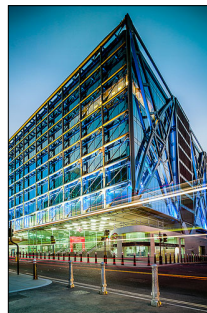

GROUND INVESTIGATION REPORT

15–17 High Road
Ickenham
UB10 8LE

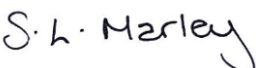
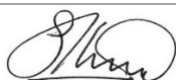
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This report is intended as a Ground Investigation Report (GIR) as defined in BS EN1997-2, unless specifically noted otherwise. The report is not a Geotechnical Design Report (GDR) as defined in EN1997-2 and recommendations made within this report are for guidance only.

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APPENDIX

EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Tully De'Ath, on behalf of Ash Properties Ltd, with respect to the redevelopment of the site through the construction of a three-storey block of flats with associated car parking and communal amenity space. The purpose of the investigation has been to review a previous desk study carried out by GEA, to review the results of contamination testing carried out at the site previously and provided by the client, to determine the risk of encountering UXO beneath the site, to determine the ground conditions and hydrogeology, to investigate the foundations of the adjacent buildings, to provide an indication of the presence of contamination and to provide information to assist with the design of suitable foundations.

PREVIOUS DESK STUDY

The previously completed desk study indicates that, at the time of the earliest map studied, dated 1891, two buildings had been established on site and a well was present in the north. The surrounding area was largely undeveloped except for the existing High Road, which was unnamed. By 1914, the buildings on site had been demolished and replaced with what appear to be the existing buildings. The buildings had been altered by 1934 to cover a larger footprint and another building was constructed in the southern corner of the site. By 1961 the site was labelled as a builder's yard, whilst the southern portion was labelled as 'Pete Cottages', but the house in the south was no longer present. Council records indicate that the site was occupied by a garden centre by 2002 and subsequently used for the illegal storage of vehicles, although had become vacant by 2004.

GROUND CONDITIONS

The expected ground conditions were encountered in that, below a nominal to moderate thickness of made ground, the London Clay was encountered over the Lambeth Group, which was proved to the maximum depth of investigation at 20.00 m. The made ground generally comprises dark brown and grey sandy gravelly clay including brick rubble, ash, organic material, roots and rootlets and extends to depths of between 0.40 m and 0.80 m, although the thickness was not proved in Trial Pit No 1 where a concrete obstruction was encountered at a depth of 1.20 m. The London Clay comprised brown and grey brown sandy silty clay with rare gravel and rootlets and extends to a depth of around 1.20 m. The underlying Lambeth Group initially comprised firm becoming stiff low strength becoming medium strength then high and very high strength light grey mottled light brown and multi-coloured (brown, grey, orange-brown mottled purple) silty clay, including occasional coarse sand to fine gravel sized fragments of claystone to a depth of around 10.10 m. Firm brown mottled blue grey sandy clay then extended to 11.80 m and was underlain by brown clayey sand including pockets of brown mottled blue grey sandy clay, which was encountered to a depth of 13.80 m. The Lambeth Group then comprised very dense grey-brown silty fine sand including occasional fragments of claystone and pockets of dark brown fine sand, which was proved to the base of the borehole at 20.00 m. A groundwater seepage was encountered at a depth of 4.00 m within the clay of the Lambeth Group and groundwater was also encountered from within the underlying sand at a depth of 13.80 m, rising to 5.70 m overnight. Perched water was encountered from within the made ground. A single sample of the made ground originating in Trial Pit No 2 contained an elevated concentration of total PAH. The results of the previous investigation indicate an elevated concentration of total PAH in a sample from the north of the site and an elevated concentration of lead in a single sample from the west of the site. Asbestos has not been detected in the samples screened.

RECOMMENDATIONS

The loads for the proposed building are not known but are anticipated to be moderate and, given the deepening of foundations likely to be required in accordance with NHBC requirements, piled foundations may be the most appropriate foundation solution. Groundwater is likely to be encountered from within silty and sandy portions of the Lambeth Group and from within the sand at depth. End users will need to be protected from potentially contaminated soils in areas of soft landscaping, where a clean cover system will need to be implemented to prevent a pathway existing to end users and to ensure successful plant growth if the site strip does not remove all of the made ground in these areas. A Remediation Method Statement report is in hand and will be issued in due course. It is likely that verification of the areas of soft landscaping, including additional testing and a report upon completion of the gardens, will be required. Site workers should be made aware of the presence of contamination and a suitable programme of work selected.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

1.0 INTRODUCTION

Geotechnical and Environmental Associates Limited (GEA) has been commissioned by Tully De'Ath, on behalf of Ash Properties Ltd, to carry out a ground investigation at 15 to 17 High Road, Ickenham, UB10 8LE. A desk study has previously been prepared by GEA (report ref J16279 dated December 2016) and is referred to in this report as appropriate.

The consulting engineers have provided the results of contamination testing carried out previously at the site, commissioned by the client, and a review is included in this report.

A Remediation Method Statement report is in hand and will be issued in due course.

1.1 Proposed Development

It is understood that the proposals include the construction of a new three-storey apartment block with associated car parking and communal amenity space. It is also understood that a site strip will be carried out and that the ground level will be reduced by around 0.50 m to fall relatively level with the site surroundings.

This report is specific to the proposed development and the advice herein should be reviewed if the development proposals are amended.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- ❑ to review the previously completed desk study;
- ❑ to review the contamination test results from a previous investigation;
- ❑ to determine the risk of encountering UXO beneath the site;
- ❑ to determine the ground conditions and hydrogeology and their engineering properties;
- ❑ to investigate the foundations of the buildings along the boundary walls;
- ❑ to provide an indication of the degree of soil contamination present; and
- ❑ to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

1.3 Scope of Work

In order to meet the above objectives, a ground investigation was carried out which comprised, in summary, the following activities:

- ❑ commissioning of a Preliminary UXO Risk Assessment by 1st Line Defence, a specialist in the field;
- ❑ a single borehole advanced to a depth of 20 m by a standard cable percussion rig;
- ❑ standard penetration tests (SPTs) carried out at regular intervals within the borehole to provide quantitative data on the strength of the soils;
- ❑ manual excavation of two trial pits along the northern and southern boundary walls to investigate the foundations;
- ❑ California Bearing Ratio (CBR) tests carried out at three locations specified by the consulting engineers;
- ❑ testing of selected soil samples for contamination and geotechnical purposes; and
- ❑ provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

The report includes a contaminated land assessment which has been undertaken in accordance with the methodology presented in Contaminated Land Report (CLR) 11¹ and involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment.

The exploratory methods adopted in this investigation have been selected on the basis of the constraints of the site including but not limited to access and space limitations, together with any budgetary or timing constraints. Where it has not been possible to reasonably use an EC7 compliant investigation technique a practical alternative has been adopted to obtain indicative soil parameters and any interpretation is based upon engineering experience, local precedent where applicable and relevant published information.

1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or ground water samples tested. No liability can be accepted for conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from third parties are given in good faith on the assumption that the information is accurate; no independent validation of third party information has been made by GEA.

1 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004

2.0 THE SITE

2.1 Site Description

The site is located in London Borough of Hillingdon, west London, approximately 400 m northwest of Ickenham London Underground (LUL) Station and 600 m southwest of West Ruislip LUL Station. The site is positioned approximately 20 m north of the junction between High Road (B466) and Austin's Lane, with High Road bordering the site to the east and Austin's Lane extending to the southeast.

The site is part of the Hillingdon Conservation Area and forms a roughly square shaped area that measures approximately 35 m north to south by 35 m west to east. At the time of the desk study, carried out in December 2016, it was occupied by a pair of semi-detached Victorian cottages with a single storey outbuilding to the rear. Evidence of a previous flat-roofed bungalow was present to the north. By the time of the ground investigation, carried out in February 2019, the buildings had been demolished although the demolition rubble remained piled in the centre of the site and a mound of soil was present in the west. A container was located in the north of the site, but the contents are unknown and general waste and discarded materials, including tyres and timber, were noted in the far north of the site, behind the container. The eastern and southern parts of the site are overgrown with vegetation.

Several trees including sycamore, willow and silver birch with heights of between approximately 5 m and 15 m are present along the boundaries of the site. The site is at an elevation of approximately 41 m OD, although the presence of the demolition rubble, waste and spoil make the site appear uneven. A concrete path remains present from the entrance in the north, off High Street, extending westwards beyond the former northern elevation of No 17 High Road and is in poor condition with cracks.

2.2 Site History

The site history was researched in the previously completed desk study, with reference to internet sources and historical Ordnance Survey (OS) maps obtained from the Envirocheck database.

The earliest map studied, dated 1891, shows two buildings and a well in the north of the site. The surrounding area was largely undeveloped except for a few residential properties towards the north and west and an unnamed road located along the eastern boundary. The next map, dated 1896, shows no change to the site but a school had been developed to the east and a canal feeder was present north of the site.

At some time between 1896 and 1914, what appear to be essentially the two existing buildings had been constructed in the centre of the site and both neighbouring sites were developed. It was used as a depot and comprised large sheds, the closest of which was approximately 100 m east of the site. By 1934, the two buildings on site had either been replaced or altered and an additional building was located in the southern corner.

By 1961 the northern and western parts of the site are labelled as a builders' yard with the southern part of the site labelled 'Pete Cottages'. By 1979, the surrounding area had been developed with housing in largely the present day configuration. On the map dated 1987, two extensions to the buildings had been constructed on site. In 2002 15-17 High Road was occupied by a garden centre, by 2004 the site was being illegally used for the sale, parking and storage of cars and by November of 2004 the site was again vacant with wooden hoarding surrounding the site.

2.3 Other Information

A search of public registers and databases has been made via the Envirocheck database and relevant extracts from the search are appended. Full results of the search can be provided if required.

The desk study research indicated that there are no active or historical landfills, waste management, transfer or disposal facilities, discharge consents or water abstraction points within 500 m of the site. A single potentially infilled area of land has been identified 230 m northeast of the site and a single pollution incident to controlled waters occurred 468 m northwest of the site.

There are four permitted or authorised local authority pollution prevention and controls sites within 500 m, the closest being 115 m northeast at 53–55 High Road, which is an active petrol filling station. One other active petrol filling station is present within 500 m of the site, located at 12 Long Lane, 190 m south of the site.

Reference to records compiled by the Health Protection Agency (formerly the National Radiological Protection Board) indicates that the site falls within an area where less than 1 % of homes are affected by radon emissions and therefore radon protective measures will not be necessary.

2.3.1 Results of Previous Investigation

The consulting engineers have provided information from a previous limited ground investigation that included the collection and subsequent testing of four samples, although the date, depth and target stratum of sampling is unknown. The results indicate that a single sample originating in the north of the site contained an elevated concentration of total PAH, whilst a sample from the west of the site contained an elevated concentration of lead. The significance of these results is considered further in Part 2 of this report.

2.4 Preliminary UXO Risk Assessment

A Preliminary UXO Risk Assessment has been completed by 1st Line Defence (report ref EP8246-01, dated 21 February 2019) and the report is included in the appendix. The risk assessment has been carried out in accordance with the guidelines provided by CIRIA, which state that the likelihood of encountering and detonating UXO below a site should be assessed along with establishing the consequences that may arise. The first phase comprises a preliminary risk assessment, which should be undertaken at an early stage of the development planning. If such an assessment identifies a high level of risk then a detailed risk assessment should be carried out by a UXO specialist, which will identify an appropriate course of action with regard to risk mitigation.

The report indicates that, during WWII, the site was within the Municipal Borough of Uxbridge, which sustained a low density of bombing. No incidents are recorded for the site or immediate surroundings and no damage as a result of nearby bombing is recorded for the site. It is also anticipated that the site was regularly accessed during the war due to the nature of the site and surroundings area, such that it is unlikely that items of UXO would have gone unnoticed.

On the basis of the above, the report concludes the risk at the site to be no higher than the background risk, such that further research in the form of a Detailed UXO Risk Assessment is unlikely to significantly alter the findings of the preliminary report. It therefore did not recommend any further action with respect to the risk of encountering UXO at this site. If the client has any anecdotal or empirical evidence of UXO risk on site, please contact 1st Line Defence.

