KEY GS

Geological & Geotechnical Consultants

Glencoe, Walford Heath

Phase 1 Desk Study & Phase 2 Report on Ground Investigation (May 2020)

Prepared for City Environmental Services (UK) Ltd

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Glencoe, Walford Heath

Phase 1 Desk Study &
Phase 2 Report on Ground Investigation

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1.0 INTRODUCTION

Key GeoSolutions Ltd (KGS) have been commissioned by City Environmental Services (UK) Limited (CES) to undertake a ground investigation at Glencoe Yard, Walford Heath, Shropshire in order to ascertain the potential ground conditions in relation to the proposed development.

The site is located to the rear of the residential property Glencoe. The proposed development will comprise a five bedroom house with an associated garage, the proposed house is approximately 14m by 11m. The development area is currently used as a commercial premises by CES, with a workshop / offices and associated hard standing areas. The proposed development will require demolition of the workshop / offices.

The investigation comprises a desk study of publically available information related to the site, including a preliminary risk assessment, and a ground investigation for both geotechnical and contamination purposes. The ground investigation comprised three boreholes to define the ground conditions and provide samples for analyses.

The comments given in this report and any opinions expressed are based in part on information made available by CES and other Third Parties. KGS has proceeded in good faith on the assumption that this information is accurate and accepts no liability for any inaccurate conclusions, assumptions or actions taken resulting from any inaccurate information supplied. There may be, however, conditions pertaining to the site which have not been disclosed by the investigation and which therefore could not be taken into account in this report. In particular, old foundations or underground services may be present that could affect the proposed development.

It should also be noted that the effects of ground and water borne contamination on the environment are constantly under review, and authoritative guidance values are potentially subject to change. The conclusions presented herein are based on the guidance available at the time this report was prepared, and no liability can be accepted for the retrospective effects of any changes or amendments to the legislation or guidance.

2.0 SITE OVERVIEW

2.1 Site Location and Description

The site of the proposed new development is located to the rear of Glencoe, Walford Heath on the B5067, at National Grid Reference 345200mE, 319670mN, the location is shown on Figure 1. The development area is delineated by a red line on the site plan, Appendix 1.

The development area is located on land to the rear of Glencoe, in an area which is currently a commercial yard containing offices and a workshop occupied by CES. The area currently comprises a large concrete/hardcore area with a large metal-framed workshop, employee carpark at the front and a vehicle/container storage yard at the rear. The site is enclosed by residential properties on its eastern, southern and western boundaries, with open agricultural land to the north-east. The development area is generally flat and level with adjacent ground.

2.2 Land Use History

2.2.1 General

Historical Ordnance Survey maps from web-based sources have been reviewed to determine historical on-site and off-site land use. Where appropriate this information has been supplemented/correlated by other information from local knowledge.

2.2.2 Historical Land uses and features

The review focuses on the land use within the site boundary and the land immediately adjacent to the site. Additional comment on the land use further from the site is added if noteworthy from a geotechnical or land contamination context.

Site – A review of the historic maps shows that from at least 1881 until c.1970 the site was undeveloped, however, the adjacent B5067 was established by 1881 and a residential property was established at Glencoe from c.1901.

The c.1970 map shows a garage on-site. Planning records suggest that a bungalow, shop and petrol pump was on-site from c.1976. In c.1981 an application to demolish the existing house and erect a bungalow (thought to be the existing residential property now at Glencoe), a garage shop and forecourt. The same year an application to erect a “temporary accommodation building” was granted; this is thought to be the existing workshop on-site.

KGS have no records of when the garage and forecourt were demolished, but have been informed that the tanks associated with the garage were removed at the same time as demolition.

Surrounding Land –

0 – 250m

Residential – the 1881 map shows a few residential properties sparsely distributed across the surrounding area, and, by 1901, Old House and Yeaton Hall, both now Grade II listed buildings. There are increases in the number of residential properties by 1954 and 1970 to the west.

Wells - there are two wells shown on the 1901 map within 250m of the site, one of which is located c.123m to the south of the site within a field, this well remains until current OS mapping, the other is located at Yeaton Hall c.245m to the southeast.

250 - 1,000m

Railway – the Shrewsbury & Chester section of the Great Western Railway lies c.680m northeast of the site, established by 1888 and remaining to date.

Brick & Tile Works – first shown on the 1881 map located approximately 711m northeast. By 1970 the site was no longer shown, however, the site is believed to have been infilled by 1965.

2.2.3 Contemporary Surrounding Land Use

The closest contemporary trade is located on site and is active. It is a licensed asbestos specialist operated by the client, City Environmental Services (UK) Limited, Walford Heath, Shrewsbury, SY4 3AZ.

None of the operations within 1000m of the site require any Pollution Prevention and Control Permits.

There are no fuel stations within 1000m of the site.

2.3 Geo-Environmental Setting

2.3.1 Geology

The site is covered by BGS 1: 50,000 Geological Sheet No. 138 (Wem) Solid & Drift Published 1967. This indicates the site to be underlain by bedrock of the Chester Formation (gravelly sandstone) of the Lower Triassic epoch.

The bedrock is shown to be overlain by superficial strata, Till Deposits (clay, sand, gravel, and boulders varying widely in size and shape) of the Devensian period.

2.3.2 Hydrogeology and Groundwater Vulnerability

The hydrogeology and groundwater vulnerability at the site has been assessed and is summarised in the following sections.

2.3.3 Classification of Aquifer

The bedrock strata, Chester Formation, is identified as Principal Aquifer, defined by the Environment Agency as:-

"These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer."

The superficial strata, Till Deposits, are identified as a Secondary Aquifer - Undifferentiated, defined by the Environment Agency as:-

"These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type."

2.3.4 Soil Vulnerability

The soils beneath the site are classed as soils of Medium groundwater vulnerability, defined as:-

"Medium: Areas that offer some groundwater protection. Intermediate between high and low vulnerability."

2.3.5 Source Protection Zone

The site is not within a Source Protection Zone. The closest Source Protection Zone lies beyond 1000m of the site.

A “Drinking Water Protected Area (Surface Water)” is located c. 10m to the southeast of the site and is associated with the Severn Uplands catchment.

2.4 Other Significant Geo-environmental Information

2.4.1 Hydrology

The closest water feature to the site is a pond which is located c.80m to the northwest of the site, a drain also lies c.134m east of the site.

The site is located in an area where there is a “*medium to high*” risk of “*Flooding from Surface Water*”, the areas at risk are located on the western part of the site, close to the adjacent Glencoe.

There are no areas at risk of *“Flooding from Rivers or Sea”* identified within 1000m of the site.

2.4.2 Radon

With reference to Annex A and B of Radon: Protective Measures for New Dwellings (BR211, 2007), the site is located in a lower probability radon area, as less than 1% of homes are estimated to be at or above the action level.

In the event there is a significant delay between reporting and construction it is therefore recommended that an updated BR 211 Radon Report is obtained.

2.4.3 Waste

Based on the Waste Carriers and Brokers Public Register for England, the site is listed as an active “Carrier, Broker, Dealer – Upper Tier” operated by City Environmental Services (UK) Limited (Company Number 04385175).

There are no Historical Landfill Sites within 250m of the site, however, there is one Historical Landfill Site located c.711m to the north of the site; the landfill is named *Old Brick Yard, Old Wood, Bomere Heath* and the specified waste is noted as *“Household Waste”*. The landfill was operational between September 1954 and December 1965, and was part of the in-filling of the Brick & Tile Works in that location.

