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PHASE 2

GEO-ENVIRONMENTAL REPORT

job number	C3018/22/E/4562	date	24.03.2023
site address	474 Bolton Road, Bury, BL8 2DU		
written by	S. Alexander	checked by	I. Sakoor
issued by	S. Alexander		



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Report on a Phase 2 Geo-environmental Investigation

Location:	474 Bolton Road, Bury, BL8 2DU.	
For:	Dr Rashad Nazir	
Consultants:	Clarkes Bespoke Design Ltd.	
Report No.	C3018/22/E/4562	Report date: March 2023

For and on behalf of **Rogers Geotechnical Services Ltd**

	
Scott Alexander BSc FGS Geo-environmental Engineer	Imran Sakoor BEng FGS Geo-environmental Engineer

Report Summary¹

Item	Comments	Section
Development	Demolition of existing building and construction of new residential dwelling.	1.
Geology	Superficial geology – Glacial Till. Solid geology – Pennine Lower Coal Measures with at least one recorded coal seam.	5.
Strata Conditions	Site separated into two main sections. West side: limited thickness of topsoil overlying firm to stiff glacial till deposits. East side: comprises made ground up to 2.30m overlying soft to very soft organic silt deposits to depths exceeding 4m. Dynamic probes suggest bedrock depth of about 7.50m across site.	6.
Groundwater	None encountered during investigation.	6.2
Foundation Design	Piled foundation solution.	10.1
Effect of Sulphates	DC-1 concrete.	10.4
Contamination	Lead contamination revealed within topsoil. Underlying reworked cohesive strata below SSVs for proposed end use.	11.
Ground Gas	Characteristic Situation Level 2	11.2

¹ This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.

1. Introduction

It is understood that the existing property at 474 Bolton Road, Bury is to be demolished and a new residential dwelling is to be constructed. Consequently, a site investigation has been undertaken in accordance with the instruction from the client. This work was required in order to determine the nature of the underlying soils, to assess their engineering properties and to assist in the design of safe and economical foundations for the proposed development. This investigation also takes into consideration the risk of any contamination present. This report describes the work undertaken, presents the data obtained and discusses the ground conditions in relation to the proposed works.

2. Limitations

The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site and of the laboratory test results. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between borehole positions, these are for guidance only and no liability can be accepted for their accuracy.

This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

3. Desk Study

A Phase 1 Desk Study has been undertaken by Rogers Geotechnical Services (RGS) and the results were presented as report number C3018/22/E/4559 in September 2022. This report has been used extensively during the current intrusive investigation.

4. Fieldworks

The fieldworks were undertaken on the 24th January 2023 and included the following:

- Three windowless sample boreholes.
 - WS01 could not be completed due to the presence of utilities encountered within the hand dug trial pit.
- Standard penetration tests within WS02 and WS04.
- Dynamic probes adjacent to WS03 and WS04.
- Three gas monitoring standpipes were installed in WS02, WS03 and WS04.

The investigatory locations are shown on the site plan which is presented in Appendix 1 to this report.

4.1 Windowless Sample Boreholes

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and reduced in diameter from 87mm for the first 1m through 77mm, 67mm and 57mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 2015 +A1: 2020 and full descriptions are given on the windowless sample records which are presented in Appendix 2. Also included on these records are the core diameters and percentages of core recovered.

4.2 Standard Penetration Tests

Standard penetration tests (SPT) were undertaken at regular depth increments within windowless sample borehole WS02 and WS04. The SPT was conducted in accordance with the procedures given in BS EN ISO 22476: Part 3: 2005 +A1: 2011, and the results are summarised on the borehole record. During this work an automatic trip hammer of 63.5kg falling through 750mm was employed to drive either a cone or split barrel sampler assembly into the ground and the recovered barrel samples were retained in air tight plastic containers.

4.3 Dynamic Probes

Dynamic penetration tests were undertaken adjacent to WS03 and WS04 in accordance with the procedure given in BS EN ISO 22476: Part 2: 2005 +A1: 2011, using the super heavy penetrometer (DPSH). This probe consists of a 63.5kg mass falling through 750mm onto an anvil, which drives a 50mm diameter cone into the ground. The number of blows required to drive the cone through successive 100mm increments are recorded as the N_{100} values. The results of the dynamic penetration tests are tabulated and presented as bar charts of N_{100} values versus depth in Appendix 3.

4.4 Gas Monitoring Standpipes

Gas monitoring standpipes were installed within WS02, WS03 and WS04 up to a depth of 3m and the installation details are shown on the appropriate borehole records. In WS02 and WS03, the monitoring standpipe consisted of a perforated pipe from the base of the borehole to 1.0m below surface, with a non-perforated pipe to ground level. In WS04 the monitoring standpipe consisted of a perforated pipe from the base of the borehole to 2.0m, with a non-perforated pipe to ground level. The response zone was filled with pea gravel, with a bentonite seal at the base and above, and the installation was capped with a stop box cover in a concrete surround.

5. Geology

The available published geological data for the site has been examined and the following table presents the anticipated geology.

Table 1: Geological Data for the Site

Strata Type	Strata Name ²	Previous Name ³	Description ³
Artificial Geology	Made Ground	N/A	Not indicated on site although previous construction may have resulted in the presence of made ground. Worked ground is indicated to be present 227m SE, associated with the railway cuttings.
Superficial Geology	Glacial Till (Devensian Age)	Boulder Clay	Generically described as a group of sediments laid down by the direct action of glacial ice. Comprises variable lithology, usually sandy, silty clay with pebbles, but can contain gravel-rich, or laminated sand layers; varied colour and consistency.
Solid Geology	Pennine Lower Coal Measures Formation	Lower Coal Measures	Interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part.

6. Strata Conditions

In accordance with the geology of the area, the succession has been shown to include the following:

Table 2: Generalised Strata Profile

Depth m below ground level to underside of layer	Strata Type	Positions Encountered	Groundwater Strikes m below ground level
Eastern Section of Site			
0.20 to 0.40	TOPSOIL.	WS01, WS02, WS04	None
0.35 to +0.60	MADE GROUND (Silt).	WS01, WS03	None
0.35 to 0.40	MADE GROUND (Granular).	WS03, WS04	None
1.40 to 2.30	MADE GROUND (Clay).	WS03, WS04	None
+4.00	Very soft light and dark grey sandy gravelly organic clayey SILT	WS03	None
2.10	Soft to very grey and light grey soft sandy organic SILT.	WS04	None
2.90	Soft to very soft brown sandy SILT.	WS03	WS03 – 2.30 to 2.90m recorded as wet.
2.90 to 3.60	Soft to very soft light greyish brown slightly sandy gravelly CLAY.	WS03, WS04	None
+3.15	Soft to firm brown slightly sandy gravelly CLAY.	WS04	None
Western Section of Site			
0.80	Soft light grey sandy clayey SILT.	WS02	None
1.20	Soft brown very sandy slightly gravelly silty CLAY.	WS02	None
+5.15	Stiff greyish brown slightly sandy gravelly CLAY.	WS02	None

² Sources: British Geological Survey (NERC Map Sheets 85; Manchester; Solid and Drift Edition, and Geology of Britain Viewer [online resource from www.bgs.ac.uk])

³ Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [online resource from www.bgs.ac.uk])

'+' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated.

6.1 General Strata

In general, the site can be split into two main sections. The western portion is underlain by a thin capping of artificial ground overlying soft cohesive soils to 1.2m depth. This stratum was found to be underlain by stiff gravelly clay. Contrastingly, within the eastern portion of the site between 1.40m and 2.30m of made ground was revealed over soft to very soft silt with localised organic deposits to the base of WS03 and to 2.90m in WS04. From 2.90m in WS04, this material was underlain by soft to firm clay to the base of the borehole where refusal was met on an inferred cobble as the adjacent dynamic probe was advanced to depths exceeding 7m without obstruction.

6.2 Groundwater

No groundwater strikes were observed during the site investigation, however the deposits recovered from WS03 at depths between 2.30m and 2.90m was recorded as "wet". Notwithstanding this, it should be appreciated that the normal rate of boring does not permit the recording of an equilibrium water level for any one strike, moreover, groundwater levels are subject to seasonal variation or changes on local drainage conditions.

7. Insitu Testing

7.1 Standard Penetration Tests

The standard penetration tests carried out in WS02 and WS04 are summarised in the following table:

Table 3: Summary of Standard Penetration Tests				
Strata	Depth Range (m)	SPT 'N' (Blows/300mm)		Comments
		Granular soils	Cohesive soils	
Brown very sandy CLAY	1.00m	–	8	SPT's indicate a soft in-situ condition. SPT crosses strata boundary.
Greyish brown CLAY	2.00 3.00 4.00 5.00	–	19 20 24 *50+	SPT's indicate material is in a stiff in-situ condition. *SPT refusal on cobble.
MADE GROUND (Cohesive)	1.00	–	3	SPT's indicate a very soft in-situ condition
Greyish brown SILT	2.00	–	2	SPT's indicate a very soft in-situ condition
Brown slightly sandy gravelly CLAY	3.00	–	31*	SPT's indicate a soft in-situ condition *SPT refusal on cobble.

7.2 Dynamic Penetration Tests

Dynamic penetration tests were undertaken adjacent to the windowless sample borehole positions. A summary of the results is presented below:

Table 4: Summary of Dynamic Penetration Tests

Position	Blows/100mm			Refusal type (Effective/ Abrupt) ⁴	Comments
	0 - 2	3 - 10	10+		
	Depth to which blow count range was observed (m)				
DP03	4.2	6.9	7.4	Effective	Very poor to 4.2m below ground level. Results then noted to gradually increase with depth.
DP04	3.3	6.5	7.5	Effective	Generally weak material to 3.3m, with gradual increase of blow counts with depth.

7.3 Gas and Water Level Monitoring

The standpipes were monitored between the 15th February and the 8th March 2023. The results of the gas monitoring undertaken to date are tabulated below and full results are presented in Appendix 4.

Table 5: Gas Monitoring

Location	Date	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow (l/hr)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS02	15.02.2023	0.1	2.1	11.5	0.1	1008↑	1.12	3.00
	22.02.2023	0.1	2.9	13.1	0.1	1000↓	0.99	
	01.03.2023	0.1	3.1	15.5	0.0	1022↓	1.00	
	08.03.2023	0.1	3.5	17.4	0.4	982↑	0.90	
WS03	15.02.2023	0.1	0.6	20.9	0.0	1009↑	1.75	3.00
	22.02.2023	0.1	0.8	20.7	0.1	1000↓	1.13	
	01.03.2023	0.1	0.5	20.7	0.0	1023↓	1.59	
	08.03.2023	0.1	0.5	20.4	0.2	984↑	1.14	
WS04	15.02.2023	0.1	5.8	12.8	0.0	1009↑	1.63	3.00
	22.02.2023	0.1	5.6	12.3	0.1	1000↓	1.57	
	01.03.2023	0.1	5.5	13.3	0.2	1023↓	1.62	
	08.03.2023	0.2	5.2	14.0	0.2	984↑	1.62	

↑ - rising pressure ↓ - falling pressure ↔ -steady pressure

This work was undertaken using a Geotechnical Instruments (UK) Ltd. GA5000 (serial No G503524) which was last calibrated on the 24th August 2022. A second monitor was used during visit two (22/02/23) using gas monitor GFM 436 (Serial No. 10767) last calibrated 8th August 2022.

⁴ Abrupt refusal: obstruction or bedrock encountered. Effective refusal: +25 blows/100mm.

8. Laboratory Testing - Geotechnical

The following programme of laboratory testing has been undertaken on samples obtained during this investigation:

- Determination of water content BS EN ISO 17892-1:2014
- Determination of liquid and plastic limits BS EN ISO 17892-12:2018
- Soluble sulphate content BS 1377-3:2018+A1:2021: Pt3: 7.3
- pH value BS 1377-3:2018+A1:2021: Pt3: 12

The test results are presented in Appendix 5 and are summarised below:

Table 6: Summary of Geotechnical Test Results				
Test type	Number of tests	Range of results		Comments
Water content determinations	8	20% to 27%		
Index properties (1 Point)	8	LL PL PI	34% to 105% 18% to 48% 16% to 57%	Clay of low to high plasticity. Silt of intermediate to extremely high plasticity. Consistency index 0.3 to 1.4 NHBC Class (Clay) – Medium NHBC Class (Silt) – High
Soluble sulphate & pH	7	SO ₄ pH	6.2 to 37.3mg/l 5.7 to 7.6	

In cohesive soil the approximate cohesion, c_u , and coefficient of consolidation, m_v , may be obtained from the equivalent SPT 'N' value using the following expressions (Stroud 1975).

$$c_u = f_1 N \quad \text{where:} \quad c = \text{cohesion (kN/m}^2\text{).}$$

$$m_v = \frac{1}{f_2 N} \quad m_v = \text{Coefficient of consolidation (m}^2\text{/MN).}$$

$$f_1 \text{ \& } f_2 = \text{factors based on plasticity index.}$$

$$N = \text{SPT 'N}_{300}' \text{ value.}$$

For the natural clay soils revealed on the west of the site (WS02) the (worst case) plasticity index⁵ of 17% could be employed, which suggests an f_1 value of 6.1 and an f_2 value of 0.60.

For the natural silt soils revealed on the east of the site the (worst case) plasticity index⁶ of 87% could be employed, which suggests an f_1 value of 4.2 and an f_2 value of 0.44.

