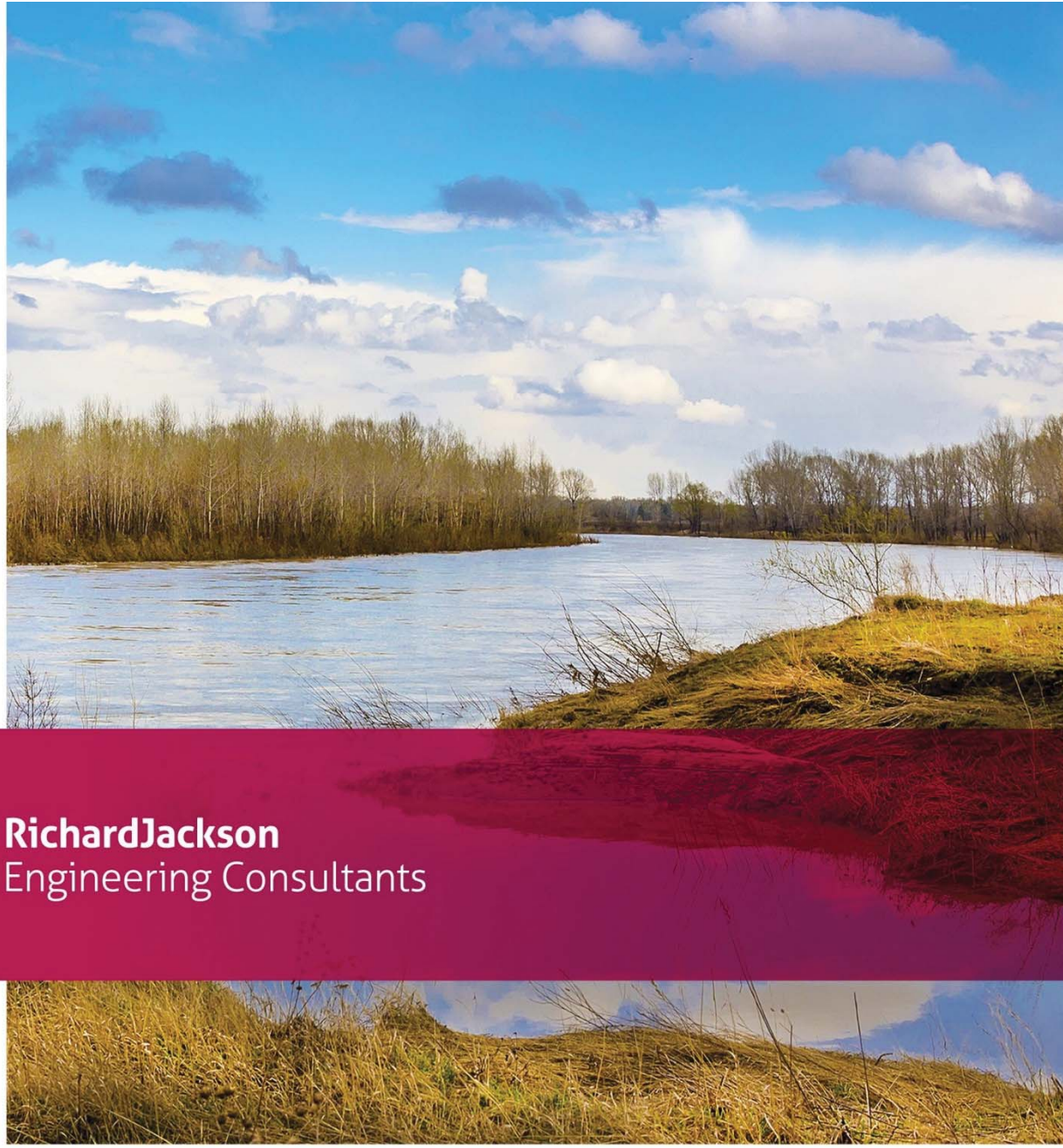


RichardJackson
Engineering Consultants

GROUND INVESTIGATION REPORT

4 Keats Grove, Hampstead, Greater London, NW3 2RT

Mr Marcus Piggott

November 2016

Project no: 51659

RichardJackson
Engineering Consultants

Document Review Sheet: -

Document prepared by: - Jack Warner
on behalf of Richard Jackson Ltd

Date: - 17/11/2016

Document checked by: - Basil Fagg
on behalf of Richard Jackson Ltd

Date: - 17/11/2016

Document Approved by: - David Wall
on behalf of Richard Jackson Ltd

Date: - 17/11/2016

Document Status

DRAFT	FINAL
☐	☒

Revision Status

Issue	Date	Description	Prepared	Checked	Approved

RichardJackson
Engineering Consultants

Contents:-

EXECUTIVE SUMMARY

Purpose:	An intrusive ground investigation to provide geological and hydrogeological information to support a Basement Impact Assessment, to provide information relating to existing foundations and to provide data for design of future underpinning.
Site Status:	At the time of investigation, the site was occupied by a two-storey structure (The Studio) to the east and vegetated garden to the west, including a mature Horse Chestnut tree of approximately 18m in height. The majority of the site was generally at an elevation of 20.7m AOD. It was understood that the existing floor level of The Studio was 19.7m AOD.
Review of Geotechnical Desk Study:	The desk study indicated that the eastern part of the site had been occupied by a two-storey studio property throughout the period examined (1865 – present day). The potential for on-site made ground was identified as a potential source of soil contamination, with the risk considered to be very low to low. The following geotechnical constraints were identified: • the potential for desiccation associated with high plasticity clay soils, • the potential presence of made ground with the potential for unacceptably high total and differential settlements, • the potential for high sulphate concentrations within the London Clay soils to affect buried concrete • the potential for ground gas derived from on-site made ground.
Fieldwork:	The fieldwork comprised the formation of two windowless sampler boreholes and one trial hole which was extended by hand augering techniques. In-situ testing, soil sampling and the installation and subsequent monitoring of standpipes was also undertaken.
Ground Conditions:	Surface materials/made ground were encountered from ground level to depths of between 2.15m and 2.25m below ground level (bgl) and was underlain by the London Clay Formation. Groundwater was encountered during monitoring at depths of 1.68m and 5.65m bgl.
Structural Foundations:	It was considered that desiccation of the London Clay Formation may be present between 2.00m to 3.00m bgl in WLS1. A safe bearing pressure of 135kN/m^2 has been determined for 0.60m wide strip footings at 1.00m bgl.
Ground Floor Construction:	Ground bearing floor slabs, bearing onto the London Clay Formation may be considered theoretically suitable for adoption on site, however should be designed to accommodate the potential for heave due to the influence of trees.
Concrete Grade:	A design sulphate class of DS-5 is considered appropriate for use on site, with an aggressive chemical environment for concrete (ACEC) classification of AC-4s recommended. Further testing may allow a lower classification to be derived.
Gas Protection Measures:	The risk posed by ground gases was considered to be low based on the geotechnical desk study report, reference 51659, dated October 2016.

Suggested Further Works:	Although not considered necessary as part of the Basement Impact Assessment, it may be prudent to undertake the following further works at the site: • An assessment of heave to determine the suitability of a ground bearing floor slab. • Undertake ground gas monitoring to confirm the risk posed by ground gases at the site. • Consideration should be given to the contamination status of the made ground at the site that may affect the identified sensitive receptors as outlined in the desk study.

1. Introduction

Richard Jackson Ltd received an instruction to undertake ground investigation works designed to provide geological and hydrogeological information to support a Basement Impact Assessment, in connection with the proposed redevelopment of The Studio at 4 Keats Grove, Hampstead, Greater London, NW3 2RT. Information to assist with the design of underpinning was also requested.

The works were instructed by the Client, Mr Marcus Piggott, and were carried out in accordance with our fee proposal, dated 30th June 2016.

The proposed development scheme is to comprise the conversion of an existing studio apartment into an indoor swimming pool by lowering the existing floor level.

A proposed development plan is presented in Appendix A.

Richard Jackson Ltd have previously prepared a geotechnical desk study report for the site, report reference 51659, dated October 2016. This is briefly reviewed in this report in Section 3.1.

This report shall be read in conjunction with the limitations of investigation provided in Appendix D.

2. Site Location and Description

The site was located to the front of no. 4 Keats Grove, Hampstead, London Borough of Camden, Greater London, NW3 2RT. The approximate Ordnance Survey grid reference for the centre of the site was TQ269856. A site location plan is presented as Figure 1 in Appendix A.

The site was rectangular in shape with maximum approximate dimensions of 10m north to south by 18m east to west. The majority of the site was generally at an elevation of approximately 20.7m AOD.

The majority of the site at the time of the fieldwork was occupied by a vegetated garden, including shrubs, hedges and a Horse Chestnut tree of approximately 18m in height.

