Environmental
Geotechnical
Specialists

REPORT

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GEOTECHNICAL ENVIRONMENTAL

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REPORT ON A GEO-ENVIRONMENTAL INVESTIGATION

at

348A LEEDS ROAD, HOWDEN CLOUGH, BIRSTALL WF17 OHY

for

PLANNED CONTRACTS

CONSULTANTS: JNP GROUP.

Report No J3546/16/E **August 2016**

1. SYNOPSIS

This investigation has demonstrated that below a surface capping of topsoil, generally natural firm slightly silty clay was encountered across the site to depths of around 1.3m to 7.8m below ground level (bgl). In addition, made ground was encountered between 0.6m and 1.1m bgl within TP3, TP5 and TP8 and organic clay within TP4. Beneath the natural superficial deposits, the weathered fraction of mudstone was revealed to the termination depths of all trailpits. In addition, rotary open-hole probing encountered strata comprising mudstones with sub-ordinate sandstone and coal seams of the Pennine Lower Coal Measures Formation to the termination of all exploratory boreholes. A void and poor ground conditions were encountered beneath the site at around 10m to 11.8m bgl (BH3).

It is understood that the proposed development is to include the construction of seventeen residential properties with associated garden, access road and hard-standing areas. In view of the above, it is considered that the proposed structures could be founded on shallow strip and spread foundations located within the natural firm slightly silty clay at depths of about 1.2m and 1.5m below ground level (bgl). However, these depths may need to be extended to cater for high volume change potential of the natural clay beneath the site.

In addition, chemical testing has revealed elevated concentrations of a range of contaminants within the soils at the site. Therefore, the site is considered to be generally contaminated with respect to its intended residential with home grown produce end use. In view of the above, it is recommended that careful consideration is given to the environmental discussion.

2. INTRODUCTION

It is understood that the client proposes to develop 348a Leeds Road, Howden Clough, Birstall by the construction of seventeen residential properties with associated garden, access road and hard-standing areas.

Consequently, a site investigation has been undertaken in accordance with instructions received from JNP Group on behalf of 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. Additionally, chemical testing of the topsoil and made ground has been undertaken to enable an assessment of the levels of contamination at this site.

This report presents the data obtained and discusses the ground conditions in relation to the proposed development.

3. 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.

4. DESK STUDY

A Phase 1 Desk Study has been undertaken by JNP Group and the results were presented as report number B21060/GEO-PH1 dated 19th April 2016. The report has been used extensively during the current intrusive investigation.

5. FIELDWORKS

The fieldworks were undertaken from the 19th to the 25th July and the 3rd August 2016 and included the following:

- Three rotary open-hole probing boreholes
- Eight machine excavated trialpits
- Three soakaway tests
- Three gas monitoring standpipes

- Four TRL probe tests

The investigatory locations are shown on the site plan, which is presented in Appendix 1 to this report. The major details of this drawing were obtained from an illustrative plan supplied by the client.

5.1 Rotary Open-Hole Boreholes

Three rotary open-hole boreholes to depths of between 13.5m and 30m were undertaken across the site at locations indicated on the site plan (Appendix 1), in the area suspected to contain workable coal seams and potentially unrecorded mine workings at shallow depths. The investigation was undertaken employing a RGS001 track-mounted rotary drilling rig, using rotary open-hole techniques employing 140mm diameter drag and tricone roller bits. Where necessary, 150mm diameter casing was temporarily installed in 1.5m lengths to support the bore, with a toothed lead section being utilised to assist with reaming. Drill chippings brought to surface in the flush returns were inspected by the driller on a screen, which forms part of the re-circulation tanks. The investigation was undertaken employing water flushing techniques in accordance with the Coal Authority and Health and Safety Executive positioning statement.

The borehole positions are shown on the site plan, which is presented in Appendix 1 and the strata conditions are presented on the borehole records in Appendix 2.

In order to undertake this investigation it was necessary to obtain permission to enter or disturb Coal Authority interests. A Coal Authority permit number 12556 was obtained prior to the commencement of the works and is presented in Appendix 2.

5.2 Machine Excavated Trialpits

Eight trialpits (TP1 to TP8) were excavated between depths of 1.4m and 2.8m below ground level (bgl) in order to reveal the nature of the near surface soils and to undertake soakaway tests, using a JCB 3CX back acting excavator, at positions shown on the site plan. The exposed soils were sampled and logged on site in general accordance with BS5930: 2015 and full descriptions are given on the trialpit records, which are presented in Appendix 3. Samples were taken from the trialpits for testing, where deemed necessary. In order to undertake the soakaway tests, the pit sides and base of TP4, TP5 and TP7 were cleaned and squared as much as practicable. Each pit was then filled with water and the level measured relative to a reference bar at set timed intervals.

Once excavations were completed, the trialpits were carefully re-instated with the arisings and capped with the removed turf. Whilst every care was taken to suitably re-compact the disturbed soils during the backfilling process, it should be appreciated that some mounding of the surface may have resulted. Moreover, the backfilled soils may be subjected to settlement over time, such that a depression in the surface may also occur. Therefore, the locations of any pits undertaken in this investigation should be conveyed to the current site user, as the mounds or depressions associated with the pits may present a risk to current site activities. Furthermore, it must be realised that the in-filled pits represent an area of disturbance within

the site soils, thus the soils at the pit locations may vary characteristically compared to the undisturbed ground. As such, foundations placed in this disturbed material may not perform as anticipated.

5.3 Monitoring Standpipes

Monitoring standpipes were installed in three of the boreholes: BH1, BH2 and BH3 respectively. The detail of each installation is shown on the appropriate borehole record. The standpipes consisted of a perforated pipe from the base to depths of 1.0m below ground level, 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. In addition, given the nature of near surface fine soils, a geosock was fitted over the slotted pipe to reduce siltation.

5.4 TRL Dynamic Probes

TRL Dynamic Cone Penetrometer tests were undertaken at locations indicated on the site plan presented in Appendix 1. The penetrometer consists of an 8kg mass falling through 575mm onto an anvil, which drives a 20mm diameter 60° cone into the ground. The depth the cone is driven per blow is recorded. The results of the dynamic penetration tests are presented as Appendix 4 and include graphs of penetration blows and CBR values versus depth. The percentage CBR value has been obtained from the correlation provided in TRRL Road Note 8 which is given below:

$$Log_{10}(CBR) = 2.48 – 1.057Log_{10}(mm/blow)$$

6. 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[1]	Previous Name[2]	Description[2]
Superficial Geology	None Recorded		
Solid Geology	Pennine Lower Coal Measures Formation (PLCM)	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.

[1] Sources: British Geological Survey (NERC) Map Sheets 77; Huddersfield; Solid and Drift Edition, Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[2] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

The available geological data indicates that the site is underlain by strata belonging to the Pennine Lower Coal Measures Formation. The inferred outcrops of several coal seams are shown close to the site. It should be appreciated that no superficial deposits are indicated to be present across the site. However, alluvial deposits are shown to be present approximately 150m to the southwest of the site and artificial ground approximately 130m to the northwest.

No faults are shown across the site although a northeast trending fault is indicated to be present approximately 40m to the south of the site, co-incident with the present Leeds Road.

7. 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)	Strata type	Positions present	Groundwater strikes (m)
0.15 – 0.90	TOPSOIL	All except TP5.	None
0.60	MADE GROUND (Cohesive)	TP3	None
0.60 – 1.10	MADE GROUND (Granular)	TP3, TP5 and TP8	None
0.86	Clayey organic SAND	TP4	None
1.30 – 7.80	Generally slightly silty CLAY	All	None
+1.40 – +2.70	MUDSTONE (Weathered)	All trialpits except TP4	None
+13.50 – +30.00	Predominantly MUDSTONE with subordinate layers of coal and sandstone including void and poor ground.	BH1, BH2 and BH3	None

'+' 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.

7.1 General Lithology

The site was generally covered by a 150mm to 900mm thick capping of topsoil generally comprising brown organic slightly clayey silty sand, except at position TP5 where granular made ground was encountered at surface to 1.10m bgl.

Upon penetrating the topsoil at the locations of TP3 and TP8, cohesive and granular made ground was revealed to depths of between 0.6m and 1.1m bgl. However, at all other locations, deposits of predominantly slightly silty, occasionally friable clay were encountered beneath the capping of topsoil to depths of between 1.3m and 7.8m. It is considered that this cohesive natural material represents the weathered fraction of strata belonging to the underlying Pennine Lower Coal Measures Formation.

Beneath the natural cohesive deposits, a thick sequence of mudstone with subordinate layers of sandstone and coal seams was revealed to the base of all rotary boreholes between 13.5m and 30.0m bgl. Layers of coal varying between 0.1m and 1.4m thick were encountered at depths of between 7.3m and 14.8m within all of the rotary boreholes. This sequence is considered to be representative of the solid geology anticipated to underlie the site.

However, it should be noted that the progression of drilling was terminated within both BH1 and BH3 due to complete loss of water flush and returns at depths of between 10.0m (BH3) and 15.2m (BH1) bgl. At position BH3, a void was encountered between 10.0m and 10.2m bgl followed by self-weight drilling to 11.8m bgl, after which resistance to drilling was encountered to the base of the borehole. In contrast, loss of flush and returns within BH1 was accompanied by drilling resistance to borehole termination. Both boreholes were terminated due to lack of water flush at the drill head.

It is considered that the void and accompanying poor ground conditions (up to 1.8m in total) encountered within BH3 could represent shallow mine workings. In contrast, the poor ground conditions revealed within BH1 from 15.2m bgl may be due to fractured rock.

7.2 Groundwater

No groundwater strikes were observed during the site investigation. However, 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.

8. INSITU TESTING

8.1 TRL Dynamic Probes

TRL dynamic probes were undertaken at locations indicated on the site plan presented in Appendix 1, in areas of proposed access roads and hard-standing. It should be appreciated that the initial recorded depth given on the logs represents self-weight penetration from surface (within garden areas). In this instance, the TRL dynamic probes revealed the presence of variable weak near surface soils indicating a CBR of 1% to 2% within the top 138mm to 153mm at the positions tested. From these depths the probe results indicated higher CBR values with increasing depth, for example the results indicate the following:

- CBR of 9% at 0.2m depth in TRL1
- CBR of 16% at 0.23m depth in TRL2
- CBR of 12% at 0.22m depth in TRL3
- CBR of 11% at 0.27m depth in TRL4

8.2 Gas and Water Level Monitoring

The standpipes were monitored during the period 9th to 25th August 2016. The results of the gas monitoring undertaken to date are tabulated below.

Table 3: ***Ground gas/water level monitoring***

Borehole No	Date	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow (l/hr)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
BH1	09.08.16	0.0	3.5	16.6	0.2	1008	2.60	2.90
	18.08.16	0.1	3.9	15.5	0.2	997	2.87	
	25.08.16	0.0	4.0	15.0	0.1	1002	2.90	
BH2	09.08.16	0.0	2.1	19.0	0.0	1009	-	2.80
	18.08.16	0.1	5.7	13.2	0.2	999	-	
	25.08.16	0.0	5.9	14.4	0.2	1003	-	
BH3	09.08.16	0.0	2.5	18.2	0.1	1009	3.80	3.98
	18.08.16	0.1	2.9	17.4	0.1	999	3.98	
	25.08.16	0.0	3.3	17.1	0.1	1003	-	

This work was undertaken using Geotechnical Instruments (UK) Ltd. GA5000, Serial No.G503450 which was last calibrated on the 8th August 2016.

8.3 Soakaway Tests

Soakaway tests were undertaken within three machine dug trialpits located at various positions across the site. The results obtained from the soakaway tests are presented in Appendix 5 and are summarised below:

Table 4: ***Soakaway test results***

TP	Depth (m)	Soakage Area Dimensions (average)	Soil Description (Base and side of trialpit within zone of test)	Infiltration Rate (m/sec)	Drainage Characteristics
TP4SA	2.60m	1.60m x 0.6m	Laminated CLAY (base) Slightly silty CLAY (side)	Not determined*	Practically impermeable
TP5SA	2.80m	1.50m x 0.6m	MUDSTONE (base) Slightly silty CLAY (sid	Not determined*	Practically impermeable
TP7SA	1.80m	1.65m x 0.6m	MUDSTONE (base) Friable CLAY (side)	Not determined*	Practically impermeable

* *N.B. Unable to obtain infiltration rate as 25% effective depth could not be achieved.*

During the soakaway tests, the water level did not achieve a fall from 75% to 25% of the effective depth of the storage volume in all trialpits. Extrapolation of these results, where

possible, by method of linear regression indicate that the underlying natural soils soils at the test depths are practically impermeable.

Given the above, it is not recommended that soakaway drainage be employed at this site within the material tested and consideration should be given to the utilisation of other methods of storm drainage design off site.

9. LABORATORY TESTING - GEOTECHNICAL

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

- Moisture content determinations — BS 1377: 1990: Pt2: 3.2
- Index properties (1 point) — BS 1377: 1990: Pt2: 4.4, 5.3 & 5.4
- Linear shrinkage — BS 1377: 1990: Pt2: 6.3
- Soluble sulphate content — BS 1377: 1990: Pt3: 5
- pH value — BS 1377: 1990: Pt3: 9
- California Bearing Ratio (CBR) — BS 1377: 1990: Pt4: 7.

