Environmental
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REPORT

job number J3374/16/E	site address Land Off Wombwell Lane, Barnsley, S70 3NR
date 31/03/2016	
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GEOTECHNICAL ENVIRONMENTAL

REPORT ON A GEO-ENVIRONMENTAL INVESTIGATION

at

LAND OFF WOMBWELL LANE, BARNSLEY S70 3NR.

for

ASHMOUNT HOMES LTD

CONSULTANTS: JNP GROUP CONSULTING ENGINEERS

Report No J3374/16/E

March 2016

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1. SYNOPSIS

This investigation has demonstrated that below a capping of made ground, extending to 0.4m in part of the site, a layer of clay underlain by weathered mudstone and siltstone were encountered to the full depths investigated. As a consequence, it is considered that the structures proposed at the site could be founded on strip or spread footings located within the firm clay at about 1.2m depth in the southern part of the site.

However, in the northern part of the site, made ground was revealed from 1.0m to a maximum depth of about 6.0m below ground level along the line of the disused railway cutting. This material was underlain locally by soft clay and by weathered mudstone and sandstone. As a result, it is considered that the proposed structures could be founded on deep strip or spread footings where the solid geology of the Pennine Middle Coal Measures Formation is encountered at between 2.0m and 2.5m below ground level or on piled footings founded within the bedrock where made ground was revealed at depths deeper than say 3m bgl.

The results of the soakaway testing indicated that the drainage characteristics of underlying soils were poor to practically impermeable and as such are unlikely to be suitable for use as storm soakaway drainage.

In addition, chemical testing has revealed that a range of contaminants are present within the soils at the site. Moreover, monitoring of the standpipes installed has indicated that there are significant concentrations of carbon dioxide present on site. In light of this, careful consideration of the geo-environmental discussion will be necessary.

2. INTRODUCTION

It is understood that Ashmount Homes Ltd plan to develop an area of land off Wombwell Lane, Barnsley. The proposed development currently includes the construction sixteen residential dwellings with associated access roads, hard standing and gardens.

Accordingly, a site investigation has been undertaken in accordance with the information provided by a desk study and as instructed by 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 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 John Newton and Partners Consulting Engineers (JNP); results were presented as report number B20556/PH1 in July 2015. That study was provided by the client and has been used extensively during the current intrusive investigation.

5. FIELDWORKS

The fieldworks were undertaken on the 22nd February and included the following:

- Four windowless sample boreholes.
- Four dynamic penetration tests adjacent to the borehole positions.
- Three gas monitoring standpipes.
- Eight machine dug trialpits.
- Three hand dug trialpits.
- Three soakaway tests.

Part of the original scope for the site investigation was to target exploratory holes in the area of a potential major fault that was identified by the desk study to be present under the site. However, during the site works a 1:10,000 scale geological map was made available by a representative of JNP (Sarah Longstaff), which indicated that the inclined fault plane was present only at significant depth beneath the site and that its surface trace was to the east of the site. 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 a survey plan supplied by John Newton and Partners Consulting Engineers.

5.1 Windowless Sample Boreholes

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and reduced in diameter from 90mm for the first 1m through 80mm, 70mm and 60mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 1999, as amended in 2010, and full descriptions are given on the window sample records which are presented in Appendix 2. Also included on these records are the core diameters and percentages of core recovered.

5.2 Dynamic Penetration Tests

Dynamic penetration tests were undertaken adjacent to the windowless sample boreholes in accordance with the procedure given in BS1377: 1990: Part 9, using the super heavy penetrometer (DPSH). This probe consists of a 63.5kg mass falling through 750mm onto an anvil, which drives a 50mm diameter cone into the ground. The number of blows required to drive the cone through successive 100mm increments are recorded as the N_{100} values. The results of the dynamic penetration tests are tabulated and presented as bar charts of N_{100} values versus depth in Appendix 3.

5.3 Monitoring Standpipes

Monitoring standpipes were installed in three of the boreholes, WS01, WS03 and WS04 respectively. The details of each installation are shown on the appropriate

borehole record. The standpipes consist of a perforated pipe from the base to depths ranging between 0.3m to 1.0m below ground level (bgl), with a non-perforated pipe to ground level. The response zone was filled with pea gravel, with a bentonite seal at the base and above and the installation was capped with a stop box cover in a concrete surround.

5.4 Machine and Hand Dug Trialpits/Soakaways

Eight machine dug trialpits (CBR1-CBR3 & TP1-TP5) were excavated between depths of 0.50m and 2.70m bgl in order assess ground conditions and to undertake soakaway tests at three of the locations. This work was undertaken using a 13 ton excavator at positions shown on the attached site plan. The exposed soils were logged on site in general accordance with BS5930: 1999, as amended in 2010, and full descriptions are given on the trialpit records, which are presented in Appendix 4. Samples were taken from the trialpits for testing, where deemed necessary.

In order to undertake the soakaway testing at the elected positions, the pit sides and base were cleaned and squared as much as practicable. The pit was then filled with water and the level measured relative to a reference bar at set timed intervals.

In addition, at the client's request, three hand dug trialpits were undertaken on existing bunds of soil to recover representative samples for chemical testing (Bund 1 to 3). As the bunds were not covered, the top layer of soil was discarded and samples were taken from below the surface to ensure that they were free of potential dust borne contamination. The samples were placed in appropriate jars and tubs and stored in cool boxes for onward transportation to the chemical testing laboratory.

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	Non-recorded.		
Solid Geology	Oaks Rock	-	A sandstone member of the Pennine Middle Coal Measures Formation.

According to available geological maps the site is underlain by the Oaks Rock, a named sandstone member of the Pennine Middle Coal Measures. However, the 1:50,000 scale geological map also indicates that a major north-northeast trending

[1] Sources: British Geological Survey (NERC) Map Sheets 87; Barnsley; 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*]

fault is present across the site, with the solid geology being downthrown to the north. The anticipated trace of this fault is shown on the site plan. However, as noted previously, the near surface trace of the north-northeast trending fault is now believed to be to the east of the site. In addition, this fault intersects a regional east-west trending fault approximately 170m to the east of the site, which is shown to be present to the immediate north of the site.

An area of made ground is indicated to be present to the north of the site within the undifferentiated rocks of the Pennine Middle Coal Measures Formation. It should be appreciated that the area shown as Area B on the site plan is indicated on historical plans as once forming a railway cutting, which has been subsequently filled in following disuse.

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 below ground level, *to underside of layer)*	**Strata type**	**Positions layer revealed in**	**Groundwater strikes** (m below ground level)
0.3 – +1.8	Made Ground (Silty slightly sandy slightly gravelly CLAY).	WS4, TP1, TP2, TP3, TP4, TP5, CBR1, CBR2 and CBR3.	None
1.0 – +4.0	Made Ground (Clayey gravelly SAND)	WS1, WS2, WS3	None
0.45 – 2.0	Silty slightly sandy slightly gravelly CLAY	TP1, TP2, TP4, TP5, WS4 CBR1, CBR2 and CBR3	None
1.2	Silty sandy CLAY	TP1	None
1.58	Sandy CLAY	WS2	None
+1.35 – +2.7	Silty sandy GRAVEL	TP1, TP2, TP4, TP5	None
2.5	Clayey silty sandy GRAVEL	TP1	None
+1.8	SANDSTONE	TP3	None
+2.0	MUDSTONE	WS2	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 Comments on the Strata

It should be appreciated that the site comprises two distinct areas of different ground conditions, namely Areas A and B.

Area A

Under a capping of made ground to a maximum of 0.4m depth, the strata underlying this part of the site consists of generally silty sandy and gravelly clay grading down into the weathered fraction of mudstone and siltstone (represented by silty sandy gravels) of the Pennine Middle Coal Measures Formation. Considering the presence of mudstone and siltstone lithorelics within the overlying clays, it is considered that these strata represent a continuum of the weathered fraction of the Pennine Middle Coal Measures Formation from residual to partially weathered mudstone. It should be appreciated that the anticipated Oaks Sandstone was not encountered beneath any part of Area A during the investigation.

It should be appreciated that an area of very soft ground shown on the site plan was noted within the location of Plots 7/8, where a trailer mounted bowser sank to its axel within minutes of entering this area.

In addition, no extensively disturbed natural materials were identified on site that may have been associated with a major fault plane (e.g. WS4 and TP5).

Area B

This area is underlain by variable thicknesses of cohesive and granular anthropogenic fill to depths of between 1.0m and at least 4.0m depth (possibly to about 6.0m as indicated by the probe results). Below this made ground, very soft clay was revealed to a depth of 1.58m and very weak mudstone to 2.0m within WS2. TP3 was terminated at a depth of 1.8m due to the presence of sandstone. It is possible that this sandstone represents the top of the Oaks Sandstone, which is anticipated to underlie the site or a very large obstruction as part of the made ground. Given the nature of the made ground revealed during this investigation is not considered to be representative of engineered fill.

For full soil descriptions and depths, reference should be made to the borehole and trialpit logs presented in Appendices 2 and 4.

7.2 Groundwater

No groundwater strikes were observed during the investigation. However, groundwater levels are subject to seasonal variation or changes on local drainage conditions.

8. INSITU TESTING

8.1 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 3: *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
TP1	2.4m	3.2m x 1.0m	Base: GRAVEL of siltstone lithorelicts. Sides: Silty sandy gravelly CLAY.	None Recorded*	Practically Impermeable.
TP2	2.0m	3.0m x 0.8m	Base: GRAVEL of siltstone lithorelicts. Sides: Silty sandy gravelly CLAY.	None Recorded*	Practically Impermeable.
TP4	1.9m	1.70m x 0.9m	Base: GRAVEL of siltstone lithorelicts. Sides: Silty sandy gravelly CLAY.	$6.4x10^{-6}$**	Poor.

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

** *N.B. Results using linear extrapolation.*

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 three trial pits. Indeed, very little movement of water was noted within TP1 and TP2, indicating that the underlying soils at the test depths were practically impermeable. However, a fall in water level was observed within TP4 over two hours, but insuffiecent to acheive 75% of effective depth. Extrapolation of these results indicates that the drainage condition of strata at this location is poor.

8.2 Dynamic Penetration Tests

Dynamic penetration tests were conducted adjacent to the windowless sample boreholes.

Area A

In general, the resistance to penetration was noted to typically range between 1 and 2 blows/100mm in the underlying made ground and natural clay to a depth of 1.2m bgl. From this depth, a marked increase the strength with increasing depth was

noted, with effective[3] refusal being revealed at a depth of between 1.7m bgl, presumably within weak to moderately strong strata of the underlying Pennine Middle Coal Measures Formation.

Area B

The results demonstrate that at the location of DP1 resistances to penetration typically ranging between 3 and 11blows/100mm were encountered within the made ground to a depth of 5.8m bgl with occasional results of less than 3 being recorded throughout the profile. In contrast, at the location of DP2 initial resistances to penetration of between 3 and 11blows/100mm were encountered within the made ground to a depth of 1.0m bgl. Below this depth, resistances to penetration of 1blow/100mm were encountered to 1.5m bgl, probably related to the layer of natural clay, before increasing significantly with depth to 23blows/100mm to 2.7m bgl within the weathered mudstone revealed by WS2. In addition, resistances to penetration ranging generally between 1 and 2blows/100mm were encountered within the made ground at the location of DP3 to a depth of around 0.8m bgl, below which results of between 3 and 8blows/100mm were revealed to 2.0m depth.

It is considered that the variance of recorded results most likely reflects the variable nature of made ground underlying the site. Effective and abrupt refusals were recorded at depths of between 2.1m and 5.9m bgl across the site, presumably within weak to moderately strong strata of the underlying Pennine Middle Coal Measures Formation.

8.3 Gas and Water Level Monitoring

The standpipes were monitored during the period from the 8th to the 22nd March 2016. The results of the gas monitoring undertaken to date are tabulated below.

Table 4: ***Landfill 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)
WS1	08.03.16	0.0	0.2	21.4	0.2	1005	-	3.91
	15.03.16	0.0	6.0	4.4	0.1	1027	-	
	22.03.16	0.0	6.1	5.1	0.2	1011	-	
WS3	08.03.16	0.0	0.5	20.8	0.0	1005	1.3	1.93
	15.03.16	0.0	1.0	17.8	0.1	1027	1.8	
	22.03.16	0.0	1.1	18.7	0.1	1012	1.9	
WS4	08.03.16	0.0	0.1	21.2	0.3	1005	0.5	0.98
	15.03.16	0.0	0.2	20.8	0.1	1027	1.0	
	22.03.16	0.0	0.7	20.4	0.1	1011	1.0	

This work was undertaken using Geotechnical Instruments (UK) Ltd. GA5000, (Serial No.G503524), which was last calibrated on the 29th February 2016.

[3] 25 blows/100mm

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
- California Bearing Ratio — BS 1377: 1990: Pt4: 7
- Soluble sulphate content — BS 1377: 1990: Pt3: 5
- pH value — BS 1377: 1990: Pt3: 9

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 25%		Generally reducing with depth.
Index Properties	4	LL PL PI LS	38 to 77 18 to 22 18 to 55 09 to 12	Clay of intermediate to very high plasticity. Consistency index 0.9 NHBC Class – Low to high
California Bearing Ratio	2	MC CBR	21 to 24% 3 to 4%	Silty CLAY.
Soluble sulphate & pH	8	SO_4 pH	<10 to 97mg/l 7.4 & 9.8	Reasonable pH values.

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)	Low to High		Silty sandy gravelly CLAY.
Shear strength parameters (at foundation level)	c_u γ	60kN/m^2 18kN/m^3	Based on consistency indices, field descriptions and probe results.
Concrete classification	DC1		Brown field site (static ground 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 sixteen residential dwellings with associated access roads, hard standing and gardens. 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.

Given the significant difference in ground conditions revealed beneath Areas A and B, it is recommended that consideration is given to separate foundation solution for each part of the site. These options are discussed in more detail below.

Area A - Strip or Spread Foundations

In broad terms, it is considered that the foundation solution in Area A 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 silty sandy and gravelly clay comprising the weathered fraction of the local mudstone/siltstone 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

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	120	215	200	185

The allowable increase in stress given above assumes a factor of safety of 3 against general shear failure, with 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 (i.e., as in the soft spot under Plot 7/8) they should be locally removed and replaced with lean-mix concrete or compacted granular soil.

