

CONTENTS

1.0 INTRODUCTION	Page 3
2.0 SITE DETAILS	Page 3
3.0 SCOPE OF WORKS	Page 3
4.0 INVESTIGATION RATIONALE	Page 4
4.1 – Contamination Related Sampling & Site Protocols	Page 4
5.0 GROUND CONDITIONS	Page 4
5.1 – Soil Profile	Page 4
5.2 – Shallow Coal Mining Assessment	Page 5
5.3 – Groundwater	Page 5
6.0 INSITU TESTING	Page 5
6.1 – Insitu Standard Penetration Tests	Page 5
6.2 – Insitu Dynamic Cone Penetration Tests	Page 6
6.3 – Insitu Gas and Groundwater Monitoring	Page 6
7.0 LABORATORY TESTING	Page 8
7.1 – Determination of pH & SO ₄	Page 8
7.2 – Determination of Liquid & Plastic Limits	Page 9
7.3 – Contamination Screening / Screening Strategy	Page 9
8.0 GROUND CONTAMINATION RISK ASSESSMENT	Page 10
8.1 – Methodology	Page 10
8.2 – Level 1 Risk Assessment (Human Health)	Page 10
8.3 – Level 1 Risk Assessment (Controlled Waters)	Page 12
8.4 – Revised Conceptual Site Model (CSM)	Page 14
9.0 CONCLUSIONS & RECOMMENDATIONS	Page 15
9.1 – Ground Conditions	Page 16
9.2 – Groundwater	Page 16
9.3 – Foundation Options	Page 16
9.4 – Gas Protection Measures	Page 16
9.5 – Ground Contamination	Page 17
9.6 – Waste Classification	Page 17
9.7 – UXO Risk	Page 18
9.8 – General Comments	Page 18

APPENDICES

Appendix I	Location Plan, Aerial Photograph, Existing Site Layout Plan, Proposed Development Layout Plan
Appendix II	Exploratory Hole Location Plan & Borehole Record Sheets
Appendix III	DCP Test Results & Gas Monitoring Certificate
Appendix IV	Laboratory Results (Geotechnical & Ground Contamination)
Appendix V	Waste Classification Report (HazWasteOnline™)
Appendix VI	UXO Risk Map / RSK Detailed UXO Risk Assessment Report

1.0 Introduction

March 2024

As requested by Alan Wood & Partners on behalf of Veolia, and in line with a Phase 1: Desk Top Study Report (Arc Environmental, Ref. 24-787 January 2024), Phase 2: Ground Investigation works have been carried out within the existing Veolia Waste Transfer Station, off Ellis Ashton Street, Liverpool, where proposals have been made to construct a new food waste bulking facility within the current refuse treatment site.

The intrusive investigation works comprised 4 no. windowless sampling boreholes (WS01 to WS04) incorporating the installation of 3 no. combined gas and groundwater monitoring wells (WS01, WS03 & WS04) and 3 no. open hole rotary boreholes (RH01 to RH03). The positions of which can be seen on the Exploratory Hole Location Plan, a copy of which can be seen in Appendix II. It should be noted that this plan should be used for orientating purposes only, as the positions shown are approximate, and the plan is not to a standard scale.

2.0 Site Details

Table 2.1

N = north, S = south, etc.

Site Name & Address:	Veolia Huyton Food Waste Project, Ellis Ashton Street, Liverpool, L36 6BJ
National Grid Reference:	345800, 390160 (representative for the central part of the whole site).
Description of Location:	The site is located within the south-east corner of a wider refuse treatment site located south of Ellis Ashton Street and east of Link Road. The wider site comprises a large warehouse within the west of the site and a smaller office and welfare building within the north-east of the site. The site itself comprises a number of storage containers and is surrounded by trees and hedges on the southern, western and eastern perimeters. The Logwood Mill Brook is located to the east of the site.
Site Boundaries:	N = The wider Veolia Waste Transfer Site, E = Logwood Mill Brook, S & W = Industrial Sites

3.0 Scope of Works

Table 3.1

Client:	Veolia.
Project type:	Proposed Commercial Development.
Site Location plan:	See Appendix I.
Layout plan (existing):	See Appendix I.
Layout plan (proposed):	See Appendix I.
Reporting:	Factual & Interpretative.
Laboratory Testing:	Geotechnical and Ground Contamination.
CLEA End-Use Classification:	Level 1 GQRA – Commercial.

The information contained in this report is limited to the areas of the site, as indicated on the Existing and Proposed Site Layout Plans shown in Appendix I, and to those areas accessible during the ground investigation. The depths of strata on the record sheets are recorded from current ground levels. When considering the full scope of the development any features and / or issues not specifically mentioned in this report cannot be assumed to have been covered.

4.0 Investigation Rationale

This ground investigation has been designed to provide information on the general ground and groundwater conditions where access would allow, within the boundaries of the site. The rationale behind the location of each exploratory hole is summarised in Table 4.1 below.

Table 4.1

<u>Potential issue</u>	<u>Exploratory hole</u>
Geotechnical considerations across the proposed development areas	WS01 to WS04
Determination of shallow coal workings below the site	RH01 to RH03
Shallow groundwater and ground gas monitoring	WS01, WS03 & WS04
General site wide contamination assessment	WS01 to WS04

4.1 Contamination Related Sampling & Site Protocols: -

All works associated with this ground contamination assessment and investigations have generally been completed in accordance with BS10175:2011+A2:2017: Investigation of potentially contaminated sites – Code of practice & Land Contamination Risk Management (LCRM: October 2020), with the precautions below specific to this project.

4.1.1 Ground Contamination Sampling: -

Samples were recovered by a representative of ARC Environmental Ltd. during the intrusive investigation works. All samples were stored at approximately c.2°C to c.8°C using cool boxes and ice packs prior to delivery to a UKAS / MCERTS accredited laboratory. Sampling was carried out in accordance with 'Technical Policy Statement 63: UKAS Policy on Deviating Samples'.

4.1.2 Avoiding Cross-Contamination between Sample Locations: -

To avoid possible cross-contamination of materials between soil horizons, drill casing was used to seal off the made ground. Disposable plastic liners were used to collect samples from the windowless sampling boreholes carried out.

5.0 Ground Conditions

For an accurate description of the ground conditions encountered at each investigation position, reference should be made to the borehole record sheets attached in Appendix II. It should be noted that there is always the possibility of variation in the ground conditions around and between the exploratory hole locations.

5.1 Soil Profile: -

A summary of the soil profile for this site can be seen in Table 5.1 below.

Table 5.1

BGL = Below Ground Level.

<u>Type of Strata</u>	<u>Depths Recorded (BGL)</u>	<u>Description & General Comments</u>
MADE GROUND:	From 0.00m up to c.1.00m to c.4.27m	Comprised site surfacing of reinforced concrete overlying light grey sandy limestone gravel. Underlain by sandy gravelly soil with anthropogenic debris (i.e. brick, glass, concrete etc).
SUPERFICIAL DEPOSITS: (Glacial Till)	From c.1.00m to c.2.00m up to c.3.50m to c.4.00m	Comprised soft brown, grey and orangish brown sandy gravelly CLAY with coal fragments.

5.0 Ground Conditions (Cont'd)

5.1 Soil Profile (Cont'd):

Table 5.1 (Cont'd)

BGL = Below Ground Level.

Type of Strata	Depths Recorded (BGL)	Description & General Comments
SOLID GEOLOGY (Pennine Middle Coal Measures)	From c.3.50m to c.4.00m up to at least c.30.00m	Comprised variable bands of grey MUDSTONE and grey SILTSTONE (initially recovered as gravel) and bands of intact COAL.

There was no visual and / or olfactory evidence of significant ground contamination (i.e. fuel-derived contaminants, asbestos, ash, etc.) present at any of the exploratory positions undertaken across the site.

5.2 Shallow Coal Mining Assessment:-

As highlighted within the Phase 1: Desk Top Study previously carried out, the site was deemed to be at potential risk from potential 'unrecorded' shallow coal workings. Therefore, a series of open hole rotary boreholes have been completed across the site to determine the level of risk to the proposed development.

From the rotary boreholes carried out, bands of intact coal were encountered within the rotary boreholes at a depth of c.9.50m – c.10.20m (c.0.70m thick) & c.19.10m – c.19.50m (c.0.40m thick) bgl within RH01, c.6.00m – c.6.90m (c.0.90m thick) & c.17.90m – c.18.30m (c.0.40m thick) bgl within RH02 and c.6.50m – c.7.40m (c.0.90m thick) & c.18.60m – c.19.00m bgl (c.0.40m thick) within RH03. There was no evidence of workings in the form of broken ground or voids during the creation of the boreholes with 100% flush return noted during the drilling process to a terminal depth of c.30.00m. Therefore, it is felt that the proposed development can be constructed without the need for incorporating any remedial measures to mitigate against future shallow mining related ground movement. Consequently, it is considered that the risk of surface instability associated with shallow coal workings is negligible and no further assessment and / or remedial works are deemed necessary.

5.3 Groundwater: -

Groundwater ingress was noted within windowless sample boreholes WS01 and WS03 at depths of between c.1.85m and c.3.50m bgl.

Combined ground gas and groundwater monitoring wells were installed within WS01, WS03 and WS04 to carry out a subsequent programme of gas and groundwater monitoring. The results are discussed further in Section 6.3.

6.0 Insitu Testing

6.1 Insitu Standard Penetration Tests: -

Standard penetration tests (SPT's) were carried out with the use of a normal split spoon sampler on the made ground, superficial deposits and solid geology encountered within the boreholes to determine the relative density / strength of the materials tested. The results are shown as 'N' values on the graphic borehole record sheets, adjacent to the appropriate sample level. A summary of the test results can be seen in Table 6.1 on the following page.

6.0 Insitu Testing (Cont'd)

6.1 Insitu Standard Penetration Tests (Cont'd): -

Table 6.1

Type of Strata	Range of SPT 'N' Values	Result details
MADE GROUND:	10 – 34 and blows of 60 to 75 for limited penetration.	Indicative of loose to dense deposits
SUPERFICIAL DEPOSITS: (Glacial Till)	1 – 26	Indicative of very soft to firm and stiff deposits
SOLID GEOLOGY: (Pennine Middle Coal Measures)	Blows of 74 to 75 for limited penetration.	Indicative of very weak deposits*

* = Using N60 Values after Clayton 1995

When considering these results, it is felt that the higher values obtained for the made ground have been influenced by the coarse nature of the soils tested (i.e. presence of coarse gravel and cobbles etc).

6.2 Insitu Dynamic Cone Penetration (DCP) Tests: -

Dynamic Cone Penetrometer (DCP) tests were undertaken at the location of WS02 to determine the insitu density of the shallow soils (future sub-grade materials), to assess their suitability. The DCP uses an 8kg hammer dropping through a height of 575mm to penetrate a 60° cone (20mm Ø) into the underlying ground. Readings are taken following a set number of blows or change in strength / density to determine the penetration of the cone.

The DCP field results are analysed using the UK DCP 3.1 software package to calculate the thickness and strength / density of differing layers. The calculated results provided comprise penetration rates (mm/blow) and CBR values (%).

A summary of the results of the tests undertaken can be seen in Table 6.2 below, whilst the full results including a graphical representation can be seen in Appendix III.

Table 6.2

Position	Soil Type	Depth to Base (mm)	Range of Penetration Indices (mm/blow)	Range of CBR Values (%)
WS02 / DCP01	Made ground	804	10.19	26
	Made ground	860	4.67	59

When considering these results, it is felt that the higher values obtained for the made ground have been influenced by the coarse nature of the soils tested (i.e. presence of coarse gravel and cobbles etc) and as a result, where the made ground is to be used as an undisturbed subgrade, a conservative characteristic design CBR value of 2.50% should be taken. The formation level should be proof rolled with additional stone emplaced to take care of any soft spots.

6.3 Insitu Gas & Groundwater Monitoring: -

From The Phase 1 Desk Top Study previously carried out, the site was at potential risk from hazardous ground gas generation / migration as associated with off-site sources. As a result, a standard 50mm diameter HDPE standpipe, with gravel and/or geo-wrap surround, bentonite seal, gas valve cap and security cover, was installed to depths of c.4.00m below current ground level within WS01, WS03 and WS04, and the soil gas and water levels were allowed to reach equilibrium, prior to the first monitoring visit.

6.0 Insitu Testing (Cont'd)

6.3 Insitu Gas & Groundwater Monitoring (Cont'd): -

Monitoring was undertaken using a GFM 435 series soil gas analyser, with integral flow meter, and a Geotechnical Instruments electronic dip-meter. In accordance with CIRIA Report C665, November 2007, the current NHBC Document; Guidance on evaluation of development proposals on site where methane and carbon dioxide are present, Report Edition No. 04, March 2007 and BS8485:2015: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, it is felt that an adequate risk assessment can be undertaken based on the following limiting factors:

- The development has been considered as **low sensitivity** (Table 5.5 – Typical/Idealised frequency and period of monitoring, after Wilson et al, 2005).
- The risk associated with the generation potential of a source was considered as **very low**, (assessment based on the environmental setting) as well as observations noted during the fieldworks.
- Monitoring over a **minimum** of **one month** with **four recorded** readings (Table 5.5 – Typical /idealised frequency and period of monitoring after Wilson et al, 2005).
- **Negligible** flow rates have been recorded (Table 8.5 – Modified Wilson & Card classification).
- A targeted and phased program of gas monitoring has been completed, which obtained gas monitoring readings during varying atmospheric conditions, which covers the 'worst case' scenario for ground gas emissions to occur, particularly during rapid falls in atmospheric pressure (i.e. from c.1020mb and c.1010mb).

Monitoring of the weather conditions and predicated atmospheric pressures (Met Office Surface Pressure Charts) are carried out up to 72 hours in advance of proposed monitoring visits, in order that a reasonable period of data is obtained to determine atmospheric trends, and also to target the 'worst case' scenario. A summary of the results for the 4 no. visits undertaken, compared with the 'inert' background gas levels are presented in Table 6.3 below with a copy of the monitoring certificate attached in Appendix III.

Table 6.3

Position	Date	Atmospheric Pressure (mbar)	Water (m bgl)	CH ₄ (%v/v)	LEL (%v/v)	CO ₂ (%v/v)	O ₂ (%v/v)	Flow Rate (l/hr)
Background		~	~	0	0	0	21.0	0
WS01	21/01/2025	990 - 991 (Rising trend)	1.72	0.0	0.0	0.0	20.2	<0.1
WS03			1.70	0.0	0.0	0.1	19.2	<0.1
WS04			2.44	0.0	0.0	0.5	18.9	<0.1
WS01	06/02/2025	1039 - 1042 (Falling trend)	1.94	0.0	0.0	0.0	20.1	<0.1
WS03			1.67	0.0	0.0	0.2	19.9	<0.1
WS04			2.66	0.0	0.0	0.7	19.3	<0.1
WS01	19/02/2025	1010 - 1011 (Falling trend)	2.02	0.0	0.0	0.0	20.1	<0.1
WS03			1.79	0.0	0.0	0.3	19.4	<0.1
WS04			2.64	0.0	0.0	0.4	19.6	<0.1
WS01	05/03/2025	1016 (Falling trend)	2.04	0.0	0.0	0.0	20.4	<0.1
WS03			1.81	0.0	0.0	0.4	19.4	<0.1
WS04			2.64	0.0	0.0	0.8	19.1	<0.1

Atmospheric trend taken from www.weatheronline.com for Liverpool Airport.

From the results undertaken to date, no levels of Methane (CH₄) have been recorded during the monitoring period. However, detectable concentrations of Carbon Dioxide (CO₂) have been recorded, up to a maximum recorded level of 0.8% v/v, with slightly reduced oxygen (O₂) concentrations (minimum 18.9% v/v). Negligible flow rates (<0.1l/hr) have been recorded during the monitoring visits undertaken to date.

6.0 Insitu Testing (Cont'd)

6.3 Insitu Gas & Groundwater Monitoring (Cont'd): -

Based on the results undertaken to date, in accordance with CIRIA Report C665, an initial risk assessment has been completed for this site, by converting the results in Table 6.3 above to a gas screening value (GSV), calculated by multiplying the typical maximum gas concentrations with the recorded maximum positive flow rates (after Wilson & Card). Using the maximum values recorded, as no increased levels of Methane have been recorded, the GSV for Carbon Dioxide only has been calculated, the results of which are shown below:

$$\text{Carbon Dioxide GSV} = 0.008 (0.8\%) \times 0.1 = 0.0008 \text{ l/hr}$$

When considering these results, in accordance with CIRIA C665, the GSV for CO₂ would fall below the lower target concentration of 0.07l/hr and would equate to a Characteristic Situation 1 (CS1) site classification, resulting in no gas protective measures being required for the proposed development.

When considering the results of the groundwater monitoring, standing levels were recorded at depths of between c.1.67m to c.2.66m during the monitoring visits undertaken. These levels are likely to be reflective of 'perched' water collecting within the standpipes which will be effectively acting as a conduit for trapped surface infiltration rather than representing a shallow continuous groundwater surface below the site.

As can be seen from the results of the water monitoring undertaken and from the observations noted during the field works, shallow water ingresses may be present during future construction related excavations. Therefore, it would be prudent to allow for the introduction of suitable groundwater control measures, to take care of any localised ingresses of groundwater which may occur during the construction period, especially during the wetter periods of the year.

7.0 Laboratory Testing

All geotechnical testing was carried out in accordance with BS1377-1:2016 unless otherwise stated, at a UKAS accredited laboratory. Ground contamination screening was undertaken by a suitably experienced and qualified laboratory (UKAS and MCERTS accredited, unless otherwise stated).

7.1 Determination of pH & SO₄: -

Representative samples (10 no.) of made ground and natural deposits recovered from across the site, were tested to determine their pH value and Soluble Sulphate (SO₄) levels. The results are shown in Table 7.1 below and are also contained in the Eurofins Chemtest Limited Analytical Report (Ref No. 25-01544-3) a copy of which is attached in Appendix IV.

Table 7.1

Position	Strata	Depth (m)	pH value	SO ₄ (mg/l)	Design SO ₄ Class	ACEC Class
WS01	Made Ground	0.50	9.4	<10	DS-1	AC-1
WS01	Made Ground	1.50	8.8	28	DS-1	AC-1
WS01	Made Ground	2.25	8.9	580	DS-2	AC-2
WS01	Made Ground	3.25	8.1	38	DS-1	AC-1
WS02	Made Ground	1.50	8.6	1200	DS-2	AC-2
WS03	Made Ground	1.00	8.8	170	DS-1	AC-1
WS03	Natural Strata	2.50	7.2	88	DS-1	AC-1
WS03	Natural Strata	3.80	7.7	57	DS-1	AC-1
WS04	Made Ground	1.00	9.0	31	DS-1	AC-1
WS04	Natural Strata	3.85	7.8	24	DS-1	AC-1

ACEC = Aggressive Chemical Environment for Concrete site classification

7.0 Laboratory Testing (Cont'd)

7.1 Determination of pH & SO₄ (Cont'd): -

From these results, the samples tested range in pH from 7.2 to 9.4 and the amount of Soluble Sulphate present ranges between <10mg/l and 1200mg/l. Therefore, in accordance with BRE Special Digest 1: 2005, in a dataset of 10 samples when considering the mean of the highest 20% of values, the site should be given a classification of Class DS-2. When considering the nature of the materials tested and assuming mobile groundwater the assessment of the Aggressive Chemical Environment for Concrete (ACEC), is AC-2

7.2 Determination of Liquid & Plastic Limits: -

A representative sample of the natural clays recovered were tested to determine its liquid and plastic limits, so this material might be classified. The results can be seen in Table 7.2 below and are also contained in the PSL Analytical Report (Ref no. PSL25/0307), a copy of which is attached in Appendix IV.

Table 7.2

Position	Depth (m)	M/C (%)	LL	PL	PI	Class	% Passing 425µm Sieve
WS04	2.50	24.1	42	24	18	CIM	75

M/C = Moisture Content, LL = Liquid Limit, PL = Plastic Limit, Plastic PI = Plasticity Index, CH = Clay High

The sample tested is inorganic in nature, and when plotted on the plasticity chart, falls within the medium plasticity range, and from the resulting plasticity index, has a low volume change potential, when considering the amount passing the 425µm sieve.

Therefore, the natural clay deposits tested are unlikely to undergo significant changes in volume, if large changes in their natural moisture content were to occur due to seasonal variations or the like.

7.3 Contamination Screening / Screening Strategy: -

Representative samples of the made ground recovered from across the proposed development area were passed onto Eurofins Chemtest Ltd, so that soil contamination screening could be carried out. The samples were screened using a standard generic contamination suite (based on the current CLEA SGV listed analytes with historical additions), which is used to assess typical made ground (disturbed natural strata mixed with anthropogenic debris) of an unknown source.

Although no visual or olfactory evidence of significant hydrocarbon / fuel derived contamination was noted within the exploratory positions, for completeness and to assist in any assessment for off-site disposal classification, the samples were also tested for Speciated PAH (Polycyclic Aromatic Hydrocarbons), Speciated TPH (Total Petroleum Hydrocarbons) & Asbestos.

Following the results of the soil contamination screening, in order to determine the potential risks to Controlled Waters and adjacent sites, 2 no. water samples have been subjected to groundwater screening.

The catalogue of testing results can be found in the Eurofins Chemtest Analytical Reports (Ref Nos. 25-01544-3 & 25-02505-1), copies of which is attached in Appendix IV with the total analysis carried out summarised below:

Soils

- 4 no. soil samples screened for a generic (metals and non-organics) soil suite which includes the following determinants: Arsenic, Cadmium, Chromium (III & VI), Copper, Lead, Mercury, Nickel, Selenium, Zinc, Cyanide and Total Organic Carbon (TOC).

7.0 Laboratory Testing (Cont'd)

7.3 Contamination Screening / Screening Strategy: -

- 4 no. soil samples screened for Speciated Polycyclic Aromatic Hydrocarbons (PAH's)
- 4 no. soil samples screened for Speciated Total Petroleum Hydrocarbons (based on full Aliphatic / Aromatic Split & BTEX).
- 4 no. samples screened for the presence of Asbestos with quantification testing on 1 no. sample.

Groundwater

- 2 no. water samples screened for a generic (metals and non-organics) soil suite which includes the following determinants: Arsenic, Cadmium, Chromium (III & VI), Copper, Lead, Mercury, Nickel, Selenium, Zinc, Cyanide and Total Organic Carbon (TOC).
- 2 no. water samples screened for Speciated Polycyclic Aromatic Hydrocarbons (PAH's)
- 2 no. water samples screened for Speciated Total Petroleum Hydrocarbons (based on full Aliphatic / Aromatic Split & BTEX).

The results have been used to carry out a Level 1: Quantitative Human Health Assessment for the ground contamination present and are discussed in further detail in Section 8.0 on the following pages.

8.0 Ground Contamination Risk Assessment

8.1 Methodology: -

Following completion of the contamination screening undertaken, Level 1 quantitative ground contamination risk assessments have been undertaken, generally in accordance with BS10175:2011+A2:2017: Investigation of potentially contaminated sites – Code of practice & Land Contamination Risk Management (LCRM: October 2020).

This quantitative ground contamination risk assessment uses the current UK practice for assessing the risks from land contamination, which is based on the established *source-pathway-receptor* pollutant linkage methodology and 'suitable for use' approach (Part IIA, EPA 1990 - inserted through Section 57 EA 1995).

Based on the Conceptual Site Model (CSM) for this site (described further in Section 8.4), a site-specific screening strategy for the site has been developed (see Section 7.3) and risks from potential contaminants have been assessed for both Human Health and Controlled Waters. The results of the risk assessment can be found in Section 8.2 (Human Health) and Section 8.3 (Controlled Waters).

8.2 Level 1 Risk Assessment (Human Health): -

The soil screening results have been assessed by comparing the Maximum Concentration values (C_M) recorded for each analyte to the Critical Concentration (C_C) values chosen for this site. The results of the testing are contained in Appendix IV, and the risk assessments have been summarised in Table 8.1 below and on the following page and have identified the following.

Table 8.1

Bold = Elevated result

Analyte	Critical Conc. (C_C) mg/kg	No. of Samples Screened	Max. Conc. (C_M) recorded mg/kg	No. of Samples > C_C
Arsenic	640 ⁽¹⁾	4	99	0
Cadmium	190 ⁽¹⁾	4	0.71	0
Chromium III	8600 ⁽¹⁾	4	49	0

8.0 Ground Contamination Risk Assessment (Cont'd)

8.2 Level 1 Risk Assessment (Human Health) (Cont'd): -

Table 8.1 (Cont'd)

Bold = Elevated result

Analyte	Critical Conc. (C _c) mg/kg	No. of Samples Screened	Max. Conc. (C _M) recorded mg/kg	No. of Samples > C _c
Chromium VI	33 ⁽¹⁾	4	<0.50*	0
Copper	68000 ⁽¹⁾	4	260	0
Lead	2330 ⁽²⁾	4	5100	1 (ws01)
Mercury	1100 ⁽¹⁾	4	0.39	0
Nickel	980 ⁽¹⁾	4	69	0
Selenium	12000 ⁽¹⁾	4	5.4	0
Zinc	730000 ⁽¹⁾	4	210	0
Cyanide	34 ⁽³⁾	4	<0.50*	0
Speciated PAH's				
Acenaphthene	84000 ⁽¹⁾	4	0.18	0
Acenaphthylene	83000 ⁽¹⁾	4	<0.10*	0
Anthracene	520000 ⁽¹⁾	4	0.24	0
Benzo(a)anthracene	170 ⁽¹⁾	4	0.45	0
Benzo(a)pyrene	35 ⁽¹⁾	4	<0.10*	0
Benzo(b)fluoranthene	44 ⁽¹⁾	4	0.43	0
Benzo(ghi)perylene	3900 ⁽¹⁾	4	<0.10*	0
Benzo(k)fluoranthene	1200 ⁽¹⁾	4	0.17	0
Chrysene	350 ⁽¹⁾	4	0.46	0
Dibenz(ah)anthracene	3.5 ⁽¹⁾	4	<0.10*	0
Fluoranthene	23000 ⁽¹⁾	4	0.11	0
Fluorene	63000 ⁽¹⁾	4	0.16	0
Indeno(123cd)pyrene	500 ⁽¹⁾	4	<0.10*	0
Naphthalene	190 ⁽¹⁾	4	0.31	0
Phenanthrene	22000 ⁽¹⁾	4	1.0	0
Pyrene	54000 ⁽¹⁾	4	0.87	0
Speciated TPH's				
VPH Aliphatic (>C5-C6)	3200 ⁽¹⁾	4	<0.05*	0
VPH Aliphatic (>C6-C8)	7800 ⁽¹⁾	4	<0.10*	0
VPH Aliphatic (>C8-C10)	2000 ⁽¹⁾	4	<0.05*	0
EPH Aliphatic (>C10-C12)	9700 ⁽¹⁾	4	<2.0*	0
EPH Aliphatic (>C12-C16)	59000 ⁽¹⁾	4	4.7	0
EPH Aliphatic (>C16-C35)	1600000 ⁽¹⁾	4	14.3	0
EPH Aliphatic (>C35-C44)	1600000 ⁽¹⁾	4	<20*	0
VPH Aromatic (>EC5-EC7)	26000 ⁽¹⁾	4	<0.05*	0
VPH Aromatic (>EC7-EC8)	56000 ⁽¹⁾	4	<0.05*	0
VPH Aromatic (>EC8-EC10)	3500 ⁽¹⁾	4	<0.05*	0
EPH Aromatic (>EC10-EC12)	16000 ⁽¹⁾	4	1.7	0
EPH Aromatic (>EC12-EC16)	36000 ⁽¹⁾	4	8.1	0
EPH Aromatic (>EC16-EC21)	28000 ⁽¹⁾	4	15	0
EPH Aromatic (>EC21-EC35)	28000 ⁽¹⁾	4	4.7	0
EPH Aromatic (>EC35-EC44)	28000 ⁽¹⁾	4	<11*	0
BTEX				
Benzene	27 ⁽¹⁾	4	<1.0*	0
Toluene	56000 ⁽¹⁾	4	<1.0*	0
Ethylbenzene	57000 ⁽¹⁾	4	<1.0*	0
m&p-Xylene	5900 ⁽¹⁾	4	<1.0*	0
o-Xylene	6600 ⁽¹⁾	4	<1.0*	0
Asbestos	Presence	4	Chrysotile	1 (ws04)

⁽¹⁾ = LQM CIEH Suitable 4 Use Levels (S4UL Nov 2014 (Revised August 2015)) – Commercial – 1.0% SOM), ⁽²⁾ = C4SL Values (Commercial), ⁽³⁾ = ATRISK^{soil} SSV, ⁽⁴⁾ = Laboratory Detection Limit

8.0 Ground Contamination Risk Assessment (Cont'd)

8.2 Level 1 Risk Assessment (Human Health) (Cont'd): -

- The maximum concentration (C_M) values for Lead exceed the Critical Concentration (C_C) value taken for the site at the location of WS01 (c.2.25m bgl).
- Chrysotile Asbestos was detected within WS04 (c1.00m bgl).
- When considering the Chrysotile Asbestos recorded, further quantitative screening has been carried out on the sample of made ground where asbestos has been identified, to assess the level of risk posed to future end users. The results of this testing recorded a concentration of 0.78% w/w (WS04)

When considering these results, the made ground below the proposed development represents a potential risk to the end users where exposure pathways are available. However, when considering the proposed development layout plan, the locations of the exceedances (i.e. WS01 & WS04) will all be below areas of hardstanding post completion of the development. As a result, this will remove the pathway from the *Source-Pathway-Receptor* model therefore, removing the risks to the proposed end users.

8.3 Level 1 Risk Assessment (Controlled Waters): -

Based on the results of the soils screening carried out on the various samples chosen, groundwater screening has been carried out on a total of 2 no. water samples and the results have been used to complete a Level 1 Risk Assessment for the potential impact on Controlled Waters and adjacent sites (based on EA Remedial Targets Methodology: Hydrological Risk Assessment for Land Contamination, 2006).

The results have been assessed against appropriate EQS Fresh Water & Drinking Water Standards and are summarised in Table 8.2 below and on the following page.

