

Redrow Homes (NW)

Ground Investigation Report

for

Lower Road, Halewood

December 2018

REPORT NO: 17RED147/GI

- *Desk Studies and Site Walkovers*
- *Intrusive Contaminated Land Investigations*
- *Geotechnical Appraisals and Ground Investigations*
- *Landfill Gas Assessments and Remedial Design*
- *Remediation Design and Implementation*
- *Remediation Project Management and Supervision*
- *Site Abnormal Assessments (Foundations and Contaminated Land)*

GEOTECHNICAL - CONTAMINATED LAND - FLOOD RISK

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DOCUMENT ISSUE RECORD

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Client: Redrow Homes (NW)

Contract: Lower Road, Halewood

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0	September 18	Draft for comment, partial gas results	RD / KR
1	December 18	Final with complete gas results	RD

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1 EXECUTIVE SUMMARY

Note – The following summary is not exhaustive and is to be used for guidance purposes only. The full report should be consulted for full details.

1. Site Location

The site is located to the south of Lower Road and to the west of Finch Lane. The closest postcode is L26 3UA. The coordinates on National Grid are 345680, 385460. The proposed site is approximately 20.17 hectares (Ha) in total.

2. Site Description

On Site

The site is square shaped, and access is possible through a double metal gate on the north eastern boundary of site. In the majority of site, the ground is flat with wet, soft ground and localised depressions, generally to the western boundary and the north eastern corner of site. On the eastern and southern boundary drains are noticeable with overgrown mature vegetation, trees and hedges. Beyond the north western border, a stream and an embankment for railway purposes forms in very short distance from site (20m) while several manholes are present on site and close to that border.

Surrounding Area

The area surrounding the site comprises of the following;

- North – Immediately N railway line and embankment, 0m – 750m N grass open fields and agricultural land, 750 – 1000m Greens Bridge Plantation with open agricultural land >1000m.
- East – 0m – 1000m open agricultural land, cottages and farms.
- South – Grass open fields and agricultural land 0 – >1000m.
- West – Residential developments immediately W and up to >1000m.

3. Proposed Development

The proposed construction of residential dwellings and associated gardens, public open spaces and associated infrastructure.

4. Site History

On Site

The site has never been developed and has remained for an agricultural enduse. However, several ponds have been noted on the site, and have possibly changed shape, implying they may have been modified by infilling.

Surrounding Area

The site is located within a largely agricultural area and with residential homes more recently. The most salient historical features are sewage works and opencast mining located within 250m of the site.

5. Published Geology

The drift geology map (BGS Sheet 110, 1:50,000) indicates that the site to be underlain glacial till (clay).

Bedrock is shown to comprise the Kinnerton and Wilmslow Sandstone Formations, with Wilmslow Formation only present in the eastern extremity of the site.

6. Hydrogeology and Hydrology

- The superficial deposits of Glacial Till are classed as a Secondary Undifferentiated Aquifer (Negligible – Low Permeability).
- The bedrock deposits of Sandstone are classed as a Principal Aquifer (High Permeability).
- The site lies within a Groundwater Source Protection Zone 3 (Total Catchment Zone) as defined by the Environment Agency.

- The nearest surface water feature is a stream on the northeast of site.
- There is a Source Protection Zone with a Borehole 600m north of site.
- Site lies within a Nitrate Vulnerable Zone.

7. Summary of Environmental Data

Possible Contamination Sources

- Current Land Use on Site – No.
- Historical Land Use – Unlikely.
- Neighbouring Land Uses - Possible

In this qualitative risk assessment, a Low – Low / Moderate risk for contamination and ground gas implies that remedial action may be necessary at the site, the likes of which cannot be confirmed until the geotechnical and contamination ground investigation has been completed.

8. Scope of Investigation

- Fifteen (15 No) days trial pitting to 2.20m – 3.40mbgl using a JCB.
- Twelve (12 No) small diameter boreholes to 3.00mbgl installed with gas monitoring wells with upstanding covers to assess risk of ground gas migration at anticipated foundation depth to target where possibility of localised Made Ground is significant and the majority of infilled ponds on site.
- Six (6 No) ground gas monitoring visits over a period of at least 3 months with varying barometric pressures.
- Thirty (30 No) soil samples (topsoil, made ground and natural) taken for chemical analysis to benchmark contamination levels across the site. Proposed testing will include but not be limited to the following; heavy metals suite (comprising; As, Cd (low level), Cr, Vi, Pb, Hg, Se, Ni, Cu, Zn), Organic Matter, Sulphate, pH, speciated polycyclic aromatic hydrocarbons, TPH CWG. Asbestos testing within topsoil and Made Ground with quantification for positive samples.

9. Ground Conditions Encountered

Summary of main ground conditions;

Ground conditions consisted of TOPSOIL (to a maximum depth of 0.40mbgl) over reddish brown CLAY with occasional Brown Sand and black SILT within former pond locations.

MADE GROUND was observed to a maximum depth of 2.20mbgl. Made Ground comprised 'white SAND', SAND and GRAVEL and CLAY, all with anthropogenic constituents such as glass and brick.

Peat has been identified in two locations as peaty inclusions and Soft black spongy fibrous peat in TP110 and TP115 respectively.

10. Contamination Encountered

A single exceedance of Benzo(a)pyrene has been observed in WS103 at a depth of 0.20mbgl, located within the topsoil. The observed concentration of 3.10mg/kg marginally exceeds the AtRisk 2017 threshold of 1.51mg/kg.

Whilst not exhibiting any elevated concentrations of the determinants tested for, TP115 did have a pH of 11.97, indicating that the material is very alkaline. Substances with a pH of >10 may be considered a contaminative risk to humans, controlled waters and its associated flora / fauna. This level of alkalinity is in line with the assumption that its lime used to stabilise the pond deposits.

No elevated levels of arsenic or other heavy metals were found within this location, so it is not currently considered to be Galligu or other chemical waste.

11. Remedial Actions

Soils

- No specialist measures are required.
- Care should be undertaken when dealing with ground works in and around TP115.

12. Off-Site Disposal of Surplus Soil

It is recommended that the results of the contamination testing (including the history of the site) be presented to the proposed landfills, to obtain their acceptance of the information to date and to determine the actual WAC limits used by them.

Segregation of topsoil and natural strata should be possible given the very different visual identification.

13. Specialist Ground Gas Measures

Elevated Carbon Dioxide (CO₂) has been observed in two (2 No.) locations, WS103 and WS105, with concentrations of 7.2% and 6.6% respectively. It's noted that WS103 encountered elevated CO₂ levels on several visits and on peak and steady flows. WS103 is located in the vicinity of a former pond. WS105 encountered elevated peak CO₂ during one visit and is not located in the vicinity of a former pond/fill area

Elevated Methane (CH₄) has been observed in one (1 No.) location, WS109, with a maximum concentration of 12.6%. WS109 is located within a former pond area.

It should be noted that gas flows remain low, ≤2.1l/h for all boreholes except for WS102 with a peak gas flow of 12.7l/h.

Peak CO₂ was only encountered in WS105 on one occasion and with very low flow identified. Given that no other elevated levels of CO₂, or infilled pond/fill/source of significant ground gas was encountered in the vicinity, no ground gas protection measures are required in the vicinity of WS5.

It is currently considered that gas protection measures will be required within the new development in the vicinities of WS105 and WS109 where former ponds are located. As such, the majority of site is categorised as Green – no gas protection measure required with Amber 1 protection in the vicinity of WS103 and other infilled pond areas on site, Amber 2 protection will be required in the vicinity of WS109.

With Local Authority approval, plot by plot zoning of the gas protection measures may be possible due to the nature of the ground gas risk (infilled ponds). Delineation of the pond areas may be required to determine plots affected depending upon the final layout.

14. Foundations

Strip / trench foundations may be suitable across most of the site, with the following allowable bearing capacities;

- Loose SAND strata with an allowable bearing pressure of circa 50-75kN/m²
 - Plot by plot assessment required due to possible presence of groundwater
- Firm CLAY strata with an allowable bearing pressure of circa 75kN/m²
- Stiff CLAY strata with an allowable bearing pressure of circa 100kN/m²

Where groundwater is found with granular soil, the allowable bearing pressure (ABP) can be expected to be half. A plot by plot assessment should be undertaken to further assess this.

Areas of soft ground conditions such as soft SILT and PEAT have been identified on the site. In these areas, or others where similar conditions are found, the plots in these locations may require piling. A specialist piling contractor should be consulted with regards to pile design.

15. Highway

According to the criteria of Highways Agency HD 25/95 Volume 7 Section 2 Part 2 HD 25/94, a CBR value of around 3% is anticipated.

16. Heave / Shrinkage Potential

Geotechnical testing has shown the natural CLAY deposits to be low expansion potential.

17. Ground Floor Construction

Suspended floor construction e.g. either in situ RC slabs or block and beam flooring is recommended as per NHBC guidance.

18. Control of Groundwater

Limited groundwater was encountered during the fieldwork. It is likely that provision of pumping/shuttering will be necessary during excavation of foundation trenches during wet weather, close to surface water features and to deeper excavations for sewers etc. It is good practice to have such equipment on standby in case of seasonal / abnormal weather conditions.

19. Concrete Design

It is considered for concrete design purposes that a greenfield site and mobile groundwater conditions are applicable, and the results are summarised below: Design Sulphate Class: DS-1, ACEC Class: AC-1s, Design Chemical Class: DC-1 – For the majority of the site.

Design Sulphate Class: DS-2, ACEC Class: AC-2, Design Chemical Class: DC-2 – For the area around TP110.

2 SITE DESCRIPTION

2.1 Introduction

This investigation was carried out on the instruction of Redrow Homes. The purpose of the work was to carry out a Desk Study to provide geotechnical and contamination risk information for the proposed construction of residential dwellings with associated infrastructure, gardens and public open space.

2.2 Site Location

The site is located to the south of Lower Road and to the west of Finch Lane. The closest postcode is L26 3UA. The coordinates on National Grid are 345680, 385460. The proposed site is approximately 20.17 hectares (Ha) in total. See Site Location Plan in Appendix A.



2.3 Site Description

2.3.1 On Site

Site was visited by a Geo-Environmental Engineer on the 24th October 2017 and photographs can be found in Appendix A.

The site is square shaped and access is possible through a double metal gate on the north eastern boundary of site. Extra caution should be undertaken when accessing site since ground in that area is generally boggy. In the majority of site, the ground is flat with wet, soft ground and localised depressions, generally to the western boundary and the north eastern corner of site. On the eastern and southern boundary drains are noticeable with overgrown mature vegetation, trees and hedges. Beyond the north western border, a stream and an embankment for railway purposes forms in very short distance from site (20m) while several manholes are present on site and close to that border.

A pond immediately south of site was identified to the southern border within an area of mature vegetation and many trees. A big tree was also noted on the same boundary with an associated big depression.

Overhead electric cables cross the site at the south eastern corner coming from the north and terminate on a pylon to the southern boundary of site.

Topography of the site is generally level.

Surrounding Area

The area surrounding the site comprises of the following;

- North – Immediately N railway line and embankment, 0m – 750m N grass open fields and agricultural land, 750 – 1000m Greens Bridge Plantation with open agricultural land >1000m.
- East – 0m – 1000m open agricultural land, cottages and farms.
- South – Grass open fields and agricultural land 0 – >1000m.
- West – Residential developments immediately W and up to >1000m.

3 SITE HISTORY

3.1 Previously Undertaken Reports

Betts Geo previously undertook a Desk Study Report for the above site. The report reference is provided below:

- Desk Study Report, Finch Lane, Halewood on behalf of Redrow Homes, report ref. 17RED147/DS, dated October 2017.

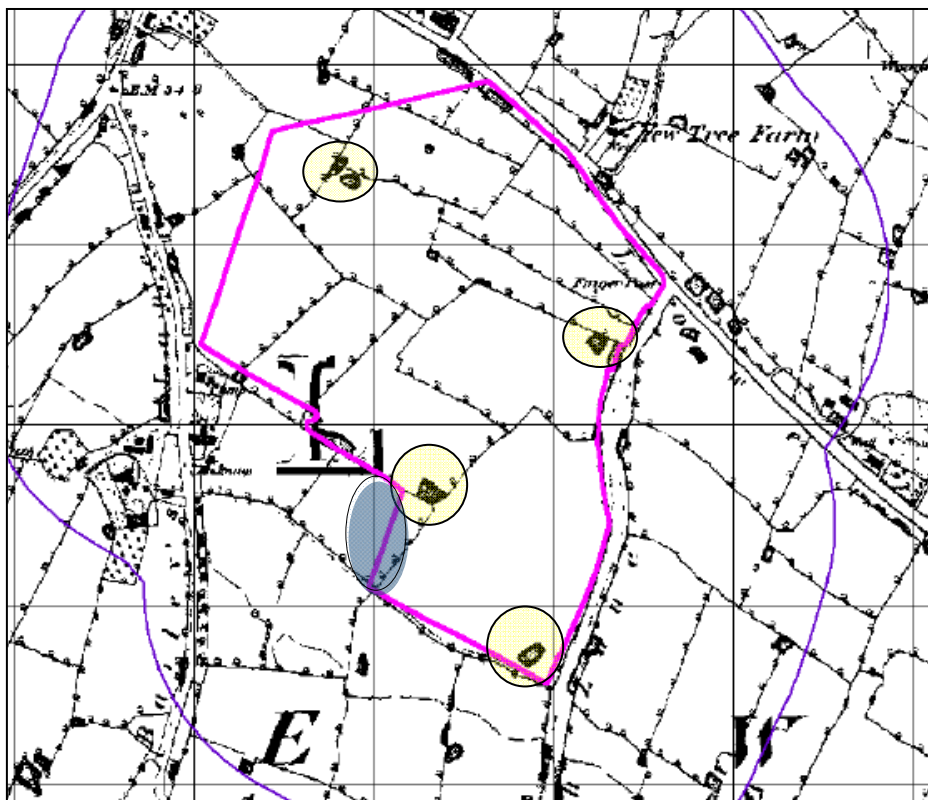
Where necessary, the above report has been used throughout this report and referenced accordingly. The following 'Site History Summary', 'Geology', 'Environmental Data', 'Summary of Environmental Sensitivity', 'Contamination Conceptual Model' and 'Scope of Ground Investigation' have been summarised from the Desk Study report.

3.2 Summary of Site History

3.2.1 On Site

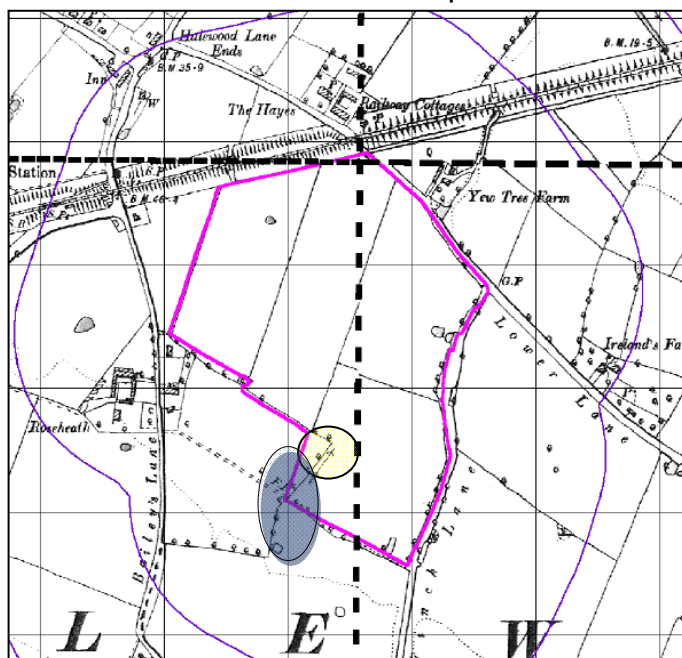
The earliest map is the 1849 1:10,000 map which shows the site as undeveloped and consisting of several open grass fields. The map shows several ponds on site and a ditch. An extract of this is shown below;

1849 1:10,560 map



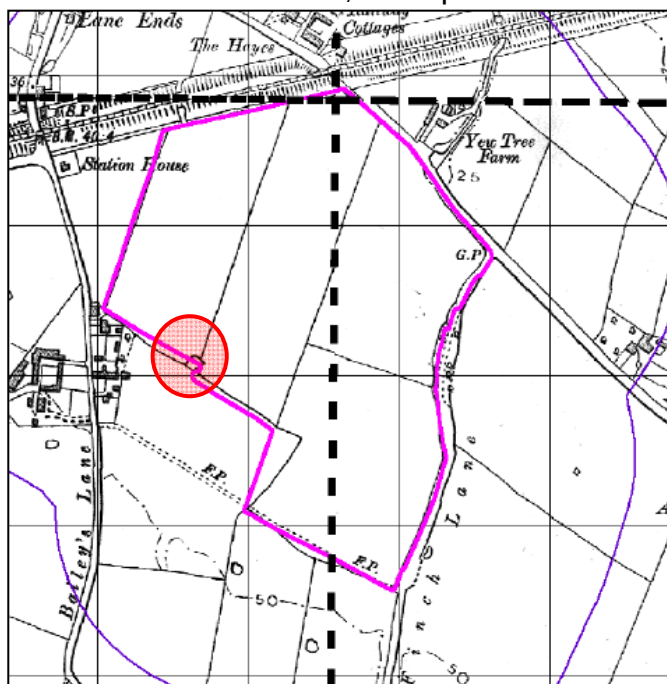
Circa 1894, the pond in the highlighted area is not shown any more on site. Mapping also shows possible change in shape and size of remaining ponds. The ditch is shown as a stream. An extract of this is shown overleaf;

1894 1:10,560 map



Circa 1908, the rest of the ponds of site are no longer shown. However, a possible pond is shown in the west of the site. An extract of this is shown below;

1908 1:10,560 map



No further significant changes have occurred on site post circa 1908.

3.2.2 Surrounding area

The following table summarises the significant changes in historical use surrounding the site:

Map Date	Land Uses
1893	Immediately N – Railway lines and embankment (still present). 90m SW – Pond (still present). 400m NE – Ditton Brook 100m SW – Roseheath (demolished circa 1954 – 1966). 120m SW – Pond (not shown circa 1967 – 1970). Immediately NE – Yew tree farm and well (still present). 200m E – Pond (still present). 150 – 300m W – Ponds (not shown 1959 – 1965). 300m SE – Ponds (still present). 300m SE – Finch Farm (circa 2017 Everton Football Centre, still present).
1907 - 1958	No significant changes occur during that time.
1958 - 1965	Immediately W – Residential development (extended circa 1964 – 1991, still present). 250m NE – Sewage works (circa 1989 works are demolished and refuse tip in its place).
1959 - 1967	150m E – Caravan Site (still present).
1970-1977	Constructions of roads and large works to south. Immediately N and E - Drains
1965 - 1999	No significant changes occur during that time.
1999	247m N – Opencast Workings (pond circa 2006).
1999 - 2017	No significant changes.

4 GEOLOGY

4.1 Published Geology

The documented geology of the site is summarised on the British Geological Survey map principally, with further site-specific details detailed below.

Geology	Drift	Solid
1:10,000 SJ48SW (1946), SJ48NW (1946), SJ48NE (1951), SJ48SE (1946)	Till – Devensian – Diamicton	Kinnerton Sandstone Formation – Sandstone. Wilmslow Sandstone Formation – Sandstone (eastern extremity only)

Geology 1:10,000 Maps Legends

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Flandrian - Pleistocene
	TILLD	Till, Devensian	Diamicton	Devensian - Ipswichian

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WLSF	Wilmslow Sandstone Formation	Sandstone	Early Triassic - Early Triassic
	KNSF	Kinnerton Sandstone Formation	Sandstone	Early Triassic - Early Triassic
	CPB	Chester Pebble Beds Formation	Sandstone	Early Triassic - Early Triassic
	ETM	Etruria Formation	Mudstone, Sandstone and Conglomerate	Westphalian - Westphalian
	Fault			



Superficial Geology



Bedrock Geology

4.1.1 Fault Lines

There is one (1 No) fault line running on the northeast border of the site in a northwest to southeast transect.

4.2 Geological Features

There are no BGS Recorded Mineral Sites, Man Made Mining Cavities or Natural Cavities identified within 500m of site.

4.2.1 Radon

The site boundary is in a low probability radon area as less than 1% of properties are above the action level. Therefore, no radon protective measures are necessary in the construction of new dwellings or extensions.

4.3 Hydrogeological and Hydrological Features

The table below summarises the presence/absence of any hydrological licences and incidents within 500m of the proposed site.

Data Type	Detail
Discharge Consents	39m SE, Everton Football Club – sewerage and trade combined discharge. 217m NE, UU pumping station sewage discharges.
Pollution Incidents to Controlled Waters	63m N: Crude sewage into Ditton Brook. Category 3- minor incident, 30.08.94.
Water Abstractions	54m and 60m SE, ground water abstraction for spray irrigation.

4.4 Hydrogeology:

- The superficial deposits of Glacial Till are classed as a Secondary Undifferentiated Aquifer (Negligible – Low Permeability).
- The bedrock deposits of Sandstone are classed as a Principal Aquifer (High Permeability).
- The site lies within a Groundwater Source Protection Zone 3 (Total Catchment Zone) as defined by the Environment Agency.
- The nearest surface water feature is a stream on the northeast of site.
- There is a Source Protection Zone with a Borehole 600m north of site.
- Site lies within a Nitrate Vulnerable Zone.

5 ENVIRONMENTAL DATA

The table below summarises the presence/absence of any waste, hazardous substance sites and/or industrial land uses within 500m of the proposed site. If entries are present within 250m, further details are provided in the relevant section below.

Data Type	On Site	0 – 250m	250 – 500m
Pollution Controls/Registers			
Integrated Pollution Controls	-	-	-
Integrated/Local Authority Pollution Prevention and Controls	-	-	-
Prosecutions Relating to Authorised Processes	-	-	-
Registered Radioactive Substances	-	-	-
Substantiated Pollution Incident Register	-	-	-
Waste			
BGS Recorded Landfill Sites	-	-	-
Historic Landfill Sites	-	-	-
Integrated Pollution Control Registered Waste Sites	-	-	-
Licensed Waste Management Facilities (Landfill Boundaries and Locations)	-	-	-
Local Authority Recorded Landfill Sites	-	-	-
Potentially Infilled Land (Non-Water)	-	-	-
Potentially Infilled Land (Water)	-	10	14
Registered Landfill Sites	-	-	-
Registered Waste Transfer Sites	-	-	-
Registered Waste Treatment or Disposal Sites	-	-	-
Hazardous Sites			
COMAH/Explosive sites/NIHHS/Planning Hazardous Substances	-	-	-
Industrial Land Uses			
Contemporary Trade Directory Entries	-	1	2
Fuel Station Entries	-	-	1
Points of Interest – Commercial Services	-	2	3
Points of Interest – Education and Health	-	-	-
Points of Interest – Manufacturing and Production	-	1	-
Points of Interest – Public Infrastructure	-	-	2
Points of Interest – Recreational and Environmental	-	-	-
Gas Pipelines	-	-	-

5.1 Waste

5.1.1 Potentially Infilled Land (Water)

There are ten (10 No) Potentially Infilled Land entries within 250m, one (1 No) of which is located onsite as detailed below;

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
113	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1849	A11NW (N)	24	-	345694 385797
114	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1849	A10SE (NW)	30	-	345450 385703
115	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1849	A10NE (N)	49	-	345548 385790
116	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1849	A10SE (NW)	73	-	345379 385629
117	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1955	A10SW (W)	142	-	345267 385490
118	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1849	A10NE (N)	173	-	345554 385918
119	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1849	A10SW (NW)	206	-	345257 385684
120	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1955	A6NE (SW)	212	-	345330 385288
121	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1849	A10NE (N)	227	-	345479 385956
122	Potentially Infilled Land (Water) Use: Unknown Filled Ground (Pond, marsh, river, stream, dock etc) Date of Mapping: 1849	A10SW (W)	235	-	345210 385633

5.2 Industrial Land Uses

5.2.1 Contemporary Trade Directory Entries

There is one (1 No) Contemporary Trade Directory Entry within 250m as detailed below;

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
171	Contemporary Trade Directory Entries Name: J & M Haulage Ltd Location: 32, Baileys Lane, Halewood, Liverpool, L26 0TZ Classification: Road Haulage Services Status: Inactive Positional Accuracy: Automatically positioned to the address	A10SW (NW)	146	-	345316 385669

5.2.2 Points of Interest – Commercial Services

There are two (2 No) Points of Interest – Commercial Services within 250m as detailed below;

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
184	Points of Interest - Commercial Services Name: J & M Haulage Ltd Location: 32 Baileys Lane, Halewood, Liverpool, L26 0TZ Category: Transport, Storage and Delivery Class Code: Distribution and Haulage Positional Accuracy: Positioned to address or location	A10SW (NW)	146	8	345316 385669
184	Points of Interest - Commercial Services Name: J & M Haulage Liverpool Ltd Location: 32 Baileys Lane, Halewood, Liverpool, L26 0TZ Category: Transport, Storage and Delivery Class Code: Distribution and Haulage Positional Accuracy: Positioned to address or location	A10SW (NW)	146	8	345316 385669

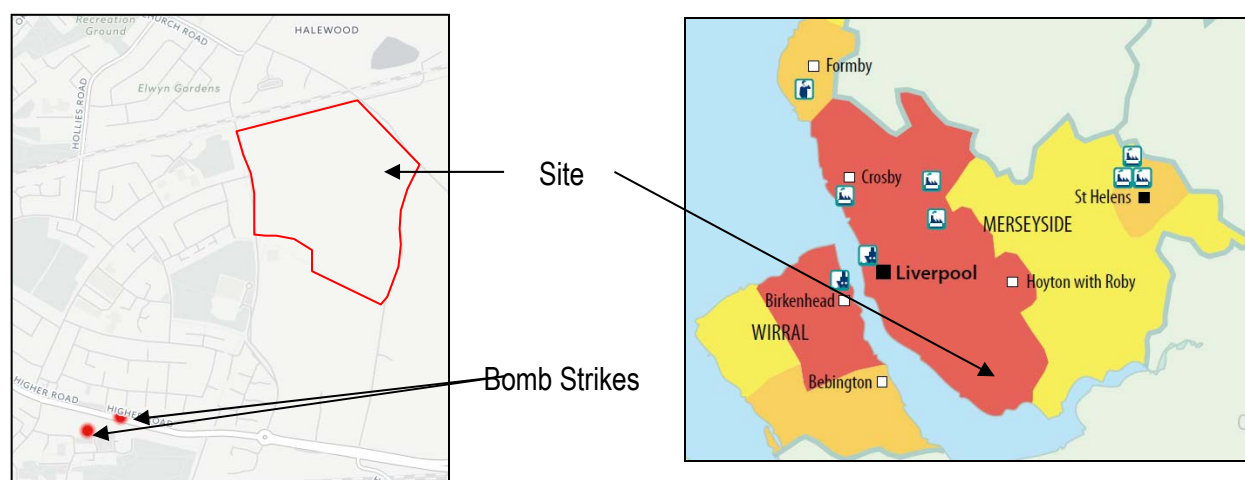
5.2.3 Points of Interest – Manufacturing and Production

There is (1 No) Points of Interest – Manufacturing and Production within 250m as detailed below;

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
189	Points of Interest - Manufacturing and Production Name: Opencast Workings Location: L26 Category: Extractive Industries Class Code: Unspecified Quarries Or Mines Positional Accuracy: Positioned to an adjacent address or location	A11NW (N)	247	8	345828 386007

5.3 UXB Risk

The site is potentially within a 'high' Regional Unexploded Bomb Risk zone as outlined by Zetica (extract below). Although an internet search suggests bomb damage during the Blitz within the immediate vicinity of the site (again extract below) is not likely, it would be prudent to have a specialist UXB company undertake a risk assessment for the site since the locations of the bombs are only approximate.