2.4.4 Ground Stability, Mineral Workings and Coal Mining

As would be expected based on the published geology the site is not in a “*coal mining reporting*” area. Hazards associated with coal mining activity are unlikely on site.

The mapping indicated a potential clay pit located c.711m to the north of the site, no mining sites were located within 250m of the site.

2.4.5 Environmentally Sensitive Land Uses

A Nitrate Vulnerable Zone for groundwater is located c.286m to the northwest, West Shropshire NVZ.

None of the following sensitive land uses were identified within 1000m of the site; Ancient Woodlands, Area of Adopted Green Belt, Areas of Outstanding Natural Beauty, Area of Unadopted Green Belt, Environmentally Sensitive Area, Forest Parks, Local Nature Reserve, Marine Nature Reserve, National Nature Reserves, National Parks, Nitrate Sensitive Areas, Ramsar Sites, Sites of Special Scientific Interest, Special Areas of Conservation, Special Protection Areas or World Heritage Sites.

2.4.6 Walkover Survey

A site walkover survey was carried out on 15th May 2020 by KGS. During the survey the site was found to comprises a large concrete/hardcore area with a large metal-framed workshop, employee carpark at the front and a vehicle/container storage yard at the rear. The area was generally flat and level with adjacent ground. No visible evidence of contamination, invasive weeds, presence of asbestos, PCBs, old tanks or chemicals were noted.

3.0 CONCEPTUAL MODEL AND PRELIMINARY RISK ASSESSMENT

3.1 Introduction

This section of the report comprises a qualitative assessment of the potential for contaminated land to be present at the site. The statutory definition for "contaminated land" being as follows:

> *"any land which appears to the local authority in whose area it is situated to be in such a condition by reason of substances in, on, or under the land, that:*
> *(a) significant harm is being caused or there is significant possibility of such harm being caused; or*
> *(b) significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused."*

Consequently, the assessment of contaminated land can be seen as a two phase risk based process, comprising:

(1) A qualitative assessment of the likelihood of plausible contaminant linkages, i.e. there must not only be a source of contamination, but a pathway and a receptor; and
(2) A quantitative element which will seek to determine the degree of harm and the significance of such harm on a receptor.

The Statutory definition of contaminated land was introduced through Part 2A of the Environment Protection Act 1990 to specifically address the historical legacy of land contamination. Where a site is being submitted for redevelopment under the planning regime it should on completion be suitable for use and should not be capable of being determined Contaminated Land under Part 2A of the Environment Protection Act 1990.

The proposed development will comprise a five bedroom house with an associated garage. The construction is assumed to a traditional build. The new building will be surrounded by a mixture of soft and hard landscaping. The proposed development will require removal of an existing workshop building.

Considering the proposed end use of the site and the findings from the desk study presented in the preceding sections a Conceptual Site Model (CSM) has been derived identifying plausible contaminant linkages and a preliminary risk assessment undertaken as set out below to determine whether plausible significant contaminant linkages are present. This CSM is further reviewed in Chapter 6 as part of the assessment of the results from the preliminary ground investigation undertaken as part of this commission.

3.2 Sources of Contamination

The possible on-site sources of contamination include:

- Contaminated ground from previous use as a garage with fuel tanks.
- Made ground associated with the demolition of previous buildings and garage and infilling as part of the fuel tanks removal.
- Incidental contamination from the processes undertaken at the workshop both previously as a garage and under its current use as an asbestos specialist's yard.

Off-site sources of contamination have not been identified.

3.3 Potential Contaminants of Concern

From the specific land uses mentioned above possible contaminants of concern could include: asbestos, metals, sulphates, nitrates, chloride, cyanide, sulphide, phenols, petroleum hydrocarbons, Polychlorinated Biphenyl (PCB), Polyaromatic Hydrocarbons (PAH) and gases from made ground.

3.4 Pathways for Migration

Potential pathways between sources and receptors for the proposed development are:

- Direct contact with and ingestion of contaminated soils, and inhalation of dust by site workers during construction and by end users of the site.
- Inhalation of vapours by site workers during construction and by end users of the site in enclosed spaces.
- Uptake of contaminated through soil or groundwater by plants grown in any gardens or landscaped areas.
- Ingestion of contaminated vegetable produce by end users.
- Migration of contaminants to the underlying aquifers.
- Accumulation of made ground gases in enclosed spaces, and subsequent ignition or inhalation by site workers during construction and by end users. There is also the potential for pathways to be created along new infrastructure including utility trenches and pipework as well as foundations.
- Direct contact with contaminated soils by structures and services.

3.5 Potential Receptors

The potential receptors include, site users, construction workers, controlled water of underlying Primary and Secondary Aquifer, plants grown in any gardens/landscaped areas, buildings and buried structures and services.

3.6 Assessment of Plausible Contaminant linkages

A risk assessment of the identified plausible contaminant linkages has been undertaken for the site in line with current legislation described above. (The assessment takes into consideration the sources of possible contamination risk and the presence of any plausible pathways or receptors as outlined in the Environmental Protection Act 1990 (Part 2A)). The risk assessment has been undertaken on the understanding that the site is to be developed as a new five bedroom house and associated gardens. As such, some assumptions have been made with respect to the following assessment as set out immediately below. The geo-environmental risk assessment should be reviewed in the event that the proposed end use is significantly altered from that described in Section 3.1 above.

It has been assumed that appropriate health and safety practices will be adopted during site clearance, preparation, earthworks and construction, and appropriate environmental protection / mitigation measures will be employed. It is also assumed that the proposed development will not introduce contaminative substances into the ground. It is anticipated that the building will be surrounded by a mixture of soft and hard landscaping.

Table 2 presents a qualitative assessment of the significance of the plausible contaminant linkages identified, those that are likely to only occur during construction are highlighted in italics. The classifications of consequence (severity) are taken from R&D Publication 66 (NHBC and Environment Agency, 2008). It should be noted that as this PRA is based on desk study information, it has been assumed where there is no definite evidence of whether contamination is present or not or the significance of this contamination, that generally a “medium” consequence category has been selected except for the secondary aquifers where due to their limited resource value a “mild” consequence has been selected. As already stated, the PRA is reviewed as part of the assessment of results from the preliminary ground investigation in Chapter 6. The scope of the investigation is set out in Chapters 4 and 5.

Table 2 - Plausible Contaminant linkages and Qualitative Preliminary Risk Assessment – Proposed Development (Based on desk study information)

Potential Source	Nature of Hazard	Associated Contaminants	Pathway	Receptor	Consequence	Probability	Risk
Contaminated ground associated with previous and current uses [3]	Contaminated soil [3]	General Contaminants: asbestos, metals, petroleum hydrocarbons, PCBs, PAHs.	Direct Contact / Ingestion of soil. Inhalation of dust. Inhalation of vapours. Ingestion of contaminated vegetable produce.	Site Users	Medium	Likely	Moderate Risk
			Permeation to potable water supplies	Site Users	Medium	Likely	Moderate Risk
			Direct Contact / Ingestion of soil. *Inhalation of dust.* *Inhalation of vapours.*	*Construction Workers*	*Medium*	*Low Likelihood*	*Moderate / Low Risk*
			Uptake via contaminated soil or groundwater	Vegetation	Medium	Likely	Moderate Risk
			Vertical and lateral movement of mobile contaminants to groundwater	Controlled Waters (Principal and Secondary Aquifers)	Mild	Likely	Moderate / Low Risk
			Direct Contact	Buried Services (plastic pipes etc)	Medium	Likely	Moderate Risk