The test results are presented in Appendix 6 and are summarised below:

Table 5: *Summary of geotechnical test results*

Test type	Number of tests	Range of results	Comments
Moisture content determinations	8	13 to 36%	Generally increasing with depth.
Index Properties	7 7	LL 37 to 71% PL 18 to 26% PI 19 to 45% LS 9 to 14%	Clay of intermediate to very high plasticity. Consistency index 0.4 to 1.3 NHBC Class – Negligible to high.
California Bearing Ratio	1	2.3 and 2.6% Average 2.4%	
Soluble sulphate & pH	7	SO_4 13 to 200 mg/l pH 3.8 to 7.8	DS-1; ACEC Class AC-1s

9.1 Geotechnical Properties

The idealised geotechnical properties employed in design are summarised below.

Table 6: *Summary of geotechnical properties*

Property	Range of values	Comments
Volume change potential (NHBC)	Negligible to high.	Orange mottled grey CLAY.
Shear strength parameters (at foundation level)	c_u 60kN/m^2 γ 19kN/m^3	Based on sample descriptions, indices and TRL probe results.
Concrete classification	DC1	Natural ground locations (static water).

10. 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 SO_4^{2-}.
- Asbestos Identification Testing

This testing was undertaken by Chemtest Ltd and the results of all of the chemical testing are presented in Appendix 7 of this report.

11. DISCUSSION OF GROUND CONDITIONS – GEOTECHNICAL

It is proposed to develop the site by the construction of seventeen residential properties with associated garden, access road and hard-standing areas. At the time of writing this report the precise details of the proposed structures are not known, thus this discussion is of a generalised nature.

11.1 Foundations

It cannot be recommended that foundations be constructed directly within the made ground revealed at the site. These soils are present in a weak and variable condition such that excessive total and or differential settlement could occur under moderately light surface loading.

In broad terms, it is considered that the foundation solution could include the provision of strip or spread footings. Additionally, it should be appreciated that any relict underground structures related to the site's previous residential use should be removed as these could form 'hard-spots' under the new structures.

It is considered that the underlying natural clay comprising the weathered fraction of the local mudstone sequence will provide a suitable bearing stratum, provided that the foundations are placed within soil generally described as being present in a firm insitu condition. It is considered that strip or spread foundations constructed within this material at a minimum depth of say 1.2m to 1.5m could be designed assuming an allowable increase in load given in the following table.

Table 7: *Allowable increase in stress*

Foundation type		Strip Footings			Spread Footings		
Foundation Breadth	(B)	0.6	1.0	1.5	0.6	1.0	2.0
Foundation Depth	(D)	1.2			1.2		
Allowable Increase in Stress	(kN/m²)	140	130	125	200	185	175

The allowable increase in stress given above assumes a factor of safety of 3 against general shear failure, with minimum cohesion of 60kN/m^2 at the foundation depths. Settlements at the above loading intensities should remain within tolerable limits for the type of structure proposed provided that the underlying soils are carefully inspected immediately final trimming has taken place. Should any soft or weak material be encountered they should be locally removed and replaced with lean-mix concrete or compacted granular soil. It should also be appreciated that higher allowable bearing capacity can be achieved with deeper foundations.

To reduce the potential of differential settlement it is recommended that very loose, cohesive or weak material encountered during construction be locally removed and replaced with lean-mix concrete or well-compacted granular soil. In areas of soft or weak ground, a thickening of the sub-base may be employed to improve the strength of the structure.

11.2 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.

11.3 Volume Change Potential

In light of the vegetation observed during the investigation, it should be appreciated the cohesive soils beneath the site have been found to possess volume change potential under the guidance of the NHBC standards. It will therefore be necessary to ensure that foundations placed within the cohesive soils, which was found to have a high volume change potential in the most onerous case, are designed in accordance with the Chapter 4.2 of the standards[3]. The methodology provided in the guidance will require the identification of any trees, still

[3] NHBC Standards, Chapter 4.2, *Building near trees*

present at or recently removed from the site, and the distance from the proposed foundations. Foundations lying inside the zone of influence of existing or proposed vegetation should be constructed at depths determined from the guidance, which may result in the foundation depths greater than those given in section 11.1. Moreover, there may also be a requirement for heave protection to be employed against foundations and below the underside of the floors and beams.

11.4 Ground Floor Slab

In view of the presence of variable thickness and condition of the topsoil, cohesive and granular near surface soils revealed across the site, it is recommended that in the first instance consideration is given to the use of fully suspended ground floor slabs. Similarly, given the presence of natural clays susceptible to high potential volume change in the most onerous case, should the floor be placed within the zone of influence of any existing, or proposed, trees and shrubs, it would be necessary to provide a suitable void or utilize proprietary materials beneath the slab. Further guidance is available in the NHBC standards, although clearly if it were necessary to employ such provisions beneath the floor, it would have to be suspended.

11.5 Access Roads and Hard-standing

It is considered that the access road and hard-standing areas associated with the new development could be constructed employing traditional pavement design. On the basis of laboratory tests conducted on cohesive near surface soils (silty clay) exposed during this investigation, it is recommended that a CBR value of no more than 2.5% should be taken in design. However, the TRL dynamic penetrometer test results undertaken at locations of proposed access roads indicated higher CBR values with increasing depth, although these results may be a reflection of the mixed cohesive and granular near surface soils revealed within the trialpits.

Notwithstanding the above, proof rolling should be undertaken to establish the suitability of the soils, expose any soft or weak ground and ensure the sub-grade is well compacted prior to construction. In areas of soft or weak ground, a thickening of the pavement sub-base may be employed to improve the strength of the structure. Alternatively, weak material could be locally removed and replaced with compacted granular soil.

11.6 Soakaways

On the basis of soakaway tests undertaken within three trialpits excavated to reveal slightly silty clay at depths of between 1.80m and 2.80m bgl, it can be seen that in the most onerous case, the drainage characteristics of this clay dominated sequence were found to be practicably impermeable. These results indicate that materials at those locations and depths were not suitable for storm soakaway drainage.

11.7 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 C2[4], 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 D1[5], 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.

11.8 Shallow Coal and Mine Workings

It may be noted that guidance available from both the NHBC and the CIRIA publication *construction over abandoned mine* workings suggests that an overburden thickness above the coal should be greater than 10 times the thickness of a seam plus 1 metre in order that the collapse of workings would pose a low risk to surface structures. On the basis that the typical maximum thickness of a coal seam in the United Kingdom would be about 3m, boreholes to establish the risk to a development from the collapse of coal workings are normally drilled to approximately 30m. In this case however, there is potentially one 0.76m thick workable seam (Low Fenton) anticipated at about 9m bgl, which could pose such a risk under the site as indicated from the Phase 1 Desk Study (B21060/GEO-PH1); therefore, the focus of this investigation was to prove this seam. The next workable seam is given as the Middleton Main and is anticipated at a depth of 52m below the site. In addition, the Phase 1 Desk Study B21060/GEO-PH1 states that coal mining records indicate the presence of a mine entry within 20m of the site boundary.

Beneath the natural cohesive deposits, a thick sequence of mudstone with subordinate layers of sandstone and coal seams was revealed to the base of all rotary open-hole boreholes between 13.5m and 30.0m bgl. Layers of coal varying between 0.1m and 1.4m thick were encountered at depths of between 7.3m and 14.8m within all of the rotary boreholes. This sequence is considered to be representative of the solid geology anticipated to underlie the site.

However, it should be noted that the progression of drilling was terminated within both BH1 and BH3 due to complete loss of water flush and returns at depths of between 10.0m (BH3) and 15.2m (BH1) bgl. At position BH3, a void was encountered between 10.0m and 10.2m bgl followed by self-weight drilling to 11.8m bgl, after which resistance to drilling was encountered to the base of the borehole. In contrast, loss of flush and returns within BH1 was accompanied

[4] Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield sites.*
[5] 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.*

by drilling resistance to borehole termination. Both boreholes were terminated due to lack of water flush at the drill head.

It is considered that the void and accompanying poor ground conditions (up to 1.8m in total) encountered within BH3 could represent collapsed shallow mine workings. In contrast, the poor ground conditions revealed within BH1 from 15.2m bgl may be due to the presence of fractured rock (fault zone), as the next workable seam is anticipated at a depth of 52m below the site (Middleton Main).

A 1.4m thick layer of coal was encountered from 11.6m to 13.0m bgl within BH1 and a 0.9m thick seam at a depth of 9.3m to 10.2m within BH2. It should be appreciated that the site comprises sloping land, thus all boreholes were undertaken at various surface elevations above ordinance datum (AOD). Notwithstanding the above, it is considered that the above seams represent the Low Fenton, although multiple thinner seams were also encountered at both locations to 14.5m and 14.8m bgl, respectively. It should also be noted that no coal seams were encountered below 14.5m to the termination of BH2 at 30m bgl. Two seams of 0.4m and 0.6m thickness were revealed between 8.6m and 9.8m bgl within BH3. However, beneath these seams, a 0.2m void underlain by 1.6m of weak material was encountered between 10.0m and 11.8m bgl within BH3. It is considered that this feature most likely represents a collapsed shallow mine working beneath the site, as it is within the depth range of the Low Fenton revealed within BH1 and BH2.

Given the above data, it is reasonable to conclude that the close proximity of a known mine entry, the presence of potentially shallow workable coal seams revealed within a range of depths and thicknesses of the expected Low Fenton coal seam, the voids and loss of flush encountered during the drilling at comparable depths, can collectively be taken to indicate the presence of shallow mine workings beneath the site.

Guidance available from both the NHBC and the CIRIA publication *construction over abandoned mine* workings suggests that an overburden thickness above the coal should be greater than 10 times the thickness of a seam plus 1 metre in order that additional treatment of the coal workings would not be required. However, in this instance the thickness of potentially voided ground is approximately 1.80m (i.e., based on thickness of void and associated weak material revealed within BH3) at a depth of 10.0m bgl. It should also be appreciated that between 3.8m (BH1), 7.5m (BH2) and 8.4m (BH3) of competent strata is available above the thickest seams and the void, thus remedial measures will be required prior to the construction of the proposed dwellings. This is to mitigate the potentially high risk of ground movement as a consequence of shallow underground mine workings beneath the proposed development.

In the first instance, it is recommended that pressure grouting of any remaining voided ground be undertaken, although care will be required to ensure that the pressured grout does not issue into adjacent properties. Consequently, the advice of specialist grouting contractors should be sought prior to undertaking the works.

In order to undertake this work it may also be necessary to obtain a further permit to enter or disturb Coal Authority mining interests. As the use of relatively high pressure grouting

techniques will be required, it is considered that there may be a displacement of potentially harmful mine gas and a regime of gas monitoring may be required in the immediate vicinity.

12 DISCUSSION OF GROUND CONDITIONS – ENVIRONMENTAL

12.1 Discussion of Test Results

As the proposed development is to include the construction of seventeen residential properties with associated garden, access road and hard-standing areas, the site may be classified as having a residential with home grown produce (plant uptake) end use.

12.1.1 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. 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 website[6] 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 7. These results indicate the following:

Table 8: *Summary of contaminated areas*

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with Plant Uptake)
TP2	0.2 – 0.7	TPH [Aromatic 216-C35)].
TP4	0.4 – 0.6	Lead.
TP5	0.0 – 0.5	PAH [Benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, benzo(g,h,i)perylene].
TP6	0.3 – 0.5	Lead and PAH [Pyrene, benz(a)anthracene, chrysene, benzo(b,k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, benzo(g,h,i)perylene].

Concentrations of chromium^{VI}, free cyanide, phenols (total), petroleum hydrocarbons (aliphatic C5 to C6 and aromatic C5 to C7) were below the detection limits for the tests. Detectable levels of all other contaminants were recorded, but these fell below the associated ATRISK Soil Screening Values.

It should be appreciated that the soil screening values for the PAHs 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 criterion[7]. In view of this, the ATRISK soil SSVs notes that the users may wish to consider using a combined assessment criterion given by CLEA if free product is not observed, the values for which are also provided on the summary of contamination analysis. As these products are formed by the incomplete

[6] http://www.atrisksoil.co.uk/pages/general/subscribers.asp
[7] Ref: ATRISK soil, SSVs derived using CLEA v1.04 for 6% SOM, Residential with Plant Uptake, 09/1/2015.

combustion of organic materials it is probable that they are associated with ash products within the made ground and as such will not be present as free product. In this case, no free product was observed. It is therefore considered that the CLEA criteria should be adopted for the PAHs 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*

Position	Depth (m)	Contaminants found to be exceeding CLEA Criterion (Residential with Plant Uptake)
TP2	0.2 – 0.7	None.
TP4	0.4 – 0.6	None.
TP5	0.0 – 0.5	PAH [Benzo(a)pyrene].
TP6	0.3 – 0.5	PAH [Benz(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene].

On the basis of all the information provided above, it is considered that there is some contamination by lead, PAHs and TPHs in the topsoil and made ground across the site. The TPHs are typical of heavy fuel and lubricating oils, waxes, asphalts and pitch. As PAHs are typically formed by the incomplete combustion of organic materials, they are likely to be associated with ash products within the topsoil and made ground, in this case probably from historic activities on and around the site.

It should be appreciated that the Atkins ATRISK soil screening criteria provides screening values that adhere to the principals of ensuring that contamination levels are kept to concentrations where a minimal risk of harm may result. However, recent work by DEFRA has set about determining a set of screening criteria, which assess whether a low risk of harm is present from the contamination. Whilst this is felt to reflect a more pragmatic approach to contamination risk assessment, it is still strongly precautionary. From this work Category 4 Screening Levels (C4SLs) have been determined for a limited range of compounds.

