



=Ground and Environmental Services Limited

**Unit 2 Montpelier Business Park
Dencora Way
Ashford
Kent
TN23 4FG
01233 646237**

**Land to the rear of 83 Whitehill Road,
Hitchin
Hertfordshire
SG4 9HP**

Phase 2 Contamination Risk Assessment

On behalf of Soil Investigation (Eastern) Ltd



Document Reference: 12248

October 2023

air quality assessment contaminated land ecology environmental audits noise assessment
environmental impact assessments flood risk assessments geotechnical engineering ground investigation
hydrogeology noxious weeds remediation design risk assessments waste management

**Site: Land to the rear of 83 Whitehill Road, Hitchin,
Hertfordshire, SG4 9HP**

Document Reference No: 12248

Quality Management

Prepared by:	MP
Reviewed by:	KM
Authorised by:	KM
Date	October 2023
Revision	0

Table of Contents

1	INTRODUCTION	3
2	SITE LOCATION AND LAYOUT.....	3
3	ENVIRONMENTAL SETTING	4
3.1	GEOLOGY.....	4
3.2	GROUNDWATER	4
4	INTRUSIVE INVESTIGATION.....	5
4.1	FIELDWORK	5
4.2	GROUNDWATER	6
5	LABORATORY TESTING.....	7
5.1	ANALYTICAL TESTING.....	7
6	GROUND CONDITIONS	7
7	GROUND CONTAMINATION ASSESSMENT	9
7.1	SOIL QUALITY	9
7.1.1	Toxic Metals	10
7.1.2	Phytotoxic Metals	10
7.1.3	Organic Compounds.....	10
7.1.4	Inorganic Compounds	12
7.1.5	Asbestos.....	12
7.2	SOIL GAS	12
7.3	WATCHING BRIEF AND DISCOVERY STRATEGY	13
8	CONTAMINATION RISK ASSESSMENT	14
8.1	CONTAMINANT SOURCES	15
8.2	RISK TO HUMAN HEALTH.....	15
8.3	RISKS TO WATER RESOURCES	18
8.4	RISKS TO PLANTS	18
8.5	RISKS TO BUILDINGS & SERVICES	19
8.6	GAS RISK ASSESSMENT	19

8.7	WASTE DISPOSAL	20
9	CONCEPTUAL SITE MODEL	20
10	CONCLUSIONS AND RECOMMENDATIONS.....	23

Appendices

1. CFA Borehole logs
2. Trial Pit Logs
3. Gas Monitoring Results
4. Analytical Testing Results
5. Contamination Assessment Guidelines
6. ESI Statistics Calculator Results
7. BRE Cover System Spreadsheet

Figures

1. Site Layout Plan

1 INTRODUCTION

Ground and Environmental Services Ltd (GES) was commissioned to undertake a Phase 2 Contamination Risk Assessment at a proposed development site on land to the rear of 83 Whitehill Road, Hitchin, Hertfordshire, SG4 9HP.

It was understood that the proposed development is to comprise the construction of 2 houses constructed over three stories including a basement with associated private gardens, soft landscaping and parking.

The purpose of the ground investigation was to determine the ground profile and in addition, contamination testing and a soil gas survey were carried out to provide a preliminary assessment of contamination issues based on current Contaminated Land Legislation.

2 SITE LOCATION AND LAYOUT

The site is situated in the North Hertfordshire district of Hitchin, in a predominantly urban/residential setting. The site is located at approximate Grid Reference TL192286, with the following features immediately bounding the site:

- Northeast, the site is bound by Whitehill Road, beyond which is residential housing and Willoughby Road;
- Northwest, Southwest and Southeast, the site is bound by residential housing.

The site is approximately rectangular and occupies an area of approximately 0.2 acres. Access was gained through a gated driveway off Whitehill Road.

3 ENVIRONMENTAL SETTING

3.1 GEOLOGY

Reference to the British Geological Survey online geological map of the area indicates that the site is underlain by superficial geology comprising Glaciofluvial deposits (sand and gravel) over solid geology of the Holywell Nodular Chalk Formation.

The geological memoir for the area described the Holywell Nodular Chalk Formation as Chalk with flints with discrete marl seams, nodular chalk, sponge-rich and flint seams throughout.

3.2 GROUNDWATER

Reference to the British Geological Survey 1:50,000 scale Aquifer Designation Dataset, shows the site to be set upon a Secondary A Aquifer in the superficial geology on site and a Principal Aquifer in the bedrock.

Secondary Aquifers include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage.

Secondary A are permeable layers capable of supporting water supplies at a local scale and may be an important source of base flow to rivers. These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage.

Principal Aquifers are highly permeable formations. They 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.

The site is situated within an Environment Agency-designated Groundwater Source Protection Zone 3.

4 INTRUSIVE INVESTIGATION

4.1 FIELDWORK

The site works were carried out on the 7th August 2023 and comprised:

- Continuous Flight Auger Boreholes
- Hand Dug Trial Pits
- Soil gas and groundwater monitoring

The positions of the above works on the site are indicated on Figure 1, Site Location Plan.

All fieldwork was undertaken by Soil Investigation Eastern Limited and generally executed in accordance with the recommendations given in British Standard BS 5930:1999, "Code of Practice for Site Investigations".

Contamination sampling was undertaken in accordance with BS 10175, "Code of Practice for the Investigation of Potentially Contaminated Sites".

Continuous Flight Auger (CFA) Boreholes

Three 100mm diameter CFA boreholes (BH1 to BH3) were excavated to depths of between 5.0m and 12.0m below existing ground level. The soils and materials encountered in the holes were logged and representative samples recovered for laboratory analysis.

Upon completion all boreholes were installed with groundwater monitoring standpipes to depths of between 5.0m to 9.0m.

CFA Borehole Logs are presented at Appendix 1.

Hand Dug Trial Pits

Nine hand dug trial pits were excavated in order to determine depth of Made Ground and provide additional samples for laboratory analysis. The trial pits were excavated to depths of between 800mm and 900mm.

Trial pit logs are presented in Appendix 2

Soil Gas and Groundwater Monitoring

A soil vapour survey was undertaken across the site and comprised the monitoring of the atmosphere within the dedicated standpipes installed at the site. Portable gas monitoring equipment (GA 5000) was used to monitor the boreholes for concentrations of carbon dioxide (CO₂), methane (CH₄) and oxygen (O₂).

The gas monitoring results are presented in Appendix 3.

4.2 GROUNDWATER

During the fieldwork, groundwater was not encountered in borehole BH1 and BH2. A water strike was observed at 2.3m below ground level in BH3.

During the period of post fieldwork monitoring, groundwater was encountered at depths between 1.59m and 1.85m.

It should be noted that groundwater levels may vary due to seasonal fluctuations in rainfall, but in the shorter term, can be affected by antecedent weather conditions or other causes.

5 LABORATORY TESTING

5.1 ANALYTICAL TESTING

Six soil samples were selected and scheduled for chemical analysis which was undertaken by The Environmental Laboratory Ltd (ELAB). Soil samples were analysed for a screening suite of contaminants considered appropriate to the current usage and past history of the site and surrounding area.

Toxic Metals	Phytotoxic Metals	Inorganic Compounds	Organic Compounds
Arsenic Cadmium Chromium Lead Mercury Nickel Selenium	Copper Nickel Zinc	Water Soluble Boron Water Soluble Sulphate pH Asbestos	Total Polyaromatic Hydrocarbons (PAH) Total Petroleum Hydrocarbons (TPH)

In addition, one sample of arisings from BH3 was prepared and submitted for analysis in accordance with the Environment Agency's waste acceptance criteria (WAC) for the off-site disposal of soils.

Soil samples were stored in appropriate containers as specified within BS10175. The containers comprised of 1 kg capacity plastic containers with fitted lids.

Where organic compounds were to be determined, inert containers, which prevent loss by absorption, or volatilization, i.e. wide-mouthed amber glass containers, were used.

Samples were stored in appropriately cooled cool boxes and were transported to the laboratory as quickly as possible in order to minimize any potential for chemical and biological changes to take place.

The results of the analytical testing are presented in Appendix 4.

6 GROUND CONDITIONS

The ground profile found during this ground investigation comprised Made Ground over soils typical of the Glaciofluvial Deposits over chalk.

Made Ground

The Made Ground was encountered to depths of between 0.5m and 0.9m below ground level. The made ground generally comprised mid brown to dark brown and grey gravelly sandy silt with brick, clinker, granite chippings, cement sheet, ash, chalk, china, glass, pottery, bone and manmade fragments.

Land to the rear of 83 Whitehill Road, Hitchin

Phase 2 Contamination Risk Assessment



Fragments of asbestos cement sheeting were observed at ground level at various locations over the site.

Glaciofluvial Deposits

The Glaciofluvial Deposits were encountered at all locations below the Made Ground and comprised a heterogenous mix of mid brown, orange brown mottled orange and grey, sandy silty clay, gravelly silty clay, very silty sand, gravelly sandy silt with occasional laminations of orange and olive silt and fine sand, and frequent chalk nodules.

The base of the formation was not found.

7 GROUND CONTAMINATION ASSESSMENT

The current guidelines used for this contamination assessment are presented within Appendix 5.

The contaminant concentrations encountered as part of this investigation have been compared against either Land Quality Management Generic Assessment Criteria (LQM GAC) for a residential development, the Chartered Institute of Environmental Health's (CIEH) Suitable for Use Levels (S4USL), or where available against newly published Category 4 Screening Levels (C4SLs) for a Residential (with home-grown produce) end use. Where neither guidelines have limit values, Contaminated Land Exposure Assessment (CLEA) framework guideline limit values have been assessed.

Category 4 Screening Levels (C4SLs) have currently been published for six substances as per the table below.

Substance	Residential (with home- grown produce)	Residential (without home- grown produce)	Allotments	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	37	40	49	640	79	170
Benzene	0.87	3.3	0.18	98	140	230
Benzo(a)Pyrene	5.0	5.3	5.7	77	10	21
Cadmium	22	150	3.9	410	220	880
Chromium VI	21	21	170	49	21	250
Lead	200	310	80	2300	630	1300

All concentrations expressed in mg/kg

This table should be read in conjunction with the Final C4SL R&D Report

7.1 SOIL QUALITY

In terms of any proposed redevelopment of the site, the results of the analysis of the selected soil samples recovered during the site investigation indicated that the concentrations of *metals and metalloids* considered to be potentially toxic to humans were below the respective guideline values in all samples tested with the exception of elevated concentrations of lead, arsenic and zinc.

Organic contamination across the site was generally low and concentrations which may be considered to pose an unacceptable risk to human health should any viable pathway exist were generally not encountered with the exception of certain PAH compounds.

Asbestos contamination was encountered within two soil samples in the form of chrysotile, and crocidolite cement and lagging.

A comprehensive description of the soil quality as measured as part of the intrusive site investigation is given below.

7.1.1 Toxic Metals

Concentrations of toxic metals barium, beryllium, cadmium, chromium, mercury, nickel, selenium, vanadium and zinc were all below their respective soil guidance values for either a residential development under the CLEA/LQM GAC guidelines and the C4SL/S4USL guideline values for residential (with home-grown produce) where appropriate in all samples tested.

Lead concentrations were above the 200 mg/kg Category 4 Screening Level within Made Ground soil samples retrieved from BH2 (gl.), TP1 (0.1m), TP3 (0.15m), TP5 (0.3m) and TP6 (0.1m) with concentrations of 1060mg/kg, 378mg/kg, 828mg/kg, 474mg/kg and 603mg/kg respectively.

Arsenic concentration were above the 37mg/kg Category 4 Screening Level within Made Ground soil samples retrieved from BH2 (gl.), TP1 (0.1m), TP3 (0.15m), TP5 (0.3m), TP6 (0.1m) and TP9 (0.4m) with concentrations of 43.5mg/kg, 41.2mg/kg, 41.3mg/kg, 43.2mg/kg, 49.1mg/kg and 56.2mg/kg respectively.

Zinc concentrations were above the 3700mg/kg Category 4 Screening Level within Made Ground soil samples retrieved from TP5 (0.3m) with a concentration of 5020mg/kg.

All other samples had contaminant concentrations of below their relevant guideline values.

7.1.2 Phytotoxic Metals

Concentrations of phytotoxic metals copper, zinc and nickel were compared against the maximum permissible concentration in the Sewage Sludge (Use in Agriculture) Regulations 1989.

The concentrations for nickel were all found to be below the maximum permissible concentration for the relevant pH level.

The concentrations of zinc were above the maximum permissible concentration of 450mg/kg in locations BH2 (gl.), TP3 (0.15m), TP5 (0.3m) and TP6 (0.1m) with concentrations of 2930mg/kg, 3360mg/kg, 5020mg/kg and 2750mg/kg respectively.

The concentrations of copper were above the maximum permissible concentration of 200mg/kg in location TP1 (0.1m) with a concentration of 293mg/kg.

7.1.3 Organic Compounds

Polycyclic Aromatic Hydrocarbons (PAH)

Concentrations of PAH were found to be below the inert waste acceptance criteria of 100 mg/kg as detailed in the Landfill (England and Wales) (Amended) Regulations 2004 in all

Land to the rear of 83 Whitehill Road, Hitchin Phase 2 Contamination Risk Assessment



of the samples tested with the exception of locations TP3 (0.15m) and TP5 (0.3m) with slightly elevated concentration of 107mg/kg and 104mg/kg respectively.

Speciated PAH

A number of exceedances of the relevant guideline values for certain PAH compounds were noted as per the table below.