⁵ See paragraph 6.2 'Index Property Tests'

⁶ See paragraph 6.2 'Index Property Tests'

8.1 Geotechnical Properties

The idealised geotechnical properties employed in design are summarised below.

Table 7: Summary of Geotechnical Properties

Property	Range of values		Comments
Volume change potential (NHBC)	Low (west) High (east)		Brown slightly sandy gravelly CLAY. Light grey sandy SILT.
Shear strength parameters (at proposed foundation level)	c_u c_u γ	40kN/m ² (west) 12 kN/m ² (east) 20kN/m ³	Stroud (1974) where $c_u = f_1N$ Bulk density assumed.
Consolidation characteristics	m_v m_v	0.20m ² /MN (west) 0.75m ² /MN (east)	Stroud (1974) where $m_v = 1/f_2N$
Concrete classification	DC1		Natural ground locations (Static water)

9. Laboratory Testing - Environmental

A suite of testing was conducted on samples from across the site and the following regime was undertaken.

- Metals – Cd, Cr^{VI}, Cu, Hg, Ni, Pb, V and Zn.
- Semi and Non-Metals - As, Se, Free CN⁻ and Phenols.
- Polycyclic aromatic hydrocarbons (PAHs).
- Petroleum hydrocarbons (TPHs).
- Others – pH, organic content and total/soluble SO₄²⁻.
- Asbestos.

This testing was undertaken by i2 Analytical Ltd and the results of all of the chemical testing are presented in Appendix 5 of this report.

10. Discussion of Ground Conditions - Geotechnical

It is understood that the existing building is to be demolished and a new residential dwelling is to be constructed. A plan of the proposed building is presented in the site plans in Appendix 1.

Based on the site investigation it can be determined that the site can be split into two main portions. The western portion is predominantly firm to stiff natural cohesive deposits upon which the existing structure appears to have founded, whereas the eastern portion (outside the existing building footprint - local to WS03 and WS04) has been found to be underlain by deeper made ground and soft to very soft locally organic silt deposits.

From the historical maps and information within the desk study it is apparent that a former track/roadway was present on the eastern portion of the site, which connected nearby brick pits and coal mines to the north and south of the property. As such, the deep made ground encountered is most probable resultant of this previous activity on site.

As a result of the findings of this investigation, based on the proposed developments at present it cannot be recommended to adopt any shallow foundations due to the following issues:

- Deep made ground encountered across the proposed eastern footprint which are present in a weak and variable condition.
- Underlying natural deposits on the eastern part of the site are also in a weak and variable condition.
- Risk of differential settlement with foundations spanning both differing strata types and ground strengths, comprising firm to stiff clay and very soft organic silt.

In light of the above, it cannot be recommended that shallow footings are considered for the development and piles should be adopted in order to transfer foundation loads through the weak and variable made ground and superficial deposits to competent strata at depth. A piled foundation will have the advantage of limiting differential settlement of the new structure across the site.

10.1 Piled Foundations

There are a number of piling options that could be considered for use at this site, which include:

- Driven piles.
- Continuous flight auger bored piles.
- Drilled piles.

In order to formulate a suitable design it is recommended that the advice of specialist piling contractors be sought. However, for preliminary design and estimating purposes the following discussion is presented.

It is anticipated that the piles will achieve sufficient 'set' capacity at depths of between 7.00m to 7.50m bgl, where the dynamic probes were driven to refusal (DP03 and DP04). It should be noted that both WS02 and WS03 encountered refusal of cobbles which obstructed the advancement of boreholes once encountering natural clay deposits.

It is considered that driven pre-cast concrete piles could be adopted at this site, although, it would be prudent to utilise a driving shoe or a lead steel section to minimise the risk of pile breakages, whilst penetrating the piles into the underlying Pennine Lower Coal Measures Formation or obstructions within the Glacial Till as suggested from the site investigation.

The chosen contractor should be aware that near surface contamination is present within the topsoil which will need to be taken into consideration. Consideration may be given to the use of pointed ends to reduce the risk of pushing a plug of contaminated soil into strata at depth.

In order to reduce the risk of pile breakage, steel tubular driven piles may be employed, which could include thin walled bottom drive piles or thick walled top drive piles. It should be appreciated that thin walled piles will need to be concrete filled and possibly reinforced as the steel casing alone would not be sufficient to carry vertical or horizontal imposed loads. However, this is not necessarily the case with thick walled tubular piles.

For both pile types care is required to ensure that the connection between the pile and pile cap is adequate. In addition, it is recommended that any relict structures relating to the site's previous use (i.e. drainage and footings) are removed to ensure that there are no 'hard-spots' within the footprint of the proposed development.

Should the piles be required to resist a combination of axial compression or tension loading and a coexistent bending moment, a positive connection between segmental piles should be employed to transfer loads between the pile segments. Moreover, in view of the weak and variable nature of the soils encountered to depths of 4.0m, it will be necessary to check the buckling performance of the piles.

In light of the close proximity of the proposed development to existing properties and the nature of near soils encountered at the site, some caution will be necessary to ensure that the installation of driven piles does not lead to settlement of neighbouring buildings should they have been founded on shallow footings. In this event, it is recommended that existing buildings be carefully monitored and should significant movements be observed, it will be necessary to consider use of bored piles as an alternative.

In view of the above, consideration may also be given to the use of bored cast-in-place piles using continuous flight augers (CFA). In this type of piling an auger borehole is formed and concrete placed via the hollow stem of the auger as they are withdrawn. A reinforcement cage is then placed into the fluid concrete filled hole to complete the pile. Given the appropriate rock auger, CFA piles can achieve significant end-bearing capacity on rock. However, spoil will be produced at the surface which will need to be disposed of. Moreover, should such piles encounter an obstruction or the underlying bedrock, a condition known as 'flighting' may occur. Flighting is where loose soils immediately adjacent to the pile borehole are pulled laterally into the drill string when the augers rotate quickly with little downward penetration.

Finally, drill and cased piles (Odex, Symmetrix or similar) could be employed at this site. These methods employ down the hole hammers which have the capacity to bore through obstructions and into the underlying hard stratum to form a rock socket. Through the overburden, the drill bit is attached to casing which prevents the pile borehole collapsing. When rock is encountered the drilling can continue using open hole drilling techniques. On completion of the boring operations, concrete is then pumped into the hole and a steel reinforcing cage can be installed. The steel casing can be removed or left in place.

It should be appreciated that the methods and installation of piles will largely be dependent on the characteristic properties of the underlying Pennine Lower Coal Measures Formation.

Irrespective of the method of pile installation a working platform must be provided, the thickness of which will be determined by the type of piling rig employed and the strength of the near surface soils. The design of the platform should be undertaken in accordance with the procedures and specification given in the BRE publication entitled *Working platforms for tracked plant*.

In addition, the cohesive fraction of the superficial geology has been found to possess medium volume change potential in most onerous case. Therefore, piles should be able to cater for shrinkage or swelling of the cohesive soils should they be installed within the zone of any existing trees or shrubs. For design purposes, in particular the derivation of heave forces on the piles, the zone of desiccation may be considered as equivalent to the minimum foundation depth recommended for a shallow footing in the NHBC Standards, Chapter 4.2 – *Building Near Trees*.

The results of the water content testing undertaken in this investigation may also be taken into consideration in determining the zone of desiccation. However, it should be appreciated that soil water content is subject to seasonal variation and the most onerous conditions may not have been observed where this investigation was drilled during winter. With potential heave forces in mind, it must be noted that the piles may be required to resist significant vertical tension forces, thus it will be necessary to ensure that the sections of driven piles are suitably reinforced. Moreover, it is possible that sufficient resistance cannot be derived from the soils above the rock head; therefore,

care must be taken to establish that piles will achieve sufficient embedment into bedrock in order to resist any upward forces.

In this particular instance, given the location of the site within a residential area, and the presence of cobble and boulder obstructions within the natural cohesive deposits the use of driven piles may not be practical at this site. Moreover, due to the small footprint of the site it should be noted that CFA piles will produce volumes of spoil which may not be easily handled on the site. In view of this, it is likely that the most practical solution would be to use drill and cased piles which would reduce risks from nearby vibrations, can drill through obstructions in superficial deposits and produce less quantities of spoil at the surface,

Further investigation work may be requested by piling contractors in order to establish the precise nature of the soils at depth. Such work would need to employ the use of methods capable of proving rock-head and obtaining suitable samples for geotechnical testing. In this instance, rotary open hole drilling to bedrock with rotary core follow-on drilling technique is considered to be the most appropriate for this site. The depth of such investigations may be required to extend between 5m to 7.5m beyond the end bearing depth of the pile.

In addition to the above the client should be aware that the site is located within a coal mining affected area and a high-risk development area most likely resultant from the Doe coal seam which is inferred to outcrop just to the north of the site. As such the Coal Authority may require a Coal Mining Risk Assessment to be undertaken, possibly followed up by intrusive investigation in order to determine the risks from underground workings. Clearly, the design of the piled foundations will need to take into account any underground workings if present. It should be appreciated that a permit will be required from the Coal Authority for any work which is likely to penetrate any coal seams or workings below the site.

10.2 General Comments for Excavations

The stability of excavation faces cannot be guaranteed thus temporary support to the excavation faces may become necessary unless the foundations are constructed using trench-fill techniques. In this method the foundation trenches should be excavated, inspected and backfilled with concrete as a continuous operation. Under no circumstances should operatives be allowed to enter unsupported excavations.

Should the excavations be required to stand open, it is considered that a blinding layer of lean-mixed concrete be placed over the sub-grade. This expedient will reduce loosening or softening of the underling soil due to both physical disturbance and the ingress of surface water.

Should seepage of groundwater be encountered it is considered that it could be dealt with using a simple form of de-watering. Such a system could include the excavation of sumps from which the water could be pumped.

10.3 Ground-floors

In light of the made ground and weak near surface soils, it is not recommended that ground bearing ground floor slabs be employed. In this instance it would be necessary to suspend floors between foundation positions, such that the floor loads are transmitted via the foundations to competent soils at depth.

Further to the above, due to the volume change potential at the site, should the floor be placed within the zone of influence of any existing, or proposed, trees and shrubs, an allowance for soil volume change should be included. Further guidance is available in the NHBC standards, however, soil volume change can typically be catered for by providing a suitable void or utilize proprietary materials beneath the floor slab.

10.4 Effect of Sulphates

In view of the nature of the underlying soils it is considered that the design sulphate class be assessed with reference to Table C2⁷, which is provided in BRE Special Digest 1, *Concrete in aggressive ground*: Part C. On the basis of this table and considering the soluble sulphate contents recorded, it can be shown that well compacted buried concrete should be designed in accordance with Class DS-1 requirements. Assuming static groundwater, the table also indicates that the aggressive chemical environment for concrete (ACEC) classification is AC-1s.

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1⁸, which can be found in Part D, *Specifying concrete for general cast-in-situ use*, of BRE Special Digest 1. From this table it may be shown that for an intended working life of at least 50 years the concrete design class DC-1 is required.

11. Discussion of Ground Conditions - Environmental

11.1 Discussion of Test Results

It is understood that the site is to be developed by the demolition of the existing building and construction of a new residential dwelling. Consequently, the site may be classified as residential with plant uptake.

11.1.1 Soil Samples

The results of the chemical testing undertaken on soil samples obtained during this investigation have been compared to the ATRISK soil screening values (SSVs) as compiled by WS Atkins plc. With respect to the results it should be appreciated that the soil organic matter (SOM) content for the samples tested was found to range between 5.4% and 6.4%. On this basis, it is considered that the screening values associated with 6% SOM should be adopted. These values have been derived in such a way as to adhere to the principles within the revised CLEA model and include the most current release of the SGVs. A list of subscribers is provided within the website⁹ and these include many local authorities.

A comparison of the results of the testing, together with the data given above, can be found within Appendix 5. These results indicate the following:

⁷ Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations*

⁸ Table D1, *Selection of the DC Class and the number of APMs for concrete elements where the hydraulic gradient due to groundwater is 5 or less: for general in-situ use of concrete.*

⁹ <http://www.atrisksoil.co.uk/pages/general/subscribers.asp>

Table 8: Summary of Contaminated Areas

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with plant uptake)
WS02 (Topsoil)	0.20	Metals – Lead. PAHs - benzo(a)pyrene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene.
WS03 (Made Ground)	0.40	PAHs - benzo(g,h,i)perylene.
WS04 (Made Ground)	0.80	None

Concentrations of cadmium, chromium^{VI}, mercury, selenium, free cyanide, phenols (total) and majority of total petroleum hydrocarbons (aliphatic C5 to C35; aromatic C5 to C16) were below the detection limits for the tests. Detectable levels of all other contaminants were recorded, but these fell below the associated At Risk Soil Screening Values other than those listed in the table above. In addition, no asbestos was detected within the soils samples tested.

It should be appreciated that the soil screening values for PAHs and TPHs (where appropriate) represents vapour saturation limits. The inhalation of vapour pathway contributes less than 10% of total exposure, which is unlikely to significantly affect the combined assessment criterion¹⁰. In view of this, the ATRISK soil SSVs notes that the users may wish to consider using a combined assessment criterion if free product is not observed, the values for which are also provided on the summary of contamination analysis. It is therefore considered that the criteria for no free product should be adopted for the PAHs and TPHs at this site. The results of the contaminants found to exceed these screening values are tabulated below:

Table 9: Summary of Areas Contaminated by PAHs & TPHs

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with Plant Uptake)
WS02 (Topsoil)	0.20	None
WS03 (Made Ground)	0.40	None
WS04 (Made Ground)	0.80	None

On the basis of the above information it can be concluded that the topsoil on the site is contaminated with respect to lead. Samples recovered from the made ground can be classified as below the human health thresholds with regard to a residential with plant uptake end use.

