

SITE INVESTIGATION REPORT

**MALLINSON SPORTS CENTRE, HIGHGATE SCHOOL
BISHOPSWOOD ROAD, LONDON N6 4PH**



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TABLE OF CONTENTS

1.0	Introduction	1
2.0	Site description	2
3.0	Geo-Environmental Desk Study	3
3.1	Envirocheck historical map pack and reports	3
3.2	Walk-over survey	7
4.0	Exploratory work	8
5.0	Ground conditions	9
5.1	Made ground	9
5.2	Claygate Member	9
5.3	London Clay	9
5.4	Groundwater	9
5.5	Environmental observations	10
5.6	Trial pits/foundations	10
6.0	Geotechnical assessment	11
6.1	Spread foundations	11
6.2	Piled foundations	12
6.3	Ground floor slabs	14
6.4	Foundation concrete	15
7.0	Environmental assessment	16
7.1	Environmental setting and context	16
7.2	Potential contamination sources (on-site and off-site)	16
7.3	Contamination testing	16
7.4	Disposal of excavated soils	17
7.5	Ground gas	17
7.6	Risk Assessment and Conceptual Model	17

APPENDIX A

Fieldwork, in-situ testing and monitoring

- ✚ Cable percussive borehole records
- ✚ Standard Penetration Test results
- ✚ SPT hammer energy rating certificate
- ✚ Trial pit records

Laboratory testing

- ✚ Index property testing
- ✚ Plasticity charts
- ✚ Triaxial test results

Contamination and chemical testing

QTS Environmental Ltd Reports:

- ✚ 16-39880 (25/01/16)
- ✚ 16-39814 (28/01/16)

Ground profiles

- ✚ Plot of SPT 'N' and undrained cohesion versus level

Plans & drawings

- ✚ Photographs
- ✚ Site Plan
- ✚ Location Plan

APPENDIX B

Groundsure reports

- ✚ SCL-2713490 Enviroinsight
- ✚ SCL-2713491 Geoinsight
- ✚ SCL-2713492 Historical maps

1.0 INTRODUCTION

Consideration is being given to the extension of the existing Sports Centre, comprising the construction of a new studio/teaching facility and an access-way extension at its main entrance. In connection with the proposed works, Soil Consultants Ltd (SCL) were commissioned by Pringuer-James Consulting Engineers (PJCE) on behalf of the client to carry out a site investigation to include the following elements:

-  Desk Study to identify site history and potential contaminative uses
-  Identification of ground sequence, groundwater levels and geotechnical parameters
-  Recommendations for spread/piled foundation design
-  Contamination appraisal, risk assessment and conceptual model

This report describes the investigation undertaken, gives a summary of the ground conditions encountered and then provides recommendations for the design of foundations and retaining walls. An environmental appraisal is then provided together with a site specific risk assessment and conceptual model.

2.0 SITE DESCRIPTION

Mallinson Sports Centre is located within the existing Highgate School campus which lies on the eastern side of Bishopswood Road in Highgate, north London. The sports centre is a single level complex which includes a swimming pool, sports hall and office space. The overall dimensions of the building are approximately 62m x 42m and its centre lies at approximate NGR 527925E, 187755N. The north-eastern boundary is formed by a shallow surface drainage ditch and open games courts are present to the north-west. An open grassed area is present to the south and south-east and Bishopswood Road forms the south-western boundary.

The centre is cut into an existing slope such that higher-lying ground is present on the south-western and south-eastern sides of the building, with steps down to the lower ground on the north-eastern and north-western sides. There is a partially enclosed, courtyard area between the swimming pool and sports hall; the courtyard lies at the lower level. This is an external area which is used for storage of sports equipment and is open to the north-east.

A topographical drawing, untitled, was provided by PJCE and the levels referred to in this report have been taken from this drawing. It indicates that the higher ground at the southern corner of the centre lies at about +109.5mOD, falling gradually to about +108mOD and 108.5mOD at the north-western and south-eastern corners respectively. The ground surface then steps down to about +106.7mOD along the north-western and north-eastern sides; this includes the central courtyard area.

Existing significant vegetation includes the following:

-  A number of mature deciduous trees (probably 12m to 15m high) on the south-western site boundary along Bishopswood Road
-  Large mature deciduous trees along the line of a shallow drainage ditch on the eastern side of the site. These trees are probably up to 15m in height

The current site features are shown on the site plan and photographs which are included in Appendix A.

3.0 GEO-ENVIRONMENTAL DESK STUDY

3.1 Envirocheck historical map pack and reports

An historical map and environmental database search was commissioned from Groundsure to ascertain the site history/usage and surrounding land usage. An indication of the gradual development of the site over the years can be gained by a study of the historical maps (shown in Appendix B). The following table contains a summary of the site development obtained from the source maps provided in the Envirocheck historical maps.

Historical development of site and surrounding area		
Map date	The site and immediate surrounding areas	Significant development / features in surrounding area (generally within 250m)
1864-1873	- The site is shown to be an open undeveloped area - A tree-lined north-eastern boundary is shown, much as the present-day, with a ditch which drains the pond just to the south-east	- The National School is present about 220m to the east - Ponds are identified about 20m and 120m to the south-east and about 240m to the south-west - The area immediately to the south of the site shows some unidentified features, possibly terracing or landscape features? - A cricket ground is present about 50m to the south-west
1894-1896	The site is still undeveloped with no significant changes	- Bishopswood Road has been developed immediately to the west with a school house and presumed residential properties on its western side - Broadlands Road is present to the north, again with presumed associated residential properties - The pond which was present 20m to the south-east is no longer shown and has presumably been infilled - Some excavations/terracing appear to have taken place within the grounds of the National School to the east – presumably this was to provide level playing fields
1914-1920	The site is still undeveloped with no significant changes	- Residential development has occurred up to the north-eastern boundary - The cricket ground is now immediately to the south and south-east of the site - On the other side of Bishopswood Road is a Schoolhouse and another cricket field

Historical development of site and surrounding area		
Map date	The site and immediate surrounding areas	Significant development / features in surrounding area (generally within 250m)
✚ 1935-1974	✚ The site is still undeveloped with no significant changes	✚ The area immediately to the north-west now contains 'Fives Courts' and tennis courts ✚ A miniature rifle range is identified about 150m to the east
✚ 1986-1991	✚ The north-western part of the site contains an unidentified building, presumably the swimming pool ✚ A small cut area is present to the south of the building	✚ No significant changes
✚ 2002-present	✚ The south-eastern part of the site is now occupied, presumably with the sports hall	✚ No significant changes

The relevant historical maps are included in Appendix B of this report.

The Groundsure Report includes information from a database of local activities encompassing a range of subjects related to land use, pollution, and geological/hydrological conditions. A summary of contaminative uses and other environmental issues covered by the desk study within the site and its immediate surroundings (250m unless otherwise stated) is as follows:

GROUNDSURE ENVIROINSIGHT

Historical Industrial Sites

- ✚ Potentially contaminative uses: nearest is 95m E 'unspecified ground workings'. These refer to the levelled area associated with the school to the east, used as a sports ground. Others include a Fire Engine Station 160m E and further unspecified workings 194m N
- ✚ Historical Energy Features: electricity sub-station 238m E
- ✚ Potentially infilled land: 95m E, see above. Ponds are identified 212m SW

Environmental Permits, Incidents and Registers Map

- ✚ Records of List 1 dangerous substances inventory: nearest is 223m N, no details
- ✚ Records of Part A(2) and Part B activities/enforcements: nearest is 222m E, petrol vapour recovery

Landfill and other Waste Sites Maps

- ✚ None identified within buffer

Current Land Use Map

- ✚ Current industrial data: 3no sites within 250m, the nearest being shooting facilities 87m E. Others include published goods and an electricity sub-station
- ✚ Petrol and fuel sites: nearest is 363m SE, open

Geology (see Geoinsight summary below)

Hydrogeology and Hydrology

- ✚ Aquifer within superficial deposits: none
- ✚ Aquifer within bedrock deposits: Secondary A on site
- ✚ Groundwater and surface water abstraction points: none within 2000m
- ✚ Source protection zones: none within 500m
- ✚ Groundwater vulnerability and soil leaching potential: minor aquifer and high leaching potential on site
- ✚ Detailed river network: secondary river 320m SW
- ✚ Surface water features: none identified by the Groundsure report within 250m. However, a shallow surface drainage ditch was observed on the eastern boundary of the site

Environment Agency Flood Map

- ✚ River and coastal Zones 2 and 3 flooding: none within 250m
- ✚ Risk of flooding: very low
- ✚ Groundwater flooding susceptibility areas: there is a BGS susceptibility area (Clearwater) within 50m of the site, 'limited potential'
- ✚ Groundwater flooding confidence areas: BGS confidence rating is 'low'

Designated Environmentally Sensitive Site Map

- ✚ Records of SSSIs: nearest is 721m W, Hampstead Heath Woods
- ✚ Records of ancient woodlands: nearest is 667m NE
- ✚ Records of local nature reserves: nearest is 817m E

Natural Hazards Findings and Mining (see Geosight summary below)

GROUNDSURE GEOINSIGHT

Geology

-  Artificial ground: none within 500m
-  Superficial deposits: none within 500m
-  Solid geology: Claygate Member (clay, silt and sand) on site, very low to high permeability. No faults within 500m
-  Radon data: the site is not in a Radon affected area and no Radon protective measures are necessary

Ground Workings Map

-  Historical surface ground working features: nearest is 95m E, unspecified workings
-  Historical underground working features: nearest is 654m NE, tunnels

Mining, Extraction & Natural Cavities Map

-  Historical mining: nearest is 850m NW, unspecified shaft
-  Other mining activities and natural cavities: none with 1000m

Natural Ground Subsidence

-  Shrink/swell clays: moderate on site
-  All other hazards: very low to negligible on site

Borehole Records Map

-  16no records within 250m

Estimated Background Soil Chemistry (no data)

Railways and Tunnels

-  Railway projects: the site is within 5km of HS2

3.2 Walk-over survey

Our walkover survey was undertaken on 4th January 2016. The site was essentially occupied by the existing sports centre, which appeared to be well-maintained and in good order. Access to the pool plant area was not available and it was not possible to establish whether any pool water-treatment chemicals were stored on site; this will need to be established. However, this is a relatively modern building and we would expect the risk of any leakage into the ground to be low. There was no evidence of any fuel/oil tanks on the site. The surrounding area is mainly occupied by other school buildings, playing fields and residential houses.

Overall, the site was found to be in a clean and tidy state and we did not identify any particular features or land use which are likely to give rise to significant contamination risks; we thus have no particular concerns in this regard.

Representative photographs of the site are shown in Appendix A.

4.0 EXPLORATORY WORK

The ground investigation was carried out in January 2016 and comprised the following elements:

Cable percussive boreholes

Two cable percussive boreholes, designated BH Nos 1 and 2, were carried out using a demountable rig; the boreholes were taken to depths of 14.00m and 20.00m. Sampling and in-situ testing (SPT) were carried out at regular intervals and a monitoring pipe was installed in BH1 to a depth of 6m. An energy ratio, E_r , of 70.5% is applicable to the SPT hammer used.

Trial pits

Six trial pits (TP Nos 1 to 6) were excavated using hand-excavation and logged by a geotechnical engineer. The pits extended to depths of up to 2.10m.

Geotechnical laboratory testing

The following geotechnical laboratory testing was completed:

-  Natural Moisture Content and index properties tests
-  Unconsolidated, undrained triaxial tests
-  Soluble sulphate/pH (QTS Environmental Ltd)

Contamination and chemical testing

Selected soil and groundwater samples were delivered to a specialist laboratory (QTS Environmental Ltd) and the following testing was carried out:

- | | | | |
|---|----------------------------------|---|-------------|
|  | General soil suite | - | 5no samples |
|  | Waste Acceptance Criterion (WAC) | - | 1no sample |
|  | Soluble sulphate/pH | | |

The engineering logs of the exploratory holes and the geotechnical laboratory testing results are included in Appendix A. The ground levels at the exploratory locations have been interpolated from the untitled topographical survey drawing provided by PJCE.

5.0 GROUND CONDITIONS

Reference to published BGS data indicates that the site is underlain by the Claygate Member resting upon the London Clay Formation. The investigation confirmed this sequence, with a variable thickness of made ground overlying the natural soils.

5.1 Made ground

Either topsoil (200mm to 300mm thick) or concrete hard surfacing (300mm thick) was generally present at the borehole and trial pit positions. The underlying made ground was relatively variable comprising brown/grey or brown/orange silty gravelly clay with subsidiary brick and concrete fragments. The clay was assessed as being of a generally soft or soft to firm consistency. Occasional live roots were observed within the made ground. The made ground extended to depths of between 0.25m and 0.90m where proven.

5.2 Claygate Member

This formation generally comprised soft, locally firm, brown/orange and pale grey mottled silty slightly sandy clay with sand/silt partings. The presence of localised flint gravel suggests that some natural re-working has occurred. Hand vane readings of between 42kPa and 50kPa were measured in the trial pits and SPT N_{60} values of between 5 and 14 were recorded; these measurements indicate a low to medium strength classification.

Index property tests indicate a low to medium plasticity clay/silt (BS scheme) and either a non-plastic or a low to medium volume change potential (NHBC scheme).

5.3 London Clay

This formation was only encountered in the cable percussive boreholes and was met at depths of between 4.00m and 2.30m; this is equivalent to between approximately +104.5mOD and +105mOD. The formation comprised dark grey/grey silty clay with occasional to frequent silt/sand partings and scattered shell fragments.

In-situ SPT and laboratory triaxial tests indicate the clay to be locally low strength in its upper levels (BH1), becoming medium to high strength with depth. Index property testing indicated an intermediate to high plasticity classification using the BS scheme and a medium to high volume change potential with the NHBC scheme.

5.4 Groundwater

Groundwater inflows occurred at depths of between 2.90m and 3.60m in BH Nos 1 and 2 respectively; short term 20-minute rest levels at 2.40m and 3.10m depth were recorded. In the trial pits located in the low-lying 'courtyard' area, localised shallow groundwater was observed with standing levels in the pits at depths of between 0.90m to 1.20m. Some of the trial pits remained dry and this suggests that the shallow occurrences may be localised perched water pockets.

