

Taylor Wimpey (UK) Ltd

Ground Investigation Report

Fox's Bank, Halsnead Garden Village

May 2020

REPORT NO: 18TAY042/GI

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

GEOTECHNICAL - CONTAMINATED LAND - FLOOD RISK

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DOCUMENT ISSUE RECORD

Contract No: 18TAY042

Client: TAYLOR WIMPEY UK LIMITED

Contract: Land off Fox's Bank Lane, Whiston, Prescot

Document: Ground Investigation Report

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Date: Feb 2020

REVISION RECORD

Revision	Date	Description	Prepared by
0	Oct 18	Draft for comment with partial ground gas results and awaiting surface water testing results.	JS
1	Nov 18	Update with surface water testing results	JS
2	Mar 19	Update with final gas results	RD
3	May 20	Revised planning layout and Clients	MJF

CONTENTS

1	EXECUTIVE SUMMARY	6
2	SITE DESCRIPTION	12
2.1	Introduction	
2.2	Site Location	
2.3	Site Description	
3	ENVIRONMENTAL SETTING AND DATA	14
3.1	Previously Undertaken Reports/Investigation	
3.2	Summary of Site History	
4	GEOLOGY	16
4.1	Published Geology	
4.2	Hydrogeological and Hydrological Features	
5	ENVIRONMENTAL DATA	18
5.1	Landfill Sites and Waste Treatment Sites	
5.2	Industrial Land Uses	
5.3	Unexploded Ordnance	
6	PREVIOUSLY UNDERTAKEN SITE INVESTIGATION (E3P)	19
6.1	Introduction	
6.2	Fieldwork Scope	
6.3	Ground Conditions Encountered	
6.4	Groundwater	
6.5	Soil Contamination Encountered	
6.6	Ground Gas	
6.7	Geotechnical Recommendations	
7	SUMMARY OF ENVIRONMENTAL SENSITIVITY	21
7.1	Sources	
7.2	Pathways	
8	INITIAL CONCEPTUAL SITE MODEL	23
8.1	Source-Pathway-Receptor Linkages	
8.2	Summary	
8.3	Betts Conclusion on Desk Based/Previous Investigation	
8.4	Geotechnical Risk	
9	FIELDWORK	26
9.1	Fieldwork Objectives	
9.2	Fieldwork Scope	
9.3	Targeted Investigation	
10	GROUND CONDITIONS	27

10.1	General	
10.2	Ground Conditions Summary	
10.3	Visual and Olfactory Contamination	
10.4	Obstructions	
10.5	Groundwater – Fieldwork	
10.6	Groundwater – Post Fieldwork Monitoring	
11	LABORATORY TESTING	29
11.1	General	
11.2	Scheduled Chemical Testing: Soils	
12	CONTAMINATION ASSESSMENT	30
12.1	General	
12.2	Soils Contamination Summary	
12.3	Water Contamination Summary	
12.4	Groundwater Contamination Summary	
13	ENVIRONMENTAL RISK ASSESSMENT	35
13.1	General	
13.2	Assessment of Contamination Analytical Results	
14	GROUND GAS ASSESSMENT	37
14.1	Ground Gas Requirements – Radon	
14.2	Ground Gas Assessment	
15	REVISED CONCEPTUAL SITE MODEL	39
15.1	General	
15.2	Final Conceptual Site Model	
16	OUTLINE STRATEGY FOR RISK REDUCTION/REMEDIALATION STRATEGY	40
16.1	General	
16.2	Construction/Maintenance Workers	
16.3	Site-End Users	
16.6	Controlled Waters	
16.7	Ground Gas Protection Measures	
16.8	Piped Drinking Water Supplies	
16.9	Off-Site Disposal of Surplus Soil	
17	SHALLOW COAL AND MINE SHAFT INVESTIGATION – OCTOBER 2018	42
17.1	Shallow Coal Mine Workings Ground Investigation	
17.2	Ground Conditions	
17.3	Mining Investigation Summary	
18	GEOTECHNICAL ASSESSMENT	44
18.1	Introduction	
18.2	Site Preparation and Excavation	

18.3	Control of Groundwater	
18.4	Foundations	
18.5	Ground Floor Construction	
18.6	Soakaways	
18.7	Heave / Shrinkage Potential	
18.8	Highway	
18.9	Protection of Buried Concrete	
19	ADDITIONAL WORKS REQUIRED	47
20	REFERENCES	48

APPENDIX A

- (i) Site Location Plan

APPENDIX B

- (i) Betts Exploratory Hole Location Plan

APPENDIX C

- (i) Betts Exploratory Hole Logs
- (ii) Coal Investigation – Rotary Logs

APPENDIX D

- (i) Contamination Test Results
- (ii) Surface Water Test Results
- (iii) Geotechnical Test Results

APPENDIX E

- (i) Gas Monitoring Data

APPENDIX F

- (i) Conceptual Model

APPENDIX G

- (i) Notes on Ground Gas

APPENDIX H

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

APPENDIX I

- (i) Validation Report Guidance Notes

APPENDIX J

- (i) Notes on Limitations

1 EXECUTIVE SUMMARY

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

1. Site Location

The site is located west of Fox's Bank Lane, Whiston, Prescot (nearest postcode: L35 3PS). The coordinates for the centre of the site on National Grid are 347640, 390000. The site is approximately 13.87 hectares in size.

2. Site Description

On Site

The site is irregular in shape and can be accessed off Fox's Bank Lane to the east. The site is predominantly used for agricultural use. A farm steading (consisting of both residential and agricultural buildings) is located along the eastern site boundary.

A circular area of woodland is located within the centre of site, along with three small ponds located across the site. The site and surrounding area gently slopes down gradient from west to east.

Surrounding Area

The surrounding area consists of open fields to the north, a golf course to the east, open fields and the M62 to the south and a caravan park to the west.

3. Proposed Development

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

4. Previously Undertaken Reports

Taylor Wimpey provided Betts Geo with two previously undertaken reports for the site. These reports are as follows;

- Phase I Geo-Environmental Site Assessment for Fox's Bank Lane, Whiston for Reynard Land Whiston Limited by E3P – November 2017 (Report ref: 12-141r1).
- Geo-Environmental Summary Assessment for Fox's Bank Lane, Whiston for Reynard Land Whiston Limited by E3P – November 2017 (Ref: 12-141-11).

Where necessary the above report has been used throughout this report and referenced accordingly.

5. Site History

On Site

“Historical mapping indicates that the site has been largely in agricultural use throughout its mapped history. A farm steading was built in the east sector in the mid-1900's. Planning records indicate that an agricultural building was added in the late 1900's.

Planning records indicate an application for infilling and site restoration was made in the 1970's for an area extending across the south sector and beyond the southern boundary of site. No further details were provided in the online public records. The application may be associated with the construction of, and groundworks for the M62 motorway to the south of the site.”

Surrounding Area

The historic surrounding area generally consisted of farms, collieries, nurseries and a cemetery.

6. Published Geology

The BGS map shows the geology beneath the site as the following:

- Drift – Glacial Till – Sandy gravelly CLAY.
- Majority of site – Kinnerton Sandstone Formation. Western area of site - Pennine Lower Coal Measures Formation – Mudstone, Siltstone and Sandstone.

Coal Mining

“The site is underlain by 4 No Coal Outcrops, two of which are related to the Crombouke, as well as the London Delph and

the Roger seam. The site is underlain by past underground mining related to the Wigan Four Feet and Rushy park at shallowest depth of 229mbgl. There are no known coal mine entries within, or within 20 metres of the site boundary.

Based on the Coal Authority Report, E3P concluded that a high risk of unrecorded coal mining at shallow depth within the west of the site has been identified. The Coal Authority as a statutory consultee will require a series of rotary open holes across the site to determine the presence of any coal on site and understand the nature of any coal workings".

7. Hydrogeology and Hydrology

- *"The superficial deposits of the Glacial Till are classed as a Secondary Undifferentiated Aquifer (Low Permeability).*
- *The bedrock deposits of the Kinnerton Sandstone Formation across most of the site is classed as a Principle Aquifer.*
- *The site is located within a Total Catchment area of a Groundwater Source Protection Zone as defined by the Environment Agency.*
- *The nearest surface water features are the ponds on site and the drain 40m E."*

8. Previously Undertaken Site Investigation (E3P)

E3P undertook a Site Investigation on site in 2017. The fieldwork comprised 24 No. mechanically excavated trial pits and 4 No. BRE 365 soakaway tests.

Ground Conditions

"MADE GROUND was encountered within 4 No trial pits (TP102, TP103, TP112 and TP115) to a maximum depth of 1.20mbgl and comprised of reworked CLAY. The Made Ground is thought to be associated with the area of former excavation for the construction of the M62.

The drift deposits are encountered within all exploratory holes and typically consisted of interbedded gravelly fine to medium SAND and firm to stiff CLAY.

Bedrock was not encountered during the investigation, however, BGS boreholes from immediately south of site suggest SANDSTONE bedrock within the upper 5.00m."

Groundwater

"Groundwater strikes were not encountered during the Ground Investigation.

To date, a limited groundwater risk assessment has been undertaken comprising of two leachate samples taken from the site. Neither leachate samples returned any elevated results and given the undeveloped nature of the site, it is likely that further assessment would come to the conclusion that the site will pose no unacceptable degree of risk to controlled water".

Contamination Encountered

"Laboratory analysis of the soils across the site has not indicated any elevated levels of potential contaminants. Although the material is mostly natural in the E3P investigation only tested a limited amount of samples for this preliminary assessment. However, at this stage chemical analysis would largely suggest that natural drift deposits are chemically suitable for use within a proposed residential development."

Betts Conclusions

Insufficient exploratory holes/samples have been undertaken to adequately assess the full site.

Betts Geo therefore recommends that the following investigation is undertaken to allow for a more robust risk assessment, and as a result of this, any significant risks to site end users be successfully mitigated:

- Further trial pitting and contamination testing across the site - filling in any information gaps across site and delineating any hotspots identified during the E3P SI.
- Ten (10 No) rotary holes in the western extremity of site to assess the potential for shallow coal workings.
- Installation of 6 ground gas monitoring wells with 6 ground gas monitoring visits over a period of at least 3 months.

9. Summary of Environmental Data

Possible Contamination Sources

- Current Land Use on Site – Possible.

- Historical Land Use – On Site – Possible.
- Coal Mining – On Site – Yes.
- Pollution Incident – 11m NE – No.

Pathways and Receptors

- Ponds – On Site – Possible.
- Aquifer below site – Possible.

In this qualitative risk assessment, a Low – Low/Moderate risk of contamination and ground gas exists. Remedial action may be necessary however, the extent of the remedial action cannot be confirmed until the additional ground investigation is carried out.

10. Scope of Investigation

The fieldwork was carried out between the 19th September - 21st September 2018 for the trial pitting and window sampling and 9th - 15th October 2018 for the rotary boreholes and comprised of the following;

- Sixteen (16 No) rotary open boreholes drilled up to 30.00mbgl under a Coal Authority Permit.
- Sixteen (16 No) machine excavated trial holes to between 1.60mbgl (TP14) and 3.40mbgl (TP1).
- Six (6 No) small diameter boreholes to a maximum of 3.00mbgl, all installed with gas/groundwater monitoring wells.
- Six (6 No) ground gas monitoring visits over a period of at least three months with varying barometric pressures.
- Chemical analysis (Metals, PAH's, TPH's) of fifteen (15 No) samples.
- Analysis of fifteen (15 No) samples for asbestos analysis.
- Five (5 No) samples for geotechnical analysis.
- Two (2 No) samples of the material located within the elevated hotspot area screened for leachable lead and leachable arsenic.
- Two (2 No) surface water samples taken from the pond closest to the elevated hotspot area and tested for BOD, COD, pH and metals.

11. Ground Conditions Encountered

Ground conditions generally consists of TOSPOIL (to a maximum depth of 0.60mbgl) overlying a mixture of both firm to stiff CLAY and loose to medium dense gravelly SAND. Shallow bedrock (SANDSTONE recovered as SAND & GRAVEL and SHALE) was encountered in the northern and western area of site between depths of 0.95mbgl – 3.10mbgl.

A localised area of Made Ground was encountered in TP1 between 0.90mbgl 0 1.70mbgl.

12. Contamination Encountered

Soils

One (1 No) elevated occurrence of arsenic and one (1 No) elevated occurrence of lead was identified across the site meaning further assessment will be required.

Both elevations were located within the Made Ground found in TP1 at 1.10mbgl. Statistical analysis indicates that this area is classed as a hotspot (both for arsenic and lead) and will therefore require further delineation. It is important to note that TP1 was in close proximity to an existing pond, and is therefore a results of probable historical infilling.

Leachates

Due to the soil contamination identified in TP1, lead and arsenic leachates were tested for. Leachable lead was identified above the threshold guidance within TP1 (147ug/kg V guidance value of 20ug/kg) therefore surface water sampling in the adjacent pond was undertaken

Surface Water

Two (2 No) surface water samples were taken from the pond adjacent to the hotspot area. All determinants tested for came back below the laboratories limit of detection. From the surface water testing, it can be suggested that none of the contamination is leaching into the adjacent pond, and the superficial clay deposits are providing an adequate barrier to the underlying aquifer.

13. Remedial Actions

Soils

One (1 No) elevated occurrence of arsenic and one (1 No) elevated occurrence of lead was identified across the site meaning further assessment will be required.

Both elevations were located within the Made Ground found in TP1 at 1.10mbgl. Statistical analysis indicates that this area is classed as a hotspot (both for arsenic and lead) and will therefore require further delineation. It is important to note that TP1 was in close proximity to an existing pond, and is therefore a results of probable historical infilling.

Based on the current site layout and the fact the contaminated strata was identified at depths of between 0.90mgl – 1.70mbgl, it may be possible to leave this material in-situ due to the area being proposed as public open space (depending on the results of the delineation).

No significantly elevated contamination was encountered across the remainder of the site. It is therefore likely that a minimum thickness of 300mm of debris-free soil within garden areas to provide a growing medium will be required as per NHBC guidance; this is likely to be made up of site-won subsoil and topsoil.

If delineation finds the hotspot to extend under proposed plots/residential gardens, then it is likely that either:

- A 600mm cover system (150mm topsoil/450mm subsoil) will be required in this area; or
- The hotspot is dug out and filled with a chemically and geotechnically suitable alternative.

If the proposed layout is to change, then the proposed cover system options will require a re-assessment.

Groundwater, Surface Water and Aquifer Risk

Due to the hotspot area being in close proximity to the current pond, leachate analysis was undertaken on the contaminated material, and surface water sampling was undertaken in the pond. Elevated leachable lead was identified, however, dissolved lead levels within the pond were all below the laboratories limit of detection. There is therefore no risk to surface waters from this source.

No significant risks to groundwater and aquifers are anticipated across the remainder of the site due to both the shallow cohesive superficial deposits encountered and no elevated contamination being identified during the ground investigation.

14. Off-Site Disposal of Surplus Soil

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

Segregation of topsoil, made ground and natural should be possible given the chemical analysis and very different visual identification.

15. Specialist Ground Gas Measures

BRE211 (2007) Radon: guidance on protective measures for new buildings shows that between 1 - 3% of properties are above the action level, therefore no radon protection measures are necessary.

Ground gas monitoring is complete. No significantly elevated levels of ground gas have been identified therefore the site has been classed as Green – no specialist ground gas protection is required.

16. Betts Shallow Coal and Mine Shaft Investigation – September 2018

Betts Geo Ltd was commissioned under a Coal Authority License to investigate the areas where there was a potential for shallow coal mining. The work was undertaken by a Montabert Hydrofore rig on the 9th – 15th October 2018. Drilling comprised of sixteen rotary open holed boreholes to up to 30.00mbgl.

The geological succession proven by the drilling work confirms the Geological Survey of the area with the 450m Eccleston East Fault trending north across the site. The fault throws coal bearing Carboniferous Coal Measures against Triassic Lower Mottled Sandstone. There are no shallow coal seams east of the fault although mining at 700m depth did take place from Cronton Colliery in the Felcroft Mine 2km south east of the site in 1977.

Four coal seams are present at very shallow depth west of the fault. No coal thicker than 1.20m was encountered in the drilling. There was no evidence of any mining activity in any of the coal seams, with the strata being consistently firm and hard with no soft drilling or loss of water flush.

As with any former coal mining area, despite no evidence to suggest worked coal seams at shallow depth, site vigilance is advised during development/site strip to ensure no evidence of shallow excavations are evident.

17. Foundations

Both shallow bedrock and a mixture of firm to stiff CLAY and medium dense gravelly SAND was encountered at founding depth across the site. It is recommended that conventional strip/trench foundations can be adopted across the site. The following allowable bearing capacities can be assumed for foundation design;

- Loose to medium dense gravelly SAND with an allowable bearing pressure of 50 kN/m² - 75 kN/m².
- Firm to stiff gravelly sandy CLAY with an allowable bearing pressure of 100 kN/m²- 125kN/m².
- Weathered SANDSTONE/MUDSTONE/SILTSTONE strata an allowable bearing pressure of 150kN/m².

Localised deepening of foundations and/or piled foundations are likely to be required in the vicinity of trees or in the area of deep Made Ground identified in TP1. A foundation zoning plan should be undertaken when proposed levels are made available. For the piled foundations, a specialist piling foundation contractor should be consulted with regards to the design of the foundations and provision for proof digging plots to remove obstructions.

Due to shallow bedrock and defined fault line in the west of site, reinforcing of footings with mesh in this locality is advised. Foundations should be excavated wholly on one stratum. Should proposed foundations span different strata, trenching and stepping of foundations and/or nominal reinforcement will be required.

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

18. Highway

According to the criteria of Highways Agency HD 25/95 Volume 7 Section 2 Part 2 HD 25/94, a CBR value of 3-5% on the on the firm to stiff clay is anticipated, however in-situ CBR's should be undertaken during construction to confirm. Placement of geotextiles within the areas of roads / parking could also be designed to minimise the subgrade thickness.

19. Heave / Shrinkage Potential

LOW plasticity is evident across the materials tested. Foundation design for tree heave protection could be designed accordingly following discussion with the NHBC.

20. Ground Floor Construction

Shrinkable soils are present at shallow depth across the site and it is therefore recommended that suspended floor construction (e.g. either in-situ RC slabs or block and beam flooring) is adopted in accordance with NHBC guidance.

21. Control of Groundwater

Limited groundwater was encountered on site, however a number of the exploratory holes encountered damp CLAY. It is likely that provision of pumping/shuttering will be necessary during excavation of foundation trenches during wet weather and to deeper excavations for sewers etc. It is good practice to have such equipment on standby in case of seasonal / abnormal weather conditions.

Should sewers/excavations deeper than the boreholes/trial pits undertaken be required, further SI will be needed.

22. Concrete Design

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

Concrete Classification	
Design Sulphate Class	DS-1
ACEC Class	AC-1
Design Chemical Class	DC-1

2 SITE DESCRIPTION

2.1 Introduction

This investigation was carried out on the instruction of Taylor Wimpey on behalf of Taylor Wimpey, Gino Frederick Fantin & Dawn Sara Fantin, Mrs K Mullin, Reynard Land Whiston Limited and Evo Living Limited 17. The applicant is hereafter referred to as 'Taylor Wimpey'. The purpose of the work was to carry out a ground investigation to provide geotechnical and contamination risk information for the demolition of existing farm buildings and erection of 337 residential dwellings together with new vehicular access, SUDs ponds, landscaping and other associated works. A site boundary plan can be seen below;



Fox Wood Garden Village Planning Layout – Taylor Wimpey – 15.02.2019 – Dwg. No. LPE PLA 01

2.2 Site Location

The site is located west of Fox's Bank Lane, Whiston, Prescot (nearest postcode: L35 3PS). The coordinates for the centre of the site on National Grid are 347640, 390000. The site is approximately 13.87 hectares in size. See Site Location Plan in Appendix A.

2.3 Site Description

2.3.1 On Site

The site is irregular in shape and can be accessed off Fox's Bank Lane to the east. The site is predominantly used for agricultural use. A farm steading (consisting of both residential and agricultural buildings) is located along the eastern site boundary.

A circular area of woodland is located within the centre of site, along with three small ponds located across the site.

The site and surrounding area gently slopes down gradient from west to east.

