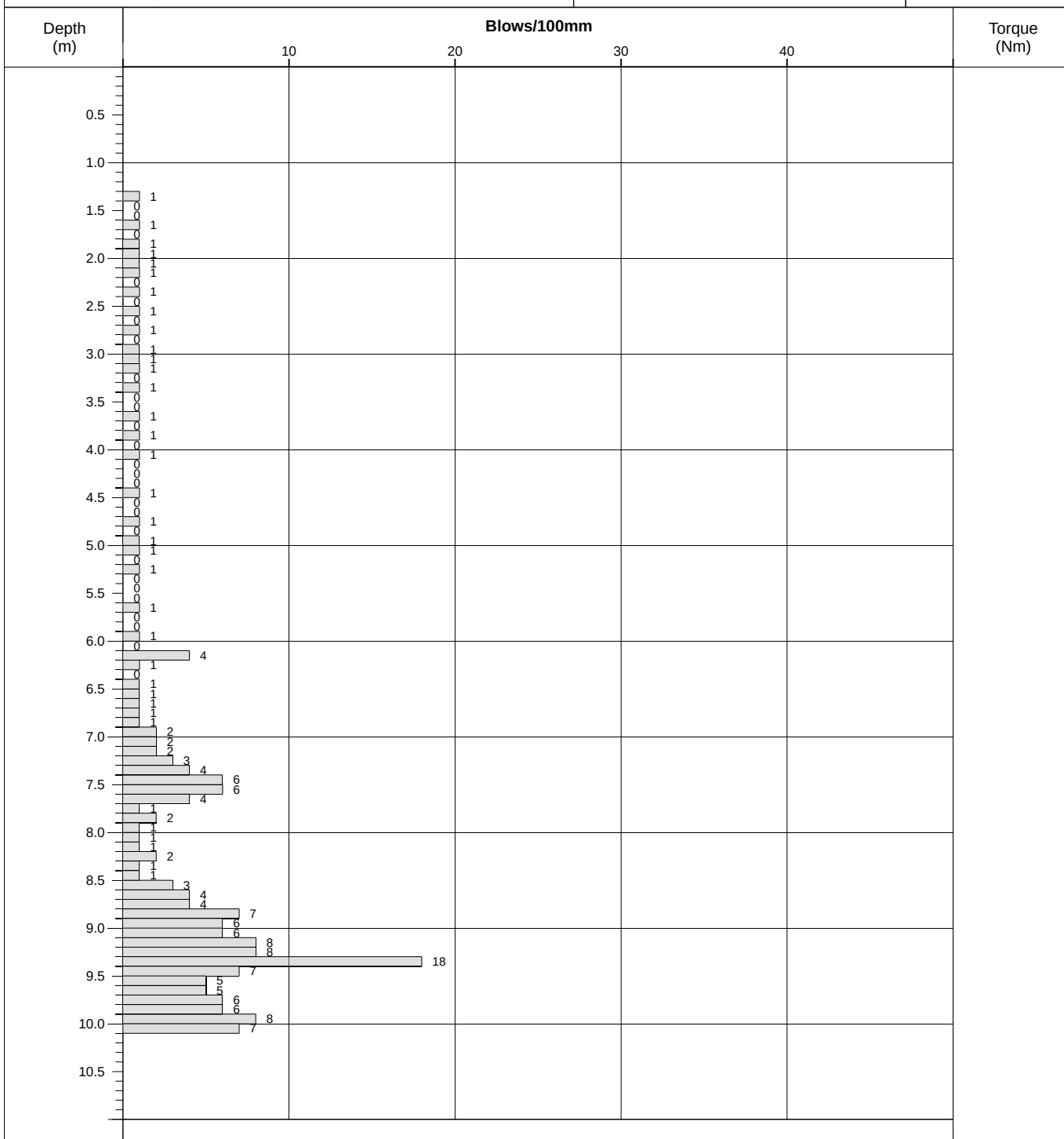
Dates: 26/10/2017

Project Number:

08.03.014i

Hole Type:

SHDP - B


Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



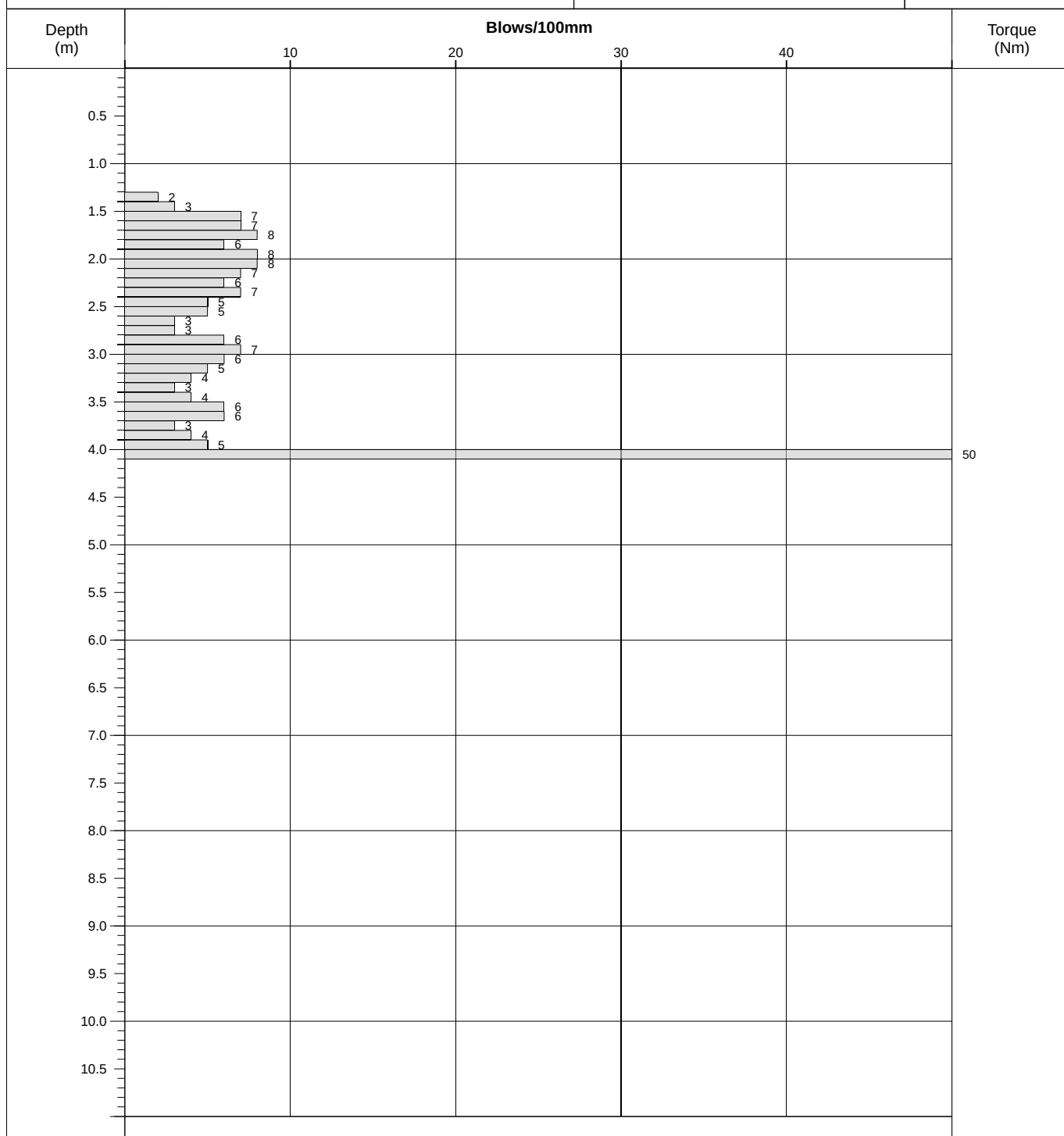
Super Heavy Dynamic Probe

 Borehole No.
SHDP CT 04
Project Location: Phase 2c, Dee Park, Reading, Bershire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 27/10/2017

Project Number:
 08.03.014i

Hole Type:
 SHDP - B

Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



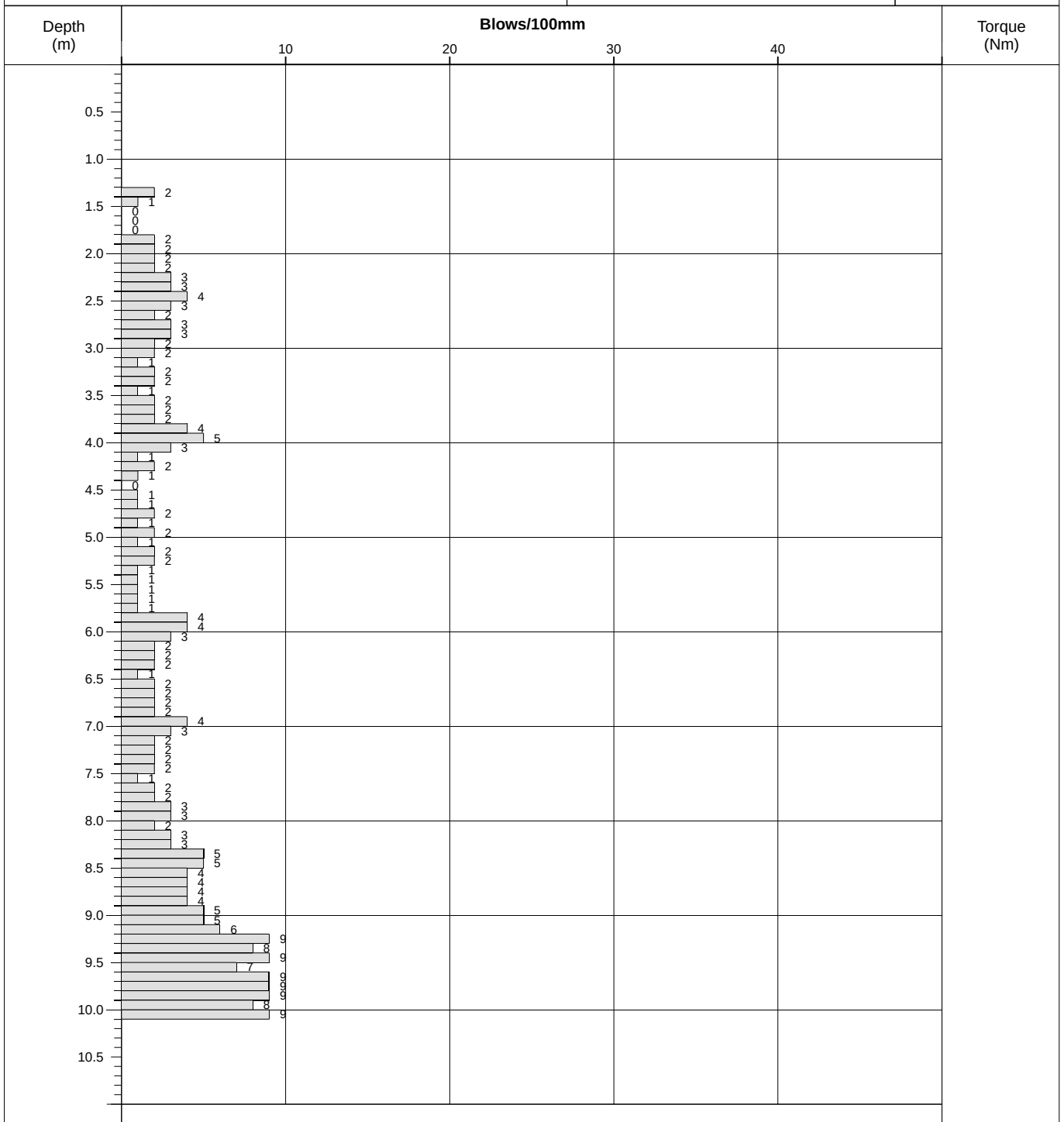
Super Heavy Dynamic Probe

 Borehole No.
SHDP CT 05
Project Location: Phase 2c, Dee Park, Reading, Bershire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 27/10/2017

