DESK STUDY & GROUND INVESTIGATION REPORT

17 Acacia Road
London
NW8 6AN

Client: Mr Barry Townsley

J19229

December 2019

GEA

Document Control

Project title	17 Acacia Road, London NW8 6AN	**Project ref**	J19229
Report prepared by			
	Lina Seoudi BSc MSc FGS Geotechnical Engineer		
Report checked by			
	Juliet Fuller BSc MSc DIC FGS Associate Director		
Report checked and approved for issue by			
	Steve Branch BSc MSc CGeol FGS FRGS Managing Director		

Issue No	Status	Amendment Details	Date	Approved for Issue
1	Final		03 December 2019	

This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.

✓	**Hertfordshire**	tel 01727 824666
	Nottinghamshire	tel 01509 674888
	Manchester	tel 0161 209 3032

Geotechnical & Environmental Associates Limited (GEA) disclaims any responsibility to the Client and others in respect of any matters outside the scope of this work. This report has been prepared with reasonable skill, care and diligence within the terms of the contract with the Client and taking account of the manpower, resources, investigation and testing devoted to it in agreement with the Client. This report is confidential to the Client and GEA accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known, unless formally agreed beforehand. Any such party relies upon the report at their own risk. This report may provide advice based on an interpretation of legislation, guidance notes and codes of practice. GEA does not however provide legal advice and if specific legal advice is required a lawyer should be consulted.

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.

CONTENTS

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 Engineers HRW Ltd on behalf of Mr Barry Townsley, with respect to the remodelling of the existing house through the extension of the existing single level basement beneath the central eastern portion of the house to a lower level and the construction of a single-storey extension at ground level to the rear of the house. The purpose of the investigation has been to research the history of the site with respect to possible contaminative uses, to determine the ground conditions and hydrogeology, to assess the extent of any contamination and to provide information to assist with the design of retaining walls and spread foundations.

SITE HISTORY

The earliest map studied, dated 1850, shows the local road network to have been established, including Acacia Road. By the time of the next map, dated 1872, the site had been developed with two terraced houses with associated rear gardens, and the surrounding area had also been predominately developed with houses of the same construction. At some time between 1915 and 1936, the two houses that occupied the site appear to have been replaced, to resemble the existing house configuration. By the next map, dated 1954, the houses that bordered the site to the south are shown to have been demolished, although the boundary was still in place. By the next map, dated 1960, the entire area to the south of the site had been redeveloped with Robinsfield Primary Infants School, which mainly comprised an L-shaped building, along with surrounding playground areas. Both the site and surrounding area have since remained essentially unchanged.

GROUND CONDITIONS

Below a moderate thickness of made ground, Head Deposits were encountered over the London Clay Formation, which was proved to the maximum depth investigated of 8.00 m (35.90 m OD). The made ground generally comprised light orange-brown silty sandy gravelly clay with occasional brick, concrete, clinker, flint gravel and rare rootlets and extended to the base of the trial pits at depths of 0.40 m (41.47 m OD), 0.60 m (43.41 m OD) and 1.30 m (42.78 m OD) in Trial Pit Nos 1, 2 and 2A, respectively, and to a depth of 1.30 m (42.60 m OD) in Borehole No 1. The Head Deposits initially comprised soft becoming firm light orange-brown and grey silty slightly sandy clay with occasional fine to medium subrounded flint gravel, fine silt pockets and occasional carbonaceous material to a depth of 3.70 m (40.20 m OD), becoming light yellow-brown silty sandy very gravelly clay to a depth of 4.10 m. The London Clay comprised firm light brown occasionally mottled grey becoming light brown silty clay with occasional carbonaceous material and lenses of fine silt and extended to the maximum depth investigation at 8.00 m (35.90 m OD). During drilling, groundwater was encountered as a water strike from within the Head Deposits at a depth of 3.70 m (40.20 m OD) and groundwater has subsequently been measured at depths of 1.20 m (42.70 m OD) and 1.30 m (42.60 m OD). Elevated concentrations of lead have been measured in two samples of the made ground tested with respect to residential end use with plant uptake.

RECOMMENDATIONS

The proposed basement extension will be lowered to a depth of roughly 3.00 m (41.27 m OD) below ground floor level and approximately 0.40 m below existing lower ground floor level, such that formation level should be within the soft silty slightly sandy slightly gravelly clay of the Head Deposits. Although groundwater has been measured in the standpipe this is most likely to be due to the accumulation of perched groundwater unable to drain away due to the low permeability of the surrounding clay. Significant groundwater inflows are not therefore anticipated in the basement excavation and any minor inflows should be suitably dealt with by sump pumping, although monitoring of the standpipe should be continued to confirm this view and to establish equilibrium water levels and any seasonal fluctuations. Rising head tests should also be carried to provide an indication of the inflow rates. The proposed basement extension should not have any effect on the local hydrological and hydrogeological setting. No special precautions should be required with respect to contamination.

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 Engineers HRW Ltd on behalf of Mr Barry Townsley, to carry out a desk study and ground investigation at 17 Acacia Road, London NW8 6AN.

1.1 Proposed Development

It is understood that it is proposed to remodel the existing house through the extension of the existing single level basement beneath the central eastern portion of the house to a lower level and the construction of a single-storey extension at ground level to the rear of the house. The proposals also include the demolition of infilled sections on the first and second floors. The excavation for the proposed basement extension will extend to approximately 3.00 m (41.27 m OD) below ground floor level and about 0.40 m below the existing lower ground floor level.