A two storey brickwork structure with a pitched roof (The Studio) occupied the eastern part of the site, fronting onto Keats Grove. Access to the rear of The Studio was at a lower ground level than the garden (approximately 18.8m AOD). It is understood that the existing floor level of The Studio is approximately 19.7m AOD.

A detailed site description is presented in Section 4 of our aforementioned geotechnical desk study report.

3. Review of Previous Investigations

As mentioned in Section 1, a previous study has been undertaken at the site. This is summarised in the following section.

3.1. Richard Jackson Ltd, Geotechnical Desk Study Report, Dated October 2016

As mentioned above, a geotechnical desk study report has been previously prepared for the site by Richard Jackson Ltd, dated October 2016. This is summarised below.

The ground conditions were indicated to comprise the London Clay Formation (clay, silt and sand).

A two-storey structure, The Studio, had occupied the eastern part of the site throughout the period examined (1865 – present day). There were no current or historical industrial land uses identified on-site over this period.

The surrounding area had undergone significant residential development, particularly between the 1860s and 1890s. Industrial development was noted to be on a small scale and included development of the railway and associated tunnels, several phases of redevelopment of the nearby hospital, two unspecified works, a depot and a garage.

It was considered possible that made ground associated with the structural development and terracing/levelling of the site may exist and may be considered a potential source of soil contamination. No off-site sources of soil contamination were identified that were considered to pose a significant risk of contamination to the site.

Several potential receptors of contamination were identified, including residential end users, construction site workers, flora in areas of soft landscaping, structures and services.

The risk of soil contamination to the site was considered to be very low to low.

The following geotechnical constraints were identified in the preliminary geotechnical risk assessment as the most significant to affect the development at the subject site and should be investigated further:

- High risk associated with high plasticity London Clay soils with potential for desiccation and hence subsidence/heave
- Moderate/low risk associated with the presence of made ground with the potential for unacceptably high total and differential settlements
- High risk to buried concrete associated with high sulphate concentrations within the London Clay

- Low risk associated with ground gas derived from on-site made ground

4. Factual Ground Investigation Information

The findings of the factual ground investigation are provided in the following sections.

4.1. Fieldwork

The fieldwork on which the report is based was undertaken on 12th September 2016. It comprised the forming of two small diameter windowless sampler (WLS) boreholes (WLS1 & WLS2) and one trial hole (TH1) which was excavated by hand to the level of the underside of the existing foundations of The Studio and then extended using augering techniques.

The windowless sampling (WLS) utilised a demountable hydraulic power-pack and percussive hammer to drive a series of small diameter windowless sampler tubes into the ground.

The WLS boreholes (WLS1 and WLS2) were formed to depths of 6.00m below ground level (bgl) (14.76m AOD). TH1 and the subsequent auger was formed to a depth of 3.10m bgl (15.70m AOD).

An exploratory hole location plan is presented as Figure 2 in Appendix A.

In-situ standard penetration tests (SPTs) were undertaken throughout the depth of the WLS boreholes to provide an indication of the soil density / stiffness. The number of blows required to advance a 60° nose cone over the final 300mm of a 450mm total drive was recorded as the 'N' value. These values were presented on the borehole logs.

Where cohesive soils were encountered, either a hand shear vane or pocket penetrometer were used to assess the undrained shear strength of the encountered soils. The results of these tests are recorded as the 'IVN' and 'PP' values respectively and are presented on the logs in Appendix B.

Disturbed soil samples were recovered from throughout the depth of the exploratory holes for geotechnical testing and record purposes.

On completion of the three exploratory holes, semi-permanent HDPE gas and groundwater monitoring standpipes were installed to maximum depths of 6.00m bgl (14.76m AOD) in each of the WLS boreholes.

A groundwater monitoring visit was undertaken on 5th October 2016. The ground level elevations of the exploratory hole well heads (WLS1, WLS2 & HA1) were also surveyed with a GPS rover on this date.

Table 1, provides a summary of the exploratory hole well head elevations.

Table 1: Exploratory Hole Well Head Elevations

Exploratory Hole	Location	Elevation, m AOD
WLS1	Front Garden (west of The Studio)	20.76
WLS2		20.76
TH1	Rear (south) of The Studio	18.80

Exploratory hole logs are presented in Appendix B and give descriptions and depths of strata encountered, together with details of samples taken, in-situ tests, well installations and other relevant information.

Where applicable, investigative techniques, sampling, logging of soils and in-situ testing complied with the requirements of British Standard BS5930:- 'Code of Practice for Site Investigations' (2015).

4.2. Laboratory Testing

4.2.1. Geotechnical Testing

Disturbed and undisturbed soil samples recovered from the exploratory holes were sent to a UKAS accredited soil testing laboratory Soil Property Testing (SPT) Ltd. The following tests were carried out in accordance with BS1377:1990:

- 30 natural moisture content (NMC) determinations;
- 5 atterberg limit tests (liquid limit four point cone method);
- 5 pH value and 2:1 water soluble sulphate content determinations;
- 2 BRE Pyrites Suite Tests;

The results of these tests are presented in Appendix C.

4.2.2. Root Identification and Starch Testing

The root identification and starch testing was undertaken on a sample recovered from the London Clay Formation in TH1 at a depth of 2.00m bgl (16.80m AOD) by Richardson's Botanical Identifications.

The results of this testing are provided as Appendix C.

4.3. Ground Conditions

The British Geological Survey (BGS) 1:50,000 scale series mapping of the area, Sheet 256, North London, Bedrock and Superficial edition (2006 indicates the London Clay Formation to exist beneath the site.

The deposits encountered in this investigation comprised the following sequence:

- Surfacing Materials / Made Ground
- London Clay Formation

4.3.1. Surfacing materials / Made Ground

Concrete surfacing was encountered in TH1 from ground level to a depth of 0.40m bgl comprising stone slabs, a lean mix cement bed, a further concrete slab with further lean mix cement below.

Made ground was encountered from ground level in the WLS boreholes and beneath the concrete surfacing in TH1. The depth of the made ground in the WLS boreholes ranged from 2.15m (WLS2) to 2.25m bgl (WLS1) (18.61m and 18.51m AOD). The depth of made ground in TH1 extended to 0.85m bgl (17.95m AOD). Greater thicknesses of made ground were present to the west of the site and were considered to be associated with the higher level of the front garden.

The made ground was typically encountered as a stiff, brown, slightly sandy, gravelly clay with roots and gravel of flint and fragments of brick, coal dust and concrete.

Towards the base of the made ground, possibly disturbed natural soils were encountered in the WLS boreholes as a firm, brown/reddish brown mottled, slightly gravelly, slightly sandy clay with rare roots and iron staining and gravel of flint and fragments of brick and coal dust.

4.3.2. London Clay Formation

Soils considered to represent the London Clay Formation were encountered beneath the made ground in the three exploratory holes from depths of between 0.85m (17.95m AOD) and 2.25m bgl (18.51m AOD).

The full depth and thickness of the London Clay Formation remained unproved in the three exploratory holes.

The London Clay Formation was typically encountered as a firm to stiff becoming stiff, slightly fissured, brown/grey mottled, silty clay with rare silt partings.

Selenite crystals were encountered from a depth of 3.30m bgl (17.46m AOD) in WLS2 and 4.00m bgl (16.76m AOD) in WLS1.

SPTs were undertaken throughout the depth of the London Clay Formation in the WLS boreholes. The results of these tests ranged from N=12 to N=21. Full results are provided on the WLS boreholes logs presented in Appendix B and summarised on the 'N' Value –vs- Depth Plot also presented in Appendix B.

Hand shear vane (HSV) and pocket penetrometer tests were also undertaken throughout the depth of the London Clay Formation. The results of the HSV tests ranged from 74 kN/m^2 to 98 kN/m^2. Full results are provided on the exploratory hole logs and summarised on the Undrained Shear Strength -vs- Depth plots presented in Appendix B.

Atterberg limit tests were undertaken on five samples of the London Clay Formation and indicated the clay to be of high to very high plasticity and hence of medium to high volume change potential. Full results of these tests are provided in Appendix C.

Root identification was undertaken on a root sample obtained from the London Clay Formation. The root identification identified that the root, which was described as being in a poor condition, could be either of the following tree species:

- Acer (Sycamore Maple)
- Carpinus (Hornbeam)

The root encountered within the sample was identified to be very decayed (dead) using the iodine test for starch. The results of this testing are provided in Appendix C.

4.3.3. Groundwater

Groundwater was not encountered in the exploratory holes during formation, however it was encountered during subsequent monitoring on 5th October 2016. Table 2, provides a summary of the groundwater data and includes strike depths during formation and standing water level depths (SWL) during monitoring on 5th October 2016.