Project Number:
 08.03.014i

Hole Type:
 SHDP - B

Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



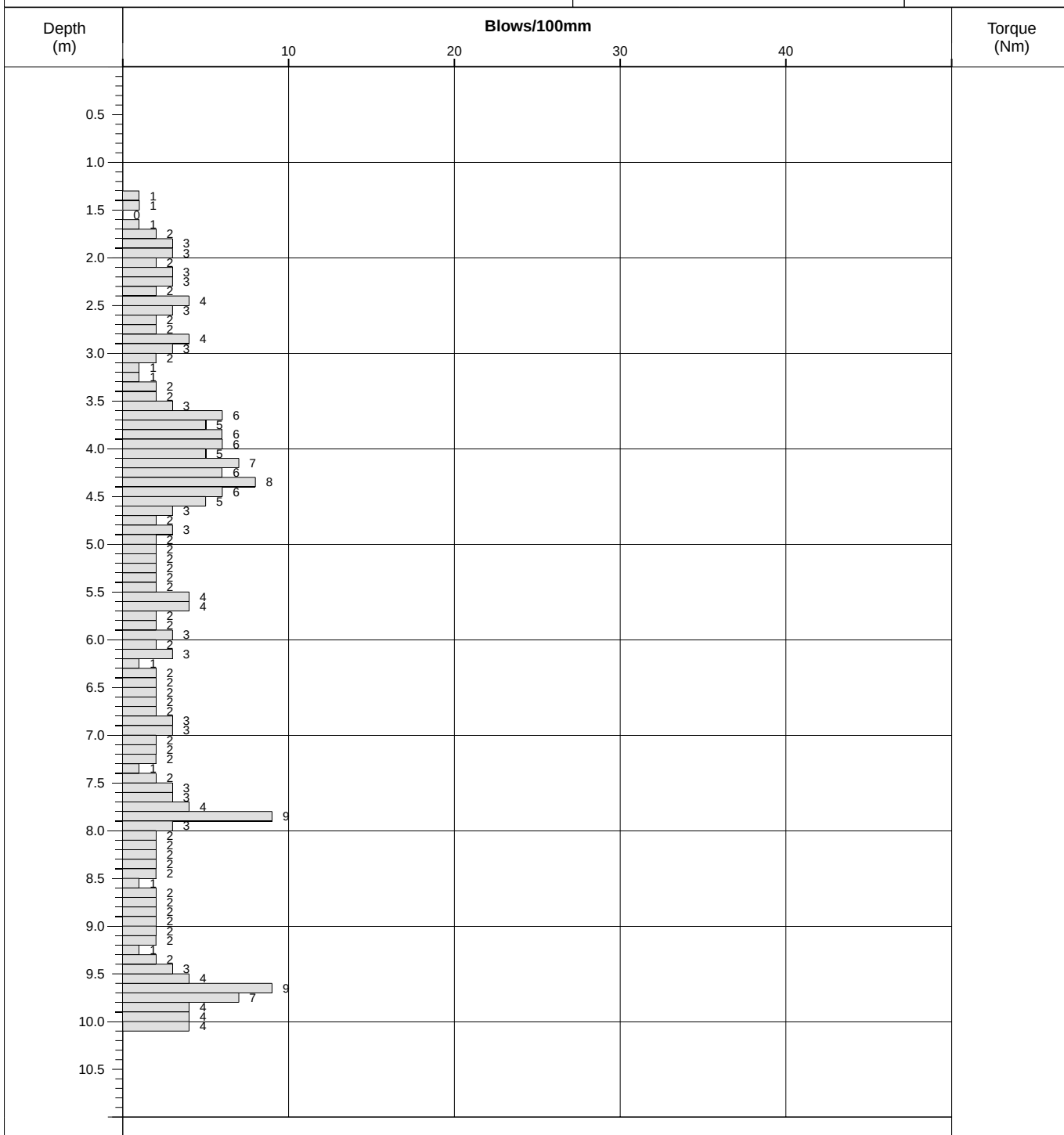
Super Heavy Dynamic Probe

 Borehole No.
SHDP CT 06
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 27/10/2017

Project Number:
 08.03.014i

Hole Type:
 SHDP - B

Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



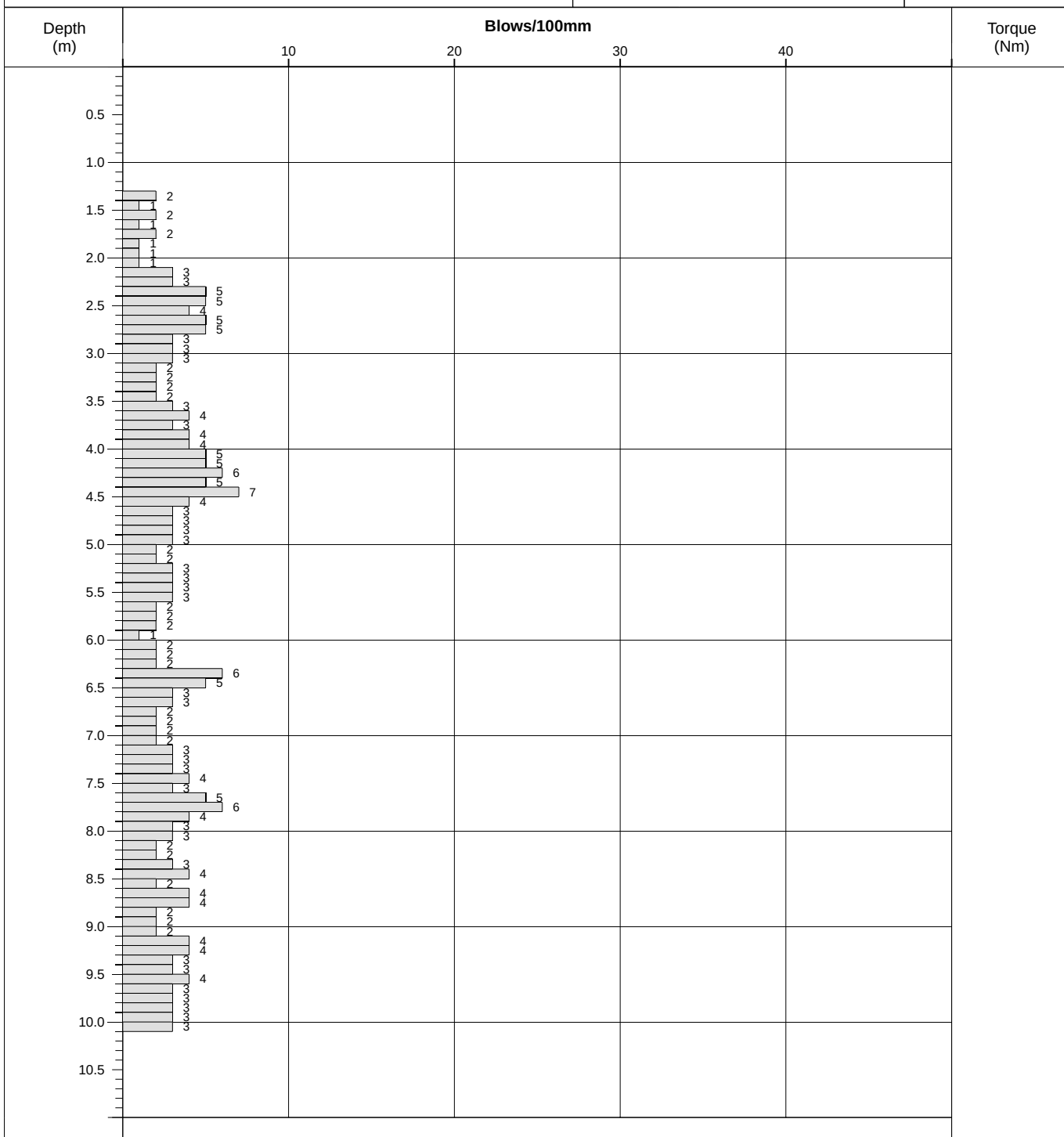
Super Heavy Dynamic Probe

 Borehole No.
SHDP CT 08
Project Location: Phase 2c, Dee Park, Reading, Bershire, RG30 4DD.

Co-ords:
Level: mAOD

Dates: 27/10/2017

Project Number:
 08.03.014i

Hole Type:
 SHDP - B

Hammer Weight: 63.5kgs **Fall Height:** 0.75m **Cone Area:** 20cm²
Remarks:

* = settled under own weight



Hand Auger Log

Borehole No.

HA 01
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level:
Dates: 30/10/2017

Project Number:
08.03.014i

Logged By:
Matthew Johnston
to BS 5930:2015

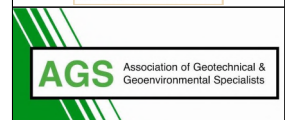
Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	(kPa)					
	0.15	D		0.19		MADE GROUND Dark brown very sandy slightly gravelly TOPSOIL. Gravel is fine, medium to coarse sub-angular to sub-rounded flint and concrete with rare fine roots		
	0.60	D		0.62		MADE GROUND Soft grey brown slightly sandy very gravelly CLAY. Gravel is fine, medium to coarse sub-angular to sub-rounded flint, red brick and concrete		
	1.00	D		1.05		MADE GROUND Brown very clayey slightly gravelly SAND. Gravel is fine, medium to coarse sub-angular to sub-rounded flint and red brick		1
						End of Borehole at 1.05m		2
								3
								4

Method of excavation: Dutch portable hand auger

Stability: Sides Stable

Groundwater: None encountered

Hand Auger Dimensions: 55mm

Remarks: Depth of visible roots: 0.10m


Hand Auger Log

Borehole No.

HA 03
Project Location: Phase 2c, Dee Park, Reading, Berkshire, RG30 4DD.