2.5 Geology

The British Geological Survey (BGS) map of the area indicates that the site is underlain by the London Clay Formation, which is underlain by the Lambeth Group.

The BGS hold archive records of a borehole advanced around 140 m to the south of the site (ref TQ08NE8). The ground conditions encountered comprised 'various coloured clay' over clay and sand extending to a depth of 12.19 m, beneath which was sand and water to a depth of 16.46 m, over blue clay then black flints encountered to a depth of 19.51 m. A note at the base of the records suggests that the initial 0.15 m to 0.20 m of clay comprised the London Clay. The stratum are collectively labelled as both the London Clay and the Lambeth Group, formerly referred to as the Woolwich and Reading Beds, although most likely can all be attributed to the Lambeth Group. The Lambeth Group was underlain by the Upper Chalk, which was proved to the base of the borehole at 43.89 m. Thanet Sand is not recorded.

The BGS also hold records of a borehole advanced approximately 175 m to the east of the site (ref TQ08NE19). The ground conditions encountered comprised made ground to a depth of 1.30 m (39.47 m OD), which consisted of ash, cinder, slag and brick rubble. This was underlain by soft becoming firm brown and grey silty sandy to very sandy clay, with some fossil remains, likely to comprise the London Clay Formation and extending to a depth of 3.50 m (37.27 m OD). Stiff to very stiff red, brown and grey silty clay was then encountered to a depth of 6.50 m (34.27 m OD), beneath which was very stiff fissured brown and grey silty clay extending to the base of the borehole at 10.00 m (30.72 m OD), which is expected to comprise the Lambeth Group.

2.6 Hydrology and Hydrogeology

The London Clay Formation is classified by the Environment Agency (EA) as an Unproductive Stratum, which refers to rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The nearest listed water abstraction is approximately 820 m southwest of the site. The site is not located within a Groundwater Source Protection Zone, as defined by the EA.

The nearest surface water feature is located approximately 25 m to the southeast of the site and is associated with a former canal feeder that has been culverted. The nearest natural surface water feature is the River Pinn located 660 m to the west and a tributary of the river is located approximately 200 m to the north.

Groundwater is not recorded on the aforementioned BGS archive records.

Infiltration of rainwater into the ground beneath the site is currently possible in areas of soft landscaping and overgrown vegetation and through gaps and cracks in the hardstanding.

2.7 Preliminary Risk Assessment

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a "suitable for use" approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

2.7.1 Source

The desk study findings indicate that the site has a potentially contaminative history, having been in use as a builders yard and then a garden centre and later for car storage. These former uses are typically associated with hydrocarbon and heavy metal contamination

The use of fertilisers and pesticides commonly associated with garden centres may have also occurred on site however, given the size of the site and the short time that the site was occupied by a garden centre, the resulting contamination would be limited.

No sources of soil gas or migrating landfill gas have been identified on or in proximity to the site.

2.7.2 Receptor

The proposed redevelopment of the building for residential purposes will result in the end users representing relatively high sensitivity receptors.

The London Clay beneath the site is classified as an Unproductive Stratum, and as such groundwater does not represent a sensitive receptor.

Buried services, concrete and site workers are also considered to be receptors.

2.7.3 Pathway

The proposed redevelopment of the site will result in the majority of the site being covered by the footprint of the proposed building and extent of hardstanding, although in the proposed communal garden a pathway will exist whereby end users could come into direct contact with potentially contaminated soils.

The site is expected to be directly underlain by an Unproductive Stratum and as a result, there is not expected to be a pathway for offsite sources to the site, the migration of contaminants on or off site via groundwater flow or for groundwater percolation into the underlying deep aquifer.

Buried services may come into contact with any contaminants present within the soils through which they pass and site workers could come into direct contact with any contaminants present in the soil and through inhalation of vapours or dust during construction and site works.

2.7.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a MODERATE to LOW risk of there being a significant contaminant linkage at this site which would result in a requirement for major remediation work.

3.0 EXPLORATORY WORK

At the time of the fieldwork, the buildings previously occupying the site had been demolished but the building rubble remained piled in the middle of the site, limiting access. As such, the location of Borehole No 1 was moved further to the north to an accessible location for the standard cable percussion drilling rig.

In order to meet the objectives described in Section 1.2 whilst working within the access restrictions described above, a single borehole was advanced to a depth of 20.00 m using a standard cable percussion rig. Additionally, two trial pits were manually excavated along the northern and southern boundaries in order to investigate the party wall foundations and CBR tests were undertaken at three locations specified by the consulting engineers.

During boring, disturbed and undisturbed samples were obtained from the borehole for subsequent laboratory examination and testing. Standard Penetration Tests (SPTs) were carried out at regular intervals to provide additional quantitative data on the strength of soils encountered.

A selection of the samples recovered from the borehole and trial pits was submitted to a soil mechanics laboratory for a programme of geotechnical testing and an analytical laboratory for a programme of contamination testing.

All of the above work was carried out under the supervision of a geotechnical engineer from GEA.

The borehole, trial pit and CBR records are appended, together with a site plan indicating the exploratory positions.

3.1 Sampling Strategy

The trial pit and borehole locations were specified by the consulting engineers, Tully De'Ath, and agreed with GEA during an initial conversation and positioned on site by a geotechnical engineer from GEA whilst avoiding known and suspected buried services.

Three samples of the made ground have been tested for the presence of contamination. The analytical suite of testing was selected to identify contamination resulting from the former use of the site and a range of typical industrial contaminants for the purposes of general coverage. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. Samples were also screened for the presence of asbestos.

Samples of the natural soil were collected and submitted to a geotechnical laboratory and scheduled for a programme of geotechnical testing, which included quick undrained triaxial compression testing, Atterberg limit testing, and soluble sulphate and pH analysis.

The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. A summary of the MCERTs accreditation and test methods are included with the attached results and further details are available upon request.

4.0 GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, beneath a moderate thickness of made ground, the London Clay Formation was encountered over the Lambeth Group.

4.1 Made Ground

The made ground comprised dark brown and grey sandy gravelly clay including brick rubble, ash, organic material, roots and rootlets and extended to a depth of 0.80 m in the borehole and extended to the base of Trial Pit No 1 at 1.20 m and was proved to a depth of around 0.40 m in Trial Pit No 2.

A concrete obstruction was encountered at a depth of 1.20 m in Trial Pit No 1, excavated along the northern boundary of the site, and could have been encasing a drain run. Perched water was encountered just above the obstruction.

Apart from the presence of fragments of extraneous material noted above, no visual or olfactory evidence of contamination was observed during the fieldwork. Three samples of the made ground have however been analysed for a range of contaminants as a precautionary measure and the results are detailed within Section 4.6.

4.2 London Clay

The London Clay was encountered in Borehole No 1 only and comprised brown and grey brown slightly sandy silty clay with rare gravel and rootlets, extending to a depth of around 1.20 m. The presence of gravel suggests that the London Clay may have naturally been reworked.

The results of plasticity index tests indicate the clay to be of high volume change potential.

4.3 Lambeth Group

The Lambeth Group initially comprised firm becoming stiff low strength becoming medium strength then high and very high strength light grey mottled light brown and multi-coloured (brown, grey, orange-brown mottled purple) silty clay, including occasional coarse sand to fine gravel sized fragments of claystone. This clay was encountered to a depth of around 10.10 m, whereupon firm brown mottled blue grey sandy clay extended to 11.80 m. This was underlain by brown clayey sand including pockets of brown mottled blue grey sandy clay, which was encountered to a depth of 13.80 m. The Lambeth Group then comprised very dense brown silty sand including occasional fragments of claystone, which was proved to the base of the borehole at 20.00 m.

The decrease in strength noted at a depth of around 4.00 m is likely to be associated with the groundwater seepage also encountered at that depth.

The results of the plasticity index testing indicate the clay at depths of 1.20 m and 1.75 m to be of medium volume change potential, with the underlying clay from 2.75 m to 6.00 m of high and very high volume change potential.

4.4 Groundwater

A groundwater seepage was encountered within the sandy clay of the Lambeth Group at a depth of around 4.00 m and groundwater was recorded at a depth of 13.80 m from within the silty sand of the Lambeth Group during drilling of Borehole No 1. The groundwater rose to a level of 5.70 m over night.

Perched water was encountered in Trial Pit No 1 at a depth of around 1.20 m and is expected to be associated with the concrete obstruction encountered at that depth.

4.5 Soil Contamination

The table below sets out the values measured within the three samples analysed; all concentrations are in mg/kg unless otherwise stated.

Determinant	BH1 0.50 m	TP1 0.50 m	TP2 0.30 m
pH	8.4	8.2	7.8
Arsenic	13	15	15
Cadmium	< 0.2	< 0.2	0.4
Chromium	24	28	30
Lead	53	41	110
Mercury	< 0.3	< 0.3	< 0.3
Selenium	2.3	< 1.0	< 1.0
Copper	25	31	42
Nickel	17	24	17
Zinc	67	66	240
Total Cyanide	< 1	< 1	< 1
Total Phenols	< 1.0	< 1.0	< 1.0
Total PAH	3.81	< 0.80	94.0
Sulphide	< 1.0	< 1.0	41
Benzo(a)pyrene	0.41	< 0.05	9.1
Naphthalene	< 0.05	< 0.05	0.24
TPH	< 10	< 10	620
Total Organic Carbon %	0.8	0.8	2.5

Note: Figure in bold indicates concentration in excess of risk-based soil guideline values, as discussed in Part 2 of this report.

4.6.1 Generic Quantitative Risk Assessment

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. Contaminants of concern are those that have a value in excess of a generic human health risk-based guideline value, which is either the CLEA Soil Guideline Value where available, a Generic Screening Value calculated using the CLEA UK Version 1.06 software assuming a residential end use with plant uptake, or is based on the DEFRA Category 4 Screening values. The key generic assumptions for this end use are as follows:

- ❑ that groundwater will not be a critical risk receptor;
- ❑ that the critical receptor for human health will be young female children aged zero to six years old;
- ❑ that the exposure duration will be six years;
- ❑ that the critical exposure pathways will be direct soil and indoor dust ingestion, consumption of home grown produce, consumption of soil adhering to home grown produce, skin contact with soils and dust and inhalation of dust and vapours; and
- ❑ that the building type equates to a terraced house.

It is considered that these assumptions are acceptable for this generic assessment of this site. The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

Where contaminant concentrations are measured at concentrations below the generic screening value it is considered that they pose an acceptable level of risk and thus further consideration of these contaminant concentrations is not required. However, where concentrations are measured in excess of these generic screening values there is considered to be a potential that they could pose an unacceptable risk and thus further action will be required which could include;

- ❑ additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;
- ❑ site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or
- ❑ soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

The results of the chemical analyses indicate that a single sample of made ground, from Trial Pit No 2 at a depth of 0.30 m, contained an elevated concentration of total PAH, including benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene and dibenz(a,h)anthracene. Asbestos has not been detected.

The significance of these results is considered further in Part 2 of the report.

4.7 CBR Test Results

California Bearing Ratio (CBR) testing has been carried out at three locations as specified by the consulting engineers in order to provide parameters for the design of hardstanding. The results indicate values of between 2.7 % and 4.6 % at a depth of 0.50 m. The results are included in the appendix.

4.8 Existing Foundations

The findings of the trial pits are summarised in the table below. The trial pits were logged by a geotechnical engineer from GEA and sketches of each pit have been provided by the Consulting Engineers and are included in the Appendix.

Trial Pit No	Structure	Foundation detail	Bearing Stratum
1	Neighbouring building to the north	Two brick corbels over concrete strip Top brick: 0.25 m Top concrete: 0.35 Base: 0.60 m Lateral projection 160 mm	Made Ground (brown mottled grey slightly sandy slightly gravelly clay including occasional fragments of red brick and carbonaceous material)
2	Neighbouring building to the south	Concrete strip Top: 0.25 m Base: 0.95 m Lateral projection 350 mm	Firm brown mottled light grey silty slightly gravelly CLAY including roots and rootlets. Gravel is fine subrounded black flint.