Therefore, a UXB report was obtained. The salient points are summarised below;

Pre-WWI Military Activity on or Affecting the Site	None identified.
WWI Military Activity on or Affecting the Site	None identified
WWI Strategic Targets (within 5km of Site)	The following strategic targets were located in the vicinity of the Site: ■ Transport infrastructure and public utilities, including mainline railways and sidings. ■ Garston Docks and associated shipyards. ■ Industries important to the war effort, including metal and engineering works.
WWI Bombing	None identified on the Site.
Interwar Military Activity on or Affecting the Site	None identified.
WWII Military Activity on or Affecting the Site	None identified.
WWII Strategic Targets (within 5km of Site)	The following strategic targets were located in the vicinity of the Site: ■ Transport infrastructure and public utilities, including mainline railways and sidings. ■ Royal Air Force (RAF) Speke. ■ Garston Docks and associated shipyards. ■ Military camps. ■ Industries important to the war effort, including aircraft factories, iron and engineering works. ■ Anti-invasion and Anti-Aircraft (AA) defences.
WWII Bombing Decoys (within 5km of Site)	2No. The nearest was located within approximately 0.3km northeast of the Site. No records have been found to indicate that the decoy was heavily bombed.
WWII Bombing	During WWII the Site was located in the Rural District (RD) of Whiston, which officially recorded 280No. High Explosive (HE) bombs with a low regional bombing density of 9.5 bombs per 405 hectares (ha). At this stage of the research, records have been found to indicate that only 1No. HE bomb fell on the Site. This was recorded as an Unexploded Bomb (UXB) and removed.
Post-WWII Military Activity on or Affecting the Site	None identified.

Preliminary UXO Hazard Assessment

Records indicate that only 1No. HE bomb fell on the Site during WWII. This was recorded as UXB and removed.

No records of further bombing or other significant sources of Unexploded Ordnance (UXO) hazard have been identified on the Site.

At this stage of the research, it is considered that the Site has a low UXO hazard level, as shown on the preliminary UXO hazard zone plan below.



This preliminary hazard assessment will be subject to confirmation or amendment in the final report.

6 SUMMARY OF ENVIRONMENTAL SENSITIVITY

The following section is a review of the environmental sensitivity of the site as discussed in Sections 2 - 5. Significant potential risks are discussed in the following subsections and will then be evaluated as part of the Site Conceptual Model in Section 7.

Sources are defined as where pollution comes from, pathways are a route in which the pollution travels and receptors are anything affected by a pollutant. Further details on Source-Pathway-Receptor methodology can be found in Appendix D.

The table below focuses on significant site-specific sources, pathways and receptors. More 'generic' pathways and receptors (such as site end uses) will be covered as part of the full Site Conceptual Model in Section 7.

6.1 Sources

Source	Distance/ Direction	Details	Significant Risk
Current Land Use	On Site	Currently open grass land and not in use, so contamination from current use is unlikely.	No
Historical Land Use on site	On Site	Several infilled ponds on site could be a possible source of contamination. Infilled ponds could be a ground gas source and possible contaminants include heavy metals, TPH, PAH and asbestos. Ground investigation and ground gas monitoring to confirm.	Possible
Neighbouring Land Use Railway Lines	Immediately N	Shown from circa 1893 - present. Possible contaminants from this land use include heavy metals, sulphates, TPH's, PAH's, PCB's and asbestos. Anticipated cohesive strata deposits decreases the risk of contamination migration. Ground investigation and ground gas monitoring to confirm.	Possible
Neighbouring Land Use Infilled Ponds	0 – 250m N & NW	Several infilled ponds could be a possible source of contamination. Infilled ponds could be a ground gas source and possible contaminants include heavy metals, TPH, PAH and asbestos. Anticipated cohesive strata deposits decreases the risk of contamination migration. Ground investigation and ground gas monitoring to confirm.	Possible
Neighbouring Land Use Roseheath	100m SW	Shown from circa 1893 and demolished circa 1954 – 1966. In its place residential developments were constructed circa 1958 – 1965. Made ground and demolished material could possibly be buried although area must have been cleared out before residential developments were constructed. Anticipated cohesive strata deposits decreases the risk of contamination migration. Ground investigation and ground gas monitoring to confirm.	Unlikely
Neighbouring Land Use Extraction of clay	247m N	Shown circa 1999 – 2006. Post circa 2006 shown as a pond that could be a possible source of contamination. Possible ground gas source and potential contaminants include heavy metals, TPH, PAH and asbestos. However, pit might have been infilled with water and could be clay lined and in big distance from site. Ground investigation and ground gas monitoring to confirm.	Unlikely

Neighbouring Land Use Sewage Works	250m NE	Shown from circa 1959 – 1965 and later demolished and shown as a refuse tip in its place. Possible contaminants from this land use could be heavy metals, cyanides, sulphates, PCB's, fuel oils and asbestos. Ground gas from buried demolished material possible. Anticipated cohesive strata deposits decreases the risk of contamination migration and it is in a big distance from site. Ground investigation and ground gas monitoring to confirm.	Unlikely
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6.2 Pathways and Receptors

Pathways and Receptors	Distance/ Direction	Details	Significant Risk
Aquifers	Below Site	Bedrock deposits are classed as a Principal Aquifer (High Permeability). Cohesive strata should limit any downward migration into the underlying aquifer from possible sources of contamination identified on site.	Unlikely
Stream	On Site	Stream at the northeast of site could be a potential pathway from site into the aquifer and Ditton Brook to the north. Presence of cohesive superficial deposits minimise migration of contaminants from site.	No

7 INITIAL CONTAMINATION CONCEPTUAL MODEL

For details on how the conceptual model is evaluated please refer to Appendix D.

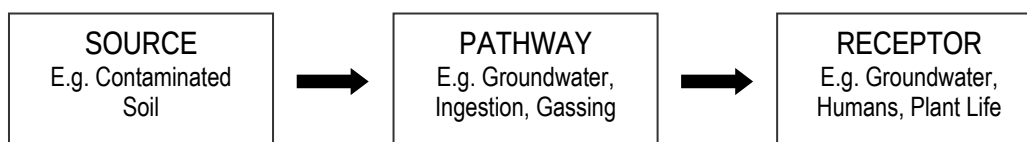
This section of the report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

Potential contamination sources and environmentally sensitive receptors have been discussed in Section 5. Potentially significant risks are evaluated as part of the subsequent sub-sections.

7.1 Source-Pathway-Receptor-Linkages

The risk assessment uses a 'Source-Pathway-Receptor' methodology for assessing whether a source of contamination could potentially lead to harmful consequences. This means that there needs to be a pollutant linkage from source to receptor for harm to be caused, this linkage consisting of: a source of pollution; a pathway for the pollutant to move along; a receptor that is affected by the pollutant.

The current potential risks to site arising from various Source-Pathway-Receptor linkages are assessed below. A risk may be considered significant if all three of the stages are present and therefore providing a pollution linkage. The various sources, pathways and receptors are considered separately. The assessment is based on the future use, which is understood to be residential with home-grown produce.



Type of Contamination	Potential Sources	Potential Pathway	Potential Receptors	Pollution Linkage	Comment	Estimated Level of Risk
Ground Gas	Historical Land Use on site	Inhalation of Vapours	Construction/Maintenance Workers	Potentially Active	Possible ground gas production due to infilled ponds on site and migration from off-site sources. Targeted ground investigation and ground gas monitoring to confirm.	Low - Moderate
	Neighbouring Land Use					
	Railway Lines	Vapours Penetrating Unprotected Buildings	Future Site Users	Potentially Active	Possible ground gas production due to infilled ponds on site and migration from off-site sources. Targeted ground investigation and ground gas monitoring to confirm.	Low - Moderate
	Infilled Ponds					
Surface and Near Surface Contaminants Within Soils	Historical Land Use on site Neighbouring Land Use Railway Lines Infilled Ponds	Ingestion, Inhalation, Dermal Contact	Current Site Users	Potentially Active	Site is currently grassed open fields. No significant risk of contamination from current site use.	Low
			Construction Workers	Potentially Active	Main risk are the infilled ponds on site. Potential for contaminants include heavy metals, PAH, TPH, asbestos and ground gas. Potential of contaminants to migrate on site from off – site sources include cyanides, sulphates, PCB's, fuel oils, chlorinated and non – chlorinated solvents and esters - from the sewage works and garage. PPE to protect.	Low-Moderate
			Future Site Users	Potentially Active	Main risk are the infilled ponds on site. Potential for contaminants include heavy metals, PAH, TPH, asbestos and ground gas. Potential of contaminants to migrate on site from off – site sources include cyanides, sulphates, PCB's, fuel oils, chlorinated and non – chlorinated solvents and esters - from the sewage works and garage. PPE to protect.	Low-Moderate
			Adjacent Land Users	Potentially Active	Residential to the west. Contamination migration risk reduced due to anticipated presence of cohesive superficial deposits. Ground investigation to confirm.	Low/Low - Moderate
		Direct Contact	Structures	Potentially Active	Main risk is the unknown nature of Made Ground from demolition of Roseheath where currently residential developments but unlikely due to probable site clearance before construction. Possible TPH, PAH, heavy metals and sulphates within the made ground demolition material from neighbouring sewage works. Ground gas possible. SI required to confirm.	Low - Moderate
		Absorption in Root Zone	Plants	Potentially Active	Main risk is the unknown nature of Made Ground from demolition of Roseheath where currently residential developments but unlikely due to probable site clearance before construction. Possible TPH, PAH, heavy metals and sulphates within the made ground demolition material from neighbouring sewage works. Ground gas possible. SI required to confirm.	Low - Moderate
Mobile Contaminants, Leachables e.g. from Pollution Sources Adjacent to Site/On Site	Historical Land Use on site	Leaching into Groundwater	Groundwater	Potentially Active	Anticipated superficial deposits are cohesive so leaching contaminants are unlikely.	Low
	Neighbouring Land Use	Off-site Migration in Surface Water/ Groundwater	Abstractions	Potentially Active	There are two groundwater abstractions within 250m of site. Site falls within a Total Catchment Zone (Zone 3).	Low - Moderate
	Railway Lines		Controlled Waters	Potentially Active	Closest surface water feature is a stream to the northeast corner of site. Ditton Brook is linked to the stream but there is no significant risk of it being a pathway of contaminants to site since there are no identified sources of contamination upstream.	Low
	Infilled Ponds					

Type of Contamination	Potential Sources	Potential Pathway	Potential Receptors	Pollution Linkage	Comment	Estimated Level of Risk
Organic and Inorganic Contaminants Within Soils / Groundwater	Historical Land Use on site Neighbouring Land Use Railway Lines Infilled Ponds	Potable Water Supply Pipes	Utilities Workers	Potentially Active	Possible localised TPH and PAH contamination from former uses and made ground from demolition material from sewage works. Ground investigation to confirm, then liaise with local water authority supplier.	Low-Moderate

7.2 Contamination Summary

In this qualitative risk assessment, a Low – Low / Moderate risk for contamination and ground gas implies that remedial action may be necessary at the site, the likes of which cannot be confirmed until the geotechnical and contamination ground investigation has been completed.

7.3 Geotechnical Constraints

- Existing and redundant services across site.
- Limited access to site.
- Possible infilled ponds.
- Potential tree heave as cohesive strata anticipated.
- Possible ditches along former hedge lines.

8 SCOPE OF GROUND INVESTIGATION

8.1 Objectives of the Ground Investigation

The objectives of the intrusive ground investigation will be to:

- Clarify the 'Initial Contamination Conceptual Model'.
- Clarify the initial risk assessment.
- Benchmark the contamination status of the site.
- Provide data for the design of any remedial works that may be required.
- Provide a geotechnical appraisal for the site.

8.2 Proposed Ground Investigation Scope

On assessing the potential risks on site, we have compiled the following recommendations for further initial investigation;

- Fifteen (15 No) days trial pitting to 2.20m – 3.40mbgl using a JCB.
- Twelve (12 No) small diameter boreholes to 3.00mbgl installed with gas monitoring wells with upstanding covers to assess risk of ground gas migration at anticipated foundation depth to target where possibility of localised Made Ground is significant and the majority of infilled ponds on site.
- Six (6 No) ground gas monitoring visits over a period of at least 3 months with varying barometric pressures.
- Thirty (30 No) soil samples (topsoil, made ground and natural) taken for chemical analysis to benchmark contamination levels across the site. Proposed testing will include but not be limited to the following; heavy metals suite (comprising; As, Cd (low level), Cr, Vi, Pb, Hg, Se, Ni, Cu, Zn), Organic Matter, Sulphate, pH, speciated polycyclic aromatic hydrocarbons, TPH CWG. Asbestos testing within topsoil and Made Ground with quantification for positive samples.
- Should elevated determinant levels be encountered, additional leachate testing within soil and/or groundwater testing may be required.
- Geotechnical analysis of samples if clay strata is encountered for tree heave protection and concrete design classification.

The exploratory hole positions were selected and set out by Betts Geo as shown on the Exploratory Hole Location Plan in Appendix B.

Prior to any intrusive works, each location was checked for services using a cable avoidance tool (CAT) and review of statutory service plans.

9 GROUND CONDITIONS

9.1 General

The exploratory holes were logged by an Engineer in general accordance with the recommendations of BS5930:1999+A2:2010. Detailed descriptions, together with relevant comments, are given in the exploratory hole logs included in Appendix C.

Ground conditions consisted of TOPSOIL (to a maximum depth of 0.40mbgl) over reddish brown CLAY with occasional Brown Sand and black SILT within former pond locations.

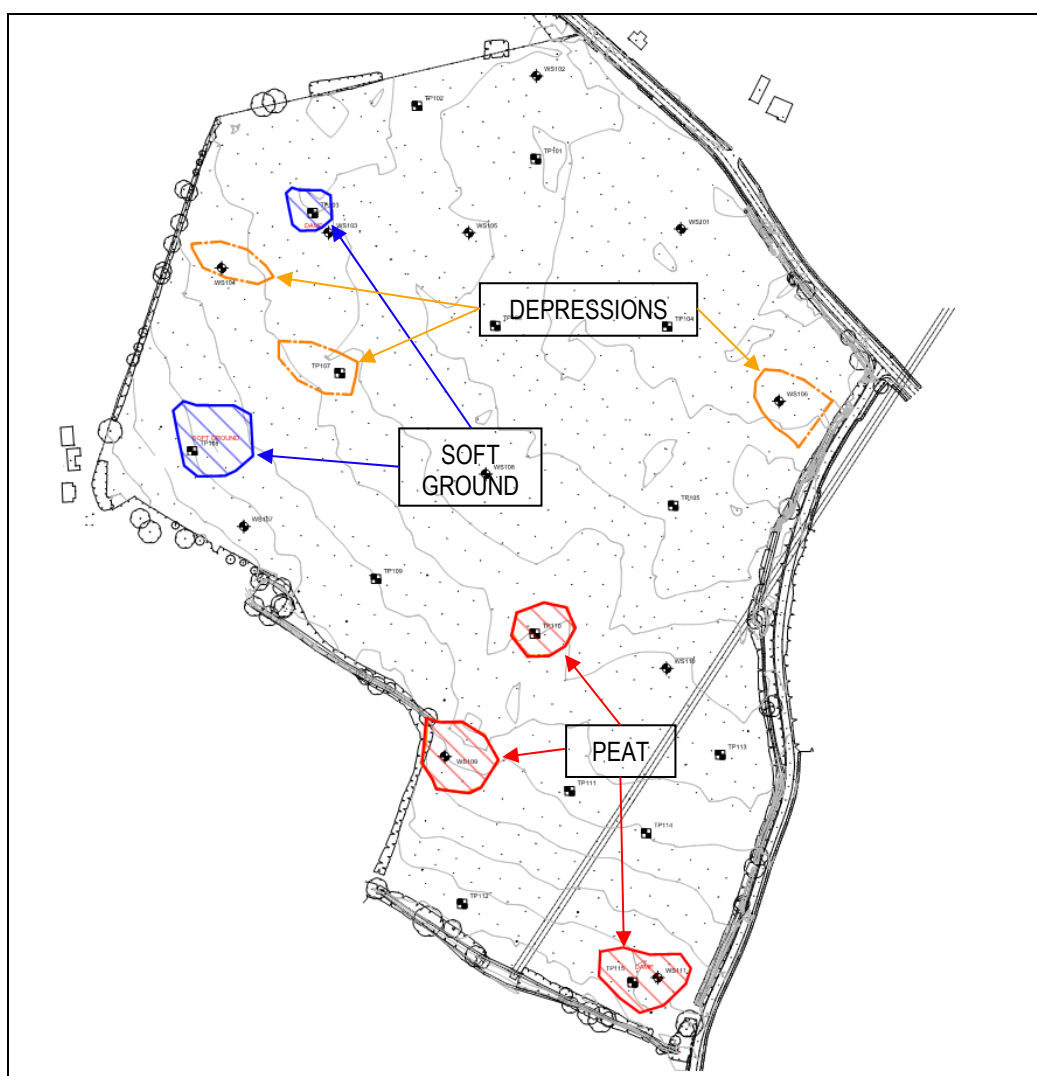
MADE GROUND was observed to a maximum depth of 2.20mbgl. Made Ground comprised 'white SAND', SAND and GRAVEL and CLAY, all with anthropogenic constituents such as glass and brick.

Peat has been identified in two locations as peaty inclusions and Soft black spongy fibrous peat in TP110 and TP115 respectively.

Strata	General Description	Typical Thickness (m)	
		Top	Base
MADE GROUND (1)	Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium angular to subrounded of rootlets, wire, plastic, ceramics, concrete and brick.	0.10	0.60
MADE GROUND (2)	Loose black loose to medium dense sand and gravel of mixed waste including rootlets, wire, plastic, ceramics, concrete and brick. Slight hydrocarbon odour.	0.60	0.70
MADE GROUND (3)	Soft greyish brown very sandy silty clay with occasional gravels and cobbles of brick.	0.30	1.90
MADE GROUND (4)	Mixed clay and fine to coarse sand and gravel. Gravel is fine to coarse angular to subangular of mixed lithology including bricks, roots, tiles and ceramics. Standing water noted from 1.90mbgl.	1.90	2.30
MADE GROUND (5)	Very dense White sand, becoming loose sand once past 'crust'. Strata wet and standing water below crust. Some roots present. Unusual acidic/citrus odour. Some collapse within Made Ground Strata.	0.85	1.60
TOPSOIL	Dark brown, sometimes clayey, occasionally gravelly fine SAND. Gravel is fine to medium of rootlets with rare black subangular gravel.	0.00	0.30
CLAY	Stiff reddish brown occasionally gravelly slightly sandy CLAY. Gravel fine to	0.30	1.40

	coarse subangular to subrounded of Sandstone and Mudstone. Occasional sand lenses.		
SILT	Soft black slightly sandy SILT.	1.40 (WS109)	2.90 (WS109)
SAND	Loose brown gravelly fine to medium SAND.	2.90 (WS109)	3.70 (WS109)
CLAY (2)	Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional sand lenses.	2.00	3.00
PEAT	Peaty inclusions / Soft black spongy fibrous PEAT. (TP110 and TP115 only)	1.20	2.20

The plan below shows the areas of peat and soft ground;



9.2 Visual and Olfactory Contamination

Unusual acidic / citrus odour was noted from TP115 (0.85-1.60mbgl) with deposits of a white SAND substance.

9.3 Obstructions

No significant obstructions were recorded in any locations.

9.4 Groundwater – Fieldwork

With the exception of WS104 (3.0mbgl), WS109 (3.00mbgl), WS111 (1.80mbgl), TP103 (1.90mbgl) and TP115 (0.85mbgl) all exploratory hole locations were recorded as dry.

9.5 Groundwater – Monitoring

Groundwater has been observed in the following locations during subsequent monitoring visits;

Borehole	Depth to Water	Depth to Base of Borehole (mbgl)		No. of Visits
	(mbgl)	Initial BH depth	Final BH Depth	
WS101	1.14 - 2.80	3.12	3.10	4/6*
WS102	0.88 - Dry	3.04	2.93	6/6
WS103	0.50 - 3.00	3.04	3.01	6/6
WS104	2.75 - 2.88	3.08	3.08	2/6*
WS105	1.00 - Dry	3.03	3.00	5/6*
WS106	2.98 - Dry	3.04	3.01	3/6*
WS107	0.00 - 2.78	3.05	3.03	6/6
WS108	1.92 - 2.81	3.10	3.10	6/6
WS109	0.00 - 0.82	2.97	2.99	5/6*
WS110	0.30 - Dry	2.96	3.00	6/6
WS111	0.00 - 2.76	3.02	3.00	6/6

* - Borehole not located.

9.6 Targeted Investigation

The trial pits and window samples were used to achieve a site spread and to target possible former infilled ponds / depressions, where fill materials are more likely to have been used.

9.7 Constraints

Peat has been identified in two locations (TP110 and TP115), located within areas identified as former ponds.

TP115 also exhibited a 'white SAND crust' which had a usual acidic / citrus odour. The white material was not recorded within WS111, which was carried out towards the edge of former pond. It is thought that this is lime which has been used to attempt to stabilise the deposits forming the former pond.

10 LABORATORY TESTING

10.1 General

An assessment of potential determinands associated with the current/former site uses has been undertaken. Determinands originating from the current/former site uses may include metals, polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs) and asbestos. A general suite of testing should detect most potential contaminants.

10.2 Scheduled Chemical Testing: Soils

Soil was sent to a UKAS accredited laboratory and were generally analysed in accordance with ISO 17025 and/or MCERTS accreditation. The results are summarised in tabular and/or graphical form in Appendix D.

Chemical Test	No. of Samples	Comment/Method
pH Values	34	Determination of pH (using Cyberscan pH meter).
Sulphate - Soluble 2:1 Extract	34	Dionex.
Arsenic, Cadmium, Chromium VI, Chromium III, Total Chromium, Lead, Mercury, Selenium, Copper, Nickel, Complex and Free Cyanide and Zinc.	27	Soil samples were analysed in accordance with UKAS/MCERTS standards Inductively coupled plasma atomic emission spectroscopy (ICP-OES)
Speciated Polycyclic Aromatic Hydrocarbons (PAH),	27	Determination of Polycyclic Aromatic Hydrocarbons by GC-MS. End/end extraction using DCM on as received sample. In house method modified USEPA 8270. Include coronene if required.
TPH CWG	27	TPH CWG (Aliphatics C5-6,>6-8,>8-10,>10-12,>12-16,>16-21,>2-35) (aromatics >C5-7,>7-8,>8-10,>10-12,>12-16,>16-21,>21-35) C5-8 fractions by Headspace GC-MS (003S). C8-35 fractions on as received sample extracted with hexane/acetone, aliphatic/aromatic splits run by GC-FID (005S), banded as listed above.
GRO/BTEX/MTBE by GC-FID (C5-10; C10-C12)	27	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12).
Organic Matter	27	Determination of Organic Matter by combustion.
Asbestos Screen	27	Visual Screening for Fibres.
Atterburg Limits	7	BS1377 Part 2. 1990, 4.3,5.3,5.4
Moisture Content	7	BS1377 Part 2. 1990, 3.2

11 CONTAMINATION ASSESSMENT

11.1 General

Contaminants of concern recorded at concentrations above relevant screening values are summarised below. For ease of description, the identification of contaminant sources and possible re-use of material, Topsoil, Made Ground and Natural Strata will be dealt with in separate sub-headings in this section of the report where required.

Our assessment is based on the following assumptions:

- The proposed site end use is of a high-risk rating (residential housing with gardens). For analysis purposes, 'residential with home grown produce' is deemed most appropriate end use.
- Underlying aquifers are defined as Secondary A Aquifers within the bedrock, and Secondary A and Unproductive within the superficial deposits.
- It is deemed that some statistical analysis is appropriate. Where sample data numbers are low and/or targeted, each determinant result is however reviewed further as an individual result as opposed to an average across the site.
- The GroundSolve report indicated the site to be LOW risk.
- Statistical analysis of the chemical test results has been undertaken in general accordance with Environment Agency 2009 SGV Guidance and AtRisk 2015 using the combined assessment criterion given by CLEA (Note: all SSVs for EA derivation are for a SOM of 6%, in line with Environment Agency Report SC050021/SR4 – this figure is deemed representative as an average value for a sandy loam soil). AtRisk 2015 are used to the nearest SOM percentage deemed appropriate. Where appropriate C4SL's could be utilised, when the site is not grossly contaminated.
- No free product was noted within the exploratory holes.
- Following the withdrawal of CLR 7-10 Guidance documents by the Environment Agency, statistical analysis has been undertaken in accordance with the CIEH/CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration' (May 2008). As such, the use of the mean value test alone is not considered.

A full risk assessment is detailed within Section 10 of this report.

11.2 Soils Contamination Summary

A single exceedance of Benzo(a)pyrene has been observed in WS103 at a depth of 0.20mbgl, located within the topsoil. The observed concentration of 3.10mg/kg marginally exceeds the AtRisk 2017 threshold of 1.51mg/kg.

11.2.1 Topsoil

Determinants for TPH's, PAH's and Metals generally fell below the residential home grown produce guidance levels within the Topsoil, with the exception of the below;

Location	Depth (mbgl)	Determinant	Observed Concentration (mg/kg)	AtRisk 2017 Residential Threshold (mg/kg)	C4SL Residential Threshold (mg/kg)
WS013	0.20	Benzo(a)pyrene	3.10	1.51	4.95

11.2.2 Natural Strata

Determinants for TPH's, PAH's and Metals fell below the residential home grown produce guidance levels within the Natural strata.

11.2.3 Asbestos

No asbestos has been detected within the samples tested.

11.2.4 TP115 - White Material

Whilst not exhibiting any elevated concentrations of the determinants tested for, it did have a pH of 11.97, indicating that the material is very alkaline. Substances with a pH of >10 may be considered a contaminative risk to humans, controlled waters and its associated flora / fauna. This level of alkalinity is in line with the assumption that its lime used to stabilise the pond deposits.

No elevated levels of arsenic or other heavy metals were found within this location, so it is not currently considered to be Galligu or other chemical waste.

12 ENVIRONMENTAL RISK ASSESSMENT

12.1 General

This section assesses likely risks to the identified receptors, arising from potential contamination sources. It provides a final qualitative assessment of the risks involved, indicating whether (where appropriate) any immediate action is required to mitigate certain risks.

In assessing the risk qualitatively, it is appropriate to use the methods outlined in the CIRIA document C552, "Contaminated Land Risk Assessment a Guide to Good Practice". It uses a classification of risk based on the magnitude of the potential consequence or severity of risk occurring, compared with the magnitude of the probability or likelihood of the risk occurring. These are indicated on the attached tables in Appendix F.

The bedrock is classed a Principal Aquifer (High permeability), with superficial aquifers of Secondary Undifferentiated. Therefore, the site's environmental setting is considered to be a low to moderate environmental sensitivity. With respect to human health, the proposed end use (residential use with home-grown produce) is of high sensitivity. Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures (see Section 14.2).

12.2 Assessment of Betts Soil Contamination Results

A single exceedance of Benzo(a)pyrene has been observed in WS103 within the topsoil. The observed concentration of 3.10mg/kg marginally exceeds the AtRisk2017 threshold of 1.51mg/kg.

Double Plot Analysis of the PAHs within this sample has shown that the likely source of the Benzo(a)pyrene is coal within the soil. On this basis, the C4SL threshold is considered more appropriate to use and the exceedance can be dismissed.

Further to this, Mean Value Testing returns a US₉₅ figure of 0.45mg/kg, which is significantly lower than the most onerous threshold value of 0.45mg/kg. This indicates that this exceedance is not significant and representative of the wider site soils and can also be dismissed on these grounds.