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 determine the history of the site with respect to previous contaminative uses;
- to determine the ground conditions and their engineering properties;
- to provide advice with respect to the design of spread foundations and retaining walls;
- to determine the nature of the footings of the existing house;
- 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 desk study was carried out, followed by a ground investigation. The desk study comprised:

- a review of historical Ordnance Survey (OS) maps and environmental searches sourced from the Envirocheck database;
- a review of readily available geology maps;
- a review of a preliminary UXO Risk Assessment out by 1st Line Defence; a specialist in the field; and
- a walkover survey of the site carried out in conjunction with the fieldwork.

In the light of this desk study, an intrusive ground investigation was carried out, which comprised, in summary, the following activities:

- a single borehole advanced from ground level to a depth of 8.00 m by means of a percussive opendrive sampler (Terrier rig);
- standard penetration tests (SPTs) carried out at regular internals within the borehole to provide quantitative date on the strength of the soils;
- installation of a groundwater monitoring standpipe to a depth of 6.00 m and two subsequent monitoring visits carried out at roughly two-week intervals following installation;
- three hand dug trails pits excavated to depths of 0.40 m, 0.60 m and 1.30 m to investigate the foundations of eastern and western elevations of the existing house;
- 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) 11[1] 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 work has also been carried out to address the requirements of Policy CM28.1[2] of Westminster's City Plan, dated July 2016. The aim of the work is to provide information on land stability and groundwater and in particular to assess whether the development will affect the stability of neighbouring properties or groundwater movements and whether any identified impacts can be appropriately mitigated by the design of the development. This includes the following items and the sections of the report that address with each requirement are shown in brackets;

- a thorough desk study (Part 1);
- a site investigation which can be demonstrated to be relevant to the site (Section 3.0 to Section 4.6);
- an analysis of the Upper Aquifer (when present) and how the basement may impact on any groundwater flow (Section 2.5 and Section 7.1);
- consideration of flood risk, surface water flooding (Section 2.3 and Section 2.6); and

The methods of investigation adopted 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 GEA's engineering experience, local precedent where applicable and relevant published information.

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 City of Westminster (2016) *Westminster's City Plan: Consolidated with Basement and Mixed Use Revisions*

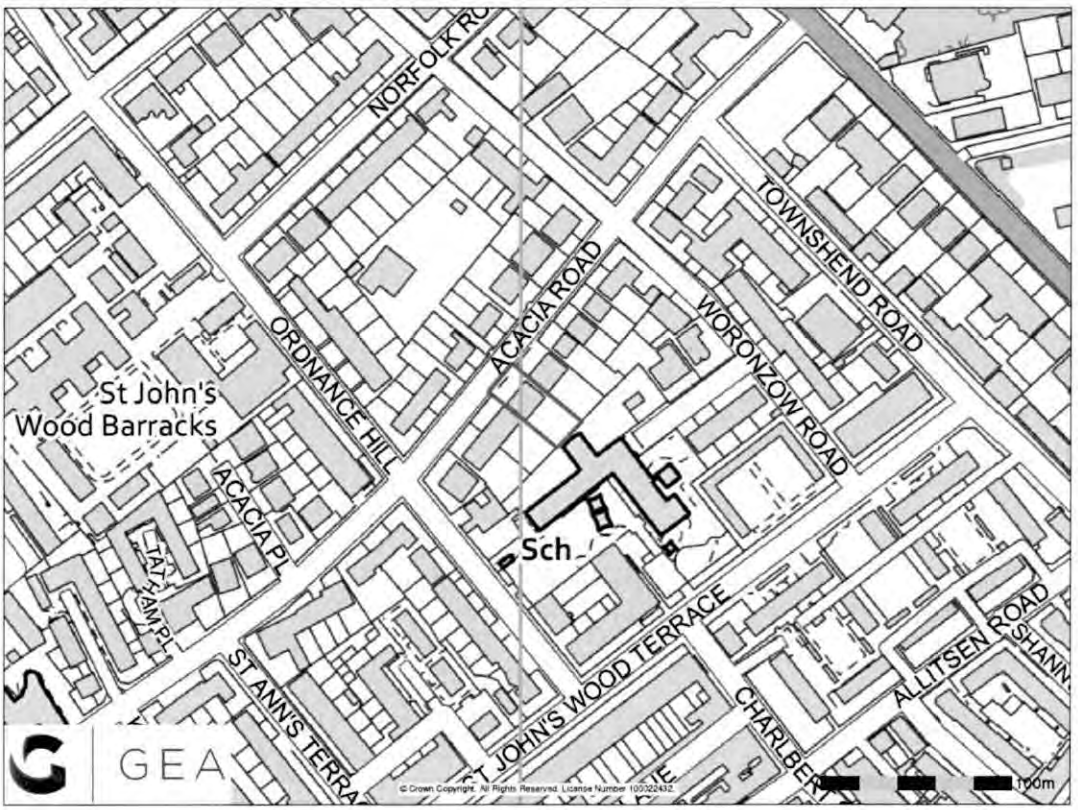
1.4 Limitations

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 and the number of locations where the ground was sampled. No liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

2.0 THE SITE

2.1 Site Description

The site is located within the City of Westminster, approximately 150 m east of St John's Wood London Underground station. It may be located by National Grid Reference, 527010, 183500 and is outlined on the map extract below.



The site fronts onto Acacia Road to the northwest and is bounded by two-storey detached houses to the east and west, although No 15 Acacia Road was noted to have a single-storey extension, in use as a garage, which shares the party wall to the west. To the southeast, beyond the rear garden, the site abuts Robinsfield Infant School.