Potential Source	Nature of Hazard	Associated Contaminants	Pathway	Receptor	Consequence	Probability	Risk
Made ground associated with the demolition of previous buildings and garage and infilling as part of the fuel tanks removal [4]	Contaminated soil	General Contaminants: asbestos, metals, sulphates, nitrates, chloride, cyanide, sulphide, phenols, petroleum hydrocarbons, PCBs, PAHs.	Direct Contact / Ingestion of soil. Inhalation of dust. Inhalation of vapours. Ingestion of contaminated vegetable produce.	Site Users	Medium	Likely	Moderate Risk
			Permeation to potable water supplies	Site Users	Medium	Unlikely	Low Risk
			Direct Contact / Ingestion of soil. *Inhalation of dust.* *Inhalation of vapours.*	*Construction Workers*	*Medium*	*Low Likelihood*	*Moderate / Low Risk*
			Uptake via contaminated soil or groundwater	Vegetation	Medium	Likely	Moderate Risk
			Vertical and lateral movement of mobile contaminants to groundwater	Controlled Waters (Principal and Secondary Aquifers)	Mild	Likely	Moderate / Low Risk
			Direct Contact	Buildings and Structures	Medium	Likely	Moderate Risk
			Direct Contact	Buried Services (plastic pipes etc)	Medium	Likely	Moderate Risk

Potential Source	Nature of Hazard	Associated Contaminants	Pathway	Receptor	Consequence	Probability	Risk
	Ground Gases (Asphyxiation, fire and explosion) [4]	Methane Carbon Dioxide	Ingress, accumulation and inhalation	Site Users	Severe	Likely	High Risk
				Construction Workers	*Medium*	*Low Likelihood*	*Moderate Risk*
			Ingress, accumulation and ignition	Buildings and Structures	Severe	Likely	High Risk

Notes:

1. Due to health and safety requirements risks to workers should be removed by use of appropriate work methods and use of PPE. Information on the risks must be provided in advance of works in accordance with CDM 2015. Residual information on risks shall also be retained on-site in the Health and Safety File to ensure future maintenance workers understand the risks and can mitigate accordingly.
2. Plausible contaminant linkages that are likely to only occur during construction are highlighted in italics.
3. Includes contaminated ground from previous use as a garage with fuel tanks and incidental contamination from the processes undertaken at the workshop both previously as a garage and under its current use as an asbestos specialist's yard.
4. It is not known when the old fuel tanks were excavated, removed and infilled. If significant amounts of biodegradable material were included in the material used to infill the old fuel tanks, there is a risk from ground gas, and the source is considered to have the potential to affect the end users.

In summary, as can be seen from the PRA above, there is generally a perceived moderate to low risk of on-site contamination affecting the construction workers, vegetation and the underlying groundwater. However there are moderate to high risks to site users and the development; the high risks in both cases relate to the potential for ground gas on site.

4.0 GROUND INVESTIGATION

The site work was carried out on the 15th May 2020 and generally in accordance with the guidelines laid down in BS EN 1997-2:2007.

Seven window sample holes (WS01 to WS07) were sunk in the vicinity the footprint of the proposed new building to investigate the ground conditions and provide samples for chemical and physical analyses. WS01 to WS04 were located in the area around the proposed location of the new building. WS05 to WS07 were located to investigate the extent of suspected hydrocarbons identified in WS04.

The approximate locations of the boreholes are shown on Figure 2. The depths and descriptions of the soils encountered are given in the borehole records (Appendix 2). Standard Penetration Tests (SPTs) were taken at various depths during drilling of the boreholes; the depths and results of the SPTs are provided on the borehole logs.

Samples taken for contamination purposes were recovered in labelled 250g amber jars, 60g amber jars and 1kg plastic tubs (marked as “Jars” on the borehole logs). The samples were then stored in cool boxes prior to being delivered to i2 Analytical Limited in Watford. Samples were scheduled using Sample Custody forms provided by i2 Analytical.

A monitoring standpipe was installed in WS04, details of installation is given on the borehole log (see Appendix 2). The remaining boreholes were backfilled with arising’s on completion.

5.0 LABORATORY TESTING

Samples were selected and scheduled for chemical analysis by KGS: the analysis was carried out by i2 Analytical Laboratories, a UKAS accredited laboratory with MCERTs accreditation for the majority of test scheduled. The range of chemical analyses was based on the known previous land use history of the site and include asbestos screen, total cyanide, sulphide, phenols, pH, BRE Suite, polyaromatic hydrocarbons (PAH), soil organic matter (SOM), Polychlorinated Biphenyl (PCB), Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG) banded aliphatics and aromatics hydrocarbons, and metals (Arsenic, Barium, Beryllium, Boron water soluble, Cadmium, Chromium, Hexavalent Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc).

Whilst every effort has been made to schedule tests suitable for the known previous land use, there is no guarantee that other contaminants are not present on site for which analyses have not been carried out or which were not sampled in the programme of exploratory holes.

Four representative samples of the made ground were selected for contamination testing; the results are given in Appendix 3.

6.0 DISCUSSIONS ON GROUND CONDITIONS AND RECOMMENDATIONS

6.1 Soil Conditions

The following strata were encountered during the investigation:-

- Made Ground
- Topsoil
- Silty Clays (assumed to represent localised alluvium deposits)
- Silts / Sands / Clays (assumed to represent the Till Deposits)

With the exception of WS03, all boreholes encountered made ground, the depths of made ground was generally between 0.20m and 0.85m, with deeper made ground in WS02, 1.50m, and WS04 2.00m. Underlying the made ground, boreholes WS01 & WS05 encountered topsoil which was thought to be the original ground prior to development.

Below made ground and topsoil the boreholes encountered a varying succession of soft to firm clays, silts and sands which are thought to represent different lenses of the Till Deposits and possibly some alluvium deposits.

- WS01 was terminated in clay at a depth of 4.00m below ground level (bgl). Groundwater was not encountered.
- WS02 was terminated in sand at a depth of 5.00m bgl. Groundwater was encountered at 2.00m bgl.
- WS03 was terminated in clay at a depth of 2.00m bgl. Groundwater was encountered at 1.90m bgl.
- WS04 was terminated in sand at a depth of 4.00m bgl. Groundwater was not encountered.
- WS05 was terminated in silt at a depth of 2.00m bgl. Groundwater was not encountered.
- WS06 was terminated in clay at a depth of 1.00m bgl. Groundwater was not encountered.
- WS07 was terminated in sand at a depth of 2.00m bgl. Groundwater was not encountered.

6.2 Visual and Olfactory Evidence of Contamination

Visual and olfactory evidence where present is recorded on the exploratory hole logs within the relevant soil descriptions.

In WS04 and WS06 (located to the southwest of WS04), hydrocarbon odours were noted at depths of 1.0 to 1.5mbgl and at 0.6mbgl. However, material within WS05 and WS07, located to the north-west and south-east of WS04, did not identify olfactory evidence of contamination.

6.3 Foundations

Due to the presence of deep made ground and soft silts and clays, traditional strip and pad foundations would have to be taken to depths of 3m to encounter a suitable founding strata, this may not be considered feasible, particularly as groundwater was encountered above this level in three of the boreholes. The strata at a depth of 3.0m would give an allowable bearing pressure in excess of 100 kN/m².

If a piled foundation solution is to be sought, additional ground investigation, including deep boreholes, will be required to provide information on the strata at depth for pile design purposes.

6.4 Gas Monitoring

Although a gas monitoring standpipe was installed during the ground investigation, at the time of writing, no gas monitoring has yet been undertaken.