Determinand	Guideline value (mg/kg)	Location	Result (mg/kg)
Naphthalene	1	TP1 (0.1m)	1.9
		TP3 (0.15m)	1.2
Benzo(a)anthracene	7.5	TP3 (0.15m)	8.5
		TP5 (0.3m)	8.7
Benzo(b)fluoranthene	2.6	TP5 (0.3m)	7.8
		TP6 (0.1m)	2.8
Benzo(a)pyrene	5	TP3 (0.15m)	11.3
		TP5 (0.3m)	8.5
Dibenzo(a,h)anthracene	0.24	BH2 (g.l.)	1.0
		TP1 (0.1m)	0.7
		TP3 (0.15m)	1.5
		TP5 (0.3m)	1.2
		TP6 (0.1m)	0.6
		TP9 (0.4m)	0.4

Total Petroleum Hydrocarbons

Concentrations of TPH were below the inert waste acceptance criteria of 500 mg/kg as detailed within the Landfill (England and Wales) Regulations 2004 and also within the UK Water Industry Research (UKWIR) in all soil samples tested and would therefore not pose a significant risk of significant harm to human health with the exception of the sample retrieved from location BH2 (g.l.) with a TPH concentration of 3110mg/kg.

Generic Assessment Criteria (GAC) for total petroleum hydrocarbons according to both their molecular weight and chemical structure and also for a range of soil organic matter (SOM) content values have been derived using CLEA software. The LQM CIEH GACs are presented according to their soil organic matter content and proposed end use of the land.

The maximum TPH concentration recorded on site during the site investigation was at location BH2 (g.l.) comprising of 706mg/kg within the aromatic C21-C35 range which is below the relevant GAC limit of 1100 mg/kg for this range and would therefore not pose a significant risk of significant harm to human health.

7.1.4 Inorganic Compounds

Concentrations of water soluble sulphate were between 24mg/l and 1200mg/l (as SO₄). The pH values were neutral to alkaline with values of 7.1 to 8.1 units.

7.1.5 Asbestos

Asbestos screening of the soil samples identified the presence of Chrysotile and Crocidolite asbestos cement and lagging in location BH2 (g.l) and Chrysotile cement in location TP7 (0.05m).

Quantification testing indicated the asbestos in BH2 comprised 0.358% Chrysotile and Crocidolite cement and 0.008 lagging for a total concentration of 0.366%.

The asbestos at location TP7 (0.05m) comprised 1.219% Chrysotile cement.

Free fibre analysis indicated fibre concentrations were below the laboratory detection limits of <0.001% in both locations.

7.2 SOIL GAS

Three gas monitoring visits were undertaken between the 21st August and 9th September 2023 where a soil vapour survey was undertaken across the site and comprised the monitoring of the atmosphere within the purposely installed monitoring standpipes. Portable gas monitoring equipment (GA 5000) was used to monitor the standpipes for concentrations of carbon dioxide (CO₂), methane (CH₄) and oxygen (O₂)

For determining the gas protection measures which may be required in low rise buildings with a beam and block floor there is published guidance from the NHBC for use on residential developments which utilises a traffic light system of classification. For larger buildings the guidance in CIRIA 665 and BS8485 is used.

Reference has also been made to the British Standard Code of Practice BS8485:2015, *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* and regard has been given to the recommendations presented therein. The processes set out in BS8485 represent good practice and is based on the CIRIA C665 document.

In addition CIRIA document C735, *Good practice on the testing and verification of protection systems for buildings against hazardous ground gases* has also been referenced.

The results obtained from the short-term soil gas monitoring undertaken indicated that significantly elevated concentrations of soil gas are not present in the soils underlying the site. The soil gas results are attached at Appendix 3.

The results obtained from the soil gas survey undertaken indicated that levels of methane and carbon dioxide within the voids tested were below the respective action levels of 1% and 5%.

Measurement of both borehole pressure and gas emission rates indicates that no significant gas flows are present. The maximum gas flow rate measured on site was <0.1 l/hr.

The levels of photoionisable compounds measured in the monitoring wells were all below 10 ppm.

7.3 WATCHING BRIEF AND DISCOVERY STRATEGY

Whilst no significantly elevated contaminant concentrations were encountered as part of this site investigation, should discreet hotspots be encountered which were not previously detected, these should be dealt with accordingly by informing all parties involved with the site and drafting new contamination proposals if necessary. A number of options are available for handling any such material, which include:

- The removal from site and disposal to a suitably licensed landfill of all material suspected of being contaminated.
- Short-term storage of the suspected material while undertaking verification testing for suspected contamination. The storage area should be a contained area to ensure that contamination does not migrate and affect other areas of the site. Depending upon the amounts of material under consideration, this could be either a skip or a lined area.
- Treatment of the identified contamination as discussed above.
- Having a suitably experienced Environmental Engineer either on-call or with a watching brief for the visual and olfactory assessment of the material, and sampling for verification purposes.

Should a new source of contamination be suspected or identified then the relevant local authorities would be informed. A report indicating the nature of contamination and how this is to be dealt with would be submitted to their department and for their agreement. Any necessary remediation would then be detailed and verified in a supplementary remediation statement.

GES can confirm that such a watching brief should exist on this site during any demolition/construction works and should any contamination or potentially contaminative sources be discovered during the proposed demolition/enabling works all site works would cease and suitably competent consultants/engineers will attend site.

8 CONTAMINATION RISK ASSESSMENT

This risk assessment has been undertaken with due regard to the advice relating to groundwater as provided in the Environment Agency's "Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources", the advice provided in the Contaminated Land (England) Regulations 2000, and the associated statutory guidance. The guidance defines contaminated land as any land that is in such a condition that by reason of substances in, on or under the land:

- significant harm is being caused or there is a significant possibility of such harm being caused; or
- pollution of controlled water is being, or is likely to be caused.

This definition is based on the principles of risk assessment defined as a combination of the probability (or frequency) of occurrence of a defined hazard and the magnitude (including the seriousness) of the consequences. Central to the risk assessment process is the concept of pollutant linkage, that is a linkage between a contaminant and a receptor by means of a pathway.

Statutory definitions relating to pollution linkage.	
Contaminant	"a substance which is in, on or under the land and which has the potential to cause harm or to cause pollution of controlled waters."
Receptor	"a living organism, a group of living organisms, and ecological system or a piece of property" which meets given criteria. "controlled waters which are, or could be, polluted by a contaminant".
Pathway	"one or more routes or means by, or through, which a receptor: • is being exposed to, or affected by, a contaminant, or • could be so exposed or affected".

The relationship between these components is discussed below in order to identify the existence of any source-pathway-receptor linkage on the site, and hence the potential risks associated with any contamination.

This risk assessment is based on the proposed redevelopment of the site comprising 2 no. three story residential properties including basement level, private gardens and soft landscaping.

The significance of the risks to the receptors/targets identified is based on an evaluation of the potential pathways between the contaminant source and receptors based on the most sensitive end use, i.e. a residential with plant uptake end use.

Potential receptors/targets at the site and in the area in which the site is located include:

- future occupants and the general public;
- construction/maintenance workers;
- groundwater resources;
- underground services in and around the site;
- plants in proposed garden and soft landscaped areas.

8.1 CONTAMINANT SOURCES

No visual or olfactory evidence of organic contamination was noted during the intrusive investigation or noted in the detailed soil sampling logs. In general, the analytical testing of soils retrieved as part of the intrusive investigation did not reveal significantly elevated contaminant concentrations although as mentioned in Section 7.1 of this report, elevated heavy metal, PAH concentrations and asbestos containing material were encountered on site. The risks associated with these contaminants are discussed below.

8.2 RISK TO HUMAN HEALTH

Toxic Metals

Concentrations of toxic metals barium, beryllium, cadmium, chromium, copper, mercury, nickel, selenium and vanadium were all below their respective soil guidance values for a residential without plant uptake end use in all samples tested in this site investigation, therefore the risks to human health from these contaminants is considered to be low.

Six out of the six soil samples tested arsenic concentrations above the C4SL guidance level of 37 mg/kg.

Five out of the six soil samples tested contained lead concentrations above the C4SL guidance level of 310 mg/kg.

One out of the six samples tested contained zinc concentrations above the C4SL guidance level of 3700mg/kg.

The test results have been assessed following the CLAIRE/CIEH (2008) guidance for statistical testing of a data set for planning purposes involving the calculation of the sample mean and sample standard deviation, investigation of the normality of the data distribution and investigation of outliers and the calculation of 95th UCL values. The measured concentrations on site have been statistically analysed using the ESI statistics calculator

Land to the rear of 83 Whitehill Road, Hitchin *Phase 2 Contamination Risk Assessment*



as described above. The 95th UCL of the test results have been used for subsequent comparison with the CLEA SGVs or CIEH GAC values as appropriate.

The application of the above statistical test was run for the arsenic, lead and zinc datasets.

The lead and arsenic datasets both showed that no outliers were present and the sample mean exceeded the critical concentration, and therefore the soil on site, in terms of lead and arsenic, could be considered to pose a significant risk of significant harm to human health.

The test results sheet for all the datasets have been attached to this report at Appendix 6.

Organic Compounds

Concentrations of the organic compounds total PAH and total TPH, were generally low across the site and would therefore not be considered to pose a significant risk of significant harm to human health.

Slightly elevated concentrations of Naphthalene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(a)pyrene and Dibenzo(a,h)anthracene were encountered which could potentially be considered to pose a significant risk of significant harm to human health.

Areas of the site to be covered by buildings and hardstanding would not pose a significant risk of significant harm as they would sever any potential pollutant pathway however it is considered that there is a potential risk to human health under the context of Part IIA in proposed garden areas and areas of soft landscaping.

As such, soils across the site would not be considered suitable to remain on site in areas where they could come into contact with future site users, i.e. proposed garden/soft landscaped areas.

The contaminated soils indicated on site, and discussed above, could not be left in the proposed garden areas of the site since a potential contaminant source to receptor pathway would be open through the permeable garden soils.

Inorganic Compounds – Asbestos

Asbestos comprising asbestos cement of Crocidolite and Chrysotile and lagging were identified in the sample from location BH2 (g.l.), Chrysotile asbestos cement was also identified at location TP7 (0.05m). The detected asbestos was subsequently quantified with a concentration of free fibres of <0.001% by mass and total asbestos of 0.366% at location BH2 and 1.22% at location TP7.

Any asbestos content greater than 0.1% would mean that the soils on site would be classified as hazardous to human health, therefore, with respect to off-site disposal, the soils on site would be classified as hazardous waste.

Land to the rear of 83 Whitehill Road, Hitchin

Phase 2 Contamination Risk Assessment



At such low percentages, hand picking is unlikely to be a viable option for reclassifying the waste soils.

In the event that further ACM is encountered during the site enabling works then the extent of such will be delineated under the supervision of a suitably competent consultant/engineer and the material will be removed from site in accordance with the hazardous waste regulations. Should any such material be encountered it is considered likely that a single dedicated skip provided by a suitably licensed asbestos handling company would prove sufficient. If further asbestos-containing material is found on site, then all the documentation regarding its remediation including duty of care and waste transfer notes would be forwarded to the appropriate authorities.

On the balance of the toxicological risks posed by the ground contamination encountered as part of the intrusive investigation undertaken by Soil Investigation Eastern Ltd, it is considered that the potential risks to site workers and future occupants could be adequately controlled as follows:

Site Workers

- Provision of appropriate personal protective equipment and hygiene facilities.
- Good working practice in line with current legislation when safely handling and disposing of asbestos material.
- Provision of appropriate dust suppression, to minimise the generation of potentially contaminated suspended particulates during site works.

Future Occupants

- Elevated levels of contaminants have been found at the site which could pose a risk to future occupants if exposed to the material for instance in a garden or area of soft landscaping. Current development proposals include private gardens.
- With regard to the areas which may be set to soft landscaping in the proposed development it is noted that given the absence of such on site, suitable growth media would need to be imported into these areas of the site. Any such imported growth media would require analytical testing to confirm its suitability as growth media and its compliance with their relevant SGVs.
- Following the enabling works in the proposed garden areas on site material will be excavated and certified clean sub soils and topsoil imported for the garden areas. BRE cover system modelling has been carried out which confirms the thickness of clean soil required and the model results spreadsheet is attached at Appendix 7. Reference to the BRE 465 'Cover Systems for Land Regeneration, Thickness of Cover Systems for Contaminated Land' 2004 document shows that such a cover could reduce the risk of exposure.

- It is recommended that a “deter to dig” contamination marker layer should be laid in areas of soft landscaping and garden areas, below any clean topsoil materials.
- The modelling results indicates that a simple cover system of approximately 550 mm soils would be required to sever the linkage of pollutants in the soil below in the proposed soft landscaped areas based on the worst-case contamination recorded on site. It should be noted that this would be considered a conservative approach since most of the contaminated Made Ground indicated in this area will be removed as part of the site enabling works. Typically, 150 mm topsoil over approximately 400 mm clean free draining subsoils would generally be considered sufficient. Where deep rooting shrubs / trees are proposed in any landscaping it may be necessary to locally deepen the clean cover to accommodate a healthy root bowl. No such clean cover has been laid on site yet and will not be brought to site and placed until the construction phase is completed to avoid over compaction by site plant.
- In areas which are to be covered by either buildings or hard standing, no such clean cover layer is required to sever the contain source to receptor pathway.
- Following implementation of the aforementioned remedial measures the site would not be considered to pose a potential risk of significant harm to human health in the context of Part 2A.

8.3 RISKS TO WATER RESOURCES

The site is underlain by the Holywell Chalk Formation which is designated as a Principal Aquifer. The site is located within a Groundwater Source Protection Zone 3.

Significant levels of potentially soluble and therefore mobile organic contaminant sources were not measured on site within the samples tested. It is therefore considered risks to groundwater resources are considered to be classed as low.

8.4 RISKS TO PLANTS

Significantly elevated concentrations of phytotoxic metals which could be considered harmful to plants were encountered on site with elevated zinc concentrations.

However, due to an absence of a suitable growth media across the majority of the site, it is necessary to implement the remedial works detailed above i.e. the importation of clean topsoil in proposed garden and soft landscaped areas.

This action would ensure any residual contamination is isolated below the rooting zone of plants, and therefore unavailable for uptake, thus ensuring any source receptor pathways are severed. The risk to plant health posed by the contaminants identified would be considered to be low following implementation of the remedial strategy.

8.5 RISKS TO BUILDINGS & SERVICES

The risks to buried services from organic contamination such as TPH, which can degrade/permeate plastics and other polymer materials used to supply potable water is considered to be medium.

