

FACTUAL REPORT ON GEO- ENVIRONMENTAL PHASE 2 SITE INVESTIGATION

Castlebrook High School

Parr Lane,
Bury
BL9 8LP

Document Ref. 3452911014

September 2016

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VERSION CONTROL

Version	Date	Author	Changes
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1 INTRODUCTION

1.1 Appointment

Arcadis (UK) Limited (Arcadis) was instructed by the Education Funding Agency (EFA), ‘the Client’ on behalf of the Secretary of State for Education, to undertake a ground investigation at Castlebrook High School, Parr Lane, Bury BL9 8LP (the Site).

The work was carried out with consideration of The Provision of Technical Services in relation to Priority Schools Building Programme Phase 2 (PSBP2), the “Agreement”.

The scope of the ground investigation was determined by Arcadis.

This ground investigation report provides a factual account of the fieldwork undertaken, the strata encountered, results of *in situ* testing and the subsequent geotechnical and geo-environmental laboratory testing undertaken on samples obtained.

1.2 Proposed Development

It is understood that the current school is set to undergo a “new build” of block EFA-A. At the time of writing, there are three control options to the design of the new build (which also includes a number of temporary accommodation structures for use whilst the development takes place). Of the remaining blocks on Site (EFA-B and EFA-C), at the time of writing it is understood that no additional works (refurbishment or re-build) is scheduled to be undertaken.

The control options are presented in Appendix A.

1.3 Existing Information

This investigation follows on from the completion of a Phase 1 Geo-Environmental Site Investigation Report completed in September 2016; the full reference for which is as follows:

- Geo-Environmental Phase 1 Site Investigation Report, Castlebrook High School. Arcadis Ref: 3452911004; dated September 2016.

The Phase 1 Geo-Environmental Investigation included a review of readily available information to describe the environmental and geo-environmental setting of the Site in order to prepare an outline Conceptual Site Model (CSM) and determine potential development constraints that could impact the proposed redevelopment. The information was then used to define the scope of the Phase 2 intrusive investigation report herein. This Phase 2 report should be read in conjunction with the aforementioned Phase 1 report.

1.4 Objectives

The main objective of the Phase 2 intrusive investigation was to obtain site-specific information on the ground conditions beneath the Site.

1.5 Scope of Works

To achieve the objectives, the following scope of works was fulfilled:

- Five deep boreholes (BH01-BH05) to a target depth of 10.0 metres below ground level (m bgl) with *in situ* geotechnical testing;
- Eleven “window sample” boreholes (WS01-WS11) to a target depth of 5.0m bgl with *in situ* geotechnical testing;
- Eight dynamic cone penetrometer (DCP) tests to a target depth of 1.0m bgl;
- Installation of groundwater and ground gas monitoring standpipes;
- Sampling and testing of soil for geotechnical parameters/determinants;
- Groundwater monitoring;

- Sampling and testing of soil and groundwater for chemical parameters/determinants;
- Permanent ground gas monitoring (three visits).

1.6 Reliability of Information / Limitations

A complete list of Arcadis Study Limitations is presented as Appendix B.

It should be noted that ground conditions between exploratory holes may vary from those identified during this ground investigation; any design should take this into consideration. It should also be noted that groundwater levels may be subject to diurnal, tidal, seasonal, climatic variations and those recorded in this report are solely dependent on the time the ground investigation was carried out and the weather before and during the investigation.

1.7 Reliance

This report has been prepared for the use of the Education Funding Agency. The contents of this report may not be used or relied upon by any person other than this party without the express written consent and authorisation of Arcadis.

2 SITE SETTING

2.1 Site Location

Item	Details
Site Status	Secondary School
Intended end use	Secondary School
OS National Grid Coordinates	382160, 407160
Elevation	94-100m Above Ordnance Datum (AOD)
Site Size	60,100m ²

A site location plan is presented as Figure 1.

2.2 Site Description

A detailed description of the Site is included within the Phase 1 Site Assessment report.

2.3 Rationale

Following a review of the desk study and in the context of the proposed redevelopment, the site investigation was designed in order to develop the understanding of the conceptual site model and potential geo-environmental constraints.

The desk study indicated that the Site is underlain by superficial deposits described as Hummocky (moundy) glacial deposits (Diamicton), while the south eastern area of the site is shown to be underlain by glacial till. The glacial till and hummocky glacial deposits would likely provide a suitable bearing stratum for low-rise structures. However, with the hummocky glacial deposits there is a risk of variable ground conditions including soft and compressible ground. In addition, as the Site is constructed over several terraces, made ground associated with cut and fill is likely to be present throughout the Site and may require removal. Therefore, depending upon the structural loads there may be the need to consider deeper foundation options. The investigation has been designed to collect information on the near surface deposits in order to assess the variability with some boreholes extending to greater depth.

Bedrock is anticipated to comprise Pennine Middle Coal Measures Formation (described as mudstone, siltstone and pale grey sandstone with common coal seams). The Coal Authority Report obtained (Reference: 51000848878001) does not identify any underground or opencast coal mining activities within the Site or surrounding area.

The scope of works included the formation of exploratory holes to provide site wide coverage over a range of depths using different methods to provide varying testing capabilities.

The detailed approach used for these elements is presented in the following section.

3 SITE INVESTIGATION – METHODOLOGY

3.1 Borehole Formation

3.1.1 Investigation Locations

The following methods and techniques were undertaken to construct the exploratory holes at the Site. The completed scope of investigation is summarised below.

Details of the methods of investigation and associated standards adopted are presented in Appendix C; the exploratory hole records are presented in Appendix D.

- Four boreholes (BH01 to BH04), including hand dug inspection pits, were progressed by percussive sampling techniques using a Comacchio drilling rig to depths of between 9.95m and 10.45m bgl
- One borehole (BH05), including a hand dug inspection pit, was progressed by cable percussive sampling techniques using a Dando 2000 drilling rig to a depth of 10.45m bgl
- Eleven window sample boreholes (WS01 to WS11), including hand dug inspection pits, were progressed by dynamic sampling techniques using a Dando Terrier drilling rig to a maximum depth of 5.45m bgl
- Eight dynamic cone penetrometer (DCP) holes were progressed using a TRL probe to depths of between 0.93m and 1.07m bgl. These were completed immediately adjacent to locations BH01, BH02, BH03, WS01, WS02, WS05, WS08 and WS09.

3.1.2 Percussive Sampling

Percussive sampling was completed using a track-mounted sampling rig capable of driving windowless sample tubes using a percussive impact hammer mounted to the drive head.

Sub-samples of the material recovered in the liners were taken to enable representative laboratory testing. Generally small disturbed samples were taken at each change in stratum and at 0.5 m intervals thereafter in clay soils; and small bulk samples were taken at 1 m intervals where the sand and gravel content of the soil was significant.

Alternating undisturbed samples (U100) and standard penetration tests (SPT) were obtained every 1.0 m centres (until 5m depth and then were taken at 1.50 m intervals until the termination depth of the hole) or where appropriate given the predominant nature of the soil (cohesive or granular).

3.1.3 Cable Percussive Boring

Cable percussive boring was completed using Dando D2000 drilling rig equipped with 150mm casing and tools.

Sub-samples of the material recovered were taken to enable representative laboratory testing. Generally small disturbed samples were taken at each change in stratum and at 0.5 m intervals thereafter in clay soils; and small bulk samples were taken at 1 m intervals where the sand and gravel content of the soil was significant.

Alternating undisturbed samples (U100) and standard penetration tests (SPT) were obtained every 1.0 m centres (until 5 m depth and then were taken at 1.50 m intervals until the termination depth of the hole) or where appropriate given the predominant nature of the soil (cohesive or granular).

3.1.4 Dynamic Sampling

Dynamic sampling (window sampling) was completed using a track-mounted sampling rig capable of driving windowless sampling tubes using a mechanical hammer dropped repeatedly from a self-governed height. Eleven boreholes (WS01-WS11) were completed.

A description of the recovered materials was recorded by the supervising engineer.

Sub-samples of the material recovered in the liners were taken to enable representative laboratory testing. Generally small disturbed samples were taken at each change in stratum and at 0.5 m intervals thereafter in clay soils; and small bulk samples were taken at 1 m intervals where the sand and gravel content of the soil was significant.

Standard penetration tests (SPT) were undertaken using the track mounted rig at 1.0m centres until 5.0m.

3.2 *In situ* Testing

3.2.1 General

In situ testing was either carried out within the relevant exploratory hole. Where tests were undertaken within or associated with a specific borehole, the test data is presented within the relevant exploratory hole log. As such, the location details will be the same as the associated hole and its position will be the same as the exploratory hole with which it is associated.

3.2.2 Penetration Testing

3.2.2.1 Standard Penetration Tests

Standard penetration tests (SPT) were carried out as required in the investigation scope and in accordance with the methods given in the standard procedures presented within Appendix C. Generally tests were undertaken at regular intervals throughout the borehole to provide a profile of the soil's resistance with depth and a disturbed soil samples was recovered from the SPT split-spoon tool or a disturbed sample was taken over the range of the test interval.

The N-values as determined in the field are presented on the borehole logs as uncorrected values that do not take into account the energy losses or efficiency of the automatic trip hammer used to drive the test tool into the ground. The calibration certification for the test devices used in the investigation is presented in Appendix E and a summary of the SPT equipment used at each location is presented below.

Location ID	SPT Hammer Reference No.	Energy Efficiency Ratio, E_r %	Comment
BH01-BH04	AR490	62	Comacchio GEO205
BH05	PB11	89	Dando D2000
WS01-WS08	PBWS03	83	Premier Compact 110
WS09-WS11	PBWS01	89	Dando Terrier

3.2.2.2 TRL Dynamic Cone Penetrometer Test

The penetration resistance of the ground was determined by the TRL dynamic cone penetrometer at the locations specified in the ground investigation scope. Generally, the tests were undertaken adjacent to or as an extension of other exploratory holes to provide additional investigation depth or to provide a subjective record of the ground profile and therefore test results are presented with the associated exploratory hole record in Appendix D.

3.2.3 Strength Testing

3.2.3.1 Determination of undrained shear strength using Hand Vane apparatus

Hand shear vane tests were carried out using a Controls hand shear vane with a cruciform vane of 19 mm diameter. The test was performed in general accordance with the manufacturer's instructions.