Whilst showing elevated concentrations of the usual contaminants, the white material within TP115 showed a high alkalinity, with a pH of 11.97, these materials may be considered potentially contaminative and will therefore require caution when working around the area to ensure no leaching can occur.

Other than the white materials, no significant contamination was encountered across the site; therefore, no specialist remedial action is required. Despite this, construction workers should still be provided with appropriate PPE and welfare facilities.

12.3 Groundwater and Aquifer Risk

No significant risks to groundwater or aquifers beneath the site are anticipated due to the lack of contamination observed.

However, the presence of the highly alkaline white material in TP115 will need to be considered during construction to ensure no leaching can occur.

13 GROUND GAS ASSESSMENT

13.1 Ground Gas Requirements – Radon

BRE211 (2007) Radon: guidance on protective measures for new buildings shows it is not within an elevated area, as less than 1% of homes are above the action level. Therefore, no further Radon testing and building control measures may be required to address the risk.

13.2 Ground Gas Assessment

Six (6 No.) gas monitoring visits have been completed, they have shown three (3 No.) locations with elevated ground gas concentrations.

Elevated Carbon Dioxide (CO₂) has been observed in two (2 No.) locations, WS103 and WS105, with concentrations of 7.2% and 6.6% respectively. It's noted that WS103 encountered elevated CO₂ levels on several visits and on peak and steady flows. WS103 is located in the vicinity of a former pond. WS105 encountered elevated peak CO₂ during one visit and is not located in the vicinity of a former pond/fill area

Elevated Methane (CH₄) has been observed in one (1 No.) location, WS109, with a maximum concentration of 12.6%. WS109 is located within a former pond area.

It should be noted that gas flows remain low, ≤2.1l/h for all boreholes except for WS102 with a peak gas flow of 12.7l/h.

The monitoring visits are summarised in the table below as worst case;

Location	Peak Gas Flow (l/h)	Atmospheric Pressure (mB)	Peak CH ₄ (%)	Peak CO ₂ (%)	Minimum Oxygen (%)	Gas Screening Value (GSV) (l/h)		No. of Visits
						CH ₄	CO ₂	
WS101	0.0 – 0.2	1005 – 1021	0.10	1.50	19.20	0.000	0.003	4/6*
WS102	0.0 – 12.7	987 – 1022	0.10	1.20	19.70	0.013	0.152	6/6
WS103	0.0 – 2.1	987 – 1022	0.10	7.20	8.70	0.002	0.151	6/6
WS104	0.0 – 0.1	1020 – 1022	0.00	0.80	18.90	0.000	0.001	2/6*
WS105	0.0 – 0.3	987 – 1022	0.00	6.60	12.70	0.000	0.020	5/6*
WS106	0.0	1020 – 1022	0.10	1.00	19.80	0.000	0.000	3/6*
WS107	0.0 – 0.1	1011 – 1022	0.10	0.70	19.30	0.000	0.001	6/6
WS108	0.0 – 0.2	987 – 1022	0.10	0.90	19.50	0.000	0.002	6/6
WS109	0.2 – 1.2	1011 – 1021	12.60	2.20	10.10	0.151	0.026	5/6*
WS110	0.0 – 0.5	987 – 1022	0.90	1.30	19.30	0.005	0.007	6/6
WS111	0.0 – 0.6	1005 – 1022	0.10	0.80	19.10	0.001	0.005	6/6

* - Borehole not located.

Peak CO₂ was only encountered in WS105 on one occasion and with very low flow identified. Given that no other elevated levels of CO₂, or infilled pond/fill/source of significant ground gas was encountered in the vicinity, no ground gas protection measures are required in the vicinity of WS5.

It is currently considered that gas protection measures will be required within the new development in the vicinities of WS105 and WS109 where former ponds are located. As such, the majority of site is categorised as Green – no gas protection measure required with Amber 1 protection in the vicinity of WS103 and other infilled pond areas on site, Amber 2 protection will be required in the vicinity of WS109.

Gas Recommendations

Site Area	Site Classification	Recommended Ground Gas Protection Measures
Majority of Site	Green	Ground gas protection measures are not required. (note based on standard NHBC house detail with 150mm void space under suspended floor).
Vicinity of WS103/former pond areas with the exception of WS109	Amber 1	Low-level ground gas protection measures are required, using a membrane and ventilated sub-floor void that creates a permeability contrast to limit the ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Vicinity of WS109 (former pond)	Amber 2	High-level ground gas protection measures are required, creating a permeability contrast to prevent ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Membranes used should always be fitted by a specialist contractor and should be fully certified (see Appendix G). As with Amber 1, ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.

With Local Authority approval, plot by plot zoning of the gas protection measures may possible due to the nature of the ground gas risk (infilled ponds). Delineation of the pond areas may be required to determine plots affected depending upon the final layout.

14 REVISED CONCEPTUAL SITE MODEL

14.1 General

The Initial Conceptual Site Model has been amended in light of data obtained during the ground investigation.

14.2 Final Conceptual Site Model

This section reassesses likely risks to the identified receptors, arising from potential contamination sources. It provides a final qualitative assessment of the risks involved, indicating whether (where appropriate) any immediate action is required to mitigate certain risks. It also discusses (where appropriate) what longer term measures or remedial works may be required in the future if the site were to be developed. It is considered that the site has not been assessed by the Local Authority as a contaminated site under the terms of the Environmental Protection Act 1990 Part IIa.

Target (Receptor)	Potential Source-Pathway Linkage	Remedial Action Required (where appropriate)	Est. Degree of Risk to Target Following Remedial Action Where Necessary
Site End Users	Inhalation of soil gases, odours or dust.	Amber 1 gas protection measures required in vicinity of WS103 and WS105 with Amber 2 protection in vicinity of WS109.	Low
Site End Users	Ingestion of, and skin contact with, contaminated soil.	No remedial action required. No contamination observed.	Low
Site End Users	Ingestion of contaminants in vegetables etc. or in soils adhering to vegetables, etc	No remedial action required. No contamination observed.	Low
Construction/ Maintenance Workers.	Inhalation of soil gases, odours or dust.	PPE- No contamination observed	Low **
Construction/ Maintenance Workers.	Ingestion of, and skin contact with, contaminated soil	PPE- No contamination observed	Low **
Plants	Adverse effects on growth caused by presence of contaminants in soil	No remedial action required. No contamination observed.	Low
Buildings and Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion and fire hazards	Amber 1 gas protection measures required in vicinity of WS103 and WS105 with Amber 2 protection in vicinity of WS109.	Low
Foundations	Sulphate attack of foundations	Foundations to be designed as per section 17.9	Low
Water Supplies	Hydrocarbons penetrating plastic water supply pipes.	No contamination observed.	Low
Groundwater	Migration of soluble contaminants into groundwater on or off site	No remedial action required. No contamination observed.	Low
Surface Water	Migration of soluble contaminants and/or direct run-off of contaminants	No remedial action required. No contamination observed.	Low

** assumes basic PPE is used

15 OUTLINE STRATEGY FOR RISK REDUCTION/REMEDIAL STRATEGY

15.1 General

The following section details any recommendations and to reduce risk on site and recommended remedial actions (as per the previous sections of this report). For clarity, the section is split into sub-sections as per the conceptual site model (Section 15).

15.2 Construction/Maintenance Workers

Though no significant, site wide contamination was encountered on site, the following recommendations should be adhered to during site works:

- Site workers should wear gloves, boots and overalls and wash their hands before eating, drinking and smoking. Excessive dust generation should be avoided.
- It is recommended that during all excavations adequate ventilation should be maintained. If man entry is required, gas monitoring should be carried out as a precaution.
- If areas of suspected contamination are found then a suitably qualified person should undertake appropriate sampling, testing and further risk assessment.
- Although asbestos was not encountered on site, vigilance should be adhered and any suspected asbestos should be notified and a suitably qualified person to inspect.

15.3 Site-End Users

No significant contamination was encountered at the site; therefore, no specialist remedial action is required. A minimum thickness of 300mm of debris-free soil within garden areas as a growing medium will be required as per NHBC guidance; this is likely to be made up of site-won subsoil and topsoil.

Whilst not identified as contamination, the 'white SAND' observed in TP115 may prove a risk to human health. This material should be treated as potentially contaminative, and delineated and removed from site.

Site-won natural may be suitable for re-use subject to further screening and testing.

15.6 Controlled Waters

No contamination has been identified at the site and is therefore not considered to pose a risk.

15.7 Piped Drinking Water Supplies

The use of Protect-a-Line is not anticipated; a UU risk assessment should be completed to confirm.

15.8 Ground Gas Protection Measures

The site boundary is in a low probability radon area as less than 1% of properties are above the action

level. Therefore, no radon protective measures are necessary in the construction of new dwellings or extensions.

Elevated Carbon Dioxide (CO₂) has been observed in two (2 No.) locations, WS103 and WS105, with concentrations of 7.2% and 6.6% respectively. Elevated Methane (CH₄) has been observed in one (1 No.) location, WS109, with a concentration of 12.6%.

The ponds identified onsite have been altered historically and have likely been backfilled. Several of these areas have been identified onsite, both WS103 and WS109 are located in these depressions.

Due to the above, it is currently considered that gas protection measures will be required within the new the new development in the vicinities of boreholes exhibiting elevated concentrations and/or Gas Screening values. As such, the majority of site is categorised as Green – no gas protection measures required with Amber 1 protection in the vicinity of WS103 and WS105, Amber 2 protection will be required in the vicinity of WS109.

With Local Authority approval, plot by plot zoning of the gas protection measures may possible as the source is known and quantifiable.

15.9 Off-Site Disposal of Surplus Soil

It is recommended that the results of the contamination testing (including the history of the site) be presented to the proposed landfills, to obtain their acceptance of the information to date and to determine the actual WAC limits used by them, (see Appendix H for further guidance). Segregation of made ground/topsoil and natural should be possible given the chemical analysis and very different visual identification.

Site waste management plans will be required due to the size and cost of the proposed scheme.

16 GEOTECHNICAL ASSESSMENT

16.1 Introduction

It is understood that the proposed development will consist of construction of residential properties with associated rear gardens, associated infrastructure, public open space and new highway.

16.2 Site Preparation and Excavation

All excavations should be planned, and due consideration should be given to providing temporary support or suitable battering. Excavations should be regularly inspected by a competent person to ensure continued safety. Further advice on the safety of excavations is given in *Health and Safety in Construction*. Shallow (<1.20mbgl) excavations for service trenches could be complicated by collapsing sands, silts/clays, and care should be taken.

16.3 Control of Groundwater

Groundwater was encountered during the fieldwork at depths of 0.85 and 3.00mbgl in five locations, WS104 (3.0mbgl), WS109 (3.00mbgl), WS111 (1.80mbgl), TP103 (1.90mbgl) and TP115 (0.85mbgl).

In subsequent monitoring visits, groundwater has been recorded between 0.97 and 3.00mbgl.

It is likely that provision of pumping/shuttering will be necessary during excavation of foundation trenches during wet weather, close to surface water features and to deeper excavations for sewers etc. It is good practice to have such equipment on standby in case of seasonal / abnormal weather conditions.

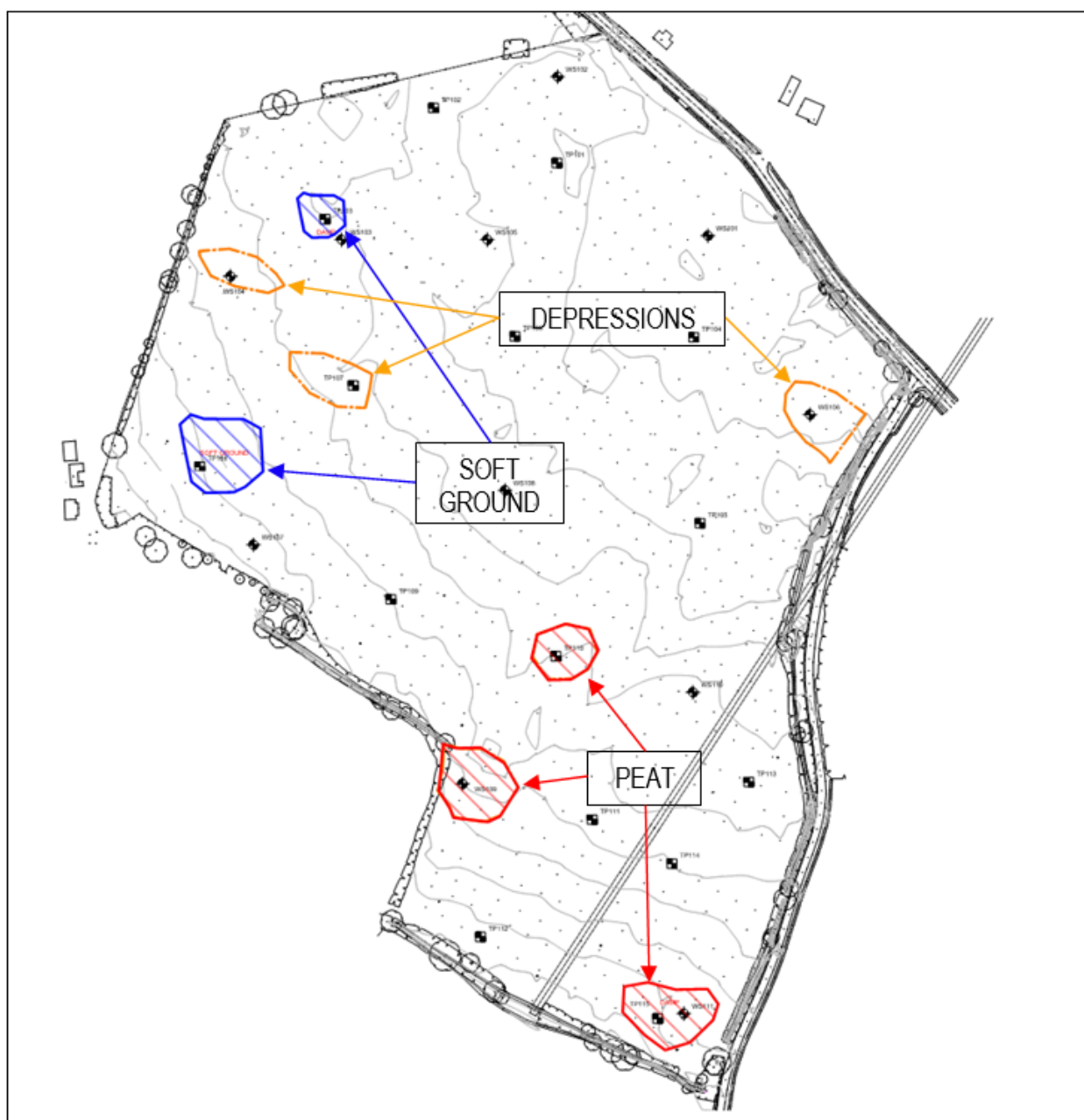
16.4 Foundations

Strip / trench foundations may be suitable across most of the site, with the following allowable bearing capacities;

- Loose SAND strata with an allowable bearing pressure of circa 50-75kN/m²
 - Plot by plot assessment required due to possible presence of groundwater
- Firm CLAY strata with an allowable bearing pressure of circa 75kN/m²
- Stiff CLAY strata with an allowable bearing pressure of circa 100kN/m²

Where groundwater is found with granular soil, the allowable bearing pressure (ABP) can be expected to be half. A plot by plot assessment should be undertaken to further assess this.

Areas of soft ground conditions such as soft SILT and PEAT have been identified on the site. In these areas, or others where similar conditions are found, the plots in these locations may require piling. A specialist piling contractor should be consulted with regards to pile design. The sketch below shows the approximate possible locations of these weaker ground conditions;



Foundations should be excavated wholly on one stratum. Should proposed foundations span different strata, trenching and stepping of foundations and/or nominal reinforcement will be required.

Calculations on the allowable bearing capacity indicate settlements of less than 25mm for a square pad using the above allowable bearing capacity.

Consideration should also be made to the fault line located on the north of the site. As shown below;



16.5 Ground Floor Construction

Suspended floor construction e.g. either in-situ RC slabs or block and beam flooring is recommended as per NHBC guidance.

16.6 Heave / Shrinkage Potential

Location	Depth (mbgl)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	% <425µm	Modified Plasticity Index	Volume Change Potential
TP105	1.10	16	35	15	20	93	19	Low
TP107	1.00	9.6	34	16	18	93	17	
TP112		14	31	16	15	89	14	
TP114		9.8	31	17	14	90	13	
WS103		13	33	14	19	91	17	
WS106	1.20	15	36	17	19	90	17	
WS110	1.50	15	33	16	17	93	16	

Geotechnical testing has shown the natural cohesive deposits to be of Low heave potential. Foundations within close proximity to trees should be designed accordingly.

16.7 Compressible Soils – Peat / Silt

Consideration to drainage runs / services impact on ground floor construction in former pond areas. Compressible soils may require removal / replacement, depending on final site layout.

A detailed foundation zoning plan will be required when site levels are known.

16.8 Protection of Buried Concrete

It is considered for concrete design purposes that a greenfield site and mobile groundwater conditions are applicable, and the results indicate:

Majority of the Site

- Design Sulphate Class: DS-1
- ACEC Class: AC-1
- Design Chemical Class: DC-1

Areas around TP103, WS103 and WS109

- Design Sulphate Class: DS-2
- ACEC Class: AC-2
- Design Chemical Class: DC-2

16.9 Further Works

Further works are recommended to delineate the Peat and 'White SAND' around TP115, and peaty inclusions in TP110 and other infilled ponds, depending on final site layout.

It may also be considered prudent to delineate the areas of reduced ground strength, depending on the proposed site layout.

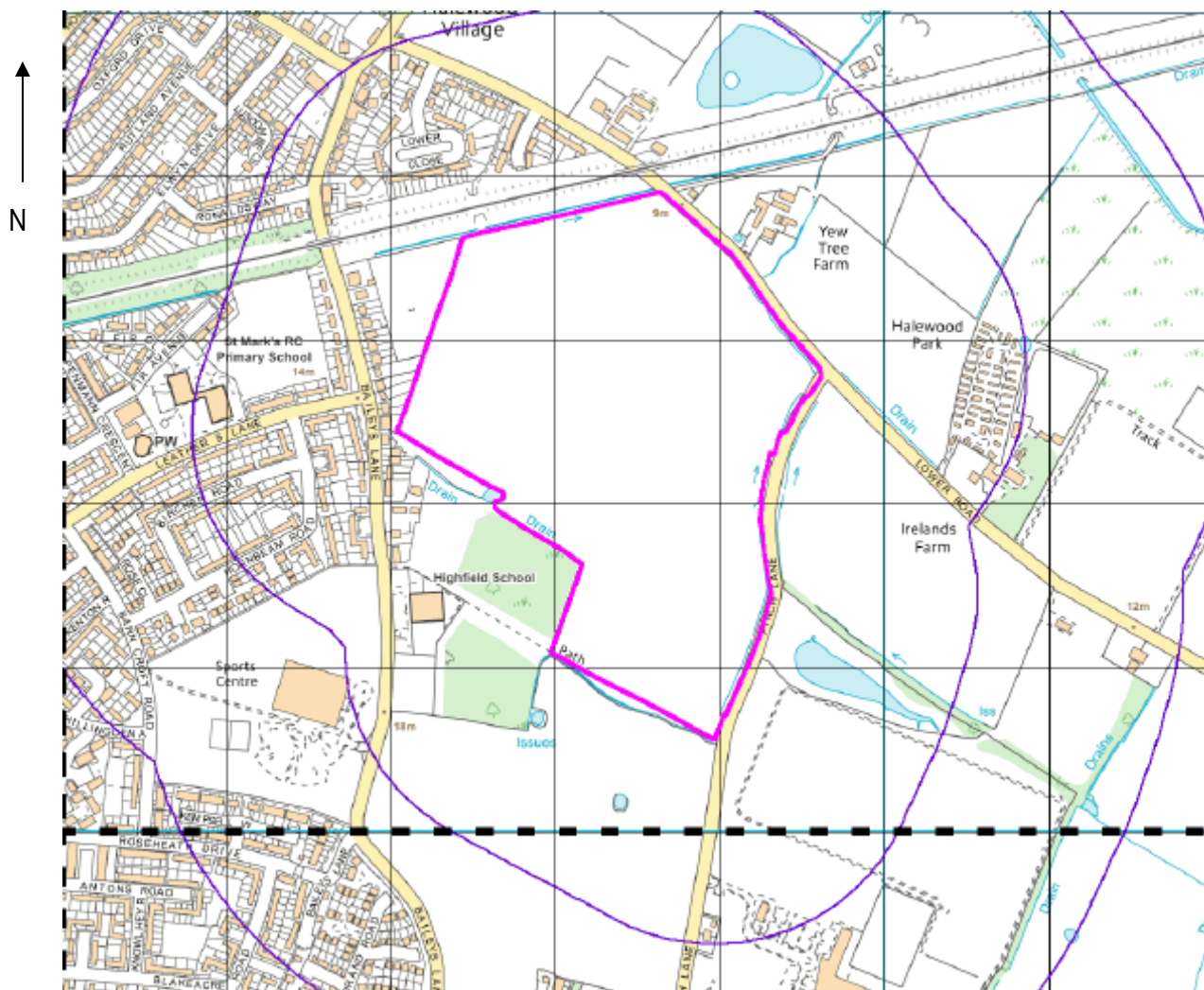
17 REFERENCES

- 17.1 *BS 5930:1999+A2 Code of Practice for Site Investigation.*
- 17.2 *BS1377: 1990 Methods of Test for Soils for Civil Engineering Purposes.*
- 17.3 *Assessment of risks to human health from land contamination: an overview of the development of guideline values and related research. EA, 2002*
- 17.4 *Contaminated Land Risk Assessment; A Guide to Good Practice; CIRIA C552: 2001.*
- 17.5 *Health and Safety in Construction, HSG150, HSE, 1996.*
- 17.6 *Hazardous Waste: Interpretation of the Definition and Classification of Hazardous Waste, Environment Agency, WM2 Version 1.0, June 2003.*
- 17.7 *DoE (1991), The Building Regulations Approved Document C, Site Preparation and Resistance to Moisture, HMSO*
- 17.8 *Baker W (1987), Investigation Strategy - lecture at City of Birmingham Development Department Symposium on Methane Generating Sites, 9 December 1987, Industrial Research Laboratories, Birmingham*
- 17.9 *NHBC Standards, Chapter 4.2, 2017. Building Near Trees*
- 17.10 *Highways Agency HD 25/95 volume 7 section 2 Part 2 HD 25/94*
- 17.11 *Water Regulations Advisory Scheme (2002) The selection of materials for water supply pipes to be laid in contaminated land*
- 17.12 *Anon (1997) Dutch in Policy Retreat on Contaminated Land ENDS (Environmental Data Services), 269, 46*
- 17.13 *Water Regulations Advisory Scheme (2002) The selection of materials for water supply pipes to be laid in contaminated land*
- 17.14 *Piling In Layered Ground: Risks to Groundwater and Archaeology Science Report SC020074/SR Environment Agency October 2006*
- 17.15 *Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention National Groundwater & Contaminated Land Centre report NC/99/73 F J Westcott, C M B Lean & M L Cunningham May 2001*
- 17.16 *'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present', Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties*
- 17.17 *CIRIA C665 'Assessing risks posed by hazardous ground gases for buildings' 2007 - for high rise residential / flats*
- 17.18 *BS8485:2007 'Code of practice for the characterization and remediation from ground gas in affected developments'*
- 17.19 *BRE 414 'Protective measures for housing on gas-contaminated land' Roger Johnson, Parkman Environment 2001*

- 17.20 *BS 8500- 1:2006 'Concrete – Complementary British Standard to BS EN 206-1 – Part 1: Method of specifying and guidance for the specifier' November 2006*
- 17.21 *'Planning Policy 23:Planning and Pollution Control' Office of the Deputy Prime Minister 2004*
- 17.22 *CLR11 'Model Procedures for the Management of Land Contamination' DEFRA 2004*
- 17.23 *BRE 465 'Cover Systems for Land Regeneration' 2004*
- 17.24 *'The UK Approach for Evaluating the Human Health Risks from Petroleum Hydrocarbons in Soils, Environment Agency Science Report P5-080/TR3', Environment Agency (May 2005)*
- 17.25 *TOX12- Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Dioxins, Furans and Dioxin-like PCBs' Environment Agency 2003*
- 17.26 *The LQM/CIEH GAC for Human Health Risk Assessment 2009 second edition*

APPENDIX A

(i) Site Location Plan

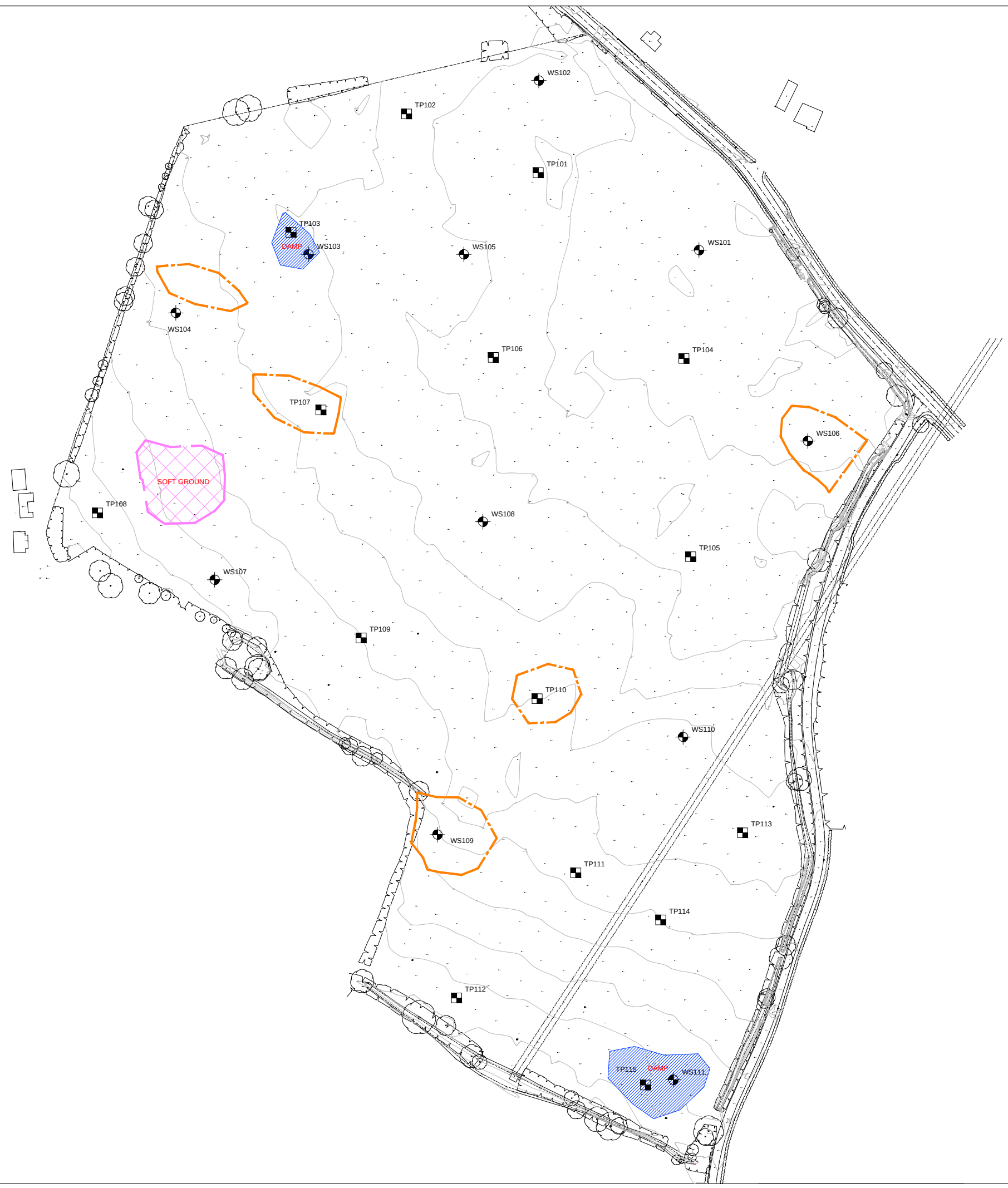


Site Location Plan

The site is located to the south of Lower Road and to the west of Finch Lane. The closest postcode is L26 3UA. The coordinates on National Grid are 345680, 385460. The proposed site is approximately 20.17 hectares (Ha) in total

APPENDIX B

(i) Drawings



NOTES

DO NOT SCALE

THIS DRAWING SHOWS THE INDICATIVE LOCATION OF EXPLORATORY HOLES UNDERTAKEN BY BETTS GEO LTD IN 2018.