Part 2: DESIGN BASIS REPORT

This section of the report provides an interpretation of the findings detailed in Part 1, in the form of a ground model, and then provides advice and recommendations with respect to the proposed development.

5.0 INTRODUCTION

It is understood that it is proposed to construct a new three storey apartment block with associated car parking and communal amenity space at the site. The proposed loads are not known but are anticipated to be moderate.

6.0 GROUND MODEL

The previous desk study revealed that the site has a potentially contaminative historical use as it has been occupied by a builders yard and then a garden centre and later used for car storage. On the basis of the fieldwork, the ground conditions at this site can be characterised as follows:

- ❑ below a nominal to moderate thickness of made ground, London Clay was encountered over the Lambeth Group, which was proved to the maximum depth of investigation at 20.00 m;
- ❑ the made ground generally comprises dark brown and grey sandy gravelly clay including brick rubble, ash, organic material, roots and rootlets and extends to depths of between 0.40 m and 0.80 m, although the thickness was not proved in Trial Pit No 1 where a concrete obstruction is present at a depth of 1.20 m;
- ❑ the London Clay Formation comprised brown and grey brown sandy silty clay with rare gravel and rootlets and extends to a depth of around 1.20 m;
- ❑ the Lambeth Group initially comprised firm becoming stiff low strength becoming medium strength then high and very high strength light grey mottled light brown and multi-coloured (brown, grey, orange-brown mottled purple) silty clay, including occasional coarse sand to fine gravel sized fragments of claystone to a depth of around 10.10 m;
- ❑ firm brown mottled blue grey sandy clay then extended to 11.80 m and was underlain by brown clayey sand including pockets of brown mottled blue grey sandy clay, which was encountered to a depth of 13.80 m;
- ❑ the Lambeth Group then comprised very dense grey-brown silty fine sand including occasional fragments of claystone and pockets of dark brown fine sand, which was proved to the base of the borehole at 20.00 m;
- ❑ a groundwater seepage was encountered at a depth of 4.00 m within the clay of the Lambeth Group and groundwater was also encountered from within the underlying sand at a depth of 13.80 m, rising to 5.70 m overnight;
- ❑ perched water was encountered from within the made ground;

- ❑ a single sample of the made ground originating in Trial Pit No 2 contained an elevated concentration of total PAH;
- ❑ the results of the previous investigation indicate an elevated concentration of total PAH in a sample from the north of the site and an elevated concentration of lead in a single sample from the west of the site; and
- ❑ asbestos has not been detected in the samples screened.

7.0 ADVICE AND RECOMMENDATIONS

Consideration is being given to the construction of a new three-storey apartment block with associated car parking and communal amenity space. It is understood that a site strip will be carried out such that the site level will be reduced by 0.50 m to match the level of the surroundings.

The shallow clay soils should provide a suitable bearing stratum for spread foundations supporting the anticipated relatively light loads. Consideration may however need to be given to piled foundations where deepening of spread foundations in accordance with NHBC guidelines renders shallow foundations uneconomic.

7.1 Spread Foundations

Moderate width strip or pad foundations bearing on the firm London Clay or Lambeth Group should be placed at a minimum depth of 1.5 m, allowing for restricted new planting in accordance with Table 5 of NHBC Standards Chapter 4.2 (2017). If trees are excluded within the zone of influence shown in Table 5 of the NHBC guidance, the minimum depth can be reduced to 1.0 m subject also to the further advice on new tree and shrub planting as detailed in the NHBC guidelines. The foundations may be designed to apply a net allowable bearing pressure of 100 kN/m². This value incorporates an adequate factor of safety against bearing capacity failure and should ensure that settlement remains within normal tolerable limits. The recommended bearing pressure takes account of the variable nature of the soils and any foundations should be nominally reinforced where they span clay and granular material to protect against differential settlement.

Foundations will need to be deepened in the vicinity of existing and proposed trees and National House Building Council (NHBC) guidelines should be followed in this respect. High shrinkability clays should be assumed. Where trees are to be removed the required founding depth should be determined on the basis of the existing tree height if it is less than 50% of the mature height and on the basis of full mature height if the current height is more than 50% of the mature height. Where a tree is to be retained the final mature height should be adopted. Notwithstanding NHBC guidelines, all foundations should extend beyond the zone of desiccation. In this respect it would be prudent to have all foundation excavations inspected by a suitably experienced engineer. Due allowance should be made for future growth of the trees.

The requirement for compressible material alongside foundations should be determined by reference to the NHBC guidelines. If trees are to be planted in close proximity to the new buildings founding depths should be deepened in accordance with NHBC guidelines and using the mature height of the tree. High shrinkability clay should be assumed.

7.2 Piled Foundations

For the ground conditions at this site a bored pile could be adopted. A conventional rotary augered pile could be utilised but consideration will need to be given to the possible instability and water ingress within the made ground and silty portions of the London Clay. The use of bored piles installed using continuous flight auger (cfa) techniques may therefore be the most appropriate.

The following table of ultimate coefficients may be used for the preliminary design of bored piles, based on the SPT and cohesion / depth graph in the appendix.

Stratum	Depths m	kN / m ²
Ultimate Skin Friction		
Made Ground	GL to 1.00	Ignore
Lambeth Group (clay)	1.00 to 12.00	Increasing linearly from 14 to 80
Lambeth Group (sand)	12.00 to 20.00	160
Ultimate End Bearing		
Lambeth Group (clay)	8.00 to 10.00	Increasing linearly from 1260 to 1800
Lambeth Group (sand)	12.00 to 15.00	Limited to 10,500

In the design of piled foundations the effect of potential future shrinkage and swelling of the clay should be taken into account. In designing for compressive loads it should be assumed that further desiccation, and hence shrinkage of the clay, could continue where trees are to remain. Pile shaft adhesion within the theoretical maximum future desiccated thickness should therefore be ignored.

Heave of the clay soils could also occur due to future swelling as a result of trees being removed. This would exert a tensile uplift force on the piles, unless piles are effectively isolated from the surrounding soil by means of a slip layer or sleeve around the pile shaft.

On completion of construction the uplift forces would, to some extent, be counteracted by the applied loads. However, since the full structural loads may well be less than the potential uplift forces the piles would, in the absence of sleeving, need to be sufficiently "anchored" below the desiccated zone to withstand the uplift forces. Adequate reinforcement would need to be provided to accommodate the resulting tension.

In the absence of pile tests, it is normal practice to apply a factor of safety of three to the above coefficients in the computation of theoretical safe working loads. A minimum factor of safety of 1.2 is generally specified to determine the length of pile required to resist potential uplift forces.

In the absence of pile tests, a factor of safety of 3 should be applied to the above coefficients in the computation of safe theoretical working loads. On the basis of the above coefficients, the following pile capacities have been estimated.

Pile diameter mm	Depth Below Ground Level m	Safe Working Load kN
300	8	130
	10	170
	12	205
450	10	285
	12	340
	15	1030

The above examples are not intended to constitute any form of recommendation with regard to pile size or type, but merely serve to illustrate the use of the above coefficients. Specialist piling contractors should be consulted with regard to the design of a suitable piling scheme and their attention should be drawn to potential groundwater inflows within siltier or sandy zones of the Lambeth Group.

If piles will be required to extend beyond the maximum depth of the investigation of 20.00 m, additional investigation should be carried out to confirm the extrapolated design parameters used in the calculation of the above safe working loads.

7.3 Shallow Excavations

On the basis of the investigation findings it is considered that it will be generally feasible to form relatively shallow excavations terminating within the made ground and London Clay without the requirement for lateral support, although localised instabilities may occur where more granular material or groundwater is encountered. Groundwater may be encountered from within the Lambeth Group at depth.

Significant inflows of groundwater into shallow excavations are not generally anticipated, but seepages may be encountered from perched water tables within the made ground, or within siltier zones of the London Clay Formation, although such inflows should be suitably controlled by sump pumping. Seepages are likely to be encountered as a result of perched water from within the made ground.

If deeper excavations are considered or if excavations are to remain open for prolonged periods it is recommended that provision be made for battered side slopes or lateral support. Where personnel are required to enter excavations, a risk assessment should be carried out and temporary lateral support or battering of the excavation sides considered in order to comply with normal safety requirements.

7.4 Ground Floor Slab

The building is likely to be within the zone of influence of the trees around the site boundaries, such that the floor slab will need to be suspended over a void in accordance with NHBC guidelines.

7.5 Effect of Sulphates

Chemical analyses of samples of the made ground and natural soil has revealed relatively low concentrations of soluble sulphate and near-neutral pH in accordance with Class DS-1 conditions of Table C2 of BRE Special Digest 1:SD Third Edition (2005). The measured pH

values of the samples show that an ACEC class of AC-1 would be appropriate for the site. This assumes a mobile water condition at the site. The guidelines contained in the digest should be followed in the design of foundation concrete.

7.6 Contamination Risk Assessment

The desk study findings indicate that the site has a potentially contaminative history, having been occupied by a builders yard and then a garden centre and later used for car storage. The results of a previous investigation indicate the presence of an elevated concentration of total PAH in a sample originating in the north of the site and an elevated concentration of lead from a sample in the west of the site, which are assumed to originate in the made ground. The results of this investigation indicate an elevated concentration of total PAH in a single sample of the made ground from a depth of 0.30 m in the far south of the site. Asbestos was not detected in the samples screened for the contaminant.

The individual PAH chain lengths are indicative of typical made ground including ash, coal or pre-war tarmac fragments and the made ground was noted as including fragments of such material. As such, the source of the elevated concentration of PAH is likely to be fragments of extraneous material within the made ground and is therefore not likely to pose a risk to groundwater or buried services. The contamination will however pose a risk to end users and construction workers and these risks are further assessed below.

The exact source of the lead contamination encountered during the previous investigation is unknown but the made ground was noted as containing fragments of extraneous material and it is possible that fragments of such material, for example, coal or old paint fragments, could account for the elevated concentration. As a result the lead contamination is not expected to be in a soluble state and should not, therefore, pose a risk to adjacent sites, groundwater or buried services.

The proposals are understood to include a site strip to a depth of around 0.50 m to reduce the level of the site to be consistent with the surroundings. As such, the majority of the made ground will be removed in any case.

The new building and extent of hardstanding will effectively form a barrier between end users and potentially contaminated soil. Only in areas of soft landscaping will a pathway exist to end users and this is further assessed below. Further detail will be provided in the Remediation Method Statement report, which will be issued in due course.

7.6.1 End Users

Within the site, end users will be isolated from direct contact with any contaminants present within the soil and made ground by the presence of the new building and extent of hardstanding. There will therefore be a relatively limited potential for contaminant exposure pathways, as the building and hardstanding will effectively form a barrier between any contaminants within the near-surface soils and end-users or infiltration of surface water. However, in areas of soft landscaping a pathway will exist by which end users can come into contact with any contamination in the shallow soils, via direct contact, accidental ingestion of soil and soil derived dust and soil adhering to home grown produce. This risk is considered to be relatively low given that the soft landscaping is likely to form managed communal space, as opposed to private gardens.

The critical exposure pathways identified will be direct soil and dust ingestion, consumption of home grown produce, consumption of soil adhering to home grown produce, skin contact with soils and dust, and inhalation of dust. Following the site strip, additional investigation

should be carried out to determine the thickness of made ground remaining in areas of proposed soft landscaping. If only a limited thickness remains it is likely to be cost-effective to remove it and import clean topsoil and subsoil to satisfy planting requirements. Where made ground remains below the site strip depth and will not be removed, a cover system should be implemented.

For the clean cover system, a thickness of imported subsoil and topsoil of 600 mm in thickness should be specified to ensure successful plant growth, in accordance with recommendations from BRE and should include a geotextile marker membrane to give a visual warning of and discourage further digging into the contaminated soils. A validation report will be required to confirm that the imported soil is certified as clean. Where a thickness of greater than 600 mm of clean imported soil is likely to be required by the Local Authority, additional testing of the garden area will be required.