Table 2: Summary of Groundwater Levels

Exploratory Hole	Strike Depth during Formation on 12/09/16 (m bgl)	SWL during Monitoring on 05/10/16 (m bgl)	SWL during Monitoring on 05/10/16 (m AOD)
WLS1	Dry	5.65	15.11
WLS2		Dry	Dry
TH1		1.68	17.12

The results did not infer a continuous groundwater body beneath the site and are considered likely to be associated with seepages from within the made ground or the London Clay Formation.

5. Geotechnical Assessment

It is understood from the schemes' structural engineers that the existing foundations of The Studio are to be underpinned beyond the depth of the excavation of the proposed swimming pool. It is also understood that the existing foundations have been previously underpinned.

The recommendations provided within this section are based upon the above information and our understanding of the proposed scheme as detailed in Section 1, together with the proposed development plans included in Appendix A.

5.1. Structural Foundations

It should be noted that the London Clay Formation is a shrinkable material and therefore, where influenced by trees, hedgerows or other vegetation, foundations will need to be designed in accordance with NHBC Standards Chapter 4.2 'Building near Trees' (2016). The London Clay Formation should be considered to have a high volume change potential.

Shallow perched groundwater may be encountered in the made ground and therefore, groundwater control measures may be required to control groundwater ingress.

The BRE Digest 412 - Desiccation in Clay Soils (1996) states that a crude indication of the onset of desiccation is when the natural moisture content is less than 0.4 x liquid limit. On this basis, the sample at 3.00m bgl at TH1 could be classified as desiccated, however the soil strengths recorded using the hand shear vane were not obviously desiccated at this depth. Furthermore, the plot of natural moisture content (%) against depth, provided with the soil test results, indicated that the soil is at or close to its equilibrium moisture content (approximately 32%).

Samples of made ground from the three exploratory holes recorded moisture content deficiencies to approximately 18.30m AOD (between 0.5m bgl in TH1 and 2.46m bgl in WLS1 and WLS2). Roots were noted on both the WLS logs. The reduced moisture content may be due to variations in the granular content of the made ground or desiccation of cohesive made ground caused by tree roots.

The consistency of the shallow clay soils at the site (made ground and the London Clay Formation) were described as very stiff in WLS2 from 0.30m to 3.30m bgl (20.46m to 17.46m AOD) and stiff or very stiff in WLS1 from 0.25m to 2.25m bgl (20.51m to 18.51m AOD), whereas at depth, the clay soils were described as firm becoming stiff in WLS1 from 3.30m (17.46m AOD) and firm becoming firm to stiff in TH1 from 0.85m bgl (17.95m AOD). This observed increase in described consistency of the shallow clay soils at the site may be a further indication of soil desiccation.

Moisture content profiles of samples recovered from the exploratory holes indicated reduced moisture contents in the London Clay Formation in WLS1 from 2.50m to 3.00m bgl (18.26m to 17.76m AOD). It is therefore

considered that desiccation in the London Clay may be present between 18.26m and 17.76m AOD in WLS1.

Where foundations exceed a depth of 1.5m, due to the influence of trees, anti-heave precautions should be adopted.

Foundations should be excavated beyond the depth of any significant roots encountered in the excavations.

It is recommended that reference is made to the latest edition of NHBC Standards when considering new areas of planting.

Conventional mass concrete foundations are considered appropriate for adoption beneath the existing studio apartment although founding levels may be deep. The London Clay Formation is considered to be an appropriate bearing stratum.

Net safe bearing pressures have been determined for the site based on conventional strip footings. The net safe bearing pressures is the permissible increase in vertical stress at the level of the underside of the foundation, above existing overburden pressure which may be calculated on the basis of a soil bulk density of 20kN/m^3.

Groundwater, believed to be perched, was encountered in WLS1 and TH1 during monitoring.

Table 3 provides a summary of the calculated net safe bearing pressure at 1.00m bgl (17.80m AOD). The assumed relative density of the soil has been inferred from the 'HSV Undrained Shear Strength –vs- Depth Plot for TH1' presented in Appendix B together with the soil descriptions provided by the site engineer. Elastic theory has been used to derive the stress distribution beneath the foundations.

Table 3: Net Safe Bearing Pressures

Foundation	Depth, m bgl (Elevation, m AOD)	Bearing Stratum	Nett Safe Bearing Pressure (kN/m^2)
0.6m wide strip footing	1.00 (17.80)	London Clay Formation	135

The total drained settlements have been calculated using modulus of elasticity values, Ev'. In over-consolidated cohesive soils, the Ev' values are based on the relationship; Ev' = 130 x C_u, after Stroud and Butler (1975), where Cu = undrained shear strength.

At the above net safe bearing pressure, a total drained settlement has been calculated to be within tolerable limits.

Settlement in cohesive soils typically comprises a small amount of immediate settlement as loads are applied and a larger proportion of consolidation settlement which will occur over a longer period of time.

Made ground should be penetrated and foundations extended at least 150mm into undisturbed natural soils. The formation should be inspected by a competent engineer prior to concreting. If very soft pockets are encountered, these should be excavated until a firm to stiff deposit suitable for bearing is encountered.

5.2. Ground Floor Construction (Swimming Pool)

Ground bearing floor slabs, bearing onto the London Clay Formation may be considered theoretically suitable for adoption on site.

It should however, be noted where structures are influenced by trees, the ground floor slabs should be designed to accommodate the potential for heave of the underlying cohesive soils which were classified to have a medium to high volume change potential. Calculating the amount of heave due to rehydration of the clay was beyond the remit of this investigation.

It should be noted that made ground is not typically considered as an appropriate bearing stratum due to its variable nature.

Removal of approximately 1.20m of soil to construct the swimming pool will reduce the pressure at slab formation level. Construction of the pool and filling with water will then increase the pressure at formation level. The ground movements associated with loading/unloading have not been assessed as part of this investigation but should be considered at the design stage.

5.3. Excavation Groundworks

The stability of any made ground or disturbed ground must not be relied upon in unsupported excavations.

Existing retaining walls should be inspected and maintained during the works.

Safe working conditions must be provided at all times where operatives are required to work in excavations.

Heavy plant and stockpiles of materials should not be permitted close to the edges of open excavations.

Based on observations made during fieldwork, perched groundwater seepages from made ground could be encountered in excavations for structures or services and the requirement for groundwater control measures should be considered.

Further reference should be made to CIRIA Report No. 97, 'Trenching Practice' (1997).

5.4. Concrete Grade

Water soluble sulphate content and pH value determinations were carried out by the geotechnical laboratory on a total of seven samples.

Water soluble sulphate content determinations undertaken by the geotechnical laboratory are presented in terms of mg/l SO_3 and have been multiplied by a factor of 1.2 to determine content as mg/l SO_4.

Values of water soluble sulphate ranged from 36 mg/l SO_4 to 3,588 mg/l SO_4 with pH values ranging from 7.4 to 7.9.

The WLS borehole logs indicated the presence of selenite crystals (calcium sulphate) within the London Clay Formation which can be detrimental to concrete as a result of their high sulphate content. In addition, the London Clay Formation can also contain iron pyrites (FeS_2) that acts as a source of oxidised sulphate, which can also adversely affect buried concrete. Therefore, in addition to the above testing, a BRE pyrites suite analysis suite was undertaken on two samples.

The above results have been compared to current guidance provided within BRE Special Digest 1, third edition 'Concrete in Aggressive Ground' (2005). Given the observed potential presence of pyrites within the soils, the methodology detailed within Section C5.1.2 has been used to determine the required concrete grade. This methodology includes a determination of the total potential sulphate content which can be derived from the oxidation of pyrites in the London Clay Formation, following ground disturbance. Values of total sulphur ranged from 0.080% S to 1.5% S and consequently recalculated total potential sulphate (TPS) ranged from 0.24% SO_4 to 4.5% SO_4.

In accordance with BRE Special Digest 1 'Concrete in Aggressive Ground', (2005), on the basis of the above results and an assumption of static groundwater, a Design Sulphate class of DS-5 is recommended for shallow buried concrete. An aggressive chemical environment for concrete (ACEC) classification of AC-4s should be adopted.

Given the high classification, it may be advisable to reassess this recommendation once founding levels are known. Further chemical testing may be required to check the concrete mix design.

5.5. Gas Protection Measures

As discussed in our geotechnical desk study report, a potential for ground gas generation at the site, derived from the breakdown of organic material in the suspected made ground, was considered to exist. The risk posed by ground gases was considered to be low.