2.3.2 Surrounding Area

The area surrounding the site comprises of the following;

- North – Open fields.
- East – Residential property, Fox's Bank Lane with fields and a golf course beyond.
- South – Open fields and M62 beyond.
- West – Caravan park.

3 ENVIRONMENTAL SETTING AND DATA

3.1 Previously Undertaken Reports/Investigation

Taylor Wimpey provided Betts Geo with two previously undertaken reports for the site. These reports are as follows;

- Phase I Geo-Environmental Site Assessment for Fox's Bank Lane, Whiston for Reynard Land Whiston Limited by E3P – November 2017 (Report ref: 12-141r1).
- Geo-Environmental Summary Assessment for Fox's Bank Lane, Whiston for Reynard Land Whiston Limited by E3P – November 2017 (Ref: 12-141-l1).

Where necessary the above report has been used throughout this report and referenced accordingly. The following 'Site History Summary', 'Geology' and 'Environmental Data' has been summarised from the report.

Whilst Betts Geo Environmental Ltd cannot be held liable for the third party, client furnished, results/data, it is suggested that it is reasonable to assume that the data provided in these reports have been undertaken with suitable care and due diligence by suitably experience consultants. As such the data is regarded as being of an appropriate standard to utilise within this report.

3.2 Summary of Site History

3.2.1 On Site

"Historical mapping indicates that the site has been largely in agricultural use throughout its mapped history. A farm steading was built in the east sector in the mid-1900's. Planning records indicate that an agricultural building was added in the late 1900's.

Planning records indicate an application for infilling and site restoration was made in the 1970's for an area extending across the south sector and beyond the southern boundary of site. No further details were provided in the online public records. The application may be associated with the construction of, and groundworks for the M62 motorway to the south of the site."

3.2.2 Surrounding Area

The following table below shows the changes in historical use surrounding the site:

Date First Shown	Land Uses
Pre 1849	Farm – 60m NE (still present).
Pre 1928	Cronton Colliery – 250m S (shown until 1900).
Pre 1951	Nursery – 0m N (shown as fields circa 1990. Fields still present). Nursery – 100m S (shown as fields circa 1966. Fields still present).
Pre 1977	Motorway – 100m S (still present).
Pre 1999	Cemetery 165m N (still present).

E3P also undertook a detailed search of online planning records held by Knowsley Metropolitan Borough Council –

“There is a record for infilling waste materials and restoration of land on the southern sector and immediately south of site: no accompanying documents were provided.

A planning application was consented in 1996 for the ‘erection of portal steel framed storage shed’ at the farm steading in the east sector of the site.

A planning application has been submitted for the extension of a cemetery, approximately 165m N of the site.”

4 GEOLOGY

The following section details the published and available geological data available for the site and the surrounding area. This summary is taken from the reports referenced in Section 3.1 above. For full details, please refer to this report.

4.1 Published Geology

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

Drift	Solid
Till, Devensian – Sandy Gravelly CLAY.	Majority of site - Kinnerton Sandstone Formation – Sandstone Western area of site – Pennine Middle Coal Measures Formation – Mudstone, Siltstone and Sandstone

4.1.1 Coal Mining

A Coal Authority Mining Report was obtained as part of the third-party report. A summary can be seen below. For full details please refer to the reports referenced in Section 3.1

“The site is underlain by 4 No Coal Outcrops, two of which are related to the Crombouke, as well as the London Delph and the Roger seam. The site is underlain by past underground mining related to the Wigan Four Feet and Rushy park at shallowest depth of 229mbgl. There are no known coal mine entries within, or within 20 metres of the site boundary.

Based on the Coal Authority Report, E3P concluded that a high risk of unrecorded coal mining at shallow depth within the west of the site has been identified. The Coal Authority as a statutory consultee will require a series of rotary open holes across the site to determine the presence of any coal on site and understand the nature of any coal workings”.

4.1.2 Radon

“The site is situated in an area where between 1-3% of homes are above the Action Level and the BGS reports that full radon protective measures are not necessary in the construction of new dwellings or extensions.”

4.2 Hydrogeological and Hydrological Features

4.2.1 Discharge Consents

“There are no discharge consents within 250m of site.”

4.2.2 Pollution Incidents to Controlled Waters

“There is one pollution incident recorded within 250m of site which occurred in 1993, involving waste and

rubbish 11m NE of site."

4.2.3 Water Abstractions

"The closest groundwater abstraction is 675m east for portable supply."

4.2.4 Hydrogeology:

- *"The superficial deposits of the Glacial Till are classed as a Secondary Undifferentiated Aquifer (Low Permeability).*
- *The bedrock deposits of the Kinnerton Sandstone Formation across most of the site is classed as a Principle Aquifer.*
- *The site is located within a Total Catchment area of a Groundwater Source Protection Zone as defined by the Environment Agency.*
- *The nearest surface water features are the ponds on site and the drain 40m E."*

4.2.5 Flood Risk and Drainage Management Strategy

"The site is located within a currently defined Flood Risk Zone 1; defined as land assessed as having less than 1 in 1,000 annual probability of river or sea flooding (<0.1%), and as such is considered to be unaffected by river flooding. In addition, the Envirocheck Report states there is a limited potential for groundwater flooding to occur at the site."

5 ENVIRONMENTAL DATA

The following section details environmental data available for the site and the surrounding area. Full details can be found in the EP3 reports referenced in Section 3.1.

5.1 Landfill Sites and Waste Treatment Sites

"According to the Envirocheck report, there are no landfill sites within 500m of the site. However, planning records indicate an application for infilling was made in the 1970s for an area extending into the south sector and beyond the south of the site.

There are no Registered Waste Transfer Sites, Licensed Waste Management Sites or Registered Waste Treatment or Disposal Sites within 500m of site."

Discussions between Betts Geo and the farmer on site confirmed that an area to the south of site had been lowered in topography due to the underlying sandstone being quarried for fill of the nearby motorway.

5.2 Industrial Land Uses

"The site is located within a predominantly agricultural area. There are two (2 No) entries within the trade directory for industrial land uses identified within 250m of the site for freight 130m NE and garage services 234m W, both inactive."

5.2.1 Fuel Station Entries

"There is no fuel station entries within 250m of site."

5.3 Unexploded Ordnance

"The regional unexploded bomb risk map from Zetica indicates that the site is in an area at low."

6 PREVIOUSLY UNDERTAKEN SITE INVESTIGATION (E3P)

6.1 Introduction

E3P undertook a Site Investigation on site in 2017. A summary of the Site Investigation can be found below. Full details can be found in their report (Geo-Environmental Summary Assessment for Fox's Bank Lane, Whiston for Reynard Land Whiston Limited by E3P – November 2017 (Ref:12-141-I1).

6.2 Fieldwork Scope

"E3P has completed a preliminary intrusive Ground Investigation comprising 24 No. mechanically excavated trial pits and 4 No. BRE 365 soakaway tests."

6.3 Ground Conditions Encountered

"MADE GROUND was encountered within 4 No trial pits (TP102, TP103, TP112 and TP115) to a maximum depth of 1.20mbgl and comprised of reworked CLAY. The Made Ground is thought to be associated with the area of former excavation for the construction of the M62."

The drift deposits are encountered within all exploratory holes and typically consisted of interbedded gravelly fine to medium SAND and firm to stiff CLAY.

Bedrock was not encountered during the investigation, however, BGS boreholes from immediately south of site suggest SANDSTONE bedrock within the upper 5.00m."

6.4 Groundwater

"Groundwater strikes were not encountered during the Ground Investigation."

To date, a limited groundwater risk assessment has been undertaken comprising of two leachate samples taken from the site. Neither leachate samples returned any elevated results and given the undeveloped nature of the site, it is likely that further assessment would come to the conclusion that the site will pose no unacceptable degree of risk to controlled water"

6.5 Soil Contamination Encountered

"Laboratory analysis of the soils across the site has not indicated any elevated levels of potential contaminants. Although the material is mostly natural in the E3P investigation only tested a limited amount of samples for this preliminary assessment. However, at this stage chemical analysis would largely suggest that natural drift deposits are chemically suitable for use within a proposed residential development."

6.6 Ground Gas

"Ground gas monitoring has not been undertaken, therefore as part of a detailed site appraisal and design of low rise dwellings, full and detailed site characterisation and assessment is required."

6.7 Geotechnical Recommendations

"It is anticipated that the optimum foundation solution would be to prepare the ground in a controlled manner so as to facilitate the use of traditional strip footings and/or mass trench fill foundations.

Existing information is sparse, however, it may be necessary to construct a pile foundation within areas immediately adjacent to trees or where ground conditions are locally poor.

Limited Made Ground has been encountered however when considering the need to grade the site to a development platform and cohesive soils, ground bearing slabs are unlikely to be viable.

4 No Soakaway tests have been completed on site. Due to the presence of clay drift deposits, there appears to be limited soakage potential across the majority of site"

7 SUMMARY OF ENVIRONMENTAL SENSITIVITY

The following section is a review of the environmental sensitivity of the site as discussed in Sections 2-6. Significant potential risks are discussed in the following subsections and will then be evaluated as part of the Site Conceptual Model in Section 8.

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

The table below focuses on significant site specific sources, pathways and receptors. More 'generic' pathways and receptors (such as site end uses) will be covered as part of the full Site Conceptual Model in Section 16.

7.1 Sources

Source	Distance/ Direction	Details	Significant Risk
Current Land Use	On Site	Site is currently agricultural with a farm stead along the eastern boundary. Possible localised Made Ground surrounding the farm stead – potential source of heavy metals, TPH's, PAH's and asbestos. Preliminary SI undertaken by E3P found no significant contamination. Further SI to confirm.	Possible
Historical Land Use	On Site	Site remains relatively undeveloped apart from a farm stead building that was built in the eastern area circa mid 1900's. Planning records also indicate an area of infilling to the south of the site – thought to be for the M62 motorway to the south of site. Possible localised Made Ground surrounding the farm stead building and within the infilled area. Possible contamination may include heavy metals, TPH's, PAH's and asbestos. Potential source of ground gas. Preliminary SI undertaken by E3P found no significant contamination. Further SI to confirm.	Possible
Coal Mining	On Site	Potential for shallow coal working on site given the underlying geology and details with the Coal Authority Report. Historic shafts could have been backfilled with an unknown material or left open. Possibility of heavy metals, TPH's, PAH's and asbestos within infill material. Also potential ground gas source. E3P SI didn't include rotary boreholes. Additional SI to confirm.	Yes
Pollution Incident	11m NE	Pollution incident occurred 11m NE circa 1993 involving waste and rubbish. Due to the age of the incident, there is no significant ongoing risk anticipated from this source.	No

7.2 Pathways

Source	Distance/ Direction	Details	Significant Risk
Ponds	On Site	A number of ponds are located on site. Possible pathway/receptor for any contamination located on site. Risk of migration into ponds is lessened due to the cohesive superficial clay anticipated on site. Additional SI to confirm.	Possible
Aquifer	Underlying Site	Bedrock underlying the site is classed as a Principle Aquifer (High Permeability) with an Unproductive Strata (clay) overlying it. Due to the anticipated clay, the downward migration potential of any contamination is lessened. Additional SI to confirm.	Possible

8 INITIAL CONCEPTUAL SITE MODEL

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

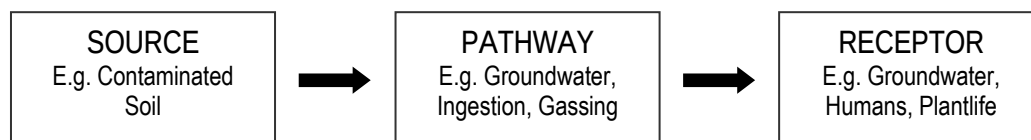
This section of the report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

Potential contamination sources and environmentally sensitive receptors have been discussed in Section 7. Potentially significant risks are evaluated as part of the subsequent sub-sections.

8.1 Source-Pathway-Receptor Linkages

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

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



Type of Contamination	Potential Sources	Potential Pathway	Potential Receptors	Pollution Linkage	Comment	Estimated Level of Risk
Ground Gas	Historic Land Use On Site	Inhalation of Vapours	Construction/ Maintenance Workers	Potentially Active	Risk of ground gas from both the sites historic use and potential underground coal shafts. Cohesive superficial deposits limit any ground gas migration (if present). Rotary works to confirm risk from coal mining. PPE to protect.	Low - Moderate
	Coal Mining On Site	Vapours Penetrating Unprotected Buildings	Future Site Users	Potentially Active	Risk of ground gas from both the sites historic use and potential underground coal shafts. Cohesive superficial deposits limit any ground gas migration (if present). Rotary works to confirm risk from coal mining. Future site use to be residential.	Moderate
Near Surface Contaminants Within Soils	Current Land Use on Site Historic Land Use On Site Coal Mining On Site	Ingestion, Inhalation, Dermal Contact	Current Site Users	Potentially Active	Potential for contaminants across site due to the sites historic site use (area of infilling) and possible coal mining (metals, TPH's, PAH's, VOC's, SVOC's and asbestos). Previous SI found no significantly elevated contamination. Current site use is agricultural therefore risk to current site end users is lessened. Additional SI to confirm.	Low - Moderate
			Construction/ Maintenance Workers	Potentially Active	Potential for contaminants across site due to the sites historic site use (area of infilling) and possible coal mining (metals, TPH's, PAH's, VOC's, SVOC's and asbestos). Previous SI found no significantly elevated contamination. Additional SI to confirm. PPE to protect.	Low - Moderate
			Future Site Users	Potentially Active	Potential for contaminants across site due to the sites historic site use (area of infilling) and possible coal mining (metals, TPH's, PAH's, VOC's, SVOC's and asbestos). Previous SI found no significantly elevated contamination. Additional SI to confirm. Future site use to be residential with homegrown produce.	Moderate
			Adjacent Land Users	Potentially Active	Adjacent land uses are residential and agricultural. Some contamination possible on site. Site anticipated to be surrounded by cohesive superficial deposits lowering the risk of migration off site.	Low
		Direct Contact	Structures	Potentially Active	Possible high/low pH's and high sulphates within the Made Ground on site which could affect foundations. Additional SI to confirm.	Low - Moderate
		Absorption in Root Zone	Plants	Potentially Active	Potential for contaminants across site due to the sites historic site use (area of infilling) and possible coal mining (metals, TPH's, PAH's, VOC's, SVOC's and asbestos). Previous SI found no significantly elevated contamination. Additional SI to confirm Future site use to be residential with homegrown produce.	Low - Moderate
Mobile Contaminants, Leachables e.g. from Pollution Sources on Site/Off Site	Current Land Use on Site	Leaching into Groundwater	Groundwater	Potentially Active	Previous SI found no elevated leachates. Site anticipated to be surrounded by cohesive superficial deposits lowering any risk of migration. Additional SI to confirm.	Low
	Historic Land Use On Site	Offsite Migration in Groundwater	Abstractions	Potentially Active	The closest groundwater abstraction is 675m E. Site is anticipated to be surrounded by cohesive superficial deposits. No groundwater contamination identified during previous SI.	Low
	Coal Mining On Site		Controlled Waters	Potentially Active	A number of ponds are located on site. Possible receptor for any contamination however the site is anticipated to be surrounded by cohesive superficial deposits lowering any risk of migration and previous SI found no elevated contamination.	Low
Organic and Inorganic Contaminants Within Soils / Groundwater	Current Land Use on Site Historic Land Use On Site Coal Mining	Potable Water Supply Pipes	Utilities Workers	Potentially Active	Potential for TPH contamination due to sites historical use. Risk to be assessed once water pipeline routes are known then liaise with local water authority supplier.	Low

8.2 Summary

In this qualitative risk assessment, a Low – Low/Moderate risk of contamination and ground gas exists. Remedial action may necessary, however, the extent of which cannot be confirmed until the additional ground investigation is carried out.

8.3 Betts Conclusion on Desk Based/Previous Investigation

Insufficient exploratory holes/samples have been undertaken to adequately assess the full site.

Betts Geo therefore recommends that the following investigation is undertaken to allow for a more robust risk assessment, and as a result of this, any significant risks to site end users be successfully mitigated:

- Further trial pitting and contamination testing across the site – filling in any information gaps across site and delineating any hotspots identified during the E3P SI.
- Ten (10 No) rotary holes in the western extremity of site to assess the potential for shallow coal workings.
- Installation of 6 ground gas monitoring wells with 6 ground gas monitoring visits over a period of at least 3 months.

8.4 Geotechnical Risk

It should be highlighted that the following geotechnical constraints exist at the site and should also be considered when undertaking the additional ground investigation to allow foundation design:

- Possible deep Made Ground within the area of infilling (although not anticipated due to results of E3P investigation).
- Possible heave / shrink in cohesive strata due to trees (anticipated).
- Likely shallow mine workings / shafts in the western extremity of site.
- Shallow bedrock.

9 FIELDWORK

9.1 Fieldwork Objectives

The objectives of the intrusive ground investigation will be to:

- Clarify the ground conditions encountered within the Third Party Reports provided by the client.
- Provide additional contamination and ground gas information for the site.
- Provide additional data for the design of any remedial works that may be required.
- Provide additional geotechnical information to be used for the design and specification of foundations and substructure requirements.

9.2 Fieldwork Scope

The fieldwork was carried out between the 19th September – 21st September 2018 for the trial pitting and window sampling and 9th – 15th October 2018 for the rotary boreholes and comprised of the following;

- Sixteen (16 No) rotary open boreholes drilled up to 30.00mbgl under a Coal Authority Permit.
- Sixteen (16 No) machine excavated trial holes to between 1.60mbgl (TP14) and 3.40mbgl (TP1).
- Six (6 No) small diameter boreholes to a maximum of 3.00mbgl, all installed with gas/groundwater monitoring wells.
- Six (6 No) ground gas monitoring visits over a period of at least three months with varying barometric pressures.
- Chemical analysis (Metals, PAH's, TPH's) of fifteen (15 No) samples.
- Analysis of fifteen (15 No) samples for asbestos analysis.
- Five (5 No) samples for geotechnical analysis.
- Two (2 No) samples of the material located within the elevated hotspot area screened for leachable lead and leachable arsenic.
- Two (2 No) surface water samples taken from the pond closest to the elevated hotspot area and tested for BOD, COD, pH and metals.

9.3 Targeted Investigation

The holes were positioned to target areas previously missed during the E3P site investigation.

10 GROUND CONDITIONS

10.1 General

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

Ground conditions generally consists of TOSPOIL (to a maximum depth of 0.60mbgl) overlying a mixture of both firm to stiff CLAY and loose to medium dense gravelly SAND. Shallow bedrock (SANDSTONE recovered as SAND & GRAVEL and SHALE) was encountered in the northern and western area of site between depths of 0.95mbgl – 3.10mbgl.

A localised area of Made Ground was encountered in TP1 between 0.90mbgl 0 1.70mbgl.