As such, in the context of a residential site with plant uptake, C4SL values of 5mg/kg are provided for benzo(a)pyrene[8]. As the maximum recorded concentration of benzo(a)pyrene in the tested samples is 13mg/kg and thus considerably higher than the appropriate C4SL value of 5mg/kg, it is reasoned that there is an unacceptable risk of harm from the concentration of this contamination at the site.

On the basis of all the information provided above, it is considered that the site can be classed as generally contaminated for the proposed end use and remediation measures will be required.

[8] DEFRA, 2014. SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document*; [Table pg 13] *Final Category 4 Screening Levels based on the risk management decisions outline above.*

12.1.2 Asbestos Identification

Seven samples of soil were sent to be tested for asbestos identification. However, the results are yet to be finalised and will be issued under separate cover.

12.1.3 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated a maximum concentration of 0.1% methane, with concentrations of carbon dioxide ranging between 2.1% and 5.9%, in association with oxygen levels of between 13.2% and 19.0%. 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 0.2 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 to date were at atmospheric pressures of between 997mb and 1009mb.

For preliminary design and 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 0.1% (0.001) methane was recorded, along with 5.9% (0.059) carbon dioxide, in association with a maximum flow rate of 0.2 l/hr. This results in a GSV of 0.0002 for methane and a GSV of 0.012 l/hr for carbon dioxide.

In accordance with Table 8.5, *Modified Wilson and Card classification* of the CIRIA report C665, *Assessing risks posed by ground gasses to building,* the site may be characterised as *Characteristic Situation Level 1*. However, as the level of carbon dioxide is over 5%, this should be increased to *Characteristic Situation Level 2*. It is, therefore, presently considered that there is a low risk of harm to end users and site operatives and, according to Table 8.6 of CIRIA C665, some precautionary gas protection measures will be required.

Reference is made to Tables 5.5a and 5.5b of CIRIA report C665 (2007). Accepting that the proposed development is of high sensitivity (residential with plant uptake) 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 3 monitoring visits were undertaken over a three week time period, at which point monitoring was terminated because it was decided to assume a *Characteristic Situation level 2* for the site. In this context it should be noted that the gas screening value threshold for *Characteristic Situation Level 2* is <0.7 l/hr. Assuming the flow rate remains constant at 0.2 l/hr the gas concentration would need to exceed 100% to move into the next risk band, which is not possible. Moreover, by keeping the concentration constant, the flow rate

would need to increase to over 58 l/hr to move into the next band, which is an increase of over a two hundred fold. We consider that these increases are not feasible as the fill is not deleterious, thus the site is not a generating source. The sufficiency of gas monitoring data is considered in BS 8576: 2013: *Guidance on investigations for ground gas – Permanent gasses and Volatile Organic Compounds (VOC's).* In this standard *Table F3, Assessing sufficiency of data* has been employed to justify the curtailment of monitoring.

12.2 Site Specific Risk Assessment

12.2.1 Chemical Contamination

The presence of contamination hazards and the risks associated with them have been assessed in accordance with industry practice and the 'suitable for use' approach. This has been conducted with reference to The Department for the Environment, Food and Rural Affairs (DEFRA) and The Environment Agency[9] advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.[10] This method dictates 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.[11]

12.2.2 Conceptual Ground Model

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

On-site – Topsoil and Made Ground (including ground gas).

[9] 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'.
[10] 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.
[11] See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.

Table 10: *Potential harm to humans and animals (fauna)*

SOURCES: Topsoil and Made Ground CONTAMINATION: CO_2, Lead, PAHs and TPHs		
Pathways	**Receptor**	**Linkage Present?**
Direct contact/dermal absorption/soil ingestion	Operative	Yes – Some contaminants exceed trigger values for proposed development. Precautionary measures are recommended during the construction phase.
	End User	Yes – Some contaminants exceed trigger values for proposed development.
	Neighbours	Yes – Some contaminants exceed trigger values for proposed development.
Inhalation of Dust/Vapours	Operative	Yes – Some contaminants exceed trigger values for proposed development. Precautionary measures are recommended during the construction phase.
	End User	Yes – Some contaminants exceed trigger values for proposed development.
	Neighbours	Yes – Some contaminants exceed trigger values for proposed development.
Ingestion of fruit/vegetables and/or waters	Operative	No – Although some contaminants exceed trigger values for proposed development, according to desk study no fruits, vegetables or surface waters present on site currently.
	End User	No – Although some contaminants exceed trigger values for proposed development, according to desk study no fruits, vegetables or surface waters present on site currently.
	Neighbours	No – Although some contaminants exceed trigger values for proposed development, according to desk study no fruits, vegetables or surface waters present on site currently.
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – Elevated concentration of CO_2 indicates *Characteristic Situation Level 2* for the site. Depleted concentration of O_2. Precautionary measures are recommended during the construction phase.
	End User	Yes – Elevated concentration of CO_2 indicates *Characteristic Situation Level 2* for the site. Depleted concentration of O_2. Workable coal seams are present at depth. However, low concentrations of ground gas indicate negligible migration from potential seams at depth below the site.
	Neighbours	No – Site is not a generating source.

Table 11: *Potential harm to controlled waters and groundwater*

SOURCES: Topsoil and Made Ground CONTAMINATION: CO_2, Lead, PAHs and TPHs		
Pathways	**Receptor**	**Linkage Present?**
Spillage/loss/run off direct to receiving water	Controlled Waters	No – No controlled waters on or adjacent to site. Contamination is present in cohesive and low permeability soils. Therefore off site mobility is unlikely.
Migration via permeable unsaturated strata	Controlled Waters	No – Some contaminants exceed trigger values for proposed development but site is underlain by mudstone, which is capped by cohesive and low permeability soils. No mobile groundwater encountered on site.
Run off via drainage/sewers etc	Controlled Waters	Yes – old drainage system is present on site, In mitigation, site is underlain by cohesive and low permeability soils, thus off site mobility is unlikely, particularly if any disused drainage system is sealed.

Table 12: *Potential harm to plants (flora)*

SOURCES: Topsoil and Made Ground CONTAMINATION: CO_2, Lead, PAHs and TPHs		
Pathways	**Receptor**	**Linkage Present?**
Direct contact with contaminated soils	Plants	Yes – Some contaminants exceed trigger values for proposed development.
Uptake via root system	Plants	Yes – Some contaminants exceed trigger values for proposed development.

Table 13: *Potential harm to buildings/structures*

SOURCES: Topsoil and Made Ground CONTAMINATION: CO_2, Lead, PAHs and TPHs		
Pathways	**Receptor**	**Linkage Present?**
Direct contact with contaminated soils	Building Materials	Yes – Some contaminants exceed trigger values for proposed development. Locally elevated PAHs and TPHs may require consideration of protection for service installation materials.
Direct contact with contaminated groundwater	Building Materials	Yes – Some contaminants exceed trigger values for proposed development. Locally elevated PAHs and TPHs may require consideration of protection for service installation materials.

12.2.3 Risk Assessment

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

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.

Table 14: *Risk assessment*

SOURCES: Topsoil and Made Ground CONTAMINATION: CO_2, Lead, PAHs and TPHs			
Pathways	**Receptor**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	High	Yes – Some contaminants exceed trigger values for proposed development. Precautionary measures are recommended during the construction phase.
	End User		
	Neighbours		
Inhalation of Dust/Vapours	Operative	High	Yes – Some contaminants exceed trigger values for proposed development. Precautionary measures are recommended during the construction phase.
	End User		
	Neighbours		

Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Low	The site is classified as *Characteristic Situation Level 2* due to elevated concentrations over 5% of CO_2.
	End User		
Run off via drainage/sewers etc	Controlled Waters	Low	Precautionary measures to de-commission and seal any disused services.
Direct contact with contaminated soil	Plants	High	Yes – Some contaminants exceed trigger values for proposed development.
Uptake via root system			
Direct contact with contaminated soils	Building Materials	Low (Concrete) High (Plastic services)	Low sulphates and reasonable pH levels indicate that well compacted buried concrete should be designed in accordance with Class DS-1 requirements. Assuming static groundwater, the aggressive chemical environment for concrete (ACEC) classification is AC-1s. Local elevated TPH and PAH contamination is present. Protection of plastic services may be required.
Direct contact with contaminated groundwater	Building Materials	Low	Groundwater not encountered at shallow depth during the site investigation.
Radon (from desk study)	End User	Moderate	Between 3% and 5% of homes in the area are above the action level for radon. Basic radon protection measures may be required in the construction of new dwellings or extensions.

12.3 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.

12.3.1 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 and vapours.
- To protect the end user and neighbours from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust and vapours.
- To protect the garden plants from direct contact with contaminated ground and uptake via root system, and hence to protect the end user from the ingestion of contaminated fruit and vegetables.
- To protect controlled waters from contamination run off via on-site drainage/sewers etc.
- To protect buried plastic services from degradation due to the presence of PAHs and TPHs in the soil.
- To protect the site operatives and end user from potentially elevated levels of ground gas (*Characteristic Situation Level 2*).

12.3.2 Development Requirements

It is understood that as the site is to be developed by the construction of seventeen residential properties with associated garden, access road and hard-standing areas, the site may be classified as having a residential with home grown produce (plant uptake) end use. For preliminary design and costing the following remediation proposals are offered.

12.3.3 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 fundamental principles of identifying potentially contaminated soils and the hazards of working with such soils.
- 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.
- Where vehicles are transferring soil to landfill site they should be covered to prevent any potential contamination of the surrounding area by dust.
- Any stockpiles of contaminated soil that may subsequently be found on site should be sheeted over to prevent excessive amounts of airborne dust and may require Waste Assessment Criteria (WAC) testing before transfer to an appropriate licensed landfill site.
- 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 any potential contamination to surrounding areas.
- Ground gas monitoring indicates that levels of carbon dioxide exceeding 5% are present within the ground and oxygen levels are generally slightly depleted. Therefore, some precaution may be required if workers are to enter confined spaces and excavations during construction.

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. It should be appreciated that any material removed from site should be considered as contaminated and be taken to landfills dealing with contaminated soils.

Construction

During the construction phase of the contract the following items are recommended to protect the end user from any potential contaminants.

- 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 operational services should be carefully inspected to ensure that they are in good condition, of a suitable type in light of the contamination revealed in this investigation and there is no ingress of contaminated soils or groundwater.
- Plastic services should be constructed in a surround of clean inert material and further testing may be required as recommended 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'. Note: The statutory water authority for the area in which site is located may require a risk assessment to be completed which allows these recommendations to be met and may affect the type of pipes used at the site.
- For buried concrete the results of the sulphate and pH testing indicate that the design sulphate class for the site should be DS-1.
- Assuming *Characteristic Situation Level 2*, the recommendations given below should be followed.
  In accordance with Table 8.6 - Typical scope of gas protection measures, of CIRIA report C665, two levels of protection are considered necessary and should include either of the following:
    - Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g DPM and underfloor venting.
    - Beam and block or pre cast concrete slab and 2000g DPM / reinforced gas membrane and underfloor venting

  Note: All joints and penetrations must be sealed.
- In light of the risks from volatile contamination it will be necessary to upgrade the gas barrier to proprietary vapour resistant membrane. Such measures are likely to exceed the basic measures required for protection against radon given in BRE211.

Garden Areas

In view of the contamination at the site, it is considered that garden areas affected by contamination will require some remediation. This could include the provision of 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. This expedient should also provide a suitable root barrier to isolate the plants from the underlying contaminated ground.

It should be appreciated that this could be achieved by removing 600mm of the soil to a licensed landfill, replacing it with clean inert fill. Alternatively, the site level could be raised by the appropriate amount.

In any event it will be necessary to validate the thickness of the remedial works. This may be undertaken by the excavation of shallow hand auger boreholes through the topsoil and subsoil to the gravel capillary break. These should be undertaken on a random grid giving coverage of one borehole every 25m^2.

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, for the following.

- It is a suitable growing medium where it is to be employed as such, including compliance with BS3883 (2007)
- 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 YAHPAC[12] 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 15: *Validation sampling and testing*

Fill Type	Frequency	Minimum Determinands
Virgin Quarried Material	1 or 2 depending on the type of stone (to confirm the inert nature of the material)	Standard metals/metalloids (As, Cd, Cr, Cr^{VI}, Cu, Hg, Ni, Pb, Se, Zn)
Crushed Hardcore, Stone, Brick	Minimum 1 per 1000m³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Greenfield/ Manufactured Soils	The greater of a minimum of 3 or 1 per 250m³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Brownfield/ Screened Soils	The greater of a minimum of 6 or 1 per 100m³	Standard metals/metalloids as above plus PAH (16 USEPA), TPH (CWG banded) and Asbestos Any additional analysis dependant on the history of the donor site.

[12] Sampling & Testing Matrix of Yorkshire and Humberside Pollution Advisory Council, 2016, *YAHPAC Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems v7.2*.