THE PLAN OVERLAYS THE TOPOGRAPHICAL SURVEY.

KEY

TP

TRIAL PIT LOCATION

WS

WINDOW SAMPLE LOCATION

LOCATION OF EXISTING SERVICE - WATER

LOCATION OF EXISTING SERVICE - OVERHEAD

LOCATION OF EXISTING SERVICE - SEWER

AREA DAMP

AREA BOGGY / SOFT / CHANGE OF VEGETATION

DEPRESSION

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS:

DRAFT

BETTS GEO

CONSULTING ENGINEERS

Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 Fax: 01244 288516 enquiries@betts-associates.co.uk

REDROW

PROJECT:

LOWER ROAD,
HALEWOOD,
KNOWSLEY

TITLE:

EXPLORATORY HOLE
LOCATION PLAN

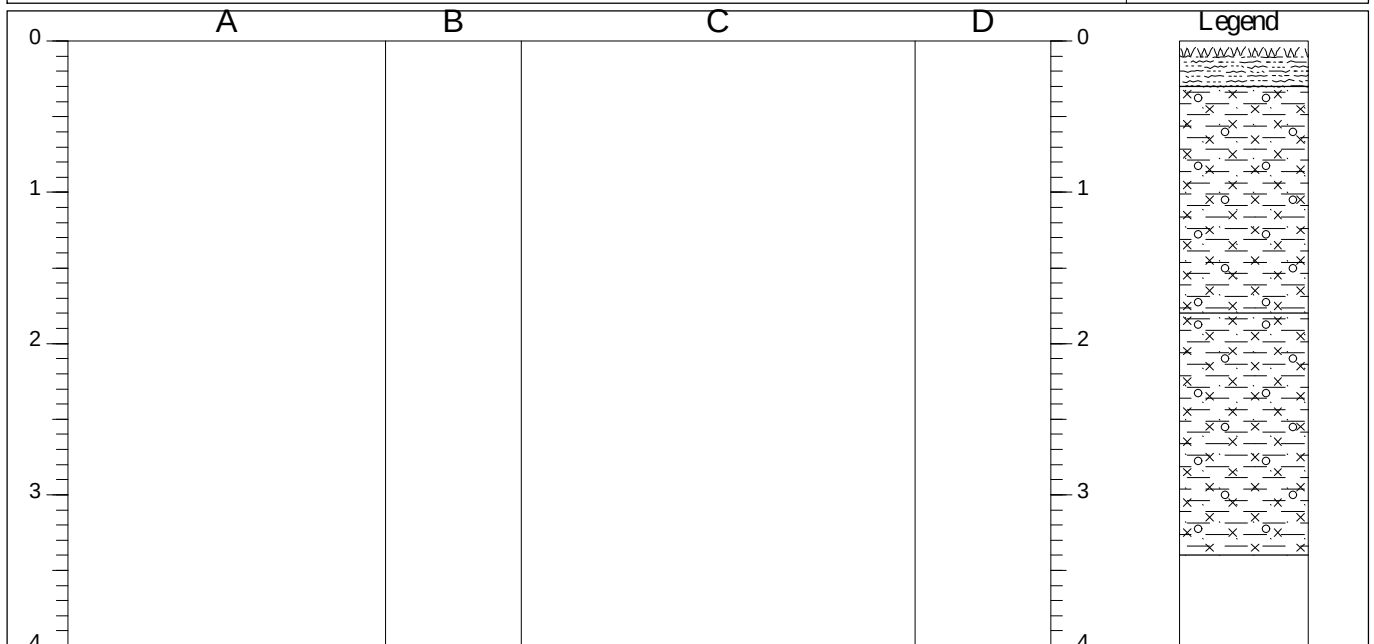
DATE: 17/08/18	SCALE @ SIZE: 1:2000 @ A3	DRAWN: PH	CHECKED: NM
PROJECT No: 17RED146	DRAWING No: EXP 101	REV: -	

APPENDIX C

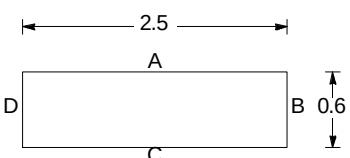
(i) Betts Exploratory Hole Logs

TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP101
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

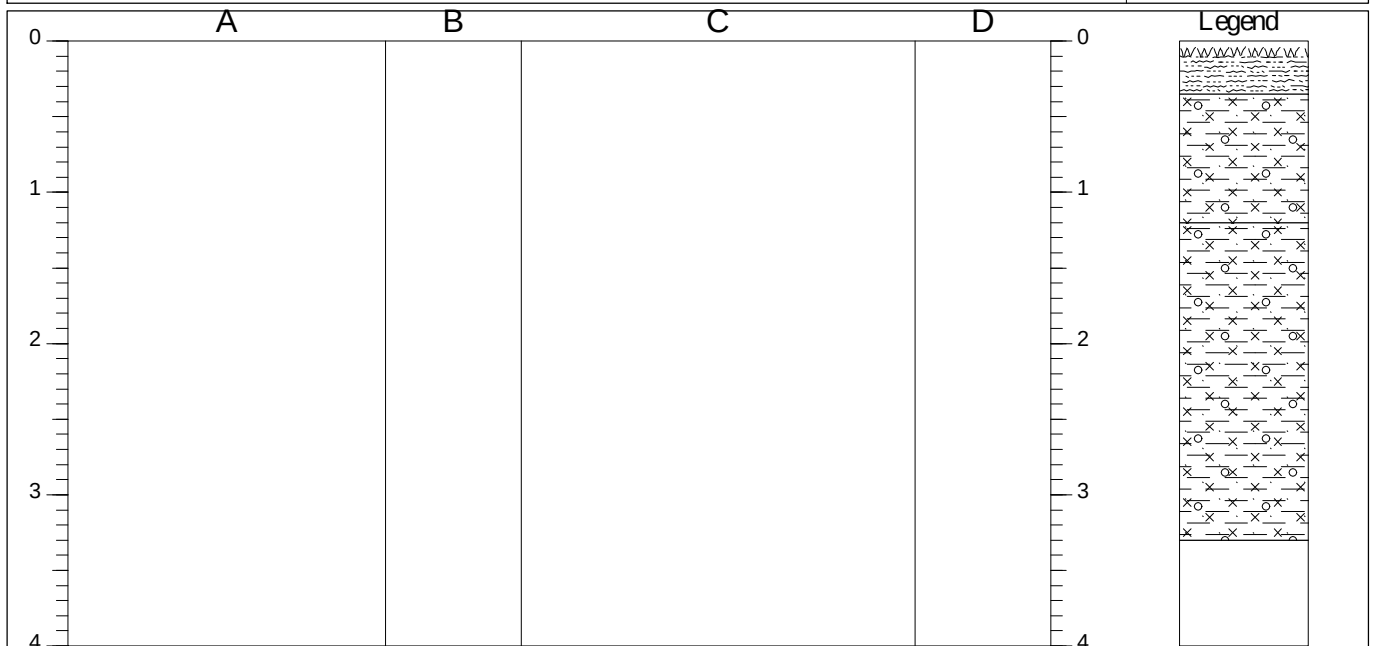


STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.30	ES	
0.30-1.80		Stiff reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
1.80-3.40		Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.	1.80	D	

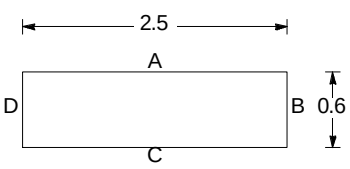
Shoring/Support: Stability: Stable 			GENERAL REMARKS Dry
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	

TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP102
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



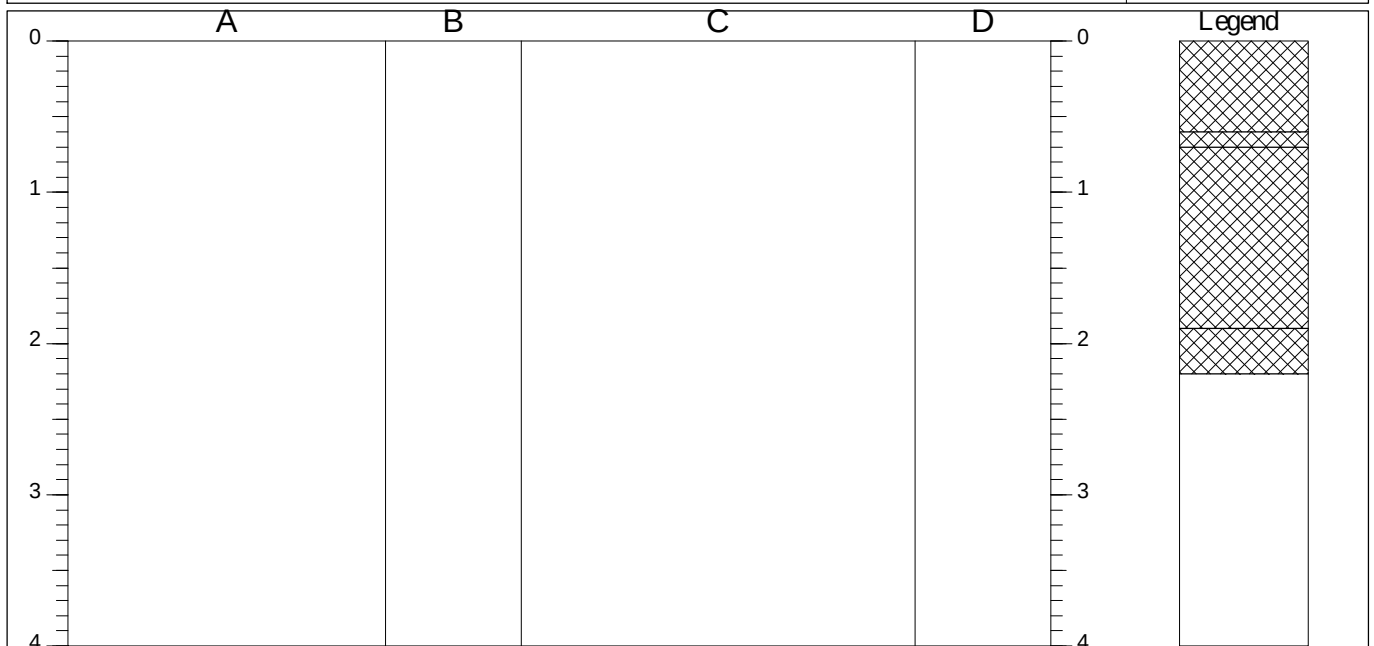
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.35		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.10	ES	
0.35-1.20		Stiff reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
1.20-3.30		Stiff to very stiff light reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.			

Shoring/Support: Stability: Stable 	GENERAL REMARKS
	Dry

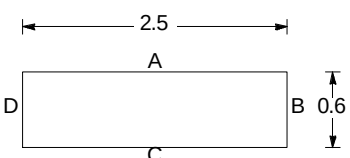
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	Logged By KR
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TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP103
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

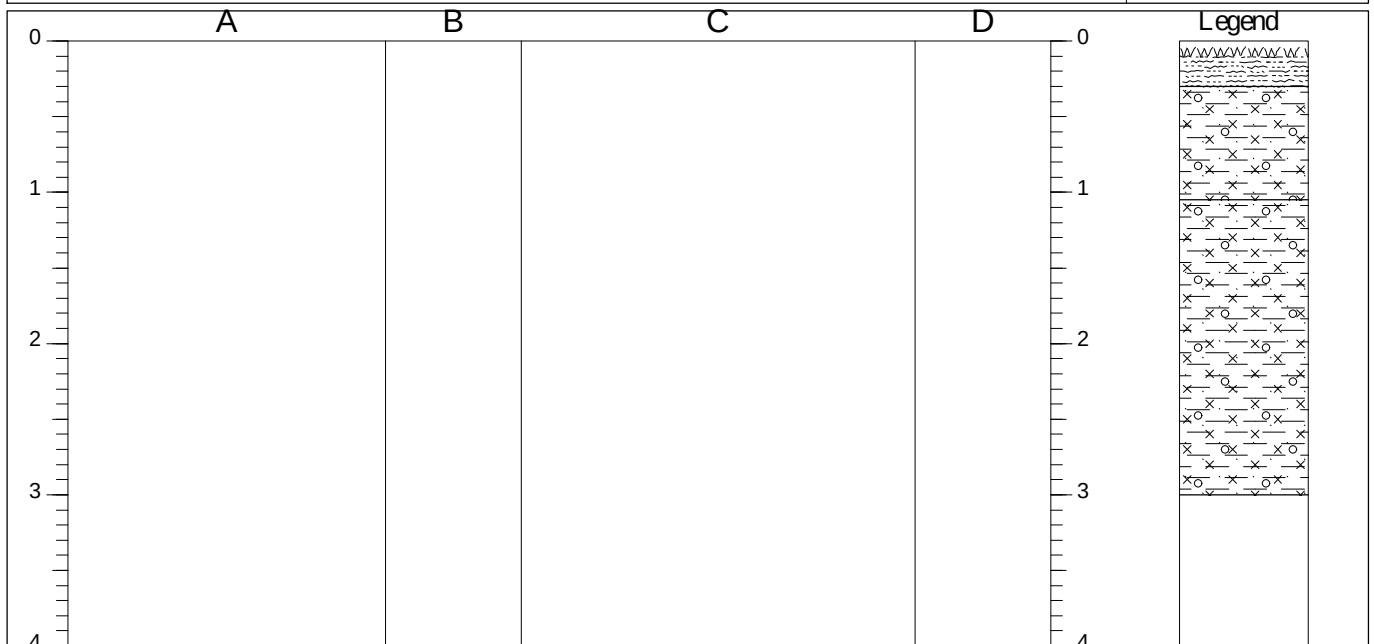


STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.60		MADE GROUND: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium angular to subrounded of rootlets, wire, plastic, ceramics, concrete and brick.	0.10	ES	
0.60-0.70		MADE GROUND: Loose black loose to medium dense sand and gravel of mixed waste including rootlets, wire, plastic, ceramics, concrete and brick. Slight hydrocarbon odour.	0.60	ES	
0.70-1.90		MADE GROUND: Soft greyish brown very sandy silty clay with occasional gravels and cobbles of brick.			
1.90-2.20		MADE GROUND: Mixed clay and fine to coarse sand and gravel. Gravel is fine to coarse angular to subangular of mixed lithology including bricks, roots, tiles and ceramics. Standing water noted from 1.90mbgl.			

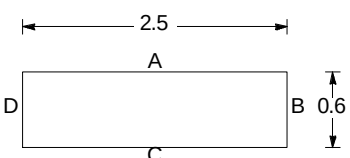
Shoring/Support: Stability: Stable		GENERAL REMARKS Standing water noted at 1.9mbgl. Some side collapse noted.	
			
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	Logged By KR

TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP104
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



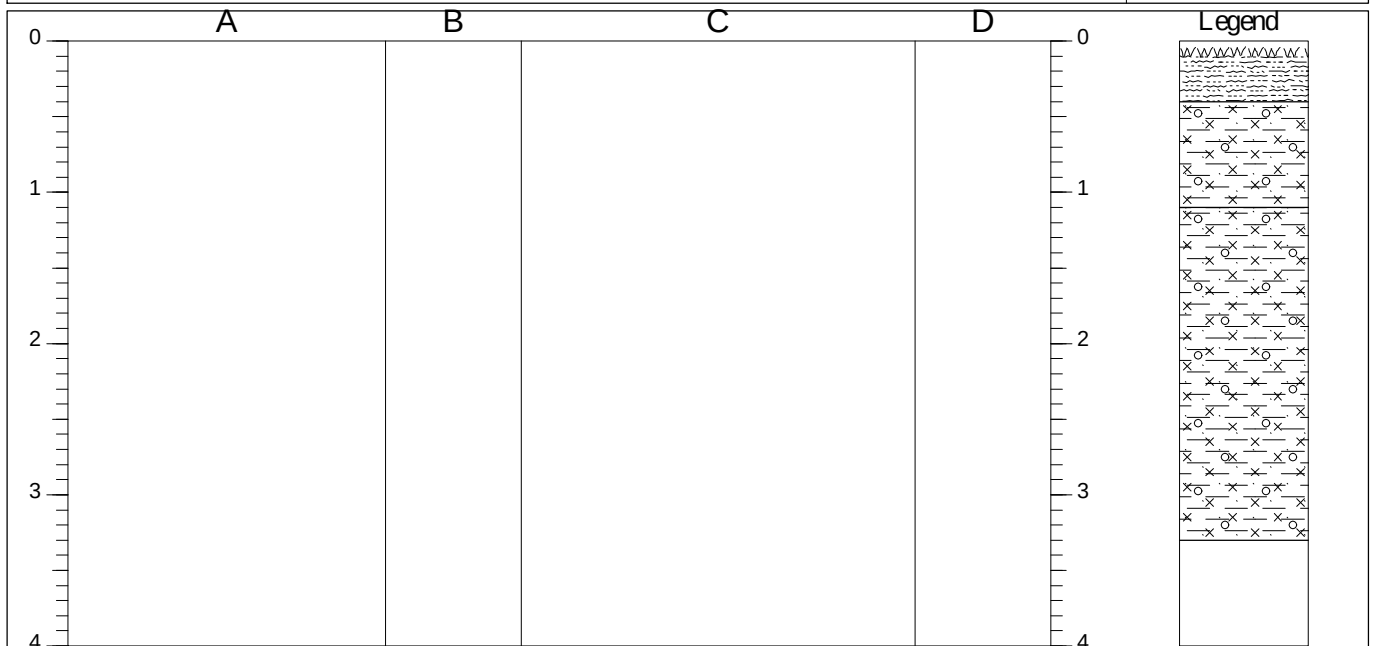
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	1.05	ES	
0.30-1.05		Stiff reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated. Occasional cobbles of sandstone noted.			
1.05-3.00		Stiff to very stiff light reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Some grey mottling noted with depth.			

Shoring/Support: Stability: Stable 	GENERAL REMARKS Dry
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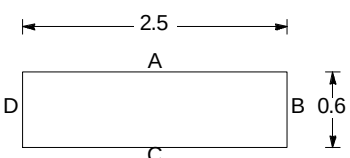
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	Logged By KR
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TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP105
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



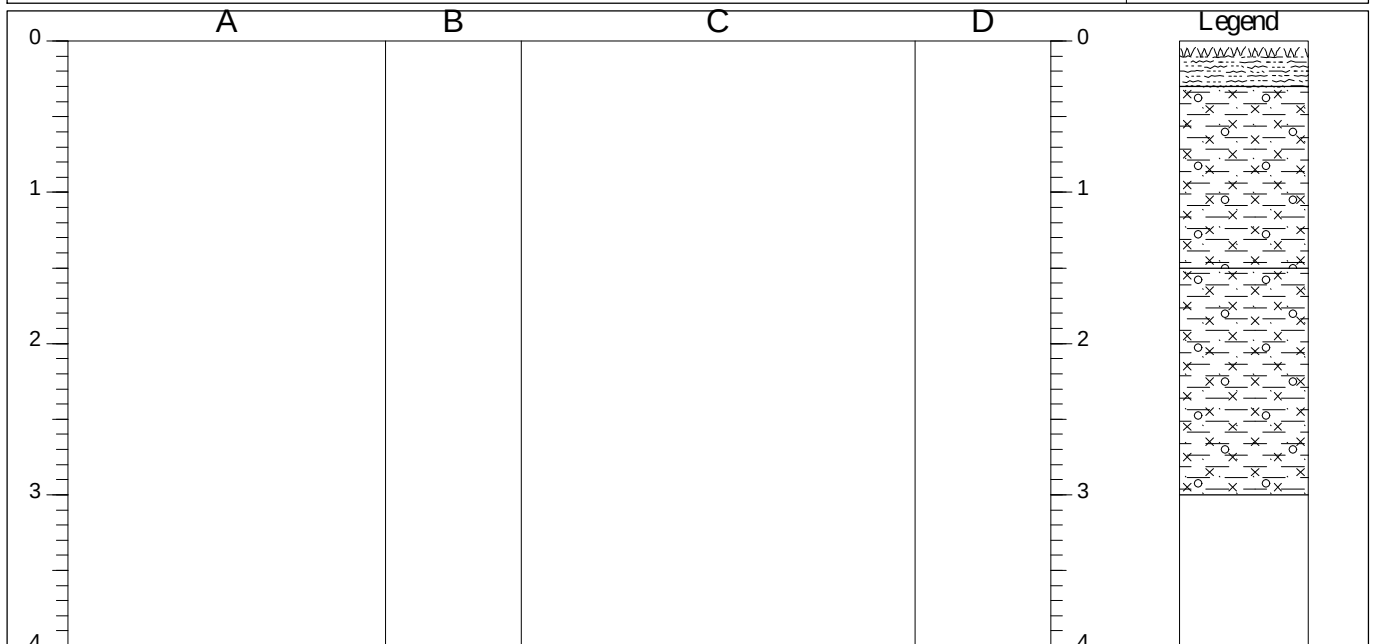
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.40		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.40	ES	
0.40-1.10		Stiff light brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
1.10-3.30		Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Very minor water strike at base of pit.			

Shoring/Support: Stability: Stable 		GENERAL REMARKS Very minor water strike at base of pit.
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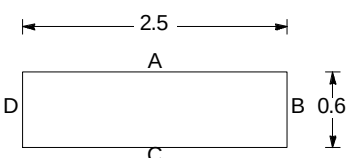
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	Logged By KR
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TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP106
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



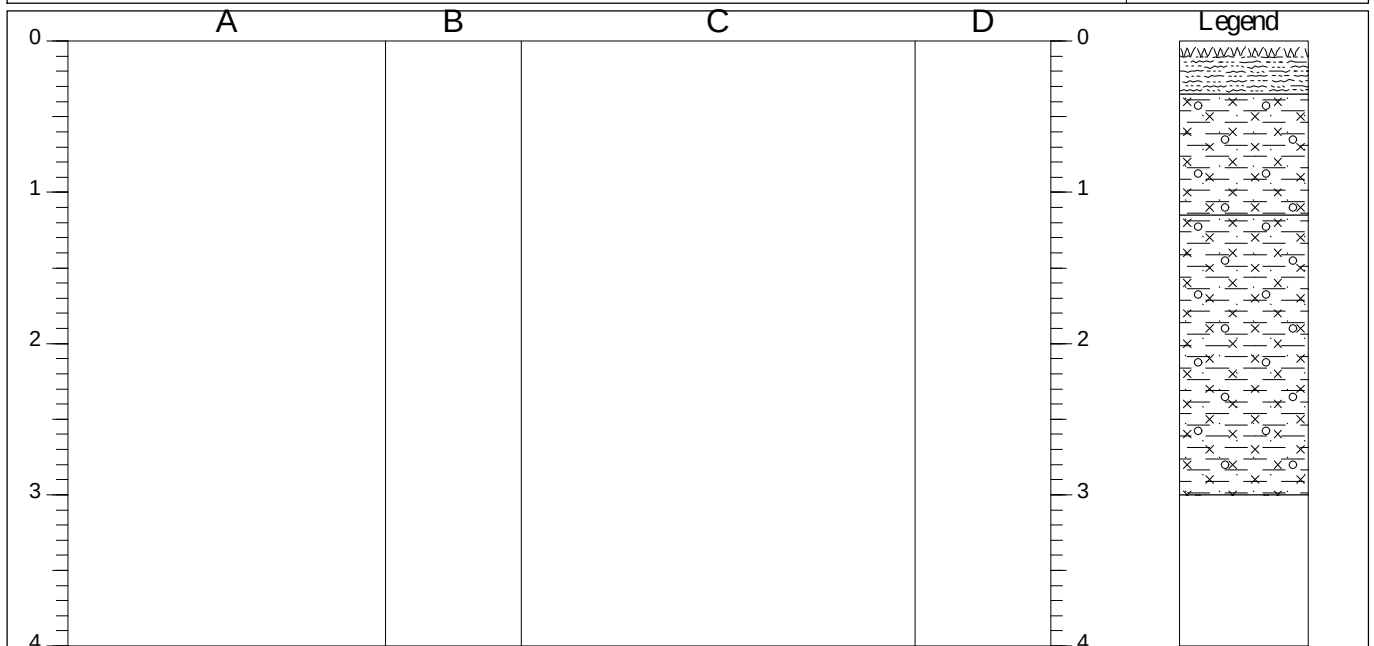
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.10	ES	
0.30-1.50		Stiff reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
1.50-3.00		Stiff to very stiff dark reddish brown occasionally mottled grey occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Grey mottle reducing with depth.			

Shoring/Support: Stability: Stable 		GENERAL REMARKS Dry.
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All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	Logged By KR
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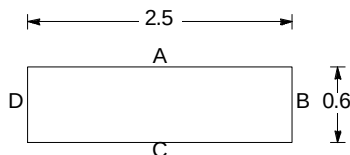
TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP107
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.35		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.50 1.00	ES D	
0.35-1.15		Stiff reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
1.15-3.00		Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.			