The vane head was pushed in to a suitable soil sample and rotated slowly at a speed not greater than 1 revolution per minute until the soil has failed in shear or the maximum reading of the device was achieved.

The undrained soil strength was calculated by comparing the reading taken against the calibration graph provided with the shear vane in kPa.

Where possible, three tests were made to provide an average value, however, it should be noted that where natural fissures or discontinuities are present the minimum values may provide a better representation of the mass consistency of the soil and may be significant.

Due to the nature of the samples tested, the results are indicative for assistance in determining soil consistency for logging purposes only and should not be used to classify soil strength. The results are presented within Appendix D.

Tests were made using hand shear vane (#95) S/N: VT12002 a copy of the current calibration certificate is presented in Appendix E.

3.2.4 VOC Head Space Screening

The presence of Volatile Organic Compounds (VOC) within the ground was determined using a photoionization detector (PID) to detect the 'headspace' vapours emitted by the compounds. The method is applicable to a wide range of compounds that have sufficiently high volatility to be effected liberated from the soil or water matrix in normal temperature and pressure ranges.

The headspace test was undertaken on the freshly extracted soil core sample at regular intervals of 0.5m (or every change in lithology) by placing a small amount of material into a dedicated sample bag, which was then tied trapping air. The sample was then shaken for about 15 seconds to break-up and disperse the soil before resting the sample for about 5 minutes.

To assess the headspace vapour, the PID probe was inserted through the side of the plastic sample bag into the headspace area. The PID reading recorded was the highest response observed in the first 10 seconds. The screening results are presented on the relevant exploratory holes logs within Appendix D.

The testing was undertaken using a RAE Systems MiniRAE 2000 with a 10.6 eV lamp.

The PID instrument was calibrated regularly throughout the day using isobutylene reference gas concentrations.

3.3 Installations and Post-fieldwork Monitoring

3.3.1 Installations

Installations to enable long term monitoring of the site were made in all boreholes, the details of which are summarised in below and are also provided on the relevant borehole logs.

3.3.2 Post-fieldwork Monitoring

Post-field work monitoring was undertaken on separate visits on 5th, 18th and 25th of August 2016. In all, three visits to the site were made to record permanent ground gas emissions and groundwater levels. During the first monitoring visit, after completion of the ground gas emission monitoring, the well was purged by removing three well volumes of groundwater and sampling was then undertaken. Where installations were purged dry, monitoring and sampling was conducted on groundwater recovered following recharging of groundwater in installations.

4 LABORATORY TESTING

4.1 General

Geotechnical and geo-environmental chemical testing was undertaken on selected samples obtained from the exploratory holes. The testing was scheduled by the geotechnical and/or geo-environmental engineer and the testing was undertaken by an Arcadis approved testing laboratory.

4.2 Geotechnical Laboratory Testing

The geotechnical tests detailed in the table below were carried out in accordance with either BS1377:1990: Parts 1 to 8; BS EN ISO 17892: Parts 1 to 12; BRE SD 1:2005; or other methods as listed. The complete results of the geotechnical laboratory testing are presented in Appendix F.

Test	Method	No of Determinations	Comment
Moisture content	BS1377 Pt2-3.2	66	None.
4-point liquid and plastic limit	BS 1377 Pt2-4.3 & 5.3	64	None.
Sedimentation	BS1377 Pt2-9.4	20	None.
Particle size distribution	EN ISO 17892 Pt4	19	None.
Single stage UU triaxial	EN ISO 17892 Pt8	10	None.
CBR Compaction 2.5kg method	BS 1377-4 Pt4	5	None.
Dry density / moisture content 2.5kg relationship	BS 1377-4 Pt4	4	None.
One dimensional consolidation	BS 1377 Pt5	4	None.
Multi stage triaxial	BS 1377 Pt7.8	1	None.
Quick undrained shear box	BS 1377 Pt7.4	1	None.

4.3 Geo-Environmental Laboratory Testing

Geo-environmental tests were undertaken on soil and groundwater specimens obtained from the samples collected from the site. Testing was carried out for the contaminants detailed in the tables below. The results of the chemical laboratory testing are presented in Appendix G.

Data	Information
Chemical laboratory	ALcontrol Laboratories Ltd. (ALcontrol).
Accreditation	ALcontrol are United Kingdom Accreditation Service (UKAS) & monitoring Certification Scheme (MCertS) accredited (for selected chemical analysis).

Data	Information
Chemical analyses (soil)	• Asbestos Identification; • Metals by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES); • Polycyclic Aromatic Hydrocarbons (PAH) by Gas Chromatography-Mass Spectrometry (GC-MS); • TPH CWG by GC-MS; • VOC by GC-MS; • BTEX; • Phenols Index by High-Performance Liquid Chromatography (HPLC); • Water soluble sulphate; • Total sulphate; • Sulphur; • pH.
Chemical analyses (groundwater)	• Dissolved Metals by Inductively Coupled Plasma Mass Spectrometry (ICP-MS); • Speciated PAH; • TPH CWG; • Cyanide; • Sulphide; • Chloride; • Sulphate; • Fluoride; • pH

5 SITE INVESTIGATION – FINDINGS

5.1 Ground Conditions

Full details of the ground conditions encountered are included in the exploratory hole logs presented as Appendix D, and are summarised below. A photo appendix to supplement the exploratory logs is presented as Appendix H.

Made Ground

Made Ground was encountered throughout the Site. Surfacing generally comprised a “topsoil”, bituminous surfacing or concrete, and in the area of WS03 paving slab underlain by sandy gravel fill.

Granular Made Ground was encountered BH02, BH03, BH04, BH05, WS01, WS03, WS04, WS06 and WS11 at depths between 0.4-0.9m bgl and generally comprised clayey sandy gravel with occasional bricks.

More cohesive Made Ground was encountered in BH03, WS04, WS05 and WS09 at depths between 0.5-1.2m bgl and generally comprised sandy gravelly clay.

Natural Ground

The natural ground varied across the Site and comprised a mixture of granular and cohesive deposits (each with varying contents of secondary constituents).

In general, cohesive material comprised the following units;

- Firm, firm to stiff and stiff; silty clay, sandy clay, silty sandy clay and sandy gravelly clay
- Clayey silt and clayey sandy silt

In general, granular units comprised the following units;

- Medium dense, occasionally loose; clayey/silty sand, gravelly sand and sand

Occasional units of soft cohesive and loose granular material were encountered across the site. Of note:

- BH01; soft to firm 1.90-2.50m bgl
- BH02; loose 3.50-4.20m bgl
- BH02; soft to firm 4.20-5.00m bgl
- BH03; soft 0.80-4.00m bgl
- BH05; soft to firm 2.00-3.75m
- BH05; loose 3.75-4.50m bgl
- WS01; loose 0.60-1.90m bgl
- WS06; soft to firm 0.60-1.20m bgl
- WS09; soft to firm 1.20-3.40m bgl
- WS10; soft to firm 0.30-1.30m bgl

5.2 On-Site Environmental Screening, Visual and Olfactory Observations

No visual or olfactory evidence of hydrocarbon contamination was observed during the intrusive works.

5.3 Groundwater Strikes

Groundwater strikes were noted during the formation of the boreholes. Details of which are presented on the borehole logs, presented as Appendix D.

5.4 Groundwater Monitoring

Details of groundwater levels observed during a subsequent monitoring visit conducted on the 5th August 2016 are presented in Appendix I.

Groundwater samples were obtained from BH01, BH02, BH03, BH04, BH05, WS01, WS02, WS08 and WS11.

No NAPL was observed and no olfactory evidence was noted in the monitoring wells on this visit.

5.5 Laboratory Analysis Results

The results of the analysis of the soil obtained during the investigation are presented in Appendices F and G.

5.6 Ground Gas Monitoring

All wells on Site were monitored for permanent ground gas and the results of the monitoring are presented as Appendix I.

6 REFERENCES

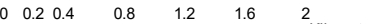
1. Geo-Environmental Phase 1 Site Investigation Report, The Clifton Centre. Arcadis Ref: 3452911003; dated June 2016.
2. TRL. 2004. Dynamic cone penetrometer tests and analysis. TRL Technical Report PR IN 277-04. Transport Research Laboratory, Crowthorne, England.
3. Jones C R and Rolt J. 1991. Operating instructions for the TRL dynamic cone penetrometer. 2nd Edition Information Note. Transport Research Laboratory, Crowthorne.
4. Building Research Establishment. 2005. Concrete in aggressive ground. BRE Special Digest 1. 3rd Edition. BRE, Watford.
5. BS EN 1997-1. 2004. Eurocode 7: Geotechnical Design. Part 1 General Rules. British Standards Institution, 2013 (revised text).
6. BS EN 1997-2. 2007. Eurocode 7: Geotechnical Design. Part 2 Ground Investigation and testing. British Standards Institution, 2010 (revised text).
7. BS 5930. 2015. Code of practice for ground investigations. British Standards Institution.
8. BS 10175. 2011+A1:2013. Investigation of potentially contaminated sites – Code of practice. British Standards Institution.
9. BS 1377. 1990. Method of test for soils for civil engineering purposes. Published in 9 Parts. British Standards Institution

FIGURE 1

Site Location Plan



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LEGEND	NOTES
 SITE LOCATION	SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.
	