6.5 Chemical Considerations

6.5.1 Laboratory Results

The laboratory testing detected in all samples the presence of most metals tested for, excluding, Hexavalent Chromium and Selenium, the laboratory testing also revealed the presence of cyanide, sulphide, water soluble sulphate, chloride, nitrate, PAHs, TPHs and organic matter. A complete set of test results is contained in Appendix 3.

Table 3: Summary of Test Results (excluding results less than detection level or less than threshold value, where applicable).

Determinand	Unit	S4UL for RwHP[1,2]	Concentrations
			WS01 No1
			0.50m
Natural Ground (1 Sample)			
pH	pH units	n/a	6.6
Arsenic (total)	mg/kg	37.00	36
Barium (total) [3]	mg/kg	1300.00	1000
Beryllium (total)	mg/kg	1.70	4.1
Boron (water soluble)	mg/kg	290.00	7.7

Determinand	Unit	S4UL for RwHP[1,2]	Concentrations
			WS01 No1
			0.50m
Cadmium (total)	mg/kg	11.00	1.1
Chromium (total)	mg/kg	910.00	29
Copper (total)	mg/kg	2400.00	110
Lead (total) [4]	mg/kg	200.00	14000
Mercury (total)	mg/kg	1.20	2
Nickel (total)	mg/kg	130	98
Vanadium (total)	mg/kg	410.00	37
Zinc (total)	mg/kg	3700.00	490
Sulphide	mg/kg	-	290
Water Soluble Sulphate	mg/kg	-	1700
Water Soluble Chloride	mg/kg	-	54
Water Soluble Nitrate	mg/kg	-	2.1
Cyanide	mg/kg	-	3
Organic Matter Content	%	-	13
Phenanthrene	mg/kg	95.00	0.59
Anthracene	mg/kg	2400.00	0.12
Fluoranthene	mg/kg	280.00	0.78
Pyrene	mg/kg	620.00	0.77
Benzo(a)anthracene	mg/kg	7.20	0.47
Chrysene	mg/kg	15.00	0.76
Benzo(b)fluoranthene	mg/kg	2.60	0.48
Benzo(k)fluoranthene	mg/kg	77.00	0.22
Benzo(a)pyrene	mg/kg	2.20	0.75
Indeno(123cd)pyrene	mg/kg	27.00	0.33
Benzo(ghi)perylene	mg/kg	320.00	0.51
PAH (total of USEPA 16)	mg/kg	-	5.78
EPH Aliphatic (>C12-C16)	mg/kg	24.00	11

Determinand	Unit	S4UL for RwHP[1,2]	Concentrations		
			WS04 No1	WS04 No2	WS06 No1
			0.50-1.00m	1.50-2.00m	0.50-0.80m
Made Ground (3 Samples)					
pH	pH units	n/a	10.5	7.6	7.1
Arsenic (total)	mg/kg	37.00	6.4	9.2	8.1
Barium (total) [3]	mg/kg	1300.00	190	240	320
Beryllium (total)	mg/kg	1.70	0.8	0.93	1.5
Boron (water soluble)	mg/kg	290.00	1.5	1.9	3.8
Cadmium (total)	mg/kg	11.00	1	0.6	0.5
Chromium (total)	mg/kg	910.00	27	24	27
Copper (total)	mg/kg	2400.00	20	19	25
Lead (total) [4]	mg/kg	200.00	200	370	190
Mercury (total)	mg/kg	1.20	0.7	0.5	0.5
Nickel (total)	mg/kg	130	27	30	32
Vanadium (total)	mg/kg	410.00	38	32	32
Zinc (total)	mg/kg	3700.00	220	350	200
Sulphide	mg/kg	-	27	27	43
Water Soluble Sulphate	mg/kg	-	160	81	170
Water Soluble Chloride	mg/kg	-	17	30	140
Water Soluble Nitrate	mg/kg	-	33	12	12
Organic Matter Content	%	-	1.7	1.9	3.6
Fluorene	mg/kg	170.00	< 0.05	< 0.05	0.25
Phenanthrene	mg/kg	95.00	< 0.05	0.48	3
Anthracene	mg/kg	2400.00	< 0.05	0.15	1
Fluoranthene	mg/kg	280.00	0.52	0.97	5.7
Pyrene	mg/kg	620.00	0.62	1.1	5.4
Benzo(a)anthracene	mg/kg	7.20	0.28	0.54	2.6
Chrysene	mg/kg	15.00	0.41	0.72	2.3
Benzo(b)fluoranthene	mg/kg	2.60	0.44	0.86	1.8
Benzo(k)fluoranthene	mg/kg	77.00	0.24	0.38	0.81
Benzo(a)pyrene	mg/kg	2.20	0.94	1.6	3.1
Indeno(123cd)pyrene	mg/kg	27.00	0.59	1	1.6

Determinand	Unit	S4UL for RwHP[1,2]	Concentrations		
			WS04 No1	WS04 No2	WS06 No1
			0.50-1.00m	1.50-2.00m	0.50-0.80m
Dibenz(ah)anthracene	mg/kg	0.24	< 0.05	< 0.05	0.38
Benzo(ghi)perylene	mg/kg	320.00	0.87	1.3	2
PAH (total of USEPA 16)	mg/kg	-	4.91	9.19	29.9
EPH Aromatic (>EC12-EC16)	mg/kg	140.00	6.4	16	2.6
EPH Aromatic (>EC16-EC21)	mg/kg	260.00	18	45	46
EPH Aromatic (>EC21-EC35)	mg/kg	1100.00	48	42	110
EPH Aliphatic (>C12-C16)	mg/kg	24.00	5.6	39	< 2.0

Notes:

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2. Where S4UL value is affected by changes in soil organic matter concentrations the S4ULs relating to 1% SOM.
3. Barium value taken from EIC/AGS/CL:AIRE publication Soil General Assessment Criteria for Human Health Risk Assessment (2010) for the a similar land use although without home grown produce and an exposure based on original CLEA model not updated C4SL approach.
4. Lead values are based on the published C4SL values published by DEFRA for the same land use.
5. The four samples were subjected to asbestos identification analysis and no asbestos was detected.

The four samples taken, one of natural “topsoil” and three of made ground, all tested positive for a wide range of contaminants, including cyanide, sulphide, water soluble sulphate, chloride, nitrate, heavy metals, PAHs and TPHs. The majority of the levels of contaminants detected fall below the S4UL threshold levels for Residential Property with Home Grown Produce; however, a number of contaminants were detected above the threshold levels.

The sample of natural ground, representing the topsoil directly below the made ground in WS01, contained levels of Beryllium, Lead and Mercury above the S4UL threshold levels for Residential Property with Home Grown Produce. The sample also had an Organic Matter Content of 13% although this would be expected with it being “topsoil” and a sulphide level of 290, for which there are no threshold levels available. Levels of other heavy metals, cyanide, PAHs and TPHs were also detected.

The samples of made ground, taken from WS04 and WS06 where hydrocarbon odours were detected, contained levels of Lead, Benzo(a)pyrene, Dibenz(ah)anthracene and TPHs (EPH

Aliphatic (>C12-C16)) above the S4UL threshold levels for Residential Property with Home Grown Produce. One of the samples, WS04 (0.50-1.00m bgl) also had a pH of 10.5. Levels of other heavy metals, sulphide, PAHs and TPHs were also detected. It seems likely that the contamination encountered is associated with the previous land-use and possibly the fuel tanks that were removed.

6.5.2 Human health – end users

In terms of long term human health, the testing undertaken within the upper 2.00m of the development area has identified contaminants present at significant concentrations that are considered to pose a risk to human health.

Natural ground in some parts of the development area appears to have been impacted by the overlying made ground, as it contains a range of contaminants at concentrations above the S4UL threshold levels for Residential Property with Home Grown Produce.