Table 8.2

Bold = result exceeds Target concentration

Analyte	Target Conc. C_T ($\mu\text{g/l}$)	No. of Samples Screened	Max. Conc. ($\mu\text{g/l}$)	Has max. C_T Value Been Exceeded	No. of Samples $\geq C_T$
Generic Metals					
Arsenic	50 ⁽¹⁾	2	39	NO	0
Boron	2000 ⁽¹⁾	2	2100	YES	1_(WS01)
Cadmium	5 ⁽¹⁾	2	0.41	NO	0
Chromium	5 - 250 ⁽¹⁾	2	8.0	NO	0
Copper	1 - 28 ⁽¹⁾	2	12	NO	0
Lead	4 - 250 ⁽¹⁾	2	<0.50*	NO	0
Mercury	1 ⁽¹⁾	2	0.12	NO	0
Nickel	50 - 200 ⁽¹⁾	2	26	NO	0
Selenium	10 ⁽²⁾	2	27	YES	1_(WS04)
Zinc	8 - 500 ⁽¹⁾	2	39	NO	0
Sulphate	400mg/l ⁽¹⁾	2	270	NO	0
Cyanide	50 ⁽²⁾	2	<0.050*	NO	0
Speciated PAH					
Acenaphthene	0.1 ⁽²⁾	2	<0.10*	NO	0
Acenaphthylene	0.1 ⁽²⁾	2	<0.10*	NO	0
Anthracene	0.1 ⁽²⁾	2	<0.10*	NO	0
Benzo(a)anthracene	0.1 ⁽²⁾	2	<0.10*	NO	0
Benzo(a)pyrene	0.1 ⁽²⁾	2	<0.10*	NO	0
Benzo(b)fluoranthene	0.1 ⁽²⁾	2	<0.10*	NO	0
Benzo(ghi)perylene	0.1 ⁽²⁾	2	<0.10*	NO	0

⁽¹⁾ = UK Fresh Water Standards, ⁽²⁾ = UK Drinking Water Standards, ⁽³⁾ = World Health Organisation (WHO) Guidelines for Drinking Water Quality 1984. Where range of value given, this is dependent upon hardness of water

8.0 Ground Contamination Risk Assessment (Cont'd)

8.3 Level 1 Risk Assessment (Controlled Waters) (Cont'd): -

Table 8.2 (Cont'd)

Bold = result exceeds Target concentration

Analyte	Target Conc. C_T ($\mu\text{g/l}$)	No. of Samples Screened	Max. Conc. ($\mu\text{g/l}$)	Has max. C_T Value Been Exceeded	No. of Samples $>C_T$
Speciated PAH (Cont'd)					
Benzo(k)fluoranthene	0.1 ⁽²⁾	2	<0.10*	NO	0
Chrysene	0.1 ⁽²⁾	2	<0.10*	NO	0
Dibenz(ah)anthracene	0.1 ⁽²⁾	2	<0.10*	NO	0
Fluoranthene	0.1 ⁽²⁾	2	<0.10*	NO	0
Fluorene	0.1 ⁽²⁾	2	<0.10*	NO	0
Indeno(123cd)pyrene	0.1 ⁽²⁾	2	<0.10*	NO	0
Naphthalene	0.1 ⁽²⁾	2	<0.10*	NO	0
Phenanthrene	0.1 ⁽²⁾	2	<0.10*	NO	0
Pyrene	0.1 ⁽²⁾	2	<0.10*	NO	0
BTEX					
Benzene	30 ⁽¹⁾	2	<1*	NO	0
Toluene	50 ⁽¹⁾	2	<1*	NO	0
Ethylbenzene	300 ⁽³⁾	2	<1*	NO	0
m & p-Xylene	30 ⁽¹⁾	2	<1*	NO	0
o-Xylene	30 ⁽¹⁾	2	<1*	NO	0
Speciated TPH					
VPH Aliphatic (>C5-C6)	10 ⁽²⁾	2	<0.10*	NO	0
VPH Aliphatic (>C6-C8)	10 ⁽²⁾	2	<0.10*	NO	0
VPH Aliphatic (>C8-C10)	10 ⁽²⁾	2	<0.10*	NO	0
EPH Aliphatic (>C10-C12)	10 ⁽²⁾	2	<0.10*	NO	0
EPH Aliphatic (>C12-C16)	10 ⁽²⁾	2	<0.10*	NO	0
EPH Aliphatic (>C16-C35)	10 ⁽²⁾	2	<0.20*	NO	0
EPH Aliphatic (>C35-C44)	10 ⁽²⁾	2	<0.10*	NO	0
VPH Aromatic (>EC5-EC7)	10 ⁽²⁾	2	<0.10*	NO	0
VPH Aromatic (>EC7-EC8)	10 ⁽²⁾	2	<0.10*	NO	0
VPH Aromatic (>EC8-EC10)	10 ⁽²⁾	2	<0.10*	NO	0
EPH Aromatic (>EC10-EC12)	10 ⁽²⁾	2	<0.10*	NO	0
EPH Aromatic (>EC12-EC16)	10 ⁽²⁾	2	<0.10*	NO	0
EPH Aromatic (>EC16-EC21)	10 ⁽²⁾	2	<0.10*	NO	0
EPH Aromatic (>EC21-EC35)	10 ⁽²⁾	2	<0.10*	NO	0
EPH Aromatic (>EC35-EC44)	10 ⁽²⁾	2	<0.10*	NO	0

⁽¹⁾ = UK Fresh Water Standards, ⁽²⁾ = UK Drinking Water Standards, ⁽³⁾ = World Health Organisation (WHO) Guidelines for Drinking Water Quality 1984. ** = All VOC's & SVOC's below analytical detection limit. Where range of value given, this is dependent upon hardness of water

- C_M values for Boron and Selenium slightly exceed the Concentration Target (C_C) values taken for the site at the locations of WS01 and WS04.
- C_M values for Chromium, Copper and Zinc exceed the minimum C_T values but do not exceed the maximum C_T values.

When considering these results, although elevated levels of some metal species have been recorded, taking into account the overall environmental setting of the site (i.e. no source protection zones / abstractions within c.250m) and that the proposed re-development works will result in predominantly hardcover / surfacing across the site, it is felt that the risk to Controlled Waters and the wider environment is negligible.

8.0 Ground Contamination Risk Assessment (Cont'd)

8.4 Revised Conceptual Site Model (RCSM): -

From the findings of the results of the intrusive investigation works, a Revised Conceptual Site Model (RCSM) has been developed for this site, Table 8.3 below summarises the various contaminant *sources*, plausible migration *pathways* and potentially sensitive *receptors* identified for this site, assuming no remediation, additional protection measures and/or removal of the *sources* contamination takes place.

Table 8.3

*= Not included in the Human Health & Controlled Waters Risk Assessment.

	Sources (S)		Pathways (P)		Receptors (R)
S1	Made ground (associated with the historical on-site and adjacent developments). Elevated levels of lead and chrysotile asbestos recorded.	P1	Ingestion & Dermal Contact	R1	Human health - (End users and workforce) Not considered to be at significant risk.
S2	Potential hazardous ground gas associated with on-site / off-site sources of made ground and mine workings beneath the site. No elevated concentrations recorded	P2	Inhalation of indoor / outdoor air	R2	Controlled Waters: No shallow groundwater anticipated. Deeper groundwater in the solid geology (Secondary Aquifer – A) Not considered to be at significant risk.
		P3	Surface runoff & Water Infiltration		
S3	Potential 'hot spots' of hydrocarbon contamination associated with the sites current use as a car park. No elevated concentrations recorded	P4	Direct contact with building materials	R3	Surface water and adjacent sites
				R4*	Building materials and protection of water supply pipes.
				R5*	Flora and fauna

8.4.1 Sources: -

The site contains made ground materials (up to c.4.27m) associated with previous and adjacent development and which represents a source of ground contamination for this site. The majority of the made ground contains some anthropogenic debris mixed with disturbed natural strata, and representative samples of these materials have been assessed using a standard generic soil suite.

No visual or olfactory evidence of significant hydrocarbon / fuel derived contamination, ash, ect. was noted within the exploratory positions. However, for completeness and to assist in any assessment for off-site disposal classification, the samples were also tested for Speciated PAH (Polycyclic Aromatic Hydrocarbons), Speciated TPH (Total Petroleum Hydrocarbons) & Asbestos.

8.4.2 Pathways: -

When considering the proposed end use, and without considering treatment, removal or protection measures, there are some potential plausible pathways available for direct contact, dermal contact, ingestion, inhalation, wind (dust / particulate), volatilization, and vertical and lateral transportation below the site.

Within the CLEA Risk Assessment Model for Human Health, there are 3 exposure mediums considered for on-site receptors, comprising ingestion of soil containing contaminants, inhalation of contaminated dust / vapours and dermal contact, with up to 10 no. exposure pathways considered, as shown on the following page.

8.0 Ground Contamination Risk Assessment (Cont'd)

8.4 Revised Conceptual Site Model (CSM) (Cont'd): -

1. *Ingestion of soil and indoor dust* 2. *Consumption of homegrown produce and attached soil* 3. *Dermal contact (indoor)* 4. *Dermal contact (outdoor)* 5. *Inhalation of dust (indoor)* 6. *Inhalation of dust (outdoor)* 7. *Inhalation of vapour (indoor)* 8. *Inhalation of vapour (outdoor)* 9. *Oral background intake* 10. *Inhalation background intake.*

Where the future site has hard cover and below new structures, the majority of these pathways will not be available.

When considering the potential pathways for leachate migration, where either hard cover and / or future surface water drainage systems are present, the potential effects of surface infiltration or contaminated surface water runoff will be greatly reduced. Similarly, when considering the construction work force, exposure pathways through direct contact, ingestion and dust inhalation will be available during part of the construction process, and therefore adequate PPE should be provided to protect the work force during this period.

8.4.3 Receptors: -

Within the CLEA Risk Assessment Model for Human Health, the potential receptors are assessed initially on site end use, followed by a delineation of age category (i.e. child or adult), with default settings for *Residential*, *Allotment* and *Public Open Space (Park)* end uses based on a child aged 0 to 6 years, *Public Open Space (Residential)* based on a child aged 3 to 9 and *Commercial* end uses based upon a working exposure period of up to 49 years (i.e. 16 to 65).

Key generic assumptions for *Residential* and *Public Open Space (Residential)* are based upon a typical residential property, consisting of a two-storey small, terraced house, with private garden, and a *Commercial* end use based upon a typical commercial or light industrial property, consisting of a three-storey office building (pre-1970). No buildings are anticipated for *Allotment* or *Public Open Space (Park)* end uses.

Within the CLEA Risk Assessment Model for Human Health there are 6 no. generic end use categories presently in use, as shown on the following page.

- 1) *Residential - with home grown produce*, 2) *Residential - without home grown produce*, 3) *Allotments*, 4) *Commercial*
5) *Public Open Space – Residential*, 6) *Public Open Space – Park*

The proposed development comprises a residential dwelling with private garden and associated driveway and the Level 1 Risk Assessment has taken the end use category as:

- 4) *Commercial*

When considering the environmental setting, the primary receptor for Controlled Waters is Logwood Mill Brook, c.17m east of the site.

9.0 Conclusions & Recommendations

9.1 Ground Conditions: -

From the information gained during these intrusive ground investigation works, made ground was recorded to depths of between c.1.00m to c.4.27m below ground level (bgl) generally comprising reinforced concrete overlying light grey sandy limestone gravel. Underlain by sandy gravelly soil with anthropogenic debris.

9.0 Conclusions & Recommendations (Cont'd)

9.1 Ground Conditions (Cont'd): -

The underlying superficial deposits comprised soft, firm and stiff brown, grey and orangish brown sandy gravelly clay with coal fragments encountered to depths of between c.3.50m to c.4.00m bgl.

The solid geology was encountered within all rotary boreholes (RH01 to RH03) and windowless sample boreholes WS03 and WS04. The solid geology comprised the Pennine Middle Coal Measures and was encountered as variable bands of grey mudstone and grey siltstone (initially recovered as gravel). Thin bands of intact COAL was recorded within RH01 (c.9.50m & c.19.10m bgl), RH02 (c.6.00m & c.18.30m bgl) and RH03 (c.6.50m & c.18.60m bgl)

9.2 Groundwater: -

Groundwater ingress was noted within windowless sample boreholes WS01 and WS03 at depths of between c.1.85m and c.3.50m bgl.

When considering the results of the groundwater monitoring, standing levels were recorded at depths of between c.1.67m to c.2.66m during the monitoring visits undertaken.

As a result, shallow water ingress is likely to be encountered within future construction excavations. Therefore, it would be prudent to allow for the introduction of suitable groundwater control measures, to take care of any localised ingresses of groundwater, especially during the wetter periods of the year. Adequate trench support will be required for all excavations.

9.3 Foundation Options: -

When considering the foundation options available for the proposed development, it is considered that due to the significant depths of made ground and geotechnically poor natural deposits, conventional strip or pad foundations are unlikely to be suitable. Therefore, when considering the proposed development is for a lightweight tent structure, a raft foundation with thickened edge beam based on a minimum 300mm compacted stone designed to a maximum allowable bearing pressure of 35kN/m² should be suitable. When considering the made ground is generally granular in nature and generally consistent in terms of type, this material would not be compressible and differential settlement should not be expected.

When considering the results of the Dynamic Cone Penetrometer (DCP) tests, where the initial made ground is to be used as an undisturbed subgrade, a characteristic design CBR value of 2.50% should be adopted for any areas of hardstanding. The formation level should be proof rolled with additional stone emplaced to take care of any soft spots.

When considering the results of the pH and soluble sulphate testing, future foundations and buried concrete should be constructed utilising a concrete design class of DS-2 and ACEC class of AC-2. Recourse to the relevant utility suppliers should be made for their advice / comments regarding any service material precautions necessary.

9.4 Gas Protection Measures: -

When considering the results of the gas monitoring completed, in accordance with CIRIA C665, the GSV for CO₂ would fall below the lower target concentration of 0.07l/hr and would equate to a Characteristic Situation 1 (CS1) site classification, resulting in no gas protective measures being required for the proposed development.

9.0 Conclusions & Recommendations (Cont'd)

9.5 Ground Contamination: -

From the results of the contamination screening carried out, elevated levels of Lead have been recorded in the made ground at the location of WS01 (c.2.25m bgl) that represent a potential risk to future end users, where exposure pathways are available. In addition, Chrysotile asbestos was recorded at the locations of WS04 (c.1.00m bgl) with quantification screening recording concentrations of 0.78% w/w, respectively (within ACMs identified within the laboratory).

However, when considering the proposed development layout plan, the locations of the exceedances will all be below areas of hardstanding post completion of the development. As a result, this will remove the pathway from the *Source-Pathway-Receptor* model therefore, removing the risks to the proposed end users and no further assessment, treatment and / or protection measures should be required.

However, when considering the presence of asbestos / ACMs within one of the samples screened, precautions will need to be taken with regards to protect the health of construction workers and members of the public during any groundwork preparation. These will include but not limited to, suitable PPE (typically dust masks, disposal overalls, etc.), the dampening down of the made ground during any excavations to prevent wind-blown particles/fibres from becoming airborne (especially during dry periods), and excavations left open for a long period of time being suitably covered to prevent windblown particles / fibres escaping from open excavations, so as to provide protection for workers and the general public.

When considering the results of the leachate screening carried out, although elevated levels of Boron and Selenium have been recorded when considering the site and environmental setting with no potable groundwater abstraction or source protection zone within a plausible distance of the site, the risks to Controlled Waters is considered to be negligible.

The results can also be used by the Main Contractor / Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations. For further guidance reference should be made to the Health and Safety Executive (HSE) document EH40 / 2005 Workplace exposure limits.

9.6 Waste Classification: -

The made ground materials recorded have been assessed using Technical Guidance WM3: Guidance on the classification and assessment of Waste in conjunction with the on-line waste classification software tool HazWasteOnlineTM. Each sample has been assessed separately to determine whether all the made ground can still be considered as a single waste stream or whether different areas of the made ground represent separate waste streams.

Based on the physical (visual and olfactory) inspection of the samples recovered from the boreholes, representative samples have been assessed as either 17 05 03 (waste soil and stones containing hazardous substances) or 17 05 04 (waste soil and stones other than those mentioned in 17 05 03) from the WM3 List of Waste (LoW). The results of this assessment are summarised in Table 9.1 below, with the full Waste Classification Report also attached in Appendix V. As part of the HazWasteOnlineTM assessment a wet weight correction has been applied to the chemical screening results.

Table 9.1

<u>Position</u>	<u>Depth (m)</u>	<u>WM3 Waste Classification</u>	<u>Waste Code</u>
WS01	0.50	Non-Hazardous	17 05 04
WS01	2.25	Hazardous	17 05 03
WS03	1.00	Non-Hazardous	17 05 04
WS04	1.00	Hazardous	17 05 03

9.0 Conclusions & Recommendations (Cont'd)

9.6 Waste Classification (Cont'd): -

The results of the assessment have identified that WS01 c.2.25m can be classified as Hazardous Waste (17 05 03) due to the recorded concentrations of Lead.

In addition to the above, WS04 c.1.00m has recorded asbestos concentrations of 0.78% *w/w* above the threshold of 0.1% *w/w*, which suggests the presence of small ACMs (identified within the laboratory as 'lagging') within the made ground soils which would also have Hazardous Waste classification (17 05 03).

Due to the Hazardous Waste classification representative samples were subject to Waste Acceptance Criteria (WAC) testing to determine if these soils would meet the criteria for disposal at a hazardous waste facility. The results are included in Appendix IV.

From these results, the majority of results meet both the Non-Reactive Hazardous Waste and Hazardous Waste criteria, due to the presence of asbestos within WS04 c.1.00m, advice should be sought from the landfill of choice before being disposed of at a Non-Reactive Hazardous Waste landfill. It is recommended that the waste classification report and results of the contamination screening should be forwarded on to the chosen landfill for their comment and assessment.

It should be noted that this Waste Classification Report is only applicable to those made ground materials which have been sampled and screened as part of the assessment (excluding any relic foundations, sub-surface structures, etc.). Where possible, removal of materials from site as a 'waste' should be kept to a minimum and ideally excavated materials should all be reused on site. However, if excavated materials have to be discarded to accommodate the proposed development, additional analysis and screening should be undertaken once each specific waste stream has been identified and the volume of material to be disposed of has been calculated, since the amount of screening required, including any pre-disposal WAC screening, will be dependent upon the final volume of material to be disposed of.

9.7 UXO Risk

According to the Unexploded Bomb Risk Map produced by ZeticaUXO, the site lies within a moderate risk area in terms of unexploded ordnance (areas indicated as having 15 to 49 bombs per 1000 acre). A copy of the ZeticaUXO Unexploded Bomb Risk Map can be seen attached in Appendix VI.

A detailed UXO risk assessment report has been procured from RSK Group Limited. The results as presented in Appendix VI, infer there to be an overall low risk from German and Allied UXO, with an overall tolerable risk of harm. Therefore, recommended risk mitigation measures for any future construction related works include UXO safety awareness briefings by a UXO specialist.

9.8 General Comments: -

Where we have sampled and tested for asbestos this is discussed in the report. Whilst we would target any asbestos sampling and testing in accordance with a Conceptual Site Model and site findings, there is always the possibility, along with other contamination, that undiscovered asbestos exists between sample locations and the possibility of unknown asbestos exists on all sites, particularly brownfield sites where previous buildings have been demolished, where there were previous features that were infilled (old hollows, pits etc) or where significant quantities of materials such as demolition and brick rubble exist.

9.0 Conclusions & Recommendations (Cont'd)

9.8 General Comments (Cont'd): -

If during any site preparatory works, any visible ACMs or other previously unidentified contamination is identified or suspected, then works should stop and recourse should be made to a suitably experienced / qualified geoenvironmental engineer and / or asbestos surveyor for their advice.

It is not uncommon for historical asbestos wastes to be deliberately buried on derelict sites or imported old demolition rubble which could contain asbestos to be imported for use as hardstanding / hardcore. Unless otherwise stated we have not assessed any below ground features such as service ducts, culverts, partly demolished or dilapidated structures, spoil heaps, fly tipped materials, etc.

For future site works, adequate lateral trench support will be required for excavations, to prevent trench wall collapse or over excavations, as well as to create a safe working environment, and any excavations on this site should remain open for as short a period as possible, since some of these materials may be susceptible to deterioration, if left open to the natural elements for any significant period.

It is also recommended for any new developments, adequate surface drainage should be designed and installed by a competent contractor, to prevent surface water 'ponding' or collection, during and post construction, particularly where the existing surface drainage system is disrupted or damaged.

In addition, for deeper excavations, drainage, service runs or the like that may pass close to or beneath any proposed new foundations, these should be undertaken with care and completed prior to the preparation of any new foundations, so as not to allow any loose or granular material to move or 'flow', thus causing settlement to occur to any new foundations based at a higher level.

An "observational technique" can be applied to the design and construction of this site, and where ground conditions seem to vary from that indicated from the conceptual ground model derived from works to date, then advice from a suitably qualified Engineer should be sought.

END OF REPORT

APPENDIX I

Location Plan

Aerial Photograph

Existing Layout Plan

Proposed Development Layout Plan

Scale as shown



Client:

ALAN WOOD & PARTNERS

Project Title:

Proposed Development Veolia
Huyton Food Waste Project
Ellia Ashton Street, Liverpool

Drawing Title:

Location Plan

Job Reference:

24-787

Drawing Number:

-

Revision:

Drawn by:

P.D

Date:

04.02.25

Scale at A4:

As shown

Checked by:

S.H

Approved by:

S.H

The contractor shall check all dimensions on
site before commencement of any works.
No dimensions to be scaled off this drawing.

© Copyright Reserved

rev.	date	amendments	drawn	chckd

ARC ENVIRONMENTAL LTD

Solum House
Unit 1 Elliott Court
St. John's Road
Meadowfield
Durham
DH7 8PN

Tel: (0191) 378 6380

e-mail: admin@arc-environmental.com

web: www.arc-environmental.com





ARC ENVIRONMENTAL LTD

Solum House
Unit 1 Elliott Court
St. John's Road
Meadowfield
Durham, DH7 8PN
Tel: (0191) 378 6380
e-mail: admin@arc-environmental.com
web: www.arc-environmental.com

The contractor shall check all dimensions on site before commencement of any works. No dimensions to be scaled off this drawing.
© Copyright Reserved

LEGEND	
	APPROXIMATE SITE BOUNDARY

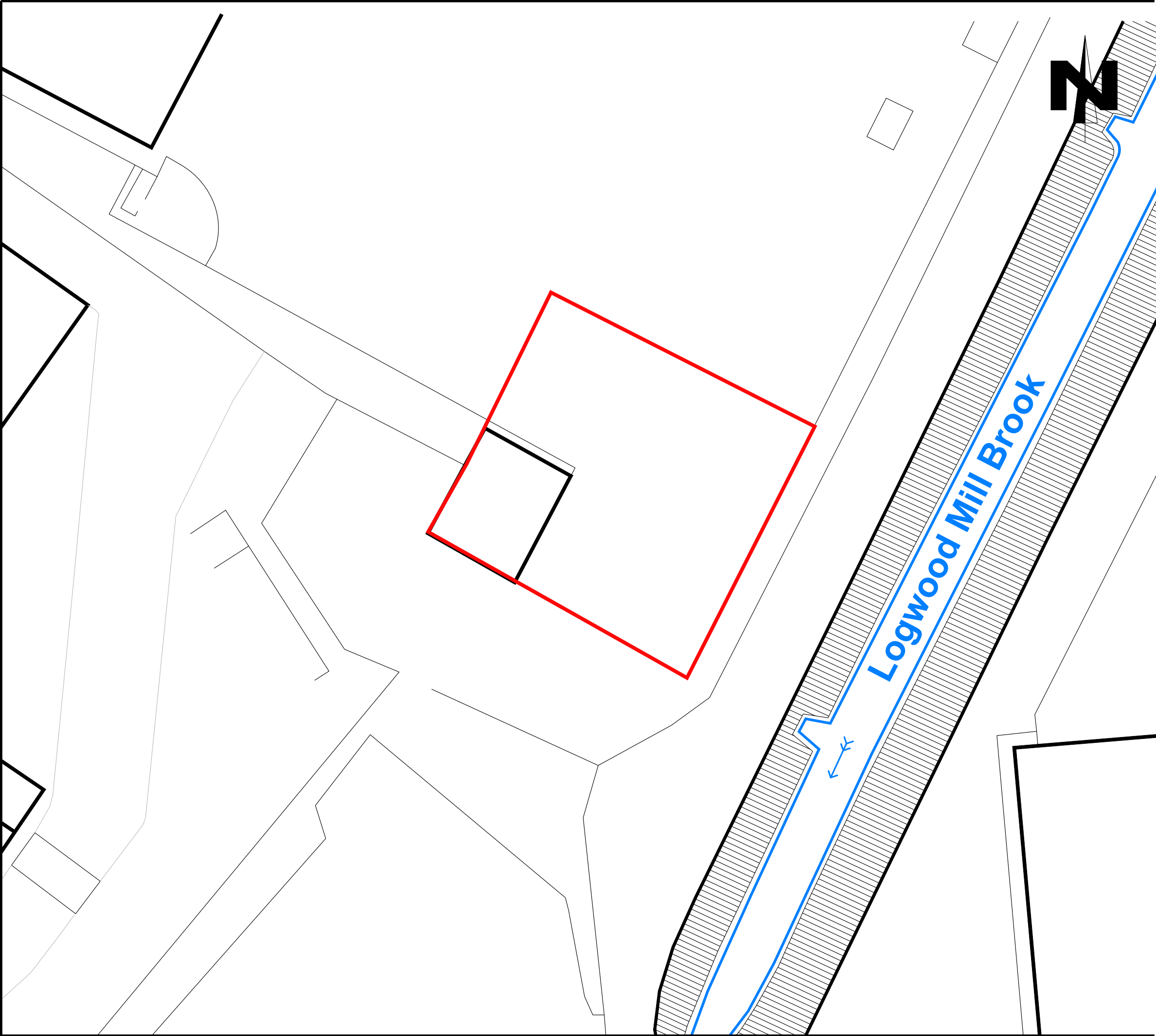
rev.	date	amendments	drawn	chckd

Client:
ALAN WOOD & PARTNERS

Project Title:
Proposed Development Veolia
Huyton Food Waste Project
Ellia Ashton Street, Liverpool, L36 6BJ

Drawing Title:
Aerial Photograph

Scale at A3: NTS @ A3	Date: 21.01.25	Drawn by: P.D	Approved by: S.H
Job Ref: 24-787	Drg no: —	Rev: —	



ARC ENVIRONMENTAL LTD

Solum House
Unit 1 Elliott Court
St. John's Road
Meadowfield
Durham, DH7 8PN
Tel: (0191) 378 6380
e-mail: admin@arc-environmental.com
web: www.arc-environmental.com

The contractor shall check all dimensions on site before commencement of any works. No dimensions to be scaled off this drawing.
© Copyright Reserved

LEGEND	
	APPROXIMATE SITE BOUNDARY

rev.	date	amendments		drawn	chckd

Client:
ALAN WOOD & PARTNERS

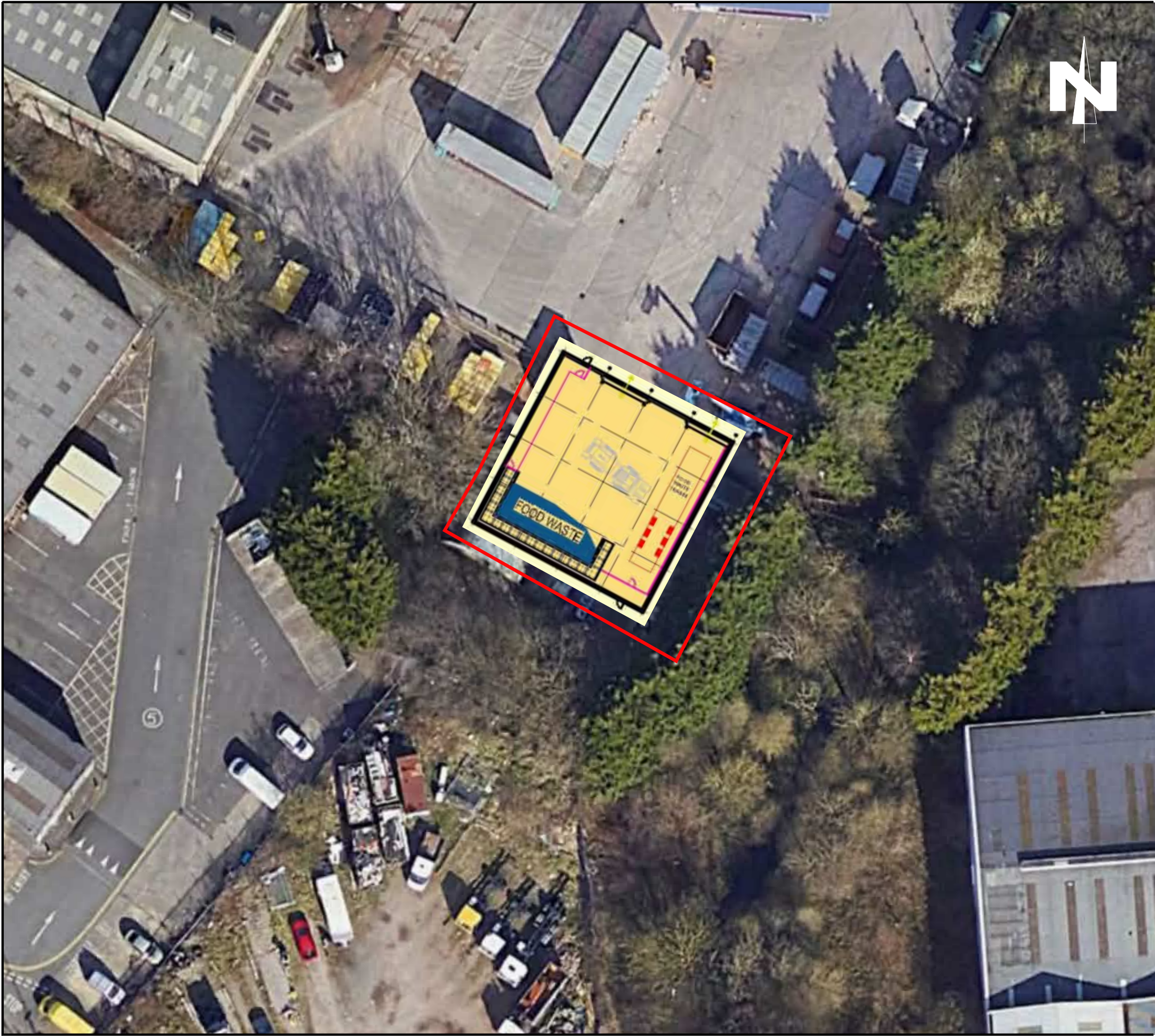
Project Title:
Proposed Development Veolia
Huyton Food Waste Project
Ellia Ashton Street, Liverpool, L36 6BJ

Drawing Title:

Existing Site Layout Plan

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	21.01.25	P.D	S.H

Job Ref:	Drg no:	Rev:
24-787	-	-



ARC ENVIRONMENTAL LTD

Solum House
Unit 1 Elliott Court
St. John's Road
Meadowfield
Durham, DH7 8PN
Tel: (0191) 378 6380
e-mail: admin@arc-environmental.com
web: www.arc-environmental.com

The contractor shall check all dimensions on site before commencement of any works. No dimensions to be scaled off this drawing.
© Copyright Reserved