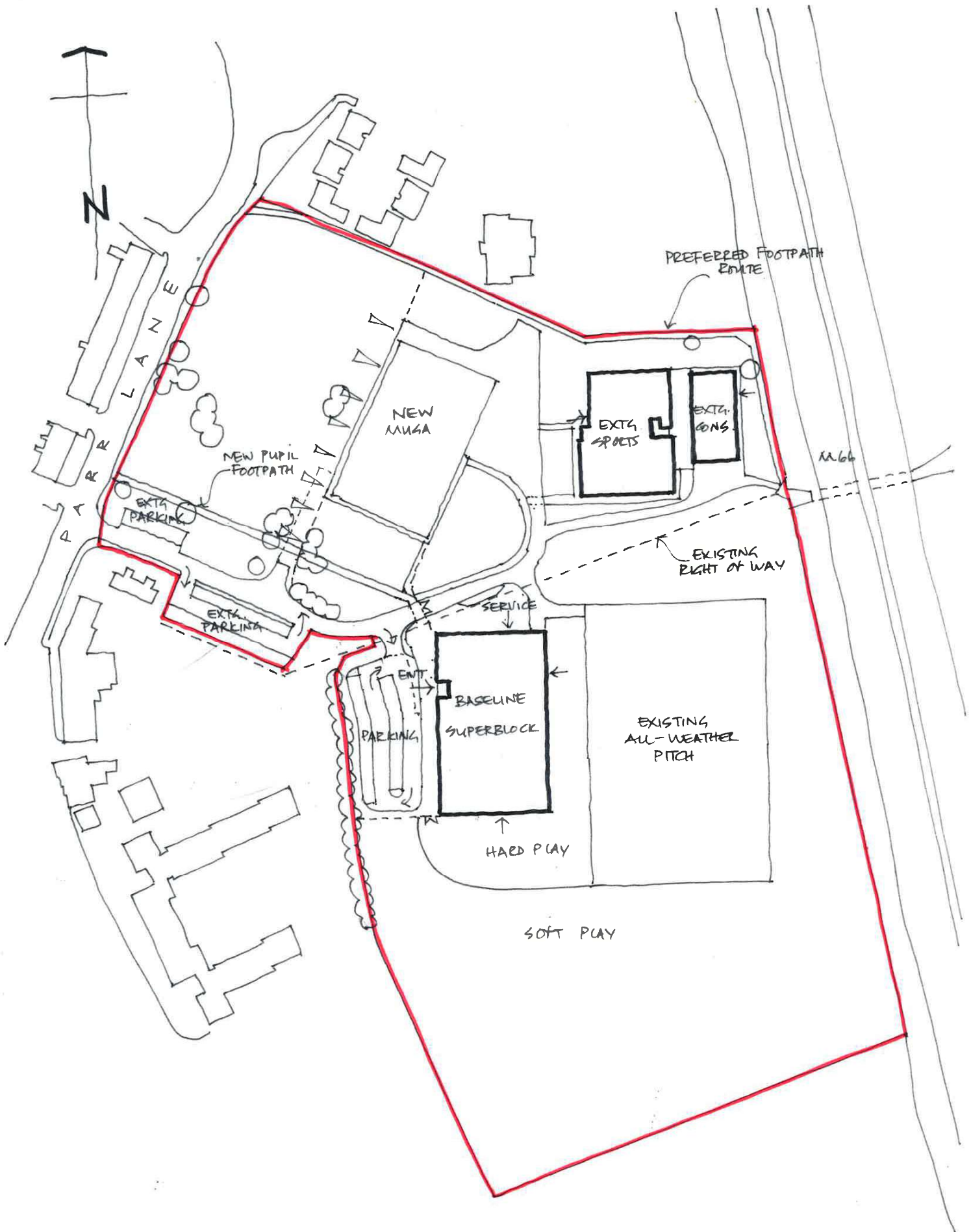
TITLE: SITE LOCATION PLAN	
SITE: CASTLEBROOK HIGH SCHOOL	
CLIENT: EDUCATION FUNDING AGENCY	
PROJECT: 34529110	FIGURE 1
DATE: 25/08/16	DRAWN BY: BNB
DRG No.: 3452911005 GIS	
SCALE: 1: 50,000	PRINT: A4
 Design & Consultancy for natural and built assets	

FIGURE 2

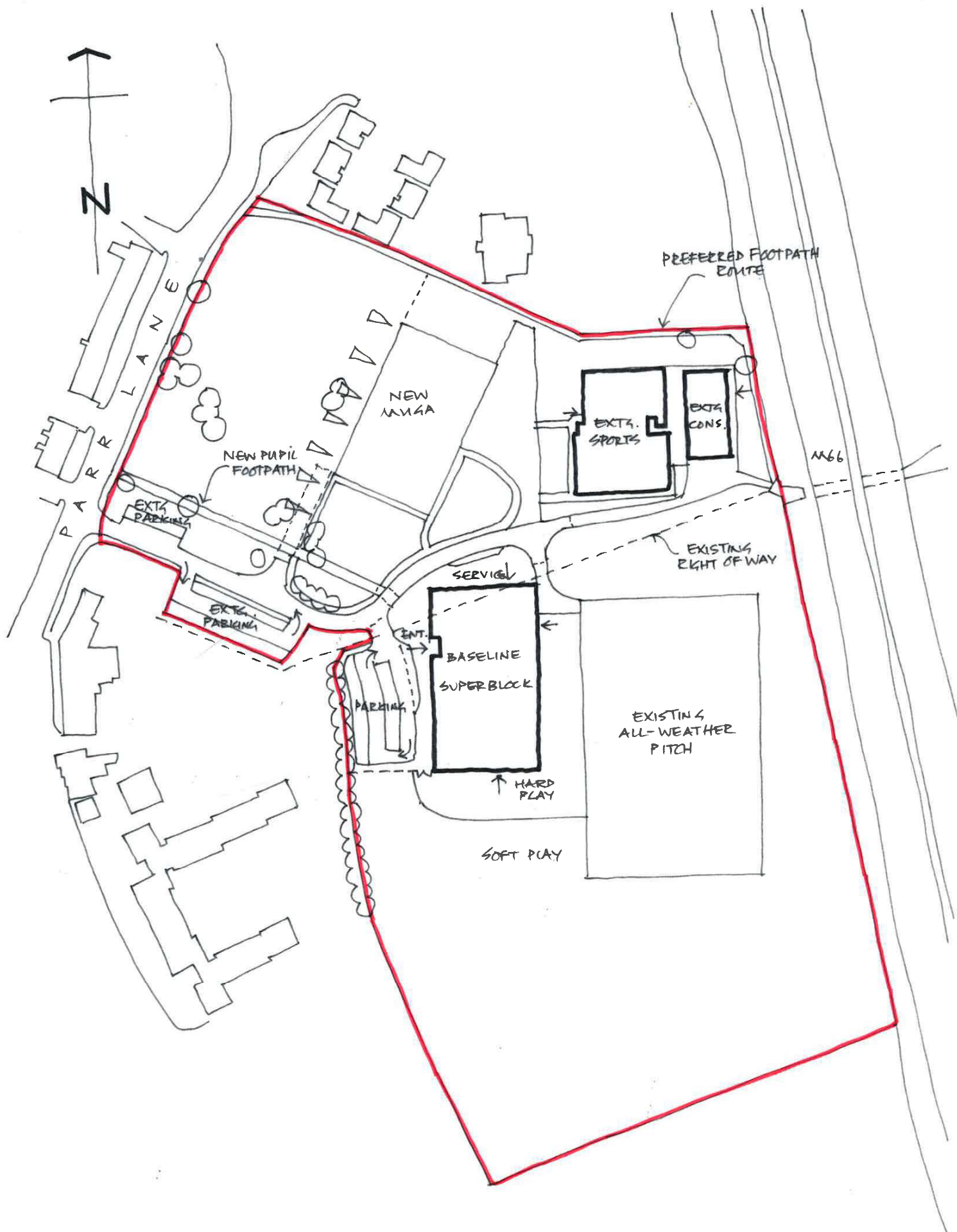
Site Layout and Borehole Location Plan

APPENDIX A

CONTROL OPTIONS



CASTLEBROOK HIGH SCHOOL
 SKETCH SITE STRATEGY
 1:1250 @ A3
 OPTION 1
 06/16



0 100m

HLM

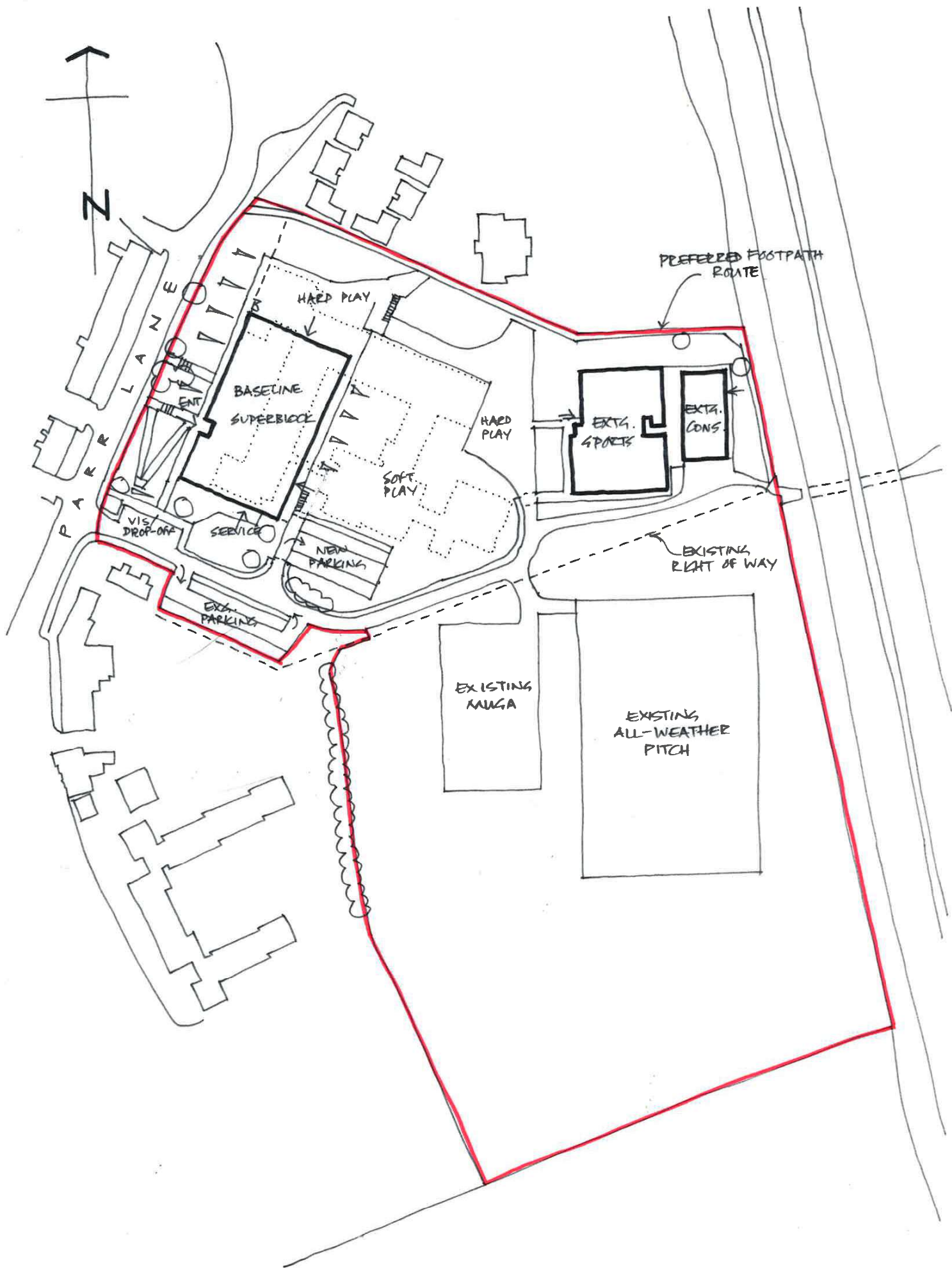
CASTLEBROOK HIGH SCHOOL

SKETCH SITE STRATEGY

OPTION 2

1:1250 @ A3

06/16



CASTLE BROOK HIGH SCHOOL
 SKETCH SITE STRATEGY OPTION 7
 1:1250 @ A3 06/16

APPENDIX B

STUDY LIMITATIONS

IMPORTANT: This section should be read before reliance is placed on any of the information, opinions, advice, recommendations or conclusions contained in this report.