Co-ords:
Level:
Dates: 30/10/2017

Project Number:
08.03.014i

Logged By:
Matthew Johnston
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	(kPa)					
	0.15	D		0.18			MADE GROUND Very soft dark brown slightly sandy very gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded flint 1	
	0.40	D		0.47			MADE GROUND Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded flint, red brick and concrete	
	0.80	D		0.85			MADE GROUND Soft brown locally mottled white slightly sandy slightly gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded flint and occasional chalk block End of Borehole at 0.85m	1
								2
								3
								4

Method of excavation: Dutch portable hand auger

Stability: Sides Stable

Groundwater: None encountered

Hand Auger Dimensions: 55mm

Remarks:


Client: HTA Design

Report No: 08.03.014i

Site: Phase 2C Dee Park, Reading

Date Tested: 26/10/2017

Test Location: TP05_Test 1

Groundwater: unknown

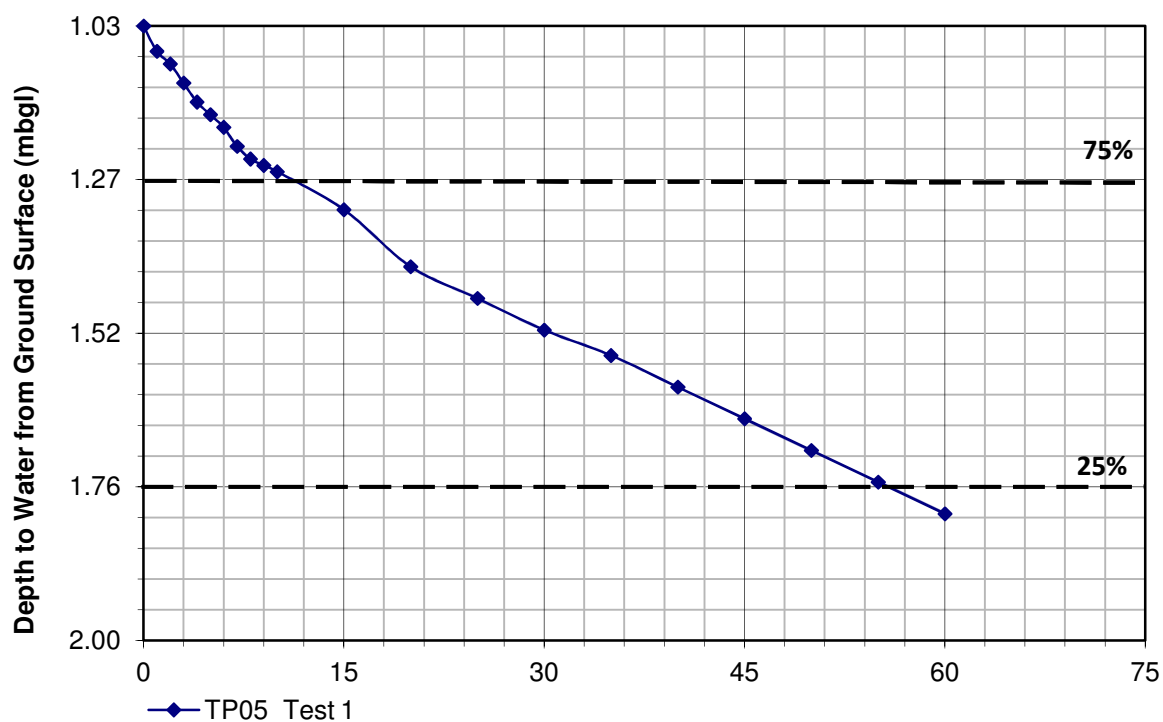
Dimensions: 0.7mWx2.4mLx2.00mD

Soil Description - test response zone:

0.55-2.2m: LAMBETH GROUP: Dark brown slightly clayey slightly gravelly SAND.
 Gravel is fine to medium sub-angular to sub-rounded
 flint

Time (mins)	Depth BGL	Time (mins)	Depth BGL	Time (mins)	Depth BGL
0	1.03	7	1.22	30	1.51
1	1.07	8	1.24	35	1.55
2	1.09	9	1.25	40	1.60
3	1.12	10	1.26	45	1.65
4	1.15	15	1.32	50	1.70
5	1.17	20	1.41	55	1.75
6	1.19	25	1.46	60	1.80

Calculated Soil Infiltration Rate, $f = 6.5 \times 10^{-5}$ m/s



**TRIAL PIT INFILTRATION TESTING
 to BRE Digest 365**

Report:
 08.03.014i

Client: HTA Design

Report No: 08.03.014i

Site: Phase 2C Dee Park, Reading

Date Tested: 26/10/2017

Test Location: TP05_Test 2

Groundwater: unknown

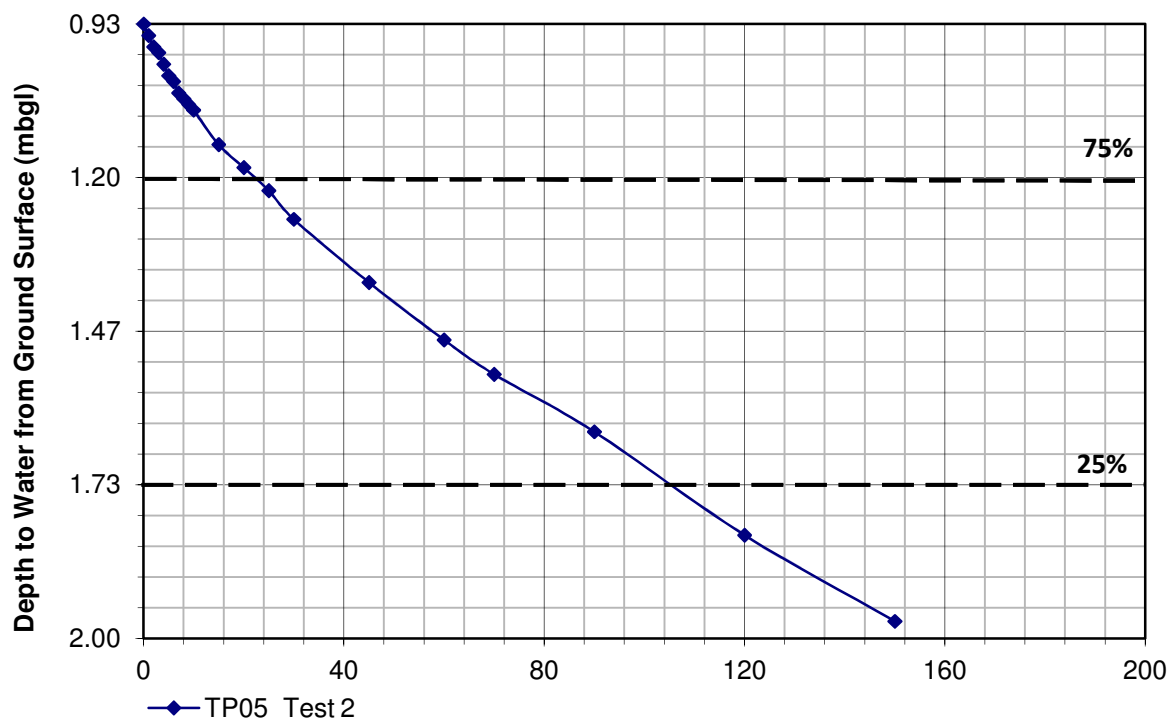
Dimensions: 0.7mWx2.4mLx2.00mD

Soil Description - test response zone:

0.55-2.2m: LAMBETH GROUP: Dark brown slightly clayey slightly gravelly SAND.
 Gravel is fine to medium sub-angular to sub-rounded
 flint

Time (mins)	Depth BGL	Time (mins)	Depth BGL	Time (mins)	Depth BGL
0	0.93	7	1.05	30	1.27
1	0.95	8	1.06	45	1.38
2	0.97	9	1.07	60	1.48
3	0.98	10	1.08	70	1.54
4	1.00	15	1.14	90	1.64
5	1.02	20	1.18	120	1.82
6	1.03	25	1.22	150	1.97

Calculated Soil Infiltration Rate, $f = 3.6 \times 10^{-5}$ m/s



**TRIAL PIT INFILTRATION TESTING
 to BRE Digest 365**

Report:
 08.03.014i

Date:	30/11/2017	Ambient air temperature (°C):	4
Time:	From 13:41 to 13:45	Barometric pressure (mB):	1006
Recorded by:	PH	Barometric trend:	Dropping
Equipment:	Geotech GA5000 gas monitor and dip-meter	Weather conditions:	Warm, cloudy

Groundwater monitoring

Hole ID	Ground level (mAOD)	Water depth (m)	Water level (mAOD)	Depth of pipe base (m)	Remarks
0803014I BH1		Dry		6.00	
0803014I BH2		Dry		6.00	

Gas monitoring

Hole ID	Methane CH ₄ (%v/v)	Carbon Dioxide CO ₂ (%v/v)	Oxygen O ₂ (%v/v)	Flow Rate (l/h)	Well Pressure (mBar)	PID* (ppm)	Remarks
0803014I BH1	0.1	0.4	20.9	0.4	-0.07		
0803014I BH2	0.1	0.2	20.8	0.5	-2.22		

SUMMARY OF GAS & GROUNDWATER MONITORING - 30.Nov.17	Report No. 17.05.016
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APPENDIX C

LABORATORY TESTING RESULTS AND TABLES

GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northants. NN12 8QD

Telephone:- 01327 860947/860060 Fax:- 01327 860430 Email: groundtech@listersgeotechnics.co.uk

PROJECT INFORMATION		SAMPLE INFORMATION																																																							
Site Location:- Phase 2C Dee Park Reading RG30 4DD	Laboratory Tests Undertaken:- <table border="1"> <thead> <tr> <th>TEST TYPE</th> <th>TEST METHOD</th> <th>TESTED</th> </tr> </thead> <tbody> <tr> <td>Natural Water Contents (WC%)</td> <td>(BS 1377:Part 2:1990 Clause 3.2)</td> <td>✓</td> </tr> <tr> <td>Liquid Limits (%)</td> <td>(BS 1377:Part 2:1990 Clause 4.3)</td> <td>✓</td> </tr> <tr> <td>Plastic Limits (%)</td> <td>(BS 1377:Part 2:1990 Clause 5.3)</td> <td>✓</td> </tr> <tr> <td>Plasticity Index (%)</td> <td>(BS 1377:Part 2:1990 Clause 5.4)</td> <td>✓</td> </tr> <tr> <td>Linear Shrinkage (%)</td> <td>(BS 1377:Part 2:1990 Clause 6.5)</td> <td></td> </tr> <tr> <td>PSD - Wet Sieving</td> <td>(BS 1377:Part 2:1990 Clause 9.2)</td> <td>✓</td> </tr> <tr> <td>Engineering Sample Descriptions</td> <td>(BS 5930 : Section 6)</td> <td></td> </tr> <tr> <td>Passing 425/63 (µm)</td> <td>-</td> <td>✓</td> </tr> <tr> <td>Hydrometer</td> <td>(BS 1377:Part 2:1990 Clause 9.5)</td> <td></td> </tr> <tr> <td>Loss on Ignition (%)</td> <td>-</td> <td>✓</td> </tr> <tr> <td>Soil Suctions (kPa)</td> <td>BRE Digest IP 4/93, 1993</td> <td></td> </tr> <tr> <td>Bulk Density (Mg/m³)</td> <td>(BS 1377:Part 2:1990 Clause 7.2)</td> <td></td> </tr> <tr> <td>Strength Tests</td> <td>(BS 1377:Part 7:1990 Clause 8 & 9)</td> <td></td> </tr> <tr> <td>Soluble Sulphate Content (SO₄g/l)</td> <td>(BS 1377:Part 3:1990 Clause 5.3)</td> <td>✓</td> </tr> <tr> <td>pH value</td> <td>(BS 1377:Part 3:1990 Clause 9.4)</td> <td>✓</td> </tr> <tr> <td>California Bearing Ratios (CBR)</td> <td>(BS 1377:Part 4:1990 Clause 7)</td> <td>✓</td> </tr> <tr> <td>Compaction Tests</td> <td>(BS 1377:Part 4:1990 Clauses 3.0-3.6)</td> <td></td> </tr> </tbody> </table>	TEST TYPE	TEST METHOD	TESTED	Natural Water Contents (WC%)	(BS 1377:Part 2:1990 Clause 3.2)	✓	Liquid Limits (%)	(BS 1377:Part 2:1990 Clause 4.3)	✓	Plastic Limits (%)	(BS 1377:Part 2:1990 Clause 5.3)	✓	Plasticity Index (%)	(BS 1377:Part 2:1990 Clause 5.4)	✓	Linear Shrinkage (%)	(BS 1377:Part 2:1990 Clause 6.5)		PSD - Wet Sieving	(BS 1377:Part 2:1990 Clause 9.2)	✓	Engineering Sample Descriptions	(BS 5930 : Section 6)		Passing 425/63 (µm)	-	✓	Hydrometer	(BS 1377:Part 2:1990 Clause 9.5)		Loss on Ignition (%)	-	✓	Soil Suctions (kPa)	BRE Digest IP 4/93, 1993		Bulk Density (Mg/m ³)	(BS 1377:Part 2:1990 Clause 7.2)		Strength Tests	(BS 1377:Part 7:1990 Clause 8 & 9)		Soluble Sulphate Content (SO ₄ g/l)	(BS 1377:Part 3:1990 Clause 5.3)	✓	pH value	(BS 1377:Part 3:1990 Clause 9.4)	✓	California Bearing Ratios (CBR)	(BS 1377:Part 4:1990 Clause 7)	✓	Compaction Tests	(BS 1377:Part 4:1990 Clauses 3.0-3.6)			
TEST TYPE	TEST METHOD	TESTED																																																							
Natural Water Contents (WC%)	(BS 1377:Part 2:1990 Clause 3.2)	✓																																																							
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pH value	(BS 1377:Part 3:1990 Clause 9.4)	✓																																																							
California Bearing Ratios (CBR)	(BS 1377:Part 4:1990 Clause 7)	✓																																																							
Compaction Tests	(BS 1377:Part 4:1990 Clauses 3.0-3.6)																																																								
Client Reference:- -																																																									
Date Samples Received:- 30th October 2017 Date Testing Completed:- 22nd November 2017																																																									
The results relate only to the samples tested																																																									
This test-report may not be reproduced, except with full and written approval of GROUNDTECH LABORATORIES		Laboratory testing in accord with BS EN ISO/IEC 17025-2000 and Quality Management in accord with ISO 9001																																																							
Signed on behalf of GroundTech Laboratories:-  Technical Signatory			Quality Assured to ISO 9001																																																						
GEOTECHNICAL LABORATORY TEST RESULTS		Report No:	08.03.014i																																																						

GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northants. NN12 8QD

Telephone: 01327 860947/860060

Fax: 01327 860430

Email: groundtech@listersgeotechnics.co.uk

**Quality Assured
to ISO 9001**

SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS			
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 μm %	Modified PI %	Class	Passing 63 μm %	WC/ LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m3	Test Type	Cell Pressure kN/m2	Deviator Stress kN/m2	Apparent Cohesion kN/m2	φ	pH Value	Soluble Sulphate Content SO4 g/l		
BH2C/01	B	0.50	PI/63	13	26	16	10	61	6	CL	39	0.50	18	-0.30									7.7	0.08		
	D	0.50		14																						
	B	1.20	PI/63	17	25	15	10	97	10	CL	71	0.68	17	0.20												
	D	1.20		16																						
	D	1.70		18																						
	B	2.00	PSD	5.2																						
	D	2.00		5.6																						
	D	2.50		5.3																						
	D	3.00		10																						
	B	3.50	PI/63	26	32	22	10	73	7	CL	65	0.81	24	0.40									7.9	0.04		
	D	3.50		26																						
	D	4.00		30																						
	D	4.50		24																						
	D	5.00		32																						
	D	5.50		35																						
	D	6.00		31																						
	D	6.50		34																						
	D	7.00		31																						
	D	7.50		32																			8.1	0.04		
	D	8.00		33																						
	D	8.50	PI/63	30	30	25	5	93	5	ML	88	1.00	27	1.00												
	D	9.00		28																						
	D	9.50		28																						
Symbols:				U	Undisturbed Sample					R	Remoulded				PI	Plasticity Index			T	Triaxial Undrained				L	100mm specimen	
				D	Disturbed Sample					63	Passing 63μm				F	Filter Paper Suction Tests			M	Multistage Triaxial				S	38mm specimen	
				B	Bulk Sample					H	Hydrometer				CC	Continuous Core			HP	Hand Penetrometer						
				W	Water Sample					PSD	Wet Sieving								V	Vane Test						
LABORATORY TEST RESULTS																				Project Reference 08.03.014i						

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SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS																																		
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 μm %	Modified PI %	Class	Passing 63 μm %	WC/ LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m3	Test Type	Cell Pressure kN/m2	Deviator Stress kN/m2	Apparent Cohesion kN/m2	φ	pH Value	Soluble Sulphate Content SO4 g/l																																	
BH2C/01	B	10.00		30																			8.2	0.06																																	
	D	10.00		25																																																					
	D	11.00		27																																																					
	D	11.50		27																																																					
	D	12.50		30																																																					
	D	13.00		27																																																					
	D	14.00		41																																																					
	D	14.50		28																																																					
	D	15.50		36																																																					
	D	16.00		27																																																					
	D	17.00		36																																																					
	D	17.50		27																																																					
	D	18.50		34																																																					
	D	19.00		28																																																					
D	20.00	33																																																							
BH2C/02	B	0.50	PI/63	11	21	16	5	65	3	ML	39	0.52	18	-1.00										8.0	0.08																																
	D	0.50		13																				7.4	0.08																																
	D	1.20		16																																																					
	D	1.70		PI/63																						20	27	16	11	91	10	CL	69	0.74	18	0.36																					
	D	2.00		PI/63																						18																															
	D	2.50																								22																						30	17	13	97	13	CL	72	0.73	19	0.38
	D	3.00																								17																															
B	3.50	27																																																							
Symbols:				U	Undisturbed Sample					R	Remoulded			PI	Plasticity Index			T	Triaxial Undrained			L	100mm specimen																																		
				D	Disturbed Sample					63	Passing 63μm			F	Filter Paper Suction Tests			M	Multistage Triaxial			S	38mm specimen																																		
				B	Bulk Sample					H	Hydrometer			CC	Continuous Core			HP	Hand Penetrometer																																						
				W	Water Sample					PSD	Wet Sieving							V	Vane Test																																						
LABORATORY TEST RESULTS																				Project Reference 08.03.014i																																					

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SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS			
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 μm %	Modified PI %	Class	Passing 63 μm %	WC/ LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m3	Test Type	Cell Pressure kN/m2	Deviator Stress kN/m2	Apparent Cohesion kN/m2	φ	pH Value	Soluble Sulphate Content SO4 g/l		
BH2C/02	D	3.50	PI/63	31	39	20	19	74	14	CI	58	1.46	22	1.95									7.9	0.04		
	D	4.00		68																						
	B	4.50		57																						
	D	4.50		61																						
	D	5.00		35																						
	D	5.50	53	PI/63	76	35	41	90	37	CV	87	0.67	37	0.39											8.1	0.06
	D	6.00	45																							
	D	6.50	51																							
	D	7.00	43																							
	D	7.50	41																							
	D	8.00	33																							
	D	8.50	31																							
	B	9.00	30																							
	D	9.00	27																							
	D	9.50	32																							
	D	10.00	25																							
	D	11.00	27																							
	D	11.50	24																							
	D	12.50	30																							
	D	13.00	23																							
	D	14.00	49																							
	D	14.50	28																							
	D	15.50	38																							
Symbols:				U	Undisturbed Sample					R	Remoulded				PI	Plasticity Index			T	Triaxial Undrained				L	100mm specimen	
				D	Disturbed Sample					63	Passing 63μm				F	Filter Paper Suction Tests			M	Multistage Triaxial				S	38mm specimen	
				B	Bulk Sample					H	Hydrometer				CC	Continuous Core			HP	Hand Penetrometer						
				W	Water Sample					PSD	Wet Sieving								V	Vane Test						
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Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 μm %	Modified PI %	Class	Passing 63 μm %	WC/ LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m3	Test Type	Cell Pressure kN/m2	Deviator Stress kN/m2	Apparent Cohesion kN/m2	φ	pH Value	Soluble Sulphate Content SO4 g/l		
BH2C/02	D	16.00		25																			8.1	0.04		
	D	17.00		26																						
	D	17.50		26																						
	D	18.50		33																						
	D	19.00		30																						
	D	20.00		30																						
	D	20.50		26																						
	D	21.50		34																						
	D	22.00		28																						
	D	23.00		22																						
	D	23.50		30																						
	D	24.50		28																						
	D	25.00		22																						
CT 02	C	1.00		PI/63	15	24	15	9	84	8	CL	47	0.63	17	0.00									7.5	0.33	
	C	1.50		18																						
	C	2.00	PI/63	10	24	14	10	39	4	CL	25	0.42	16	-0.40									7.4	0.08		
	C	2.50		8.7																						
	C	3.00		11																						
	C	3.50	PSD	17																						
	C	4.00	PSD	9.4																						
	C	4.50		29																						
	C	5.00		25																						
	C	5.50		22																						
Symbols:				U	Undisturbed Sample					R	Remoulded			PI	Plasticity Index			T	Triaxial Undrained			L	100mm specimen			
				D	Disturbed Sample					63	Passing 63μm			F	Filter Paper Suction Tests			M	Multistage Triaxial			S	38mm specimen			
				B	Bulk Sample					H	Hydrometer			CC	Continuous Core			HP	Hand Penetrometer							
				W	Water Sample					PSD	Wet Sieving							V	Vane Test							
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SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS													
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 μm %	Modified PI %	Class	Passing 63 μm %	WC/ LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m3	Test Type	Cell Pressure kN/m2	Deviator Stress kN/m2	Apparent Cohesion kN/m2	φ	pH Value	Soluble Sulphate Content SO4 g/l												
CT 03	D	0.00	PI/63	15		27	13	14	74	10	CL	43	0.78	15	0.57								7.3	0.06												
	D	0.70		15																																
	C	1.00		21																																
	C	1.50		20																																
	C	2.00		24																																
	CT 04	C	2.50	PI/63	24	50	18	32	89	28	CI	68	0.48	20	0.19																					
		C	3.00	7.7																																
		C	3.50	5.7																																
		C	4.00	9.9																																
		C	4.80	6.9																																
CT 05		D	0.00	PSD	14																															
		D	0.20		17																															
		D	0.30		14																															
		C	1.00		PI/63																					14	22	15	7	81	6	ML	54	0.64	17	-0.14
		C	1.50		4.9																															
	C	2.00	5.6																																	
	C	2.50	PSD	14																																
	C	2.80	20																																	
	CT 05	C	3.00	PSD	24																															
		C	3.50		25																															
D		0.00	16																																	
D		0.60	12																																	
	C	1.00		13																																
Symbols:				U	Undisturbed Sample					R	Remoulded					PI	Plasticity Index			T	Triaxial Undrained			L	100mm specimen											
				D	Disturbed Sample					63	Passing 63μm					F	Filter Paper Suction Tests			M	Multistage Triaxial			S	38mm specimen											
				B	Bulk Sample					H	Hydrometer					CC	Continuous Core			HP	Hand Penetrometer															
				W	Water Sample					PSD	Wet Sieving					V	Vane Test																			
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SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS			
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 μm %	Modified PI %	Class	Passing 63 μm %	WC/ LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m3	Test Type	Cell Pressure kN/m2	Deviator Stress kN/m2	Apparent Cohesion kN/m2	φ	pH Value	Soluble Sulphate Content SO4 g/l		
CT 05	C	1.50	PI/63	16	24	15	9	85	8	CL	57	0.67	17	0.11									7.8	0.38		
	C	1.75		12																						
	C	2.00		8.1																						
	C	2.50	PSD	6.7																						
	C	3.00		9.9																						
	C	3.50		12																						
	C	4.00		14																						
	C	4.50		31																						
	C	5.00		30																						
	C	5.50		23																						
CT 06	D	0.00		13																			7.5	0.08		
	D	0.60		6.3																						
	C	1.00	PSD	13																						
	C	1.50	PI/63	17	22	18	4	97	4	ML	66	0.77	20	-0.25												
	C	2.00		11																						
	C	2.50		10																						
	C	3.00	PI/63	23	31	16	15	95	14	CL	64	0.74	18	0.47												
	C	3.50		15																						
	C	4.00		23																						
	C	4.50		31																						
CT 07	C	5.00		31																						
	C	5.50		29																						
	D	0.00		14																						
Symbols:				U	Undisturbed Sample					R	Remoulded				PI	Plasticity Index			T	Triaxial Undrained				L	100mm specimen	
				D	Disturbed Sample					63	Passing 63μm				F	Filter Paper Suction Tests			M	Multistage Triaxial				S	38mm specimen	
				B	Bulk Sample					H	Hydrometer				CC	Continuous Core			HP	Hand Penetrometer						
				W	Water Sample					PSD	Wet Sieving								V	Vane Test						
LABORATORY TEST RESULTS																				Project Reference 08.03.014i						