A walkover of the site was carried out by a geotechnical engineer from GEA at the time of the fieldwork. The site is rectangular in shape and measures approximately 18 m east-west by

40 m north-south. It is occupied by a two-storey detached house with a loft conversion and a single level basement beneath the western central portion of the house. A paved driveway is present at the front in addition to a large garden to the rear.

The house occupies the northern part of the site, with bushes and shrubs around the borders. A paved patio occupies the area adjacent to the rear of the house, beyond which is the rear garden, in the southern part of the site. The garden is mostly laid to artificial turf with numerous saplings, semi-mature and mature deciduous and coniferous trees in excess of 20 m in height, located along the perimeter.

The rear garden is approximately 1.00 m lower than ground level at the front of the house. The site is otherwise essentially level.

Access to the site was limited by the presence of the existing building which continued to be occupied at the time of the investigation. No evidence of contamination was observed during the walkover.

2.2 Site History

The earliest map studied, dated 1850, shows the local road network to have been established, including Acacia Road. St John's Wood Barracks had also been established approximately 105 m of to the northwest of the site.

By the time of the next map, dated 1872, the site had been developed with two terraced houses with associated rear gardens, and the surrounding area had also been predominately developed with houses of the same construction. The site boundary is shown to have extended into the rear private gardens of terraced houses, fronting onto Henstridge Road to the south, later renamed as Henstridge Place by 1936.

At some time between 1915 and 1936, the two houses that occupied the site appear to have been replaced, to resemble the existing house configuration. The configuration of the adjacent houses to the east and west had also changed to resemble the existing detached houses layout with the boundaries enlarged to incorporate the footprint of two terraced houses each, and the properties were all labelled with their associated numbers by 1953.

By the next map, dated 1954, the houses that bordered the site to the south are shown to have been demolished, although the boundary was still in place. By the next map, dated 1960, the entire area to the south of the site had been redeveloped with Robinsfield Primary Infants School, which mainly comprised an L-shaped building, along with surrounding playground areas. In addition, on this map, the site boundary now includes the former rear garden to the south. Both the site and surrounding area have since remained essentially unchanged.

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 search has not indicated records of any existing or historic landfills within 1 km of the site and no Contaminated Land Register entries or notices within the same distance. There is a single area of potentially infilled land within 1 km of the site, located 568 m to the west and is listed as a former pit or quarry.

There are no waste transfer, waste treatment or disposal sites within 1 km of the site with the nearest waste management facility located 625 m to the southeast of the site, at Regents Park Office.

There are two pollution incidents to controlled waters listed within 700 m of the site, located 353 m to the southwest and 395 m to the southeast. Both incidents are listed as Category 3 – Minor incident. Given the distance, these are unlikely to have impacted the site

The nearest fuel station is located 426 m to the south and is currently active, although at such a distance, it is unlikely to affect the site. Additionally, there are no Contemporary Trade Directory entries within 100 m of the site.

The site is not within an area shown by the Environment Agency to be at risk from flooding and extreme flooding from rivers or the sea, additionally, it does not lie within an area with the potential for groundwater flooding to occur at the surface. There are no sensitive land uses recorded for 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.

Reference to the Local Authority planning portal has found no records of basement planning applications for No 19, the property that borders the site to the east. No 15 Acacia Road, which borders the site to the west has been granted permission in February 2004, for the demolition of a former house and subsequent construction of a new two-storey house with a basement and a conservatory to the rear (planning ref: 03/00316/FULL). A drawing associated with this planning application showed the proposed basement to extend beneath the entire footprint of No 15 Acacia Road and partly into the rear garden, (drawing number: 15AR/1/P03/D, dated 10 October 2003). The demolition of the house is recorded to have been completed by June 2005 (planning ref: 05/04820/CAC). Subsequent approved alterations to the scheme included the replacement of the rear conservatory building with smaller timber structures and the omission of the front basement lightwell and basement car hoist (planning ref: 05/04819/FULL, dated June 2005).

2.4 Preliminary UXO Risk Assessment

A Preliminary UXO Risk Assessment has been completed by 1st Line Defence (report ref EP9544-00, dated 23rd August 2019), and the report is included in the appendix. The risk assessment has been carried out in accordance with the guidelines provided by CIRIA[3], 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. It is estimated that 10 % of German high explosive bombs failed to explode as designed and this therefore represents a risk of encountering items of UXO during intrusive works.

The report indicates that during World War II, the site was located within the Metropolitan Borough of St Marylebone, which was the subject of a very high density bombing campaign.

3 CIRIA C681 (2009) *Unexploded ordnance (UXO) A guide for the construction industry*

A single 250 kg high explosive bomb is recorded to have struck immediately to the southwest boundary of the site on available London Bomb Census maps. Additionally, the properties to the east and south of the site are shown to have been damaged beyond repair with the southeastern portion of the site shown to have sustained general blast damage within London County Council (LCC) war damage maps.

The report concluded that a Detailed UXO Risk Assessment would be required in order to determine the locations of strikes identified at the site and the immediate vicinity and to what extent conditions may have been present whereby an item of UXO could have been undiscovered. However, given that further research may not eliminate the risk of UXO, it was also recommended that UXO specialist on-site support is provided for any works proposed, in lieu of a Detailed Risk Assessment.

In accordance with the report, UXO specialist on-site support was provided during intrusive works with magnetometer scanning of all borehole locations to the maximum bomb penetration depth.