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 16: *Fill screening values*

Contaminant	Screening Value (Residential with Plant Uptake) (mg/kg)	Reference
As	37	Atrisk^{SOIL} SSVs, 6% soil organic matter
Cd	22	Atrisk^{SOIL} SSVs, 6% soil organic matter
Cr^{VI}	21	Atrisk^{SOIL} SSVs, 6% soil organic matter
Cu	4020	Atrisk^{SOIL} SSVs, 6% soil organic matter
Hg	1	Atrisk^{SOIL} SSVs, 6% soil organic matter
Ni	130	Atrisk^{SOIL} SSVs, 6% soil organic matter
Pb	200	Atrisk^{SOIL} SSVs, 6% soil organic matter
V	115	Atrisk^{SOIL} SSVs, 6% soil organic matter
Zn	17200	Atrisk^{SOIL} SSVs, 6% soil organic matter
TPH CWG	See contamination analysis sheet	Atrisk^{SOIL} SSVs, 6% soil organic matter
PAH 16 USEPA	See contamination analysis sheet	Atrisk^{SOIL} SSVs, 6% soil organic matter

Testing 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.

12.4 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:

- 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 in garden and landscaped areas. This may be either at the time of placement or after placement by means of hand excavated trial pits. 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 and as detailed within the gas verification guide produced by YAHPAC[13]. 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 the local authority.

13. 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 grouting contractors in relation to stabilising any shallow mine workings beneath the site.
- Discussions with ground work contractors in relation to the requirement for testing of materials to be disposed off-site (i.e., 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 gas protection of proposed dwellings.
- 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.

14. REFERENCES

- British Geological Survey (NERC) (2016), BGS, Keyworth.
  Geology of Britain Viewer:
  (*http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)*
  Lexicon of Named Rock Units:
  (*http://www.bgs.ac.uk/lexicon/)*

- British Standards Institution (1990) BS1377: *British standard methods of test for soils for civil engineering purposes,* B.S.I., London.

[13] Yorkshire and Humberside Pollution Advisory Council, 2016, *YAHPAC Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Gas Protection Systems v1.0*.

Part 2: 1990 *inc. amendment no.1 (1996)*: *Classification tests*
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For and on behalf of
Rogers Geotechnical Services Ltd,

G.L. Bobrowicz MSc, PhD, MCSM, FGS
Principal Geotechnical Engineer

S.P. Rogers CEng, CGeol, MICE, MCIHT, FGS
Technical Director

APPENDIX 1

SITE PLAN

Plan not to scale and investigation positions approximated from site operative's notes.

Title: **Investigation Location Plan**

Rogers Geotechnical Services Ltd	Site Name: 348A Leeds Road, Howden Clough, Birstall WF17 OHY	Job No: **J3546/16/E**

APPENDIX 2

ROTARY OPEN-HOLE BOREHOLE RECORDS

Borehole Log

Borehole No. **BH1**

Sheet 1 of 2

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords:	Hole Type RO
Location: Leeds Road, Birstall, WF17 0HY		Level:	Scale 1:50
Client: Planned Contracts		Dates: 19/07/2016	Logged By AG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.25			TOPSOIL (Driller's notes).
					1.70			Orangish brown slightly silty CLAY.
					4.50			Orangish brown silty friable CLAY.
					6.00			Stiff brown CLAY (Driller's notes).
					7.80			Orangish brown slightly silty slightly sandy CLAY.
								Greyish brown MUDSTONE recovered as clayey silty fine to coarse sand.
								Continued on Next Sheet

1 2 3 4 5 6 7 8 9 10

Remarks

Casing to 4.5m. 2.0m Geosoc over slotted standpipe. Final depth due to loss of flush and returns.

AGS

Borehole Log

Borehole No. **BH1**

Sheet 2 of 2

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords:	Hole Type RO
Location: Leeds Road, Birstall, WF17 0HY		Level:	Scale 1:50
Client: Planned Contracts		Dates: 19/07/2016	Logged By AG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					11.60			Black vitreous COAL recovered as coarse sand.
					13.00			Black/grey MUDSTONE (Driller's notes).
					13.40			COAL (Driller's notes)
					13.80			Black/grey MUDSTONE (Driller's notes).
					14.30			COAL (Driller's notes).
					14.80			Grey MUDSTONE (Driller's notes).
					15.10			Driller notes complete loss of flush, however, drilling resistance maintained until 17.00m.
					17.00			End of Borehole at 17.00m

11 12 13 14 15 16 17 18 19 20

Remarks

Casing to 4.5m. 2.0m Geosoc over slotted standpipe. Final depth due to loss of flush and returns.

AGS

Borehole Log

Borehole No. **BH2**

Sheet 1 of 3

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords:	Hole Type RO
Location: Leeds Road, Birstall, WF17 0HY		Level:	Scale 1:50
Client: Planned Contracts		Dates: 20/07/2016	Logged By AG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.23			TOPSOIL (driller's notes).
								Orangish brown slightly silty CLAY. Occasional rootlets.
					1.80			Light brown becoming greyish brown MUDSTONE recovered as sandy angular to rounded fine gravel.
								6.00-7.30m. Thin coal laminations.
					7.30			Black vitreous COAL recovered as coarse sand.
					7.60			Grey MUDSTONE (Driller's notes).
					8.50			COAL (Driller's notes).
					8.70			Grey MUDSTONE (Driller's notes).
					9.30			COAL (Driller's notes).
								Continued on Next Sheet

Remarks

Casing to 4.5m. 3.0m Geosoc over slotted standpipe.

Borehole Log

Borehole No. **BH2**

Sheet 2 of 3

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords:	Hole Type RO
Location: Leeds Road, Birstall, WF17 0HY		Level:	Scale 1:50
Client: Planned Contracts		Dates: 20/07/2016	Logged By AG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					10.20			Grey SANDSONE (Driller's notes).
					10.80			COAL (Driller's notes).
					11.00			Grey SANDSTONE (Driller's notes).
					11.20			COAL (Driller's notes).
					11.50			Grey MUDSTONE (Driller's notes).
					11.80			COAL (Driller's notes).
					11.90			Grey MUDSTONE (Driller's notes).
					12.30			COAL (Driller's notes).
					12.90			Grey MUDSTONE (Driller's notes).
					13.90			COAL (Driller's notes).
					14.50			Grey MUDSTONE recovered as sandy CLAY.
								Continued on Next Sheet

11 12 13 14 15 16 17 18 19 20

Remarks

Casing to 4.5m. 3.0m Geosoc over slotted standpipe.

Borehole Log

Borehole No. **BH2**

Sheet 3 of 3

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords:	Hole Type RO
Location: Leeds Road, Birstall, WF17 0HY		Level:	Scale 1:50
Client: Planned Contracts		Dates: 20/07/2016	Logged By AG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					22.80			Grey SANDSTONE recovered as fine and medium sand.
					23.70			Grey MUDSTONE recovered as sandy clay. Coal laminations towards base.
					30.00			End of Borehole at 30.00m

21 22 23 24 25 26 27 28 29 30

Remarks

Casing to 4.5m. 3.0m Geosoc over slotted standpipe.

Borehole Log

Borehole No. **BH3**

Sheet 1 of 2

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords:	Hole Type RO
Location: Leeds Road, Birstall, WF17 0HY		Level:	Scale 1:50
Client: Planned Contracts		Dates: 25/07/2016	Logged By AG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.26			TOPSOIL (Driller's notes).
					1.60			Orangish brown slightly silty CLAY. Rare rootlets.
					5.80			Light brown MUDSTONE recovered as sandy angular to rounded occasionally tabular fine and medium gravel.
					8.60			Grey MUDSTONE recovered as sandy clay.
					9.00			Black vitreous COAL recovered as coarse sand.
					9.20			Grey MUDSTONE (Driller's notes).
					9.80			COAL (Driller's notes).
					10.00			Grey MUDSTONE (Driller's notes).
								Continued on Next Sheet

1 2 3 4 5 6 7 8 9 10

Remarks

Casing to 4.5m. 3.0m Geosoc over slotted standpipe. Final depth due to loss of flush and returns.

AGS

Borehole Log

Borehole No. **BH3**

Sheet 2 of 2

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords:	Hole Type RO
Location: Leeds Road, Birstall, WF17 0HY		Level:	Scale 1:50
Client: Planned Contracts		Dates: 25/07/2016	Logged By AG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					10.20			VOID (No flush and no returns).
								Self weight drilling. No flush, no returns. (Driller's note).
					11.80			Drill resistance, no returns (Driller's notes).
					12.30			Drill resistance. No flush, no returns (Driller's notes).
					12.90			Drill resistance. No flush, no returns (Driller's notes).
					13.50			End of Borehole at 13.50m

Remarks

Casing to 4.5m. 3.0m Geosoc over slotted standpipe. Final depth due to loss of flush and returns.

APPENDIX 3

MACHINE EXCAVATED TRIALPIT RECORDS

Trial Pit Log

Trialpit No **TP1**

Sheet 1 of 1

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords: - Level:	Date 03/08/2016
Location: Leeds Road, Birstall, WF17 0HY		Dimensions (m): 0.6 × 1.7, Depth 1.40	Scale 1:50
Client: Planned Contracts			Logged JDMI

Water Str ke	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10 - 0.40	ES		0.40			TOPSOIL. (Light brown slightly clayey silty organic SAND. Abundant rootlets and roots up to 20mm diameter).
	0.50	D					Soft to firm orange mottled grey CLAY. Occasional rootlets and roots in top 0.20m.
	1.00	D		1.30			Weak to moderately strong grey with black carbonaceous laminations thinly laminated iron rich MUDSTONE recovered as angular tabular fine to coarse gravel with angular tabular cobbles.
				1.40			End of pit at 1.40 m

Remarks:

Stability: Good.

Trial Pit Log

Trialpit No **TP2**

Sheet 1 of 1

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords: - Level:	Date 03/08/2016
Location: Leeds Road, Birstall, WF17 0HY		Dimensions (m): 1.8 × 0.6, Depth 2.15	Scale 1:50
Client: Planned Contracts			Logged JDMI

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20 - 0.40	ES		0.50			TOPSOIL. (Light brown slightly clayey silty organic SAND. Abundant rootlets).
	1.00	D					Firm orange mottled grey CLAY.
	1.90	D		1.80			Firm to stiff brown mottled grey friable CLAY.
				1.95			Extremely weak grey with black carbonaceous inclusions thinly laminated highly weathered MUDSTONE recovered as stiff laminated clay.
				2.15			End of pit at 2.15 m

Remarks:

Stability: Good.

Trial Pit Log

Trialpit No **TP3**

Sheet 1 of 1

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords: - Level:	Date 03/08/2016
Location: Leeds Road, Birstall, WF17 0HY		Dimensions (m): 1.9 × 0.6, Depth 2.70	Scale 1:50
Client: Planned Contracts			Logged JDMI

Water Str ke	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25 - 0.60	ES		0.25			TOPSOIL. (Light brown slightly clayey silty organic SAND. Abundant rootlets and roots up to 20mm diameter).
				0.60			MADE GROUND. (Black clayey sandy angular to sub-angular fine to coarse GRAVEL of coal and mudstone. Frequent rootlets).
				0.80			MADE GROUND. (Firm orange sandy CLAY occasional rootlets).
				1.10			MADE GROUND. (Black clayey sandy angular to sub-angular fine to coarse GRAVEL of coal and mudstone).
	1.50	D					Firm orange mottled grey slightly silty CLAY.
	2.00	D					
				2.50			Weak to moderately strong grey with black carbonaceous laminations thinly laminated iron rich MUDSTONE recovered as angular tabular fine to coarse gravel with angular tabular cobbles.
				2.70			End of pit at 2.70 m

Remarks:

Stability: Good.

Trial Pit Log

Trialpit No
TP4SA
Sheet 1 of 1

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords: - Level:	Date 03/08/2016
Location: Leeds Road, Birstall, WF17 0HY		Dimensions (m): Depth 2.60 — 1.6 × 0.6	Scale 1:50
Client: Planned Contracts			Logged JDMI

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.15			TOPSOIL. (Light brown clayey organic SAND. Abundant rootlets.
	0.40 - 0.60	ES		0.40			Stiff yellowish orange mottled grey CLAY.
				0.86			Dark grey slightly clayey organic SAND. Frequent rootlets and woody fragments. (Relict Topsoil).
	1.00	D					Firm orange mottled grey friable slightly silty CLAY. Occasional fine rootlets.
	2.00	D					
				2.40			Firm to stiff grey mottled brown thinly laminated CLAY. (Completely weathered Mudstone).
				2.60			End of pit at 2 60 m

Remarks: Soakaway trialpit.

Stability: Good.

Trial Pit Log

Trialpit No
TP5SA
Sheet 1 of 1

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords: - Level:	Date 03/08/2016
Location: Leeds Road, Birstall, WF17 0HY		Dimensions (m): 1.5 × 0.6, Depth 2.80	Scale 1:50
Client: Planned Contracts			Logged JDMI

Water Str ke	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.00 - 0.50	ES					MADE GROUND. (Light brown to brown grass topped slightly clayey sandy GRAVEL with cobbles. Gravel is angular to sub-rounded fine to coarse brick concrete and sandstone. Cobbles are angular sandstone and quarter, half and full brick. Occasional household refuse).
				1.10			Firm grey mottled orange slightly silty CLAY.
	1.50	D					
	2.50	D					
				2.65 2.80			Extremely weak grey and orange highly weathered MUDSTONE recovered as gravelly clay. Gravel is angular tabular fine to coarse mudstone lithorelicts.
							End of pit at 2 80 m

Remarks: Soakaway trialpit.

Stability: Good.