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SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS		
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 μm %	Modified PI %	Class	Passing 63 μm %	WC/ LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m3	Test Type	Cell Pressure kN/m2	Deviator Stress kN/m2	Apparent Cohesion kN/m2	ϕ	pH Value	Soluble Sulphate Content SO4 g/l	
CT 07	D	0.30	PI/63	8.7	23	16	7	59	4	ML	32	0.43	18	-0.87											
	D	0.80		9.9																					
	C	1.00		11																					
	C	1.50	PSD	15	35	17	18	40	7	CL	26	0.46	19	-0.06											
	C	2.00		11																					
	C	2.50		8.8																					
	C	3.00	PI/63	12	35	17	18	40	7	CL	26	0.46	19	-0.06											
	C	3.50		16																					
	C	4.00		27																					
	C	4.50	PI/63	29	35	17	18	40	7	CL	26	0.46	19	-0.06											
C	5.00	20																							
C	5.50	27																							
CT 08	C	0.00	PI/63	12	27	16	11	65	7	CL	40	0.44	18	-0.36											
	C	0.50		12																					
HA 01	D	0.15	PSD	12	27	16	11	65	7	CL	40	0.44	18	-0.36											
	D	0.60		9.3																					
D	1.00	11																							
HA 03	D	0.15	PI/63	27	28	19	9	64	6	CL	35	0.79	21	0.33											
	D	0.40		22																					
HA 04	D	0.80		PI/63																					
	D	0.10	19																						
	D	0.30	18																						
	D	0.80	PI/63	17	27	14	13	80	10	CL	44	0.63	16	0.23											
Symbols:				U	Undisturbed Sample					R	Remoulded			PI	Plasticity Index			T	Triaxial Undrained			L	100mm specimen		
				D	Disturbed Sample					63	Passing 63μm			F	Filter Paper Suction Tests			M	Multistage Triaxial			S	38mm specimen		
				B	Bulk Sample					H	Hydrometer			CC	Continuous Core			HP	Hand Penetrometer						
				W	Water Sample					PSD	Wet Sieving			V	Vane Test										
LABORATORY TEST RESULTS																					Project Reference 08.03.014i				

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SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS			
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 μm %	Modified PI %	Class	Passing 63 μm %	WC/ LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m3	Test Type	Cell Pressure kN/m2	Deviator Stress kN/m2	Apparent Cohesion kN/m2	φ	pH Value	Soluble Sulphate Content SO4 g/l		
TP 01	D	0.20	PI/63	17	27	15	12	63	8	CL	40	0.59	17	0.08									7.9	0.08		
	D	0.50		19																						
	D	0.80		16																						
	D	1.00		9.9																						
TP 02	D	1.50	PI/63	14	21	15	6	68	4	ML	40	0.67	17	-0.17												
	D	0.20	17																							
	CBR	0.50	15																							
	D	0.50	13																							
TP 05	D	1.00	PI/63	15	22	14	8	87	7	CL	53	0.68	16	0.13									7.9	0.04		
	D	1.50	9.2																							
	D	2.00	PSD	5.9																						
	D	0.20	15																							
	D	0.50	PSD	12																				7.4	0.27	
	D	1.00		12																						
	D	1.50		12																						
	D	2.00		9.3																						
Symbols:				U	Undisturbed Sample					R	Remoulded				PI	Plasticity Index			T	Triaxial Undrained				L	100mm specimen	
				D	Disturbed Sample					63	Passing 63μm				F	Filter Paper Suction Tests			M	Multistage Triaxial				S	38mm specimen	
				B	Bulk Sample					H	Hydrometer				CC	Continuous Core			HP	Hand Penetrometer						
				W	Water Sample					PSD	Wet Sieving								V	Vane Test						
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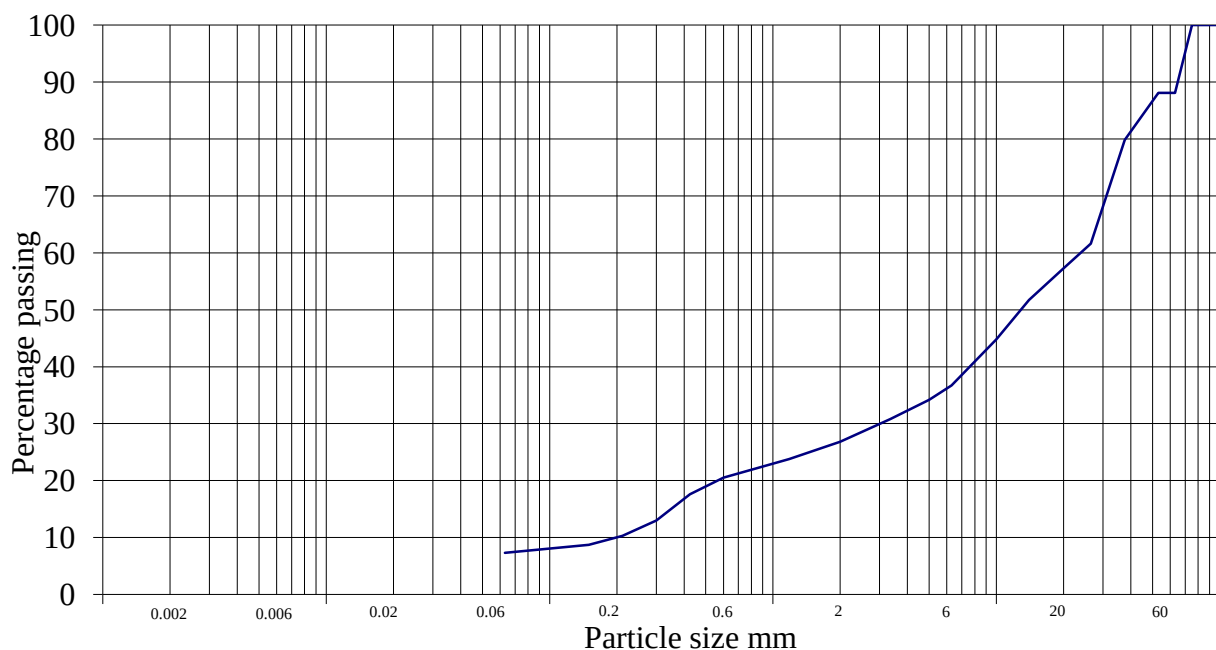
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site: Phase 2C, Dee Park, Reading, RG30 4DD.		75mm	100.00		
		63mm	88.10		
		50mm	88.10		
		37.5mm	79.80		
		26.5mm	61.60		
		20mm	57.30		
		14mm	51.70		
		10mm	44.80		
		6.3mm	36.70		
		5mm	34.20		
Hydrometer No.:		3.5mm	30.80		
SG Gs:		2mm	26.80		
Water Visc. (N):		1.18mm	23.80		
Dry Mass of Soil after pretreatment (g):		600µm	20.50		
		425µm	17.60		
		300µm	13.00		
		212µm	10.30		
		150µm	8.70		
		63µm	7.30		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

PARTICLE SIZE DISTRIBUTION

Project Reference
08.03.014i

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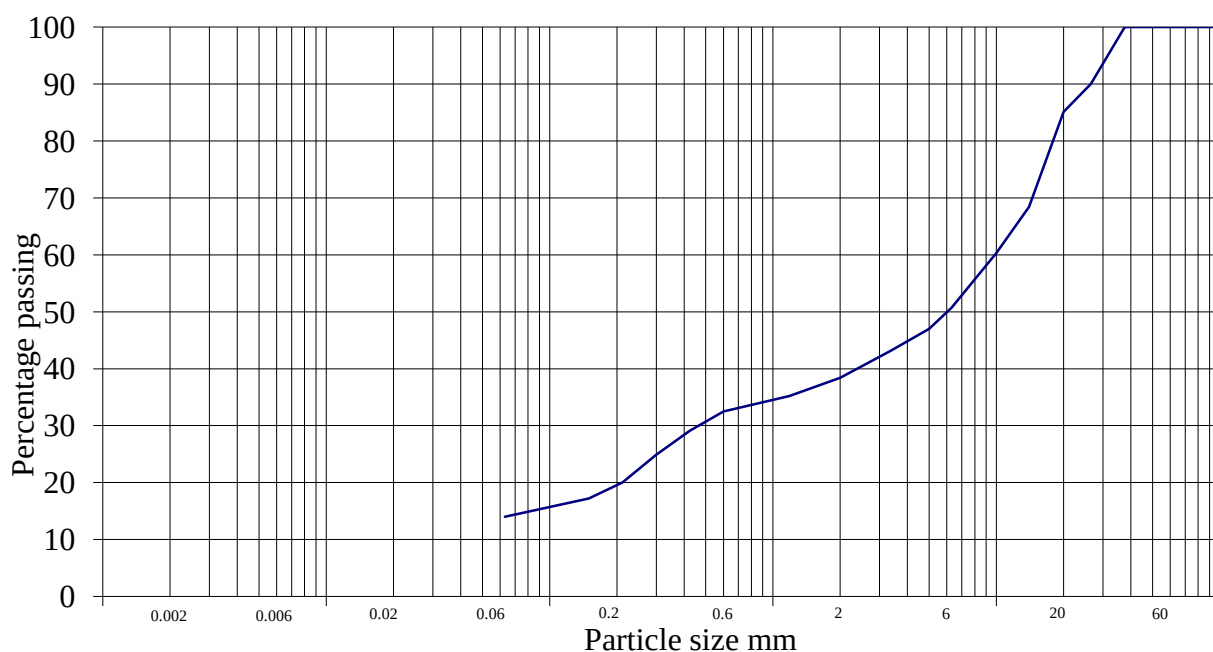
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site:	Phase 2C, Dee Park, Reading, RG30 4DD.	75mm	100.00		
		63mm	100.00		
Test Location:	CT 02	50mm	100.00		
		37.5mm	100.00		
Sample Depth:	3.50m -4.00m	26.5mm	90.00		
		20mm	85.10		
Sample Description:		14mm	68.40		
		10mm	60.30		
		6.3mm	50.70		
		5mm	47.00		
Hydrometer No.:		3.5mm	43.10		
		2mm	38.40		
SG Gs:		1.18mm	35.20		
		600µm	32.50		
Water Visc. (N):		425µm	29.10		
		300µm	24.90		
Dry Mass of Soil after pretreatment (g):		212µm	20.00		
		150µm	17.20		
		63µm	14.00		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

