Ground and Environmental Investigation Limited

8 Wapping Lane
Marton
Gainsborough
DN21 5AJ

01522 412058

71 - 73 Caversham Road
Reading
RG1 8JA

Geo-Environmental Investigation

On behalf of Soil Investigation Eastern Ltd

Document Reference: 24-728 January 2025

Site: 71 - 73 Caversham Road, Reading, RG1 8JA

Document Reference No: 24-728

Quality Management

Authorised by:	Marc Pearson BSc MSc MIEnvSc - Director
Date	January 2025
Revision	0
Contact	Marc Pearson (marc@groundenvironmental.com)

Ground and Environmental Investigation Ltd is a specialist geo-environmental consultancy and ground investigation company operating nationally.

Our approach to all of projects is to provide our clients with cost-effective solution to potential geo-environmental hazards, essential considerations before site acquisition, or prior to final development scheme design.

We offer a full range of geo-environmental services from initial due diligence site assessments through to engineering and ground remediation design.

Table of Contents

1 INTRODUCTION 1

1.1 LIMITATIONS 1

2 SITE LOCATION AND LAYOUT 1

3 ENVIRONMENTAL SETTING 1

3.1 GEOLOGY 1

3.2 GROUNDWATER 2

3.3 PHASE 1 CONCLUSIONS 2

4 INTRUSIVE INVESTIGATION 3

4.1 FIELDWORK 3

4.2 GROUNDWATER 4

5 LABORATORY TESTING 5

5.1 GEOTECHNICAL TESTING 5

5.2 ANALYTICAL TESTING 5

6 EVALUATION OF GROUND CONDITIONS 6

7 ENGINEERING DESIGN 9

7.1 FOUNDATION DESIGN OPTIONS 9

7.2 GROUND FLOORS 10

7.3 TEMPORARY WORKS 10

7.4 CHEMICAL ATTACK ON BURIED CONCRETE 10

8 GROUND CONTAMINATION ASSESSMENT 12

8.1 SOIL QUALITY 12
8.1.1 Toxic Metals 12
8.1.2 Organic Compounds 13

8.2 SOIL GAS 14

8.3 WATCHING BRIEF AND DISCOVERY STRATEGY 14

9 CONTAMINATION RISK ASSESSMENT 16

9.1 CONTAMINANT SOURCES 17

9.2 RISK TO HUMAN HEALTH 17

9.3 RISKS TO WATER RESOURCES 18

9.4 RISKS TO BUILDINGS & SERVICES 18

9.5 GAS RISK ASSESSMENT 18

9.6 WASTE DISPOSAL 19

10 CONCEPTUAL SITE MODEL 20

11 CONCLUSIONS AND RECOMMENDATIONS 23

Figures

1. Location Plan

Appendices

1. Limitations
2. CFA Borehole Logs
3. Hand Dug Trial Pit Logs
4. Groundwater and Gas Monitoring Results
5. Laboratory Testing Results
6. Analytical Testing Results
7. Guidelines on Contamination Levels

1 INTRODUCTION

Ground and Environmental Investigation Ltd (GEI) was commissioned by Soil Investigation Eastern Ltd to undertake a review of a Geo-Environmental Investigation undertaken at 71-73 Caversham Road, Reading, RG1 8JA.

It was understood that the development of the site is proposed to comprise the partial demolition of the former warehousing and the construction of a mixed-use building comprising 29 new homes, 318 sqm of retail floorspace at ground floor level and associated car parking. Limited sot landscaping is proposed in the development.

The objectives of the Geo-Environmental Investigation were to provide outline recommendations for foundation and ground floor slab design. Identification of environmental liabilities associated with the site and delineation of any potential areas of contamination resulting from the sites previous and current usage was also undertaken.

A Phase 1 Contamination Risk Assessment has previously been undertaken by RPS (Ref JER8219, January 2022) and should be read in conjunction with this report.

1.1 LIMITATIONS

The assessment is limited to the issues agreed within the proposal for the works. Notes on limitations associated with this assessment are provided in Appendix 1.

2 SITE LOCATION AND LAYOUT

The site is situated to the west of Caversham Road and to the south of Northfield Road, Reading in a mixed commercial and residential urban setting. The site is located at approximate Grid Reference SU 712 740.

At the time of the site investigation, the site comprised a broadly rectangular area of land with a large building in the east and three smaller office buildings in the west. The area between was given over to tarmac hardstanding used for car parking.

3 ENVIRONMENTAL SETTING

3.1 GEOLOGY

Reference to the British Geological Survey online geological map of the area indicates that the geology underlying the site comprises superficial deposits of the Langley Silt Member over solid geology of the Seaford and Newhaven Chalk Formations of the White Chalk Subgroup.

The geological memoir for the area described these strata as follows:

Langley Silt Member

Varies from silt to clay, commonly yellow-brown and massively bedded.

White Chalk Subgroup

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 Principal Aquifer with respect to the solid geology. The superficial deposits are classified as Unproductive strata.

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.

Unproductive Strata are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The site is not situated within an Environment Agency-designated Groundwater Source Protection Zone.

3.3 PHASE 1 CONCLUSIONS

The Phase 1 Desk Study indicated that "*a number of potential pollutant linkages could be active upon development of the site. These are predominantly associated with historical on site uses including a warehouse, works, photographic works and motor accessories warehouse".*

4 INTRUSIVE INVESTIGATION

4.1 FIELDWORK

The intrusive site works were carried out by Soil Investigation Eastern Ltd on the 18th November 2024 and comprised:

- Continuous Flight Auger (CFA) Boreholes; and
- Hand Dug Trial Pitting.

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

All intrusive fieldwork was undertaken by Soil Investigation Eastern Limited and generally executed in accordance with the recommendations given in British Standard BS 5930:2015+A1:2020, “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”.

GEI attended site on the 12th December 2024 in order to undertake groundwater and soil gas monitoring.

Continuous Flight Auger (CFA) Boreholes

Two 100mm diameter CFA boreholes (BH1 and BH2) were excavated to depths of between 6.0m and 15.0m below existing ground level.

The soils and materials encountered in the holes were logged by SIE and representative samples were recovered for laboratory analysis. In-situ Mackintosh Probe testing was carried out at regular intervals.

Upon completion the boreholes were installed with 50mm ID HDPE combined gas and groundwater monitoring standpipes to depths of 2.6m and 2.4m in locations BH1 and BH2 respectively.

The CFA borehole Logs are presented in Appendix 2.

Hand Dug Trial Pits

Three hand dug trial pits (TP1 to TP3) were excavated in order to determine the near surface soil conditions and retrieve samples for laboratory analysis. The trial pits were excavated to a depth of 0.3m.

The Trial pit logs are presented in Appendix 3.

Groundwater Level and Soil Gas Monitoring

A soil vapour survey was undertaken at the site and comprised the monitoring of the atmosphere within the installed boreholes. Portable gas monitoring equipment (GA 5000) was used to monitor the standpipe for concentrations of carbon dioxide (CO_2), methane (CH_4) and oxygen (O_2).

A photoionization device (PID) was also used to monitor any vapours present.

The monitoring results are presented in Appendix 4.

4.2 GROUNDWATER

The following groundwater observations were made during the fieldwork.

Location	Observation
BH1	Water strike at 1.4m. Water standing at 1.4m on completion.
BH2	Water strike at 1.4m. Water standing at 1.4m on completion.

Post fieldwork monitoring indicated water levels standing at 1.70m at location BH1 and 1.43m at location BH3.

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 GEOTECHNICAL TESTING

The following range of laboratory tests were scheduled, and the results are presented in Appendix 5.

i. Determination of Natural Moisture Content (2 no.).
ii. Determination of Atterberg Limits (2 no.).
iii. Determination of pH (1 no.)
iv. Determination of water-soluble sulphate (1 no.)

5.2 ANALYTICAL TESTING

Three soil samples were selected and scheduled for chemical analysis which was undertaken by Chemtech Environmental Ltd. All samples were analysed for a general 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	Water Soluble Boron Copper Nickel Zinc	Water Soluble Sulphate pH	Total Polyaromatic Hydrocarbons (PAH) Mineral oils Total Petroleum Hydrocarbons (TPH) BTEX

In addition, one sample was submitted for Waste Acceptance Criteria Testing in order to determine likely disposal routes of arisings.

Soil samples were stored in appropriate containers as specified within BS10175. The soil sample 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 6.

6 EVALUATION OF GROUND CONDITIONS

The soils encountered during this investigation are described in the Borehole and Trial Pit logs presented in Appendices 2 and 3. The ground profile encountered at the site comprised a limited Made Ground horizon over soils of the Langley Silt Member. The White Chalk Subgroup was encountered at depth.

Made Ground

Made Ground was encountered at all locations.

At locations TP1 to TP3 the Made Ground comprised tarmac over gravelly sandy silt and sandy silty gravel with brick fragments. The base of the Made Ground was not determined in these locations.

At locations BH1 and BH2, the Made Ground comprised a surface covering of reinforced concrete over brick and rubble hardcore with sand silt and gravel, and grey brown gravelly sandy very silty clay with brick fragments. The base of the Made Ground was determined to depths of between 1.1m and 1.2m.

Langley Silt Member

Soils typical of the Langley Silt Member were encountered in both boreholes and comprised an upper cohesive horizon of orange brown gravelly sandy very silty clay over a less cohesive horizon comprising orange brown silty gravelly fine to coarse sand and sandy gravel.