1. This report has been prepared by Arcadis UK Ltd (Arcadis), with all reasonable skill, care and diligence within the terms of the Appointment and with the resources and manpower agreed with Education Funding Agency (the 'Client'). Arcadis does not accept responsibility for any matters outside the agreed scope.
2. This report has been prepared for the sole benefit of the Client unless agreed otherwise in writing.
3. Unless stated otherwise, no consultations with authorities or funders or other interested third parties have been carried out. Arcadis are unable to give categorical assurance that the findings will be accepted by these third parties as such bodies may have unpublished, more stringent objectives. Further work may be required by these parties.
4. All work carried out in preparing this report has used, and is based on, Arcadis' professional knowledge and understanding of current relevant legislation. Changes in legislation or regulatory guidance may cause the opinion or advice contained in this report to become inappropriate or incorrect. In giving opinions and advice, pending changes in legislation, of which Arcadis is aware, have been considered. Following delivery of the report, Arcadis have no obligation to advise the Client or any other party of such changes or their repercussions.
5. This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report.
6. Whilst this report and the opinions made are correct to the best of Arcadis' belief, Arcadis cannot guarantee the accuracy or completeness of any information provided by third parties.
7. This report has been prepared based on the information reasonably available during the project programme. All information relevant to the scope may not have been received.
8. This report refers, within the limitations stated, to the condition of the Site at the time of the inspections. No warranty is given as to the possibility of changes in the condition of the Site since the time of the investigation.
9. The content of this report represents the professional opinion of experienced environmental consultants. Arcadis does not provide specialist legal or other professional advice. The advice of other professionals may be required.
10. Where intrusive investigation techniques have been employed they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature of sampling, no investigation technique is capable of identifying all conditions present in all areas. In some cases the investigation is further limited by site operations, underground obstructions and above ground structures. Unless otherwise stated, areas beyond the boundary of the site have not been investigated.
11. If below ground intrusive investigations have been conducted as part of the scope, service tracing for safe location of exploratory holes has been carried out. The location of underground services shown on any drawing in this report has been determined by visual observations and electromagnetic techniques. No guarantee can be given that all services have been identified. Additional services, structures or other below ground obstructions, not indicated on the drawing, may be present on Site.
12. Unless otherwise stated the report provides no comment on the nature of building materials, operational integrity of the facility or on any regulatory compliance issue

APPENDIX C

STANDARD PROCEDURES

C0 General Principles

This ground investigation was undertaken in general accordance with the principles of BS EN 1997-1 and BS EN 1997-2 and the advice given in BS5930:2015, which, provides complimentary guidance on the application of the primary standards. Where the requirements of the ground investigation specification differ from these primary standards, the investigation methodology was adapted as required and specific notes regarding methods and techniques employed were made in the appropriate report sections.

C1 Buried Services

Service clearance was undertaken in accordance with Arcadis' utility avoidance standards. This document details the methods and safe working practices used to undertake excavations safely. Prior to breaking ground, services plans were consulted and the area scanned using a Cable Avoidance Tool (CAT) and generator, and ground penetrating radar (GPR) with detected signals marked on the ground. For all investigation positions, other than for DCP locations, hand excavated inspection pits are completed to 1.20 m bgl prior to the use of drilling and boring plant.

C2 Sampling requirements

The selection of sample types and sampling techniques has been chosen to take account of the soil fabric, size and quality of sample required based on whether the soils mass properties or the intact material properties of the ground are to be determined in subsequent laboratory tests. BS EN ISO 22475-1 describes three generic sample groups that are:

- a. Sampling by drilling. Generally a disturbed sample recovered from the drilling tool or digging equipment, typically meeting Class 3 to Class 5 requirements, with the recovered material being stored in bulk bags or sealed jar or tub containers.
- b. Sampling by sampler. Typically referred to as open tube or drive sampling in which a tube with a sharp cutting edge is driven into the ground either by static thrust or dynamically driven to give a relatively undisturbed sample of Class 1 or Class 2 but may result in a Class 3 sample.
- c. Block sampling. Cylindrical large diameter samples or cuboid hand-cut samples usually relatively undisturbed Class 1 and Class 2.

The open-tube sampling equipment used on the Site was of a type and design that conformed to BS EN ISO 22475-1. For the purpose of this ground investigation block sampling was not required.

Generally samples were assessed on Site and any unexpected deterioration in sample quality was reported to the ground engineer by the lead drilling technician.

Sufficient and representative samples were taken to allow the geo-mechanical properties of the ground to be adequately characterised and to enable the sequence of soil strata to be described by a field engineer.

Where samples have been taken for chemical tests the drilling method attempted to adopt dry drilling over the sampling range that generally was achieved by the use of drill casing to separate and isolate the upper soil layers and exclude groundwater. Cross-contamination was further reduced by regular cleaning of sampling tools. Sample integrity was maintained by sealing samples immediately on collection and storing the samples in a temperature controlled cool box. Samples were despatched from the Site at the end of the shift on which they were collected or as required in the project specification. Details of best practice storage, preservation and decontamination measures undertaken are given below:

Task	Soil	Groundwater
Storage	Glass jars and vials supplied by the laboratory were used for the collection of soil samples to be analysed for volatile compounds. Plastic one-litre tubs were used to collect soil samples for metals analysis.	Glass vials supplied by the laboratory were used for the collection of samples to be analysed for volatile compounds. Samples to be analysed for lower volatility compounds were stored in laboratory prepared glass bottles.
Preservation	Filling of sample containers as far as practicable to minimise headspace and low storage temperature to minimise the potential for volatilisation and biodegradation of petroleum hydrocarbon compounds prior to analysis.	
Decontamination	Disposable gloves were worn and changed between sample collection to prevent cross-contamination.	Groundwater samples were collected using dedicated disposable tubing / bailers that were changed between monitoring well locations in order to prevent cross-contamination.
Transport	Samples stored in dedicated sample boxes provided by the laboratory. Sample details and analytical requests were recorded on the laboratory chain of custody form included with samples, prior to dispatching to laboratory for analysis. Samples were dispatched to the laboratory on the day of sampling.	

C3 Sample description

Sample description was undertaken by the Arcadis Site geologist in accordance with BS 5930: 2015. The descriptions of the individual samples were used to identify the sequence of strata at the exploratory hole location and from which representative exploratory hole logs were drawn.

C4 In situ testing

In situ geotechnical tests were undertaken taking account of the investigation scope and requirement to attain the appropriate parameters required in the geotechnical design. The tests were undertaken in accordance with the requirements of the relevant parts of BS EN ISO 22476 and other methods as follows:

Dynamic probing

Dynamic probes were undertaken in general accordance with BS EN ISO 22476-2, BS EN 1997-2 and the national annex to BS EN 1997. The tests were generally made using the super-heavy DPSH-B configuration of the apparatus, however, it should be noted that the basis for selection of the type of dynamic probe should be a consideration of the driving energy in relation to the type of ground conditions anticipated at the Site.

Where adequate correlation with borehole data is available an interpretation of the estimated soil type may be made, however, it should be noted that probing can give unreliable results in mixed soils.

Standard penetration testing

Standard penetration tests were carried out in accordance with BS EN ISO 22476-3, BS EN 1997-2 and the national Annex to BS EN 1997-2. The test records are presented on the borehole logs as blow counts for each increment with the N-value as the total number of blows of the four main test increments.

Where the N-value exceeds a total of 50 blows, the test reports the penetration in millimetres for the last test increment recorded, and the N value is indicated as greater than 50,

e.g. 4,5/12,14,18, 6 for 10 mm

indicates that the seating blows (4 and 5) were completed and that the test terminated in the 4th increment after penetrating 10 mm.

Where the seating blows exceeded 25 blows for less than 150 mm; the test was stopped and the rods remarked after which, the main drive was continued. The test is then reported as the number of blows in each seating drive for the recorded penetration with the results of the main drive given as above,

e.g. 14/11 for 45 mm/12,14,16, 8 for 10 mm.

In certain circumstances where groundwater in-flow may affect the test, particularly in fine sand or silt, low SPT blow counts may be recorded. Where the SPT blow count was very low, N values of 5 or less, the test was, at the discretion of the Site engineer, continued for a further 300 mm, recording blows for each 75 mm increment. **This is not** a standard penetration test value, it does however give an indication of potential disturbance to the ground.

TRL Dynamic cone penetrometer

The TRL DCP is a device developed by the TRL to assess the California Bearing Ratio of road sub-base by correlation. As such the device was developed for use in a limited range of soil types. The test has no formal standard the test methodology and its use is discussed in TRL report PR IN 277-04.