10.2 Ground Conditions Summary

Strata	General Description	Thickness m		No of Holes Located
		Top	Base	
TOPSOIL	TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets.	0.00	0.60 (TP1)	All holes except TP13
TOPOSIL/MADE GROUND	TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional brick and concrete cobble.	0.00	0.45 (TP13)	TP13
CLAY	Firm light greyish/reddish brown with frequent orangish brown mottling very sandy CLAY.	0.00	2.00 (BH3)	TP2, TP7, TP15, BH1, BH2, BH3, BH4, BH5, BH6, BH7, BH8, BH9, BH10, BH11, BH12, BH13, BH14, BH15, BH16
CLAY (2)	Firm to stiff brown/reddish brown with frequent grey/orangish brown mottling gravelly sandy CLAY.	0.40 (TP6)	3.00 (WS1)	TP1, TP2, TP4, TP5, TP6, TP7, TP11, TP13, TP15, TP16, WS1, WS2, WS3, WS4, WS5
SAND	Loose to medium dense reddish brown slightly clayey slightly gravelly fine to medium SAND.	0.40 (TP11)	2.90 (TP3)	TP1, TP3, TP4, TP5, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, WS1, WS6
SAND (2)	Loose to medium orangish/yellowish brown slightly clayey slightly gravelly fine to coarse SAND. Occasional clay pockets.	0.85 (WS3)	3.40 (TP1)	TP1, TP2, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP12, TP13, TP15, TP16, WS3, WS4, WS5, WS6
MADE GROUND	Dark brown occasionally black gravelly sandy CLAY. Ashy. Frequent wood, metal, wire, plastic.	0.90 (TP1)	1.70 (TP1)	TP1
CLAY/SAND	Firm reddish brown very sandy CLAY/very clayey SAND.	2.30 (TP11)	3.00 (TP11)	TP11
SANDSTONE	Weak fine grained yellowish brown SANDSTONE recovered as SAND & GRAVEL.	0.95 (WS3)	3.10 (TP4)	TP3, TP4, TP6, TP7, TP8, TP9, TP12, TP13, TP14, TP15, WS3, WS4, WS6
SANDSTONE (2)	Yellow/red SANDSTONE with occasional grey marl layers. Firm drilling.	1.00 (BH15)	30.00 (BH1)	BH1, BH2, BH3, BH5, BH7, BH8, BH9, BH10, BH11, BH12, BH13, BH14, BH15, BH16
SANDSTONE (3)	Grey SANDSTONE. Hard drilling.	6.20 (BH15)	20.00 (BH13)	BH6, BH11, BH13,
SHALE	Dark grey or black SHALE. Firm drilling.	1.80	30.00	BH3, BH4, BH5, BH6, BH8, BH11,

		(BH11)	(BH3)	BH13, BH14, BH15, BH16
MUDSTONE	Grey MUDSTONE with thin grey shale layers. Firm drilling.	4.50 (BH5)	30.00 (BH5)	BH5, BH8, BH14
COAL	Black COAL. Firm drilling.	3.40 (BH3)	27.00 (BH3)	BH3, BH4, BH5, BH6, BH8, BH11, BH14, BH15, BH16

10.3 Visual and Olfactory Contamination

Other than the Made Ground mentioned above, no other visual and/or olfactory evidence of contamination was encountered.

10.4 Obstructions

No obstructions were encountered in the exploratory holes other than shallow bedrock. Shallow bedrock was located in the following holes;

- SANDSTONE - TP3 at 2.90mbgl; TP4 at 3.00mbgl; TP6 at 2.90mbgl; TP7 at 2.00mbgl; TP8 at 1.80mbgl; TP9 at 2.60mbgl; TP12 at 2.40mbgl; TP13 at 2.30mbgl; TP14 at 1.20mbgl; TP15 at 2.60mbgl; WS3 at 0.95mbgl; WS4 at 1.65mbgl; WS6 at 1.55mbgl; BH1 at 1.80mbgl; BH2 at 1.80mbgl; BH5 at 2.00mbgl; BH7 at 1.80mbgl; BH8 at 1.80mbgl; BH9 at 1.50mbgl; BH10 at 1.80mbgl; BH12 at 1.80mbgl; BH13 at 1.80mbgl; BH15 at 1.00mbgl and BH16 at 1.50mbgl.
- SHALE – BH3 at 2.00mbgl; BH4 at 2.00mbgl; BH6 at 2.00mbgl; BH11 at 1.80mbgl and BH14 at 2.00mbgl

10.5 Groundwater – Fieldwork

The following exploratory holes encountered groundwater during the fieldwork:

Exploratory Hole	Depth (mbgl)	Strata	Remark
TP1	3.40	SAND	Slight seepage
WS1	2.40 – 2.55	CLAY	Damp
WS1	2.55 – 3.00	CLAY	Wet
WS5	1.30 – 3.00	CLAY	Damp

10.6 Groundwater – Post Fieldwork Monitoring

The table below indicates groundwater encountered during the monitoring post fieldwork (6/6 visits has been undertaken);

Exploratory Hole	Depth to Water (mbgl)		Borehole Depth (mbgl)	
	Min	Max	Min	Max
WS1	0.78	2.95	2.97	3.17
WS2	1.35	2.48	2.89	3.00
WS3	1.04	1.04	1.04	1.20
WS4	Dry	Dry	1.71	2.75
WS5	2.50	2.50	2.96	3.08
WS6	Dry	Dry	1.50	1.63

11 LABORATORY TESTING

11.1 General

An assessment of potential determinants associated with the former/current land uses has been undertaken. Determinants include metals, polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs) and asbestos.

11.2 Scheduled Chemical Testing: Soils

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

Chemical Test	No. of Samples	Comment/Method
pH Values	20	Determination of pH (using Cyberscan pH meter).
Sulphate - Soluble 2:1 Extract	20	Dionex.
Arsenic, Cadmium, Chromium VI, Chromium III, Total Chromium, Lead, Mercury, Selenium, Copper, Nickel, Complex and Free Cyanide and Zinc.	15	Soil samples were analysed in accordance with UKAS/MCERTS standards Inductively coupled plasma atomic emission spectroscopy (ICP-OES)
Speciated Polycyclic Aromatic Hydrocarbons (PAH),	15	Determination of Polycyclic Aromatic Hydrocarbons by GC-MS. End/end extraction using DCM on as received sample. In house method modified USEPA 8270. Include coronene if required.
TPH CWG	15	TPH CWG (Aliphatics C5-6,>6-8,>8-10,>10-12,>12-16,>16-21,>2-35) (aromatics >C5-7,>7-8,>8-10,>10-12,>12-16,>16-21,>21-35) C5-8 fractions by Headspace GC-MS (003S). C8-35 fractions on as received sample extracted with hexane/acetone, aliphatic/aromatic splits run by GC-FID (005S), banded as listed above.
GRO/BTEX/MTBE by GC-FID (C5-10; C10-C12)	15	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12).
Organic Matter	15	Determination of Organic Matter by combustion.
Asbestos Screen	15	Visual Screening for Fibres and PLM
Atterburg Limits	5	BS1377 Part 2. 1990, 4.3,5.3,5.4
Moisture Content	5	BS1377 Part 2. 1990, 3.2
Ground Water/ Surface Water	2	GC-FID, GC-MS Headspace, ICP-MS, Oxygen Meter, Colorimetry, GCMS

12 CONTAMINATION ASSESSMENT

12.1 General

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

Our assessment is based on the following assumptions:

- The proposed site end use is of a high risk rating (residential dwellings with proposed gardens). For analysis purposes, 'residential with home grown produce' is deemed the most appropriate end use.
- The superficial deposits of the Glacial Till are classed as a Secondary Undifferentiated Aquifer (Negligible/Low Permeability). The bedrock deposits of the Kinnerton Sandstone Formation are classed as a Principle Aquifer (High Permeability).
- It is deemed that some statistical analysis is appropriate. Where sample data numbers are low and/or targeted, each determinant result is however reviewed further as an individual result as opposed to an average across the site.
- Site history has indicated a Low/ Low - Moderate risk of contamination and ground gas.
- Statistical analysis of the chemical test results has been undertaken in general accordance with Environment Agency 2009 SGV Guidance and AtRisk 2017 using the combined assessment criterion given by CLEA (Note: all SSVs for EA derivation are for a SOM of 6% in line with Environment Agency Report SC050021/SR4 – this figure is deemed representative as an average value for sandy loam soil). AtRisk 2017 are used to the nearest SOM percentage deemed appropriate.
- No free product was noted in the exploratory holes.
- Following the withdrawal of CLR7-10 Guidance documents by the Environment Agency, statistical analysis has been undertaken in accordance with the CIEH/CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration' (May 2008). As such, the use of the mean value test alone is not considered.

A full risk assessment is detailed within Section 13 of this report.

12.2 Soils Contamination Summary

Topsoil

All determinants for heavy metals, TPH's and PAH's fell below the residential with home grown produce guidance values within the topsoil.

Made Ground

Limited Made Ground was encountered onsite, however, out of the sample taken within this strata the following elevated levels were identified:

Heavy Metals

Determinants	Location	Depth (mbgl)	Concentration (mg/kg)	SGV/GAC Used (mg/kg)	C4SL (mg/kg)
Arsenic	TP1	1.10	82	32	37
Lead	TP1	1.10	5540	-	200

All determinants for TPH's and PAH's fell below the residential with home grown produce guidance values.

Natural Strata

All determinants for heavy metals, TPH's and PAH's fell below the residential home grown produce guidance levels within the Natural Strata.

Asbestos

No asbestos was identified in the samples analysed.

12.3 Water Contamination Summary

There are a number of options available when assessing water and leachate results. The Water Supply (Water Quality) Regulations 2016, for drinking water abstracted from groundwater (DWS) is generally deemed appropriate for screening.

Drinking water standards are the most conservative values, but they will not always be appropriate.

Two alternatives are:

1. The Surface Water (Abstraction for Drinking Water) Regulations 1996 (SWA).

These Regulations give values for three alternatives (DW1, DW2 & DW3); the most appropriate alternative is dependent on treatment at the water works. However, DW1 values should be adopted unless it is known that DW2 or DW3 treatments are being applied to an existing extraction.

2. Environmental Quality Standards (EQS)

The Environment Agency use a variety of EQS values to protect and improve water quality. The EA use EQS values to calculate the potential impacts of industry and agriculture; for example, to determine conditions imposed on discharges in order to protect water quality.

EQS values have a variety of aims, including:

- Protecting wildlife and nature;
- Controlling risks to the quality of water abstracted for domestic supply or used for crop irrigation;
- Making sure that activities such as bathing, angling and boating are as safe as possible.

Most of the standards support the requirements of European Directives.

The EQS of some determinands are dependent on parameters such as hardness (calcium carbonate content). Consequently, it will usually be necessary to determine hardness of both the site water and receiving surface water. Alternatively the lowest hardness should be adopted in the screening process.

EQS values are sometimes represented as Annual Average (AA) and/or Maximum Allowable Concentrations (MAC); in the majority of cases the AA should be adopted.

Appropriate Tier 1 Values for various scenarios are suggested in the Table overleaf. When assessing groundwater quality, consideration should be given to the site's environmental setting in terms of surrounding land uses (especially those with the potential to have caused pollution of groundwaters) and therefore the likely background water quality.

Water Body	Conceptual Site Model	Appropriate Tier 1 Values	Remarks
Perched water in made ground	Potential linkage to nearby surface water	Freshwater EQS, or SWA (DW1)	SWA only appropriate if preliminary inv. identifies a downstream abstraction or the watercourse is a major river with abstraction potential (probably at least 10m wide).
	Potential linkage to deeper groundwater aquifer	DWS	n/a
	Potential linkage to human health	DWS	Only likely where there are significant VOC concentrations.
	No plausible linkages	n/a	Still worth sampling because dewatering may be required during development. Water Authority are likely to request composition data before issuing a discharge consent. Also need to consider whether development might open up new pathways (eg piles).
Groundwater in a Minor Aquifer	Potential for abstraction	DWS	n/a
	Potential linkage to nearby surface water	Freshwater EQS, or SWA (DW1)	See Remark in top box.
	Potential linkage to human health	DWS	n/a
Groundwater in a Major Aquifer	Potential for abstraction	DWS	n/a
Surface Water	n/a	Freshwater EQS, or SWA (DW1)	See Remark in top box.

Water Body	Conceptual Site Model	Appropriate Tier 1 Values	Remarks
Coastal Water	n/a	Marine EQS	n/a

Due to the hotspots proximity to the adjacent pond area, there is a potential linkage to surface water from any perched water within the Made Ground, therefore EQS (Freshwater) is deemed most appropriate. The EQS (Freshwater) screening values are detailed below

Table 1: Inorganic Tier 1 Water Environment Screening Criteria

Contaminant	Units	Hardness Banding (CaCO ₃ mg/l)	EQS (Freshwater)	EQS (Saltwater)	UK DWS	WHO
Inorganics						
Arsenic	µg/l	-	50	25	10	10
Boron	µg/l	-	2000	7000	1000	0.3
Cadmium	µg/l	-	5	2.5	5	3
Chromium	µg/l	0-50	2	15	50	50
		50-100	10			
		100-150	10			
		150-200	20			
		200-250	20			
Copper	µg/l	0-10	0.5	5	2000	2000
		10-50	0.5			
		50-200	3			
		200-250	8			
		>250	12			
Cyanide (Free)	µg/l	-	1	-	-	-
Cyanide	-	-	-	-	50	70
Iron	µg/l	-	1000	1000	200	300
Lead	µg/l	0-50	4	25	25 (reducing to 10 in 2013)	10
		50-150	10			
		150-250	20			
		>250	20			
Mercury	µg/l	-	1	0.3	1	1
Nickel	µg/l	0-50	8	30	20	70
		50-100	20			
		100-150	20			
		150-250	40			
		>250	40			
Selenium	µg/l	-	-	-	10	10
Sulphate (SO ₄)	mg/l	-	400	-	250	250
Zinc	µg/l	0-50	8	40	5000	3000
		50-150	15			
		150-250	50			
		>250	50			
pH	-	-	6-9	6-8.5	-	-

12.4 Groundwater Contamination Summary

Leachates

Due to the soil contamination identified in TP1, lead and arsenic leachates were tested for. The levels encountered on site along with different guidance values are shown in the table below:

Determinant	Location	Depth (mbgl)	Concentration (ug/kg)	EQS (Freshwater) (ug/kg)	WHO (ug/kg)	WFD 2015 (ug/kg)
Arsenic (leachable)	TP1	1.10	2	50	10	25.8 – 106
Lead (leachable)	TP1	1.10	147	20	10	0.619 – 2.54

Leachable lead was identified above the threshold guidance therefore surface water sampling in the adjacent pond was undertaken to ensure that the contaminant wasn't migrating.

Surface Water – Adjacent Pond

Two (2 No) surface water samples were taken from the pond adjacent to hotspot on the 5th November 2018. The results of the testing can be seen below:

Determinant	Location	Concentration (ug/kg)	EQS (Freshwater) (ug/kg)	WHO (ug/kg)	WFD 2015 (ug/kg)
Lead (dissolved)	Pond 1	<1	20	10	0.619 – 2.54
	Pond 2	<1	20	10	0.619 – 2.54

From the surface water testing, it can be suggested that none of the contamination is leaching into the adjacent pond, and the superficial clay deposits are providing an adequate barrier to the underlying aquifer. From these results, no further risk assessment is required in relation to surface water courses however construction activity may influence this. Surface water management plans should be implemented and approved by Statutory Authorities.

13 ENVIRONMENTAL RISK ASSESSMENT

13.1 General

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

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

The superficial deposits are classed as a Secondary Undifferentiated Aquifer (Low/Negligible Permeability) and the bedrock deposits classed as a Principle Aquifer High Permeability). With respect to human health, the proposed end use (residential with home grown produce) is of high sensitivity. Therefore the site's environmental setting is considered to be a moderate to high environmental sensitivity. Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures (see Section 16.2), therefore, the primary residual risks that require assessment are Site End Users. The following sections are split into soils and groundwater for clarity.

13.2 Assessment of Contamination Analytical Results

Soils

One (1 No) elevated occurrence of arsenic and one (1 No) elevated occurrence of lead was identified across the site meaning further assessment will be required.

Both elevations were located within the Made Ground found in TP1 at 1.10mbgl. Statistical analysis indicates that this area is classed as a hotspot (both for arsenic and lead) and will therefore require further delineation. It is important to note that TP1 was in close proximity to an existing pond, and is therefore a results of probable historical infilling.

Based on the current site layout and the fact the contaminated strata was identified at depths of between 0.90mgl – 1.70mbgl, it may be possible to leave this material in-situ due to the area being proposed as public open space (depending on the results of the delineation). The hotspot area is shown as a red dot on extract below.



No significantly elevated contamination was encountered across the remainder of the site. It is therefore likely that a minimum thickness of 300mm of debris-free soil within garden areas to provide a growing medium will be required as per NHBC guidance; this is likely to be made up of site-won subsoil and topsoil.

If delineation finds the hotspot to extend under proposed plots/residential gardens, then it is likely that either:

- A 600mm cover system (150mm topsoil/450mm subsoil) will be required in this area; or
- The hotspot is dug out and filled with a chemically and geotechnically suitable alternative.

If the proposed layout is to change, then the proposed cover system options will require a re-assessment.

Surface Water, Groundwater and Aquifer Risk

Due to the hotspot area being in close proximity to the current pond, leachate analysis was undertaken on the contaminated material, and surface water sampling was undertaken in the pond. Elevated leachable lead was identified, however, dissolved lead levels within the pond were all below the laboratories limit of detection. There is therefore no risk to surface waters from this source.

No significant risks to groundwater and aquifers are anticipated across the remainder of the site due to both the shallow cohesive superficial deposits encountered and no elevated contamination being identified during the ground investigation.

14 GROUND GAS ASSESSMENT

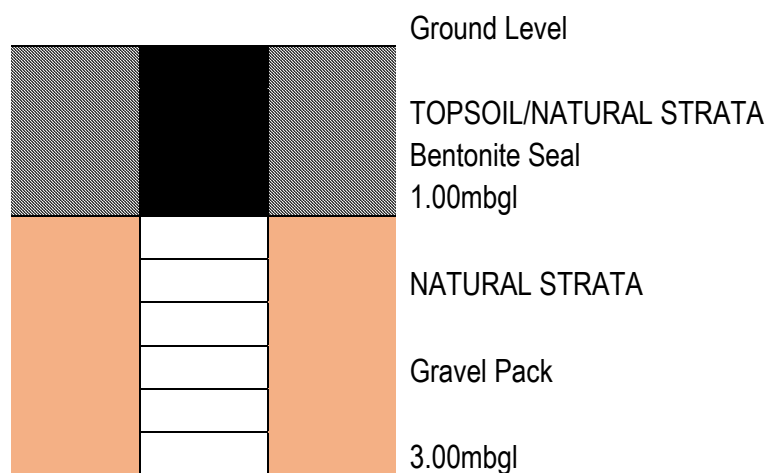
14.1 Ground Gas Requirements – Radon

BRE211 (2007) Radon: guidance on protective measures for new buildings shows it is in a lower probability area, as between 1 - 3% of homes are above the action level. Therefore, no Radon protective measures are necessary in the construction of new dwellings or extensions.

14.2 Ground Gas Assessment

14.2.1 Ground Gas Boreholes Installations

The six (6 No) boreholes were all installed to between 1.00mbgl (due to refusal) and 3.00mbgl with between 0.65m - 1.00m of plain pipe and between 0.50m – 2.00m of slotted pipe into the Natural Strata below. A typical installation is shown below;



14.2.2 Summary of Results

Six out of six (6/6) ground gas visits have been completed and the details are summarised below (see Appendix E for full results);

Borehole Number	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Baro. Pressure (mB)	Peak Flow (l/hr)	GSV CH ₄	GSV CO ₂	No. of Visits
WS1	0.0 – 0.1	1.1 – 4.9	14.5 – 19.8	991 – 1038	0.5	0.001	0.025	6/6
WS2	0.0	0.9 – 1.3	19.5 – 20.4	991 – 1038	0.1	0.000	0.001	6/6
WS3	0.0	0.6 – 1.8	19.1 – 20.3	991 – 1038	0.7	0.000	0.013	6/6
WS4	0.0	0.2 – 1.4	19.1 – 20.9	991 – 1038	0.5	0.000	0.007	6/6
WS5	0.0	0.7 – 2.7	16.7 – 20.5	991 – 1038	0.7	0.000	0.019	6/6
WS6	0.0	0.7 – 1.7	19.3 – 20.3	991 – 1038	0.3	0.000	0.005	6/6

14.2.3 Guidance

Three recent publications are used for ground gas risk assessment:

- 'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present', Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties.
- CIRIA C665 'Assessing risks posed by hazardous ground gases for buildings' 2007 - for high rise residential / flats.
- BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

Further details / accompanying notes for the following gas risk assessment are enclosed in Appendix G. The proposed development at the site is private residential two-storey houses, therefore assessments using the NHBC Guidance are deemed most appropriate.

14.2.4 Ground Gas Recommendations

Due to no significant elevated levels of ground gas being identified during the subsequent gas monitoring visits, the following ground gas assessment has been made:

Site Area	Site Classification	Recommended Ground Gas Protection Measures
Whole Site	Green	No specialist ground gas protection is required.