At location BH1, the cohesive soils were encountered to a depth of 1.4m, in location BH2 the cohesive soils were encountered to a depth of 2.8m.

The base of the Langley Silt Member was determined to a depth of 10.4m in location BH1, the base was not encountered in location BH2.

In-situ Mackintosh probe testing was undertaken in the Langley Silt Member and is presented in the table below.

Depth	Result (blows count per 75mm penetration)	
	BH1	BH2
2.0	43 50(22mm) 50(18mm) 50(16mm)	12 13 12 13
3.0	50(0mm) Too dense to drive	28 30 31 33
4.0	50(0mm) Too dense to drive	50(0mm) Too dense to drive
5.0	50(0mm)	50(0mm)

Depth	Result (blows count per 75mm penetration)	
	BH1	BH2
	Too dense to drive	Too dense to drive
6.0	50(0mm) Too dense to drive	50(0mm) Too dense to drive
8.0	50(0mm) Too dense to drive	-
10.0	50(0mm) Too dense to drive	-
12.0	50(0mm) Too dense to drive	-
15.0	50(0mm) Too dense to drive	-

The results can be interpreted using the generally accepted correlation for Mackintosh Probe Tests which is as follows:

Mackintosh N75 X 0.38 = SPT 'N' Value or

Mackintosh N300 X 0.1 = SPT 'N' Value.

Calculated 'N' values are presented in the table below. Where the test has been described as too dense to drive, the N75 blows have been conservatively assumed to be 50.

Depth	Equivalent 'N' Value	
	Equivalent 'N' Value	BH2
2.0	20	5 *(cohesive soils)*
3.0	20	12
4.0	20	20
5.0	20	20
6.0	20	20
8.0	20	-
10.0	20	-
12.0	20	-
15.0	20	-

Classification testing of the more cohesive soils of location BH2 indicated intermediate to low plasticity clay with modified plasticity indices of between 10% and 19%. This indicated the soils have a low shrink/swell potential.

For preliminary foundation design purposes, the following parameters may be used for consideration of shallow foundations within the non-cohesive deposits of the Langley Silt Member:

SPT N = 12 (conservative – medium dense)

Angle of shearing resistance = 31° (estimated)

White Chalk Subgroup

Soils of the White Chalk Subgroup were encountered in location BH1 at a depth of 10.4m. The base of the formation was not encountered.

The strata comprised white chalk with hard white chalk nodules.

7 ENGINEERING DESIGN

7.1 FOUNDATION DESIGN OPTIONS

At the time of reporting, applied structural loads were unknown.

In deliberation of suitable foundation options consideration was given to the geotechnical hazards and risks as presented below:

Geotechnical Hazard	Qualitative Risk & Consequences	Possible Risk Reduction Measures
Existing underground structures such as service runs, underground fuel tanks and old footings.	**Low to moderate** Implication for foundation depth and economic feasibility of shallow foundations.	New foundations to be constructed in undisturbed ground or alternatively disturbed ground to be removed and replaced with suitable engineering fill.
Variations in stiffness of ground below foundation depth that could give rise to unacceptable total and differential settlement.	**Low** Buildings particularly sensitive to differential settlement. Would result in cracking of superstructure if conventional brickwork or brick cladding.	Calculate likely magnitude of settlement and determine if within acceptable tolerances. Make foundations act as reinforced beams. Include movement joints if and where necessary.
Shrinkage/swelling of foundation soils due to action of tree roots.	**Low** Foundation movement and cracking of brickwork.	Comply with NHBC recommendations to low shrinkability soils.

Shallow Foundations – Langley Silt Member

For preliminary design purposes shallow foundations founded within the non-cohesive soils of the Langley Silt Member will provide a suitable foundation solution for the proposed new structures on the site.

Foundations should not cross soil horizons (i.e. clay vs sand) due to the potential for differential settlement.

It is noted that based on the results of this investigation, the upper cohesive soil layer was determined to depths of between 1.4m and 2.8m and is not considered suitable for founding within due to the low N values recorded.

Based upon the findings of this ground investigation it is recommended that a minimum foundation depth of 1.5m is adopted with the foundations placed within the non-cohesive (i.e. sand) deposits of the Langley Silt Member. Depending on the proposed foundation layout, deepening of the foundations may be required to excavate past the upper clay soil horizon.

Based on field observations, in situ testing and laboratory test results, a maximum allowable bearing pressure of 175kN/m^2 is recommended for foundations placed at a minimum depth of 1.5m and within non-cohesive soils.

All foundation excavations should be inspected by a suitably qualified person to ensure adequate depth and bearing has been achieved prior to casting.

Piled Foundations

If a piled foundation is preferred, the non-cohesive deposits of the Langley Silt Member and underlying White Subgroup would be considered suitable founding stratum for piles.

It is recommended that piling design is undertaken by the piling contractor.

7.2 GROUND FLOORS

The NHBC guidance advises that suspended ground floors should be adopted when the plasticity index (PI) of the founding soils is greater than 10%.

Based upon the results of this ground investigation it is recommended that suspended ground floor slabs should be adopted.

7.3 TEMPORARY WORKS

Excavations in excess of 1.2 m depth may be required in connection with the proposed development on this site. If there is a requirement for personnel to enter into excavations, then the need for trench side support should be considered for any depth of excavation and, therefore, appropriate equipment should be available on site prior to excavation proceeding. A site-specific risk assessment should be carried out where man entry into excavations is required.

The base of foundation excavations should be inspected and any soft loose, organic or otherwise deleterious material at foundation level removed and replaced with lean mix concrete. The soils encountered will be liable to softening/loosening when exposed to surface water infiltration. In order to avoid deterioration of the prepared formation the base of foundations should be blinded with concrete as soon as practical after excavation and particularly if there is delay before placing foundation concrete.

7.4 CHEMICAL ATTACK ON BURIED CONCRETE

The results of the chemical testing indicated a concentration of water-soluble sulphate of 170mg/l as SO_4. pH values were neutral to slightly alkaline with values of 7.3 to 8.4 pH units recorded.

In accordance with BRE Special Digest 1 (SD1:2005) entitled 'Concrete in Aggressive Ground' a design sulphate class for the site of DS-1 is recommended. Using SD1 an ACEC (Aggressive Chemical Environment for Concrete) class of AC-1 is recommended.

8 GROUND CONTAMINATION ASSESSMENT

The current guidelines used for this contamination assessment are presented within Appendix 7.

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 published Category 4 Screening Levels (C4SLs) for a residential end use (without home grown produce). 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

8.1 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 for all samples tested.

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 not encountered.

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

8.1.1 Toxic Metals

Concentrations of toxic metals arsenic, cadmium, chromium, lead, mercury, nickel, selenium, 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 end use (without home grown produce) where appropriate in all samples tested.

8.1.2 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 of the samples tested.

Speciated PAH

No exceedances of the relevant guideline values for specific PAH compounds were noted across the site.

BTEX

No BTEX concentrations above the relevant guideline values were detected across the site.

sVOCs

No sVOC concentrations above the laboratory detection limit of 0.1mg/kg were detected across the site.

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.

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 TP1 (0.10m) comprising of 148mg/kg within the aromatic C25-C44 range which is below the relevant GAC limit of 1900mg/kg for this range and soil organic matter concentration and would therefore not pose a significant risk of significant harm to human health.

8.2 SOIL GAS

One gas monitoring visit was undertaken on the 12th December 2024 where a soil vapour survey was undertaken and comprised the monitoring of the atmosphere within the purposely installed monitoring standpipes. Portable gas monitoring equipment (GFM 436) was used to monitor the standpipes for concentrations of carbon dioxide (CO_2), methane (CH_4), oxygen (O_2), carbon monoxide (CO), and Hydrogen Sulphide (H_2S). A Photoionization detector (PID) was used in order to undertake a soil vapour survey with respect to volatile organic compounds.

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 building*s 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 elevated concentrations of soil gas are not present in the soils underlying the site. The soil gas results are attached at Appendix 4.

The results obtained from the soil gas survey undertaken indicated that elevated carbon dioxide concentrations were not recorded at the site above the action level of 5%. No elevated methane concentrations above the action level of 1% were recorded.

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.

Concentrations of photoionisable compounds were measured below 10ppm in all monitoring wells.

8.3 WATCHING BRIEF AND DISCOVERY STRATEGY

Should discreet hotspots be encountered, which were not previously detected during the site clearance or groundworks, 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.

GEI 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.

9 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.

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 without 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; and

- underground services in and around the site.

9.1 CONTAMINANT SOURCES

The following general potential contaminant sources have been identified at the site and in the surrounding area:

Potential Source	Source Description	Principal Contaminants of Concern
Current and Historic Site Use	*Use as warehouse, works, photographic works and motor accessories warehouse.*	PAH, TPH, Metals
	Near surface in-fill/ reworked material of unknown origin.	PAH, TPH, Metals, Ground Gases

The analytical testing of soils retrieved as part of the intrusive investigation did not reveal significantly elevated contaminant concentrations.

9.2 RISK TO HUMAN HEALTH

Toxic Metals

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

Organic Compounds

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

On the balance of the toxicological risks posed by the ground contamination encountered as part of the intrusive investigation undertaken by GEI, 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.

Future Occupants

- The site is not considered to pose a potential risk of significant harm to human health in the context of Part 2A for future occupants.