It may be possible to reduce the final thickness of cover required, but this will need to be determined once it has been established if made ground is to be removed from site in areas of soft landscaping, what the final levels are and what the concentrations of potential contaminants within the imported material are. The imported soil should be certified as clean at source with appropriate documentation, including chemical analyses. Certificates obtained for all imported soil demonstrating that it is free from contamination will form part of the validation process. On site testing will also be required to demonstrate the suitability of the material. Further detail is provided in the Remediation Method Statement for the site.

7.6.2 Services

Consideration may need to be given to the protection of buried plastic services laid within the made ground. Details of the proposed protection measures for buried plastic services will in any case need to be approved by the EHO and the relevant service authority prior to the adoption of any scheme. It is possible that barrier pipe will be required or additional testing will need to be carried out.

7.6.3 Site Workers

Elevated concentrations of lead and PAH have been measured in the shallow soils at the site. Site workers should be made aware of the contamination and a programme of working should be identified to protect workers handling any soil. The method of site working should be in accordance with guidelines set out by HSE and CIRIA² and the requirements of the Local Authority Environmental Health Officer.

7.7 Waste Disposal

Under the European Waste Directive, waste is classified as being either Hazardous or Non-Hazardous and landfills receiving waste are classified as accepting hazardous or non-hazardous wastes or the non-hazardous sub-category of inert waste in accordance with the Waste Directive. Waste classification is a staged process and this investigation represents the preliminary sampling exercise of that process. Once the extent and location of the waste that is to be removed has been defined, further sampling and testing may be necessary. The results from this ground investigation should be used to help define the sampling plan for such further testing, which could include WAC leaching tests where the totals analysis indicates the soil to be a hazardous waste or inert waste from a contaminated site. It should however be noted that the Environment Agency guidance WM3³ states that landfill WAC analysis, specifically leaching test results, must not be used for waste classification purposes.

2 CIRIA (1996) *A guide for safe working on contaminated sites* - Report 132, Construction Industry Research and Information Association

3 Environment Agency 2015. *Guidance on the classification and assessment of waste*. Technical Guidance WM3 First Edition

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE⁴ guidance, will need to be disposed of to a licensed tip. Waste going to landfill is subject to landfill tax at either the standard rate of £88.95 per tonne (about £160 per m³) or at the lower rate of £2.80 per tonne (roughly £5 per m³). However, the classifications for tax purposes and disposal purposes differ and currently all made ground and topsoil is taxable at the 'standard' rate and only naturally occurring soil and stones, which are accurately described as such in terms of the 2011 Order, would qualify for the 'lower rate' of landfill tax.

Based upon on the technical guidance provided by the EA it is considered likely that the soils encountered during this ground investigation, as represented by the chemical analyses carried out, would be generally classified as follows;

Soil Type	Waste Classification (Waste Code)	WAC Testing Required Prior to Landfill Disposal?	Current applicable rate of Landfill Tax
Made ground	Non-hazardous (17 05 04)	No	£88.95/tonne (Standard rate)
Lambeth Group	Should be Inert (17 05 04)	Should not be required but confirm with receiving landfill	£2.80 / tonne (Reduced rate for uncontaminated naturally occurring rocks and soils)

Under the requirements of the European Waste Directive all waste needs to be pre-treated prior to disposal. The pre-treatment process must be physical, thermal, chemical or biological, including sorting. It must change the characteristics of the waste in order to reduce its volume, hazardous nature, facilitate handling or enhance recovery. The waste producer can carry out the treatment but they will need to provide documentation to prove that this has been carried out. Alternatively, the treatment can be carried out by an approved contractor. The Environment Agency has issued a position paper⁵ which states that in certain circumstances, segregation at source may be considered as pre-treatment and thus excavated material may not have to be treated prior to landfilling if the soils can be segregated onsite prior to excavation by sufficiently characterising the soils insitu prior to excavation.

The above opinion with regard to the classification of the excavated soils is provided for guidance only and should be confirmed by the receiving landfill once the soils to be discarded have been identified.

The local waste regulation department of the Environment Agency (EA) should be contacted to obtain details of tips that are licensed to accept the soil represented by the test results. The tips will be able to provide costs for disposing of this material but may require further testing.

4 CL:AIRE March 2011. *The Definition of Waste: Development Industry Code of Practice* Version 2

5 Environment Agency 23 Oct 2007 *Regulatory Position Statement Treating non-hazardous waste for landfill - Enforcing the new requirement*

8.0 OUTSTANDING RISKS AND ISSUES

This section of the report aims to highlight areas where further work is required as a result of limitations on the scope of this investigation, or where issues have been identified by this investigation that warrant further consideration. The scope of risks and issues discussed in this section is by no means exhaustive, but covers the main areas where additional work may be required.

The ground is a heterogeneous natural material and variations will inevitably arise between the locations at which it is investigated. This report provides an assessment of the ground conditions based on the discrete points at which the ground was sampled, but the ground conditions should be subject to review as the work proceeds to ensure that any variations from the Ground Model are properly assessed by a suitably qualified person.

If during ground works any visual or olfactory evidence of contamination is identified it is recommended that further investigation be carried out and that the risk assessment is reviewed.

A Remediation Method Statement report is in hand and will be issued in due course. It is likely that verification, including additional testing and a verification report, will be required for soft landscaped areas.

These areas of doubt should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.

APPENDIX

Borehole Records

Trial Pit Records (provided by consultant engineers)

CBR Test Results

Geotechnical Test Results

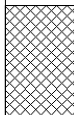
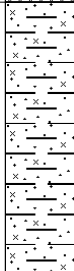
SPT & Cohesion/Depth Graph

Contamination Test Results

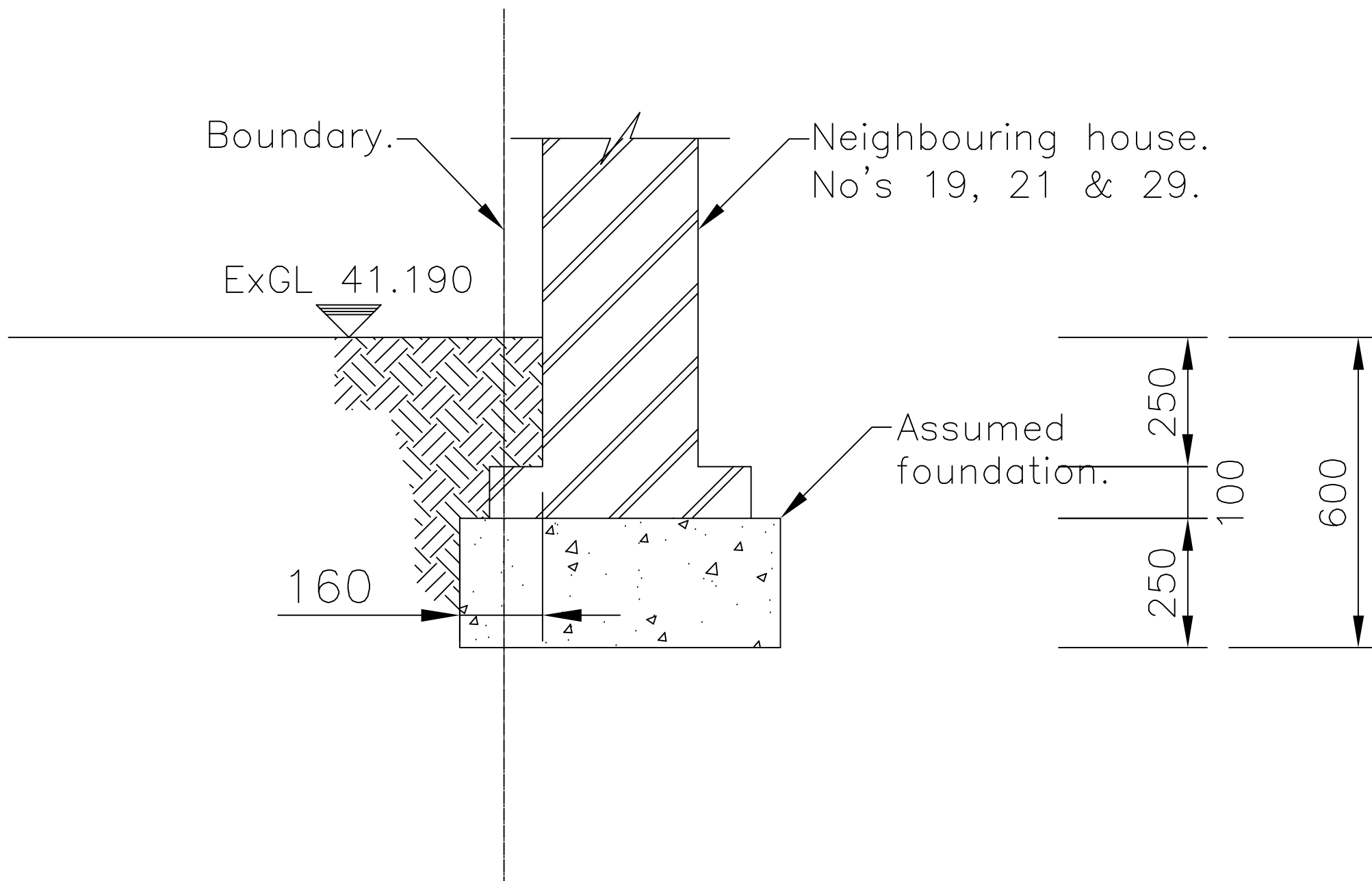
Generic Risk Based Screening Values

Preliminary UXO Risk Assessment

Site Plan

 Geotechnical & Environmental Associates Widbury Barn Widbury Hill Ware SG12 7QE						Site 15-17 High Road, Ickenham, UB10 8LE		Borehole Number BH1		
Boring Method Cable Percussion		Casing Diameter 200mm cased to 14.00m 150mm cased to 20.00m			Ground Level (mOD)		Client Ash Properties Ltd		Job Number J19045	
		Location In the north of the site			Dates 25/02/2019- 26/02/2019		Engineer Tully De'Ath		Sheet 1/2	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	
0.30	D					(0.80)	Made Ground (dark brown and grey sandy gravelly clay including brick rubble, ash, organic material, roots and rootlets)			
0.50	B					0.80				
1.00	D						Soft becoming firm medium strength brown and brown-grey, becoming mottled purple, silty sandy CLAY with rare gravel. Sand is fine.			
1.20-1.65	SPT N60=9			1, 1/2, 1,2,2		(1.80)				
1.20-1.65	D									
1.75	D									
2.00-2.45	U			20 blows						
						2.60				
2.75	D						Firm becoming stiff low strength becoming high then very high strength light grey mottled light brown and purple silty CLAY with coarse sand to fine gravel sized fragments of claystone and occasional pockets of calcareous fine sand.			
3.00-3.45	SPT N60=18			1,2/2,3,4,5						
3.00-3.45	D									
3.00-3.75	D									
				SEEPAGE(1) at 4.00m.						
4.00-4.45	U			35 blows						
4.75	D									
5.00-5.45	SPT N60=28			3,4/5,5,6,6						
5.00-5.45	D									
6.00	D									
6.50-6.95	U			43 blows		(7.50)				
7.50	D									
8.00-8.45	SPT N60=35			4,6/6,7,7,8						
8.00-8.45	D									
9.00	D									
9.50-9.95	U			50 blows						
Remarks One hour spent excavating a service pit to a depth of 1.20 m. Groundwater rose to a depth of 5.70 m overnight and sand blown up to a depth of 14.10 m. Borehole backfilled upon completion.								Scale (approx) 1:50	Logged By SM	
								Figure No. J19045.BH1		

 GEA Geotechnical & Environmental Associates Widbury Barn Widbury Hill Ware SG12 7QE							Site 15-17 High Road, Ickenham, UB10 8LE		Borehole Number BH1
Boring Method Cable Percussion		Casing Diameter 200mm cased to 14.00m 150mm cased to 20.00m		Ground Level (mOD)		Client Ash Properties Ltd		Job Number J19045	
		Location In the north of the site		Dates 25/02/2019- 26/02/2019		Engineer Tully De'Ath		Sheet 2/2	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.50	D					10.10	Soft becoming firm brown mottled blue-grey sandy CLAY. Sand is fine.		
11.00-11.45 11.00-11.45	SPT N60=44 D			5,7/7,8,10,10		(1.70)			
12.00	D					11.80	Dense brown clayey SAND including pockets of brown mottled blue-grey sandy CLAY. Sand is fine.		
12.50-12.95 12.50-12.95	SPT N60=49 D			5,7/8,9,11,11		(2.00)			
13.50	D								
14.00-14.45 14.00-14.45	SPT N60=39 D			Water strike(2) at 13.80m. 2,4/6,7,8,10		13.80 (0.20) 14.00	Dense brown SAND.		∇2
15.00	D						Dense becoming very dense grey-brown silty SAND. Sand is fine to medium, generally fine.		
15.50-15.95 15.50-15.45	SPT N60=66 D			4,7/10,12,14,16					
16.50	D								
17.00-17.45 17.00-17.45	SPT(C) N60=53 D			7,14/1,18,23		(6.00)	... slightly silty after 17.00 m and including coarse angular gravel sized fragments of claystone and pockets of dark grey fine sand from this depth.		
18.00	D								
18.50-18.95 18.50-18.95	SPT(C) N60=79 D			10,15/18,21,23					
19.00	D								
19.55-20.00 19.55-20.00	SPT(C) N60=87 D			8,16/20,23,26			... medium subangular gravel sized fragments of claystone around 19.50 m.		
						20.00			
Remarks One hour spent excavating a service pit to a depth of 1.20 m. Groundwater rose to a depth of 5.70 m overnight and sand blown up to a depth of 14.10 m. Borehole backfilled upon completion.								Scale (approx) 1:50	Logged By SM
								Figure No. J19045.BH1	



Neighbouring house.
No. 9.