LEGEND	
	APPROXIMATE SITE BOUNDARY

rev.	date	amendments	drawn	chckd

Client:
ALAN WOOD & PARTNERS

Project Title:
Proposed Development Veolia
Huyton Food Waste Project
Ellia Ashton Street, Liverpool, L36 6BJ

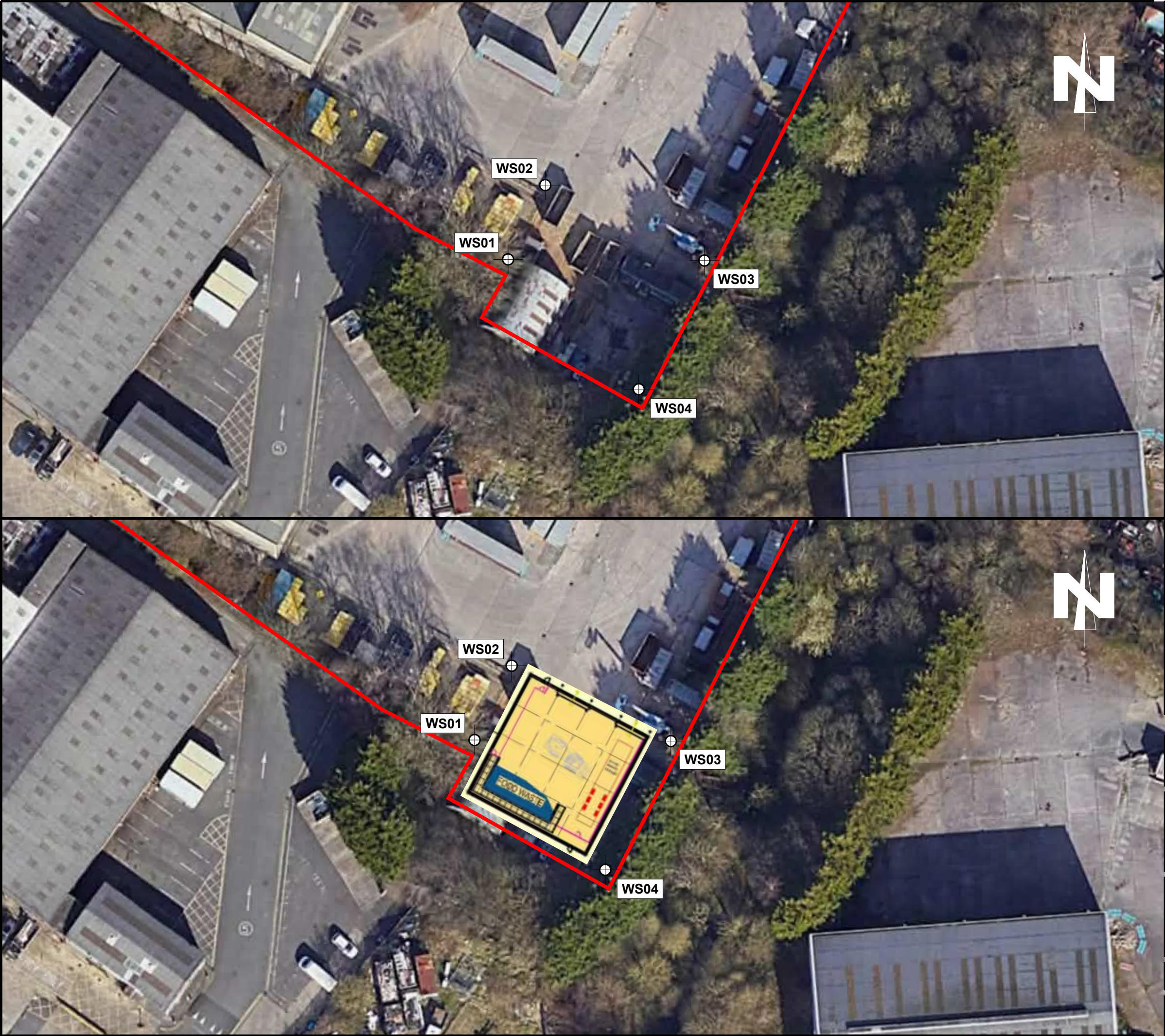
Drawing Title:
Proposed Development Layout Plan

Scale at A3: NTS @ A3	Date: 21.01.25	Drawn by: P.D	Approved by: S.H
Job Ref: 24-787	Drg no: —	Rev: —	

APPENDIX II

Exploratory Hole Location Plans

Borehole Record Sheets



ARC ENVIRONMENTAL LTD

Solum House
Unit 1 Elliott Court
St. John's Road
Meadowfield
Durham, DH7 8PN
Tel: (0191) 378 6380
e-mail: admin@arc-environmental.com
web: www.arc-environmental.com

The contractor shall check all dimensions on site before commencement of any works. No dimensions to be scaled off this drawing.
© Copyright Reserved

LEGEND	
	WIDER VEOLIA SITE BOUNDARY
	WINDOWLESS SAMPLING BOREHOLE POSITION

rev.	date	amendments			drawn chkd

Client:
ALAN WOOD & PARTNERS

Project Title:
Proposed Development Veolia
Huyton Food Waste Project
Ellia Ashton Street, Liverpool, L36 6BJ

Drawing Title:
Exploratory Hole Location Plan

Scale at A3: NTS @ A3	Date: 21.01.25	Drawn by: P.D	Approved by: S.H
--------------------------	-------------------	------------------	---------------------

Job Ref: 24-787	Drg no: —	Rev: —
--------------------	--------------	-----------



ARC ENVIRONMENTAL LTD

Solum House
Unit 1 Elliott Court
St. John's Road
Meadowfield
Durham, DH7 8PN
Tel: (0191) 378 6380
e-mail: admin@arc-environmental.com
web: www.arc-environmental.com

The contractor shall check all dimensions on site before commencement of any works. No dimensions to be scaled off this drawing.
© Copyright Reserved

LEGEND	
	WIDER VEOLIA SITE BOUNDARY
	WINDOWLESS SAMPLING BOREHOLE POSITION

rev.	date	amendments		drawn	chckd

Client:
ALAN WOOD & PARTNERS

Project Title:
Proposed Development Veolia
Huyton Food Waste Project
Ellia Ashton Street, Liverpool, L36 6BJ

Drawing Title:
Exploratory Hole Location Plan

Scale at A3: NTS @ A3	Date: 21.01.25	Drawn by: P.D	Approved by: S.H
--------------------------	-------------------	------------------	---------------------

Job Ref: 24-787	Drg no: —	Rev: —
--------------------	--------------	-----------

**BOREHOLE LOG**

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No WS01	
Job No 24-787	Date 14-01-25 14-01-25	Ground Level (m)	Co-Ordinates ()		
Contractor Arc Environmental Limited				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.50	J/D	N=12				(0.28) 0.28	Concrete with 0.01m rebar (MADE GROUND).		
0.75	J/D					(0.32) 0.60	Light grey sandy gravel. Gravel is coarse, subangular limestone (MADE GROUND) .		
1.00-1.45	SPT					(1.20)	Dark grey and mottled orange slightly gravelly silty sand. Gravel is coarse, subangular siltstone (MADE GROUND).		
1.50	B	N=34				1.80			
2.00-2.45	SPT					(0.60) 2.40	Dark grey gravelly sand. Gravel is coarse, subangular slate (MADE GROUND).		
2.25	B					(0.60) 3.00	Grey gravelly sand. Gravel is fine to coarse, subangular limestone (MADE GROUND).		
3.00-3.45	SPT	N=10				(1.27) 4.27	Brownish grey, gravelly sand. Gravel is fine to coarse, subrounded to subangular brick and limestone (MADE GROUND).		
3.25	B								
4.00 4.00-4.27	D SPT								
		60 Blows							

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											WATER OBSERVATIONS: Groundwater recorded at c.1.85m bgl after works completed.
All dimensions in metres Scale 1:31.25			Client Alan Wood and Partners			Method/ Plant Used Windowless Sampling Rig				Logged By SH	

**BOREHOLE LOG**

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No WS02	
Job No 24-787	Date 14-01-25 14-01-25	Ground Level (m)	Co-Ordinates ()		
Contractor Arc Environmental Limited				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						0.23	Concrete with 0.01m rebar (MADE GROUND).		
						0.30	Light grey sandy gravel. Gravel is coarse, subangular limestone (MADE GROUND).		
						(1.97)	Dark grey slightly gravelly silty sand. Gravel is fine to coarse, subangular brick and glass (MADE GROUND).		
1.00 1.00-1.45	D SPT	N=19							
1.50	B								
2.00-2.27	SPT	75 Blows				2.27	Possible obstruction		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											WATER OBSERVATIONS: Borehole remained dry.
All dimensions in metres Scale 1:31.25			Client Alan Wood and Partners			Method/ Plant Used Windowless Sampling Rig				Logged By SH	

**BOREHOLE LOG**

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No WS03	
Job No 24-787	Date 14-01-25 14-01-25	Ground Level (m)	Co-Ordinates ()		
Contractor Arc Environmental Limited				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
1.00	J/D SPT	N=16				0.21	Concrete with 0.01m rebar (MADE GROUND).		
1.00-1.45						(0.29) 0.50	Light grey sandy gravel. Gravel is coarse, subangular limestone (MADE GROUND) .		
						(1.50)	Dark grey slightly gravelly silty sand. Gravel is fine, subangular brick (MADE GROUND).		
2.00-2.45	SPT	N=1				2.00	Very soft, grey and orange sandy CLAY with coal fragments (GLACIAL TILL).		
2.50	B					(1.80)			
3.00-3.45	SPT	N=1				3.80			
3.50	B					(0.49)	Very weak, black carbonaceous MUDSTONE recovered as fine to coarse gravel. (PENNINE MIDDLE COAL MEASURES).		
4.00-4.29	SPT	74 Blows				4.29			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											WATER OBSERVATIONS: Groundwater encountered at c.3.50m bgl.
All dimensions in metres Scale 1:31.25			Client Alan Wood and Partners			Method/ Plant Used Windowless Sampling Rig				Logged By SH	

**BOREHOLE LOG**

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No WS04	
Job No 24-787	Date 14-01-25 14-01-25	Ground Level (m)	Co-Ordinates ()		
Contractor Arc Environmental Limited				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						0.21	Concrete with 0.01m rebar (MADE GROUND).		
1.00 1.00-1.45	B SPT	N=14				(1.09)	Reddish brown gravelly sand with a low cobble content. Gravel is fine to coarse, suangular brick and concrete. Cobbles are subangular brick and concrete. (MADE GROUND)		
						1.30 1.40	Dark grey slightly gravelly silty sand. Gravel is fine, subangular brick (MADE GROUND). Firm becoming stiff orangish brown sandy CLAY with coal fragments (GLACIAL TILL).		
2.00-2.45	SPT	N=12							
2.50	B					(2.60)			
3.00-3.45	SPT	N=26							
3.85 4.00-4.21	B SPT	75 Blows				4.00 4.21	Very Weak, highly weathered mudstone recovered as dense grey clayey gravel. Gravel is fine to coarse, subangular mudstone (PENNINE MIDDLE COAL MEASURES).		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											WATER OBSERVATIONS: Borehole remained dry.
All dimensions in metres Scale 1:31.25			Client Alan Wood and Partners			Method/ Plant Used Windowless Sampling Rig				Logged By SH	

**BOREHOLE LOG**

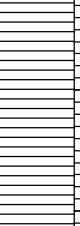
Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No RH01	
Job No 24-787	Date 11-03-25 11-03-25	Ground Level (m)	Co-Ordinates ()		
Contractor Arc Environmental Limited				Sheet 1 of 3	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						0.20	Concrete with 0.01m rebar (MADE GROUND).		
						(0.80) 1.00	Dark grey, gravelly sand. Gravel is brick. Drillers description (MADE GROUND).		
						(1.50) 2.50	Dark grey gravelly CLAY. Drillers description (GLACIAL TILL).		
						(1.20) 3.70	Light brown, sandy CLAY. Drillers description (GLACIAL TILL).		
						(3.10) 6.80	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						(2.20) 9.00	Light grey SILTSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						(0.50) 9.50	Dark grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						(0.70)	Black, intact COAL. Drillers description (PENNINE MIDDLE COAL MEASURES).		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											All descriptions based on drillers interpretations of cuttings brought to the surface and drilling rates monitored.
All dimensions in metres Scale 1:62.5			Client Alan Wood and Partners			Method/ Plant Used Open Hole Rotary			Logged By SH		

**BOREHOLE LOG**

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No RH01	
Job No 24-787	Date 11-03-25 11-03-25	Ground Level (m)	Co-Ordinates ()		
Contractor Arc Environmental Limited				Sheet 2 of 3	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						10.20	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						(2.10)			
						12.30			
						(6.40)			
						18.70	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						19.10			
						19.50			
									

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
All dimensions in metres Scale 1:62.5		Client Alan Wood and Partners				Method/ Plant Used Open Hole Rotary					Logged By SH



BOREHOLE LOG

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No RH01
Job No 24-787	Date 11-03-25 11-03-25	Ground Level (m)	Co-Ordinates ()	
Contractor Arc Environmental Limited				Sheet 3 of 3

SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)		
						(1.60)	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES). <i>(continued)</i>	
					x x x	(5.90)	Dark grey SILTSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).	
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
					x x x			
						21.10	Dark grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).	
						(3.00)	Dark grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).	
						30.00		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											All descriptions based on drillers interpretations of cuttings brought to the surface and drilling rates monitored.

All dimensions in metres Scale 1:62.5	Client Alan Wood and Partners	Method/ Plant Used Open Hole Rotary	Logged By SH
--	-------------------------------	--	--------------

AGS3 UK BH 24-787 RH LOGS.GPJ AGS3 ALL.GDT 3/24/25

**BOREHOLE LOG**

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No RH02	
Job No 24-787	Date 11-03-25 12-03-25	Ground Level (m)	Co-Ordinates ()		
Contractor Arc Environmental Limited				Sheet 1 of 3	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						0.15	Concrete with 0.01m rebar (MADE GROUND).		
						(1.25)	Dark grey, gravelly sand. Gravel is brick. Drillers description (MADE GROUND).		
						1.40			
						(2.60)	Light brown, sandy gravelly CLAY. Drillers description (GLACIAL TILL).		
						4.00			
						(2.00)	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						6.00			
						(0.90)	Black, intact COAL. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						6.90			
						(5.10)	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											All descriptions based on drillers interpretations of cuttings brought to the surface and drilling rates monitored.
All dimensions in metres Scale 1:62.5			Client Alan Wood and Partners			Method/ Plant Used Open Hole Rotary			Logged By SH		



BOREHOLE LOG

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No RH02	
Job No 24-787	Date 11-03-25 12-03-25	Ground Level (m)	Co-Ordinates ()		
Contractor Arc Environmental Limited				Sheet 2 of 3	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						12.00	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES). <i>(continued)</i>		
					x x x x	(5.60)	Light grey and light brown SILTSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						17.60			
						17.90	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						18.30	Black, intact COAL. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						(2.80)	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											All descriptions based on drillers interpretations of cuttings brought to the surface and drilling rates monitored.
All dimensions in metres Scale 1:62.5			Client Alan Wood and Partners			Method/ Plant Used Open Hole Rotary			Logged By SH		



BOREHOLE LOG

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No RH02
Job No 24-787	Date 11-03-25 12-03-25	Ground Level (m)	Co-Ordinates ()	
Contractor Arc Environmental Limited				Sheet 3 of 3

[illegible]

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											All descriptions based on drillers interpretations of cuttings brought to the surface and drilling rates monitored.

**BOREHOLE LOG**

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No RH03	
Job No 24-787	Date 12-03-25 12-03-25	Ground Level (m)	Co-Ordinates ()		
Contractor Arc Environmental Limited				Sheet 1 of 3	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						0.15	Concrete with 0.01m rebar (MADE GROUND).		
						(1.95)	Dark grey, gravelly sand. Gravel is brick. Drillers description (MADE GROUND).		
						2.10			
						(1.40)	Brown CLAY. Drillers description (GLACIAL TILL).		
						3.50			
						(1.00)	Weathered clayey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						4.50			
						(2.00)	Dark grey / black SHALE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						6.50			
						(0.90)	Black, intact COAL. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						7.40			
						(3.30)	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											All descriptions based on drillers interpretations of cuttings brought to the surface and drilling rates monitored.
All dimensions in metres Scale 1:62.5			Client Alan Wood and Partners			Method/ Plant Used Open Hole Rotary			Logged By SH		



BOREHOLE LOG

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No RH03
Job No 24-787	Date 12-03-25 12-03-25	Ground Level (m)	Co-Ordinates ()	
Contractor Arc Environmental Limited				Sheet 2 of 3

SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											All descriptions based on drillers interpretations of cuttings brought to the surface and drilling rates monitored.

Logged By	SH
-----------	----

AGS3 UK BH 24-787 RH LOGS.GPJ AGS3 ALL.GDT 3/24/25



BOREHOLE LOG

Project Proposed Development Veolia, Huyton Food waste				BOREHOLE No RH03	
Job No 24-787	Date 12-03-25 12-03-25	Ground Level (m)	Co-Ordinates ()		
Contractor Arc Environmental Limited				Sheet 3 of 3	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						(3.40)	Light grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES). <i>(continued)</i>		
						22.40			
						(4.80)	Dark grey SILTSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						27.20			
						(2.80)	Dark grey MUDSTONE. Drillers description (PENNINE MIDDLE COAL MEASURES).		
						30.00			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											All descriptions based on drillers interpretations of cuttings brought to the surface and drilling rates monitored.
All dimensions in metres Scale 1:62.5			Client Alan Wood and Partners			Method/ Plant Used Open Hole Rotary			Logged By SH		

APPENDIX III

DCP Test Results

Ground Gas and Groundwater Monitoring Certificate

Penetration Data Report

Project Name: 24-787 DCPs

Chainage (km): 1.000

Direction:

Location/Offset: Lay-by / other

Cone Angle: 60 degrees

Zero Error (mm): 0

Test Date: 14/01/2025

Surface Type:

Thickness (mm):

Base Type:

Thickness (mm):

Surface Moisture:

Moisture adjustment factor:

Unpaved

0

Unknown

Not adjusted

[illegible]

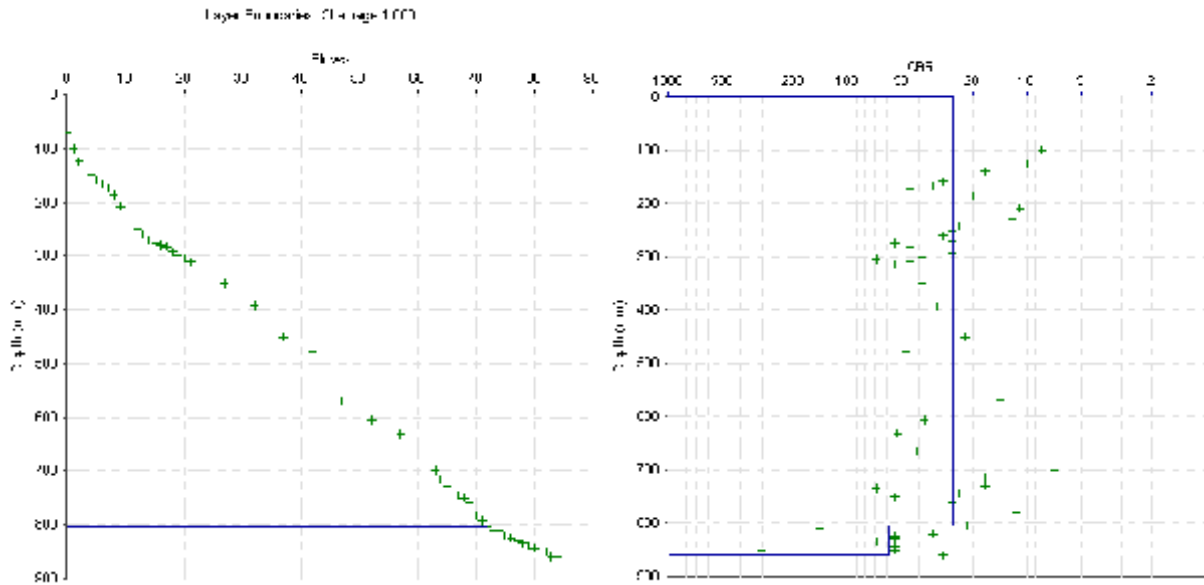
Remarks: DCP01 / WS02

DCP Layer Strength Analysis Report

Project Name: 24-787 DCPs

Chainage (km): WS02 / DCP
 Direction:
 Location/Offset: Lay-by / other
 Cone Angle: 60 degrees
 Zero Error (mm): 0
 Test Date: 14/01/2025

Surface Type: Unpaved
 Thickness (mm): 0
 Base Type:
 Thickness (mm):
 Surface Moisture: Unknown
 Moisture adjustment factor: Not adjusted



Layer Boundaries Chart

CBR Chart

Layer Properties

No.	Penetration Rate (mm/blow)	CBR (%)	Thickness (mm)	Depth to layer bottom (mm)
1	10.19	26	804	804
2	4.67	59	56	860

CBR Relationship:

TRL equation: $\log_{10}(\text{CBR}) = 2.48 - 1.057 \times \log_{10}(\text{Strength})$

Report produced by

Penetration Data Report

Project Name: 24-787 DCPs

Chainage (km):	WS02 / DCP
Direction:	
Location/Offset:	Lay-by / other
Cone Angle:	60 degrees
Zero Error (mm):	0
Test Date:	14/01/2025

Surface Type:	Unpaved
Thickness (mm):	0
Base Type:	
Thickness (mm):	
Surface Moisture:	Unknown
Moisture adjustment factor:	Not adjusted

[illegible]

Remarks: DCP01 / WS02

Arc Environmental Ground Gas & Groundwater Monitoring Certificate



Site:	FOODWASTE HUYTON
Ref:	24-787

Visit	Date	Time	Equipment	Weather	Initials	Comments	Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Trend	Methane (% v/v)		Methane (% LEL)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Hydrocarbons (GFM 435 only)		Other Gases (PPM)			
											Initial	Steady	Initial	Steady	Initial	Steady	Initial	Steady	Hex %	PID Cf	PID (Isobutylene)	H ₂ S	CO	
1	23/01/25	11.00am	GFM430	RAIN	PR		WS01	<0.1	991	Falling		0.0		0.0		0.0		20.2				0.0	0.0	1.72
							WS03	<0.1	990	Falling		0.0		0.0		0.1		19.2				0.0	0.0	1.70
							WS04	<0.1	991	Falling		0.0		0.0		0.5		18.9				0.0	0.0	2.44
2	02/06/2025	10.45am	GFM435	CLEAR	PR		WS01	<0.1	1042			0.0		0.0		0.0		20.1				0.0	0.0	1.94
							WS03	<0.1	1042			0.0		0.0		0.2		19.9				0.0	0.0	1.67
							WS04	<0.1	1039			0.0		0.0		0.7		19.3				0.0	0.0	2.66
3	19/2/25	10.30am	GFM435	OVERCAST	PR		WS01	<0.1	1011			0.0		0.0		0.0		20.1				0.0	0.0	2.02
							WS03	<0.1	1011			0.0		0.0		0.3		19.4				0.0	0.0	1.79
							WS04	<0.1	1010			0.0		0.0		0.4		19.6				0.0	0.0	2.64
4	03/05/2025	9.40am	GFM435	CLEAR	PR		WS01	<0.1	1016			0.0		0.0		0.0		20.0				0.0	0.0	2.04
							WS03	<0.1	1016			0.0		0.0		0.4		19.4				0.0	0.0	1.81
							WS04	<0.1	1016			0.0		0.0		0.8		19.1				0.0	0.0	2.64

Notes:
Detection limits - Methane = 0.0%, Carbon Dioxide = 0.0%, LEL = 0.0%, Oxygen = 0.0%, Flow = 0.1l/hr
Monitoring order is from **Left to Right** across table
Monitoring should be for **Not Less** than 3 minutes However, if high concentrations of gases initially recorded, monitoring should be for up to 10 minutes
N/A = Not applicable
= Off the scale

Cf = PID compensation Factor (1-10) - Must be used to multiply the PID reading to give an accurate measure of the total hydrocarbons in the borehole when methane is present
Hex = Hexane (Valid and in range up to 2.000%) - Recorded when abnormally high methane is present.
PID = Photo Ionisation Detector (Calibrated to Isobutylene)

APPENDIX IV

Laboratory Results

(Geotechnical and Ground Contamination)



Amended Report

Report No.:	25-01544-3		
Initial Date of Issue:	28-Jan-2025	Date of Re-Issue:	11-Feb-2025
Re-Issue Details:	This report has been revised and directly supersedes 25-01544-2 in its entirety		
Client	Arc Environmental Ltd		
Client Address:			
Contact(s):	Results		
Project	24-787 Veolia		
Quotation No.:	Q24-36354	Date Received:	20-Jan-2025
Order No.:		Date Instructed:	05-Feb-2025
No. of Samples:	10		
Turnaround (Wkdays):	5	Results Due:	11-Feb-2025
Date Approved:	11-Feb-2025		
Approved By:			

Details: David Smith, Technical Director

For details about application of accreditation to specific matrix types, please refer to the Table at the back of this report

Results - Soil

Project: 24-787 Veolia

Client: Arc Environmental Ltd		Chemtest Job No.:						25-01544	25-01544	25-01544	25-01544	25-01544	25-01544
Quotation No.: Q24-36354		Chemtest Sample ID.:						1919341	1919342	1919343	1919344	1919345	1919346
		Client Sample ID.:						WS01	WS01	WS03	WS04	WS01	WS01
		Sample Type:						SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):						0.50	2.25	1.00	1.00	1.50	3.25
		Date Sampled:						14-Jan-2025	14-Jan-2025	14-Jan-2025	14-Jan-2025	14-Jan-2025	14-Jan-2025
		Asbestos Lab:						DURHAM	DURHAM	DURHAM	DURHAM		
Determinand	HWOL Code	Accred.	SOP	Units	LOD								
Moisture		N	2030	%	0.020	5.9	23	26	12	20	18	26	
Arsenic		M	2455	mg/kg	0.5	10	98	99	3.2				
Cadmium		M	2455	mg/kg	0.10	0.71	0.52	0.42	< 0.10				
Chromium		M	2455	mg/kg	0.5	8.7	49	47	14				
Chromium (Trivalent)		N	2490	mg/kg	1.0	8.7	49	47	14				
Chromium (Hexavalent)		N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50				
Copper		M	2455	mg/kg	0.50	21	260	110	10				
Mercury		M	2455	mg/kg	0.05	0.06	0.39	0.26	< 0.05				
Nickel		M	2455	mg/kg	0.50	9.5	68	69	9.0				
Lead		M	2455	mg/kg	0.50	32	5100	99	20				
Selenium		M	2455	mg/kg	0.25	0.80	5.0	5.4	0.32				
Zinc		M	2455	mg/kg	0.50	46	210	130	28				
pH at 20C		M	2010		4.0	9.4	8.9	8.8	9.0	8.8	8.1	8.6	
Sulphate (2:1 Water Soluble) as SO4 mg/l		M	2120	mg/l	10.000	< 10	580	170	31	28	38	1200	
Cyanide (Free)		M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50				
Total Organic Carbon		M	2625	%	0.20	2.5	4.8	7.4	0.74				
Acenaphthene		M	2800	mg/kg	0.10	< 0.10	0.18	< 0.10	< 0.10				
Acenaphthylene		N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10				
Anthracene		M	2800	mg/kg	0.10	< 0.10	0.24	< 0.10	< 0.10				
Benzo[g,h,i]perylene		M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10				
Benzo[a]anthracene		M	2800	mg/kg	0.10	< 0.10	0.45	< 0.10	< 0.10				
Benzo[a]pyrene		M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10				
Benzo[b]fluoranthene		M	2800	mg/kg	0.10	< 0.10	0.43	< 0.10	< 0.10				
Benzo[k]fluoranthene		M	2800	mg/kg	0.10	< 0.10	0.17	< 0.10	< 0.10				
Chrysene		M	2800	mg/kg	0.10	< 0.10	0.46	< 0.10	< 0.10				
Dibenz(a,h)Anthracene		N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10				
Fluoranthene		M	2800	mg/kg	0.10	0.14	1.1	< 0.10	< 0.10				
Fluorene		M	2800	mg/kg	0.10	< 0.10	0.16	< 0.10	< 0.10				
Indeno(1,2,3-c,d)Pyrene		M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10				
Naphthalene		M	2800	mg/kg	0.10	0.13	0.31	< 0.10	< 0.10				
Phenanthrene		M	2800	mg/kg	0.10	0.13	1.0	< 0.10	< 0.10				
Pyrene		M	2800	mg/kg	0.10	0.14	0.87	< 0.10	< 0.10				
Total Of 16 PAH's		N	2800	mg/kg	2.0	< 2.0	5.4	< 2.0	< 2.0				
Benzene		M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0				
Toluene		M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0				
Ethylbenzene		M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0				
m & p-Xylene		M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0				
o-Xylene		M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0				
ACM Type		U	2192		N/A	-	-	-	Cement				