Due to the levels of contamination it is recommended that the made ground is removed and replaced with a suitable clean fill. As the made ground is being removed further testing should be undertaken to confirm that all contaminated ground has been removed.

6.5.3 Human health - Construction Workers/Maintenance Workers

Short term risks to construction workers from identified contamination can be mitigated by adoption of normal standards of health, safety and hygiene adopted on construction sites.

The risks associated with ground gas can be mitigated by ensuring all work areas are well ventilated and that a full risk assessment is undertaken and appropriate measures are taken to protect workers, prior to working in any enclosed spaces.

6.5.4 Soft Landscaping and Plant Uptake

Based on the testing undertaken, both the made ground and impacted near surface soils exceeded the values given in BS3882:2015 Specification for Topsoil for phytotoxic metals for a soil with a pH between 6.0 and 7.0, and greater than 7.0, as set out in the table below.

Table 4: Showing the phytotoxic thresholds for metals (taken from BS3882:2015)

Phytotoxic contaminant	Concentrations not to be exceeded for topsoil (mg/kg)	
	pH 6.0 – 7.0	pH>7.0
Zinc	200	300
Copper	135	200
Nickel	75	110

In order to remove the risk to the soft landscaping, the contaminated near surface soils would need to be removed and replaced with clean soils, which should be separated from the soils below by a suitable membrane.

6.5.5 Controlled Waters

As the soils contain high concentrations of a number of contaminants, and groundwater in the area has been encountered at 2.0m bgl, a similar level to the base of made ground in WS04, it is considered likely that there is currently a risk to controlled waters.

The Secondary Aquifer associated with the superficial strata is most at risk, however, as the strata encountered appeared to comprise a varying succession of clays, silts and sands which are thought to represent different lenses, the groundwater encountered may not be highly mobile.

The Principle Aquifer is likely to be partially isolated from the contaminants by the superficial strata; with its lenticular nature and comprising silts and clays, the superficial strata is likely to significantly slow the vertical migration of contaminants and offer some attenuation.

Removal of the contaminated made ground and any impacted natural ground would remove the risks to controlled waters.

Any further site investigation undertaken to investigate the extents and nature of the contaminants identified should be carefully designed so that it does not itself create additional pathways for migration of contaminants down to the principal aquifer represented by the sandstone of the Chester Formation.
If a piled foundation solution is to be sought, additional ground investigation, including deep boreholes, will be required to give information on the strata at depth and to ensure that a piling solution does not mobilise additional contamination or create additional source-receptor pathways.

6.5.6 Potable Water Supply Pipes

Plastic pipes can be affected by the presence of contamination leading to stress cracking and or permeation. The route of the potable water supply is not currently known and further testing could determine the risk actually along the route at the depth and location of the pipe. However if it is a relatively small diameter pipe and a relatively short run then the adoption of barrier pipe without further testing may be the more cost effective approach. Consultation with the local water supplier is recommended in order to confirm appropriate measures for mitigation.

6.5.7 Buried Concrete

The presence of sulphate can have a deleterious effect on concrete. Given the results of the BRE Suite testing, the topsoil encountered in WS01 classified as DS-3 for concrete design, and the made ground encountered in WS04 & WS06 classified as DS-1 for concrete design.

6.5.8 Ground Gas

A gas monitoring standpipe was installed during the ground investigation; however, at the time of writing, no gas monitoring has yet been undertaken. The ground conditions could give rise to unknown levels of carbon dioxide and methane gas due to presence of made ground on-site; there will be the potential for such gas to migrate through to the proposed building.

It has been recommended that the contaminated made ground be removed, this will remove the potential source of any gas.

6.5.9 *Summary*

The presence of both contaminated made ground and impacted natural ground were identified on site, the samples tested identified contaminants present at significant concentrations that are considered to pose a risk to human health, soft landscaping and controlled waters. It is recommended that the contaminated made ground be removed and replaced with a suitable clean fill. Further testing will be required at this time in order to confirm that all contaminated ground has been removed.

The short term risks to construction workers from identified contamination can be mitigated by adoption of normal standards of health, safety and hygiene adopted on construction sites.

The topsoil encountered in WS01 classified as DS-3 for concrete design, whilst the made ground encountered in WS04 & WS06 classified as DS-1 for concrete design.

The risks to potable water supply pipes should be reviewed once the route of the pipes is known.

6.5.10 Classification of Arising's for disposal to landfill

Should any materials be required to be disposed of off-site, representative samples of the materials should be sent for WAC testing so that the waste can be classified and sent to the appropriate landfill site.