6. Suggested Further Works

Although not considered necessary as part of the Basement Impact Assessment, this section provides a summary of the further works which

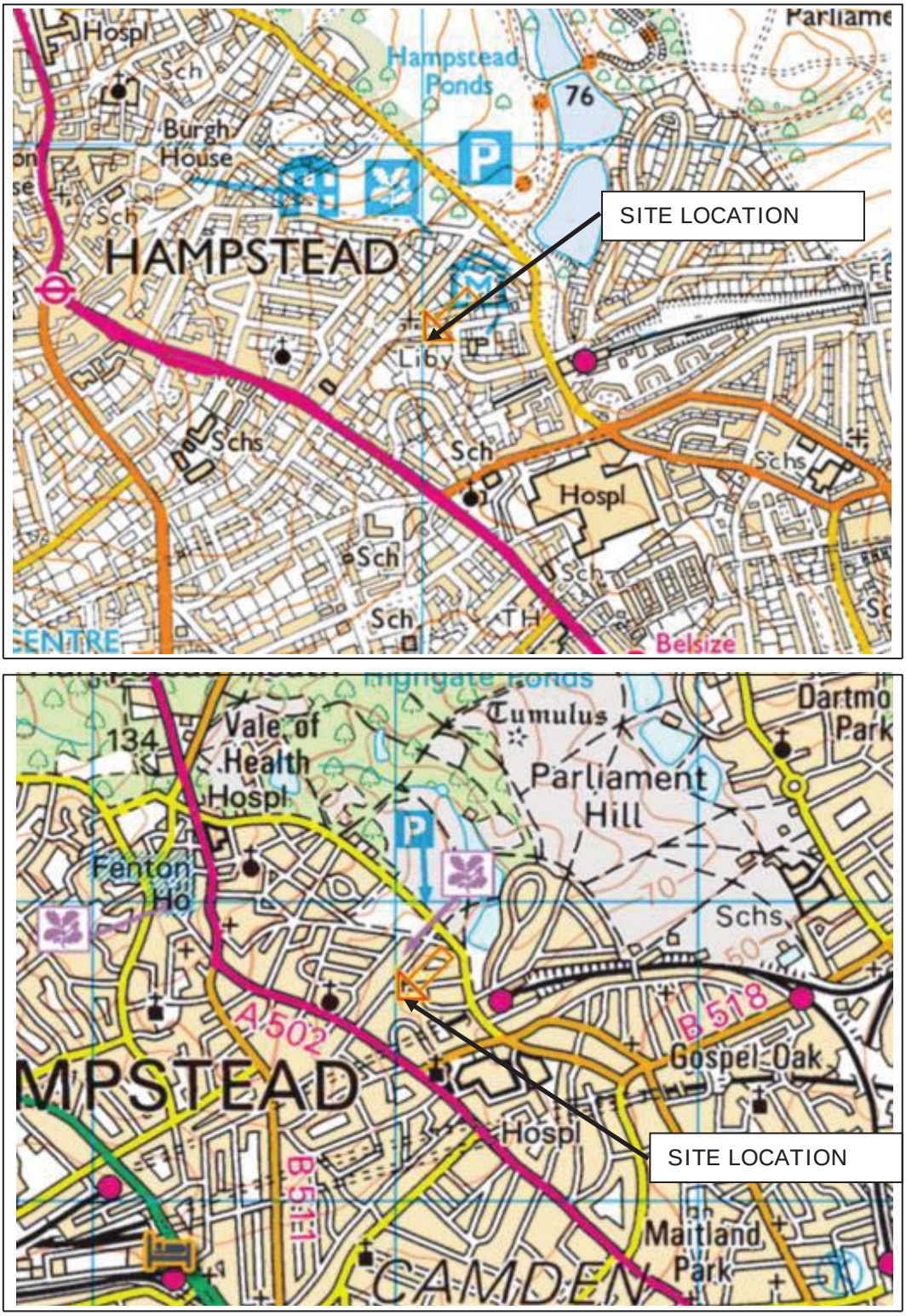
may be prudent to be undertaken. The following further works are recommended:

- An assessment of heave due to soil removal for swimming pool construction.
- Undertake ground gas monitoring at the site to confirm the risk posed by ground gases at the site.
- Consideration should be given to the contamination status of the made ground at the site that may affect the sensitive receptors as identified in the desk study.

RichardJackson
Engineering Consultants

Appendix A

Figures & Drawings



RichardJackson Engineering Consultants

consulting civil & structural engineers
847 The Crescent, Colchester, CO4 9YQ
Tel: 01206 228800

4 Keats Grove, Hampstead, London NW3 2RT

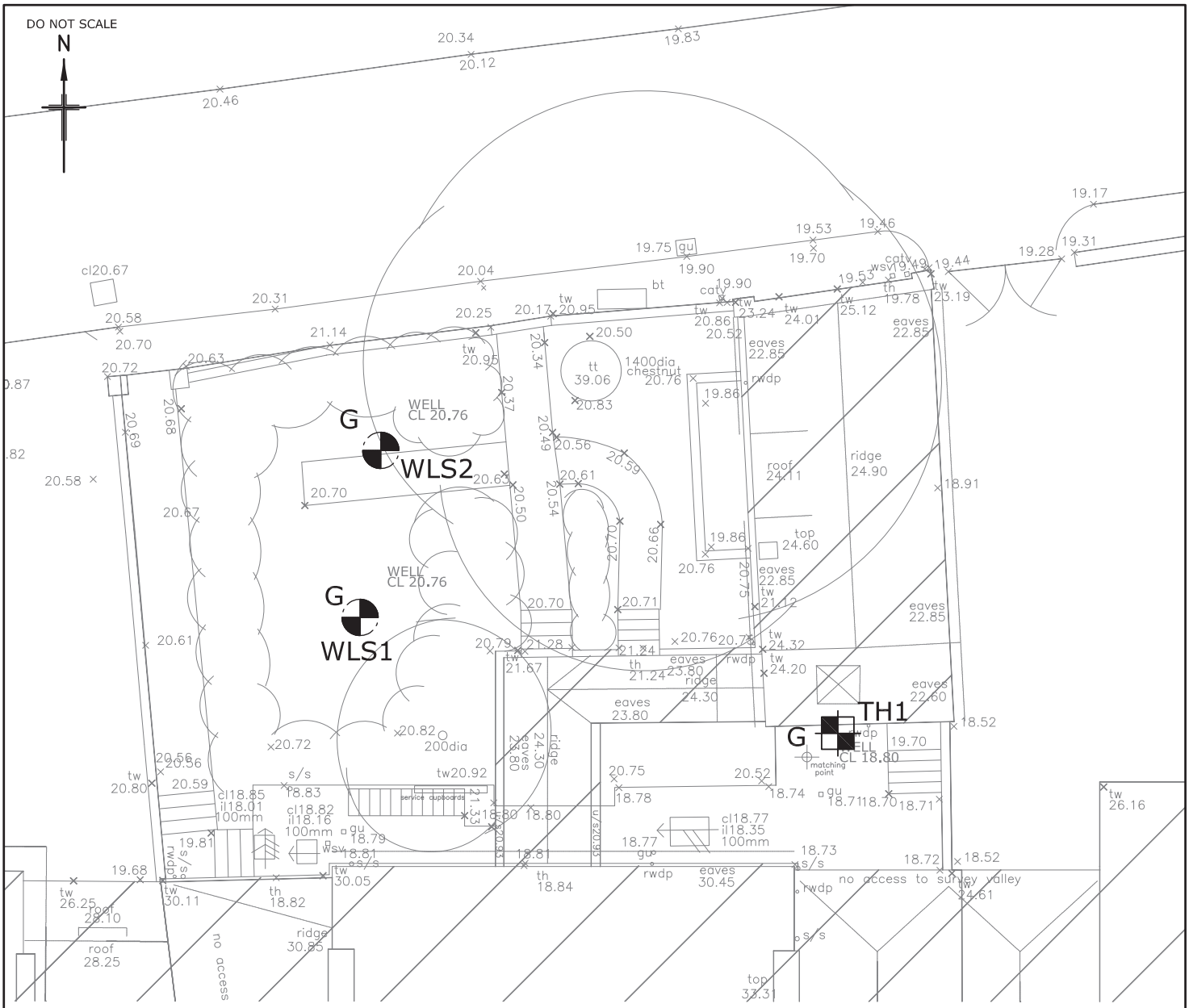
FIGURE 1

SITE LOCATION PLAN

SCALE: N.T.S.

JOB NO: 51659

DO NOT SCALE



KEY:

WINDOWLESS SAMPLER BOREHOLE LOCATIONS (WLS1 & WLS2)

TRIAL HOLE LOCATIONS (TH1)

G GROUNDWATER MONITORING STANDPIPE INSTALLED

REV	DATE	DESCRIPTION	DRAWN	CHKD

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.