Trial Pit Log

Trialpit No **TP6**

Sheet 1 of 1

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords: - Level:	Date 03/08/2016
Location: Leeds Road, Birstall, WF17 0HY		Dimensions (m): 1.7 × 0.6, Depth 2.80	Scale 1:50
Client: Planned Contracts			Logged JDMI

Water Str ke	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.30 - 0.50	ES					TOPSOIL. (Black sandy organic CLAY with occasional full brick and textile fragment and plastic sheeting).
				0.90			Firm orange mottled grey slightly silty CLAY.
	1.50	D		1.60			Firm grey mottled orange friable CLAY.
	2.60	D		2.65			Weak to moderately strong grey with black carbonaceous laminae thinly laminated iron rich MUDSTONE recovered as angular tabular fine to coarse gravel with angular tabular cobbles.
				2.80			End of pit at 2 80 m

Remarks:

Stability: Good.

Trial Pit Log

Trialpit No **TP7SA** Sheet 1 of 1

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords: - Level:	Date 03/08/2016
Location: Leeds Road, Birstall, WF17 0HY		Dimensions (m): 1.65 × 0.6, Depth 1.80	Scale 1:50
Client: Planned Contracts			Logged JDMI

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.00 - 0.70	ES					TOPSOIL. (Light brown slightly clayey silty organic SAND. Abundant rootlets).
	0.50	D		0.70			Soft to firm orange mottled grey CLAY.
				0.86			Firm to stiff grey mottled brown friable CLAY.
	1.50	D					
				1.67			Extremely weak grey with black carbonaceous inclusions thinly laminated highly weathered MUDSTONE recovered as stiff laminated clay.
				1.80			End of pit at 1 80 m

Remarks: Soakaway trialpit.

Stability: Good.

Trial Pit Log

Trialpit No **TP8**

Sheet 1 of 1

Project Name: Howden Clough	Project No. J3546/16/E	Co-ords: - Level:	Date 03/08/2016
Location: Leeds Road, Birstall, WF17 0HY		Dimensions (m): 1.7 × 0.6, Depth 2.30	Scale 1:50
Client: Planned Contracts			Logged JDMI

Water Str ke	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20 - 0.60	ES		0.20			TOPSOIL. (Light brown slightly clayey silty organic SAND. Abundant rootlets).
				0.60			MADE GROUND. (Dark grey clayey sandy GRAVEL. Gravel is angular fine to coarse coal and mudstone).
	1.00	D					Firm orange mottled grey silty CLAY.
				1.50			Firm to stiff brown mottled grey friable CLAY.
	2.00	D		2.10			Weak to moderately strong grey with black carbonaceous laminations thinly laminated iron rich MUDSTONE recovered as angular tabular fine to coarse gravel with angular tabular cobbles.
				2.30			End of pit at 2 30 m

Remarks:

Stability: Good.

APPENDIX 4

TRL DYMANIC PROBE RESULTS

Rogers Geotechnical Services Ltd
Offices 1&2, Barncliffe Business Park,
Near Bank, Shelley,
Huddersfield
HD8 8LU

www.rogersgeotech.co.uk

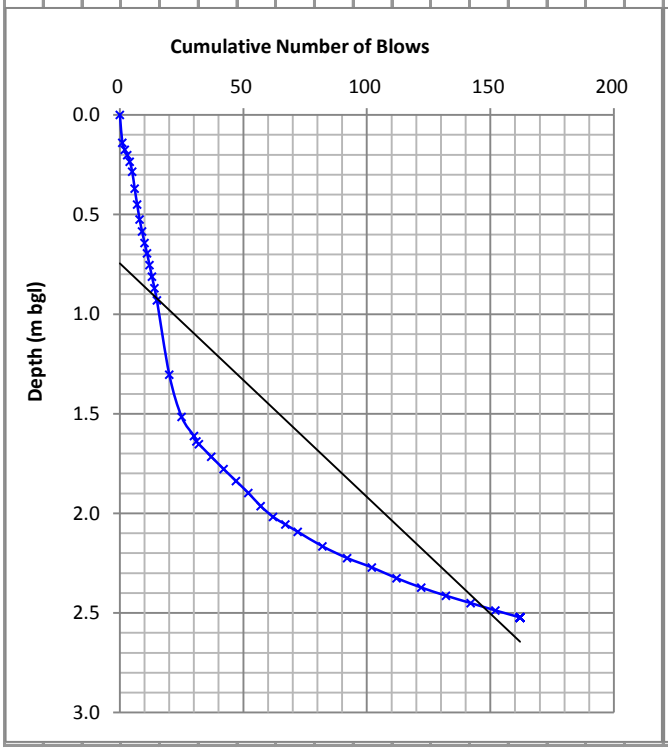
Tel : 0843 50 66687 **Fax : 0843 51 59930**

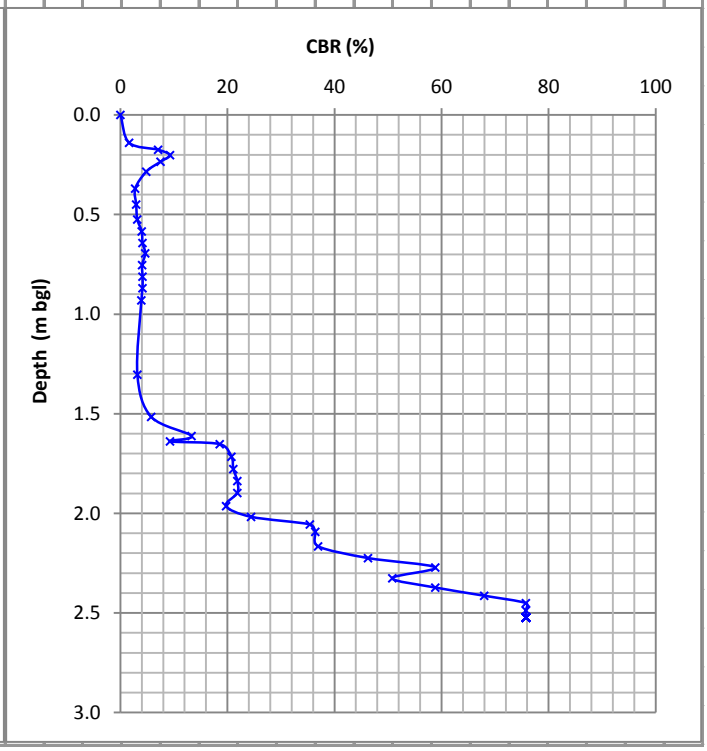
Job No:	Location:
J33546/16/E	TRL1
Site:	Client:
Howden Clough, Birstall	Planned Contracts
Test Date:	Tested By:
03/08/2016	RM

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
0	0			1	32	1653	19				
1	1	140	2	5	37	1716	21				
1	2	175	7	5	42	1778	21				
1	3	202	9	5	47	1838	22				
1	4	235	7	5	52	1898	22				
1	5	285	5	5	57	1964	20				
1	6	370	3	5	62	2018	24				
1	7	450	3	5	67	2056	35				
1	8	525	3	5	72	2093	36				
1	9	585	4	10	82	2166	37				
1	10	643	4	10	92	2225	46				
1	11	695	5	10	102	2272	59				
1	12	754	4	10	112	2326	51				
1	13	812	4	10	122	2373	59				
1	14	870	4	10	132	2414	68				
1	15	931	4	10	142	2451	76				
5	20	1304	3	10	152	2488	76				
5	25	1516	6	10	162	2523	76				
5	30	1612	13								
1	31	1639	9								





Rogers Geotechnical Services Ltd
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HD8 8LU

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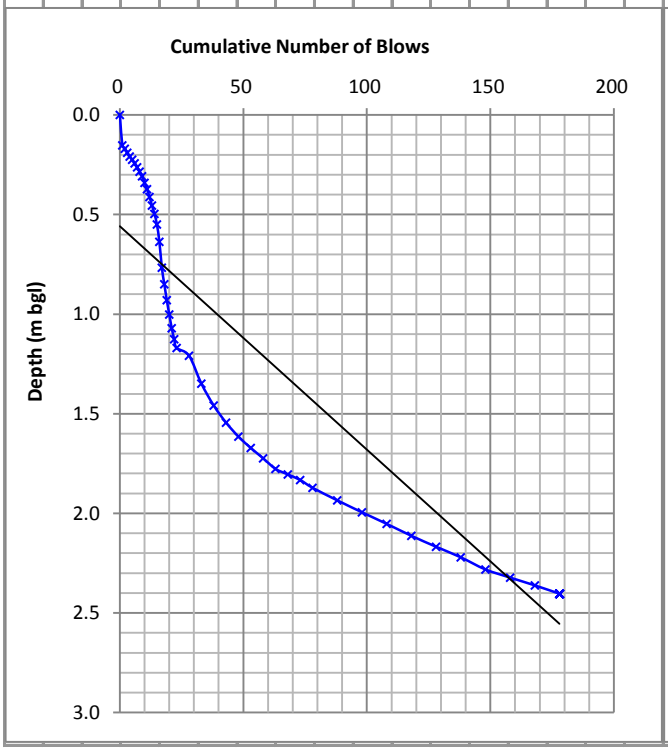
Tel : 0843 50 66687 **Fax : 0843 51 59930**

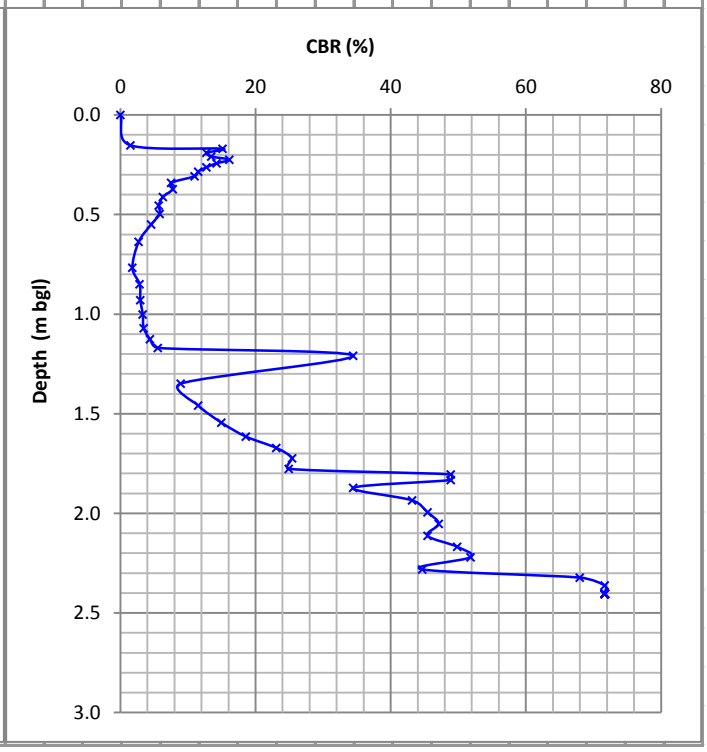
Job No:	Location:
J33546/16/E	TRL2
Site:	Client:
Howden Clough, Birstall	Planned Contracts
Test Date:	Tested By:
03/08/2016	RM

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
0	0			1	20	1002	3	10	138	2221	52
1	1	153	1	1	21	1071	3	10	148	2282	45
1	2	170	15	1	22	1126	4	10	158	2323	68
1	3	190	13	1	23	1170	6	10	168	2362	72
1	4	209	13	5	28	1209	34	10	178	2404	72
1	5	225	16	5	33	1349	9				
1	6	243	14	5	38	1459	12				
1	7	263	13	5	43	1545	15				
1	8	285	12	5	48	1615	19				
1	9	308	11	5	53	1672	23				
1	10	341	7	5	58	1724	25				
1	11	373	8	5	63	1777	25				
1	12	412	6	5	68	1805	49				
1	13	455	6	5	73	1833	49				
1	14	497	6	5	78	1872	34				
1	15	550	5	10	88	1935	43				
1	16	637	3	10	98	1995	45				
1	17	767	2	10	108	2053	47				
1	18	850	3	10	118	2113	45				
1	19	930	3	10	128	2168	50				





Rogers Geotechnical Services Ltd
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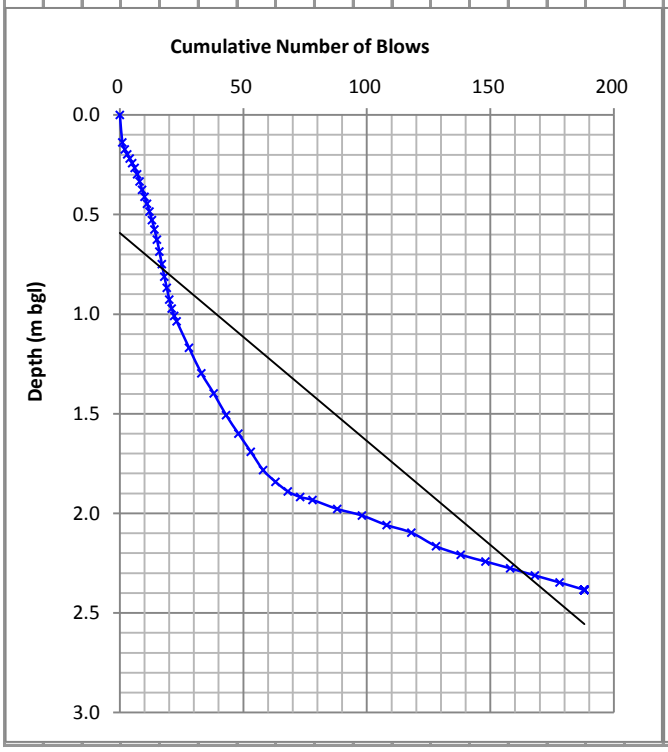
Tel : 0843 50 66687 **Fax : 0843 51 59930**