The TRL dynamic penetrometer is a hand-held test apparatus that uses a lightweight (8 kg) free-fall hammer to drive a 20 mm diameter 60° cone into the ground. The penetration of the cone is recorded after a set number of blows as millimetres per blow. The tests were undertaken in accordance with PR IN 277-04, and the results have been assessed in terms of the CBR-value using the relationship proposed by Jones and Rolt given as:

$$\text{Log (CBR)} = 2.48 - 1.057 \cdot \text{Log} \left(\frac{\text{mm}}{\text{blow}} \right)$$

C5 References

1. BS EN 1997-1. 2004. Eurocode 7: Geotechnical Design. Part 1 General Rules. British Standards Institution, 2013 (revised text).
2. BS EN 1997-2. 2007. Eurocode 7: Geotechnical Design. Part 2 Ground Investigation and testing. British Standards Institution, 2010 (revised text).
3. BS EN ISO 22282-1:2012. Geotechnical investigation and testing – Geohydraulic testing. Part 1: General Rules. British Standards Institution.
4. BS EN ISO 22475-1. Geotechnical investigation and testing – Sampling methods and groundwater measurements – Part 1 Technical principles for execution.
5. BS EN ISO 22476-1:2015. Geotechnical investigation and testing – Field testing – Part 1: Electrical cone and piezocone test. British Standards Institution
6. BS EN ISO 22476-2. Geotechnical investigation and testing – Field testing – Part 2: Dynamic Probing. British Standards Institution
7. BS EN ISO 22476-3 2005. Geotechnical investigation and testing – Field testing – Part 3: Standard penetration test. British Standards Institution
8. BS 5930: 2015. Code of practice for ground investigation. British Standards Institution.
9. BS 8574. Code of practice for the management of geotechnical data for ground engineering projects.
10. BS 1377-9. 1990. Methods of test for soils for civil engineering purposes. Part 9: In-situ tests. British Standards Institution.
11. TRL. 2004. Dynamic cone penetrometer tests and analysis. TRL Technical Report PR IN 277-04. Transport Research Laboratory, Crowthorne, England.
12. TRL. 2004. Dynamic cone penetrometer tests and analysis. TRL Technical Report PR IN 277-04. Transport Research Laboratory, Crowthorne, England.

APPENDIX D

EXPLORATORY HOLE LOGS

**ARCADIS**Design & Consultancy
for natural and
built assets2 Craven Court, Newmarket, Suffolk CB8 7FA
Tel: +44(0)1638 674767
Fax: +44(0)1638 668191Borehole
Number

BH01

Site:
Castlebrook High SchoolLocation:
Castlebrook High School, Parr
Lane, Bury BL9 8LP

Ground Level (mAOD): 98.57

Hole Diameter (mm): 116

Scale
1:55Client:
Education Funding
Agency

Easting: 382063

Well Diameter (mm): 50

Logged by:
T. Costema

Northing: 407272

Filter Material: Gravel

Project: 34529110

Date: 05/07/2016

Method: Hand dug inspection pit to 1.2m. Percussive to
10.45mChecked by:
JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: (soft) brown slightly gravelly sandy CLAY with frequent rootlets. Gravel is rounded to subrounded, fine to coarse quartz, coal, mudstone.		0.40	98.17	PID J	0.30 0.40-0.80	<1				
Firm to stiff light grey and light yellowish brown sandy CLAY.				D PID U	0.80 1.00 1.20-1.65	<1	72			1
Firm light greyish brown sandy gravelly CLAY. Gravel is rounded to subrounded, fine to coarse quartz, sandstone, coal and mudstone.		1.50	97.07	PID D	1.50 1.50-1.90	<1	79			
Soft to firm greyish brown sandy slightly gravelly CLAY.		1.90	96.67	D B SPT	1.65-1.70 1.90-2.50 2.00-2.45	<1	30	N=14 (0,0/1,4,4,5)		2
Brown fine to coarse silty SAND.		2.50	96.07	B PID	2.50-3.00 3.00	<1	34			3
Brown and grey sandy clayey SILT.		3.50	95.07	PID B D PID	3.50 3.50-5.00 4.00-4.10 4.50	<1		N=12 (2,2/2,3,3,4)		4
Brown sandy clayey SILT.		5.00	93.57	B SPT PID	5.00-5.90 5.00-5.45 5.50	<1		N=15 (1,1/1,2,4,8)		5
Stiff greyish brown sandy silty CLAY.		5.90	92.67	D	5.90-6.10	<1				6
Brown fine to coarse SAND.		6.10 6.20	92.47 92.37							
Stiff greyish brown sandy gravelly CLAY. Gravel is rounded to subangular, fine to medium quartz, coal, mudstone and sandstone (becoming less sandy and gravelly with depth).		7.00	91.57	PID U	6.50 7.00-7.45	<1	90 95			7
Stiff brown silty slightly sandy CLAY with rare rounded to subrounded fine to medium gravel of quartz, mudstone, sandstone and coal.				D J D U D B PID SPT	7.45-7.50 7.50 8.00-8.50 8.50-8.95 8.95-9.00 9.00-10.00 9.50 10.00-10.45		94 82 97 107 99			8 9 10
End of Borehole at 10.45 m		10.45	88.12					N=24 (2,3/5,6,6,7)		

Key:

D	Disturbed Sample	PPT	Pocket Penetrometer Test
B	Bulk Sample	PID	Photoionisation Detector
U	Undisturbed Sample	SPT	Standard Penetration Test (Uncorrected)
J	Jar Sample		
	Water Strike		
	Standing Water Level		

Remarks: Groundwater strike at 2.5m during drilling.



ARCADIS

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built assets

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Fax: +44(0)1638 668191

Borehole
Number

BH02

Site:
Castlebrook High School

Location:
Castlebrook High School, Parr
Lane, Bury BL9 8LP

Ground Level (mAOD): 98.59

Hole Diameter (mm): 116

Scale
1:55

Client:
Education Funding
Agency

Easting: 382064

Well Diameter (mm): 50

Logged by:
T. Costema

Northing: 407211

Filter Material: Gravel

Project: 34529110

Date: 06/07/2016

Method: Hand dug inspection pit to 1.2m. Percussive to 9.95m

Checked by:
JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: (soft) brown sandy gravelly CLAY with frequent rootlets. Gravel is angular to subrounded, fine to coarse brick and limestone.		0.20	98.39	PID J	0.00-0.20 0.20-0.50	<1				
MADE GROUND: Brown clayey gravelly fine to coarse SAND with rare half bricks. Gravel is angular to subrounded, fine to coarse brick, sandstone, bituminous surfacing, limestone.		1.20	97.39	PID SPT D J	1.00 1.20-1.65 1.20-1.80	<1 <1		N=17 (1,4/4,4,5,4)		1
Medium dense light orangey brown into orange silty fine to medium SAND.		1.80	96.79	J U B	1.80 2.00-2.45 2.00-2.90	<1	47			2
Firm light brown silty slightly sandy CLAY.				D	2.45-2.50	<1	55			
Firm brownish grey silty sandy CLAY.		2.90	95.69	B	2.90-3.50	<1				3
Loose light brown silty fine to medium SAND. ---Occasional bands of firm greyish brown clay between 3.7m and 4.2m.		3.50	95.09	SPT	3.50-3.95	<1		N=6 (0,0/1,1,1,3)		4
Soft to firm greyish brown very silty sandy CLAY with rare rounded to subrounded, fine to coarse mudstone and quartz gravel.		4.20	94.39	D	4.00-4.20	<1				
Firm to stiff greyish brown silty sandy CLAY.		5.00	93.59	J PID D U	4.50 4.80-5.00 5.00-5.45	<1 <1	39 44			5
				D B	5.45-5.50 5.50-6.50	<1				
				PID	6.00	<1				6
				SPT	6.50-6.95	<1		N=18 (2,2/4,4,5,5)		7
Greyish brown clayey silty fine to medium SAND.		7.00	91.59	D	7.00-7.50	<1				
Firm to stiff greyish brown silty sandy CLAY.		7.60	90.99	PID	7.50	<1				
				U	8.00-8.45	<1				8
				D B	8.45-8.50 8.50-9.00	<1	160			
Very stiff greyish brown silty sandy CLAY.		8.60	89.99	PID	9.00	<1	172			9
				SPT	9.50-9.95	<1	174	N=18 (2,1/3,4,5,6)		
End of Borehole at 9.95 m		9.95	88.64							10

Key:

D	Disturbed Sample	PPT	Pocket Penetrometer Test
B	Bulk Sample	PID	Photoionisation Detector
U	Undisturbed Sample	SPT	Standard Penetration Test (Uncorrected)
J	Jar Sample		
	Water Strike		
	Standing Water Level		

Remarks: No groundwater strike noted during drilling.

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Tel: +44(0)1638 674767
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Number

BH03

Site:
Castlebrook High SchoolLocation:
Castlebrook High School, Parr
Lane, Bury BL9 8LP

Ground Level (mAOD): 91.01

Hole Diameter (mm): 116

Scale
1:55Client:
Education Funding
Agency

Easting: 382152

Well Diameter (mm): 50

Logged by:
T. Costema

Northing: 407184

Filter Material: Gravel

Project: 34529110

Date: 07/07/2016

Method: Hand dug inspection pit to 1.2m. Percussive to
10.45mChecked by:
JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: (soft) dark brown sandy gravelly CLAY. Gravel is rounded to angular, fine to coarse brick, limestone, sandstone and quartz.		0.40	90.61	J	0.00-0.40					
		0.60	90.41	PID	0.40	<1				
		0.60	90.41	PID	0.50	<1				
MADE GROUND: Light greyish brown clayey sandy angular to subrounded, fine to coarse GRAVEL of sandstone and limestone.		0.80	90.21	PID	0.70	<1	25			
				PID	1.00	<1				1
MADE GROUND: (Firm) light brownish grey sandy gravelly CLAY. Gravel is angular to rounded, fine to coarse brick, concrete, limestone, sandstone and quartz.				D	1.20-1.65	<1				
				B	1.20-2.00		37			
Soft becoming firm light brownish grey sandy CLAY.		2.00	89.01	U	2.00-2.45	<1	55			2
Soft to firm greyish brown silty CLAY.				D	2.45-2.50	<1	29			
				SPT	3.00-3.45	<1	32	N=0 (0,0/0,0,0 ,0)		3
				B	3.00-4.00					
				J	3.50		27			
				D	3.50-3.70					
Brown clayey silty fine to coarse SAND.		4.00	87.01	B	4.00-5.00	<1	30			4
Medium dense greyish brown fine to coarse SAND.		4.10	86.91	D	4.00-4.45					
				SPT	5.00-5.45	<1		N=11 (1,0/1,3,3 ,4)		5
				B	5.50-7.00	<1				
				J	6.00	<1				6
				PID	6.00-6.50					
				PID	6.00					
				PID	6.50	<1				
				SPT	7.00-7.45	<1		N=14 (1,1/2,3,4 ,5)		7
Firm to stiff greyish brown sandy slightly gravelly CLAY. Gravel is subrounded to subangular, fine to coarse mudstone, sandstone and coal.		7.30	83.71	B	7.30-8.00	<1	70			
Greyish brown silty fine to coarse SAND.		8.00	83.01	D	8.00-8.50	<1				8
				D	8.50-9.00	<1				
				SPT	9.00-9.45	<1		N=15 (0,1/1,3,5 ,6)		9
				B	9.30-10.00	<1	70			
Firm to stiff greyish brown sandy gravelly CLAY. Gravel is rounded to subangular, fine to coarse mudstone, coal, sandstone and quartz.		9.30	81.71	SPT	10.00-10.45		72			10
End of Borehole at 10.45 m		10.45	80.56							

Key:

D	Disturbed Sample	PPT	Pocket Penetrometer Test
B	Bulk Sample	PID	Photoionisation Detector
U	Undisturbed Sample	SPT	Standard Penetration Test
J	Jar Sample		(Uncorrected)
▽	Water Strike		
▽	Standing Water Level		

Remarks: Groundwater strike at 4.0m during drilling.