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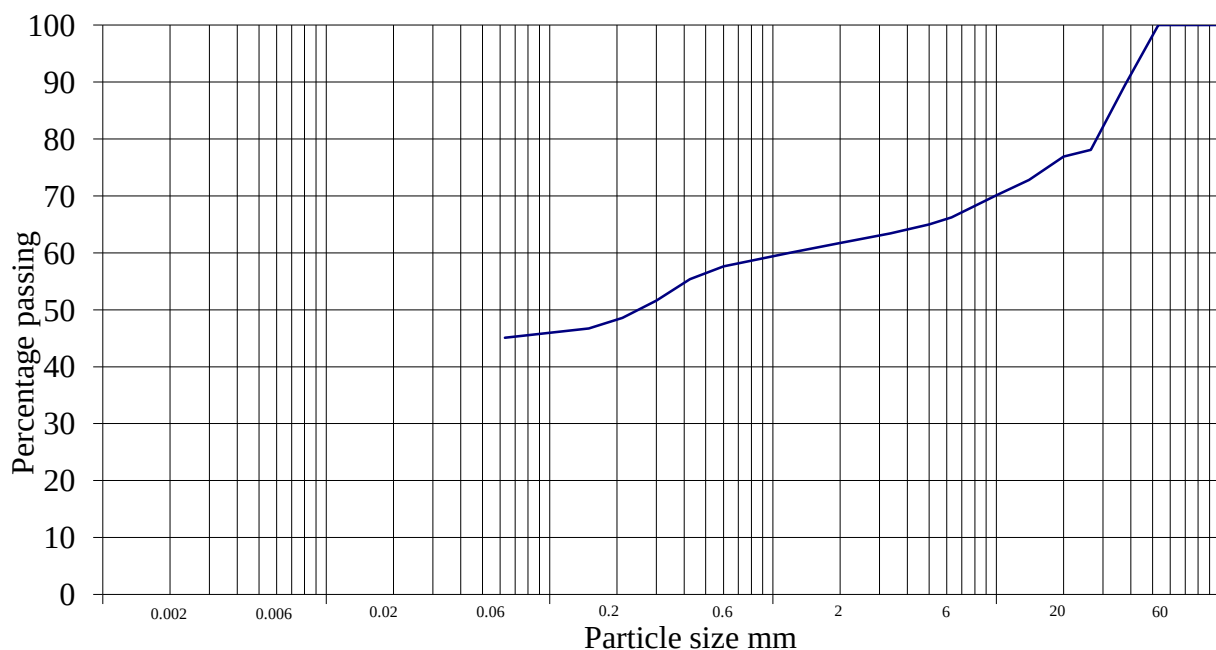
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site: Phase 2C, Dee Park, Reading, RG30 4DD. Test Location: CT 02 Sample Depth: 4.00m -4.50m Sample Description: Hydrometer No.: SG Gs: Water Visc. (N): Dry Mass of Soil after pretreatment (g):		75mm	100.00		
		63mm	100.00		
		50mm	100.00		
		37.5mm	89.40		
		26.5mm	78.10		
		20mm	76.90		
		14mm	72.80		
		10mm	70.10		
		6.3mm	66.20		
		5mm	65.00		
		3.5mm	63.40		
		2mm	61.70		
		1.18mm	60.00		
		600µm	57.60		
		425µm	55.40		
		300µm	51.60		
		212µm	48.60		
		150µm	46.70		
		63µm	45.10		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

PARTICLE SIZE DISTRIBUTION

Project Reference
08.03.014i

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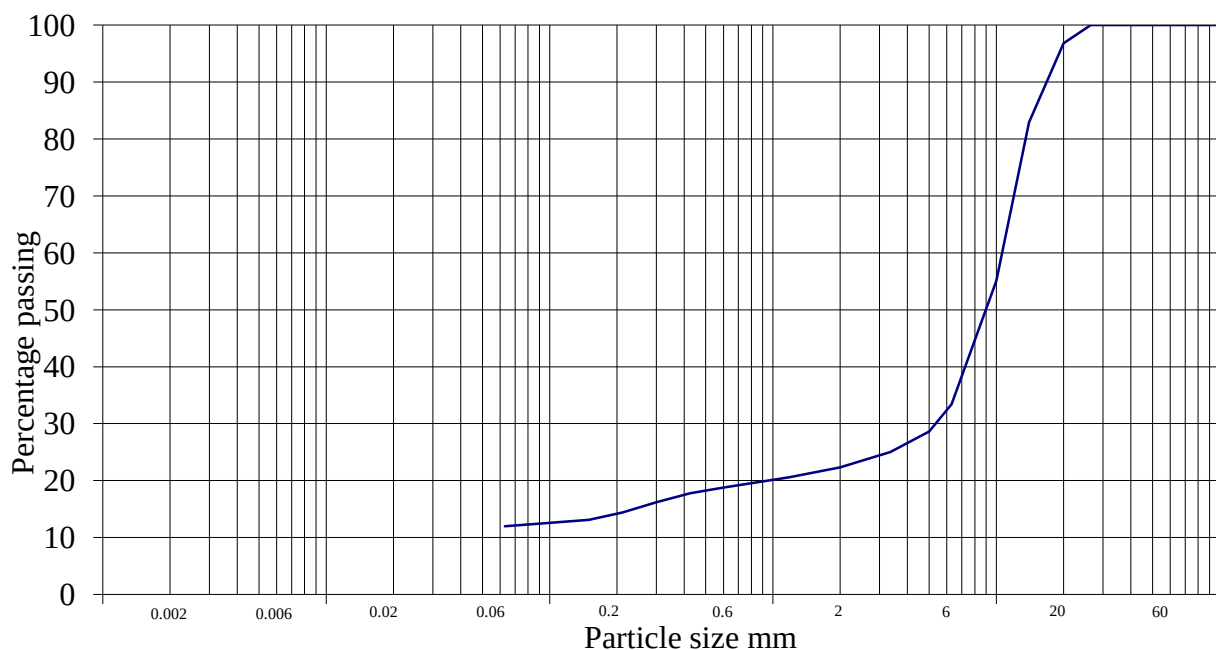
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site:	Phase 2C, Dee Park, Reading, RG30 4DD.	75mm	100.00		
		63mm	100.00		
Test Location:	CT 03	50mm	100.00		
		37.5mm	100.00		
Sample Depth:	4.00m -4.80m	26.5mm	100.00		
		20mm	96.80		
Sample Description:		14mm	82.90		
		10mm	55.10		
		6.3mm	33.40		
		5mm	28.60		
Hydrometer No.:		3.5mm	25.00		
		2mm	22.30		
SG Gs:		1.18mm	20.60		
		600µm	18.80		
Water Visc. (N):		425µm	17.80		
		300µm	16.20		
Dry Mass of Soil after pretreatment (g):		212µm	14.40		
		150µm	13.10		
		63µm	12.00		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

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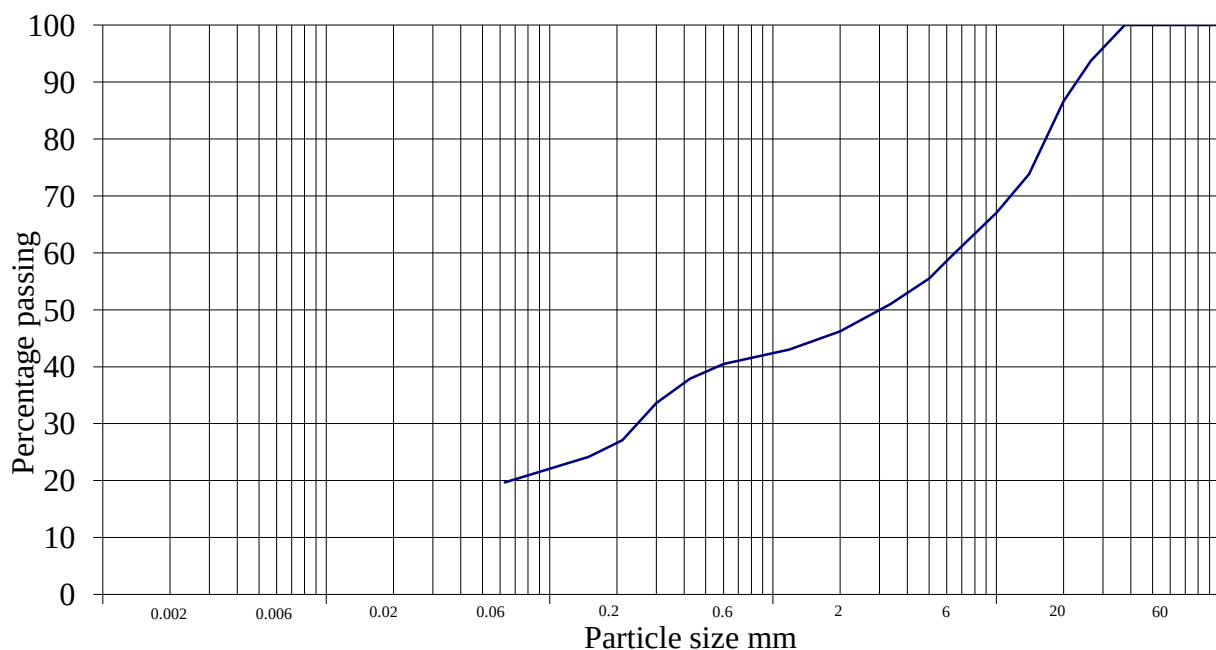
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site: Phase 2C, Dee Park, Reading, RG30 4DD. Test Location: CT 04 Sample Depth: 2.50m -2.80m Sample Description: Hydrometer No.: SG Gs: Water Visc. (N): Dry Mass of Soil after pretreatment (g):		75mm	100.00		
		63mm	100.00		
		50mm	100.00		
		37.5mm	100.00		
		26.5mm	93.70		
		20mm	86.60		
		14mm	73.80		
		10mm	67.00		
		6.3mm	59.40		
		5mm	55.50		
		3.5mm	51.00		
		2mm	46.20		
		1.18mm	43.00		
		600µm	40.50		
		425µm	37.90		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