Results - Soil

Project: 24-787 Veolia

Client: Arc Environmental Ltd		Chemtest Job No.:		25-01544	25-01544	25-01544	25-01544	25-01544	25-01544	25-01544	25-01544
Quotation No.: Q24-36354		Chemtest Sample ID.:		1919341	1919342	1919343	1919344	1919345	1919346	1919347	
		Client Sample ID.:		WS01	WS01	WS03	WS04	WS01	WS01	WS02	
		Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	
		Top Depth (m):		0.50	2.25	1.00	1.00	1.50	3.25	1.50	
		Date Sampled:		14-Jan-2025	14-Jan-2025	14-Jan-2025	14-Jan-2025	14-Jan-2025	14-Jan-2025	14-Jan-2025	
		Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM				
Determinand	HWOL Code	Accred.	SOP	Units	LOD						
Asbestos Identification		U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	Chrysotile		
Asbestos by Gravimetry		U	2192	%	0.001				0.78		
Total Asbestos		U	2192	%	0.001				0.78		
Soil Colour		N	2040		N/A	Grey	Brown	Brown	Brown	Brown	Brown
Other Material		N	2040		N/A	Stones	Stones	Stones	Stones	Stones	None
Soil Texture		N	2040		N/A	Loam	Clay	Loam	Loam	Clay	Clay
Aliphatic VPH >C5-C6	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Aliphatic VPH >C6-C7	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Aliphatic VPH >C7-C8	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Aliphatic VPH >C6-C8 (Sum)	HS_2D_AL	N	2780	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10		
Aliphatic VPH >C8-C10	HS_2D_AL	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Total Aliphatic VPH >C5-C10	HS_2D_AL	U	2780	mg/kg	0.25	< 0.25	< 0.25	< 0.25	< 0.25		
Aliphatic EPH >C10-C12 MC	EH_2D_AL_#1	M	2690	mg/kg	2.00	< 2.0	< 2.0	< 2.0	< 2.0		
Aliphatic EPH >C12-C16 MC	EH_2D_AL_#1	M	2690	mg/kg	1.00	< 1.0	2.9	4.7	3.3		
Aliphatic EPH >C16-C21 MC	EH_2D_AL_#1	M	2690	mg/kg	2.00	< 2.0	6.0	8.8	4.1		
Aliphatic EPH >C21-C35 MC	EH_2D_AL_#1	M	2690	mg/kg	3.00	< 3.0	< 3.0	5.5	< 3.0		
Aliphatic EPH >C35-C40 MC	EH_2D_AL_#1	N	2690	mg/kg	10.00	< 10	< 10	< 10	< 10		
Aliphatic EPH >C40-C44 MC	EH_2D_AR_#1	N	2690	mg/kg	10.00	< 10	< 10	< 10	< 10		
Total Aliphatic EPH >C10-C35 MC	EH_2D_AL_#1	M	2690	mg/kg	5.00	< 5.0	11	20	8.8		
Total Aliphatic EPH >C10-C40 MC	EH_2D_AL_#1	N	2690	mg/kg	10.00	< 10	11	20	< 10		
Aromatic VPH >C5-C7	HS_2D_AR	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Aromatic VPH >C7-C8	HS_2D_AR	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Aromatic VPH >C8-C10	HS_2D_AR	U	2780	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05		
Total Aromatic VPH >C5-C10	HS_2D_AR	U	2780	mg/kg	0.25	< 0.25	< 0.25	< 0.25	< 0.25		
Aromatic EPH >C10-C12 MC	EH_2D_AR_#1	U	2690	mg/kg	1.00	< 1.0	< 1.0	< 1.0	1.7		
Aromatic EPH >C12-C16 MC	EH_2D_AR_#1	U	2690	mg/kg	1.00	< 1.0	< 1.0	1.0	8.1		
Aromatic EPH >C16-C21 MC	EH_2D_AR_#1	U	2690	mg/kg	2.00	< 2.0	< 2.0	3.0	15		
Aromatic EPH >C21-C35 MC	EH_2D_AR_#1	U	2690	mg/kg	2.00	< 2.0	< 2.0	4.7	< 2.0		
Aromatic EPH >C35-C40 MC	EH_2D_AR_#1	N	2690	mg/kg	1.00	< 1.0	< 1.0	< 1.0	< 1.0		
Aromatic EPH >C40-C44 MC	EH_2D_AR_#1	N	2690	mg/kg	10.00	< 10	< 10	< 10	< 10		
Total Aromatic EPH >C10-C35 MC	EH_2D_AR_#1	U	2690	mg/kg	5.00	< 5.0	< 5.0	8.7	25		
Total Aromatic EPH >C10-C40 MC	EH_2D_AR_#1	N	2690	mg/kg	10.00	< 10	< 10	< 10	25		
Total VPH >C5-C10	HS_2D_Total	U	2780	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50		
Total EPH >C10-C35 MC	EH_2D_Total_#1	U	2690	mg/kg	10.00	< 10	13	29	34		
Total EPH >C10-C40 MC	EH_2D_Total_#1	N	2690	mg/kg	10.00	< 10	13	29	34		
Total EPH >C10-C44 MC	EH_2D_Total_#1	N	2690	mg/kg	10.00	< 10	13	29	34		

Results - Soil

Project: 24-787 Veolia

Client: Arc Environmental Ltd		Chemtest Job No.:				25-01544	25-01544	25-01544
Quotation No.: Q24-36354		Chemtest Sample ID.:				1919348	1919349	1919350
		Client Sample ID.:				WS03	WS03	WS04
		Sample Type:				SOIL	SOIL	SOIL
		Top Depth (m):				2.50	3.80	3.85
		Date Sampled:				14-Jan-2025	14-Jan-2025	14-Jan-2025
		Asbestos Lab:						
Determinand	HWOL Code	Accred.	SOP	Units	LOD			
Moisture		N	2030	%	0.020	20	19	12
Arsenic		M	2455	mg/kg	0.5			
Cadmium		M	2455	mg/kg	0.10			
Chromium		M	2455	mg/kg	0.5			
Chromium (Trivalent)		N	2490	mg/kg	1.0			
Chromium (Hexavalent)		N	2490	mg/kg	0.50			
Copper		M	2455	mg/kg	0.50			
Mercury		M	2455	mg/kg	0.05			
Nickel		M	2455	mg/kg	0.50			
Lead		M	2455	mg/kg	0.50			
Selenium		M	2455	mg/kg	0.25			
Zinc		M	2455	mg/kg	0.50			
pH at 20C		M	2010		4.0	7.2	7.7	7.8
Sulphate (2:1 Water Soluble) as SO4 mg/l		M	2120	mg/l	10.000	88	57	24
Cyanide (Free)		M	2300	mg/kg	0.50			
Total Organic Carbon		M	2625	%	0.20			
Acenaphthene		M	2800	mg/kg	0.10			
Acenaphthylene		N	2800	mg/kg	0.10			
Anthracene		M	2800	mg/kg	0.10			
Benzo[g,h,i]perylene		M	2800	mg/kg	0.10			
Benzo[a]anthracene		M	2800	mg/kg	0.10			
Benzo[a]pyrene		M	2800	mg/kg	0.10			
Benzo[b]fluoranthene		M	2800	mg/kg	0.10			
Benzo[k]fluoranthene		M	2800	mg/kg	0.10			
Chrysene		M	2800	mg/kg	0.10			
Dibenz(a,h)Anthracene		N	2800	mg/kg	0.10			
Fluoranthene		M	2800	mg/kg	0.10			
Fluorene		M	2800	mg/kg	0.10			
Indeno(1,2,3-c,d)Pyrene		M	2800	mg/kg	0.10			
Naphthalene		M	2800	mg/kg	0.10			
Phenanthrene		M	2800	mg/kg	0.10			
Pyrene		M	2800	mg/kg	0.10			
Total Of 16 PAH's		N	2800	mg/kg	2.0			
Benzene		M	2760	µg/kg	1.0			
Toluene		M	2760	µg/kg	1.0			
Ethylbenzene		M	2760	µg/kg	1.0			
m & p-Xylene		M	2760	µg/kg	1.0			
o-Xylene		M	2760	µg/kg	1.0			
ACM Type		U	2192		N/A			

Results - Soil

Project: 24-787 Veolia

Client: Arc Environmental Ltd		Chemtest Job No.:						25-01544	25-01544	25-01544
Quotation No.: Q24-36354		Chemtest Sample ID.:						1919348	1919349	1919350
		Client Sample ID.:						WS03	WS03	WS04
		Sample Type:						SOIL	SOIL	SOIL
		Top Depth (m):						2.50	3.80	3.85
		Date Sampled:						14-Jan-2025	14-Jan-2025	14-Jan-2025
		Asbestos Lab:								
Determinand	HWOL Code	Accred.	SOP	Units	LOD					
Asbestos Identification		U	2192		N/A					
Asbestos by Gravimetry		U	2192	%	0.001					
Total Asbestos		U	2192	%	0.001					
Soil Colour		N	2040		N/A	Brown	Black	Brown		
Other Material		N	2040		N/A	None	Wood	Stones		
Soil Texture		N	2040		N/A	Clay	Loam	Clay		
Aliphatic VPH >C5-C6	HS_2D_AL	U	2780	mg/kg	0.05					
Aliphatic VPH >C6-C7	HS_2D_AL	U	2780	mg/kg	0.05					
Aliphatic VPH >C7-C8	HS_2D_AL	U	2780	mg/kg	0.05					
Aliphatic VPH >C6-C8 (Sum)	HS_2D_AL	N	2780	mg/kg	0.10					
Aliphatic VPH >C8-C10	HS_2D_AL	U	2780	mg/kg	0.05					
Total Aliphatic VPH >C5-C10	HS_2D_AL	U	2780	mg/kg	0.25					
Aliphatic EPH >C10-C12 MC	EH_2D_AL_#1	M	2690	mg/kg	2.00					
Aliphatic EPH >C12-C16 MC	EH_2D_AL_#1	M	2690	mg/kg	1.00					
Aliphatic EPH >C16-C21 MC	EH_2D_AL_#1	M	2690	mg/kg	2.00					
Aliphatic EPH >C21-C35 MC	EH_2D_AL_#1	M	2690	mg/kg	3.00					
Aliphatic EPH >C35-C40 MC	EH_2D_AL_#1	N	2690	mg/kg	10.00					
Aliphatic EPH >C40-C44 MC	EH_2D_AR_#1	N	2690	mg/kg	10.00					
Total Aliphatic EPH >C10-C35 MC	EH_2D_AL_#1	M	2690	mg/kg	5.00					
Total Aliphatic EPH >C10-C40 MC	EH_2D_AL_#1	N	2690	mg/kg	10.00					
Aromatic VPH >C5-C7	HS_2D_AR	U	2780	mg/kg	0.05					
Aromatic VPH >C7-C8	HS_2D_AR	U	2780	mg/kg	0.05					
Aromatic VPH >C8-C10	HS_2D_AR	U	2780	mg/kg	0.05					
Total Aromatic VPH >C5-C10	HS_2D_AR	U	2780	mg/kg	0.25					
Aromatic EPH >C10-C12 MC	EH_2D_AR_#1	U	2690	mg/kg	1.00					
Aromatic EPH >C12-C16 MC	EH_2D_AR_#1	U	2690	mg/kg	1.00					
Aromatic EPH >C16-C21 MC	EH_2D_AR_#1	U	2690	mg/kg	2.00					
Aromatic EPH >C21-C35 MC	EH_2D_AR_#1	U	2690	mg/kg	2.00					
Aromatic EPH >C35-C40 MC	EH_2D_AR_#1	N	2690	mg/kg	1.00					
Aromatic EPH >C40-C44 MC	EH_2D_AR_#1	N	2690	mg/kg	10.00					
Total Aromatic EPH >C10-C35 MC	EH_2D_AR_#1	U	2690	mg/kg	5.00					
Total Aromatic EPH >C10-C40 MC	EH_2D_AR_#1	N	2690	mg/kg	10.00					
Total VPH >C5-C10	HS_2D_Total	U	2780	mg/kg	0.50					
Total EPH >C10-C35 MC	EH_2D_Total_#1	U	2690	mg/kg	10.00					
Total EPH >C10-C40 MC	EH_2D_Total_#1	N	2690	mg/kg	10.00					
Total EPH >C10-C44 MC	EH_2D_Total_#1	N	2690	mg/kg	10.00					

Results - Single Stage WAC

Project: 24-787 Veolia

Chemtest Job No: 25-01544						Landfill Waste Acceptance Criteria		
Chemtest Sample ID: 1919342						Limits		
Sample Ref:						Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID: WS01								
Sample Location:								
Top Depth(m): 2.25								
Bottom Depth(m):								
Sampling Date: 14-Jan-2025								
Determinand	SOP	HWOL Code	Accred.	Units				
Total Organic Carbon	2625		M	%	4.8	3	5	6
Loss On Ignition	2610		M	%	0.50	--	--	10
Total BTEX	2760		M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815		M	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	EH_CU_1D_Total	M	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800		N	mg/kg	5.4	100	--	--
pH at 20C	2010		M		8.9	--	>6	--
Acid Neutralisation Capacity	2015		N	mol/kg	0.0090	--	To evaluate	To evaluate
Eluate Analysis				10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1455		U	0.039	0.39	0.5	2	25
Barium	1455		U	0.069	0.69	20	100	300
Cadmium	1455		U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455		U	0.0036	0.036	0.5	10	70
Copper	1455		U	0.0032	0.032	2	50	100
Mercury	1455		U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455		U	0.0041	0.041	0.5	10	30
Nickel	1455		U	0.0021	0.021	0.4	10	40
Lead	1455		U	0.0033	0.033	0.5	10	50
Antimony	1455		U	0.0088	0.088	0.06	0.7	5
Selenium	1455		U	0.0059	0.059	0.1	0.5	7
Zinc	1455		U	< 0.003	< 0.025	4	50	200
Chloride	1220		U	4.1	41	800	15000	25000
Fluoride	1220		U	0.25	2.5	10	150	500
Sulphate	1220		U	41	410	1000	20000	50000
Total Dissolved Solids	1020		N	92	920	4000	60000	100000
Phenol Index	1920		U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610		U	< 2.5	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	14

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 24-787 Veolia

Chemtest Job No: 25-01544						Landfill Waste Acceptance Criteria		
Chemtest Sample ID: 1919344						Limits		
Sample Ref:						Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID: WS04								
Sample Location:								
Top Depth(m): 1.00								
Bottom Depth(m):								
Sampling Date: 14-Jan-2025								
Determinand	SOP	HWOL Code	Accred.	Units				
Total Organic Carbon	2625		M	%	0.74	3	5	6
Loss On Ignition	2610		M	%	5.7	--	--	10
Total BTEX	2760		M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815		M	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	EH_CU_1D_Total	M	mg/kg	25	500	--	--
Total (Of 17) PAH's	2800		N	mg/kg	< 2.0	100	--	--
pH at 20C	2010		M		9.0	--	>6	--
Acid Neutralisation Capacity	2015		N	mol/kg	0.0050	--	To evaluate	To evaluate
Eluate Analysis				10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1455		U	0.0020	0.020	0.5	2	25
Barium	1455		U	0.009	0.088	20	100	300
Cadmium	1455		U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455		U	0.0043	0.043	0.5	10	70
Copper	1455		U	0.0025	0.025	2	50	100
Mercury	1455		U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455		U	0.0015	0.016	0.5	10	30
Nickel	1455		U	0.0026	0.026	0.4	10	40
Lead	1455		U	0.0013	0.013	0.5	10	50
Antimony	1455		U	< 0.0005	< 0.0050	0.06	0.7	5
Selenium	1455		U	0.0007	0.0069	0.1	0.5	7
Zinc	1455		U	< 0.003	< 0.025	4	50	200
Chloride	1220		U	3.3	33	800	15000	25000
Fluoride	1220		U	0.17	1.7	10	150	500
Sulphate	1220		U	2.9	29	1000	20000	50000
Total Dissolved Solids	1020		N	38	380	4000	60000	100000
Phenol Index	1920		U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610		U	< 2.5	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	9.8

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary	Water Accred.
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity at 25°C and Total Dissolved Solids (TDS) in Waters	Conductivity Meter	
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.	RE PW PL LE DW FW
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).	RE PW PL SW DW FW
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation	PL SW FW
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.	
2010	pH Value of Soils	pH at 20°C	pH Meter	
2015	Acid Neutralisation Capacity	Acid Reserve	Titration	
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <30°C.	
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930	
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES	
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry	
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.	
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.	
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazine.	
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.	
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.	
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID	
2690	EPH A/A Split	Aliphatics: >C10–C12, >C12–C16, >C16–C21, >C21– C35, >C35– C40 Aromatics: >C10–C12, >C12–C16, >C16–C21, >C21– C35, >C35– C40	Acetone/Heptane extraction / GCxGC FID detection	
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.	
2780	VPH A/A Split	Aliphatics: >C5–C6, >C6–C7,>C7–C8,>C8-C10 Aromatics: >C5–C7,>C7-C8,>C8–C10	Water extraction / Headspace GCxGC FID detection	
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS	

Test Methods

SOP	Title	Parameters included	Method summary	Water Accred.
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS. Reported PCB 101 results may contain contributions from PCB 90 due to inseparable chromatography.	
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge	

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

This report shall not be reproduced except in full, and only with the prior approval of the laboratory.

Any comments or interpretations are outside the scope of UKAS accreditation.

The Laboratory is not accredited for any sampling activities and reported results relate to the samples 'as received' at the laboratory.

Uncertainty of measurement for the determinands tested are available upon request .

None of the results in this report have been recovery corrected.

All results are expressed on a dry weight basis.

The following tests were analysed on samples 'as received' and the results subsequently corrected to a dry weight basis EPH, VPH, TPH, BTEX, VOCs, SVOCs, PCBs, Phenols.

For all other tests the samples were dried at $\leq 30^{\circ}\text{C}$ prior to analysis.

All Asbestos testing is performed at the indicated laboratory .

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1.

NEW_ASB Eurofins Chemtest Limited, 11 Depot Road, Newmarket, CB8 0AL

DURHAM Eurofins Chemtest Limited, Unit A North Wing, Prospect Business Park, Crookhall Lane, Consett, Co Durham, DH8 7PW

Sample Deviation Codes

A - Date of sampling not supplied

B - Sample age exceeds stability time (sampling to extraction)

C - Sample not received in appropriate containers

D - Broken Container

E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt.

All water samples will be retained for 14 days from the date of receipt.

Charges may apply to extended sample storage.

Water Sample Category Key for Accreditation

Report Information

DW - Drinking Water
GW - Ground Water
LE - Land Leachate
NA - Not Applicable
PL - Prepared Leachate
PW - Processed Water
RE - Recreational Water
SA - Saline Water
SW - Surface Water
TE - Treated Effluent
TS - Treated Sewage
UL - Unspecified Liquid

Clean Up Codes

NC - No Clean Up
MC - Mathematical Clean Up
FC - Florisil Clean Up

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 - Aromatic only
2D - GC-GC – Double coil gas chromatography
#1 - EH_2D_Total but with humics mathematically subtracted
#2 - EH_2D_Total but with fatty acids mathematically subtracted
+ - Operator to indicate cumulative e.g. EH+EH_Total or EH_CU+HS_Total

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com



Final Report

Report No.: 25-02505-1

Initial Date of Issue: 03-Feb-2025

Re-Issue Details:

Client Arc Environmental Ltd

Client Address:

Contact(s): Results

Project 24-787 Veolia, Huyton Food Waste

Quotation No.: Q24-36354

Date Received: 27-Jan-2025

Order No.:

Date Instructed: 27-Jan-2025

No. of Samples: 2

Turnaround (Wkdays): 5

Results Due: 31-Jan-2025

Date Approved: 03-Feb-2025

Approved By:

Details: Technical Director

For details about application of accreditation to specific matrix types, please refer to the Table at the back of this report

Results - Water

Project: 24-787 Veolia, Huyton Food Waste

Client: Arc Environmental Ltd		Chemtest Job No.:				25-02505	25-02505
Quotation No.: Q24-36354		Chemtest Sample ID.:				1922626	1922627
		Client Sample ID.:				WS01	WS04
		Sample Type:				WATER	WATER
		Sample Sub Type:				Ground Water	Ground Water
		Top Depth (m):				1.72	2.44
		Date Sampled:				24-Jan-2025	24-Jan-2025
		Time Sampled:				10:30	10:50
Determinand	HWOL Code	Accred.	SOP	Units	LOD		
pH at 20C		U	1010		4.0	7.4	7.6
Sulphate		U	1220	mg/l	1.0	200	270
Cyanide (Free)		U	1300	mg/l	0.050	< 0.050	< 0.050
Arsenic (Dissolved)		U	1455	µg/l	0.20	39	0.67
Boron (Dissolved)		U	1455	µg/l	10.0	2100	350
Cadmium (Dissolved)		U	1455	µg/l	0.11	< 0.11	0.41
Chromium (Dissolved)		U	1455	µg/l	0.50	8.0	7.8
Copper (Dissolved)		U	1455	µg/l	0.50	3.2	12
Mercury (Dissolved)		U	1455	µg/l	0.05	0.12	< 0.05
Nickel (Dissolved)		U	1455	µg/l	0.50	21	26
Lead (Dissolved)		U	1455	µg/l	0.50	< 0.50	< 0.50
Selenium (Dissolved)		U	1455	µg/l	0.50	27	4.6
Zinc (Dissolved)		U	1455	µg/l	2.5	5.4	39
Aliphatic TPH >C5-C6	EH_2D_AL_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C6-C8	EH_2D_AL_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C8-C10	EH_2D_AL_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C10-C12	EH_2D_AL_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C12-C16	EH_2D_AL_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C16-C21	EH_2D_AL_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C21-C35	EH_2D_AL_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C35-C44	EH_2D_AL_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Total Aliphatic Hydrocarbons	EH_2D_AL_#1	N	1675	µg/l	5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	EH_2D_AR_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C7-C8	EH_2D_AR_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C8-C10	EH_2D_AR_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C10-C12	EH_2D_AR_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C12-C16	EH_2D_AR_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C16-C21	EH_2D_AR_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C21-C35	EH_2D_AR_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C35-C44	EH_2D_AR_#1	N	1675	µg/l	0.10	< 0.10	< 0.10
Total Aromatic Hydrocarbons	EH_2D_AR_#1	N	1675	µg/l	5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	EH_2D_Total_#1	N	1675	µg/l	10	< 10	< 10
Benzene		U	1760	µg/l	1.0	< 1.0	< 1.0
Toluene		U	1760	µg/l	1.0	< 1.0	< 1.0
Ethylbenzene		U	1760	µg/l	1.0	< 1.0	< 1.0
m & p-Xylene		U	1760	µg/l	1.0	< 1.0	< 1.0
o-Xylene		U	1760	µg/l	1.0	< 1.0	< 1.0
Naphthalene		U	1800	µg/l	0.10	< 0.10	< 0.10

Results - Water

Project: 24-787 Veolia, Huyton Food Waste

Client: Arc Environmental Ltd		Chemtest Job No.:				25-02505	25-02505
Quotation No.: Q24-36354		Chemtest Sample ID.:				1922626	1922627
		Client Sample ID.:				WS01	WS04
		Sample Type:				WATER	WATER
		Sample Sub Type:				Ground Water	Ground Water
		Top Depth (m):				1.72	2.44
		Date Sampled:				24-Jan-2025	24-Jan-2025
		Time Sampled:				10:30	10:50
Determinand	HWOL Code	Accred.	SOP	Units	LOD		
Acenaphthylene		U	1800	µg/l	0.10	< 0.10	< 0.10
Acenaphthene		U	1800	µg/l	0.10	< 0.10	< 0.10
Fluorene		U	1800	µg/l	0.10	< 0.10	< 0.10
Phenanthrene		U	1800	µg/l	0.10	< 0.10	< 0.10
Anthracene		U	1800	µg/l	0.10	< 0.10	< 0.10
Fluoranthene		U	1800	µg/l	0.10	< 0.10	< 0.10
Pyrene		U	1800	µg/l	0.10	< 0.10	< 0.10
Benzo[a]anthracene		U	1800	µg/l	0.10	< 0.10	< 0.10
Chrysene		U	1800	µg/l	0.10	< 0.10	< 0.10
Benzo[b]fluoranthene		U	1800	µg/l	0.10	< 0.10	< 0.10
Benzo[k]fluoranthene		U	1800	µg/l	0.10	< 0.10	< 0.10
Benzo[a]pyrene		U	1800	µg/l	0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene		U	1800	µg/l	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene		U	1800	µg/l	0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene		U	1800	µg/l	0.10	< 0.10	< 0.10
Total Of 16 PAH's		U	1800	µg/l	2.0	< 2.0	< 2.0

Test Methods

SOP	Title	Parameters included	Method summary	Water Accred.
1010	pH Value of Waters	pH at 20°C	pH Meter	RE PW TE TS PL DW GW
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.	RE PW PL LE DW GW
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.	GW
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).	RE PW PL SW DW GW
1675	TPH Aliphatic/Aromatic split in Waters by GC-FID(cf. Texas Method 1006 / TPH CWG)	Aliphatics: >C5–C6, >C6–C8, >C8– C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Pentane extraction / GCxGC FID detection	
1760	Volatile Organic Compounds (VOCs) in Waters by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics. (cf. USEPA Method 8260)	Automated headspace gas chromatographic (GC) analysis of water samples with mass spectrometric (MS) detection of volatile organic compounds.	PL GW
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-MS	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Pentane extraction / GCMS detection	PL GW

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

This report shall not be reproduced except in full, and only with the prior approval of the laboratory.

Any comments or interpretations are outside the scope of UKAS accreditation.

The Laboratory is not accredited for any sampling activities and reported results relate to the samples 'as received' at the laboratory.

Uncertainty of measurement for the determinands tested are available upon request .

None of the results in this report have been recovery corrected.

All results are expressed on a dry weight basis.

The following tests were analysed on samples 'as received' and the results subsequently corrected to a dry weight basis EPH, VPH, TPH, BTEX, VOCs, SVOCs, PCBs, Phenols.

For all other tests the samples were dried at $\leq 30^{\circ}\text{C}$ prior to analysis.

All Asbestos testing is performed at the indicated laboratory .

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1.

NEW_ASB Eurofins Chemtest Limited, 11 Depot Road, Newmarket, CB8 0AL

DURHAM Eurofins Chemtest Limited, Unit A North Wing, Prospect Business Park, Crookhall Lane, Consett, Co Durham, DH8 7PW

Sample Deviation Codes

A - Date of sampling not supplied

B - Sample age exceeds stability time (sampling to extraction)

C - Sample not received in appropriate containers

D - Broken Container

E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt.

All water samples will be retained for 14 days from the date of receipt.

Charges may apply to extended sample storage.

Water Sample Category Key for Accreditation

Report Information

DW - Drinking Water
GW - Ground Water
LE - Land Leachate
NA - Not Applicable
PL - Prepared Leachate
PW - Processed Water
RE - Recreational Water
SA - Saline Water
SW - Surface Water
TE - Treated Effluent
TS - Treated Sewage
UL - Unspecified Liquid

Clean Up Codes

NC - No Clean Up
MC - Mathematical Clean Up
FC - Florisil Clean Up

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 - Aromatic only
2D - GC-GC – Double coil gas chromatography
#1 - EH_2D_Total but with humics mathematically subtracted
#2 - EH_2D_Total but with fatty acids mathematically subtracted
+ - Operator to indicate cumulative e.g. EH+EH_Total or EH_CU+HS_Total

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com



LABORATORY REPORT



Contract Number: PSL25/0307

Report Date: 30 January 2025
Client's Reference: 24-787
Client Name: ARC Environmental
Solum House
Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham
DH7 8PN

For the attention of: Shona Hetherington

Contract Title: Veolia, Huyton Food Waste Project

Date Received: 16/01/2025
Date Commenced: 16/01/2025
Date Completed: 30/01/2025

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Managing Director)

R Berriman
(Associate Director)

S Royle
(Laboratory Manager)

L Knight
(Assistant Laboratory Manager)

(Senior Technician)

T Watkins
(Senior Technician)

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

[illegible]

Veolia, Huyton Food Waste Project

Contract No:

PSL25/0307

Client Ref:

24-787

SUMMARY OF SOIL CLASSIFICATION TESTS

BS 1377 - Part 2 : 2022 in accordance with BS EN ISO 17892 (as below)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Water Content %	Linear Shrinkage	Particle Density Mg/m ³	Liquid Limit %	Plastic Limit %	Plasticity Index %	Passing 0.425mm %	Remarks
WS04		B	2.50		24.1			42	24	18	75	Medium Plasticity CIM

Water Content - BS 1377 - Part 2 : 2022 : Clause 4 in accordance with BS EN ISO 17892 - 1 : 2014 + A1 : 2022

Linear Shrinkage - BS 1377 - Part 2 : 2022 : Clause 7

Particle Density (Gas Jar method) - BS 1377 - Part 2 : 2022 : Clause 9

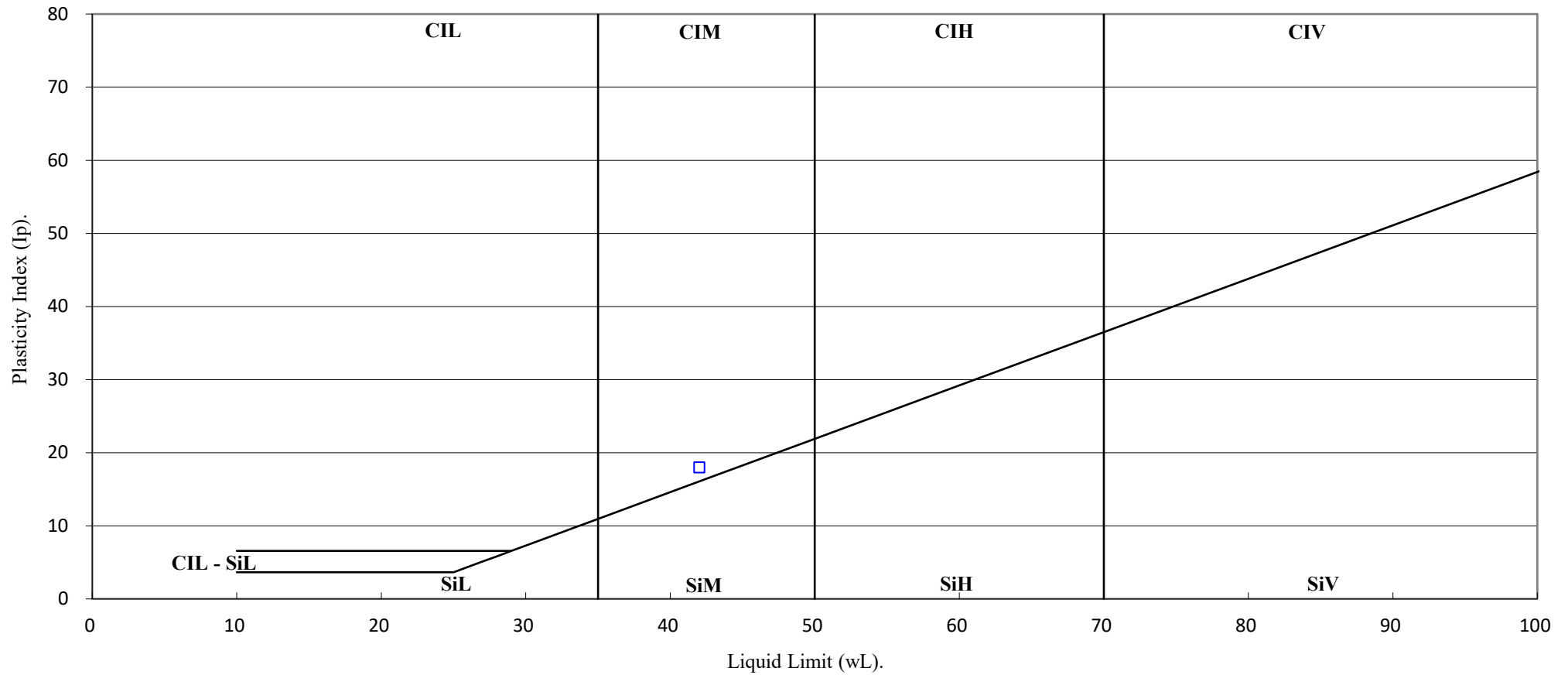
Liquid, Plastic Limit & Plasticity Index - BS 1377 - Part 2 : 2022 : Clause 5 & 6 in accordance with BS EN ISO 17892 - 12 : 2018 + A2 : 2022

SYMBOLS : NP = Non Plastic

 	Veolia, Huyton Food Waste Project	Contract No:
		PSL25/0307
		Client Ref:
		24-787

PLASTICITY CHART

BS EN ISO 14688-2:2017 Clause 4.4



Veolia, Huyton Food Waste Project

Contract No:

PSL25/0307

Client Ref:

24-787

APPENDIX V

Waste Classification Report (HazWasteOnline™)



Waste Classification Report

HazWasteOnline™ classifies waste as either **hazardous** or **non-hazardous** based on its chemical composition, related legislation and the rules and data defined in the current UK or EU technical guidance (Appendix C) (note that HP 9 Infectious is not assessed). It is the responsibility of the classifier named below to:

- understand the origin of the waste
- select the correct List of Waste code(s)
- confirm that the list of determinands, results and sampling plan are fit for purpose
- select and justify the chosen metal species (Appendix B)
- correctly apply moisture correction and other available corrections
- add the meta data for their user-defined substances (Appendix A)
- check that the classification engine is suitable with respect to the national destination of the waste (Appendix C)

To aid the reviewer, the laboratory results, assumptions and justifications managed by the classifier are highlighted in **pale yellow**.