Based on current guidance, the need to protect incoming water supplies, e.g. by the use of barrier pipes, is likely given the contaminant levels encountered as part of this investigation, however it is always advisable that confirmation from utility suppliers should be sought.

8.6 GAS RISK ASSESSMENT

The levels of soil gas underlying the site have been monitored as part of a short-term soil gas monitoring programme carried out across the site during August 2023. The results obtained from the soil gas survey indicate that elevated levels of soil gas, which may require gas protection measures to be incorporated into the development are present on site. No elevated gas flow rates were recorded during the monitoring. Significant biodegradable material was not encountered in any of the window sample holes excavated at the site.

The highest carbon dioxide concentration encountered on site during this current investigation was measured in BH1 at 1.5% which does not exceed the relevant guideline limit of 5%. No elevated methane concentrations were encountered across the site.

Measurement of both borehole pressure and gas emission rates indicates that no significant gas flows are present. The maximum gas flow rate measured on site was <0.1 l/hr. In order to allow for a worst-case scenario, GES have used a gas flow rate across the site of 1.0 l/h in the following calculations. It should be noted that the maximum gas flow rate detected on site during the short-term gas monitoring was less than 0.1 l/h which was measured directly with an internal flow meter.

Based on BS 8485:2015 and C716, we have assessed the site based on the gas monitoring undertaken as part of the site investigation in order to calculate a Characteristic Gas Situation (CS).

Based on the worst-case gas characteristic situation, the worst case implied CS derived by combining the maximum observed concentrations from different window sample standpipes during any monitoring event and a worst-case flow rate of 1.0 l/h are as follows.

Flow Rate (l/h)	CH4 (%)	CO2 (%)	GSV – CH4 (l/h)	GSV – CO2 (l/h)	Implied CH4 CS	Implied CO2 CS
1.0	0	1.5	0.000	0.015	1	1

On the basis of the measurements in the table above, the GSV is taken to be 0.015 l/h, which is the worst case for methane and carbon dioxide. A GSV of 0.015 l/h lies within the GSV values for **CS1** (<0.07 l/h) which has a very low hazard potential.

BS 8485:2015 enables the minimum level gas protection (score) for the site or zones to be determined based on the determined CS and the type of proposed building. Given the proposed end use of the site, a high-risk Type A building has been used for calculating the appropriate gas protection score.

Given that the site has an implied CS1, the minimum gas protection score required for a Type A building is 0, which means that no gas protection measures would be required as part of the proposed development based on current gas concentrations.

8.7 WASTE DISPOSAL

Should an excess volume of soil be required to be disposed of off-site then a waste classification may be required.

For a waste classification to be undertaken, materials may need to be subjected to chemical testing which would give an indication to the contaminants present and, therefore those most toxic to the environment in the waste. Following the assessment of the waste as hazardous or non-hazardous waste acceptance criteria leachate testing allows the appropriate disposal pathway to a suitably licensed disposal facility to be further determined.

As a preliminary waste assessment and based on the results of materials tested to date, it is considered that a proportion of any surplus soils requiring off-site disposal would be classified as EWC 17 05 03* stabilised non-reactive hazardous waste and following WAC testing to determine their leachable content, may or may not be acceptable at a waste facility licenced to accept non-hazardous material. Any soils found to contain in excess of 0.1% asbestos would be classified as hazardous.

9 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is a system diagram identifying contaminant sources, routes of exposure (pathways), and which receptors are affected by contaminants moving along those pathways.

The model is produced to identify the zones of the site with different potential contaminations characteristics (e.g. whether contaminants in the soil are likely to be on the surface or at depth, distributed over an entire area or in localised 'hot spots').

The conceptual site model presented in the table below is based on the findings of the site investigation undertaken.

Land to the rear of 83 Whitehill Road, Hitchin
Phase 2 Contamination Risk Assessment



Source	Pollutant		Pathway	Hazard		Receptor	Observations/ Recommendations	Assessed Risk
Contaminated ground	Metals, organic (hydrocarbons) could be present	→	Direct contact, ingestion, inhalation.	Health risks including skin irritation.	→	Humans: site workers	Normal health and safety precautions. Elevated contaminant concentrations present in soils likely to be removed from site during site preparatory works. Placement of clean topsoil required in any proposed soft landscaped areas.	Low following proposed remedial works
			Surface run off.	Lateral movement to surface watercourses.	→	Aquatic resources, ecology and subsequent users including humans.	No surface water courses in immediate vicinity of the site.	Low
			Leaching/ Dispersion.	Downward migration to groundwater.	→	Aquatic resources – Groundwater, abstraction wells) / surface waters.	No significantly elevated contaminant concentrations encountered.	Low
			Uptake by plants.	Phytotoxic effects.	→	Soft landscaped areas / plants.	Elevated contaminant concentrations present in soils likely to be removed from site during site preparatory works. Placement of clean topsoil required in any proposed soft landscaped areas.	Low following proposed remedial works
			Direct contact	Aggressive chemical attack	→	Building structures and services	It is considered that protection of services is likely to be required on this site however advice should be sought from Statutory Providers especially as to whether potable water pipes should be protected.	Low

Land to the rear of 83 Whitehill Road, Hitchin

Phase 2 Contamination Risk Assessment



Source	Pollutant	Pathway	Hazard	Receptor	Observations/ Recommendations	Assessed Risk
Liquid contaminant sources	Diesel, Petrol and Oils.	Direct contact; ingestion, inhalation.	Health risks including skin irritation. Lateral and vertical migration of contaminants.	Humans: site workers. Groundwater and surface water.	Elevated contaminant concentrations encountered. Placement of clean topsoil required in any proposed soft landscaped areas.	Low following proposed remedial works
Asbestos	Asbestos fibres within made ground and waste on site	Inhalation.	Health risks including asbestosis, mesothelioma, and lung cancer.	Humans: site workers and future occupants.	Appropriate PPE should be worn during site works.	Moderate
Landfill, made ground,	Ground Gases (CO ₂ , CH ₄)	Inhalation and ingress into buildings	Asphyxiation and explosions	Buildings/humans/ future site users	Significantly elevated ground gases have not been noted on site. Gas protection measures are not recommended in new development.	Low
Redundant Waste, Demolition Waste		Dermal Contact/ingestion. Potential for migration via surface water run-off	Health Risks	Humans: Site workers	All waste on site is to be removed from site during site preparatory works and disposed of in accordance with current legislation. Normal health and safety precautions.	Low

10 CONCLUSIONS AND RECOMMENDATIONS

Ground and Environmental Services Ltd undertook a Phase 2 Contamination Risk Assessment on land to the rear of 83 Whitehill Road, Hitchin, Hertfordshire, SG4 9HP. The purpose of the Contamination Risk Assessment was to provide an assessment of contamination issues based on current Contaminated Land Legislation with regards to the proposed construction of 2 houses constructed over three stories including a basement with associated private gardens, soft landscaping and parking

- The ground investigation found the anticipated geology with Made Ground over soils typical of Glaciofluvial Deposits encountered.
- The site is located above a Secondary A Aquifer in the superficial deposits and a Principal Aquifer in the underlying chalk. It is within an Environment Agency defined groundwater Source Protection Zone 3.
- Concentrations of toxic metals were found to be below their respective soil guideline values with the exception of elevated lead, arsenic and zinc.
- Elevated PAH concentrations, including Naphthalene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(a)pyrene and Dibenz(a,h)anthracene were encountered at a level that could pose a significant risk of significant harm to human health.
- The modelling results indicates that a simple cover system of approximately 550 mm soils would be required to sever the linkage of pollutants in the soil below in the proposed garden areas based on the worst-case contamination recorded on site. It is recommended that a contamination marker layer should be laid in all garden and soft landscaping areas, beneath the clean imported soils.
- Concentrations of TPH were generally low within soil across the site and would therefore not be considered to pose a significant risk of significant harm to human health.
- The risks posed to workers involved in any future redevelopment of the site are not considered significant providing standard health and hygiene practices are adopted.
- It is likely that any new services, in particular potable water, will require protection, however it is advisable to seek service provider confirmation of this.
- Based on gas monitoring results, the site has been given a classification of CS1 which has a very low hazard potential and therefore no gas protection measures need be incorporated into any new buildings constructed on the site.
- The risks to groundwater in the underlying Secondary A and Principall Aquifers are considered to be low due to the lack of any significant mobile organic contamination.
- Asbestos was identified in near surface made ground in concentrations which would make the soils on site hazardous waste in terms of off-site disposal.
- It is recommended that a watching brief is implemented on this site during enabling works and should any contamination or potentially contaminative sources be discovered during the proposed enabling works all site works would cease and

Land to the rear of 83 Whitehill Road, Hitchin *Phase 2 Contamination Risk Assessment*



suitably competent consultants/engineers will attend site to agree a formal remediation strategy.

Based on the principles and definitions outlined under section 57 of the Environment Act 1995, the site would not be considered to be “Contaminated Land” based on its proposed residential redevelopment end use following implementation of the above remedial measures.

Site Location Plan

Sheet: 1 of 1

Job No: AU3361

Scale: Not to scale

Date: 07/08/2023

Client: Orchard Home Development Ltd.

SOIL
INVESTIGATION
EASTERN LIMITED

Tel/Fax 01245 237555 Mobile 07810 820620

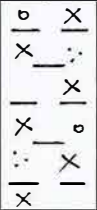
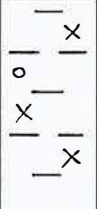
Site: 83 Whitehill Road, Hitchin.



0 5 10
1:500 1cm = 5 metre



APPENDIX 1
CFA BOREHOLE LOGS

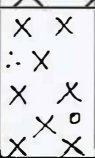
Borehole No: 1		Sheet: 1 of 1		 SOIL INVESTIGATION EASTERN LIMITED Tel/Fax 01245 237555 Mobile 07810 820620					
		Job No: AU3361							
Boring Method: 100mmø CFA		Date: 07/08/2023							
Client: Orchard Home Developments Ltd.				Site: 83 Whitehill Road, Hitchin.					
Depth (m)	Description of Strata	Thick-Ness (m)	Legend	Sample	Test Type	Result	Depth (m)	Field Records/ Comments	Depth to water (m)
G.L.	MADE GROUND: Medium compact, mid brown, mottled grey, gravelly, sandy, clayey, SILT, with brick & clinker rubble.	700		•	Tub & Jar		G.L.	No roots observed.	
700	Firm, mid brown, mottled orange, gravelly, sandy, very silty, CLAY.	700		•	I	2 4 9 13	1.0		
1.4	Stiff, mid brown, mottled orange & grey, gravelly, silty to very silty, CLAY, with numerous chalk nodules. Thinly laminated with orange & brown silt & fine sand.	1.9		•	V	112 114	1.5 2.0		
3.3	Very stiff, mid brown/grey, gravelly, silty to very silty, CLAY, with numerous chalk nodules. Thinly laminated with orange & olive silt & fine sand.	900		•	V	136 138	2.5 3.0		
4.2	Very stiff, mid grey, gravelly, silty to very silty, CLAY, with numerous chalk nodules. Thinly laminated with olive silt & fine sand.	800		•	V	140+ 140+	4.0		
5.0	Borehole ends at 5.0m. Standpipe installed.			•	V	140+ 140+	5.0		
Remarks: Borehole dry & open on completion. Monitoring Standpipe installed from Ground Level to 5.0m, using 4.0m of slotted standpipe, and 1.0m of plain standpipe b.g.l. Backfilled with 4.0m of gravel, 600mm of bentonite pellets, and a 400mm concrete collar installed. A standpipe cap with gas taps installed.				Key: • Small disturbed sample B Bulk disturbed sample U Undisturbed sample(U100) W Water sample J Jar sample V Pilcon Vane (kPa) I Mackintosh Probe S Standard penetration test N SPT blow count					

Borehole No: 2		Sheet: 1 of 1			SOIL INVESTIGATION EASTERN LIMITED Tel/Fax 01245 237555 Mobile 07810 820620				
		Job No: AU3361							
Boring Method: 100mmø CFA		Date: 07/08/2023							
Client: Orchard Home Developments Ltd.					Site: 83 Whitehill Road, Hitchin.				
Depth (m)	Description of Strata	Thick-Ness (m)	Legend	Sample	Test Type	Result	Depth (m)	Field Records/ Comments	Depth to water (m)
G.L.	MADE GROUND: Medium compact, dark grey, gravelly, sandy, SILT, with granite chippings & brick fragments & cement sheet (may contain asbestos).	200		•	Tub & Jar		G.L.		
200	MADE GROUND: Firm, mid to dark brown, gravelly, clayey, sandy, SILT, with brick fragments.	700						200 Numerous roots of live appearance to 6mmø to	
900	Firm, mid brown/orange, gravelly, very sandy, very silty, CLAY, with chalk nodules.	800		•	I	2 3 3 9	1.0	600 Numerous roots of live appearance to 3mmø to	
1.7	Stiff, mid brown, mottled orange & grey, gravelly, very silty, CLAY, with numerous chalk nodules. Thinly laminated with orange & brown silt & fine sand.	100		•			1.5	1.3 Numerous hair & fibrous roots to 2.2m.	
1.8	Very stiff, as above.	1.1		•	V	140+ 140+	2.0	No roots observed below 2.2m.	
2.9	Very stiff, mid grey, gravelly, silty to very silty, CLAY, with numerous chalk nodules. Thinly laminated with orange & olive silt & fine sand.	2.1		•	V	140+ 140+	3.0		
5.0	Borehole ends at 5.0m. Standpipe installed.			•	V	140+ 140+	5.0		
Remarks: Borehole dry & open on completion. Monitoring Standpipe installed from Ground Level to 5.0m, using 4.0m of slotted standpipe, and 1.0m of plain standpipe b.g.l. Backfilled with 4.0m of gravel, 600mm of bentonite pellets, and a 400mm concrete collar installed. A standpipe cap with gas taps installed.					Key: • Small disturbed sample V Pilcon Vane (kPa) B Bulk disturbed sample I Mackintosh Probe U Undisturbed sample(U100) S Standard W Water sample penetration test J Jar sample N SPT blow count				