2.5 Geology

The British Geological Survey (BGS) map of the area (Sheet 256) indicates that the site is directly underlain by the London Clay Formation. Head Deposits are also indicated approximately 295 m to the east of the site. The London Clay typically comprises bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt with layers of sandy clay.

The BGS holds archive records of three boreholes drilled at St Marylebone and a single borehole at St Johns Wood located approximately 130 m and 169 m to the southwest and southeast of the site, respectively. The boreholes encountered made ground to depths of between 0.50 m and 2.30 m, over firm brown grey clay with frequent gravel to a depth of 1.20 m, in the borehole to the southeast only. Beneath this, firm becoming stiff brown stained blue clay was encountered to depth 8.00 m, becoming very stiff fissured blue grey clay to the maximum depth of the investigations at 20.00 m.

2.6 Hydrology and Hydrogeology

The London Clay is classified as a Non-Aquifer and Unproductive Stratum, which refers to a soil or rock with low permeability that has a negligible significance for local water supplies or river base flow, as defined by the Environment Agency (EA). As the London Clay comprises predominantly clay soils, they cannot support groundwater flow and as such do not support a "water table" or continuous piezometric surface. Boreholes constructed within clays do fill with water due to capture of shallow drainage; however, this is not reflective of the type of groundwater flow that would occur in a porous and permeable saturated stratum. Published data for the permeability of the London Clay indicates the horizontal permeability to generally range between 1×10^{-10} m/s and 1×10^{-8} m/s, with an even lower vertical permeability.

According to the Envirocheck Report the nearest surface water feature is located approximately 444 m to the southeast of the site, referring to Regent's Canal. The River Thames is located around 4.50 km to the southeast of the site.

Published records[4] indicate that the former River Tyburn ran southeastwards towards Regent's Park approximately 145 m to the east of the site, and was diverted into a sewer by the late 19th Century. Groundwater beneath the site is likely to be flowing in southeasterly direction along the line of flow of the Tyburn, towards the boating lake in Regent's Park and on towards the River Thames.

There are no water abstractions recorded within 1 km of the site.

Groundwater was encountered as a water strike at a depth of 2.50 m from within a claystone in the aforementioned BGS boreholes.

2.6.1 Flood Risk

The site is not within an area shown by the Environment Agency to be at risk from flooding and extreme flooding from rivers or the sea, and does not lie within an area with the potential for groundwater flooding to occur at the surface. However, the site does lie within a Critical Drainage Area (CDA) within Westminster's Surface Water Management Plan[5]. A CDA is a discrete geographic area where multiple and interlinked sources of flood risk, including surface water, groundwater, sewer, main river and/or tidal, cause flooding in one or more Local Flood Risk Zones. Local Flood Risk Zones (LFRZs) are discrete areas/extents of predicted surface water flooding. It also lies within a Surface Water Flood Risk Hotspot area within Westminster's SPD for Basement Development and as such a separate Flood Risk Assessment is likely to be required.

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 does not have a potentially contaminative history as it has apparently only been developed with houses since prior to 1872. The buildings would originally have had solid fuel heating and therefore coal and ash residue may be present in the near surface soils. Bomb damage within or close to the site boundary may have also resulted in fragments of demolition waste such as asbestos and lead (from lead paint), being present in the near surface soils. The potential on site contaminant sources are highlighted in the table below.

On site		
Site use	Potential Contamination	
	Sources	Typical contaminants
Private domestic property and made ground resulting from general blast damage	Solid fuel heating	Heating oil and hydrocarbon fuels, paraffin, ash
	Building materials including insulation	Asbestos
	Paint	Lead

4 Barton, N and Myers, S (2016) *The Lost Rivers of London (Revised edition).* Historical Publications Ltd
5 City of Westminster (2011) *Surface Water Management Plan,* Version 0.8

There are no historic or existing landfills within 1 km of the site and no areas of infilled land (water or non-water) within 560 m of the site, such that a risk of soil gas has not been identified.

2.7.2 Receptor

The site will continue to have a residential end use, such that end users will represent high sensitivity receptors, as at present. As the site is expected to be directly underlain by unproductive strata, shallow groundwater is not a potential receptor. The underlying deep aquifer would be considered a highly sensitive receptor, along with adjacent sites.

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

2.7.3 Pathway

The negligibly permeable London Clay will limit the potential for groundwater percolation into the underlying chalk, and thus a pathway is not considered likely to exist to the principal aquifer.

Within the site, end users will be effectively isolated from direct contact with any contaminants in the near surface soils by the presence of the building and areas of hardstanding, thus limiting potential contaminant exposure pathways. However, they may be exposed in areas of soft landscaping, as at present.

Buried services and concrete may be exposed to any contaminants present within the soil through direct contact and site workers will come into contact with the soils during construction works.

There is thus considered to be a low potential for a contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

2.7.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a VERY 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

Access for the ground investigation was limited by the presence of the existing house, which continued to be occupied during the investigation. Therefore, in order to meet the objectives described in Section 1.2, as far as possible within the access limitations, a single borehole was advanced to a depth of approximately 8.00 m by means of an opendrive sampler (terrier rig). Additionally, three trial pits were hand excavated to depths of 0.40 m, 0.60 m and 1.30 m to explore the foundations of the eastern and western elevations of the existing house.

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

A selection of the samples recovered from the borehole 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 full-time supervision of a geotechnical engineer from GEA.

A groundwater monitoring standpipe was installed in the borehole to a depth of 6.00 m to facilitate groundwater monitoring which has been carried out on two occasions to date, at approximately two week intervals following installation.