5IXJN-T9B7V-2JRXT

Report is invalid if pages are removed.

Job name

HWOL_25-01544-20250128 155430

Description/Comments

Classification of MG for off site disposal

Project

24-787

Site

Veolia Huyton

Classified by

Name: **John Ditchburn**
Date: **04 Feb 2025 09:55 GMT**
Telephone: **0191 378 6380**
Company: **Arc Environmental Ltd**
Solum House, Unit 1, Elliott Court, St.
Johns Road
Meadowfield
DH7 8PN

HazWasteOnline™ provides a two day, hazardous waste classification course that covers the use of the software and both basic and advanced waste classification techniques. Certification has to be renewed every 3 years.

HazWasteOnline™ Certification:

CERTIFIED

Course
Hazardous Waste Classification
Most recent 3 year Refresher

Date
03 Dec 2020
05 Dec 2023

Next 3 year Refresher due by Dec 2026

Purpose of classification

2 - Material Characterisation

Address of the waste

Veolia Huyton

Post Code **N/A**

SIC for the process giving rise to the waste

41201 Construction of commercial buildings

Description of industry/producer giving rise to the waste

Construction and demolition type rubble

Description of the specific process, sub-process and/or activity that created the waste

Arising from foundation excavation, service trenches and any earthworks

Description of the waste

Limestone gravel, silty sand and gravelly sand with brick, concrete and glass fragments



Job summary

#	Sample name	Depth [m]	Classification Result	Hazard properties	Page
1	WS01-14/01/2025-0.50	0.50	Non Hazardous		3
2	WS01-14/01/2025-2.25	2.25	Hazardous	HP 7, HP 10, HP 14	6
3	WS03-14/01/2025-1.00	1.00	Non Hazardous		9
4	WS04-14/01/2025-1.00	1.00	Hazardous	HP 7	12

Related documents

#	Name	Description
1	HWOL_25-01544-20250128 155430.hwol	Eurofins Chemtest .hwol file used to populate the Job
2	Arc 2021 with acid alkali reserve	waste stream template used to create this Job

Report

Created by: John Ditchburn

Created date: 04 Feb 2025 09:55 GMT

Appendices	Page
Appendix A: Classifier defined and non GB MCL determinands	15
Appendix B: Rationale for selection of metal species	16
Appendix C: Version	17

Classification of sample: WS01-14/01/2025-0.50

✔ **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:	LoW Code:	
WS01-14/01/2025-0.50	Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
0.50 m		
Moisture content:		
5.9%		
(wet weight correction)		

Hazard properties

None identified

Determinands

Moisture content: 5.9% Wet Weight Moisture Correction applied (MC)

#		Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number							
1		arsenic { arsenic trioxide }				10 mg/kg	1.32	12.424 mg/kg	0.00124 %	✓	
		033-003-00-0	215-481-4	1327-53-3							
2		cadmium { cadmium oxide }				0.71 mg/kg	1.142	0.763 mg/kg	0.0000763 %	✓	
		048-002-00-0	215-146-2	1306-19-0							
3		chromium in chromium(III) compounds {  chromium(III) oxide (worst case) }				8.7 mg/kg	1.462	11.965 mg/kg	0.0012 %	✓	
			215-160-9	1308-38-9							
4		chromium in chromium(VI) compounds { chromium(VI) oxide }				<0.5 mg/kg	1.923	<0.962 mg/kg	<0.0000962 %		<LOD
		024-001-00-0	215-607-8	1333-82-0							
5		copper { dicopper oxide; copper (I) oxide }				21 mg/kg	1.126	22.249 mg/kg	0.00222 %	✓	
		029-002-00-X	215-270-7	1317-39-1							
6		lead {  lead compounds with the exception of those specified elsewhere in this Annex (worst case) }			1	32 mg/kg		30.112 mg/kg	0.00301 %	✓	
		082-001-00-6									
7		mercury { mercury dichloride }				0.06 mg/kg	1.353	0.0764 mg/kg	0.00000764 %	✓	
		080-010-00-X	231-299-8	7487-94-7							
8		nickel { nickel chromate }				9.5 mg/kg	2.976	26.606 mg/kg	0.00266 %	✓	
		028-035-00-7	238-766-5	14721-18-7							
9		selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }				0.8 mg/kg	1.405	1.058 mg/kg	0.000106 %	✓	
		034-002-00-8									
10		zinc { zinc chromate }				46 mg/kg	2.774	120.082 mg/kg	0.012 %	✓	
		024-007-00-3	236-878-9	13530-65-9							
11		pH				9.4 pH		9.4 pH	9.4 pH		
				PH							
12		cyanides {  salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<0.5 mg/kg	1.884	<0.942 mg/kg	<0.0000942 %		<LOD
		006-007-00-5									
13		acenaphthene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
			201-469-6	83-32-9							



#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
14	acenaphthylene	205-917-1	208-96-8		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
15	anthracene	204-371-1	120-12-7		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
16	benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
17	benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
18	benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
19	benzo[ghi]perylene	205-883-8	191-24-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
20	benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
21	chrysene	601-048-00-0	205-923-4	218-01-9	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
22	dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
23	fluoranthene	205-912-4	206-44-0		0.14 mg/kg		0.132 mg/kg	0.0000132 %	✓	
24	fluorene	201-695-5	86-73-7		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
25	indeno[123-cd]pyrene	205-893-2	193-39-5		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
26	naphthalene	601-052-00-2	202-049-5	91-20-3	0.13 mg/kg		0.122 mg/kg	0.0000122 %	✓	
27	phenanthrene	201-581-5	85-01-8		0.13 mg/kg		0.122 mg/kg	0.0000122 %	✓	
28	pyrene	204-927-3	129-00-0		0.14 mg/kg		0.132 mg/kg	0.0000132 %	✓	
29	benzene	601-020-00-8	200-753-7	71-43-2	<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
30	toluene	601-021-00-3	203-625-9	108-88-3	<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
31	ethylbenzene	601-023-00-4	202-849-4	100-41-4	<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
32	xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]	<0.002 mg/kg		<0.002 mg/kg	<0.0000002 %		<LOD
33	TPH (C6 to C40) petroleum group		TPH		<10.5 mg/kg		<10.5 mg/kg	<0.00105 %		<LOD
34	confirm TPH has NOT arisen from diesel or petrol				☒					
35	asbestos	650-013-00-6	-----	12001-28-4 132207-32-0 12172-73-5 77536-66-4 77536-68-6 77536-67-5 12001-29-5	< mg/kg		< mg/kg	<		ND
Total:								0.0239 %		



Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

Classification of sample: WS01-14/01/2025-2.25

Hazardous Waste
Classified as **17 05 03 ***
in the List of Waste

Sample details

Sample name:	LoW Code:
WS01-14/01/2025-2.25	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
2.25 m	Entry:
Moisture content:	17 05 03 * (Soil and stones containing hazardous substances)
23%	
(wet weight correction)	

Hazard properties

HP 7: Carcinogenic "waste which induces cancer or increases its incidence"

Hazard Statements hit:

Carc. 1A; H350 "May cause cancer [state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard]."

Because of determinand:

lead compounds with the exception of those specified elsewhere in this Annex (worst case) (Note 1 conc.: 0.393%)

HP 10: Toxic for reproduction "waste which has adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in the offspring"

Hazard Statements hit:

Repr. 1A; H360Df "May damage the unborn child. Suspected of damaging fertility."

Because of determinand:

lead compounds with the exception of those specified elsewhere in this Annex (worst case) (Note 1 conc.: 0.393%)

HP 14: Ecotoxic "waste which presents or may present immediate or delayed risks for one or more sectors of the environment"

Hazard Statements hit:

Aquatic Chronic 1; H410 "Very toxic to aquatic life with long lasting effects."

Because of determinand:

lead compounds with the exception of those specified elsewhere in this Annex (worst case) (Note 1 conc.: 0.393%)

Determinands

Moisture content: 23% Wet Weight Moisture Correction applied (MC)

#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
1	arsenic { arsenic trioxide }				98 mg/kg	1.32	99.632 mg/kg	0.00996 %	✓	
	033-003-00-0	215-481-4	1327-53-3							
2	cadmium { cadmium oxide }				0.52 mg/kg	1.142	0.457 mg/kg	0.0000457 %	✓	
	048-002-00-0	215-146-2	1306-19-0							
3	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				49 mg/kg	1.462	55.144 mg/kg	0.00551 %	✓	
		215-160-9	1308-38-9							
4	chromium in chromium(VI) compounds { chromium(VI) oxide }				<0.5 mg/kg	1.923	<0.962 mg/kg	<0.0000962 %		<LOD
	024-001-00-0	215-607-8	1333-82-0							
5	copper { dicopper oxide; copper (I) oxide }				260 mg/kg	1.126	225.403 mg/kg	0.0225 %	✓	
	029-002-00-X	215-270-7	1317-39-1							



#	Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number									
6	lead { lead compounds with the exception of those specified elsewhere in this Annex (worst case) }			1	5100	mg/kg		3927	mg/kg	0.393 %	✓	
	082-001-00-6											
7	mercury { mercury dichloride }				0.39	mg/kg	1.353	0.406	mg/kg	0.0000406 %	✓	
	080-010-00-X	231-299-8	7487-94-7									
8	nickel { nickel chromate }				68	mg/kg	2.976	155.837	mg/kg	0.0156 %	✓	
	028-035-00-7	238-766-5	14721-18-7									
9	selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }				5	mg/kg	1.405	5.409	mg/kg	0.000541 %	✓	
	034-002-00-8											
10	zinc { zinc chromate }				210	mg/kg	2.774	448.579	mg/kg	0.0449 %	✓	
	024-007-00-3	236-878-9	13530-65-9									
11	pH				8.9	pH		8.9	pH	8.9 pH		
			PH									
12	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<0.5	mg/kg	1.884	<0.942	mg/kg	<0.0000942 %		<LOD
	006-007-00-5											
13	acenaphthene				0.18	mg/kg		0.139	mg/kg	0.0000139 %	✓	
		201-469-6	83-32-9									
14	acenaphthylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		205-917-1	208-96-8									
15	anthracene				0.24	mg/kg		0.185	mg/kg	0.0000185 %	✓	
		204-371-1	120-12-7									
16	benzo[a]anthracene				0.45	mg/kg		0.347	mg/kg	0.0000346 %	✓	
	601-033-00-9	200-280-6	56-55-3									
17	benzo[a]pyrene; benzo[def]chrysene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
	601-032-00-3	200-028-5	50-32-8									
18	benzo[b]fluoranthene				0.43	mg/kg		0.331	mg/kg	0.0000331 %	✓	
	601-034-00-4	205-911-9	205-99-2									
19	benzo[ghi]perylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		205-883-8	191-24-2									
20	benzo[k]fluoranthene				0.17	mg/kg		0.131	mg/kg	0.0000131 %	✓	
	601-036-00-5	205-916-6	207-08-9									
21	chrysene				0.46	mg/kg		0.354	mg/kg	0.0000354 %	✓	
	601-048-00-0	205-923-4	218-01-9									
22	dibenz[a,h]anthracene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
	601-041-00-2	200-181-8	53-70-3									
23	fluoranthene				1.1	mg/kg		0.847	mg/kg	0.0000847 %	✓	
		205-912-4	206-44-0									
24	fluorene				0.16	mg/kg		0.123	mg/kg	0.0000123 %	✓	
		201-695-5	86-73-7									
25	indeno[123-cd]pyrene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
		205-893-2	193-39-5									
26	naphthalene				0.31	mg/kg		0.239	mg/kg	0.0000239 %	✓	
	601-052-00-2	202-049-5	91-20-3									
27	phenanthrene				1	mg/kg		0.77	mg/kg	0.000077 %	✓	
		201-581-5	85-01-8									
28	pyrene				0.87	mg/kg		0.67	mg/kg	0.000067 %	✓	
		204-927-3	129-00-0									
29	benzene				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		<LOD
	601-020-00-8	200-753-7	71-43-2									
30	toluene				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		<LOD
	601-021-00-3	203-625-9	108-88-3									
31	ethylbenzene				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		<LOD
	601-023-00-4	202-849-4	100-41-4									



#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
32	xylene 601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.002 mg/kg		<0.002 mg/kg	<0.0000002 %		<LOD
33	TPH (C6 to C40) petroleum group				13 mg/kg		10.01 mg/kg	0.001 %	✓	
34	confirm TPH has NOT arisen from diesel or petrol				☒					
35	asbestos 650-013-00-6	-----	12001-28-4 132207-32-0 12172-73-5 77536-66-4 77536-68-6 77536-67-5 12001-29-5		< mg/kg		< mg/kg	<		ND
Total:								0.493 %		

Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Hazardous result
•	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and <= 75°C"

Force this Hazardous Property to non-hazardous for cumulative determinand results below the threshold of: 1000 mg/kg (0.1%)
because: No liquid phase; too low to be flammable

Hazard Statements hit:

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinand:

TPH (C6 to C40) petroleum group (conc.: 0.001%)

Classification of sample: WS03-14/01/2025-1.00

✔ **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:	LoW Code:	
WS03-14/01/2025-1.00	Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:	Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
1.00 m		
Moisture content:		
26%		
(wet weight correction)		

Hazard properties

None identified

Determinands

Moisture content: 26% Wet Weight Moisture Correction applied (MC)

#		Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number								
1		arsenic { arsenic trioxide }				99 mg/kg	1.32	96.727 mg/kg	0.00967 %	✓		
		033-003-00-0	215-481-4	1327-53-3								
2		cadmium { cadmium oxide }										
		048-002-00-0	215-146-2	1306-19-0								
3		chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				47 mg/kg	1.462	50.833 mg/kg	0.00508 %	✓		
			215-160-9	1308-38-9								
4		chromium in chromium(VI) compounds { chromium(VI) oxide }										<0.5 mg/kg
		024-001-00-0	215-607-8	1333-82-0								
5		copper { dicopper oxide; copper (I) oxide }			110 mg/kg	1.126	91.647 mg/kg	0.00916 %	✓			
		029-002-00-X	215-270-7	1317-39-1								
6		lead { lead compounds with the exception of those specified elsewhere in this Annex (worst case) }									1	99 mg/kg
		082-001-00-6										
7		mercury { mercury dichloride }			0.26 mg/kg	1.353	0.26 mg/kg	0.000026 %	✓			
		080-010-00-X	231-299-8	7487-94-7								
8		nickel { nickel chromate }									69 mg/kg	2.976
		028-035-00-7	238-766-5	14721-18-7								
9		selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }			5.4 mg/kg	1.405	5.614 mg/kg	0.000561 %	✓			
		034-002-00-8										
10		zinc { zinc chromate }									130 mg/kg	2.774
		024-007-00-3	236-878-9	13530-65-9								
11		pH			8.8 pH		8.8 pH	8.8 pH				
12		cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<0.5 mg/kg	1.884	<0.942 mg/kg	<0.0000942 %		<LOD	
		006-007-00-5										
13		acenaphthene										<0.1 mg/kg
			201-469-6	83-32-9								



#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number							
14	acenaphthylene	205-917-1	208-96-8		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
15	anthracene	204-371-1	120-12-7		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
16	benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
17	benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
18	benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
19	benzo[ghi]perylene	205-883-8	191-24-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
20	benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
21	chrysene	601-048-00-0	205-923-4	218-01-9	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
22	dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
23	fluoranthene	205-912-4	206-44-0		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
24	fluorene	201-695-5	86-73-7		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
25	indeno[123-cd]pyrene	205-893-2	193-39-5		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
26	naphthalene	601-052-00-2	202-049-5	91-20-3	<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
27	phenanthrene	201-581-5	85-01-8		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
28	pyrene	204-927-3	129-00-0		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
29	benzene	601-020-00-8	200-753-7	71-43-2	<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
30	toluene	601-021-00-3	203-625-9	108-88-3	<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
31	ethylbenzene	601-023-00-4	202-849-4	100-41-4	<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
32	xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]	<0.002 mg/kg		<0.002 mg/kg	<0.0000002 %		<LOD
33	TPH (C6 to C40) petroleum group		TPH		29 mg/kg		21.46 mg/kg	0.00215 %	✓	
34	confirm TPH has NOT arisen from diesel or petrol				☒					
35	asbestos	650-013-00-6	-----	12001-28-4 132207-32-0 12172-73-5 77536-66-4 77536-68-6 77536-67-5 12001-29-5	< mg/kg		< mg/kg	<		ND
Total:								0.0763 %		



Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
■	Determinand defined or amended by HazWasteOnline (see Appendix A)
■	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and <= 75°C"

Force this Hazardous Property to non-hazardous for cumulative determinand results below the threshold of: 1000 mg/kg (0.1%)
because: No liquid phase; too low to be flammable

Hazard Statements hit:

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinand:

TPH (C6 to C40) petroleum group (conc.: 0.00215%)

Classification of sample: WS04-14/01/2025-1.00

 **Hazardous Waste**
Classified as **17 05 03 ***
in the List of Waste

Sample details

Sample name:	LoW Code:
WS04-14/01/2025-1.00	Chapter:
Sample Depth:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
1.00 m	Entry:
Moisture content:	17 05 03 * (Soil and stones containing hazardous substances)
12%	
(wet weight correction)	

Hazard properties

HP 7: Carcinogenic "waste which induces cancer or increases its incidence"

Hazard Statements hit:

Carc. 1A; H350 "May cause cancer [state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard]."

Because of determinand:

asbestos (conc.: 0.686%)

Determinands

Moisture content: 12% Wet Weight Moisture Correction applied (MC)

#		Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number							
1		arsenic { arsenic trioxide }				3.2 mg/kg	1.32	3.718 mg/kg	0.000372 %	✓	
		033-003-00-0	215-481-4	1327-53-3							
2		cadmium { cadmium oxide }				<0.1 mg/kg	1.142	<0.114 mg/kg	<0.0000114 %		<LOD
		048-002-00-0	215-146-2	1306-19-0							
3		chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				14 mg/kg	1.462	18.006 mg/kg	0.0018 %	✓	
			215-160-9	1308-38-9							
4		chromium in chromium(VI) compounds { chromium(VI) oxide }				<0.5 mg/kg	1.923	<0.962 mg/kg	<0.0000962 %		<LOD
		024-001-00-0	215-607-8	1333-82-0							
5		copper { dicopper oxide; copper (I) oxide }				10 mg/kg	1.126	9.908 mg/kg	0.000991 %	✓	
		029-002-00-X	215-270-7	1317-39-1							
6		lead { lead compounds with the exception of those specified elsewhere in this Annex (worst case) }			1	20 mg/kg		17.6 mg/kg	0.00176 %	✓	
		082-001-00-6									
7		mercury { mercury dichloride }				<0.05 mg/kg	1.353	<0.0677 mg/kg	<0.00000677 %		<LOD
		080-010-00-X	231-299-8	7487-94-7							
8		nickel { nickel chromate }				9 mg/kg	2.976	23.572 mg/kg	0.00236 %	✓	
		028-035-00-7	238-766-5	14721-18-7							
9		selenium { selenium compounds with the exception of cadmium sulphoselenide and those specified elsewhere in this Annex }				0.32 mg/kg	1.405	0.396 mg/kg	0.0000396 %	✓	
		034-002-00-8									
10		zinc { zinc chromate }				28 mg/kg	2.774	68.355 mg/kg	0.00684 %	✓	
		024-007-00-3	236-878-9	13530-65-9							
11		pH		PH		9 pH		9 pH	9pH		



#	Determinand			CLP Note	User entered data	Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
	EU CLP index number	EC Number	CAS Number								
12	cyanides { salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex }				<0.5 mg/kg	1.884	<0.942 mg/kg	<0.0000942 %			<LOD
	006-007-00-5										
13	acenaphthene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
		201-469-6	83-32-9								
14	acenaphthylene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
		205-917-1	208-96-8								
15	anthracene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
		204-371-1	120-12-7								
16	benzo[a]anthracene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
	601-033-00-9	200-280-6	56-55-3								
17	benzo[a]pyrene; benzo[def]chrysene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
	601-032-00-3	200-028-5	50-32-8								
18	benzo[b]fluoranthene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
	601-034-00-4	205-911-9	205-99-2								
19	benzo[ghi]perylene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
		205-883-8	191-24-2								
20	benzo[k]fluoranthene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
	601-036-00-5	205-916-6	207-08-9								
21	chrysene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
	601-048-00-0	205-923-4	218-01-9								
22	dibenz[a,h]anthracene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
	601-041-00-2	200-181-8	53-70-3								
23	fluoranthene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
		205-912-4	206-44-0								
24	fluorene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
		201-695-5	86-73-7								
25	indeno[123-cd]pyrene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
		205-893-2	193-39-5								
26	naphthalene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
	601-052-00-2	202-049-5	91-20-3								
27	phenanthrene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
		201-581-5	85-01-8								
28	pyrene				<0.1 mg/kg		<0.1 mg/kg	<0.00001 %			<LOD
		204-927-3	129-00-0								
29	benzene				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %			<LOD
	601-020-00-8	200-753-7	71-43-2								
30	toluene				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %			<LOD
	601-021-00-3	203-625-9	108-88-3								
31	ethylbenzene				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %			<LOD
	601-023-00-4	202-849-4	100-41-4								
32	xylene				<0.002 mg/kg		<0.002 mg/kg	<0.0000002 %			<LOD
	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]								
33	TPH (C6 to C40) petroleum group				34 mg/kg		29.92 mg/kg	0.00299 %		✓	
			TPH								
34	confirm TPH has NOT arisen from diesel or petrol				☒						
35	asbestos				7800 mg/kg		6864 mg/kg	0.686 %		✓	
	650-013-00-6	-----	12001-28-4 132207-32-0 12172-73-5 77536-66-4 77536-68-6 77536-67-5 12001-29-5								
Total:									0.704 %		



Key

	User supplied data
	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
	Hazardous result
	Determinand defined or amended by HazWasteOnline (see Appendix A)
	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
CLP: Note 1	Only the metal concentration has been used for classification

Supplementary Hazardous Property Information

HP 3(i): Flammable "flammable liquid waste: liquid waste having a flash point below 60°C or waste gas oil, diesel and light heating oils having a flash point > 55°C and <= 75°C"

Force this Hazardous Property to non-hazardous for cumulative determinand results below the threshold of: 1000 mg/kg (0.1%)
because: No liquid phase; too low to be flammable

Hazard Statements hit:

Flam. Liq. 3; H226 "Flammable liquid and vapour."

Because of determinand:

TPH (C6 to C40) petroleum group (conc.: 0.00299%)

Appendix A: Classifier defined and non GB MCL determinands

• **chromium(III) oxide (worst case)** (EC Number: 215-160-9, CAS Number: 1308-38-9)

Description/Comments: Data from C&L Inventory Database

Data source: <https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/33806>

Data source date: 17 Jul 2015

Hazard Statements: Acute Tox. 4; H332 , Acute Tox. 4; H302 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Resp. Sens. 1; H334 , Skin Sens. 1; H317 , Repr. 1B; H360FD , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

• **lead compounds with the exception of those specified elsewhere in this Annex (worst case)**

GB MCL index number: 082-001-00-6

Description/Comments: Worst Case: IARC considers lead compounds Group 2A; Probably carcinogenic to humans; Lead REACH Consortium, following MCL protocols, considers lead compounds from smelting industries, flue dust and similar to be Carcinogenic category 1A

Additional Hazard Statement(s): Carc. 1A; H350

Reason for additional Hazards Statement(s):

20 Nov 2021 - Carc. 1A; H350 hazard statement sourced from: IARC Group 2A (Sup 7, 87) 2006; Lead REACH Consortium www.reach-lead.eu/substanceinformation.html (worst case lead compounds). Review date 29/09/2015

• **pH** (CAS Number: PH)

Description/Comments: Appendix C4

Data source: WM3 1st Edition 2015

Data source date: 25 May 2015

Hazard Statements: None.

• **salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex**

GB MCL index number: 006-007-00-5

Description/Comments: Conversion factor based on a worst case compound: sodium cyanide

Additional Hazard Statement(s): EUH032 >= 0.2 %

Reason for additional Hazards Statement(s):

20 Nov 2021 - EUH032 >= 0.2 % hazard statement sourced from: WM3, Table C12.2

• **acenaphthene** (EC Number: 201-469-6, CAS Number: 83-32-9)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 17 Jul 2015

Hazard Statements: Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410 , Aquatic Chronic 2; H411

• **acenaphthylene** (EC Number: 205-917-1, CAS Number: 208-96-8)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 17 Jul 2015

Hazard Statements: Acute Tox. 4; H302 , Acute Tox. 1; H330 , Acute Tox. 1; H310 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315

• **anthracene** (EC Number: 204-371-1, CAS Number: 120-12-7)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 17 Jul 2015

Hazard Statements: Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Skin Sens. 1; H317 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

• **benzo[ghi]perylene** (EC Number: 205-883-8, CAS Number: 191-24-2)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 28/02/2015

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 23 Jul 2015

Hazard Statements: Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

• **fluoranthene** (EC Number: 205-912-4, CAS Number: 206-44-0)

Description/Comments: Data from C&L Inventory Database

Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>

Data source date: 21 Aug 2015

Hazard Statements: Acute Tox. 4; H302 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

■ **fluorene** (EC Number: 201-695-5, CAS Number: 86-73-7)

Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 06 Aug 2015
Hazard Statements: Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

■ **indeno[123-cd]pyrene** (EC Number: 205-893-2, CAS Number: 193-39-5)

Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 06 Aug 2015
Hazard Statements: Carc. 2; H351

■ **phenanthrene** (EC Number: 201-581-5, CAS Number: 85-01-8)

Description/Comments: Data from C&L Inventory Database
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 06 Aug 2015
Hazard Statements: Acute Tox. 4; H302 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Carc. 2; H351 , Skin Sens. 1; H317 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410 , Skin Irrit. 2; H315

■ **pyrene** (EC Number: 204-927-3, CAS Number: 129-00-0)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 2014
Data source: <http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database>
Data source date: 21 Aug 2015
Hazard Statements: Skin Irrit. 2; H315 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

■ **ethylbenzene** (EC Number: 202-849-4, CAS Number: 100-41-4)

GB MCL index number: 601-023-00-4
Description/Comments:
Additional Hazard Statement(s): Carc. 2; H351
Reason for additional Hazards Statement(s):
20 Nov 2021 - Carc. 2; H351 hazard statement sourced from: IARC Group 2B (77) 2000

■ **TPH (C6 to C40) petroleum group** (CAS Number: TPH)

Description/Comments: Hazard statements taken from WM3 1st Edition 2015; Risk phrases: WM2 3rd Edition 2013
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Hazard Statements: Flam. Liq. 3; H226 , Asp. Tox. 1; H304 , STOT RE 2; H373 , Muta. 1B; H340 , Carc. 1B; H350 , Repr. 2; H361d , Aquatic Chronic 2; H411

■ **confirm TPH has NOT arisen from diesel or petrol**

Description/Comments: Chapter 3, section 4b requires a positive confirmation for benzo[a]pyrene to be used as a marker in evaluating Carc. 1B; H350 (HP 7) and Muta. 1B; H340 (HP 11)
Data source: WM3 1st Edition 2015
Data source date: 25 May 2015
Hazard Statements: None.