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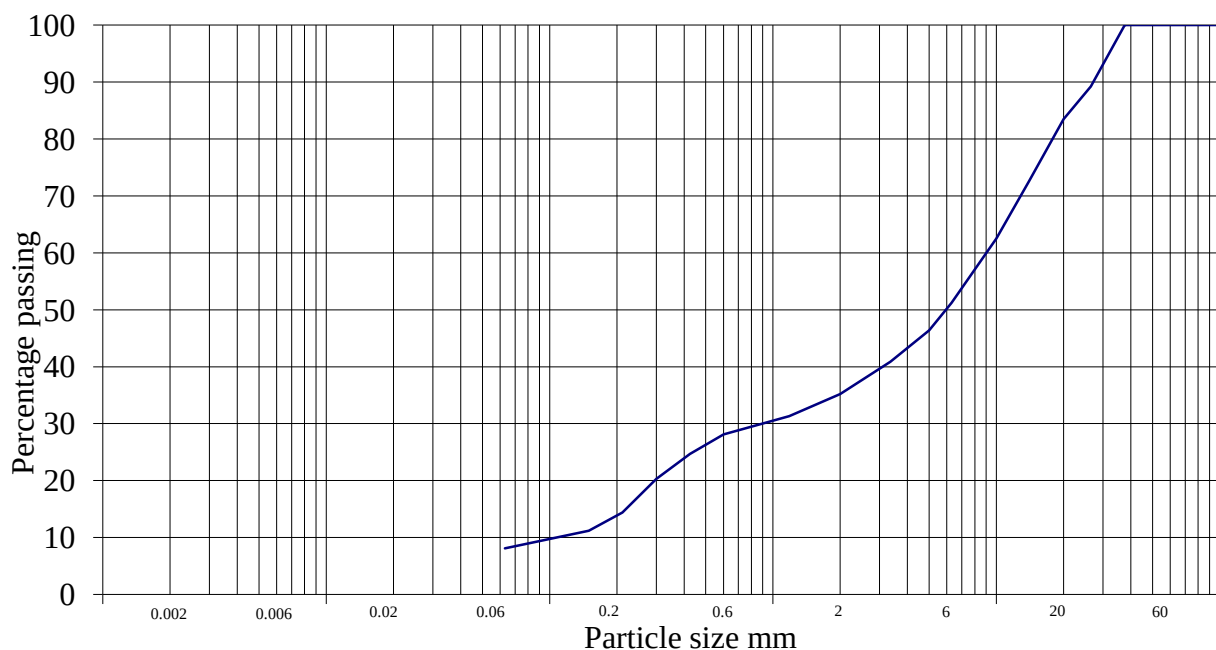
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site:	Phase 2C, Dee Park, Reading, RG30 4DD.	75mm	100.00		
		63mm	100.00		
Test Location:	CT 05	50mm	100.00		
		37.5mm	100.00		
Sample Depth:	2.50m -3.00m	26.5mm	89.20		
		20mm	83.50		
Sample Description:		14mm	72.60		
		10mm	62.50		
Hydrometer No.:		6.3mm	51.20		
		5mm	46.40		
SG Gs:		3.5mm	40.90		
		2mm	35.20		
Water Visc. (N):		1.18mm	31.30		
		600µm	28.10		
Dry Mass of Soil after pretreatment (g):		425µm	24.70		
		300µm	20.30		
		212µm	14.40		
		150µm	11.20		
		63µm	8.10		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

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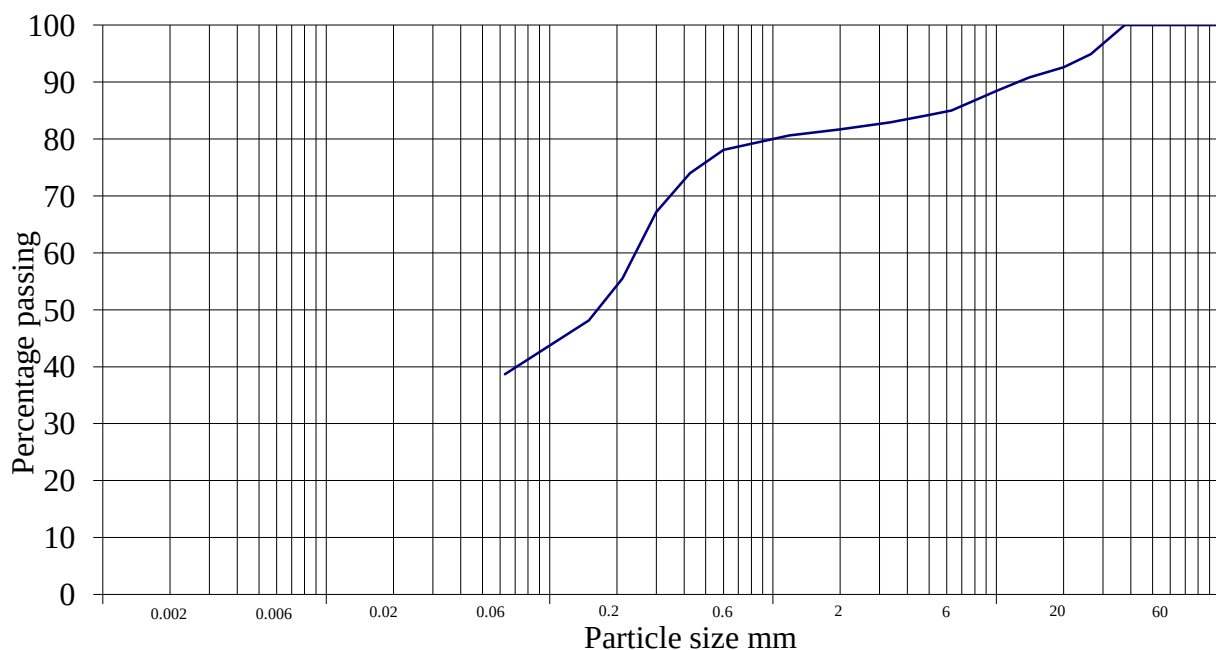
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site: Phase 2C, Dee Park, Reading, RG30 4DD. Test Location: CT 06 Sample Depth: 1.00m -1.50m Sample Description: Hydrometer No.: SG Gs: Water Visc. (N): Dry Mass of Soil after pretreatment (g):		75mm	100.00		
		63mm	100.00		
		50mm	100.00		
		37.5mm	100.00		
		26.5mm	94.90		
		20mm	92.60		
		14mm	90.80		
		10mm	88.40		
		6.3mm	85.00		
		5mm	84.20		
		3.5mm	82.90		
		2mm	81.70		
		1.18mm	80.60		
		600µm	78.10		
		425µm	74.00		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

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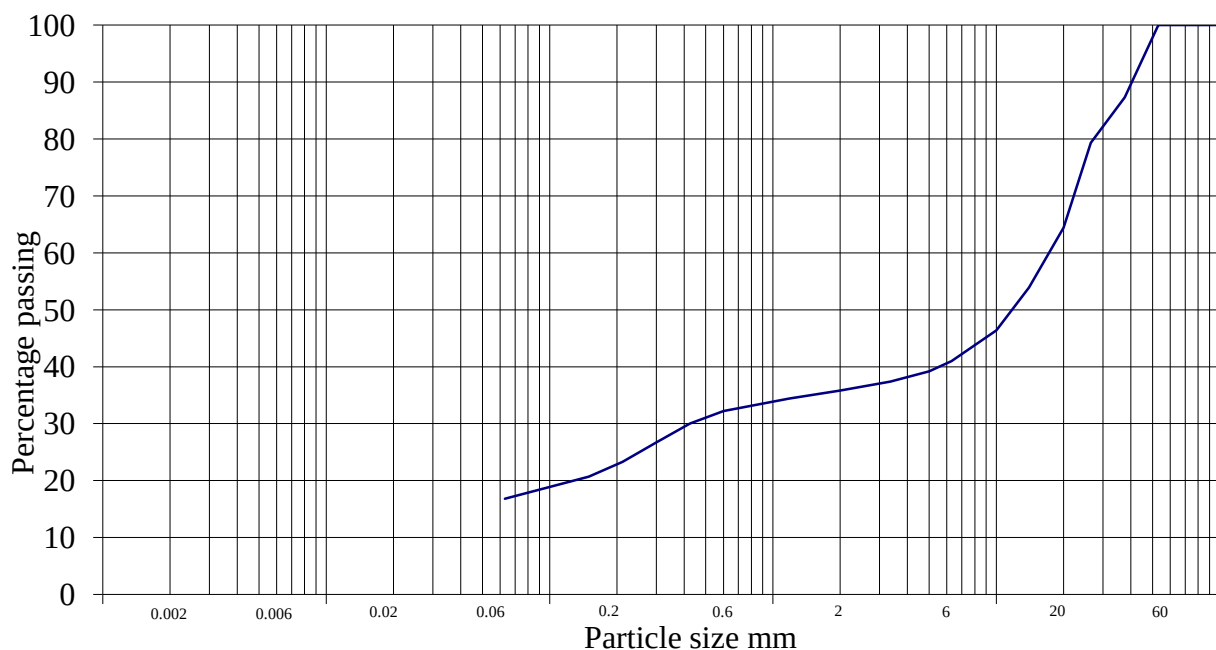
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site: Phase 2C, Dee Park, Reading, RG30 4DD. Test Location: CT 07 Sample Depth: 2.00m -2.50m Sample Description: Hydrometer No.: SG Gs: Water Visc. (N): Dry Mass of Soil after pretreatment (g):		75mm	100.00		
		63mm	100.00		
		50mm	100.00		
		37.5mm	87.30		
		26.5mm	79.30		
		20mm	64.40		
		14mm	53.90		
		10mm	46.40		
		6.3mm	41.00		
		5mm	39.20		
		3.5mm	37.40		
		2mm	35.80		
		1.18mm	34.40		
		600µm	32.20		
		425µm	30.00		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

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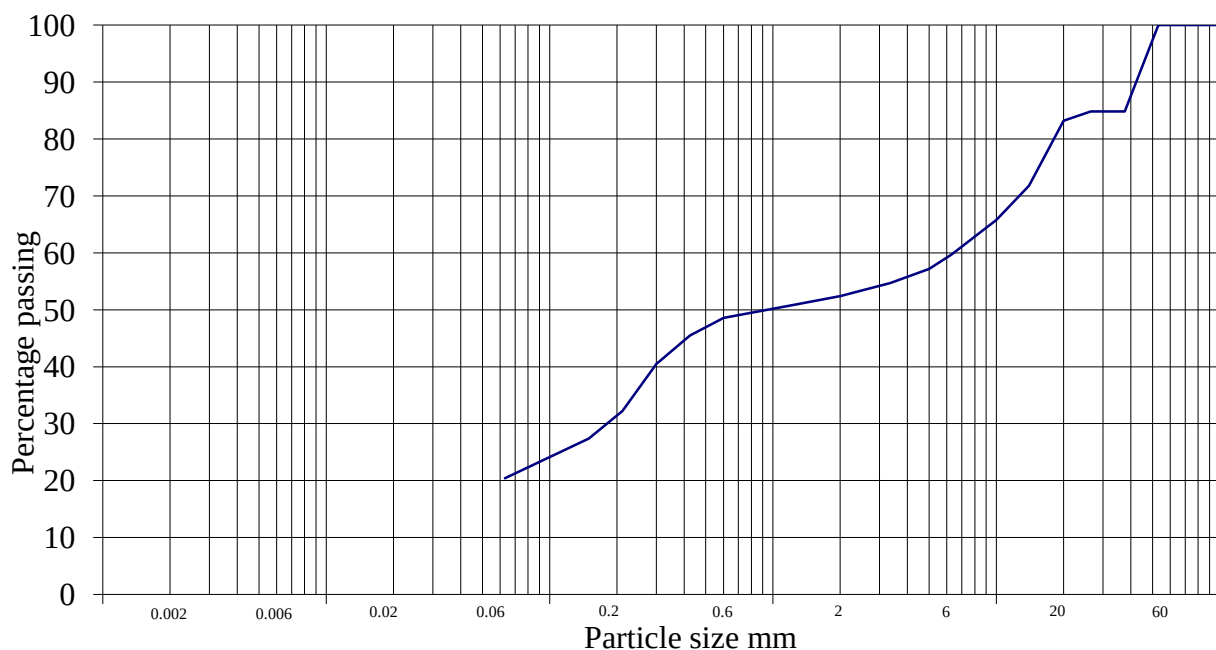
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site:	Phase 2C, Dee Park, Reading, RG30 4DD.	75mm	100.00		
		63mm	100.00		
Test Location:	HA 01	50mm	100.00		
		37.5mm	84.80		
Sample Depth:	1.00m	26.5mm	84.80		
		20mm	83.20		
Sample Description:		14mm	71.80		
		10mm	65.80		
		6.3mm	59.70		
		5mm	57.20		
Hydrometer No.:		3.5mm	54.70		
		2mm	52.40		
SG Gs:		1.18mm	50.70		
		600µm	48.60		
Water Visc. (N):		425µm	45.50		
		300µm	40.50		
Dry Mass of Soil after pretreatment (g):		212µm	32.20		
		150µm	27.40		
		63µm	20.40		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