Area B – Deep Strip or Spread and Piled Foundations

It cannot be recommended that traditional shallow strip or spread foundations be constructed directly within the made ground encountered within Area B, given its variable lateral and vertical nature to depths in excess of 4.0m bgl (and probably to about 6.0m bgl) within the area of WS1. It must also be appreciated that the dynamic probe results indicated areas of variably competent material across the site and with depth, such that it is considered highly unlikely that the historic railway cutting was restored to its present surface level with engineered fill. Furthermore, the cross sectional and longitudinal profile of the cutting has been outlined by this investigation to comprise a concealed railway track deepening from about 2.0m depth in the southeast to approximately 6.0m bgl to the northwest of Area B. Perpendicular to this concealed railway track, the anticipated cross sectional profile of the old cutting has been revealed to typically deepen from about 1.0m bgl in the southwest at the location of WS2 to 1.8m bgl in the northeast at the position of TP3. It is also possible that part of the made ground is underlain by weathered and very weak mudstone (i.e., in the area of WS2) and part is underlain by sandstone bedrock (i.e., in the area of TP3 and WS3).

Borehole, trialpit and probing results (WS2/DP2, WS3/DP3 and TP3) along the eastern part of Area B suggest that potentially competent strata are present at about 2.0m depth in the location of Plots 9/10, 11 and 12. In light of this, it is recommended that consideration be directed to the use of deep strip or spread foundations at these locations. It is considered that the underlying very weak mudstone or possibly sandstone could provide a suitable bearing stratum, provided that the foundations are placed directly onto competent bedrock.

It is considered that deep traditional foundations constructed at a minimum depth of say 2.0m at these locations could be designed assuming a minimum allowable increase in stress of at least 200kN/m² (for medium dense sand and

gravel/weathered sandstone and for stiff clay/weathered mudstone) with a factor of safety against general shear failure of in excess of 3. Settlements at these loading intensities should remain within tolerable limits for the type of structure proposed provided that the underlying materials are carefully inspected immediately final trimming has taken place. This is based on the assumption that the sandstone revealed at the base of TP3 (and abrupt refusal at WS3/DP3) represents the top of a sandstone member and not a large boulder. It should also be appreciated that higher allowable bearing capacity can be achieved with deeper foundations.

Notwithstanding the above, where made ground is significantly deeper, say greater than 3m in depth in the area of Plots 13 to 16, and in order to reduce the risk of differential settlement causing local distortion of the foundations and cracking within the superstructure, some consideration may be given to the employment of ground improvement techniques such that shallow strip and spread footings could be utilised. In this case, it is considered that ground stabilisation could include the use of vibro-stone columns. An explanation of this method of construction is provided in the *NHBC Standards, Part 4, Foundations, Chapter 4.6 Vibratory ground improvement techniques*. Briefly the method includes the insertion of a gravel column through weak near surface soils by inserting a vibrating poker into the ground and filling the void created with coarse gravel. These columns are positioned at designed spacing on the line of the footings, which are subsequently constructed using reinforced concrete. There are a number of techniques available, thus in order to fully assess the efficacy of this approach, the advice of specialist contractors should be sought.

However, on the basis of the poor resistance to penetration of the natural clay underlying parts of the made ground, the uneven depth to various parts of the concealed cutting (i.e., unknown buried sloping topography), the discrete and discontinuous nature of the made ground, combined with the presence of a relatively shallow groundwater table that may fluctuate due to seasonal variation, it is recommended that consideration be directed to the use of a piled foundation solution for Plots 13 to 16. Such foundations would transfer the loads through the made ground to the underlying solid geology of the Pennine Middle Coal Measures Formation (possibly mixed sandstone and mudstone sequence).

For preliminary design purposes it is considered that drilled piles using down the hole hammers (DTH) techniques (Odex, Symmetrix or similar) socketed into the underlying competent mudstone and sandstone sequence could be utilised. Such a system would be expected to transfer structural loads through the soft or loose material and into the underlying bedrock by means of a rock socket. From the results of the dynamic probing, it is considered that suitable competent strata of the underlying Pennine Middle Coal Measures Formation are present below depths of between 2.0m and 6.0m bgl across the site.

Additionally, concern should be raised over the possible presence of large boulders within the made ground underlying the site, as potentially indicated by the presence of sandstone revealed at the base of TP3. Whilst it should be possible to penetrate

any encountered boulders using DTH techniques, it may become necessary to pre-bore at the pile position during the works.

The use of driven piles is not recommended due to the potentially variable nature of underlying strata (i.e., mudstone and sandstone sequence) and the topography of the concealed cutting. Thus the depth and lateral extent of suitable material for the piles to be 'set' in within the bedrock is likely to be variable (i.e., unknown) across the site.

In order to formulate a suitable design it is recommended that the advice of specialist contractors be sought. The chosen piling contractor should be made aware that piles may be subject to negative skin friction due to further settlement of made ground and very weak natural soils revealed by this investigation. Moreover, whilst small diameter piles may be employed, it will be necessary to ensure that slender piles are checked against buckling through significant thicknesses of loose and soft material, which will offer low levels of lateral support.

In view of the weak near surface soils it will be necessary to construct a working platform. This work should be undertaken in accordance with the procedures and specification given in the BRE publication entitled *Working platforms for tracked plant.*

Whilst a combination of foundation techniques could be employed for individual units in this part of the site, under no circumstance should mixed foundations types be employed for a structure. The differing performance of the foundations could lead to unacceptable levels of differential settlement. Moreover, if structures with different foundation solutions are required to adjoin, a suitable movement joint should be created.

11.2 Volume Change Potential

In light of the vegetation observed during the investigation, particularly the presence of mature trees on site, 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[4]. The methodology provided in the guidance will require the identification of any trees, still present at or recently removed from the site, and the distance from the proposed foundations. Foundations lying inside the zone of influence of the 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.

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

In addition, piled foundations should also be able to cater for shrinkage or swelling of the cohesive material within or below the made ground, should they be installed within the zone of influence of any existing or proposed trees and shrubs. For design purposes, in particular the derivation of heave forces on the piles, the zone of desiccation may be considered as equivalent to the minimum foundation depth recommended for a shallow footing in the NHBC Standards, Chapter 4.2 - *Building Near Trees*.

11.3 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.

11.4 Ground Floor Slab

In view of the presence of variable thickness and condition of the cohesive and granular made ground revealed beneath Area B, it is recommended that 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 beneath Area A, 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 Hardstanding

It is considered that the access roads, car parking and hard standing areas could be constructed employing traditional pavement design. On the basis of the soils exposed in this investigation and the laboratory testing a design CBR value of no more than 4% should be taken in design.

It is recommended that proof rolling 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 sandy gravelly clay at depths of between 1.30m and 2.30m bgl, it can be seen that in the most onerous case, the drainage characteristics of this predominantly cohesive sequence were found to be practicably impermeable, and the material encountered within the base of TP4 poor. These results indicate that materials at those locations and depths were not suitable for 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[5], 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-1.

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1[6], 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.

12 DISCUSSION OF GROUND CONDITIONS – ENVIRONMENTAL

12.1 Discussion of Test Results

As the proposed works are to include the construction of residential dwellings with associated access roads, hard standing and gardens, the site may be classified as having a residential with plant uptake (with home grown produce) 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

[5] Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brown field sites*
[6] 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.*

current release of the SGVs. A list of subscribers is provided within the website[7] 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 (Area A).*

Location	Contaminants found to be exceeding SSVs (Residential with Plant Uptake)
TP1	PAH [Chrysene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].
TP2	None Recorded.
TP4	None Recorded.
WS4	None Recorded.

Table 9: *Summary of contaminated areas (Area B).*

Location	Contaminants found to be exceeding SSVs (Residential with Plant Uptake)
WS1	None Recorded.
WS2	PAH [Naphthalene, anthracene, pyrene, benzo(a)anthracene, chrysene, benzo(b,k)flouranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].
WS3	PAH [Benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].
TP3	PAH [Anthracene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].

Table 10: *Summary of contaminated areas (Bunds).*

Location	Contaminants found to be exceeding SSVs (Residential with Plant Uptake)
Bund1	PAH [Indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].
Bund2	PAH [Pyrene, benzo(a)anthracene chrysene, benzo(b,k)flouranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].
Bund3	Lead, PAH [Chrysene, benzo(b,k)flouranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].

[7] http://www.atrisksoil.co.uk/pages/general/subscribers.asp

Concentrations of chromium^{VI}, free cyanide, phenols (Total), petroleum hydrocarbons (aliphatic C5 to C16 and aromatic C5 to C12) 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[8]. 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. 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 11: *Summary of areas contaminated by PAHs.*

Borehole Location	Contaminants found to be exceeding CLEA Criterion (Residential with Plant Uptake)
TP1	PAH[Benzo(a)pyrene].
TP3	PAH[Benzo(a)pyrene].
WS2	PAH [Naphthalene, benzo(a)anthracene, benzo(b)flouranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene].
WS3	PAH[Benzo(a)pyrene].
Bund2	PAH [Benzo(a)anthracene, benzo(b)flouranthene, benzo(a)pyrene, dibenz(a,h)anthracene].
Bund3	PAH[Benzo(a)pyrene].

Notwithstanding this, it should be appreciated that the ATRISK soil screening criteria and the CLEA guidance provides screening values that adhere to the principals of ensuring that contamination levels are kept to a 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 a harm present from contamination[9]. 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.

[8] Ref: ATRISK soil, SSVs derived using CLEA v1.04 for 6% SOM, Residential with home grown produce land use, 14.12.09.
[9] DEFRA, 2014. SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document*.

As such, in the context of a residential site with plant uptake, a C4SL value of 200mg/kg is given for lead and 5mg/kg is provided for benzo(a)pyrene[10] . As the concentration of benzo(a)pyrene is lower than this in certain parts of the site, it is reasoned, for example, that whilst the risk of harm from the concentration of this contamination in the area of WS3 and TP1 is not minimal, it may be considered low. However, as there are areas where concentrations of benzo(a)pyrene are above the C4SL value, in combination of elevated concentrations of other PAHs, it cannot be considered that the risk of harm is low across the whole of the site.

Accordingly, on the basis of all the information provided above, it is considered that the shallow soils are contaminated by lead and PAH's with respect to the proposed end use.

It should be appreciated that although the concentration levels of lead and benzo(a)pyrene within some but not all samples taken from the bunds may fall below the published C4SL values for these determinands, these values cannot be used for screening or validating soils to be re- used as inert fill on site due to the methodology used to derived them. On the basis of the results of this investigation and the potential of cross-contamination of soils (i.e., not covered) it is recommended that soil comprising Bund1 to Bund3 is not used on garden areas without further investigation and improved on-site material handling (i.e., covered to prevent it becoming mixed with contaminated soils or dust, or penetrated by mobile contaminants).

Nine samples of soil were tested for asbestos identification. No asbestos fibres were detected, thus it is considered that the site is not contaminated by asbestos.

12.1.2 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated a maximum gas concentration of negligible methane, with concentrations of carbon dioxide ranging between 0.1% and 6.1%, in association with oxygen levels of between 4.4% and 21.4%. 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 0.3 litres per hour was recorded and will be employed in any 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 1005mb and 1027mb.

[10] 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.*

For 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 the maximum gas concentration of 6.1% (0.061) of carbon dioxide and 0.0% (0.00) of methane, in association with a maximum flow of 0.3l/hr, was recorded. This results in a GSV of 0.018l/hr for carbon dioxide and a GSV of 0l/hr for methane.

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 upgraded 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 some special protection measures are 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) and that the generation potential is low, these tables suggest that between 6 and 9 readings could be undertaken over a period of 3 to 6 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.

Nonetheless, it should be appreciated that this assessment is based upon three readings undertaken over a three week period and a further gas monitoring visit is still to be undertaken. The results of that visit will be issued under separate cover.

In view of the above, it is considered that the site is provisionally characterised as Situation Level 2.

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[11] advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.[12] 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

[11] 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'.
[12] 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.

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.'[13]

12.2.2 Conceptual Ground Model

Potential sources of contamination include the following:

On site: Made ground and ground gas (elevated levels of carbon dioxide).

Table 12: *Potential Harm to Humans and Animals (fauna)*

SOURCES: MADE GROUND CONTAMINATION: Lead, PAH and CO_2 (Residential with Plant Uptake)		
Pathways	**Receptor**	**Linkage Present?**
Direct contact/dermal absorption/soil ingestion	Operative	Yes – Some contamination is present which exceeds trigger values for proposed end use. Appropriate precautions will need to be taken during the construction phase.
	End User	Yes – Some contamination is present which exceeds trigger values for proposed end use.
	Neighbours	Yes – Some contamination is present which exceeds trigger values for proposed end use. Appropriate precautions will need to be taken during the construction phase.
Inhalation of Dust/Vapours	Operative	Yes – Some contamination is present which exceeds trigger values for proposed end use. Appropriate precautions will need to be taken during the construction phase.
	End User	Yes – Some contamination is present which exceeds trigger values for proposed end use.
	Neighbours	Yes – Some contamination is present which exceeds trigger values for proposed end use. Appropriate precautions will need to be taken during the construction phase.
Ingestion of fruit/vegetables and/or waters	Operative	No – Some contamination is present which exceeds trigger values for proposed end use. Appropriate precautions will need to be taken during the construction phase. No fruits, vegetables or waters present on site currently.
	End User	Yes – Some contamination is present which exceeds trigger values for proposed end use.
	Neighbours	No – Some contamination is present which exceeds trigger values for proposed end use. No fruits, vegetables or waters present on site currently.
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – Elevated levels of CO_2 recorded. Depleted oxygen levels. No shallow mining activity.
	End User	Yes – Elevated levels of CO_2 recorded. Depleted oxygen levels. No shallow mining activity.
	Neighbours	No – Site is not a generating source. Gas levels typical of on site made ground. Probable vertical venting into atmosphere as no evidence of horizontal migration across the site, i.e., from Area B to Area A. No shallow mining activity.

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

Table 13: *Potential Harm to Controlled Waters and Groundwater*

SOURCES: MADE GROUND CONTAMINATION: Lead, PAH and CO_2 (Residential with Plant Uptake)		
Pathways	**Receptor**	**Linkage Present?**
Spillage/loss/run off direct to receiving water	Controlled Waters	No – Potential contamination is present in cohesive and low (clayey) permeability soils, therefore off site mobility is unlikely. No surface waters present on site. Nearest is 160m off site.
Migration via permeable unsaturated strata	Controlled Waters	No – Secondary A aquifer under site. However, contamination is present in generally cohesive and low (clayey) permeability soils, therefore vertical off site mobility is likely to be low. Large areas of site underlain by mudstone and siltstone. No surface waters present on site.
Run off via drainage/sewers, etc.	Controlled Waters	Yes – Potentially through existing services. In mitigation, potential contamination is present in cohesive and low permeability soils, therefore off site mobility is unlikely.