Site:
Castlebrook High School

Location:
Castlebrook High School, Parr
Lane, Bury BL9 8LP

Ground Level (mAOD): 90.48

Hole Diameter (mm): 116

Scale
1:55

Client:
Education Funding
Agency

Easting: 382145

Well Diameter (mm): 50

Logged by:
T. Costema

Northing: 407137

Filter Material: Gravel

Project: 34529110

Date: 04/07/2016

Method: Hand dug inspection pit to 1.2m. Percussive to
10.45m

Checked by:
JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: Bituminous surfacing.		0.10	90.38	PID	0.10-0.40	<1				
MADE GROUND: Brownish grey sandy angular to subangular, fine to coarse GRAVEL of limestone with medium cobble content. Cobbles are angular to subangular limestone and sandstone.		0.40	90.08	J PID	0.40-0.80	<1				
MADE GROUND: Brownish grey clayey sandy angular to subrounded, fine to coarse GRAVEL of limestone, sandstone and brick.		0.80	89.68							1
Stiff greyish brown CLAY.				SPT B	1.20-1.65 1.50-2.00	<1	94	N=7 (1,1/1,1,2,3)		
				U	2.00-2.45		87			2
Brown fine to coarse SAND.		2.30	88.18	B D	2.30-3.00 2.45-2.50	<1				▽
Medium dense brown silty fine to coarse SAND.		3.00	87.48	SPT B	3.00-3.45 3.00-4.00	<1		N=10 (1,2/2,2,3,3)		3
				PID	4.00	<1				4
---Very silty between 4.5m and 4.8m.				D	4.50-4.80	<1				
Stiff brown sandy gravelly CLAY. Gravel is rounded to subrounded, fine to medium coal, mudstone and sandstone.		5.10	85.38	J SPT B	5.00 5.00-5.45 5.50-6.00	<1	107 115	N=13 (1,1/2,3,3,5)		5
				PID D	6.00 6.20-6.50	<1	110			6
Recovered as: (heavily saturated) brown fine to coarse SAND with occasional layers of black subangular fine coal gravel.		6.50	83.98	D	6.50-6.95	<1	124			▽
				PID	7.00	<1				7
				D	7.50-8.00	<1				
				J PID SPT	8.00 8.30-8.75	<1		N=29 (5,11/9,8,8,4)		8
Brown sandy slightly clayey rounded to angular fine to coarse GRAVEL of coal, mudstone quartz and sandstone.		8.30	82.18		8.30-8.75					
		8.50	81.98	D	8.50-9.20	<1	87			
Stiff brown sandy gravelly CLAY. Gravel is rounded to subangular, fine to coarse sandstone, coal and quartz.				PID	9.00	<1	80			9
		9.20	81.28	D	9.20-9.40					
		9.40	81.08	B	9.40-10.00	<1	87			
Brown clayey gravelly SAND. Gravel is rounded to subangular, fine to coarse sandstone, coal and quartz.				U	10.00-10.45	<1	97			10
				J	10.00					
Firm to stiff brown sandy gravelly CLAY. Gravel is rounded to subangular, fine to coarse mudstone, coal, quartz and sandstone (becomes less sandy and gravelly with depth).		10.45	80.03	D	10.45-10.50					
End of Borehole at 10.45 m										

Key:
D Disturbed Sample PPT Pocket Penetrometer Test
B Bulk Sample PID Photoionisation Detector
U Undisturbed Sample SPT Standard Penetration Test (Uncorrected)
J Jar Sample
▽ Water Strike
▽ Standing Water Level

Remarks: Groundwater strikes at 2.3m and 6.5m during drilling.

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Number

BH05

Site:
Castlebrook High SchoolLocation:
Castlebrook High School, Parr
Lane, Bury BL9 8LP

Ground Level (mAOD): 100.71

Hole Diameter (mm): 130

Scale
1:55Client:
Education Funding
Agency

Easting: 382074

Well Diameter (mm): 50

Logged by:
T. Costema

Northing: 407325

Filter Material: Gravel

Project: 34529110

Date: 01/08/2016

Method: Hand dug inspection pit to 1.2m. Cable Percussion to
10.45mChecked by:
JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: (Soft) dark brown slightly sandy slightly gravelly CLAY with frequent rootlets.		0.40	100.31	PID	0.00-0.40	<1				
MADE GROUND: Greyish brown clayey sandy angular to subrounded, fine to coarse GRAVEL of brick, limestone, coal & ash with frequent bricks and half bricks.		1.00	99.71	PID SPT B	1.00 1.20-1.65	<1 <1	54	N=6 (1,0/1,2,1,2)		1
Firm greyish brown sandy CLAY.		2.00	98.71	D U	2.00 2.00-2.45	<1	50			2
Soft to firm greyish brown sandy CLAY.				SPT	3.00-3.45	<1	34	N=6 (1,1/2,1,1,2)		3
Loose greyish brown clayey very silty slightly gravelly fine to coarse SAND. Gravel is fine to medium.		3.50	97.21	B	3.50-3.75	<1	32			4
				SPT	4.00-4.45	<1		N=4 (1,1/1,1,1,1)		4
Firm greyish brown sandy CLAY.		4.50	96.21	B	4.50-5.00	<1				5
				SPT	5.00-5.45	<1	45	N=15 (3,2/3,4,4,4)		5
Firm into stiff brown silty sandy CLAY with occasional sandy layers.		5.50	95.21	B	5.50-6.00	<1	60			6
				D U	6.00 6.00-6.45	<1	74			6
				B	6.50-7.00	<1	92			
				SPT	7.00-7.45	<1	89	N=15 (1,2/3,4,4,4)		7
				B	7.50-8.00	<1	104			
				U D	8.00-8.45 8.00	<1	112			8
Stiff brown slightly sandy slightly gravelly CLAY. Gravel is rounded to subangular, fine to coarse mudstone, sandstone, quartz and coal.		8.50	92.21	B	8.50-9.00	<1	114			
				SPT	9.00-9.45	<1	105	N=15 (2,2/3,3,4,5)		9
				B	9.50-10.00	<1	112			
				U D	10.00-10.45 10.00	<1	117			10
End of Borehole at 10.45 m		10.45	90.26							

Key:

D	Disturbed Sample	PPT	Pocket Penetrometer Test
B	Bulk Sample	PID	Photoionisation Detector
U	Undisturbed Sample	SPT	Standard Penetration Test (Uncorrected)
J	Jar Sample		
	Water Strike		
	Standing Water Level		

Remarks: No groundwater strike noted during drilling.

STRATA RECORD	IN SITU TESTS / SAMPLES	Sheet 1 of 1
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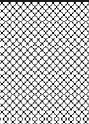
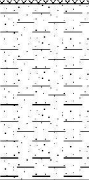
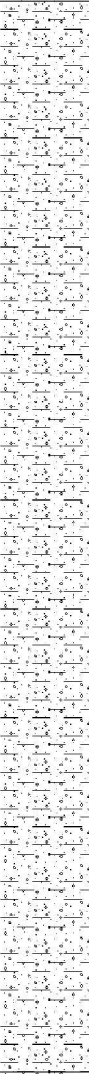
Key: D Disturbed Sample PPT Pocket Penetrometer Test B Bulk Sample PID Photoionisation Detector U Undisturbed Sample SPT Standard Penetration Test J Jar Sample (Uncorrected)  Water Strike  Standing Water Level	Remarks: Groundwater strike at 0.9m.
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Site: Castlebrook High School	Location: Castlebrook High School, Parr Lane, Bury BL9 8LP	Ground Level (mAOD): 99.05	Hole Diameter (mm): 101	Scale 1:30
Client: Education Funding Agency		Easting: 382045 Northing: 407236	Well Diameter (mm): 50 Filter Material: Gravel	Logged by: T. Costema
Project: 34529110	Date: 11/07/2016	Method: Hand dug inspection pit to 1.2m. Dynamic percussive to 5.45m.		Checked by: JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: (Soft) dark brown sandy CLAY with frequent rootlets.				J	0.00-0.50					
Firm light grey mottled light yellowish grey sandy CLAY.		0.50	98.55	D PID	0.50-0.80 0.50	<1				
				PID	1.00	<1				▽ 1
Firm to stiff brown slightly sandy slightly gravelly CLAY. Gravel is rounded to subangular, fine to coarse quartz, mudstone, sandstone.		1.20	97.85	SPT B	1.20-1.65 1.20-2.00		44	N=10 (1,2/2,2,3,3)		
				PID	1.50	<1	45			
				PID SPT	2.00 2.00-2.45	<1	59	N=13 (2,2/2,3,4,4)		2
				PID D	2.50 2.50-2.70	<1	54			
				PID SPT B	3.00 3.00-3.45 3.00-4.00	<1	64	N=16 (3,3/3,4,4,5)		3
				J PID	3.50	<1	89			
				PID SPT D	4.00 4.00-4.45 4.00-5.00	<1	94	N=12 (2,2/2,3,3,4)		4
				PID	4.50	<1	100			
				SPT PID	5.00-5.45 5.00	<1	110	N=14 (2,2/3,3,4,4)		5
End of Borehole at 5.45 m		5.45	93.60							

Key:

D	Disturbed Sample	PPT	Pocket Penetrometer Test
B	Bulk Sample	PID	Photoionisation Detector
U	Undisturbed Sample	SPT	Standard Penetration Test (Uncorrected)
J	Jar Sample		
▽	Water Strike		
▼	Standing Water Level		

Remarks: Groundwater strike at 1.0m.