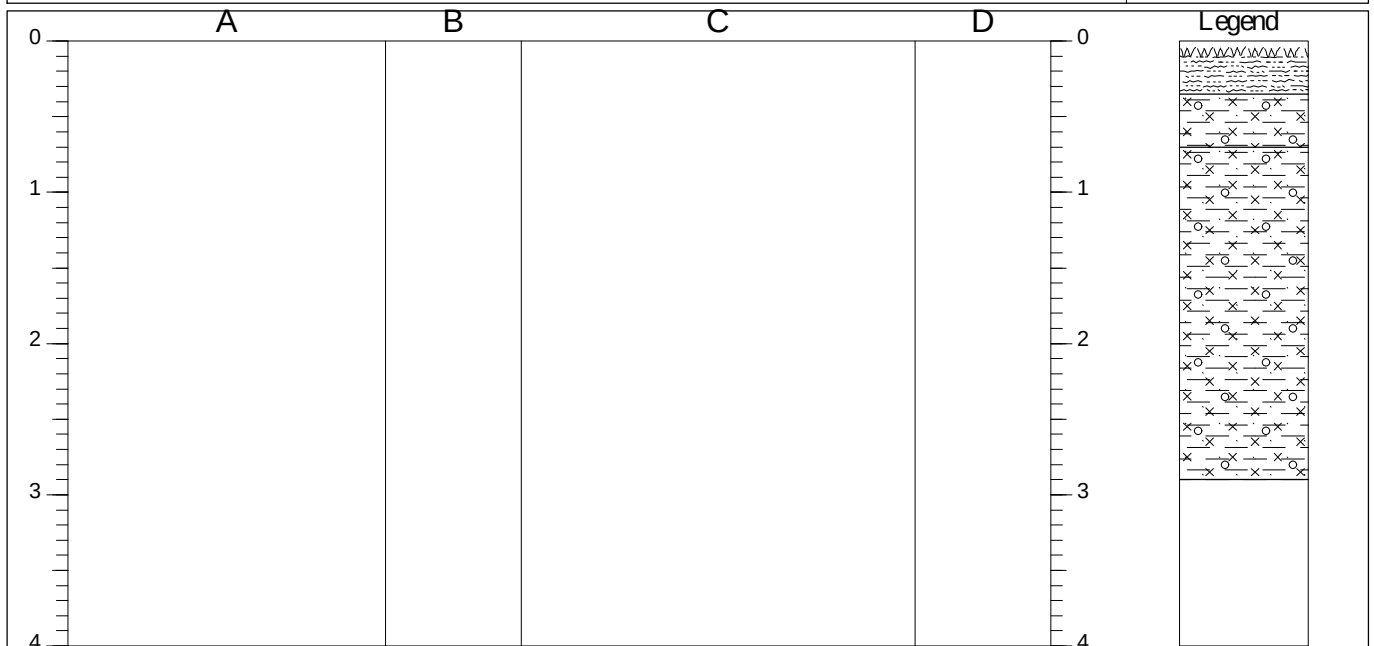
Shoring/Support: Stability: Stable	GENERAL REMARKS
	Dry



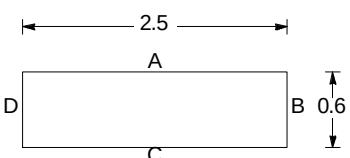
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	Logged By KR
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TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP108
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

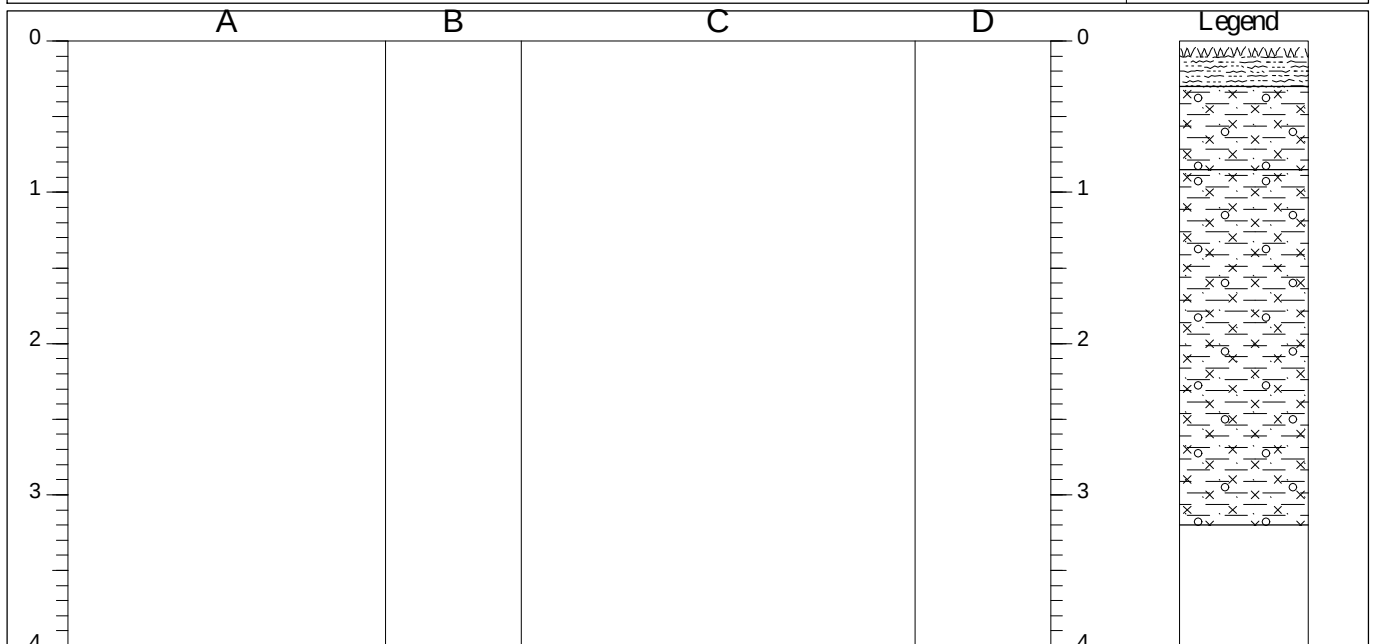


STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.35		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.50	ES	
0.35-0.70		Stiff orangish brown occasionally gravelly slightly very sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
0.70-2.90		Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Becoming very sandy from 2.1mbgl.			

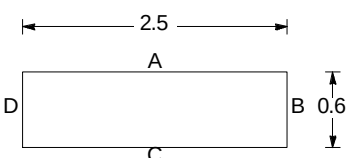
Shoring/Support: Stability: Stable 			GENERAL REMARKS Dry
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	

TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP109
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

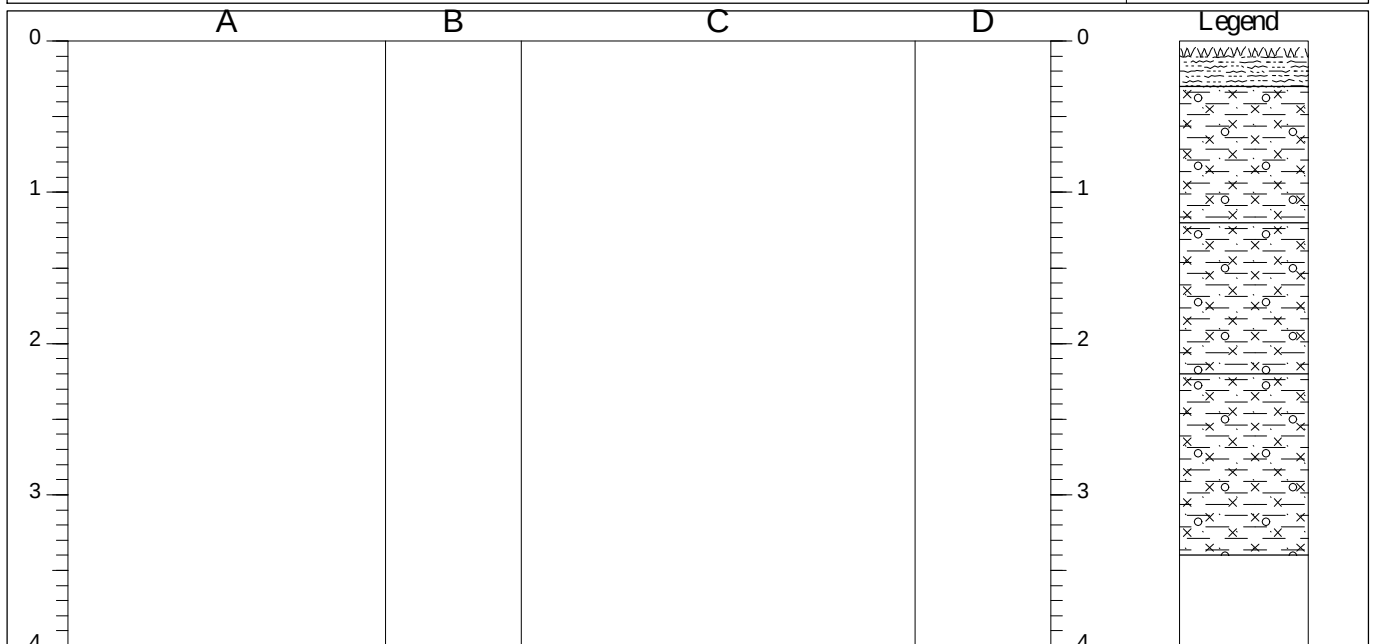


STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.10	ES	
0.30-0.85		Stiff light reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
0.85-3.20		Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Occasional cobbles and sandstone boulders noted at depth.			

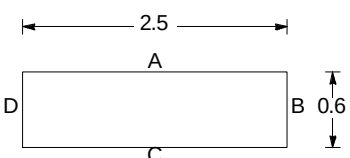
Shoring/Support: Stability: Stable 			GENERAL REMARKS Dry.
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	

TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP110
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



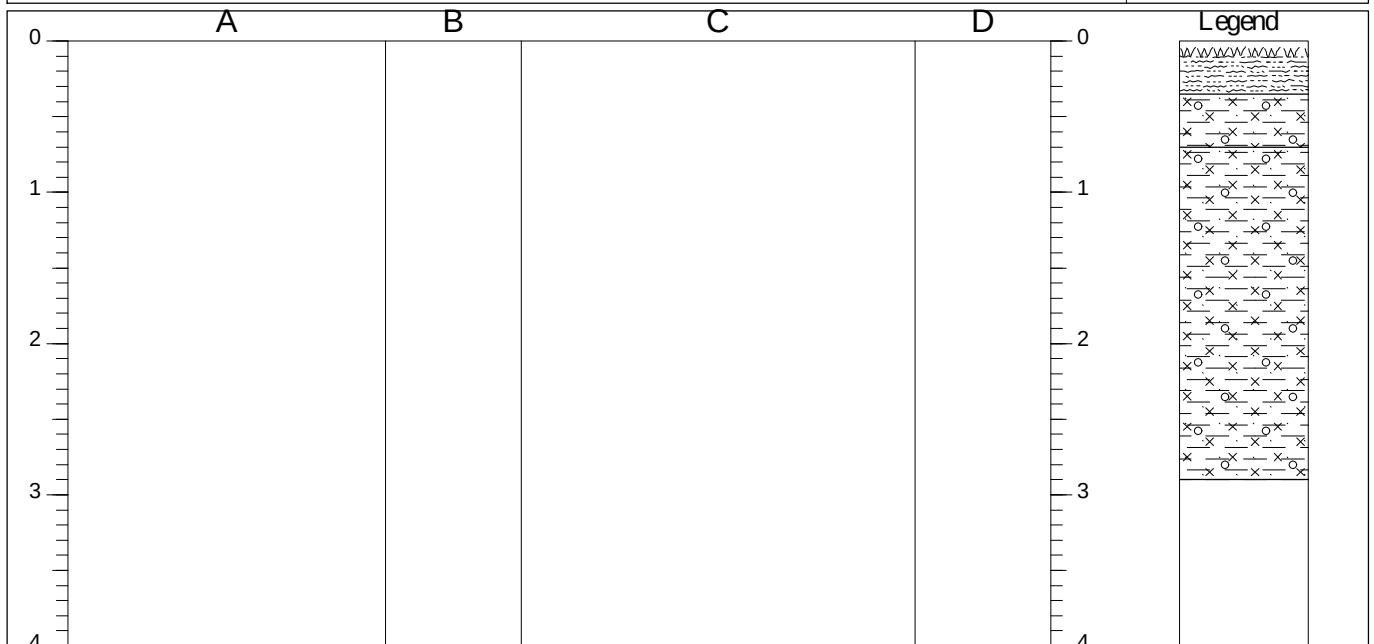
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.30	ES	
0.30-1.20		Firm to stiff yellowish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.			
1.20-2.20		Soft greyish brown very sandy silty CLAY with occasional small organic/peaty inclusions.			
2.20-3.40		Firm to stiff brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.	2.20	D	

Shoring/Support: Stability: Stable 		GENERAL REMARKS Dry
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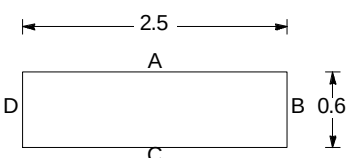
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	Logged By KR
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TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP111
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

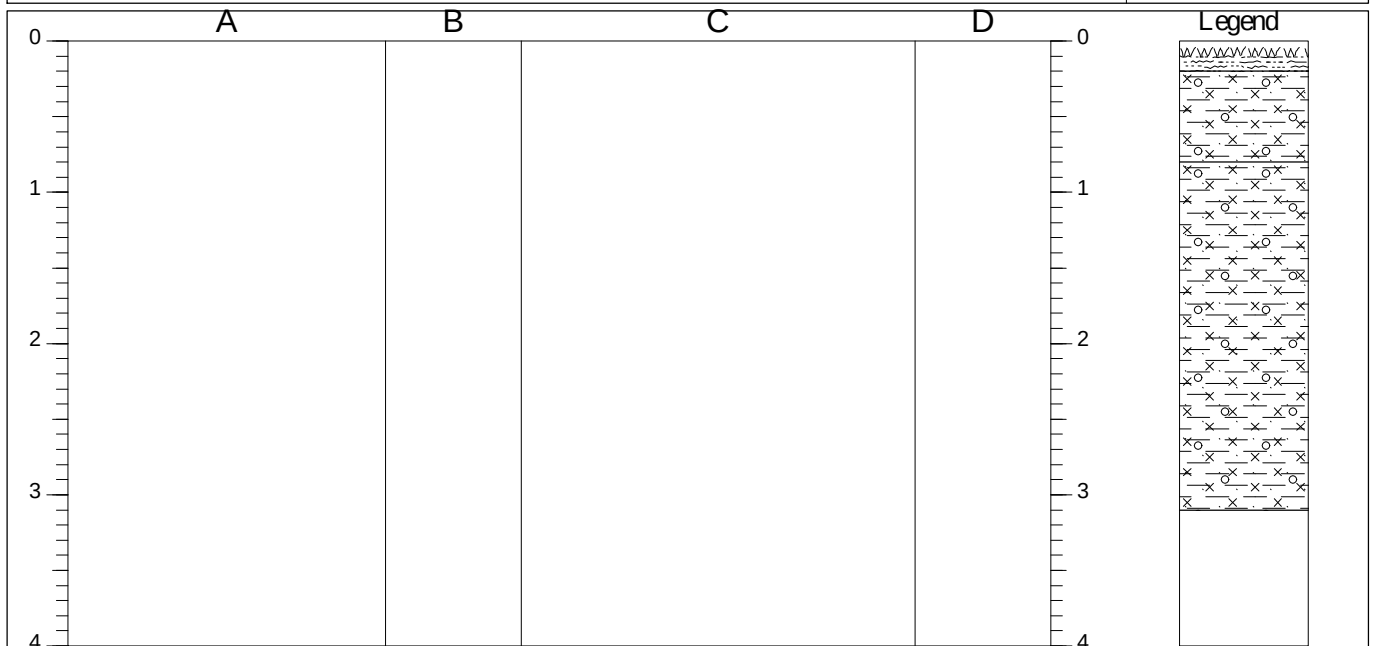


STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.35		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.10	ES	
0.35-0.70		Stiff yellowish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
0.70-2.90		Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.	1.00	D	

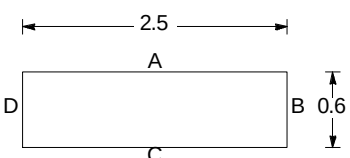
Shoring/Support: Stability: Stable 		GENERAL REMARKS Dry
All dimensions in metres Scale 1:50	Client Redrow Method/ Plant Used JCB 3CX Logged By KR	

TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP112
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

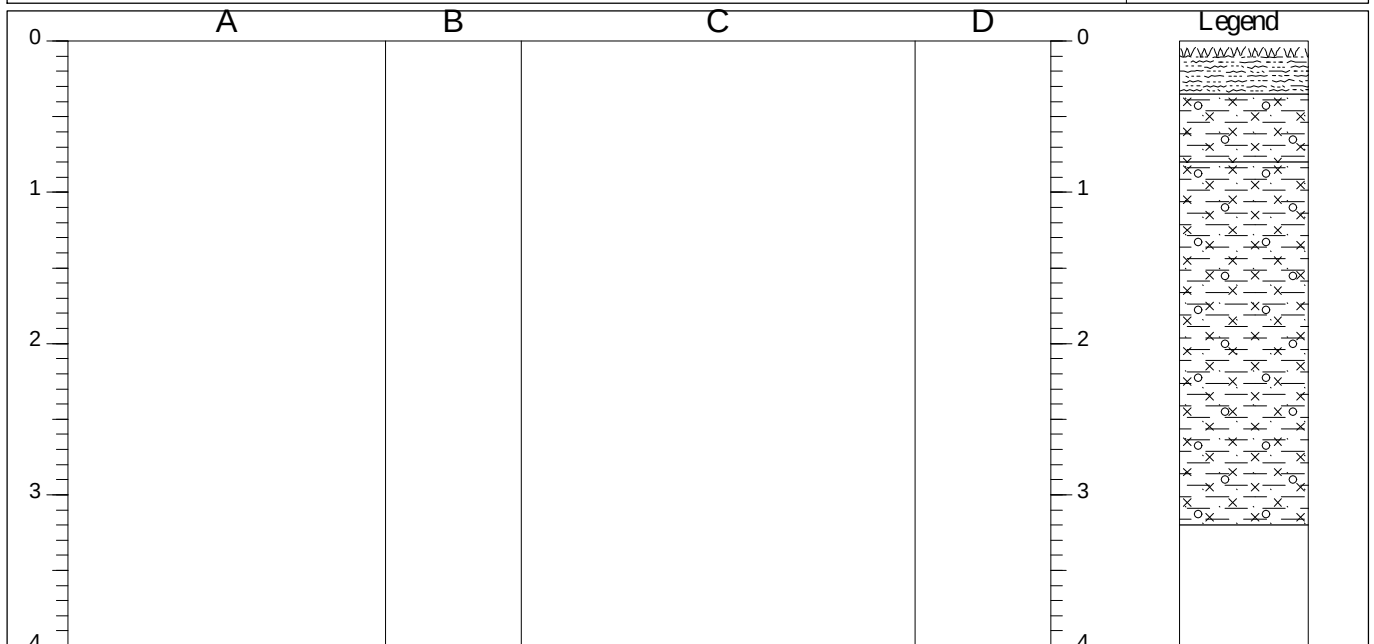


STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.20		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.80 1.00	ES D	
0.20-0.80		Stiff reddish brown occasionally gravelly very sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
0.80-3.10		Firm to stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.			

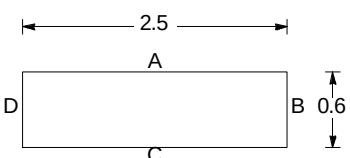
Shoring/Support: Stability: Stable 			GENERAL REMARKS Dry
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	

TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP113
Job No 17RED147	Date 10-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

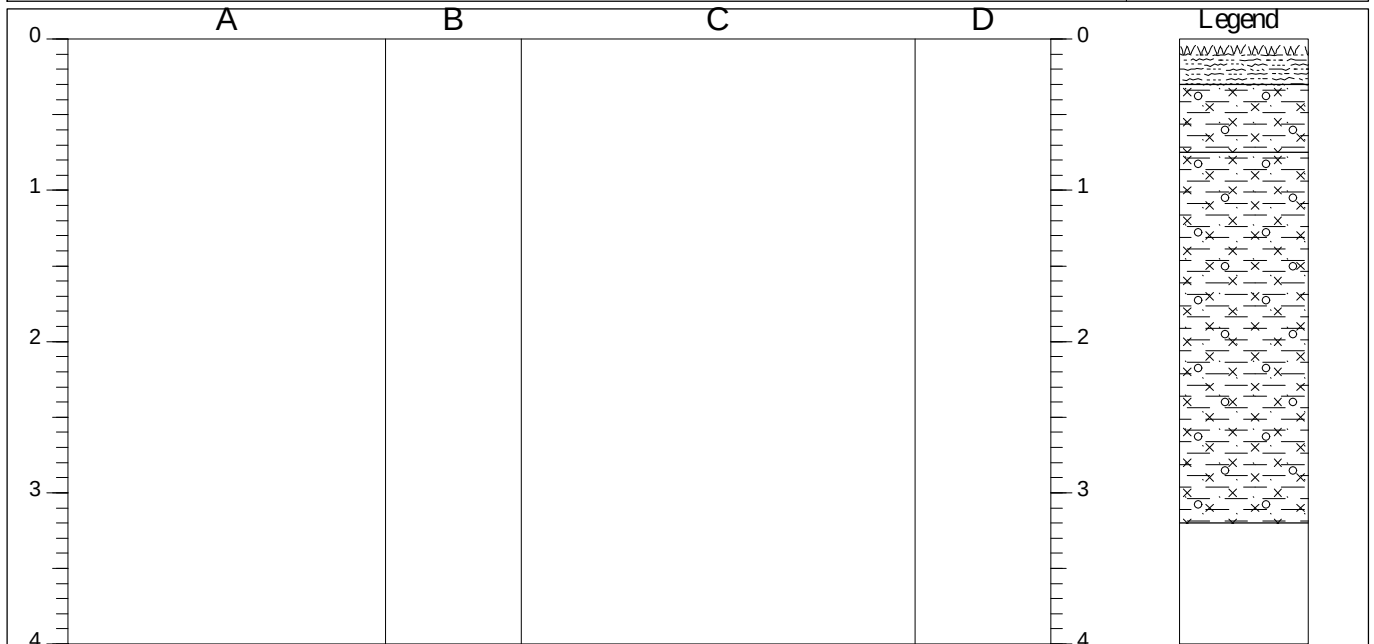


STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.35		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.50	ES	
0.35-0.80		Firm to stiff light reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
0.80-3.20		Stiff to very stiff dark reddish brown and occasionally mottled grey occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Grey mottle reducing with depth.			

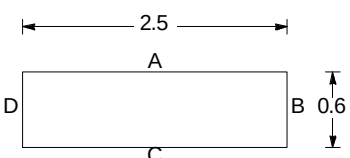
Shoring/Support: Stability: Stable 			GENERAL REMARKS Dry	
All dimensions in metres Scale 1:50		Client Redrow		Method/ Plant Used JCB 3CX
			Logged By KR	

TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP114
Job No 17RED147	Date 10-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

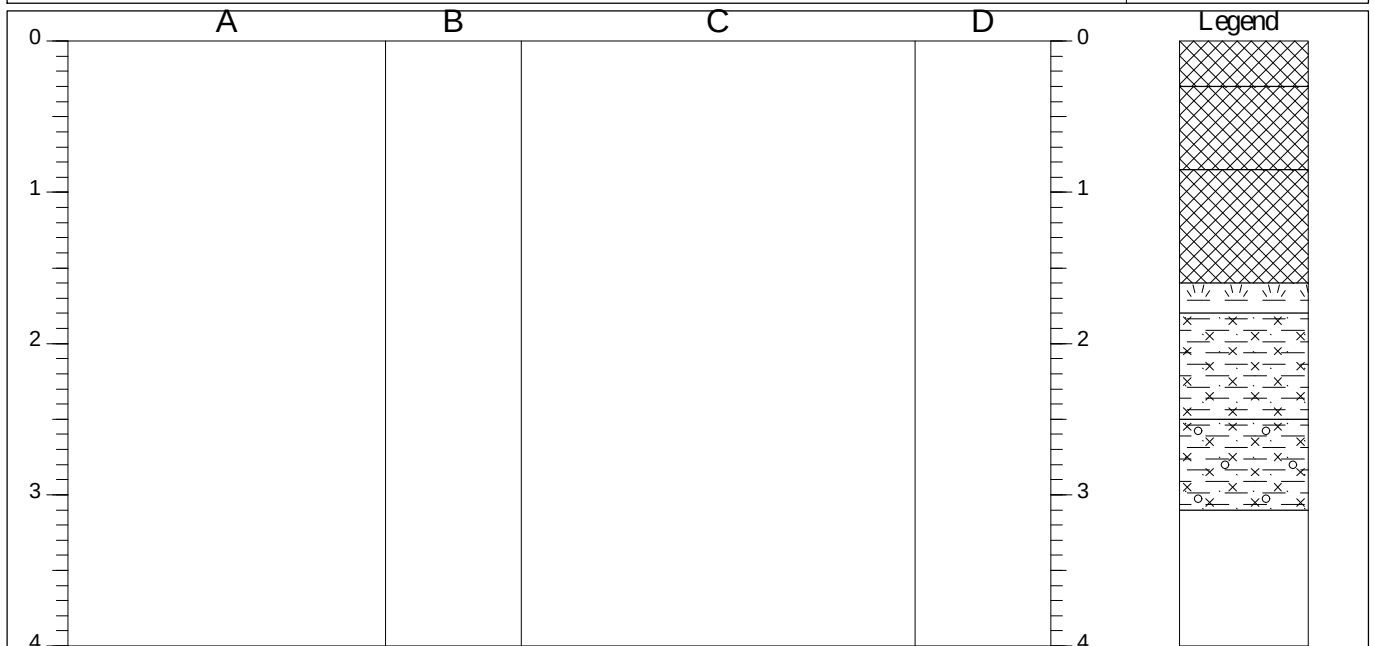


STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.10	ES	
0.30-0.75		Stiff yellowish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.			
0.75-3.20		Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Occasional damp laminations noted from 2.00mbgl.	1.00	D	

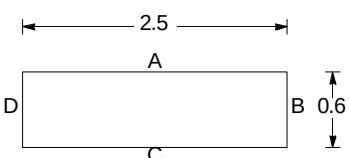
Shoring/Support: Stability: Stable 		GENERAL REMARKS Occasional damp laminations noted from 2.00mbgl.	
All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	Logged By KR

TRIAL PIT LOG

Project Lower Road, Halewood				TRIAL PIT No TP115
Job No 17RED147	Date 10-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



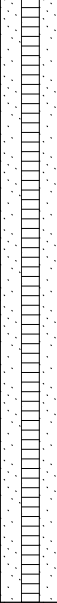
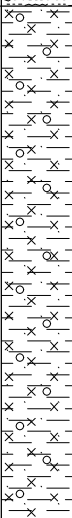
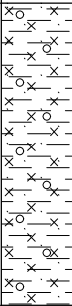
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		MADE GROUND: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	0.50	ES	
0.30-0.85		MADE GROUND: Soft to firm brown and grey silty sandy clay. Some collapse within Made Ground Strata.			
0.85-1.60		MADE GROUND: Very dense White sand, becoming loose sand once past 'crust'. Strata wet and standing water below crust. Some roots present. Unusual acidic/citrus odour. Some collapse within Made Ground Strata.			
1.60-1.80		Soft black spongy fibrous PEAT. Strata is wet.			
1.80-2.50		Very soft brown very sandy very silty CLAY.			
2.50-3.10		Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.			

Shoring/Support: Stability: Some collapse within Made Ground strata.		GENERAL REMARKS Standing water from 0.85mbgl with unusual acidic/citrus odour.
		

All dimensions in metres Scale 1:50	Client Redrow	Method/ Plant Used JCB 3CX	Logged By KR
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BOREHOLE LOG

Project Lower Road, Halewood				BOREHOLE No WS101	
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

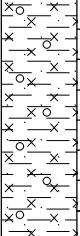
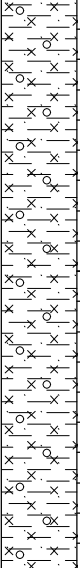
SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)		
0.10	ES					(0.30) 0.30	TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	 
						(1.70) 2.00	Stiff reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.	
						(1.00) 3.00	Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.	

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry
All dimensions in metres Scale 1:25			Client Redrow			Method/ Plant Used Competitor Rig			Logged By KR		

AGS3 UK BH 17RED147 - LOWER ROAD, HALEWOOD.GPJ GINT STD AGS 3.1.GDT 23/8/18

BOREHOLE LOG

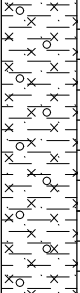
Project Lower Road, Halewood				BOREHOLE No WS102	
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)	DESCRIPTION		
1.10	ES					(0.30) 0.30	TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.		
						(0.80) 1.10	Stiff reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.		
						(1.90) 3.00	Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry
All dimensions in metres Scale 1:25			Client Redrow			Method/ Plant Used Competitor Rig			Logged By KR		

BOREHOLE LOG

Project Lower Road, Halewood				BOREHOLE No WS103	
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

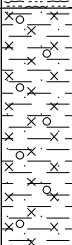
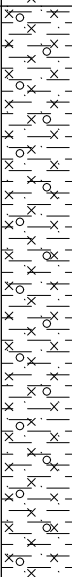
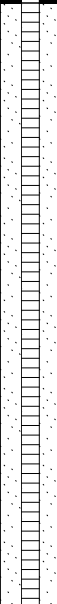
SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.20	ES					(0.30) 0.30	TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.		
1.00	D					(1.00) <			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry
All dimensions in metres Scale 1:25			Client Redrow			Method/ Plant Used Competitor Rig			Logged By KR		

AGS3 UK BH 17RED147 - LOWER ROAD, HALEWOOD.GPJ GINT STD AGS 3.1.GDT 23/8/18

BOREHOLE LOG

Project Lower Road, Halewood				BOREHOLE No WS104
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

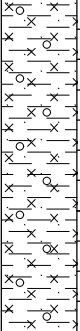
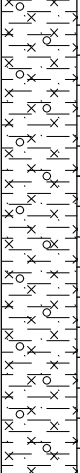
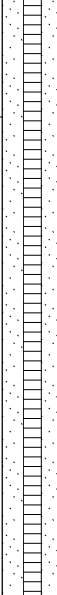
SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)		
0.50	ES					(0.30) 0.30	TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.	
						(0.80) 1.10	Stiff reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.	
						(1.90) 3.00	Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Strata is slightly damp.	
								