Table 14: *Potential Harm to Plants (flora)*

SOURCES: MADE GROUND CONTAMINATION: Lead, PAH and CO_2 (Residential with Plant Uptake)		
Pathways	**Receptor**	**Linkage Present?**
Direct contact with contaminated soils	Plants	Yes – Some contamination is present which exceeds trigger values for proposed end use.
Uptake via root system	Plants	Yes – Some contamination is present which exceeds trigger values for proposed end use.

Table 15: *Potential Harm to Buildings/Structures*

SOURCES: MADE GROUND CONTAMINATION: Lead, PAH and CO_2 (Residential with Plant Uptake)		
Pathways	**Receptor**	**Linkage Present?**
Direct contact with contaminated soils	Building Materials	Yes - Some contamination is present which exceeds trigger values for proposed end use.
Direct contact with contaminated groundwater	Building Materials	Yes - Contamination is present in cohesive and low permeability soils; however, contamination of groundwater is possible. Groundwater is at relatively shallow depth (1.0m~1.9m below surface) within predominantly cohesive soil. May represent local perched water tables within made ground, but sequence generally dominated by low permeability soils.

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 16: *Risk Assessment*

SOURCES: MADE GROUND CONTAMINATION: Lead, PAH and CO_2 (Residential with Plant Uptake)			
Pathways	**Receptor**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	Moderate	Yes – Some contamination is present which exceeds trigger values for proposed end use. Precautionary measures will be required during the construction phase to protect operative and neighbours.
	End User		
	Neighbours		
Inhalation of Dust/Vapours	Operative	Moderate	Yes – Some contamination is present which exceeds trigger values for proposed end use. Precautionary measures will be required during the construction phase to protect operative and neighbours.
	End User		
	Neighbours		
Ingestion of fruit/vegetables and/or waters	End User	Moderate	Yes – Some contamination is present which exceeds trigger values for proposed end use.
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Low	The site is considered as *Characteristic Level 2,* as levels of over 5% CO_2 were recorded. Depleted oxygen levels in made ground. Precautionary measures will be required during the construction phase to protect operative.
Run off via drainage/sewers, etc.	Controlled Waters	Low	Yes – Potentially through existing services. In mitigation, potential contamination is present in cohesive and low permeability soils, therefore off site mobility is unlikely.
Direct contact with contaminated soil	Plants	Low to moderate	Yes – Some contamination is present which exceeds trigger values for proposed end use.
Uptake via root system			
Direct contact with contaminated soils	Building Materials	Low (Concrete)	Test results show 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-1.
		High (Plastic Services)	PAH contamination is present underlying the site. Protection of plastic services will be required.
Direct contact with contaminated groundwater	Building Materials	Low	Groundwater is at relatively shallow depth (1.0m~1.9m below surface) within predominantly cohesive soil.

12.3 Remediation Strategy

In view of the site specific risk assessment and proposed end use, it is considered that, in general terms, remediation will not be required at this site with respect to the proposed end use. However, consideration should be given for the following main points:

- 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 neighbour from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust and vapours.

- To protect the site operatives and end user from elevated levels of ground gas.

- To protect plants from contact with contaminated ground, uptake via root system.

- To protect buried plastic services from degradation due to the presence of PAH's in the soil.

- To protect off site migration of water via drainage by sealing any redundant services.

- The desk study (Ref: John Newton and Partners Consulting Engineers B20556/PH1) indicated that between 1 and 3 % of homes in the area are above the action level for radon. Therefore, the desk study states that no radon protection measures are necessary in the construction of new dwellings or extensions.

12.3.1 Development Requirements

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

12.3.2 Strategy

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

Ground-works

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

- Site operatives at all levels should be made aware of the hazards of working with contaminated soils.
- Personal hygiene facilities, including washing and messing, must be provided and site operatives be encouraged to make use of them.
- Site operatives at all levels should be made aware of the hazards of working with soils contaminated by asbestos and the dangers of ground gases and depleted oxygen being present in enclosed spaces (in particular trenches and basement areas). Risk assessments in relation to these aspects should be carried out and appropriate PPE provided where necessary.
- 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 the landfill site they should be covered to prevent contamination of the surrounding area by dust.
- Any stockpiles of contaminated soil on site should be sheeted over to prevent excessive amounts of airborne dust.
- Where work is undertaken in wet weather, vehicle and wheel washing facilities are required to ensure that the vehicles leaving the site do not transfer contamination to surrounding areas.

On completion of the ground-works a careful site inspection of the sub-grade would be required. Should visual or olfactory evidence of contamination be revealed then further testing may become necessary. Buried asbestos should, if present and as far as is possible, be left *in situ* and covered by hard standing, floor slabs or inert fill to remove the linkage to human receptors. Although no asbestos fibres were detected within near surface soils, if asbestos containing materials are found during excavation of say the deeper areas of fill, it is recommended that it is removed by a specialist contractor.

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 required to protect the end user from the potential contaminants revealed at this site.

- Beneath buildings, pavements and hard-standings clean inert granular sub-base should be employed.
- For buried concrete the results of the sulphate and pH testing indicate that the design sulphate class for the site should be DS-1.
- 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.
- Due to the levels of carbon dioxide recorded on site 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.

Garden Areas

In view of the contamination revealed across at the site, it is considered that proposed garden areas found to be affected by elevated contamination levels may 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.

Imported Fill Material

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 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[14] 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 17: *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.

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 18: *Fill screening values*

Contaminant	Screening Value (Residential with plant uptake) (mg/kg)	Reference
As	32	$Atrisk^{SOIL}$ SSVs, 6% soil organic matter
Cd	10	$Atrisk^{SOIL}$ SSVs, 6% soil organic matter
Cr^{VI}	14.7	$Atrisk^{SOIL}$ SSVs, 6% soil organic matter
Cu	4020	$Atrisk^{SOIL}$ SSVs, 6% soil organic matter
Hg	1.0	$Atrisk^{SOIL}$ SSVs, 6% soil organic matter
Ni	130	$Atrisk^{SOIL}$ SSVs, 6% soil organic matter
Pb	168	$Atrisk^{SOIL}$ 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

The frequency of such testing should be sufficient to give statistical confidence for the validation results. For sub-soil the frequency should be 1 per 250m³ or a

[14] Sampling & Testing Matrix of Yorkshire and Humberside Pollution Advisory Council, 2013, *YAHPAC Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems v2.1*, Appendix 1a.

minimum of three samples, whichever is the greater. 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 immediate or sufficiently quarantined to ensure they do not become mixed with other materials. If it is necessary, the quarantined material should be placed on appropriate sheeting and covered to prevent it becoming mixed with off-site contaminated soils or dust, or penetrated by mobile contaminants.

12.4 Verification Report

In order to demonstrate that the remedial works including gas protection measures 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 over areas where made ground remains. 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.
- Photographic and logged evidence that the appropriate gas protection measures have been installed to the manufacture’s specifications.

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

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 ground work contractors in relation to the requirement for testing of materials to be disposed off-site (Waste Acceptance Criteria) and the suitability of imported materials.
- Discussions with ground improvement contractors regarding their method for providing suitable foundation schemes for the site.
- Discussions with piling contractors regarding their method for installing piles and for further investigation of the soils at depth should this option be preferred.
- Testing the soils in accordance with the UKWIR suite for selection of water pipes as recommended by water utility providers.
- Discussions with service providers regarding the materials suitable for pipework.
- Detailed design of the sub-structure.
- Produce a validation report to demonstrate that the geo-environmental risks discussed in this report have been mitigated.

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

14. REFERENCES

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For and on behalf of
Rogers Geotechnical Services Ltd,

Gabriel Bobrowicz MSc, PhD, MCSM, FGS,
Principal Geotechnical Engineer

J. Farnsworth BEng, FGS
Senior Geotechnical Engineer

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: **Wombwell Lane, Barnsley, S70 3NR**	Job No: **J3374/16/E**

APPENDIX 2

WINDOWLESS SAMPLE BOREHOLE RECORDS

Borehole Log

Borehole No. **WS1**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords:	Hole Type WLS
Location: Barnsley S70 3NR		Level:	Scale 1:50
Client: Ashmount Homes Ltd		Dates: 22/02/2016	Logged By JDMI

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.35 - 0.54	ES	90	95					MADE GROUND. (Mottled pink yellow brown grey and black clayey gravelly SAND. Gravel is sub-angular to rounded fine to coarse occasionally tabular brick ash coal and concrete).
				80	74		1.00			MADE GROUND. (Light to dark grey clayey gravelly SAND. Gravel is angular to rounded fine to coarse concrete and mixed lithologies).
				70	76					
				60	62					
							4.00			End of Borehole at 4.00m

1 2 3 4 5 6 7 8 9 10

Remarks

Borehole Log

Borehole No. **WS2**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords:	Hole Type WLS
Location: Barnsley S70 3NR		Level:	Scale 1:50
Client: Ashmount Homes Ltd		Dates: 22/02/2016	Logged By JDMI

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.27 - 0.38	ES	90	100					MADE GROUND. (Mottled pink yellow brown grey and black clayey gravelly SAND. Gravel is sub-angular to rounded fine to coarse occasionally tabular brick ash coal and concrete).
				60	78		1.00			Very soft grey friable slightly sandy CLAY.
							1.58			Very weak thinly laminated highly weathered MUDSTONE.
							2.00			End of Borehole at 2.00m

Remarks

Refusal at 2.0m

Borehole Log

Borehole No. **WS3**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords:	Hole Type WLS
Location: Barnsley S70 3NR		Level:	Scale 1:50
Client: Ashmount Homes Ltd		Dates: 22/02/2016	Logged By JDMI

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.35 - 0.55	ES	90	98					MADE GROUND. (Brown mottled pink yellow grey and black slightly clayey gravelly SAND. Gravel is sub-angular to rounded fine to coarse occasionally tabular brick ash coal and concrete).
				60	81					
							2.00			End of Borehole at 2.00m

Remarks

Refusal at 2.0m

Borehole Log

Borehole No. **WS4**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords:	Hole Type WLS
Location: Barnsley S70 3NR		Level:	Scale 1:50
Client: Ashmount Homes Ltd		Dates: 22/02/2016	Logged By JDMI

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.11 - 0.28	ES	90	96		0.40			MADE GROUND (Dark brown speckled pink and black sandy gravelly CLAY. Gravel is sub-angular to rounded fine to medium brick and ash. Rare woody fragments and rootlets).
		0.75	D				1.00			Soft to firm orangish brown slightly sandy slightly gravelly CLAY. Gravel is sub-angular to sub-rounded fine to medium of mixed lithologies).
										End of Borehole at 1.00m

Remarks

Refusal at 1.0m

APPENDIX 3

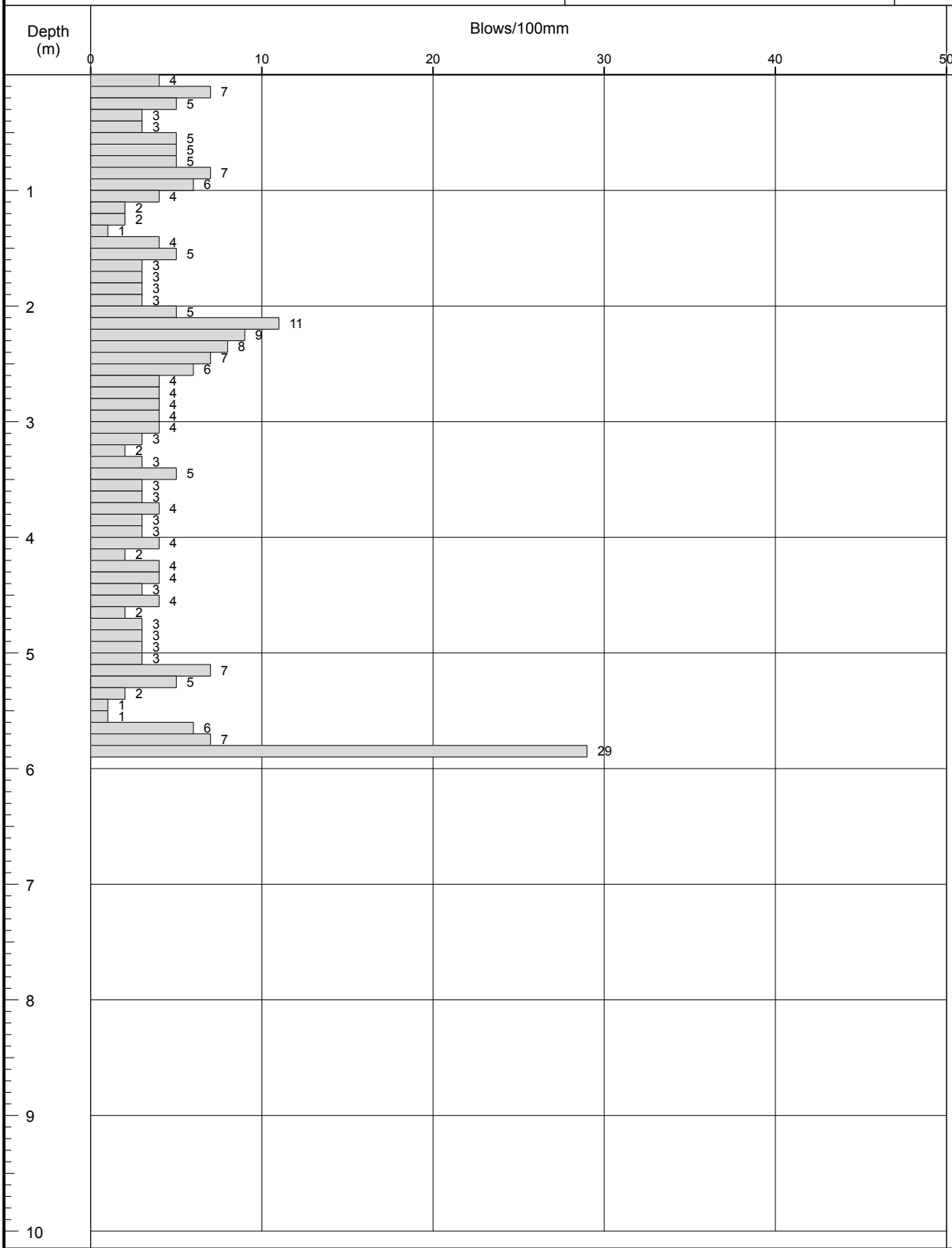
DYNAMIC PROBE RECORDS

Probe Log

Probe No. **DP1**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords:	Hole Type DCP
Location: Barnsley S70 3NR		Level:	Scale 1:50
Client: Ashmount Homes Ltd		Dates: 22/02/2016	Logged By KW