Project Title

4 KEATS GROVE, HAMPSTEAD
LONDON, NW3 2RS

Drawing Title

EXPLORATORY HOLE LOCATION PLAN

RichardJackson Engineering Consultants

847 The Crescent, Colchester, Essex CO4 9YQ Tel: 01206 228800 ☐
Suite 409, 1 Alie Street, London E1 8DE Tel: 020 7448 9910 ☒
York House, 3 Station Court, Great Shelford, Cambs CB22 5NE Tel: 01223 314794 ☐
6 The Old Church, St. Matthews Road, Norwich, Norfolk NR1 1SP Tel: 01603 230240 ☐
The Wheelhouse, Bonds Mill, Stonehouse, Gloucestershire GL10 3RF Tel: 01172 020070 ☐
Email Address: mail@rj.uk.com Website: http://www.rj.uk.com

Client Title

MR MARCUS PIGGOTT

Drawing No. 51659-G-FIG02

Revision

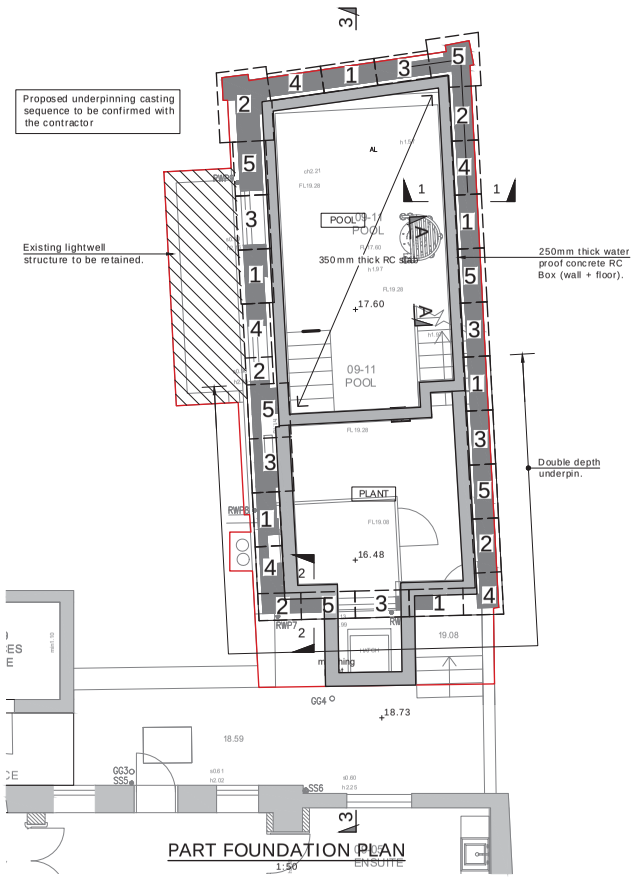
Drawing Status

☒ INFORMATION ☐ APPROVAL ☐ COSTING
☐ TENDER ☐ CONSTRUCTION ☐ AS CONSTRUCTED

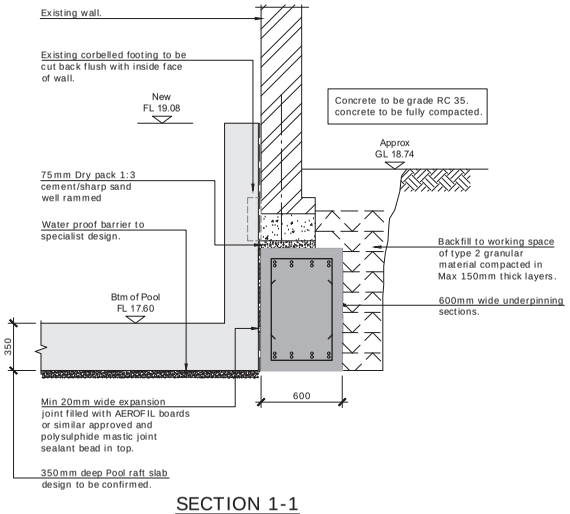
Scale	Drawn	Date	Job Manager	Checked	Approved
1:100 @A3	J. PITCHER	13/09/16	J. MANKU	J. WARNER	J. MANKU

A3

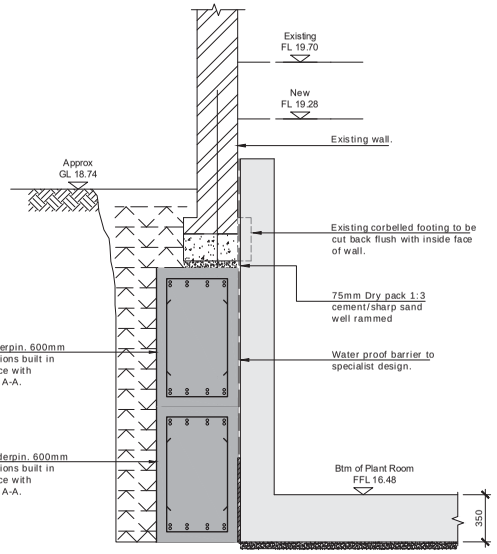
DO NOT SCALE



PART FOUNDATION PLAN
1:50



SECTION 1-1
1:20



SECTION 2-2
1:20

NOTES

1. The Contractor shall verify all dimensions before starting work.
2. It is essential to read this drawing in conjunction with the specification.
3. The design assumes natural clay with allowable bearing pressure of 100kN/sq.m at the underpinning formation.
4. Unexpected conditions must be reported to the Engineer immediately so that the design can be reviewed and altered if necessary.
5. This drawing is to be read in conjunction with Ground Investigation Report by Richard Jackson Ltd dated November 2016, ref: 51659.

HEALTH AND SAFETY

1. The contractor is responsible for identifying hazards and for carrying out risk assessments and for taking all necessary precautions to eliminate or reducer risks so far as reasonably practicable. The building may not be considered stable in its temporary state and the contractor is to provide all necessary temporary support until all structural works are complete.

2. The following hazards are known:

Collapse of excavations. All excavations to be shored.

i) Instability of building being underpinned: Maximum single length of building to be left unsupported = 1200mm. No more than 4No. legs to be left unsupported. Maximum percentage of excavation on any elevation not to exceed 25%. Minimum distance between unsupported legs = 3600mm. Working space may not be excavated outside the unsupported legs. "Unsupported" applies to the period between start of excavation for working space and 12 hours after hard packing. Provide sacrificial props/stools if necessary at centres to suit the site conditions to archive stability of wall over.

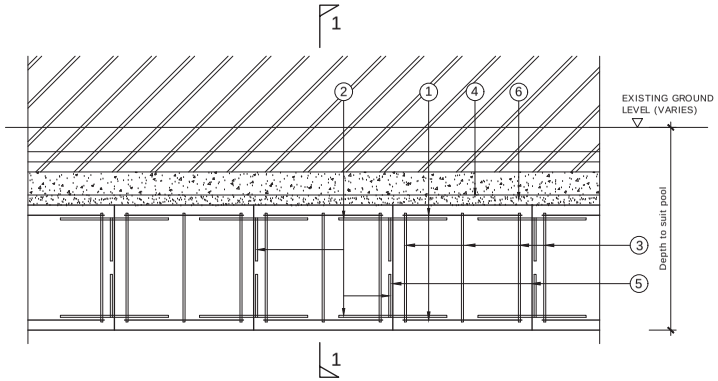
ii) Underground services. Services may be present. Contractor to check and locate.

iii) Adjacent building to remain occupied: Contractor to agree with residents areas of control and access.

iv) Silica dust from breaking out: dampen down to avoid dusting. PPE essential.

v) Exposure to noise: ears defenders essential.

vi) Expose to exhaust fumes: vent to external air.