15 REVISED CONCEPTUAL SITE MODEL

15.1 General

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

15.2 Final Conceptual Site Model

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

Target (Receptor)	Potential Source-Pathway Linkage	Remedial Action Required (where appropriate)	Est. Degree of Risk to Target Following Remedial Action Where Necessary
Site End Users	Inhalation of soil gases, odours or dust.	Gas monitoring complete – site classified as Green – no ground gas protection required.	Low
Site End Users	Ingestion of, and skin contact with, contaminated soil.	Further investigation required within hotspot area required to see if hotspot area extends under plots.	Low
Site End Users	Ingestion of contaminants in vegetables etc. or in soils adhering to vegetables, etc	Further investigation required within hotspot area.	Low
Construction/ Maintenance Workers	Inhalation of soil gases, odours or dust.	PPE	Low (assumed basic PPE is used)
Construction/ Maintenance Workers	Ingestion of, and skin contact with, contaminated soil	PPE	Low (assumed basic PPE is used)
Plants	Adverse effects on growth caused by presence of contaminants in soil	Further investigation required within hotspot area required to see if hotspot area extends under plots.	Low
Buildings and Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion and fire hazards	Gas monitoring complete – site classified as Green – no ground gas protection required.	Low
Foundations	Sulphate attack of foundations	Foundations to be designed as per section 18.4.	Low
Water Supplies	Hydrocarbons penetrating plastic water supply pipes.	United Utilities pipeline risk assessment required.	Low
Groundwater	Migration of soluble contaminants into groundwater on or off site	No remedial action required.	Low
Surface Water	Migration of soluble contaminants and/or direct run-off of contaminants	No significantly elevated determinants identified within the pond however protection may be required during future ground breaking works	Low

16 OUTLINE STRATEGY FOR RISK REDUCTION/REMEDIAL STRATEGY

16.1 General

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

16.2 Construction/Maintenance Workers

Limited contamination was encountered on site, therefore, the following recommendations should be adhered to during site works:

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

16.3 Site-End Users

A hotspot (arsenic and lead) was identified in TP1 between 0.90mbgl – 1.70mbgl and will therefore require further delineation.

Based on the current site layout and the fact the contaminated strata was identified at depths of between 0.90mgl – 1.70mbgl, it may be possible to leave this material in-situ due to the area being proposed as public open space (depending on the results of the delineation).

No significantly elevated contamination was encountered across the remainder of the site. It is therefore likely that a minimum thickness of 300mm of debris-free soil within garden areas to provide a growing medium will be required as per NHBC guidance; this is likely to be made up of site-won subsoil and topsoil.

If delineation finds the hotspot to extend under proposed plots/residential gardens, then it is likely that either:

- A 600mm cover system (150mm topsoil/450mm subsoil) will be required in this area; or
- The hotspot is dug out and filled with a chemically and geotechnically suitable alternative.

If the proposed layout is to change, then the proposed cover system options will require a re-assessment.

Imported soils are unlikely to be needed for the cover system, however any imported soils should be tested for contamination to ensure that they are suitable for the proposed use. It is generally advisable to test a

minimum of three samples, or one sample per 150m³ (greenfield source- topsoil) and 250m³ (greenfield source- subsoil) so that a representative mean value can be calculated.

16.6 Controlled Waters

Following surface water testing, it can be concluded that there is no risk to surface waters/pond areas from the identified hotspot area.

No significant risks to groundwater and aquifers are anticipated due both the cohesive superficial deposits encountered and no real significant contamination being identified during the ground investigation.

16.7 Ground Gas Protection Measures

BRE211 (2007) Radon: guidance on protective measures for new buildings shows that between 1-3% of properties are above the action level, therefore no radon protection measures are necessary.

Gas monitoring complete – site classified as Green – no ground gas protection required.

16.8 Piped Drinking Water Supplies

The use of Protect-a-Line is not anticipated, however a pipeline assessment should be undertaken and confirmed with United Utilities.

16.9 Off-Site Disposal of Surplus Soil

If there is the need to remove soil off-site, it is recommended that the results of the contamination testing (including the history of the site) be presented to the proposed landfills to obtain their acceptance of the information to date and to determine the actual WAC limits used by them (see Appendix L for further guidance).

Segregation of the Topsoil, Made Ground and Natural Strata should be possible given the chemical analysis and very different visual identification. If moved to other sites for use, it is proposed to use the results of the contamination testing to determine if it is deemed suitable for re-use as topsoil or subsoil.

17 SHALLOW COAL AND MINE SHAFT INVESTIGATION – OCTOBER 2018

Betts Geo Ltd was commissioned under a Coal Authority License to investigate the areas where there was a potential for shallow coal mining. The work was undertaken by a Montabert Hydrofore rig on the 9th – 15th October 2018.

17.1 Shallow Coal Mine Workings Ground Investigation

Drilling comprised sixteen (16 No) rotary open holed boreholes drilled to up to 30.00mbgl under Coal Authority Permit 16701 to investigate the depth of the overlying drift strata and whether there was evidence of shallow coal mine workings to the sub-cropping coal seams. Several of the holes were drilled to prove the precise position of the Ecclestone East Fault.

The borehole logs can be found in Appendix C.

17.2 Ground Conditions

The geological succession proven by the drilling work confirms the Geological Survey of the area with the 450m Ecclestone East Fault trending north across the site. The fault throws coal bearing Carboniferous Coal Measures against Triassic Lower Mottled Sandstone. There are no shallow coal seams east of the fault although mining at 700m depth did take place from Cronton Colliery in the Felcroft Mine 2km south east of the site in 1977.

Four coal seams are present at very shallow depth west of the fault. In descending order these seams have the following local names and succession at Cronton Colliery:

- Felcroft Mine 1.5m thick perhaps 9m measures.
- Pasture Mine 2.4m thick 9m measures.
- Discovery Mine 2.0m thick 16m measures.
- Yard Mine 1.0m thick.

No coal thicker than 1.20m was encountered in the drilling. There was no evidence of any mining activity in any of the coal seams, with the strata being consistently firm and hard with no soft drilling or loss of water flush.

17.3 Mining Investigation Summary

The seams are of good quality and extensively mined elsewhere in Whiston and Prescott. The lack of mining under the site is most likely due to the proximity and effect of the Ecclestone East Fault. There are records of three shafts 50m north of site, however there are no mineplans of workings from the shafts with the shaft positions being derived solely from the First Edition Ordnance Survey.

There is no evidence of any past shallow mining activity under the site and the presence of the Ecclestone East Fault and associated minor faulting would have deterred any early shallow mining.

As with any former coal mining area, despite no evidence to suggest worked coal seams at shallow depth, site vigilance is advised during development/site strip to ensure no evidence of shallow excavations are evident.

An extract of the coal mining borehole plan overlain the site layout can be seen below. This also shows the fault line identified.

It is important to note that due to shallow bedrock and a defined fault line in the west of site, reinforcing of foundation footings with mesh in this locality is advised.



18 GEOTECHNICAL ASSESSMENT

All geotechnical recommendations are to be confirmed upon completion of rotary mining investigation and coal risk assessment.

18.1 Introduction

It is understood that the proposed development will comprise two – three storey residential dwellings with associated gardens, public open spaces, new road and associated infrastructure. Associated foundation loadings are anticipated to be low.

18.2 Site Preparation and Excavation

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

18.3 Control of Groundwater

Limited groundwater was encountered on site, however a number of the exploratory holes encountered damp CLAY. It is likely that provision of pumping/shuttering will be necessary during excavation of foundation trenches during wet weather and to deeper excavations for sewers etc. It is good practice to have such equipment on standby in case of seasonal / abnormal weather conditions.

Should sewers/excavations deeper than the boreholes/trial pits undertaken be required, further SI will be needed.

18.4 Foundations

Both shallow bedrock and a mixture of firm to stiff CLAY and medium dense gravelly SAND was encountered at founding depth across the site. It is recommended that conventional strip/trench foundations can be adopted across the site. The following allowable bearing capacities can be assumed for foundation design;

- Loose to medium dense gravelly SAND with an allowable bearing pressure of 50 kN/m² - 75 kN/m².
- Firm to stiff gravelly sandy CLAY with an allowable bearing pressure of 100 kN/m² - 125kN/m².
- Weathered SANDSTONE/MUDSTONE/SILTSTONE strata an allowable bearing pressure of 150kN/m².

Localised deepening of foundations and/or piled foundations are likely to be required in the vicinity of trees or in the area of deep Made Ground identified in TP1. A foundation zoning plan should be undertaken when proposed levels are made available. For the piled foundations, a specialist piling foundation contractor should be consulted with regards to the design of the foundations and provision for proof digging plots to remove obstructions.

Due to shallow bedrock and defined fault line in the west of site, reinforcing of footings with mesh in this locality is advised.

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

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

18.5 Ground Floor Construction

Shrinkable soils are present at shallow depth across the site and it is therefore recommended that suspended floor construction (e.g. either in-situ RC slabs or block and beam flooring) is adopted in accordance with NHBC guidance.

18.6 Soakaways

Soakaway tests were not undertaken during the fieldwork due to the cohesive (low permeability) strata encountered on site. ESP undertook soakaway testing as part of their fieldwork and determined that *"due to the presence of clay drift deposits, there appears to be limited soakage potential across the majority of site."*

18.7 Heave / Shrinkage Potential

A summary of Atterburg limit tests is shown below. Full results are located in Appendix D.

Exploratory Position ID	Depth (m)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	% <425um	% Plasticity Index	NHBC Modified Plasticity Level
TP2	1.50	15	24	10	68	14	LOW
TP6	1.70	14	31	13	84	18	LOW
TP15	1.70	12	33	13	84	20	LOW
WS1	1.90	10	29	12	80	17	LOW
WS2	1.50	10	33	14	92	19	LOW

LOW plasticity is evident across the materials tested. Foundation design for tree heave protection could be designed accordingly following discussion with the NHBC.

18.8 Highway

According to the criteria of Highways Agency HD 25/95 Volume 7 Section 2 Part 2 HD 25/94, a CBR value of 3-5% on the firm to stiff clay is anticipated, however in-situ CBR's should be undertaken during construction to confirm. Placement of geotextiles within the areas of roads / parking could also be designed to minimise the subgrade thickness.

18.9 Protection of Buried Concrete

It is considered for concrete design purposes that a greenfield site and static groundwater conditions are applicable and the results are summarised below:

Concrete Classification	
Design Sulphate Class	DS-1
ACEC Class	AC-1
Design Chemical Class	DC-1

19 ADDITIONAL WORKS REQUIRED

The following works are required on site before the development can commence:

- Further investigation and delineation in the vicinity of TP1.

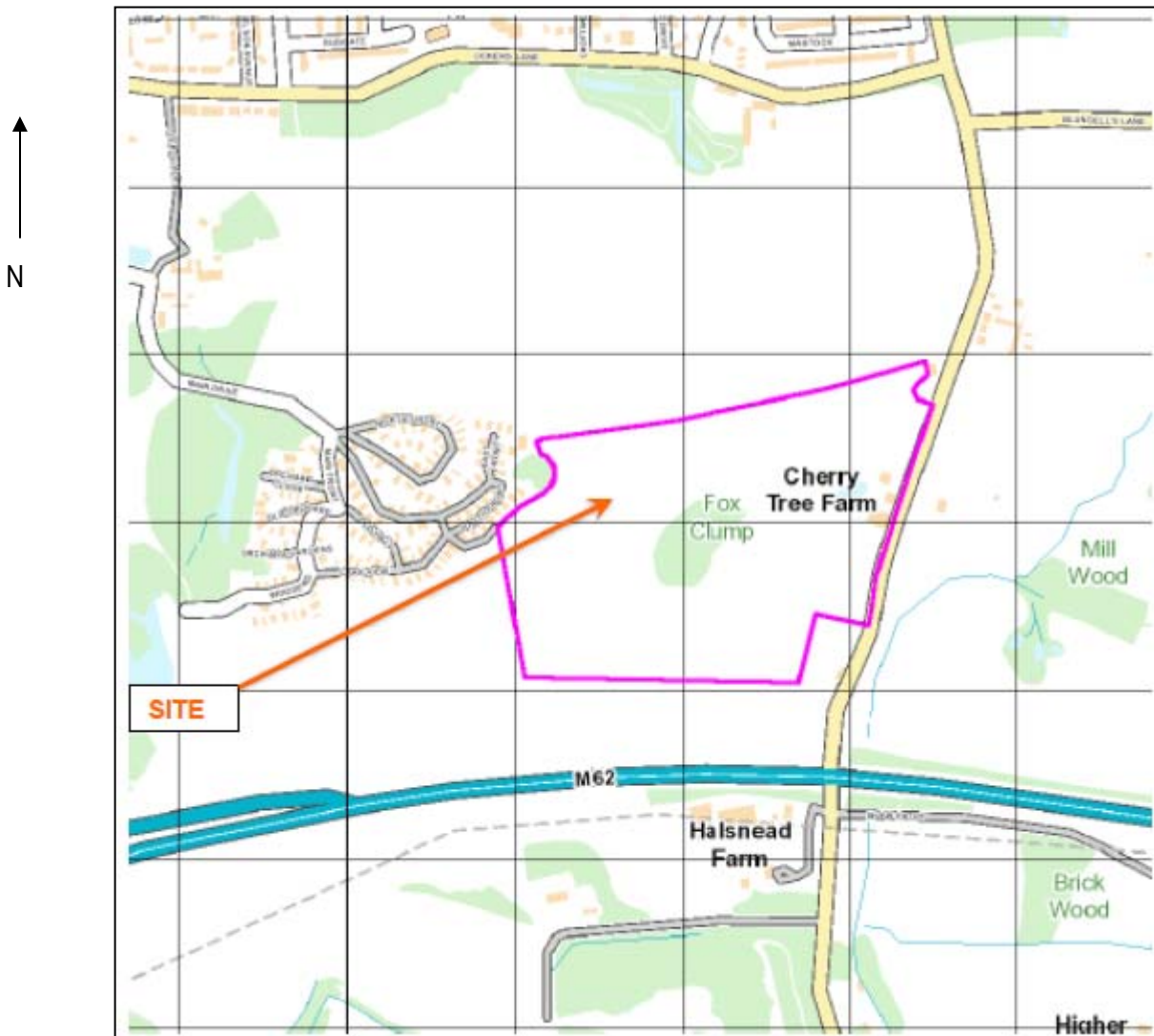
20 REFERENCES

- 20.1 *Phase I Geo-Environmental Site Assessment for Fox's Bank Lane, Whiston for Reynard Land Whiston Limited by E3P - November 2017 (Report ref: 12-141r1).*
- 20.2 *Geo-Environmental Summary Assessment for Fox's Bank Lane, Whiston for Reynard Land Whiston Limited by E3P - November 2017 (Ref:12-141-l1).*
- 20.3 *BS 5930:2015 Code of Practice for Site Investigation.*
- 20.4 *BS1377: 2016 Methods of Test for Soils for Civil Engineering Purposes.*
- 20.5 *Assessment of risks to human health from land contamination: an overview of the development of guideline values and related research. EA, 2002.*
- 20.6 *Contaminated Land Risk Assessment; A Guide to Good Practice; CIRIA C552: 2001.*
- 20.7 *Health and Safety in Construction, HSG150, HSE, 1996.*
- 20.8 *Hazardous Waste: Interpretation of the Definition and Classification of Hazardous Waste, Environment Agency, WM2 Version 1.0, June 2003.*
- 20.9 *DoE (1991), The Building Regulations Approved Document C, Site Preparation and Resistance to Moisture, HMSO.*
- 20.10 *Baker W (1987), Investigation Strategy - lecture at City of Birmingham Development Department Symposium on Methane Generating Sites, 9 December 1987, Industrial Research Laboratories, Birmingham.*
- 20.11 *NHBC Standards, Chapter 4.2, 2017 Building Near Trees.*
- 20.12 *Highways Agency HD 25/95 volume 7 section 2 Part 2 HD 25/94.*
- 20.13 *Water Regulations Advisory Scheme (2002) The selection of materials for water supply pipes to be laid in contaminated land.*
- 20.14 *Anon (1997) Dutch in Policy Retreat on Contaminated Land ENDS (Environmental Data Services), 269, 46.*
- 20.15 *Water Regulations Advisory Scheme (2002) The selection of materials for water supply pipes to be laid in contaminated land.*
- 20.16 *Piling In Layered Ground: Risks to Groundwater and Archaeology Science Report SC020074/SR Environment Agency October 2006.*
- 20.17 *Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention National Groundwater & Contaminated Land Centre report NC/99/73 F J Westcott, C M B Lean & M L Cunningham May 2001.*
- 20.18 *'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present', Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties.*
- 20.19 *CIRIA C665 'Assessing risks posed by hazardous ground gases for buildings' 2007 - for high rise residential / flats*

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- 20.20 *BS8485:2015 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.*
- 20.21 *BRE 414 'Protective measures for housing on gas-contaminated land' Roger Johnson, Parkman Environment 2001.*
- 20.22 *BS 8500- 1:2006 'Concrete – Complementary British Standard to BS EN 206-1 – Part 1: Method of specifying and guidance for the specifier' November 2006.*
- 20.23 *'Planning Policy 23:Planning and Pollution Control' Office of the Deputy Prime Minister 2004.*
- 20.24 *CLR11 'Model Procedures for the Management of Land Contamination' DEFRA 2004.*
- 20.25 *BRE 465 'Cover Systems for Land Regeneration' 2004.*
- 20.26 *'The UK Approach for Evaluating the Human Health Risks from Petroleum Hydrocarbons in Soils, Environment Agency Science Report P5-080/TR3', Environment Agency (May 2005).*
- 20.27 *TOX12- Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Dioxins, Furans and Dioxin-like PCBs' Environment Agency 2003.*
- 20.28 *Atkins 2017 AtRisksoil.co.uk SSV's derived using CLEA for 1 or 6% SOM. Residential with homegrown produce.*
- 20.29 *Phase 1 Geo-Environmental Desk Study for the Proposed Development of Land to the West of Whalley Road, Barrow, Lancashire by Capita Symonds – January 2012 (Doc reference: 18394-DS02).*
- 20.30 *Atkins 2017 AtRisksoil.co.uk SSV's derived using CLEA for 1 or 6% SOM. Residential with homegrown produce.*

APPENDIX A

(i) Site Location Plan

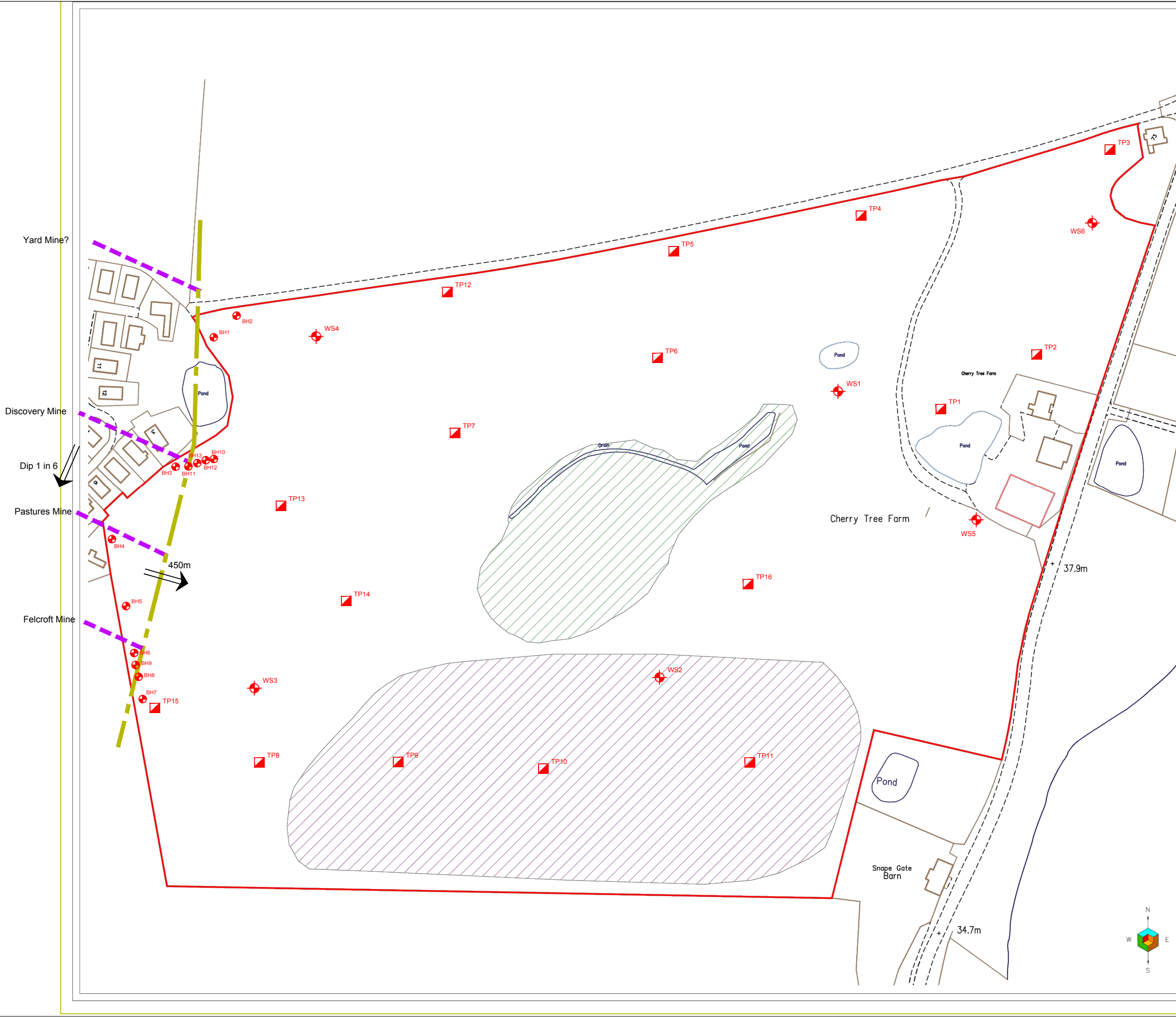


Site Location Plan

West of Fox's Bank Lane, Whiston, Prescot (nearest postcode: L35 3PS). The coordinates for the centre of the site on National Grid are 347640, 390000. The site is approximately 13.87 hectares in size.