A deeper inflow was observed in the London Clay at a depth of 13.00m in BH No 1.

5.5 Environmental observations

No visual or olfactory evidence of contamination was observed.

5.6 Trial pits/foundations

A summary of the findings of the trial pit is as follows:

Ref	Location	Observations
TP1	Corner of swimming pool and changing rooms	 Swimming pool: probable concrete ground beam  Changing rooms: possible strip foundation at about 1.10m depth
TP2	Changing rooms	 Unable to penetrate concrete slab at 0.30m depth (numerous drains in the vicinity)
TP3	Sports hall	 Possible foundation at about 1.10m depth  Groundwater standing at 0.90m; base of pit obscured
TP4	Sports hall	 Possible foundation at about 1.40m depth  Groundwater standing at 1.20m; base of pit obscured
TP5	Swimming pool	 Possible ground beam
TP6	High-lying Bishopswood Road elevation	 Trial pit excavated down behind sheet pile retaining wall. Base >2.10m depth

6.0 GEOTECHNICAL ASSESSMENT

The proposed development scheme involves the following elements:

-  A new 2-storey studio block between the swimming pool and the sports hall. This is located in the low-lying part of the site. Maximum column loads of 395kN (DL + LL) are envisaged for this structure
-  A 2-storey access extension on the southern part of the south-western elevation

The investigation has indicated that beneath a relatively small thickness of made ground, the natural Claygate Member is present overlying the London Clay. Lightly loaded spread foundations resting within the Claygate Member could be adopted although where the underlying London Clay is within a practical depth, more highly loaded spread foundations on this more competent stratum may be a preferable alternative. Localised high groundwater is present and some control measures will be required; it should be noted that water level can vary seasonally and continued monitoring of the observation pipe should be carried out. Piled foundations will present an alternative solution.

6.1 Spread foundations

New studio block

This new block is to be located between the swimming pool and the sports hall structure. In this area, the made ground extended to depths of between 0.25m and 0.90m (BH No 2 and TP Nos 1 to 5). The underlying natural soils initially comprise soft, locally firm clays of the Claygate Member. Spread foundations should be placed within the natural clay soils at a minimum depth of 0.90m. Moderate-sized strip or pad foundations (say up to 2.5m width) should be designed at an allowable bearing pressure of 55kPa. This limited bearing pressure takes account of the variable and locally low-strength nature of the natural clay. Higher loadings could be applied to deeper foundations placed within the London Clay. Based upon BH No 2, an excavation depth of about 2.30m will be required to expose this more competent stratum. Moderate sized strip or pad foundations (again up to say 2.5m width) may be designed at an allowable bearing pressure of 150kPa. Careful inspection of the excavations should be carried out to ensure that an appropriate formation is exposed. These recommended pressures should ensure that a Factor of Safety of at least three is in operation against bearing capacity failure and that settlements remain within tolerable limits.

As previously discussed, localised high groundwater was observed during the investigation in this area. Shallow foundations placed within the upper natural soils may remain dry but there will be a significant risk of inflows; we therefore recommend that the presence of groundwater is anticipated for all excavations. Certainly with any deeper excavations to the London Clay, provision should be made for groundwater control measures; this may require cut-off trench sheeting to seal any inflows and internal pumping. We recommend that advance excavations are carried out by the groundworks contractor to assess the excavation stability/practicality and the most appropriate water control technique. The upper clays will be highly susceptible to water softening/disturbance and the utmost care should be exercised when constructing foundations in this stratum; we recommend that a suitable contingency is put in place against the requirement to deepen the foundations to bear within the more competent London Clay.

It is noted that there is a row of mature deciduous trees to the north-east of this development area. Whilst this is not a residential development, we recommend that the foundations are designed in full accordance with the NHBC Standards (Chapter 4.2, 'Building near trees'). This document can be regarded as an industry standard for mitigating the risk of shrink/swell effects in clays due to tree root action. We recommend that the species of trees are confirmed by an arboriculturalist and that safe depths are determined using a medium volume change potential for the Claygate Member soils, with a high volume change potential for the London Clay. The trees are probably in excess of 15m from the proposed building line at its closest and the requirements of the standards should not therefore be overly onerous. Notwithstanding this, the excavations should be carefully inspected and local deepening carried out if root-infested or desiccated clays are observed.

Access extension

In this area (BH No 1) the Claygate Member extended to a depth of 4.00m. The upper natural clay appears to be slightly more competent in this higher-lying area and we consider that a higher allowable bearing pressure of say 70kPa could be adopted for spread foundations. As above, a minimum depth of 0.90m is recommended for moderate sized strip or pad foundations. Deeper spread foundations bearing in the London Clay are unlikely to be practical in this location as excavation depths of up to about 6m below existing ground level would be required to expose appreciably more competent soils.

On the basis of BH No 1, shallow foundation excavations are expected to remain dry. However, as above, the presence of groundwater should be anticipated for all groundworks operations and appropriate precautions/contingencies put in place. Advance trial excavations by the groundworks contractor would again be useful in determining the extent and type of any water control measures.

A number of mature deciduous trees are present within about 5m of the proposed extension. As above, we recommend that any foundations are designed in full accordance with the NHBC Standards, assuming medium volume change potential soil. If any of the nearby trees are high water demand species, this will probably result in safe founding depths >2.5m, in which case piles should be adopted. This demonstrates the requirement for a comprehensive tree survey to identify species/heights and to allow an accurate assessment of desiccation risks.

6.2 Piled foundations

Piled foundations would transfer the structural loads to the more competent London Clay at depth. For the ground and groundwater conditions encountered, we consider that Continuous-flight Auger-injected piles (CFA) are likely to be the most appropriate. The following table of coefficients may be used for the preliminary design of CFA piles and, based upon the measured strength profile.

Shaft adhesion

Stratum	Depth/level	Undrained cohesion (from strength profile)	Ultimate unit shaft adhesion ' q_s' '
Made ground	Up to 1.10m thick	N/A	Ignore
Claygate Member and upper London Clay (note e)	Above +103mOD	30kPa	15kPa
London Clay	Below +103mOD to +89mOD	Increases linearly from 120kN/m ² at a rate of 5.7kPa/m	Increases linearly from 60kPa at a rate of 2.85kPa/m (incorporates $\alpha = 0.50$)

Notes:

- Unit shaft adhesion ' $q_s' = \alpha \times c_u$ (where $\alpha = 0.50$ and c_u is the undrained cohesion from the design line)
- The α value of 0.5 is based upon 102mm diameter triaxial tests and this should not be varied
- The average shaft adhesion over the pile length should be limited to 110kN/m²
- The maximum value for unit shaft adhesion should be limited to 140kN/m²
- The contribution of all potentially desiccated soils within the zone of tree influence should be ignored

End bearing

Stratum	Depth/level	Undrained cohesion (from strength profile)	Ultimate unit base resistance ' q_b' '
London Clay	Below +95mOD to +89mOD	Increases linearly from 166kPa at a rate of 5.7kPa/m	Increases linearly from 1,494kPa at a rate of 51.3kPa/m (incorporates $N_c = 9$)

Notes:

- Unit base resistance in clay ' $q_b' = N_c \times c_u$ (where $N_c = 9$ and c_u is the equivalent undrained cohesion from the design line)

An overall Factor of Safety of 2.6 should be appropriate when applied to these ultimate parameters, in accordance with LDSA guidelines. As a preliminary guide to the use of the coefficients, we have calculated the capacities of single piles with a range of diameters terminating at various depths:

Pile diameter (mm)	Pile toe level (mOD)	Pile toe depth – note c (mbgl)	Working load (kN)
300	+93	16	330
	+91	18	400
	+89	20	470
450	+93	16	525
	+91	18	630
	+89	20	745
600	+93	16	745
	+91	18	890
	+89	20	1040

Notes:

- a) Working load is calculated using F_{shaft} and $F_{\text{base}} = 2.6$
- b) Concrete stress should self-evidently be considered in the final design
- c) Relative to ground level at +109mOD
- d) Ignores the contribution of all soils to 3m depth

The above examples are not recommendations for pile diameter/length but are intended to illustrate the use of the shaft and base parameters.

Eurocode 7 adopts a different approach, applying partial factors to the ultimate pile capacity. The pile resistance is calculated using the above parameters in accordance with EC7 (BS EN 1997-1:2004 and UK National Annex) for the ultimate limit state GEO Design Approach 1, Combinations 1 and 2. The following partial factors, as recommended in the UK National Annex, are applied:

- a] Model Factor, γ_{Rd} = 1.4 (Combinations 1 and 2)
- b] Factor on shaft resistance, γ_s = 1.6 (Combination 2)
- c] Factor on base resistance, γ_b = 2.0 (Combination 2)

The design engineer must ensure that the correct comparisons are made between the Design Actions and Design Resistances and that SLS checks are made.

We recommend that a specialist piling contractor is consulted to provide the final pile design, taking into account the above recommendations.

6.3 Ground floor slabs

Studio Block

For lightly loaded slabs, say up to 15kPa, it is considered that a ground bearing floor slab could be adopted. Proof-rolling must be carried out and any soft/loose spots so identified should be removed and replaced with compacted granular fill. The formation should be carefully inspected, and if any root-infested or desiccated clays are present these should be removed and replaced. The zone of tree influence should be determined using the NHBC guidelines, and if the theoretical wedge of potentially desiccated soils extends

beneath the slab these should be removed and replaced with compacted granular fill. The practicality of this approach would need to be assessed taking into account the localised high groundwater levels.

The alternative of a suspended slab should be considered for slab loadings greater than say 15kPa or within the zone of tree influence. In the latter case, a suitable void should be incorporated to accommodate any swelling clays.

Access extension

Whilst no evidence of desiccation was observed in BH No 1, this structure almost certainly lies within the theoretical zone of influence of the mature deciduous trees on the south-western boundary. We recommend that a suspended floor slab is adopted for this structure, incorporating a suitable void beneath to accommodate potential swelling in compliance with NHBC guidelines.

6.4 Foundation concrete

Low to moderate concentrations of soluble sulphates were measured with slightly alkaline pH values. The results fall into Site Design Classes DS-1 to DS-2 of Table C2 given in BRE Special Digest 1 (2005). We assess the site as having 'mobile' ground water and recommend that buried concrete is designed in accordance with ACEC Site Class AC-2.

7.0 ENVIRONMENTAL ASSESSMENT

This appraisal adopts the current UK practice which uses the Source-Pathway-Receptor methodology to assess contamination risks. For a site to be designated as contaminated a plausible linkage between any identified sources and receptors must be identified, ie whether significant pollution linkages (SPLs) are present. In considering the potential for contamination to cause a significant effect, the extent and nature of the potential source are assessed and pathways/receptors identified; without an SPL there is theoretically no risk to the receptors from contamination. The assessed risks to the various potential receptors are summarised in the tabulated Conceptual Site Model which forms Section 7.6 of this report.

7.1 Environmental setting and context

The Groundsure report indicates a Bedrock Aquifer Designation of 'Secondary A'. No groundwater abstraction points or source protection zones are identified within 2000m. The site is assessed as being of **low** Environmental Sensitivity.

7.2 Potential contamination sources (on-site and off-site)

The desk study has not identified any significant potential contamination sources within the site or its immediate surroundings. Some ground workings were identified to the east of the site but these appear to be associated with a levelling exercise to provide a sports area. A small pond which was present within 20m of the site was infilled by the end of the 19th century. We assess there to be a **low** risk of potential contaminative sources which could affect the site.

7.3 Contamination testing

In order to identify whether known or unknown sources within (and outside) the site have caused contamination, we have carried out testing on a series of soil and groundwater samples. The desk study has indicated that the main risk to the site and potential receptors is likely to be only the very limited thickness of made ground present. Testing for a general range of contaminants was therefore initially undertaken.

The results were assessed where relevant against the DEFRA Soil Guideline Values (SGV) and the LQM/CIEH Generic Assessment Criteria (GAC) for Human Health Risk Assessment in which LQM/CIEH have derived additional SGVs from the current CLEA Model (2nd Edition, 2009). There are currently no published SGV's or GAC's for Extractable/Total Petroleum Hydrocarbons and the results were compared with the frequently used EA remedial target of 1,000mg/kg. The SGV for lead contamination has been withdrawn but Category 4 Screening Levels (C4SLs) recently introduced by DEFRA can be useful values for comparison with recorded results. C4SLs have also been useful for comparison with several other contaminants.

The contamination testing was carried out specifically for the purpose of providing a general guidance evaluation for the proposed development. Reference should be made to the foreword to the appended contamination test results in order to fully understand the context in which this discussion should be viewed.

There are no specific published guidelines for school use and we therefore assessed the results against the criteria for residential development, generally the most stringent. Using the relevant the trigger levels, all of the results fell below the threshold values.

The results of the testing suggest that there is no widespread contamination present at the borehole positions. It should be noted of course that there may of course be pockets of undetected contamination between exploratory points. Although not detected in our samples, asbestos containing materials [ACMs] are common in made ground and in buildings constructed before 2000, and this aspect should be addressed in the construction/health and safety procedures.

7.4 Disposal of excavated soils

A rigorous hazard assessment of the results was not within the scope of our investigation, but our preliminary conclusion from the contamination testing and WAC testing is that the made ground will probably classify as either 'inert' or 'non-hazardous industrial' waste with an 'inert' classification for natural soils. Early consultations must be made with appropriate waste facilities or regulators to confirm the requirements for off-site disposal.

7.5 Ground gas

No significant ground gas risk was identified and no degradable soils were observed during the investigation. We consider that the risk of harmful ground gases affecting the new buildings as being low and no protective measures are likely to be required in this regard.