Remarks:

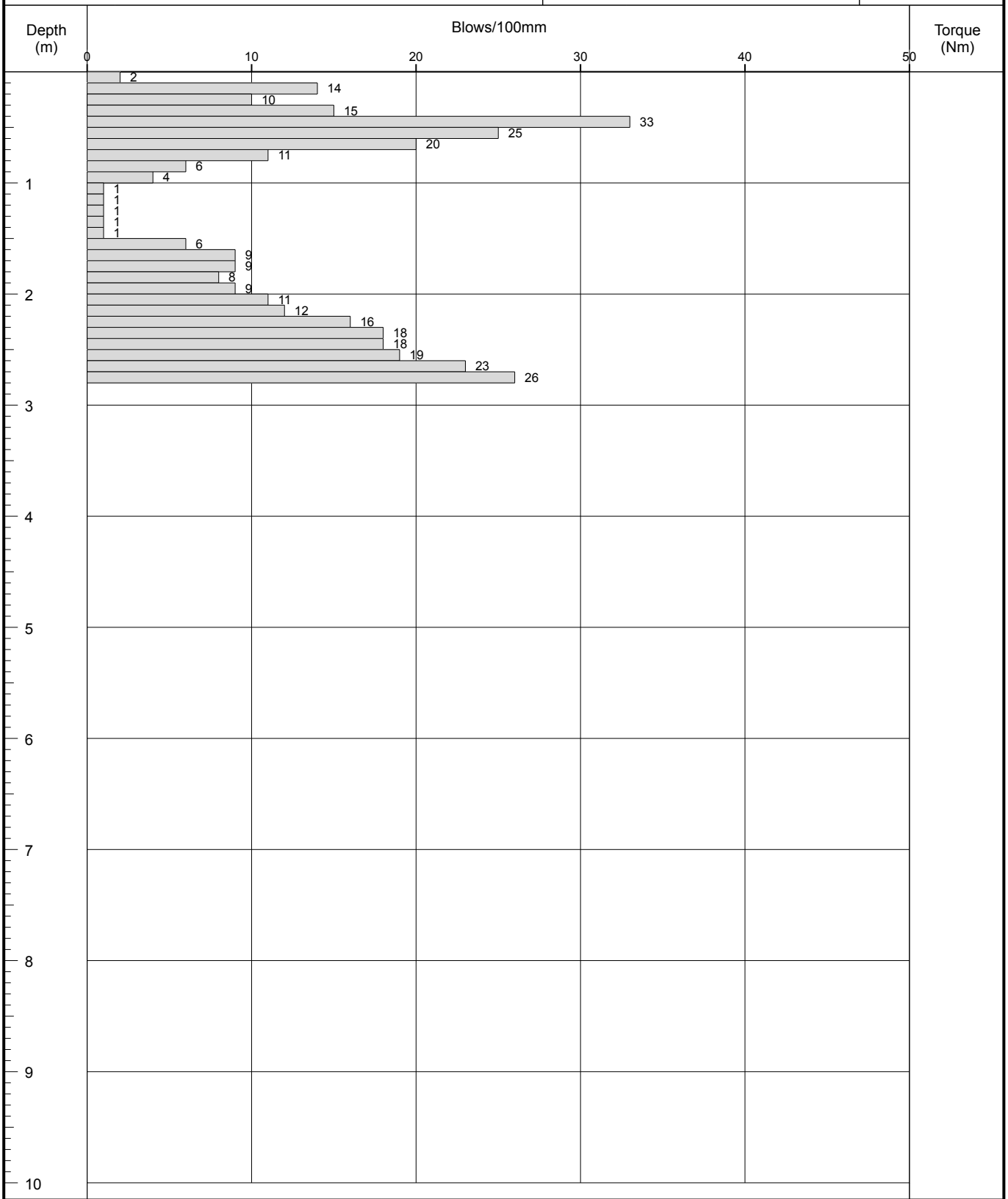
Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	5.8m
Probe Type	DPSH-B		

Probe Log

Probe No. **DP2**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords:	Hole Type DCP
Location: Barnsley S70 3NR		Level:	Scale 1:50
Client: Ashmount Homes Ltd		Dates: 22/02/2016	Logged By KW



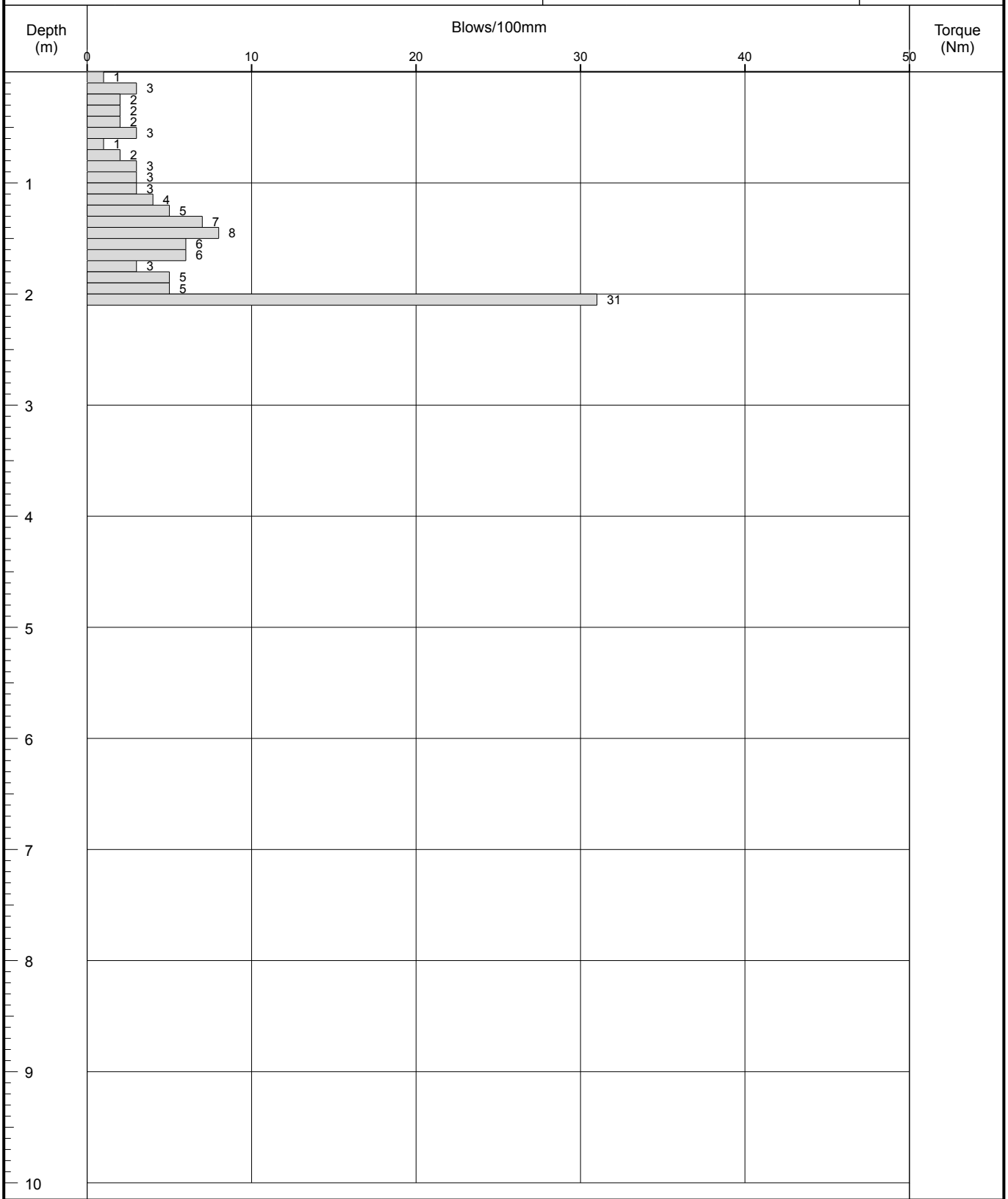
Remarks:

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	2.7m
Probe Type	DPSH-B		

Probe Log

Probe No.
DP3
Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords:	Hole Type DCP
Location: Barnsley S70 3NR		Level:	Scale 1:50
Client: Ashmount Homes Ltd		Dates: 22/02/2016	Logged By KW



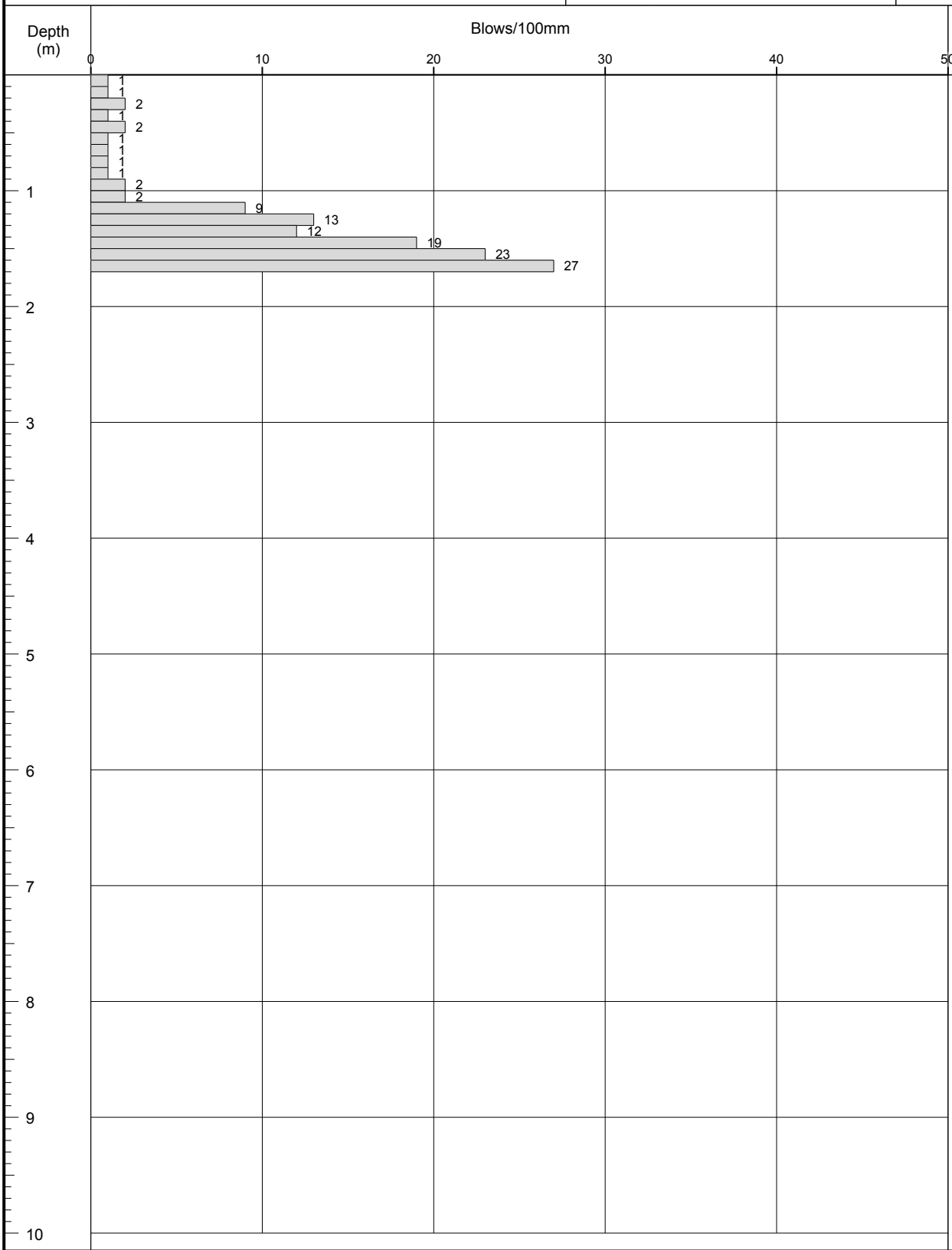
Remarks:
Abrupt Refusal

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	2m
Probe Type	DPSH-B		

Probe Log

Probe No.
DP4
Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords:	Hole Type DCP
Location: Barnsley S70 3NR		Level:	Scale 1:50
Client: Ashmount Homes Ltd		Dates: 22/02/2016	Logged By KW



Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	1.6m
	Probe Type	DPSH-B		

APPENDIX 4

MACHINE AND HAND DUG TRIALPIT RECORDS

Trial Pit Log

Trialpit No **TP1**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): 3.2 (1) Depth 2.70	Scale 1:50
Client: Ashmount Homes Ltd			Logged RAP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.70	D		0.70			MADE GROUND (Dark brown silty slightly sandy gravelly CLAY with occasional rootlets and rare sandstone boulders. Gravel is sub-angular to angular, fine to coarse of sandstone).
							Soft to firm brown silty sandy CLAY with rare rootlets.
	1.30	D		1.20			Soft and firm grey mottled brown silty slightly sandy slightly gravelly CLAY.
							1.8m Becoming more gravelly. Sub-angular fine to coarse sandstone lithorelics.
				2.00			Grey and brown clayey silty sandy sub-angular fine to coarse GRAVEL of siltstone.
				2.50			Brown silty sandy tabular fine to coarse GRAVEL of siltstone lithorelicts with occasional tabular cobbles of siltstone.
				2.70			End of pit at 2.70 m
	3.00	D					

Remarks:

Stability: Good.

Trial Pit Log

Trialpit No **TP2**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): 3 × 0.8, Depth 2.00	Scale 1:50
Client: Ashmount Homes Ltd			Logged RAP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.35			MADE GROUND (Dark brown silty slightly sandy slightly gravelly CLAY with occasional rootlets and bricks fragments and rare scrap metal).
	0.75	D					Soft greyish brown mottled orangish brown silty slightly sandy gravelly CLAY. Gravels is sub-rounded and tabular fine to coarse sandstone lithorelicts.
							0.8m Becoming soft to firm.
	1.40	D					*1.45m Firm to stiff.*
				1.90			Brown and dark grey sandy tabular fine to coarse GRAVEL of siltstone with occasional cobbles of tabular siltstone.
				2.00			End of pit at 2.00 m

Remarks:

Stability: Good.