APPENDIX B

- (i) Betts Exploratory Hole Location Plan



NOTES

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

THE PLAN OVERLAYS THE EXISTING SITE LAYOUT.

KEY

TP

WS

BH

TRIAL PIT LOCATION.

WINDOW SAMPLE HOLE LOCATION.

ROTARY BOREHOLE LOCATION – NKC 9th –15th OCT 18.

SKETCH LOCATION OF OUTCROP.

SKETCH LOCATION OF KNOWN FAULT LINE.

A	14.11.18	PH	UPDATED WITH NKC LOCATIONS	JS
REV	DATE	BY	DESCRIPTION	CHK

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

TAYLOR WIMPEY

PROJECT: FOX BANK LANE, WHISTON

TITLE: EXPLORATORY HOLE LOCATION PLAN

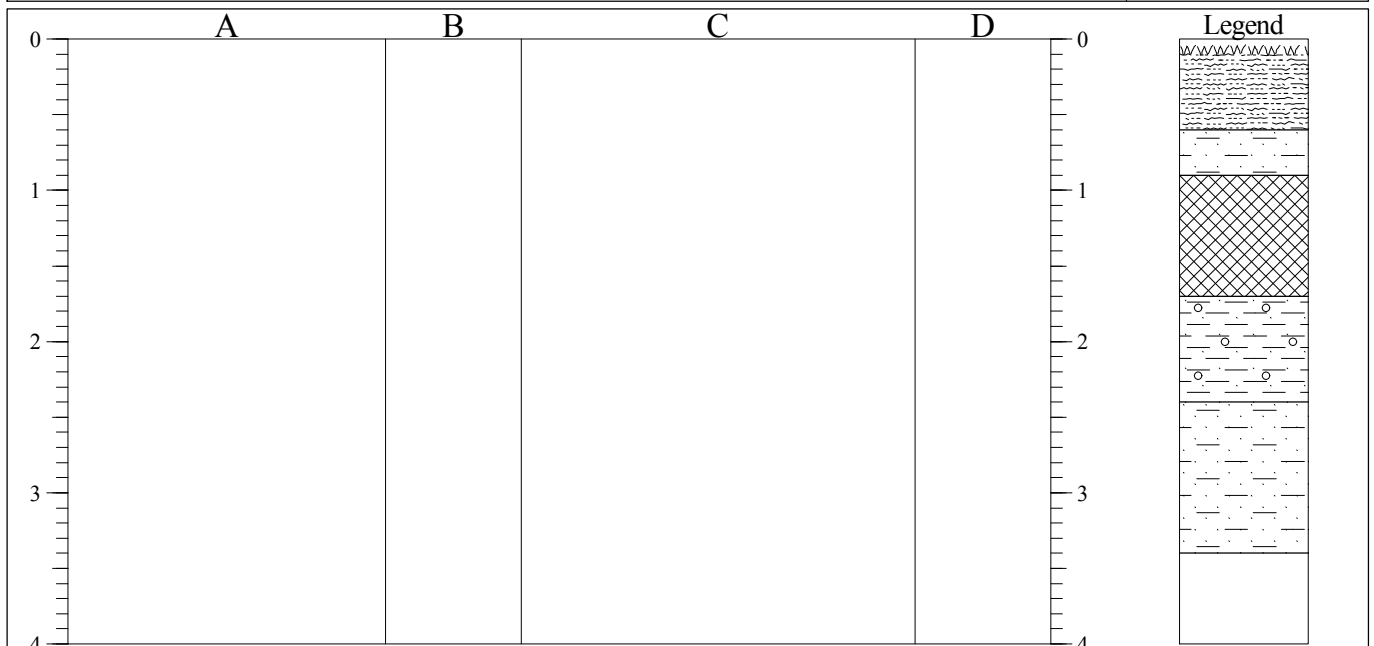
DATE: 25.09.18	SCALE @ SIZE: NTS @ A3	DRAWN: PH	CHECKED: MJF
PROJECT No: 18TAY042	DRAWING No: EXP 101	REV: A	

APPENDIX C

- (i) Betts Exploratory Hole Logs
- (ii) Coal Investigation – Rotary Logs

TRIAL PIT LOG

Project Foxs Lane, Whiston				TRIAL PIT No TP1
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.60		TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets.				
0.60-0.90		Loose to medium reddish brown slightly clayey fine to medium SAND.				
0.90-1.70		MADE GROUND: Dark brown occasionally black gravelly sandy CLAY. Ashy. Frequent burnt wood, metal, wire, plastic and rope.	1.10	ES		
1.70-2.40		Stiff brown with frequent grey and orangish brown mottling slightly gravelly slightly sandy CLAY. Occasional sand pocket. Gravel is fine to medium subangular to subrounded.				
2.40-3.40		Loose to medium brown/orangish brown slightly clayey fine to coarse SAND. Occasional clay pockes.				
		Slight seepage.				

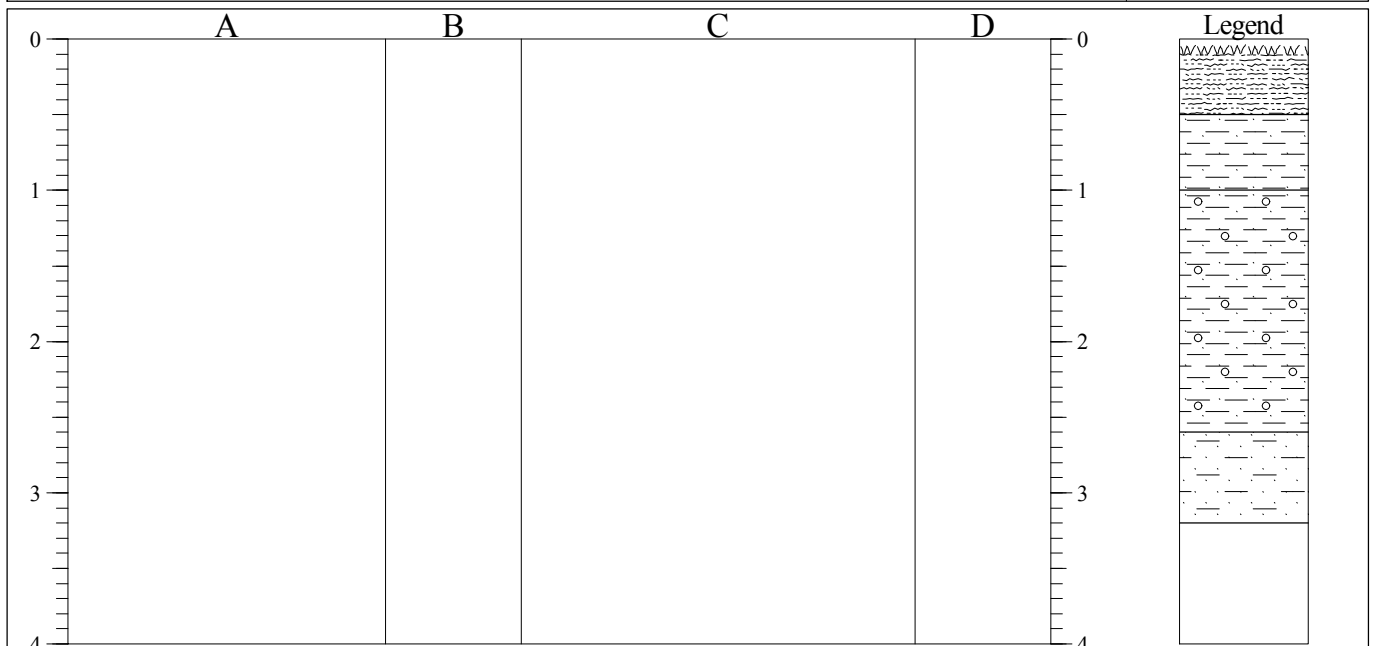
Shoring/Support: Stability: Slightly unstable between 0.90mbgl - 1.70mbgl.		GENERAL REMARKS	
Diagram of a rectangular trial pit. The top horizontal dimension is labeled '3' with arrows at both ends. The bottom horizontal dimension is labeled 'C'. The right vertical dimension is labeled '0.6' with arrows at both ends. The right vertical dimension is also labeled 'B'. The left vertical dimension is labeled 'D'. A north arrow points upwards to the right of the diagram.		Slight seepage at 3.40mbgl.	

All dimensions in metres Scale 1:50	Client Taylor Wimpey	Method/ Plant Used JCB 3CX	Logged By JS
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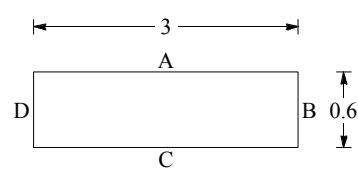
AGS3 UK TP 18TAY042 - FOXS LANE, WHISTON.GPJ GINT STD AGS 3.1.GDT 24/9/18

TRIAL PIT LOG

Project Foxs Lane, Whiston				TRIAL PIT No TP2
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



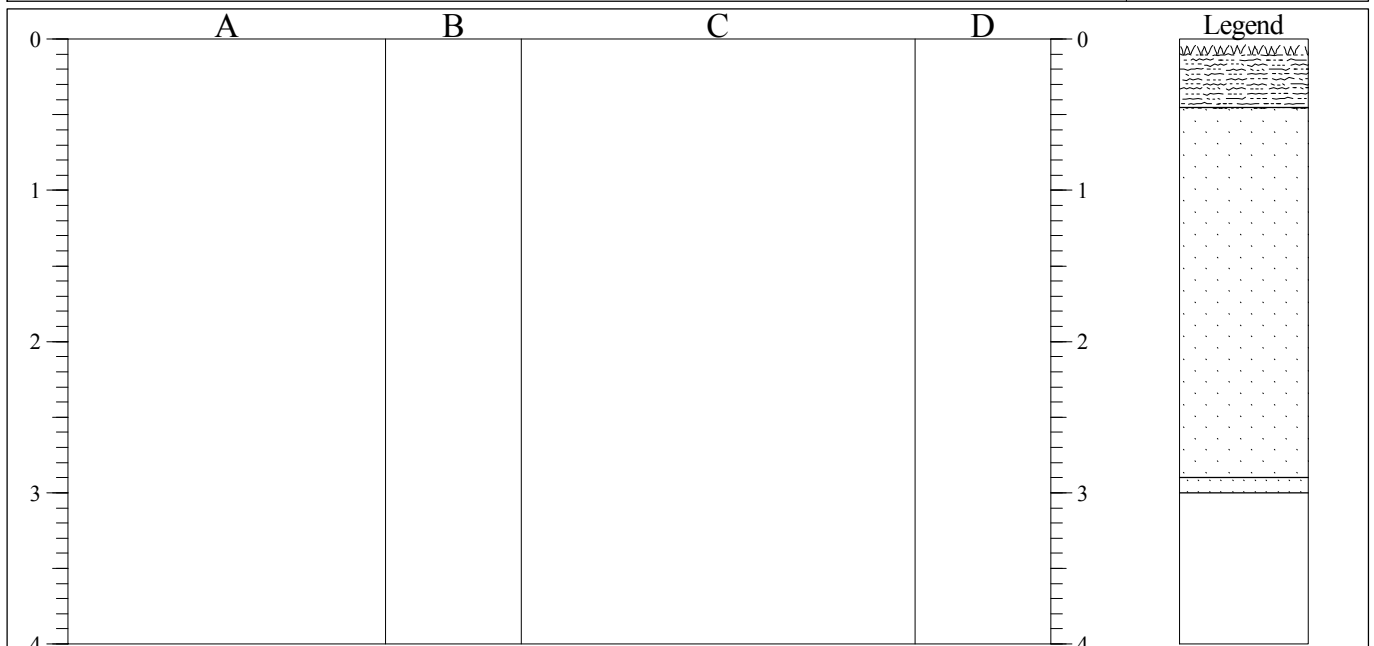
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.50		TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets.	1.50	D	
0.50-1.00		Firm light greyish brown with frequent orangish brown mottling very sandy CLAY. Frequent light grey sand pockets. 0.50 Plastic land drain surrounded by gravel - dry.			
1.00-2.60		Stiff brown with occasional grey mottling slightly gravelly slightly sandy CLAY. Becomes friable with depth.			
2.60-3.20		Loose to medium brown/orangish brown slightly clayey fine to coarse SAND.			

Shoring/Support: Stability: Stable.		GENERAL REMARKS	
		Dry.	

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

Project Foxs Lane, Whiston				TRIAL PIT No TP3
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



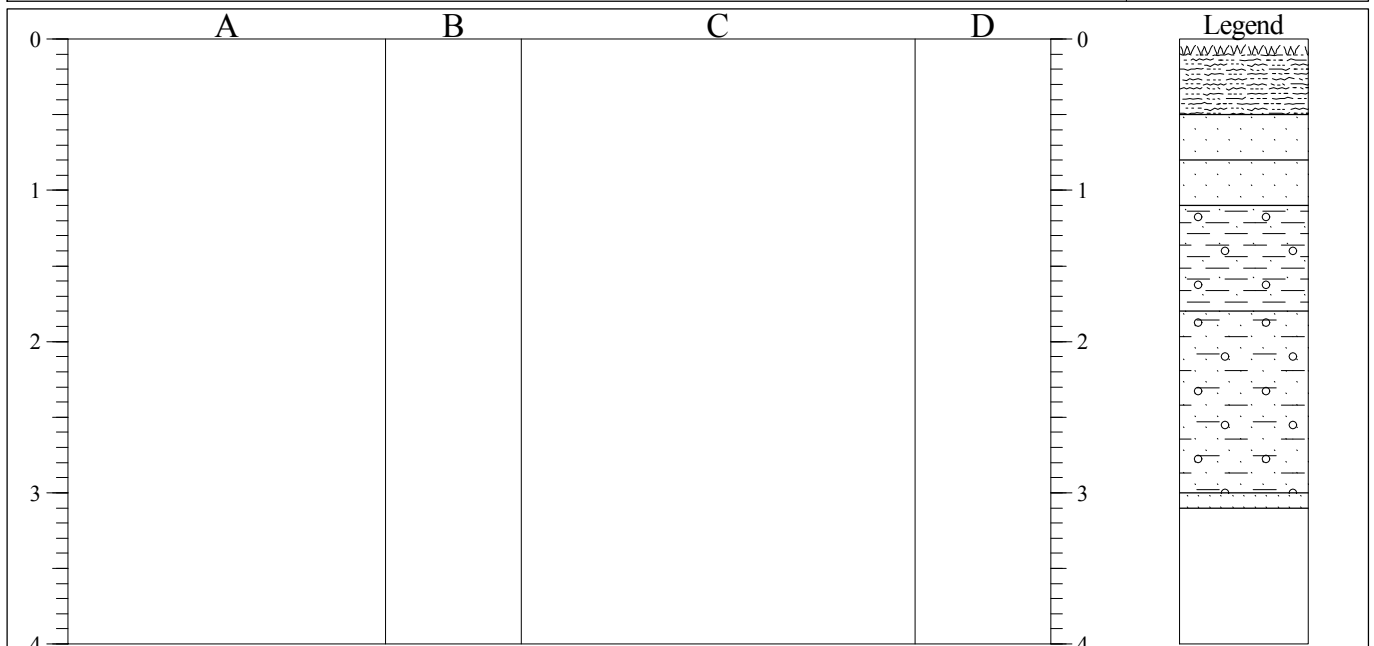
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.45		TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets.	0.10	ES		
0.45-2.90		Loose to medium reddish/orangish brown occasionally yellowish brown fine to coarse SAND. Rare medium subangular gravel.				
		2.30 - 3.00 Becomes yellowish brown with depth.				
2.90-3.00		Weak fine grained yellowish brown SANDSTONE recovered as SAND & GRAVEL.				

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

Project Foxs Lane, Whiston				TRIAL PIT No TP4
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



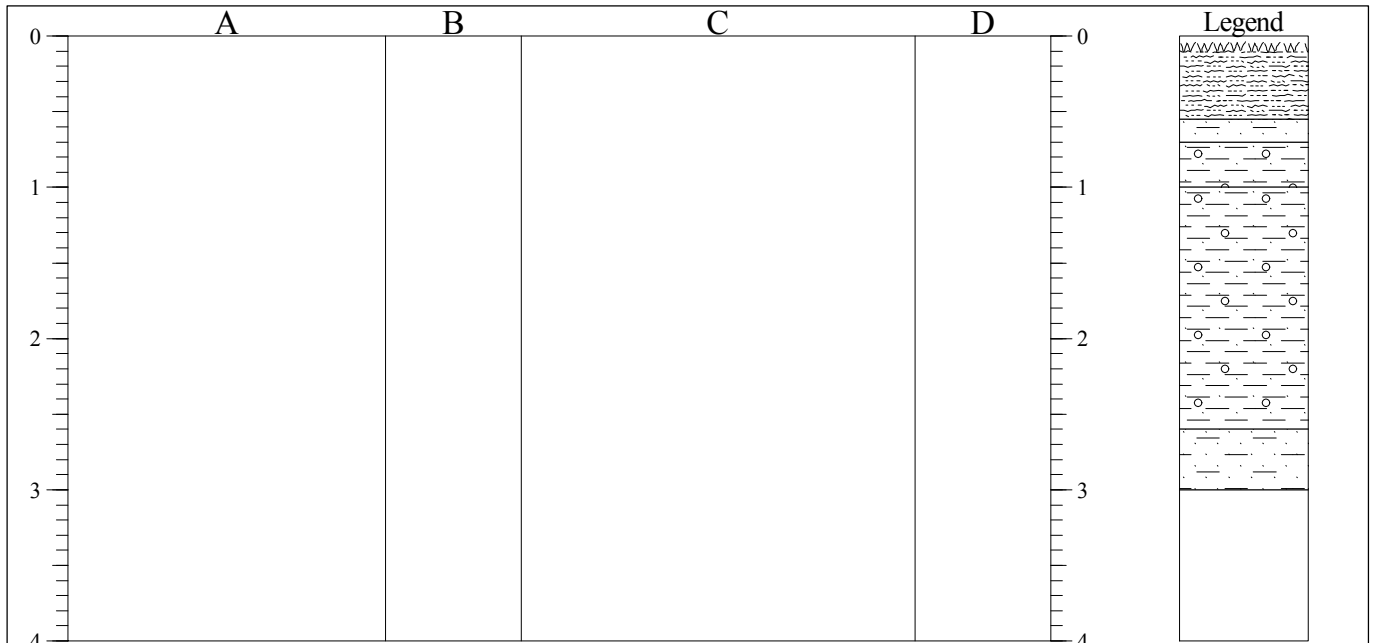
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.50		TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets.	0.60	ES	
0.50-0.80		Loose to medium dark reddish brown fine to medium SAND. Rare medium subangular gravel.			
0.80-1.10		Loose to medium brown fine to medium SAND. Rare medium subangular gravel.			
1.10-1.80		Stiff reddish brown with frequent grey mottling sandy gravelly CLAY. Occasional sand pockets and cobbles. Gravels and cobbles are medium subrounded to subangular.			
1.80-3.00		Loose to medium yellowish brown slightly clayey gravelly fine to medium SAND. Occasional light brown sand pockets.			
3.00-3.10		Weak fine grained yellowish brown SANDSTONE recovered as SAND & GRAVEL.			