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	
											Slightly damp 1.1-3.0mbgl.
All dimensions in metres Scale 1:25		Client Redrow				Method/ Plant Used Competitor Rig					Logged By KR

AGS3 UK BH 17RED147 - LOWER ROAD, HALEWOOD.GPJ GINT STD AGS 3 1.GDT 23/8/18

BOREHOLE LOG

Project Lower Road, Halewood				BOREHOLE No WS105	
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

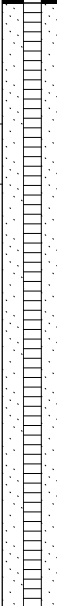
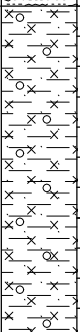
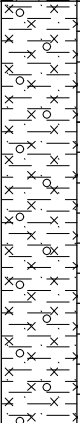
SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.10	ES					(0.30) 0.30	TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.		
						(1.10) 1.40	Stiff reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.		
						(1.60) 3.00	Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.		
									
				</					

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry
All dimensions in metres Scale 1:25			Client Redrow			Method/ Plant Used Competitor Rig			Logged By KR		

AGS3 UK BH 17RED147 - LOWER ROAD, HALEWOOD.GPJ GINT STD AGS 3.1.GDT 23/8/18

BOREHOLE LOG

Project Lower Road, Halewood				BOREHOLE No WS106	
Job No 17RED147	Date 09-08-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)	DESCRIPTION		
0.10	ES					(0.30) 0.30	TOPSOIL: Dark brown slightly clayey occasionally gravelly fine SAND. Gravel is fine to medium of rootlets.		 
						(1.10) 1.40	Stiff reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted. Upper section of strata is dessicated.		
						(0.20) 1.60	Loose brown gravelly SAND. Gravel is fine to medium subangular to subrounded of mixed lithology including sandstone.		
						(1.40) 3.00	Stiff to very stiff dark reddish brown occasionally gravelly slightly sandy slightly silty CLAY. Gravel is fine to coarse subangular to subrounded of sandstone and mudstone. Occasional small pockets / lenses noted.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry
All dimensions in metres Scale 1:25			Client Redrow			Method/ Plant Used Competitor Rig			Logged By KR		

AGS3 UK BH 17RED147 - LOWER ROAD, HALEWOOD.GPJ GINT STD AGS 3.1.GDT 23/8/18

BOREHOLE LOG

Project Lower Road, Halewood				BOREHOLE No WS107	
Job No 17RED147	Date 10-08-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

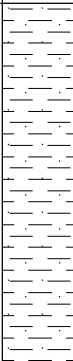
SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						(0.30) 0.30	TOPSOIL: Dark brown slightly clayey SAND. Rare black subangular gravel.		
						(1.20) 1.50	Firm to stiff / stiff light orangish brown sandy CLAY. Occasional subangular - subrounded gravel of various lithologies.		
						(0.50) 2.00	No recovery - Assumed pushing cobble down.		
						(1.00) 3.00	Stiff brown slightly sandy CLAY. Frequent subangular - subrounded gravel of various lithologies.		

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	
											Dry.
All dimensions in metres Scale 1:25			Client Redrow			Method/ Plant Used Competitor Rig			Logged By PH		

AGS3 UK BH 17RED147 - LOWER ROAD, HALEWOOD.GPJ GINT STD AGS 3.1.GDT 23/8/18

BOREHOLE LOG

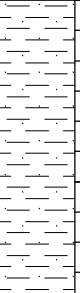
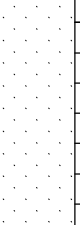
Project Lower Road, Halewood				BOREHOLE No WS108
Job No 17RED147	Date 10-08-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)		
						(0.30) 0.30	TOPSOIL.: Dark brown slightly clayey SAND. Rare black subangular gravel.	
						(0.20) 0.50	Firm orangish brown sandy CLAY.	
						(1.20) 1.70	Stiff to hard reddish brown slightly sandy CLAY. Frequent small to medium subangular to subrounded gravel of various lithologies.	
						(1.30) 3.00	Stiff brown slightly sandy CLAY. Frequent subangular - subrounded gravel of various lithologies.	

[illegible]

BOREHOLE LOG

Project Lower Road, Halewood				BOREHOLE No WS109	
Job No 17RED147	Date 10-08-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

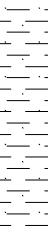
SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						(0.40) 0.40	Stiff brown slightly sandy CLAY. Frequent subangular - subrounded gravel of various lithologies. Occasional coal fragments.		
						(1.00) 1.40	Firm orangish brown sandy CLAY.		
						(1.50) 2.90	Soft black slightly sandy SILT. Damp.		
						(0.80) 3.70	Loose to medium dense light brown fine to coarse SAND.		
						(0.30) 4.00	Firm to stiff orangish brown sandy CLAY.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Damp - 1.40mbgl - 2.90mbgl. Groundwater at 3.00mbgl.
All dimensions in metres Scale 1:25			Client Redrow			Method/ Plant Used Competitor Rig			Logged By PH		

AGS3 UK BH 17RED147 - LOWER ROAD, HALEWOOD.GPJ GINT STD AGS 3.1.GDT 23/8/18

BOREHOLE LOG

Project Lower Road, Halewood				BOREHOLE No WS110	
Job No 17RED147	Date 10-08-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
1.00	N16					(0.30) 0.30	TOPSOIL: Dark brown slightly clayey SAND. Rare black subangular gravel.		
						(1.00) 1.30	Stiff reddish brown slightly sandy CLAY. Frequent small to medium subangular to subrounded gravel of various lithologies.		
2.00	N19					(1.70) 3.00	Stiff brown slightly sandy CLAY. Occasional small subrounded gravel of various lithologies.		
3.00	N31								

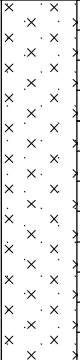
Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry.

All dimensions in metres Scale 1:25	Client Redrow	Method/ Plant Used Competitor Rig	Logged By PH
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AGS3 UK BH 17RED147 - LOWER ROAD, HALEWOOD.GPJ GINT STD AGS 3.1.GDT 23/8/18

BOREHOLE LOG

Project Lower Road, Halewood				BOREHOLE No WS111	
Job No 17RED147	Date 10-08-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)		
						(0.30) 0.30	TOPSOIL: Dark brown slightly clayey SAND. Rare black subangular gravel.	
						(0.30) 0.60	Soft to firm damp orangish brown sandy very silty CLAY.	
						(1.20) 1.80	Soft dark grey with black mottling slightly sandy SILT.	
						(1.20) 3.00	Stiff orangish / reddish brown slightly sandy CLAY. Occasional subrounded to subangular gravel of various lithologies.	

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Damp - 0.30mbgl - 1.80mbgl.
All dimensions in metres Scale 1:25			Client Redrow			Method/ Plant Used Competitor Rig			Logged By PH		

APPENDIX D

- (i) Contamination Test Results
- (ii) Geotechnical Test Results

SUMMARY OF CONTAMINATION ANALYSIS: METALS

Project Name Lower Road, Haleswood
Project No 17RED147
Date 9-10/8/18

SOIL TYPE	N	TS	MG	MG	N	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	TS	N	
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Metals	Mean Value Test 1	Range		AIRisk 2017 (mg/kg)	AIRisk 2017 (mg/kg)	DEFRA C4SL 2017
	US ₂₅	Largest Value (mg/kg)	Smallest Value (mg/kg)	With Homegrown Produce (1% SOM)	With Homegrown Produce (6% SOM)	
pH	8.13	11.97	6.53			-
Sulphate (water soil 2:1)	0.27	1.25	0.01			-
Organic matter	2.85	7.90	0.20			-
Arsenic	6.15	16.00	1.00	32	32	37
Cadmium	0.58	1.30	0.60	10	10	22.1
Copper	50.30	210.00	2.00	4730	4790	-
Chromium (hexavalent)	1.00	<1	<1	3.62	3.63	26.5
Lead	50.16	171.00	4.00			269
Mercury	0.40	1.20	0.21	8.81	15.8	-
Nickel	30.25	51.00	2.00	EAIATrisk withdrawn Aug 2015		
Selenium	1.00	<1		375	375	-
Zinc	83.71	237.00	7.00	20000	20300	-

NOTE:
Any individual results and mean value tests above SOVs are shown RED highlighted.
Any outlier values which exceed relevant SOVs are shown in red

*, The calculations for the mean value test include outliers
- Results for this assessment are assessed with no background levels taken into account
Results are expressed as mg/kg unless otherwise stated

ALL RESULTS PRESENTED ARE ASSESSED UNDER THE COMBINED CLEA ASSESSMENT CRITERION AS OUTLINED WITHIN SH4 ASSUMING NO USE

BS5092 HAS OBSERVED DURING FIELDWORK. SEE OUTLIER NOTES ON CONTAMINATION

SOVs are derived from the EA 2009 SOVs which are taken from AIRisk 2015. Category 4 leaching levels have been adopted by the EA and have been included as new guidance.
Note: The SOV for elemental mercury has been used to assess total mercury contamination at the site. The Environment Agency's Science Report SC000201 Mercury SOV states that "for general surface contamination and to simplify the assessment the SOVs for inorganic mercury can normally be compared with chemical analysis for total mercury content". Based on the latter, SOV for elemental mercury (170mg/kg) in the soil assessment is used
NAD - NO ASBESTOS DETECTED

TS - Topsoil, MG - Made Ground and N - Natural Ground

SUMMARY OF CONTAMINATION ANALYSIS: SOIL

SUMMARY OF CONTAMINATION ANALYSIS: TPH

Project Name	Lower Road, Halewood
Project No	17RED147
Date	9-10/8/18

[illegible]

TPH	Mean Value Test ¹	Range		Affixit 2017 (mg/kg) Residential with Home Grown Produce	Affixit 2017 (mg/kg) Residential with Home Grown Produce	DEBRA C45L 2017
	US ³	Largest Value (mg/kg)	Smallest Value (mg/kg)	1% SOM WITHOUT Free Product ²	6% SOM WITHOUT Free Product ²	6% SOM WITHOUT Free Product ²
All >C5-C6	0.01	<0.1	<0.1	42.7	389	-
All >C6-C8	0.01	<0.1	<0.1	39.3	1240	-
All >C8-C10	0.01	<0.1	<0.1	13.9	204	-
All >C10-C12	0.33	2.40	<0.1	81.7	1190	-
All >C12-C16	0.86	7.50	<0.1	385	4130	-
All >C16-C21	1.00	6.20	<0.1	210000	2100	-
All >C21-C35	17.82	105.00	<0.1			-
Total Aromatics	19.51	109.00	<0.1			-
Aro >C5-C7	0.01	<0.1	<0.1	0.137	0.871	-
Aro >C7-C8	0.01	<0.1	<0.1	113	780	-
Aro >C8-C10	0.01	<0.1	<0.1	20.5	232	-
Aro >C10-C12	0.10	<0.1	<0.1	70	168	-
Aro >C12-C16	0.42	3.20	<0.1	165	830	-
Aro >C16-C21	1.95	6.00	<0.1	319	1040	-
Aro >C21-C35	13.03	112.00	<0.1	1120	1710	-
Total Aromatics	14.26	121.00	<0.1			-
TPH (All & Aro)	32.88	230.00	<0.1	0.0493	0.33	0.871
BTEX - Benzene	0.01	<0.1	<0.1			
BTEX - Toluene	0.01	<0.1	<0.1	113	780	-
BTEX - Ethyl Benzene	0.01	<0.1	<0.1	59.7	453	-
BTEX - m & p Xylene	0.01	<0.1	<0.1	24	312	-
BTEX - o Xylene	0.01	<0.1	<0.1	26.4	336	-
MTBE	0.01	<0.1	<0.1	27.6	220	-

	UU Drinking Water Guidelines
	PE Threshold
Total BTEX & MTBE	0.1
ECS-EC10 All-Aro	2
EC10-EC16 All-Aro	10
EC16-EC40 All-Aro	500

Results expressed as mg/kg air dried unless otherwise stated

* - The calculations for the mean value test include outliers.

*** THESE RESULTS PRESENTED ARE ASSESSED UNDER THE COMBINED CLEA ASSESSMENT CRITERION AS OUTLINED WITHIN ASSUMING NO FREE
PRODUCT WAS OBSERVED DURING FIELDWORK. SEE GUIDANCE NOTES ON CONTAMINATION

NOTES

For the Purpose of this investigation, results will be assessed using **RESIDENTIAL GUIDELINES WITH HOMEOWN PRODUCT WITH NO FREE PRODUCT**

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/06465
Issue Number: 1
Date: 29 August, 2018

Client: Betts Geo Environmental
Old Marsh Farm Barns
Welsh Road
Sealand
Flintshire
UK
CH5 2LY

Project Manager: Betts Geolab
Project Name: Lower Road, Halewood
Project Ref: 17RED147
Order No: BG2906
Date Samples Received: 13/08/18
Date Instructions Received: 14/08/18
Date Analysis Completed: 28/08/18

Prepared by:


Melanie Marshall
Laboratory Coordinator

Approved by:


Richard Wong
Client Manager

Envirolab Job Number: 18/06465

Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/1	18/06465/2	18/06465/3	18/06465/4	18/06465/5	18/06465/6	18/06465/7	18/06465/8	Units	Method ref
Client Sample No	N	TS	MG	MG	N	N	N	TS		
Client Sample ID	TP101	TP102	TP103	TP103	TP104	TP105	TP105	TP106		
Depth to Top	0.30	0.10	0.10	0.60	1.05	0.40	1.10	0.10		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D	Soil - ES		
Sample Matrix Code	6AE	6E	4AE	4AE	5A	1A	3	4AE		
% Stones >10mm _A	1.7	<0.1	33.7	29.5	<0.1	2.2	<0.1	<0.1	% w/w	A-T-044
pH _D ^{M#}	8.21	7.62	7.76	7.79	8.14	7.89	8.21	8.07	pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.02	0.01	0.94	1.01	0.02	0.02	0.02	0.01	g/l	A-T-026s
Organic matter _D ^{M#}	0.5	4.2	2.7	5.3	0.5	0.2	-	0.5	% w/w	A-T-032 OM
Arsenic _D ^{M#}	4	8	6	6	3	5	-	9	mg/kg	A-T-024s
Cadmium _D ^{M#}	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	mg/kg	A-T-024s
Copper _D ^{M#}	22	67	59	48	16	9	-	36	mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1	<1	-	<1	mg/kg	A-T-040s
Lead _D ^{M#}	7	62	91	69	8	7	-	51	mg/kg	A-T-024s
Mercury _D	0.53	0.44	0.60	0.58	0.55	0.34	-	0.50	mg/kg	A-T-024s
Nickel _D ^{M#}	51	22	17	26	44	25	-	22	mg/kg	A-T-024s
Selenium _D [#]	<1	<1	<1	<1	<1	<1	-	<1	mg/kg	A-T-024s
Zinc _D ^{M#}	39	110	141	152	45	24	-	80	mg/kg	A-T-024s
VPH total (>C5-C10) _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
1.01 % Moisture BS1377 1990 pt2 cl3.2 _A [#]	-	-	-	-	-	-	Appended	-		Subcon SS
1.02 Atterburg 4Pt BS1377 1990 pt2 cl4.4,5.3+5.4 _A [#]	-	-	-	-	-	-	Appended	-		Subcon SS

Envirolab Job Number: 18/06465

Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/1	18/06465/2	18/06465/3	18/06465/4	18/06465/5	18/06465/6	18/06465/7	18/06465/8	Units	Method ref
Client Sample No	N	TS	MG	MG	N	N	N	TS		
Client Sample ID	TP101	TP102	TP103	TP103	TP104	TP105	TP105	TP106		
Depth to Top	0.30	0.10	0.10	0.60	1.05	0.40	1.10	0.10		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D	Soil - ES		
Sample Matrix Code	6AE	6E	4AE	4AE	5A	1A	3	4AE		
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD	NAD	NAD	-	NAD		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A		

Envirolab Job Number: 18/06465

Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/1	18/06465/2	18/06465/3	18/06465/4	18/06465/5	18/06465/6	18/06465/7	18/06465/8	Units	Method ref
Client Sample No	N	TS	MG	MG	N	N	N	TS		
Client Sample ID	TP101	TP102	TP103	TP103	TP104	TP105	TP105	TP106		
Depth to Top	0.30	0.10	0.10	0.60	1.05	0.40	1.10	0.10		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D	Soil - ES		
Sample Matrix Code	6AE	6E	4AE	4AE	5A	1A	3	4AE		
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	0.01	0.19	0.10	<0.01	<0.01	-	0.01	mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	0.02	0.02	<0.01	<0.01	-	<0.01	mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	0.02	0.34	0.14	<0.02	<0.02	-	<0.02	mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	0.13	0.52	0.50	<0.04	<0.04	-	0.09	mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	0.16	0.64	0.60	<0.04	<0.04	-	0.12	mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	0.19	0.63	0.62	<0.05	<0.05	-	0.14	mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	0.07	0.31	0.28	<0.05	<0.05	-	0.05	mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	0.20	0.22	<0.07	<0.07	-	<0.07	mg/kg	A-T-019s
Chrysene _A ^{M#}	<0.06	0.17	0.52	0.49	<0.06	<0.06	-	0.13	mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	0.07	0.07	<0.04	<0.04	-	<0.04	mg/kg	A-T-019s
Fluoranthene _A ^{M#}	<0.08	0.23	1.31	1.20	<0.08	<0.08	-	0.20	mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01	0.20	0.09	<0.01	<0.01	-	<0.01	mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	0.11	0.39	0.34	<0.03	<0.03	-	0.08	mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	0.14	<0.03	<0.03	<0.03	-	<0.03	mg/kg	A-T-019s
Phenanthrene _A ^{M#}	<0.03	0.13	1.37	0.69	<0.03	<0.03	-	0.11	mg/kg	A-T-019s
Pyrene _A ^{M#}	<0.07	0.21	1.03	1.05	<0.07	<0.07	-	0.17	mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	1.43	7.88	6.41	<0.08	<0.08	-	1.10	mg/kg	A-T-019s

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Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/1	18/06465/2	18/06465/3	18/06465/4	18/06465/5	18/06465/6	18/06465/7	18/06465/8	Units	Method ref
Client Sample No	N	TS	MG	MG	N	N	N	TS		
Client Sample ID	TP101	TP102	TP103	TP103	TP104	TP105	TP105	TP106		
Depth to Top	0.30	0.10	0.10	0.60	1.05	0.40	1.10	0.10		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D	Soil - ES		
Sample Matrix Code	6AE	6E	4AE	4AE	5A	1A	3	4AE		
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C8-C10 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C10-C12 _A [#]	<0.1	<0.1	<0.1	2.4	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Ali >C12-C16 _A [#]	<0.1	<0.1	0.7	7.5	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Ali >C16-C21 _A [#]	<0.1	<0.1	3.1	6.2	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Ali >C21-C35 _A [#]	<0.1	<0.1	105	81.7	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Total Aliphatics _A	<0.1	<0.1	109	97.8	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C8-C9 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C9-C10 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C10-C12 _A [#]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Aro >C12-C16 _A [#]	<0.1	<0.1	3.2	0.4	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Aro >C16-C21 _A [#]	<0.1	<0.1	6.0	2.4	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Aro >C21-C35 _A [#]	<0.1	<0.1	112	11.5	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Total Aromatics _A	<0.1	<0.1	121	14.3	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
TPH (Ali & Aro) _A	<0.1	<0.1	230	112	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s

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Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/9	18/06465/10	18/06465/11	18/06465/12	18/06465/13	18/06465/14	18/06465/15	18/06465/16	Units	Method ref
Client Sample No	N	N	N	TS	N	TS	N	N		
Client Sample ID	TP107	TP107	TP108	TP109	TP110	TP111	TP112	TP112		
Depth to Top	0.50	1.00	0.50	0.10	0.30	0.10	0.80	1.00		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	6AE	6AE	5A	4E	5	4AE	5	5A		
% Stones >10mm _A	<0.1	4.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	% w/w	A-T-044
pH _D ^{M#}	7.91	7.86	7.07	7.02	7.58	6.53	7.13	7.92	pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	<0.01	<0.01	0.02	0.03	0.01	0.03	0.02	g/l	A-T-026s
Organic matter _D ^{M#}	1.2	-	0.5	2.6	0.7	2.8	0.8	-	% w/w	A-T-032 OM
Arsenic _D ^{M#}	2	-	2	7	<1	7	2	-	mg/kg	A-T-024s
Cadmium _D ^{M#}	<0.5	-	<0.5	0.6	<0.5	<0.5	<0.5	-	mg/kg	A-T-024s
Copper _D ^{M#}	13	-	7	41	6	38	11	-	mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	-	<1	<1	<1	<1	<1	-	mg/kg	A-T-040s
Lead _D ^{M#}	18	-	10	59	9	52	14	-	mg/kg	A-T-024s
Mercury _D	0.71	-	<0.17	<0.17	<0.17	<0.17	<0.17	-	mg/kg	A-T-024s
Nickel _D ^{M#}	31	-	29	22	23	19	26	-	mg/kg	A-T-024s
Selenium _D [#]	<1	-	<1	<1	<1	<1	<1	-	mg/kg	A-T-024s
Zinc _D ^{M#}	37	-	34	85	32	82	33	-	mg/kg	A-T-024s
VPH total (>C5-C10) _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
1.01 % Moisture BS1377 1990 pt2 cl3.2 _A [#]	-	Appended	-	-	-	-	-	Appended		Subcon SS
1.02 Atterburg 4Pt BS1377 1990 pt2 cl4.4,5,3+5.4 _A [#]	-	Appended	-	-	-	-	-	Appended		Subcon SS

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Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/9	18/06465/10	18/06465/11	18/06465/12	18/06465/13	18/06465/14	18/06465/15	18/06465/16	Units	Method ref
Client Sample No	N	N	N	TS	N	TS	N	N		
Client Sample ID	TP107	TP107	TP108	TP109	TP110	TP111	TP112	TP112		
Depth to Top	0.50	1.00	0.50	0.10	0.30	0.10	0.80	1.00		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	6AE	6AE	5A	4E	5	4AE	5	5A		
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	-	NAD	NAD	NAD	NAD	NAD	-		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	-	N/A	N/A	N/A	N/A	N/A	-		

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Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/9	18/06465/10	18/06465/11	18/06465/12	18/06465/13	18/06465/14	18/06465/15	18/06465/16	Units	Method ref
Client Sample No	N	N	N	TS	N	TS	N	N		
Client Sample ID	TP107	TP107	TP108	TP109	TP110	TP111	TP112	TP112		
Depth to Top	0.50	1.00	0.50	0.10	0.30	0.10	0.80	1.00		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	6AE	6AE	5A	4E	5	4AE	5	5A		
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	-	<0.04	0.08	<0.04	0.09	<0.04	-	mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	-	<0.04	0.11	<0.04	0.12	<0.04	-	mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	-	<0.05	0.13	<0.05	0.14	<0.05	-	mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	-	mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	-	<0.07	<0.07	<0.07	<0.07	<0.07	-	mg/kg	A-T-019s
Chrysene _A ^{M#}	<0.06	-	<0.06	0.12	<0.06	0.12	<0.06	-	mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	-	<0.04	<0.04	<0.04	<0.04	<0.04	-	mg/kg	A-T-019s
Fluoranthene _A ^{M#}	<0.08	-	<0.08	0.15	<0.08	0.16	<0.08	-	mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	-	<0.03	0.08	<0.03	0.07	<0.03	-	mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	-	mg/kg	A-T-019s
Phenanthrene _A ^{M#}	<0.03	-	<0.03	0.07	<0.03	0.08	<0.03	-	mg/kg	A-T-019s
Pyrene _A ^{M#}	<0.07	-	<0.07	0.13	<0.07	0.16	<0.07	-	mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	-	<0.08	0.87	<0.08	0.94	<0.08	-	mg/kg	A-T-019s

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Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/9	18/06465/10	18/06465/11	18/06465/12	18/06465/13	18/06465/14	18/06465/15	18/06465/16	Units	Method ref
Client Sample No	N	N	N	TS	N	TS	N	N		
Client Sample ID	TP107	TP107	TP108	TP109	TP110	TP111	TP112	TP112		
Depth to Top	0.50	1.00	0.50	0.10	0.30	0.10	0.80	1.00		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	6AE	6AE	5A	4E	5	4AE	5	5A		
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Ali >C8-C10 _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Ali >C10-C12 _A [#]	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Ali >C12-C16 _A [#]	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Ali >C16-C21 _A [#]	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Ali >C21-C35 _A [#]	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Total Aliphatics _A	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Aro >C5-C7 _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C8-C9 _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C9-C10 _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C10-C12 _A [#]	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Aro >C12-C16 _A [#]	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Aro >C16-C21 _A [#]	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Aro >C21-C35 _A [#]	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Total Aromatics _A	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
TPH (Ali & Aro) _A	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
BTEX - Benzene _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
MTBE _A [#]	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s

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Lab Sample ID	18/06465/17	18/06465/18	18/06465/19	18/06465/20	18/06465/21	18/06465/22	18/06465/23	18/06465/24	Units	Method ref
Client Sample No	TS	TS	N	N	TS	N	TS	N		
Client Sample ID	TP113	TP114	TP114	TP115	WS101	WS102	WS103	WS103		
Depth to Top	0.50	0.10	1.00	0.85	0.10	1.10	0.20	1.00		
Depth To Bottom										
Date Sampled	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - D	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	5	6AE	5A	7	4AE	3	4AE	3		
% Stones >10mm _A	<0.1	4.7	6.1	<0.1	<0.1	<0.1	4.4	<0.1	% w/w	A-T-044
pH _D ^{M#}	7.63	7.10	8.09	11.97	8.42	8.51	7.85	8.30	pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	0.02	0.02	0.03	<0.01	0.01	1.25	0.05	g/l	A-T-026s
Organic matter _D ^{M#}	0.3	2.9	-	1.0	3.0	0.5	7.9	-	% w/w	A-T-032 OM
Arsenic _D ^{M#}	2	7	-	2	7	3	9	-	mg/kg	A-T-024s
Cadmium _D ^{M#}	<0.5	<0.5	-	<0.5	<0.5	<0.5	1.3	-	mg/kg	A-T-024s
Copper _D ^{M#}	14	38	-	2	41	21	103	-	mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	-	<1	<1	<1	<1	-	mg/kg	A-T-040s
Lead _D ^{M#}	7	48	-	4	50	9	171	-	mg/kg	A-T-024s
Mercury _D	<0.17	<0.17	-	1.20	<0.17	<0.17	0.24	-	mg/kg	A-T-024s
Nickel _D ^{M#}	37	17	-	2	21	43	24	-	mg/kg	A-T-024s
Selenium _D [#]	<1	<1	-	<1	<1	<1	<1	-	mg/kg	A-T-024s
Zinc _D ^{M#}	30	73	-	7	77	52	237	-	mg/kg	A-T-024s
VPH total (>C5-C10) _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
1.01 % Moisture BS1377 1990 pt2 cl3.2 _A [#]	-	-	Appended	-	-	-	-	Appended		Subcon SS
1.02 Atterburg 4Pt BS1377 1990 pt2 cl4.4,5.3+5.4 _A [#]	-	-	Appended	-	-	-	-	Appended		Subcon SS