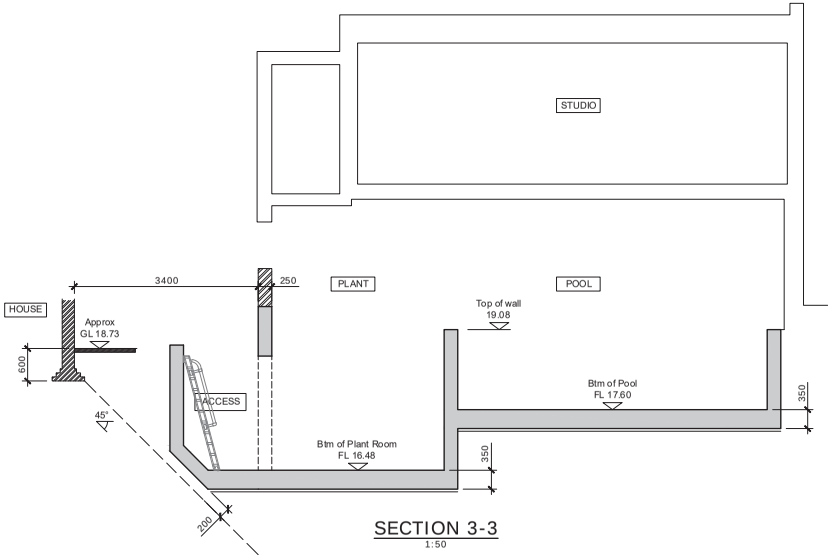


ELEVATION ON A-A
1:20

KEY

1. 8H12 LONGITUDINAL BARS (4T,4B)
2. 8H12 DOWEL BARS BENT STRAIGHT ON SITE
   500 / 500
3. H10 OVERLAPPING 'U' BARS
4. UNDERSIDE OF EXISTING FOUNDATION TO BE THOROUGHLY CLEANED AND SCABBLED AND ANY LOOSE MATERIAL REMOVED PRIOR TO CASTING NEW CONCRETE.
5. JOINT BETWEEN BAYS TO CONSIST OF EXPAMET HYRIB PERMANENT SHUTTERING. PLACE 1200g POLYTHENE AGAINST EARTH FACE TO PROTECT HYRIB AND DOWELS. REMOVE POLYTHENE ON EXCAVATION OF ADJACENT BAY
6. 75mm (1:3 CEMENT/SHARP SAND) DRY PACK WELL RAMMED IN
7. SURFACE TO BE REINSTATED AS EXISTING
8. BACKFILL TO WORKING SPACE TO BE 300mm CONCRETE PLUG OR AS DETAIL WITH DPT TYPE 2 OR AS RAISED INERT SELECTED GRANULAR MATERIAL COMPACTED IN 150mm MAXIMUM LAYERS OVER

* ENGINEER TO INSPECT AND DETERMINE EXTENT AND DEPTH OF FOUNDATION



SECTION 3-3
1:50

NOTE
SUBSTRUCTURE FOUNDATION WORKS TO COMPLY WITH ARBORICULTURAL SURVEY REPORT AND 13.6m RADIUS TREE PROTECTION ZONE (TPZ)

GENERAL NOTES

1. The drawings, design and all information contained therein are the sole copyright of Richard Jackson Ltd and reproduction in any form is forbidden unless permission is obtained in writing.
2. All drawings shall be read in conjunction with all relevant Civil/Structural Engineering drawings, the project specification and drawings produced by the Architects, Services Engineers & Landscape Architects.
3. For all setting out information refer to the Architects drawings and details.
4. Any discrepancies between the information given by the Engineer, and that provided by others, must be referred to the Engineer before the affected works proceed.
5. Dimensions must not be scaled from the Engineers drawings.
6. All dimensions are in millimetres unless noted otherwise.
7. Dimensions marked * are subject to confirmation by site measurement before construction proceeds.
8. All dimensions are given to structural surfaces unless noted otherwise.
9. No holes, chases, cut-outs or the like may be formed in any beam, column, or load bearing wall unless written permission is obtained from the Engineer.
10. Holes smaller than 225 x 225mm through slabs are not necessarily shown on the Engineers drawings.
11. For size and location of all services refer to the Service Engineers and Architects drawings.
12. Inspections made by the Local Authority or other Statutory bodies, shall be arranged by the Contractor to suit his programme. Any costs arising out of failing to carry out the work to the satisfaction of the Checking Authority will be the sole responsibility of the Contractor.
13. Non-structural fixings are generally not shown on the Engineers drawings and if any such detail is indicated it must be confirmed by cross-reference to other specialists before construction.
14. All drawing specifications are given in accordance with NBS (National Building Specification) e.g. E10/130 which refers to NBS Section E10, Clause 130.
15. Abbreviations:
    S.S.L.- Structural Slab Level.
    U.N.O.- Unless Noted Otherwise
    T.O.B.- Top Of Beam.

ISSUED FOR INFORMATION

REV	DATE	DESCRIPTION	DRAWN	CHKD
C	17.10.17	UPDATED TO SHOW PLANT ROOM WALLS	RFL	JM
B	12.06.17	ISSUED FOR INFORMATION	RFL	JM
A	15.05.17	ISSUED FOR INFORMATION	RFL	JM

REVISIONS

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.

Project

4 KEATS GROVE
HAMPSTEAD, NW7

Title

INDICATIVE
SWIMMING POOL
PROPOSED FOUNDATIONS

Client

Mr MARCUS PIGGOTT

Scale	Drawn	Date
1:50; 1:20 @ A1	RFL	01.09.16
Job Manager	Checked	Approved
JM	JM	

RichardJackson Engineering Consultants
847 The Crescent, Colchester, Essex CO4 9YQ Tel: 01206 228400
Suite 409, 1 Ale Street, London E1 8DE Tel: 020 7648 9810
York House, 3 Station Court, Great Shelford, Cambs CB22 5NE Tel: 01223 314794
6 The Old Church, St. Matthews Road, Norwich, Norfolk NR1 1SP Tel: 01603 230240
The Wheelhouse, Bonds Mill, Stonehouse, Gloucestershire GL10 3RF Tel: 01172 020170
Email Address: mail@rj.uk.com Website: http://www.rj.uk.com

Drawing No. 51659/S/01 | Revision C

Drawing Status
☒ INFORMATION ☐ APPROVAL ☐ COSTING
☐ TENDER ☐ CONSTRUCTION ☐ AS CONSTRUCTED

A1

RichardJackson
Engineering Consultants

Appendix B

Exploratory Hole Logs & Data Plots

RichardJackson Engineering Consultants
York House,
3 Station Court,
Great Shelford
Cambridge, CB22 5NE

Borehole No. **WLS1**

Sheet 1 of 2

Project Name: 4 Keats Grove	**Dates** 12/09/2016	**Project no.** 51659	Hole Type **WLS**
Location: Hampstead, Greater London, NW3 2RT	**Co-ordinates:**		Scale **1:20**
Client: Mr Marcus Piggott	**Ground Level (m, aOD)** 20.76		Logged By **JW**

Well	Water Strike	Samples & In-situ Tests: Casing	SWL	Depth	Type	Results	Level (m)	Depth (m)	Legend	Stratum Description	Scale
							20.51	0.25		Dark brown, slightly gravelly, slightly clayey, silty, fine SAND with frequent roots. Gravel of sub-angular, fine to coarse flint and brick fragments. MADE GROUND	
				0.50	D1					Stiff, brown/light brown mottled, slightly sandy CLAY with occasional roots with rare iron staining. Gravel of sub-angular, fine to coarse flint and fragments of brick, coal dust and concrete. MADE GROUND	
		1.00		1.00	C	N=17				*...friable between 0.60m and 1.10m.*	1
				1.00	D2	(3,4/4,5,4,4)					
				1.50	D3						
							19.06	1.70		Very stiff, brown/reddish brown mottled, slightly gravelly, sandy CLAY with rare iron staining. Gravel of sub-angular flint and fragments of brick and coal dust. MADE GROUND	
		1.00		2.00	C	N=16					2
				2.00	D4	(3,3/3,4,5,4)					
							18.51	2.25		Stiff, slightly fissured, brown/grey mottled, silty CLAY with rare orange/brown silt partings. LONDON CLAY FORMATION	
				2.50	PP	130					
				2.50	D5						
		1.00		3.00	C	N=21					3
				3.00	D6	(3,3/4,5,6,6)					
				3.30	PP	98				*...becoming firm to stiff from 3.30m.*	
				3.50	D7						
				3.80	PP	82					
		1.00		4.00	C		16.76	4.00			

Groundwater: Groundwater not encountered during drilling.

Remarks: Groundwater standing at 5.65m bgl (15.11m AOD) on 05/10/16.

Groundwater Key		Sample Type Key		Test Type Key	
▽	Groundwater Strike	**D**	Disturbed	**IVN**	Hand vane
		B	Bulk	**S/C**	SPT / CPT
▼	Standing water level	**U**	Undisturbed	**PP**	Pocket penetrometer
		ES	Environmental	**PID**	PID Reading

RichardJackson Engineering Consultants	York House, 3 Station Court, Great Shelford Cambridge, CB22 5NE	Borehole No. **WLS1** Sheet 2 of 2

Project Name: 4 Keats Grove	**Dates** 12/09/2016	**Project no.** 51659	Hole Type **WLS**
Location: Hampstead, Greater London, NW3 2RT	**Co-ordinates:**		Scale **1:20**
Client: Mr Marcus Piggott	**Ground Level (m, aOD)** 20.76		Logged By **JW**

Well	Water Strike	Samples & In-situ Tests					Level (m)	Depth (m)	Legend	Stratum Description	Scale
		Casing	SWL	Depth	Type	Results					
				4.00	D8	N=12 (2,2/2,3,3,4)				Firm to stiff, slightly fissured, brown/grey mottled, silty CLAY with rare orange/brown silt partings. LONDON CLAY FORMATION	
				4.30	PP	78				*...with rare selenite crystals (fine gravel-sized) from 4.00m.*	
				4.50	D9					*...becoming stiffer from 4.50m.*	
				4.80	PP	110					
		1.00		5.00	C	N=12					5
				5.00	D10	(2,2/2,3,3,4)					
				5.50	PP	80					
				5.50	D11						
				5.90	PP	115					
		1.00		6.00	C	N=20	14.76	6.00			6
				6.00	D12	(3,3/4,5,5,6)					
											7

Groundwater: Groundwater not encountered during drilling.