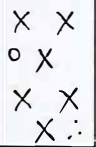
Borehole No: 3		Sheet: 1 of 1			SOIL INVESTIGATION EASTERN LIMITED Tel/Fax 01245 237555 Mobile 07810 820620				
		Job No: AU3361							
Boring Method: 100mmø CFA		Date: 07/08/2023							
Client: Orchard Home Developments Ltd.					Site: 83 Whitehill Road, Hitchin.				
Depth (m)	Description of Strata	Thick- Ness (m)	Legend	Sample	Test Type Result	Depth (m)	Field Records/ Comments	Depth to water (m)	
G.L.	MADE GROUND: Loose, black, ASH & CLINKER.	60							
60	MADE GROUND: Loose, dark brown, gravelly, clayey, sandy, SILT, with clinker & brick rubble.	640		•	Tub & Jar	1.0	100 Numerous roots of live appearance to 4mmø to		
700	Firm, mid brown/orange, gravelly, sandy, very silty, CLAY.	900		•	I 3 3 4 5	1.0	600 Numerous roots of live appearance to 2mmø to 1.2m.		
1.6	Loose, orange/brown, very silty, fine SAND.	200		•		1.5	No roots observed below 1.2m.		
1.8	Firm, mid brown/orange, slightly gravelly, very sandy, very silty, CLAY.	500		•	V 72 74	2.0	Water strike at	2.3	
2.3	Stiff, mid brown, mottled orange & grey, gravelly, very silty, CLAY, with numerous chalk nodules. Thinly laminated with orange & brown silt & fine sand.	400		•		2.5	Water standing at on completion.	2.3	
2.7	Very stiff, mid brown/grey, gravelly, silty to very silty, CLAY, with numerous chalk nodules. Thinly laminated with olive silt & fine sand.	2.1		•	V 140+ 140+	3.0			
4.8	Very stiff, mid grey, gravelly, silty to very silty, CLAY, with numerous chalk nodules. Thinly laminated with orange & olive silt & fine sand.	1.0		•	V 140+ 140+	4.0			
5.8	Very stiff, mid grey, gravelly, very silty, CLAY, with numerous chalk nodules.	6.2		•	V 140+ 140+	5.0			
				•	V 140+ 140+	6.0			
				•	V 140+ 140+	8.0			
				•	V 140+ 140+	10.0			
12.0	Borehole ends at 12.0m. Standpipe installed.			•	V 140+ 140+	12.0			
Remarks: Borehole collapsing from 1.6m to 9.0m. Monitoring Standpipe installed from Ground Level to 9.0m, using 8.0m of slotted standpipe, and 1.0m of plain standpipe b.g.l. Backfilled with 8.0m of gravel, 600mm of bentonite pellets, and a 400mm concrete collar installed. A standpipe cap with gas taps installed.					Key: • Small disturbed sample V Pilcon Vane (kPa) B Bulk disturbed sample I Mackintosh Probe U Undisturbed sample(U100) S Standard W Water sample penetration test J Jar sample N SPT blow count				



APPENDIX 2
TRIAL PIT LOGS

Trial Pit No: 1		Sheet: 1 of 1		 Tel/Fax 01245 237555 Mobile 07810 820620																								
		Job No: AU3361																										
Boring Method: Hand Tools		Date: 07/08/2023																										
Client: Orchard Home Developments Ltd.				Site: 83 Whitehill Road, Hitchin.																								
Depth (m)	Description of Strata	Thick- Ness (m)	Legend	Sample	Test Type Result	Depth (m)	Field Records/ Comments	Depth to water (m)																				
G.L.	MADE GROUND: Mid brown, gravelly, sandy, SILT, with brick fragments.	100		•	Tub & Jar	100	100 Numerous roots of live appearance to 5mmø to 900mm.																					
100	MADE GROUND: Grey ASH & CLINKER, with sand, silt & gravel.	100																										
200	MADE GROUND: Mid brown, gravelly, sandy, SILT, with brick ash, clinker & chalk fragments.	600		•	Tub & Jar	500																						
800	Orange brown, gravelly, sandy, SILT.	100																										
900	— Trial Pit ends at 900mm. —																											
Remarks: Trial Pit dry & open on completion.				Key: <table border="0"> <tr> <td>•</td><td>Small disturbed sample</td> <td>V</td><td>Pilcon Vane (kPa)</td> </tr> <tr> <td>B</td><td>Bulk disturbed sample</td> <td>I</td><td>Mackintosh Probe</td> </tr> <tr> <td>U</td><td>Undisturbed sample(U100)</td> <td>⚡</td><td>Standard penetration test</td> </tr> <tr> <td>W</td><td>Water sample</td> <td>N</td><td>SPT blow count</td> </tr> <tr> <td>J</td><td>Jar sample</td> <td></td><td></td> </tr> </table>					•	Small disturbed sample	V	Pilcon Vane (kPa)	B	Bulk disturbed sample	I	Mackintosh Probe	U	Undisturbed sample(U100)	⚡	Standard penetration test	W	Water sample	N	SPT blow count	J	Jar sample		
•	Small disturbed sample	V	Pilcon Vane (kPa)																									
B	Bulk disturbed sample	I	Mackintosh Probe																									
U	Undisturbed sample(U100)	⚡	Standard penetration test																									
W	Water sample	N	SPT blow count																									
J	Jar sample																											

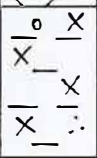
Trial Pit No: 2		Sheet: 1 of 1		 Tel/Fax 01245 237555 Mobile 07810 820620					
		Job No: AU3361							
Boring Method: Hand Tools		Date: 07/08/2023							
Client: Orchard Home Developments Ltd.				Site: 83 Whitehill Road, Hitchin.					
Depth (m)	Description of Strata	Thick- Ness (m)	Legend	Sample	Test Type	Result	Depth (m)	Field Records/ Comments	Depth to water (m)
G.L.	MADE GROUND: Mid brown, gravelly, sandy, SILT, with brick ash, clinker & chalk fragments.	800		•	Tub & Jar		200	100 Numerous roots of live appearance to 3mmø to 900mm.	
800	Orange brown, gravelly, sandy, SILT.	100		•	Tub & Jar		400		
900	Trial Pit ends at 900mm.								
Remarks: Trial Pit dry & open on completion.				Key: • Small disturbed sample - B Bulk disturbed sample - U Undisturbed sample(U100) - W Water sample - J Jar sample - V Pilcon Vane (kPa) - I Mackintosh Probe - S Standard penetration test - N SPT blow count					

Trial Pit No: 3		Sheet: 1 of 1			 Tel/Fax 01245 237555 Mobile 07810 820620				
		Job No: AU3361							
Boring Method: Hand Tools		Date: 07/08/2023							
Client: Orchard Home Developments Ltd.					Site: 83 Whitehill Road, Hitchin.				
Depth (m)	Description of Strata	Thick- Ness (m)	Legend	Sample	Test Type Result	Depth (m)	Field Records/ Comments	Depth to water (m)	
G.L.	MADE GROUND: Brown, gravelly, sandy, SILT, with brick ash, clinker, cement sheet (may contain asbestos) & chalk fragments.	800		•	Tub & Jar	100	Numerous roots of live appearance to 50mmø to		
150									
450									
800	Orange brown, gravelly, sandy, SILT.	100		•	Tub & Jar	700	Numerous roots of live appearance to 4mmø to 900mm.		
900	Trial Pit ends at 900mm.								
Remarks: Trial Pit dry & open on completion.					Key: • Small disturbed sample B Bulk disturbed sample U Undisturbed sample(U100) W Water sample J Jar sample V Pilcon Vane (kPa) I Mackintosh Probe S Standard penetration test N SPT blow count				

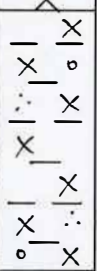
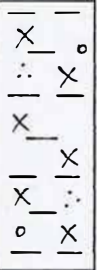
Trial Pit No: 4		Sheet: 1 of 1		 Tel/Fax 01245 237555 Mobile 07810 820620																									
		Job No: AU3361																											
Boring Method: Hand Tools		Date: 07/08/2023																											
Client: Orchard Home Developments Ltd.				Site: 83 Whitehill Road, Hitchin.																									
Depth (m)	Description of Strata	Thick- Ness (m)	Legend	Sample	Test Type	Result	Depth (m)	Field Records/ Comments	Depth to water (m)																				
G.L.	MADE GROUND: Brown, gravelly, sandy, SILT, with brick, ash, clinker & chalk fragments.	400		•	Tub & Jar		300	100 Numerous roots of live appearance to 8mm to 900mm.																					
400	MADE GROUND: Light grey, gravelly, sandy, SILT, with numerous amounts of chalk & occasional brick fragments.									400		•	Tub & Jar	600															
800	Orange brown, gravelly, sandy, SILT, with chalk nodules.	100																											
900	Trial Pit ends at 900mm.																												
Remarks: Trial Pit dry & open on completion.					Key: <table border="0"> <tr> <td>•</td><td>Small disturbed sample</td> <td>V</td><td>Pilcon Vane (kPa)</td> </tr> <tr> <td>B</td><td>Bulk disturbed sample</td> <td>I</td><td>Mackintosh Probe</td> </tr> <tr> <td>U</td><td>Undisturbed sample(U100)</td> <td>⚡</td><td>Standard</td> </tr> <tr> <td>W</td><td>Water sample</td> <td></td><td>penetration test</td> </tr> <tr> <td>J</td><td>Jar sample</td> <td>N</td><td>SPT blow count</td> </tr> </table>					•	Small disturbed sample	V	Pilcon Vane (kPa)	B	Bulk disturbed sample	I	Mackintosh Probe	U	Undisturbed sample(U100)	⚡	Standard	W	Water sample		penetration test	J	Jar sample	N	SPT blow count
•	Small disturbed sample	V	Pilcon Vane (kPa)																										
B	Bulk disturbed sample	I	Mackintosh Probe																										
U	Undisturbed sample(U100)	⚡	Standard																										
W	Water sample		penetration test																										
J	Jar sample	N	SPT blow count																										

Trial Pit No: 5		Sheet: 1 of 1			 Tel/Fax 01245 237555 Mobile 07810 820620				
		Job No: AU3361							
Boring Method: Hand Tools		Date: 07/08/2023							
Client: Orchard Home Developments Ltd.					Site: 83 Whitehill Road, Hitchin.				
Depth (m)	Description of Strata	Thick- Ness (m)	Legend	Sample	Test Type	Result	Depth (m)	Field Records/ Comments	Depth to water (m)
G.L.	MADE GROUND: Dark brown, gravelly, sandy, very silty, CLAY, with brick, china & glass fragments.	400		•	Tub & Jar		100	100 Numerous roots of live appearance to 2mmø to 900mm.	
400					Tub & Jar		300		
400	MADE GROUND: Orange brown, gravelly, sandy, very silty, CLAY, with occasional small brick fragments.	400							
800	Orange brown, gravelly, sandy, very silty, CLAY.	100							
900	— Trial Pit ends at 900mm. —								
Remarks: Trial Pit moist & open on completion.					Key: • Small disturbed sample B Bulk disturbed sample U Undisturbed sample(U100) W Water sample J Jar sample V Pilcon Vane (kPa) I Mackintosh Probe S Standard penetration test N SPT blow count				

Trial Pit No: 6		Sheet: 1 of 1		 Tel/Fax 01245 237555 Mobile 07810 820620				
		Job No: AU3361						
Boring Method: Hand Tools		Date: 07/08/2023						
Client: Orchard Home Developments Ltd.				Site: 83 Whitehill Road, Hitchin.				
Depth (m)	Description of Strata	Thick- Ness (m)	Legend	Sample	Test Type Result	Depth (m)	Field Records/ Comments	Depth to water (m)
G.L.	MADE GROUND: Mid brown, gravelly, sandy, SILT, with brick fragments.	300		•	Tub & Jar	100	100 Numerous roots of live appearance to 8mmø to 800mm.	
300	MADE GROUND: Orange brown, gravelly, sandy, very silty, CLAY, with occasional small brick fragments.							
700	Orange brown, gravelly, sandy, very silty, CLAY.	100		•	Tub & Jar	600		
800	— Trial Pit ends at 800mm. —							
Remarks: Trial Pit dry & open on completion.					Key: • Small disturbed sample B Bulk disturbed sample U Undisturbed sample(U100) W Water sample J Jar sample V Pilcon Vane (kPa) I Mackintosh Probe S Standard penetration test N SPT blow count			

Trial Pit No: 7		Sheet: 1 of 1		 Tel/Fax 01245 237555 Mobile 07810 820620				
		Job No: AU3361						
Boring Method: Hand Tools		Date: 07/08/2023						
Client: Orchard Home Developments Ltd.				Site: 83 Whitehill Road, Hitchin.				
Depth (m)	Description of Strata	Thick- Ness (m)	Legend	Sample	Test Type Result	Depth (m)	Field Records/ Comments	Depth to water (m)
G.L.	MADE GROUND: Grey, ASH & CLINKER, with sand, silt & gravel & occasional cement sheet fragments.	150		•	Tub & Jar	50	100 Occasional roots of live appearance to 1mmø to 400mm.	
150	MADE GROUND: Dark brown, gravelly, sandy, SILT, with ash, clinker, brick & chalk fragments.	350						
500	MADE GROUND: Orange brown, gravelly, sandy, very silty, CLAY, with small brick & carbon fragments.	300						
800	Orange brown, gravelly, sandy, very silty, CLAY.	100		•	Tub & Jar	700	No roots observed below 400mm.	
900	—Trial Pit ends at 900mm.							
Remarks: Trial Pit moist & open on completion.				Key: • Small disturbed sample - B Bulk disturbed sample - U Undisturbed sample(U100) - W Water sample - J Jar sample - V Pilcon Vane (kPa) - I Mackintosh Probe - S Standard penetration test - N SPT blow count				