Appendix B: Rationale for selection of metal species

arsenic {arsenic trioxide}

Reasonable case CLP species based on hazard statements/molecular weight and most common (stable) oxide of arsenic. Industrial sources include: smelting; main precursor to other arsenic compounds (edit as required)

cadmium {cadmium oxide}

Reasonable case CLP species based on hazard statements/molecular weight, very low solubility in water. Industrial sources include: electroplating baths, electrodes for storage batteries, catalysts, ceramic glazes, phosphors, pigments and nematocides. (edit as required) Worst case compounds in CLP: cadmium sulphate, chloride, fluoride & iodide not expected as either very soluble and/or compound's industrial usage not related to site history (edit as required)

chromium in chromium(III) compounds {chromium(III) oxide (worst case)}

Reasonable case species based on hazard statements/molecular weight. Industrial sources include: tanning, pigment in paint, inks and glass (edit as required)

chromium in chromium(VI) compounds {chromium(VI) oxide}

Worst case CLP species based on hazard statements/molecular weight. Industrial sources include: production stainless steel, electroplating, wood preservation, anti-corrosion agents or coatings, pigments (edit as required)



copper {dicopper oxide; copper (I) oxide}

Reasonable case CLP species based on hazard statements/molecular weight and insolubility in water. Industrial sources include: oxidised copper metal, brake pads, pigments, antifouling paints, fungicide. (edit as required) Worse case copper sulphate is very soluble and likely to have been leached away if ever present and/or not enough soluble sulphate detected. (edit as required)

lead {lead compounds with the exception of those specified elsewhere in this Annex (worst case)}

No chromium VI present

mercury {mercury dichloride}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

nickel {nickel chromate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

selenium {selenium compounds with the exception of cadmium sulposelenide and those specified elsewhere in this Annex}

Harmonised group entry used as most reasonable case. Pigment cadmium sulposelenide not likely to be present in this soil. No evidence for the other CLP entries: sodium selenite, nickel II selenite and nickel selenide, to be present in this soil. (edit as required)

zinc {zinc chromate}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

cyanides {salts of hydrogen cyanide with the exception of complex cyanides such as ferrocyanides, ferricyanides and mercuric oxycyanide and those specified elsewhere in this Annex}

Harmonised group entry used as most reasonable case as complex cyanides and those specified elsewhere in the annex are not likely to be present in this soil: [Note conversion factor based on a worst case compound: sodium cyanide] (edit as required)

Appendix C: Version

HazWasteOnline Classification Engine: **WM3 1st Edition v1.2.GB - Oct 2021**

HazWasteOnline Classification Engine Version: 2025.24.6453.11761 (25 Jan 2025)

HazWasteOnline Database: 2025.24.6453.11761 (25 Jan 2025)

This classification utilises the following guidance and legislation:

WM3 v1.2.GB - Waste Classification - 1st Edition v1.2.GB - Oct 2021

CLP Regulation - Regulation 1272/2008/EC of 16 December 2008

1st ATP - Regulation 790/2009/EC of 10 August 2009

2nd ATP - Regulation 286/2011/EC of 10 March 2011

3rd ATP - Regulation 618/2012/EU of 10 July 2012

4th ATP - Regulation 487/2013/EU of 8 May 2013

Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013

5th ATP - Regulation 944/2013/EU of 2 October 2013

6th ATP - Regulation 605/2014/EU of 5 June 2014

WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014

Revised List of Waste 2014 - Decision 2014/955/EU of 18 December 2014

7th ATP - Regulation 2015/1221/EU of 24 July 2015

8th ATP - Regulation (EU) 2016/918 of 19 May 2016

9th ATP - Regulation (EU) 2016/1179 of 19 July 2016

10th ATP - Regulation (EU) 2017/776 of 4 May 2017

HP14 amendment - Regulation (EU) 2017/997 of 8 June 2017

13th ATP - Regulation (EU) 2018/1480 of 4 October 2018

14th ATP - Regulation (EU) 2020/217 of 4 October 2019

15th ATP - Regulation (EU) 2020/1182 of 19 May 2020

The Chemicals (Health and Safety) and Genetically Modified Organisms (Contained Use)(Amendment etc.) (EU Exit)

Regulations 2020 - UK: 2020 No. 1567 of 16th December 2020

The Waste and Environmental Permitting etc. (Legislative Functions and Amendment etc.) (EU Exit) Regulations 2020 - UK: 2020 No. 1540 of 16th December 2020

GB MCL List - version 1.1 of 09 June 2021

GB MCL List v2.0 - version 2.0 of 20th October 2023

GB MCL List v3.0 - version 3.0 of 11th January 2024

GB MCL List v4.0 - version 4.0 of 2nd March 2024

GB MCL List v5.0 - version 5.0 of 26th June 2024

APPENDIX V

UXO Risk Map

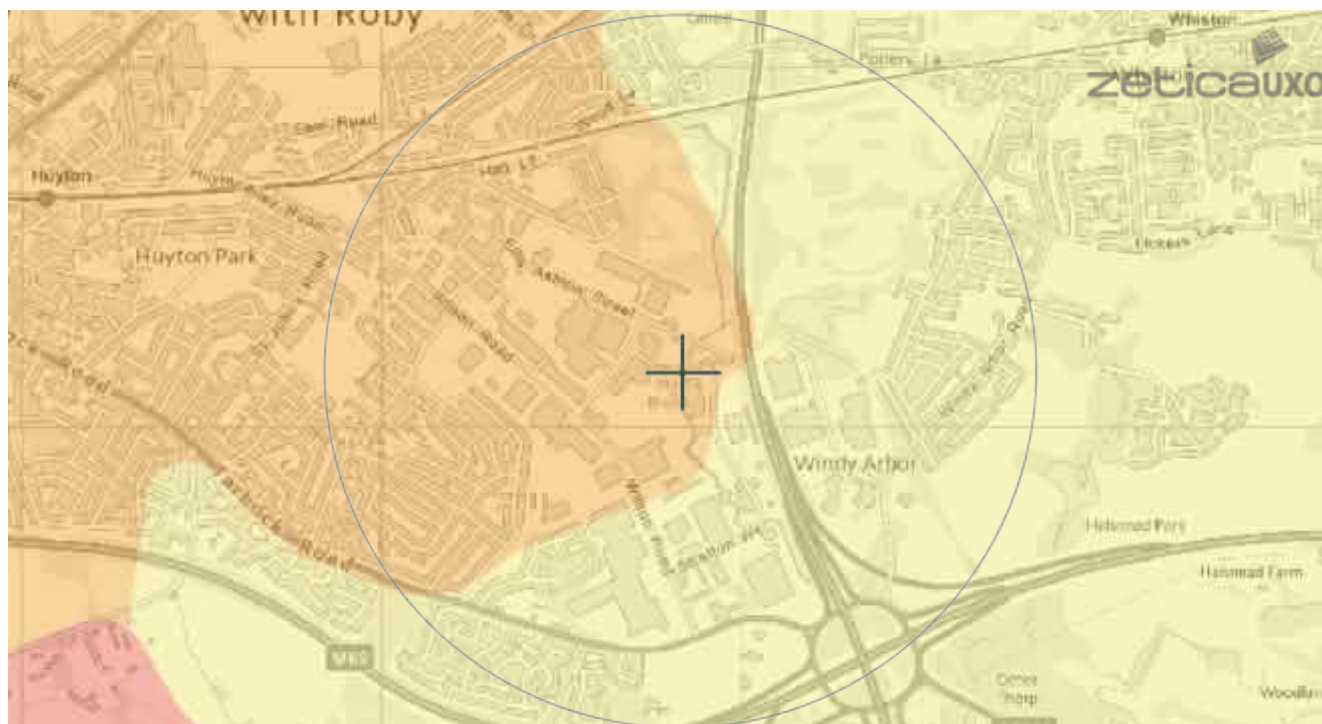
RSK Detailed UXO Risk Assessment Report

UNEXPLODED BOMB RISK MAP



SITE LOCATION

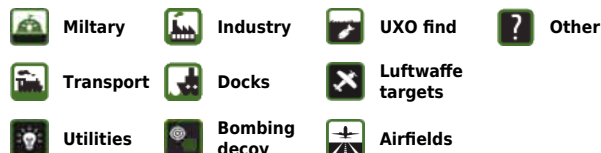
Map Centre: 345801,390160



This map principally indicates a hazard from Unexploded Bombs (UXB) due to WWII bombardment. Other sources of Unexploded Ordnance (UXO) may be present. It should be noted that this map does not represent UXO risk and should not be reported as such when reproduced.

LEGEND

- High:** Areas indicated as having a bombing density of 50 bombs per 1000acre or higher.
- Moderate:** Areas indicated as having a bombing density of 15 to 49 bombs per 1000acre.
- Low:** Areas indicated as having 15 bombs per 1000acre or less.



How to use your Unexploded Bomb (UXB) risk map?

This map indicates the potential for UXBs to be present because of World War Two (WWII) bombing. It can be incorporated into a technical report, such as a Phase 1 Desk Study, or similar document as an indication of the potential for UXO encounter on a Site. Other sources of UXO may also be indicated, although note that these are not comprehensive and more detailed research is required to confirm their presence.

What if my Site is in a moderate or high density area?

We typically recommend that a detailed UXO desk study and risk assessment is undertaken for sites in an area with a moderate or high bombing density. Additionally, if your site is in close proximity to a strategic target, military establishment, airfield or bombing decoy, then [additional detailed research](#) is recommended.

If my site is in a low risk area, do I need to do anything?

If both the map and other research confirm that there is a low potential for UXO to be present on your site, then, subject to your own comfort and risk tolerance, works can proceed with no special precautions.

If you are unsure whether other sources of UXO may be present, you can request one of our [pre-desk study assessments \(PDSA\)](#) by emailing a site boundary and location to pdsa@zetica.com.

You should never plan site work or undertake a risk assessment using these maps alone. More detail is required, to include an assessment of the likelihood of a source of UXO hazard from other military activity not reflected on these maps.

If I have any questions, who do I contact?

tel: +44 (0) 1993 886682 email: uxo@zetica.com web: www.zeticauxo.com

The information in this UXB risk map is derived from a range of sources and should be used with the [accompanying notes on our website](#).

Zetica cannot guarantee the accuracy or completeness of the information or data used and cannot accept any liability for any use of the maps. These maps can be used as part of a technical report or similar publication, subject to acknowledgement. The copyright remains with Zetica Ltd.



RSK  **M**
ORDNANCE MANAGEMENT

Project Information

Report Title	Ellis Ashton Street, Liverpool		
Address	Ellis Ashton Street, Huyton, Liverpool, L36 6BJ		
Client	Arc Environmental	Author	Euan Ridley
Report Reference	S2RA-1054	Reviewer	Will Hunnisett
Internal Reference	4240266	Authoriser	Andrew Lane

Report History

Date of Order	07/01/2025	Company Address
Final Version	05/02/2025	RSK Ordnance Management ADAS Boxworth Battlegate Road Cambridge, CM23 4NN
Date of Issue	05/02/2025	

RSK Ordnance Management

RSK are an environmental, engineering and technical services group, established in 1989. RSK Ordnance Management, established in in 2023, aim to provide best in class UXO support to clients in the UK, and around the world. Serving time in the Royal Engineers and achieving the highest standards of civilian EOD qualifications, IMAS 3+, our Senior Management Team have also advised and held voting rights at prestigious mine action centres around the globe.

Legal Advisement

This report adheres to the guidelines as laid out in the relevant CIRIA document, which govern the way that the UK construction industry interacts with the threat posed by potential UXO. The report should be read in full with information taken in the intended context.

Conclusions contained within this report have been derived from information obtained from third-party sources. All efforts have been made to analyse the validity and reliability of these sources, although RSK OM cannot be held responsible for inaccuracies contained within these sources. We therefore do not and will not accept responsibility for any potential future damages caused by the conclusions of this report exclusive of gross negligence on our part.

Copyright

The report has been produced exclusively for the client, and should not be shared in any form with third-parties without prior permission from RSK Ordnance Management. The report is copyrighted to RSK Ordnance Management.

Executive Summary

Risk of Encounter	RSK OM believes there to be an overall LOW RISK from items of German UXO.	
Risk of Harm	RSK OM believes there to be an overall TOLERABLE risk of harm.	
Site Information	National Grid Reference	Region
	SJ 45799 90158	Huyton, Lancashire
	The site is mostly occupied by hardstanding ground, with a single-storey, domed structure located in the south-west corner. It is bound to the north and north-west by hardstanding, and to the east, south and south-west by vegetation.	
The Proposed Works	It is understood that future works include the construction of a food waste facility.	
German UXO Risk	- During WWII, the site – which consisted of open land/marshland – was situated within the Urban District of Huyton with Roby. This district sustained an overall low bombing density. - No bombs were recorded on/adjacent to the site. The nearest HE bombs fell approximately 250-750m to the north-west along Ellis Ashton Street. An AA shell also fell at a brickworks approximately 500m to the north-west. - WWII-era aerial imagery dated 1945 did not show any obvious signs of bomb cratering on site. - As it comprised undeveloped land/marshland, evidence of a UXB strike on site would have been difficult to spot, nor would it have been frequently accessed. In addition, a brook ran through/adjacent to the south-western corner of the site. Any UXBs that fell in water would not have been easily identifiable or recoverable. - In summary, no bombs were recorded on site. Though the ground cover on site would not have been uncondusive to the detection of UXBs, the risk of contamination from German UXBs is not thought to be elevated, due to the lack of recorded bombing. - However, considering the site's wartime ground conditions and the evidence of bombing in Huyton Quarry, UXO Safety Awareness Briefings are strongly recommended.	
British/Allied UXO Risk	- RSK OM has accessed an open-source database recording anti-aircraft positions in Britain; this records 22 HAA batteries within a 15km radius. - Considering the relative lack of bombing in the local area, the risk from unexploded AA shells is analogous to the risk from German UXBs.	
Recommended Risk Mitigation Measures	All Risk Areas UXO Safety Awareness Briefings	

Annexes and Appendices

Annexes		Appendices	
A	Site Locator Maps	i	Contextual Information Document
B	Contemporary Aerial Photography	ii	Examples of German ADWs
C	Historical OS Maps	iii	British AA Ammunition – Most Common
D	Historical Aerial Photography	iv	Bibliography
E	Lancashire Bomb Mapping		

Glossary

AA	Anti-Aircraft	RNAS	Royal Naval Air Service
ALARP	As Low As Reasonably Practicable	RNPF	Royal Navy Propellant Factory
AP	Armour Piercing	ROF	Royal Ordnance Factory
APBC	Armour Piercing Ballistic Cap	SAA	Small Arms Ammunition
APFSDS	Armour Piercing Fin Stabilised Discarding Sabot	SIP	Self-Igniting Phosphorous
AP	Anti-Personnel	TNT	Trinitrotoluene
ARP	Air Raid Precautions	UC	Unclassified Bomb
AT	Anti-Tank	UP	Unrotated Projectile
BL	Breech Loading	USAAF	United States Army Air Force
DA	Delayed Action	UXAA	Unexploded Anti-Aircraft
EOC	Explosive Ordnance Clearance	UXB	Unexploded Bomb
EOD	Explosive Ordnance Disposal	UXO	Unexploded Ordnance
FP	Fire Pot	V1	Flying Bomb
HAA	Heavy Anti-Aircraft	V2	Long Range Rocket
HE	High Explosive	WAAF	Women's Auxiliary Air Force
HEAT	High Explosive Anti-Tank	WWI	World War One
HESH	High Explosive Squash Head	WWII	World War Two
HG	Home Guard		
IB	Incendiary Bomb		
LAA	Light Anti-Aircraft		
LCC	London County Council		
LSA	Land Service Ammunition		
ML	Muzzle Loading		
NFF	National Filling Factory		
PAC	Pilotless Aircraft		
PB	Phosphorous Bomb		
PM	Parachute Mine		
POW	Prisoner of War		
QF	Quick Firing		
RAF	Royal Air Force		
RFC	Royal Flying Corps		

Contents

1	Introduction	1
1.1	The Client and Site.....	1
1.2	The UK Regulatory Framework.....	1
1.3	The Health and Safety at Work Act, 1974	1
1.4	Construction (Design and Management) Regulations, 2015.....	1
1.5	CIRIA	1
1.6	Control of Major Accident Hazards (COMAH), 2015	1
2	The Roles of the Public and Private Sectors.....	2
2.1	Public Sector	2
2.2	Private Sector.....	2
3	Methodology and This Report	3
3.1	Aims and Objectives.....	3
3.2	Methodology.....	3
3.3	Sources of Information	3
4	Background Information on Records.....	4
4.1	The Accuracy of WWII-era Records	4
5	The Site	5
5.1	Site Location and Description – Annex A & B.....	5
5.2	The Scope and Nature of Proposed Works	5
5.3	Ground Conditions	5
6	Site History	6
6.1	Introduction	6
6.2	Historical Mapping – Annex C	6
6.3	Historical Aerial Photography – Annex D.....	6
7	The Risk Posed by German Ordnance.....	7
7.1	Introduction	7
7.2	Target Areas/Bombing Decoys.....	7
7.3	Primary/Secondary Bombing Sources	8
7.3.1	WWII Home Office Bombing Statistics.....	8
7.3.2	Lancashire Bomb Mapping – Annex F.....	9
7.3.3	Lancashire ARP Incident Books	9
7.3.4	Lancashire UXB Register	10
7.3.5	Home Security Summaries for the Manchester Region, 1939 – April 1941	10
7.3.6	Huyton Bomb Register	11
7.3.7	Huyton War Emergency Committee Minutes, 1939-1945.....	11
7.3.8	Secondary Sources.....	11

7.3.9	Abandoned Bombs.....	11
7.4	Assessing the Likelihood of German UXO Contamination.....	12
7.5	Maximum Bomb Penetration Depth.....	12
8	The Risk Posed by British/Allied Ordnance	13
8.1	Introduction	13
8.2	Anti-Aircraft Batteries.....	13
9	The Likelihood that UXO Contaminated the Site	14
10	Post-WWII Risk Mitigation	15
10.1	Introduction	15
10.2	EOC Tasks	15
10.3	Post-WWII Redevelopment.....	15
11	Assessed Risk of Encounter Rating	16
12	Risk of Initiation.....	16
12.1	Introduction	16
12.2	Site Specific Risk of Initiation.....	16
12.2.1	The Condition of Potential UXO	16
12.2.2	The Nature of the Proposed Works.....	17
12.2.3	Potential Fuzing Technology	17
12.2.4	Conclusion.....	17
13	Risk of Harm.....	17
13.1	Introduction	17
13.2	Risk of Harm on Site.....	17
14	Proposed Risk Mitigation Measures	17

1 Introduction

1.1 The Client and Site

RSK Ordnance Management have been commissioned by Arc Environmental to complete a Stage 2 Detailed Risk Assessment for the Ellis Ashton Street site. This report adheres to guidelines detailed in CIRIA C681, 'Unexploded Ordnance (UXO) A Guide for the Construction Industry'.

1.2 The UK Regulatory Framework

Unlike other industries, no legally binding regulations exist for the construction industry. Instead, industry best practice, alongside CIRIA C681 (published in 2009), guides construction projects. The aim of these regulations, which will be outlined below, is to make construction firms aware of their responsibility to, where possible, keep their workforce engaged in ground-breaking activities safe from any potential UXO risks.

1.3 The Health and Safety at Work Act, 1974

As detailed above, this seminal act in the UK legislature places a duty of care on employers to protect their workforce 'as far as reasonably practicable' from any reasonably foreseeable UXO risks. Of note is that the same duty of care has to be applied to the general public, as well as their own workforce.

1.4 Construction (Design and Management) Regulations, 2015

CDM 2015 ensures that health and safety within the construction industry is continually improved in many ways, including but not limited to, ensuring works are sensibly managed and planned in a way that risks are identified and managed suitably while ensuring that any staff conducting works are able to complete their tasks safely. This is achieved by ensuring cooperation between all parties and ensuring clear channels of communication.

1.5 CIRIA

The Construction Industry Research and Information Association (CIRIA) provides guidelines to the UK construction industry regarding the risk posed by UXO. Written in 2009, C681 provides this in report format and focusses on land-based construction projects. Its sister report, C754, focuses on construction projects in the marine environment.

1.6 Control of Major Accident Hazards (COMAH), 2015

Contamination as a result of Allied military activity can sometimes result in a chemical hazard, as well as an explosive one. Alternatively, a detonation of an item of UXO may result in an unrelated major hazard. Substances used or stored at COMAH establishments can be dangerous, although the establishments are strictly regulated under the COMAH Regulations 2015. As a result, they have to manage their activities in a way which reduces risks to workers and the public, in line with the Health and Safety Act 1974. Operators must take all measures necessary to prevent major accidents and to limit their consequences for people and the environment. This is achieved through appropriate plant design, process control, mitigation measures and emergency procedures.

The regulations are enforced by a Competent Authority which comprises jointly the Health and Safety Executive in Great Britain and the relevant environment agency (the Environment Agency in England, Scottish Environment Protection Agency in Scotland and Natural Resources Body for Wales in Wales). Nuclear establishments are regulated by the Office for Nuclear Regulation and the relevant environment agency.

2 The Roles of the Public and Private Sectors

2.1 Public Sector

In the event of a possible UXO encounter on a construction site in the UK, the police will be called. They will then assess whether the find could potentially comprise an item of UXO, and place a safety cordon around the find if that is deemed to be a possible scenario. If so, the Joint Services Explosive Ordnance Disposal Operations Centre (JSEODOC) will be informed, who will arrange for the next steps in the process; this involves the investigation, and if necessary, the disposal of the find. The speed at which JSEODOC will be able to attend the site to conduct these next steps depends on the level of risk that they believe the find poses. This is influenced by many factors, such as the location of the find, the type of UXO that it may be, and the potential for risk of harm.

It is unlikely that the military will conduct multiple further investigations unless there are extenuating circumstances, such as high-risk situations. For example, where multiple ordnance finds are encountered on a site, due to limited funding and personnel issued to JSEODOC, it is likely that the construction project will be tasked with appointing a private sector firm to ensure that potential items of UXO are dealt with safely.

2.2 Private Sector

Both pro-active and reactive risk mitigation measures can be implemented by firms in the private sector. Whether these are required will first be assessed via a Stage 1, and if necessary a Stage 2, Risk Assessment. The exact type of support needed can be tailored to each construction project, considering factors such as the proposed works, number of ground intrusions, and how those ground intrusions are carried out (e.g. by hand or plant etc.).

A wide variety of risk mitigation measures can be enacted to ensure safety during the construction phase. Having a UXO Engineer on site conducting a Watching Brief ensures that timely delays can be avoided if a suspicious find can be safely declared not to be UXO, while an intrusive survey prior to piling can allow for amendments to the pile layout/design before deployment to site, if necessary. Furthermore, UXO Safety Briefings allow for a large number of staff to continue their CPD and be upskilled on potential hazards they may encounter on site.

3 Methodology and This Report

3.1 Aims and Objectives

This report will provide a comprehensive assessment of the potential risk from UXO at the proposed site. Located in the Executive Summary and at the end of the report are carefully considered and appropriate recommended work-specific risk mitigation measures to reduce the risk potentially posed by items of UXO during the proposed works to a level that is As Low As Reasonably Practicable (ALARP).

3.2 Methodology

In order to ensure that any recommended risk mitigation measures are appropriate and proportionate, the following factors key to our methodology will be assessed:

- The risk that the site became contaminated with unexploded ordnance.
- The risk that any such UXO remains on site.
- The risk that any such ordnance may be encountered during the proposed intrusive works.
- The risk that any such ordnance may be initiated during this process.
- The consequences of initiating or encountering any such ordnance.

To ensure the accuracy and completeness of our work when following the methodology detailed above, RSK Ordnance Management have carefully considered the following factors::

- An assessed maximum bomb penetration depth.
- The nature of UXO which may be found on a site.
- Post-WWII re-development works.
- Any evidence relating to German Air Dropped Weapons (ADWs) or items of Allied UXO. coming to contaminate the site area.
- UXO clearance tasks undertaken on site post-WWII.

3.3 Sources of Information

During the writing of this assessment, RSK Ordnance Management have collated and analysed wide ranging sources. Proportionate efforts have been made to access all relevant materials, most of which are held in the public domain. Below is an example of sources checked and analysed, although it is not exhaustive.

- The National Archives.
- Relevant local archives.
- The Defence of Britain Extended Database.
- Open-source Google Mapping Information.
- Historical Aerial Photography - Historic England, National Collection of Aerial Photography, Britain from Above.
- ProMap.
- Relevant books, journal/web articles.
- Extensive in-house knowledge and experience at RSK Group Limited.

4 Background Information on Records

4.1 The Accuracy of WWII-era Records

In cities that were heavily bombed, such as London or Plymouth, ARP Wardens (among other personnel) were tasked with accurately recording the date, time, nature and any other details regarding bomb strikes in their areas of operations. During periods of intense raids, this was often a difficult task and inevitably not all raids were accurately recorded.

Likewise, precise details regarding historical Allied activity in many areas around the UK were not typically well recorded. This leads to situations where it is difficult, and sometimes impossible, to accurately predict where associated items of UXO may be encountered. Not all defensive positions established in 1940 when the feared German invasion was anticipated were recorded. Also, maps of military training areas do not accurately record impact areas for weapon ranges. In addition to this, ad hoc training conducted by the Home Guard or British/Allied military units were often not recorded.

To ensure this report is as accurate and complete as possible, many sources have been cross referenced in an attempt to minimise any issues caused by incomplete/inaccurate record sets. However, RSK Ordnance Management cannot be held accountable for any errors/omissions in WWII-era records. The same applies to information that is released to the public domain or becomes newly available after the production of this report.

5 The Site

5.1 Site Location and Description – Annex A & B

The site is approximately centred on the grid reference SJ 45799 90158.

The site is mostly occupied by hardstanding ground, with a single-storey, domed structure located in the south-west corner. It is bound to the north and north-west by hardstanding, and to the east, south and south-west by vegetation. It is located within a larger industrial estate/waste management service.

5.2 The Scope and Nature of Proposed Works

Although no precise scope of works was provided, it is understood that future works include the construction of a food waste facility.

5.3 Ground Conditions

Information sourced from the British Geological Survey confirms that the site is underlain by the Pennine Middle Coal Measures Formation - sandstone. The superficial deposits are recorded as Till, Devensian - diamicton.

No relevant contemporary geological information for the site was found. However, a borehole log from the same geology and in close proximity to the site sunk in 1993 (BGS ID 165861) recorded the following conditions:

- 0.40m of TOPSOIL
- 3.48m of very sandy CLAY
- 1.85m of SANDSTONE
- 0.55m of SILTSTONE
- 1.99m of SANDSTONE
- 1.03m of SILTSTONE
- 0.5m of SANDSTONE
- 2.20m of SILTSTONE
- 3.77m of MUDSTONE
- 0.23m of black COAL
- 3.57m of SILTSTONE

6 Site History

6.1 Introduction

The historic make-up and usage of a site can be key in determining the risk that UXO may pose. Historic mapping editions, aerial photography, and any additional information (where possible) will be analysed to determine the likelihood that a site may have been accessed frequently, or that bomb damage may have been observed, among other factors. For more information, please see **Section 1** in the **Contextual Information Document**, presented in **Appendix i**.

6.2 Historical Mapping – Annex C

	Date	Scale	Observations
Pre-WWII	1925-27	1:2,500	The site consisted of open, undeveloped land, with 'Logwood Mill Brook' running through/adjacent to the south-western corner. It was bound on all sides by similar topography. Small railway tracks were located approximately 250m to the north, and Logwood Farm was located approximately 250m to the south. Filter beds and setting tanks were also located 200-300m south-east.
Post-WWII	1956-57	1:2,500	There was little change on site, as it still comprised undeveloped land. However, this mapping also showed that the site consisted of marshland. The filter beds and setting banks to the south-east had been cleared. It is believed that part of Ellis Ashton Street had been laid approximately 250-300m to the north-west, and had not yet been extended to its current parameters to the north of the site.

6.3 Historical Aerial Photography – Annex D

	Date	Observations
WWII-Era	October 1941	This low-resolution image was obtained from Luftwaffe aerial photography of Huyton and Prescott. No obvious signs of bomb cratering were visible on site. An area of ground disturbance/ragged land was visible from approximately 50-300m to the south-east of the site, just above four filter beds. However, this is not thought to have been caused by bomb damage.
	10 th August 1945	Again, no obvious signs of cratering were visible on site. A potential circular depression/ground disturbance was visible in a field approximately 50-100m to the north-west of the site. However, due to the lack of bombing in the local area, it is not thought that this comprised a bombing crater. An area of white, rectangular land was also visible approximately 100-150m to the south-east. Though not marked on available OS mapping, is likely that this was used for agricultural purposes. This image has been enlarged on Annex D (iii) .

7 The Risk Posed by German Ordnance

7.1 Introduction

During WWI and WWII, Britain was subjected to aerial bombardment. This was mostly targeted at towns or cities with military or industrial importance, with many areas being subjected to their own 'Blitzes' in WWII.

Available sources pertaining to WWI aerial bombardment in the vicinity of the site have been analysed. There is no evidence to suggest that the risk from WWI UXO is elevated and therefore it will not be discussed in further depth. Please refer to **Section 2.1** in the **Contextual Information Document** for additional context pertaining to bombing in Britain during WWI.

For further information regarding the bombing campaign during WWII, please see **Section 2.2** in the **Contextual Information Document**.

7.2 Target Areas/Bombing Decoys

British Insulated Cables, a cable factory that was located approximately 2km north in Prescott, was recorded as a Luftwaffe target. The city of Liverpool, which was located approximately 5-10km to the west, was one of the most bombed cities in the country. Considering the importance of railway infrastructure to the war effort, the local train tracks, such as those that were located 250m to the north, may also have been targeted during Luftwaffe raids.



Luftwaffe target mapping denoting the cable works 2km to the north as a Luftwaffe target.

7.3 Primary/Secondary Bombing Sources

7.3.1 WWII Home Office Bombing Statistics

Amount of German Ordnance Dropped on the Urban District of Huyton with Roby	
Size of Area (Acres)	3,053
High Explosive Bombs (all types)	64
Parachute Mines	4
Oil Bombs	0
Phosphorous Bombs	0
Fire Pots	0
V1 Pilotless Aircraft (Flying Bomb)	0
V2 Rocket	0
Total (discounting V weapons and 1/2kg IBs)	68
Average number of bombs per 1,000 acres	22.3

Amount of German Ordnance Dropped on the Rural District of Whiston	
Size of Area (Acres)	29,446
High Explosive Bombs (all types)	274
Parachute Mines	3
Oil Bombs	3
Phosphorous Bombs	0
Fire Pots	0
V1 Pilotless Aircraft (Flying Bomb)	0
V2 Rocket	0
Total (discounting V weapons and 1/2kg IBs)	280
Average number of bombs per 1,000 acres	9.5

7.3.2 Lancashire Bomb Mapping – Annex F

Maps which plotted the location of bombs that fell in the county of Lancashire were obtained from Lancashire Archives. These maps covered the period of bombing between 1939 and 1941, and 1st January 1942 onwards.

- No bombs were recorded on site between either period.
- An incident labelled number 441 was plotted to the north between 1939-41.
- Further incidents were plotted approximately 1km to the east and west between 1939-41. Another incident was plotted 1km north-east between 1942-45.



Incident no. 441 to the north of the site.

7.3.3 Lancashire ARP Incident Books

Log books which recorded the date, location and type of bombs that were dropped on Lancashire were obtained from the Lancashire Archives. These log books accompanied the Lancashire bomb maps that were also examined above. It should be noted that these books did not cover much of the bombing period between 1942-45.

Date	Incident No.	Type of Bomb	Location	Comments
25 th October 1940	392/1	UXB	8 Paradise Lane, Whiston [approx. 1km north-east]	In footpath near dwelling house.
	392/2	Suspected AA shell	Paradise Lane, Whiston [approx. 1km north-east]	25 houses evacuated.
13 th November 1940	441/1	Unexploded AA shell	Tushingham Brick Works, Huyton Quarry [approx. 500 north-west]	Passed through roof of machine shop, slight damage.
7 th May 1941	1046/1	Three UX AA shells	St John's Road and Tarbock Road, Huyton [approx. 1km west]	N/A

7.3.4 Lancashire UXB Register

Likewise, a register which recorded the location and type of UXBs that were dropped on Lancashire, as well as their date of fall and date of disposal, was obtained from the Lancashire Archives. Because of the handwriting in this register, certain details were difficult to note.

Date Reported	Type of UXB	Location	Status
24 th September 1940	UX AA shell	In field, Huyton [exact location unknown]	Confirmed
26 th September 1940	AA shell	Lickers Lane, Whiston [approx. 1-2km east]	
25 th October 1940	Unknown	8 Paradise Lane, Whiston [approx. 1km north-east]	Confirmed, reported to R.C. on 26 th October.
29 th October 1940	AA shell	Haleswood Road, Whiston [approx. 1km east]	Confirmed, reported to R.C. on 29 th October.

Several more unexploded bombs/AA shells were recorded in Huyton and the wider region, however these are not thought to have fallen within 1km of the site.

7.3.5 Home Security Summaries for the Manchester Region, 1939 - April 1941

Written reports which recorded bombs dropped in Manchester and the wider north-west between the start of the war and April 1941 were obtained online. Potentially relevant incidents have been transcribed in the table below.

Date	Type of Bomb	Location	Comments
21 st October 1940	Numerous IBs	Huyton [exact location unknown]	No damage reported.
29 th November 1940	IBs		N/A
10 th January 1941	Four HEs		

7.3.6 Huyton Bomb Register

A bomb register which recorded the date, location and type of bombs that fell in Huyton, as well as any damage sustained, was obtained from Knowsley Archives. It should be noted that this register only recorded two bombing raids over the area. Relevant incidents have been transcribed below.