Boundary.

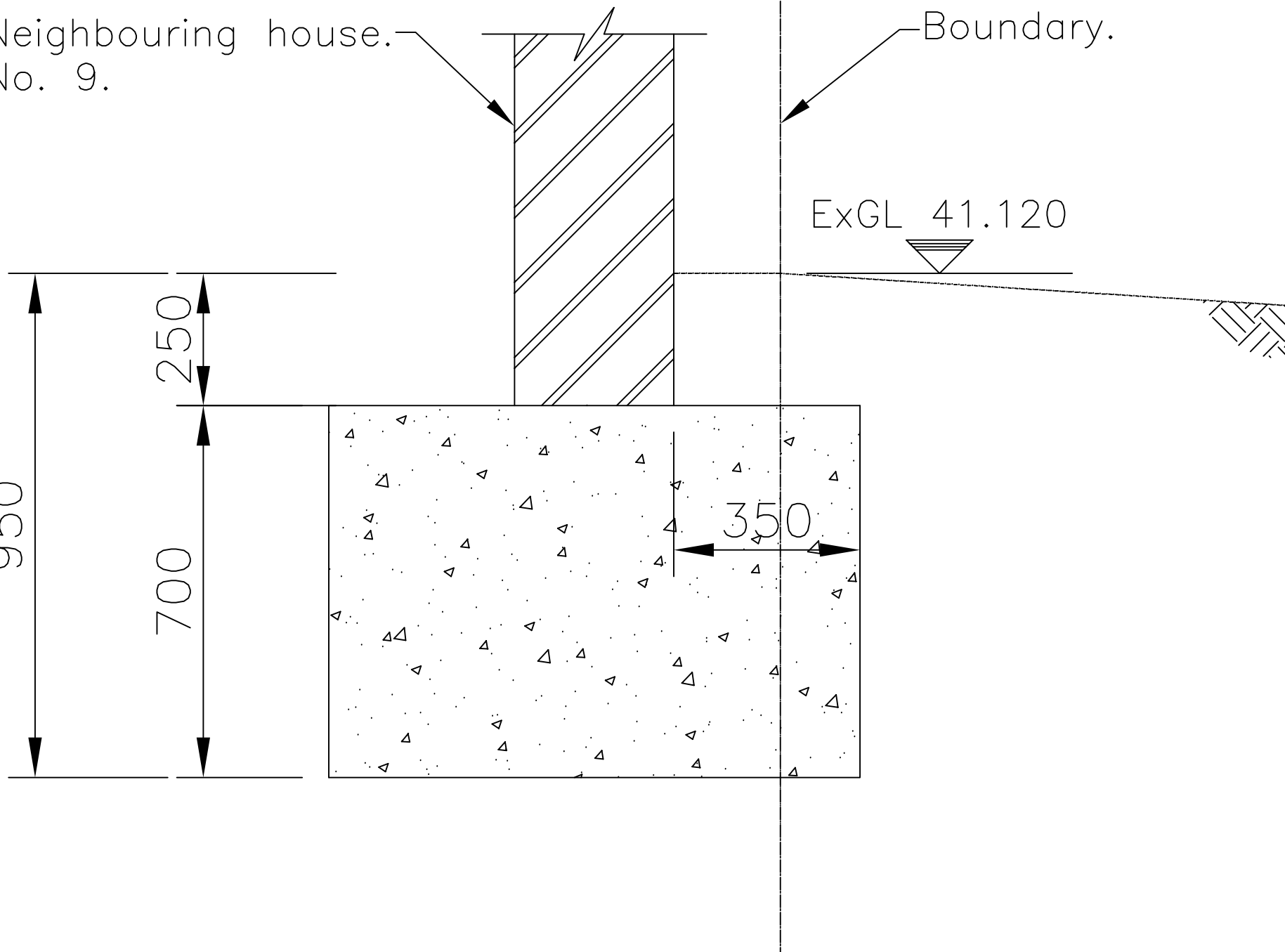
ExGL 41.120

950

250

700

350





In Situ California Bearing Ratio (CBR)

Job Ref 26130
CBR No. CBR1

Site Name 15-17 High Road, Ickenham, UB10 8LE

Depth m 0.50

Project No. J19045 Client GEA Date of Test 28/03/2019

Soil Description Dark brown slightly gravelly slightly sandy silty CLAY with occasional rootlets (gravel is fmc and sub-angular to sub-rounded)

Test Method BS1377 : Part 9 : 1990, clause 4.3 CBR Test Number 1

Note: Test only applicable when maximum particle size beneath the plunger does not exceed 20mm

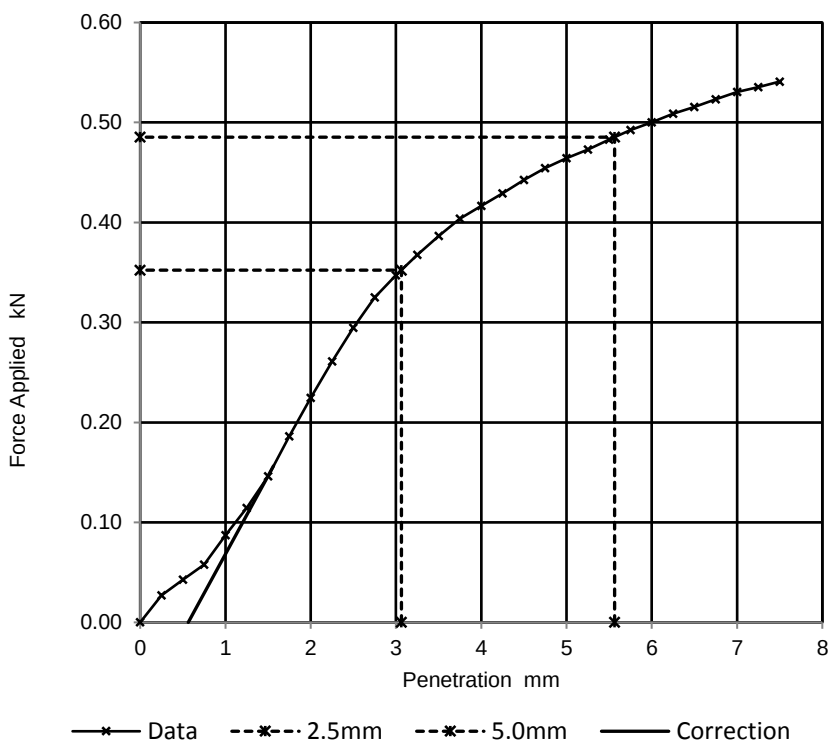
Rate of Strain 1.00 mm/min
Mass of Surcharge 4.6 kg
Proving Ring Factor 0.43 N/div

Temperature 13 °C
Environmental Conditions Clear

Readings

Penetration of Plunger mm	Force on Plunger	
	Dial Reading	Load kN
0.00	0	0.00
0.25	63	0.03
0.50	99	0.04
0.75	134	0.06
1.00	203	0.09
1.25	266	0.11
1.50	340	0.15
1.75	433	0.19
2.00	522	0.22
2.25	607	0.26
2.50	685	0.29
2.75	756	0.33
3.00	807	0.35
3.25	855	0.37
3.50	899	0.39
3.75	939	0.40
4.00	969	0.42
4.25	998	0.43
4.50	1029	0.44
4.75	1057	0.45
5.00	1080	0.46
5.25	1100	0.47
5.50	1123	0.48
5.75	1145	0.49
6.00	1163	0.50
6.25	1183	0.51
6.50	1199	0.52
6.75	1217	0.52
7.00	1234	0.53
7.25	1245	0.54
7.50	1258	0.54

Force versus Penetration Plot



Remarks

Results

Curve correction applied	CBR Values, %			Moisture Content
	Penetration		CBR Value	
	2.5mm	5mm		%
Yes	2.7	2.4	2.7	27



Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU

Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved

Initials: J.P

Date: 01/04/2019



In Situ California Bearing Ratio (CBR)

Job Ref 26130
CBR No. CBR2

Site Name 15-17 High Road, Ickenham, UB10 8LE

Depth m 0.50

Project No. J19045 Client GEA Date of Test 28/03/2019

Soil Description Dark brown slightly gravelly slightly sandy silty CLAY with occasional rootlets (gravel is fmc and sub-angular to sub-rounded)

Test Method BS1377 : Part 9 : 1990, clause 4.3 CBR Test Number 2

Note: Test only applicable when maximum particle size beneath the plunger does not exceed 20mm

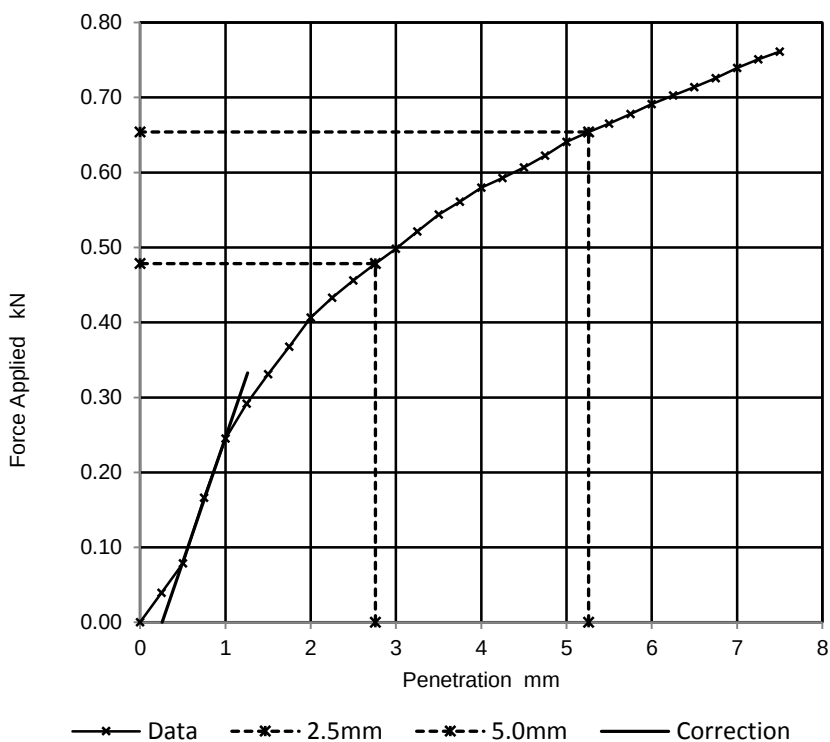
Rate of Strain 1.00 mm/min
Mass of Surcharge 4.6 kg
Proving Ring Factor 0.43 N/div