Trial Pit Log

Trialpit No **TP3**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): Depth 1.80 — 1.9 × 0.6	Scale 1:50
Client: Ashmount Homes Ltd			Logged RAP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							MADE GROUND (Dark brown silty slightly sandy slightly gravelly CLAY with brick fragments).
				0.55			
				0.62			MADE GROUND (Dark grey silty sandy GRAVEL of ash).
							MADE GROUND (Dark brown malodorous silty slightly sandy slightly gravelly CLAY with brick fragments masonry sandstone clinker plastic and wood).
				1.80			End of pit at 1.80 m

Remarks: Refusal met at 1.8m due to presence of sandstone at base of trialpit.

Stability: Good.

Trial Pit Log

Trialpit No **TP4**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): 1.7 x 0.9 Depth 1.90	Scale 1:50
Client: Ashmount Homes Ltd			Logged RAP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.50			MADE GROUND (Soft brown silty slightly sandy slightly gravelly CLAY).
				1.05			Soft to firm brownish grey mottled orangish brown silty slightly sandy slightly gravelly CLAY.
	1.35	D					Brown and dark grey silty sandy tabular fine to coarse GRAVEL of siltstone lithorelics with occasional tabular cobbles of siltstone.
				1.90			End of pit at 1.90 m

Remarks:

Stability: Good.

Trial Pit Log

Trialpit No **TP5**

Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): 1.8 × 0.6, Depth 1.35	Scale 1:50
Client: Ashmount Homes Ltd			Logged RAP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			MADE GROUND (Soft dark brown and brown silty slightly gravelly CLAY. Gravel is sub-rounded to angular of brick and concrete).
	0.60	D		0.45			Grey mottled orangish brown silty slightly sandy slightly gravelly CLAY.
							Grey mottled orangish brown silty sandy tabular fine to coarse GRAVEL of siltstone.
				1.35			End of pit at 1.35 m

Remarks:

Stability: Good.

Trial Pit Log

Trialpit No
CBR1
Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): 1 × 0.6, Depth 0.50	Scale 1:50
Client: Ashmount Homes Ltd			Logged GLB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.35 - 0.50	B		0.50			Brown silty slightly gravelly CLAY.
							End of pit at 0.50 m

1 2 3 4 5 6 7 8 9 10

Remarks: Sample recovered for laboratory CBR testing.

Stability: Good.

Trial Pit Log

Trialpit No
CBR2
Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): 1 × 0.6, Depth 0.50	Scale 1:50
Client: Ashmount Homes Ltd			Logged GLB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30 - 0.50	B		0.50			Brown silty gravelly CLAY.
							End of pit at 0.50 m

1 2 3 4 5 6 7 8 9 10

Remarks: Sample recovered for laboratory CBR testing.

Stability: Good.

Trial Pit Log

Trialpit No
CBR3
Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): 1 × 0.6, Depth 0.60	Scale 1:50
Client: Ashmount Homes Ltd			Logged GLB

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.50 - 0.60	B		0.60			Brown silty slightly gravelly CLAY.
							End of pit at 0.60 m

1 2 3 4 5 6 7 8 9 10

Remarks: Sample recovered for laboratory CBR testing.

Stability: Good.

Trial Pit Log

Trialpit No
Bund1
Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): Depth 0.60 (0.4 × 0.4)	Scale 1:50
Client: Ashmount Homes Ltd			Logged RP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20 - 0.60	ES		0.60			MADE GROUND (Brown slightly sandy gravelly clay with rootlets. Gravel is sub-angular to angular fine to coarse of brick, sandstone, concrete and ash).
							End of pit at 0.60 m

Remarks: Sample recovered for environmental chemical testing.

Stability: Good

Trial Pit Log

Trialpit No
Bund2
Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): Depth 0.60 (0.4 × 0.4)	Scale 1:50
Client: Ashmount Homes Ltd			Logged RP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20 - 0.60	ES		0.60			MADE GROUND (Brown slightly sandy gravelly clay with rootlets. Gravel is sub-angular to angular fine to coarse of brick, sandstone, concrete and ash).
							End of pit at 0.60 m

Remarks: Sample recovered for environmental chemical testing.

Stability: Good

Trial Pit Log

Trialpit No
Bund3
Sheet 1 of 1

Project Name: Wombwell Lane	Project No. J3374/16/E	Co-ords: - Level:	Date 22/02/2016
Location: Barnsley S70 3NR		Dimensions (m): 0.4 × 0.4 Depth 0.60	Scale 1:50
Client: Ashmount Homes Ltd			Logged RP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20 - 0.60	ES		0.60			MADE GROUND (Brown slightly sandy gravelly clay with rootlets. Gravel is sub-angular to angular fine to coarse of brick, sandstone, concrete and ash).
							End of pit at 0.60 m

1 2 3 4 5 6 7 8 9 10

Remarks: Sample recovered for environmental chemical testing.

Stability: Good

APPENDIX 5

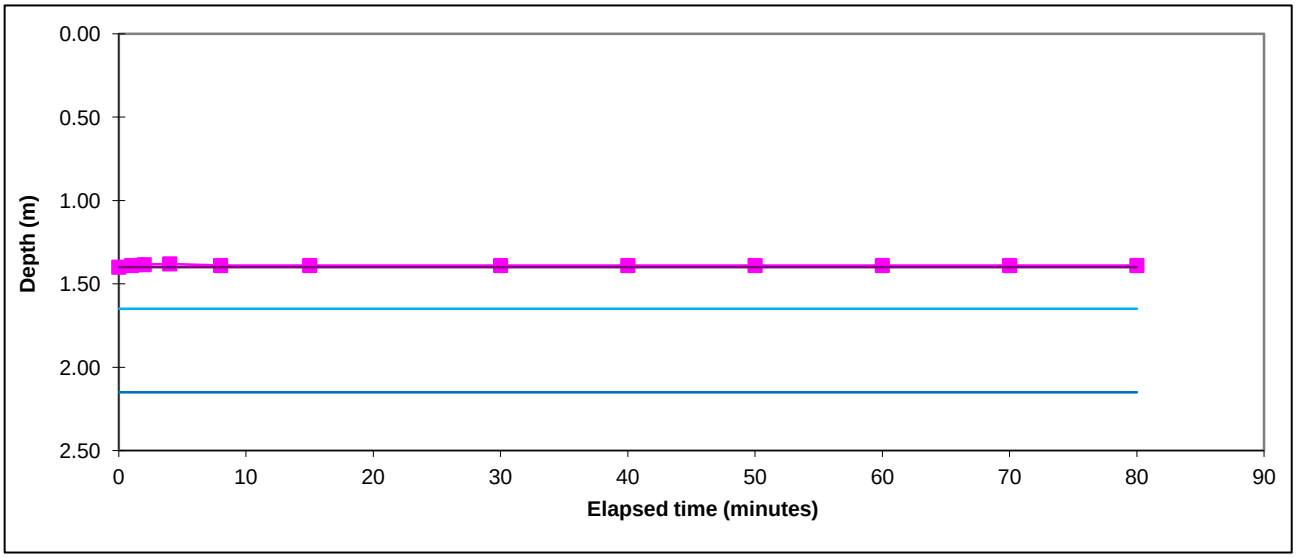
SOAKAWAY TEST RESULTS

Rogers Geotechnical Services Ltd

Soakaway Test

Trial Pit No:	TP1/SA1	Test No:	1	Date:	22/02/2016
Length (m):	3.200		Datum Height:	0.00	m agl
Width (m):	1.00		Granular infill:	None	
Depth (m):	2.40		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.400		
1	1.390		
2	1.385		
4	1.380		
8	1.390		
15	1.390		
30	1.390		
40	1.390		
50	1.390		
60	1.390		
70	1.390		
80	1.390		



Start water depth for analysis (mbgl):	1.40		
75% effective depth (mbgl):	1.65	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.90		
25% effective depth (mbgl):	2.15	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	2.40		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):			7.40
(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).

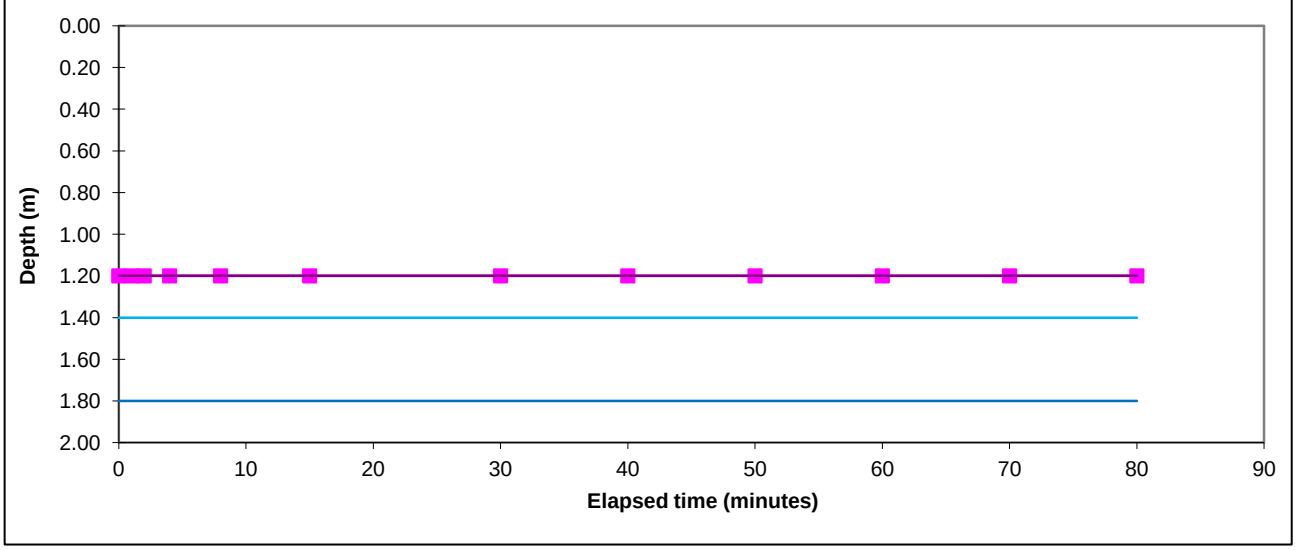
Client:	Ashmount Homes Ltd	**Job No:**
Site:	Land off Wombwell Lane	J3374/16/E

Rogers Geotechnical Services Ltd

Soakaway Test

Trial Pit No:	TP2/SA2	Test No:	1	Date:	22/02/2016
Length (m):	3.000		Datum Height:	0.00	m agl
Width (m):	0.80		Granular infill:	None	
Depth (m):	2.00		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.200		
1	1.200		
2	1.200		
4	1.200		
8	1.200		
15	1.200		
30	1.200		
40	1.200		
50	1.200		
60	1.200		
70	1.200		
80	1.200		



Start water depth for analysis (mbgl):	1.20		
75% effective depth (mbgl):	1.40	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.60		
25% effective depth (mbgl):	1.80	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	2.00		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):			5.44
(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).

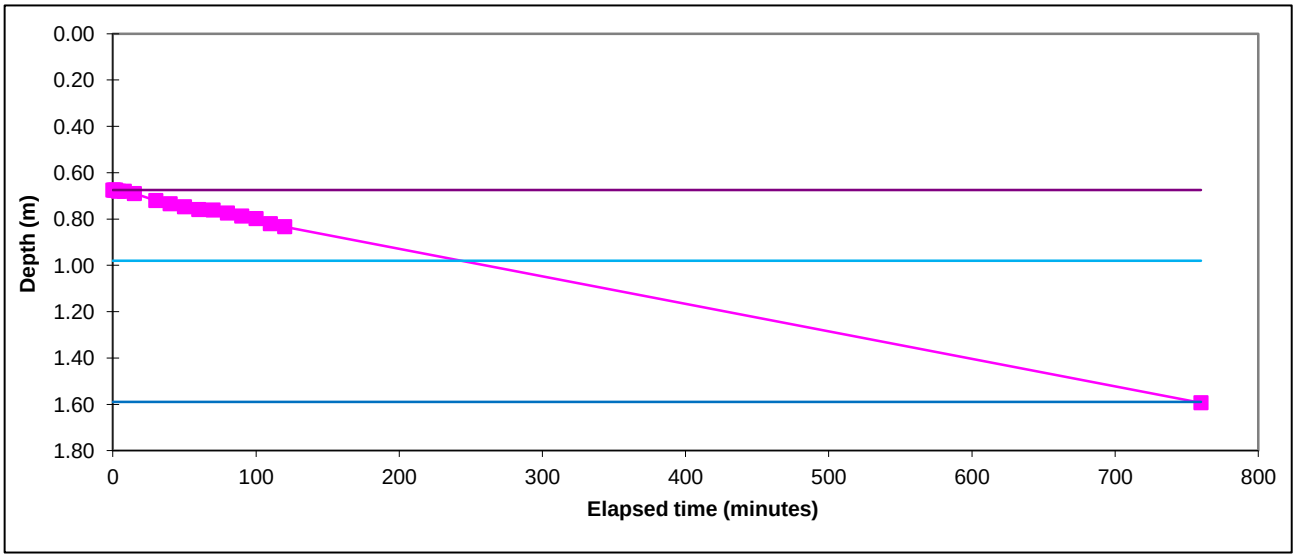
Client:	Ashmount Homes Ltd	**Job No:**
Site:	Land off Wombwell Lane	J3374/16/E

Rogers Geotechnical Services Ltd

Soakaway Test

Trial Pit No:	TP4/SA3	Test No:	1	Date:	22/02/2016
Length (m):	1.700		Datum Height:	0.00	m agl
Width (m):	0.90		Granular infill:	None	
Depth (m):	1.90		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.675	110	0.820
1	0.675	120	0.833
2	0.675	*760*	*1.593*
4	0.680		
8	0.680		
15	0.690		
30	0.720		
40	0.734		
50	0.747		
60	0.759		
70	0.761		
80	0.774		
90	0.787		
100	0.798		



Start water depth for analysis (mbgl):	0.68		
75% effective depth (mbgl):	0.98	Elapsed time (mins):	243.8
50% effective depth (mbgl):	1.29		
25% effective depth (mbgl):	1.59	Elapsed time (mins):	757.5
Base of soakage zone (mbgl):	1.90		

Volume outflow between 75% and 25% effective depth (m^3):	0.933
Mean surface area of outflow (m^2):	4.70
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	513.7

Soil infiltration rate (m/s):	**6.4E-6**

Remarks Results processed following BRE 365 (2007).
Numbers in *italics* have been derived by linear extrapolation.