It is noted that due to the absence of such on site imported suitable growth media would be required in any soft landscaping proposed in the development. Any such growth media would require analytical testing to confirm its suitability as growth media and its compliance with their relevant SGVs.

9.3 RISKS TO WATER RESOURCES

The site is underlain by a Principal Aquifer in the solid geology and not located within a groundwater Source Protection Zone.

Significant levels of potentially soluble and therefore mobile organic contaminant sources were not measured on site within the samples tested.

Due to the absence of any clear onsite contamination sources and the low sensitivity location, the risk to water resources is considered to be low.

9.4 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 low.

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

9.5 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 at the site during December 2024. 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 not present on site. No elevated gas flow rates were recorded during the monitoring.

The highest carbon dioxide concentration encountered on site during this current investigation was measured in BH2 at 0.6% which is below the relevant guideline limit of 5%. No elevated methane concentrations were encountered across the site. A survey of volatile organic compounds undertaken across the site using a PID indicated the levels of photoionisable compounds measured in the monitoring wells were <10ppm.

Measurement of both borehole pressure and gas emission rates indicates that no significant gas flows are present. In order to allow for a worst-case scenario, GEI have used a gas flow rate across the site of 1.0l/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 0.1l/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 borehole 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	0.0	0.6	0.000	0.006	1	1

On the basis of the measurements in the table above, the GSV is taken to be 0.006 l/h, which is the worst case for methane and carbon dioxide. A GSV of 0.006 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 Type A building has been used for calculating the appropriate gas protection score.

The development, considered to consist of a Type A building in a Site with a CS1 ground gas regime characterisation would not require ground gas protection measures in any new buildings

9.6 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 the majority of any surplus soils requiring off-site disposal would be classified as EWC 17 05 04 non-hazardous and may be acceptable at a waste facility licenced to accept inert material.

10 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.

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 and future occupants	Normal health and safety precautions. No significantly elevated concentrations encountered.	Low
			Surface run off.	Lateral movement to surface watercourses.	➔	Aquatic resources, ecology and subsequent users including humans.	No significantly elevated mobile contaminant concentrations encountered	Low
			Leaching/ Dispersion.	Downward migration to groundwater.	➔	Aquatic resources – Groundwater, abstraction wells) / surface waters.	No significantly elevated mobile contaminant concentrations encountered. Site located above a Principal Aquifer and not within a groundwater SPZ	Low
			Direct contact	Aggressive chemical attack	➔	Building structures and services	It is considered that protection of any new services is unlikely 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

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.	Significantly elevated contaminant concentrations not encountered.	Low
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.	Low
Ground gases	CO2, CH4, VOCs	➔	Inhalation and ingress into buildings	Asphyxiation and explosions	➔	Buildings/humans/future site users	Site classified as CS1; no gas protection measures will be required.	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.	Low

11 CONCLUSIONS AND RECOMMENDATIONS

Based on the site investigation, intrusive works and subsequent data assessment, the following conclusions and recommendations have been drawn in respect of the proposed development on land at 71 – 73 Caversham Road, Reading, RG1 8JA.

Geotechnical

- The ground investigation found the anticipated geology with Made Ground over soils typical of the Langley Silt Member with the White Chalk Subgroup being encountered at depth.
- The Langley Silt Member soils can be broadly split into an upper horizon of cohesive (clay) soils that are not considered suitable for the founding of shallow foundations and a lower horizon of non-cohesive (sand and gravel) soils that are considered suitable. The upper horizon was encountered to depths of between 1.4m and 2.8m.
- The non-cohesive soils of the Langley Silt Member were identified as a suitable founding stratum for shallow foundations with an allowable bearing capacity of 175kN/m^2 at a depth of 1.5m.
- It was noted that foundations should not cross soil type in order to prevent the potential for differential settlement and therefore localised deepening of the foundations may be required to establish foundations in the non-cohesive soils.
- Alternatively, the underlying non-cohesive soils of the Langley Silt Member and the chalk of the White Chalk Subgroup are considered suitable founding stratum for piled foundations.
- Suspended ground floor slabs are recommended.
- A design sulphate class for the site of DS-1 and an ACEC class of AC-1 is recommended.

Environmental

- The site is located above a Principal Aquifer and is not within a Source Protection Zone.
- Concentrations of toxic metals were found to be below their respective soil guideline values in all locations.
- Concentrations of TPH, total PAH and specific PAH were 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.

- Based on concentrations of VOCs and SVOCs found across the site it is unlikely that any potential new services, in particular potable water, will require protection, however it is advisable to seek service provider confirmation of this.
- The risks to groundwater and surface water are considered to be low due to the lack of any significant mobile organic contamination.
- It is noted that due to the absence of such on site imported suitable growth media would be required in any soft landscaping proposed in the development. Any such growth media would require analytical testing to confirm its suitability as growth media and its compliance with their relevant SGVs.
- The majority of any surplus soil material to be removed off site is likely to be classified as non-hazardous and may be acceptable at a facility licensed to accept inert waste.
- The development, considered to consist of a Type A building in a Site with a CS1 ground gas regime characterisation would not require ground gas protection measures in any new buildings.
- 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 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 a residential without plant uptake end use.

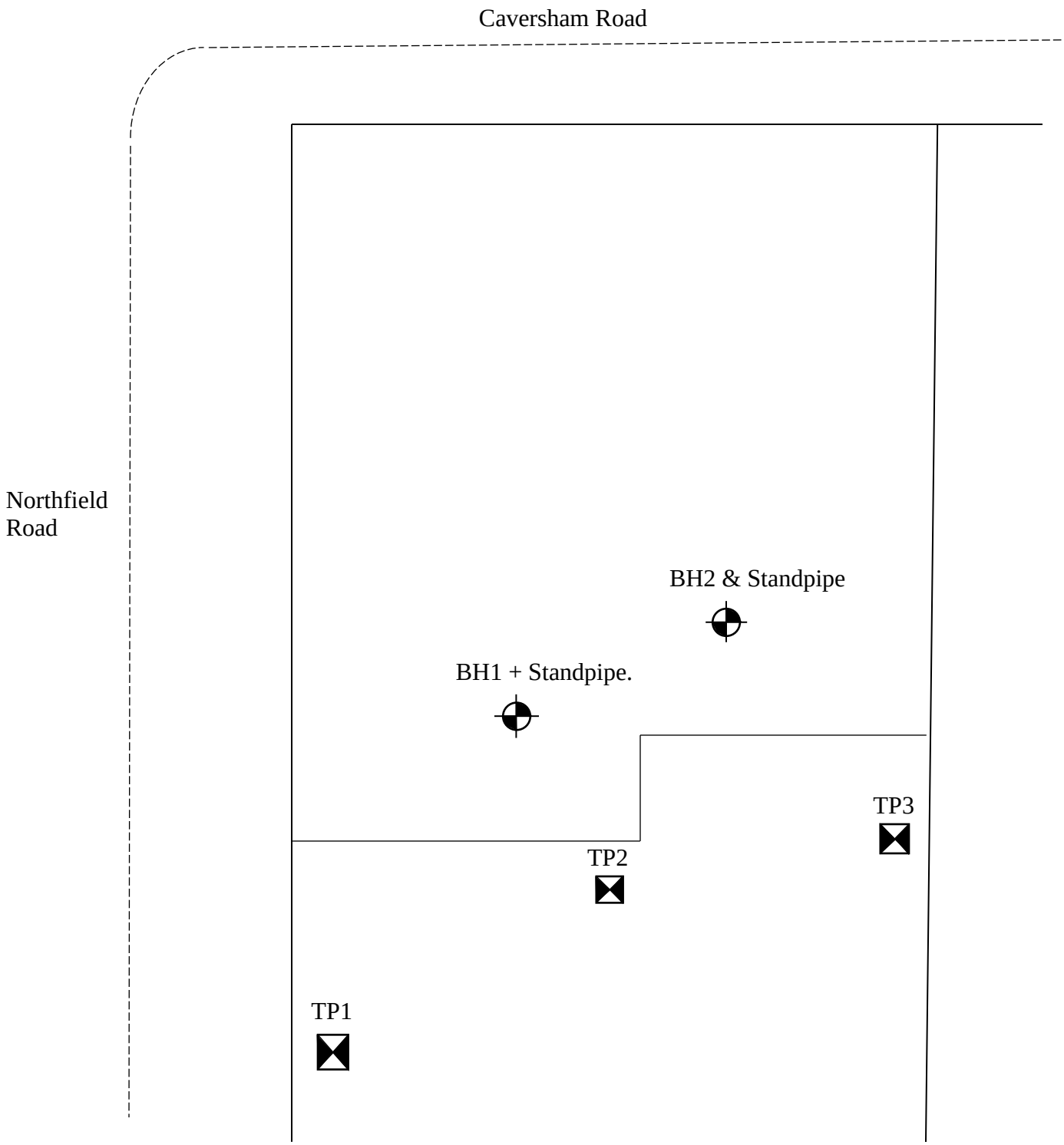
FIGURES

1. Location Plan

Site Location Plan	Sheet: 1 of 1
	Job No: WP4544
Scale: Not to scale	Date: 18/11/2024
Client: Westbury Projects Ltd	

SOIL INVESTIGATION EASTERN LIMITED
Tel/Fax 01245 237555 Mobile 07810 820620

Site: 71-73 Caversham Road, Reading. RG1 8JA



Remarks: ON SITE TREE IDENTIFICATION FOR GUIDANCE ONLY. NOT AUTHENTICATED

Key:
- Trial Pit
- Borehole
- MH Man Hole
- G Gulley
- SVP Soil Vent Pipe
- RWP Rain Water Pipe
- Tree / Bush (approx. ht. in m)

APPENDIX 1

LIMITATIONS

The recommendations contained in this Report represent GEI's professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant.