7.6 Risk Assessment and Conceptual Model

Taking into account the above discussion, the assessed risks to potential receptors are summarised as follows:

Source/ hazard	Pathway	Receptor	Mitigation measures/explanation	Assessed Risk level
Contaminated soil: on-site and off-site sources	Ingestion/ contact	End user and construction workers	- No potential contaminative uses identified on site or its immediate surroundings - No contamination was indicated by soil testing 100% hard cover will be provided by the new buildings and no SPLs are expected with respect to the end-users/ occupiers - Appropriate PPE should be worn by construction workers	LOW

In conclusion, based upon the information reviewed and the results of the investigation, our assessment is that the residual risks to potential receptors should be **LOW** provided appropriate remedial measures are adopted. It is self-evident that there may be zones of contamination within the site which were not encountered in our boreholes. A careful watching brief should be kept during construction and if obvious or suspected contamination is encountered this should be dealt with prescriptively; a suitable contingency should be in place in this regard.



GENERAL INFORMATION, LIMITATIONS AND EXCEPTIONS

Unless otherwise stated, our Report should be construed as being a Ground Investigation Report (GIR) as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report (GDR) as defined in EN1997-2. Any 'design' recommendations which are provided are for guidance only and are intended to allow the designer to assess the results and implications of our investigation/testing and to permit preliminary design of relevant elements of the proposed scheme.

The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access and space limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique we have adopted a practical technique to obtain indicative soil parameters and any interpretation is based upon our engineering experience and relevant published information.

The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during our investigation. In addition Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata both between the exploratory points and/or below the maximum depth of the investigation; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

Comments made relating to ground-water or ground-gas are based upon observations made during our investigation unless otherwise stated. Ground-water and ground-gas conditions may vary with time from those reported due to factors such as seasonal effects, atmospheric effects and and/or tidal conditions. We recommend that if monitoring installations have been included as part of our investigation, continued monitoring should be carried out to maximise the information gained.

Specific geotechnical features/hazards such as (but not limited to) areas of root-related desiccation and dissolution features in chalk/soluble rock can exist in discrete localised areas - there can be no certainty that any or all of such features/hazards have been located, sampled or identified. Where a risk is identified the designer should provide appropriate contingencies to mitigate the risk through additional exploratory work and/or an engineered solution.

Where a specific risk of ground dissolution features has been identified in our Report (anything above a 'low' risk rating), reference should be made to the local building control to establish whether there are any specific local requirements for foundation design and appropriate allowances should be incorporated into the design. If such a risk assessment was not within the scope of our investigation and where it is deemed that the ground sequence may give rise to such a risk (for example near-surface chalk strata) it is recommended that an appropriate assessment should be undertaken prior to design of foundations.

Where spread foundations are used, we recommend that all excavations are inspected and approved by suitably experienced personnel; appropriate inspection records should be kept. This should also apply to any structures which are in direct contact with the soil where the soil could have a detrimental effect on performance or integrity of the structure.

Ground contamination often exists in small discrete areas - there can be no certainty that any or all such areas have been located, sampled or identified.

The findings and opinions conveyed in this Report may be based on information from a variety of sources such as previous desk studies, investigations or chemical analyses. Soil Consultants Limited cannot and does not provide any guarantee as to the authenticity, accuracy or reliability of such information from third parties; such information has not been independently verified unless stated in our Report.

Our Report is written in the context of an agreed scope of work between Soil Consultants Ltd and the Client and should not be used in any different context. In light of additional information becoming available, improved practices and changes in legislation, amendment or re-interpretation of the assessment or the Report in part or in whole may be necessary after its original publication.

Unless otherwise stated our investigation does not include an arboricultural survey, asbestos survey, ecological survey or flood risk assessment and these should be deemed to be outside the scope of our investigation.

(Rev_1_08_03_2013)

APPENDIX A

Fieldwork, in-situ testing and monitoring

- ✚ Cable percussive borehole records
- ✚ Standard Penetration Test results
- ✚ SPT hammer energy rating certificate
- ✚ Trial pit records

Laboratory testing

- ✚ Index property testing
- ✚ Plasticity charts
- ✚ Triaxial test results

Contamination and chemical testing

QTS Environmental Ltd Reports:

- ✚ 16-39880 (25/01/16)
- ✚ 16-39814 (28/01/16)

Ground profiles

- ✚ Plot of SPT 'N' and undrained cohesion versus level

Plans & drawings

- ✚ Photographs
- ✚ Site Plan
- ✚ Location Plan

FOREWORD FOR CABLE PERCUSSIVE DRILLING - GUIDANCE NOTES

GENERAL

The Borehole Records are compiled from the driller's description of the strata encountered, an examination of the samples by our Geotechnical Engineer and the results of in-situ and laboratory tests. Based on this data, the report presents an opinion on the configuration of strata within the site. However, such reasonable assumptions are given for guidance only and no liability can be accepted for changes in conditions not revealed by the boreholes.

BORING METHODS

The Cable Percussion technique of boring is normally employed and allows the ground conditions to be reasonably well established. However, some disturbance of the ground is inevitable, particularly some "softening" of the upper zone of clay immediately beneath a granular soil. The presence of thin layers of different soils within a stratum may not always be detected.

GROUND WATER

The depth at which ground water was struck is entered on the Borehole Records. However, this observation may not indicate the true water level at that period. Due to the speed of boring and the relatively small diameter of the borehole, natural ground water may be present at a depth slightly higher than the water strike. Moreover, ground water levels are subject to variations caused by changes in the local drainage conditions and by seasonal effects. When a moderate inflow of water does take place, boring is suspended for at least 10 minutes to enable a more accurate short-term water level to be achieved. An estimate of the rate of inflow is also given. This is a relative term and serves only as a guide to the probable flow of water into an excavation.

Further observations of the water level made during the progress of the borehole are shown including end of shift and overnight readings and the depth at which water was sealed off by the borehole casing, if applicable.

Whilst drilling through granular soils, it is usually necessary to introduce water into the borehole to permit their extraction. When additional water has been used a remark is made on the Borehole Record and the implications are discussed in the text.

SAMPLES

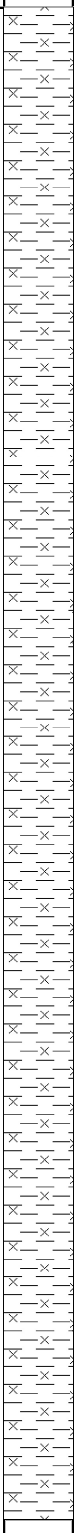
Undisturbed samples of the predominantly cohesive soils are obtained using a 100mm diameter open-drive sampler. In granular soils, disturbed bulk samples are taken and placed in polythene bags. Small jar samples are taken at frequent intervals in all soils for subsequent visual examination. Where ground water is encountered in sufficient quantity, a sample of the ground water is also taken.

IN-SITU STANDARD PENETRATION TESTS

This test is performed in accordance with the procedure given in B.S.1377:1990. The individual blow count record for each test is given on a separate table. The 'N' value is normally the number of blows to achieve a penetration of 0.3m following a seating distance of 0.15m and is quoted at the mid-depth of the test zone. However if a change of stratum occurs within the test zone then a revised 'N' value is calculated to assess one layer in particular. In hard strata full penetration may not be obtained. In such cases the suffix + indicates that the result has been extrapolated from the limited penetration achieved. Where ground water has affected the measured values, the resultant 'N' values have been placed in brackets since it is unlikely to represent the true in-situ density of the soil.

Mallinson Sports Centre, Highgate School						Borehole No: BH1			
Site & Location: Bishopswood Road, London N6 4PH									
Client: Highgate School				Coordinates: 527947E, 187718N		Sheet 1 of 2			
Engineer: Pringuer-James Consulting Engineers Ltd				Ground Level: +109.10mOD		Report No: 9916/JRCB			
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation	
	Type	Depth (m)		Depth (m)	Level (m)				
BH commenced: 05/01/16							MADE GROUND: topsoil over soft brown/grey silty gravelly clay with brick and glass fragments and occasional roots		
BH/casing diameter: 150mm	B	0.50		0.60	108.50				
	E	0.50					Soft, locally firm, brown/orange and pale grey mottled slightly silty CLAY with occasional partings of silty fine sand		1
	B	1.00							
	SPT/S	1.50	N=6						
	D	1.50	N60=7						
	D	2.00							2
	E	2.00							
	U	2.50							
Water inflow at 2.90m depth: - rose to 2.40m (20 mins) - sealed at 5.40m	D	3.00							3
	SPT/S	3.50	N=12						
	D	3.50	N60=14						
	D	4.00		4.00	105.10		Soft to firm becoming stiff dark grey silty CLAY with occasional to frequent partings of pale grey fine sand.		4
	E	4.00							
	U	4.50							
	D	5.00							5
	D	5.50							
BH cased to 6.00m	SPT/S	6.00	N=23				becoming stiff below about 6.00m		6
	D	6.00	N60=27						
	D	6.75							7
	U	7.50					occasional shell fragments at 7.50m		
	D	8.00							8
	D	8.50							
	SPT/S	9.00	N=25						9
	D	9.00	N60=29						
	D	9.75		10.00	99.10				10
Continued on next sheet									
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet								Borehole type: Cable Percussion	
Remarks: a) Approximate coordinates interpolated from public domain data b0 Monitoring pipe (50mm ID) installed to 6.00m; slotted from 1.00m to 6.00m with gravel response zone								Borehole No: BH1	

SoilConsultants

Mallinson Sports Centre, Highgate School										Borehole No: BH1				
Site & Location: Bishopswood Road, London N6 4PH														
Client: Highgate School					Coordinates: 527947E, 187718N					Sheet 2 of 2				
Engineer: Pringuer-James Consulting Engineers Ltd					Ground Level: +109.10mOD					Report No: 9916/JRCB				
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation						
	Type	Depth (m)		Depth (m)	Level (m)									
End of shift: 05/01/16 BH depth: 12.00m Casing depth: 6.00m Water depth pm: dry BH continued: 06/01/16 Water depth am: 2.00m Water inflow at 13.00 depth: - rose to 12.80m (20 mins) - not sealed BH complete: 06/01/2016 BH depth: 20.00m Water depth: 7.30m	U	10.50	N=28 N ₆₀ =33				Stiff to very stiff grey silty CLAY with partings of pale grey silty fine sand and occasional shell fragments							
	D	11.00												
	D	11.50												
	SPT/S	12.00												
	D	12.00												
	D	12.75												
	U	13.50												
	D	14.00												
	D	14.50												
	SPT/S	15.00												
	D	15.00												
	D	15.75												
	U	16.50												
	D	17.00												
	D	17.50												
	SPT/S	18.00												
	D	18.00												
	D	18.75												
	U	19.50												
	D	20.00			20.00					89.10		End of borehole at 20.00m		20
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet										Borehole type: Cable Percussion				
Remarks: a) Approximate coordinates interpolated from public domain data b0 Monitoring pipe (50mm ID) installed to 6.00m; slotted from 1.00m to 6.00m with gravel response zone										Borehole No: BH1				

Mallinson Sports Centre, Highgate School								Borehole No: BH2	
Site & Location: Bishopswood Road, London N6 4PH									
Client: Highgate School				Coordinates: 527929E, 187754N				Sheet 1 of 2	
Engineer: Pringuer-James Consulting Engineers Ltd				Ground Level: +106.80mOD				Report No: 9916/JRCB	
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation	
	Type	Depth (m)		Depth (m)	Level (m)				
BH commenced: 08/01/16 									

Mallinson Sports Centre, Highgate School								Borehole No: BH2								
Site & Location: Bishopswood Road, London N6 4PH																
Client: Highgate School					Coordinates: 527929E, 187754N			Sheet 2 of 2								
Engineer: Pringuer-James Consulting Engineers Ltd					Ground Level: +106.80mOD			Report No: 9916/JRCB								
Progress & Observations	Samples & Tests		Field Test Results	Strata		Legend	Strata Descriptions	Backfill / Installation								
	Type	Depth (m)		Depth (m)	Level (m)											
BH complete: 08/01/2016 BH depth: 14.00m Water depth: dry	U	10.50	N=28 N ₆₀ =33	14.00	92.80		Stiff to very stiff grey silty CLAY with partings of pale grey silty fine sand and occasional shell fragments		11							
	D	11.00														
	D	11.50														
	SPT/S	12.00														
	D	12.00														
	D	12.75														
	U	13.50														
	D	14.00														
	End of borehole at 14.00m										14					
												15				
							16									
							17									
							18									
							19									
							20									
Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub SPT/S = split spoon SPT/C = solid cone HV = Hand Vane [kPa] PP = Pocket Penetrometer [kg/cm²] PID = Photo Ionisation Detector [ppmv] * = full SPT penetration not achieved - see summary sheet								Borehole type: Cable Percussion								
Remarks: a) Approximate coordinates interpolated from public domain data								Borehole No: BH2								

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Report No:	9916 / JRCB
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STANDARD PENETRATION TEST SUMMARY

BH ID	Depth [m]	Test type	'N' value and blow-counts [Seating blows/Test blows]	N ₆₀	N ₆₀ - ext	Casing depth [m]	Water depth [m]	Remarks
BH1	1.50	S	N = 6 :1 1/ 1 1 2 2	7		1.50	Dry	
BH1	3.50	S	N = 12 :2 2/ 2 3 3 4	14		3.50	Dry	
BH1	6.00	S	N = 23 :2 4/ 5 6 6 6	27		6.00	Dry	
BH1	9.00	S	N = 25 :3 5/ 6 6 6 7	29		6.00	Dry	
BH1	12.00	S	N = 28 :4 6/ 6 7 7 8	33		6.00	Dry	
BH1	15.00	S	N = 32 :5 7/ 7 8 8 9	38		6.00	Dry	
BH1	18.00	S	N = 37 :5 7/ 8 9 9 11	43		6.00	Dry	
BH2	1.50	S	N = 4 :0 1/ 1 1 1 1	5		1.50	Dry	
BH2	3.50	S	N = 13 :2 3/ 3 3 3 4	15		3.50	Dry	
BH2	6.00	S	N = 21 :3 4/ 5 5 5 6	25		4.20	Dry	
BH2	9.00	S	N = 27 :5 6/ 6 7 7 7	32		4.20	Dry	
BH2	12.00	S	N = 28 :4 5/ 6 6 7 9	33		4.20	Dry	