Temperature 13 °C
Environmental Conditions Clear

Readings

Penetration of Plunger mm	Force on Plunger	
	Dial Reading	Load kN
0.00	0	0.00
0.25	92	0.04
0.50	183	0.08
0.75	387	0.17
1.00	570	0.25
1.25	678	0.29
1.50	770	0.33
1.75	855	0.37
2.00	945	0.41
2.25	1007	0.43
2.50	1061	0.46
2.75	1111	0.48
3.00	1159	0.50
3.25	1212	0.52
3.50	1265	0.54
3.75	1305	0.56
4.00	1348	0.58
4.25	1378	0.59
4.50	1411	0.61
4.75	1448	0.62
5.00	1490	0.64
5.25	1520	0.65
5.50	1547	0.67
5.75	1577	0.68
6.00	1607	0.69
6.25	1634	0.70
6.50	1660	0.71
6.75	1688	0.73
7.00	1720	0.74
7.25	1746	0.75
7.50	1770	0.76

Force versus Penetration Plot



Remarks

Results

Curve correction applied	CBR Values, %			Moisture Content
	Penetration		CBR Value	
	2.5mm	5mm		%
Yes	3.6	3.3	3.6	25



Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU

Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved

Initials: J.P

Date: 01/04/2019



In Situ California Bearing Ratio (CBR)

Job Ref 26130
CBR No. CBR3

Site Name	15-17 High Road, Ickenham, UB10 8LE			Depth m	0.50
Project No.	J19045	Client	GEA	Date of Test	28/03/2019
Soil Description	Brown slightly sandy gravelly silty CLAY with numerous roots and rootlets (gravel is fmc and sub-angular to sub-rounded)				
Test Method	BS1377 : Part 9 : 1990, clause 4.3			CBR Test Number	3

Note: Test only applicable when maximum particle size beneath the plunger does not exceed 20mm

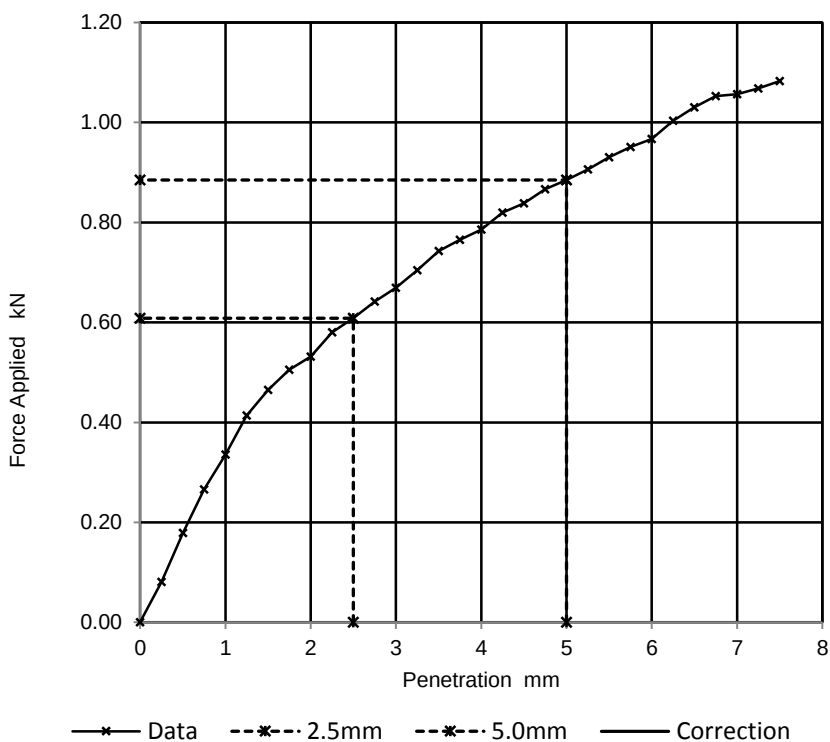
Rate of Strain 1.00 mm/min
Mass of Surcharge 4.6 kg
Proving Ring Factor 0.43 N/div

Temperature 13 °C
Environmental Conditions Clear

Readings

Penetration of Plunger mm	Force on Plunger	
	Dial Reading	Load kN
0.00	0	0.00
0.25	188	0.08
0.50	416	0.18
0.75	618	0.27
1.00	781	0.34
1.25	962	0.41
1.50	1081	0.46
1.75	1176	0.51
2.00	1237	0.53
2.25	1349	0.58
2.50	1415	0.61
2.75	1493	0.64
3.00	1556	0.67
3.25	1638	0.70
3.50	1727	0.74
3.75	1780	0.77
4.00	1827	0.79
4.25	1906	0.82
4.50	1950	0.84
4.75	2015	0.87
5.00	2058	0.88
5.25	2108	0.91
5.50	2164	0.93
5.75	2211	0.95
6.00	2249	0.97
6.25	2333	1.00
6.50	2397	1.03
6.75	2448	1.05
7.00	2458	1.06
7.25	2484	1.07
7.50	2519	1.08

Force versus Penetration Plot



Remarks

Results

Curve correction applied	CBR Values, %			Moisture Content
	Penetration		CBR Value	
	2.5mm	5mm		%
No	4.6	4.4	4.6	24



Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU

Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved

Initials: J.P

Date: 01/04/2019

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH1	1.00		D	Brown, grey brown mottled dark brown fine sandy silty CLAY with rare gravel and rootlets.	28.1	69	24	45	96										
BH1	1.20-1.65		D	Brown mottled light grey fine sandy silty CLAY.	23.7	51	18	33	99							8.1	0.02		
BH1	1.75		D	Multi-coloured fine sandy silty CLAY with rare gravel.	24.2	42	19	23	98										
BH1	2.00-2.45		U	Very stiff fissured multi-coloured silty CLAY with rare fine to medium gravel.	14.9					2.16	1.88	Undisturbed	40	145	72				
BH1	2.75		D	Light brown and orange brown fine sandy silty CLAY with rare red brown mottling.	32.8	81	31	50	99										
BH1	3.00-3.45		D	Light grey and orange brown fine sandy silty CLAY.	24.5	93	27	66	99										
BH1	3.75		D	Light brown and purple fine sandy silty CLAY.	25.5	80	23	57	99										
BH1	4.00-4.45		U	Very stiff fissured yellowish brown mottled purple silty CLAY	25.7					2.02	1.60	Undisturbed	80	66	33				
BH1	4.75		D	Light brown and purple fine sandy silty CLAY.	27.2	73	27	46	99										
BH1	6.00		D	Light brown mottled purple fine sandy silty CLAY.	16.5	58	17	41	99							9.2	<0.01		

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by  S Burke - Senior Technician 20/03/2019	Project Number: GEO / 28868 Project Name: 15-17 HIGH ROAD, ICKENHAM J19045	
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SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Borehole / Trial Pit	Depth (m)	Sample Ref	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH1	6.50-6.95		U	Firm brown mottled grey and reddish brown fine sandy CLAY	24.7					2.04	1.64	Undisturbed	130	169	84				
BH1	9.50-9.95		U	Very stiff fissured reddish brown mottled grey silty CLAY with rare fine to medium limestone gravel.	18.3					2.13	1.80	Undisturbed	190	346	173				

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke - Senior Technician
20/03/2019

Project Number:

Project Name:

GEO / 28868

15-17 HIGH ROAD, ICKENHAM
J19045



QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

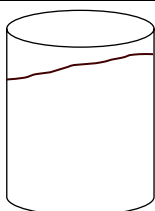
BH/TP No BH1
 Depth (m) 2.00-2.45
 Sample Type U

Description:

Very stiff fissured multicoloured silty CLAY with rare fine to medium gravel.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.0
Diameter	(mm)	101.5
Moisture Content	(%)	14.9
Bulk Density	(Mg/m ³)	2.16
Dry Density	(Mg/m ³)	1.88
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.2
Axial displacement rate	(%/min)	1.0
Cell pressure	(kPa)	40
Strain at failure	(%)	2.7
Maximum Deviator Stress	(kPa)	145
Shear Stress Cu	(kPa)	72

Mode of failure

Orientation of the sample	Vertical
Distance from top of tube mm	80

Checked and Approved by:

S Burke - Senior Technician
 20/03/2019

Project Number:

GEO / 28868

Project Name:

15-17 HIGH ROAD, ICKENHAM
J19045

GEOLABS

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

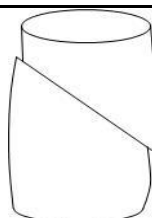
BH/TP No BH1
 Depth (m) 4.00-4.45
 Sample Type U

Description:

Very stiff fissured yellowish brown mottled purple silty CLAY

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.6
Diameter	(mm)	102.5
Moisture Content	(%)	25.7
Bulk Density	(Mg/m ³)	2.02
Dry Density	(Mg/m ³)	1.60
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.1
Axial displacement rate	(%/min)	1.0
Cell pressure	(kPa)	80
Strain at failure	(%)	1.5
Maximum Deviator Stress	(kPa)	66
Shear Stress Cu	(kPa)	33

Mode of failure

Orientation of the sample	Vertical
Distance from top of tube mm	60

Checked and Approved by:

S Burke

S Burke - Senior Technician
 20/03/2019

Project Number:

GEO / 28868

Project Name:

**15-17 HIGH ROAD, ICKENHAM
 J19045**

GEOLABS



QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No BH1
 Depth (m) 6.50-6.95
 Sample Type U

Description:

Firm brown mottled grey and reddish brown fine sandy CLAY

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	200.2
Diameter	(mm)	101.6
Moisture Content	(%)	24.7
Bulk Density	(Mg/m ³)	2.04
Dry Density	(Mg/m ³)	1.64
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	1.1
Axial displacement rate	(%/min)	1.0
Cell pressure	(kPa)	130
Strain at failure	(%)	20.0
Maximum Deviator Stress	(kPa)	169
Shear Stress Cu	(kPa)	84

Mode of failure

Orientation of the sample	Vertical
Distance from top of tube mm	50

Checked and Approved by:

S Burke - Senior Technician
 20/03/2019

Project Number:

GEO / 28868

Project Name:

15-17 HIGH ROAD, ICKENHAM
J19045



QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

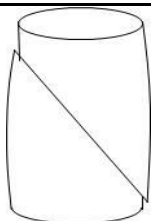
BH/TP No BH1
 Depth (m) 9.50-9.95
 Sample Type U

Description:

Very stiff fissured reddish brown mottled grey silty CLAY with rare fine to medium limestone gravel.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.5
Diameter	(mm)	102.7
Moisture Content	(%)	18.3
Bulk Density	(Mg/m ³)	2.13
Dry Density	(Mg/m ³)	1.80
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.4
Axial displacement rate	(%/min)	1.0
Cell pressure	(kPa)	190
Strain at failure	(%)	5.4
Maximum Deviator Stress	(kPa)	346
Shear Stress Cu	(kPa)	173

Mode of failure

Orientation of the sample	Vertical
Distance from top of tube mm	70

Checked and Approved by:

S Burke - Senior Technician
20/03/2019

Project Number:

GEO / 28868

Project Name:

15-17 HIGH ROAD, ICKENHAM
J19045

GEOLABS



GEA

www.gea-ltd.co.uk

Herts | 01727 824666 Notts | 01509 674888

SPT & Cohesion / Depth Graph

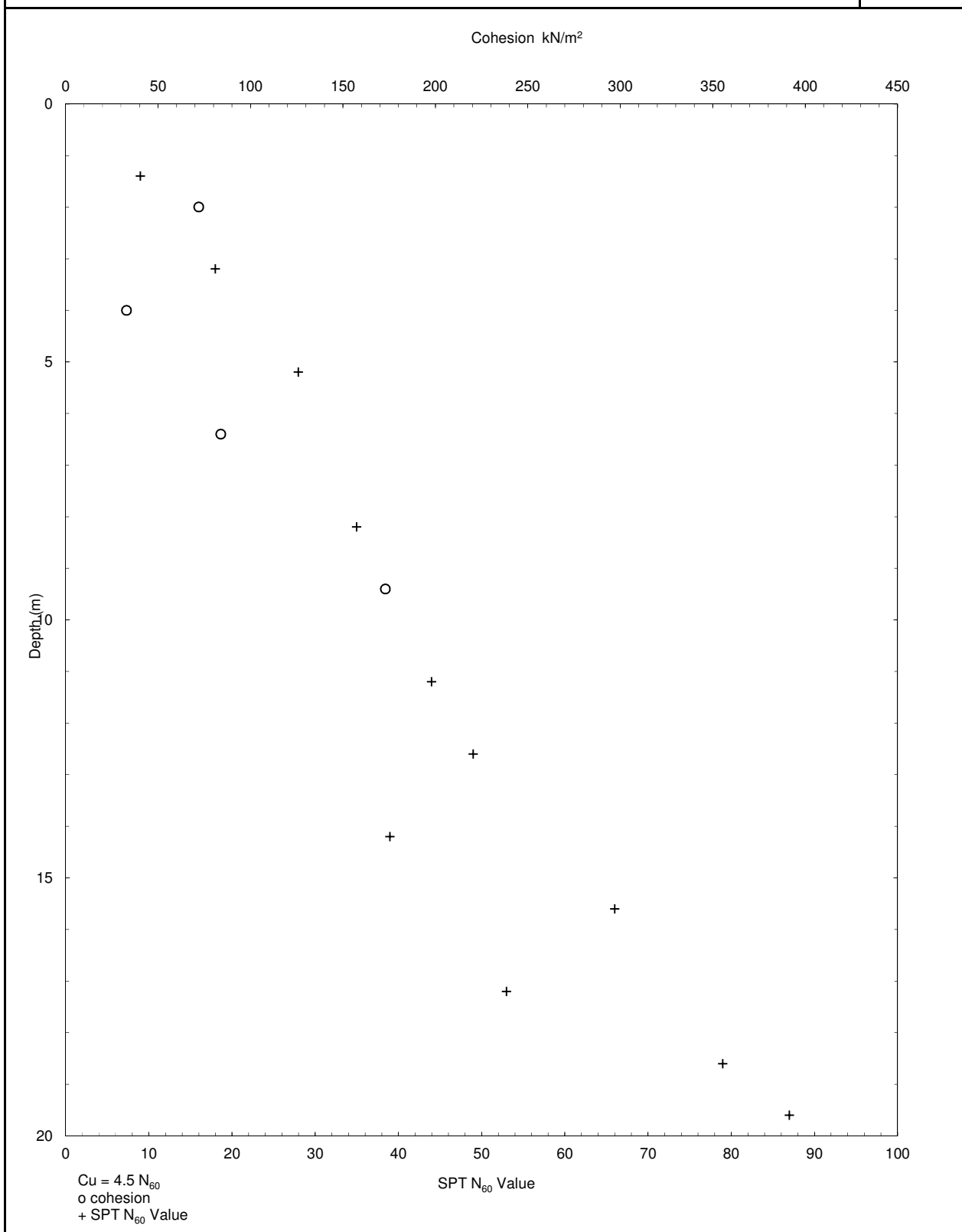
Site 15-17 High Road, Ickenham, UB10 8LE

Client Ash Properties Ltd

Engineer Tully De'Ath

Job Number
J19045

Sheet
1 / 1



**Susie Marley**

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t: 01923 225404
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Analytical Report Number : 19-31393

Project / Site name:	15-17 High Road, Ickenham, UB10 8 LE	Samples received on:	27/02/2019
Your job number:	J19045	Samples instructed on:	05/03/2019
Your order number:	J19045	Analysis completed by:	11/03/2019
Report Issue Number:	1	Report issued on:	11/03/2019
Samples Analysed:	4 soil samples		

Signed:

Rexona Rahman
Head of Customer Services
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 19-31393

Project / Site name: 15-17 High Road, Ickenham, UB10 8 LE

Your Order No: J19045

Lab Sample Number				1168819	1168820	1168821	1168822	
Sample Reference				BH1	TP1	TP2	TP1	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.50	0.50	0.30	None Supplied	
Date Sampled				25/02/2019	25/02/2019	26/02/2019	26/02/2019	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		
Stone Content				%	0.1	NONE	< 0.1	< 0.1
Moisture Content				%	N/A	NONE	17	18
Total mass of sample received				kg	0.001	NONE	0.95	1.0

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected	Not-detected	
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.4	8.2	7.8	-	
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	-	
Total Sulphate as SO ₄	mg/kg	50	MCERTS	440	470	920	-	
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.062	0.062	0.076	-	
Sulphide	mg/kg	1	MCERTS	< 1.0	< 1.0	41	-	
Water Soluble Chloride (2:1)	mg/kg	1	MCERTS	12	6.3	5.2	-	
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.8	0.8	2.5	-	

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.24	-	
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.42	-	
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.66	-	
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.66	-	
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	8.9	-	
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.1	-	
Fluoranthene	mg/kg	0.05	MCERTS	0.56	< 0.05	16	-	
Pyrene	mg/kg	0.05	MCERTS	0.51	< 0.05	13	-	
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.39	< 0.05	8.1	-	
Chrysene	mg/kg	0.05	MCERTS	0.45	< 0.05	7.6	-	
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.55	< 0.05	12	-	
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.27	< 0.05	3.5	-	
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.47	< 0.05	9.1	-	
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.28	< 0.05	5.0	-	
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.1	-	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.33	< 0.05	6.3	-	

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	3.81	< 0.80	94.0	-	
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Analytical Report Number: 19-31393

Project / Site name: 15-17 High Road, Ickenham, UB10 8 LE

Your Order No: J19045

Lab Sample Number				1168819	1168820	1168821	1168822	
Sample Reference				BH1	TP1	TP2	TP1	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.50	0.50	0.30	None Supplied	
Date Sampled				25/02/2019	25/02/2019	26/02/2019	26/02/2019	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	13	15	15	-	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.4	-	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	24	28	30	-	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	25	31	42	-	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	53	41	110	-	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	-	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	24	17	-	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	2.3	< 1.0	< 1.0	-	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	67	66	240	-	

Monoaromatics & Oxygenates

Benzene	ug/kg	1	MCERTS	-	-	< 1.0	-	
Toluene	ug/kg	1	MCERTS	-	-	< 1.0	-	
Ethylbenzene	ug/kg	1	MCERTS	-	-	< 1.0	-	
p & m-xylene	ug/kg	1	MCERTS	-	-	< 1.0	-	
o-xylene	ug/kg	1	MCERTS	-	-	< 1.0	-	
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	-	-	< 1.0	-	

Petroleum Hydrocarbons

TPH C10 - C40	mg/kg	10	MCERTS	< 10	< 10	620	-	
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	< 0.001	-	
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	< 0.001	-	
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	< 0.001	-	
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	< 1.0	-	
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	4.5	-	
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	16	-	
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	160	-	
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	180	-	
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	< 0.001	-	
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	< 0.001	-	
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	< 0.001	-	
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	2.3	-	
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	11	-	
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	80	-	
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	220	-	
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	310	-	
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	-	
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	3.1	-	
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	16	-	
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	< 1.0	95	-	
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0	< 1.0	370	-	



Analytical Report Number : 19-31393

Project / Site name: 15-17 High Road, Ickenham, UB10 8 LE

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1168819	BH1	None Supplied	0.50	Brown clay with gravel and vegetation.
1168820	TP1	None Supplied	0.50	Brown clay with gravel.
1168821	TP2	None Supplied	0.30	Brown clay and loam with gravel and vegetation.
1168822	TP1	None Supplied	None Supplied	-

Analytical Report Number : 19-31393

Project / Site name: 15-17 High Road, Ickenham, UB10 8 LE

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L0738-PL	W	MCERTS
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests. 2:1 extraction.	L082-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests ^{***}	L009-PL	D	MCERTS
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/cleanup.	L088/76-PL	W	MCERTS

Iss No 19-31393-1 15-17 High Road, Ickenham, UB10 8 LE J19045

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The results included within the report are representative of the samples submitted for analysis.

Page 5 of 7

Analytical Report Number : 19-31393

Project / Site name: 15-17 High Road, Ickenham, UB10 8 LE

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH1		S	19-31393	1168819	c	Total cyanide in soil	L080-PL	c
TP1		S	19-31393	1168820	c	Total cyanide in soil	L080-PL	c
TP2		S	19-31393	1168821	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
TP2		S	19-31393	1168821	b	TPHCWG (Soil)	L088/76-PL	b

		www.gea-ltd.co.uk		Generic Risk-Based Soil Screening Values																																																																																																																																																																																																																						
Herts 01727 824666 Notts 01509 674888																																																																																																																																																																																																																										
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C5-C6</td><td>30</td><td>LQM/CIEH</td></tr><tr><td>Aliphatic C6-C8</td><td>73</td><td>LQM/CIEH</td></tr><tr><td>Aliphatic C8-C10</td><td>19</td><td>LQM/CIEH</td></tr><tr><td>Aliphatic C10-C12</td><td>93</td><td>LQM/CIEH</td></tr><tr><td>Aliphatic C12-C16</td><td>740</td><td>LQM/CIEH</td></tr><tr><td>Aliphatic C16-C35</td><td>45,000</td><td>LQM/CIEH</td></tr><tr><td>Aromatic C6-C7</td><td>See Benzene</td><td>LQM/CIEH</td></tr><tr><td>Aromatic C7-C8</td><td>See Toluene</td><td>LQM/CIEH</td></tr><tr><td>Aromatic C8-C10</td><td>27</td><td>LQM/CIEH</td></tr><tr><td>Aromatic C10-C12</td><td>69</td><td>LQM/CIEH</td></tr><tr><td>Aromatic C12-C16</td><td>140</td><td>LQM/CIEH</td></tr><tr><td>Aromatic C16-C21</td><td>250</td><td>LQM/CIEH</td></tr><tr><td>Aromatic C21-C35</td><td>890</td><td>LQM/CIEH</td></tr><tr><td>PRO (C₅ –C₁₀)</td><td>269</td><td>Calc</td></tr><tr><td>DRO (C₁₂ –C₂₈)</td><td>46,130</td><td>Calc</td></tr><tr><td>Lube Oil (C₂₈ 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exp & LQM/CIEH</td></tr><tr><td>Screening value for PAH</td><td>62.1</td><td>B(a)P / 0.15</td></tr><tr><td colspan="3">Chlorinated Solvents</td></tr><tr><td>1,1,1 trichloroethane (TCA)</td><td>11.7</td><td>LQM/CIEH</td></tr><tr><td>tetrachloroethane (PCA)</td><td>0.56</td><td>LQM/CIEH</td></tr><tr><td>tetrachloroethene (PCE)</td><td>1.01</td><td>LQM/CIEH</td></tr><tr><td>trichloroethene (TCE)</td><td>0.134</td><td>LQM/CIEH</td></tr><tr><td>1,2-dichloroethane (DCA)</td><td>0.0054</td><td>LQM/CIEH</td></tr><tr><td>vinyl chloride (Chloroethene)</td><td>0.000953</td><td>LQM/CIEH</td></tr><tr><td>tetrachloromethane (Carbon tetrac</td><td>0.018</td><td>LQM/CIEH</td></tr><tr><td>trichloromethane (Chloroform)</td><td>0.888</td><td>LQM/CIEH</td></tr></table>			Contaminant	Screening Value mg/kg	Data Source	Anions			Soluble Sulphate	500 mg/l	Structures	Sulphide	50	Structures	Chloride	400	Structures	Others			Organic Carbon (%)	6	Methanogenic potential	Total Cyanide	140	WRAS	Total Mono Phenols	184	SGV	PAH			Naphthalene	2.20	C4SL exp & LQM/CIEH	Acenaphthylene	170	LQM/CIEH	Acenaphthene	210	LQM/CIEH	Fluorene	160	LQM/CIEH	Phenanthrene	92	LQM/CIEH	Anthracene	2,300	LQM/CIEH	Fluoranthene	260	LQM/CIEH	Pyrene	560	LQM/CIEH	Benzo(a) Anthracene	4.3	C4SL exp & LQM/CIEH	Chrysene	8	C4SL exp & LQM/CIEH	Benzo(b) Fluoranthene	7.7	C4SL exp & LQM/CIEH	Benzo(k) Fluoranthene	12.1	C4SL exp & LQM/CIEH	Benzo(a) pyrene	4.35	C4SL	Indeno(1 2 3 cd) Pyrene	4.4	C4SL exp & LQM/CIEH	Dibenzo(a h) Anthracene	1.10	C4SL exp & LQM/CIEH	Benzo (g h i) Perylene	65	C4SL exp & LQM/CIEH	Screening value for PAH	62.1	B(a)P / 0.15	Chlorinated Solvents			1,1,1 trichloroethane (TCA)	11.7	LQM/CIEH	tetrachloroethane (PCA)	0.56	LQM/CIEH	tetrachloroethene (PCE)	1.01	LQM/CIEH	trichloroethene (TCE)	0.134	LQM/CIEH	1,2-dichloroethane (DCA)	0.0054	LQM/CIEH	vinyl chloride (Chloroethene)	0.000953	LQM/CIEH	tetrachloromethane (Carbon tetrac	0.018	LQM/CIEH	trichloromethane (Chloroform)	0.888	LQM/CIEH
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Notes Concentrations measured below the above values may be considered to represent 'uncontaminated conditions' which pose 'LOW' risk to human health. Concentrations measured in excess of these values indicate a potential risk which require further, site specific risk assessment. SGV - Soil Guideline Value, derived from the CLEA model and published by Environment Agency 2009 LQM/CIEH - Generic Assessment Criteria for Human Health Risk Assessment 2nd edition (2009)derived using CLEA 1.04 model 2009 C4SL - Defra Category 4 Screening value based on Low Level of Toxicological Risk C4SL exp & LQM/CIEH calculated using C4SL revisions to exposure assessment but LQM/CIEH health criteria values Calc - sum of nearest available carbon range specified including BTEX for PRO fraction B(a)P / 0.15 - GEA experience indicates that Benzo(a) pyrene (one of the most common and most carcinogenic of the PAHs) rarely exceeds 15% of the total PAH concentration, hence this Total PAH threshold is regarded as being conservative																																																																																																																																																																																																																										