Client:	Ashmount Homes Ltd	**Job No:**
Site:	Land off Wombwell Lane	J3374/16/E

APPENDIX 6

LABORATORY TESTING – GEOTECHNICAL

Summary of Classification Test Results

Project No.: J3374/16/E

Project Name: Wombwell Lane

Hole No.	Sample Ref	Sample Top	Sample Base	Sample Type	Soil Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Remarks
TP1	1	0.70		D	Sandy gravelly CLAY.			23.0	92	39 -1pt	21	18		
TP1	2	1.30		D	Sandy gravelly CLAY.			22.0	97	43 -1pt	20	23		
TP1	3	3.00		D	Weathered MUDSTONE.			14.0						
TP2	1	0.75		D	Orange grey sandy CLAY.			21.0	87	38 -1pt	18	20		
TP2	2	1.40		D	Orange mottled grey sandy gravelly CLAY.			17.0						
TP4	1	1.35		D	Brown grey GRAVEL.			10.0						
TP5	1	0.60		D	Grey mottled orangish brown weathered MUDSTONE.			13.0						
WS04	2	0.75		D	Orangish brown sandy gravelly CLAY.			25.0	100	77 -1pt	22	55		

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

Key

Density test | Liquid Limit | Particle density

Linear measurement unless : | 4pt cone unless : | sp - small pyknometer

wd - water displacement | cas - Casagrande method | gj - gas jar

wi - immersion in water | 1pt - single point test

Date Printed: 03/10/2016 00:00

Approved By: Jude

Table 1

sheet 1

Linear Shrinkage - Summary of Results

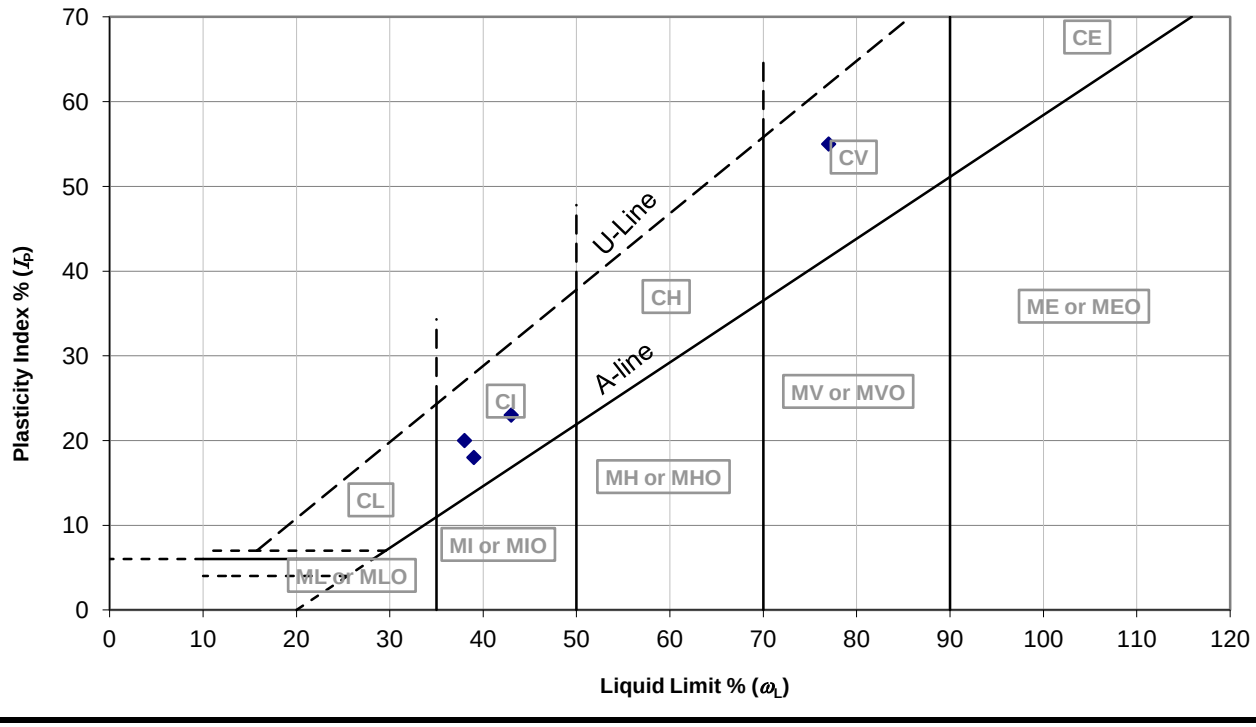
Project No.	Project Name
J3374/16/E	Wombwell Lane

Hole No.	Sample				Soil Description	Material <425µm %	Preparation	Linear Shrinkage %	Remarks
	Ref	Top	Base	Type					
TP1	1	0.70		D	Sandy gravelly CLAY.	92	Specimen prepared from natural material	9	
TP1	2	1.30		D	Sandy gravelly CLAY.	97	Specimen prepared from natural material	11	
TP2	1	0.75		D	Orange grey sandy CLAY.	87	Specimen prepared from natural material	9	
WS04	2	0.75		D	Orangish brown sandy gravelly CLAY.	100	Specimen prepared from natural material	12	

Notes	Date Printed	Approved By	Table
Tests performed in accordance with BS 1377 : Part 2 : 1990, clause 6.5 unless annotated otherwise	10/03/2016	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**	**J3374/16/E**	
Project Name: Wombwell Lane	**B.S 1377: Part 2: 1990: 3.2, 4 and 5**	Fig. 3	Sheet. 2
Location: Barnsley		Input By: CJN Date: 10.03.16	
Client: Ashmount Homes Ltd		Check By: CJN Date: 10.03.16	

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	0.70	23	39	21	18	8	25	17	0.1	0.9	C I	LOW
TP1	1.30	22	43	20	23	3	23	22	0.1	0.9	C I	MEDIUM
TP2	0.75	21	38	18	20	13	24	17	0.2	0.9	C I	LOW
WS04	0.75	25	77	22	55	0	25	55	0.1	0.9	C V	HIGH



Rogers Geotechnical Services Ltd.
CALIFORNIA BEARING RATIO
BS.1377 : Part 4 : 1990 : 7

Client:
Site: Wombwell Lane, Barnsley.

Input by : CJN **Chkd by :**

Date: 15.03.16 **Date:**

borehole /trial pit no.	sample no.	sample depth (m)	sample prep.	gravel >20mm (%)	natural moisture content (%)	bulk density (Mg/m^2)	dry density (Mg/m^2)	CBR top (%)	CBR bottom (%)	descriptions/remarks
CBR1	B	_	BN	6	24	1.944	1.568	3	4	Yellow/ orange/ brown mottled silty CLAY.
CBR3	B	_	BN	0	21	2.043	1.688	3	4	Yellowish brown very silty CLAY.

sample preparation :		soaked	CONTRACT	FIGURE
A - undisturbed	D - vibrating plate compaction	Y - yes		
B - dynamic comp. 2.5kg	E - static comp (MDD & OMC)	N - No	J3374/16/E	4
C - dynamic comp. 4.5kg	F - nat. density & m/c			

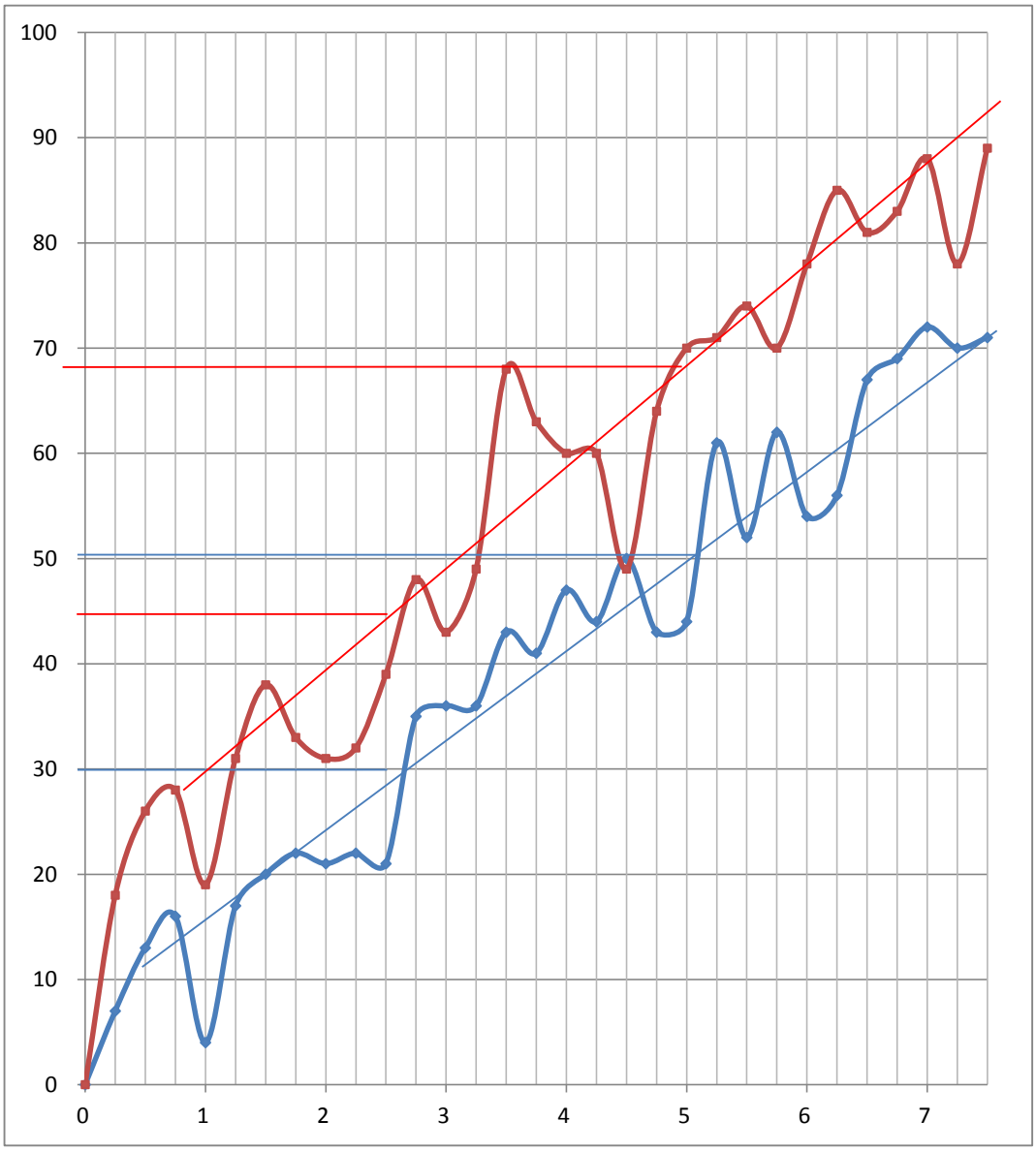
Rogers Geotechnical Services Ltd
Offices 1&2 Barncliffe Business Park, Near
Bank, Shelley
Huddersfield HD8
8LU
www.rogersgeotech.co.uk
Tel : 0843 5066687 **Fax : 0843 5159930**

Job No:	Client:
J3374/16/E	
Site: Wombwell Lane	BH/TP No: CBR1
Depth: –	Date: 14.03.16

California Bearing Ratio

BS. 1377 : PART 4 : 1990 : 7

Penetration of Plunger	Top	Bottom
0	0	0
0.25	7	18
0.50	13	26
0.75	16	28
1.00	4	19
1.25	17	31
1.50	20	38
1.75	22	33
2.00	21	31
2.25	22	32
2.50	21	39
2.75	35	48
3.00	36	43
3.25	36	49
3.50	43	68
3.75	41	63
4.00	47	60
4.25	44	60
4.50	50	49
4.75	43	64
5.00	44	70
5.25	61	71
5.50	52	74
5.75	62	70
6.00	54	78
6.25	56	85
6.50	67	81
6.75	69	83
7.00	72	88
7.25	70	78
7.50	71	89



Dry Density (Mg/m³)		1.568	Proving ring constant	0.01
		Corrected Dial Guage Reading	Force On Plunger kN	CBR %
Penetration Top	2.5	30	0.3	2%
	5	51	0.51	3%
Penetration Bottom	2.5	45	0.45	3%
	5	78	0.78	4%
Moisture Content		24%		

Prepared by:	Tested by:	Calculated by:	Checked by:	Engineer:	Contract No:
CJN	CJN	CJN		GLB	J3374/16/E

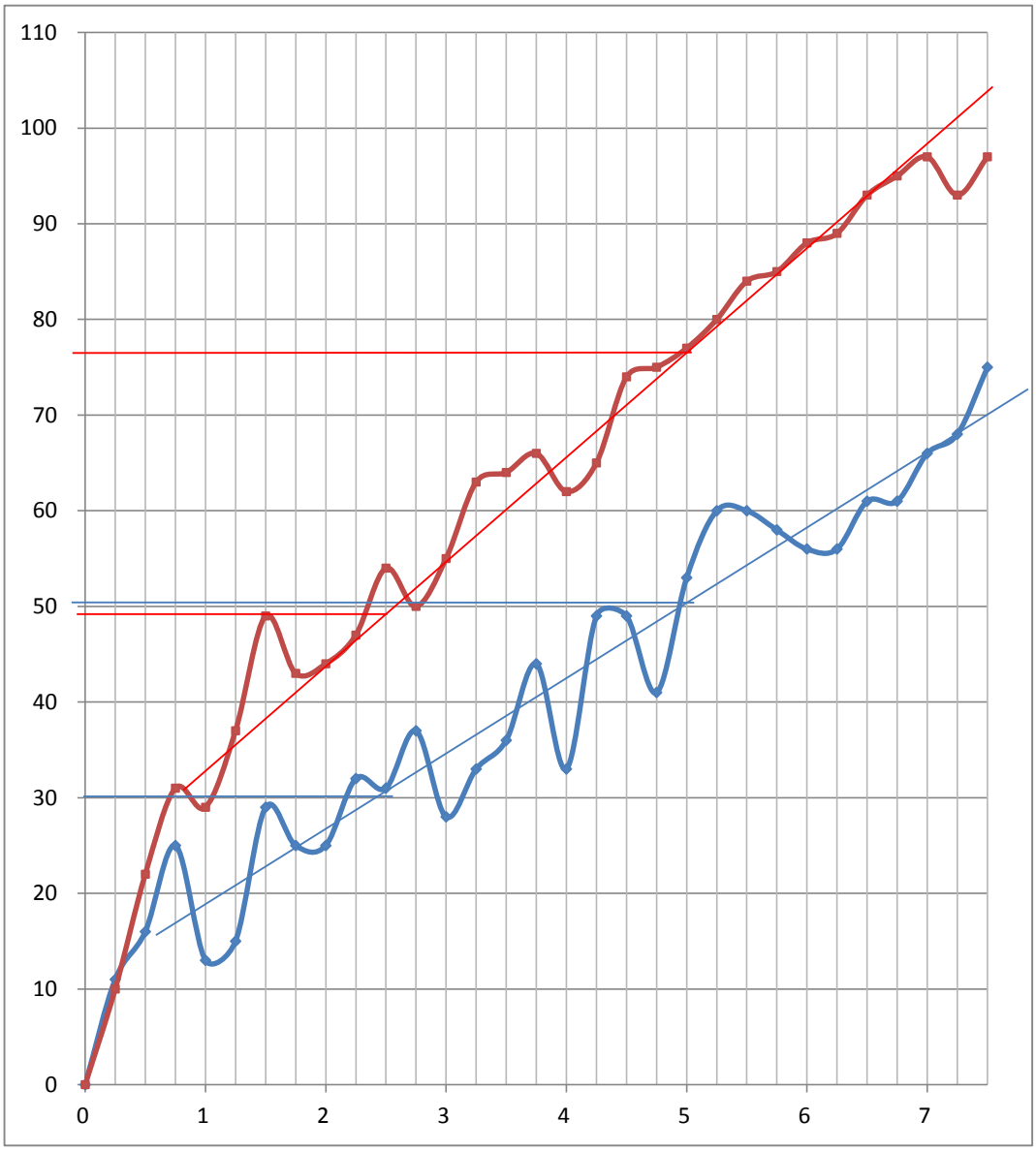
Rogers Geotechnical Services Ltd
Offices 1&2 Barncliffe Business Park, Near
Bank, Shelley
Huddersfield HD8
8LU
www.rogersgeotech.co.uk
Tel : 0843 5066687 **Fax : 0843 5159930**