GEI does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

GEI obtained, reviewed and evaluated information in preparing this Report from the Client and others. GEI's conclusions, opinions and recommendations has been determined using this information. GEI does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which GEI has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by GEI for the sole and exclusive use of the Client and for the specific purpose for which GEI was instructed.

Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and GEI, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party.

In particular, GEI does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client.

Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless GEI from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of / or resulting from the performance of the work by the Consultant.

APPENDIX 2

CFA BOREHOLE LOGS

Borehole No: 1	Sheet: 1 of 1	SOIL INVESTIGATION EASTERN LIMITED
	Job No: WP4544	Tel/Fax 01245 237555 Mobile 07810 820620
Boring Method: 100mmø CFA	Date: 18/11/2024	
Client: Westbury Projects Ltd.		Site: 71-73 Caversham Road, Reading

Depth (mm/m)	Description of Strata	Thick-Ness (mm/m)	Legend	Sample	Test Type	Test Result	Depth (mm/m)	Field Records/ Comments	Depth to water (mm/m)
Floor level	CONCRETE, reinforced with 6mmø mild steel mesh.	200							
200	MADE GROUND: HARDCORE & BRICK RUBBLE, with sand, silt & gravel.	200						No roots observed.	
400				•	Tub & Jar		900	Water strike at	1.4
1.2	MADE GROUND: Grey brown, gravelly, sandy, very silty, CLAY, with brick fragments.	800		•	I	12 13 17 18	1.0	Water standing at on completion.	1.4
1.4	Firm, orange brown, gravelly, sandy, very silty, CLAY.	200							
1.8	Medium dense, orange brown, silty, gravelly, fine, medium & coarse SAND.	400		•			1.5		
	Medium dense to dense, orange brown, sandy, GRAVEL.	8.6		•	I	43 50(22mm) 50(18mm) 50(16mm)	2.0		
				•			2.5		
				•	I	50(0mm) Too Dense To Drive	3.0		
				•	I	50(0mm) T.D.T.D.	4.0		
				•	I	50(0mm) T.D.T.D.	5.0		
				•	I	50(0mm) T.D.T.D.	6.0		
10.4	White CHALK, with hard white chalk nodules.	4.6		•	I	50(0mm) T.D.T.D.	8.0		
				•	I	50(0mm) T.D.T.D.	10.0		
				•	I	50(0mm) T.D.T.D.	12.0		
15.0	Borehole ends at 15.0m			•	I	50(0mm) T.D.T.D.	15.0		

Remarks: Borehole collapsing continuously. Backfilled to 2.6m. Gas monitoring standpipe installed from ground level to 2.6m, using 1.6m of slotted standpipe, and 1.0m of plain standpipe b.g.l. Backfilled with 1.6m 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
	Job No: WP4544	Tel/Fax 01245 237555 Mobile 07810 820620
Boring Method: 100mmø CFA	Date: 18/11/2024	
Client: Westbury Projects Ltd.		Site: 71-73 Caversham Road, Reading

Depth (mm/m)	Description of Strata	Thick-Ness (mm/m)	Legend	Sample	Test Type	Test Result	Depth (mm/m)	Field Records/ Comments	Depth to water (mm/m)
Floor level 200	CONCRETE, reinforced with 6mmø mild steel mesh.	200						No roots observed.	
400	MADE GROUND: HARDCORE & BRICK RUBBLE, with sand, silt & gravel.	200							
1.1	MADE GROUND: Grey brown, gravelly, sandy, very silty, CLAY, with brick fragments.	700		•	I	12 12 12 13	1.0	Water strike at	1.4
2.8	Firm, orange brown, gravelly, sandy, very silty, CLAY.	1.7		• • •	I	12 13 12 13	1.5 2.0 2.5	Water standing at on completion.	1.4
3.5	Medium dense, orange brown, slightly gravelly, very silty, fine, medium & coarse SAND.	700		•	I	28 30 31 33	3.0		
6.0	Medium dense to dense, orange brown, sandy, GRAVEL.	2.5		• •	I I	50(0mm) Too Dense To Drive 50(0mm) T.D.T.D.	4.0 5.0		
	Borehole ends at 6.0m			•	I	50(0mm) T.D.T.D.	6.0		

Remarks: Borehole collapsing from 1.4m. Backfilled to 2.4m. Gas monitoring standpipe installed from ground level to 2.4m, using 1.4m of slotted standpipe, and 1.0m of plain standpipe b.g.l. Backfilled with 1.4m 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

APPENDIX 3

HAND DUG TRIAL PIT LOGS

Trial Pit No: 1	Sheet: 1 of 1	SOIL INVESTIGATION EASTERN LIMITED
	Job No: WP4544	Tel/Fax 01245 237555 Mobile 07810 820620
Boring Method: Hand Tools	Date: 18/11/2024	
Client: Westbury Projects Ltd.		Site: 71-73 Caversham Road, Reading

Depth (mm/m)	Description of Strata	Thick-Ness (mm/m)	Legend	Sample	Test Type	Test Result	Depth (mm/m)	Field Records/ Comments	Depth to water (mm/m)
G.L.	TARMAC, over MADE GROUND: Gravelly, sandy, SILT, with numerous brick rubble.	300		•	Tub & Jar		100	No roots observed.	
300	Trial pit ends at 300mm								

Remarks:

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: 2	Sheet: 1 of 1	SOIL INVESTIGATION EASTERN LIMITED Tel/Fax 01245 237555 Mobile 07810 820620
	Job No: WP4544	
Boring Method: Hand Tools	Date: 18/11/2024	
Client: Westbury Projects Ltd.		Site: 71-73 Caversham Road, Reading

Depth (mm/m)	Description of Strata	Thick-Ness (mm/m)	Legend	Sample	Test Type	Test Result	Depth (mm/m)	Field Records/ Comments	Depth to water (mm/m)
G.L.	TARMAC, over MADE GROUND: Sandy, silty, GRAVEL, with brick fragments.	300						No roots observed.	
300	Trial pit ends at 300mm			•	Tub & Jar		300		

Remarks:

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	SOIL INVESTIGATION EASTERN LIMITED Tel/Fax 01245 237555 Mobile 07810 820620
	Job No: WP4544	
Boring Method: Hand Tools	Date: 18/11/2024	
Client: Westbury Projects Ltd.		Site: 71-73 Caversham Road, Reading

Depth (mm/m)	Description of Strata	Thick-Ness (mm/m)	Legend	Sample	Test Type	Test Result	Depth (mm/m)	Field Records/ Comments	Depth to water (mm/m)
G.L.	TARMAC, over MADE GROUND: Sandy, gravelly, SILT.	300		•	Tub & Jar		150	No roots observed.	
300	Trial pit ends at 300mm								

Remarks:

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 4

GROUNDWATER AND GAS MONITORING RESULTS

SOIL GAS SURVEY

Project:	71-73 Caversham Road	Date:	12/12/2024	Equipment Used:	GFM 436
Location:	Reading	Weather:	Light rain		
Job No.	24-728	Temp:	7°C		

Monitoring Point No.	Time	O2 (% v/v)	CO2 (% v/v)	CH4 (% v/v)	H2S (PPM)	CO (PPM)	PID (PPM)	Flow (l/hr)	Differential Pressure (mbar)	Water (mbgl)
BH1		20.3	0.5	0	0	0	<5	<0.1	-	1.7
BH2		20.2	0.6	0	0	0	<5	<0.1	-	1.43

Site Observations/ Comments	
Time	Barometric Pressure
09:00	1020
	falling
Datum:	

Tested by: MP

mbgl = metres below ground level

Ground and Environmental Investigation Limited

Accuracy and range of Gas Analyser GFM436

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_2S			+/-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)

APPENDIX 5

LABORATORY TESTING RESULTS

F . S . T

FLAWLESS
SOIL TESTING

REPORT NUMBER:
SIE230

CLIENT :
Soil Investigations (Eastern)Ltd
Unit 8, Hill Farm
Church Lane

SITE ADDRESS:
71-73 Caversham Road,
Reading,
RG1 8JA

DATE OF SITE VISIT:
18 November 2024

DATE RECEIVED BY LABORATORY:
20 November 2024

Complied By:.....
L. Kirby - Office Administrator

Approved By:.....
J. Garrett - Director

DATE REPORTED:
30 November 2024

UKAS TESTING
28443

22 Francis Road, Braintree, Essex, CM7 2NR
Tel : 07778442814
Registered in England Company Reg. No. 14487335
VAT No: 443 1025 40

www.Flawless-Soils.com
Email - Enquiries@flawless-soils.com

Laboratory Summary Results

Our Ref :	SIE230	Date Sampled:	18/11/2024
Location :	71-73 Caversham Road, Reading, RG1 8JA	Date Received :	20/11/2024
Client:	Soil Investigations (Eastern)Ltd	Date Tested :	20/11/2024
Address:	Unit 8, Hill Farm, Church Lane, Ford End, Chelmsford, Essex, CM3 1LN	Date of Report :	30/11/2024