11.1.2 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated a maximum concentration of 0.2% methane, with concentrations of carbon dioxide ranging between 0.5% and 5.8%, in association with oxygen levels of between 11.5% and 20.9%. It should be appreciated that on non-contaminated sites there is generally about 20% by volume of oxygen, associated with low levels of carbon dioxide. In addition, a maximum flow rate of 0.4 litres per hour was recorded and will be employed in the following calculations.

The principal driving force for initiating the movement of gas in the ground is a change in barometric pressure. The most onerous gas condition on a site is usually observed on days of low or falling barometric pressure, preferably below 1000mb. It has been noted that measurements undertaken solely during high pressure conditions may be of lesser value. At this site the readings undertaken

¹⁰ Ref: ATRISK soil, SSVs derived using CLEA v1.071 for 6% SOM, Residential with home grown produce land use, 23.06.17.

to date were at atmospheric pressures of between 982mb and 1022mb during periods of both rising and falling pressure trends.

In order to establish the gas screening value (GSV) for carbon dioxide or methane, the maximum gas concentration (expressed as a decimal) is multiplied by the borehole flow rate (l/hr). In this case 0.2% (0.002) methane was recorded along with 5.8% (0.058) carbon dioxide, in association with a maximum flow rate of 0.4 l/hr. This results in a GSV of 0.0008 l/hr for methane and a GSV of 0.0232 l/hr for carbon dioxide. It should be noted that during all visits carbon dioxide levels were recorded above the action limit of 5% in WS04 alongside depleted oxygen in WS02 and WS04 during all visits.

In accordance with Table 2 of BS8485: 2015, *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*, the site may be characterised as *Characteristic Situation Level 2*. It is therefore considered that there is a potential risk of harm to end users and site operatives and special precautionary measures are required in accordance to Table 8.6, *Typical scope of gas protection measures*, of CIRIA report C665.

With regard to the number of monitoring visits required reference is made to Tables 5.5a and 5.5b of CIRIA report C665 (2007)¹¹. Accepting that the proposed development is of moderate sensitivity and that the generation potential is very low, these tables suggest that 6 readings could be undertaken over a period of 3 months. However, C665 notes that *not all sites will require gas monitoring for the period and frequency indicated in Tables 5.5a and 5.5b*.

In this case, a total of 4 monitoring visits were undertaken over a four week time period and for the purpose of this assessment, it is considered that the site can be classified as Characteristic Situation Level 2 as the action level (carbon dioxide exceeding 5.0%) to require CS2 measures has been exceeded during every visit in WS04.

To further increase to CS3 where the gas screening value is recorded as <0.7l/hr then one of the following must become true; should ground gas levels remain relatively stable, as noted to date, then flow rates must increase to levels exceeding 12l/hr which would represent an excess of thirty-fold increase, which based on the proven ground conditions is highly unlikely, or should flow rates remain stable the ground gas concentration of carbon dioxide will need to exceed 100% which is not feasible.

Carbon monoxide was also recorded during monitoring; however this was at levels which fall below the WHO 24 hour (<6ppm) recommended safe level and no action is required.

11.2 Site Specific Risk Assessment

11.2.1 Approach

The presence of contamination hazards and the risks associated with them should be assessed in accordance with industry practice and the 'suitable for use' approach. This has been conducted with reference to The Department for Environment, Food and Rural Affairs (DEFRA) and The Environment Agency¹² advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.¹³ This method dictates

¹¹ Adapted from tables 5.5a and 5.5b of CIRIA C665, 2007, *Assessing risks posed by hazardous ground gas to buildings*, p60.

¹² R&D Publication CLR 8, 'Assessment of Risks to Human Health from Land Contamination: An overview of the Development of Soil Guideline Values and Related Research'.

¹³ The pollution linkage approach was developed by 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990' which provides meanings for the terms contained in The Environmental Protection Act 1990 Part IIA, the primary legislation for addressing the issues of contaminated land.

that there must be a risk of contaminant produced at a 'source' in sufficient concentration to cause harm and there must be a 'pathway' for the contaminant to reach an identifiable 'receptor' for the linkage to be proved and a contamination hazard to be considered present. Not all substances are contaminants and not all contaminants are considered to be a risk. Indeed DEFRA and The Environment Agency state that 'a contaminant is a substance which has the potential to cause harm, while a risk itself is considered to exist if such a substance is present in sufficient concentration to cause harm and a pathway exists for a receptor to be exposed to the substance.'¹⁴

11.2.2 Conceptual Ground Model and Risk Assessment

In view of the results of the chemical testing undertaken the conceptual site model is presented accordingly as Table 10. Sources of contamination include the following:

On-site – Topsoil (Lead).

The preliminary risk assessment has been evaluated with reference to the following ratings and definitions:

N/A -	A source-pathway-receptor linkage is not considered to exist and therefore a risk assessment is not required.
Low -	A pollution linkage is unlikely and/or the likelihood of harm occurring is low and of minor consequence.
Moderate -	The linkage exists but the likelihood of harm occurring is not considered to be significant although remedial action may be necessary
High -	The linkage exists and the available data indicates that significant harm may be caused and remedial action could be necessary.

The results of the risk assessment are presented in Table 10.

¹⁴ See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.

Table 10: Conceptual Site Model and Site-Specific Risk Assessment [Contamination: Lead]

Conceptual Site Model			Site Specific Risk Assessment	
Pathways	Receptor	Linkage Present?	Risk Rating	Notes
Direct contact/dermal absorption/soil ingestion	Operative	Yes – contamination found to be present at the site and contact with soil likely during works.	High	Some contamination is present in the soils underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways. However, as the site is anticipated to be secured during the development phase, contamination is not anticipated to affect neighbours.
	End User	Yes – contamination found to be present at the site and site to be developed into residential use.	High	
	Neighbours	Yes – contamination found to be present at the site and a populated residential area surrounds the site.	Low	
Inhalation of Dust/Vapours	Operative	Yes – dust may be derived from contaminated soils.	High	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways.
	End User	Yes – dust may be derived from contaminated soils.	High	
	Neighbours	Yes – contamination found to be present at the site and residential and commercial properties located within 250m radius of the site.	High	
Ingestion of fruit/vegetables and/or waters	Operative	Yes – site is currently garden area.	High	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways. However, the contamination at the site is considered to be of limited mobility, therefore the likelihood of contamination affecting neighbouring gardens is considered low risk.
	End User	Yes – contamination found to be present at the site and site to be developed into residential use.	High	
	Neighbours	Yes – contamination found to be present at the site and a populated residential area surrounds the site.	Low	
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – Concentrations of methane and carbon dioxide have been found to be present at the site which may be harmful to human health (<i>Characteristic Situation Level 2</i>).	High	Concentrations of harmful gases (methane and carbon dioxide) were detected at the site. If ground gas conditions remain the same, special precautionary measures are deemed to be required. Remediation will be required to either remove the contamination or break pathways.
	End User		High	

	Neighbours	No – whilst concentrations of ground gas have been found to be present at the site (assuming <i>Characteristic Situation Level 2</i>), no structures directly adjoin the site, therefore gases migrating from the site would vent to atmosphere before reaching neighbouring structures.	N/A	
Spillage/loss/run off direct to receiving water	Controlled Waters	No – No controlled waters within 250m of site.	N/A	Some contamination is present underlying the site. Remediation will be required to either remove the contamination or break pathways. Old services to be removed or capped.
Migration via permeable unsaturated strata	Controlled Waters	Yes – Secondary A aquifer is present beneath the site. Some contamination is present within topsoil. Underlain by generally low permeability cohesive strata. Contamination by lead is not anticipated to be significantly mobile.	Low	
Run off via drainage/sewers etc	Controlled Waters	Yes – old services may be present on site. Secondary A aquifer is present beneath the site. Some contamination in topsoil. Underlain by generally impermeable cohesive strata. Contamination by lead is not anticipated to be significantly mobile.	Moderate	
Direct contact with contaminated soils	Plants	Yes – Lead contamination recorded within topsoil.	Moderate	Some contamination is present in samples of topsoil. Remediation will be required to either remove the contamination or break pathways.
Uptake via root system			Moderate	
Direct contact with contaminated soils	Building Materials	Yes – Minor PAH contamination revealed at the site may represent a significant risk to building materials or plastic water pipes. Moreover, testing indicates that the aggressive chemical environment for concrete classification is AC-1s.	Moderate (plastic services)	Please see section 11.3.3 for information on good building practice.
Direct contact with contaminated groundwater			Low (buried concrete)	
Migration of mine gas via permeable strata	Operative	Yes – in an area affected by coal mining activity and where shallow worked seams may be present.	Moderate	Concentrations of harmful gases (methane and carbon dioxide) were detected at the site. If ground gas conditions remain the same, special precautionary measures are deemed to be required.
	End User			Remediation will be required to either remove the contamination or break pathways. Further investigation required to determine presence of underground workings beneath the site.
Mining Instability	End User	Yes – in an area affected by coal mining activity and where shallow worked seams may be present.	Moderate	Further knowledge required to reach a firm conclusion.
Exposure to Radon	Operative	No – Not in a radon affected area.	N/A	Less than 1% of properties are above the action level. No radon protection measures required.

	End User			
UXO Risk	Operative	Yes – the Zetica ¹⁵ online maps indicate that the site is at low risk from UXO.	Low	No further action required

¹⁵ Pre-desk study assessment [online resource from www.zeticauxo.com].

11.3 Indicative Remediation Strategy

In view of the site specific risk assessment it is considered that remediation will be required at this site. Such a strategy should include the following main elements.

11.3.1 Remediation Objectives

Based on the site-specific risk assessment the object of the remediation is likely to be as follows.

- To protect the site operatives during the construction process from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust.
- To protect the end user from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust.
- To protect the end user from the elevated levels of carbon dioxide.
- To protect neighbours from the inhalation and ingestion dust during the construction process.
- To protect operatives, end users and neighbours from the ingestion of contaminated fruit and vegetables.
- To protect plants from direct contact with contamination and prevent uptake via root system.
- To ensure that contamination cannot enter services occupying the site which may return to controlled waters.
- To protect plastic services from being penetrated by, or degrading due to the presence of, contamination in the soil or groundwaters.

11.3.2 Development Requirements

It is understood that the existing building is to be demolished and a new residential dwelling is to be constructed. In view of the above, a site-specific remediation strategy should be undertaken after the proposed development has been finalised. However, for preliminary design and costing the following remediation proposals are offered.

11.3.3 Outline Strategy

In order to fulfil the objectives defined above it is likely that the following remedial strategy could be utilised. It is recommended that a pragmatic approach be undertaken, with observational techniques being employed at each stage of the work.

Ground-works

During the ground-works phase of the development, protection to the site operatives is required. The risk to site operatives is considered under the Health and Safety at Work Act 1974, together with regulations made under the act, which includes the Control of Substances Hazardous to Health (COSHH) regulations. Therefore, the risks to site personnel must be considered under the Construction Design and Management (CDM) regulations at the planning stage and be included in the contractor's Health and Safety Plan and site specific Method Statements. These documents should include the following main elements.

- Site operatives at all levels should be made aware of the hazards of working with contaminated soils and the potential hazards associated with workings in areas where accumulations of carbon dioxide could occur.
- Personal hygiene facilities, including washing and messing, must be provided and site operatives be encouraged to use them.
- Where work is undertaken in dry weather the site should be dampened down to avoid dust. In addition, dust masks must be provided to all site operatives for use in dry weather.
- In order for contaminated soils to be disposed of to an appropriate landfill, it may be necessary to carry out Waste Acceptance Criteria (WAC) testing in accordance with BS EN 12457.
- Any stockpiles of contaminated soil on site should be sheeted over to prevent excessive amounts of airborne dust and cross contamination of imported fill.
- Where vehicles are transferring soil to the landfill site they should be covered to prevent contamination of the surrounding area by dust.
- Where work is undertaken in wet weather, vehicle and wheel washing facilities are required to ensure that the vehicles leaving the site do not transfer contamination to surrounding areas.

On completion of the ground-works a careful site inspection of the sub-grade would be required. Should visual or olfactory evidence of contamination be revealed then further testing may become necessary.

Construction

During the construction phase of the contract the following items are required to protect the end user from the potential contaminants revealed at this site.

- Beneath buildings, pavements and hard-standings clean inert granular sub-base should be employed.
- Any redundant services revealed at this site should be de-commissioned and piped services sealed. Any existing services that are to be employed in the new development should be carefully inspected to ensure that they are serviceable.
- New plastic services should be constructed in a surround of clean inert material and selected in accordance with the recommendation given in the United Kingdom Water Industry Research (UKWIR) website under Report Ref. No. 10/WM/03/21 - 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'. The statutory water authority for the area in which site is located may have a risk assessment form to complete which allows these recommendations to be met. However, further determinand specification contamination testing may be necessary.
- For buried concrete the results of the sulphate and pH testing indicate that the design sulphate class for the site should be DS-1, AC-1(s).

Landscaped Areas

It is understood that there is proposed to include garden areas as part of the development. In view of this and the lead contamination recorded within the topsoil, it is considered that landscaped areas will require remediation. This could include the provision of a clean cover system including a capping layer of say 500mm of inert material, which will put the contaminated ground out of the end users' dig range. At the base of this layer, a granular capillary break of say 100mm of free draining granular soil should be placed in order to prevent mobile contamination rising upward. This expedient should also provide a suitable root barrier to isolate the plants from the underlying contaminated ground.