Standard Penetration Test : BS EN ISO 22476:2005 Part 3

Hammer Energy Ratio, Er = 70.5%

* where full penetration not achieved, the reported N₆₀ is based on maximum uncorrected blow-counts of 50

** extrapolated N₆₀ value where full penetration not achieved - this is indicative only and should be used with caution

[SPT Sheet 1 of 1]

SPT Calibration Report

Hammer Energy Measurement Report

Type of Hammer SPT HAMMER
 Client GEH GROUNDWORKS
 Test No EQU1366_1
 Test Depth (m) 7.50
 Date of Test 16 October 2015
 Valid until 15 October 2016
 Hammer ID GEH3

Mass of the hammer $m = 63.5\text{kg}$
 Falling height $h = 0.76\text{m}$
 $E_{\text{theor}} = m \times g \times h = 473\text{J}$

Characteristics of the instrumented rod

Diameter $d_r = 0.052\text{ m}$
 Length of the instrumented rod 0.558 m
 Area $A = 11.61\text{ cm}^2$
 Modulus $E_a = 206843\text{ MPa}$

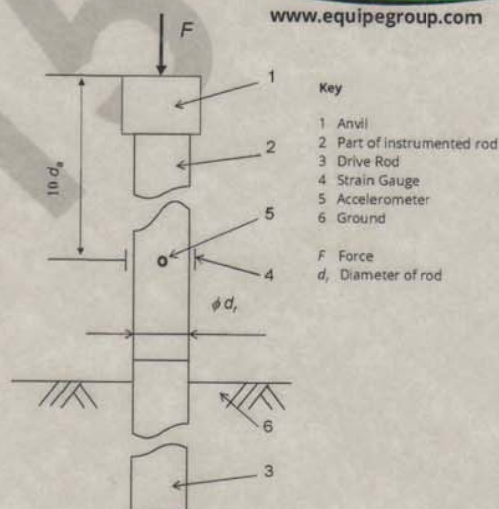
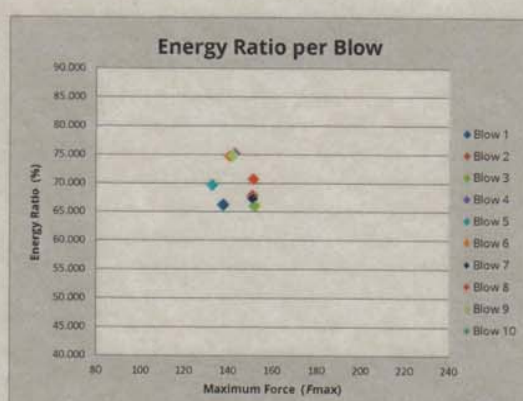
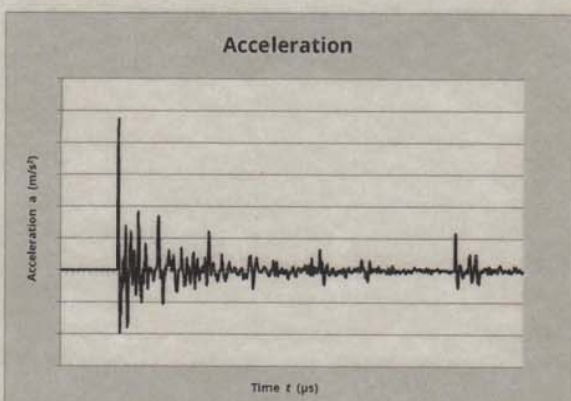
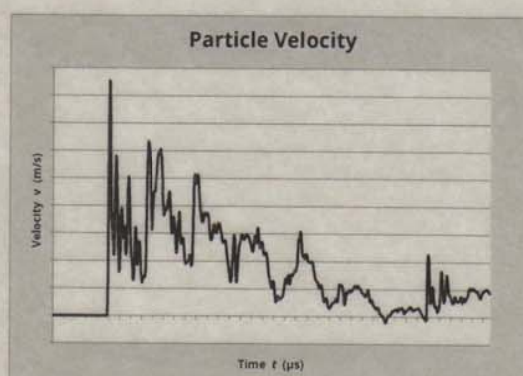
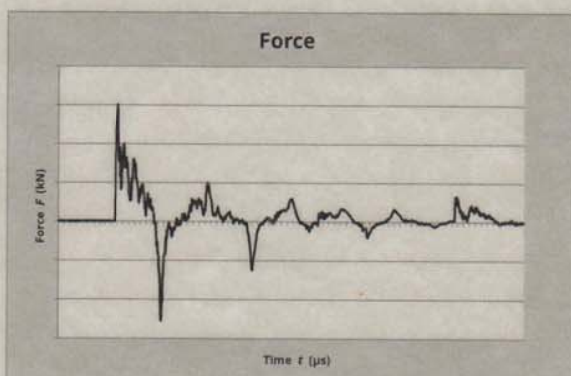


Fig. B.1 and B.2 BS EN ISO 22476-3: 2005 + A1: 2011



Observations:
 1.

$E_{\text{meas}} = 0.333\text{ kN-m}$
 $E_{\text{theor}} = 0.473\text{ kN-m}$

$$\text{Energy Ratio} = \frac{E_{\text{meas}}}{E_{\text{theor}}} = 70.48\%$$

Equipe SPT Analyzer Operators:

MH

Prepared by:

[Signature]

Checked by:

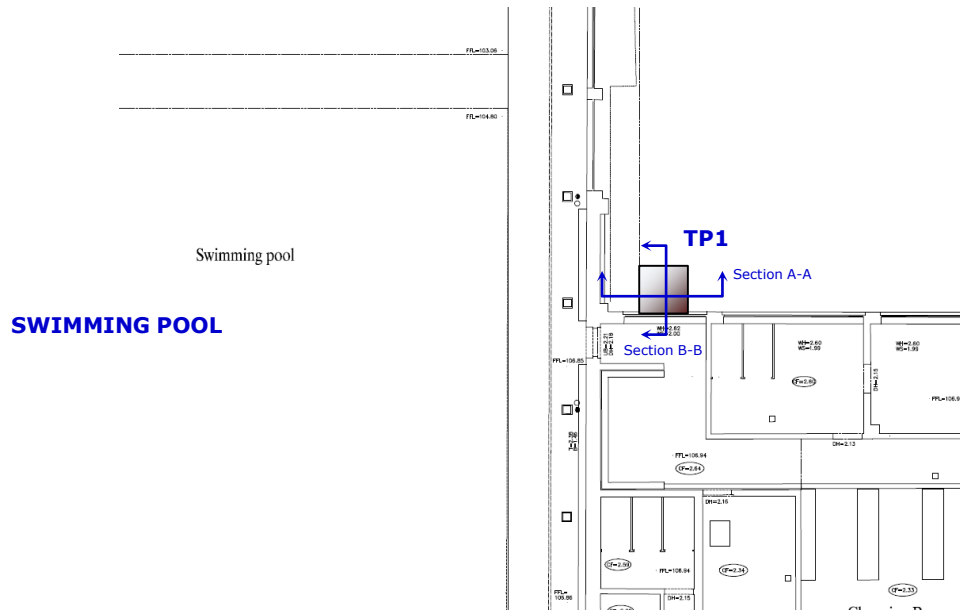
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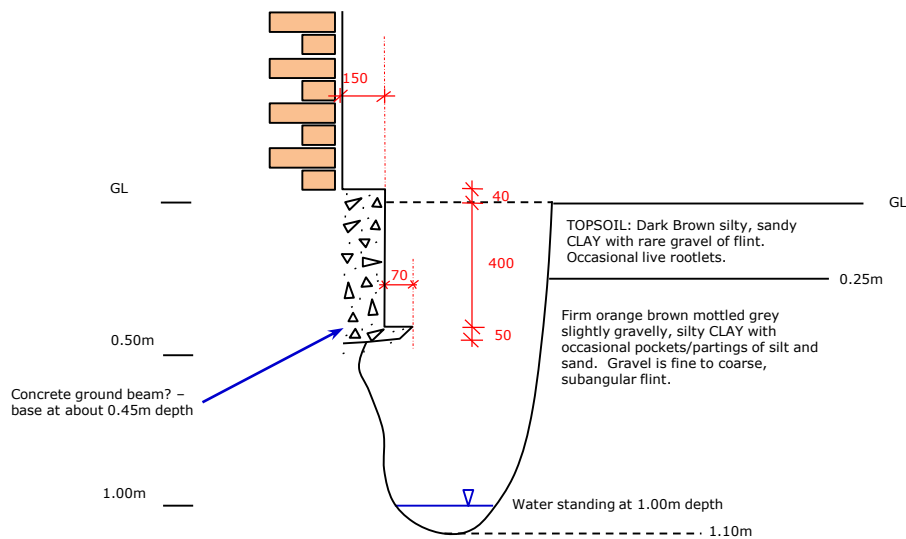
21/10/2015

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP1 (Page 1 of 3)
Client:	Highgate School	Report No: 9916/JRCB
Engineer:	Pringuer-James Consulting Engineers Ltd	

PLAN:



SECTION: A - A

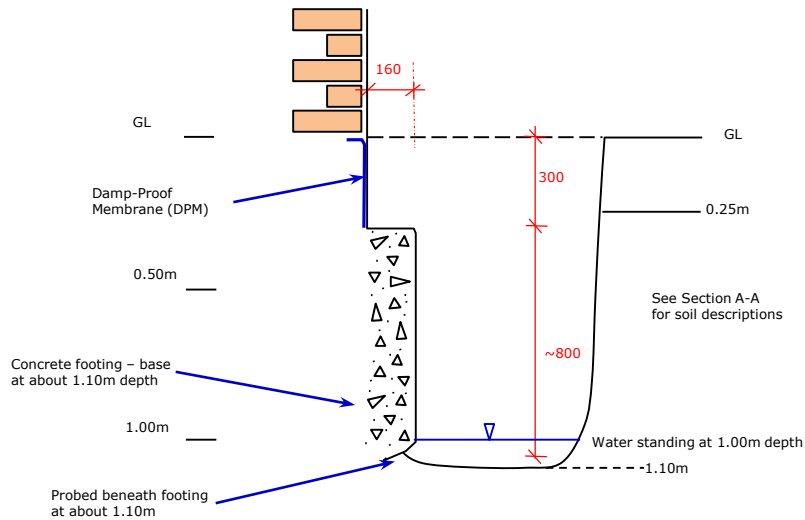


D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation	• Groundwater standing at 1.00m	HV: 55kPa @ 0.70m
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 1 (Page 2 of 3)
Client:	Highgate School	Report No: 9916/JRCB
Engineer:	Pringuer-James Consulting Engineers Ltd	

SECTION: B – B



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation	• Groundwater standing at 1.00m	
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 1 (Page 3 of 3)
Client:	Highgate School	Report No: 9916/JRCB
Engineer:	Pringuer-James Consulting Engineers Ltd	

PHOTOGRAPHS

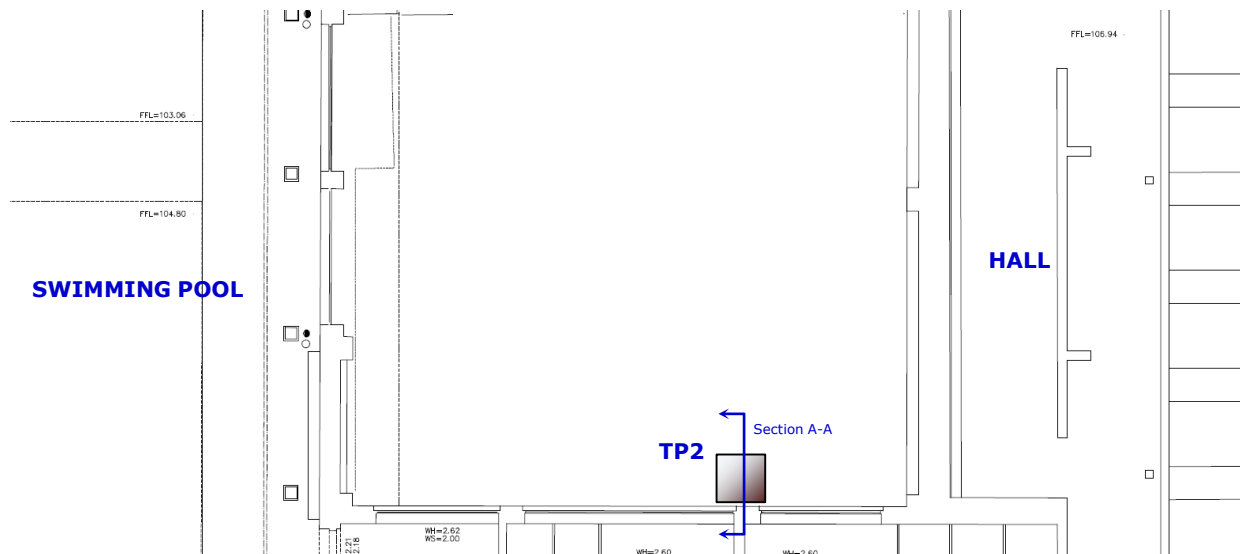


D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

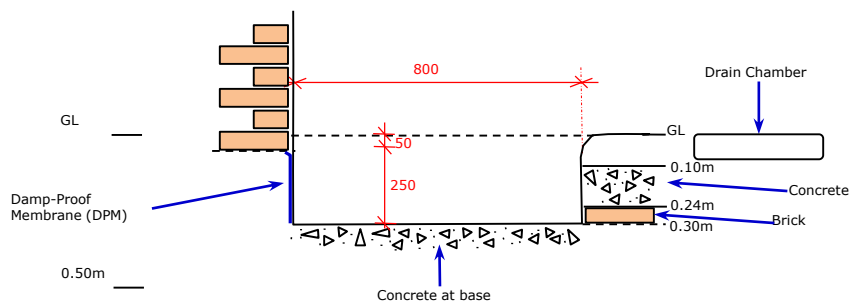
Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation	• Groundwater standing at 1.00m	
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 2 (Page 1 of 2)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

PLAN



SECTION A - A



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation		
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 2 (Page 2 of 2)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