The borehole and trial pit records are appended, together with a site plan indicating the exploratory positions. The Ordnance Datum (OD) levels on the borehole and trial pit records have been interpolated from spot heights shown on a survey drawing provided by the consulting engineer (drawing No 1937-SK-001, dated June 2019).

3.1 Sampling Strategy

The borehole and trial pits locations were specified by the consulting engineers, Engineers HRW. The locations were positioned on site by an engineer from GEA as close to the agreed positions as possible whilst avoiding known and suspected services. The site continued to be occupied at the time of the investigation.

Three samples of the made ground have been tested for 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. In addition, three samples were screened for the presence of asbestos. 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 encountered a moderate thickness of made ground, beneath which Head Deposits were encountered to a depth of 4.10 m, over the London Clay to the full depth investigated at 8.00 m (35.90 m OD).

4.1 Made Ground

Beneath a surface layer of paving, typically 90 mm in thickness, the made ground generally comprised light orange-brown silty sandy gravelly clay with occasional brick, concrete, clinker, flint gravel and rare rootlets and extended to the base Trail Pit Nos 2 and 2A, at depths of 0.60 m (43.41 m OD) and 1.30 m (42.78 m OD), respectively, and to a depth of 1.30 m (42.60 m OD) in Borehole No 1.

In Trial Pit No 1, the made ground comprised light orange-brown slightly clayey silty very sandy gravel with occasional whole and half bricks, clinker, frequent concrete and flint gravel and extended to the base of the pit at 0.40 m (41.47 m OD).

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 4.5.

4.2 Head Deposits

Soils interpreted as Head Deposits were encountered directly below the made ground in Borehole No 1 and initially comprised soft becoming firm light orange-brown and grey silty slightly sandy clay with occasional fine to medium subrounded flint gravel, fine silt pockets

and occasional carbonaceous material to a depth of 3.30 m (40.6 m OD), becoming more gravelly with depth to 3.70 m (40.20 m OD). Below this layer, light yellow-brown silty sandy very gravelly clay was encountered to a depth of 4.10 m (39.80 m OD).

The results of three plasticity index tests indicate the clay layers to be of medium volume change potential.

4.3 London Clay

The London Clay generally comprised firm light brown occasionally mottled grey becoming light brown silty clay with occasional carbonaceous material and lenses of fine silt pockets and extended to the maximum depth investigation at 8.00 m (35.90 m OD).

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

4.4 Groundwater

Groundwater was encountered in Borehole No 1 as a water strike from within the gravelly clay layer at a depth of approximately 3.70 m (40.20 m OD). A standpipe was installed in this borehole to a depth of 6.00 m (37.90 m OD) and the findings of two groundwater monitoring visits carried out to date are presented in the table below.

Date	Borehole No	Depth to water (m) [Level in (m OD)]
27/09/2019	1	1.20 [42.70]
15/10/2019	1	1.30 m [42.60]

4.5 Soil Contamination

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

Determinant	TP2A 1.00 m	TP1 0.30 m	BH1 0.40 m
pH	7.8	11.1	9.2
Arsenic	12	11	6.3
Cadmium	< 0.2	< 0.2	< 0.2
Chromium	30	24	19
Lead	840	220	140
Mercury	<0.3	<0.3	<0.3
Selenium	<1.0	<1.0	<1.0
Copper	32	19	29
Nickel	20	16	13
Zinc	92	83	47

Determinant	TP2A 1.00 m	TP1 0.30 m	BH1 0.40 m
Total Cyanide	<1.0	<1.0	<1.0
Total Phenols	<1.0	<1.0	<1.0
Total PAH	1.47	2.93	54.2
Sulphide	<1.0	<1.0	4.7
Benzo(a)pyrene	<0.05	0.26	3.8
Naphthalene	<0.05	<0.05	< 0.05
TPH	<10	<10	350
Total Organic Carbon %	0.6	0.3	1.4

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

In addition, the samples were screened for the presence of asbestos and none was detected.

4.5.1 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[6] Soil Guideline Value where available, a Generic Screening Value calculated using the CLEA UK Version 1.06[7] software assuming a residential end use with plant uptake end use, or is based on the DEFRA Category 4 Screening values[8]. 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 a young female child aged 0 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 homegrown produce, consumption of soil adhering to homegrown produce, skin contact with soils and dust, and inhalation of dust and vapours; and
- that the building type equates to a two-storey small 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 have been compared to the generic values for a residential end use with plant uptake and have measured elevated concentration of lead within two samples of the made ground originating in Trial Pit Nos 1 and 2A, at concentrations of 220 kg/mg and 840 mg/kg, above a screening value of 200 mg/kg.

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

---

6 *Updated Technical Background to the CLEA Model (Science Report SC050021/SR3) Jan 2009* and Soil Guideline Value reports for specific contaminants; all DEFRA and Environment Agency.

7 Contaminated Land Exposure Assessment (CL|EA) Software Version 1.06 Environment Agency 2009

8 CL:AIRE (2013) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Final Project Report SP1010 and DEFRA (2014) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Policy Companion Document SP1010

4.6 Existing Foundations

The findings of the trial pits are summarised in the table below. Sketches and photographs of each pit are included in the Appendix.