Sample Ref		Type	Water Content	Soil Fraction > 0.425mm	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index*	Modified Plasticity Index*	Soil Class*	Filter Paper Contact Time	Soil Sample Suction	Roots Present or No Roots Observed*	In situ Shear Vane Strength*	Organic Matter O.M	pH Value	Sulphate Content (g / l)		Class*
TP/BH No	Depth (m)		(%) *[1]*	(%) *[2]*	(%) *[3]*	(%) *[4]*	(%) *[5]*	*[5]*	(%) [6]	*[7]*	(d)	(kPa) [8]	*[9]*	(kPa) [10]	(%)*[11]*	*[12]*	SO_3 *[13]*	SO_4 *[14]*	*[15]*
BH2	1.5	D	24.8	<5	35	16	19	0.47	19	CI			No Roots Observed			7.3	0.14	0.17	DS-1
	2.5	D	21.8	41	34	17	17	0.28	10	CL			No Roots Observed						

Test Methods / Notes

[1] BS EN ISO 17892-1 : 2014 + A1 : 2022

[2] Not recorded if <5%, otherwise measured as agreed with client

[3] BS EN ISO 17892-12 : 2018 + A2 : 2022 Clause 5.3 - 1 Pt Test - Cone 80g/30°

[4] BS BS EN ISO 17892-12 : 2018 + A2 : 2022 Clause 5.5

[5] BS BS EN ISO 17892-12 : 2018 + A2 : 2022 Clause 6.5

[6] BRE Digest 240 : 1993

[7] BS 5930 : 2018 : Figure 8 - Plasticity Chart for the classification of fine soils

[8] BRE IP 4/93

[9] Roots present at depth or below. Info taken from logs if provided

[10] Values of shear strength were determined in situ using a pilcon hand vane.

[11] E010 based on Walkely-Black methodology. Completed by DETS UKAS no. 4480.

[12] BS 1377 : Part 3 : 2018 + A1 2021 Clause 12. PH testing is completed by K4 Soils Ltd who are accredited for the test UKAS no.2519. Full reports can be provided upon written request.

[13] BS 1377 : Part 3 : 2018 + A1 2021 Clause 7.6. Sulphate testing is completed by K4 Soils Ltd who are accredited for the test UKAS no.2519. Full reports can be provided upon written request.

[14] SO_4 = 1.2 x SO_3

[15] BRE Special Digest One (Concrete in Aggressive Ground) August 2005 Note that if the SO_4 content falls into the DS-4 or DS-5 class, it would be prudent to consider the sample as falling into the DS-4M or DS-5M class respectively unless water soluble magnesium testing is undertaken to prove otherwise.

*** Non UKAS Accredited Testing.**

Key

D	Disturbed sample (small)
B	Disturbed sample (bulk)
U	Undisturbed sample
W	Groundwater sample
ENP	Essentially Non-Plastic by inspection
U/S	Underside of Foundation
H&F	Hair & Fibrous
D&D	Dead & Decomposing
DEV	Deviation

UKAS TESTING 28443

Test results reported relate only to the items tested.

This report shall not be reproduced except in full without approval of the laboratory.

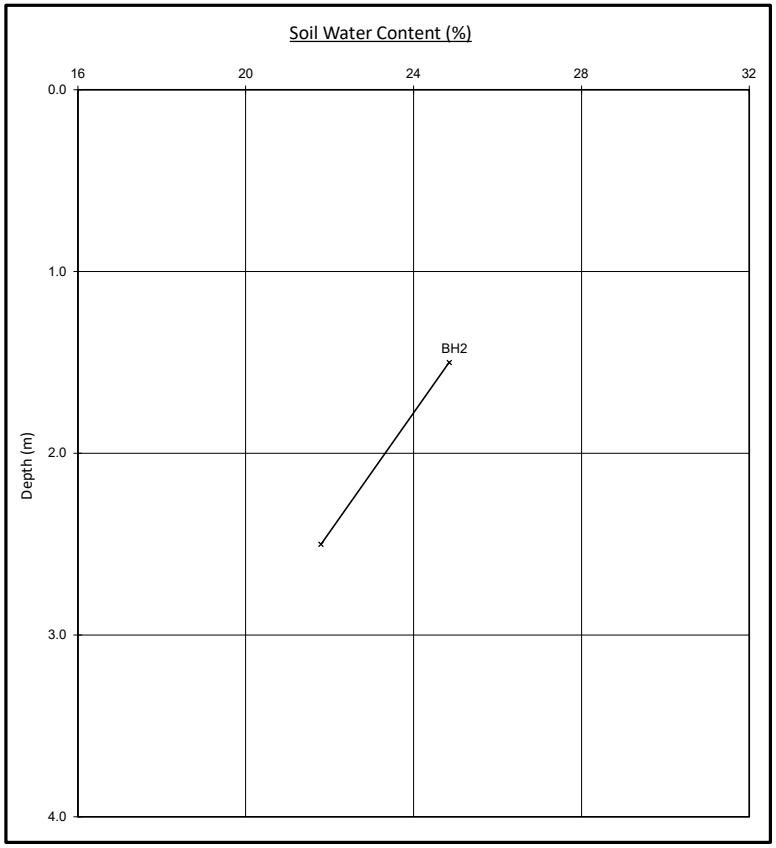
Version: SumRep (Issue 1, Rev 0 & Issued 17.11.23)

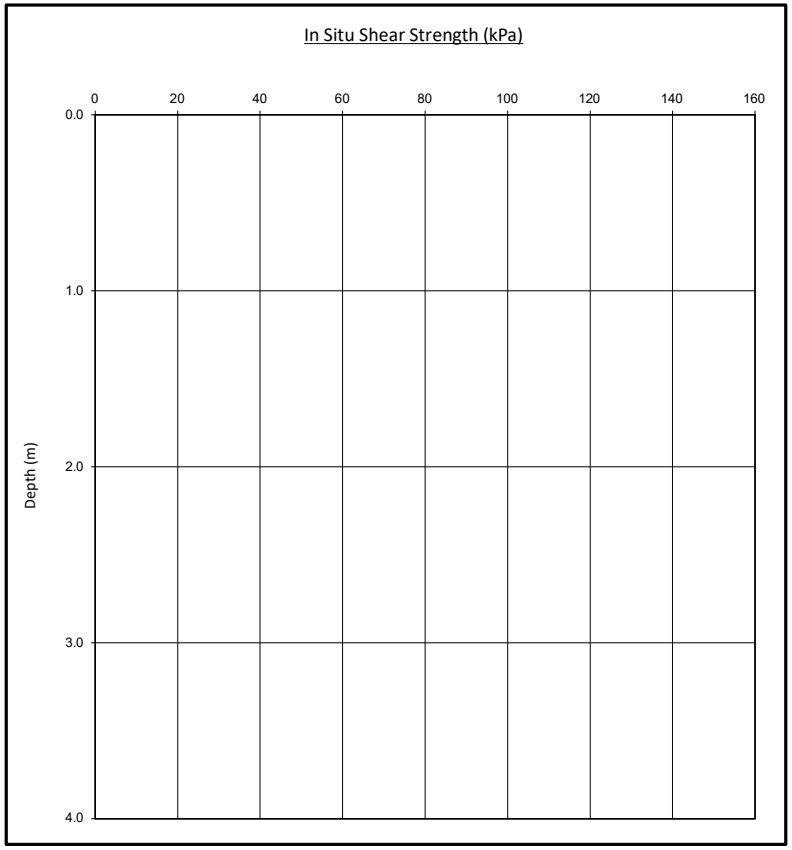
Water Content Profiles

Shear Strength Profiles

Our Ref : SIE230
Location : 71-73 Caversham Road, Reading, RG1 8JA
Work carried out for: Soil Investigations (Eastern)Ltd
Unit 8, Hill Farm, Church Lane, Ford End, Chelmsford, Essex, CM3 1LN

Date Sampled : 18/11/2024
Date Received : 20/11/2024
Date Tested : 20/11/2024
Date of Report : 30/11/2024