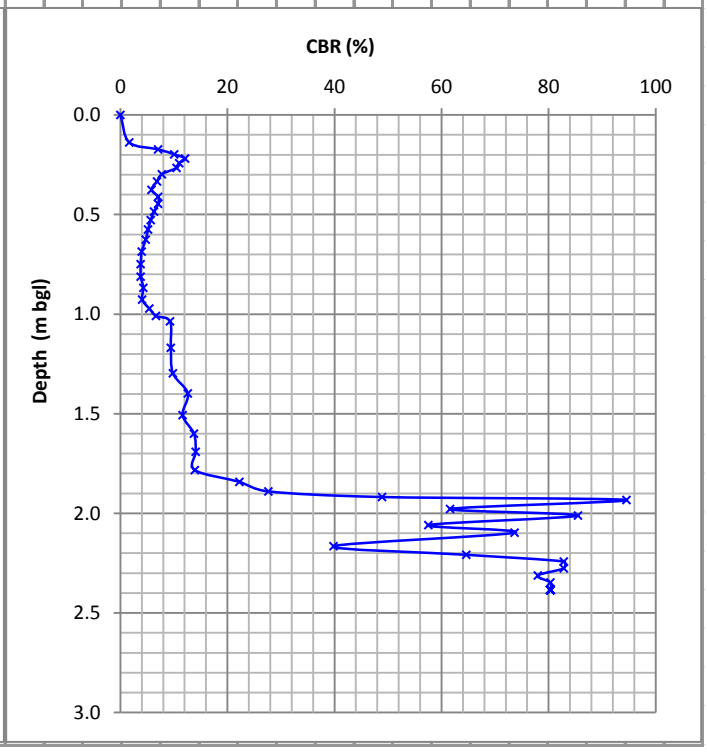
Job No:	Location:
J33546/16/E	TRL3
Site:	Client:
Howden Clough, Birstall	Planned Contracts
Test Date:	Tested By:
03/08/2016	RM

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
0	0			1	20	927	4	10	138	2208	65
1	1	138	2	1	21	972	5	10	148	2242	83
1	2	173	7	1	22	1009	7	10	158	2276	83
1	3	198	10	1	23	1036	9	10	168	2312	78
1	4	219	12	5	28	1169	9	10	178	2347	80
1	5	242	11	5	33	1297	10	10	188	2384	80
1	6	266	10	5	38	1398	13				
1	7	298	8	5	43	1507	12				
1	8	334	7	5	48	1600	14				
1	9	376	6	5	53	1691	14				
1	10	411	7	5	58	1783	14				
1	11	446	7	5	63	1842	22				
1	12	485	6	5	68	1890	28				
1	13	528	6	5	73	1918	49				
1	14	575	5	5	78	1933	95				
1	15	626	5	10	88	1978	62				
1	16	686	4	10	98	2011	85				
1	17	749	4	10	108	2059	58				
1	18	812	4	10	118	2097	74				
1	19	868	4	10	128	2165	40				





Rogers Geotechnical Services Ltd
Offices 1&2, Barncliffe Business Park,
Near Bank, Shelley,
Huddersfield
HD8 8LU

www.rogersgeotech.co.uk

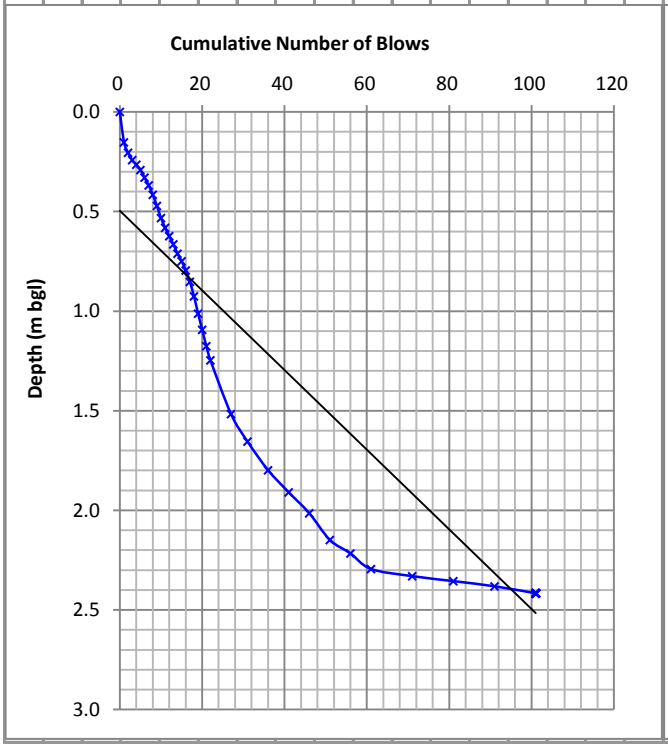
Tel : 0843 50 66687 **Fax : 0843 51 59930**

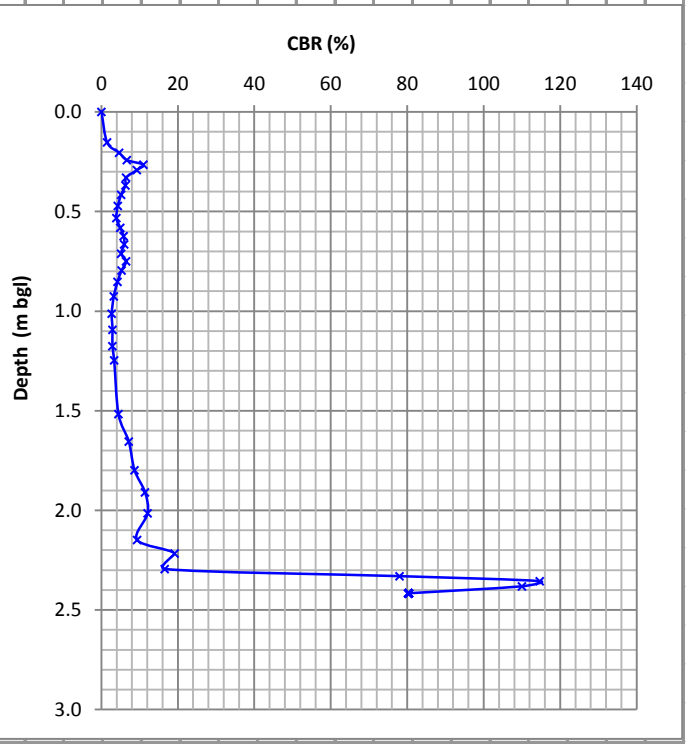
Job No:	Location:
J33546/16/E	TRL4
Site:	Client:
Howden Clough, Birstall	Planned Contracts
Test Date:	Tested By:
03/08/2016	RM

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
0	0			1	20	1094	3				
1	1	153	1	1	21	1176	3				
1	2	205	5	1	22	1247	3				
1	3	242	7	5	27	1517	4				
1	4	265	11	4	31	1655	7				
1	5	292	9	5	36	1799	9				
1	6	330	6	5	41	1910	11				
1	7	369	6	5	46	2015	12				
1	8	416	5	5	51	2149	9				
1	9	472	4	5	56	2217	19				
1	10	533	4	5	61	2295	17				
1	11	582	5	10	71	2331	78				
1	12	624	6	10	81	2356	115				
1	13	665	6	10	91	2382	110				
1	14	712	5	10	101	2417	80				
1	15	750	6								
1	16	796	5								
1	17	853	4								
1	18	926	3								
1	19	1013	3								





APPENDIX 5

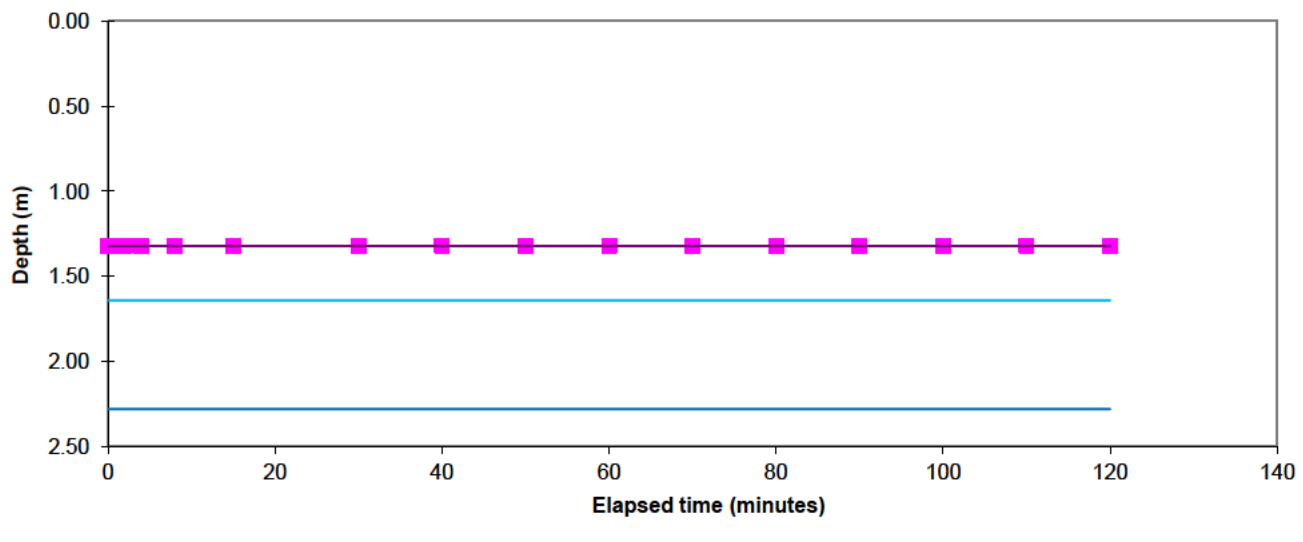
SOAKAWAY TEST RESULTS

Rogers Geotechnical Services L

Soakaway Test

Trial Pit No:	TP4SA	Test No:	1	Date:	8/3/2016
Length (m):	1.600		Datum Height:	0.00	m agl
Width (m):	0.60		Granular infill:	None	
Depth (m):	2.60		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.320	110	1.320
1	1.320	120	1.320
2	1.320		
4	1.320		
8	1.320		
15	1.320		
30	1.320		
40	1.320		
50	1.320		
60	1.320		
70	1.320		
80	1.320		
90	1.320		
100	1.320		



Start water depth for analysis (mbgl):	1.32		
75% effective depth (mbgl):	1.64	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.96		
25% effective depth (mbgl):	2.28	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	2.60		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):			3.78
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks Results processed following BRE 365 (2007).

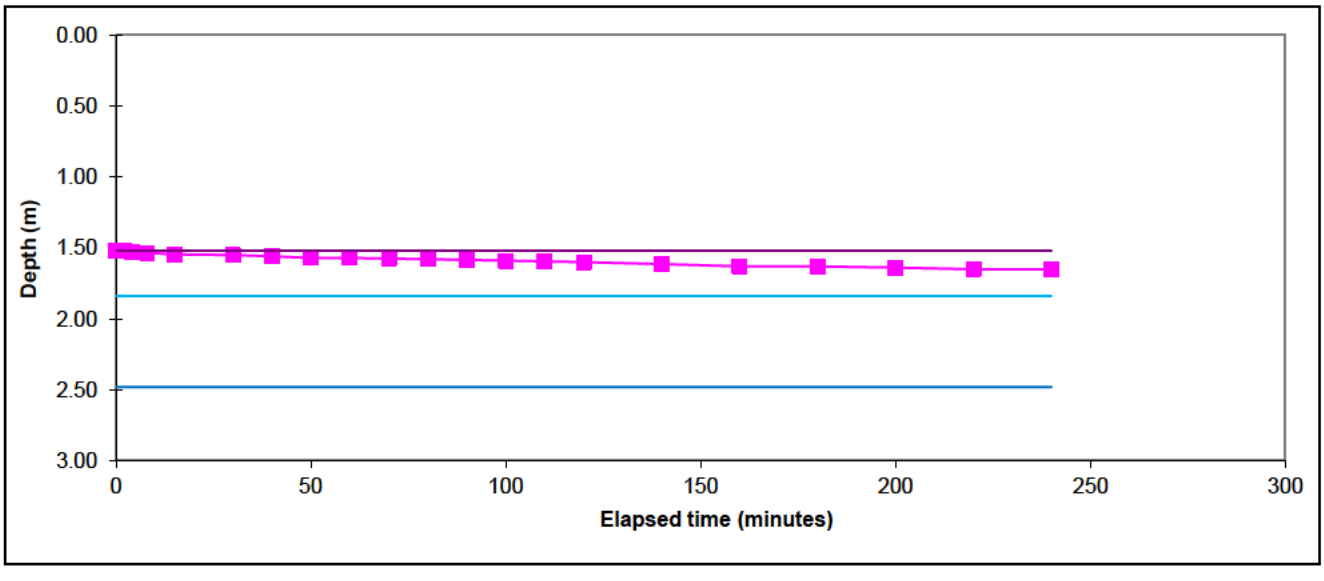
Client:	Planning Contracts Limited	**Job No:**
Site:	Howden Clough	J3546/16/E

Rogers Geotechnical Services L

Soakaway Test

Trial Pit No:	TP5SA	Test No:	1	Date:	8/3/2016
Length (m):	1.500		Datum Height:	0.00	m agl
Width (m):	0.60		Granular infill:	None	
Depth (m):	2.80		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.520	110	1.595
1	1.520	120	1.600
2	1.520	140	1.615
4	1.530	160	1.631
8	1.535	180	1.631
15	1.545	200	1.640
30	1.550	220	1.650
40	1.560	240	1.650
50	1.570		
60	1.570		
70	1.575		
80	1.580		
90	1.585		
100	1.590		



Start water depth for analysis (mbgl):	1.52		
75% effective depth (mbgl):	1.84	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	2.16		
25% effective depth (mbgl):	2.48	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	2.80		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):			3.59
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.