Job No:	Client:
J3374/16/E	
Site: Wombwell Lane	BH/TP No: CBR3
Depth: –	Date: 14.03.16

California Bearing Ratio

BS. 1377 : PART 4 : 1990 : 7

Penetration of Plunger	Top	Bottom
0	0	0
0.25	11	10
0.50	16	22
0.75	25	31
1.00	13	29
1.25	15	37
1.50	29	49
1.75	25	43
2.00	25	44
2.25	32	47
2.50	31	54
2.75	37	50
3.00	28	55
3.25	33	63
3.50	36	64
3.75	44	66
4.00	33	62
4.25	49	65
4.50	49	74
4.75	41	75
5.00	53	77
5.25	60	80
5.50	60	84
5.75	58	85
6.00	56	88
6.25	56	89
6.50	61	93
6.75	61	95
7.00	66	97
7.25	68	93
7.50	75	97



Dry Density (Mg/m³)		1.688	Proving ring constant	0.01
		Corrected Dial Guage Reading	Force On Plunger kN	CBR %
Penetration Top	2.5	30	0.3	2%
	5	50	0.5	3%
Penetration Bottom	2.5	50	0.5	4%
	5	77	0.77	4%
Moisture Content		21%		

Prepared by:	Tested by:	Calculated by:	Checked by:	Engineer:	Contract No:
CJN	CJN	CJN		GLB	J3374/16/E

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

UKAS TESTING
2183

Final Report

Report No.:	16-04637-1
Initial Date of Issue:	03-Mar-2016
Client	Rogers Geotechnical Services Ltd
Client Address:	Offices 1 & 2, Barncliffe Business Near Bank Shelley Huddersfield West Yorkshire HD8 8LU
Contact(s):	Gabriel Bobrowicz
Project	J3374/16/E Wombwell

Quotation No.:		**Date Received:**	26-Feb-2016
Order No.:	0216-58	**Date Instructed:**	26-Feb-2016
No. of Samples:	4	**Target Date:**	03-Mar-2016
Turnaround (Wkdays):	5	**Results Due:**	03-Mar-2016

Date Approved: 03-Mar-2016

Approved By:



Details: Glynn Harvey, Laboratory Manager

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3374/16/E Wombwell

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			16-04637	16-04637	16-04637	16-04637
Quotation No.:		**Chemtest Sample ID.:**			260188	260189	260190	260191
Order No.: 0216-58		Client Sample Ref.:			TP1	TP2	TP3	TP4
		Client Sample ID.:			D	D	D	D
		Sample Type:			SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.0	0.0	0.0	0.0
		Bottom Depth (m):			0.6	0.6	0.6	0.6
		Date Sampled:			22-Feb-2016	22-Feb-2016	22-Feb-2016	22-Feb-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Cadmium	M	2450	mg/kg	0.10	0.23	0.10	0.30	0.14
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Copper	M	2450	mg/kg	0.50	38	23	16	25
Mercury	M	2450	mg/kg	0.10	0.14	< 0.10	< 0.10	< 0.10
Nickel	M	2450	mg/kg	0.50	36	39	18	44
Lead	M	2450	mg/kg	0.50	41	19	29	20
Zinc	M	2450	mg/kg	0.50	110	75	72	67
Vanadium	U	2450	mg/kg	5.0	24	25	18	24
Arsenic	M	2450	mg/kg	1.0	12	8.8	13	11
Selenium	M	2450	mg/kg	0.20	0.53	< 0.20	0.20	0.32
Cyanide (Free)	M	2300	mg/kg	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
Naphthalene	M	2700	mg/kg	0.10	5.0	< 0.10	0.63	< 0.10
Acenaphthylene	M	2700	mg/kg	0.10	0.13	< 0.10	0.35	< 0.10
Acenaphthene	M	2700	mg/kg	0.10	0.93	< 0.10	1.1	< 0.10
Fluorene	M	2700	mg/kg	0.10	0.85	< 0.10	0.25	< 0.10
Phenanthrene	M	2700	mg/kg	0.10	13	< 0.10	1.5	< 0.10
Anthracene	M	2700	mg/kg	0.10	2.0	< 0.10	0.52	< 0.10
Fluoranthene	M	2700	mg/kg	0.10	14	< 0.10	3.2	0.59
Pyrene	M	2700	mg/kg	0.10	13	< 0.10	3.4	0.53
Benzo[a]anthracene	M	2700	mg/kg	0.10	5.6	< 0.10	2.2	< 0.10
Chrysene	M	2700	mg/kg	0.10	6.4	< 0.10	2.2	< 0.10
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	6.7	< 0.10	2.7	< 0.10
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	2.7	< 0.10	1.3	< 0.10
Benzo[a]pyrene	M	2700	mg/kg	0.10	4.3	< 0.10	2.7	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	3.3	< 0.10	1.4	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	0.92	< 0.10	0.79	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	3.2	< 0.10	2.7	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2.0	82	< 2.0	27	< 2.0
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3374/16/E Wombwell

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			16-04637	16-04637	16-04637	16-04637
Quotation No.:		**Chemtest Sample ID.:**			260188	260189	260190	260191
Order No.: 0216-58		Client Sample Ref.:			TP1	TP2	TP3	TP4
		Client Sample ID.:			D	D	D	D
		Sample Type:			SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.0	0.0	0.0	0.0
		Bottom Depth (m):			0.6	0.6	0.6	0.6
		Date Sampled:			22-Feb-2016	22-Feb-2016	22-Feb-2016	22-Feb-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Total Aliphatic Hydrocarbons	M	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	2.8	< 1.0	2.1	< 1.0
Aromatic TPH >C16-C21	M	2680	mg/kg	1.0	9.0	< 1.0	8.2	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	15	< 1.0	12	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	1.2	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	M	2680	mg/kg	5.0	28	< 5.0	22	< 5.0
Total Petroleum Hydrocarbons	M	2680	mg/kg	10	28	< 10	22	< 10
pH	M	2010		N/A	7.6	7.4	8.1	7.9
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010	0.097	< 0.010	< 0.010
ACM Type	U	2192		N/A	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	13	15	10	15
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Loam	Sand	Loam
Sulphate (Total)	M	2430	%	0.010	0.054	0.041	0.12	0.020
Organic Matter	M	2625	%	0.40	2.9	0.90	3.1	1.1

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 60 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

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.:	16-05361-1
Initial Date of Issue:	14-Mar-2016
Client	Rogers Geotechnical Services Ltd
Client Address:	Offices 1 & 2, Barncliffe Business Near Bank Shelley Huddersfield West Yorkshire HD8 8LU
Contact(s):	Gabriel Bobrowicz
Project	J3374/16/E - Wombwell

Quotation No.:		**Date Received:**	07-Mar-2016
Order No.:	0316-03	**Date Instructed:**	07-Mar-2016
No. of Samples:	4	**Target Date:**	11-Mar-2016
Turnaround (Wkdays):	5	**Results Due:**	11-Mar-2016

Date Approved: 14-Mar-2016

Approved By:



Details: Robert Monk, Technical Development Chemist

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3374/16/E - Wombwell

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			16-05361	16-05361	16-05361	16-05361
Quotation No.:		**Chemtest Sample ID.:**			263635	263636	263637	263638
Order No.: 0316-03		Client Sample Ref.:			WS01	WS02	WS03	WS04
		Client Sample ID.:			C1	C1	C1	C1
		Sample Type:			SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.35	0.27	0.35	0.11
		Bottom Depth (m):			0.54	0.38	0.55	0.28
		Date Sampled:			03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Cadmium	M	2450	mg/kg	0.10	< 0.10	0.16	0.26	0.23
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Copper	M	2450	mg/kg	0.50	27	19	19	40
Mercury	M	2450	mg/kg	0.10	0.23	< 0.10	< 0.10	0.15
Nickel	M	2450	mg/kg	0.50	36	16	16	32
Lead	M	2450	mg/kg	0.50	47	28	28	57
Zinc	M	2450	mg/kg	0.50	45	49	110	82
Vanadium	U	2450	mg/kg	5.0	20	22	19	33
Arsenic	M	2450	mg/kg	1.0	17	9.8	8.2	25
Selenium	M	2450	mg/kg	0.20	0.49	< 0.20	< 0.20	0.63
Cyanide (Free)	M	2300	mg/kg	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
Naphthalene	M	2700	mg/kg	0.10	< 0.10	19	0.44	0.51
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10	16	0.15	0.10
Acenaphthene	M	2700	mg/kg	0.10	< 0.10	8.1	0.10	< 0.10
Fluorene	M	2700	mg/kg	0.10	< 0.10	60	0.14	0.16
Phenanthrene	M	2700	mg/kg	0.10	< 0.10	160	0.65	0.39
Anthracene	M	2700	mg/kg	0.10	< 0.10	51	0.21	0.13
Fluoranthene	M	2700	mg/kg	0.10	0.49	72	1.5	0.78
Pyrene	M	2700	mg/kg	0.10	0.60	80	1.8	0.88
Benzo[a]anthracene	M	2700	mg/kg	0.10	< 0.10	24	0.96	0.54
Chrysene	M	2700	mg/kg	0.10	< 0.10	39	1.5	0.87
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	< 0.10	26	2.9	0.58
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	< 0.10	9.2	1.2	0.51
Benzo[a]pyrene	M	2700	mg/kg	0.10	< 0.10	12	2.8	0.55
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	< 0.10	11	2.4	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	< 0.10	3.0	0.37	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	< 0.10	16	3.6	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2.0	< 2.0	610	21	6.0
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	14	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3374/16/E - Wombwell

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			16-05361	16-05361	16-05361	16-05361
Quotation No.:		**Chemtest Sample ID.:**			263635	263636	263637	263638
Order No.: 0316-03		Client Sample Ref.:			WS01	WS02	WS03	WS04
		Client Sample ID.:			C1	C1	C1	C1
		Sample Type:			SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.35	0.27	0.35	0.11
		Bottom Depth (m):			0.54	0.38	0.55	0.28
		Date Sampled:			03-Mar-2016	03-Mar-2016	03-Mar-2016	03-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Total Aliphatic Hydrocarbons	M	2680	mg/kg	5.0	< 5.0	< 5.0	14	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	4.8	11	< 1.0	4.8
Aromatic TPH >C16-C21	M	2680	mg/kg	1.0	1.0	81	12	17
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	180	440	91
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	17	< 1.0	2.5
Total Aromatic Hydrocarbons	M	2680	mg/kg	5.0	5.9	290	460	120
Total Petroleum Hydrocarbons	M	2680	mg/kg	10	< 10	290	470	120
pH	M	2010		N/A	7.5	8.7	9.8	7.9
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	0.050	0.045	0.083	0.020
ACM Type	U	2192		N/A	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	15	7.8	9.0	22
Soil Colour	N	2040		N/A	Black	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones, Brick	NONE
Soil Texture	N	2040		N/A	Sand	Sand	Sand	Sand
Sulphate (Total)	M	2430	%	0.010	0.052	0.073	0.13	0.10
Organic Matter	M	2625	%	0.40	4.5	4.8	5.9	8.8

Report Information

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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 60 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

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.:	16-06047-1
Initial Date of Issue:	21-Mar-2016
Client	Rogers Geotechnical Services Ltd
Client Address:	Offices 1 & 2, Barncliffe Business Near Bank Shelley Huddersfield West Yorkshire HD8 8LU
Contact(s):	Gabriel Bobrowicz
Project	J3374/16/E - Wombwell

Quotation No.:		**Date Received:**	15-Mar-2016
Order No.:	0316-20	**Date Instructed:**	14-Mar-2016
No. of Samples:	3	**Target Date:**	18-Mar-2016
Turnaround (Wkdays):	5	**Results Due:**	18-Mar-2016

Date Approved: 21-Mar-2016

Approved By:



Details: Robert Monk, Technical Development Chemist

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3374/16/E - Wombwell

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			16-06047	16-06047	16-06047
Quotation No.:		**Chemtest Sample ID.:**			267044	267045	267046
Order No.: 0316-20		Client Sample Ref.:			Bund 1	Bund 2	Bund 3
		Client Sample ID.:			C1	C1	C1
		Sample Type:			SOIL	SOIL	SOIL
		Top Depth (m):			0.00	0.00	0.00
		Bottom Depth (m):			0.60	0.60	0.60
		Date Sampled:			10-Mar-2016	10-Mar-2016	10-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Cadmium	M	2450	mg/kg	0.10	0.40	1.4	0.62
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Copper	M	2450	mg/kg	0.50	54	54	110
Mercury	M	2450	mg/kg	0.10	0.42	0.21	0.21
Nickel	M	2450	mg/kg	0.50	37	38	38
Lead	M	2450	mg/kg	0.50	100	130	170
Zinc	M	2450	mg/kg	0.50	130	170	210
Vanadium	U	2450	mg/kg	5.0	42	39	35
Arsenic	M	2450	mg/kg	1.0	24	26	22
Selenium	M	2450	mg/kg	0.20	1.0	0.90	0.92
Cyanide (Free)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Total Phenols	M	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30
Naphthalene	M	2700	mg/kg	0.10	0.51	0.31	0.36
Acenaphthylene	M	2700	mg/kg	0.10	0.10	0.46	0.32
Acenaphthene	M	2700	mg/kg	0.10	< 0.10	2.0	0.34
Fluorene	M	2700	mg/kg	0.10	0.12	2.7	0.19
Phenanthrene	M	2700	mg/kg	0.10	0.67	30	2.8
Anthracene	M	2700	mg/kg	0.10	0.12	11	0.70
Fluoranthene	M	2700	mg/kg	0.10	1.4	34	5.2
Pyrene	M	2700	mg/kg	0.10	1.4	30	5.0
Benzo[a]anthracene	M	2700	mg/kg	0.10	0.67	10	2.2
Chrysene	M	2700	mg/kg	0.10	1.2	13	3.1
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	1.1	9.9	2.6
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	0.51	4.3	1.3
Benzo[a]pyrene	M	2700	mg/kg	0.10	0.77	7.2	1.8
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	0.52	4.2	1.2
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	< 0.10	1.2	0.23
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	0.84	4.3	1.4
Total Of 16 PAH's	M	2700	mg/kg	2.0	9.9	160	29
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3374/16/E - Wombwell

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			16-06047	16-06047	16-06047
Quotation No.:		**Chemtest Sample ID.:**			267044	267045	267046
Order No.: 0316-20		Client Sample Ref.:			Bund 1	Bund 2	Bund 3
		Client Sample ID.:			C1	C1	C1
		Sample Type:			SOIL	SOIL	SOIL
		Top Depth (m):			0.00	0.00	0.00
		Bottom Depth (m):			0.60	0.60	0.60
		Date Sampled:			10-Mar-2016	10-Mar-2016	10-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Total Aliphatic Hydrocarbons	M	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	1.9	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	6.3	15	< 1.0
Aromatic TPH >C16-C21	M	2680	mg/kg	1.0	31	280	16
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	45	360	51
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	31	< 1.0
Total Aromatic Hydrocarbons	M	2680	mg/kg	5.0	84	690	67
Total Petroleum Hydrocarbons	M	2680	mg/kg	10	84	690	67
pH	M	2010		N/A	7.3	7.7	7.9
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010	< 0.010	0.011
ACM Type	U	2192		N/A		-	
Asbestos Identification	U	2192	%	0.001		No Asbestos Detected	
Moisture	N	2030	%	0.020	16	18	12
Soil Colour	N	2040		N/A	Brown	Brown	Brown
Other Material	N	2040		N/A	Roots	Roots, Stones	Stones, Roots
Soil Texture	N	2040		N/A	Loam	Loam	Sand
Sulphate (Total)	M	2430	%	0.010	0.11	0.13	0.11
Organic Matter	M	2625	%	0.40	9.9	13	9.6

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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

2011 6% SSV- Residential with Homegrown Produce Landuse for all locations

Client: Ashmount Homes Ltd
Site: Wombwell Lane
Job Number: J3374/16/EDS
Date: 23.03.16

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	0.3	10		A
4	Chromium VI	<0.5	<0.5	14.7		A
	Copper	16	40	4020		A
7	Mercury	<0.1	0.23	1.00		A
8	Nickel	16	44	130		A
	Lead	19	57	168		A
	Zinc	45	110	17200		A
	Vanadium	18	33	115		A
	Semi and Non Metals					
1	Arsenic	8.2	25	32		A
10	Selenium	<0.2	0.63	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	19	8.71		A
	Acenaphthene	<0.3	8.1	937	2130	A
	Fluorene	<0.1	60	746	1930	A
	Anthracene	<0.1	52	20.9	18300	A
	Fluoranthene	<0.1	72	113	2160	A
	Pyrene	<0.1	80	13.2	1550	A
	Benzo(a)anthracene	<0.1	24	8.54		A
2	Chrysene	<0.1	39	2.64	927	A
2	Benzo(b)fluoranthene	<0.1	26	7.29	9.86	A
2	Benzo(k)fluoranthene	<0.1	9.2	4.12	100	A
2	Benzo(a)pyrene	<0.1	12	0.998		A
2	Dibenzo(a,h)anthracene	<0.1	3	0.0236	1	A*
2	Indeno(1,2,3-cd)pyrene	<0.1	11	0.368	9.75	A
2	Benzo(g,h,i)perylene	<0.1	16	0.112	103	A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	<1.0	<1.0	26.1		A
	Aliphatic C6-C8	<1.0	<1.0	87.8		A
	Aliphatic C8-C10	<1.0	<1.0	14.5		A
	Aliphatic C10-C12	<1.0	<1.0	87.7		A
	Aliphatic C12-C16	<1.0	<1.0	126		A
	Aliphatic C16-C21	<1.0	14	88200		A
	Aliphatic C21-C35	<0.1	14	88200		A
	Aromatic C5-C7 (Benzene)	<1.0	<1.0	0.33		A
	Aromatic C7-C8 (Toluene)	<1.0	<1.0	610		A
	Aromatic C8-C10	<1.0	<1.0	23.7		A
	Aromatic C10-C12	<1.0	<1.0	132		A
	Aromatic C12-C16	<1.0	11	452		A
	Aromatic C16-C21	<1.0	81	804		A
	Aromatic C21-C35	<1.0	440	1220		A
	Others					
	pH			-		-
	Organic Content (%)			-		-
	Soluble Sulphate (g/l)			-		-
	Total Sulphate (%)			-		-
	Asbestos			None detected		

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.

Rogers Geotechnical Services Ltd.

SUMMARY OF CONTAMINATION ANALYSIS - including Atkins ATRISK SSVs

2011 6% SSV- Residential with Homegrown Produce Landuse AREA A (TP1 TP2 TP4 TP5 and WS04)

Client: Ashmount Homes Ltd
Site: Wombwell Lane
Job Number: J3374/16/EDS
Date: 23.03.16

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	0.23	10		A
4	Chromium VI	<0.5	<0.5	14.7		A
	Copper	23	40	4020		A
7	Mercury	<0.1	0.15	1.00		A
8	Nickel	32	44	130		A
	Lead	19	57	168		A
	Zinc	57	110	17200		A
	Vanadium	24	33	115		A
	Semi and Non Metals					
1	Arsenic	8.8	25	32		A
10	Selenium	<0.2	0.63	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	<0.5	5	8.71		A
	Acenaphthene	<0.1	0.93	937	2130	A
	Fluorene	<0.1	0.85	746	1930	A
	Anthracene	<0.1	2	20.9	18300	A
	Fluoranthene	<0.1	14	113	2160	A
	Pyrene	<0.1	13	13.2	1550	A
	Benzo(a)anthracene	<0.1	5.6	8.54		A
2	Chrysene	<0.1	6.4	2.64	927	A
2	Benzo(b)fluoranthene	<0.1	6.7	7.29	9.86	A
2	Benzo(k)fluoranthene	<0.1	2.7	4.12	100	A
2	Benzo(a)pyrene	<0.1	4.3	0.998		A
2	Dibenzo(a,h)anthracene	<0.1	0.92	0.0236	1	A*
2	Indeno(1,2,3-cd)pyrene	<0.1	3.3	0.368	9.75	A
2	Benzo(g,h,i)perylene	<0.1	3.2	0.112	103	A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	<1.0	<1.0	26.1		A
	Aliphatic C6-C8	<1.0	<1.0	87.8		A
	Aliphatic C8-C10	<1.0	<1.0	14.5		A
	Aliphatic C10-C12	<1.0	<1.0	87.7		A
	Aliphatic C12-C16	<1.0	<1.0	126		A
	Aliphatic C16-C21	<1.0	<1.0	88200		A
	Aliphatic C21-C35	<1.0	<1.0	88200		A
	Aromatic C5-C7 (Benzene)	<1.0	<1.0	0.33		A
	Aromatic C7-C8 (Toluene)	<1.0	<1.0	610		A
	Aromatic C8-C10	<1.0	<1.0	23.7		A
	Aromatic C10-C12	<1.0	<1.0	132		A
	Aromatic C12-C16	<1.0	4.8	452		A
	Aromatic C16-C21	<1.0	17	804		A
	Aromatic C21-C35	<1.0	91	1220		A
	Others					
	pH	7.4	7.9	-		-
	Organic Content (%)	0.9	8.8	-		-
	Soluble Sulphate (g/l)	<0.01	0.097	-		-
	Total Sulphate (%)	0.02	0.1	-		-
	Asbestos			None detected		

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.

Rogers Geotechnical Services Ltd.

SUMMARY OF CONTAMINATION ANALYSIS - including Atkins ATRISK SSVs

2011 6% SSV- Residential with Homegrown Produce Landuse AREA B (WS01 WS02 WS03 TP3)

Client: Ashmount Homes Ltd
Site: Wombwell Lane
Job Number: J3374/16/EDS
Date: 23.03.16

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	0.3	10		A
4	Chromium VI	<0.5	<0.5	14.7		A
	Copper	16	27	4020		A
7	Mercury	<0.1	0.23	1.00		A
8	Nickel	18	36	130		A
	Lead	28	47	168		A
	Zinc	45	110	17200		A
	Vanadium	18	22	115		A
	Semi and Non Metals					
1	Arsenic	8.2	17	32		A
10	Selenium	<0.2	0.49	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	19	8.71		A
	Acenaphthene	<0.1	8.1	937	2130	A
	Fluorene	<0.1	60	746	1930	A
	Anthracene	<0.1	51	20.9	18300	A
	Fluoranthene	0.49	72	113	2160	A
	Pyrene	0.6	80	13.2	1550	A
	Benzo(a)anthracene	<0.1	24	8.54		A
2	Chrysene	<0.1	39	2.64	927	A
2	Benzo(b)fluoranthene	<0.1	26	7.29	9.86	A
2	Benzo(k)fluoranthene	<0.1	9.2	4.12	100	A
2	Benzo(a)pyrene	<0.1	12	0.998		A
2	Dibenzo(a,h)anthracene	<0.1	3	0.0236	1	A*
2	Indeno(1,2,3-cd)pyrene	<0.1	11	0.368	9.75	A
2	Benzo(g,h,i)perylene	<0.1	16	0.112	103	A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	<1.0	<1.0	26.1		A
	Aliphatic C6-C8	<1.0	<1.0	87.8		A
	Aliphatic C8-C10	<1.0	<1.0	14.5		A
	Aliphatic C10-C12	<1.0	<1.0	87.7		A
	Aliphatic C12-C16	<1.0	<1.0	126		A
	Aliphatic C16-C21	<1.0	<1.0	88200		A
	Aliphatic C21-C35	<1.0	14	88200		A
	Aromatic C5-C7 (Benzene)	<1.0	<1.0	0.33		A
	Aromatic C7-C8 (Toluene)	<1.0	<1.0	610		A
	Aromatic C8-C10	<1.0	<1.0	23.7		A
	Aromatic C10-C12	<1.0	<1.0	132		A
	Aromatic C12-C16	<1.0	11	452		A
	Aromatic C16-C21	1	81	804		A
	Aromatic C21-C35	12	440	1220		A
	Others					
	pH	7.5	9.8	-		-
	Organic Content (%)	3.1	5.9	-		-
	Soluble Sulphate (g/l)	<0.01	0.083	-		-
	Total Sulphate (%)	0.052	0.13	-		-
	Asbestos			None detected		

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.

Rogers Geotechnical Services Ltd.

SUMMARY OF CONTAMINATION ANALYSIS - including Atkins ATRISK SSVs

2011 6% SSV- Residential with Homegrown Produce Landuse for bunds

Client: Ashmount Homes Ltd
Job Number: J3374/16/EDS
Site: Wombwell Lane
Date: 23.03.16

Tox Data Report No.	Compound	Range of Values Found (mg/kg)		Residential with Homegrown Produce Landuse (mg/kg)		Reference
	Metals	*Min*	Max			
3	Cadmium	0.4	1.4	10		A
4	Chromium VI	<0.5	<0.5	14.7		A
	Copper	54	110	4020		A
7	Mercury	0.21	0.42	1.00		A
8	Nickel	37	38	130		A
	Lead	100	170	168		A
	Zinc	130	210	17200		A
	Vanadium	35	42	115		A
	Semi and Non Metals					
1	Arsenic	22	26	32		A
10	Selenium	0.9	1	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	0.31	0.51	8.71		A
	Acenaphthene	<0.1	2	937	2130	A
	Fluorene	0.12	20.7	746	1930	A
	Anthracene	0.12	11	20.9	18300	A
	Fluoranthene	1.4	34	113	2160	A
	Pyrene	1.4	30	13.2	1550	A
	Benzo(a)anthracene	0.67	10	8.54		A
2	Chrysene	1.2	13	2.64	927	A
2	Benzo(b)fluoranthene	1.1	9.9	7.29	9.86	A
2	Benzo(k)fluoranthene	0.51	4.3	4.12	100	A
2	Benzo(a)pyrene	0.77	7.2	0.998		A
2	Dibenzo(a,h)anthracene	<0.1	1.2	0.0236	1	A*
2	Indeno(1,2,3-cd)pyrene	0.52	4.2	0.368	9.75	A
2	Benzo(g,h,i)perylene	0.84	4.3	0.112	103	A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	<1.0	<1.0	26.1		A
	Aliphatic C6-C8	<1.0	<1.0	87.8		A
	Aliphatic C8-C10	<1.0	<1.0	14.5		A
	Aliphatic C10-C12	<1.0	<1.0	87.7		A
	Aliphatic C12-C16	<1.0	<1.0	126		A
	Aliphatic C16-C21	<1.0	<1.0	88200		A
	Aliphatic C21-C35	<1.0	<1.0	88200		A
	Aromatic C5-C7 (Benzene)	<1.0	<1.0	0.33		A
	Aromatic C7-C8 (Toluene)	<1.0	<1.0	610		A
	Aromatic C8-C10	<1.0	<1.0	23.7		A
	Aromatic C10-C12	<1.0	1.9	132		A
	Aromatic C12-C16	<1.0	15	452		A
	Aromatic C16-C21	16	280	804		A
	Aromatic C21-C35	45	360	1220		A
	Others					
	pH	7.3	7.9	-		-
	Organic Content (%)	9.6	13	-		-
	Soluble Sulphate (g/l)	<0.01	0.011	-		-
	Total Sulphate (%)	0.11	0.13	-		-
	Asbestos(Bund 2)			None detected		

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.