Express Preliminary UXO Risk Assessment

Client	Geotechnical & Environmental Associates
Project	15-17 Ickenham High Road
Site Address	15-17 Ickenham High Road, Ickenham, Uxbridge, UB10 8LE
Report Reference	EP8246-01
Date	21/02/19
Originator	HAS

Assessment Objective

This preliminary risk assessment is a qualitative screening exercise to assess the likely potential of encountering unexploded ordnance (UXO) at the 15-17 Ickenham High Road site. The assessment involves the consideration of the basic factors that affect the potential for UXO to be present at a site as outlined in Stage One of the UXO risk management process.

Background

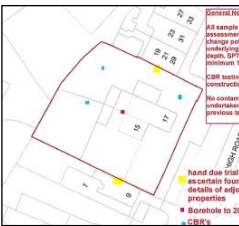
This assessment uses the sources of information available in-house to 1st Line Defence Ltd to enable the placement of a development site in context with events that may have led to the presence of German air-delivered or Allied military UXO. The report will identify any immediate necessity for risk mitigation or additional research in the form of a Detailed UXO Risk Assessment. It makes use of 1st Line Defence's extensive historical archives, library and unique geo-databases, as well as internet resources, and is researched and compiled by UXO specialists and graduate researchers.

The assessment directly follows CIRIA C681 guidelines "Unexploded Ordnance, a Guide for the Construction Industry". The document will therefore assess the following factors:

- Basic Site Data
- Previous Military Use
- Indicators of potential aerial delivered UXO threat
- Consideration of any Mitigating Factors
- Extent of Proposed Intrusive Works
- Any requirement for Further Work

It should be noted that the vast majority of construction sites in the UK will have a low or negligible risk of encountering UXO and should be able to be screened out at this preliminary stage. The report is meant as a common sense 'first step' in the UXO risk management process. The content of the report and conclusions drawn are based on basic, preliminary research using the information available to 1st Line Defence at the time this report was produced. It should be noted that the only way to entirely negate risk from UXO to a project would be to support the works proposed with appropriate UXO risk mitigation measures. It is rarely possible to state that there is absolutely 'no' risk from UXO to a project.



Risk Assessment Considerations	
Site location and description/current use	The site is located in Ickenham, within the London Borough of Hillingdon. The area currently comprises a zoned off area that has been recently demolished, bordering Ickenham High Road to the east. The site is bordered to the north and south by commercial and residential property. Additionally, the site borders residential property to the north west. The site is approximately centred on the OS grid reference: TQ 0801186356. 
Are there any indicators of current/historical military activity on/close to the site?	At this stage, records do not indicate that the site had any former military use. The region was used during WWII with RAF Northolt to the south east of the site and Battle of Britain Bunker in the neighbouring town of Uxbridge. The conditions in which unexploded anti-aircraft ordnance may have fallen unrecorded within the proposed site are analogous to that of aerially delivered German bombs - see below for further information.
What was the pre- and post-WWII history of the site?	Comparison of Pre-WWII OS mapping from 1914 and 1934 indicate significant development on site and in the vicinity during the period. Parkfield Road was constructed, residential property bordering north west of the site was added and development of structures within the boundary appear altered. Post-WWII mapping from 1968 does not indicate any further substantial development within the site boundary, although a small structure in the south of the site has been cleared. The structures on site are now labelled as 'Pete Cottages'. Immediately north of the site, additional structures were developed and the entrance to Parkfield Road from the High Road appears altered.
Was the area subject to bombing during WWII?	According to Home Office statistics, the Municipal Borough of Uxbridge sustained a low density bombing campaign during WWII with an average of 21.3 items recorded per 1,000 acres. This includes 192 high explosive (HE) bombs, 2 parachute mines, 12 oil bombs, 5 phosphorus bombs, 5 V-1 pilotless aircraft and 1 V-2 long range rocket bomb. London Bomb Census Mapping, does not record any incidents within or immediately adjacent to the site. Considering the low density of bombing across the district, as well as a lack of anecdotal evidence, it is not considered likely that the site sustained significant bombing.
Is there any evidence of bomb damage on/close to the site?	Middlesex County Council (MCC) bomb damage mapping does not indicate the site sustained any significant damage. OS mapping does not indicate any substantial change within the site area, with the majority of the structures from pre-war shown in post-war mapping. There are no typical signs of bomb damage present, such as large-scale clearance or ruined structures. One structure in the south of the site is no longer present, but this is thought unlikely to be related to bomb damage.





To what degree would the site have been subject to access?	The site is likely to have seen relatively frequent amounts of access, due to the residential nature of the area. Due to the low density of bombing and lack of bomb damage evidence it is unlikely the area was abandoned or vacated for significant periods of time. Evidence of UXO is less likely to go unnoticed and unrecorded within frequently accessed areas.
To what degree has the site been developed post-WWII?	A comparison of 1968 and 1990 OS mapping indicates a small structure was built in the north east area of the site, directly adjacent to the existing structures. Recent imagery indicates the structures constructed pre-WWII were still present until the recent demolition of the site.
What is the nature and extent of the intrusive works proposed?	The proposed works are understood to include boreholes to a depth of 20m and trail pits throughout the site.

Summary and Conclusions

During WWII, the site was situated within the Municipal Borough of Uxbridge, which sustained a low density of bombing according to Home Office statistics, with an average of 21.3 items recorded per 1,000 acres. London Bomb Census mapping records no incidents within the site or in the surrounding area.

No significant damage is recorded on or adjacent to the site within the MCC bomb damage mapping and the composition of the site in post-WWII OS mapping is mostly consistent with pre-war mapping, indicating that the site was not significantly damaged.

Additionally, it is anticipated that the site would have seen regular access due to the nature of the site area. Given the lack of bombing, damage and the likely regularity of access it is considered unlikely that evidence of UXO may have gone unnoticed and unrecorded.

Recommendations

Given the findings of this preliminary report, the risk is not considered to be higher than the 'background risk' of encountering UXO within this site.

Whilst it would be possible to conduct a Detailed UXO Risk Assessment for this site, it is not anticipated that any further research would significantly alter the findings of this report. **It is therefore not recommended that any further action is taken for this site.**

If the client has any anecdotal or empirical evidence of UXO risk on site, please contact 1st Line Defence.



Site	15-17 High Road, Ickenham, UB10 8LE
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Client	Ash Properties Limited
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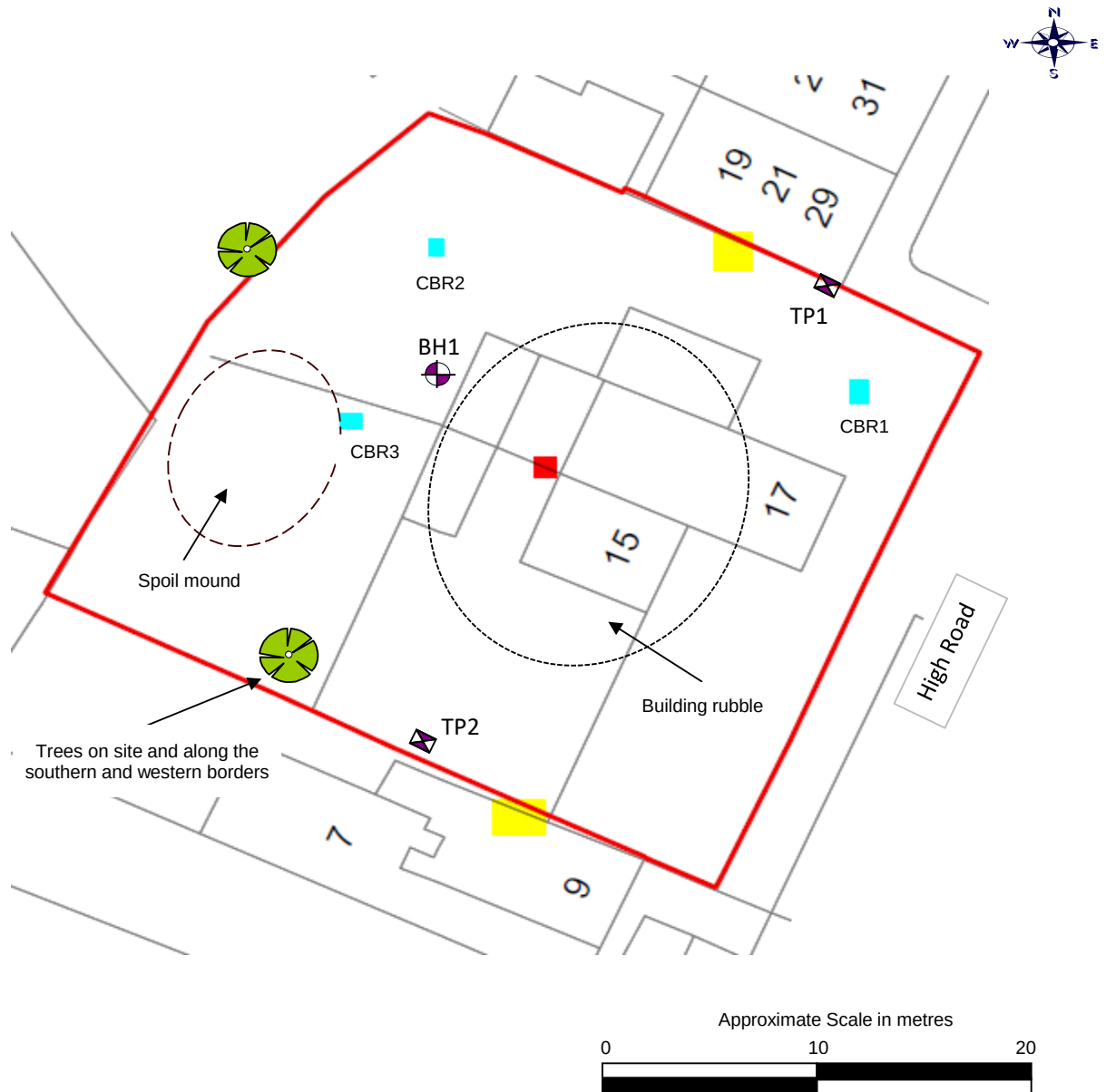
Engineer Tully De'Ath Consultants

Job Number

J19045

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