Remarks: Groundwater standing at 5.65m bgl (15.11m AOD) on 05/10/16.

Groundwater Key		Sample Type Key		Test Type Key	
▽	Groundwater Strike	**D**	Disturbed	**IVN**	Hand vane
		B	Bulk	**S/C**	SPT / CPT
▼	Standing water level	**U**	Undisturbed	**PP**	Pocket penetrometer
		ES	Environmental	**PID**	PID Reading

RichardJackson Engineering Consultants	York House, 3 Station Court, Great Shelford Cambridge, CB22 5NE	Borehole No. **WLS2** Sheet 1 of 2

Project Name: 4 Keats Grove	**Dates** 12/09/2016	**Project no.** 51659	Hole Type **WLS**
Location: Hampstead, Greater London, NW3 2RT	**Co-ordinates:**		Scale **1:20**
Client: Mr Marcus Piggott	**Ground Level (m, aOD)** 20.76		Logged By **JW**

Well	Water Strike	Samples & In-situ Tests					Level (m)	Depth (m)	Legend	Stratum Description	Scale
		Casing	SWL	Depth	Type	Results					
							20.46	0.30		Dark brown, slightly gravelly, slightly clayey, silty, fine SAND with frequent roots. Gravel of sub-angular, fine to coarse flint and fragments of brick, coal dust and concrete. MADE GROUND	
				0.50	D1					Very stiff, very friable, dark brown/brown mottled, slightly gravelly, slightly sandy CLAY with rare roots. Gravel of sub-angular to sub-rounded, fine to coarse flint and fragments of brick, concrete and coal dust. MADE GROUND	
		1.00		1.00	C	N=20					1
				1.00	D2	(4,4/5,5,5,5)					
				1.50	D3						
							18.96	1.80		Very stiff, light brown/grey mottled, slightly gravelly, slightly sandy, silty CLAY with rare roots and rare iron staining. Gravel of sub-angular to sub-rounded, fine to coarse flint and rare fragments of coal dust and brick. MADE GROUND	
				1.90	PP	250					
		1.00		2.00	C	N=10					2
				2.00	D4	(1,2/2,2,3,3)					
				2.20	PP	177	18.61	2.15		Very stiff, fissured, light brown/orange brown/ grey mottled, silty CLAY with rare roots and rare orange/brown silt partings. LONDON CLAY FORMATION	
				2.50	D5						
				2.75	PP	72				*...firm to stiff from 2.75m.*	
		1.00		3.00	C	N=14					3
				3.00	D6	(2,2/3,3,4,4)					
				3.30	PP	97				*...with occasional selenite crystals (fine gravel-sized) from 3.30m.*	
				3.50	D7						
				3.80	PP	98					
		1.00		4.00	C		16.76	4.00			

		Groundwater Key		Sample Type Key		Test Type Key	
Groundwater:	Groundwater not encountered during drilling.	▽	Groundwater Strike	**D**	Disturbed	**IVN**	Hand vane
				B	Bulk	**S/C**	SPT / CPT
Remarks:	No groundwater during monitoring on 05/10/16.	▼	Standing water level	**U**	Undisturbed	**PP**	Pocket penetrometer
				ES	Environmental	**PID**	PID Reading

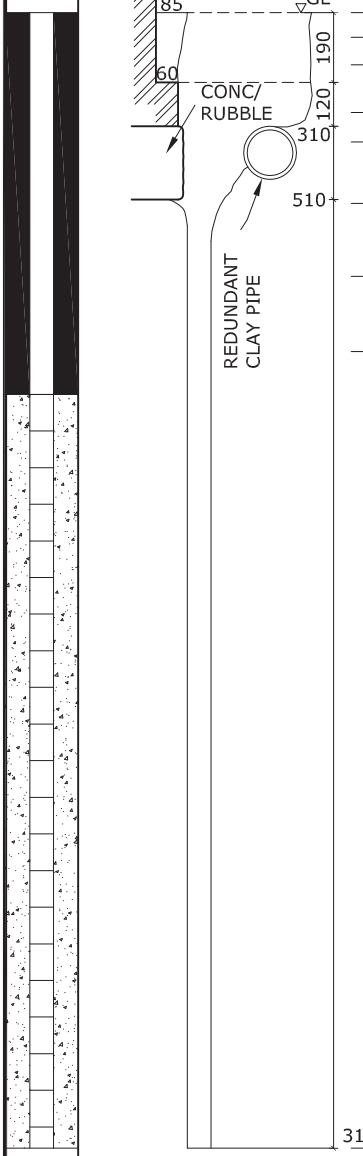
RichardJackson Engineering Consultants	York House, 3 Station Court, Great Shelford Cambridge, CB22 5NE	Borehole No. **WLS2** Sheet 2 of 2

Project Name:	4 Keats Grove	**Dates** 12/09/2016	**Project no.** 51659	Hole Type **WLS**
Location:	Hampstead, Greater London, NW3 2RT	**Co-ordinates:**		Scale **1:20**
Client:	Mr Marcus Piggott	**Ground Level (m, aOD)** 20.76		Logged By **JW**

Well	Water Strike	Samples & In-situ Tests					Level (m)	Depth (m)	Legend	Stratum Description	Scale
		Casing	SWL	Depth	Type	Results					
				4.00	D8	N=13 (2,3/3,3,3,4)				Firm to stiff, fissured, light brown/orange brown/grey mottled, silty CLAY with rare roots and rare orange/brown silt partings. LONDON CLAY FORMATION	
				4.30	PP	82					
				4.50	D9					*...becoming stiff from 4.50m.*	
				4.70	PP	128					
		1.00		5.00	C	N=16					5
				5.00	D10	(2,3/3,4,4,5)					
				5.40	PP	98					
				5.50	D11						
				5.70	PP	142					
		1.00		6.00	C	N=20	14.76	6.00			6
				6.00	D12	(3,3/4,5,5,6)					
											7

Groundwater:	Groundwater not encountered during drilling.
Remarks:	No groundwater during monitoring on 05/10/16.

Groundwater Key		Sample Type Key		Test Type Key	
▽	Groundwater Strike	**D**	Disturbed	**IVN**	Hand vane
		B	Bulk	**S/C**	SPT / CPT
▼	Standing water level	**U**	Undisturbed	**PP**	Pocket penetrometer
		ES	Environmental	**PID**	PID Reading



Description	Depth (mm)	Description Type	Description Depth (mm)	Tests Type	Tests Depth (mm)
York stone slabs (MADE GROUND).	0				
Sand/cement bed (MADE GROUND).	30				
Lean mix Sand cement/concrete (MADE GROUND).	65				
Concrete (MADE GROUND).	105				
Lean mix Sand cement/concrete (MADE GROUND).	220				
Brown gravelly SAND. Gravel of sub-angular fine to coarse brick and tile fragments (MADE GROUND).	260				
Brown silty gravelly SAND. Gravel of sub-angular, fine to coarse brick and tile fragments (MADE GROUND).	400	D1	510		
Firm brown/orange brown/grey mottled silty CLAY, (LONDON CLAY FORMATION).	850	D2	1000	SV=74	1000
...becoming firm to stiff with depth.	1500	D3	1500	SV=78	1500
Root observed and becoming brown/grey mottled with depth.	1800	D4	2000	SV=96	2000
		D5	2500	SV=92	2500
		D6	3000	SV=98	3000
	3100 END				

Sample test key:
D - Disturbed sample.
SV - Shear vane test.

Remarks
No groundwater encountered during excavation.
Ground level at 18.80 AOD.
Standing water level at 1.68m BGL, (17.12m AOD) on 05/10/2016.

Project
4 KEATS GROVE, HAMPSTEAD
LONDON, NW3 2RT

Title
TH1

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.