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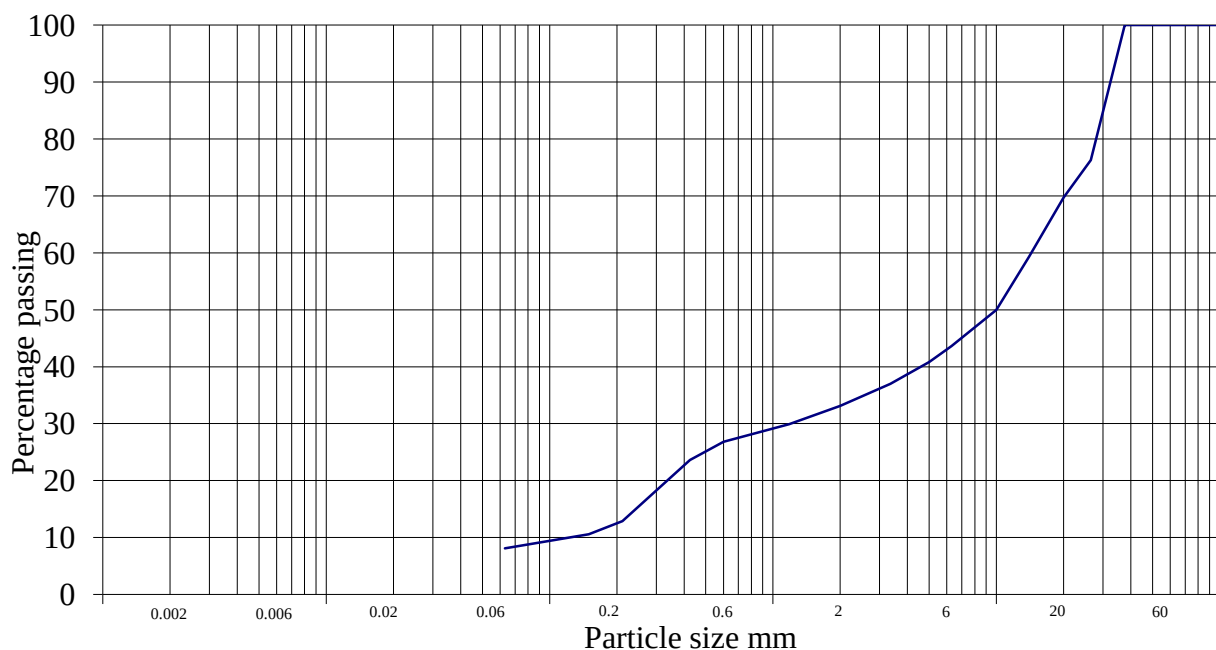
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site: Phase 2C, Dee Park, Reading, RG30 4DD. Test Location: TP 02 Sample Depth: 2.00m Sample Description: Hydrometer No.: SG Gs: Water Visc. (N): Dry Mass of Soil after pretreatment (g):		75mm	100.00		
		63mm	100.00		
		50mm	100.00		
		37.5mm	100.00		
		26.5mm	76.30		
		20mm	69.70		
		14mm	59.30		
		10mm	50.00		
		6.3mm	43.60		
		5mm	40.80		
		3.5mm	37.00		
		2mm	33.10		
		1.18mm	29.90		
		600µm	26.80		
		425µm	23.60		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

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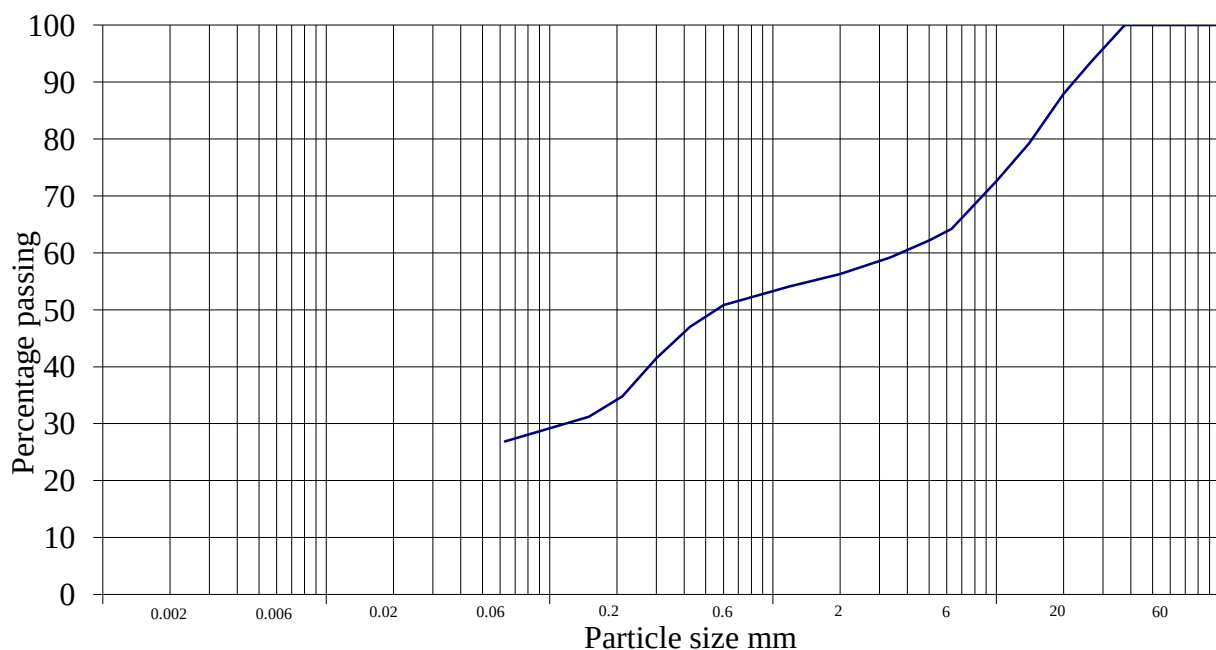
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site: Phase 2C, Dee Park, Reading, RG30 4DD. Test Location: TP 05 Sample Depth: 1.00m Sample Description: Hydrometer No.: SG Gs: Water Visc. (N): Dry Mass of Soil after pretreatment (g):		75mm	100.00		
		63mm	100.00		
		50mm	100.00		
		37.5mm	100.00		
		26.5mm	93.50		
		20mm	87.90		
		14mm	79.20		
		10mm	72.60		
		6.3mm	64.20		
		5mm	62.20		
		3.5mm	59.20		
		2mm	56.30		
		1.18mm	54.10		
		600µm	50.80		
		425µm	47.00		



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

PARTICLE SIZE DISTRIBUTION

Project Reference
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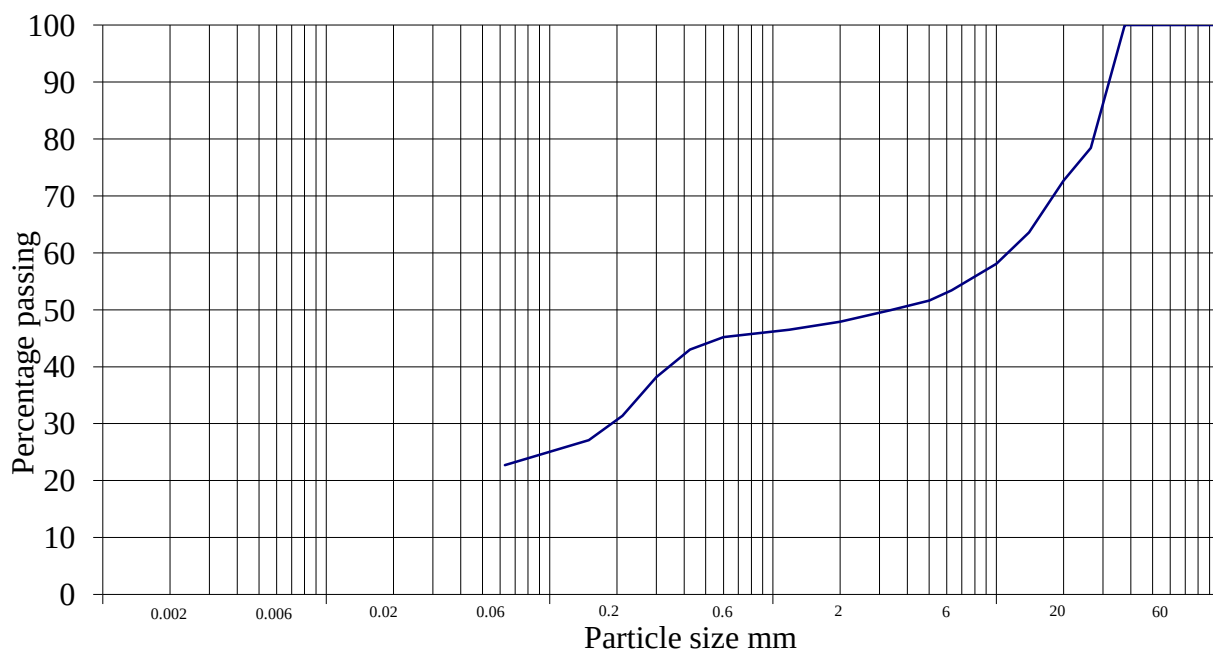
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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site:	Phase 2C, Dee Park, Reading, RG30 4DD.	75mm	100.00		
		63mm	100.00		
Test Location:	TP 05	50mm	100.00		
Sample Depth:	1.50m	37.5mm	100.00		
Sample Description:		26.5mm	78.40		
		20mm	72.70		
		14mm	63.60		
		10mm	58.10		
		6.3mm	53.40		
		5mm	51.60		
		3.5mm	49.90		
		2mm	47.90		
		1.18mm	46.50		
		600µm	45.20		
		425µm	43.00		
		300µm	38.20		
		212µm	31.40		
		150µm	27.10		
		63µm	22.70		
Hydrometer No.:					
SG Gs:					
Water Visc. (N):					
Dry Mass of Soil after pretreatment (g):					



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

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Test Location	Depth (m)	C.B.R. Value %		Final Water Content %	Bulk Density Mg/m3	Dry Density Mg/m3	Remarks
		Top:	Base				
BH2C/02	0.50	1.1	1.6	11	1.90	1.71	HEAD DEPOSITS. Soft to firm, brown, silty, sandy, gravelly CLAY. Gravel is fine to coarse sub angular to sub rounded flint. The gravel retained on the 20mm sieve is 11%.
TP 02	0.50	4.5	4.2	15	1.88	1.64	Firm, brown, silty, sandy, gravelly CLAY. Gravel is fine to coarse sub angular to sub rounded flint and calcareous with rare fine to medium red brick and glass. The gravel retained on the 20mm sieve is 6%.
Samples recompacted using standard compaction Surcharge 8kg							
CALIFORNIA BEARING RATIO						Report No. 08.03.014i	

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Hole No.	Sample				Spec Ref.	SWC %	Bulk Density Mg/m³	Dry Density Mg/m³
	Ref	Top	Base	Type				
BH2C/02	71	17.00		D	1	31	1.91	1.46
BH2C/02	75	20.00		D	1	34	1.88	1.4
BH2C/02	79	23.00		D	1	27	1.97	1.55
					</			