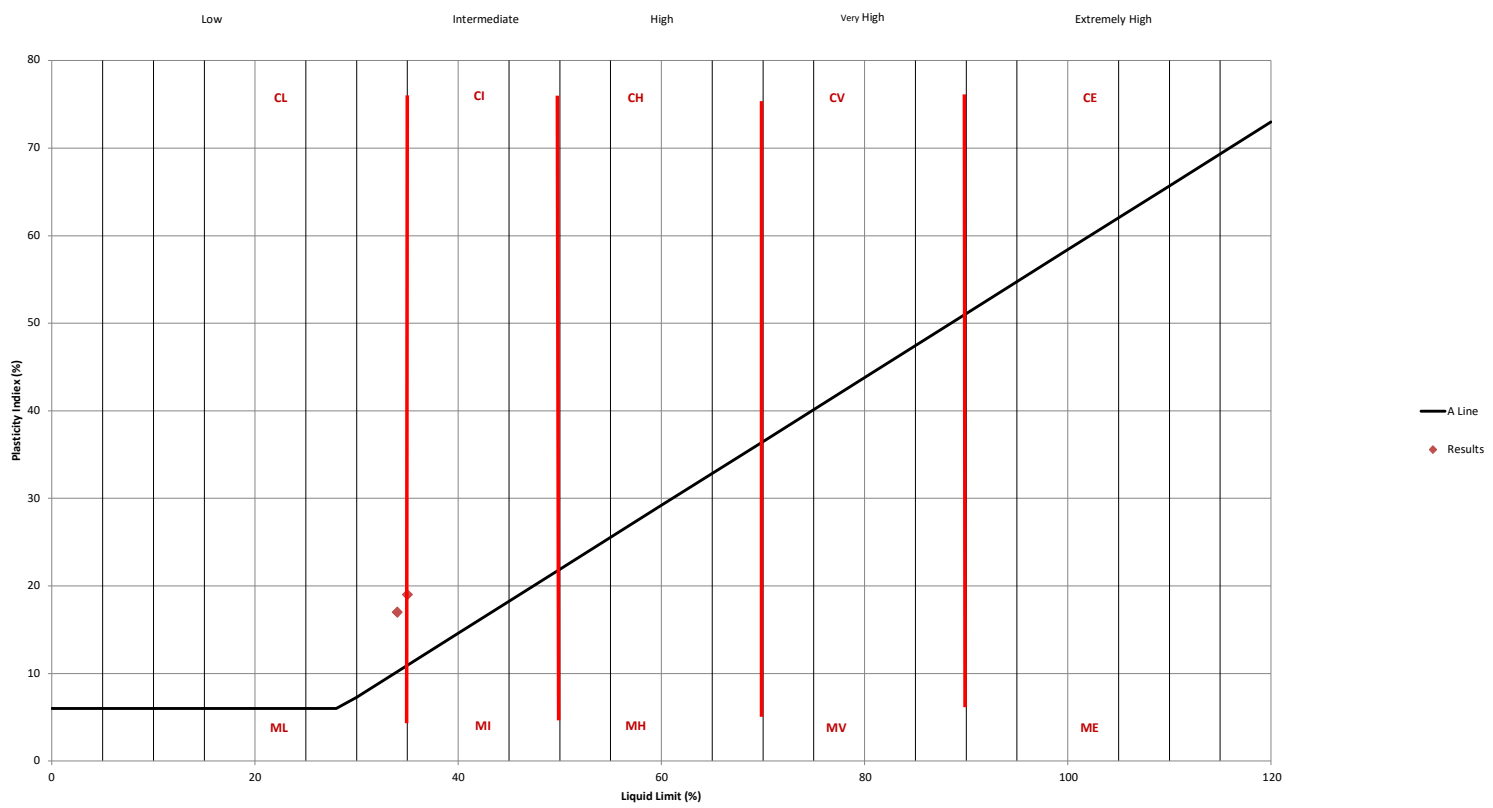
Notes
1. If plotted, 0.4 LL and PL+2 (after Driscoll, 1983) should only be applied to London Clay (and similarly overconsolidated clay) at shallow depths.

Note
1. Values of Shear Strength were determined in situ by use of a pilcon hand vane of which is limited to a maximum reading of 140kPa.

Plasticity Chart

Our Ref : SIE230
Location : 71-73 Caversham Road, Reading, RG1 8JA
Work carried out for: Soil Investigations (Eastern)Ltd
Unit 8, Hill Farm, Church Lane, Ford End, Chelmsford, Essex, CM3 1LN

Date Sampled : 18/11/2024
Date Received : 20/11/2024
Date Tested : 20/11/2024
Date of Report : 30/11/2024



APPENDIX 6

ANALYTICAL TESTING RESULTS

ANALYTICAL TEST REPORT

Report Number	24-04417, issue number 1
Contract name:	71-73 Caversham
Client reference:	WP4544
Clients name:	Soil Investigation (Eastern) Ltd
Clients address:	Eastern Unit 8, Hill Farm Church Lane Chelmsford Essex CM3 1LH
Samples received:	21/11/2024
Analysis started:	21/11/2024
Analysis completed:	05/12/2024
Report issued:	05/12/2024

Key

U	UKAS accredited test
M	MCERTS & UKAS accredited test
$	Test carried out by an approved subcontractor
I/S	Insufficient sample to carry out test
U/S	Sample not suitable for testing
NAD	No Asbestos Detected

Approved by:

Abbie Neasham-Bourn
Senior Reporting Administrator

Unit 6 Parkhead, Greencroft Industrial Park, Stanley, County Durham, DH9 7YB

Telephone: (01207) 528578, Email supportsquad@chemtech-env.co.uk

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Lab ref	Sample ID	Depth (m)	Sample description	Material removed	% Removed	% Moisture
23909	TP1	0.1 - 0.1	Brown Sand with Gravel.	-	-	10.8
23910	TP3	0.150 - 0.150	Brown Sand with Gravel.	-	-	9.2
23911	BH1	0.9 - 0.9	Brown Sandy Clay with Gravel.	-	-	13.6

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

a	Sampling date not provided
b	Sampling time not provided (waters only)
c	Sample not received in appropriate containers
d	Storage Temperature
e	Headspace present in sample container
f	Sample exceeded sampling to reciept
g	Sample exceeded holding time(s)

Lab ref	Sample ID	Depth (m)	Deviating	Tests (Reason for deviation)
23909	TP1	0.1 - 0.1	N	
23910	TP3	0.150 - 0.150	N	
23911	BH1	0.9 - 0.9	N	

SOILS

Lab Number					23909	23910	23911
Sample ID					TP1	TP3	BH1
Depth (m)					0.1 - 0.1	0.150 - 0.150	0.9 - 0.9
Sampling Date					18/11/2024	18/11/2024	18/11/2024
Sampling Time					AM	AM	AM
Test	Method	Accred	LoD	Units			
Asbestos							
Asbestos Identification	SUBCON	SU	0	-	NAD	NAD	n/t
Metals							
Acid Soluble Sulphate (SO4)	CE062	M	0.01	%	0.31	0.05	n/t
Water Soluble Boron	CE063	N	0.5	mg/kg	1.04	0.59	n/t
Antimony	CE264	N	5	mg/kg	n/t	n/t	< 5.0
Arsenic	CE264	U	1.8	mg/kg	13.8	6.1	23.8
Barium	CE264	U	1.9	mg/kg	n/t	n/t	65.0
Cadmium	CE264	M	1.6	mg/kg	< 1.6	< 1.6	< 1.6
Chromium	CE264	U	2	mg/kg	22.9	16.3	35.5
Copper	CE264	M	1.6	mg/kg	21.7	6.9	16.0
Lead	CE264	U	2.3	mg/kg	85.7	23.6	44.1
Mercury	CE264	U	0.7	mg/kg	< 0.7	< 0.7	< 0.7
Molybdenum	CE264	U	1.6	mg/kg	n/t	n/t	< 1.6
Nickel	CE264	M	2.1	mg/kg	20.5	6.0	25.7
Selenium	CE264	U	3	mg/kg	< 3.0	< 3.0	< 3.0
Zinc	CE264	M	4	mg/kg	86.4	32.8	66.1
PCB (ICES 7 congeners)							
Total PCBs (7 congeners)	CE137	M	0.035	mg/kg	n/t	n/t	< 0.035
PCB 101	CE137	M	0.015	mg/kg	n/t	n/t	< 0.015
PCB 118	CE137	M	0.015	mg/kg	n/t	n/t	< 0.015
PCB 138	CE137	M	0.015	mg/kg	n/t	n/t	< 0.015
PCB 153	CE137	M	0.01	mg/kg	n/t	n/t	< 0.010
PCB 180	CE137	M	0.01	mg/kg	n/t	n/t	< 0.010
PCB 28	CE137	M	0.015	mg/kg	n/t	n/t	< 0.015
PCB 52	CE137	M	0.01	mg/kg	n/t	n/t	< 0.010
Colourimetric							
Water Soluble Chromium VI	CE263	N	0.04	mg/kg	< 0.040	< 0.040	n/t
Total Monohydric Phenols	CE078	N	0.5	mg/kg	< 0.50	< 0.50	n/t
Total Cyanide	CE077	N	1	mg/kg	< 1.0	< 1.0	n/t
Thiocyanate	CE145	M	1	mg/kg	< 1.0	< 1.0	n/t