PHOTOGRAPHS

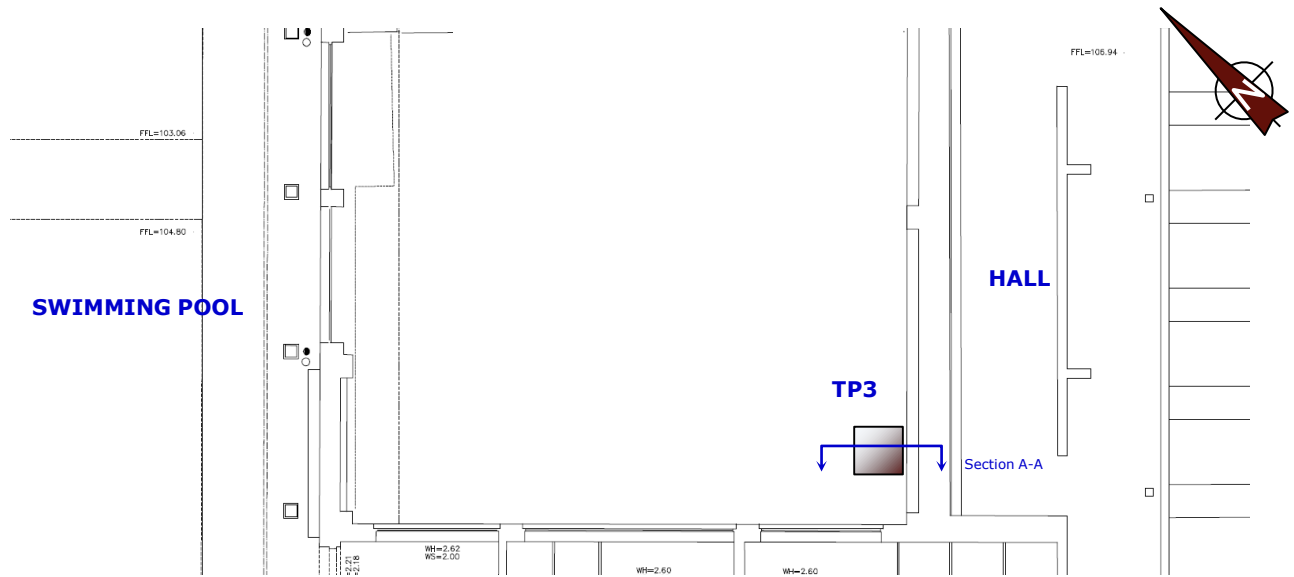


D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

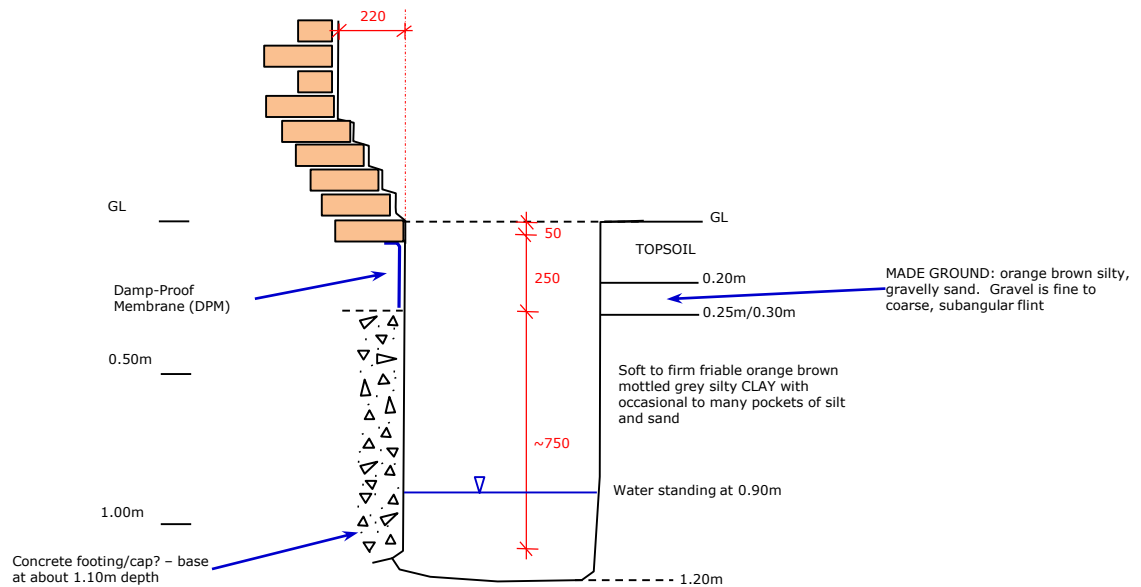
Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation	• None observed	
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 3 (Page 1 of 2)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

PLAN:



SECTION: A – A

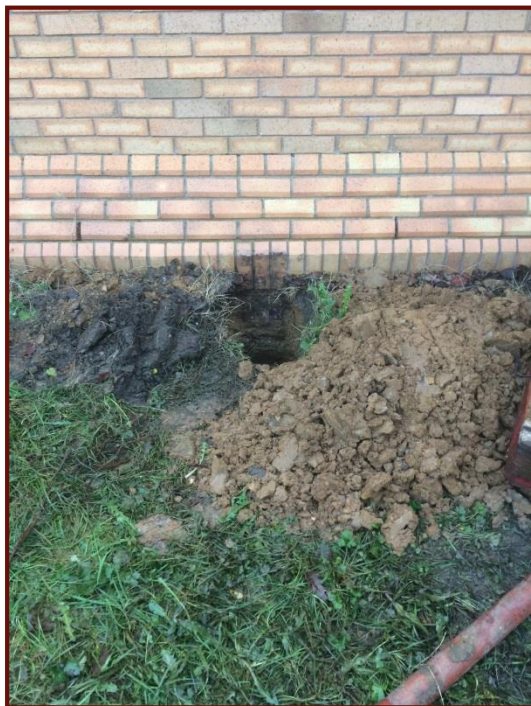


D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation	• Groundwater standing at 0.90m	HV: 50kPa @ 0.45m
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 3 (Page 2 of 2)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

PHOTOGRAPHS:

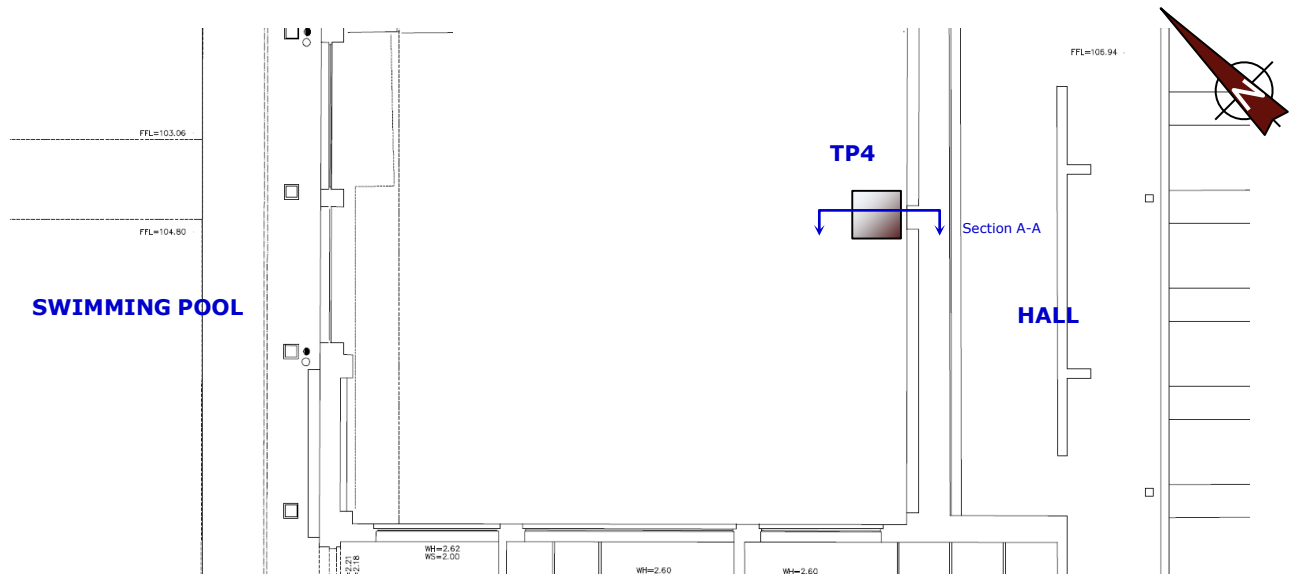


D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

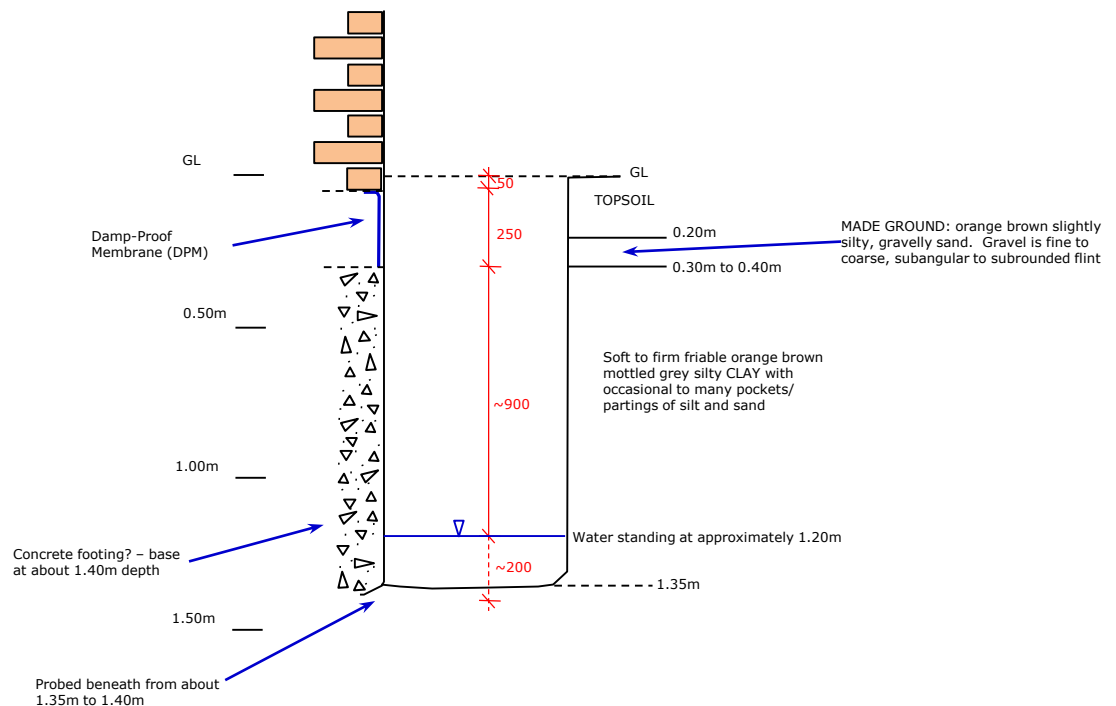
Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation		
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 4 (Page 1 of 2)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

PLAN:



SECTION: A - A



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation	• Groundwater standing at about 1.20m	
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 4 (Page 2 of 2)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

PHOTOGRAPHS

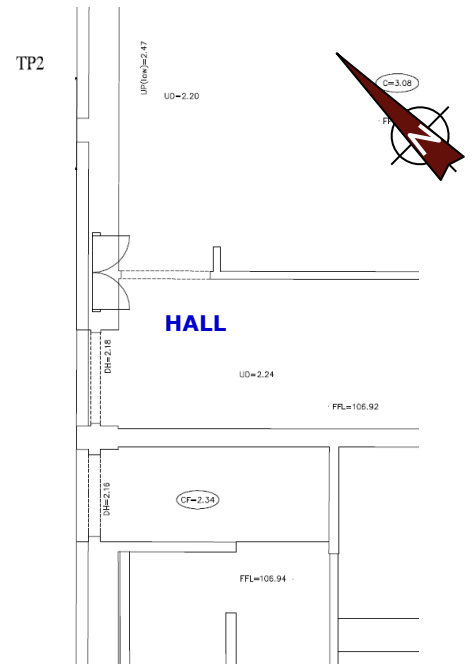
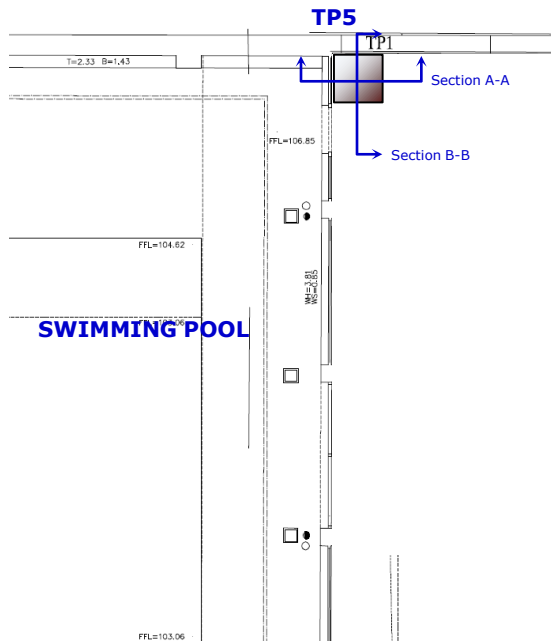