Trial Pit No	Structure	Foundation detail	Bearing Stratum
1 (Section A – A')	Western elevation	Bricks over plastic sheeting over polystyrene Top: GL Base: 0.16 m Lateral projection: none	MADE GROUND
2 (Section A – A')	Eastern elevation	Bricks Top: GL Base: could not be determined to 0.60 m Lateral projection: none	Not determined (trial pit terminated due to suspected drainage pipe encased in concrete at base of pit)
2A (Section A – A')	Eastern elevation	Bricks Top: GL Base: could not be determined to 1.30 m Lateral projection: none	Not determined

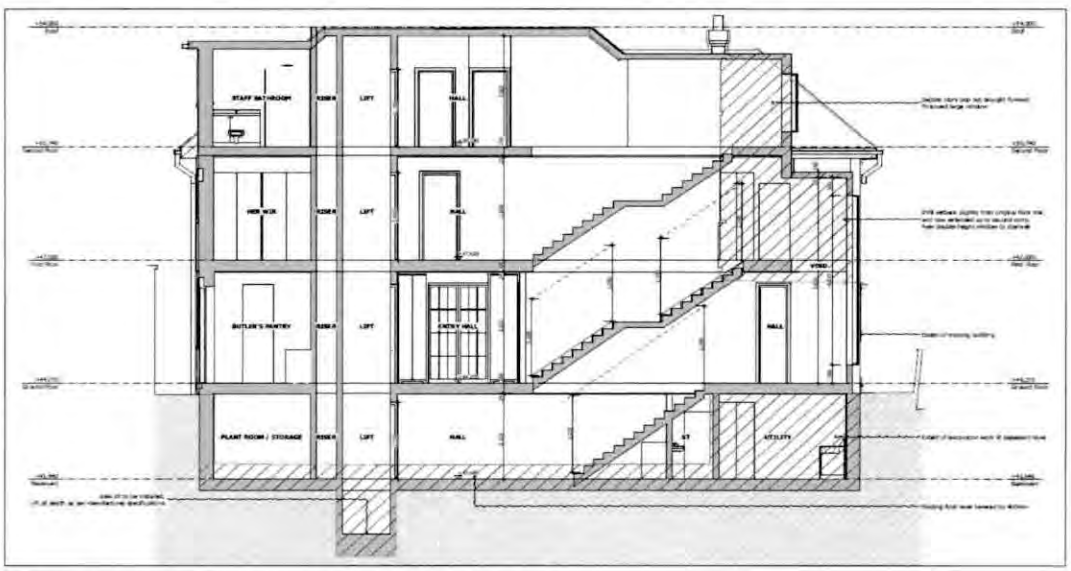
Groundwater was not encountered in any of the trial pits.

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 foundation options and methods of constructing the proposed basement.

5.0 INTRODUCTION

It is understood that it is proposed to remodel the existing house through the extension of the existing single-level basement beneath the central eastern portion of the house and the construction of a single-storey extension at ground level to the rear. The proposals also include the demolition of infilled sections on the first and second floors. The excavation for the proposed basement extension will extend to approximately 3.00 m (41.24 m OD) below ground floor level and about 0.40 m below the existing lower ground floor level. The loads are not known but are anticipated to be light.



Existing section with proposed extension hatched in blue

6.0 GROUND MODEL

The desk study has revealed that the site has not had any potentially contaminative historical uses as it has only been developed with houses since prior to 1872. On the basis of the fieldwork, the ground conditions at this site can be characterised as follows:

- below a moderate thickness of made ground, Head Deposits are present over the London Clay, which extends to the maximum depth of the investigation, of 8.00 m (35.90 m OD);
- the made ground generally comprises light orange-brown silty sandy gravelly clay with occasional brick, concrete, clinker, flint gravel and rare rootlets and extends to at least 1.30 m (42.60 m OD);

- Head Deposits initially comprise soft becoming firm light orange-brown extremely mottled grey silty slightly sandy gravelly clay to 3.70 m (40.20 m OD), becoming light yellow-brown silty sandy very gravelly clay to a depth of 4.10 m (39.80 m OD);
- the London Clay consists of firm light brown occasionally mottled grey becoming light brown silty clay with occasional carbonaceous material and lenses of fine silt pockets and extends to the maximum depth investigated at 8.00 m (35.90 m OD);
- high volume change potential clays should be assumed;
- groundwater has been measured at depths of 1.20 m (42.70 m OD) and 1.30 m (42.60 m OD) and is likely to be perched groundwater from within the Head Deposits;
- elevated concentrations of lead have been measured within two samples of the made ground with respect to a residential end use with plant uptake; and
- asbestos was not detected in the four samples screened.

7.0 ADVICE AND RECOMMENDATIONS

The basement excavation will extend to a depth of approximately 3.03 m (41.24 m OD) below ground floor level and formation level should therefore be within soft silty slightly sandy slightly gravelly clay of the Head Deposits. Significant groundwater inflows are not anticipated in the basement excavation, although groundwater is likely to be encountered from within the sandy and gravelly horizons of the Head Deposits and it should be possible to adopt spread foundations constructed from basement level to support the new extension.

Excavations for the proposed basement structure will require temporary support to maintain stability of the excavation and surrounding structures at all times. The existing foundations will need to be underpinned prior to construction of the proposed new basement extension or will need to be supported by new retaining walls.

7.1 Basement Construction

The formation level for the basement extension is likely to be within the soft silty slightly sandy slightly gravelly clay of the Head Deposits at a depth of about 3.00 m (41.27 m OD) below existing ground floor level.