7.0 CONCLUSIONS AND RECOMMENDATIONS

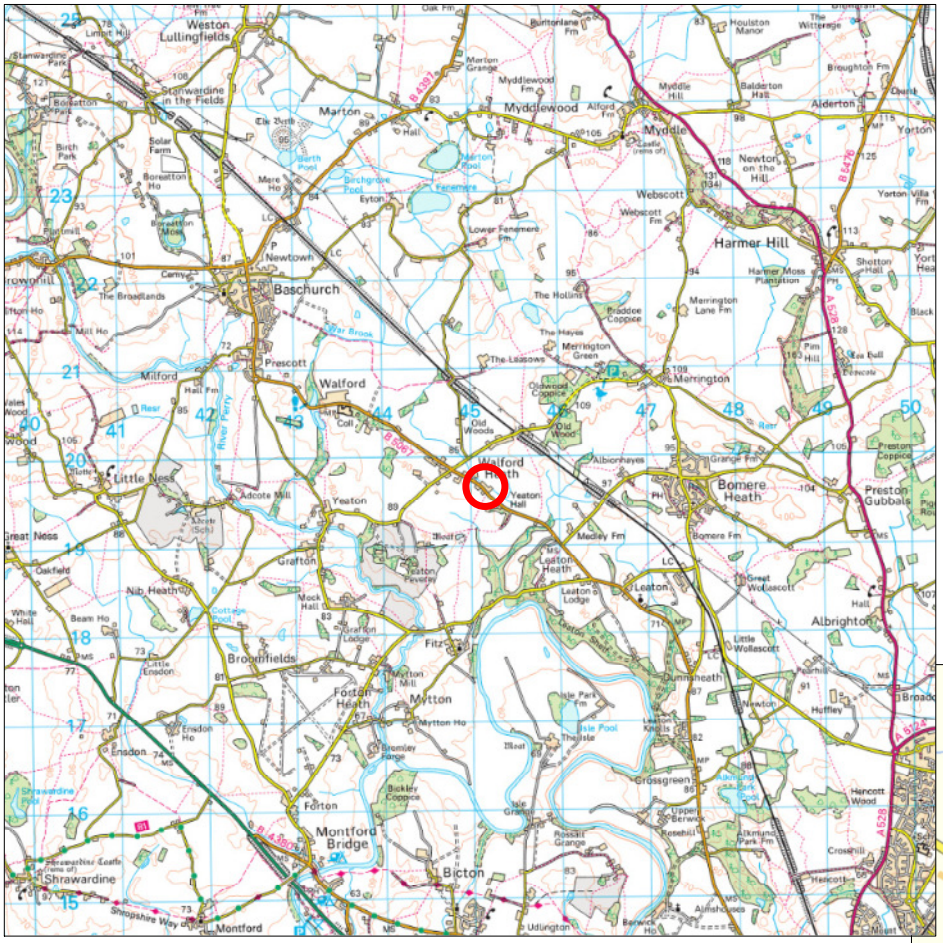
7.1 Conclusions

- The development at Glencoe, Walford Heath will comprise a new five bedroom house.
- The site is underlain by bedrock of the Chester Formation; a Principal Aquifer.
- The bedrock is overlain by superficial strata, Till Deposits; a Secondary A Aquifer.
- The soils beneath the site are classed as soils of Medium groundwater vulnerability.
- The site was previously a garage and forecourt. The tanks associated with the garage were reportedly removed at the same time as its demolition.
- The site is currently used as a commercial yard and workshop / workshop for CES, an asbestos removal specialist.
- Groundwater was encountered c.2.0m below ground level in some of the boreholes, groundwater appears to be perched in lenses of sand and gravel.
- Due to the presence of deep made ground and soft silts and clays, traditional strip and pad foundations would have to be taken to depths of 3m to encounter a suitable founding strata, this may not be considered feasible, particularly as groundwater was encountered above this level in three of the boreholes. A piled foundation solution may offer a more economic solution.
- The strata at a depth of 3.0m would give an allowable bearing pressure in excess of 100 kN/m².
- If a piled foundation solution is to be sought, additional ground investigation, including deep boreholes, will be required to provide information on the strata at depth for pile design purposes.
- The presence of both contaminated made ground and impacted natural ground were identified on site, the samples tested identified contaminants present at significant concentrations that are considered to pose a risk to human health, soft landscaping and controlled waters.
- There is a potential risk to human health associated with the potential for ground gas from the made ground on-site.
- The risks to potable water supply pipes should be reviewed once the route of the pipes is known.

7.2 Recommendations

- Vigilance should be maintained during groundworks in case different ground conditions from those anticipated are encountered.
- In order to remove the risks to human health, soft landscaping and controlled waters, the contaminated near surface soils & made ground would need to be removed and replaced with clean fill and clean soils, which should be separated by a suitable membrane.
- Further testing should be undertaken when the made ground is being removed to confirm the extent of the contamination and to ensure that all contaminated ground has been removed.
- Good practice should be employed in order to limit amount of surface water entering the excavation area.
- If a piled foundation solution is to be sought, additional ground investigation, including deeper boreholes, will be required.
- Any site investigation should be carefully designed so that it does not itself create additional pathways for migration of contaminants down to the principal aquifer, represented by the sandstone of the Chester Formation.
- Short term risks to construction workers from potential unidentified contamination can be mitigated by adoption of normal standards of health, safety and hygiene adopted on construction sites.
- Plastic pipes can be affected by the presence of contamination leading to stress cracking and or permeation. If development is to include water supply pipes, consultation with the local water supplier is recommended in order to confirm appropriate measures for mitigation.
- The presence of sulphate can have a deleterious effect on concrete. Given the results of the BRE Suite testing the topsoil encountered in WS01 classified as DS-3 for concrete design, and the made ground encountered in WS04 & WS06 classified as DS-1 for concrete design.
- Should any materials be required to be disposed of off-site, representative samples of the materials should be send for WAC testing so that the waste can be classified and sent to the appropriate landfill site.

FIGURES



Rev.	Revision Detail	Drawn	Date
01	First Issue	WR	29/06/20

CLIENT:

CES (UK) LTD

PROJECT:

GLENCOE,
WALFORD HEATH

TITLE:

SITE LOCATION

DRAWN:	CHECKED:	DATE:
WR	BD	JUN '20
SCALE:	ORIGINAL SHEET SIZE:	STATUS:
NTS	A4	DRAFT

DRAWING NO.

FIGURE 1

REVISION: 01

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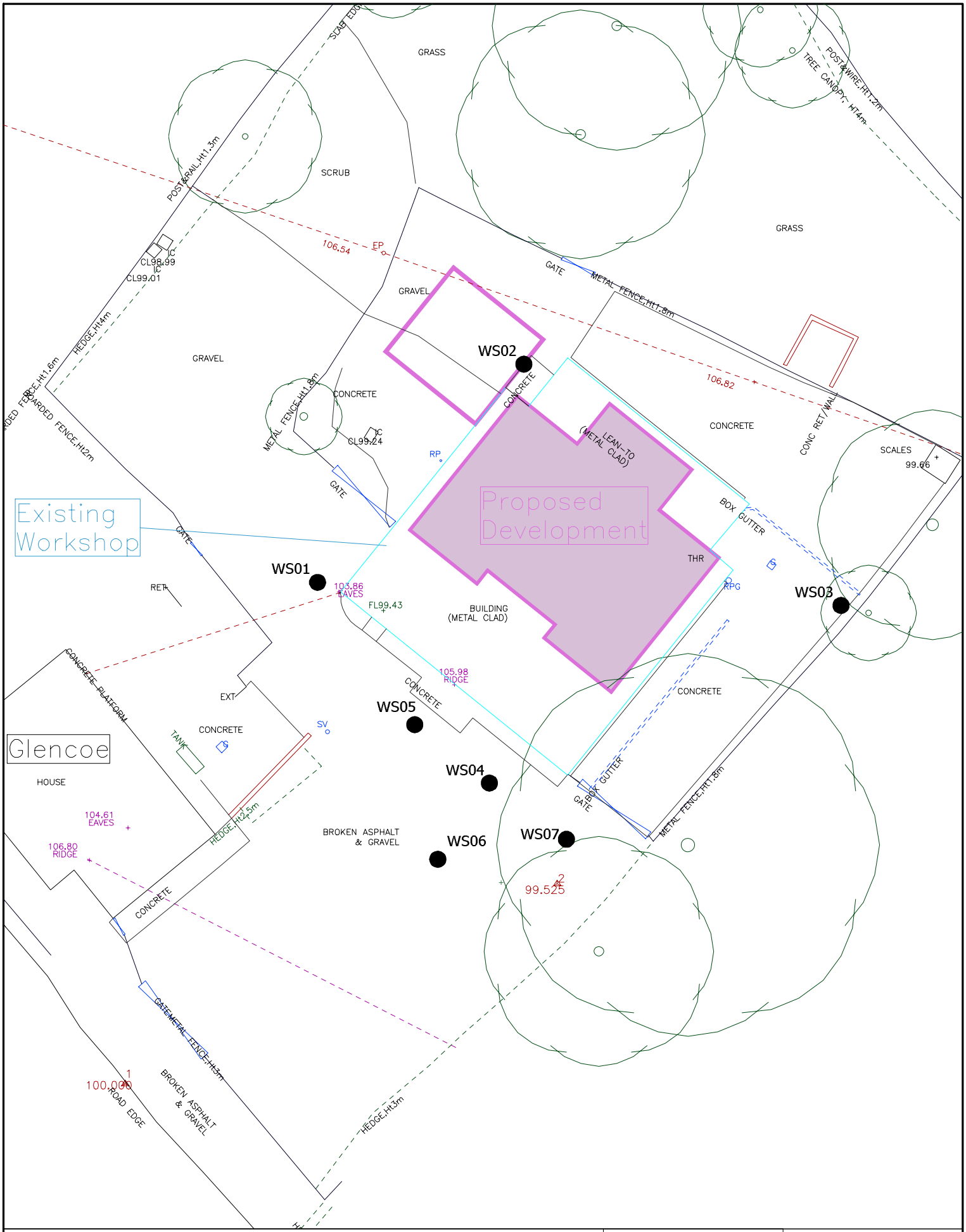

REV.	REVISION DETAIL	DRAWN	DATE
01	FIRST ISSUE	WR	29/06/20

CLIENT: CES (UK) LTD

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PROJECT: GLENCOE, WALFORD HEATH