Trial Pit No: 8		Sheet: 1 of 1			 Tel/Fax 01245 237555 Mobile 07810 820620					
		Job No: AU3361								
Boring Method: Hand Tools		Date: 07/08/2023								
Client: Orchard Home Developments Ltd.					Site: 83 Whitehill Road, Hitchin.					
Depth (m)	Description of Strata	Thick- Ness (m)	Legend	Sample	Test Type Result	Depth (m)	Field Records/ Comments	Depth to water (m)		
G.L.	MADE GROUND: Dark brown, gravelly, sandy, SILT, with ash, clinker, pottery, brick & bone fragments.	500		•	Tub & Jar	250	100 Occasional roots of live appearance to 1mmø to 800mm.			
500	Orange brown, gravelly, sandy, very silty, CLAY, with occasional small brick & carbon fragments.								200	
700	Orange brown, gravelly, sandy, very silty, CLAY.								100	
800	Trial Pit ends at 800mm.									
Remarks: Trial Pit dry & open on completion.					Key: • Small disturbed sample B Bulk disturbed sample U Undisturbed sample(U100) W Water sample J Jar sample V Pilcon Vane (kPa) I Mackintosh Probe S Standard penetration test N SPT blow count					

Trial Pit No: 9		Sheet: 1 of 1		 Tel/Fax 01245 237555 Mobile 07810 820620				
		Job No: AU3361						
Boring Method: Hand Tools		Date: 07/08/2023						
Client: Orchard Home Developments Ltd.				Site: 83 Whitehill Road, Hitchin.				
Depth (m)	Description of Strata	Thick- Ness (m)	Legend	Sample	Test Type Result	Depth (m)	Field Records/ Comments	Depth to water (m)
G.L.	MADE GROUND: Dark brown, gravelly, sandy, SILT, with brick ash, bone & man-made fragments.	200		•	Tub & Jar	100	100 Occasional roots of live appearance to 1mmø to 500mm.	
200	MADE GROUND: Dark brown, gravelly, sandy, SILT, with brick bone & carbon fragments.	300		•	Tub & Jar	400		
500	Orange brown, gravelly, sandy, very silty, CLAY, with occasional brick & carbon fragments.	200					No roots observed below 500mm.	
700	Orange brown, gravelly, sandy, very silty, CLAY.	200						
900	— Trial Pit ends at 900mm. —							
Remarks: Trial Pit dry & open on completion.				Key: • Small disturbed sample B Bulk disturbed sample U Undisturbed sample(U100) W Water sample J Jar sample V Pilcon Vane (kPa) I Mackintosh Probe S Standard penetration test N SPT blow count				



APPENDIX 3
GAS MONITORING RESULTS



SOIL GAS SURVEY

Project:	83 Whitehill Road			Date:	21/08/2023					GA 5000/Dipmeter	
Location:	Hitchin			Weather:	Sunny, 1/8 cloud						
Job No.	12248			Temp:	18°C						
Monitoring Point No.	Time	O2 (% v/v)	CO2 (% v/v)	CH4 (% v/v)	H2S (PPM)	CO (PPM)	PID (PPM)	Flow (l/hr)	Water (mbgl)	Site Observations/ Comments	
										Time	Barometric Pressure
BH1		19.5	1.5	0	0	0	NR	0	1.69		
BH2		19.4	1.1	0	0	0	NR	0	1.85	11:20	1016mbar
BH3		19.8	0.7	0	0	0	NR	0	1.59	Datum:	
										NR - Not recorded	

Tested by: MP

Checked by:

Ground and Environmental Services Limited

Accuracy and range of Gas Analyser 5000 (GA5000)				
Accuracy			Range	
Gas	Gas Concentrations			
	0-5%	5-15%	0-FS	
CH ₄	+/-0.5%	+/-3%		0-70% to specification, 0-100% reading
CO ₂	+/-0.5%	+/-3%		0-40% to specification, 0-100% reading
O ₂	+/-1%	+/-1%		0-25%
CO			+/-10%FS	0-500ppm
H ₂ S			+/-10%FS	0-200ppm
B.P.	+/- 5 mBar			700-1200 mBar
Flow:				

Notes:

CH₄: methane in percent volume per volume (% v/v)

CO₂: carbon dioxide in %v/v

O₂: oxygen in % v/v

H₂S: hydrogen sulphide in part per million (ppm)

CO: carbon monoxide in ppm

B.P.: Barometric pressure in mBar

Flow: Gas flow in litre per hour (l/h)



Tested by: MP

Checked by: **Ground and Environmental Services Limited**

Notes:
CH ₄ : methane in percent volume per volume (% v/v)
CO ₂ : carbon dioxide in %v/v
O ₂ : oxygen in % v/v
H ₂ S: hydrogen sulphide in part per million (ppm)
CO: carbon monoxide in ppm
B.P.: Barometric pressure in mBar
Flow: Gas flow in litre per hour (l/h)



Tested by: MP

Checked by: **Ground and Environmental Services Limited**

Accuracy and range of Gas Analyser 5000 (GA5000)					Notes: CH4: methane in percent volume per volume (% v/v) CO2: carbon dioxide in %v/v O2: oxygen in % v/v H2S: hydrogen sulphide in part per million (ppm) CO: carbon monoxide in ppm B.P.: Barometric pressure in mBar Flow: Gas flow in litre per hour (l/h)
Accuracy				Range	
Gas	Gas Concentrations				
	0-5%	5-15%	0-FS		
CH ₄	+/-0.5%	+/-3%		0-70% to specification, 0-100% reading	
CO ₂	+/-0.5%	+/-3%		0-40% to specification, 0-100% reading	
O ₂	+/-1%	+/-1%		0-25%	
CO			+/-10%FS	0-500ppm	
H ₂ S			+/-10%FS	0-200ppm	
B.P.	+/- 5 mBar			700-1200 mBar	
Flow:					



APPENDIX 4
ANALYTICAL TESTING RESULTS



Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY
Telephone: (01424) 718618

cs@elab-uk.co.uk
info@elab-uk.co.uk

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number: 19-24369

Issue: 2. Replaces Analytical Report number 19-24369; issue no.1

Date of Issue: 29/08/2023

Contact: Sandra Brown

Customer Details: Soil Investigation (Eastern) Ltd
Office F, The Dutch Barn
Old Park Farm
Chelmsford
EssexCM3 1LN

Quotation No: Q17-00801

Order No: AU3361

Customer Reference: AU3361

Date Received: 09/08/2023

Date Approved: 29/08/2023

Details: 83 Whitehill Road, Hitchin

Approved by:

Mike Varley, Technical Manager

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

This report may only be reproduced in full



Sample Summary

Report No.: 19-24369, issue number 2

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
181153	BH1 G.L.	07/08/2023	12/08/2023		
181154	BH2 G.L.	07/08/2023	28/08/2023	Silty loam	
181155	BH3 (WAC) 1.00	07/08/2023	12/08/2023	Silty loam	
181156	TP1 0.10	07/08/2023	12/08/2023	Silty loam	
181157	TP1 0.50	07/08/2023	12/08/2023		
181158	TP2 0.20	07/08/2023	12/08/2023		
181159	TP2 0.40	07/08/2023	12/08/2023		
181160	TP3 0.15	07/08/2023	12/08/2023	Silty loam	
181161	TP3 0.45	07/08/2023	12/08/2023		
181162	TP4 0.30	07/08/2023	12/08/2023	Silty loam	
181163	TP4 0.60	07/08/2023	12/08/2023		
181164	TP5 0.10	07/08/2023	12/08/2023		
181165	TP5 0.30	07/08/2023	12/08/2023	Silty loam	
181166	TP6 0.10	07/08/2023	12/08/2023	Silty loam	
181167	TP6 0.60	07/08/2023	12/08/2023		
181168	TP7 0.05	07/08/2023	28/08/2023		
181169	TP7 0.70	07/08/2023	12/08/2023		
181170	TP8 0.25	07/08/2023	12/08/2023		
181171	TP8 0.55	07/08/2023	12/08/2023		
181172	TP9 0.10	07/08/2023	12/08/2023		
181173	TP9 0.40	07/08/2023	12/08/2023	Silty loam	

Results Summary

2683

Report No.: 19-24369, issue number 2

ELAB Reference	181154	181155	181156	181160
Customer Reference		(WAC)		
Sample ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sample Location	BH2	BH3	TP1	TP3
Sample Depth (m)	G.L.	1.00	0.10	0.15
Sampling Date	07/08/2023	07/08/2023	07/08/2023	07/08/2023

Determinand	Codes	Units	LOD				
Soil sample preparation parameters							
Moisture Content	N	%	0.1	14.7	n/t	6.3	9.1
Material removed	N	%	0.1	39.9	11.7	44.7	25.5
Description of Inert material removed	N		0	Stones	Stones	Stones,clinker	Stones,clinker
Metals							
Arsenic	M	mg/kg	1	43.5	n/t	41.2	41.3
Cadmium	M	mg/kg	0.5	4.7	n/t	0.9	4.5
Chromium	M	mg/kg	5	49.9	n/t	31.5	37.8
Chromium (III)	N	mg/kg	5	49.9	n/t	31.5	37.8
Copper	M	mg/kg	5	165	n/t	293	117
Lead	M	mg/kg	5	1060	n/t	378	828
Mercury	M	mg/kg	0.5	0.6	n/t	< 0.5	0.7
Nickel	M	mg/kg	5	67.3	n/t	66.0	59.7
Selenium	M	mg/kg	1	1.5	n/t	< 1.0	1.5
Zinc	M	mg/kg	5	2930	n/t	423	3360
Anions							
Water Soluble Sulphate	M	g/l	0.02	1.20	n/t	0.09	0.05
Water Soluble Sulphate	M	mg/l	20	1200	n/t	93	48
Water Soluble Sulphate	M	mg/kg	40	2390	n/t	186	95
Inorganics							
Hexavalent Chromium	N	mg/kg	0.8	< 0.8	n/t	< 0.8	< 0.8
Water Soluble Boron	N	mg/kg	0.5	8.6	n/t	1.2	1.2
Miscellaneous							
Acid Neutralisation Capacity	N	mol/kg	0.1	n/t	< 0.1	n/t	n/t
Loss On Ignition (450°C)	M	%	0.01	n/t	3.48	n/t	n/t
pH	M	pH units	0.1	8.1	7.9	8.1	7.5
Total Organic Carbon	N	%	0.01	n/t	0.90	n/t	n/t
Polyaromatic hydrocarbons							
Naphthalene	M	mg/kg	0.1	0.6	n/t	1.9	1.2
Acenaphthylene	M	mg/kg	0.1	0.7	n/t	0.2	0.6
Acenaphthene	M	mg/kg	0.1	0.2	n/t	0.3	0.8
Fluorene	M	mg/kg	0.1	0.2	n/t	0.2	0.6
Phenanthrene	M	mg/kg	0.1	2.9	n/t	3.7	7.5
Anthracene	M	mg/kg	0.1	1.2	n/t	1.1	2.7
Fluoranthene	M	mg/kg	0.1	5.8	n/t	6.5	13.6
Pyrene	M	mg/kg	0.1	6.3	n/t	5.9	12.4
Benzo(a)anthracene	M	mg/kg	0.1	3.0	n/t	3.8	8.5
Chrysene	M	mg/kg	0.1	4.8	n/t	4.5	10.1
Benzo(b)fluoranthene	M	mg/kg	0.1	5.7	n/t	4.3	9.2
Benzo(k)fluoranthene	M	mg/kg	0.1	4.3	n/t	5.3	10.4
Benzo(a)pyrene	M	mg/kg	0.1	2.4	n/t	5.0	11.3
Indeno(1,2,3-cd)pyrene	M	mg/kg	0.1	3.7	n/t	4.1	8.7
Dibenzo(a,h)anthracene	M	mg/kg	0.1	1.0	n/t	0.7	1.5
Benzo[g,h,i]perylene	M	mg/kg	0.1	6.7	n/t	3.9	7.3
Total PAH(16)	M	mg/kg	0.4	49.3	n/t	51.6	107
Total PAH (Including Coronene)	N	mg/kg	2	n/t	11	n/t	n/t



Results Summary

2683

Report No.: 19-24369, issue number 2

ELAB Reference				181154	181155	181156	181160
Customer Reference					(WAC)		
Sample ID							
Sample Type				SOIL	SOIL	SOIL	SOIL
Sample Location				BH2	BH3	TP1	TP3
Sample Depth (m)				G.L.	1.00	0.10	0.15
Sampling Date				07/08/2023	07/08/2023	07/08/2023	07/08/2023
Determinand	Codes	Units	LOD				
BTEX							
Total BTEX	M	mg/kg	0.01	n/t	< 0.01	n/t	n/t
TPH CWG							
>C5-C6 Aliphatic	N	mg/kg	0.01	< 0.01	n/t	< 0.01	< 0.01
>C6-C8 Aliphatic	N	mg/kg	0.01	< 0.01	n/t	< 0.01	< 0.01
>C8-C10 Aliphatic	N	mg/kg	1	3.2	n/t	< 1.0	< 1.0
>C10-C12 Aliphatic	N	mg/kg	1	4.2	n/t	< 1.0	< 1.0
>C12-C16 Aliphatic	N	mg/kg	1	12.6	n/t	< 1.0	< 1.0
>C16-C21 Aliphatic	N	mg/kg	1	101	n/t	2.1	4.5
>C21-C35 Aliphatic	N	mg/kg	1	1590	n/t	39.4	29.3
>C35-C40 Aliphatic	N	mg/kg	1	395	n/t	6.8	3.1
>C5-C7 Aromatic	N	mg/kg	0.01	< 0.01	n/t	< 0.01	< 0.01
>C7-C8 Aromatic	N	mg/kg	0.01	< 0.01	n/t	< 0.01	< 0.01
>C8-C10 Aromatic	N	mg/kg	1	< 1.0	n/t	< 1.0	< 1.0
>C10-C12 Aromatic	N	mg/kg	1	< 1.0	n/t	< 1.0	< 1.0
>C12-C16 Aromatic	N	mg/kg	1	3.0	n/t	< 1.0	1.6
>C16-C21 Aromatic	N	mg/kg	1	46.8	n/t	8.0	21.4
>C21-C35 Aromatic	N	mg/kg	1	706	n/t	90.0	182
>C35-C40 Aromatic	N	mg/kg	1	247	n/t	15.8	20.8
Total (>C5-C40) Ali/Aro	N	mg/kg	1	3110	n/t	162	263
Total Petroleum Hydrocarbons							
Mineral Oil	M	mg/kg	5	n/t	^ 6	n/t	n/t
Total TPH (>C8-C40)	M	mg/kg	5	4800	n/t	179	284
PCB (ICES 7 congeners)							
PCB 28	M	mg/kg	0.01	n/t	n/t	n/t	n/t
PCB 52	M	mg/kg	0.01	n/t	n/t	n/t	n/t
PCB 101	M	mg/kg	0.01	n/t	n/t	n/t	n/t
PCB 118	M	mg/kg	0.01	n/t	n/t	n/t	n/t
PCB 153	M	mg/kg	0.01	n/t	n/t	n/t	n/t
PCB 138	M	mg/kg	0.01	n/t	n/t	n/t	n/t
PCB 180	M	mg/kg	0.01	n/t	n/t	n/t	n/t
PCB (Total of 7 Congeners)	M	mg/kg	0.03	n/t	< 0.03	n/t	n/t