Date	Type of Bomb	Location	Comments
29/30 th September 1940	Approx. 100 IBs	Huyton Quarry [potentially on/near to the site]	No casualties, no damage.
9/10 th January 1940	Four HEs	Ellis Ashton Street [between approx. 250-750m north-west]	129 dwelling houses. Broken windows.
	Several hundred IBs	Dropped in district	All IBs extinguished, some damage caused by fires
	One HE	Manley Road [approx. 650-850m south]	N/A

7.3.7 Huyton War Emergency Committee Minutes, 1939-1945

Committee minute books which noted air raid damage in the Huyton area were examined by Knowsley Archives. These did not record any damage in Ellis Ashton Street nor Huyton Quarry.

7.3.8 Secondary Sources

Anecdotal accounts obtained from the BBC's 'WW2: People's War' project described bombing in the local area. These have been transcribed below:

I was fourteen years old when war broke out, and at that time I was attending Accrington Grammar School. Instead of our usual School Camp in the Dales, some of us volunteered to go potato lifting and pea picking. Our first destination was near Huyton-with-Roby on the outskirts of Liverpool, but because of bombing we were moved after a day or so to Latham Hall, near Ormskirk.¹

All five of us went to Nanny's house in Roby, about five and a half miles from the Mersey. [...] Through autumn and winter 1940-41 we were bombed. [...] Our very own incendiary landed in the garden hedge.²

Beyond this, no evidence of bombing in Huyton was found.

7.3.9 Abandoned Bombs

No abandoned bombs were recorded in the vicinity of the site.

¹ <https://www.bbc.co.uk/history/ww2peopleswar/stories/14/a4095614.shtml>

² <https://www.bbc.co.uk/history/ww2peopleswar/stories/69/a1947369.shtml>

7.4 Assessing the Likelihood of German UXO Contamination

UXO Risk Factor	Yes/No	Observations
Was there a high density of bombing in the wider area?	No	The site was situated within a district with a low bombing density. A cable factory that was located approximately 2km north in Prescot was identified as a bombing target. No bombs were recorded on site. Four HEs were dropped along Ellis Ashton Street, which was located 250-750m north-west of the site during WWII, in January 1941. An unexploded AA shell fell through the roof of Tushingham Brick Works, approximately 500 north-west, in November 1940, and approximately 100 incendiary bombs were dropped in Huyton Quarry in September 1940.
Was bomb damage sustained on or adjacent to the site?	No	WWII-era aerial imagery dated 1945 did not show any obvious signs of cratering on site. A potential circular depression/ground disturbance was visible in a field approximately 50-100m to the north-west of the site. However, it is not thought that this comprised a bombing crater. The four HEs that fell in Ellis Ashton Street resulted in minor damage to 129 properties; the 100 IBs that fell in Huyton Quarry caused no damage.
Was ground cover conducive to the observation of evidence of UXO?	No	As the site and surrounding area comprised open land/marshland, any signs of UXBs that fell in the area would have been difficult to spot; for example, UXB entry holes could have easily been obscured in undeveloped ground. This may potentially increase the likelihood that a UXB fell in the area unrecorded. The brook that ran through/adjacent to the site's south-western corner would also have been uncondusive to the detection of UXBs. Any UXBs that fell in water would not have left a discernible trace, and would have been difficult to detect and dispose of.
Would the site have been accessed frequently?	No	As the site comprised an area of open land/marshland and was surrounded by similar geography, it is unlikely to have been frequently access/observed. The filter beds and setting tanks to the south-east may have provided a degree of observation, though this would have been dependent on how regularly these were used by a local farmer.

7.5 Maximum Bomb Penetration Depth

Due to the large amount of siltstone recorded in the borehole log that was analysed in **Section 5.3**, it has not been possible to calculate the maximum bomb penetration depth on site. For more information on how bomb penetration depths are calculated, please see **Section 2.6** of the **Contextual Information Document**.

8 The Risk Posed by British/Allied Ordnance

8.1 Introduction

RSK OM does not believe that the majority of pathways through which a site may have become contaminated with items of British/Allied UXO (ordnance storage, military training etc.) are relevant to this site. However, one pathway of potential contamination will be discussed below.

To see an overview of the most common types of Allied/British UXO encountered on sites today, please see **Section 3** of the **Contextual Information Document**.

8.2 Anti-Aircraft Batteries

RSK OM has accessed an open-source database recording anti-aircraft gun positions in Britain during WWII; this records 22 HAA batteries within a 15km radius of the site. Additional defences, such as LAA guns defending Huyton Quarry and local railway tracks, may have been present at points, though this cannot be confirmed. An AA shell which did not explode at the correct altitude could have come to contaminate the site.

9 The Likelihood that UXO Contaminated the Site

The previously discussed factors regarding UXO contamination will now be summarised in this table. A discussion on the likelihood that UXO may remain, in conjunction with the likelihood that it may be discovered and subsequently initiated, will follow.

German Ordnance
• During WWII, the site – which primarily consisted of open land/marshland – was situated within the Urban District of Huyton with Roby. This district was subject to an average of 22.3 bombs per 1,000 acres, a low bombing density. The site was also located near the Rural District of Whiston, which sustained a very low bombing density. A cable factory that was located approximately 2km north in Prescot was identified as a bombing target. • Available records for both Huyton and the wider Lancashire/north-west region did not record bombing on site. Written records for Huyton recorded four HEs along Ellis Ashton Street in January 1941. Additional bombing records which covered the north-west region likewise recorded four HEs in Huyton on this date. However, it should be noted that, during WWII, Ellis Ashton Street was located 250-750m north-west of the site, as it had not yet been expanded to its current parameters. In addition, while these HEs were said to have damaged multiple properties, there was no mention in available records that they cratered in open land. As such, these HE bombs are not thought to have fallen near to the site. • Bomb mapping and written records for Lancashire recorded an unexploded AA shell approximately 500m to the north-west. This fell through the roof of a local brickworks in November 1940. In addition, approximately 100 incendiary bombs were dropped in Huyton Quarry in September 1940. These were said to have caused no damage. • It must also be noted that available bomb mapping for Lancashire did not corroborate the four HEs dropped Ellis Ashton Street. These variances are indicative of inaccurate record keeping, raising the possibility of a UXB strike in the local area remaining unnoticed. However, considering the low bombing density in the region, this possibility is thought to be unlikely. • WWII-era aerial imagery dated 1945 did not show any obvious signs of cratering on site. A potential circular depression/ground disturbance was visible in a field approximately 50-100m to the north-west of the site. However, it is not thought that this comprised a bombing crater. • As the site and surrounding area comprised open land/marshland, any signs of UXBs that fell in the area would have been difficult to spot; for example, UXB entry holes could have easily been obscured in undeveloped ground. In addition, a brook ran through/adjacent to the site's south-western corner. This would also have been uncondusive to the detection of UXBs, as any that fell in water would not have left a discernible trace. Considering these ground conditions, it is also unlikely that the site was frequently access/observed during WWII. These factors may potentially increase the likelihood that a UXB fell in the area unrecorded. • In summary, no HE bombs were recorded on site, with the nearest thought to have fallen approximately 250-750m to the north-west. WWII-era aerial imagery also did not show any signs of cratering on site. While the site's wartime ground conditions would not have been conducive to the detection of UXO, and nor is the site likely to have been frequently accessed, the risk of contamination on site is not thought to be elevated, due to the lack of recorded bombing in close proximity to the site. As such, the site has been assessed to be at Low Risk from German UXBs. • However, considering the site's ground conditions and the evidence of bombing in Huyton Quarry, UXO Safety Awareness Briefings are strongly recommended.

Allied Ordnance

- RSK OM has accessed an open-source database recording anti-aircraft positions in Britain; this records 22 HAA batteries within a 15km radius of the site. Local LAA guns defending Huyton Quarry and railway tracks may have been present at points, though this cannot be confirmed.
- A HAA shell which did not explode at the correct altitude could have come to contaminate the site, remaining unseen within undeveloped ground. However, the risk from unexploded AA shells is analogous to that from German UXBs.

10 Post-WWII Risk Mitigation

10.1 Introduction

Although an item of UXO may have come to contaminate the site in WWII, this does not necessarily mean that it will remain today. For example, should extensive post-WWII development have occurred on site, these may have discovered an item of UXO. Furthermore, an Explosive Ordnance Clearance (EOC) task, which are typically carried out on military land but can also occur in civilian areas, would have searched for items of UXO. For more information, please see **Section 4** of the **Contextual Information Document**.

10.2 EOC Tasks

There is no evidence to suggest that the site has been subject to EOC tasks.

10.3 Post-WWII Redevelopment

The site has seen a degree of post-WWII redevelopment. Huyton Business Park is thought to have been developed during the 1960s, during which time much of the farmland/marshland in the local area would have been cleared and paved over.³ Shallow ground intrusions likely occurred on site when the hardstanding was established.

Approximately one hundred incendiary bombs were recorded as having fallen on Huyton Quarry. Any unexploded IBs that fell in the area are likely to have been found during these post-war works.

Please note that it is possible for UXO to be present even in areas of post-WWII redevelopment. For example, the rubble/debris created by bombing was utilised as fill in certain cities such as Liverpool and London. If items of UXO had fallen within the debris prior to its clearance and potential use elsewhere, it could have been transported, unnoticed, alongside it. Such UXO has been encountered by RSK OM staff previously, such as a possible AA or rocket warhead found in Bermondsey in October 2023, which was discovered within post-WWII fill and fell out of the side wall of a shallow excavation. While such an incident is not considered to be a likely scenario, it highlights the unpredictable locations within which items of UXO can be encountered, and why the risk can never be wholly ruled out before breaking ground.

³ <https://www.novaloca.com/property-details/12873>

11 Assessed Risk of Encounter Rating

As demonstrated, RSK OM has diligently and proportionately assessed the factors considered in our assessment, detailed in **Section 3.2**. See below for the assessed risk ratings for each type of potential UXO.

Type of UXO	Assessed Risk of Encounter Rating				
	Low	Low-Moderate	Moderate	Moderate-High	High
German HE Bombs	×				
German 1/2kg Incendiary Bombs	×				
Anti-Aircraft Shells	×				
Allied Land Service Ammunition	×				
Allied Small Arms Ammunition	×				

12 Risk of Initiation

12.1 Introduction

The risk of UXO initiation on site will largely depend on the type and condition of the item, as well as the nature of the proposed works. For more information, please see **Section 6 & 7** of the **Contextual Information Document**.

12.2 Site Specific Risk of Initiation

12.2.1 The Condition of Potential UXO

The site is underlain by clay, siltstone and sandstone. Items of UXO are typically well-preserved in clay, as the lack of aeration prevents the rusting of the ferrous metals that were used in bomb casings. However, sandier soils can erode/abrade these casings.

Part of a brook was also located in/adjacent the south-western corner of the site. Water can significantly affect UXO, such as through the rusting and/or corrosion of the bomb casing, or by water seeping into the bomb fuze. Many bomb fuzes contained lead azide; should these fuzes have come into contact with water, a highly sensitive substance known as copper azide would have formed

12.2.2 The Nature of the Proposed Works

The construction of a food waste facility on site is likely to disturb a moderate amount of WWII-era soil. The excavation of this soil, most likely utilising plant, increases the likelihood of initiation through the blind nature of the intrusions, which do not allow for stopping work if a possible item is identified. This may result in direct impact to the body or fuze pocket of the item of UXO, possibly causing the item to explode

12.2.3 Potential Fuzing Technology

The 50kg HE bomb, the most commonly dropped over Britain, could be armed with a variety of fuzes; for example, at the start of the Battle of Britain, the Luftwaffe were still using stocks of the Type 5, largely left over from the Spanish Civil War.

Type 25 (B) fuzes were commonly used in 50kg HE bombs. Four firing circuits, three of which are under B plunger. A screw in the fuze head operates a switch which cuts out the two short delay circuits, leaving only the long delay circuit under plunger B. This fuze could be set to detonate upon impact, or with various time delays up to 17 seconds.

12.2.4 Conclusion

As the risk of encounter on site is not significantly elevated, the risk of initiation on site is not thought to be relevant.

13 Risk of Harm

13.1 Introduction

Although there may be an elevated risk from UXO on site, this does not necessarily mean that there will also be a risk of harm. For more information pertaining to the risk of harm ratings utilised by RSK OM, as well as examples of UXO that may fall within each category, please see **Section 8** of the **Contextual Information Document**.

13.2 Risk of Harm on Site

As the site has been assessed to be at **Low** risk from encountering German UXO, there is thought to be a **Tolerable** risk of harm.

14 Proposed Risk Mitigation Measures

The below risk mitigation measures are recommended to support the upcoming works.

Risk Mitigation Measures		
Risk of Harm Zone	Type of Work	Recommended UXO Support
Tolerable	All	UXO Safety Awareness Briefings Recommended for all personnel working on site. The briefings will provide a basic level of knowledge regarding UXO, ensuring workers know what to do when they suspect they may have found an item of UXO. Delivered by a UXO specialist with refresher courses offered at intervals.

Annexes



A - E

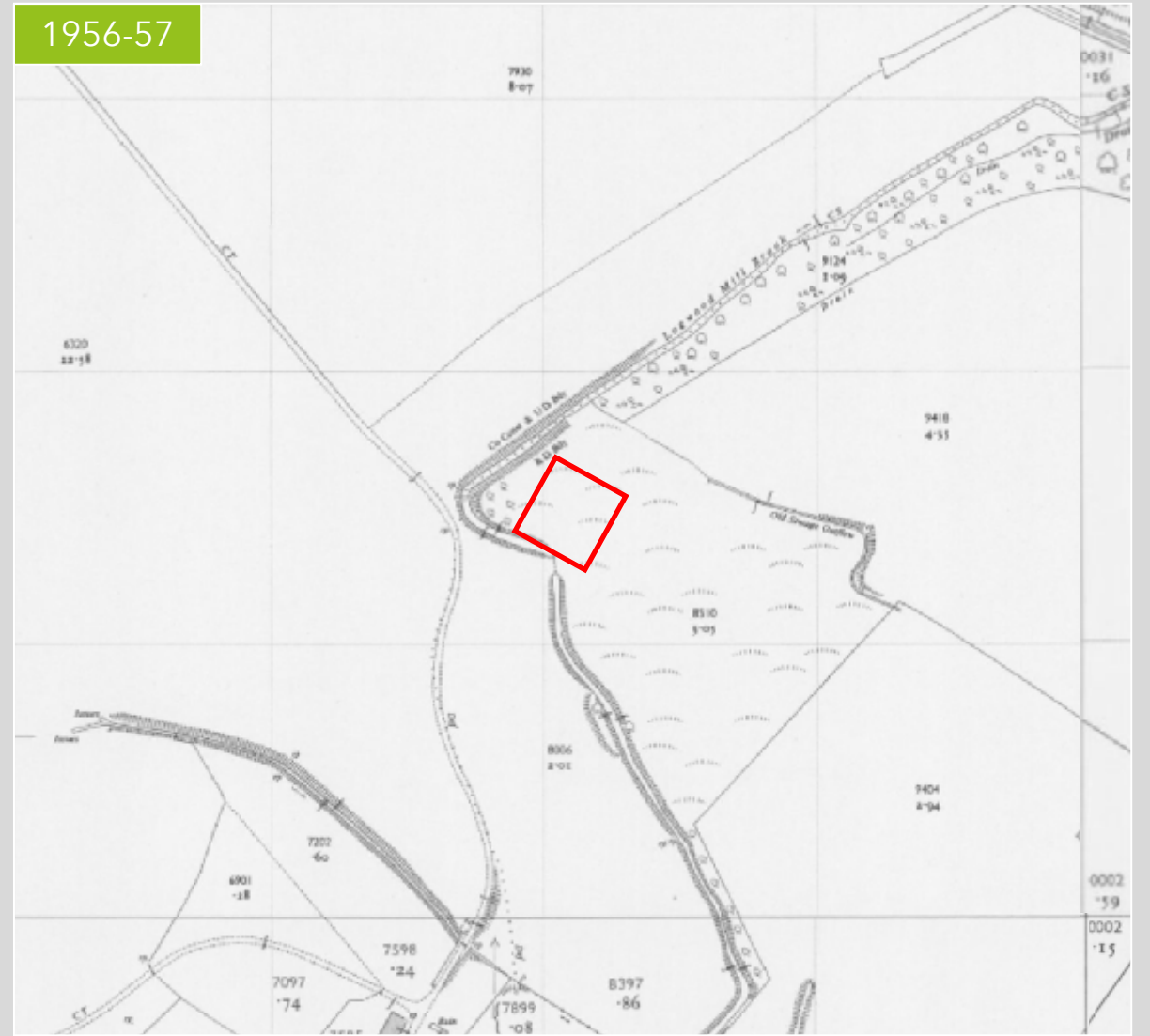




1925-27



1956-57



October 1941



Key	
	Potential Ground Disturbance

Project Name	Client	Report Reference
Ellis Ashton Street, Liverpool	Arc Environmental	S2RA-1054



10th August 1945



10th August 1945
(Site View)



Key



Potential Ground Disturbance







Project Name	Client	Report Reference
Ellis Ashton Street, Liverpool	Arc Environmental	S2RA-1054



Appendices



i - iv

Appendix i - Contextual Information Document

Contents

1	Background Site Information.....	3
1.1	OS Mapping	3
1.2	Historical Aerial Photography	3
2	Introduction to German Air Delivered Weapons	4
2.1	Background to WWI German Bombing Campaigns over Britain	4
2.2	Background to WWII German Bombing Campaigns over Britain	4
2.3	Most Common German Air Delivered Weapons.....	6
2.4	German ADW Failure Rate	6
2.5	German ADW Failure Rate	7
2.6	The 'J-Curve' Effect.....	7
2.7	Bomb Penetration Depth	7
3	Most Common British Ordnance.....	8
3.1	AA Shells	8
4	UXO Risk Mitigation	8
4.1	Clearance of Items of UXO	8
4.2	Post-WWII Construction Works	8
5	UXO Encounter	8
5.1	Pathways.....	8
5.2	Encounter Depths	9
6	Effect of the Environment on UXO.....	9
6.1	Introduction	9
6.2	Impact of Geology on UXO	9
6.3	Impact of Water on UXO	9
6.4	The Ageing of High Explosives.....	10
7	UXO Initiation	11
7.1	German UXO Initiation.....	11
7.2	British/Allied UXO Initiation.....	11
7.3	Consequences.....	11
8	Risk of Harm.....	11
8.1	Introduction	11
8.2	Assessed Risk Levels.....	12
8.3	Risk of Harm and Relevant Examples of UXO	12
9	Risk Mitigation Methodology	13

Glossary

AA	Anti-Aircraft	POW	Prisoner of War
ALARP	As Low As Reasonably Practicable	QF	Quick Firing
AP	Armour Piercing	RAF	Royal Air Force
APBC	Armour Piercing Ballistic Cap	RFC	Royal Flying Corps
APFSDS	Armour Piercing Fin Stabilised Discarding Sabot	RNAS	Royal Naval Air Service
AP	Anti-Personnel	TNT	Trinitrotoluene
ARP	Air Raid Precautions	RNPF	Royal Navy Propellant Factory
AT	Anti-Tank	ROF	Royal Ordnance Factory
BL	Breech Loading	SAA	Small Arms Ammunition
DA	Delayed Action	SIP	Self-Igniting Phosphorous
EOC	Explosive Ordnance Clearance	UC	Unclassified Bomb
EOD	Explosive Ordnance Disposal	UP	Unrotated Projectile
FP	Fire Pot	USAAF	United States Army Air Force
HAA	Heavy Anti-Aircraft	UXAA	Unexploded Anti-Aircraft
HE	High Explosive	UXB	Unexploded Bomb
HEAT	High Explosive Anti-Tank	UXO	Unexploded Ordnance
PB	Phosphorous Bomb	V1	Flying Bomb
POW	Prisoner of War	V2	Long Range Rocket
QF	Quick Firing	WAAF	Women's Auxiliary Air Force
RAF	Royal Air Force	WWI	World War One
RFC	Royal Flying Corps	WWII	World War Two
RNAS	Royal Naval Air Service	TNT	Trinitrotoluene
PB	Phosphorous Bomb		

1 Background Site Information

1.1 OS Mapping

The ability to determine whether a site may have suffered bomb damage necessarily depends on the makeup of the site during WWII. For example, if the site comprised an area of open, undeveloped ground, damage would not be noticeable within this source. However, if the site was composed of a section of terraced structures, a bomb strike which caused significant damage may result in the clearance of structures, resulting in easily identifiable evidence. Alternatively, a significantly damaged structure may be marked as a 'ruin'.

Every effort has been made to analyse as many large-scale maps as possible, providing the best possible details through which to assess the potential UXO risk on site. Of note is military censorship of military training grounds or airfields, where relevant features will not be identified.

1.2 Historical Aerial Photography

This source is often more useful in identifying potential bomb damage. Like OS mapping, this can often be more difficult in areas of open, undeveloped ground. Dense vegetation growth or ploughed soil may conceal evidence of a UXB strike, although craters with lipped edges, caused by exploded bombs or larger UXBs, can be clearly visible. Alternatively, evidence of minor damage to structures, in the form of light-coloured roofing repairs, can be immediately identifiable, with large areas of structural clearance obvious. Where vertical images may obscure internal damage in a structure, oblique photography, if available, will also be consulted to attempt to gain a more complete view of the site.

Of note is that this source can also be very illuminating when assessing potential Allied/British risk. For example, trench systems not recorded on OS mapping can be more easily identifiable in this source, even if recently infilled. Likewise, an impact area from a mortar/artillery range often leaves clear evidence of its presence in the form of impact craters of varying sizes. Other evidence of military activity, such as scrape marks from an anti-tank range, are also observable in imagery. When paired with LiDAR imagery, a wealth of information can be gleamed from these sources.

2 Introduction to German Air Delivered Weapons

2.1 Background to WWI German Bombing Campaigns over Britain

The bombing campaign against Britain during WWI can be broken down into two distinct periods; that of the Zeppelin raids at the outbreak and the mid-war years, and the latter-war raids of the twin-engine Gotha bombers.

52 Zeppelin raids occurred over England during WWI, which killed 556 people and injured 1,357 more. These were mainly conducted in 1914 – 1916, with damage being done to London and towns in the south-east during this period. However, these large airships were vulnerable the unpredictability and strength of the wind, while their lack of manoeuvrability and fragile construction left them vulnerable to British fighter aircraft.¹ As a result, the Germans developed the aforementioned twin-engine Gotha bombers and later four-engine ‘Giants’ with a wingspan of 42 metres. These were more powerful than the airships, with a more substantial design proving more effective against incoming fire.

Unlike WWII, where bombing targets were dispersed throughout Britain, the main targets during WWI comprised London and towns in the south-east of England. On 25 May 1917, the Germans carried out a mass air raid on targets in south-east England deploying 23 Gotha heavy bomber aircraft - 95 people were killed and 192 wounded, including soldiers and civilians. Ramsgate was commonly referred to as the most bombed town in WWI.

To counter the threat posed by the more powerful and deadly Gotha bombers, anti-aircraft fire had become much more accurate, and barrage balloons had forced enemy aircraft higher, compromising their bombing accuracy. By May 1918, over 60 Gothas had been destroyed and the aerial threat to Britain was effectively over.²

2.2 Background to WWII German Bombing Campaigns over Britain

Timeline of Luftwaffe Campaigns over Britain					
1940	1940-1941	1942	1943	1944	1944-1945
Battle of Britain fought to deny the Luftwaffe air supremacy required prior to Operation Sealion.	London, and other major cities, subjected to Blitzes of indiscriminate bombing.	Baedeker Raids target cultural and historic sites throughout Britain. Bath and Exeter badly damaged.	‘Tip and Run’ raids launched which utilise low-flying high-speed aircraft. Southern coastal towns targeted.	Operation Steinboch targets southern England and London with 31 raids. Last raids on the capital.	V weapon campaign launched against Britain. V1 launch sites overrun following D-Day.

Knowing that they would require air supremacy before launching Operation Sealion (the planned German invasion of Britain), in the summer and autumn of 1940, the Luftwaffe set about targeting RAF airfields (as well as radar stations and other supporting infrastructure). Many of RAF Fighter Command’s key airfields, such as RAF Biggin Hill, were raided repeatedly, with the south-east of England suffering the heaviest raids during this period. Once the Luftwaffe realised that they had failed to achieve air supremacy, their attention turned to the indiscriminate ‘Blitz’ against London.

¹ <https://historicengland.org.uk/research/current/discover-and-understand/military/first-world-war-home-front/air/first-blitz>

² <https://www.iwm.org.uk/history/the-air-raids-that-shook-britain-in-the-first-world-war>

In the hope of destroying civilian morale and causing the collapse of the government from within, the heaviest raid of this period marked the end of the London Blitz on 12th May 1941. From 7th September 1940, London had been subject to repeated and intense raids, centred on the City of London and eastern boroughs, where the majority of industry in the city was located. This method was mirrored in other large cities across Britain, such as Glasgow, Plymouth and Liverpool. Notably, the Clydebank Blitz of 13th – 15th March 1941 was targeted at the key shipbuilding and ordnance production areas of Glasgow. Bombing of other areas also occurred during this period, likely due to them being identified as targets of opportunity (if aircraft could not locate their target, or did not jettison their entire bombload over it, secondary targets such as transport infrastructure or industrial structures were identified). Furthermore, anti-aircraft fire and the lack of accurate targeting mechanisms in aircraft at the start of WWII led to many bombs missing their intended targets, sometimes by many miles. Landing with live ordnance on board was also dangerous, so aircraft would often jettison any remaining ordnance over Britain before they flew back to mainland Europe. This resulted in rural, and seemingly insignificant areas, being subject to bomb strikes.

In contrast to the raids targeted at military installations during the Battle of Britain, and to an extent those aimed at industrial areas during the Blitzes, the Baedeker Raids of 1942 targeted areas of cultural importance in some of Britain's most historic cities, such as Canterbury and Exeter. These were followed in 1943 by an identification of British weakness to raids carried out by fighter bomber aircraft conducting high-speed low-level raids which would evade radar; the aircraft would pop up when they reached their target, drop their bombs and return home. The raids were therefore named 'Tip and Run'. Notably, by this time, large amounts of American and Canadian troops were stationed in southern Britain. Utilising their LAA guns, as well as repurposing some British ones located around previously heavily bombed cities, an interlocking series of defences were established on the south coast to deter these raiders.

Switching back to targeting London for the first concentrated raids since the London Blitz, Operation Steinboch comprised 31 large-scale raids over southern England in 1944. However, as aforementioned, the massing of anti-aircraft defences in southern England, coupled with significant rates of attrition of pilots in the Luftwaffe meant that these raids were not successful. As a result, the final concentrated Luftwaffe raid over London occurred in May 1944.

Knowing that they could no longer successfully bomb Britain using piloted aircraft, the V1 pilotless aircraft offered an opportunity to inflict casualties in southern England. Equipped with a 850kg HE warhead, the blast wave was lethal. The same was true of the V2 rocket, with an even larger warhead at just over a ton of HE. These weapons were very large and often garnered public attention. Furthermore, a three fuze system in the V1 was designed so that they would never be examined by British forces. As such, the UXO risk that these items pose is typically very low.

2.3 Most Common German Air Delivered Weapons

It is important that the different characteristics and defining features of WWII-era German air delivered weapons (ADWs) are understood. This allows for an accurate assessment of the hazards that each item poses, which feeds into the assessed UXO risk in this report. The table below outlines the most common types of ordnance dropped on Britain. For a visual representation of the types of ordnance described below, please see **APPENDIX ii**.

Type of ADW	Penetrative Ability	Explosive Hazard	Background Information
HE Bomb	High. Their aerodynamics and weight (sometimes up to 2,000kg) greatly aided ground penetration.	General Purpose variant higher at around 50%. For the semi-armour piercing variant, this could drop to around 30% as a cap was added.	The most commonly dropped by weight over Britain. RSK OM's experience proves that large HE UXB entry holes were sometimes assumed to be caused by the detonation of smaller HE bombs. These ADWs pose the greatest risk to sites nowadays.
Mines	Low. The blast power was derived from their air or ground burst ability.	High explosive hazard, with variants possessing approximately 700kg of explosive fill.	Known to have caused significant damage when employed effectively. Due to their slow descent, they do not pose a significant risk to current construction sites.
Incendiary bombs	1/2kg incendiary bombs had very limited penetrative ability. Larger ones could penetrate to shallow depths in soft soil.	Small bursting charge in small IBs. Large variants, such as the Flam 500, had larger bursting charges.	1/2kg IBs were dropped in quantities often too large to accurately record over wide areas. These were small items, so could go overlooked in vegetated areas. Bursting charges to increase anti-personnel effect could be a hazard during intrusive works.
Anti-personnel bombs	Very low due to their low weight.	Approximate 225g HE charge.	Like small IBs, these were dropped in containers in batches of up to 108. Descent-slowed by design, many were encountered during post-raid checks if they did not explode. Still encountered on construction sites today.

2.4 German ADW Failure Rate

During WWII, Bomb Disposal Units (BDUs) accurately recorded all aspects of their work. Based off of this, it is generally accepted that 10% of bombs dropped by the Luftwaffe failed to explode. There are many reasons for this, including:

- Release of bombs at a low altitude, not allowing enough time for the bombs to arm successfully.
- Failure to successfully arm the bombs in the aircraft, likely due to either human or mechanical error.
- Incorrectly functioning fuze, or gaine, mechanism. Evidence suggests that large-scale sabotage in factories staffed by slave labour contributed heavily to this.

2.5 German ADW Failure Rate

Key to assessing the potential risk that German ADWs pose to a site is the maximum depth to which they may have reasonable penetrated. In making this calculation, several factors are considered:

- Weight and type of bomb.
- Height, angle, and velocity of release.
- Geological makeup of the site.

2.6 The 'J-Curve' Effect

As stated in CIRICA C681, as the velocity of a bomb slows down during its passage through underlying soils, it can curve upwards towards the surface again, creating what is known as the 'J-Curve' effect. This affirmed what many BDUs had experienced during WWII when investigating UXBs. This horizontal offset can sometimes be up to 15m, although was more likely to be around one third of the bomb's maximum penetration depth.

2.7 Bomb Penetration Depth

RSK OM has obtained original WWII-era studies (from The National Archives) conducted by the Ministry of Home Security regarding the average and maximum penetration depths of HE bombs in different geologies. This test comprised studies on 1,328 different bombs encountered by BDUs, with measurements produced by analysing the penetration depths of different sized bombs in different geologies. Below is a table presenting their findings:

Bomb Mass (kg)	Geological Conditions and Penetrative Depth (m)									
	Sand		Gravel		Chalk		Clay		Sandstone	
	Average	Max.	Average	Max.	Average	Max.	Average	Max.	Average	Max.
50	2.8	7.8	2.8	7.8	3.5	7.7	4.0	9.1	2.7	6
250	4.8	13.7	4.8	13.7	6	13.1	6.8	15.8	4.6	10.3
500	6	17.3	6	17.3	7.6	16.4	8.7	19.8	5.8	13.1
1,000	7.6	21.9	7.6	21.9	9.6	20.7	10.9	24.9	7.3	16.4

3 Most Common British Ordnance

For a visual representation of the types of ordnance described below, please see **APPENDIX iii**.