Shoring/Support: Stability: Stable.				GENERAL REMARKS	
				Dry.	

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

Project Foxs Lane, Whiston				TRIAL PIT No TP5
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.55		TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets.				
0.55-0.70		Loose to medium dark reddish brown slightly clayey fine to medium SAND. Rare medium subangular gravel. Firm to stiff brown with frequent grey mottling slightly gravelly sandy to very sandy CLAY. Occasional orangish brown sand pocket. Rare cobble. Gravels and cobbles are medium subrounded to subangular. Dark reddish brown/brown with rare grey mottling slightly gravelly slightly sandy CLAY.				
0.70-1.00						
1.00-2.60						
2.60-3.00		Loose to medium orangish brown slightly clayey fine to medium SAND.				

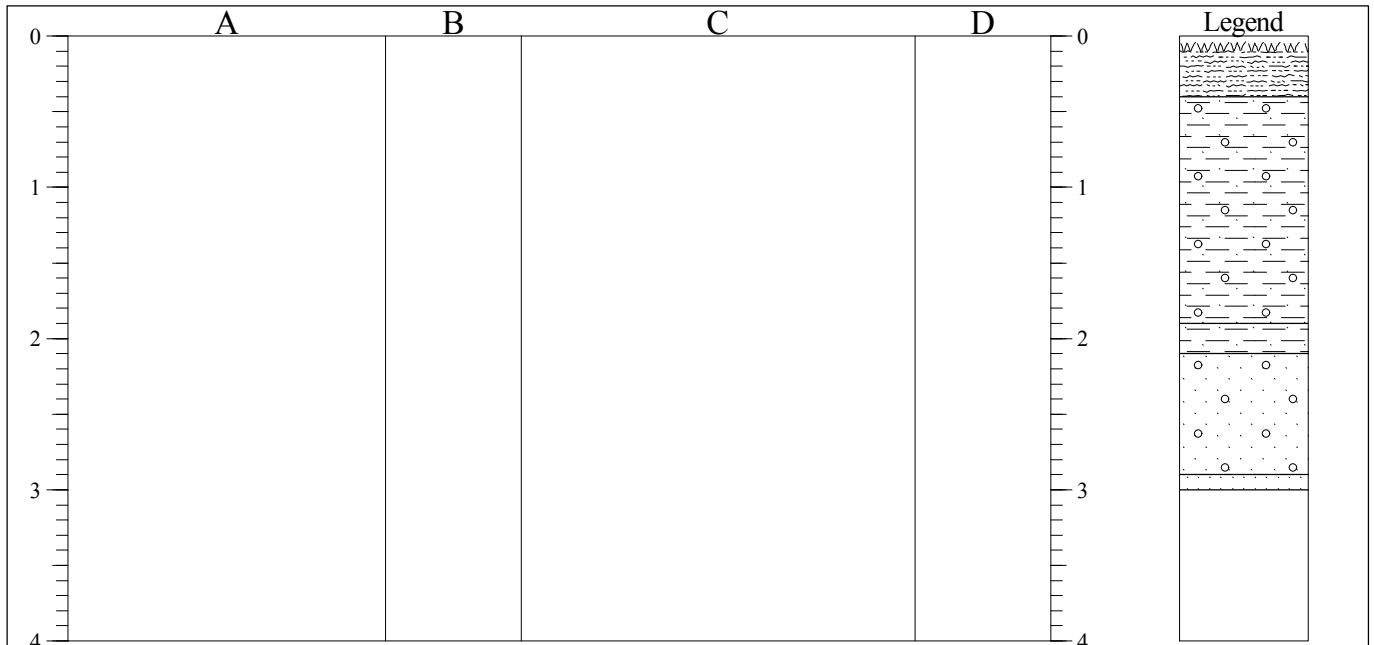
Shoring/Support: Stability: Stable.		GENERAL REMARKS	
Diagram of a rectangular trial pit. The top horizontal dimension is labeled 'A' with a dimension line above it showing a length of 3. The bottom horizontal dimension is labeled 'C' with a dimension line below it. The right vertical dimension is labeled 'B' with a dimension line to its right showing a height of 0.6. The left vertical corner is labeled 'D'. A north arrow points upwards from the center of the diagram.		Dry.	

All dimensions in metres Scale 1:50	Client Taylor Wimpey	Method/ Plant Used JCB 3CX	Logged By JS
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AGS3 UK TP 18TAY042 - FOXS LANE, WHISTON.GPJ GINT STD AGS 3.1.GDT 24/9/18

TRIAL PIT LOG

Project Foxs Lane, Whiston				TRIAL PIT No TP6
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



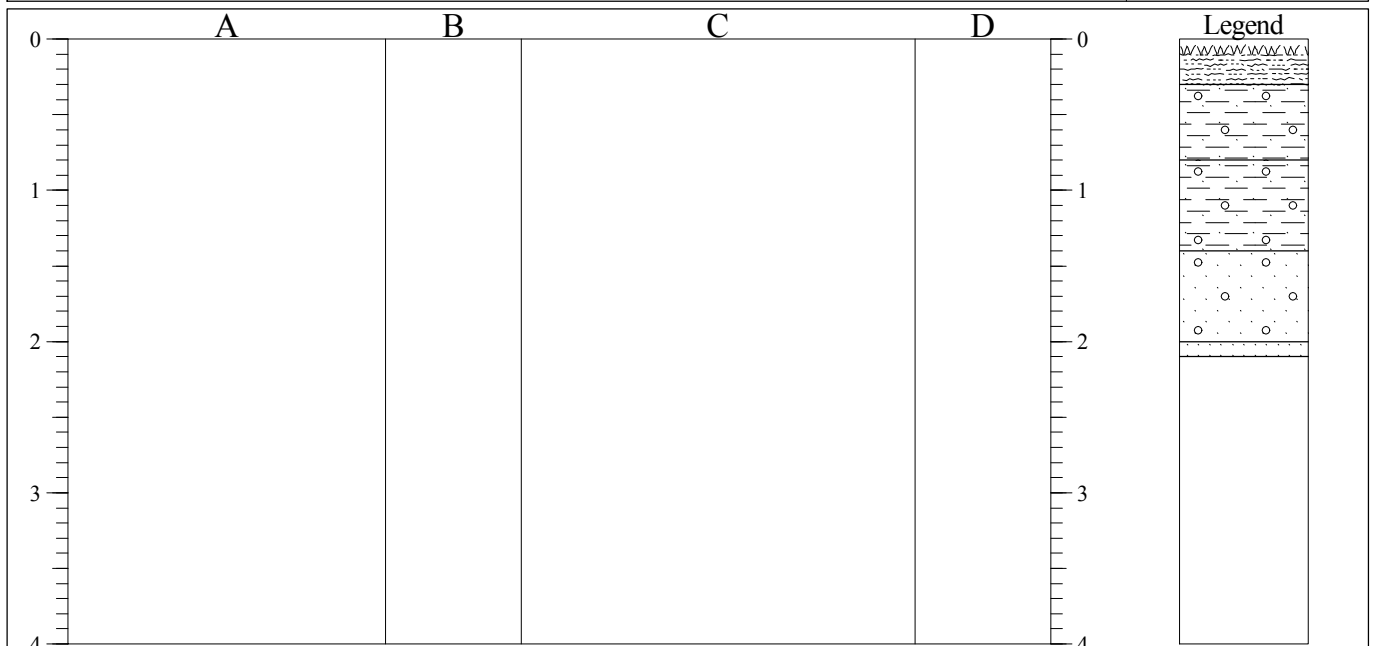
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.40		TOPSOIL: Blackish brown clayey fine to medium SAND. Frequent twigs and rootlets.	0.35	ES	
0.40-1.90		Firm to stiff brown/reddish brown with occasional grey and orangish brown mottling slightly gravelly sandy CLAY. Occasionally very sandy. Frequent sand pockets. Gravels and cobbles are medium subrounded to subangular.			
1.90-2.10		Firm brown sandy CLAY.	1.70	D	
2.10-2.90		Loose to medium orangish brown/pale yellow slightly gravelly fine to medium SAND. Rare medium subrounded to subangular gravel. Rare pale brown pockets.			
2.90-3.00		Weak fine grained orangish brown SANDSTONE recovered as SAND & GRAVEL.			

Shoring/Support: Stability: Stable.		GENERAL REMARKS

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

Project Foxs Lane, Whiston				TRIAL PIT No TP7
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



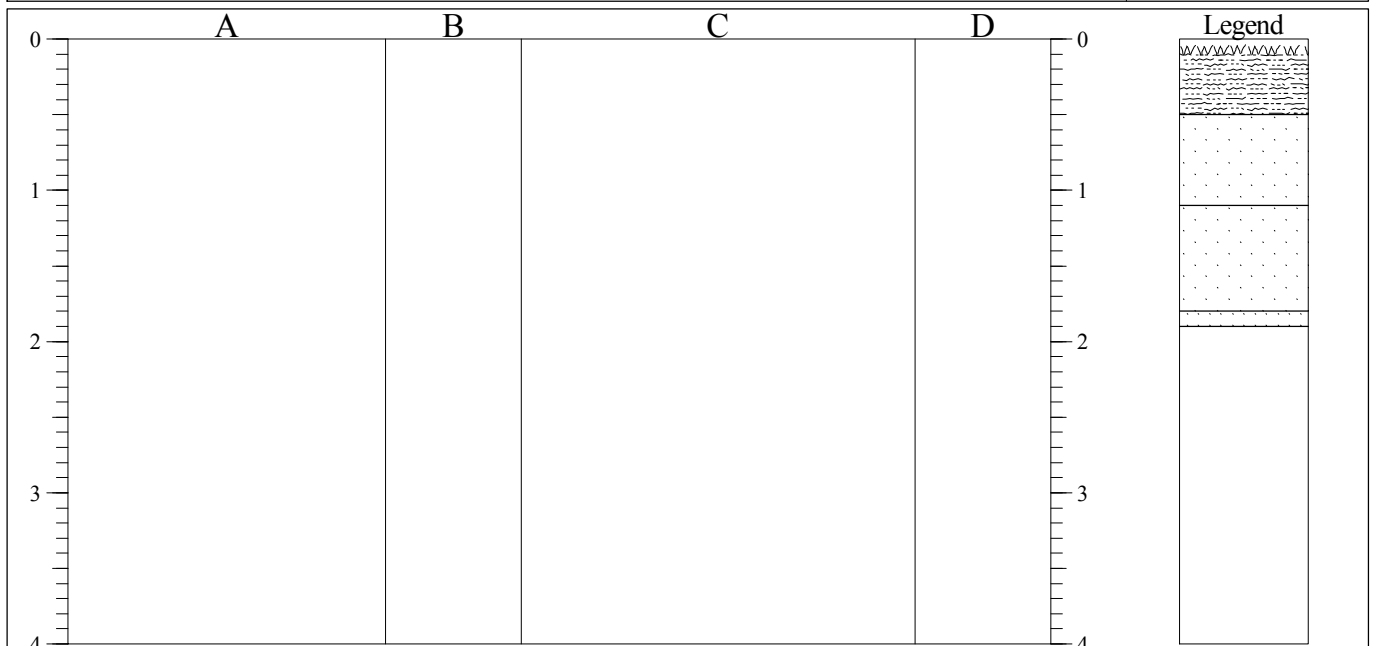
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		TOPSOIL: Blackish brown clayey fine to medium SAND. Frequent twigs and rootlets.	0.60	ES	
0.30-0.80		Loose to medium reddish brown slightly gravelly very clayey fine to medium SAND. Occasional clay pockets. 0.60 Clay land drain - dry.			
0.80-1.40		Firm brown/reddish brown with occasional grey mottling slightly gravelly sandy CLAY. Frequent sand pockets. Gravels are medium subrounded to subangular.			
1.40-2.00		Loose to medium yellowish brown/pale yellow slightly gravelly fine to medium SAND. Gravel is medium subrounded to subangular.			
2.00-2.10		Weak fine grained yellowish brown SANDSTONE recovered as SAND & GRAVEL.			

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

Project Foxs Lane, Whiston				TRIAL PIT No TP8
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



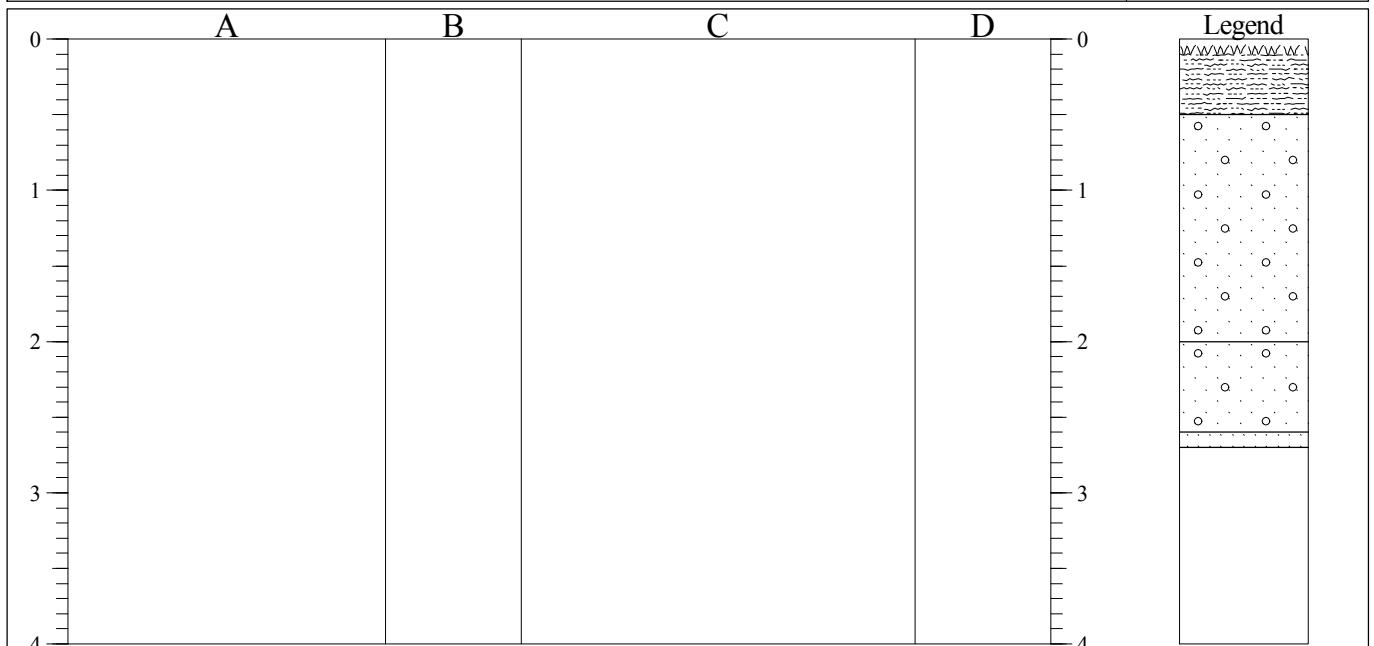
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.50		TOPSOIL: Blackish brown clayey fine to medium SAND. Frequent rootlets.	0.20	ES	
0.50-1.10		Loose to medium light brown fine to medium SAND.			
1.10-1.80		Medium dense reddish brown fine to medium SAND.			
1.80-1.90		Weak fine grained reddish brown SANDSTONE recovered as SAND & GRAVEL.			

Shoring/Support: Stability: Stable.	GENERAL REMARKS Dry.

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

Project Foxs Lane, Whiston				TRIAL PIT No TP9
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



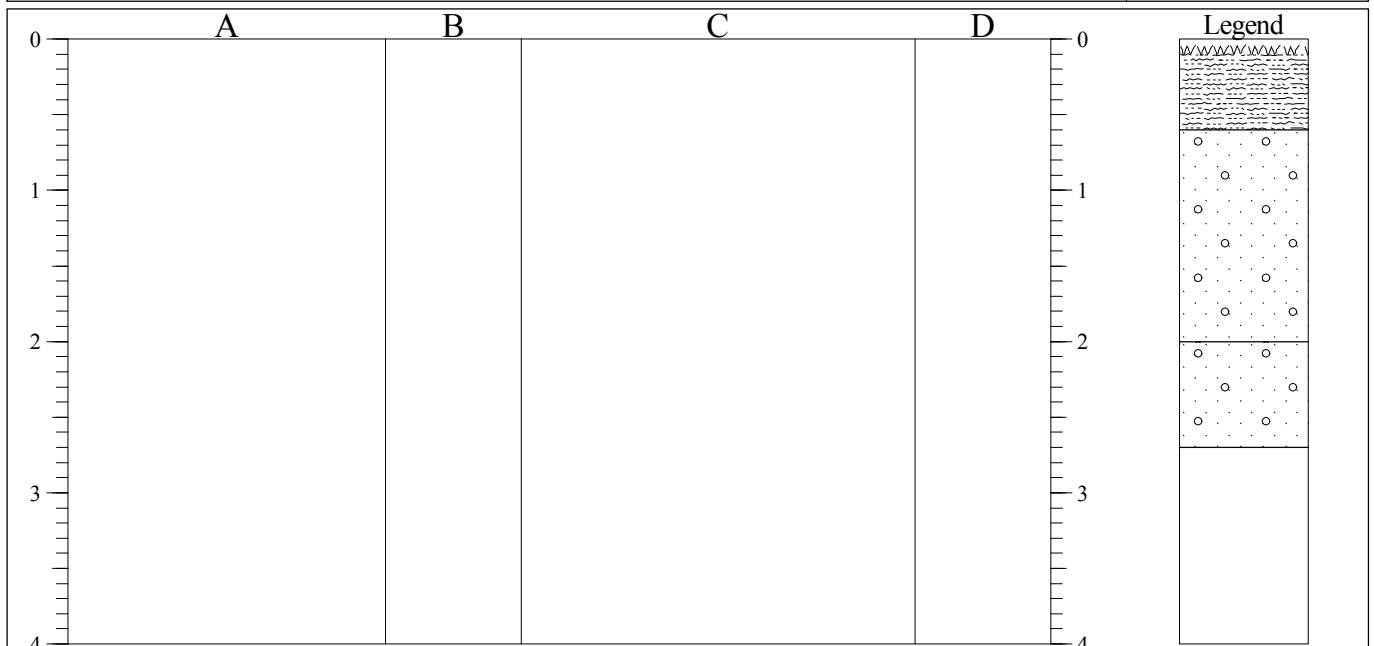
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.50		TOPSOIL: Blackish brown clayey fine to medium SAND. Frequent rootlets.	0.55	ES	
0.50-2.00		Loose to medium reddish brown slightly gravelly fine to medium SAND. Gravel is medium subangular of sandstone.			
2.00-2.60		Medium dense yellowish brown very gravelly fine to medium SAND. Gravel is medium subangular of sandstone.			
2.60-2.70		Weak fine grained reddish brown SANDSTONE recovered as SAND & GRAVEL.			

Shoring/Support: Stability: Stable.				GENERAL REMARKS	
				Dry.	