Groundwater was encountered as a water strike in Borehole No 1, at a depth of approximately 3.70 m (40.20 m OD) and it has subsequently been measured in the standpipe in Borehole No 1 at depths of 1.20 m (42.70 m OD) and 1.30 m (42.60 m OD) on two occasions. On this basis groundwater is likely to be encountered within the basement excavation and at variable depths, although monitoring of the standpipes should be continued to establish equilibrium levels and determine the extent of any seasonal fluctuations. Rising head tests should also be carried out to provide an indication of the inflow rate.

Groundwater within the Head Deposits is likely to be within discrete pockets and not within continuous layers. Each individual pocket may therefore be of relatively low volume and individual inflows may cease once the pocket is emptied. The clay soils are relatively impermeable, and inflows are not anticipated to be significant, such that it is considered that sump pumping should adequately control minor inflows. However, as the basement excavation will cover a much larger area than that covered by the investigation, it is possible

that larger pockets or inter-connected layers of groundwater could be encountered. It would therefore be prudent, once access is available, to carry out a trial excavation, to a depth as close to the full basement depth as possible, to provide an indication of the likely ground water conditions.

The selected contractor should have a contingency plan in place to deal with more significant or prolonger inflows as a precautionary measure if a watertight retention scheme is not adopted.

The design of basement support in the temporary and permanent conditions needs to take account of the necessity to maintain the stability of the excavation and the surrounding structures and to protect against potential groundwater inflows. There are a number of methods by which the sides of the basement excavation could be supported in the temporary and permanent conditions. The choice of wall may be governed to a large extent by whether it is to be incorporated into the permanent works and have a load bearing function.

Provided that groundwater inflows can be controlled it should be possible to form the retaining walls by means of concrete underpinning using a traditional 'hit and miss' approach. Careful workmanship will be required to ensure that movement of the surrounding structures is restricted but this method will have the benefit of minimising the plant required and maximising usable space in the new basement. Consideration should be given to the stability of excavations to form the underpins and the contractor should have measures in place to deal with groundwater inflows such as sump pumping or localised grouting.

The ground movements associated with the basement excavation will depend on the method of excavation and support and the overall stiffness of the basement structure in the temporary condition. Thus, a suitable amount of propping will be required to provide the necessary rigidity. In this respect the timing of the provision of support to the wall will have an important effect on movements. Consideration will also need to be given to a retention system that maintains the stability at all times of the existing building, neighbouring properties and structures. The existing foundations will need to be underpinned prior to excavation of the basement or will need to be supported by new retaining walls.

7.1.1 Basement Retaining Walls

The following parameters are suggested for the design of the permanent basement retaining walls.

Stratum	Bulk Density (kg/m^3)	Effective Cohesion (c' – kN/m^2)	Effective Friction Angle (ϕ' – degrees)
Made ground	1800	Zero	25
Head Deposits	1850	Zero	25
London Clay	1950	Zero	23

Groundwater has been measured at a minimum depth of 1.20 m (42.60 m OD). Monitoring of the standpipes should be continued to assess the design water level but at this stage it would appear that groundwater may be assumed to be encountered within basement level and a design water level of 1 m below ground level adopted; the advice in BS8102:2009[9] should also be followed in this respect.

9 BS8102 (2009) *Code of practice for protection of below ground structures against water from the ground*

7.1.2 Basement Heave

The excavation of the basement extension will result in an unloading of around 55 kN/m^2 beneath the central eastern portion of the property. This will result in differential heave of the underlying London Clay across the basement footprint, comprising immediate elastic movement, which will account for approximately 40 % of the total movement and be expected to be complete during the construction period, and long term movements, which will theoretically take many years to complete. These movements will, to some extent, be mitigated by the loads applied by the retained building but should be checked in more details once the loads have been finalised.

7.2 Spread Foundations

7.2.1 Basement level

Moderate width strip or pad foundations constructed from basement level to bear on the soft silty slightly sandy slightly gravelly clay of the Head Deposits may be designed to apply a net allowable bearing pressure of 100 kN/m^2. This value incorporates an adequate factor of safety and should ensure that settlement remains within tolerable level.

The rear garden is laid to artificial turf and is therefore considered to be essentially devoid of vegetation, although a number of semi mature and mature trees are present just around the perimeter to the north, south and west. No particular visual indication of desiccation was noted during the fieldwork and this was further confirmed by the results of the geotechnical testing.

As a result of the proposed basement excavation, the foundations will be formed below the likely maximum depth of any desiccation. However, it would be prudent to have the formation level inspected for the signs of tree root growth. If no roots are seen to be present, desiccation should not affect the development. If roots are found to be present, the excavation may have to be deepened to extend about 500 mm below the level of the deepest root encountered and NHBC guidelines should be followed in this respect.

7.2.2 Ground level

Foundations constructed from ground level to bear on the head deposits should be placed at a minimum depth of 1.50 m allowing for restricted new planting in accordance with Table 5 of NHBC guidance, the minimum depth can be reduced to 1.0 m subject also to further advice on new tree and shrub plating as detailed in the NBC guidelines.

The foundation may be designed to apply a new allowable pressure of 80 kN/m^2.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.

Notwithstanding the above, 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.

All foundations need to extend beyond any made ground and to found in the natural soils, and care will need to be taken not to undermine the existing foundations.

7.3 Hydrogeological Assessment

The results of recent monitoring indicate the presence of perched groundwater accumulating in the standpipe. The Head Deposits are unclassified while the London Clay is considered to be an Unproductive Stratum such that the basement development is unlikely to have a negative impact on groundwater flow.