D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

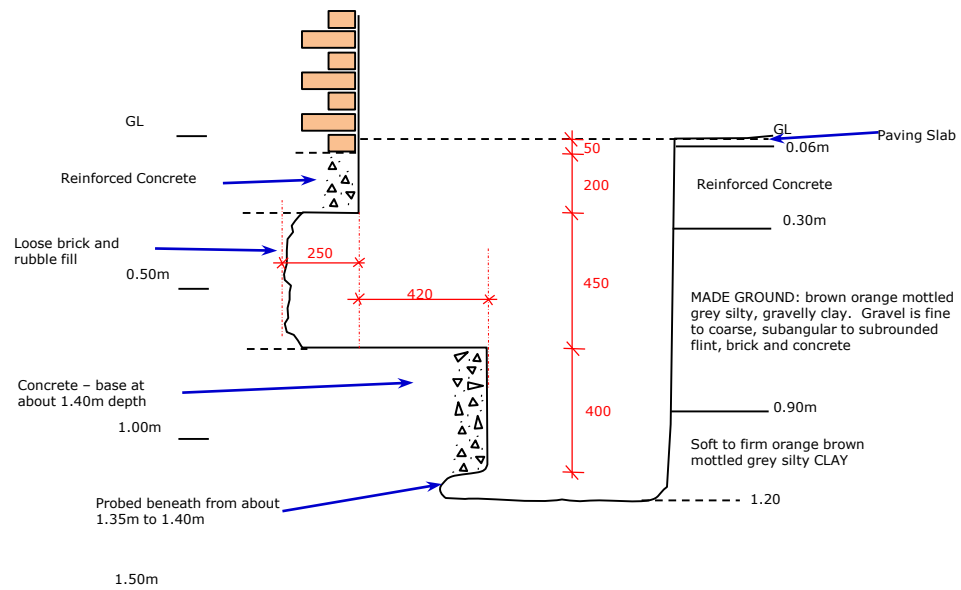
Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation	Groundwater standing at about 1.20m	
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 5 (Page 1 of 3)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

PLAN:



SECTION: A – A

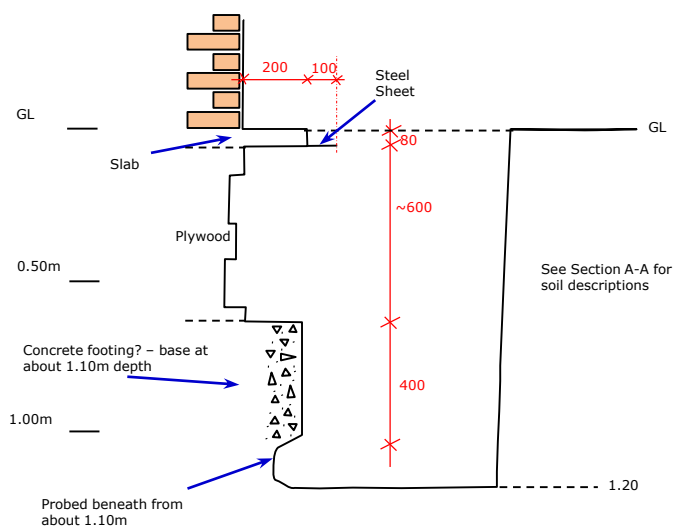


D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation	• None observed	
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 5 (Page 2 of 3)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

SECTION: B - B



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	5 th January 2016	Groundwater details None Recorded	Samples
Equipment:	Hand excavation		Logged by: MR
Stability:	Stable		
Remarks:			

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 5 (Page 3 of 3)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

PHOTOGRAPHS:

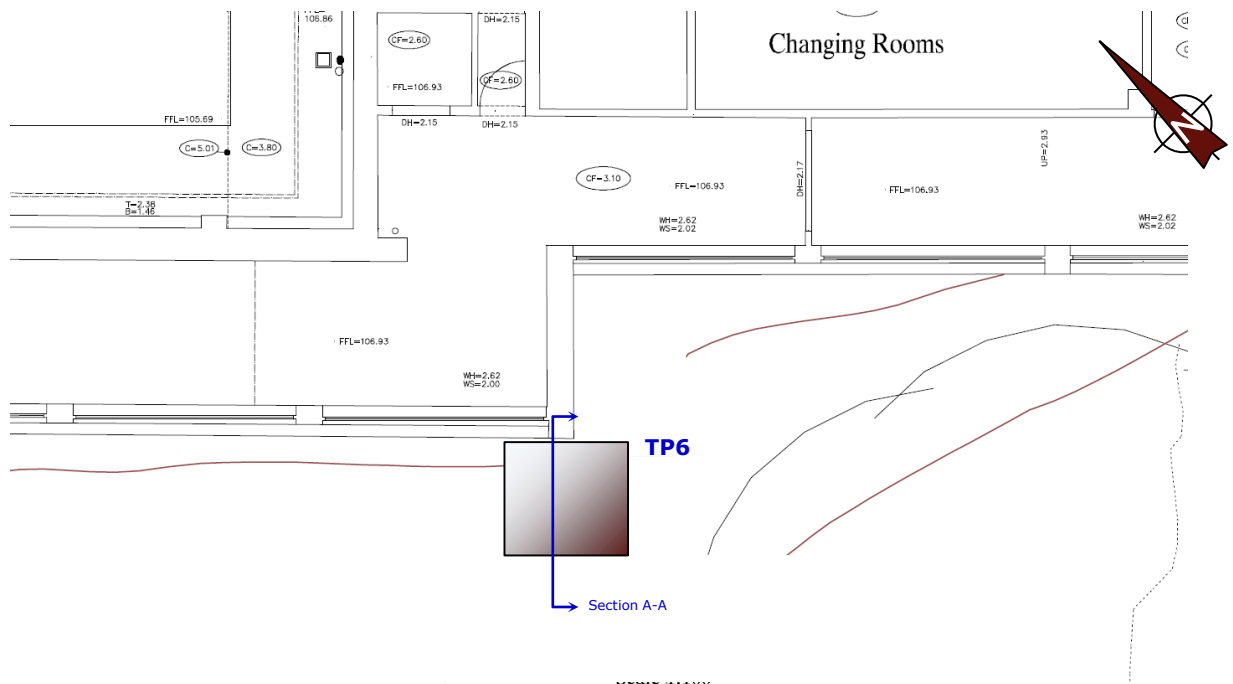


D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

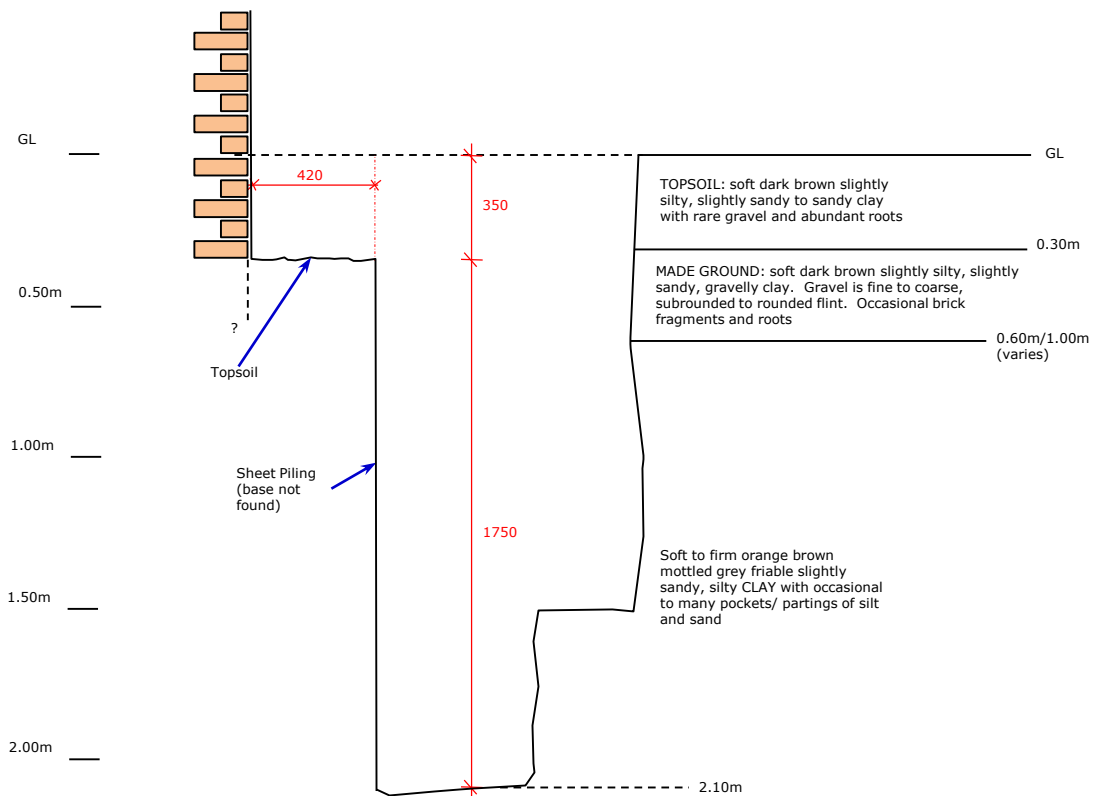
Date:	5 th January 2016	Groundwater details None observed	Samples
Equipment:	Hand excavation		
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 6 (Page 1 of 2)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

PLAN:



SECTION: A - A



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Mini Digger and Hand Dug	• None observed	HV: 42 @ 1.80m
Stability:	Stable		
Remarks:			Logged by: MR

Site & Location	Mallinson Sports Centre, Highgate School Bishopswood Road, London N6 4PH	Trial Pit No: TP 6 (Page 2 of 2)
Client:	Highgate School	Report No:
Engineer:	Pringuer-James Consulting Engineers Ltd	9916/JRCB

PHOTOGRAPHS



D = small disturbed sample, E = environmental sample (glass jar and tub), HV = hand shear vane test (kPa), pp = pocket penetrometer (kg/cm²)

Date:	5 th January 2016	Groundwater details	Samples
Equipment:	Hand excavation and mini-digger	• None observed	HV: 42 @ 1.80m
Stability:	Stable		
Remarks:			Logged by: MR

b	Mallinson Sports Centre, Highgate School	Report	9916 / JRCB
Location	Bishopswood Road, London N6 4PH	No:	

SUMMARY OF CLASSIFICATION TEST RESULTS

BH ID	Depth (m)	Type	w (%)	w _L (%)	w _p (%)	Pass 425 (%)	I _p (%)	Mod I _p (%)	I _L (%)	LOI (%)	Description
BH1	1.50	D	20	34	24	>95	10		-0.40		Brown/orange and pale grey mottled silty slightly sandy CLAY with occasional partings of silty fine sand
BH1	2.50	U	31	38	29	>95	9		0.23		Brown/orange and pale grey mottled silty slightly sandy CLAY with occasional partings of silty fine sand
BH1	4.50	U	28	47	18	>95	29		0.35		Dark grey silty CLAY with occasional to frequent partings of pale grey fine sand
BH1	7.50	U	23								Dark grey silty CLAY with occasional to frequent partings of pale grey fine sand
BH1	10.50	U	21	47	24	>95	23		-0.14		Grey silty CLAY with partings of pale grey silty fine sand and occasional shell fragments
BH1	13.50	U	26								Grey silty CLAY with partings of pale grey silty fine sand and occasional shell fragments
BH1	16.50	U	19	56	22	>95	34		-0.09		Grey silty CLAY with partings of pale grey silty fine sand and occasional shell fragments
BH1	19.50	U	23	61	19	>95	42		0.10		Grey silty CLAY with partings of pale grey silty fine sand and occasional shell fragments
BH2	1.20	D	14	28	18	>95	10		-0.40		Brown and grey mottled silty sandy slightly gravelly CLAY
BH2	2.00	D	27	49	23	>95	26		0.16		Brown/grey mottled silty CLAY
BH2	2.50	U	25								Dark grey silty CLAY with frequent pockets/partings of silty fine sand
BH2	4.50	U	23								Dark grey silty CLAY with frequent pockets/partings of silty fine sand
BH2	7.50	U	23								Dark grey silty CLAY with frequent pockets/partings of silty fine sand
BH2	10.50	U	22								Grey silty CLAY with partings of pale grey silty fine sand and occasional shell fragments
BH2	13.50	U	23	59	23	>95	36		0.00		Grey silty CLAY with partings of pale grey silty fine sand and occasional shell fragments

Testing in accordance with BS EN ISO 17892 unless specified otherwise

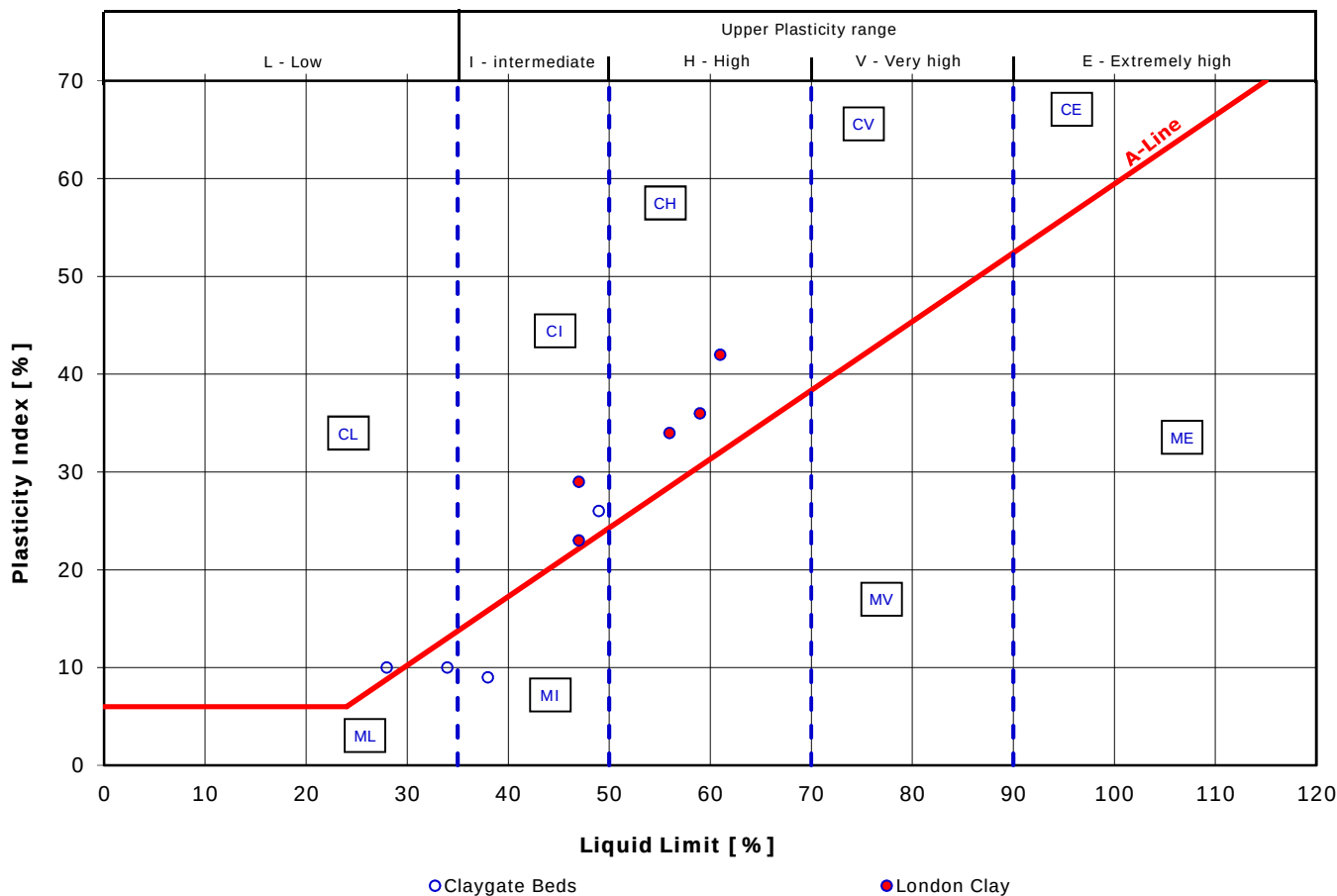
Date: 26 Jan 16

Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)