The underlying reworked cohesive material recovered from the boreholes on site has been generally shown to be below the Atkins Soil Screening Values (SSVs) for the proposed residential with plant uptake end use and subject to appropriate screening could be reused on site as sub soil.

Gas Protection Measures

In order to assess the protection measures required BS8485: 2015+A1:2019: *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* has been employed. In accordance with Table 3, *Building types*, of the code, the development may be considered to conform to Type A. Therefore, on the basis of Table 4 *Gas protection score by CS and type of building*, the minimum gas protection score (points) is 3.5. The gas protection system should consist of at least two different elements. The elements work independently and collaboratively, and a single element should not be used because there would be no redundancy to allow for defects in the component.

In order to achieve this score the following shall be undertaken.

Table 11: Combination of Protection Elements (BS8485: 2015) for CS2

Reference	Protection Element	Score
Table 5	Precast suspended segmental subfloor (i.e. beam and block)	0
Table 6 <i>Either option is appropriate</i>	Passive sub-floor dispersal layer: good performance (Note 1) (see Annex B of the Code for detail)	1.5
Table 7	Gas resistant membrane complying with the requirements given in Table 7 (Note 2)	2
Total Score		3.5

Note 1:

As a ground floor suspended between foundation positions is likely to be required it is likely that a clear void with air bricks in the external walls would be utilised. The details of the system to be adopted shall be included on the technical drawings provided by the engineer/architect.

Note 2:

The gas resistant membrane shall meet the following criteria:

- Sufficiently impervious (methane gas transmission rate <40.0ml/day/m²/atm (average) BS ISO 15105-1 manometric method).
- Sufficiently durable and strong to remain serviceable for the anticipated life of the building, to withstand in-service stresses and installation process.
- Capable, after installation, of providing a complete barrier to the entry of the relevant gas.

- Verified in accordance with CIRIA C735: 2014: *Good practice on the testing and verification of protection systems of buildings against hazardous ground gasses.*
- Chemically resistant to degradation by other contamination that might be present.

In addition to the above, the following points shall be considered.

- Technical drawings of the incorporation of the gas protection measures into the sub-structure will be provided by a suitably qualified engineer/architect and produced in accordance with the guidance given in BRE 414.
- The sequence of construction indicating when the gas protection system will be installed will be included with the remediation statement. Where possible the installation of membranes will take place as a unique activity on site and shall not take place until sub-structure construction is complete.
- During and following the installation of the membrane, all parties in attendance at the site shall be made aware that a gas protection system is to be employed within the construction. Such communications should include, but not be limited to, the CDM documentation for the site and site inductions.
- The installation of the membrane shall be carried out only by suitable personnel and the qualifications or experience/training will be included as part of the remediation statement. The suitability of personnel will be assessed in accordance with Annex 1 of CIRIA C735.
- The installation shall be in strict accordance with manufacturer specifications and recommendations, which shall also be included as part of the remediation statement.
- The membrane system employed will not be an ensemble (i.e. a system comprising a mixture of products from different manufacturers will not be employed).
- Membranes shall be supplied to site on a single wound roll, creased product will not be accepted or employed.
- Whilst membranes are exposed, signage will be provided to indicate the access to the installation area is prohibited unless authorised. Footwear will be checked prior to accessing the membrane surface to ensure no sharp objects are apparent, such as stones caught in treads. The use of sharp objects or hot-works around the exposed membrane will be strictly prohibited unless the risk of damaging the membrane has been fully assessed and mitigated.
- Non-conformance of manufacturer recommendations shall be discussed and agreed as acceptable, in writing, with a suitably qualified person from the manufacturer.

Verification of the installation of the gas protection system will be carried out on each plot, unless agreed with any statutory authorities prior to construction.

11.4 Fill Materials

It should also be appreciated that any fill material, either site-won or imported, to be employed at the site should be subjected to the following assessment to determine its suitability.

Fill materials should be initially screened, by a suitably qualified engineer to establish that:

- It is a suitable growing media if it is to be employed as such, including compliance with BS3882 (2015)
- It is free from obvious contamination i.e. visual or olfactory evidence
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants are suspected to be growing
- It is not a statutory nuisance, such as being odorous
- It is free from unsuitable material i.e. whole bricks, brick ties, timber or glass.

It should also be appreciated that any fill should be subjected to validation testing to assess its suitability. The following table has been taken from YALPAG¹⁶ documentation and may be used as a guide. Depending on the origin and nature of the material, not all fill will require the sampling frequency and testing indicated, although this should be in agreement with any regulatory bodies (such as the Local Authority).

Table 12: Validation Sampling and Testing

Fill Type	Frequency	Minimum Determinands
Virgin Quarried Material	1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.	Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn)
Crushed Hardcore, Stone, Brick	Minimum 1 per 500m ³	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).
Greenfield/ Manufactured Soils	Minimum 3 Dependent on source and receptor, between 1 per 50m ³ and 1 per 250m ³	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).
Brownfield/ Screened Soils	Minimum 6 Dependent on source and receptor, between 1 per 50m ³ and 1 per 100m ³	Standard metals/ metalloids (as above), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE)..

The screening values for the above regime should also be agreed with any regulatory bodies; however, the following is recommended in the first instance.

Table 13: Fill Screening Values

Contaminant	Screening Value (Residential with Plant Uptake) (mg/kg)		Reference
	1% SOM	6% SOM	
As	37	37	Atrisk ^{SOIL} SSVs
Cd	22.1	22.1	Atrisk ^{SOIL} SSVs
Cr(VI)	3.62	3.63	Atrisk ^{SOIL} SSVs
Cu	4730	4790	Atrisk ^{SOIL} SSVs
Hg	8.81	15.8	Atrisk ^{SOIL} SSVs
Ni	136	136	Atrisk ^{SOIL} SSVs
Pb	200	200	Atrisk ^{SOIL} SSVs
V	136	138	Atrisk ^{SOIL} SSVs
Zn	20000	20300	Atrisk ^{SOIL} SSVs

Please see summary sheet within Appendix 6 for full screening values including PAHs & TPHs.

The above screening values should be considered with respect to the Soil Organic Matter (SOM) of the subject material i.e. 1% SOM would be typical for granular fill and 6% SOM for topsoil. Testing

¹⁶ YALPAG Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems V4 .1 Appendix 1a, June 2021

should comply with UKAS and MCERTS, where applicable, and undertaken by an accredited laboratory.

Where the material has been derived from a commercial company, certificates or other industry quality protocol compliance i.e. WRAP should be obtained. However, it will be necessary to ensure that this documentation specifically related to the material being imported, it is no more than two months old and complies with the screening and frequency requirements given above.

Suitable fill materials should be either placed immediately or sufficiently quarantined to prevent cross-contamination. If it is necessary, the quarantined material should be placed on appropriate sheeting and covered to prevent it becoming mixed with contaminated soils or dust, or penetrated by mobile contaminants.

11.5 Verification Report

In order to demonstrate that the remedial works and provision of clean cover has been sufficiently carried out where applicable, it will be necessary to produce a verification report for submission to any statutory authorities.

It will be necessary for this report to include the following:

- The extents of any areas where contaminated topsoil/made ground has been removed from site and records of any samples taken.
- Characterisation of the suitability of the clean material including the derivation of the material, comments from a visual screen, the tests results of chemical screening, delivery tickets where appropriate and the conditions by which the clean material has been stored and handled on site.
- Photographic and logged evidence the clean material has been handled on site and placed in a sufficient thickness over areas where made ground remains. This may be either at the time of placement or after placement by means of hand excavated trialpits. Photographs should include visual site references or reference boards to prove the location and date taken. A measurement reference should be visible in the photographs to substantiate the thickness of material placed. Please note that it may also be necessary to undertake a topographical survey and the requirement for which should be checked with any statutory authorities.
- Evidence that suitable gas protection measures have been implemented and installed in accordance with manufacturer's instructions. The evidence should also demonstrate that all joints and penetrations have been adequately sealed.

The report detailed above should be produced by a suitably qualified engineer. The number of verification areas for the development should be confirmed with any statutory authorities for the site.

12. Recommendations for Further Work

- This report should be forwarded to the relevant authorities as soon as practicable to ensure they have sufficient time to review and discuss any issues.
- Discussions with piling contractors regarding their method for installing piles and requirements for additional investigative work if required.
- Discussions with ground work contractors in relation to the requirement for testing of materials to be disposed off-site (Waste Acceptance Criteria) and the suitability of imported materials.
- Discussions with service providers regarding suitable materials for pipe work given the nature of chemical determinands found within the soils on site.
- Discussions with contractors in relation to the suitability of materials and installation methods for ground gas protection measures.
- Produce a validation report to demonstrate that the geo-environmental risks discussed in this report have been mitigated.
- Detailed design of the sub-structure.

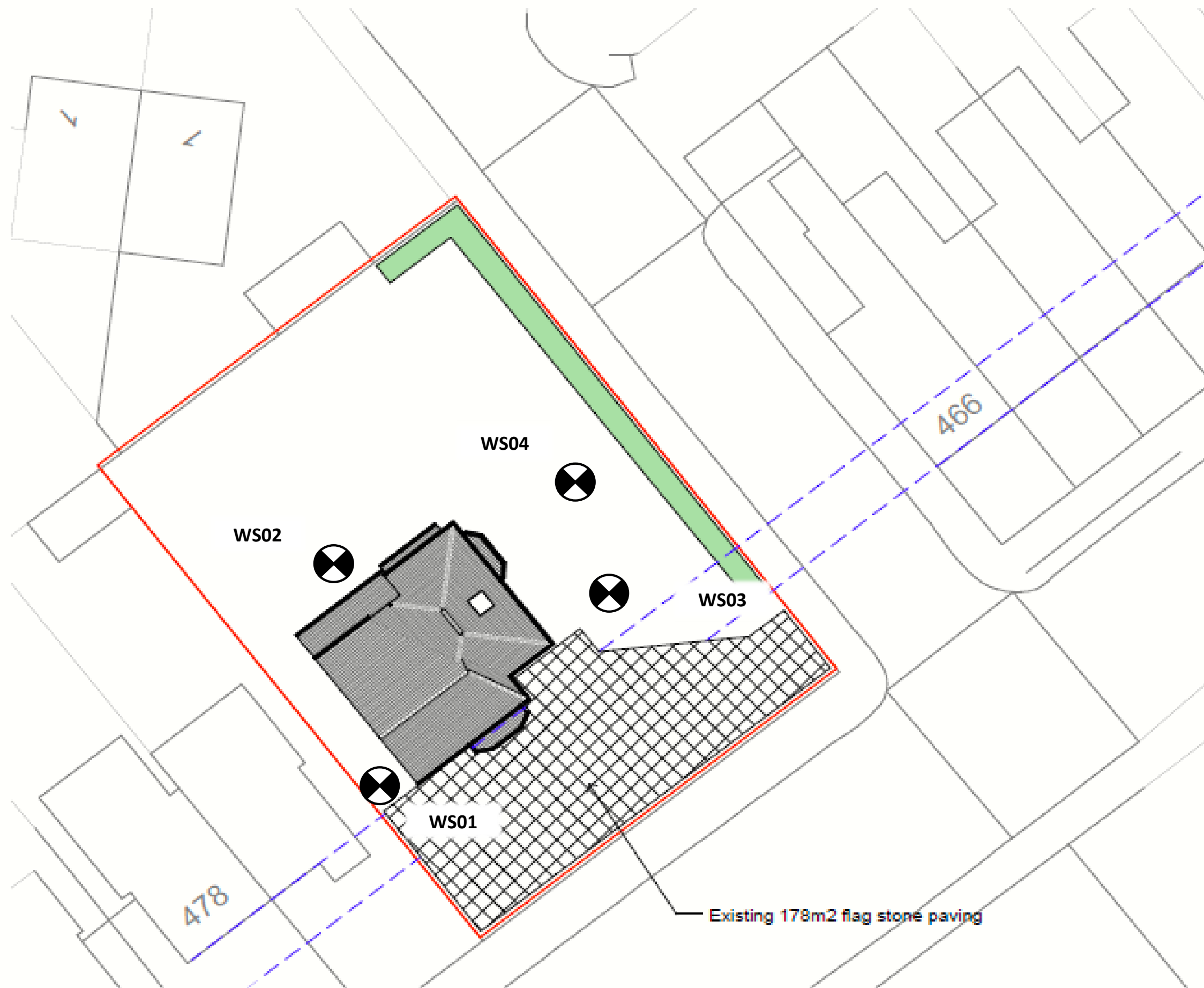
Clearly Rogers Geotechnical Services Ltd would be happy to offer advice with respect to the above and assist where necessary.

13. References

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Appendix 1

Site Plan



Notes:
Investigation positions approximated from site operative's notes.