TITLE: BOREHOLE LOCATION PLAN

DRAWN:	CHECKED:	DATE:
WR	BD	JUN '20
SCALE: 1:250	ORIGINAL SHEET SIZE: A4	STATUS: DRAFT

DRAWING NO.: FIGURE 2

REVISION: 01

APPENDICES

APPENDIX 1

PROPOSED SITE PLAN

Site Area
0.203 Ha

Drawing Revisions:
A

BERRYS
PROPERTY | BUSINESS | PLANNING
01743 271697 | SY2 6FG
www.berrys.uk.com

Client:
City Environmental Services

Project:
Land Adj Glencoe, Walford Heath, Shropshire

Drawing:
Location Plan

Drawing Number:	Rev.	Scale	Paper	Drawn By: AW
SA34742_SK_01		1:1250	A3	Date: 7.11.19

APPENDIX 2

BOREHOLE LOGS

Key GeoSolutions
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BOREHOLE NUMBER WS01

CLIENT CES (UK) Limited
PROJECT NAME Glencoe, Walford Heath
PROJECT NUMBER 20-128
PROJECT LOCATION Shrewsbury

DATE STARTED 15/5/20 **COMPLETED** 15/5/20
CO-ORDINATES 345185 mE, 319671 mN
DRILLING CONTRACTOR GSS
GROUND ELEVATION **HOLE SIZE** 100mm
DRILLING METHOD Windowless Sampler
LOGGED BY Brian Duthie **CHECKED BY** WR

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (SPT N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION & REMARKS
					MADE GROUND comprising crushed stone
					0.20
					Black ash and shale with occasional wood fragments [MADE GROUND]
					0.40
	J	()	BH1 No1		Dark brown compact TOPSOIL
					0.90
1					Firm pale grey CLAY
	SPT	2-2-2-2 (8)			
					1.40
2					Grey sandy SILT with occasional rootlets
	SPT	2-2-3-2 (9)			
					2.30
3					Medium dense brownish grey silty SAND with some fine to medium gravel
	SPT	2-3-4-3 (12)			
					3.90
4					Firm to stiff dark grey CLAY with some fine to coarse gravel
	SPT	3-3-4-3 (13)			
					4.45

Bottom of borehole at 4.45 metres.

NOTES Groundwater not encountered.

SAMPLE TYPE KEY U = Undisturbed D = Disturbed B = Bulk J = Jar VA = Shear Vane SPT = Standard Penetration Test

Key GeoSolutions
info@keygs.com
Telephone: 01952 822960

BOREHOLE NUMBER WS02

CLIENT CES (UK) Limited
PROJECT NAME Glencoe, Walford Heath
PROJECT NUMBER 20-128
PROJECT LOCATION Shrewsbury
DATE STARTED 15/5/20 **COMPLETED** 15/5/20
CO-ORDINATES 345196 mE, 319682 mN
DRILLING CONTRACTOR GSS
GROUND ELEVATION **HOLE SIZE** 100mm
DRILLING METHOD Windowless Sampler
LOGGED BY Brian Duthie **CHECKED BY** WR

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (SPT N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION & REMARKS
1					MADE GROUND comprising Type 1 surface. Brown clay matrix with fragments of brick and concrete
	SPT	2-1-1-1 (5)			0.95 - 1.00m; layer of slate
					1.50 Soft silty CLAY with rootlets and pieces of wood [ALLUVIUM]
2					2.00 ▽
	SPT	1-1-2-2 (6)			Loose reddish brown grey silty fine SAND
					2.30 Soft to firm brown grey laminated CLAY with partings of fine to medium sand
3					
	SPT	5-3-4-3 (15)			3.00m; becoming firm
4					
	SPT	6-6-5-6 (23)			
					4.70 Medium dense reddish brown silty fine SAND with some fine to medium gravel
5					
	SPT	7-8-7-8 (30)			5.45
					Bottom of borehole at 5.45 metres.

NOTES

SAMPLE TYPE KEY U = Undisturbed D = Disturbed B = Bulk J = Jar VA = Shear Vane SPT = Standard Penetration Test

Key GeoSolutions
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BOREHOLE NUMBER WS03

CLIENT CES (UK) Limited
PROJECT NAME Glencoe, Walford Heath
PROJECT NUMBER 20-128
PROJECT LOCATION Shrewsbury

DATE STARTED 15/5/20 **COMPLETED** 15/5/20
CO-ORDINATES 345213 mE, 319670 mN
DRILLING CONTRACTOR GSS
GROUND ELEVATION **HOLE SIZE** 100mm
DRILLING METHOD Windowless Sampler
LOGGED BY Brian Duthie **CHECKED BY** WR

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (SPT N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION & REMARKS
1					Topsoil with roots
0.60					
	SPT	2-2-3-3 (10)			Firm light grey with brown mottling SILT with rootlets
1.40					
2					Grey orange brown silty fine SAND
1.90 ▽					
	SPT	1-2-2-2 (7)			Soft to firm reddish brown clay with rootlets
2.45					

Bottom of borehole at 2.45 metres.

NOTES

SAMPLE TYPE KEY U = Undisturbed D = Disturbed B = Bulk J = Jar VA = Shear Vane SPT = Standard Penetration Test

Key GeoSolutions
info@keygs.com
Telephone: 01952 822960

WELL NUMBER WS04

CLIENT CES (UK) Limited
PROJECT NAME Glencoe, Walford Heath
PROJECT NUMBER 20-128
PROJECT LOCATION Shrewsbury

DATE STARTED 15/5/20 **COMPLETED** 15/5/20
CO-ORDINATES 345194 mE, 319660 mN
DRILLING CONTRACTOR GSS
GROUND ELEVATION **HOLE SIZE** 100mm
DRILLING METHOD Windowless Sampler
LOGGED BY Brian Duthie **CHECKED BY** WR

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (SPT N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION & REMARKS	WELL DIAGRAM
					MADE GROUND comprising crushed stone	
					0.20	
					0.30 MADE GROUND comprising crushed brick	
					MADE GROUND comprising firm grey clay matrix with gravel and rock fragments. Hydrocarbon odour detected	
1	J	()	BH4 No1			
	SPT	2-1-2-2 (7)			1.00 - 1.50m; Strong hydrocarbon odour	
2	J	()	BH4 No2		2.00 ▽	
	SPT	2-2-3-2 (9)			Loose red brown silty fine SAND with occasional fine gravel	
					2.50	
3					Soft grey brown mottled CLAY with rootlets	
	SPT	3-3-4-6 (16)			3.00	
4					Medium dense brown fine SAND	
	SPT	4-4-4-4 (16)			4.45	

Bottom of borehole at 4.45 metres.

NOTES

SAMPLE TYPE KEY U = Undisturbed D = Disturbed B = Bulk J = Jar VA = Shear Vane SPT = Standard Penetration Test

Key GeoSolutions
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BOREHOLE NUMBER WS05

CLIENT CES (UK) Limited
PROJECT NAME Glencoe, Walford Heath
PROJECT NUMBER 20-128
PROJECT LOCATION Shrewsbury

DATE STARTED 15/5/20 **COMPLETED** 15/5/20
CO-ORDINATES 345190 mE, 319663 mN
DRILLING CONTRACTOR GSS
GROUND ELEVATION **HOLE SIZE** 100mm
DRILLING METHOD Windowless Sampler
LOGGED BY Brian Duthie **CHECKED BY** WR

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION & REMARKS
			Type 1 [MADE GROUND]
			0.20
			MADE GROUND comprising clay with black gravel and ash
			0.40
			Topsoil
			0.65
1			Soft to firm pale grey with brown mottling CLAY with rootlets
			1.30
2			Soft to firm pale grey SILT with fine sand and occasional fine gravel
			2.00

Bottom of borehole at 2.00 metres.