Percent passing 425µm: by estimation, by hand* or by sieving**

(Classification Sheet 1 of 1)

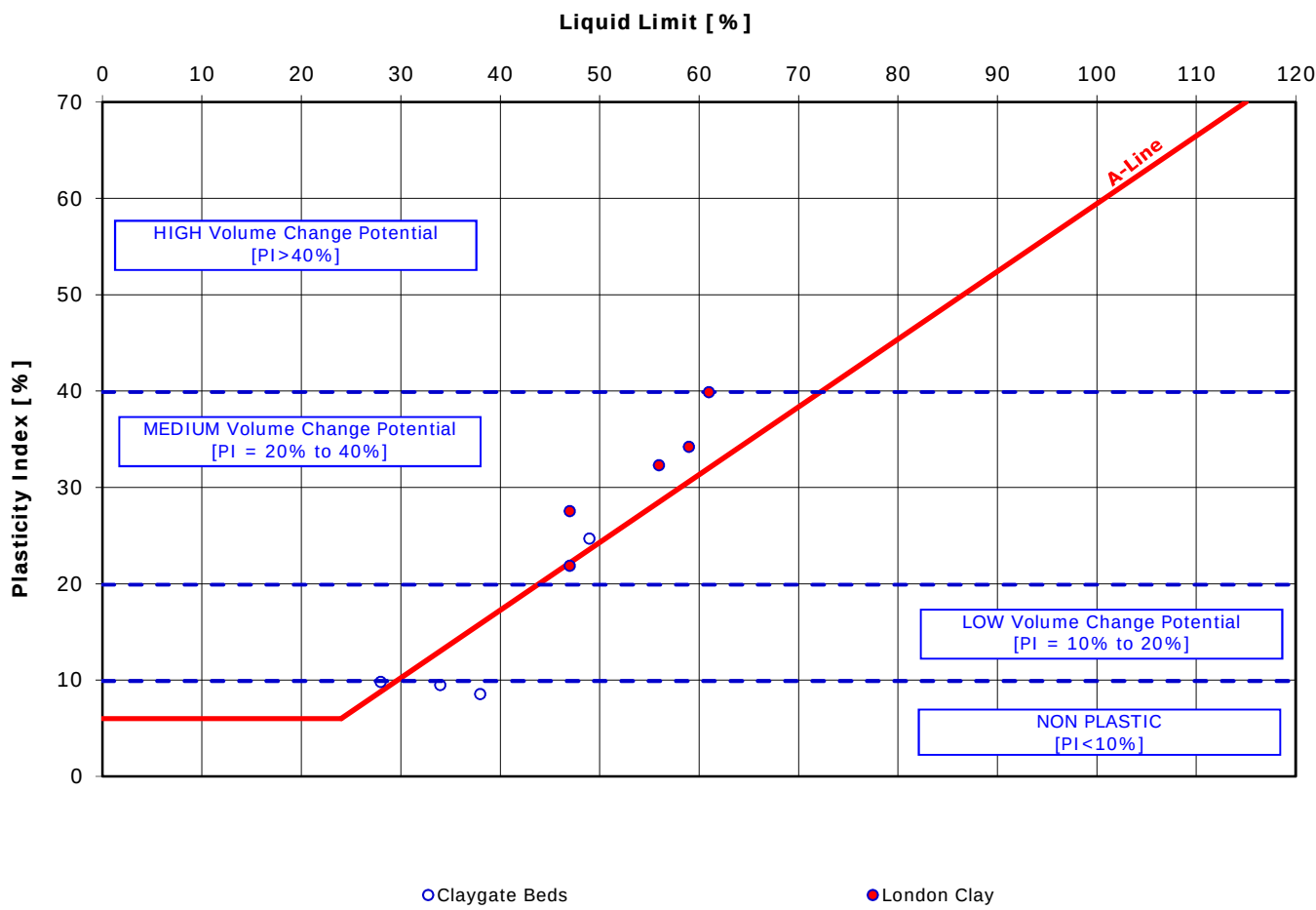
Plasticity Chart



M - SILT [plots below the A-Line]
C - CLAY [plots above the A-Line]

Classification in accordance with BS5930:1999+A2:2010 "Code of practice for site investigations"

Plasticity Chart



Modified Plasticity Index, I_p:

$$I_p = \frac{I_p \times (\% \text{ passing } 425\text{mm})}{100\%} \quad [\text{where } I_p = \text{Plasticity Index}]$$

Classification in accordance with NHBC Standards, Part 4 'Foundations', Chapter 4.2 'Building near trees'

Site	Mallinson Sports Centre, Highgate School
Location	Bishopswood Road, London N6 4PH

Report No: **9916 / JRCB**

SUMMARY OF UNDRAINED SHEAR STRENGTH TEST RESULTS

[illegible]

Testing in accordance with BS EN ISO 17892 UU = unconsolidated, undrained; MUU = multistage, unconsolidated, ur Date: 20 January 16

Unless stated otherwise: Rate of strain = 2mm/min, Standard latex membrane used with thickness = 0.5mm

Failure modes: B = brittle, I = intermediate, P = plastic

[Triaxial Sheet 1 of 1]

FOREWORD TO CONTAMINATION TESTING AND ASSESSMENT

The following statements are designed to inform and guide the Client and other potential parties intending to rely upon this report, with the express intent of protecting them from misunderstanding as to the extent and thus the potential associated risks that may result from proceeding without further evaluations or guidance.

- 1) Unless otherwise stated in this report, the testing of soils and waters is based on a range of commonly occurring potential contaminants for the specific purpose of providing a general guidance evaluation for the proposed form of development. Thus, the range of potential contaminants is neither exhaustive nor specifically targeted to any previous known uses or influences upon the site.
- 2) The amount and scope of the testing should not be assumed to be exhaustive but has been selected, at this stage, to provide a reasonable, general view of the site ground conditions. In many cases this situation is quite sufficient for the site to be characterised for the purposes of development and related Health and Safety matters for persons involved in or directly affected by the site development works. It must be understood, however, that in certain circumstances aspects or areas of the site may require further investigation and testing in order to fully clarify and characterise contamination issues, both for regulatory compliance and for commercial reasons.
- 3) The scope of the contamination testing must not automatically be regarded as being sufficient to fully formulate a remediation scheme. For such a scheme it may be necessary to consider further testing to verify the effectiveness of the remedial work after the site has been treated. It must be understood that a remediation scheme which brings a site into a sufficient state for the proposed development ("fit for purpose") under current legislation and published guidance, may result in some contamination being left in-situ. It is possible that forthcoming legislation may result in a site being classified by the Local Authority and assigned a "Degree of Risk" related to previous use or known contamination.
- 4) The scope of the environmental investigation and contamination testing must not be automatically regarded as sufficient to satisfy the requirements in the wider environmental setting. The risks to adjacent properties and to the water environment are assessed by the regulatory authorities and there may be a requirement to carry out further exploration, testing and, possibly monitoring in the short or long term. It is not possible to sensibly predict the nature and extent of such additional requirements as these are the direct result of submissions to and liaison with the regulatory authorities. It is imperative, therefore, that such submissions and contacts are made as soon as possible, especially if there are perceived to be critical features of the site and proposed scheme, in this context.
- 5) New testing criteria have been implemented by the Environment Agency to enable a waste disposal classification to be made. The date of implementation of this Waste Acceptance Criteria (WAC) was July 2005. It is this testing that will be used by the waste regulatory authorities, including waste disposal sites, to designate soils for disposal in landfill sites. In certain circumstances, to satisfy the waste regulations, there may be the necessity to carry out additional testing to clarify and confirm the nature of any contamination that may be present. If commercial requirements are significant then this process may also necessitate further field operations to clarify the extent of certain features. Thus, the waste classification must be obtained from the waste regulation authorities or a licensed waste disposal site and we strongly recommend that this classification is obtained as soon as possible and certainly prior to establishing any costings or procedures for this or related aspects of the scheme.



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t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 16-39814

Site Reference: Highgate

Project / Job Ref: 9916/JRCB

Order No: None Supplied

Sample Receipt Date: 22/01/2016

Sample Scheduled Date: 22/01/2016

Report Issue Number: 1

Reporting Date: 28/01/2016

Authorised by:

Russell Jarvis
Associate Director of Client Services
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Associate Director of Laboratory
On behalf of QTS Environmental Ltd



John Bartley
Soil Consultants Ltd
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QTS Environmental Report No: 16-39880

Site Reference: Highgate MSC School, Highgate, London N6 4PH

Project / Job Ref: 9916/JRCB

Order No: 9916/JRCB

Sample Receipt Date: 25/01/2016

Sample Scheduled Date: 25/01/2016

Report Issue Number: 1

Reporting Date: 29/01/2016

Authorised by:

Russell Jarvis
Associate Director of Client Services
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Associate Director of Laboratory
On behalf of QTS Environmental Ltd



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Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate						
QTS Environmental Report No: 16-39880	Date Sampled	08/01/16	08/01/16			
Soil Consultants Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Highgate MSC School, Highgate, London N6 4PH	TP / BH No	BH1	BH2			
Project / Job Ref: 9916/JRCB	Additional Refs	None Supplied	None Supplied			
Order No: 9916/JRCB	Depth (m)	4.50	10.50			
Reporting Date: 29/01/2016	QTSE Sample No	188420	188421			

Determinand	Unit	RL	Accreditation				
pH	pH Units	N/a	MCERTS	8.1	8.8		
Total Sulphate as SO ₄	mg/kg	< 200	NONE	1036	541		
Total Sulphate as SO ₄	%	< 0.02	NONE	0.10	0.05		
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	129	137		
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.13	0.14		
Total Sulphur	%	< 0.02	NONE	1.16	0.60		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

Subcontracted analysis ⁽⁵⁾



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Soil Analysis Certificate - Sample Descriptions

QTS Environmental Report No: 16-39880

Soil Consultants Ltd

Site Reference: Highgate MSC School, Highgate, London N6 4PH

Project / Job Ref: 9916/JRCB

Order No: 9916/JRCB

Reporting Date: 29/01/2016

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
\$ 188420	BH1	None Supplied	4.50	18.5	Grey loamy clay
\$ 188421	BH2	None Supplied	10.50	18.1	Grey sandy clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{u/s}

Unsuitable Sample ^{u/s}

\$ samples exceeded recommended holding times

Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 16-39880

Soil Consultants Ltd

Site Reference: Highgate MSC School, Highgate, London N6 4PH

Project / Job Ref: 9916/JRCB

Order No: 9916/JRCB

Reporting Date: 29/01/2016

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCS	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

Soil Analysis Certificate						
QTS Environmental Report No: 16-39814	Date Sampled	13/01/16	13/01/16	13/01/16	13/01/16	13/01/16
Soil Consultants Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Highgate	TP / BH No	BH1	BH1	BH2	BH1	BH1
Project / Job Ref: 9916/JRCB	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	13.50	19.50	7.50	0.50	2.00
Reporting Date: 28/01/2016	QTSE Sample No	188122	188123	188124	188125	188126

Determinand	Unit	RL	Accreditation					
Asbestos Screen	N/a	N/a	ISO17025				Not Detected	Not Detected
pH	pH Units	N/a	MCERTS	8.5	8.8	8.7	7.8	8.1
Electrical Conductivity	uS/cm	< 5	NONE				205	497
Total Cyanide	mg/kg	< 2	NONE				< 2	< 2
Total Sulphate as SO ₄	mg/kg	< 200	NONE	663	787	4132	496	1299
Total Sulphate as SO ₄	%	< 0.02	NONE	0.07	0.08	0.41	0.05	0.13
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	67	77	462	34	668
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.07	0.08	0.46	0.03	0.67
Total Sulphur	%	< 0.02	NONE	0.50	0.52	0.30	0.03	1.15
Organic Matter	%	< 0.1	MCERTS				3	2.2
Arsenic (As)	mg/kg	< 2	MCERTS				13	12
W/S Boron	mg/kg	< 1	NONE				< 1	2.5
Cadmium (Cd)	mg/kg	< 0.2	MCERTS				< 0.2	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS				26	43
Chromium (hexavalent)	mg/kg	< 2	NONE				< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS				49	18
Lead (Pb)	mg/kg	< 3	MCERTS				184	14
Mercury (Hg)	mg/kg	< 1	NONE				< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS				16	38
Selenium (Se)	mg/kg	< 3	NONE				< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS				119	70
Total Phenols (monohydric)	mg/kg	< 2	NONE				< 2	< 2
EPH (C10 - C40)	mg/kg	< 6	MCERTS				16	25

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.

The material description shall be regarded as tentative and is not included in our scope of UKAS Accreditation.