Rogers Geotechnical Services Ltd

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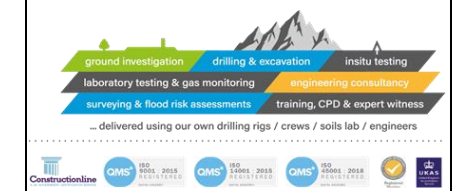
Telephone: 0843 50 66 87
www.rogersgeotech.co.uk

Client:

Job Number:
C

Project Details:

Scale: Not to scale - reference only

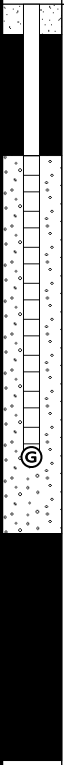
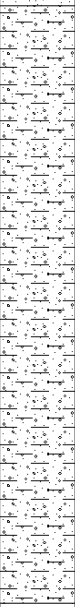


Appendix 2

Borehole Records

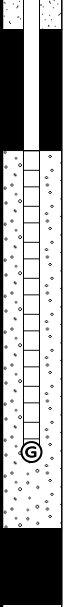
							Borehole Log			Borehole No. WS01		
Project Name: Bolton Road, Bury							Project No. C3018/22/E/4562		Co-ords: 378571.63E - 410020.89N		Sheet 1 of 1	
Location: Bolton Road, Bury							Level:		Hole Type WLS		Scale 1:50	
Client: Dr Nazir							Dates: 24/01/2023		Logged By SA			
Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results						
		0.00 - 0.20	D				0.20			TOPSOIL. (Dark grey slightly sandy clayey SILT. Occasional plant rootlets.)	1	
							0.60			MADE GROUND. (Soft to firm light and dark grey sandy clayey SILT. Occasional Plant rootlets.) [Reworked natural material] End of Borehole at 0.60m		
											2	
											3	
											4	
											5	
											6	
											7	
											8	
											9	
											10	
Remarks												
1. Hand dug trial pit attempted. Drain encountered at 0.60m, backfilled and moved 2m to east. 2nd hand dug pit to 0.40m CAT scan started receiving signals. Unable to find another place where CAT scan doesn't indicate services present. Borehole abandoned.												

						Borehole Log				Borehole No. WS02 Sheet 1 of 1	
Project Name: Bolton Road, Bury						Project No. C3018/22/E/4562		Co-ords: 378573.21E - 410029.03N		Hole Type WLS	
Location: Bolton Road, Bury						Level:		Scale 1:50		Logged By SA	
Client: Dr Nazir						Dates: 24/01/2023					

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
		0.20 - 0.30	ES	87	100	N=8 (1,1/2,2,1,3)	0.40			TOPSOIL. (Dark grey slightly sandy clayey SILT. Occasional plant rootlets.)	1
		0.60	D				0.80				
		0.80	D								
		1.00 - 2.45	D								
		1.00	SPT								
		1.20	D								
				87	100	1.20		Stiff greyish brown slightly sandy gravelly becoming very gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub rounded fine to coarse of sandstone, mudstone, limestone and coal. Increasing gravel content with increasing depth. Refusal on Limestone cobble.	2		
		2.00 - 2.45	D								
		2.00	SPT								
		2.40	D	77	100						
			77	100							
	3.00	SPT									
			67	70							
	4.00	SPT									
			50 (25,20/50 for 150mm)								
	5.00	SPT									
						5.15			End of Borehole at 5.15m	5	
										6	
										7	
										8	
										9	
										10	

Remarks
 

							Borehole Log			Borehole No. WS03 Sheet 1 of 1	
Project Name: Bolton Road, Bury				Project No. C3018/22/E/4562		Co-ords: 378586.69E - 410026.96N			Hole Type WLS		
Location: Bolton Road, Bury						Level:			Scale 1:50		
Client: Dr Nazir						Dates: 24/01/2023			Logged By		

Well	Water Strikes	Samples and In Situ Testing				Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)					
		0.40 - 0.60	ES	87	90				MADE GROUND. (Mixed dark brownish grey and white sandy gravelly clayey SILT. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of limestone and crushed brick. Common plant rootlets.)	
									MADE GROUND. (Soft to firm light and dark grey sandy clayey SILT. Occasional Plant rootlets.)	1
					77	90			[Reworked natural material]	
									MADE GROUND. (Blue grey angular coarse GRAVEL of slate overlying yellow fine to medium SAND.)	
									MADE GROUND. (Dark brownish grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub rounded fine to coarse of brick, mudstone, sandstone and coal. Slight organic odour.)	2
		2.60	D	67	60				MADE GROUND. (Very soft mixed light and dark grey and light brown slightly sandy slightly gravelly CLAY. Gravel is angular to sub angular fine to medium of coal, mudstone and limestone. Slight organic odour noted. Wet. Angular cobbles of brick at base of unit.)	3
									Soft to very soft brown sandy locally very sandy slightly gravelly clayey SILT with rare sand interlamination. Sand is fine to medium. Gravel is sub rounded to sub angular fine of coal and mudstone generally near interlamination. Common partially decomposed plant matter and rootlets. Strong organic odour.	4
									Very soft light brownish grey sandy slightly gravelly clayey SILT with rare sand interlamination. Sand is fine to coarse. Gravel is sub rounded to sub angular fine of coal and mudstone. Rare to occasional partially decomposed plant matter. Strong organic odour.	5
									Very soft light and dark grey and brown slightly sandy slightly gravelly clayey SILT. Sand is fine to coarse. Gravel is angular fine of coal and mudstone. Occasional partially decomposed plant matter and pockets of completely decomposed fibrous peat. Strong organic odour.	6
									End of Borehole at 4.00m	7
									8	
									9	
									10	

Remarks
 

						Borehole Log				Borehole No. WS04 Sheet 1 of 1	
Project Name: Bolton Road, Bury						Project No. C3018/22/E/4562		Co-ords: 378583.88E - 410033.71N		Hole Type WLS	
Location: Bolton Road, Bury						Level:		Scale 1:50		Logged By SA	
Client: Dr Nazir						Dates: 24/01/2023					

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
		0.25 - 0.35	ES SPT	87	100	N=3 (1,0/1,1,0,1)	0.25			TOPSOIL. (Dark grey slightly sandy slightly gravelly clayey SILT. Sand is fine to coarse. Gravel is rounded to sub angular limestone. Occasional plant rootlets.)	1
		0.80 - 1.00					0.80			MADE GROUND. (Yellow slightly gravelly fine to medium SAND. Gravel is rounded to subangular slate and sandstone.)	
		1.00 - 1.60	D SPT	87	80	N=2 (0,0/0,0,1,1)	1.40		MADE GROUND. (Firm mixed light and dark grey and brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub rounded fine to coarse of coal, mudstone, and sandstone. Common plant matter.)	2	
		2.00 - 2.45					2.10		MADE GROUND. (Soft to firm mixed light grey and light and dark brown slightly sandy gravelly to very gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub rounded fine to coarse of coal, mudstone and sandstone.)		
		2.00 - 2.20	D SPT	77	65	N=31 (2,2/2,2,2,25)	2.90		Soft rapidly becoming very soft by 1.60m greyish brown sandy to very sandy clayey SILT. Rare sand interlamination. Rare partially decomposed plant matter. Slight organic odour.	3	
		3.00 - 3.45					3.15		Soft to very soft light greyish brown sandy to very sandy slightly gravelly silty CLAY with occasional sand interlamination. Sand is fine to coarse. Gravel is fine to medium of coal and sandstone. Occasional plant matter. Slight organic odour.		
		3.00	D SPT						Soft to firm brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to sub rounded fine to coarse of sandstone, mudstone and coal. Borehole abandoned on cobble obstruction.	4	
									End of Borehole at 3.45m		
											5
											6
									7		
									8		
									9		
									10		

Remarks
 

Appendix 3

Dynamic Probing Records



Probe Log

Probe No.

DP03

Sheet 1 of 1

Project Name: Bolton Road, Bury

Project No.

C3018/22/E/4562

Co-ords:

Hole Type

DP

Location: Bolton Road, Bury

Level:

Scale

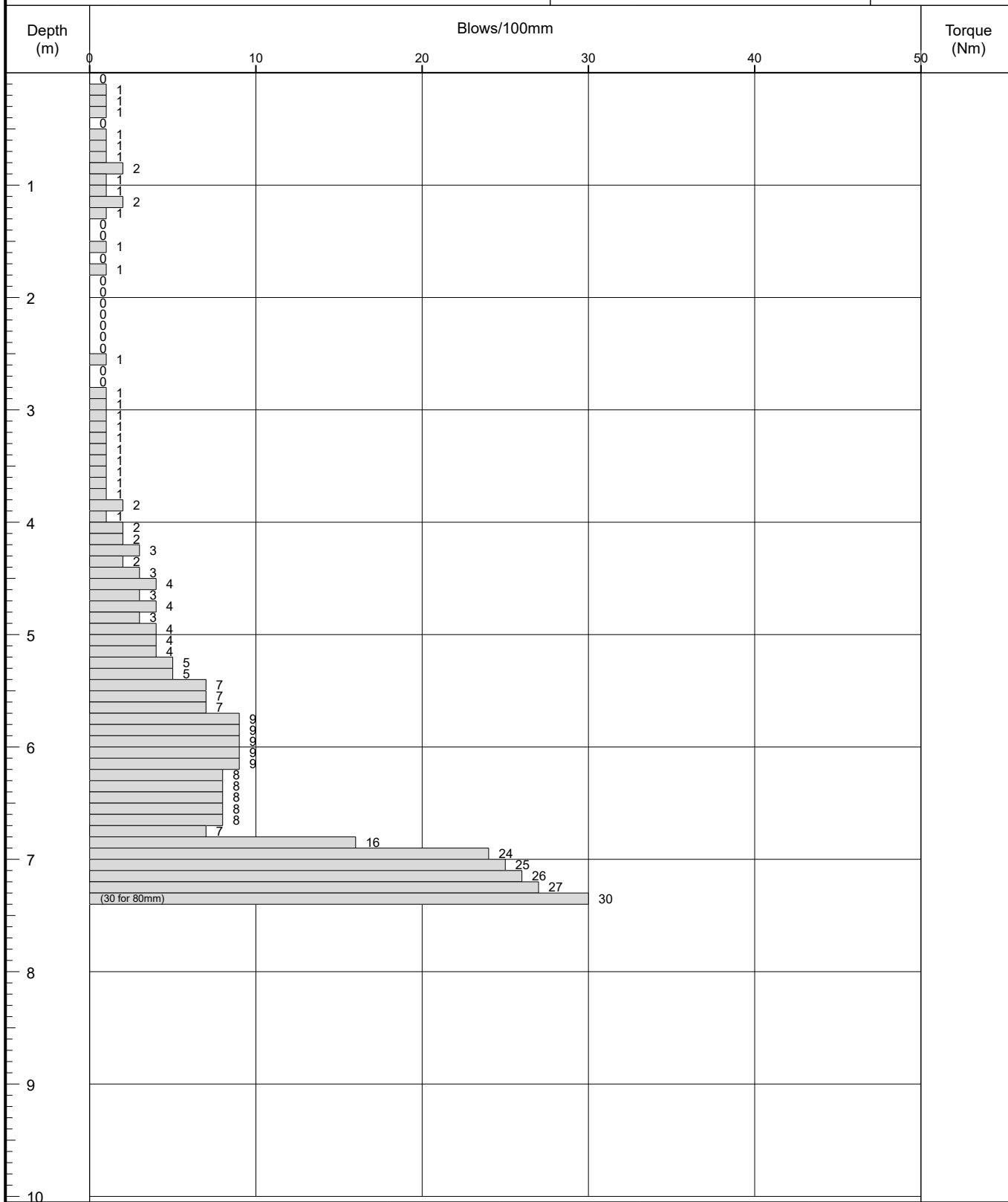
1:50

Client: Dr Nazir

Dates:

Logged By

AB AS



Remarks:

1.DP probe adjacent to WS03

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth m

Probe Type DPSH-B





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Probe Log

Probe No.

DP04

Sheet 1 of 1

Project Name: Bolton Road, Bury

Project No.
C3018/22/E/4562

Co-ords:

Hole Type
DP

Location: Bolton Road, Bury

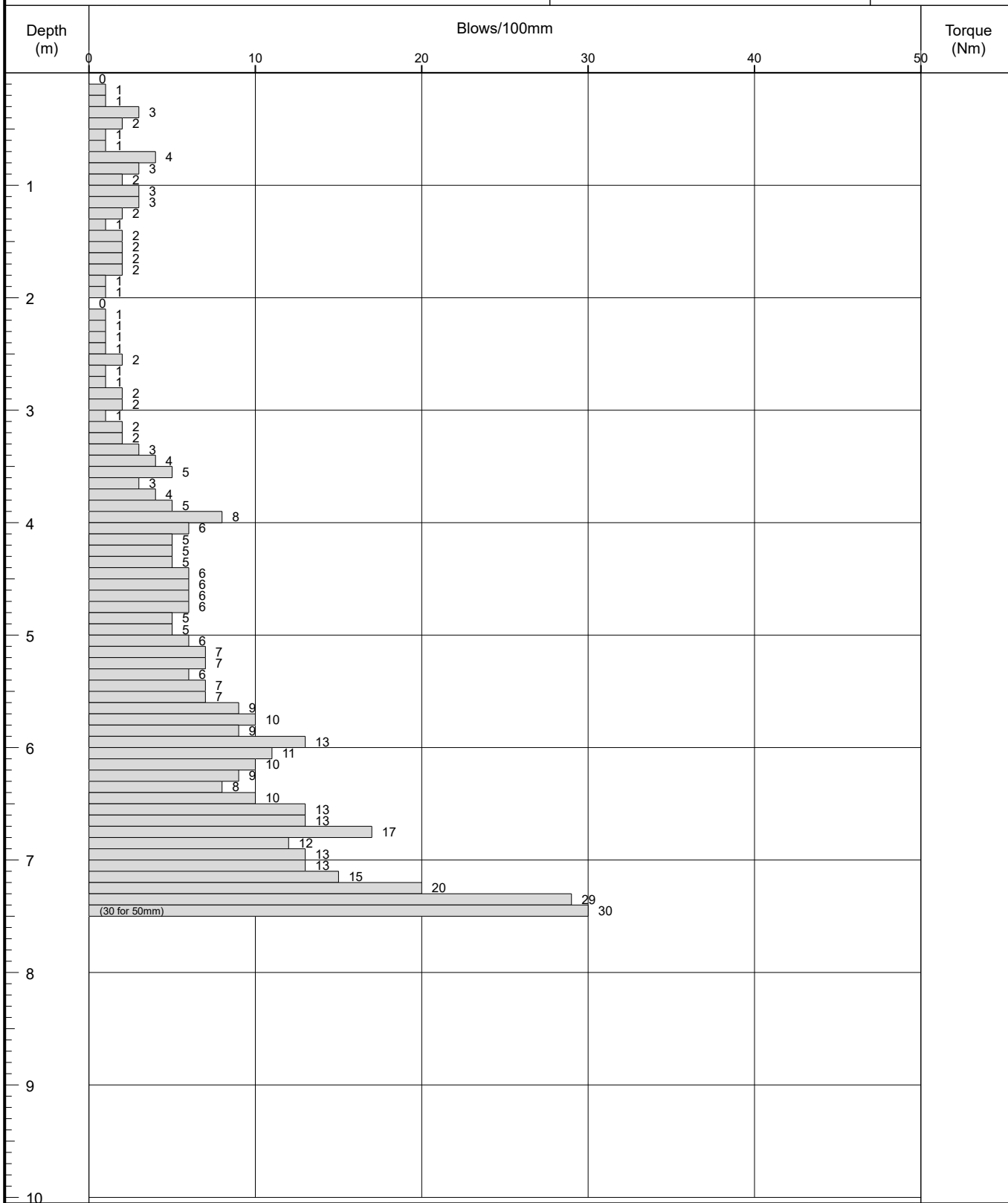
Level:

Scale
1:50

Client: Dr Nazir

Dates:

Logged By
AB AS



Remarks:
1. DP probe adjacent to WS04

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth m

Probe Type DPSH-B



Appendix 4

Gas Monitoring Sheets

GAS/WATER MONITORING - SITE RECORD

Client:

Site:

Input by : M. Tuck Chkd by: S. Alexander

Date : 08.03.2023 Date: 20.03.2023



Gas Monitor: Geotech GA5000

Serial No. G503524

Calibration Date: 24.08.2022

Dip Meter: 003

(If second monitor is used)

Gas Monitor: GFM 436

Serial No. 10767

Calibration Date: 08.08.2022

Dip Meter

Borehole No	Date	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow (l/hr)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS02	15.02.2023	0.1	2.1	11.5	0.1	1008	1.12	
	22.02.2023	0.1	2.9	13.1	0.1	1000	0.99	
	01.03.2023	0.1	3.1	15.5	0.0	1022	1.00	
	08.03.2023	0.1	3.5	17.4	0.4	982	0.90	
WS03	15.02.2023	0.1	0.6	20.9	0.0	1009	1.75	
	22.02.2023	0.1	0.8	20.7	0.1	1000	1.13	
	01.03.2023	0.1	0.5	20.7	0.0	1023	1.59	
	08.03.2023	0.1	0.5	20.4	0.2	984	1.14	
WS04	15.02.2023	0.1	5.8	12.8	0.0	1009	1.63	
	22.02.2023	0.1	5.6	12.3	0.1	1001	1.57	
	01.03.2023	0.1	5.5	13.3	0.2	1023	1.62	
	08.03.2023	0.2	5.2	14.0	0.2	984	1.62	

[illegible]

Appendix 5

Laboratory Testing

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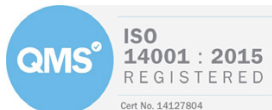


LABORATORY REPORT

job number	C/3018/22/E/4562	date	27/02/2023
site address	474 Bolton Road Bury, Greater Manchester, BL8 2DU		
date scheduled	30/01/2023	date issued	27/02/2023
issued by	H J Letch		



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Schedule of UKAS Accredited Laboratory Tests



1. CLASSIFICATION OF SOIL	BS 1377-2:1990	BS EN ISO 17892	Accredited (A)	Unaccredited (U)
1.1 Moisture / Water content determination				
i. Oven drying	Pt 2 : 3.2	Pt 1 : 2014 Pt 12 : 2018 : 5.3 / 5.5	A	
ii. Saturation m/c of chalk	Pt 2 : 3.3			U
1.2 Index Properties				
i. Liquid limit – cone penetrometer	Pt 2 : 4.3		A	
ii. Plastic limit	Pt 2 : 5.3		A	
iii. Shrinkage limit	Pt 2 : 6.3			U
iv. Linear shrinkage	Pt 2 : 6.5		A	
1.3 Particle Density				
i. Gas jar	Pt 2 : 8.2		A	
ii. Large pycnometer	Pt 2 : 8.3			U
iii. Small pycnometer	Pt 2 : 8.4	Pt 3 : 2015 : 5.1		U
1.4 Density Tests				
i. Linear measurement	Pt 2 : 7.2	Pt 2 : 2014 : 5.1	A	
ii. Immersion in water	Pt 2 : 7.3	Pt 2 : 2014 : 5.2		U
iii. Fluid / Water displacement	Pt 2 : 7.4	Pt 2 : 2014 : 5.3		U
iv. Sand replacement	Pt 9 : 2.1, 2.2			U
v. Core cutter	Pt 9 : 2.4			U
1.5 Particle Size Distribution				
i. Dry Sieve	Pt 2 : 9.2	Pt 4 : 2016 : 5.2	A	
ii. Wet Sieve	Pt 2 : 9.3	Pt 4 : 2016 : 5.2	A	
iii. Sedimentation by pipette	Pt 2 : 9.4	Pt 4 : 2016 : 5.3 / 5.4	A	
iv. Sedimentation by hydrometer	Pt 2 : 9.5			U
2. CHEMICAL TESTS	BS 1377-3:2018			
ii. Mass loss on ignition	Pt 3 : 4			U
3. COMPACTION RELATED TESTS	BS 1377-4:1990			
3.1 Dry density/moisture relationship				
i. 2.5kg rammer – 1 litre mould	Pt 4 : 3		A	
- CBR mould	Pt 4 : 3		A	
ii. 4.5kg rammer – 1 litre mould	Pt 4 : 3		A	
- CBR mould	Pt 4 : 3		A	
3.2 Moisture Condition Value				
i. Single point test	Pt 4 : 5.4			U
ii. MCV/moisture content relationship	Pt 4 : 5.5			U
3.3 California Bearing Ratio				
i. Undisturbed sample	Pt 5 : 7		A	
ii. Recompacted sample	Pt 5 : 7		A	
iii. Soaked, inc measurement of swell	Pt 5 : 7		A	
4. COMPRESSIBILITY OF SOIL	BS 1377-5:1990			
i. One dimensional consolidation	Pt 5 : 3		A	
ii. Swelling pressure test	Pt 5 : 3			U
5. SHEAR STRENGTH OF SOIL	BS 1377-7:1990			
i. Hand shear vane	Makers instructions			U
ii. Shear box (100mm square sample)	BS 1377 : Pt 7 : 4			U
iii. Triaxial – quick undrained	BS 1377 : Pt 7 : 8, 9		A	
6. PERMEABILITY				
i. Falling head	K. H. Head Vol 2			U
ii. Constant head	BS 1377 : Pt 6 : 6			U
iii Triaxial cell	BS 1377 : Pt 6 : 6			U
7. ROCK TESTS				
7.1 Classification Tests				
i. Natural moisture content	-			U
ii. Saturated moisture content	-			U
iii. Natural density	-			U
iv. Porosity	-			U
7.2 Strength Tests				
i. Point load index	ISRM '85			U
ii. Uniaxial compression test	ISRM '81			U

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Disclaimer

The results reported herein relate only to the material supplied to the laboratory.



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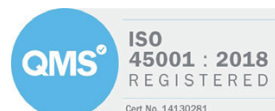


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GEOTECHNICAL TESTING RESULTS



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Summary of Classification Test Results

Project No.

Project Name

C3018/22/E/4562

Bolton Road, Bury

[illegible]

All tests performed in accordance with BS EN ISO 17892 unless specified otherwise

Key	Value
1	1
2	2
3	3
4	4
5	5
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100	100

Density test

Linear measurement unless :

wd - water displacement

wi - immersion in water

Liquid Limit

4pt cone unless :

cas - Casagrande method

1pt - single point test

Particle density

sp - small pyknometer

qi - gas iar

Date Printed

27/02/2023

Approved By	
-------------	--

Harry

Table
1

sheet
1



Rogers Geotechnical Services Ltd.
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HD8 8LU

Classification of Index Properties

C3018/22/E/4562

Project Name: Bolton Road, Bury

BS EN ISO: 17892: Parts 1, 12

Fig. 2
Sheet. 1

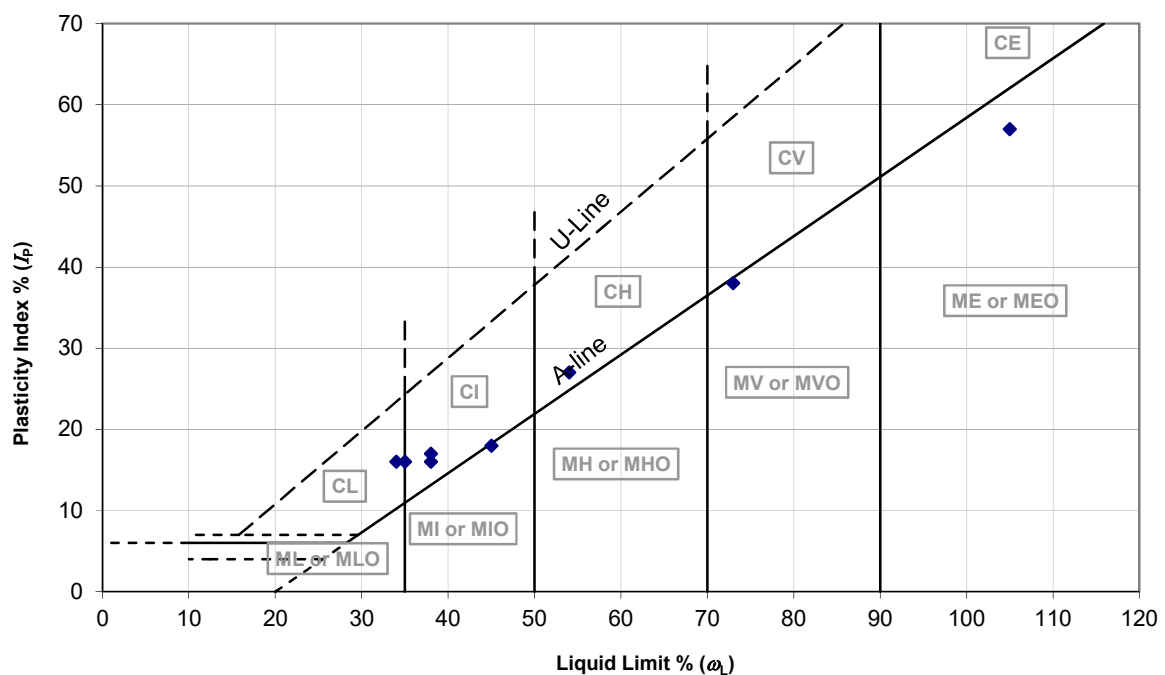
Location:

Input By: Harry

Client: Dr Afzal

Check By: Harry

Location	Depth (m)	Water Content (w) (%)	Liquid Limit (wL) (%)	Plastic Limit (wP) (%)	Plasticity Index (IP) (%)	Retained by 0.425mm (%)	Modified (w) (w') (%)	Modified (IP) (IP') (%)	Liquidity/ Consistency		Casagrande Class	N.H.B.C Class (%)
									(IL) (%)	(IC) (%)		
WS02	0.60	25.7	35	19	16	2	26	16	0.4	0.6	C I	LOW
WS02	0.80	27.9	38	22	16	4	29	15	0.4	0.6	C I	LOW
WS02	1.20	19.7	38	21	17	7	21	16	-0.1	1.1	C I	LOW
WS02	2.40	15.2	34	18	16	19	19	13	-0.2	1.2	C L	LOW
WS03	2.60	61.6	73	35	38	0	62	38	0.7	0.3	M V	MEDIUM
WS03	3.40	23.4	105	48	57	0	23	57	-0.4	1.4	M E	HIGH
WS04	1.60	38	45	27	18	0	38	18	0.6	0.4	M I	LOW
WS04	2.20	41	54	27	27	2	42	26	0.5	0.5	C H	MEDIUM





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ENVIRONMENTAL TESTING RESULTS



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Harry Letch

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t: 01484 604354

e: harry.leitch@rogersgeotech.co.uk

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 23-15006

Project / Site name: Bolton Road, Bury

Samples received on: 31/01/2023

Your job number: C3018-22-E-4562

**Samples instructed on/
Analysis started on:** 31/01/2023

Your order number: PO-2504

Analysis completed by: 07/02/2023

Report Issue Number: 1

Report issued on: 07/02/2023

Samples Analysed: 7 soil samples

Signed:

Joanna Wawrzeczko
Joanna Wawrzeczko
Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