3.1 AA Shells

Although large anti-aircraft shells may appear similar in appearance to smaller German HE bombs, a copper driving band around the base can be used to correctly identify the item. As these items were not intended to penetrate the ground, they are often found at shallower depths. Due to the large size of unexploded HAA rounds, they possess a higher Net Explosive Quantity than many items of smaller LSA, such as grenades. Likewise, smaller unexploded LAA rounds pose a lower explosive risk.

4 UXO Risk Mitigation

4.1 Clearance of Items of UXO

Land owned by the military, or formerly used by the military, may be subject to Explosive Ordnance Clearance (EOC) tasks in an effort to remove items of UXO. These tasks may be undertaken to allow the land to be used safely by the public. Alternatively, as construction and redevelopment occurs on military land, they may want to make sure that contractors will be as safe as possible; many training areas require clearance operations to take place prior to ground intrusions. It must be noted that the efficacy of historic EOC tasks intended to achieve complete clearance has been called into question in the last few decades, where subsequent re-investigations have discovered items of UXO that were not identified previously. Naturally, as technology has improved, so has the effectiveness of EOC tasks. Therefore, it cannot be ruled out that items of UXO may remain in an area that has been searched in an EOC task.

4.2 Post-WWII Construction Works

Many stages of post-WWII redevelopment will also have mitigated a degree of risk on a site, if not entirely. Such works can generally be split into three sections:

- Very shallow works.
- Shallow works.
- Deep works.

For example, shell scrapes at very shallow depths may encounter buried SAA just below the surface, while foundations for a residential structure are more likely to encounter a buried HAA shell. Mass soil excavation for a basement level of a multi-storey car park is most likely to encounter a deep buried HE UXB, although these can also be found at shallower depths.

It must be noted that the risk can only be considered to be mitigated in the exact locations and to the exact depths of any post-WWII redevelopment. Any undisturbed ground down to the maximum bomb penetration depth, even if it remains between post-WWII foundations, must be considered unmitigated.

5 UXO Encounter

5.1 Pathways

If UXO is to be encountered on a site, a pathway between the works and the UXO must be present. A pathway almost certainly includes intrusive works, although UXO can sometimes be found on the surface, particularly on sites with a military history. Generally, the greater the volume of soil that will be disturbed, the greater the likelihood of a UXO encounter.

5.2 Encounter Depths

Encountering German ADWs is more likely at shallow and deep depths, such as when constructing a residential estate or piling deep foundations. This is due to the velocity that such items would have impacted the ground, in conjunction with their greater mass.

Items of LSA/SAA are generally encountered within the top 1m of soil. This is as a result of the usual contamination pathways relating to these items; improper disposal (burial), losing them, or burning them. As was noted above, UXO can sometimes be found on the surface. This is most likely to occur when encountering items of LSA/SAA on military training grounds.

6 Effect of the Environment on UXO

6.1 Introduction

This section will discuss the impact of various environmental factors on UXO, including the effects on ageing and the role this may play with regards to the likelihood of initiation (discussed further in **Section 7**). The information presented has been sourced from RSK OM's extensive experience when dealing with UXO, as well as documents published by CIRIA³ and GICHD⁴.

6.2 Impact of Geology on UXO

The geological conditions within which an item of UXO may remain have a significant impact on its ageing, which in turn may increase or decrease the sensitivity of the device to stimuli that can cause it to initiate.

The makeup of the soil within which UXO may be present – such as the moisture content, mineral/element composition, pH level and presence of oxygen – plays an important role in the ageing of UXO. The extent to which an item may abrade can be exacerbated by sandier soils, which are more erosive than cohesive soils which contain a higher percentage of clay. Clay can also assist with preserving items of UXO, due to its typically dense nature and the lack of aeration as a result; less oxygen is present, without which rusting cannot occur, protecting the ferrous metals which form the casing of many items of ordnance. Indeed, items of WWI-era UXO have been found well preserved in dense clay. In addition, soils with a high organic carbon content, such as wetter environments like swamps, peat or marshes, as well as soils polluted with fuel ash, slag coal, or wastewater, are more likely to be highly corrosive to UXO.

Overall, the geological conditions on a given site are key to understanding the current state of any UXO that may be present. Whilst the condition of UXO should never be assumed, if evidence indicates a potentially increased or decreased sensitivity – and therefore a greater likelihood of the device initiating – this may play a role in the risk mitigation measures that are required prior to or during ground works.

6.3 Impact of Water on UXO

Water plays an important role in the ageing of UXO, whether fresh water in rivers or lakes, rainwater, groundwater or sea water.

Sea water is highly corrosive to most types of UXO and can cause a number of effects. For example, sea water can corrode the casing and internal metallic structures of UXO, not only compromising its structural integrity, but also its explosive stability; the sensitivity of UXO can be increased or decreased with respect to a given initiation mechanism such as a shockwave or vibrations. Indeed, explosives in older munitions deteriorate over time and can cling to the surface of munitions, often

³ Stone, K., et al., *Unexploded Ordnance (UXO) A Guide For The Construction Industry (C681)*., CIRIA, 2009

⁴ *Guide to the Ageing of Explosive Ordnance in the Environment*, GICHD, 2023

near the fuze pocket. When this occurs, the residue is often particularly sensitive to friction and shock, which can initiate the fuze and potentially the whole device.

Whilst fresh water is unlikely to be as corrosive to UXO as sea water, it is integral to the process of rusting, which itself can damage the structural integrity of UXO in the ground.

Although water damage can desensitise items of UXO, another potential adverse effect of water/moisture can occur when it enters into the fuze pocket of a device. Many historical items of UXO contained lead azide within their fuze, which once hydrolysed in the presence of moisture or water to form hydrazoic acid, can react with copper to form copper azide. Copper azide is a highly sensitive explosive compound which is particularly reactive to nearby shockwaves and vibrations. Although it cannot always be confirmed which type of fuze is will be present within UXO on any given site, if it is known that the risk of encounter with a type of ordnance which utilised fuzes containing lead azide, caution should be exercised.

The wreck of the SS Richard Montgomery in the River Thames is a useful case study in relation to copper azide and how the risk of initiation can be affected. A 1964 report on the matter indicated that the risk was lower while the UXO remained immersed in water. However, the risk of a spontaneous detonation would steadily increase, before diminishing given years of exposure to sea water, fluctuating temperatures and pressures, and tidal action. For UXO submerged in fresh water, less disturbed by fluctuating environmental factors, it is conceivable that the risk curve – whereby the risk of spontaneous detonation increases and then decreases – may be elongated.

6.4 The Ageing of High Explosives

A study published in March 2024 investigated how the ageing of high explosives, particularly Amatol (a combination of TNT and ammonium nitrate), can affect their sensitivity to impact.⁵ The article concludes that:

‘This study demonstrates that Amatols extracted from ERW [Explosive Remnants of War], with the expected exception of the sample of high moisture content, are still sensitive to impact. For only one of the samples studied, the impact sensitivity coincided with what is recorded in the literature as expected for Amatol. All the other samples studied were, on the other hand, significantly more sensitive to impact. In the most extreme case [...] the substance was nearly four times more sensitive than anticipated’.⁶

The findings of the study go against what was typically thought about the ageing of high explosives; that they can increase in sensitivity to impact stimuli. However, this is one study, conducted in Norway where the items of UXO were located in cold climatic areas, and their moisture contents were found to be negligible; this is unlikely to be the case for most UXO in the UK. Yet, whilst the findings cannot be directly applied to UXO in the UK, the potential for impact sensitivity to increase in high explosives is something worth factoring into the risk on a site, should Amatol be known to be present and environmental conditions similar to those in the aforementioned study.

⁵ Novik. G. P., Christensen. D., ‘Increased impact sensitivity in ageing high explosives; analysis of Amatol extracted from explosive remnants of war’, *Royal Society Open Science*, 11 (2024), <https://doi.org/10.1098/rsos.231344>

⁶ Ibid., p. 9

7 UXO Initiation

7.1 German UXO Initiation

An item of ordnance that has remained unexploded for a number of years will almost always require an external influence to begin the sequence of detonation. If a fuze has malfunctioned, there are a number of ways that this can restart, or the HE fill can be detonated, such as:

- Percussive/direct impact effect from a high density object, such as a piling rig. Even if the impact occurs away from where the fuze is located on the bomb, direct impact with the HE fill could cause a detonation if hit with enough force.
- Although the Luftwaffe primarily used electrical fuzes, as outlined in **Section 2.3**, clockwork fuzes were occasionally employed. The prevailing thinking is that if the clockwork fuze malfunctioned at the time of use, it is unlikely to be initiated again. However, this has been known to happen, and the reader should be aware of this possibility.
- Items of unexploded ordnance, like most other buried objects, degrade over time. Part of this degradation process can include sensitive parts of the bomb, such as the fuze pocket, leaking materials. Over time, these materials can crystallise outside of the bomb, coming into contact, and rubbing against, external features. The friction created can sometimes initiate the sequence of detonation.

7.2 British/Allied UXO Initiation

Unlike German ADW UXBs, if not interfered with, it is very unlikely that an item of LSA/SAA would ever initiate. This may be an acceptable risk on a current military training ground that is unlikely to return to public use. However, this would not be the case for military land due to be sold off. Of note is that SAA is even less likely to be initiated, although this can occur if the firing cap is struck, or items are burned.

7.3 Consequences

Consequences of UXO initiation will differ depending on the receptors in the vicinity. The most significant consequence would be the loss of life on site, or in the vicinity, depending on the nature of the UXO find. Of note is that consequences may extend beyond the potential risk of harm; delays in major construction projects, potentially requiring major transport hubs or roadways to be shut down, or leaving plant hire stranded on site, can have large financial ramifications.

8 Risk of Harm

8.1 Introduction

A risk of encountering UXO does not necessarily equate to an elevated risk of harm. Although there may be deemed to be an elevated likelihood of encountering 3kg practice bombs whose spotting charges have not functioned on a site, the Net Explosive Quantity (NEQ) of these items is far lower than that of a grenade, for example. An unexploded grenade, if it functioned, has the potential to cause fatal injuries, which would indicate a severe risk of harm associated with this item. However, while the 3kg practice bombs would likely not cause fatal injuries if functioning, they are capable of causing serious injuries.

8.2 Assessed Risk Levels

Therefore, the risk of harm can be split into three risk levels:

1. **Tolerable** – Unlikely to cause any injuries or damage to property/plant.
 If the risk of harm is deemed to be Tolerable on a given site, minimal risk mitigation measures will be recommended. Since the risk cannot be entirely mitigated at a desktop stage, sites / zones at a Tolerable risk of harm will most often be prescribed UXO Safety Awareness Briefings. Proactive risk mitigation measures are not typically recommended.
2. **Intolerable** – Potential to cause slight and serious injuries, and/or damage to property/plant.
 Should an Intolerable risk of harm be assessed, proactive risk mitigation measures will be recommended. The type of measures will vary based on the scope of works, although items of UXO that pose an intolerable risk of harm (i.e., small IBs and practice bombs, autocannon rounds, flares etc.) are typically found at shallower depths than those which pose a Severe risk of harm. This is often due to the reduced weight of the item, resulting in a lesser penetration depth. As a result, clearance may not be required to deeper depths, as is typically the case with aerially delivered HE bombs that did not explode.
3. **Severe** – Potential to cause fatal injuries and/or extreme damage to property/plant.
 A Severe risk of harm will be assessed if an elevated risk of encountering items of UXO with a high NEQ has been determined, such as HE bombs, artillery shells, grenades, mortars and heavy anti-aircraft shells. Proactive risk mitigation measures will always be recommended – assuming that ground will be broken on site – and clearance may be needed to deeper depths if the risk of harm stems from aerially delivered HE bombs.

8.3 Risk of Harm and Relevant Examples of UXO

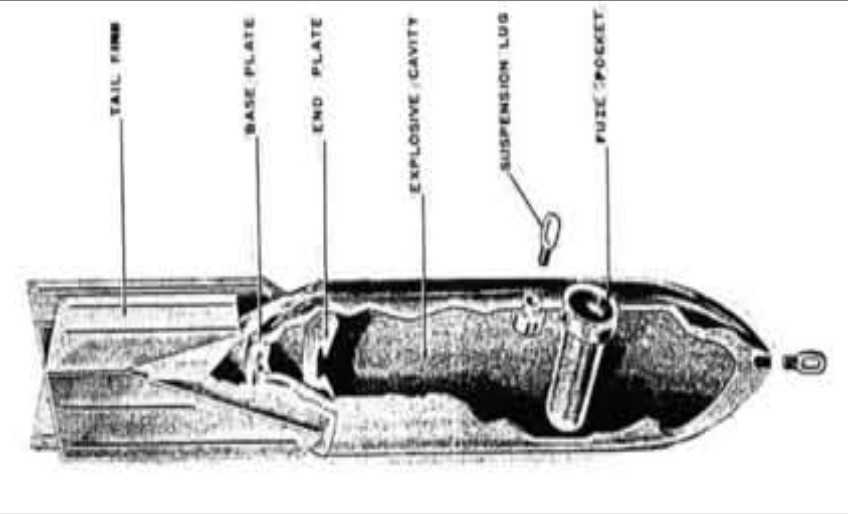
Assessed Risk of Harm Rating	Type(s) of UXO
Tolerable	• Small Arms Ammunition (SAA) • Practice ammunition
Intolerable	• Small incendiary bombs • Small practice bombs • 20mm autocannon rounds • Flares • Illumination ammunition
Severe	• HE aerially-delivered bombs • Grenades • Mortar rounds • Artillery shells • HE anti-tank ammunition • HE incendiary bombs • Larger practice bombs • Sea mines • Land mines • HAA shells

9 Risk Mitigation Methodology

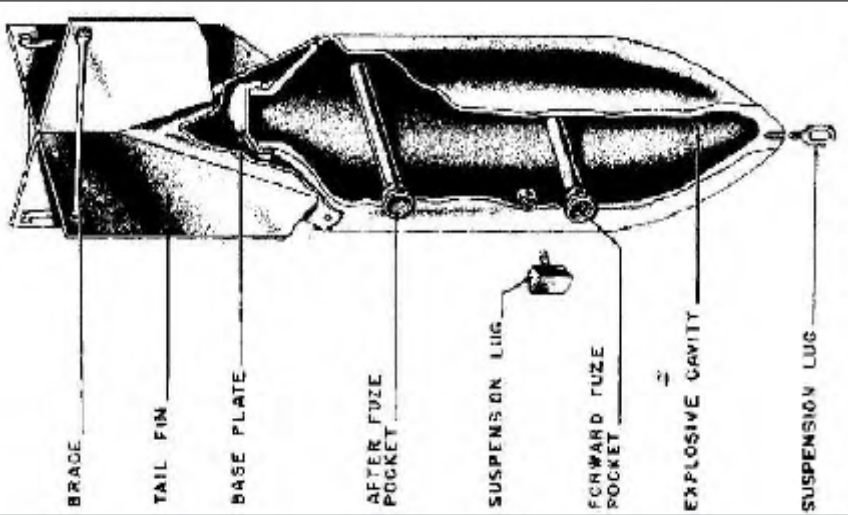
RSK OM has the capability to deliver a wide range of risk mitigation measures. Below is a breakdown of the services we offer. The Executive Summary of this report will detail what risk mitigation measures are recommended for your site specific works.

Risk Mitigation Methods	
UXO Safety Awareness Briefings	Recommended for all personnel working on site. The briefings will provide a basic level of knowledge regarding UXO, ensuring workers know what to do when they suspect they may have found an item of UXO. Delivered by a UXO specialist with refresher courses offered at intervals.
UXO Watching Brief	An alternative method to ensure safety on site for when conditions are not appropriate for a non-intrusive survey. A UXO Engineer with a man-portable magnetometer can provide assurances during open excavations to avoid unnecessary timely delays. Allows for borehole clearance and visual identification of potentially items of UXO, avoiding potentially unnecessary evacuations from site.
Non-Intrusive Magnetometer Survey	RSK OM has the capability to deliver non-intrusive surveys via a number of methods; contact our Operations department for specific requirements. A portable magnetometer probe collects data from your site which is then interpreted for evidence of ferrous anomalies. The final stage in this process is a Target Investigation, where any anomalies found can be investigated on site. Note, this survey is only applicable for magnetically clean (i.e. greenfield) ground.
Intrusive Magnetometer Survey	Similarly to non-intrusive magnetometer surveys, RSK OM can deliver an intrusive magnetometer survey in a variety of ways. This survey will successfully clear pile positions to the required bomb penetration depth. Discussion with our Operations team will dictate the best method to deliver this survey once factors such as the site specific geological conditions have been considered.

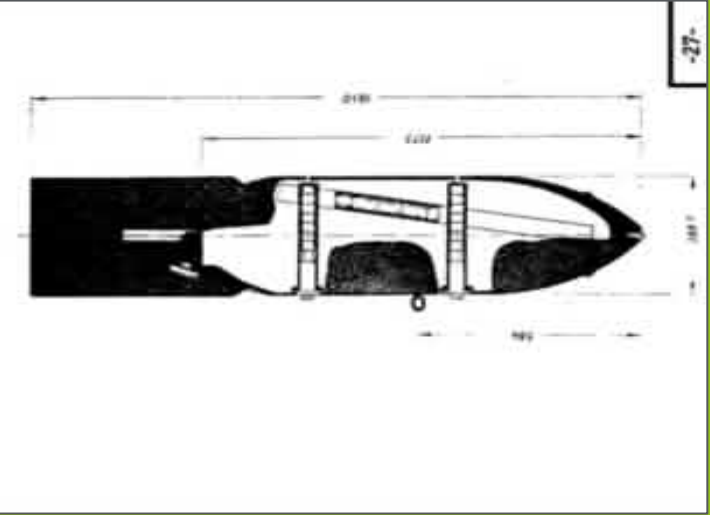
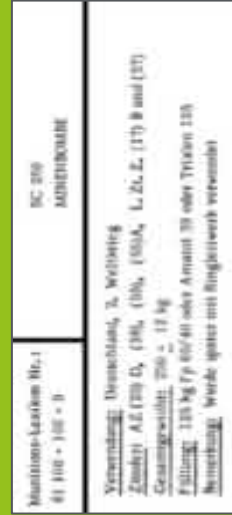
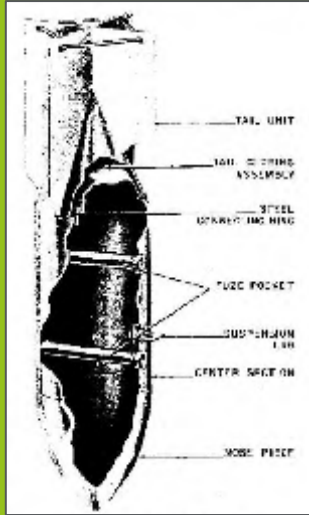
50kg HE Bomb	
Bomb Weight	54kg
Weight of Explosive Fill	25kg amatol/TNT/trialen
Bomb Dimensions	1090mm x 280mm
Type of Fuze	Impact or electrical time delay
Notes	Most dropped bomb by weight over Britain. Useful against light targets.



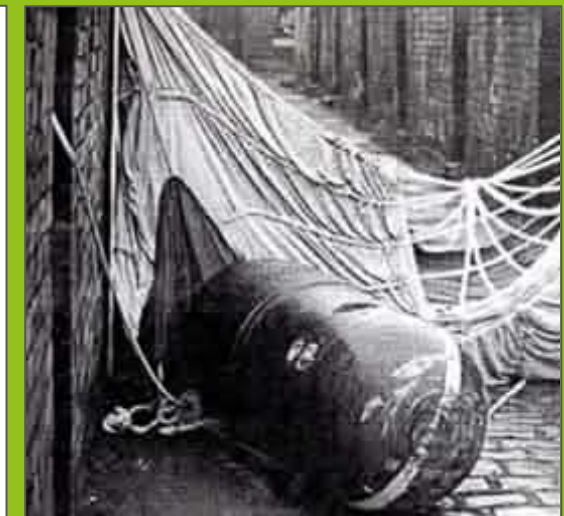
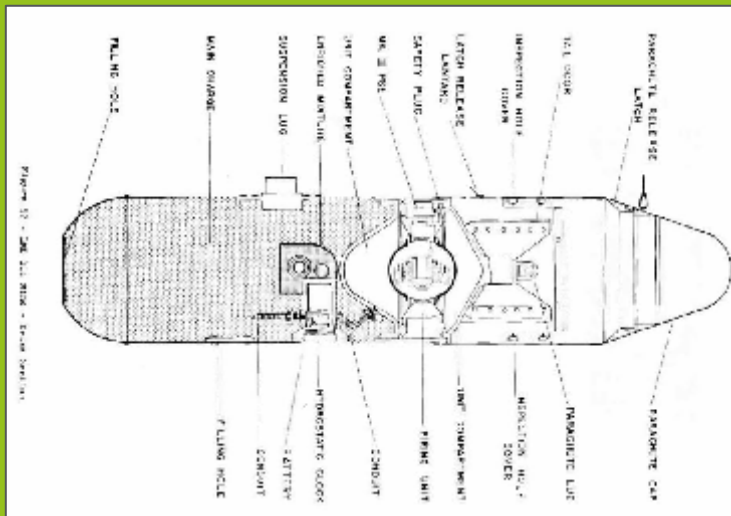
250kg HE Bomb	
Bomb Weight	256kg
Weight of Explosive Fill	130kg amatol/TNT/trialen
Bomb Dimensions	1640mm x 512mm
Type of Fuze	Impact or electrical time delay
Notes	Increased penetrative ability proved useful against sub-terranean targets.



500kg HE Bomb	
Bomb Weight	520kg
Weight of Explosive Fill	220kg amatol/TNT/trialen
Bomb Dimensions	1957mm x 640mm
Type of Fuze	Impact or electrical time delay
Notes	Used against large industrial/military targets, including infrastructure

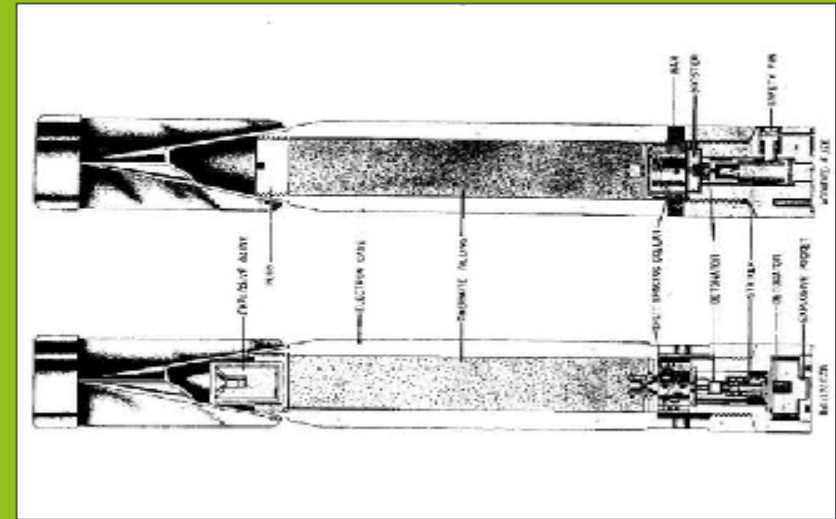
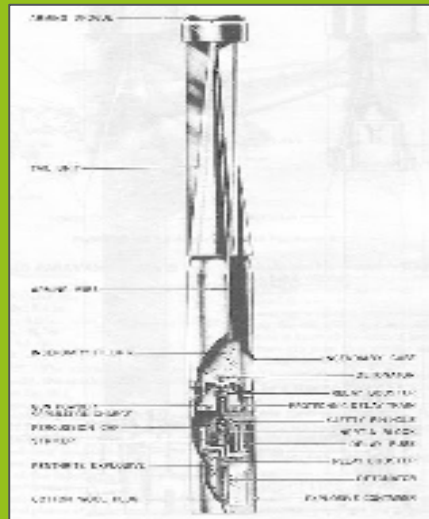


Parachute Mine (Luftmine B)	
Bomb Weight	1000kg
Weight of Explosive Fill	Approximately 700kg amatol/minol
Bomb Length	2640mm
Type of Fuze	Impact or electrical time delay
Notes	Larger than Luftmine A (500kg). Descent retarded by parachute.



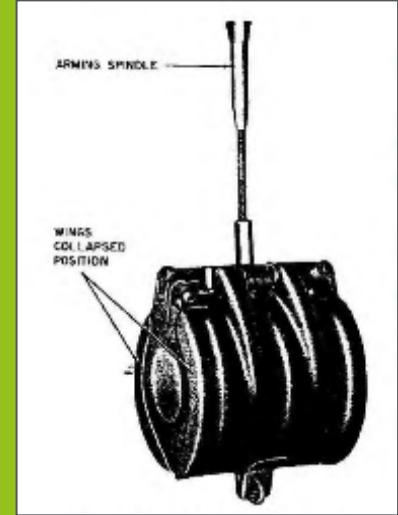
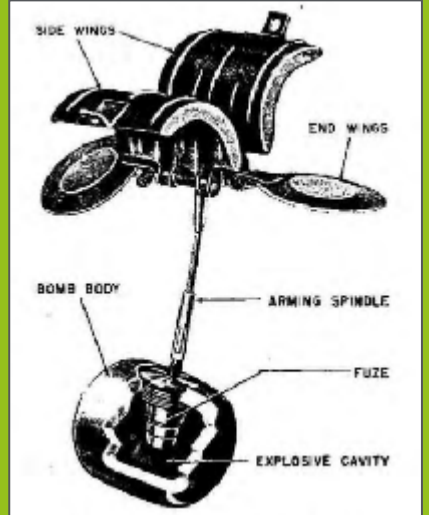
2kg Incendiary Bomb

2kg Incendiary Bomb	
Bomb Weight	2.2kg
Weight of Explosive Fill	100g HE bursting charge
Bomb Dimensions	311mm x 50mm
Type of Fuze	Electrical impact fuze
Notes	Dropped in container in batched of up to 372. Also had 1kg variant.



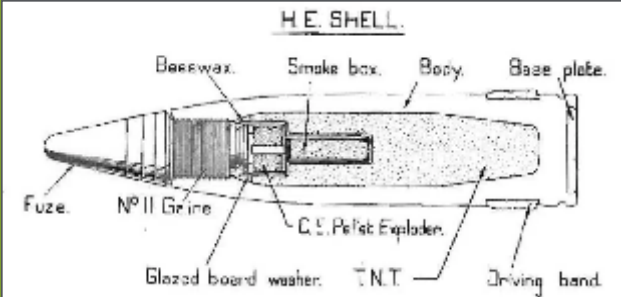
SD2 AP Butterfly Bomb

SD2 AP Butterfly Bomb	
Bomb Weight	2kg
Weight of Explosive Fill	220g amatol
Bomb Diameter	762mm
Type of Fuze	Time delay, anti-handling device
Notes	Fragmentation device. Bomb armed by wings as they spun on descent.

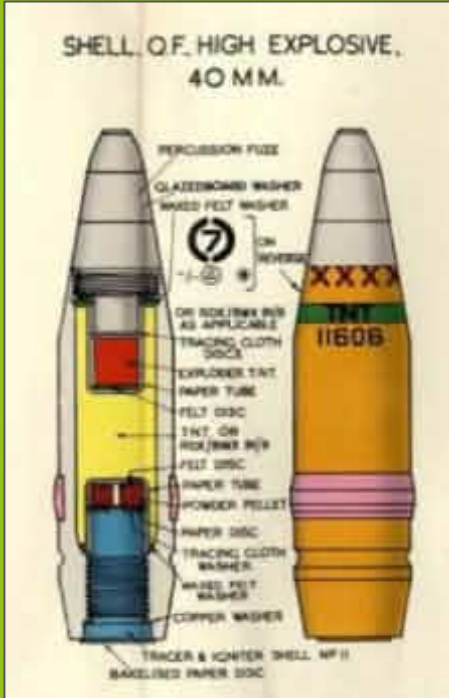


[illegible]

3.7" QF Shell	
Shell Weight	12.7kg
Weight of Explosive Fill	1.1kg
Shell Dimensions	94mm x 438mm
Type of Fuze	Mechanical time delay fuze
Notes	Both HE and shrapnel variants were utilised.



40mm Bofors Shell	
Shell Weight	0.84kg
Weight of Explosive Fill	70g
Shell Dimensions	40mm x 180mm
Type of Fuze	Impact fuze
Notes	Both HE and armour piercing variants were utilised.



- *Bates, H. E.*, Flying Bombs over England, Frogletts Publications Ltd., 1994
- *Castle, I.*, London 1914-17 The Zeppelin Menace, Osprey, 2008
- *Castle I.*, London 1917-18 The Bomber Blitz, Osprey, 2010
- *Clarke, N. J.*, Adolf's British Holiday Snaps: Luftwaffe Aerial Reconnaissance Photographs of England, Scotland and Wales, Fonthill Media Ltd., 2012
- *Dobinson, C.*, AA Command: Britain's Anti-Aircraft Defences of the Second World War, Methuen., 2001
- *Dobinson, C.*, Fields of Deception: Britain's Bombing Decoys of World War II, Methuen Publishing Ltd, 2013
- *Fegan, T.*, The 'Baby Killers': German Air Raids on Britain in the First World War, Leo Cooper Ltd., 200
- *Fleischer, W.*, German Air-Dropped Weapons to 1945, Midland Publishing., 2004
- *Hogg, I.*, The Guns 1939-1945, MacDonald and Co. Publishers, 1970
- *Johnson, C.*, Weapons & Warfare of the 21st Century, Cathay Books
- *Morris, J.*, German Air Raids on Britain: 1914 – 1918, The Naval & Military Press., 1993
- *Price, A.*, Blitz on Britain, The Bomber Attacks on the United Kingdom 1939 – 1945, Purnell Book Services Ltd., 1977
- *Ramsey, W.*, The Blitz Then and Now, Volumes 1,2 & 3, Battle of Britain Prints International Ltd., 1987, 1988 & 1990
- *Ramsey, W.*, The East End Then and Now, After the Battle, 1997
- *Scofield, J.*, Modern Military Matters., Council for British Archaeology., 2004
- *Stone, K., et al.*, Unexploded Ordnance (UXO) A Guide For The Construction Industry (C681)., CIRIA, 2009
- *Whiting, C.*, Britain Under Fire: The Bombing of Britain's Cities 1940-1945, Pen & Sword Books Ltd., 1999



RSK M

ORDNANCE MANAGEMENT

Address	ADAS Boxworth, Battlegate Road, Cambridge, CM23 4NN
Website	https://rskgroup.com/
Contact Us	https://rskgroup.com/contact-us/