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Asbestos Analyst: Graham Revell

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).

Subcontracted analysis ⁽⁵⁾

Soil Analysis Certificate						
QTS Environmental Report No: 16-39814	Date Sampled	13/01/16	13/01/16	13/01/16		
Soil Consultants Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Highgate	TP / BH No	BH1	BH2	BH2		
Project / Job Ref: 9916/JRCB	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	4.00	0.50	2.50		
Reporting Date: 28/01/2016	QTSE Sample No	188127	188128	188130		

Determinand	Unit	RL	Accreditation				
Asbestos Screen	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	
pH	pH Units	N/a	MCERTS	7.0	7.5	7.5	
Electrical Conductivity	uS/cm	< 5	NONE	80	59	117	
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	
Total Sulphate as SO ₄	mg/kg	< 200	NONE	< 200	< 200	887	
Total Sulphate as SO ₄	%	< 0.02	NONE	< 0.02	< 0.02	0.09	
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	43	< 10	28	
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.04	< 0.01	0.03	
Total Sulphur	%	< 0.02	NONE	0.03	< 0.02	0.03	
Organic Matter	%	< 0.1	MCERTS	0.1	< 0.1	2	
Arsenic (As)	mg/kg	< 2	MCERTS	9	9	9	
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1	
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2	< 0.2	
Chromium (Cr)	mg/kg	< 2	MCERTS	28	32	30	
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	
Copper (Cu)	mg/kg	< 4	MCERTS	8	8	7	
Lead (Pb)	mg/kg	< 3	MCERTS	9	8	8	
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	
Nickel (Ni)	mg/kg	< 3	MCERTS	18	15	18	
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	
Zinc (Zn)	mg/kg	< 3	MCERTS	43	37	35	
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	
EPH (C10 - C40)	mg/kg	< 6	MCERTS	< 6	< 6	< 6	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.

The material description shall be regarded as tentative and is not included in our scope of UKAS Accreditation.

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Asbestos Analyst: Graham Revell

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).

Subcontracted analysis ⁽⁵⁾



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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 16-39814	Date Sampled	13/01/16	13/01/16	13/01/16	13/01/16	13/01/16
Soil Consultants Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Highgate	TP / BH No	BH1	BH1	BH1	BH2	BH2
Project / Job Ref: 9916/JRCB	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	Depth (m)	0.50	2.00	4.00	0.50	2.50
Reporting Date: 28/01/2016	QTSE Sample No	188125	188126	188127	188128	188130

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	0.21	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.44	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	0.36	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.22	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	0.21	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.27	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.19	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	1.9	< 1.6	< 1.6	< 1.6	< 1.6

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Waste Acceptance Criteria Analytical Certificate - BS EN 12457/3

QTS Environmental Report No: 16-39814		Date Sampled	13/01/16			Landfill Waste Acceptance Criteria Limits				
Soil Consultants Ltd		Time Sampled	None Supplied							
Site Reference: Highgate		TP / BH No	BH2							
Project / Job Ref: 9916/JRCB		Additional Refs	None Supplied							
Order No: None Supplied		Depth (m)	1.00							
Reporting Date: 28/01/2016		QTSE Sample No	188129							
Determinand	Unit	MDL								
TOC ^{MU}	%	< 0.1	< 0.1							
Loss on Ignition	%	< 0.01	1							
BTEX ^{MU}	mg/kg	< 0.05	< 0.05							
Sum of PCBs	mg/kg	< 0.1	< 0.1							
Mineral Oil ^{MU}	mg/kg	< 10	< 10							
Total PAH ^{MU}	mg/kg	< 1.7	< 1.7							
pH ^{MU}	pH Units	N/a	7.5							
Acid Neutralisation Capacity		mol/kg (+/-)	< 1	< 1						
Eluate Analysis			2:1 mg/l	8:1 mg/l		Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)			
Arsenic ^U			< 0.01	< 0.01		< 0.2	0.5	2	25	
Barium ^U			< 0.02	< 0.02		< 0.1	20	100	300	
Cadmium ^U			< 0.0005	< 0.0005		< 0.02	0.04	1	5	
Chromium ^U			< 0.005	< 0.005		< 0.20	0.5	10	70	
Copper ^U			< 0.01	< 0.01		< 0.5	2	50	100	
Mercury ^U			< 0.005	< 0.005		< 0.01	0.01	0.2	2	
Molybdenum ^U			< 0.001	< 0.001		< 0.1	0.5	10	30	
Nickel ^U			< 0.007	< 0.007		< 0.2	0.4	10	40	
Lead ^U			< 0.005	< 0.005		< 0.2	0.5	10	50	
Antimony ^U			< 0.005	< 0.005		< 0.06	0.06	0.7	5	
Selenium ^U			< 0.005	< 0.005		< 0.1	0.1	0.5	7	
Zinc ^U			< 0.005	< 0.005		< 0.2	4	50	200	
Chloride ^U			2	4		42	800	15000	25000	
Fluoride ^U			< 0.5	< 0.5		< 1	10	150	500	
Sulphate ^U			2	< 1		< 20	1000	20000	50000	
TDS			37	32		322	4000	60000	100000	
Phenol Index			< 0.01	< 0.01		< 0.5	1	-	-	
DOC			4.6	2.4		24.7	500	800	1000	
Leach Test Information										
Sample Mass (kg)			0.22							
Dry Matter (%)			81.1							
Moisture (%)			23.4							
Stage 1										
Volume Eluate L2 (litres)			0.31							
Filtered Eluate VE1 (litres)			0.06							

Results are expressed on a dry weight basis, after correction for moisture content where applicable
 Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepancies with current legislation
 M Denotes MCERTS accredited test
 U Denotes ISO17025 accredited test



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Soil Analysis Certificate - Sample Descriptions

QTS Environmental Report No: 16-39814

Soil Consultants Ltd

Site Reference: Highgate

Project / Job Ref: 9916/JRCB

Order No: None Supplied

Reporting Date: 28/01/2016

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
188122	BH1	None Supplied	13.50	17.9	Brown sandy clay
188123	BH1	None Supplied	19.50	19.3	Brown sandy clay
188124	BH2	None Supplied	7.50	32.4	Grey sandy clay with concrete
188125	BH1	None Supplied	0.50	21	Brown sandy clay with stones and vegetation
188126	BH1	None Supplied	2.00	19.8	Brown sandy clay
188127	BH1	None Supplied	4.00	22.3	Brown sandy clay
188128	BH2	None Supplied	0.50	17.5	Light brown sandy loam
188129	BH2	None Supplied	1.00	18.9	Light brown clay
188130	BH2	None Supplied	2.50	21.1	Brown sandy clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{U/S}

Unsuitable Sample ^{U/S}

Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 16-39814

Soil Consultants Ltd

Site Reference: Highgate

Project / Job Ref: 9916/JRCB

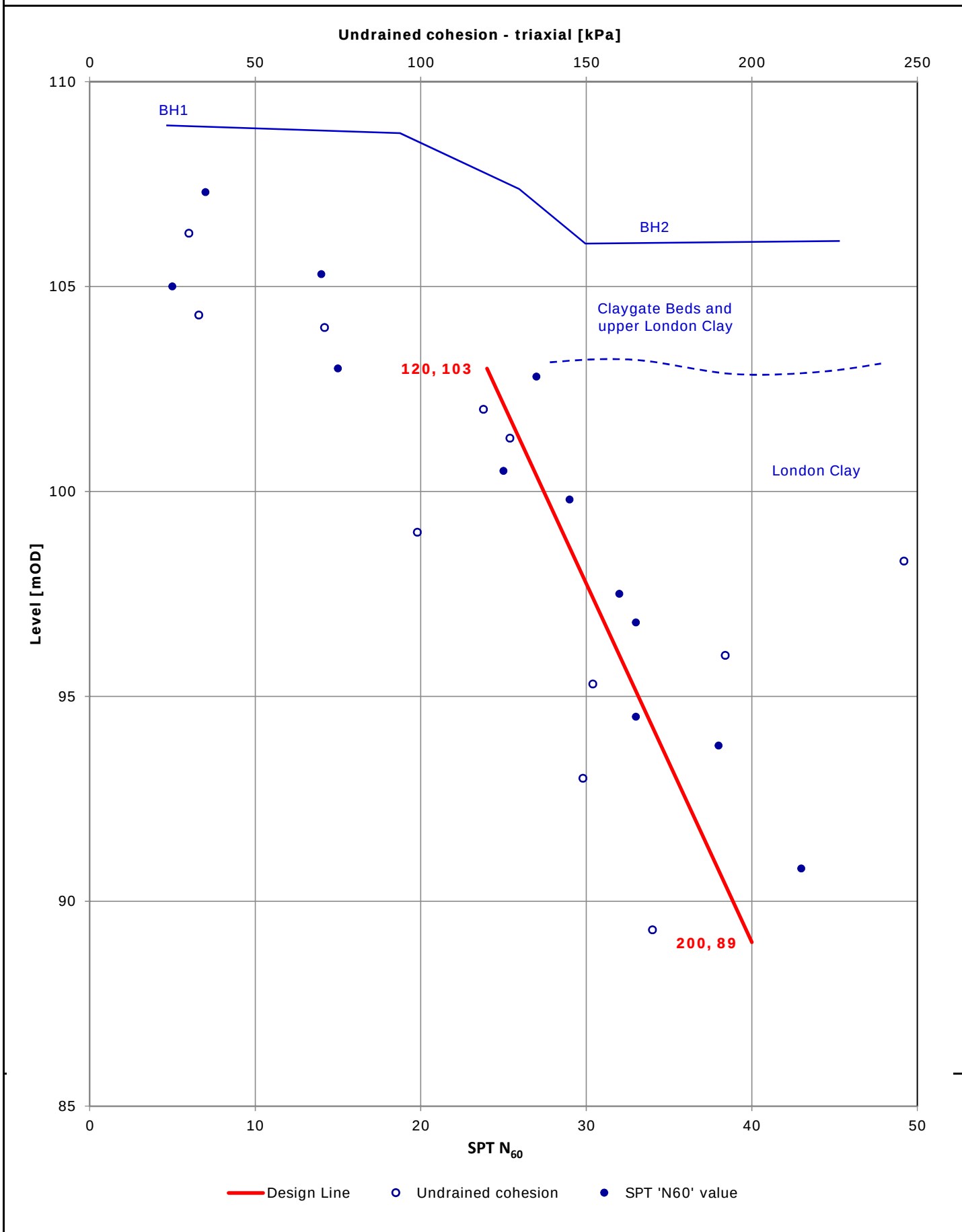
Order No: None Supplied

Reporting Date: 28/01/2016

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCS	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

Undrained cohesion and SPT (N_{60}) vs level



Design Line $\Delta cu = 5.71 \text{ kPa/m}$

Note: this plot may incorporate extrapolated results, generally where ' N ' > 50 - these are indicative only and should be used with caution

Site photographs (Page 1 of 11)



General view of NE elevation of sports centre (looking NW)



Boundary with Bishopswood Road (looking NW)

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Site photographs (Page 2 of 11)



Boundary with Bishopswood Road (looking SE)



**General view of sports centre from Bishopswood
Road boundary (looking N)**

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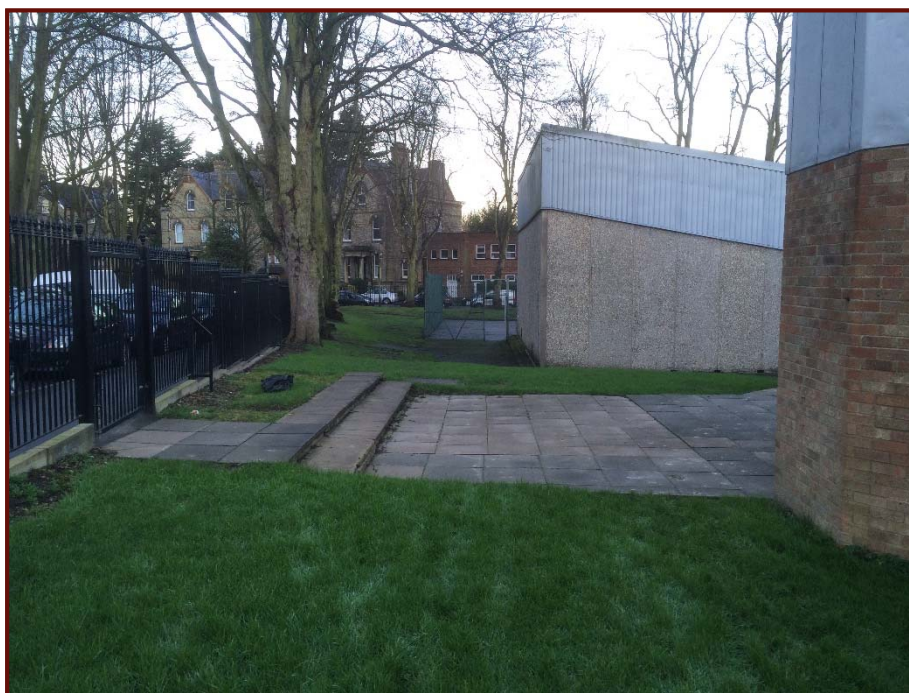
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Site photographs (Page 3 of 11)



Bishopswood Road boundary (looking NW)



Western corner of sports centre (looking NW)

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Site photographs (Page 4 of 11)



View along Bishopswood Road boundary (looking SE)



View along side of swimming pool boundary with games courts on left (looking NE)

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Site photographs (Page 5 of 11)



View along side of swimming pool boundary with games courts on right (looking SW)



Swimming pool building showing plant rooms (looking S)

Site photographs (Page 6 of 11)



Shallow tree-lined drainage ditch to NE of swimming pool (looking SE)



Shallow tree-lined drainage ditch to NE of swimming pool (looking SE)

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Site photographs (Page 7 of 11)



General view of 'courtyard' area (looking SW)



'Courtyard' area; sports hall on left and changing rooms on right (looking S)

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Site photographs (Page 8 of 11)



'Courtyard' area; changing rooms on left and swimming pool on right (looking W)



General view from 'courtyard' area (looking NE)

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