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

Analytical Report Number: 23-15006
Project / Site name: Bolton Road, Bury

Lab Sample Number				2570935	2570936	2570937	2570938	2570939
Sample Reference				WS02	WS03	WS04	WS02	WS02
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20-0.30	0.40-0.60	0.80-1.00	1.00-1.45	2.00-2.45
Date Sampled				30/01/2023	30/01/2023	30/01/2023	24/01/2023	24/01/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	18	15	14	12	9.8
Total mass of sample received	kg	0.001	NONE	0.8	0.8	0.8	0.5	0.5

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	-	-
Asbestos Analyst ID	N/A	N/A	N/A	DSA	DSA	DSA	N/A	N/A

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	6.1	7.6	7.6	5.7	6.9
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Total Sulphate as SO ₄	%	0.005	MCERTS	0.06	0.068	0.046	-	-
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	16	75	12	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0079	0.037	0.0062	0.0093	0.0069
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	7.9	37.3	6.2	-	-
Organic Matter (automated)	%	0.1	MCERTS	5.5	5.4	6.2	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	0.15	< 0.05	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	-
Acenaphthene	mg/kg	0.05	MCERTS	0.37	< 0.05	< 0.05	-	-
Fluorene	mg/kg	0.05	MCERTS	0.22	< 0.05	< 0.05	-	-
Phenanthrene	mg/kg	0.05	MCERTS	2.7	1.2	0.48	-	-
Anthracene	mg/kg	0.05	MCERTS	0.55	0.28	0.09	-	-
Fluoranthene	mg/kg	0.05	MCERTS	4.5	1.9	0.5	-	-
Pyrene	mg/kg	0.05	MCERTS	4.2	1.7	0.51	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.9	0.85	0.23	-	-
Chrysene	mg/kg	0.05	MCERTS	1.8	0.84	0.23	-	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	1.7	0.87	0.19	-	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	1.1	0.29	0.08	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.7	0.67	< 0.05	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.82	0.35	< 0.05	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.21	< 0.05	< 0.05	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.1	0.52	< 0.05	-	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	22.7	9.6	2.31	-	-
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	25	17	10	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	-	-
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	95	39	24	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	660	67	23	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	16	27	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	32	20	22	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	95	83	56	-	-

Monoaromatics & Oxygenates

Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
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Analytical Report Number: 23-15006
Project / Site name: Bolton Road, Bury

Lab Sample Number				2570935	2570936	2570937	2570938	2570939
Sample Reference				WS02	WS03	WS04	WS02	WS02
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20-0.30	0.40-0.60	0.80-1.00	1.00-1.45	2.00-2.45
Date Sampled				30/01/2023	30/01/2023	30/01/2023	24/01/2023	24/01/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
p & m-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
o-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	-	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS 1D AL}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aliphatic >EC6 - EC8 _{HS 1D AL}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aliphatic >EC8 - EC10 _{HS 1D AL}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aliphatic >EC10 - EC12 _{EH CU 1D AL}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
TPH-CWG - Aliphatic >EC12 - EC16 _{EH CU 1D AL}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	-	-
TPH-CWG - Aliphatic >EC16 - EC21 _{EH CU 1D AL}	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	-
TPH-CWG - Aliphatic >EC21 - EC35 _{EH CU 1D AL}	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	-
TPH-CWG - Aliphatic (EC5 - EC35) _{EH CU+HS 1D AL}	mg/kg	10	NONE	< 10	< 10	< 10	-	-

TPH-CWG - Aromatic >EC5 - EC7 _{HS 1D AR}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aromatic >EC7 - EC8 _{HS 1D AR}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aromatic >EC8 - EC10 _{HS 1D AR}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aromatic >EC10 - EC12 _{EH CU 1D AR}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
TPH-CWG - Aromatic >EC12 - EC16 _{EH CU 1D AR}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	-	-
TPH-CWG - Aromatic >EC16 - EC21 _{EH CU 1D AR}	mg/kg	10	MCERTS	10	< 10	< 10	-	-
TPH-CWG - Aromatic >EC21 - EC35 _{EH CU 1D AR}	mg/kg	10	MCERTS	18	< 10	< 10	-	-
TPH-CWG - Aromatic (EC5 - EC35) _{EH CU+HS 1D AR}	mg/kg	10	NONE	29	< 10	< 10	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 23-15006
Project / Site name: Bolton Road, Bury

Lab Sample Number				2570940	2570941
Sample Reference				WS04	WS04
Sample Number				None Supplied	None Supplied
Depth (m)				2.00-2.45	3.00-3.45
Date Sampled				24/01/2023	24/01/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	19	15
Total mass of sample received	kg	0.001	NONE	0.5	0.5

Asbestos in Soil	Type	N/A	ISO 17025	-	-
Asbestos Analyst ID	N/A	N/A	N/A	N/A	N/A

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.3	7.4
Free Cyanide	mg/kg	1	MCERTS	-	-
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0066	0.023
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-
Organic Matter (automated)	%	0.1	MCERTS	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	-	-
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-
Chromium (hexavalent)	mg/kg	1.8	MCERTS	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-

Monoaromatics & Oxygenates

Benzene	µg/kg	5	MCERTS	-	-
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Analytical Report Number: 23-15006
Project / Site name: Bolton Road, Bury

Lab Sample Number				2570940	2570941
Sample Reference				WS04	WS04
Sample Number				None Supplied	None Supplied
Depth (m)				2.00-2.45	3.00-3.45
Date Sampled				24/01/2023	24/01/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Toluene	µg/kg	5	MCERTS	-	-
Ethylbenzene	µg/kg	5	MCERTS	-	-
p & m-xylene	µg/kg	5	MCERTS	-	-
o-xylene	µg/kg	5	MCERTS	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 HS_1D_AL	mg/kg	0.001	NONE	-	-
TPH-CWG - Aliphatic >EC6 - EC8 HS_1D_AL	mg/kg	0.001	NONE	-	-
TPH-CWG - Aliphatic >EC8 - EC10 HS_1D_AL	mg/kg	0.001	NONE	-	-
TPH-CWG - Aliphatic >EC10 - EC12 EH_CU_1D_AL	mg/kg	1	MCERTS	-	-
TPH-CWG - Aliphatic >EC12 - EC16 EH_CU_1D_AL	mg/kg	2	MCERTS	-	-
TPH-CWG - Aliphatic >EC16 - EC21 EH_CU_1D_AL	mg/kg	8	MCERTS	-	-
TPH-CWG - Aliphatic >EC21 - EC35 EH_CU_1D_AL	mg/kg	8	MCERTS	-	-
TPH-CWG - Aliphatic (EC5 - EC35) EH_CU+HS_1D_AL	mg/kg	10	NONE	-	-

TPH-CWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.001	NONE	-	-
TPH-CWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.001	NONE	-	-
TPH-CWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.001	NONE	-	-
TPH-CWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	-	-
TPH-CWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	-	-
TPH-CWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	-	-
TPH-CWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	-	-
TPH-CWG - Aromatic (EC5 - EC35) EH_CU+HS_1D_AR	mg/kg	10	NONE	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 23-15006

Project / Site name: Bolton Road, Bury

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2570935	WS02	None Supplied	0.20-0.30	Brown clay and sand with gravel and vegetation.
2570936	WS03	None Supplied	0.40-0.60	Brown clay and sand with gravel.
2570937	WS04	None Supplied	0.80-1.00	Brown clay and sand with gravel and vegetation.
2570938	WS02	None Supplied	1.00-1.45	Brown clay and sand with gravel.
2570939	WS02	None Supplied	2.00-2.45	Brown clay and sand with gravel.
2570940	WS04	None Supplied	2.00-2.45	Brown clay and sand with gravel.
2570941	WS04	None Supplied	3.00-3.45	Brown clay and sand with gravel.

Analytical Report Number : 23-15006

Project / Site name: Bolton Road, Bury

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260	L0738-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

Analytical Report Number : 23-15006
Project / Site name: Bolton Road, Bury

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

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Analytical Report Number : 23-15006

Project / Site name: Bolton Road, Bury

Samples received on: 31/01/2023

Your job number: C3018-22-E-4562

**Samples instructed on/
Analysis started on:** 31/01/2023

Your order number: PO-2504

Analysis completed by: 07/02/2023

Report Issue Number: 1

Report issued on: 07/02/2023

Samples Analysed: 7 soil samples

Signed:

Joanna Wawrzeczko
Joanna Wawrzeczko
Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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

Analytical Report Number: 23-15006
Project / Site name: Bolton Road, Bury

Lab Sample Number				2570935	2570936	2570937	2570938	2570939
Sample Reference				WS02	WS03	WS04	WS02	WS02
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20-0.30	0.40-0.60	0.80-1.00	1.00-1.45	2.00-2.45
Date Sampled				30/01/2023	30/01/2023	30/01/2023	24/01/2023	24/01/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	18	15	14	12	9.8
Total mass of sample received	kg	0.001	NONE	0.8	0.8	0.8	0.5	0.5

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	-	-
Asbestos Analyst ID	N/A	N/A	N/A	DSA	DSA	DSA	N/A	N/A

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	6.1	7.6	7.6	5.7	6.9
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Total Sulphate as SO ₄	%	0.005	MCERTS	0.06	0.068	0.046	-	-
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	16	75	12	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0079	0.037	0.0062	0.0093	0.0069
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	7.9	37.3	6.2	-	-
Organic Matter (automated)	%	0.1	MCERTS	5.5	5.4	6.2	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	0.15	< 0.05	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	-	-
Acenaphthene	mg/kg	0.05	MCERTS	0.37	< 0.05	< 0.05	-	-
Fluorene	mg/kg	0.05	MCERTS	0.22	< 0.05	< 0.05	-	-
Phenanthrene	mg/kg	0.05	MCERTS	2.7	1.2	0.48	-	-
Anthracene	mg/kg	0.05	MCERTS	0.55	0.28	0.09	-	-
Fluoranthene	mg/kg	0.05	MCERTS	4.5	1.9	0.5	-	-
Pyrene	mg/kg	0.05	MCERTS	4.2	1.7	0.51	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.9	0.85	0.23	-	-
Chrysene	mg/kg	0.05	MCERTS	1.8	0.84	0.23	-	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	1.7	0.87	0.19	-	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	1.1	0.29	0.08	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.7	0.67	< 0.05	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.82	0.35	< 0.05	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.21	< 0.05	< 0.05	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.1	0.52	< 0.05	-	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	22.7	9.6	2.31	-	-
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	25	17	10	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	-	-
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	95	39	24	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	660	67	23	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	16	27	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	32	20	22	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	95	83	56	-	-

Monoaromatics & Oxygenates

Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
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Analytical Report Number: 23-15006
Project / Site name: Bolton Road, Bury

Lab Sample Number				2570935	2570936	2570937	2570938	2570939
Sample Reference				WS02	WS03	WS04	WS02	WS02
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20-0.30	0.40-0.60	0.80-1.00	1.00-1.45	2.00-2.45
Date Sampled				30/01/2023	30/01/2023	30/01/2023	24/01/2023	24/01/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
p & m-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
o-xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	-	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS,1D,AL}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aliphatic >EC6 - EC8 _{HS,1D,AL}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aliphatic >EC8 - EC10 _{HS,1D,AL}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aliphatic >EC10 - EC12 _{EH,CU,1D,AL}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
TPH-CWG - Aliphatic >EC12 - EC16 _{EH,CU,1D,AL}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	-	-
TPH-CWG - Aliphatic >EC16 - EC21 _{EH,CU,1D,AL}	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	-
TPH-CWG - Aliphatic >EC21 - EC35 _{EH,CU,1D,AL}	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	-
TPH-CWG - Aliphatic (EC5 - EC35) _{EH,CU+HS,1D,AL}	mg/kg	10	NONE	< 10	< 10	< 10	-	-

TPH-CWG - Aromatic >EC5 - EC7 _{HS,1D,AR}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aromatic >EC7 - EC8 _{HS,1D,AR}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aromatic >EC8 - EC10 _{HS,1D,AR}	mg/kg	0.001	NONE	< 0.001	< 0.001	< 0.001	-	-
TPH-CWG - Aromatic >EC10 - EC12 _{EH,CU,1D,AR}	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
TPH-CWG - Aromatic >EC12 - EC16 _{EH,CU,1D,AR}	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	-	-
TPH-CWG - Aromatic >EC16 - EC21 _{EH,CU,1D,AR}	mg/kg	10	MCERTS	10	< 10	< 10	-	-
TPH-CWG - Aromatic >EC21 - EC35 _{EH,CU,1D,AR}	mg/kg	10	MCERTS	18	< 10	< 10	-	-
TPH-CWG - Aromatic (EC5 - EC35) _{EH,CU+HS,1D,AR}	mg/kg	10	NONE	29	< 10	< 10	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 23-15006
Project / Site name: Bolton Road, Bury

Lab Sample Number				2570940	2570941
Sample Reference				WS04	WS04
Sample Number				None Supplied	None Supplied
Depth (m)				2.00-2.45	3.00-3.45
Date Sampled				24/01/2023	24/01/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	19	15
Total mass of sample received	kg	0.001	NONE	0.5	0.5

Asbestos in Soil	Type	N/A	ISO 17025	-	-
Asbestos Analyst ID	N/A	N/A	N/A	N/A	N/A

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.3	7.4
Free Cyanide	mg/kg	1	MCERTS	-	-
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	-	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0066	0.023
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-
Organic Matter (automated)	%	0.1	MCERTS	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	-	-
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	-
Chromium (hexavalent)	mg/kg	1.8	MCERTS	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	-

Monoaromatics & Oxygenates

Benzene	µg/kg	5	MCERTS	-	-
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Analytical Report Number: 23-15006
Project / Site name: Bolton Road, Bury