Results Summary

2683

Report No.: 19-24369, issue number 2

ELAB Reference	181162	181165	181166	181173
Customer Reference				
Sample ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sample Location	TP4	TP5	TP6	TP9
Sample Depth (m)	0.30	0.30	0.10	0.40
Sampling Date	07/08/2023	07/08/2023	07/08/2023	07/08/2023

Determinand	Codes	Units	LOD				
Soil sample preparation parameters							
Moisture Content	N	%	0.1	n/t	25.0	16.7	9.9
Material removed	N	%	0.1	< 0.1	< 0.1	6.4	21.3
Description of Inert material removed	N		0	None	None	Stones	Stones
Metals							
Arsenic	M	mg/kg	1	n/t	43.2	49.1	56.2
Cadmium	M	mg/kg	0.5	n/t	3.7	1.1	< 0.5
Chromium	M	mg/kg	5	n/t	40.1	35.1	29.5
Chromium (III)	N	mg/kg	5	n/t	40.1	35.1	29.5
Copper	M	mg/kg	5	n/t	99.6	100	69.3
Lead	M	mg/kg	5	n/t	474	603	159
Mercury	M	mg/kg	0.5	n/t	0.9	0.8	< 0.5
Nickel	M	mg/kg	5	n/t	51.3	50.7	47.9
Selenium	M	mg/kg	1	n/t	< 1.0	1.2	< 1.0
Zinc	M	mg/kg	5	n/t	5020	2750	318
Anions							
Water Soluble Sulphate	M	g/l	0.02	n/t	0.06	0.02	0.13
Water Soluble Sulphate	M	mg/l	20	n/t	56	24	134
Water Soluble Sulphate	M	mg/kg	40	n/t	112	47	267
Inorganics							
Hexavalent Chromium	N	mg/kg	0.8	n/t	< 0.8	< 0.8	< 0.8
Water Soluble Boron	N	mg/kg	0.5	n/t	1.0	< 0.5	2.1
Miscellaneous							
Acid Neutralisation Capacity	N	mol/kg	0.1	n/t	n/t	n/t	n/t
Loss On Ignition (450°C)	M	%	0.01	n/t	n/t	n/t	n/t
pH	M	pH units	0.1	n/t	7.4	7.1	7.4
Total Organic Carbon	N	%	0.01	n/t	n/t	n/t	n/t
Polyaromatic hydrocarbons							
Naphthalene	M	mg/kg	0.1	n/t	0.3	< 0.1	< 0.1
Acenaphthylene	M	mg/kg	0.1	n/t	0.8	0.4	0.1
Acenaphthene	M	mg/kg	0.1	n/t	0.4	0.1	< 0.1
Fluorene	M	mg/kg	0.1	n/t	0.7	< 0.1	< 0.1
Phenanthrene	M	mg/kg	0.1	n/t	8.8	1.8	0.8
Anthracene	M	mg/kg	0.1	n/t	3.1	0.5	0.3
Fluoranthene	M	mg/kg	0.1	n/t	19.5	4.2	2.6
Pyrene	M	mg/kg	0.1	n/t	15.8	3.9	2.3
Benzo(a)anthracene	M	mg/kg	0.1	n/t	8.7	2.2	1.8
Chrysene	M	mg/kg	0.1	n/t	9.8	2.9	2.0
Benzo(b)fluoranthene	M	mg/kg	0.1	n/t	7.8	2.8	1.7
Benzo(k)fluoranthene	M	mg/kg	0.1	n/t	8.3	2.8	2.1
Benzo(a)pyrene	M	mg/kg	0.1	n/t	8.5	2.7	2.0
Indeno(1,2,3-cd)pyrene	M	mg/kg	0.1	n/t	5.4	2.2	1.3
Dibenzo(a,h)anthracene	M	mg/kg	0.1	n/t	1.2	0.6	0.4
Benzo[g,h,i]perylene	M	mg/kg	0.1	n/t	4.5	2.0	1.2
Total PAH(16)	M	mg/kg	0.4	n/t	104	29.3	18.7
Total PAH (Including Coronene)	N	mg/kg	2	n/t	n/t	n/t	n/t

Results Summary

2683

Report No.: 19-24369, issue number 2

ELAB Reference	181162	181165	181166	181173
Customer Reference				
Sample ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sample Location	TP4	TP5	TP6	TP9
Sample Depth (m)	0.30	0.30	0.10	0.40
Sampling Date	07/08/2023	07/08/2023	07/08/2023	07/08/2023

Determinand	Codes	Units	LOD				
BTEX							
Total BTEX	M	mg/kg	0.01	n/t	n/t	n/t	n/t
TPH CWG							
>C5-C6 Aliphatic	N	mg/kg	0.01	n/t	< 0.01	< 0.01	< 0.01
>C6-C8 Aliphatic	N	mg/kg	0.01	n/t	< 0.01	< 0.01	< 0.01
>C8-C10 Aliphatic	N	mg/kg	1	n/t	< 1.0	< 1.0	< 1.0
>C10-C12 Aliphatic	N	mg/kg	1	n/t	< 1.0	< 1.0	< 1.0
>C12-C16 Aliphatic	N	mg/kg	1	n/t	< 1.0	< 1.0	< 1.0
>C16-C21 Aliphatic	N	mg/kg	1	n/t	< 1.0	< 1.0	< 1.0
>C21-C35 Aliphatic	N	mg/kg	1	n/t	1.9	3.9	1.1
>C35-C40 Aliphatic	N	mg/kg	1	n/t	< 1.0	< 1.0	< 1.0
>C5-C7 Aromatic	N	mg/kg	0.01	n/t	< 0.01	< 0.01	< 0.01
>C7-C8 Aromatic	N	mg/kg	0.01	n/t	< 0.01	< 0.01	< 0.01
>C8-C10 Aromatic	N	mg/kg	1	n/t	< 1.0	< 1.0	< 1.0
>C10-C12 Aromatic	N	mg/kg	1	n/t	< 1.0	< 1.0	< 1.0
>C12-C16 Aromatic	N	mg/kg	1	n/t	< 1.0	< 1.0	< 1.0
>C16-C21 Aromatic	N	mg/kg	1	n/t	3.2	2.4	< 1.0
>C21-C35 Aromatic	N	mg/kg	1	n/t	19.8	23.5	4.0
>C35-C40 Aromatic	N	mg/kg	1	n/t	< 1.0	2.9	< 1.0
Total (>C5-C40) Ali/Aro	N	mg/kg	1	n/t	24.9	32.7	4.0
Total Petroleum Hydrocarbons							
Mineral Oil	M	mg/kg	5	n/t	n/t	n/t	n/t
Total TPH (>C8-C40)	M	mg/kg	5	n/t	24	45	< 5
PCB (ICES 7 congeners)							
PCB 28	M	mg/kg	0.01	< 0.01	< 0.01	n/t	n/t
PCB 52	M	mg/kg	0.01	< 0.01	< 0.01	n/t	n/t
PCB 101	M	mg/kg	0.01	< 0.01	< 0.01	n/t	n/t
PCB 118	M	mg/kg	0.01	< 0.01	< 0.01	n/t	n/t
PCB 153	M	mg/kg	0.01	< 0.01	< 0.01	n/t	n/t
PCB 138	M	mg/kg	0.01	< 0.01	0.01	n/t	n/t
PCB 180	M	mg/kg	0.01	< 0.01	< 0.01	n/t	n/t
PCB (Total of 7 Congeners)	M	mg/kg	0.03	< 0.03	0.04	n/t	n/t

Results Summary

2683

Report No.: 19-24369, issue number 2

WAC Analysis

Elab Ref:	181155					Landfill Waste Acceptance Criteria Limits*		
Sample Date:	07/08/2023					Inert Waste Landfill	Stable Non-reactive Hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID:	BH3 (WAC)							
Depth (m)	1							
Site:	83 Whitehill Road, Hitchin							
Determinand		Code	Units					
Total Organic Carbon		N	%		0.90	3	5	6
Loss on Ignition		M	%		3.5	--	--	10
Total BTEX		M	mg/kg		< 0.01	6	--	--
Total PCBs (7 congeners)		M	mg/kg		< 0.03	1	--	--
TPH Total WAC		M	mg/kg		6	500	--	--
Total (of 17) PAHs		N	mg/kg		11.0	100	--	--
pH		M			7.9	--	>6	--
Acid Neutralisation Capacity		N	mol/kg		< 0.1	--	To evaluate	To evaluate

Eluate Analysis

			mg/l		mg/kg	using BS EN 12457-2 at L/S 10 l/kg		
Arsenic		N	0.007		0.07	0.5	2	25
Barium		N	0.007		0.07	20	100	300
Cadmium		N	< 0.001		< 0.01	0.04	1	5
Chromium		N	< 0.005		< 0.05	0.5	10	70
Copper		N	< 0.005		< 0.05	2	50	100
Mercury		N	< 0.005		< 0.01	0.01	0.2	2
Molybdenum		N	0.008		0.08	0.5	10	30
Nickel		N	< 0.001		< 0.05	0.4	10	40
Lead		N	< 0.001		< 0.05	0.5	10	50
Antimony		N	< 0.005		< 0.05	0.06	0.7	5
Selenium		N	< 0.005		< 0.05	0.1	0.5	7
Zinc		N	< 0.005		< 0.05	4	50	200
Chloride		N	< 5		< 50	800	15000	25000
Fluoride		N	< 5		< 10	10	150	500
Sulphate		N	25		250.00	1000	20000	50000
Total Dissolved Solids		N	110		1100.00	4000	60000	100000
Phenol Index		N	< 0.01		< 0.10	1	-	-
Dissolved Organic Carbon		N	17.800		178.00	500	800	1000

Leach Test Information

pH	N	7.7				
Conductivity (uS/cm)	N	164				
Dry mass of test portion (g)		102.000				
Dry Matter (%)		89				
Moisture (%)		13				
Eluent Volume (ml)		983				

Results are expressed on a dry weight basis, after correction for moisture content where applicable

* Stated limits are for guidance only, and not for conformity assessment.



Unit A2, Windmill Road, Ponswood Industrial Estate, St Leonards on Sea, East Sussex, TN38 9BY
Tel: +44 (0)1424 718618, Email: info@elab-uk.co.uk, Web: www.elab-uk.co.uk

Results Summary
Report No.: 19-24369, Issue number 2

Asbestos Results

Analytical result only applies to the sample as submitted by the client. Any comments, opinions or interpretations (marked #)
in this report are outside UKAS accreditation (Accreditation No:2983). They are subjective comments only which must be verified by the client.

Elab No	Depth (m)	Clients Reference	Description of Sample Matrix #	Asbestos Identification	Gravimetric Analysis Total (%)	Gravimetric Analysis by ACM Type (%)	Free Fibre Analysis (%)	Total Asbestos (%)
181153	G.L.	BH1	Brown Sandy Soil, Stones, Clinker, Plant Material	No asbestos detected	n/t	n/t	n/t	n/t
181154	G.L.	BH2	Brown Sandy Soil, Stones, Clinker, Plant Material	Chrysotile Crocidolite (Asbestos Cement	0.366	0.3665646 (0.3580383 A/C Chrysotile and Crocidolite, 0.0085263, Laqing,	< 0.001	0.366
181156	0.10	TP1	Brown Sandy Soil, Stones, Clinker, Plant Material	No asbestos detected	n/t	n/t	n/t	n/t
181158	0.20	TP2	Brown Sandy Soil, Stones, Clinker, Brick, Plant Material	No asbestos detected	n/t	n/t	n/t	n/t
181160	0.15	TP3	Brown Sandy Soil, Stones, Clinker, Plant Material, Roots	No asbestos detected	n/t	n/t	n/t	n/t
181164	0.10	TP5	Brown Sandy Soil, Stones, Clinker, Plant Material	No asbestos detected	n/t	n/t	n/t	n/t
181165	0.30	TP5	Brown Sandy Soil, Stones, Clinker, Plant Material	No asbestos detected	n/t	n/t	n/t	n/t
181166	0.10	TP6	Brown Sandy Soil, Stones, Clinker, Plant Material	No asbestos detected	n/t	n/t	n/t	n/t
181168	0.05	TP7	Brown Sandy Soil, Stones, Concrete, Clinker, Plant	Chrysotile (Asbestos Cement)	1.22	1.2186355 (A/C Chrysotile)	< 0.001	1.22
181170	0.25	TP8	Brown Sandy Soil, Stones, Clinker, Brick, Plant Material	No asbestos detected	n/t	n/t	n/t	n/t
181172	0.10	TP9	Brown Sandy Soil, Stones, Clinker, Slate	No asbestos detected	n/t	n/t	n/t	n/t
181173	0.40	TP9	Brown Sandy Soil, Stones, Clinker	No asbestos detected	n/t	n/t	n/t	n/t