Remarks Results processed following BRE 365 (2007).

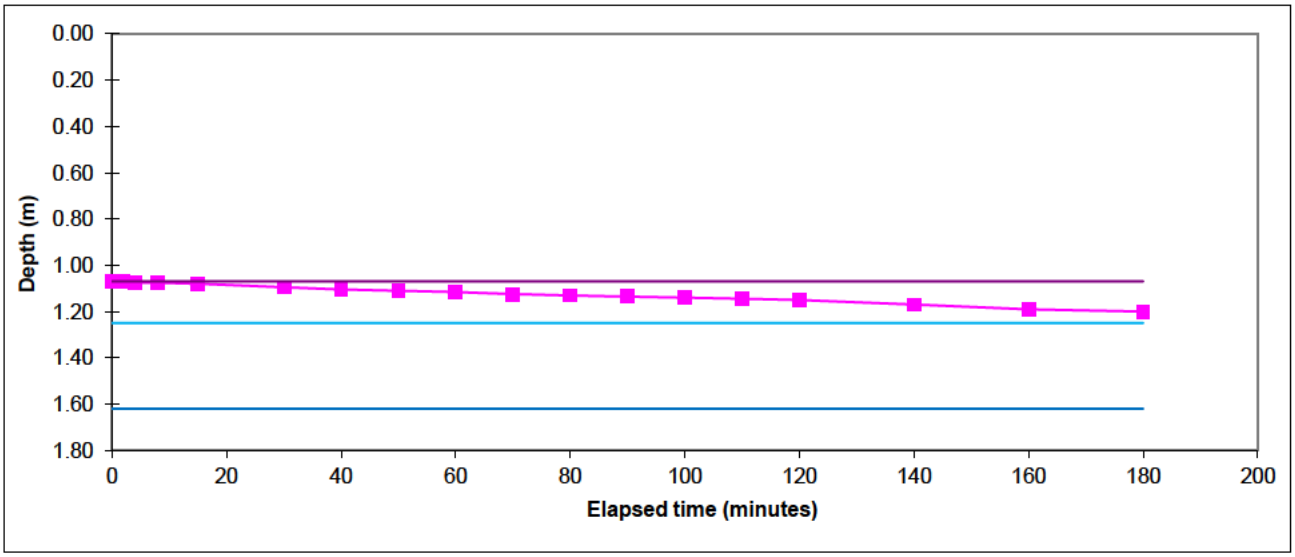
Client:	Planning Contracts Limited	**Job No:**
Site:	Howden Clough	J3546/16/E

Rogers Geotechnical Services Ltd

Soakaway Test

Trial Pit No:	TP7SA	Test No:	1	Date:	03/08/2016
Length (m):	1.650		Datum Height:	0.00	m agl
Width (m):	0.60		Granular infill:	None	
Depth (m):	1.80		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.070	110	1.145
1	1.070	120	1.150
2	1.070	140	1.170
4	1.075	160	1.190
8	1.075	180	1.200
15	1.080		
30	1.095		
40	1.105		
50	1.110		
60	1.115		
70	1.125		
80	1.130		
90	1.135		
100	1.140		



Start water depth for analysis (mbgl):	1.07		
75% effective depth (mbgl):	1.25	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.44		
25% effective depth (mbgl):	1.62	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.80		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):			2.61
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks Results processed following BRE 365 (2007).

Client:	Planning Contracts Limited	**Job No:**
Site:	Howden Clough	J3546/16/E

APPENDIX 6

LABORATORY TESTING – GEOTECHNICAL

Summary of Classification Test Results

Project No.	Project Name
J3546/16/E	Howden Clough

Hole No.	Sample				Soil Description	Density bulk / dry Mg/m3		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Remarks
	Ref	Top	Base	Type										
TP1	2	0.50		D	Orange mottled grey CLAY			31.0	98	68 -1pt	25	43		
TP2	2	1.00		D	Orange mottled grey CLAY.			36.0	100	71 -1pt	26	45		
TP3	3	2.00		D	Orange mottled grey slightly silty CLAY.			15.0	59	37 -1pt	18	19		
TP4SA	3	2.00		D	Orange mottled grey friable slightly silty CLAY.			24.0	87	56 -1pt	22	34		
TP5SA	2	1.50		D	Grey mottled orange slightly silty CLAY.			16.0						
TP5SA	3	2.50		D	Firm mottled light Grey and yellowish brown silty CLAY			27.0	100	57 -1pt	21	36		
TP6	2	1.50		D	Grey mottled orange friable CLAY.			13.0	94	64 -1pt	25	39		
TP7SA	3	1.50		D	Grey mottled brown friable CLAY.			30.0	50	37 -1pt	18	19		

All tests performed in accordance with BS1377:1990 unless specified otherwise

Key			Date Printed	Approved By	Table
Density test	Liquid Limit	Particle density			1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer	18/08/2016		
wd - water displacement	cas - Casagrande method	gj - gas jar			sheet
wi - immersion in water	1pt - single point test			Jude	1

Linear Shrinkage - Summary of Results

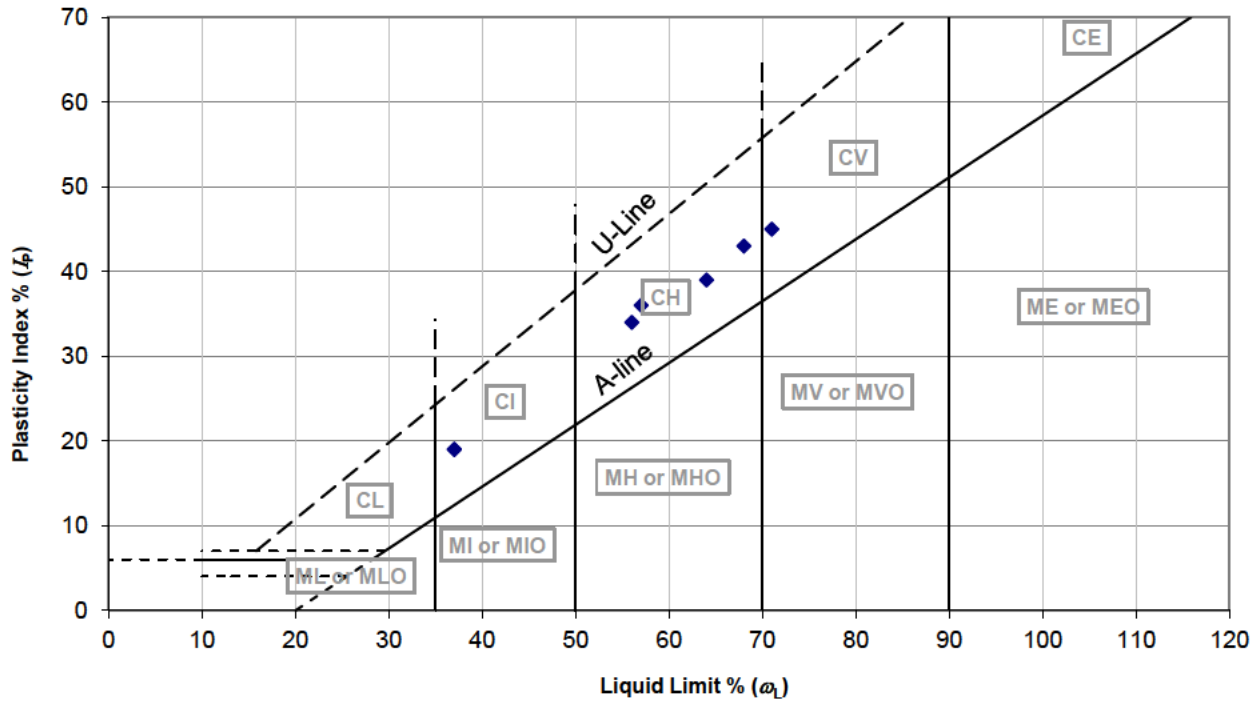
Project No.	Project Name
J3546/16/E	Howden Clough

Hole No.	Sample				Soil Description	Material <425µm %	Preparation	Linear Shrinkage %	Remarks
	Ref	Top	Base	Type					
TP1	2	0.50		D	Orange mottled grey CLAY	98	Specimen prepared from natural material	9	
TP2	2	1.00		D	Orange mottled grey CLAY.	100	Specimen prepared from natural material	14	
TP3	3	2.00		D	Orange mottled grey slightly silty CLAY.	59	Specimen prepared from natural material	9	
TP4SA	3	2.00		D	Orange mottled grey friable slightly silty CLAY.	87	Specimen prepared from natural material	12	
TP5SA	3	2.50		D	Firm mottled light Grey and yellowish brown silty CLAY	100	Specimen prepared from natural material	13	
TP6	2	1.50		D	Grey mottled orange friable CLAY.	94	Specimen prepared from natural material	10	
TP7SA	3	1.50		D	Grey mottled brown friable CLAY.	50	Specimen prepared from natural material	9	

Notes	Date Printed	Approved By	Table
Tests performed in accordance with BS 1377 : Part 2 : 1990, clause 6 5 unless annotated otherwise	18/08/2016	Jude	2 sheet 1

Rogers Geotechnical Services Ltd. Offices 1&2, Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU	**Interpretation of Moisture Content, Liquid and Plastic Limits**	**J3546/16/E**
Project Name: Howden Clough	**B.S 1377: Part 2: 1990: 3.2, 4 and 5**	Fig. 3 Sheet. 1
Location: Howden Clough		Input By: CJN Date: 30.08.16
Client: Planned Contracts		Check By: CJN Date: 30.08.16

Location	Depth (m)	Moisture Content (w) (%)	Liquid Limit (wL) (%)	Plastic Limit (wP) (%)	Plasticity Index (IP) (%)	Retained by 425mm (%)	Modified (w) (w') (%)	Modified (IP) (IP') (%)	Liquidity/ Consistency (IL) (%)	Liquidity/ Consistency (IC) (%)	Casagrande Class	N.H.B.C Class (%)
TP1	0.50	31	68	25	43	2	32	42	0.1	0.9	C H	HIGH
TP2	1.00	36	71	26	45	0	36	45	0.2	0.8	C V	HIGH
TP3	2.00	15	37	18	19	41	25	11	-0.2	1.2	C I	LOW
TP4SA	2.00	24	56	22	34	13	28	30	0.1	0.9	C H	MEDIUM
TP5SA	2.50	27	57	21	36	0	27	36	0.2	0.8	C H	MEDIUM
TP6	1.50	13	64	25	39	6	14	37	-0.3	1.3	C H	MEDIUM
TP7SA	1.50	30	37	18	19	50	60	10	0.6	0.4	C I	*

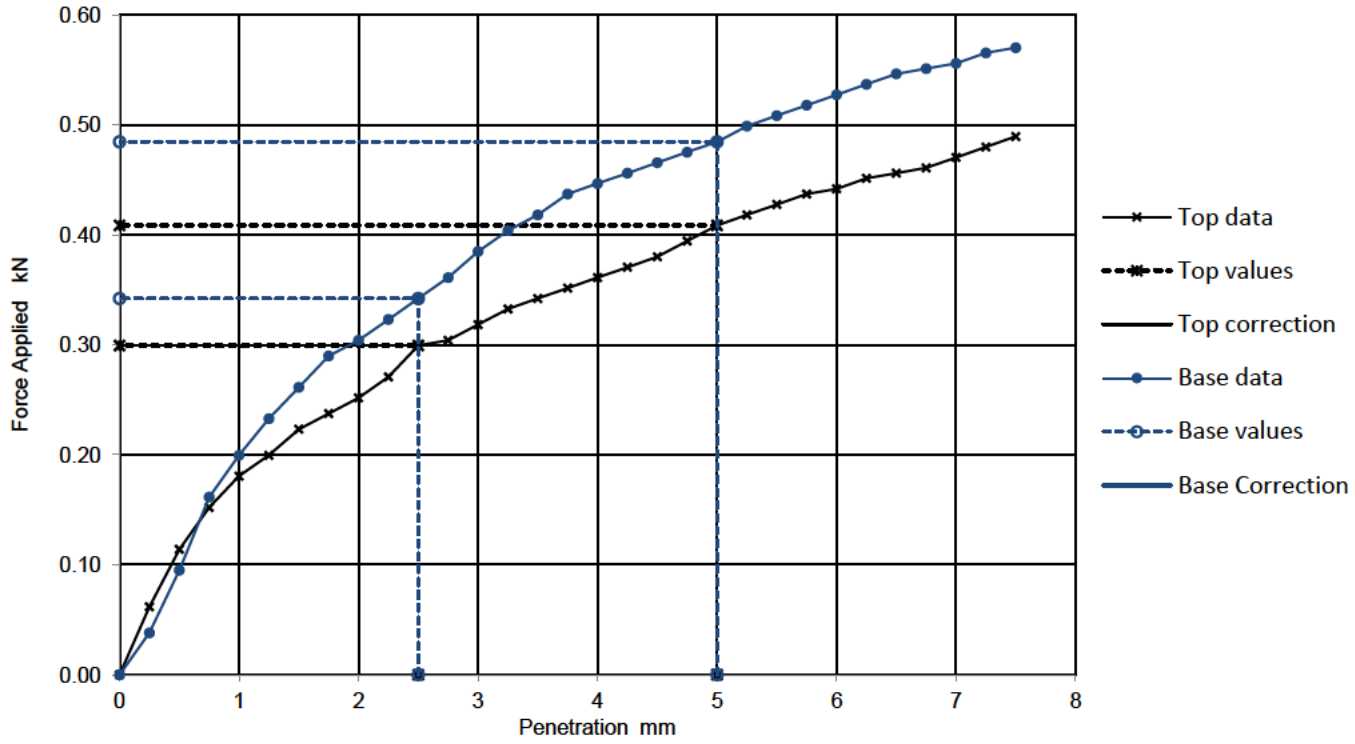


	California Bearing Ratio (CBR)				Job Ref	J3546/16/E
					Borehole/Pit No.	TP8
Site Name	Howden Clough				Sample No.	3
Soil Description	Orange mottled grey silty CLAY				Depth m	0.60
Specimen Reference		Specimen Depth	0.60	m	Sample Type	D
Specimen Description	soft to firm mottled yellowish brown and light grey silty CLAY				KeyLAB ID	RGS_201608127
Test Method	BS1377 : Part 4 : 1990, clause 7				CBR Test Number	1