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Fax: +44(0)1638 668191

Borehole
Number
WS03

Site: Castlebrook High School	Location: Castlebrook High School, Parr Lane, Bury BL9 8LP	Ground Level (mAOD): 94.01	Hole Diameter (mm): 101	Scale 1:30
Client: Education Funding Agency		Easting: 382097 Northing: 407238	Well Diameter (mm): 50 Filter Material: Gravel	Logged by: T. Costema
Project: 34529110	Date: 12/07/2016	Method: Hand dug inspection pit to 1.2m. Dynamic percussive to 5.45m.		Checked by: JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: Paving slabs.		0.05	93.96	J	0.05-0.40					
MADE GROUND: Black sandy angular to subangular fine to medium GRAVEL of ash and clinker.		0.40	93.61	J	0.50-1.00 0.50	<1				
Firm to stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse mudstone, coal, sandstone and quartz.				PID	1.00	<1				1
				SPT B	1.20-1.65 1.20-2.00		52	N=7 (1,1/1,2,2,2)		
				PID	1.50	<1				
				PID	2.00	<1	54	N=12 (1,2/2,3,3,4)		2
				SPT B	2.00-2.45 2.00-3.00					
				PID	2.50	<1	60			
				PID	3.00	<1	75	N=13 (2,2/2,3,4,4)		3
				SPT B	3.00-3.45 3.00-4.00					
				PID	3.50	<1	90			
				PID	4.00	<1	107	N=14 (2,2/3,3,4,4)		4
				SPT B	4.00-4.45					
				PID	4.50	<1	105			
				PID	4.50-5.00					
				SPT PID	5.00-5.45 5.00	<1	114	N=15 (1,1/2,4,4,5)		5
End of Borehole at 5.45 m		5.45	88.56							

Key:

D	Disturbed Sample	PPT	Pocket Penetrometer Test
B	Bulk Sample	PID	Photoionisation Detector
U	Undisturbed Sample	SPT	Standard Penetration Test
J	Jar Sample		(Uncorrected)
	Water Strike		
	Standing Water Level		

Remarks: No groundwater encountered.

STRATA RECORD	IN SITU TESTS / SAMPLES	Sheet 1 of 1
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Key: D Disturbed Sample PPT Pocket Penetrometer Test B Bulk Sample PID Photoionisation Detector U Undisturbed Sample SPT Standard Penetration Test J Jar Sample (Uncorrected) ▽ Water Strike ▴ Standing Water Level	Remarks: No groundwater encountered.
--	--------------------------------------

Site: Castlebrook High School	Location: Castlebrook High School, Parr Lane, Bury BL9 8LP	Ground Level (mAOD): 96.13	Hole Diameter (mm): 101	Scale 1:30
Client: Education Funding Agency		Easting: 382095 Northing: 407192	Well Diameter (mm): 50 Filter Material: Gravel	Logged by: T. Costema
Project: 34529110	Date: 12/07/2016	Method: Hand dug inspection pit to 1.2m. Dynamic percussive to 3.0m.		Checked by: JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: (soft) dark brown sandy gravelly CLAY. Gravel is angular to subrounded, fine to coarse brick, concrete, sandstone.		0.30	95.83	J PID	0.30-1.00 0.30 0.50	<1 <1				
MADE GROUND: (firm) dark brown sandy gravelly CLAY with occasional whole and half bricks. Gravel is angular to subrounded, fine to coarse brick, concrete, sandstone and limestone.		1.00	95.13	PID	1.00	<1				
Firm grey into light yellowish brown sandy CLAY.		1.70	94.43	SPT B	1.20-1.65 1.20-1.70		49 50	N=8 (1,1/2,2,2,2)		
Orange brown fine to coarse SAND.		2.00	94.13	PID SPT D J	2.00 2.00-2.45 2.00-2.50 2.00	<1		N=7 (1,1/2,2,2,1)		
Firm brown sandy CLAY.		2.50	93.63	PID D	2.50 2.50-3.00	<1	54			
Brown very clayey very silty fine to coarse SAND.		3.00	93.13	PID	3.00	<1				
End of Borehole at 3,00 m										

Key:

D	Disturbed Sample	PPT	Pocket Penetrometer Test
B	Bulk Sample	PID	Photoionisation Detector
U	Undisturbed Sample	SPT	Standard Penetration Test (Uncorrected)
J	Jar Sample		
	Water Strike		
	Standing Water Level		

Remarks: Groundwater strike at 1.0m.

STRATA RECORD	IN SITU TESTS / SAMPLES	Sheet 1 of 1
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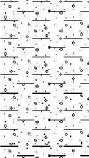
Key: D Disturbed Sample PPT Pocket Penetrometer Test B Bulk Sample PID Photoionisation Detector U Undisturbed Sample SPT Standard Penetration Test J Jar Sample (Uncorrected)  Water Strike  Standing Water Level	Remarks: No groundwater encountered.
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Site: Castlebrook High School	Location: Castlebrook High School, Parr Lane, Bury BL9 8LP	Ground Level (mAOD): 91.04	Hole Diameter (mm): 101	Scale 1:30
Client: Education Funding Agency		Easting: 382129 Northing: 407150	Well Diameter (mm): 50 Filter Material: Gravel	Logged by: T. Costema
Project: 34529110	Date: 11/07/2016	Method: Hand dug inspection pit to 1.2m. Dynamic percussive to 3.45m.		Checked by: JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: (soft) dark brown sandy gravelly CLAY with frequent rootlets. Gravel is rounded to subangular fine to coarse quartz, mudstone and sandstone.		0.40	90.64	PID	0.30	<1				
Firm light grey slightly sandy slightly gravelly CLAY. Gravel is rounded to subangular, fine to medium mudstone.		1.50	89.54	PID SPT	1.00 1.20-1.65	<1	49	N=1 (0,1/0,0,1,0)		1
Stiff grey silty slightly sandy slightly gravelly CLAY. Gravel is rounded to subangular, fine to medium mudstone.		1.90	89.14	B PID	1.50-1.90 1.50	<1				
Firm to stiff grey slightly sandy slightly gravelly CLAY. Gravel is rounded to subangular, fine to coarse mudstone and coal.		2.60	88.44	SPT D PID	1.90-2.35 1.90-2.60 2.00	<1	169	N=10 (1,1/1,2,4,3)		2
Medium dense brown fine to coarse SAND.		3.45	87.59	PID SPT	2.50 2.60-3.00 3.00 3.00-3.45	<1	127	N=10 (2,2/3,2,2,3)		3
End of Borehole at 3.45 m										

Key:

D	Disturbed Sample	PPT	Pocket Penetrometer Test
B	Bulk Sample	PID	Photoionisation Detector
U	Undisturbed Sample	SPT	Standard Penetration Test (Uncorrected)
J	Jar Sample		
▽	Water Strike		
▼	Standing Water Level		

Remarks: Groundwater strike at 2.5m.

Site:
Castlebrook High School

Location:
Castlebrook High School, Parr
Lane, Bury BL9 8LP

Ground Level (mAOD): 90.69

Hole Diameter (mm): 101

Scale
1:30

Client:
Education Funding
Agency

Easting: 382167

Well Diameter (mm): 50

Logged by:
T. Costema

Northing: 407103

Filter Material: Gravel

Project: 34529110

Date: 11/07/2016

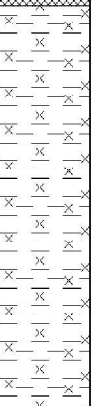
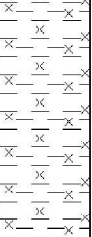
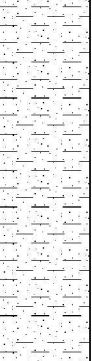
Method: Hand dug inspection pit to 1.2m. Dynamic percussive
to 4.45m.

Checked by:
JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: (soft) dark brown sandy gravelly CLAY. Gravel is angular to rounded, fine to coarse quartz, mudstone coal.										
Firm into stiff light grey silty CLAY.		0.40	90.29	PID	0.30	<1				
				D	0.50-0.70					
				PID	1.00	<1				1
				SPT B	1.20-1.65 1.20-2.00		47	N=10 (1,2/2,3,3 ,2)		
				PID D	1.50	<1				
Poor recovery ~30%. Recovered as: Soft brownish grey silty CLAY.		2.00	88.69	PID SPT D	2.00 2.00-2.45 2.00-3.00	<1	50	N=11 (1,2/2,3,3 ,3)		2
				PID	2.50	<1				
Poor recovery ~40%. Recovered as: Firm to stiff grey sandy CLAY.		3.00	87.69	PID SPT D	3.00 3.00-3.45 3.00-4.00	<1	32	N=12 (2,2/3,3,3 ,3)		3
				PID	3.50	<1				
				PID SPT	4.00 4.00-4.45	<1	80	N=22 (2,2/2,5,6 ,9)		4
End of Borehole at 4.45 m		4.45	86.24							5

Key:
D Disturbed Sample PPT Pocket Penetrometer Test
B Bulk Sample PID Photoionisation Detector
U Undisturbed Sample SPT Standard Penetration Test
J Jar Sample (Uncorrected)
 Water Strike
 Standing Water Level

Remarks: Groundwater strike at 1.2m.



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Borehole
Number
WS09

Site:
Castlebrook High School

Location:
Castlebrook High School, Parr
Lane, Bury BL9 8LP

Ground Level (mAOD): 99.96

Hole Diameter (mm): 101

Scale
1:30

Client:
Education Funding
Agency

Easting: 382061

Well Diameter (mm): 50

Logged by:
T. Costema

Northing: 407230

Filter Material: Gravel

Project: 34529110

Date: 01/08/2016

Method: Hand dug inspection pit to 1.2m. Dynamic percussive
to 5.45m.