SOILS

Combustion							
Moisture Content	CE001	N	0.1	%	10.8	9.2	13.6
Total Organic Carbon	CE197	N	0.1	%	n/t	n/t	0.79
Loss on Ignition	CE006	U	0.1	%	n/t	n/t	5.10
Soil Organic Matter	CE072	N	0.1	%	1.57	1.74	n/t
TPH Ali/Aro							
>C5-C6 Aliphatic (HS_1D_MS_AL)	PHCWG44	SN	0.01	mg/kg	< 0.01	< 0.01	n/t
>C6-C8 Aliphatic (HS_1D_MS_AL)	PHCWG44	SN	0.05	mg/kg	< 0.05	< 0.05	n/t
>C8-C10 Aliphatic (HS_1D_MS_AL)	PHCWG44	SM	2	mg/kg	< 2.00	< 2.00	n/t
>C10-C12 Aliphatic (EH_CU_1D_AL)	PHCWG44	SM	2	mg/kg	< 2.00	< 2.00	n/t
>C12-C16 Aliphatic (EH_CU_1D_AL)	PHCWG44	SM	3	mg/kg	< 3.00	< 3.00	n/t
>C16-C21 Aliphatic (EH_CU_1D_AL)	PHCWG44	SM	3	mg/kg	< 3.00	< 3.00	n/t
>C21-C34 Aliphatic (EH_CU_1D_AL)	PHCWG44	SM	10	mg/kg	39.0	27.0	n/t
>C34-C44 Aliphatic (EH_CU_1D_AL)	PHCWG44	SN	10	mg/kg	45.0	39.0	n/t
>C5-C44 Aliphatic (EH_CU_1D_AL)	PHCWG44	SN	21	mg/kg	84.0	66.0	n/t
>C5-C7 Aromatic (HS_1D_MS_AR)	PHCWG44	SN	0.01	mg/kg	< 0.01	< 0.01	n/t
>C7-C8 Aromatic (HS_1D_MS_AR)	PHCWG44	SN	0.05	mg/kg	< 0.05	< 0.05	n/t
>C8-C10 Aromatic (HS_1D_MS_AR)	PHCWG44	SM	2	mg/kg	< 2.00	< 2.00	n/t
>C10-C12 Aromatic (EH_CU_1D_AR)	PHCWG44	SM	2	mg/kg	< 2.00	< 2.00	n/t
>C12-C16 Aromatic (EH_CU_1D_AR)	PHCWG44	SM	2	mg/kg	< 2.00	9.00	n/t
>C16-C21 Aromatic (EH_CU_1D_AR)	PHCWG44	SM	3	mg/kg	29.0	74.0	n/t
>C21-C35 Aromatic (EH_CU_1D_AR)	PHCWG44	SM	10	mg/kg	146	104	n/t
>C35-C44 Aromatic (EH_CU_1D_AR)	PHCWG44	SN	10	mg/kg	148	115	n/t
>C5-C44 Aromatic (EH_CU_1D_AR)	PHCWG44	SN	21	mg/kg	325	301	n/t
>C5-C44 Total (HS_1D_MS+EH_CU_1D_Total)	PHCWG44	SN	42	mg/kg	409	367	n/t
Organics							
Elemental Sulphur	CE034	M	10	mg/kg	32.4	15.0	n/t
Polyaromatic hydrocarbons							
Naphthalene	CE087	M	0.016	mg/kg	< 0.016	< 0.016	< 0.016
Acenaphthylene	CE087	M	0.015	mg/kg	0.081	< 0.015	< 0.015
Acenaphthene	CE087	M	0.013	mg/kg	0.033	0.760	< 0.013
Fluorene	CE087	U	0.013	mg/kg	0.016	0.951	< 0.013
Phenanthrene	CE087	M	0.014	mg/kg	0.139	11.1	0.082
Anthracene	CE087	U	0.017	mg/kg	0.125	1.72	0.029
Fluoranthene	CE087	M	0.017	mg/kg	3.85	12.0	0.130
Pyrene	CE087	M	0.016	mg/kg	8.49	8.35	0.101
Benzo(a)anthracene	CE087	U	0.012	mg/kg	1.19	2.32	0.110

SOILS

Chrysene	CE087	M	0.028	mg/kg	1.04	2.03	0.091
Benzo(b)fluoranthene	CE087	M	0.02	mg/kg	2.96	1.70	0.077
Benzo(k)fluoranthene	CE087	M	0.025	mg/kg	0.796	0.614	0.036
Benzo(a)pyrene	CE087	U	0.019	mg/kg	2.27	1.19	0.069
Indeno(1,2,3-cd)pyrene	CE087	M	0.019	mg/kg	1.14	0.745	0.042
Dibenzo(a,h)anthracene	CE087	M	0.017	mg/kg	0.257	0.177	< 0.017
Benzo(g,h,i)perylene	CE087	M	0.019	mg/kg	0.986	0.593	0.038
Coronene	CE087	N	0.02	mg/kg	n/t	n/t	< 0.020
Total PAH(16)	CE087	N	0.28	mg/kg	23.4	44.2	n/t
Total PAH(17)	CE087	N	0.3	mg/kg	n/t	n/t	0.805
BTEX							
Benzene	CE267	U	0.0005	mg/kg	< 0.0005	< 0.0005	0.0018
Toluene	CE267	U	0.001	mg/kg	< 0.001	< 0.001	< 0.001
Ethylbenzene	CE267	U	0.001	mg/kg	* < 0.001	* 0.019	< 0.001
Xylenes	CE267	N	0.003	mg/kg	n/t	n/t	< 0.003
MTBE	CE267	N	0.002	mg/kg	< 0.002	< 0.002	< 0.002
Total BTEX	CE267	N	0.006	mg/kg	< 0.006	0.170	< 0.006
m,p-Xylene	CE267	U	0.002	mg/kg	< 0.002	0.092	< 0.002
oXylenes	CE267	U	0.002	mg/kg	< 0.002	0.059	< 0.002
Wet Chem							
pH	CE004	M	0.1	pH units	8.4	7.8	8.2
Acid Neutralisation Capacity pH4	CE083	N	0.02	mol/kg	n/t	n/t	0.020
Acid Neutralisation Capacity pH7	CE083	N	0.02	mol/kg	n/t	n/t	< 0.020
EPH							
Mineral Oil (>C10-C40 Total) (EH_CU_1D_T	CE162	N	19	mg/kg	n/t	n/t	22

SOIL SVOCS

Lab Number					23909	23910
Sample ID					TP1	TP3
Depth (m)					0.1 - 0.1	0.150 - 0.150
Sampling Date					18/11/2024	18/11/2024
Sampling Time					AM	AM
Test	Method	Accred	LoD	Units		
SVOC						
Phenol	CE189	N	0.1	mg/kg	< 0.10	< 0.10
Cresols	CE189	N	0.1	mg/kg	< 0.10	< 0.10
Xylenols	CE189	N	0.1	mg/kg	< 0.10	< 0.10
Naphthols	CE189	N	0.1	mg/kg	< 0.10	< 0.10
Trimethylphenols	CE189	N	0.1	mg/kg	< 0.10	< 0.10

LEACHATE

Lab Number					23911
Sample ID					BH1
Depth (m)					0.9 - 0.9
Sampling Date					18/11/2024
Sampling Time					AM
Test	Method	Accred	LoD	Units	
Metals					
Arsenic 10:1	CE265	U	0.1	µg/l	2.41
Barium 10:1	CE265	U	0.9	µg/l	4.87
Cadmium 10:1	CE265	U	0.1	µg/l	< 0.100
Chromium 10:1	CE265	U	0.5	µg/l	3.45
Copper 10:1	CE265	U	0.6	µg/l	5.41
Mercury 10:1	CE265	N	0.05	µg/l	< 0.050
Molybdenum 10:1	CE265	N	0.9	µg/l	3.84
Nickel 10:1	CE265	U	0.4	µg/l	< 0.400
Lead 10:1	CE265	U	0.6	µg/l	< 0.600
Antimony 10:1	CE265	N	0.8	µg/l	< 0.800
Selenium 10:1	CE265	U	1.1	µg/l	< 1.10
Zinc 10:1	CE265	U	3	µg/l	< 3.00
Arsenic 10:1	CE265	U	0.001	mg/kg	0.024
Barium 10:1	CE265	U	0.009	mg/kg	0.049
Cadmium 10:1	CE265	U	0.001	mg/kg	< 0.001
Chromium 10:1	CE265	U	0.005	mg/kg	0.035
Copper 10:1	CE265	U	0.006	mg/kg	0.054
Mercury 10:1	CE265	N	0.0005	mg/kg	< 0.0005
Molybdenum 10:1	CE265	N	0.009	mg/kg	0.038
Nickel 10:1	CE265	U	0.004	mg/kg	< 0.004
Lead 10:1	CE265	U	0.006	mg/kg	< 0.006
Antimony 10:1	CE265	N	0.008	mg/kg	< 0.008
Selenium 10:1	CE265	U	0.011	mg/kg	< 0.011
Zinc 10:1	CE265	U	0.03	mg/kg	< 0.03
Colourimetric					
Chloride 10:1	CE257	U	0.4	mg/l	1.60
Fluoride 10:1	CE257	U	0.08	mg/l	0.500
Sulphate 10:1	CE257	U	0.3	mg/l	26.7
Phenol Index 10:1	CE148	N	0.01	mg/l	< 0.01
Chloride 10:1	CE257	U	4	mg/kg	16.0

LEACHATE

Fluoride 10:1	CE257	U	0.8	mg/kg	5.00
Sulphate 10:1	CE257	U	3	mg/kg	267
Phenol Index 10:1	CE148	N	0.1	mg/kg	< 0.10
Combustion					
Total Dissolved Solids 10:1	CE039	N	10	mg/l	157
Dissolved Organic Carbon 10:1	CE247	N	5	mg/l	10.1
Total Dissolved Solids 10:1	CE039	N	100	mg/kg	1570
Dissolved Organic Carbon 10:1	CE247	N	50	mg/kg	101
Wet Chem					
pH 10:1	CE213	U	0	pH units	8.0
Conductivity 10:1	CE214	U	50	µS/cm	207
WACZ					
Temperature 10:1	CE002	N	0	°C	20
Moisture Content 10:1	CE001	N	0.1	%	15.8
Dry mass of test portion	CE002	N	0	kg	0.090
Wet Sample Mass Taken (Actual)	CE002	N	0	kg	0.104
Dry Matter 10:1	CE002	N	0.1	%	86.4
Eluent Volume	CE002	N	0	l	0.884