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Lab Sample ID	18/06465/17	18/06465/18	18/06465/19	18/06465/20	18/06465/21	18/06465/22	18/06465/23	18/06465/24	Units	Method ref
Client Sample No	TS	TS	N	N	TS	N	TS	N		
Client Sample ID	TP113	TP114	TP114	TP115	WS101	WS102	WS103	WS103		
Depth to Top	0.50	0.10	1.00	0.85	0.10	1.10	0.20	1.00		
Depth To Bottom										
Date Sampled	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - D	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	5	6AE	5A	7	4AE	3	4AE	3		
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	-	NAD	NAD	NAD	NAD	-		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	-	N/A	N/A	N/A	N/A	-		

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Lab Sample ID	18/06465/17	18/06465/18	18/06465/19	18/06465/20	18/06465/21	18/06465/22	18/06465/23	18/06465/24	Units	Method ref
Client Sample No	TS	TS	N	N	TS	N	TS	N		
Client Sample ID	TP113	TP114	TP114	TP115	WS101	WS102	WS103	WS103		
Depth to Top	0.50	0.10	1.00	0.85	0.10	1.10	0.20	1.00		
Depth To Bottom										
Date Sampled	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - D	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	5	6AE	5A	7	4AE	3	4AE	3		
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	0.01	-	<0.01	<0.01	0.07	0.14	-	mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	0.01	-	<0.01	<0.01	<0.01	0.05	-	mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	0.06	-	<0.02	<0.02	0.03	0.33	-	mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	0.61	-	<0.04	<0.04	0.21	2.25	-	mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	0.64	-	<0.04	<0.04	0.26	3.10	-	mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	0.71	-	<0.05	<0.05	0.31	3.15	-	mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	0.19	-	<0.05	<0.05	0.10	1.20	-	mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	0.21	-	<0.07	<0.07	0.09	1.11	-	mg/kg	A-T-019s
Chrysene _A ^{M#}	<0.06	0.68	-	<0.06	<0.06	0.27	2.13	-	mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	0.07	-	<0.04	<0.04	<0.04	0.31	-	mg/kg	A-T-019s
Fluoranthene _A ^{M#}	<0.08	0.93	-	<0.08	<0.08	0.40	3.59	-	mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	0.02	-	<0.01	<0.01	0.03	0.10	-	mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	0.33	-	<0.03	<0.03	0.14	1.57	-	mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	0.03	-	<0.03	<0.03	<0.03	0.04	-	mg/kg	A-T-019s
Phenanthrene _A ^{M#}	<0.03	0.24	-	0.09	<0.03	0.29	1.32	-	mg/kg	A-T-019s
Pyrene _A ^{M#}	<0.07	0.82	-	<0.07	<0.07	0.38	3.48	-	mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	5.56	-	0.09	<0.08	2.58	23.9	-	mg/kg	A-T-019s

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Lab Sample ID	18/06465/17	18/06465/18	18/06465/19	18/06465/20	18/06465/21	18/06465/22	18/06465/23	18/06465/24	Units	Method ref
Client Sample No	TS	TS	N	N	TS	N	TS	N		
Client Sample ID	TP113	TP114	TP114	TP115	WS101	WS102	WS103	WS103		
Depth to Top	0.50	0.10	1.00	0.85	0.10	1.10	0.20	1.00		
Depth To Bottom										
Date Sampled	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - D	Solid	Soil - ES	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	5	6AE	5A	7	4AE	3	4AE	3		
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Ali >C8-C10 _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Ali >C10-C12 _A [#]	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Ali >C12-C16 _A [#]	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Ali >C16-C21 _A [#]	<0.1	<0.1	-	<0.1	<0.1	<0.1	3.0	-	mg/kg	A-T-023s
Ali >C21-C35 _A [#]	<0.1	<0.1	-	<0.1	<0.1	<0.1	55.4	-	mg/kg	A-T-023s
Total Aliphatics _A	<0.1	<0.1	-	<0.1	<0.1	<0.1	58.5	-	mg/kg	A-T-023s
Aro >C5-C7 _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C8-C9 _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C9-C10 _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C10-C12 _A [#]	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Aro >C12-C16 _A [#]	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	-	mg/kg	A-T-023s
Aro >C16-C21 _A [#]	<0.1	<0.1	-	<0.1	<0.1	<0.1	4.6	-	mg/kg	A-T-023s
Aro >C21-C35 _A [#]	<0.1	<0.1	-	<0.1	<0.1	<0.1	30.2	-	mg/kg	A-T-023s
Total Aromatics _A	<0.1	<0.1	-	<0.1	<0.1	<0.1	34.8	-	mg/kg	A-T-023s
TPH (Ali & Aro) _A	<0.1	<0.1	-	<0.1	<0.1	<0.1	93.3	-	mg/kg	A-T-023s
BTEX - Benzene _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	mg/kg	A-T-022s

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Client Sample No	N	TS	N	N	N	N	TS	N		
Client Sample ID	WS104	WS105	WS107	WS108	WS107	WS109	WS110	WS110		
Depth to Top	0.50	0.10	0.50	0.80	1.20	3.00	0.10	1.50		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	6E	4AE	5	5	5	6	4AE	5		
% Stones >10mm _A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	% w/w	A-T-044
pH _D ^{M#}	8.02	7.07	7.65	8.29	8.30	7.06	7.00	8.08	pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.02	<0.01	0.02	0.01	0.02	0.54	<0.01	0.03	g/l	A-T-026s
Organic matter _D ^{M#}	1.5	3.2	0.4	0.4	-	6.9	2.9	-	% w/w	A-T-032 OM
Arsenic _D ^{M#}	2	7	2	1	-	3	7	-	mg/kg	A-T-024s
Cadmium _D ^{M#}	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-	mg/kg	A-T-024s
Copper _D ^{M#}	17	40	10	14	-	37	41	-	mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	-	<1	<1	-	mg/kg	A-T-040s
Lead _D ^{M#}	20	53	8	6	-	53	55	-	mg/kg	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	<0.17	-	<0.17	0.21	-	mg/kg	A-T-024s
Nickel _D ^{M#}	20	18	27	37	-	51	21	-	mg/kg	A-T-024s
Selenium _D [#]	<1	<1	<1	<1	-	<1	<1	-	mg/kg	A-T-024s
Zinc _D ^{M#}	43	78	29	39	-	90	84	-	mg/kg	A-T-024s
VPH total (>C5-C10) _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
1.01 % Moisture BS1377 1990 pt2 cl3.2 _A [#]	-	-	-	-	Appended	-	-	Appended		Subcon SS
1.02 Atterburg 4Pt BS1377 1990 pt2 cl4.4,5.3+5.4 _A [#]	-	-	-	-	Appended	-	-	Appended		Subcon SS

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Lab Sample ID	18/06465/25	18/06465/26	18/06465/27	18/06465/28	18/06465/29	18/06465/30	18/06465/31	18/06465/32	Units	Method ref
Client Sample No	N	TS	N	N	N	N	TS	N		
Client Sample ID	WS104	WS105	WS107	WS108	WS107	WS109	WS110	WS110		
Depth to Top	0.50	0.10	0.50	0.80	1.20	3.00	0.10	1.50		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	6E	4AE	5	5	5	6	4AE	5		
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD	-	NAD	NAD	-		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	-	N/A	N/A	-		

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Lab Sample ID	18/06465/25	18/06465/26	18/06465/27	18/06465/28	18/06465/29	18/06465/30	18/06465/31	18/06465/32	Units	Method ref
Client Sample No	N	TS	N	N	N	N	TS	N		
Client Sample ID	WS104	WS105	WS107	WS108	WS107	WS109	WS110	WS110		
Depth to Top	0.50	0.10	0.50	0.80	1.20	3.00	0.10	1.50		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	6E	4AE	5	5	5	6	4AE	5		
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	-	<0.01	0.02	-	mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02	<0.02	<0.02	-	<0.02	0.03	-	mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	0.08	<0.04	<0.04	-	<0.04	0.10	-	mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	0.12	<0.04	<0.04	-	<0.04	0.11	-	mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	0.14	<0.05	<0.05	-	<0.05	0.15	-	mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-	mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	<0.07	<0.07	-	<0.07	<0.07	-	mg/kg	A-T-019s
Chrysene _A ^{M#}	<0.06	0.12	<0.06	<0.06	-	<0.06	0.12	-	mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04	-	<0.04	<0.04	-	mg/kg	A-T-019s
Fluoranthene _A ^{M#}	<0.08	0.15	<0.08	<0.08	-	<0.08	0.20	-	mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	-	<0.01	0.02	-	mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	0.08	<0.03	<0.03	-	<0.03	0.08	-	mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03	-	mg/kg	A-T-019s
Phenanthrene _A ^{M#}	<0.03	0.07	<0.03	<0.03	-	<0.03	0.19	-	mg/kg	A-T-019s
Pyrene _A ^{M#}	<0.07	0.15	<0.07	<0.07	-	<0.07	0.19	-	mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	0.91	<0.08	<0.08	-	<0.08	1.21	-	mg/kg	A-T-019s

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Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/25	18/06465/26	18/06465/27	18/06465/28	18/06465/29	18/06465/30	18/06465/31	18/06465/32	Units	Method ref
Client Sample No	N	TS	N	N	N	N	TS	N		
Client Sample ID	WS104	WS105	WS107	WS108	WS107	WS109	WS110	WS110		
Depth to Top	0.50	0.10	0.50	0.80	1.20	3.00	0.10	1.50		
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18	10-Aug-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - D	Soil - ES	Soil - ES	Soil - D		
Sample Matrix Code	6E	4AE	5	5	5	6	4AE	5		
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
Ali >C8-C10 _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
Ali >C10-C12 _A [#]	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
Ali >C12-C16 _A [#]	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
Ali >C16-C21 _A [#]	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
Ali >C21-C35 _A [#]	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
Total Aliphatics _A	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C8-C9 _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C9-C10 _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
Aro >C10-C12 _A [#]	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
Aro >C12-C16 _A [#]	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
Aro >C16-C21 _A [#]	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
Aro >C21-C35 _A [#]	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
Total Aromatics _A	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
TPH (Ali & Aro) _A	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	mg/kg	A-T-023s
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	mg/kg	A-T-022s

Envirolab Job Number: 18/06465

Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/33	18/06465/34							Units	Method ref
Client Sample No	N	N								
Client Sample ID	WS111	WS111								
Depth to Top	0.40	1.20								
Depth To Bottom										
Date Sampled	10-Aug-18	10-Aug-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	6A	6								
% Stones >10mm _A	1.9	<0.1							% w/w	A-T-044
pH _D ^{M#}	7.93	7.64							pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	0.22							g/l	A-T-026s
Organic matter _D ^{M#}	3.6	1.8							% w/w	A-T-032 OM
Arsenic _D ^{M#}	16	6							mg/kg	A-T-024s
Cadmium _D ^{M#}	<0.5	<0.5							mg/kg	A-T-024s
Copper _D ^{M#}	210	32							mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1							mg/kg	A-T-040s
Lead _D ^{M#}	60	28							mg/kg	A-T-024s
Mercury _D	<0.17	<0.17							mg/kg	A-T-024s
Nickel _D ^{M#}	23	21							mg/kg	A-T-024s
Selenium _D [#]	<1	<1							mg/kg	A-T-024s
Zinc _D ^{M#}	56	40							mg/kg	A-T-024s
VPH total (>C5-C10) _A [#]	<0.01	<0.01							mg/kg	A-T-022s

Envirolab Job Number: 18/06465

Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/33	18/06465/34							Units	Method ref
Client Sample No	N	N								
Client Sample ID	WS111	WS111								
Depth to Top	0.40	1.20								
Depth To Bottom										
Date Sampled	10-Aug-18	10-Aug-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	6A	6								
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD								A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A								

Envirolab Job Number: 18/06465

Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/33	18/06465/34							Units	Method ref
Client Sample No	N	N								
Client Sample ID	WS111	WS111								
Depth to Top	0.40	1.20								
Depth To Bottom										
Date Sampled	10-Aug-18	10-Aug-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	6A	6								
PAH-16MS										
Acenaphthene _A ^{M#}	0.01	<0.01							mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01							mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02							mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.13	<0.04							mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.16	<0.04							mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.19	<0.05							mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	0.07	<0.05							mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07							mg/kg	A-T-019s
Chrysene _A ^{M#}	0.17	<0.06							mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04							mg/kg	A-T-019s
Fluoranthene _A ^{M#}	0.24	<0.08							mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01							mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.11	<0.03							mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03							mg/kg	A-T-019s
Phenanthrene _A ^{M#}	0.10	<0.03							mg/kg	A-T-019s
Pyrene _A ^{M#}	0.23	<0.07							mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	1.41	<0.08							mg/kg	A-T-019s

Envirolab Job Number: 18/06465

Client Project Name: Lower Road, Halewood

Client Project Ref: 17RED147

Lab Sample ID	18/06465/33	18/06465/34							Units	Method ref
Client Sample No	N	N								
Client Sample ID	WS111	WS111								
Depth to Top	0.40	1.20								
Depth To Bottom										
Date Sampled	10-Aug-18	10-Aug-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	6A	6								
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01							mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01							mg/kg	A-T-022s
Ali >C8-C10 _A [#]	<0.01	<0.01							mg/kg	A-T-022s
Ali >C10-C12 _A [#]	<0.1	<0.1							mg/kg	A-T-023s
Ali >C12-C16 _A [#]	<0.1	<0.1							mg/kg	A-T-023s
Ali >C16-C21 _A [#]	<0.1	<0.1							mg/kg	A-T-023s
Ali >C21-C35 _A [#]	<0.1	<0.1							mg/kg	A-T-023s
Total Aliphatics _A	<0.1	<0.1							mg/kg	A-T-023s
Aro >C5-C7 _A [#]	<0.01	<0.01							mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01							mg/kg	A-T-022s
Aro >C8-C9 _A [#]	<0.01	<0.01							mg/kg	A-T-022s
Aro >C9-C10 _A [#]	<0.01	<0.01							mg/kg	A-T-022s
Aro >C10-C12 _A [#]	<0.1	<0.1							mg/kg	A-T-023s
Aro >C12-C16 _A [#]	<0.1	<0.1							mg/kg	A-T-023s
Aro >C16-C21 _A [#]	<0.1	<0.1							mg/kg	A-T-023s
Aro >C21-C35 _A [#]	<0.1	<0.1							mg/kg	A-T-023s
Total Aromatics _A	<0.1	<0.1							mg/kg	A-T-023s
TPH (Ali & Aro) _A	<0.1	<0.1							mg/kg	A-T-023s
BTEX - Benzene _A [#]	<0.01	<0.01							mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01							mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01							mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01							mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01							mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01							mg/kg	A-T-022s

REPORT NOTES

General:

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

All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure and there is insufficient sample to repeat the analysis. These are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Betts Geo Environmental, Old Marsh Farm Barns, Welsh Road, Sealand,
Flintshire, UK, CH5 2LY

Project: Lower Road, Halewood

Clients Project No: 17RED147

Project No: 18/06465

Date Instructions Received: 14/08/2018 (am)

Cool Box Temperatures (°C): 20.4, 20.1, 19.9

Lab Sample ID	18/06465/17
Client Sample No	TS
Client Sample ID/Depth	TP113 0.50m
Date Sampled	10/08/18
Deviation Code	
B1 (no VPH)	✓
D (no glass)	✓

Key

B1 (no VPH)

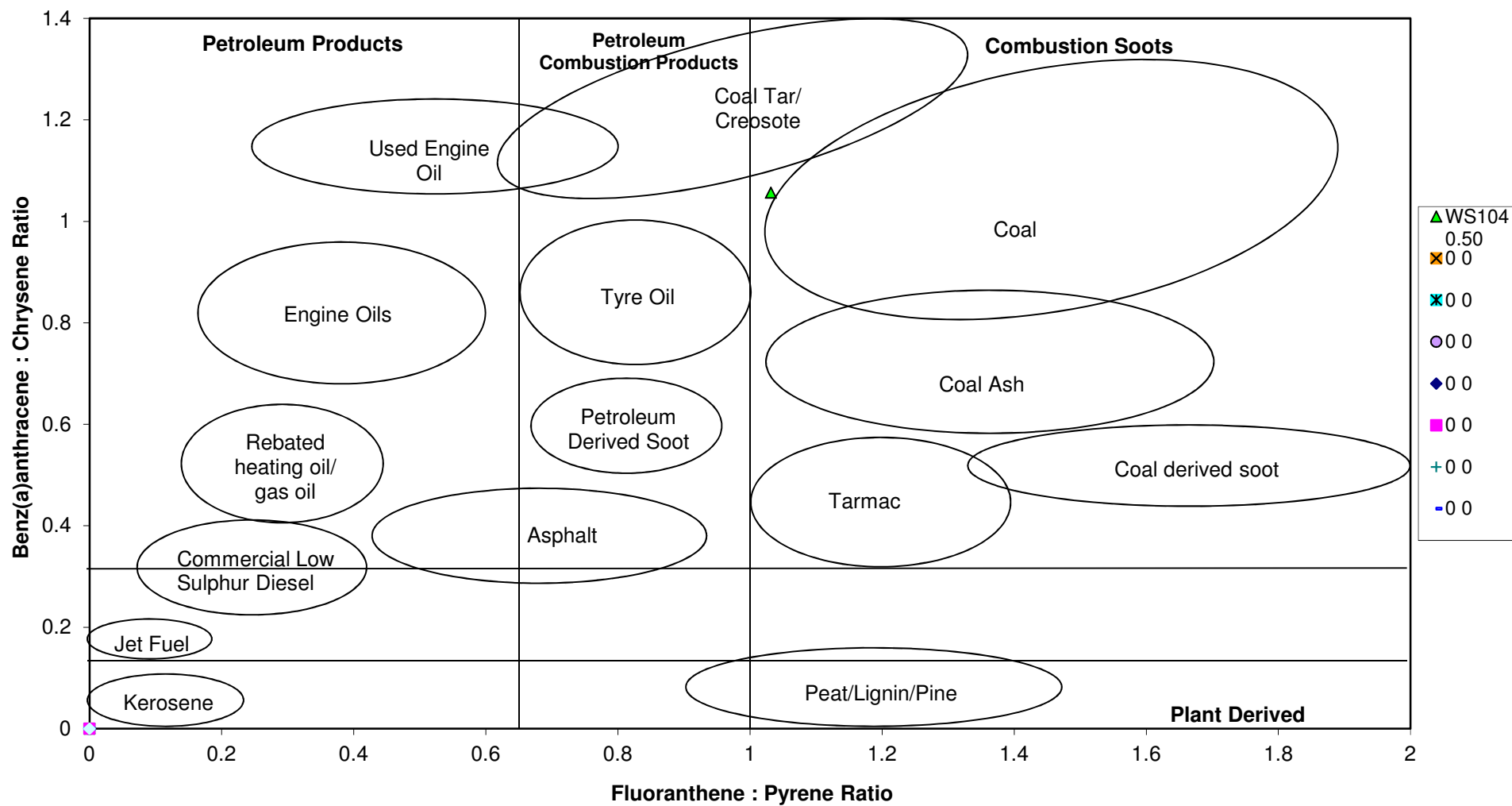
Separate container not supplied for VPH/BTEX analysis

D (no glass)

Glass container not provided for extractable organics analysis

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Double Ratio Plot of Benz(a)anthracene : Chrysene versus Fluoranthene : Pyrene





STRUCTURAL SOILS LTD
TEST REPORT



Report No. 783326 R1

Date 28-August-2018 Contract 18/06465

Client Envirolab Ltd
Address Units 7 & 8 Sandpits Business Park
Mottram Road
Hyde
SK14 3AR

For the Attention of Iain Haslock

Samples submitted by client 15/08/2018
Testing Started 17/08/2018
Testing Completed 28/08/2018

Client Reference 18/06465
Client Order No. P0738801
Instruction Type Written

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests Undertaken

Moisture Content (oven drying method) BS1377:Part 2:1990,clause 3.2 (superseded)**
Liquid Limit (definitive method) BS1377:Part 2:1990,clause 4.3
Plastic Limit BS1377:Part 2:1990,clause 5.3
Plasticity Index Derivation BS1377:Part 2:1990,clause 5.4

* This clause of BS1377 is no longer the most up to date method due to the publication of ISO17892

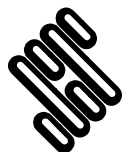
Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of.
Test were undertaken on samples 'as received' unless otherwise stated.
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Structural Soils Ltd, The Potteries, Pottery Street, Castleford, WF10 1NJ Tel.01977 552255. E-mail mark.athorne@soils.co.uk

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	% <425um	Description of Sample
TP105	18/06465/7	D	1.10	16	35	15	20	93	Brown slightly sandy slightly gravelly CLAY
TP107	18/06465/10	D	1.00	9.6	34	16	18	93	
TP112	18/06465/16	D	1.00	14	31	16	15	89	Brown slightly sandy gravelly CLAY
TP114	18/06465/19	D	1.00	9.8	31	17	14	90	Brown slightly sandy gravelly CLAY
WS103	18/06465/24	D	1.00	13	33	14	19	91	Brown slightly sandy slightly gravelly CLAY
WS106	18/06465/29	D	1.20	15	36	17	19	90	Brown slightly sandy slightly gravelly CLAY
WS110	18/06465/32	D	1.50	15	33	16	17	93	Brown slightly sandy slightly gravelly CLAY



**STRUCTURAL
SOILS LTD**

Contract:

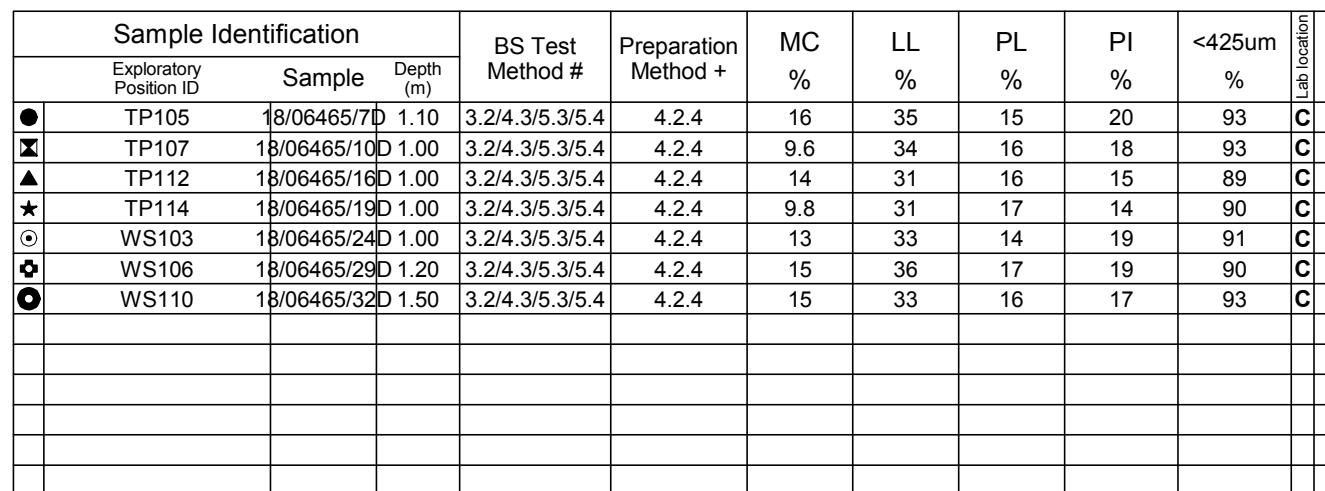
18/06465

Contract Ref:

783326



In accordance with BS5930:2015
Testing in accordance with BS1377-2:1990

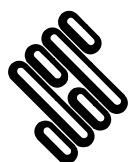


- 3.2 - Moisture Content
- 4.3 - Cone Penetrometer Method
- 4.4 - One Point Cone Penetrometer Method
- 4.6 - One Point Casagrande Method
- 5.3 - Plastic Limit Method
- 5.4 - Plasticity Index

4.2.3 - Natural State
4.2.4 - Wet Sieved

Key: * = Insufficient material to perform standard test, NP = Non plastic.

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)



STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By

Date _____

M. Fisher

MAUREEN FISHER

28/08/18

Contract

Contract Ref:

18/06465

783326



APPENDIX E

(i) Ground Gas Monitoring

Site: Lower Road, Halewood

Job Number: 17RED147

Date of Monitoring: 20/08/18

Ground Gas Monitoring Round 1



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS101	0.0	1020	0.0	0.0	1.5	1.5	20	20.0	-	-	-	2.80	3.12
WS102	0.1	1020	0.0	0.0	1	0.9	20	20	-	-	-	Dry	3.04
WS103	0.1	1020	0.0	0.0	7.2	7.1	8.7	8.7	-	-	-	3.00	3.04
WS104	0.1	1020	0.0	0.0	0.8	0.7	18.9	19.9	-	-	-	2.88	3.08
WS105	0.0	1020	0.0	0.0	0.8	0.8	20.2	20.2	-	-	-	Dry	3.03
WS106	0.0	1020	0.1	0.1	0.9	0.9	20.4	20.4	-	-	-	Dry	3.04
WS107	0.0	1020	0.0	0.0	0.7	0.7	19.3	19.3	-	-	-	2.78	3.05
WS108	0.0	1020	0.0	0.0	0.8	0.8	20.1	20.1	-	-	1 CO	2.81	3.10
WS109	0.3	1020	3.5	3.0	1.5	1.2	19.1	19.4	-	-	2 CO	0.82	2.97
WS110	0.0	1020	0.1	0.1	0.7	0.7	20.1	20.1	-	-	-	Dry	2.96
WS111	0.1	1020	0.1	0.1	0.1	0.1	20.2	20.3	-	-	2 CO	1.12	3.02

Notes:

Monitoring order is left to right across the table

Monitoring should be for not less than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	PH
Weather:	Cloudy, Warm, Mild
Equipment Used:	GA2000+
Visible signs of damage/stress:	N/A
Other Comments/Observations:	Air pressure steady

Site: Lower Road, Halewood

Job Number: 17RED147

Date of Monitoring: 03/09/18

Ground Gas Monitoring Round 2



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS101	Unable to Locate Well												
WS102	0.0	1022	0.0	0.0	0.6	0.5	20.6	20.6	-	-	-	Dry	3.04
WS103	0.0	1022	0.0	0.0	7.0	6.9	11.3	11.3	-	-	-	2.73	3.05
WS104	0.0	1022	0.0	0.0	0.8	0.8	21.1	21.1	-	-	-	2.75	3.08
WS105	0.0	1022	0.0	0.0	6.6	0.5	12.7	20.8	-	-	-	Dry	3.02
WS106	0.0	1022	0.0	0.0	0.8	0.8	20.6	20.5	-	-	-	Dry	3.06
WS107	0.0	1022	0.0	0.0	0.4	0.3	20.8	20.8	-	-	-	1.47	3.09
WS108	0.0	1022	0.0	0.0	0.7	0.7	20.2	20.2	-	-	-	2.62	3.13
WS109	Unable to Locate Well												
WS110	0.0	1022	0.0	0.0	0.8	0.8	20.6	20.4	-	-	-	Dry	2.98
WS111	0.6	1022	0.1	0.0	0.8	0.1	21.0	20.7	-	-	-	0.97	2.99

Notes:

Monitoring order is left to right across the table

Monitoring should be for not less than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	RD
Weather:	Light rain, no wind, warm, overcast.
Equipment Used:	GA2000+
Visible signs of damage/stress:	None
Other Comments/Observations:	Pressure Stable.