Method Summary

Report No.: 19-24369, issue number 2

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
Hexavalent chromium	N	As submitted sample	14/08/2023	110	Colorimetry
Aqua regia extractable metals	M	Air dried sample	14/08/2023	118	ICPMS
PAH (GC-FID)	M	As submitted sample	14/08/2023	133	GC-FID
Water soluble anions	M	Air dried sample	14/08/2023	172	Ion Chromatography
Low range Aliphatic hydrocarbons soil	N	As submitted sample	14/08/2023	181	GC-MS
Low range Aromatic hydrocarbons soil	N	As submitted sample	14/08/2023	181	GC-MS
Water soluble boron	N	Air dried sample	14/08/2023	202	Colorimetry
Aliphatic hydrocarbons in soil	N	As submitted sample	14/08/2023	214	GC-FID
Aliphatic/Aromatic hydrocarbons in soil	N	As submitted sample	16/08/2023	214	GC-FID
Aromatic hydrocarbons in soil	N	As submitted sample	14/08/2023	214	GC-FID
Asbestos identification	U	Air dried sample	14/08/2023	260	Microscopy
Leachate					
Arsenic	N		16/08/2023	101	ICPMS
Cadmium	N		16/08/2023	101	ICPMS
Chromium	N		16/08/2023	101	ICPMS
Lead	N		16/08/2023	101	ICPMS
Nickel	N		16/08/2023	101	ICPMS
Copper	N		16/08/2023	101	ICPMS
Zinc	N		16/08/2023	101	ICPMS
Mercury	N		16/08/2023	101	ICPMS
Selenium	N		16/08/2023	101	ICPMS
Antimony	N		16/08/2023	101	ICPMS
Barium	N		16/08/2023	101	ICPMS
Molybdenum	N		16/08/2023	101	ICPMS
pH Value	N		16/08/2023	113	Electrometric
Electrical Conductivity	N		16/08/2023	136	Probe
Dissolved Organic Carbon	N		16/08/2023	102	TOC analyser
Chloride	N		16/08/2023	131	Ion Chromatography
Fluoride	N		16/08/2023	131	Ion Chromatography
Sulphate	N		16/08/2023	131	Ion Chromatography
Total Dissolved Solids	N		16/08/2023	144	Gravimetric
Phenol index	N		16/08/2023	121	HPLC
WAC Solids analysis	N				
pH Value	M	Air dried sample	16/08/2023	113	Electrometric
Total Organic Carbon	N	Air dried sample	16/08/2023	210	IR
Loss on Ignition	M	Air dried sample	16/08/2023	129	Gravimetric
Acid Neutralization Capacity to pH 7	N	Air dried sample	19/08/2023	NEN 737	Electrometric
Total BTEX	M	As submitted sample	14/08/2023	181	GCMS
Mineral Oil	M	As submitted sample	14/08/2023	117	GCFID
Total PCBs (7 congeners)	M	Air dried sample	14/08/2023	120	GCMS
Total PAH (17)	N	As submitted sample	15/08/2023	133	GCFID

Tests marked N are not UKAS accredited

Report Information

Report No.: 19-24369, issue number 2

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
NS	Subcontracted to approved laboratory. UKAS accreditation is not applicable.
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

Soil sample results are expressed on an air dried basis (dried at < 30°C), and are uncorrected for inert material removed.

ELAB are unable to provide an interpretation or opinion on the content of this report.

The results relate only to the sample received.

PCB congener results may include any coeluting PCBs

Uncertainty of measurement for the determinands tested are available upon request

Unless otherwise stated, sample information has been provided by the client

Deviation Codes

-
- | | |
|---|--|
| a | No date of sampling supplied |
| b | No time of sampling supplied (Waters Only) |
| c | Sample not received in appropriate containers |
| d | Sample not received in cooled condition |
| e | The container has been incorrectly filled |
| f | Sample age exceeds stability time (sampling to receipt) |
| g | Sample age exceeds stability time (sampling to analysis) |

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month

All water samples will be retained for 7 days following the date of the test report

Charges may apply to extended sample storage



APPENDIX 5
CONTAMINATION ASSESSMENT GUIDELINES

Guidelines on Contamination Levels.

Human Health

CLEA Soil Guideline values (SGV)

The UK's primary contaminated land guidance is contained within the Contaminated Land Exposure Assessment (CLEA) framework. Within this framework a number of Soil Guideline Values (SGVs) were published for key contaminants along with toxicological guideline values relating to intake thresholds. The soil guideline values provided by the CLEA model represent intervention values for end uses based upon potential human exposure and soil concentrations of a contaminant above these values might represent an unacceptable risk to the health of the site users. The Environment Agency had an ongoing programme of SGV publication with associated toxicological information for key contaminants. Where SGVs are available then they should be used as the basis for any human health risk assessment.

All CLEA SGVs were withdrawn for use by the Environment Agency in 2008 whilst they are under review and pending the availability of new toxicological data. To date, new SGV values have been set for benzene, toluene, ethylbenzene and xylene and mercury and selenium. In the absence of the new SGVs and toxicological report data, GES have used appropriate screening tools or Generic Assessment Criteria Levels as assessment criteria guidelines for those determinands not currently assigned SGVs. It should be noted that the former SGVs for metals were in general agreement with those site specific levels generated by RBCA and other similar computer model based risk assessment tools.

The GES screening assessment of contaminants within samples has been carried out using these model generated values in the absence of any other values or guidelines. The version of the CLEA model, v1.06, was used. The published SGVs are shown below. Nickel SGV has been withdrawn (2015) pending an assessment of the toxicological data used in the model for nickel. Published SGV values:

Land use	Soil Guideline Value (mg kg ⁻¹)		
	Residential	Allotment	Commercial
Inorganic arsenic	32	43	640
Nickel	130	230	1,800
Cadmium	10	1.8	230
Phenol	420	280	3200
Elemental Hg	1	26	26
Inorganic Hg	170	80	3600
Methyl Hg	11	8	410
Selenium	350	120	13,000
Benzene	0.33	0.07	95
Toluene	610	120	4400
Ethylbenzene	350	90	2800
o-Xylene	250	160	2600
r-Xylene	240	180	3500
m-Xylene	230	160	3200

Based on a sandy loam soil as defined in Environment Agency (2009b) and 6% SOM.

Guidelines on Contamination Levels.

DEFRA Category four screening level (C4SL)

In addition to the SGVs, guideline screening values proposed in the DEFRA document SP1010-Development of Category 4 Screening Levels for Assessment of Land affected by Contamination Final Project Report (C4SL) are considered along with the suitable for use levels (S4USL) derived by the Chartered Institute of Environmental Health (CIEH) in partnership with the Land Quality Management Organization (LQM). The screening levels are given for residential, commercial, allotment or public open space end uses.

PARAMETER	Residential		Commercial	Allotment	Public open Space near residential POS _{resi}	Public park land POS _{park}	Sources
	With Plant uptake	Without Plant uptake					
Inorganics - mg/kg unless stated							
Arsenic (inorganic)	37	40	640	49	79	170	DEFRA C4SL
Beryllium	1.7	1.7	12	35	2.2	63	LQM/S4USL
Boron	290	11,000	240,000	45	21,000	46,000	LQM/CIEH
Cadmium	22	150	410	3.9	220	880	LQM/S4USL
Chromium III	910	910	8,600	18,000	1,500	33,000	LQM/CIEH
Chromium VI	21	21	49	170	21	250	LQM/S4USL
Copper	2,400	7,100	68,000	520	12,000	44,000	LQM/CIEH
lead	200	310	2,300	80	630	1,300	DEFRA C4SL
Mercury (Inorganic)	40	56	1,100	19	120	240	LQM/CIEH
Nickel	180	180	980	230	230	3,400	LQM/CIEH
Selenium	250	430	12,000	88	1,100	1,800	LQM/CIEH
Vanadium	410	1,200	9,000	91	2,000	5,000	LQM/CIEH
Zinc	3,700	40,000	730,000	620	81,000	170,000	LQM/CIEH
Total sulphate	2400	2400	2400	2400	2400	2400	BRE (2005)
Water-soluble sulphate (g/l)	0.5	0.5	0.5	0.5	0.5	0.5	BRE (2005)
pH	<5	<5	<5	<5	<5	<5	-

CLEA does not currently provide guidance for total Polycyclic Aromatic Hydrocarbons (PAHs). A standalone Defra C4SL for benzo(a)pyrene has been assigned and is shown below. In addition, the Chartered Institute of Environmental Health (CIEH) in partnership with the Land Quality Management Organization (LQM) used CLEA software to derive Generic Assessment Criteria (GAC) and Assessment Sub Criteria (ASC) for the following PAH compounds.



Guidelines on Contamination Levels.

PARAMETER	Residential						Commercial			Allotment			PO S resi	PO S park	Source
	With Plant uptake			Without Plant uptake											
	SOM %	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5			
Organics - mg/kg unless stated															
Acenaphthene	200	490	1080	2000	3600	5200	75000	92000	100000	34	85	202			CLEA/LQM CIEH
Acenaphthylene	170	400	900	2000	3600	5200	76000	92000	100000	28	68	163			CLEA/LQM CIEH
Anthracene	2300	5400	10700	30000	34000	36000	520000	530000	540000	380	947	2230			CLEA/LQM CIEH
Benzo(a)anthracene	7.5	11	13	12	14	15	170	170	180	2.9	6.5	13			CLEA/LQM CIEH
Benzo(a)pyrene C4SL			5			5.3			77			5.7	10	21	DEFRA C4SL
Benzo(a)pyrene	2.2	2.7	3	3.2	3.2	3.2	3.6	3.7	3.7	35	35	36			CLEA/LQM CIEH
Benzo(b)fluoranthene	2.6	3.3	3.7	3.9	4	4	44	45	45	1	2.2	3.9			CLEA/LQM CIEH
Benzo(g,h,i)perylene	315	340	350	360	360	360	3900	4000	4000	290	480	646			CLEA/LQM CIEH
Benzo(k)fluoranthene	77	93	100	110	110	110	1200	1200	1200	37	76	129			CLEA/LQM CIEH
Chrysene	15	22	27	30	31	32	350	350	350	4.1	9.5	19			CLEA/LQM CIEH
Dibenzo(a,h)anthracene	0.24	0.28	0.3	0.31	0.32	0.32	3.5	3.6	3.6	0.14	0.27	0.44			CLEA/LQM CIEH
Fluoranthene	280	560	890	1500	1600	1600	23000	23000	23000	52	127	288			CLEA/LQM CIEH
Fluorene	165	390	850	2200	3400	4200	60000	67000	70000	27	67	158			CLEA/LQM CIEH
Indeno(1,2,3-cd)pyrene	27	36	41	45	46	46	500	510	510	9.5	21	40			CLEA/LQM CIEH
Naphthalene	1	2.3	5.5	1	2.4	6	100	260	600	4	9.8	23			CLEA/LQM CIEH
Phenanthrene	95	220	440	1300	1400	1500	22000	22000	23000	15	38	90			CLEA/LQM CIEH
Pyrene	620	1200	2000	3700	3800	3800	54000	54000	55000	11	271	620			CLEA/LQM CIEH

Petroleum Hydrocarbons represent a complex situation being a mixture of a range of compounds, the relative concentrations of which may change over time.

As discussed above, Generic Assessment Criteria (GAC) for total petroleum hydrocarbons according to both their molecular weight and chemical structure and also for a range of soil organic matter (SOM) content values have been derived using CLEA software.

The LQM CIEH GACs are again presented according to their soil organic matter content and proposed end use of the land. The generic assessment criteria for a 1%, 2.5% and 6% SOM content are tabulated below and presented according to the proposed end use.



Guidelines on Contamination Levels.

	LQM CIEH Generic Assessment Criteria (mg/kg dry weight soil)													
	Residential						Allotment Land Use			Commercial Land Use				
	With Plant Uptake			Without Plant Uptake										
SOM %	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6		
Aliphatic														
EC 5 – 6	24	40	80	24	40	80	752	1730	3900	2400	4000	8000		
EC > 6 – 8	52	110	250	52	110	250	2304	5580	13000	5200	11000	25000		
EC > 8 – 10	13	30	70	13	30	70	321	770	1700	1300	3000	7000		
EC > 10 – 12	60	150	360	60	150	360	2153	4300	7150	6000	15000	32000		
EC > 12 – 16	500	1200	2600	500	1200	2600	10800	12400	13200	42000	72000	90000		
EC > 16 – 35	41000	69000	94000	41000	69000	94000	240000	260000	260000	140000	160000	180000		
EC > 35 – 44	41000	69000	94000	41000	69000	94000	240000	260000	260000	140000	160000	180000		
Aromatic														
EC 5 – 7 (benzene)	50	110	240	155	300	630	12	25	57	15000	28000	55000		
EC > 7 – 8 (toluene)	100	240	550	370	800	1800	21	50	117	33000	68000	130000		
EC > 8 – 10	20	50	110	20	53	125	8.6	21	50	2000	5000	120000		
EC > 10 – 12	63	150	340	120	280	650	12.5	31	74	11000	22000	31000		
EC > 12 – 16	140	320	660	1100	1900	2300	23	57	134	35000	37000	38000		
EC > 16 – 21	260	540	930	1800	1900	1900	47	112	260	28000	28000	28000		
EC > 21 – 35	1100	1400	1700	1900	1900	1900	370	820	1500	28000	28000	28000		
EC > 35 – 44	1100	1400	1700	1900	1900	1900	370	820	1500	28000	28000	28000		
													POS _{resi}	POS _{park}
Benzene DEFRA C4SL	0.06	0.13	0.3 (0.87)	0.16	0.3	0.64 (3.3)	0.016	0.033	0.073 (0.18)	15	28	57 (98)	140	230
Toluene	104	240	550	370	830	1800	22	50	117	33000	68000	130000		
Ethylbenzene	30	62	150	34	81	190	16	38	91	3200	7000	16000		
o-xylene	30	70	170	40	90	200	28	67	160	3700	8000	19000		
m-xylene	30	70	160	34	80	190	30	74	170	3400	8000	18000		
p-xylene	30	70	160	33	80	180	28	69	160	3200	8000	17000		

TPH values calculated using CLEA v1.06 with parameter changes in accord with DEFRA (2014) C4SL and LQM/CIEH (2015)

Guidelines on Contamination Levels.