Lab Sample Number				2570940	2570941
Sample Reference				WS04	WS04
Sample Number				None Supplied	None Supplied
Depth (m)				2.00-2.45	3.00-3.45
Date Sampled				24/01/2023	24/01/2023
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Toluene	µg/kg	5	MCERTS	-	-
Ethylbenzene	µg/kg	5	MCERTS	-	-
p & m-xylene	µg/kg	5	MCERTS	-	-
o-xylene	µg/kg	5	MCERTS	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	-	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 HS_1D_AL	mg/kg	0.001	NONE	-	-
TPH-CWG - Aliphatic >EC6 - EC8 HS_1D_AL	mg/kg	0.001	NONE	-	-
TPH-CWG - Aliphatic >EC8 - EC10 HS_1D_AL	mg/kg	0.001	NONE	-	-
TPH-CWG - Aliphatic >EC10 - EC12 EH_CU_1D_AL	mg/kg	1	MCERTS	-	-
TPH-CWG - Aliphatic >EC12 - EC16 EH_CU_1D_AL	mg/kg	2	MCERTS	-	-
TPH-CWG - Aliphatic >EC16 - EC21 EH_CU_1D_AL	mg/kg	8	MCERTS	-	-
TPH-CWG - Aliphatic >EC21 - EC35 EH_CU_1D_AL	mg/kg	8	MCERTS	-	-
TPH-CWG - Aliphatic (EC5 - EC35) EH_CU+HS_1D_AL	mg/kg	10	NONE	-	-

TPH-CWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.001	NONE	-	-
TPH-CWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.001	NONE	-	-
TPH-CWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.001	NONE	-	-
TPH-CWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	MCERTS	-	-
TPH-CWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	MCERTS	-	-
TPH-CWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	MCERTS	-	-
TPH-CWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	MCERTS	-	-
TPH-CWG - Aromatic (EC5 - EC35) EH_CU+HS_1D_AR	mg/kg	10	NONE	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 23-15006

Project / Site name: Bolton Road, Bury

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2570935	WS02	None Supplied	0.20-0.30	Brown clay and sand with gravel and vegetation.
2570936	WS03	None Supplied	0.40-0.60	Brown clay and sand with gravel.
2570937	WS04	None Supplied	0.80-1.00	Brown clay and sand with gravel and vegetation.
2570938	WS02	None Supplied	1.00-1.45	Brown clay and sand with gravel.
2570939	WS02	None Supplied	2.00-2.45	Brown clay and sand with gravel.
2570940	WS04	None Supplied	2.00-2.45	Brown clay and sand with gravel.
2570941	WS04	None Supplied	3.00-3.45	Brown clay and sand with gravel.

Analytical Report Number : 23-15006

Project / Site name: Bolton Road, Bury

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260	L0738-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

Analytical Report Number : 23-15006

Project / Site name: Bolton Road, Bury

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total



< ENVIRONMENTAL > < GEOTECHNICAL >

End of Report



Environmental
Geotechnical
Specialists

Rogers Geotechnical Services Ltd
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☎ 01484 604354 Company No. 5130864



Rogers Geotechnical Services: Soil Screening Values Comparison Sheet



Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet													
Job Number	C3018/22/E/4562			A = WS Atkins PLC, Atrisk Soil Screening Values. A+ = Values updated June 2017. A* = Atrisk's SSV is lower than Chemtest's detectable limit for this compound. B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report. C = Category 4 Screening Levels (C4SLs) based on 6% soil organic matter. D = Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known KEY Exceeds SSV Exceeds 2017, Below 2015 Below limit of detection (LOD) KEY Exceeds SSV Exceeds 2017, Below 2015 Below limit of detection (LOD)									
Job Name	Bolton Road, Bury												
Date	20/03/2023			Sample Location	WS02	WS03	WS04	WS02	WS02	WS04	WS04		
Client	Dr Nazir			Depth Top	0.2	0.4	0.8	1.00	2.00	2.00	3.00		
				Depth Base	0.30	0.60	1.00	1.45	2.45	2.45	3.45		
Determinand	Units	Ref	LOD	Residential With Plant Uptake 6%									
				Atrisk 2015 (No Free Product)	Atrisk 2017								
Cadmium	mg/kg	C	0.20		22.1	< 0.2	< 0.2	< 0.2					
Chromium (Hexavalent)	mg/kg	B/C	1.80	20.5	3.62	< 1.8	< 1.8	< 1.8					
Copper	mg/kg	A+	1.00		4790	95	39	24					
Mercury	mg/kg	A/D	0.30		15.8	< 0.3	< 0.3	< 0.3					
Nickel	mg/kg	A+	1.00		136	17	16	27					
Lead	mg/kg	C	1.00		200	660	67	23					
Zinc	mg/kg	A+	1.00		20300	95	83	56					
Vanadium	mg/kg	A+	1.00		138	32	20	22					
Arsenic	mg/kg	C	1.0		37	25	17	10					
Selenium	mg/kg	A	1.00		375	< 1.0	< 1.0	< 1.0					
Cyanide (Free)	mg/kg	A	1.00		34	< 1.0	< 1.0	< 1.0					
Total Phenols	mg/kg	A	1.00		1200	< 1.0	< 1.0	< 1.0					
Naphthalene	mg/kg	A+	0.05	0	12.2	< 0.05	0.15	< 0.05					
Acenaphthylene	mg/kg		0.05			< 0.05	< 0.05	< 0.05					
Acenaphthene	mg/kg	A+	0.05	0	2760	0.37	< 0.05	< 0.05					
Fluorene	mg/kg	A+	0.05	0	2610	0.22	< 0.05	< 0.05					
Phenanthrene	mg/kg		0.05			2.7	1.2	0.48					
Anthracene	mg/kg	A+	0.05	0	26200	0.55	0.28	0.09					
Fluoranthene	mg/kg	A+	0.05		2980	4.5	1.9	0.5					
Pyrene	mg/kg	A+	0.05		2120	4.2	1.7	0.51					
Benzo[a]anthracene	mg/kg	A	0.05	0	8.54	1.9	0.85	0.23					
Chrysene	mg/kg	A	0.05	927	2.64	1.8	0.84	0.23					
Benzo[b]fluoranthene	mg/kg	A	0.05	9.86	7.29	1.7	0.87	0.19					
Benzo[k]fluoranthene	mg/kg	A	0.05	100	4.12	1.1	0.29	0.08					
Benzo[a]pyrene	mg/kg	B/C	0.05	5	0.998	1.7	0.67	< 0.05					
Indeno(1,2,3-c,d)Pyrene	mg/kg	A*	0.05	9.75	0.368	0.82	0.35	< 0.05					
Dibenz(a,h)Anthracene	mg/kg	A	0.05	4.95	2.05	0.21	< 0.05	< 0.05					
Benzo[g,h,i]perylene	mg/kg	A	0.05	103	0.112	1.1	0.52	< 0.05					
Total Of 16 PAH's	mg/kg		2.0										
Aliphatic TPH >C5-C6	mg/kg	A+	0.001	0	369	< 0.001	< 0.001	< 0.001					
Aliphatic TPH >C6-C8	mg/kg	A+	0.001	1240	768	< 0.001	< 0.001	< 0.001					
Aliphatic TPH >C8-C10	mg/kg	A+	0.001	0	204	< 0.001	< 0.001	< 0.001					
Aliphatic TPH >C10-C12	mg/kg	A+	1.0	1180	297	< 1.0	< 1.0	< 1.0					
Aliphatic TPH >C12-C16	mg/kg	A+	2.0	4130	125	< 2.0	< 2.0	< 2.0					
Aliphatic TPH >C16-C21	mg/kg	A+	8.0		210100	< 8.0	< 8.0	< 8.0					
Aliphatic TPH >C21-C35	mg/kg	A+	8.0		210100	< 8.0	< 8.0	< 8.0					
Total Aliphatic Hydrocarbons	mg/kg		10			< 10	< 10	< 10					
Aromatic TPH >C5-C7	mg/kg	A+	0.001		0.871	< 0.001	< 0.001	< 0.001					
Aromatic TPH >C7-C8	mg/kg	A+	0.001	0	780	< 0.001	< 0.001	< 0.001					



Rogers Geotechnical Services: Soil Screening Values Comparison Sheet



Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet														
Job Number	C3018/22/E/4562			A = WS Atkins PLC, Atrisk Soil Screening Values. A+ = Values updated June 2017. A* = Atrisk's SSV is lower than Chemtest's detectable limit for this compound. B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report. C = Category 4 Screening Levels (C4SLs) based on 6% soil organic matter. D = Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known					KEY Exceeds SSV Exceeds 2017, Below 2015 Below limit of detection (LOD)			KEY Exceeds SSV Exceeds 2017, Below 2015 Below limit of detection (LOD)		
Job Name	Bolton Road, Bury													
Date	20/03/2023			Sample Location	WS02	WS03	WS04	WS02	WS02	WS04	WS04			
Client	Dr Nazir			Depth Top	0.2	0.4	0.8	1.00	2.00	2.00	3.00			
				Depth Base	0.30	0.60	1.00	1.45	2.45	2.45	3.45			
Determinand	Units	Ref	LOD	Residential With Plant Uptake 6%										
Aromatic TPH >C8-C10	mg/kg	A+	0.001		232	< 0.001	< 0.001	< 0.001						
Aromatic TPH >C10-C12	mg/kg	A+	1.0		468	< 1.0	< 1.0	< 1.0						
Aromatic TPH >C12-C16	mg/kg	A+	2.0	830	830	< 2.0	< 2.0	< 2.0						
Aromatic TPH >C16-C21	mg/kg	A+	10		1040	10	< 10	< 10						
Aromatic TPH >C21-C35	mg/kg	A+	10		1710	18	< 10	< 10						
Total Aromatic Hydrocarbons	mg/kg		10			29	< 10	< 10						
Total Petroleum Hydrocarbons	mg/kg		10.0			22.7	9.6	2.31						
pH			N/A			6.1	7.6	7.6	5.7	6.9	7.3	7.4		
Sulphate (2:1 Water Soluble) as SO4	g/l		0.00125			0.0079	0.037	0.0062	0.0093	0.0069	0.0066	0.023		
ACM Type			N/A											
Asbestos Identification	%		0.001			Not-detected	Not-detected	Not-detected						
ACM Detection Stage			N/A											
Moisture	%		0.01			18	15	14	12	9.8	19	15		
Sulphate (Total)	%		0.005			0.06	0.068	0.046	-	-	-	-		
Organic Matter	%		0.10			5.5	5.4	6.2						

Appendix 6

Fill Screening Values

Rogers Geotechnical Services Ltd.

Atkins ATRISK Soil Screening Values (SSVs) - Residential With Plant Uptake Landuse

Tox Data Report No.	Compound	Residential with Homegrown Produce Landuse (mg/kg)				Reference
	<i>Metals</i>	SOM: 1%		SOM: 6%		
3	Cadmium	22.1		22.1		C
4	Chromium VI	3.62	20.5	3.62	20.5	B/C
	Copper	4730		4790		A+
7	Mercury	8.81		15.80		A/D
8	Nickel	136		136		A+
	Lead	200		200		C
	Zinc	20000		20300		A+
	Vanadium	136		138		A+
	<i>Semi and Non Metals</i>					
1	Arsenic	37		37		C
10	Selenium	375		375		A
	Free Cyanide	34		34		A
9	Phenols (total)	267		1200		A
	<i>Poly Aromatic Hydrocarbons</i>	Free product	No free product	Free product	No free product	
20	Napthalene	0.829		12.2		A+
	Acenaphthene	157	608	2760		A+
	Fluorene	735		2610		A+
	Anthracene	10200		26200		A+
	Fluoranthene	983		2980		A+
	Pyrene	668		2120		A+
	Benzo(a)anthracene	1.71	4.52	8.54		A
2	Chrysene	0.44	585	2.64	927	A
2	Benzo(b)fluoranthene	1.22	7.72	7.29	9.86	A
2	Benzo(k)fluoranthene	0.686	84.4	4.12	100	A
2	Benzo(a)pyrene	1.51	4.95	0.998	5	B/C
2	Dibenzo(a,h)anthracene	0.00393	0.838	2.05	4.95	A*
2	Indeno(1,2,3-cd)pyrene	0.0614	7.31	0.368	9.75	A
2	Benzo(g,h,i)perylene	0.0187	96.2	0.112	103	A
	<i>Petroleum Hydrocarbons</i>					
	Aliphatic C5-C6	42.7		369		A+
	Aliphatic C6-C8	99.3		768	1240	A+
	Aliphatic C8-C10	13.9		204		A+
	Aliphatic C10-C12	49.9	81.7	297	1180	A+
	Aliphatic C12-C16	20.9	385	125	4130	A+
	Aliphatic C16-C21	210000		210100		A+
	Aliphatic C21-C35	210000		210100		A+
	Aromatic C5-C7 (Benzene)	0.137		0.871		A+
	Aromatic C7-C8 (Toluene)	113		780		A+
	Aromatic C8-C10	20.5		232		A+
	Aromatic C10-C12	70		468		A+
	Aromatic C12-C16	155	165	830		A+
	Aromatic C16-C21	319		1040		A+
	Aromatic C21-C35	1120		1710		A+
A+ = Values update June 2017.						
A* Atrisk's SSV is lower than Chemtest's detectable limit for this compound.						
B = Health Criterion Values (available from toxicological reviews published in the C4SL project methodology report).						
C = Category 4 Screening Levels (C4SLs).						
D = SSV provided is for Methyl Mercury.						