Client
MR MARCUS PIGGOTT

Scale AS SHOWN @ A4 | Drawn RDL | Date OCTOBER 2016 | Logged By J. WARNER | Checked | Approved

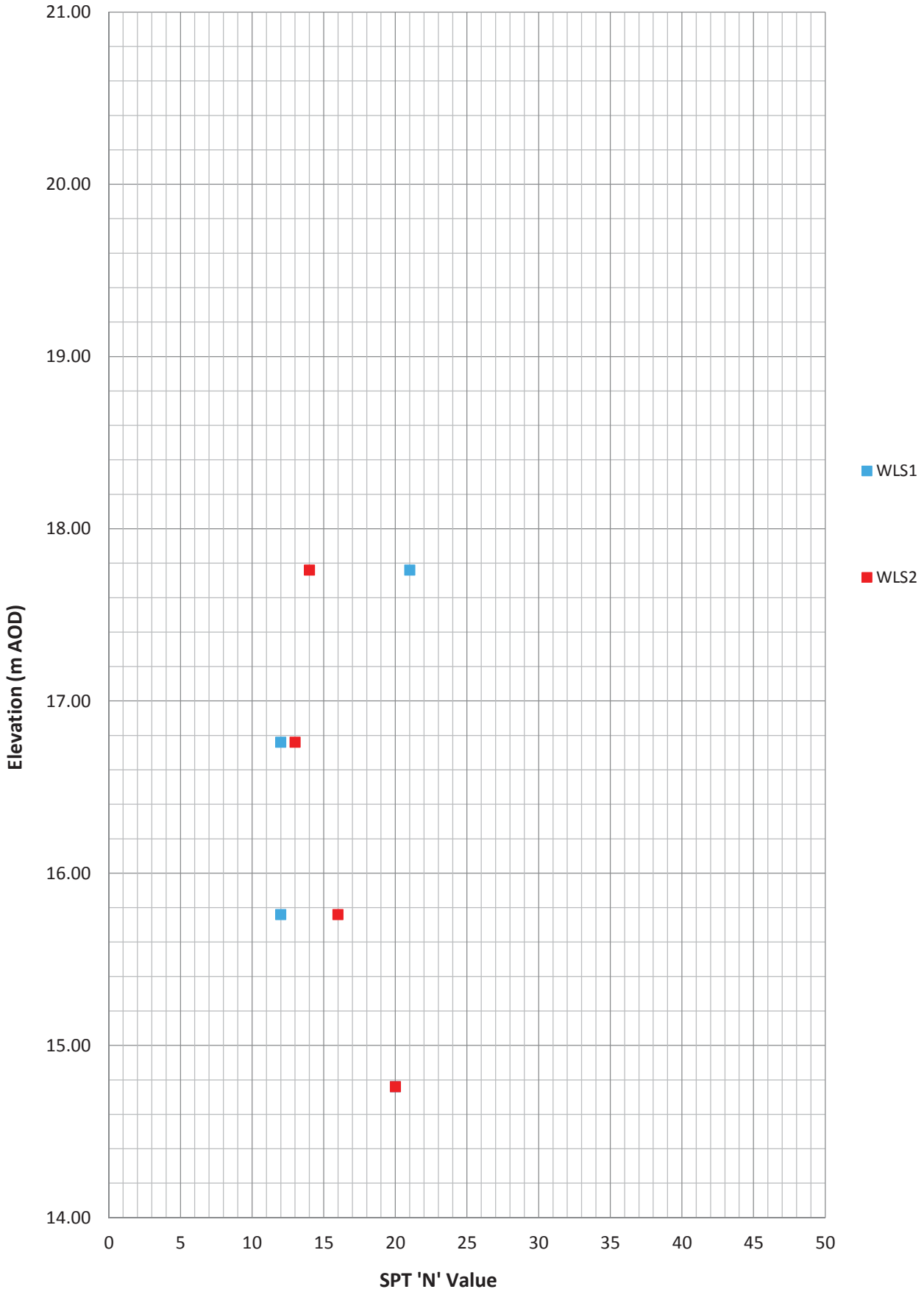
RichardJackson Engineering Consultants
847 The Crescent, Colchester Business Park, Essex, CO4 9YQ Tel: 01206 228800 ☒
Suite 409, 1 Alie Street, London E1 8DE Tel: 020 7448 9910 ☐
York House, 3 Station Court, Great Shelford, Cambs CB22 5NE Tel: 01223 314794 ☐
6 The Old Church, St. Matthews Road, Norwich, Norfolk NR1 1SP Tel: 01603 230240 ☐
The Wheelhouse, Bonds Mill, Stonehouse, Gloucestershire GL10 3RF Tel: 01172 020070 ☐
Email Address: mail@rj.uk.com Website: http://www.rj.uk.com

Borehole/Trial Hole Log No.
51659/G/TH1

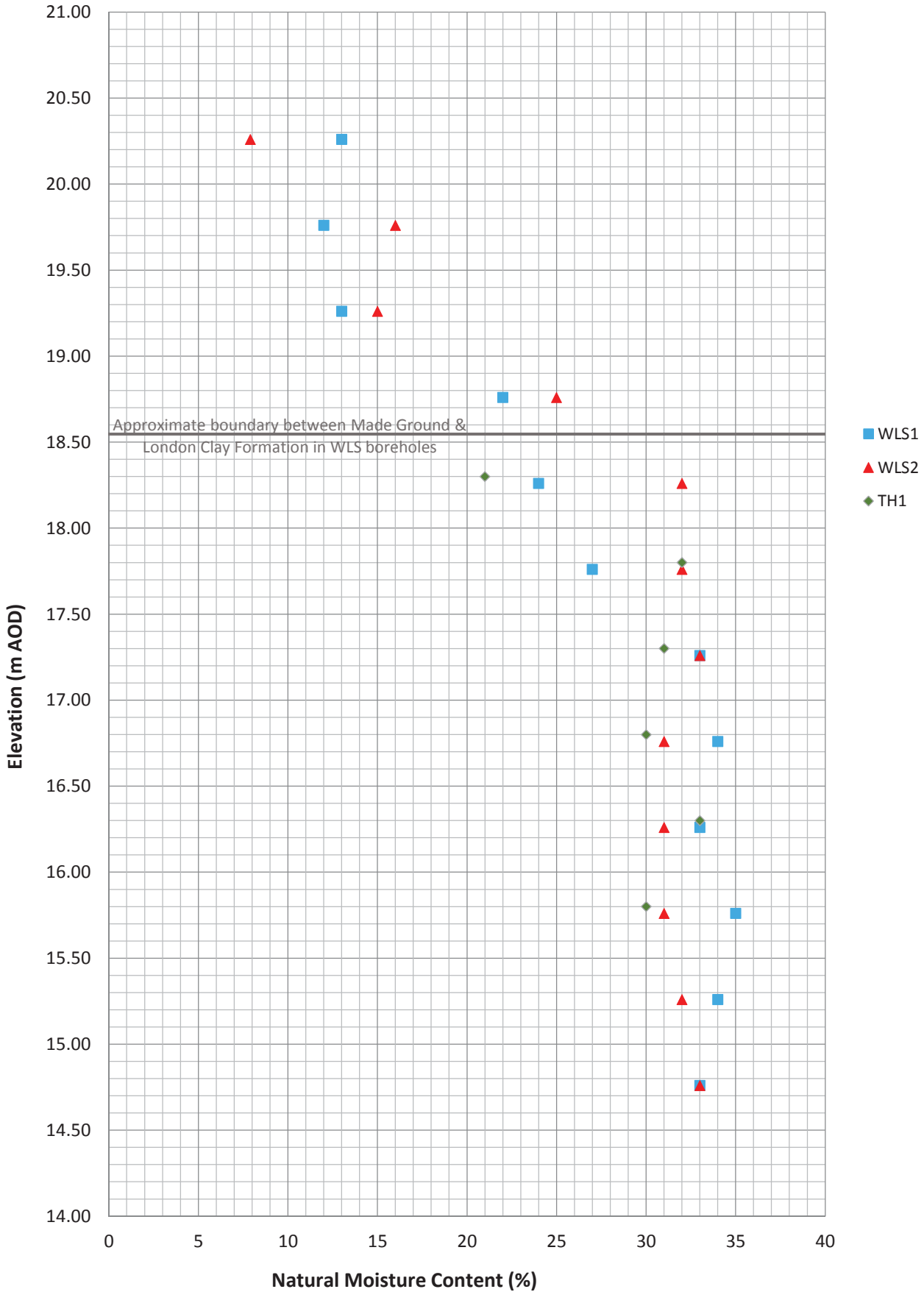
Drawing Status
☒ INFORMATION ☐ APPROVAL ☐ COSTING
☐ TENDER ☐ CONSTRUCTION ☐ AS CONSTRUCTED

A4
DO NOT SCALE

51659 - 4 Keats Grove, Hampstead, Greater London
SPT 'N' Value - vs- Elevation Profile



51659 - 4 Keats Grove, Hampstead, Greater London
Natural Moisture Content - vs- Elevation Profile



51659 - 4 Keats Grove, Hampstead, Greater London Undrained Shear Strength (Hand Pocket Penetrometer & Hand Shear Vane) - vs- Elevation Profile