Site: Lower Road, Halewood
 Job Number: 17RED147
 Date of Monitoring: 04/10/18

Ground Gas Monitoring Round 3



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS101	0.2	1021	0	0	0.1	0	21.5	21.5	-	-	1	1.43	3.11
WS102	0.2	1021	0	0	1.2	1.2	19.7	19.7	-	-	1	2.67	3.05
WS103	0.1	1021	0	0	3.8	3.8	16.3	16.3	-	-	2	0.65	3.03
WS104	Unable to locate, possibly destroyed by ploughing.												
WS105	0	1021	0	0	0.8	0.8	20.2	20.2	-	-	1	2.90	3.03
WS106	0	1021	0	0	1	1.0	19.8	19.8	-	-	1	2.98	3.01
WS107	0.1	1021	0	0	0.2	0.2	20.9	21	-	-	1	0.47	3.05
WS108	0.1	1021	0	0	0.8	0.8	19.5	19.5	-	-	-	2.46	3.12
WS109	0.2	1021	12.6	12.5	2.2	2.2	10.1	10.1	-	-	1	0.72	2.93
WS110	0	1021	0.9	0	0.8	0.8	20.6	20.6	-	-	1	2.50	2.97
WS111	Flooded.											0.30	3.03

Notes:

Monitoring order is left to right across the table

Monitoring should be for not less than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	PH
Weather:	Cloudy with sun, light wind, warmish.
Equipment Used:	GA2000+
Visible signs of damage/stress:	WS104 possibly destroyed by ploughing.
Other Comments/Observations:	Pressure falling.

Site: Lower Road, Halewood
 Job Number: 17RED147
 Date of Monitoring: 26/10/18

Ground Gas Monitoring Round 4



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS101	0.2	1011	0.1	0.1	1.1	1.1	19.9	19.9	-	-	2	1.14	3.12
WS102	0.0	1011	0.1	0.1	1.1	1.1	19.9	19.9	-	-	-	1.74	3.06
WS103	0.1	1011	0.1	0.1	0.9	0.9	20.1	20.1	-	-	1	0.71	3.03
WS104	Unable to Locate Well - assumed destroyed												
WS105	Unable to Locate Well												
WS106	Unable to Locate Well												
WS107	0.0	1011	0.1	0.1	0.7	0.2	20.4	20.7	-	-	-	0.43	3.05
WS108	0.0	1011	0.1	0.1	0.9	0.9	19.9	19.9	-	-	-	2.17	3.12
WS109	1.2	1011	1.4	1.3	1.7	1.7	11.1	11.2	-	-	-	0.15	2.92
WS110	Flooded											0.32	3.02
WS111	0.0	1011	0.0	0.0	0.8	0.8	19.1	20.2	-	-	-	2.76	2.98

Notes:

Monitoring order is left to right across the table

Monitoring should be for not less than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	PH
Weather:	Overcast, cold, windy
Equipment Used:	GA5000
Visible signs of damage/stress:	WS104 - Assumed destroyed during ploughing. WS105/WS106 Assumed destroyed during seeding
Other Comments/Observations:	Air pressure falling slowly.

Site: Lower Road, Halewood
 Job Number: 17RED147
 Date of Monitoring: 12/11/18

Ground Gas Monitoring Round 5



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS101	0.1	1005	0.0	0.0	1.5	1.5	19.2	19.2	-	-	4.0	1.50	3.10
WS102	0	1005	0.0	0.0	1.0	1.0	19.9	19.9	-	-	-	1.48	3.04
WS103	2.1	1005	0.0	0.0	3.0	3.0	19.5	19.5	-	-	1.0	0.65	3.03
WS104	Unable to locate well - assumed destroyed.												
WS105	0	1005	0.0	0.0	1.2	1.2	19.6	19.6	-	-	-	2.75	3.02
WS106	Unable to locate well.												
WS107	Flooded.											0.40	3.04
WS108	0.2	1005	0.0	0.0	0.8	0.8	20.3	20.3	-	-	-	2.00	3.10
WS109	Flooded.											0.35	2.90
WS110	Flooded.											0.30	3.02
WS111	0	1005	0.0	0.0	0.7	0.7	20.4	20.4	-	-	2.0	2.63	3.00

Notes:

Monitoring order is left to right across the table

Monitoring should be for not less than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	PH
Weather:	Cold, wet, windy, cloudy.
Equipment Used:	GA2000+
Visible signs of damage/stress:	WS104 - Assumed destroyed during ploughing. WS106 Assumed destroyed during seeding.
Other Comments/Observations:	Pressure falling.

Site: Lower Road, Halewood

Job Number: 17RED147

Date of Monitoring: 29/11/18

Ground Gas Monitoring Round 6



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS101	Unable to locate.												
WS102	12.7	987	0.0	0.0	1.0	1.0	19.9	19.9	-	-	-	0.88	2.93
WS103	0.0	987	0.0	0.0	1.2	1.0	19.7	19.9	-	-	-	0.50	3.01
WS104	Unable to locate.												
WS105	0.3	987	0.0	0.0	0.2	0.5	20.6	21.0	-	-	-	1.00	3.00
WS106	Unable to locate.												
WS107	Well flooded.											0.00	3.03
WS108	0.0	987	0.0	0.0	0.7	0.5	20.3	20.9	-	-	-	1.92	3.10
WS109	Well flooded.											0.00	2.99
WS110	0.5	987	0.0	0.0	1.3	1.1	19.3	19.7	-	-	-	2.45	3.00
WS111	Well flooded.											0.00	3.00

Notes:

Monitoring order is left to right across the table

Monitoring should be for not less than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	RD
Weather:	Strong wind, heavy rain, overcast with dark cloud, warm.
Equipment Used:	GA2000+
Visible signs of damage/stress:	N/A
Other Comments/Observations:	Pressure rising.

APPENDIX F

(i) Conceptual Model

The report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

The assessment also aims to identify land which would be regarded as 'contaminated land' under the terms of the Environmental Protection Act 1990, Part IIa. This act includes a stricter test for contaminated land than that outlined above. Land is considered to be contaminated if either:

- the land is causing significant harm to people, ecosystems or infrastructure; or
- there is a significant possibility that such harm could be caused; or
- Pollution of controlled waters is being, or is likely to be, caused.

The following situations are defined as being where harm is to be regarded as significant:

- chronic or quite toxic effect, serious injury or death to humans;
- irreversible or other adverse harm to the ecological system;
- substantial damage to or failure of buildings;
- death of, or disease or other physical damage affecting, livestock or crops;
- Pollution of controlled waters.

The risk assessment uses a 'Source-Pathway-Receptor' methodology for assessing whether a source of contamination could potentially lead to harmful consequences. This means that there needs to be a pollutant linkage from source to receptor for harm to be caused, this linkage consisting of:

- a source of pollution;
- a pathway for the pollutant to move along;
- A receptor that is affected by the pollutant.

As an example, the pollutant source could be an identified leak of oil or an area of dumped waste.



The pathways could include transport of the contaminant by groundwater, surface water, windblown dust, or vapours, and for human receptors will include the means, by which contaminants enter the body, for example skin contact, ingestion and inhalation.

Receptors include people, other living organisms, the built environment and groundwater and surface waters (these latter two also being contaminant pathways).

The source-pathway-receptor methodology relationship allows an assessment of the environmental risk to be determined, based on the nature of the source, the degree of exposure of the receptor to the source and the sensitivity of the receptor.

This section of the report is based on the information set out in the previous sections of the report and should not be read independently of such sections.

Initial Conceptual Model

From the available information the preliminary conceptual model is visualised as follows:

Target (Receptor)	POTENTIAL SOURCE-PATHWAY LINKAGE
Site users / residents	Inhalation of soil gas, odours or dust.
	Ingestion of, and skin contact with, contaminated soil.
	Ingestion of contaminants in vegetables etc. or in soils adhering to vegetables, etc.
Construction/ maintenance workers.	Inhalation of soil gas, odours or dust
	Ingestion of, and skin contact with, contaminated soil
Plants	Adverse effects on growth caused by presence of contaminants in soil
Buildings and Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion and fire hazards
	Sulphate attack of foundations
	Hydrocarbons penetrating plastic water supply pipes
Groundwater	Migration of soluble contaminants into groundwater on or off site. Migration of oils into groundwater on or off site.
Surface water	Migration of soluble contaminants and/or direct run-off of contaminants. Migration of oils into groundwater on or off site.

Initial Environmental Risk Assessment

General

It is accepted that an environmental risk assessment can be based on a source-pathway-target model. An examination is carried out as to whether a target will be at risk from a contamination source, that a source exists, and whether there are any pathways (routes of exposure) which might actually link the source to the target.

Environmental risk assessments rely heavily on numerical trigger concentrations or guidelines because exposure of targets to contamination is difficult to quantify directly. Quantification of risk is therefore mainly undertaken for general scenarios in order to derive trigger levels. These are derived for various contaminants for particular targets and routes of exposure. An example of a sensitive target would be users of a domestic back garden, where routes of exposure might be skin contact, dust inhalation, direct ingestion and indirect ingestion via cultivation and consumption of fruit and vegetables.

In March 2002, the first parts of the new CLEA risk assessment guidance were released by DEFRA/Environment Agency.

The risk assessment approach is an extension of the 'fit for use' concept whereby land is cleaned up to a standard fit for the proposed use, that is, so all remaining risks are acceptable. However, as well as being 'fit for use', the environmental risk assessment approach also addresses the soil and water environment so that these are also safeguarded where necessary. For example if a site was contaminated with heavy metals and the development comprised the proposed construction of hard standings and buildings only, the fit-for-use approach might require no remediation for the site. However, consideration of the wider environment needs to address whether groundwater is being contaminated, and if so whether remediation is required for this reason.

The following classification presented by CIRIA has been used in the assessment of risk:

Estimation of risk from consideration of magnitude, consequences and probabilities				
Probability	Consequences			
	Severe	Moderate	Mild	Minor
High	Very high	High	Moderate	Moderate / Low
Medium	High	Moderate	Moderate / Low	Low
Low	Moderate	Moderate / Low	Low	Very Low
Unlikely	Moderate / Low	Low	Very Low	Very Low

Reference: Contaminated Land Risk Management; A Guide to Good Practice, CIRIA C552:2001

CIRIA C665 Situation A Ground Gas Conceptual Model

The risk table contained in C665 is basically a modified risk assessment from CIRIA 152 1995, by which a conceptual model and semi-quantitative risk assessment can be made.

APPENDIX G

(i) Notes on Ground Gas

Ground Gas

The Building Regulations and BRE Report 212 state that precautions are not mandatory against carbon dioxide unless 5.0% volume is exceeded. These documents do not give a threshold level for methane, but Baker suggests that this level is 0.1% volume. For methane up to 1.0% volume, and carbon dioxide above 5.0% volume, the Building Regulations and BRE Report state that passive measures may be adopted. Above 1.0% methane further specific guidance must be sought.

CIRIA Report 149 gives further guidance on the appropriate precautions for various gas regimes, called characteristic situations in this report. In the DETR Guide for Design by Ove Arup, various types of passive measures are assessed for performance with different gas regimes. The assessments used computational fluid dynamic (CFD) modelling.

A gas regime is essentially defined by two parameters:

- i) The concentration of the gas (e.g. % methane)
- ii) The emission rate of the gas from the ground.

The fact that two parameters are used is problematic if the site is to be classified on the basis of Table 28 in CIRIA Report 149. This is because high gas concentrations are often encountered which fall into an onerous gas regime; whereas the low flow rates which are also frequently encountered fall into less onerous gas regimes.

In order to use the Guide for Design to decide if passive measures are suitable, it is necessary to combine the gas concentration and the emission rate.

Three recent publications are used for ground gas risk assessment:

- CIRIA C665 for high rise residential / flats
- 'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present' Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties
- BS8485:2007 'Code of practice for the characterization and remediation from ground gas in affected developments'

These documents improve upon the approach used in previous CIRIA and Wilson /Card Papers, by placing emphasis on gas flow rates, but still retain some reliance on the gas concentrations themselves.

CIRIA C665 Situation A Ground Gas Conceptual Model

The risk table contained in C665 is basically a modified risk assessment from CIRIA 152 1995, by which a conceptual model and semi-quantitative risk assessment can be made.

High Rise / Flats (CIRIA 665 Table 8.5)

Characteristic Situation (CIRIA Report 149)	Risk Classification	Gas Screening Value (CH ₄ or CO ₂) (l/hr) ¹	Additional factors	Typical source of generation
1	Very low risk	<0.07	Typically methane ≤1%v/v and/or carbon dioxide ≤5%v/v. Otherwise consider increase to Situation 2	Natural soils with low Organic content. "Typical" Made Ground
2	Low risk	<0.7	Borehole flow rate not to exceed 70l/hr. Otherwise consider increase to Situation 3	Natural soil, high peat/organic content. "Typical" Made Ground
3	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
4	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures	Mineworking susceptible to flooding, completed landfill (WMP 26B criteria)
5	High risk	<70		Mineworking unflooded inactive with shallow workings near surface
6	Very high risk	>70		Recent landfill site

Notes:

1. Gas screening value: litres of gas/hour is calculated by multiplying the gas concentration (%) by the measured borehole flow rate (l/hr);
2. Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods as defined within CIRIA Report 665;
3. Source of gas and generation potential/performance must be identified;
4. Soil gas investigation to be in accordance with guidance contained within CIRIA Report 665;
5. If there is no detectable flow, use the limit of detection of the instrument;
6. The boundaries between the Partners in Technology classifications do not fit exactly with the boundaries for the above classification.

Typical scope of protective measures (extract from CIRIA Report 665 Table 8.6)

Characteristic Situation (from Table 8.5)	Number of levels of protection	Typical scope of protective measures for residential building (not low-rise traditional housing) ¹
1	None	No special precautions
2	2	a) Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g DPM and under-floor venting b) Beam and block or pre-cast concrete and 2000 g DPM/reinforced gas membrane and under-floor venting. All joints and penetrations sealed.
3	2	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised under-floor sub-space.
4	3	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated under-floor subspace or positively pressurised under-floor sub-space, over-site capping or blinding and in ground venting layer
5	4	Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and ventilated or positively pressurised under-floor sub-space, over-site capping and in ground venting layer and in ground venting wells or barriers.
6	5	Not suitable unless gas regime is reduced first and quantitative risk assessment carried out to assess design of protection measures in conjunction with foundation design.

Notes:

1. Not suitable for use with low rise traditional housing. (Use the NHBC document instead);
2. Typical scope of protective measures may be rationalised for specific developments on the basis of quantitative risk assessments;
3. Note the type of protection is given for illustration purposes only. Information on the detailing and construction of passive protection measures is given in BR414 (Johnson, 2001). Individual site specific designs should provide the same number of separate protective methods for any given characteristic situation. See CIRIA Report 49;
4. In all cases there should be minimum penetration of ground slabs by services and minimum number of confined spaces such as cupboards above the ground slab. Any confined spaces should be ventilated;
5. Foundation design must minimise differential settlement particularly between structural elements and ground-bearing slabs;
6. Commercial buildings with basement car parks, provided with ventilation in accordance with the Building Regulations, may not require gas protection for Characteristic Situations 3 and 4;
7. Floor slabs should provide an acceptable formation on which to lay the gas membrane. If a block beam floor is used it should be well detailed so it has no voids in it that membranes have to span, and all holes for service penetrations should be filled. The minimum density of the blocks should be 600kg/m³ and the top surface should have a 4:1 ratio sand to cement grout brushed into all joints before placing any membrane (this is also good practice to stabilise the floor and should be carried out regardless of the need for ground gas membranes);
8. The ground gas-resistant membrane can also act as the damp-proof membrane;
9. Based on Building Regulations Approved Document C (Office of the Deputy Prime Minister, 2004a), which states that "a membrane below the concrete could be formed with a sheet of polyethylene, which should be at least 300µ thick (1200 gauge)". Please note the alteration from 300mm (as stated in the Approved Document C) to 300µ, as 300mm is a typographical error that has been recognised and corrected for within this report and CIRIA Report 665.

Low Rise Residential (NHBC)

Table 14.1: Gas Risk Assessment - Traffic Lights with Typical Maximum Concentrations and Gas Screening Values

Classification	Methane ¹		Carbon Dioxide ¹	
	Typical Maximum Concentration ³ (%v/v)	Gas Screening Value ^{2,4} (l/hr)	Typical Maximum Concentration ³ (%v/v)	Gas Screening Value ^{2,4} (l/hr)
Green				
Amber 1	1	0.13	5	0.78
	5	0.63	10	1.60
Amber 2	20	1.60	30	3.10
Red				

Notes:

1. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst case temporal conditions that the site may be expected to encounter will be the decider as to what Traffic Light is allocated;
2. Borehole Gas Volume Flow Rate, in litres per hour as defined in Wilson and Card (1999), is the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered;
3. The Typical Maximum Concentrations can be exceeded in certain circumstances should the Conceptual Site Model indicate it is safe to do so;
4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.

Table 14.2: Ground Gas Protection Measures Required for the Traffic Lights

Traffic Light	Ground Gas Protection Measures Required
Green	Ground gas protection measures are not required. (note based on standard NHBC house detail with 150mm void space under suspended floor)
Amber 1	Low-level ground gas protection measures are required, using a membrane and ventilated sub-floor void that creates a permeability contrast to limit the ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Amber 2	High-level ground gas protection measures are required, creating a permeability contrast to prevent ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Membranes used should always be fitted by a specialist contractor and should be fully certified (see Appendix G). As with Amber 1, ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Red	Standard residential housing is not normally acceptable without further Ground Gas Risk Assessment and/or possible remedial mitigation measures to reduce/remove the source of the ground gases. In certain circumstances, active protection methods could be applied, but only when there is a legal agreement assuring the management and maintenance of the system for the life of the property.

BS8485: 2007

Table 2: Required Gas Protection By Characteristic Gas Situation & Type Of Building

Characteristic gas situation, CS	NHBC traffic light	Required gas protection			
		Non-managed property, e.g. private housing	Public building ^{A)}	Commercial buildings	Industrial buildings ^{B)}
1	Green	0	0	0	0
2	Amber 1	3	3	2	1 ^{C)}
3	Amber 2	4	3	2	2
4	Red	6 ^{D)}	5 ^{D)}	4	3
5			6 ^{E)}	5	4
6				7	6

NOTE Traffic light indications are taken from NHBC Report no.: 10627-R01 (04) [3] and are mainly applicable to low-rise residential housing. These are for comparative purposes but the boundaries between the traffic light indications and CS values do not coincide.

A) Public buildings include, for example, managed apartments, schools and hospitals.

B) Industrial buildings are generally open and well ventilated. However, areas such as office pods might require a separate assessment and may be classified as commercial buildings and require a different scope of gas protection to the main building.

C) Maximum methane concentration 20% otherwise consider an increase to CS3.

D) Residential building on higher traffic light/CS sites is not recommended unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.

E) Consideration of issues such as ease of evacuation and how false alarms will be handled are needed when completing the design specification of any protection scheme.

Table 3: Solutions Scores

PROTECTION ELEMENT/SYSTEM		SCORE	COMMENTS
a) Venting/dilution (See Annex A)			
Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) A)	Very good performance	2.5	Ventilation performance in accordance with Annex A.
	Good performance	1	If passive ventilation is poor this is generally unacceptable and some form of active system will be required.
Subfloor ventilation with active abstraction/pressurization (venting layer can be a clear void or formed using gravel,		2.5	There have to be robust management systems in place to ensure the continued maintenance of any ventilation system.

geocomposites, polystyrene void formers, etc.) A)			Active ventilation can always be designed to meet good performance. Mechanically assisted systems come in two main forms: extraction and positive pressurization.
Ventilated car park (basement or undercroft)		4	Assumes car park is vented to deal with car exhaust fumes, designed to Building Regulations Document F [5] and IStructE guidance [6].
b) Barriers			
Floor slabs			It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum.
Block and beam floor slab		0	
Reinforced concrete ground bearing floor slab		0.5	
Reinforced concrete ground bearing foundation raft with limited service penetrations that are cast into slab		1.5	Breaches in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances.
Reinforced concrete cast in situ suspended slab with minimal service penetrations and water bars around all slab penetrations and at joints		1.5	
Fully tanked basement		2	
c) Membranes			
Taped and sealed membrane to reasonable levels of workmanship/in line with current good practice with validation B), C)		0.5	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation, and the integrity of joints
Proprietary gas resistant membrane to reasonable levels of workmanship/in line with current good practice under independent inspection (CQA) B), C)		1	
Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation		2	
d) Monitoring and detection (not applicable to non-managed property, or in isolation)			
Intermittent monitoring using hand held equipment		0.5	
Permanent monitoring and alarm system A)	Installed in the underfloor venting/dilution system	2	Where fitted, permanent monitoring systems ought to be installed in the underfloor venting/dilution system in the first instance but can also be provided within the occupied space as a fail safe
	Installed in the building	1	
e) Pathway Intervention			
Pathway intervention		-	This can consist of site protection measures for off-site or on-site sources (see Annex A).

NOTE In practice the choice of materials might well rely on factors such as construction method and the risk of damage after installation. It is important to ensure that the chosen combination gives an appropriate level of protection

A) It is possible to test ventilation systems by installing monitoring probes for post installation validation.

B) If a 1 200 g DPM material is to function as a gas barrier it should be installed according to BRE 212 [8]/BRE 414 [9], being taped and sealed to all penetrations.

C) Polymeric Materials >1 200 g can be used to improve confidence in the barrier. Remember that their gas resistance is robust and resistant to site damage.

APPENDIX H

(i) Off-site Disposal of Surplus Soil Guidance Notes

The disposal of waste (including surplus soils and contaminated soils) to landfill sites is governed by the *Landfill (England & Wales) Regulations 2002*, the *Hazardous Waste Technical Guidance document WM2 (2003)* and associated legislation.

One of the aims of the above legislation is to encourage waste producers (including developers disposing of surplus soils etc) to reduce their waste (and not just discard and disown it). This can be achieved by recycling or reusing the waste. In the case of contaminated sites where leaving contaminated material in-situ poses a risk to a potential receptor such as groundwater resources, further testing and assessment for such risk could reduce the quantities requiring disposal. If there is still unacceptable risk from contaminated soil being left in place, then it may be possible to reduce the risk to an acceptable level (such that the material can be left in place) by in-situ or ex-situ clean-up of the soils.

Before waste can be disposed of, the producer of the waste must undertake a number of steps. '*Initial Waste Testing and Characterisation*' is firstly undertaken to determine whether the waste is non-hazardous or hazardous. The exceptions are that some wastes such as coal tars, 'tank bottom sludge's', etc are immediately classed as hazardous, regardless of any testing or threshold concentrations.

Any inert or hazardous waste destined for landfill must undergo '*Compliance Testing*' using the Waste Acceptance Criteria (WAC). There are different inert and hazardous WAC limits relating to landfill sites that are correspondingly licensed to accept inert or hazardous waste.

If the '*Initial Waste Testing and Characterisation*' shows a waste to be hazardous, then it is a requirement that the material be tested against the WAC-hazardous suite of tests. If it passes the WAC-hazardous testing, then it can be taken to a hazardous waste landfill site. If the material fails the WAC-hazardous testing, then the material must be treated before undergoing re-characterisation, further WAC-hazardous testing and then potential disposal at a hazardous waste disposal site.

If the '*Initial Waste Testing and Characterisation*' shows a waste to be non-hazardous, then it can be taken to a non hazardous waste landfill site, without further testing. The producer may however decide to undertake WAC-inert testing, in an attempt to reclassify the waste as inert, in which case the waste could then go to an inert landfill site.

The volumes of soils associated with potential hotspots on a site (be they hazardous or non hazardous) which might require off-site disposal, could potentially be reduced by further on-site sampling and subsequent testing.

With regard to the *Compliance Testing*, it should be noted that some landfill sites are permitted to increase the standard WAC-hazardous/inert limit concentrations, such that they might accept waste that would normally fail such limits.

We would recommend that the contamination testing results (including the history of the site) be presented to the proposed landfills, to determine if they will accept waste generated at the site and what classification they would impose.

APPENDIX I

(i) Validation Report Guidance Notes

Unforeseen Hotspots of Contamination

Given the existence of made ground on the site it would be prudent to maintain vigilance during site clearance and construction, in case any further areas of suspected contamination are encountered.

If areas are found then a suitably qualified person should undertake appropriate sampling, testing and further risk assessment.

Any hotspots encountered during site clearance, not previously encountered in the ground investigation, are to be removed to a suitably licensed landfill site.

A validation report (see below) will be produced on completion of these works. This report will serve to confirm that the works were undertaken in accordance with the relevant legislation, the method statement, specification and planning conditions.

Validation Report Recommendations

It is suggested that the following records will be kept on site to provide a basis for the validation report:

- Daily record sheets of the remediation works to include a summary of the day's activities
- Weather conditions
- Plant, personnel and visitors to the remediation site
- Aspects relating to Health & Safety, environmental control or non-compliance with the specification or the Method Statements.
- All in situ and laboratory testing results.

All requirements of the remediation specification should be complied with; on completion of the remediation a validation report should be provided. This report will comprise the relevant site records and act as certification that the remedial and ground preparation works have been carried out in accordance with the specification.

The validation report will include the following:

- A description of the works undertaken.
- Records of any remediation works, including daily diary sheets.
- Progress photographs.
- Any chemical and geotechnical validation test results.
- As built surveys, including base excavations and top and bottom of capping layer.
- A statement that the works have been undertaken in accordance with the agreed specification

APPENDIX J

(i) Notes on Limitations

This report does not consider ecological impacts (e.g. bats) or botanical risks (e.g. Japanese knotweed). It is recommended that these are considered as part of the assessment of development constraints for the site.

The assessment and judgements given in this report are directed by both the finite data on which they are based and the proposed works to which they are addressed. The data essentially comprised a study of available documented information from various sources (including Client Furnished reports) together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our environmental conclusions, we request the opportunity to review the information, reassess the potential concerns and modify our opinion if warranted.

It should be noted that any risks identified in this report are perceived risks based on the available information. Actual risks can only be assessed following a physical investigation of the site.

The site investigation has been carried out to provide information concerning the type and degree of contamination, and ground and groundwater conditions to allow a reasonable risk assessment to be made. Betts Geo Environmental Ltd undertake to exercise all reasonable skill, care and due diligence in the exercise of the investigation with respect to sampling techniques, sample storage and report interpretation.

The assessments and judgement given in this report are directed by both the finite data on which they are based and the proposed works to which they are addressed. Data acquisition is subject to the limitations of the methods of investigation used. Exploratory holes undertaken during fieldwork investigate small a small volume of ground in relation to the size of the site and as such can only provide an indication of site conditions. There may be conditions pertaining to the site and the proposed development i.e. localised "hotspots" of contamination, which have not been disclosed by the investigations.

The findings and opinions are relevant to the dates of our site works and should not be relied upon to represent conditions at substantially later dates. Conditions at the site will change over time due to natural variations and anthropogenic activities. Groundwater, surface water and soil gas conditions should be anticipated to change with diurnal, seasonal and meteorological variations.

The opinions expressed in this report regarding any contamination are based on simple statistical analysis and comparison with available guidance values. No liability can be accepted for the retrospective effects of any changes or amendments to these values.

This report was prepared by Betts Geo Environmental Ltd for the sole and exclusive use of Redrow Homes. In response to particular instructions, any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

This document has been prepared for the titled project only and should any third party wish to use or rely upon the contents of the report, written approval from Betts Geo Environmental Ltd must be sought.

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