Risks to Plants

The CLEA framework does not provide a method for the assessment of phytotoxic risks to plants. However maximum permissible concentrations have been published in the Sludge (Use in Agriculture) Regulations 1989 (SI 1989, No. 1263). This legislation enforces the provisions of the EC Directive 86/278/EEC for potentially toxic elements (PTEs) on soils for agricultural use where sewage sludge has been applied (see table below). These limits relate to the potential risk to plants and not human health for which CLEA is the overriding risk assessment model.

Maximum permissible concentration in agricultural soils following sewage sludge application (mg/kg).				
	pH 5.0<5.5	pH 5.5<6.0	pH 6.0-7.0	pH >7.0
Zinc	200	250	300	450
Copper	80	100	135	200
Nickel	50	60	75	110

Risks to buried concrete

The potential risks to buried concrete can be assessed by reference to the BRE Special Digest 1 (SD1) entitled 'Concrete in Aggressive Ground'. This document provides a methodology for the specification of concrete based on the ground conditions encountered and is based upon chemical analysis and associated factors (e.g. groundwater). The guidance provides a Design Sulphate Class (DS) based upon the ground conditions and it is considered that a low concentration of sulphate and pH (i.e. DS – 1 and DS – 2) is considered to represent a low risk to buildings.

Risks to buried services

In addition, where water is supplied in plastic pipes which could come into contact with contaminated ground then this can lead to premature failures, resulting in leakage and loss of water quality. Risks to water supply pipes are assessed using guidance published by the UK Water Industry Research (UKWIR) entitled '*Guidance for the Selection of Water Pipes to be used in Brownfield Sites*' (Report Ref. No. 10/WM/03/21). This is known as the UKWIR guidance.

Previous guidance from WRAS has been withdrawn but may still be in use by certain water supply companies. In general water companies have adopted a common set of guidelines as given in the ***Contaminated Land Assessment Guidance from January 2014***.

Guidelines on Contamination Levels.

Additional threshold values for determining pipe material have also been published by certain water supply companies. If these threshold values are exceeded then consideration should be given to the selection of pipe material or to the use of barrier pipes. The UKWIR threshold values, together with those of certain water supply companies are presented in the table below for a range of potential hazards.

Substance ⁽¹⁾	Water UK Guidance	Thames Water
Total VOC	0.5	-
Total BTEX & MTBE	0.1	0.1 of either
Total SVOC	2	-
EC5-EC10 aliphatic and aromatic hydrocarbons	2	-
EC5-EC12 aliphatic hydrocarbons		0.5
EC5-EC12 aromatic hydrocarbons		0.5
EC10-EC16 aliphatic and aromatic hydrocarbons	10	-
EC12-EC21 aliphatic hydrocarbons		10
EC12-EC21 aromatic hydrocarbons		10
EC16-EC40 aliphatic and aromatic hydrocarbons	500	-
EC21-EC35 aliphatic hydrocarbons		500
EC21-EC35 aromatic hydrocarbons		500
Phenols	2	5*
Cresols and chlorinated phenols	2	2
Naphthalene	-	5
Ethers	0.5	-
Nitrobenzene	0.5	-
Ketones	0.5	-
Aldehydes	0.5	-
Amines	0	-
Corrosives pH and EC	#	
	##	

All units mg kg⁻¹ in soil;

pH <7 for wrapped steel, pH <5 wrapped ductile iron and copper and ##EC >400µS/cm;

*Phenol limit at 2mg/kg in presence of BTEX.



APPENDIX 6
ESI STASTICS CALCULATOR RESULTS

Test Results

ARSENIC

Client/client ref: Soil Investigatio Site ref: 83 Whitehill Road, Hitchin

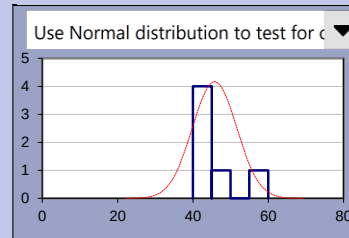
Project ref: 12248

Data description:

Date: 11-Oct-2023

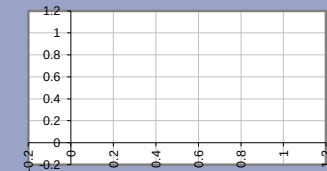
User details: MP

Dataset:	ARSENIC	▼
Sample mean	$\bar{X}$	45.75
Sample standard deviation, s		5.8736
Sample size, n		6
Critical concentration, Cc		37



Outliers & non-detects

Outliers present?	No
Significance level	5% ▼
Outliers excluded	0
Non-detects	0

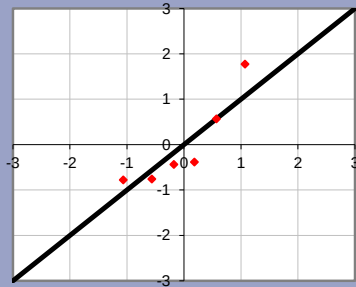


Normality test

Significance level: 5% ▼

Normal distribution

Use: Auto: One-sample t-test ▼

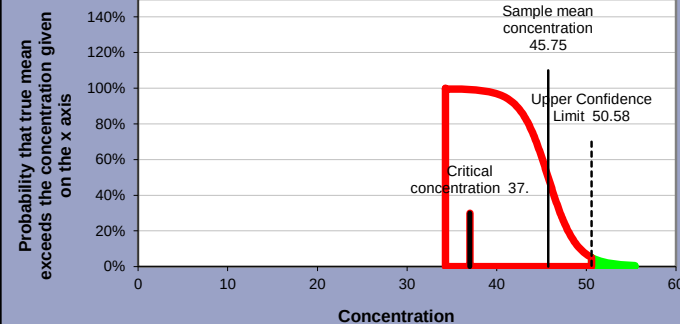


Test scenario:

Planning: is true mean lower than critical concentration ($\mu < C_c$)? ▼

Null hypothesis: The true mean concentration is equal to or greater than the critical concentration: $\mu \geq C_c$

Alternative hypothesis: The true mean concentration is less than the critical concentration: $\mu < C_c$



Evidence against Null hypothesis:

1%

Base decision on: evidence level ▼

Evidence level required: 95%

Balance of probability? N/A

Reject Null Hypothesis? No

$\mu \geq C_c$

[Back to data](#)

[Back to summary](#)

[Go to outlier test](#)

[Go to normality test](#)

Test Results

Zinc

Client/client ref: Soil Investigatio Site ref: 83 Whitehill Road, Hitchin

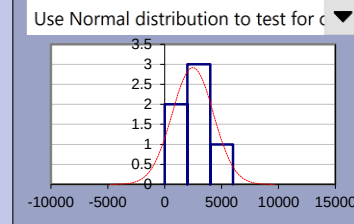
Project ref: 12248

Data description:

Date: 11-Oct-2023

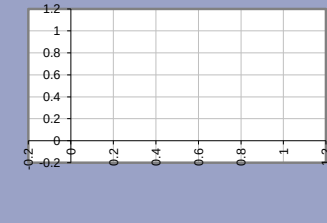
User details: MP

Dataset:	Zinc	
Sample mean	$\bar{X}$	2466.8
Sample standard deviation, s		1811.4
Sample size, n		6
Critical concentration, Cc		3700



Outliers & non-detects

Outliers present?	No
Significance level	5%
Outliers excluded	0
Non-detects	0

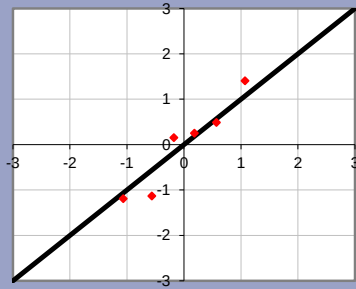


Normality test

Significance level: 5%

Normal distribution

Use: Auto: One-sample t-test

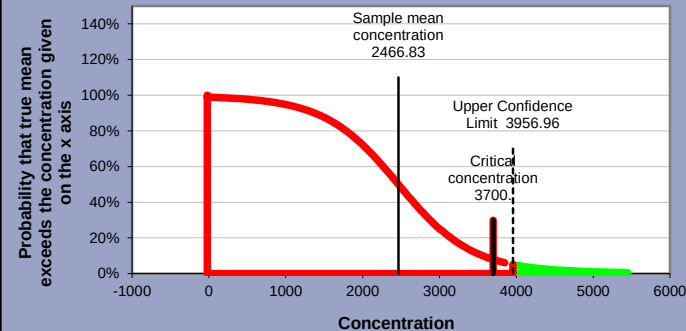


Test scenario:

Planning: is true mean lower than critical concentration ($\mu < C_c$)?

Null hypothesis: The true mean concentration is equal to or greater than the critical concentration: $\mu \geq C_c$

Alternative hypothesis: The true mean concentration is less than the critical concentration: $\mu < C_c$



Evidence against Null hypothesis:

92%

Base decision on: evidence level

Evidence level required: 95%

Balance of probability? N/A

Reject Null Hypothesis? No

Not enough evidence

[Back to data](#)

[Back to summary](#)

[Go to outlier test](#)

[Go to normality test](#)

Test Results

LEAD

Client/client ref: Soil Investigatio Site ref: 83 Whitehill Road, Hitchin

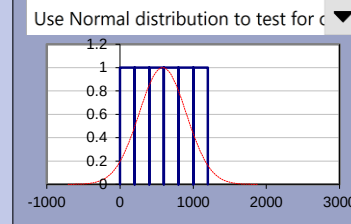
Project ref: 12248

Data description:

Date: 11-Oct-2023

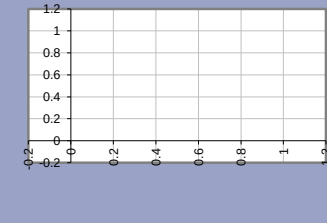
User details: MP

Dataset:	LEAD	
Sample mean	$\bar{X}$	583.67
Sample standard deviation, s		323
Sample size, n		6
Critical concentration, Cc		200



Outliers & non-detects

Outliers present?	No
Significance level	5%
Outliers excluded	0
Non-detects	0

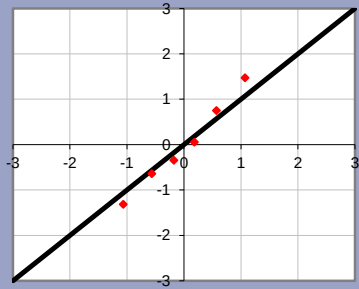


Normality test

Significance level: 5%

Normal distribution

Use: Auto: One-sample t-test

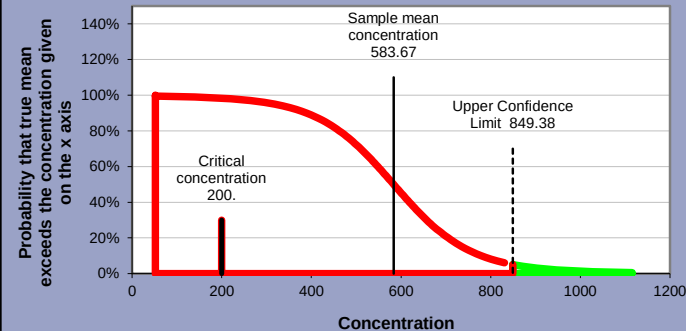


Test scenario:

Planning: is true mean lower than critical concentration ($\mu < C_c$)?

Null hypothesis: The true mean concentration is equal to or greater than the critical concentration: $\mu \geq C_c$

Alternative hypothesis: The true mean concentration is less than the critical concentration: $\mu < C_c$



Evidence against Null hypothesis:

2%

Base decision on: evidence level

Evidence level required: 95%

Balance of probability? N/A

Reject Null Hypothesis? No

$\mu \geq C_c$

Back to data

Back to summary

Go to outlier test

Go to normality test



APPENDIX 7
BRE COVER SYSTEM SPREADSHEET

Calculations based on mixed zone (M)	600	mm
--------------------------------------	-----	----

Contaminant	Site Data				Expressed as a Factor of Target Guideline Value				Cover Thickness Required for Compliance to Specified Target Guideline Value	
	Contamination of Ground (Cg)	Contamination of Cover (Cc)	Res with PU	RwPU	Soil / Res with PU	Cover / Res with PU	Soil / RwPU	Cover / RwPU	Res with PU	RwPU
	Units		Units		Fraction				(mm)	
Arsenic	56.2	1	37	40	1.5	0.0	1.4	0.0	209	176
Beryllium										
Chromium										
Chromium (VI)										
Mercury										
Selenium										
Copper										
Nickel										
Zinc	5020	100	3700	40000	1.4	0.0	0.1	0.0	161	None
Lead	1060	100	200	310	5.3	0.5	3.4	0.3	538	469
Boron (Water sol)										
Sulphate (total)										
Phenols										
Sulphide										
Cyanide										
Solvent Extractable Matter										
BAP										
Dibenz(a,h)anthracene	1.5	0.1	0.24	0.31	6.3	0.4	4.8	0.3	540	510
Benzo(a)anthracene	8.7	0.1	7.5	12	1.2	0.0	0.7	0.0	84	None
Naphthalene	1.9	0.1	1	1	1.9	0.1	1.9	0.1	300	300
Benzo(b)fluoranthene	7.8	0.1	2.6	3.9	3.0	0.0	2.0	0.0	405	304
Benzo(a)pyrene	11.3	0.1	2.2	3.2	5.1	0.0	3.5	0.0	488	434
Indeno(1,2,3-cd) pyrene										

Summary		
	Res with PU	RwPU
Number of contaminants	17	23
Number of contaminants with no thickness calculation	15	15
Breakdown - Number for which no TV specified	15	15
Breakdown - Number for which no soil specified	15	15
Breakdown - Number for which no cover specified	15	15
Breakdown - Number for which cover > TV	0	0
Number of contaminants with thickness calculation	2	8
Breakdown - Number for which no cover required	0	2
Breakdown - Number for which cover required	2	6
Overall thickness of cover required	540	510