NOTES Groundwater not encountered.

SAMPLE TYPE KEY U = Undisturbed D = Disturbed B = Bulk J = Jar VA = Shear Vane SPT = Standard Penetration Test

Key GeoSolutions
info@keygs.com
Telephone: 01952 822960

BOREHOLE NUMBER WS06

CLIENT CES (UK) Limited
PROJECT NAME Glencoe, Walford Heath
PROJECT NUMBER 20-128
PROJECT LOCATION Shrewsbury

DATE STARTED 15/5/20 **COMPLETED** 15/5/20
CO-ORDINATES 345192 mE, 319656 mN
DRILLING CONTRACTOR GSS
GROUND ELEVATION **HOLE SIZE** 100mm
DRILLING METHOD Windowless Sampler
LOGGED BY Brian Duthie **CHECKED BY** WR

DEPTH (m)	SAMPLE TYPE NUMBER	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION & REMARKS
			0.10	Type 1 [MADE GROUND]
				MADE GROUND comprising clay matrix with brick glass and gravel
	BH6 No1			0.60m; Hydrocarbon odour
			0.85	
1			1.00	Firm blue grey CLAY

Bottom of borehole at 1.00 metres.

NOTES Groundwater not encountered.

SAMPLE TYPE KEY U = Undisturbed D = Disturbed B = Bulk J = Jar VA = Shear Vane SPT = Standard Penetration Test

Key GeoSolutions
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Telephone: 01952 822960

BOREHOLE NUMBER WS07

CLIENT CES (UK) Limited
PROJECT NAME Glencoe, Walford Heath
PROJECT NUMBER 20-128
PROJECT LOCATION Shrewsbury

DATE STARTED 15/5/20 **COMPLETED** 15/5/20
CO-ORDINATES 345198 mE, 319657 mN
DRILLING CONTRACTOR GSS
GROUND ELEVATION **HOLE SIZE** 100mm
DRILLING METHOD Windowless Sampler
LOGGED BY Brian Duthie **CHECKED BY** WR

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION & REMARKS
			0.05 Tarmac
			0.20 Topsoil
			Firm pale brown orange mottled CLAY with some fine to medium gravel
			0.90
1			Orange brown silty fine SAND
2			2.00
			Bottom of borehole at 2.00 metres.

NOTES Groundwater not encountered.

SAMPLE TYPE KEY U = Undisturbed D = Disturbed B = Bulk J = Jar VA = Shear Vane SPT = Standard Penetration Test

APPENDIX 3

I2 ANALYTICAL RESULTS

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Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 20-10512

Replaces Analytical Report Number : 20-10512, issue no. 1

Additional analysis undertaken.

Project / Site name:	Walford Heath	**Samples received on:**	19/05/2020
Your job number:		**Sample instructed/ Analysis started on:**	20/05/2020
Your order number:		**Analysis completed by:**	02/07/2020
Report Issue Number:	2	**Report issued on:**	03/07/2020
Samples Analysed:	4 soil samples		

Signed:

Joanna Wawrzeczko
Technical Reviewer (Reporting Team)

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.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 20-10512

Project / Site name: Walford Heath

Lab Sample Number				1514848	1514849	1514850	1514851	
Sample Reference				BH1 No1	BH4 No1	BH4 No2	BH6 No1	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.50	0.50-1.00	1.50-2.00	0.50-0.80	
Date Sampled				15/05/2020	15/05/2020	15/05/2020	15/05/2020	
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	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	27	9.4	15	22	
Total mass of sample received	kg	0.001	NONE	1.2	1.4	1.5	1.5	
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	6.6	10.5	7.6	7.1	
Total Cyanide	mg/kg	1	MCERTS	3	< 1	< 1	< 1	
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	1.7	0.16	0.081	0.17	
Sulphide	mg/kg	1	MCERTS	290	27	27	43	
Water Soluble Chloride (2:1)	mg/kg	1	MCERTS	54	17	30	140	
Organic Matter	%	0.1	MCERTS	13	1.7	1.9	3.6	
Water Soluble Nitrate (2:1) as NO_3	mg/kg	2	NONE	2.1	33	12	12	
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.25	
Phenanthrene	mg/kg	0.05	MCERTS	0.59	< 0.05	0.48	3.0	
Anthracene	mg/kg	0.05	MCERTS	0.12	< 0.05	0.15	1.0	
Fluoranthene	mg/kg	0.05	MCERTS	0.78	0.52	0.97	5.7	
Pyrene	mg/kg	0.05	MCERTS	0.77	0.62	1.1	5.4	
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.47	0.28	0.54	2.6	
Chrysene	mg/kg	0.05	MCERTS	0.76	0.41	0.72	2.3	
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.48	0.44	0.86	1.8	
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.22	0.24	0.38	0.81	
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.75	0.94	1.6	3.1	
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.33	0.59	1.0	1.6	
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.38	
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.51	0.87	1.3	2.0	
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	5.78	4.91	9.19	29.9	

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Lab Sample Number				1514848	1514849	1514850	1514851	
Sample Reference				BH1 No1	BH4 No1	BH4 No2	BH6 No1	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.50	0.50-1.00	1.50-2.00	0.50-0.80	
Date Sampled				15/05/2020	15/05/2020	15/05/2020	15/05/2020	
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	36	6.4	9.2	8.1	
Barium (aqua regia extractable)	mg/kg	1	MCERTS	1000	190	240	320	
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	4.1	0.80	0.93	1.5	
Boron (water soluble)	mg/kg	0.2	MCERTS	7.7	1.5	1.9	3.8	
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	1.1	1.0	0.6	0.5	
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	29	27	24	27	
Copper (aqua regia extractable)	mg/kg	1	MCERTS	110	20	19	25	
Lead (aqua regia extractable)	mg/kg	1	MCERTS	14000	200	370	190	
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	2.0	0.7	0.5	0.5	
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	98	27	30	32	
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	37	38	32	32	
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	490	220	350	200	
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	11	5.6	39	< 2.0	
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	8.2	13	72	< 8.0	
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	47	< 8.0	33	< 8.0	
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	66	27	150	< 10	
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	6.4	16	2.6	
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	18	45	46	
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	48	42	110	
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	73	100	150	

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Lab Sample Number				1514848	1514849	1514850	1514851	
Sample Reference				BH1 No1	BH4 No1	BH4 No2	BH6 No1	
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	
Depth (m)				0.50	0.50-1.00	1.50-2.00	0.50-0.80	
Date Sampled				15/05/2020	15/05/2020	15/05/2020	15/05/2020	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
PCBs								
PCB Congener 077	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 081	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 105	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 114	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 118	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 123	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 126	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 156	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 157	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 167	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 169	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
PCB Congener 189	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	< 0.001	
Total PCBs	mg/kg	0.012	NONE	< 0.012	< 0.012	< 0.012	< 0.012	

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* 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 *
1514848	BH1 No1	None Supplied	0.50	Black sandy clay.
1514849	BH4 No1	None Supplied	0.50-1.00	Brown sandy clay with rubble.
1514850	BH4 No2	None Supplied	1.50-2.00	Grey clay and sand with gravel.
1514851	BH6 No1	None Supplied	0.50-0.80	Brown clay and sand with gravel.

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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
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In house method.	L082-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	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. (30 oC)	In house method.	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
Nitrate, water soluble, in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewatern & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	D	NONE
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
PCBs WHO 12 in soil	Determination of PCBs (WHO-12 Congeners) by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	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.	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

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Project / Site name: Walford Heath

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
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS

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.