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

Project Foxs Lane, Whiston				TRIAL PIT No TP10
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



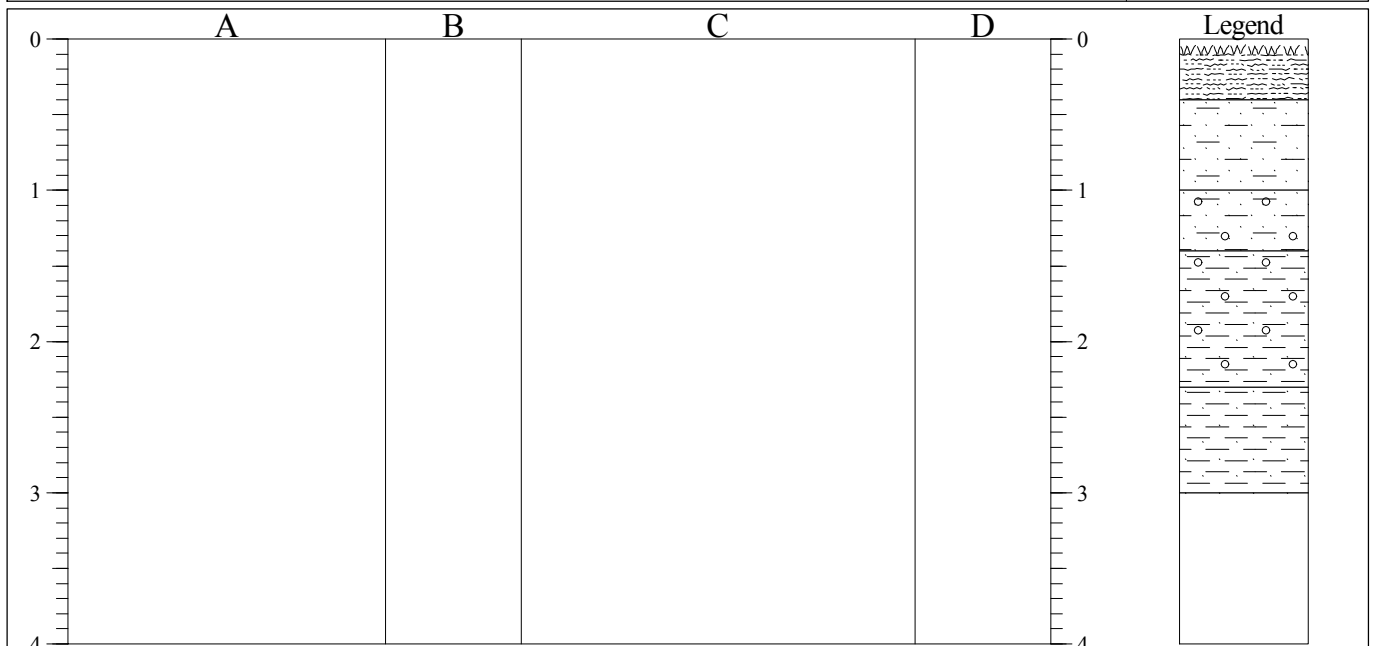
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.60		TOPSOIL: Blackish brown clayey fine to medium SAND. Frequent rootlets.				
0.60-2.00		Loose to medium reddish brown/dark brown gravelly fine to medium SAND. Gravel is medium subangular of sandstone. Rare cobble.				
2.00-2.70		Medium dense orangish/yellowish brown very gravelly fine to medium SAND. Gravel is medium subangular of sandstone.				

Shoring/Support: Stability: Stable. 	GENERAL REMARKS
	Dry.

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

Project Foxs Lane, Whiston				TRIAL PIT No TP11
Job No 18TAY042	Date 19-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



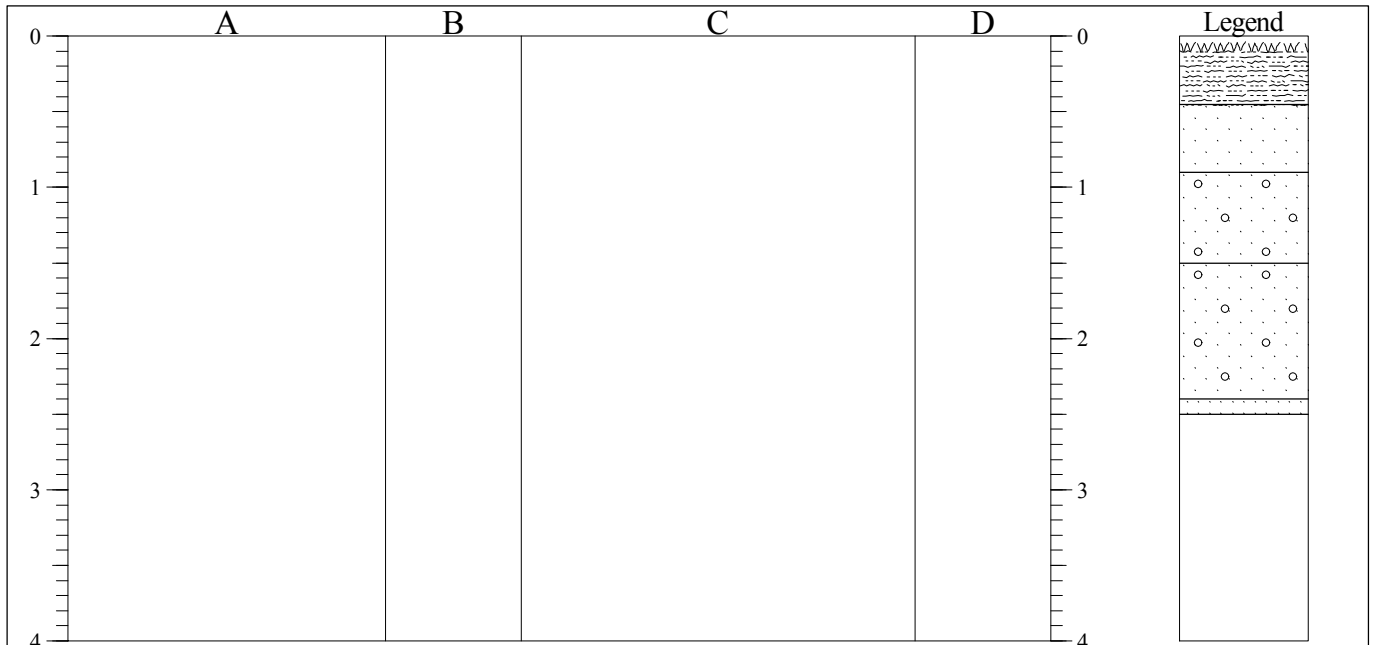
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.40		TOPSOIL: Blackish brown clayey fine to medium SAND. Frequent rootlets.	0.15	ES	
0.40-1.00		Loose to medium dark brown slightly clayey gravelly fine to medium SAND.			
1.00-1.40		Medium dense brown slightly clayey gravelly fine to medium SAND. Rare clay pockets and cobbles. Gravel and cobbles are medium subangular of sandstone.			
1.40-2.30		Firm dark brown occasionally reddish brown slightly gravelly very sandy CLAY. Frequent sand pockets.			
2.30-3.00		Firm reddish brown very sandy CLAY/very clayey SAND.			

Shoring/Support: Stability: Stable.		GENERAL REMARKS	
The diagram shows a rectangular trial pit layout. The top horizontal dimension is labeled '3'. The right vertical dimension is labeled '0.6'. The bottom horizontal dimension is labeled '0.6'. The corners are labeled A (top), B (right), C (bottom), and D (left). A north arrow points upwards.		Dry.	

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

Project Foxs Lane, Whiston				TRIAL PIT No TP12
Job No 18TAY042	Date 20-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



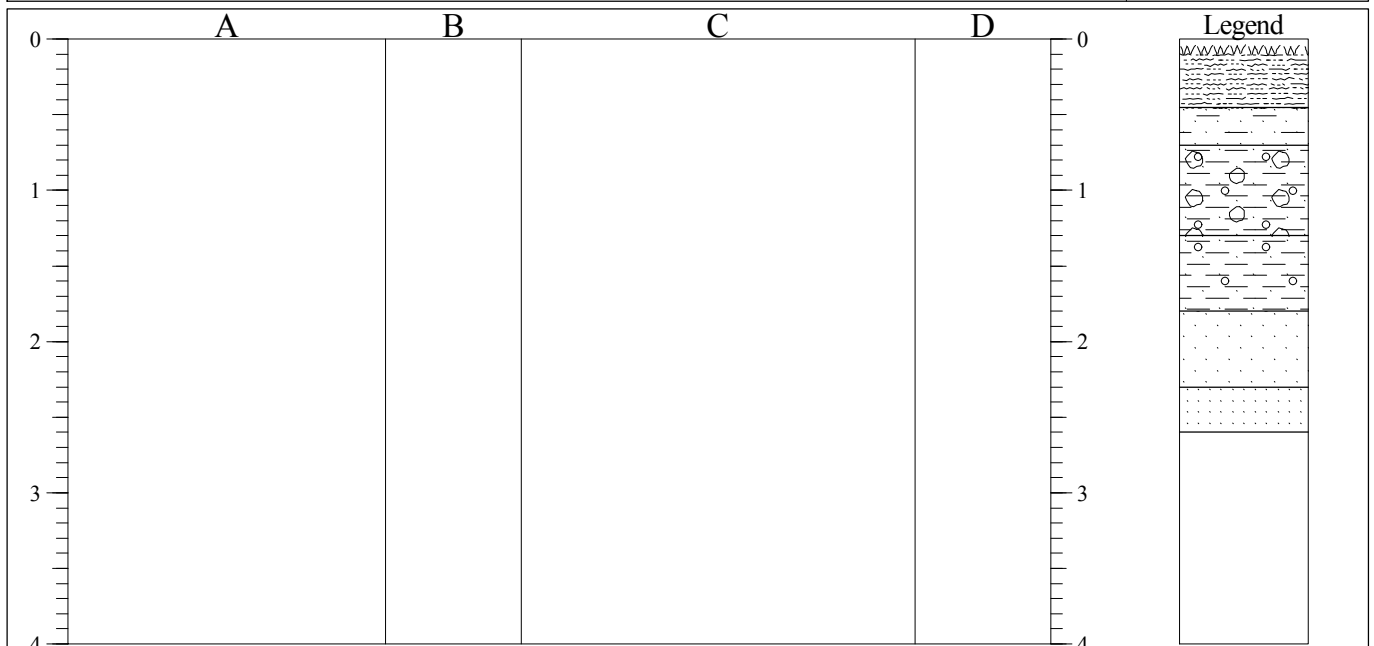
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.45		TOPSOIL: Blackish brown clayey fine to medium SAND. Frequent rootlets.	0.25	ES	
0.45-0.90		Loose to medium reddish brown fine to medium SAND.			
0.90-1.50		Medium dense orangish brown occasionally yellowish brown slightly gravelly fine to medium SAND. Gravel is medium subangular of sandstone.			
1.50-2.40		Medium dense light brown very gravelly fine to medium SAND. Gravel is medium subangular of sandstone.			
2.40-2.50		Weak brown fine grained SANDSTONE recovered as SAND & GRAVEL.			

Shoring/Support: Stability: Stable.		GENERAL REMARKS	
Diagram of a rectangular trial pit. The length is labeled 'A' with a dimension line above it showing '3'. The width is labeled 'B' with a dimension line to its right showing '0.6'. The corners are labeled 'D' (top-left), 'C' (bottom-right), and 'B' (bottom-right). A north arrow points upwards.		Dry.	

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

Project Foxs Lane, Whiston				TRIAL PIT No TP13
Job No 18TAY042	Date 20-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



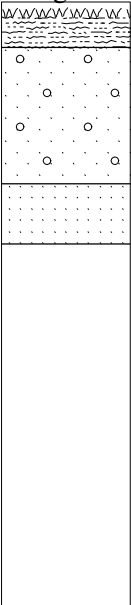
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.45		TOPSOIL/MADE GROUND: Blackish brown clayey fine to medium SAND. Frequent rootlets. Occasional brick and concrete cobble.	0.30	ES	
0.45-0.70		Loose to medium dark reddish brown clayey fine to medium SAND. Rare black pocket.			
0.70-1.30		Stiff reddish brown with occasional grey and orangish brown mottling cobbley sandy very gravelly CLAY.			
1.30-1.80		Stiff dark brown gravelly sandy CLAY. Occasional medium subangular gravel of coal.			
1.80-2.30		Medium dense yellowish brown fine to coarse SAND.			
2.30-2.60		Weak yellowish brown fine grained SANDSTONE recovered as SAND & GRAVEL.			

Shoring/Support: Stability: Stable.		GENERAL REMARKS	
The diagram shows a rectangular trial pit. The top horizontal edge is labeled 'A', the bottom horizontal edge is labeled 'C', the left vertical edge is labeled 'D', and the right vertical edge is labeled 'B'. Above the rectangle, a dimension line indicates a length of 3. To the right of the rectangle, a dimension line indicates a width of 0.6. To the right of the diagram, a north arrow points upwards, labeled 'N'.		Dry.	

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

Project Foxs Lane, Whiston				TRIAL PIT No TP14
Job No 18TAY042	Date 20-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

0	A	B	C	D	0	Legend 
1					1	
2					2	
3					3	
4					4	

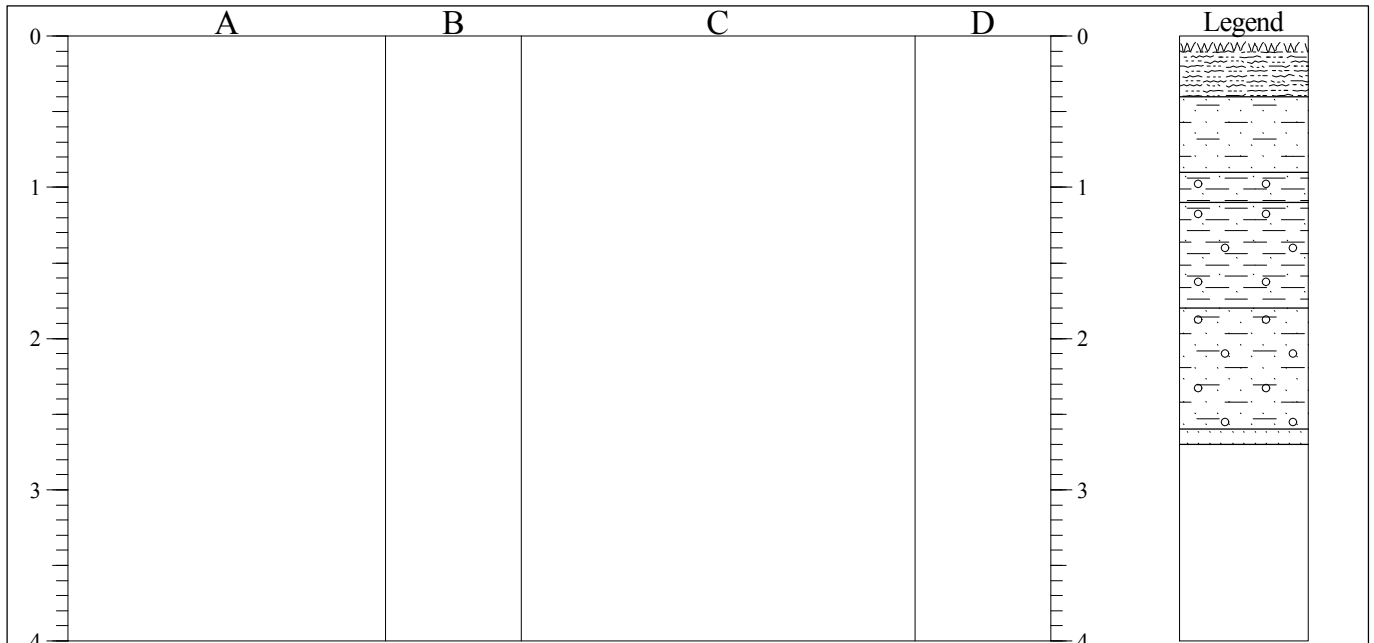
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		TOPSOIL: Blackish brown clayey fine to medium SAND. Frequent rootlets.			
0.30-1.20		Loose to medium reddish brown gravelly fine to medium SAND.			
1.20-1.60		Weak reddish brown fine grained SANDSTONE recovered as SAND & GRAVEL.			

Shoring/Support: Stability: Stable.		
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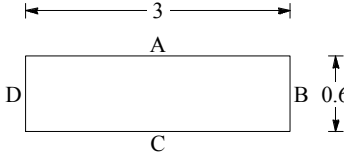
All dimensions in metres Scale 1:50	Client Taylor Wimpey	Method/ Plant Used JCB 3CX	Logged By JS
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TRIAL PIT LOG

Project Foxs Lane, Whiston				TRIAL PIT No TP15
Job No 18TAY042	Date 20-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.40		TOPSOIL: Blackish brown clayey fine to medium SAND. Frequent rootlets.				
0.40-0.90		Loose to medium brown slightly clayey fine to medium SAND. Occasional clay pockets.	0.65	ES		
0.90-1.10		Firm to stiff light brown slightly sandy gravelly CLAY. Occasional cobble.				
1.10-1.80		Stiff brown/reddish brown with occasional grey mottling gravelly sandy CLAY. Occasional sand pockets. Rare subangular gravel of coal.	1.70	D		
1.80-2.60		Loose to medium purplish/reddish brown slightly clayey gravelly fine to medium SAND.				
2.60-2.70		Weak reddish brown fine grained SANDSTONE recovered as SAND & GRAVEL.				

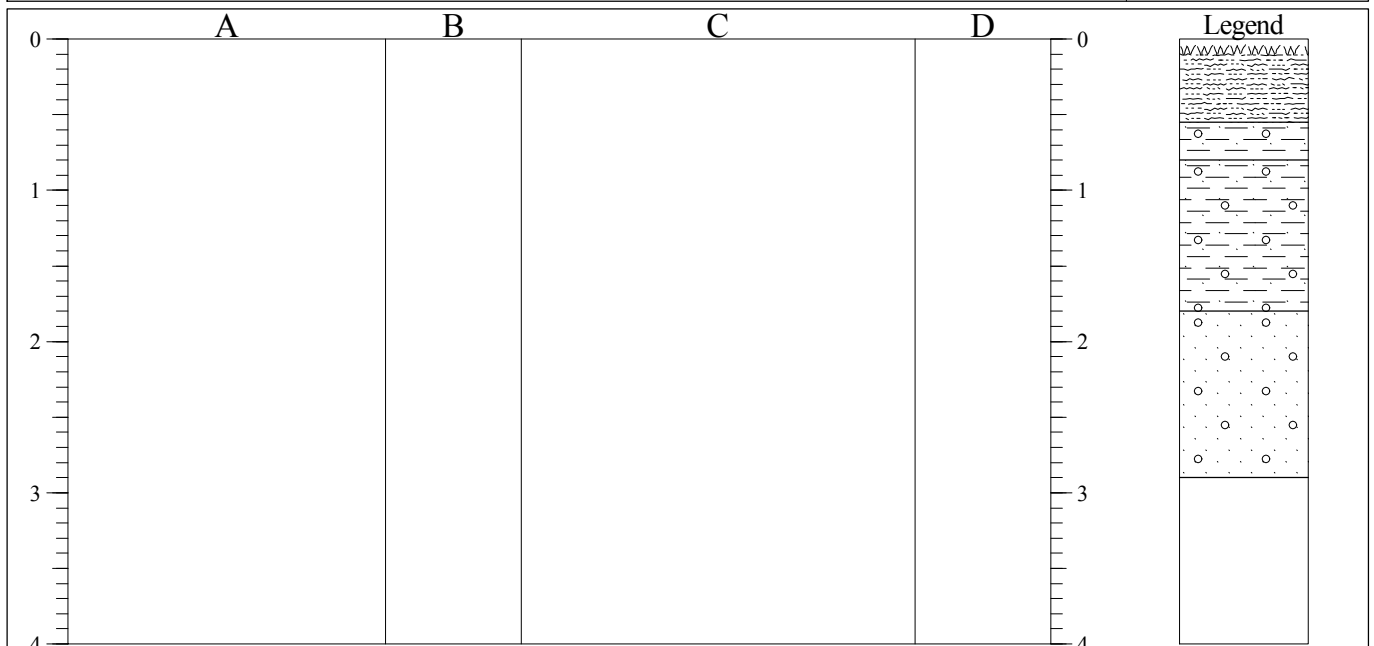
Shoring/Support: Stability: Stable.		GENERAL REMARKS	
 Diagram of a rectangular trial pit. The top horizontal edge is labeled 'A' with a dimension line above it indicating a length of 3. The bottom horizontal edge is labeled 'C'. The left vertical edge is labeled 'D' and the right vertical edge is labeled 'B'. To the right of the rectangle, a dimension line indicates a width of 0.6.		Dry.	

All dimensions in metres Scale 1:50	Client Taylor Wimpey	Method/ Plant Used JCB 3CX	Logged By JS
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AGS3 UK TP 18TAY042 - FOXS LANE, WHISTON.GPJ GINT STD AGS 3_1.GDT 24/9/18

TRIAL PIT LOG

Project Foxs Lane, Whiston				TRIAL PIT No TP16
Job No 18TAY042	Date 20-09-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.55		TOPSOIL: Blackish brown clayey fine to medium SAND. Frequent rootlets.			
0.55-0.80		Stiff greyish brown/reddish brown with frequent grey and occasional light brown mottling slightly gravelly sandy CLAY. Rare cobble. Gravel and cobbles are medium subrounded to subangular. Firm to stiff dark brown with rare grey mottling gravelly sandy CLAY. Rare cobble. Gravel and cobbles are medium subrounded to subangular. Rare gravel of coal.			
0.80-1.80					
1.80-2.90		Medium dense light reddish brown slightly gravelly fine to medium SAND. Gravel is subangular sandstone.			