Checked by:
JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: Grass over (firm) dark brown sandy gravelly CLAY with occasional cobbles and frequent rootlets. Gravel is angular to subrounded, fine to coarse brick, sandstone and metal fragments. Cobbles are angular to subangular.				B PID D	0.00-1.20	8				
Soft to firm orangey brown mottled light grey slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse sandstone and coal.		1.20	98.76	B D SPT	1.20-3.40 1.20-1.65		40 65	N=10 (2,2/2,2,3 ,3)		
				SPT	2.00-2.45		25	N=9 (1,1/2,2,2 ,3)		
				SPT	3.00-3.45		29	N=10 (1,1/2,2,3 ,3)		▽ 3
Medium dense orangey brown silty fine to medium SAND.		3.40	96.56	B D	3.40-5.00			N=11 (1,1/2,2,3 ,4)		4
				SPT	4.00-4.45			N=22 (4,6/4,6,6 ,6)		5
				SPT	5.00-5.45					
End of Borehole at 5.45 m		5.45	94.51							

Key:
D Disturbed Sample PPT Pocket Penetrometer Test
B Bulk Sample PID Photoionisation Detector
U Undisturbed Sample SPT Standard Penetration Test
J Jar Sample (Uncorrected)
▽ Water Strike
▼ Standing Water Level

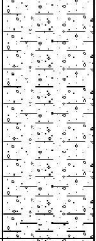
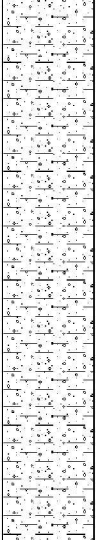
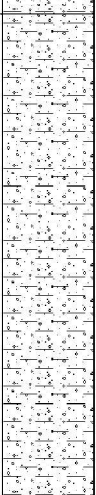
Remarks: Groundwater strike at 3.0m.

Site: Castlebrook High School	Location: Castlebrook High School, Parr Lane, Bury BL9 8LP	Ground Level (mAOD): 97.45	Hole Diameter (mm): 101	Scale 1:30
Client: Education Funding Agency		Easting: 382106 Northing: 407299	Well Diameter (mm): 50 Filter Material: Gravel	Logged by: T. Costema
Project: 34529110	Date: 01/08/2016	Method: Hand dug inspection pit to 1.2m. Dynamic percussive to 5.45m.		Checked by: JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: Bituminous surfacing.		0.15	97.30	PID D	0.00-0.15 0.15-0.30	<1 <1				
MADE GROUND: Yellowish brown sandy angular to subangular, coarse GRAVEL of sandstone.		0.30	97.15	PID PID D B	0.30-1.20 0.30-1.30	<1				
Soft to firm reddish brown mottled light grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse sandstone, coal and mudstone.		1.30	96.15	SPT D B	1.20-1.65 1.30-3.00		20 75	N=8 (2,2/2,2,2,2)		
Firm to stiff brown slightly sandy slightly gravelly CLAY. Gravel is subrounded to rounded, fine to coarse sandstone and coal.				SPT D	2.00-2.45 2.40-2.50		72 130	N=15 (2,2/2,4,4,5)		
Firm to stiff brown slightly sandy slightly gravelly CLAY. Gravel is subrounded to rounded, fine to coarse sandstone and coal.		3.50	93.95	SPT B D	3.00-3.45 3.00-5.00 3.50-4.00			N=15 (1,2/3,3,4,5)		
				SPT	4.00-4.45			N=19 (2,2/3,4,6,6)		
				SPT	5.00-5.45					
End of Borehole at 5.45 m		5.45	92.00							

Key:

D	Disturbed Sample	PPT	Pocket Penetrometer Test
B	Bulk Sample	PID	Photoionisation Detector
U	Undisturbed Sample	SPT	Standard Penetration Test (Uncorrected)
J	Jar Sample		
▽	Water Strike		
▽	Standing Water Level		

Remarks: Groundwater strike at 2.4m.

**ARCADIS**Design & Consultancy
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Tel: +44(0)1638 674767
Fax: +44(0)1638 668191Borehole
Number
WS11Site:
Castlebrook High SchoolLocation:
Castlebrook High School, Parr
Lane, Bury BL9 8LP

Ground Level (mAOD): 93.68

Hole Diameter (mm): 101

Scale
1:30Client:
Education Funding
Agency

Easting: 382128

Well Diameter (mm): 50

Logged by:
T. Costema

Northing: 407198

Filter Material: Gravel

Project: 34529110

Date: 01/08/2016

Method: Hand dug inspection pit to 1.2m. Dynamic percussive
to 5.45m.Checked by:
JJH

STRATA RECORD

IN SITU TESTS / SAMPLES

Sheet 1 of 1

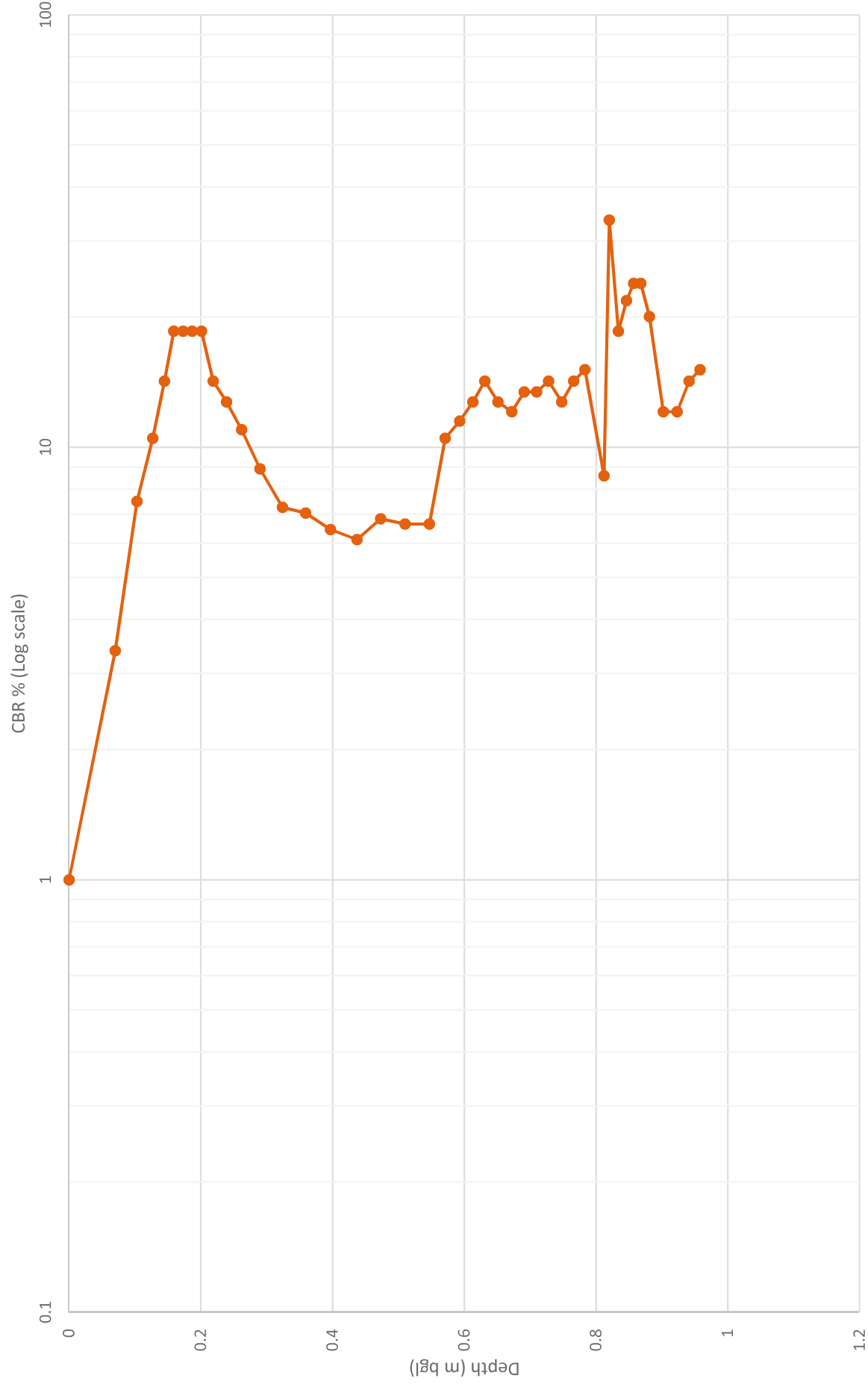
Description	Legend	Depth (m bgl)	Level (mAOD)	Sample Type	Sample Depth (m)	PID (ppm)	PPT (kPa)	SPT N Value	Well Details	Water Level
MADE GROUND: Grass over (firm) dark brown sandy gravelly SILT with frequent rootlets. Gravel is angular to subrounded, fine to coarse brick, sandstone metal wire and slate.				D B PID	0.00-0.65	<1				
MADE GROUND: Reddish brown slightly sandy clayey angular to subangular fine to coarse GRAVEL of brick with occasional angular to subangular cobbles of brick.		0.65	93.03	PID D B	0.65-0.90	1.1				
		0.90	92.78	PID D	0.90-1.20 0.90-1.25	<1				
Firm dark greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse mudstone.		1.25	92.43	SPT D	1.20-1.65 1.25-1.30		107	N=15 (2,2/2,4,5 ,4)		
Orangey yellow sandy gravelly CLAY.		1.30	92.38	D	1.30-1.60		70			
Firm orangey brown mottled grey slightly sandy CLAY.		1.60	92.08	D B	1.60-3.40		72			
Firm to stiff dark brown mottled grey slightly sandy CLAY.				SPT	2.00-2.45			N=11 (2,2/3,3,2 ,3)		
							100			
							97			
				SPT	3.00-3.45		89	N=6 (1,1/2,2,1 ,1)		
Orangey brown slightly clayey fine to medium SAND.		3.40	90.28	D B	3.40-3.85					
Stiff dark reddish brown slightly sandy CLAY.		3.85	89.83	D	3.85-4.00					
Medium dense orangey brown fine to medium SAND		4.00	89.68	B SPT	4.00-4.40 4.00-4.45			N=16 (2,3/3,3,5 ,5)		
Firm to stiff reddish brown slightly sandy CLAY.		4.40	89.28	D B	4.40-5.00					
				SPT	5.00-5.45			N=19 (2,3/4,4,5 ,6)		
End of Borehole at 5.45 m		5.45	88.23							

Key:

D	Disturbed Sample	PPT	Pocket Penetrometer Test
B	Bulk Sample	PID	Photoionisation Detector
U	Undisturbed Sample	SPT	Standard Penetration Test
J	Jar Sample		(Uncorrected)
▽	Water Strike		
▼	Standing Water Level		

Remarks: Groundwater strike at 3.4m.

BH01



BH02