CHEMTECH environmental part of Cawood

WAC Analysis

Lab Ref:	23911			Landfill Waste Acceptance Criteria Limits		
Job Number:	24-04417			Inert Waste Landfill	Stable Non-reactive Hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample Date:	18/11/2024					
Sample ID:	BH1					
Depth (m)	0.9 - 0.9					
Site:	WP4544					
Determinand	Code	Units				
Total Organic Carbon	N	%	0.79	3	5	6
Loss on Ignition	U	%	5.10	--	--	10
Total BTEX	N	mg/kg	< 0.006	6	--	--
Total PCBs (7 congeners)	M	mg/kg	< 0.035	1	--	--
Mineral Oil (>C10-C40 Aliphatic) (EH_CU_1D_AL)	N	mg/kg	22	500	--	--
Total (of 17) PAHs	N	mg/kg	0.805	100	--	--
pH	M	pH Units	8.2	--	>6	--
Acid Neutralisation Capacity (pH4)	N	mol/kg	0.020	--	To be evaluated	
Acid Neutralisation Capacity (pH7)	N	mol/kg	< 0.020	--	To be evaluated	
Eluate Analysis		Conc in Eluate	10:1	Council Decision 2003/33/EC		
		10:1	mg/kg	Limit Values mg/kg at L:S 10:1		
Arsenic (µg/l)	U	2.410	0.024	0.5	2	25
Barium (µg/l)	U	4.870	0.049	20	100	300
Cadmium (µg/l)	U	< 0.100	< 0.001	0.04	1	5
Chromium (µg/l)	U	3.450	0.035	0.5	10	70
Copper (µg/l)	U	5.410	0.054	2	50	100
Mercury (µg/l)	N	< 0.050	< 0.0005	0.01	0.2	2
Molybdenum (µg/l)	N	3.840	0.038	0.5	10	30
Nickel (µg/l)	U	< 0.400	< 0.004	0.4	10	40
Lead (µg/l)	U	< 0.600	< 0.006	0.5	10	50
Antimony (µg/l)	N	< 0.800	< 0.008	0.06	0.7	5
Selenium (µg/l)	U	< 1.10	< 0.011	0.1	0.5	7
Zinc (µg/l)	U	< 3.00	< 0.03	4	50	200
Chloride (mg/l)	U	1.60	16.0	800	15000	25000
Fluoride (mg/l)	U	0.50	5.0	10	150	500
Sulphate (mg/l)	U	26.70	267	1000	20000	50000
Total Dissolved Solids (mg/l)	N	157.0	1570	4000	60000	100000
Phenol Index (mg/l)	N	< 0.01	< 0.10	1	-	-
Dissolved Organic Carbon (mg/l)	N	10.1	101	500	800	1000

Leach Test Information

pH	U	8.0
Conductivity (uS/cm)	U	207
Temperature (°C)	N	20
Mass of dried test portion (kg)	N	0.090
Mass of wet test portion (kg)	N	0.104
Dry Matter (%)	N	86.4
Moisture (%)	N	15.8
Material Removed (%)		
Eluent Volume (l)	N	0.884

Disclaimer: The Landfill Waste Acceptance Criteria limits in this report are provided for guidance only and values are transcribed from the Council Decision annex 2003/33/EC

Chemtech Environmental Ltd does not take responsibility for any errors or omissions in the transcription, and all data should be verified by the end user.

Results will be colour flagged to the lowest threshold value breached. Any assessments made are based on the published results from the Laboratory and make no assessment of uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. Interpretation/assessment is outside the scope of the laboratory's UKAS accreditation.
Moisture Content Calculated on Wet Weight Basis

METHOD DETAILS

METHOD	TESTNAME	METHOD SUMMARY	ANALYSIS BASIS
TPHCWG44S	Subcon Solids	Subcontracted	As received Sample
SUBCON	Asbestos Solid	HSG248	Air Dried Sample
CE004	pH of Solids	Potentiometric	As submitted sample
CE001	WAC in leachates 10:1 single stage	BS12457-2	As submitted sample
CE083	Acid Neutralisation Capacity	Titration	Air dried sample
CE002	WAC moistures	Gravimetric	As submitted sample
CE062	Acid Soluble Sulphate in Solids	Primacs	Air dried sample
CE063	Water soluble boron	ICPOES	Air dried sample
CE137	PCB's in Soil	DCM Extraction and GCMS	As submitted sample
CE189	SVOC in solids	DCM Extraction and GCMS	As submitted sample
CE264	Metals by ICP in Soil	ICPOES	Air dried sample
CE267	BTEX in solids	Analysis by HSGCFID	As submitted sample
CE263	ChromiumVI by Discrete Analyser in Solid	Gallery	Air dried sample
CE087	PAH in Soil	DCM Extraction and GCMS	As submitted sample
CE034	Elemental Sulphur	HPLC UV	Air dried sample
CE078	Phenols in Solids	Continuous Flow Analyser	As submitted sample
CE077	Cyanides in Solids	Continuous Flow Analyser	As submitted sample
CE145	Thiocyanate	UV Spectrometer	Air dried sample
CE197	Primacs in Solids	Primacs	Air dried sample
CE006	Loss on ignition at 440 deg C	Gravimetric	Air dried sample
CE162	Mineral Oil in Solids	Acetone:Hexane extract, Floriil clean up and GCFID	As submitted sample

REPORT INFORMATION

Report No.:24-04417, issue number 1

Key	
U	ISO17025 Accredited Result
M	ISO17025 and MCERTS Accredited Result
N	Do not currently hold accreditation
^	MCERTS accreditation not applicable for sample matrix
*	ISO17025 accreditation not applicable for sample matrix
S	Subcontracted
I/S	Insufficient Sample
U/S	Unsuitable sample
N/T	Not tested
<	Means "less than"
>	Means "greater than"

LOD refers to limit of detection, except in the case of pH soils and pH waters where it means limit of discrimination.

This report shall not be reproduced except in full, without prior written approval.

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

The results relate only to the sample received.

Unless otherwise stated, sample information has been provided by the client. This may affect the validity of the results.

Moisture Content Calculated on a Wet Weight basis

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

Sampling was undertaken by Chemtech Environmental Limited and is outside the UKAS accreditation scope.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

BTEX compounds are identified by retention time only and may include interference from co-eluting compounds.

For soils and solids, all results are reported on a dry basis. Samples dried at no more than 30°C in a drying

For soils and solids, analytical results are inclusive of stones, where applicable.

Sample Retention and Disposal

All soil samples will be retained for a period of 4 weeks from the point of receipt

All water samples will be retained for a period of 2 weeks from the point of Reporting

Charges may apply to extended sample storage

TPH Classification - HWOL Acronym System

HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
2D	GC-GC - Double coil gas chromatography
#1	EH_Total but with humics mathematically subtracted
#2	EH_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry

Statement of Conformity

Statement of Conformity

Where Chemtech reports a statement of conformity to a specification, the decision rules applied are derived from the Ilac document ILAC G8:09/2019.
Acceptance limits (AL), applied are derived from the tolerance limits (TL) by you the client or applicable standard (e.g. 2003.33.EC Council Decision, BS3882, BS8601)

Agreed and reported Decision Rule:

"PASS" if the result < TL, and the bias / precision values for the process meet the targets defined within the methodology and/or applied accreditation.

Reported Decisions:

Result < TL for determinands: PASS
Result > TL for determinands: FAIL

Definitions Used:

Acceptance limit (AL) Specified upper or lower bounds of permissible measured quantity values.
Tolerance limit (TL) Specified upper or lower bound of permissible values of a property.

Accreditation of WAC/BS3882/BS8601

Accreditation in Soil to MCERTS is only applicable for specific matrix types identified as soil (Sand/Loam/Clay) during the sample assessment
If the sample is classified as not soil, not accreditation is conveyed

APPENDIX 7

GUIDELINES ON CONTAMINATION LEVELS

Human Health

CLEA Soil Guideline values (SGV)

The UKs 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, GEI 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 GEI 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.

	Soil Guideline Value (mg kg^{-1})		
Land use	**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.

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:

PARAMETER	Residential						Commercial			Allotment			POS	POS	Source
	With Plant uptake			Without Plant uptake											
SOM %	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	resi	park	
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	35	35	36	3.6	3.7	3.7			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.

	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)

Inert Material

The limit values for inert waste are given in the EC Landfill Directive 1999/31/EC as applied under the Environmental Permitting (England and Wales) (Amendment) (EU Exit) Regulations 2019 (*SI 2019/39*) and as defined by the council decision establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC(2003/33/EC).

The regulations and associated guidance provide waste acceptance criteria, which set the limits of contaminants permitted in various waste categories going to landfill. These criteria are of particular use where CLEA guidance or DEFRA Screening values has not yet been provided.

Inert waste is defined as waste which contains insignificant potential for pollution and does not endanger the quality of surface water or groundwater. The Landfill Directive states that inert waste will not adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health.

For risk assessment purposes we would consider that any materials (soils) containing concentrations of potential contaminants that would result in them being classified as inert would be considered as uncontaminated and therefore representing a low risk to human health.

Similarly, such material would not be considered to represent a significant risk to water resources.

Where CLEA or Defra screening values exist, these would always be used in preference to inert waste values when assessing risks to human health.

Selected inert waste acceptance criteria as given in Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills for the Landfill Directive are given below.

Landfill acceptance criteria for inert waste (mg/kg)	
Total organic carbon (TOC)	30,000
BTEX compounds	6
Mineral oils (C10 – C40)	500
PCBs	1
PAH	100

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.***

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 or 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.