The current development proposals include the extension of the existing basement to a depth of a about 3.00 m (41.27 m OD) below ground level and the investigation has indicated that the Head Deposits should extend to a level of about 4.10 m (39.80 m OD). The proposed depth of the basement is such that formation level will be within the Head Deposits, although a roughly 1.40 m of Head Deposits should remain beneath the excavation while will provide a pathway for any pockets of groundwater present. The new basement does not close a pathway or create a cut-off, and as such it is considered that any groundwater within sandy and gravelly horizons will follow a pathway beneath and around the proposed basement and will not build up significantly behind it. The basement should not, therefore, have any noticeable effect on groundwater flow.

Monitoring of the standpipes should be continued for as long as possible prior to construction to confirm this view and to account for any seasonal fluctuations.

7.4 Shallow Excavations

On the basis of the borehole and trial pit findings it is considered that it will be generally feasible to form relatively shallow excavations terminating within the made ground, head deposits or London Clay without the requirement for lateral support, although localised instabilities may occur where particularly more granular material or groundwater is encountered. However, 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.

Inflows of groundwater are likely to be encountered in shallow excavations from perched water tables within the Head Deposits, such inflows should be suitably controlled by sump pumping. Trial excavations are however recommended to confirm this.

7.5 Basement Floor Slab

Following the excavation of the basement extension, formation level will be within the Head Deposits and it should be possible to adopt a lightly loaded ground bearing basement floor slab. It is recommended that the basement slab is suitably reinforced to withstand heave or that a void or a layer of compressible material is incorporated below the slab to allow the

movement to take place. The formation level should be proof rolled in any case and any soft spots should be replaced with compacted granular fill.

7.6 Effect of Sulphates

Chemical analyses in three samples of the made ground and three samples of the natural soils have revealed low concentrations of soluble sulphate and near-neutral to slightly alkaline 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.

7.7 Contamination Risk Assessment

The desk study findings indicate that the site does not have a potentially contaminative history as it has apparently been occupied by houses since prior to 1872.

The chemical analyses have indicated elevated concentrations of lead in two samples of the made ground tested, from Trial Pit Nos 1 and 2A at depths of 0.30 m and 1.00 m respectively. A slightly elevated concentration of TPH was also measured in the sample from Borehole No 1 at a depth of 0.40 m, although it was not above the screening value. Asbestos was not detected in the three samples screened.

The exact source of the lead contamination 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 concentrations. In addition, information contained within the Envirocheck report indicates that the measured urban soil chemistry lead concentration is around 600 mg/kg to greater than 900 mg/kg, and values of between 572.40 mg/kg to 2587.50 mg/kg are indicated close to the site. The lead concentrations measured at the site are in fact lower than the background levels, and a significant proportion of the lead contamination is probably the result of background airborne pollution, particularly from the historical use of lead within vehicle exhaust emissions and bomb damage during the war, and therefore not specific to the site. 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.

It is proposed to excavate a basement extension beneath the central eastern portion of the house, such that the made ground will be removed from the areas from which the samples were taken.

No new areas of soft landscaping will be created as part of the proposals, but areas of soft landscaping will remain in the rear garden area although they are mainly covered in artificial grass as noted during the site walkover, such that the risk to end users will not be any higher than that which presently exists.

The measured contaminants in the made ground may however pose a risk to newly laid buried services and site workers during the ground works. These risks are further assessed below.

7.7.1 Services

In view of the slightly elevated concentration of TPH, consideration may need to be given to the protection of buried plastic drinking water supply 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 likely that barrier pipe will be required.

7.7.2 Site Workers

Elevated concentration of lead 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[10] and CIRIA[11] and the requirements of the Local Authority Environmental Health Officer.

7.8 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 WM3[12] states that landfill WAC analysis, specifically leaching test results, must not be used for waste classification purposes.

Any spoil arising from excavations or landscaping works, which is not to be re-used in accordance with the CL:AIRE[13] 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 £91.35 per tonne (about £219 per m^3) or at the lower rate of £2.90 per tonne (roughly £6.95 per m^3). 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 Environment Agency it is considered likely that the soils encountered during this ground investigation, as represented by the three chemical analyses carried out, would be generally classified as follows;

Soil Type	Waste Classification (Waste Code)	WAC Testing Required Prior to Landfill Disposal?	Current Landfill Tax
Made ground	Non-hazardous (17 05 04)	No	£91.35/tonne (Standard rate)
London Clay	Inert (17 05 04)	Should not be required but confirm with receiving landfill	£2.90 / 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,

10 HSE (1992) HS(G)66 *Protection of workers and the general public during the development of contaminated land* HMSO
11 CIRIA (1996) *A guide for safe working on contaminated sites* Report 132, Construction Industry Research and Information Association
12 Environment Agency 2015. *Guidance on the classification and assessment of waste.* Technical Guidance WM3 First Edition
13 CL:AIRE March 2011. *The Definition of Waste: Development Industry Code of Practice* Version 2

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 paper[14] 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.

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.

Monitoring of the standpipes should be continued to determine equilibrium groundwater levels and to establish any seasonal fluctuations and rising head tests should be carried out to provide an indication of the inflow rate Ideally, trial excavations extending to as close to the full depth of the proposed basement as possible should be carried out to determine likely groundwater inflows into the basement excavation.

The Preliminary UXO Risk Assessment recommended that site specific UXO awareness briefings should be given to all personnel conducting intrusive works and UXO mitigation measures were recommended for all intrusive works in lieu of a Detailed UXO Assessment, which comprise magnetometer scanning for borehole / pile locations to be carried out by an on-site UXO specialist.

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.

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.

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