Specimen Preparation

Condition	REMOULDED			Soaking details	Not soaked
Details	Recompacted with specified standard effort using 2.5kg rammer			Period of soaking	days
				Time to surface	days
				Amount of swell recorded	mm
Material retained on 20mm sieve removed		0	%	Dry density after soaking	Mg/m3
Initial Specimen details	Bulk density	1.89	Mg/m3	Surcharge applied	2 kg
	Dry density	1.43	Mg/m3		1 kPa
	Moisture content	31.9	%		

Force v Penetration Plots



Results

	Curve correction applied	CBR Values, % 2.5mm	5mm	Highest	Average	Moisture Content %
TOP		2.3	2.0	2.3	2.4	34.3
BASE		2.6	2.4	2.6		32.9

General remarks	Test specific remarks	Approved
		Jude

Fig No.	4
Sheet No	1

Lab Sheet Reference :

APPENDIX 7

LABORATORY TESTING – ENVIRONMENTAL

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report No.:	16-18870-1
Initial Date of Issue:	12-Aug-2016
Client	Rogers Geotechnical Services Ltd
Client Address:	Unit 4, Barncliffe Business Park Near Bank Shelley Huddersfield West Yorkshire HD8 8LU
Contact(s):	Gabriel Bobrowicz
Project	J3546/16/E Howden Clough

Quotation No.:		**Date Received:**	08-Aug-2016
Order No.:	0816-06	**Date Instructed:**	08-Aug-2016
No. of Samples:	8		
Turnaround (Wkdays):	5	**Results Due:**	12-Aug-2016
Date Approved:	12-Aug-2016		
Approved By:			
Details:	Keith Jones, Technical Manager		

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3546/16/E Howden Clough

Client: Rogers Geotechnical Services Ltd		Chemtest Job No.:			16-18870	16-18870	16-18870	16-18870	16-18870	16-18870	16-18870	16-18870
Quotation No.:		Chemtest Sample ID.:			334230	334231	334232	334233	334234	334235	334236	334237
Order No.: 0816-06		Client Sample Ref.:			TP1	TP2	TP3	TP4	TP5	TP6	TP7	TP8
		Client Sample ID.:			D1	D1	D1	D1	D1	D1	D1	D1
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.10	0.20	0.25	0.40	0.00	0.30	0.00	0.20
		Bottom Depth (m):			0.40	0.40	0.60	0.60	0.50	0.50	0.70	0.60
		Date Sampled:			03-Aug-2016	03-Aug-2016	03-Aug-2016	03-Aug-2016	03-Aug-2016	03-Aug-2016	03-Aug-2016	03-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
Cadmium	M	2450	mg/kg	0.10		< 0.10	0.11	0.46	0.72	0.50	0.37	< 0.10
Chromium (Hexavalent)	N	2490	mg/kg	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Copper	M	2450	mg/kg	0.50		68	54	53	26	69	27	29
Mercury	M	2450	mg/kg	0.10		0.13	0.13	0.24	0.36	0.37	0.10	0.11
Nickel	M	2450	mg/kg	0.50		30	16	29	23	30	22	13
Lead	M	2450	mg/kg	0.50		48	33	200	110	210	55	42
Zinc	M	2450	mg/kg	0.50		59	37	380	88	160	170	36
Vanadium	U	2450	mg/kg	5.0		39	17	34	29	52	20	20
Arsenic	M	2450	mg/kg	1.0		33	21	34	12	31	5.0	17
Selenium	M	2450	mg/kg	0.20		0.76	1.2	0.81	0.58	1.0	0.25	0.35
Cyanide (Free)	M	2300	mg/kg	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Phenols	M	2920	mg/kg	0.30		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30
Naphthalene	M	2700	mg/kg	0.10		< 0.10	8.5	0.76	0.22	0.93	< 0.10	2.3
Acenaphthylene	M	2700	mg/kg	0.10		< 0.10	1.9	0.45	0.36	1.3	< 0.10	0.55
Acenaphthene	M	2700	mg/kg	0.10		< 0.10	1.8	0.46	0.32	1.2	< 0.10	0.50
Fluorene	M	2700	mg/kg	0.10		< 0.10	2.5	0.65	0.38	1.7	< 0.10	0.30
Phenanthrene	M	2700	mg/kg	0.10		< 0.10	11	2.3	2.8	15	< 0.10	2.6
Anthracene	M	2700	mg/kg	0.10		< 0.10	0.23	0.41	0.90	5.3	< 0.10	0.11
Fluoranthene	M	2700	mg/kg	0.10		0.20	1.3	2.0	4.8	30	0.56	0.37
Pyrene	M	2700	mg/kg	0.10		0.27	1.9	1.9	4.5	29	0.54	0.53
Benzo[a]anthracene	M	2700	mg/kg	0.10		< 0.10	< 0.10	0.95	2.4	14	< 0.10	< 0.10
Chrysene	M	2700	mg/kg	0.10		< 0.10	< 0.10	1.8	2.6	15	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2700	mg/kg	0.10		< 0.10	< 0.10	1.6	2.8	16	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2700	mg/kg	0.10		< 0.10	< 0.10	1.0	1.5	7.8	< 0.10	< 0.10
Benzo[a]pyrene	M	2700	mg/kg	0.10		< 0.10	< 0.10	0.86	2.1	13	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	1.2	9.3	< 0.10	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	0.72	3.0	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	1.2	7.9	< 0.10	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2.0		< 2.0	29	15	29	170	< 2.0	7.3
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0		< 1.0	12	< 1.0	< 1.0	< 1.0	< 1.0	1.9
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0		< 1.0	13	< 1.0	< 1.0	< 1.0	< 1.0	7.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0		5.0	9.0	< 1.0	< 1.0	< 1.0	< 1.0	2.2
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0		2.2	11	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0		31	18	3.5	4.2	4.7	< 1.0	3.9
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0		170	68	53	33	61	< 1.0	60
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0		27	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3546/16/E Howden Clough

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			16-18870	16-18870	16-18870	16-18870	16-18870	16-18870	16-18870	16-18870
Quotation No.:		**Chemtest Sample ID.:**			334230	334231	334232	334233	334234	334235	334236	334237
Order No.: 0816-06		Client Sample Ref.:			TP1	TP2	TP3	TP4	TP5	TP6	TP7	TP8
		Client Sample ID.:			D1	D1	D1	D1	D1	D1	D1	D1
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.10	0.20	0.25	0.40	0.00	0.30	0.00	0.20
		Bottom Depth (m):			0.40	0.40	0.60	0.60	0.50	0.50	0.70	0.60
		Date Sampled:			03-Aug-2016	03-Aug-2016	03-Aug-2016	03-Aug-2016	03-Aug-2016	03-Aug-2016	03-Aug-2016	03-Aug-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
Total Aliphatic Hydrocarbons	M	2680	mg/kg	5.0		240	130	57	37	66	< 5.0	74
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0		1.7	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0		8.1	3.6	< 1.0	< 1.0	< 1.0	< 1.0	13
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0		8.5	6.8	< 1.0	< 1.0	1.1	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0		160	17	1.7	2.4	5.4	< 1.0	1.3
Aromatic TPH >C16-C21	M	2680	mg/kg	1.0		770	13	2.2	26	40	1.5	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0		3600	26	49	130	170	< 1.0	24
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0		97	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	M	2680	mg/kg	5.0		4600	67	53	160	220	< 5.0	38
Total Petroleum Hydrocarbons	M	2680	mg/kg	10		4900	200	110	200	290	< 10	110
pH	M	2010		N/A		3.8	4.7	5.8	7.8	7.6	6.9	5.6
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010		0.13	0.022	0.019	0.013	0.028	0.18	0.20
Moisture	N	2030	%	0.020	19	21	10	22	15	24	15	18
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Roots	Roots	Clinker	Roots	Stones	Stones	Roots	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Sulphate (Total)	M	2430	%	0.010		0.30	0.59	0.18	0.13	0.28	0.18	1.5
Organic Matter	M	2625	%	0.40		7.2	43	10	3.3	22	6.7	29
PCB 28	M	2810	mg/kg	0.010	< 0.010							
PCB 52	M	2815	mg/kg	0.010	< 0.010							
PCB 101	M	2815	mg/kg	0.010	< 0.010							
PCB 118	M	2815	mg/kg	0.010	< 0.010							
PCB 153	M	2815	mg/kg	0.010	< 0.010							
PCB 138	M	2815	mg/kg	0.010	< 0.010							
PCB 180	M	2810	mg/kg	0.010	< 0.010							
Total PCBs (7 Congeners)	N	2815	mg/kg	0.10	< 0.10							

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

Rogers Geotechnical Services Ltd.

SUMMARY OF CONTAMINATION ANALYSIS - including Atkins ATRISK SSVs 2014

Client: Planned Contracts
Site: 348A Leeds Road, Howden Clough, Birstall WF17 0HY
Job Number: J3546/16/E
Date: 25/8/2016

Tox Data Report No.	Compound	Range of Values Found (mg/kg)		Residential with Homegrown Produce Landuse (mg/kg)		Reference
	Metals	*Min*	Max			
3	Cadmium	<0.1	0.72	22		B
4	Chromium VI	<0.5	<0.5	21		B
	Copper	26	69	4020		A
7	Mercury	0.1	0.37	1.00		A
8	Nickel	13	30	130		A
	Lead	33	210	200		B
	Zinc	36	380	17200		A
	Vanadium	17	52	115		A
	Semi and Non Metals					
1	Arsenic	5	34	37		B
10	Selenium	0.25	1.2	350		A
	Free Cyanide	<0.5	<0.5	34		A
9	Phenols (total)	<0.3	<0.3	420		A
	Poly Aromatic Hydrocarbons			ATRISK	CLEA	
20	Napthalene	<0.1	8.5	8.71		A
	Acenaphthene	<0.1	1.9	937	2130	A
	Fluorene	<0.1	2.5	746	1930	A
	Anthracene	<0.1	1.8	20.9	18300	A
	Fluoranthene	0.2	30	113	2160	A
	Pyrene	0.27	29	13.2	1550	A
	Benz(a)anthracene	<0.1	14	8.54		A
2	Chrysene	<0.1	15	2.64	927	A
2	Benzo(b)fluoranthene	<0.1	16	7.29	9.86	A
2	Benzo(k)fluoranthene	<0.1	7.8	4.12	100	A
2	Benzo(a)pyrene	<0.1	13	0.998	5	A/B
2	Dibenz(a,h)anthracene	<0.1	3	0.0236	1	A*
2	Indeno(1,2,3-c,d)pyrene	<0.1	9.3	0.368	9.75	A
2	Benzo(g,h,i)perylene	<0.1	7.9	0.112	103	A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	<1	<1	259		A
	Aliphatic C6-C8	<1	12	769		A
	Aliphatic C8-C10	<1	13	144		A
	Aliphatic C10-C12	<1	9	297		A
	Aliphatic C12-C16	<1	11	126		A
	Aliphatic C16-C35	<1	31	145000		A
	Aromatic C5-C7 (Benzene)	<1	<1	0.87		B
	Aromatic C7-C8 (Toluene)	<1	1.7	610		A
	Aromatic C8-C10	<1	13	177		A
	Aromatic C10-C12	<1	8.5	389		A
	Aromatic C12-C16	<1	160	687		A
	Aromatic C16-C21	<1	770	804		A
	Aromatic C21-C35	<1	3600	1220		A
	Others					
	pH	3.8	7.8	-		-
	Organic Content (%)	3.3	43	-		-
	Soluble Sulphate (g/l)	0.013	0.2	-		-
	Total Sulphate (%)	0.13	1.5	-		-
	Asbestos	Awaiting results				
	PCB (7 Congeners)	<0.01	<0.01	Below detection limit.		

A = WS ATKINS PLC, ATRISK SOIL SCREENING VALUES BASED ON 6% SOIL ORGANIC MATTER

For PAHs ATRISK assumes free product is avalable whilst CLEA assumes no free product

A* Atrisk's SSV is lower than Chemtest's detectable limit for this compound.

B = CATAGORY 4 SCREENING LEVEL BASED ON 6% SOIL ORGANIC MATTER.