Shoring/Support: Stability: Stable.		
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All dimensions in metres Scale 1:50	Client Taylor Wimpey	Method/ Plant Used JCB 3CX	Logged By JS
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BOREHOLE LOG

Project Foxs Lane, Whiston				BOREHOLE No WS1	
Job No 18TAY042	Date 21-09-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
1.90	D					(0.40) 0.40	TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets.		
						(1.10) 1.50	Stiff brown with frequent grey and orange mottling slightly sandy CLAY. Rare gravel.		
						1.60	Loose to medium brown/light brown slightly clayey fine to medium SAND.		
						(0.80) 2.40	Stiff reddish brown sandy CLAY.		
						2.55	Loose to medium reddish brown fine to medium SAND.		
						(0.45) 3.00	2.40 - 2.55 Damp. Firm brown very sandy CLAY. Frequent sand pockets. 2.55 - 3.00 Wet.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Damp between 2.40mbgl - 2.55mbgl and wet between 2.55mbgl - 3.00mbgl.
All dimensions in metres Scale 1:50			Client Taylor Wimpey			Method/ Plant Used Competitor Rig			Logged By JS		

AGS3 UK BH 18TAY042 - FOXS LANE, WHISTON GPJ GINT STD AGS 3.1 GDT 24/9/18

BOREHOLE LOG

Project Foxs Lane, Whiston				BOREHOLE No WS2	
Job No 18TAY042	Date 21-09-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
1.50	D					(0.45) 0.45	TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets.		
						(1.45)	Firm to stiff brown/reddish brown slighty gravelly very sandy CLAY. Interbedded sand bands. Rare gravel.		
						1.90 2.00	Loose to medium brown coarse SAND.		
						(1.00) 3.00	Stiff dark brown slighty gravelly slightly sandy CLAY. Rare subangular gravel of coal.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry.
All dimensions in metres Scale 1:50						Client Taylor Wimpey		Method/ Plant Used Competitor Rig		Logged By JS	

AGS3 UK BH 18TAY042 - FOXS LANE, WHISTON GPJ GINT STD AGS 3, 1 GDT 24/9/18

BOREHOLE LOG

Project Foxs Lane, Whiston				BOREHOLE No WS3	
Job No 18TAY042	Date 21-09-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

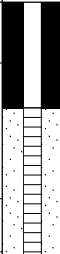
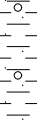
SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						(0.40) 0.40	TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets.		
						(0.45) 0.85	Stiff dark brown slighty gravelly slightly sandy CLAY. Rare subangular gravel of coal.		
						0.95	Loose to medium yellowish brown fine to medium SAND.		
						1.00	Weak yellowish brown fine grained SANDSTONE recovered as SAND & GRAVEL.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry. Hole terminated at 1.00mbgl due to refusal on weak SANDSTONE.
All dimensions in metres Scale 1:50			Client Taylor Wimpey			Method/ Plant Used Competitor Rig			Logged By JS		

AGS3 UK BH 18TAY042 - FOXS LANE, WHISTON GPJ GINT STD AGS 3, 1 GDT 24/9/18

BOREHOLE LOG

Project Foxs Lane, Whiston				BOREHOLE No WS4	
Job No 18TAY042	Date 21-09-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

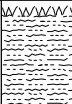
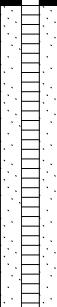
SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.50	ES					(0.40) 0.40	TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets.		
						(0.90) 1.30	Stiff brown occasionally orangish brown with rare grey mottling slightly gravelly slightly sandy CLAY. Rare subangular gravel of coal.		
						1.65	Loose to medium yellowish brown fine to medium SAND.		
						1.70	Weak yellowish brown fine grained SANDSTONE recovered as SAND & GRAVEL.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry. Hole terminated at 1.70mbgl due to refusal on weak SANDSTONE.
All dimensions in metres Scale 1:50			Client Taylor Wimpey			Method/ Plant Used Competitor Rig			Logged By JS		

AGS3 UK BH 18TAY042 - FOXS LANE, WHISTON GPJ GINT STD AGS 3, 1 GDT 24/9/18

BOREHOLE LOG

Project Foxs Lane, Whiston				BOREHOLE No WS5	
Job No 18TAY042	Date 21-09-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)	DESCRIPTION		
0.30	ES					(0.70) 0.70	TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets. Occasional sandstone cobble.		
						(0.40) 1.10	Stiff greyish brown with rare grey and orange mottling slighty gravelly slightly sandy CLAY.		
						1.30	Loose to medium reddish brown slightly clayey fine to medium SAND.		
						(1.70) 3.00	Stiff brown slightly sandy to sandy CLAY. Occasional sand pockets.		
									

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Damp between 1.30mbgl - 3.00mbgl.
All dimensions in metres Scale 1:50			Client Taylor Wimpey			Method/ Plant Used Competitor Rig			Logged By JS		

AGS3 UK BH 18TAY042 - FOXS LANE, WHISTON GPJ GINT STD AGS 3, 1 GDT 24/9/18

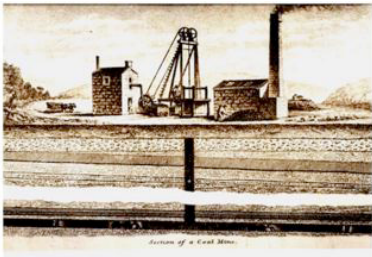
BOREHOLE LOG

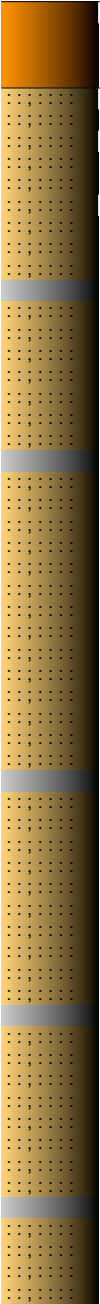
Project Foxs Lane, Whiston				BOREHOLE No WS6	
Job No 18TAY042	Date 21-09-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.45	ES					(0.40) 0.40	TOPSOIL: Blackish brown clayey fine to medium SAND. Occasional rootlets. Occasional sandstone cobble.		
						0.70	Loose to medium reddish brown slightly clayey fine to medium SAND. Rare subangular to subrounded gravel. Occasional clay pockets.		
						(0.70) 1.40	Loose to medium bright orange slightly gravelly fine to medium SAND.		
						1.55 1.60	Loose to medium yellowish brown slightly gravelly medium to coarse SAND.		
							Weak yellowish brown fine grained SANDSTONE recoeved as SAND & GRAVEL.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry. Hole terminated at 1.60mbgl due to refusal on weak SANDSTONE.
All dimensions in metres Scale 1:50			Client Taylor Wimpey			Method/ Plant Used Competitor Rig			Logged By JS		

AGS3 UK BH 18TAY042 - FOXS LANE, WHISTON GPJ GINT STD AGS 3, 1 GDT 24/9/18



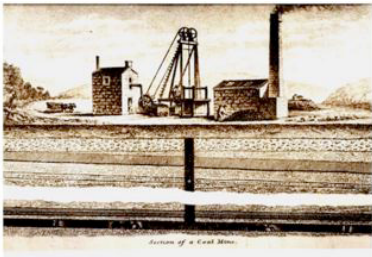
REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	9 Oct 2018
Bh 1	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT	INTERPRETATION
					N value	
0.0	0.0	clay		brown, sandy, firm		ground level
0.5						
1.0						
1.5						rockhead
2.0	1.8	sandstone		yellow, firm drilling		
2.5				occasional grey marl layers		
3.0						
3.5						Lower Mottled Sandstone
4.0						
4.5						
5.0						
5.5						
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						
10.5						
11.0						
11.5						
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						
20.0						
20.5						
21.0						
21.5						
22.0						
22.5						
23.0						
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

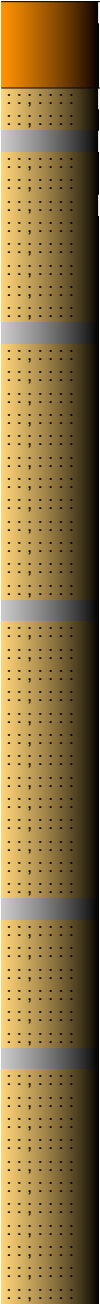
IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0



drilled and logged by
Neil Catlow B.Sc FGS



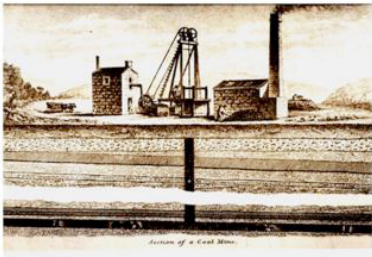
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Bh	2	CLIENT	Betts Geo-environmental		SCALE	1:200
		TITLE			GL AOD	n/a
		ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow		ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT	INTERPRETATION
					N value	
	0.0	clay		brown, sandy, firm		ground level
	0.5					
	1.0					
	1.5					rockhead
	2.0	sandstone		yellow, firm drilling		
	2.5			occasional grey marl layers		
	3.0					
	3.5					Lower Mottled Sandstone
	4.0					
	4.5					
	5.0					
	5.5					
	6.0					
	6.5					
	7.0					
	7.5					
	8.0					
	8.5					
	9.0					
	9.5					
	10.0					
	10.5					
	11.0					
	11.5					
	12.0					
	12.5					
	13.0					
	13.5					
	14.0					
	14.5					
	15.0					
	15.5					
	16.0					
	16.5					
	17.0					
	17.5					
	18.0					
	18.5					
	19.0					
	19.5					
	20.0					
	20.5					
	21.0					
	21.5					
	22.0					
	22.5					
	23.0					
	23.5					
	24.0					
	24.5					
	25.0					
	25.5					
	26.0					
	26.5					
	27.0					
	27.5					
	28.0					
	28.5					
	29.0					
	29.5					
	30.0			bottom of hole		

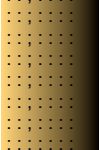
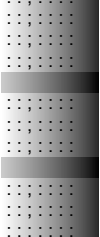
IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0



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REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	10 Oct 2018
Bh 3	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm	not taken	ground level
0.5						
1.0						
1.5						rockhead
2.0	2.0	shale		dark grey, firm drilling		
2.5						
3.0						
3.5	3.4	coal		black, firm drilling		Discovery Mine
4.0						
4.5	4.5	shale		black, firm drilling		
5.0						
5.5	5.4	sandstone		brown, firm drilling		
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						
10.5	10.3	shale		dark grey, firm drilling		
11.0						
11.5	11.6	sandstone		grey, hard drilling with grey shale layers		
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						
20.0						
20.5						
21.0	21.0	shale		black, firm drilling		
21.5						
22.0						
22.5						
23.0	23.0	shale		dark grey, firm drilling		
23.5						
24.0	24.1	shale		black, firm drilling		
24.5						
25.0						
25.5	25.6	coal		black, firm drilling		Yard Mine
26.0						
26.5						
27.0	27.0	shale		dark grey, firm drilling		
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

IN HOLE GAS TESTING

% O2

20.6

% CH4

0.0

% CO2

0.0

% LEL

0.0

ppm H2S

0.0

ppm CO

0.0

Nkc Geotech Ltd

25 Grosvenor Road

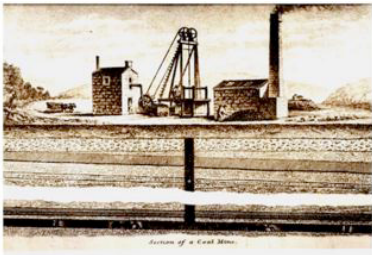
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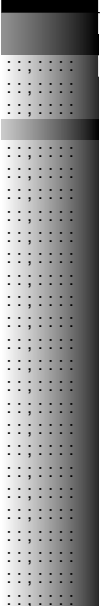
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REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	10 Oct 2018
Bh 4	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm	not taken	ground level
0.5						
1.0						
1.5						rockhead
2.0	2.0	shale		black, firm drilling		
2.5						
3.0						
3.5	3.4	coal		black, firm drilling		Pasture Mine
4.0						
4.5	4.1	shale		black, firm drilling		
5.0						
5.5						
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5	9.5	coal		black, firm drilling		Discovery Mine
10.0						
10.5	10.6	shale		dark grey, firm drilling		
11.0						
11.5	11.4	sandstone		grey, hard drilling with grey shale layers		
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						
20.0						
20.5						
21.0						
21.5						
22.0						
22.5						
23.0						
23.5						
24.0						
24.5	24.3	shale		dark grey, firm drilling with black shale layers		
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0

Nkc Geotech Ltd

25 Grosvenor Road

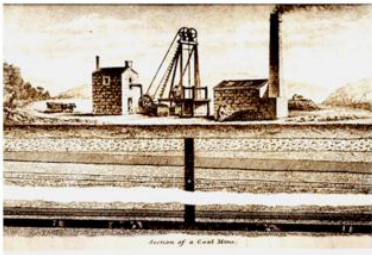
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REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	10 Oct 2018
Bh 5	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm	not taken	ground level
0.5						
1.0						
1.5						
2.0	2.0	sandstone		brown, firm drilling		
2.5						
3.0						
3.5						
4.0						
4.5	4.5	mudstone		grey, firm drilling		
5.0				thin grey shale layers		
5.5						
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5	9.6	shale		black, firm drilling		
10.0						
10.5						
11.0	11.0	coal		black, firm drilling, in thin layers		Pasture Mine
11.5						
12.0	12.1	shale		dark grey, firm drilling		
12.5						
13.0						
13.5	13.3	shale		black, firm drilling		
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5	17.3	coal		black, firm drilling		Discovery Mine
18.0						
18.5	18.2	shale		black, firm drilling		
19.0						
19.5						
20.0	21.1	mudstone		grey, firm drilling		
20.5				with sandstone layers		
21.0						
21.5						
22.0						
22.5						
23.0						
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

IN HOLE GAS TESTING

% O2

20.6

% CH4

0.0

% CO2

0.0

% LEL

0.0

ppm H2S

0.0

ppm CO

0.0

Nkc Geotech Ltd

25 Grosvenor Road

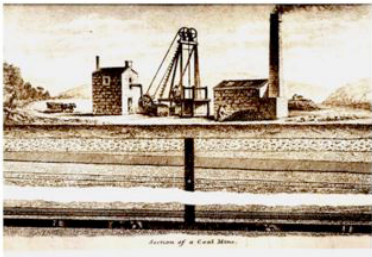
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Bh 6

REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	11 Oct 2018
Bh 6	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm	not taken	ground level
0.5						
1.0						
1.5						rockhead
2.0	2.0	shale		dark grey, firm drilling		
2.5						
3.0						
3.5						
4.0						
4.5	4.0	coal		black, firm drilling		Felcroft Mine
5.0						
5.5	5.2	shale		dark grey, firm drilling		
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						
10.5						
11.0						
11.5						
12.0	11.8	sandstone		grey, hard drilling		
12.5						
13.0						
13.5						
14.0						
14.5	14.3	shale		grey, firm drilling		
15.0						
15.5						
16.0						
16.5						
17.0	17.0	shale		black, firm drilling		
17.5						
18.0						
18.5						
19.0						
19.5	19.3	coal		black, firm drilling		Pasture Mine
20.0						
20.5	20.6	shale		black, firm drilling		
21.0						
21.5						
22.0						
22.5						
23.0						
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						
26.5	26.5	shale		dark grey, firm drilling		
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

IN HOLE GAS TESTING

% O2

20.6

% CH4

0.0

% CO2

0.0

% LEL

0.0

ppm H2S

0.0

ppm CO

0.0

Nkc Geotech Ltd

25 Grosvenor Road

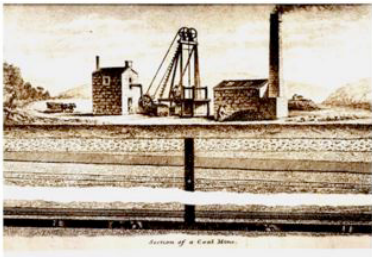
Wrexham

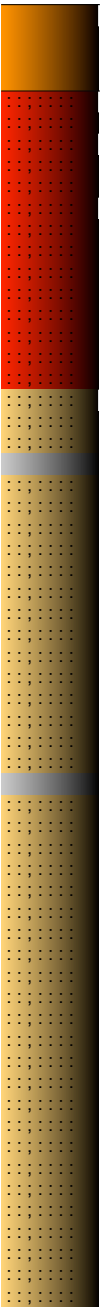
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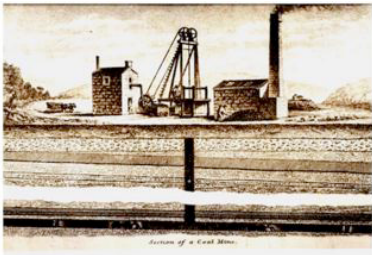
REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	11 Oct 2018
Bh 7	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
	0.0	clay		brown, sandy, firm		ground level
0.5						
1.0						
1.5						rockhead
2.0	1.8	sandstone		red, firm drilling		
2.5						
3.0						
3.5						Lower Mottled Sandstone
4.0						
4.5						
5.0						
5.5						
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0	9.2	sandstone		yellow, firm drilling occasional grey marl layers		
9.5						
10.0						
10.5						
11.0						
11.5						
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
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21.0						
21.5						
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22.5						
23.0						
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

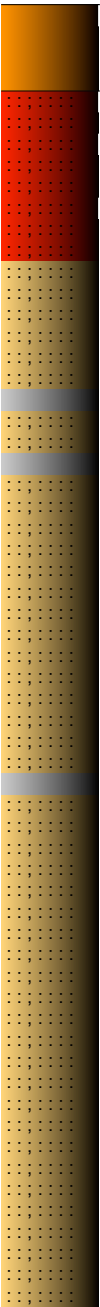
IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0



drilled and logged by
Neil Catlow B.Sc FGS



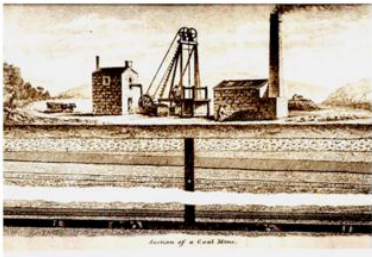
REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	11 Oct 2018
Bh 8	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm		ground level
0.5						
1.0						
1.5						rockhead
2.0	1.8	sandstone		red, firm drilling		
2.5						
3.0						
3.5						Lower Mottled Sandstone
4.0						
4.5						
5.0						
5.5						
6.0	6.1	sandstone		yellow, firm drilling		
6.5				occasional grey marl layers		
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						
10.5						
11.0						
11.5						
12.0						
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24.5						
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0



drilled and logged by
Neil Catlow B.Sc FGS

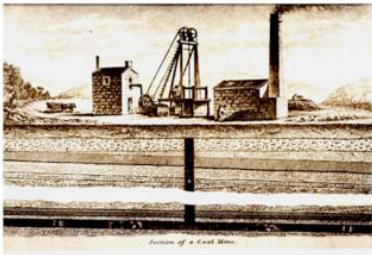


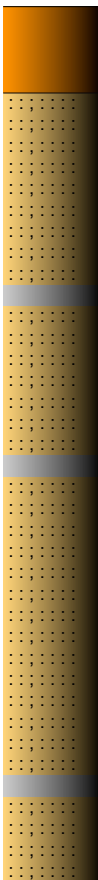
REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	11 Oct 2018
Bh 9	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm	not taken	ground level
0.5						
1.0						rockhead
1.5	1.5	sandstone		red, firm drilling		Lower Mottled Sandstone
2.0						
2.5						Eccleston East Fault
3.0						
3.5						
4.0	4.0	shale		dark grey, firm drilling		Coal Measures
4.5						
5.0						
5.5						
6.0	6.1	shale		black, firm drilling		
6.5						
7.0						
7.5						
8.0	7.8	coal		black, firm drilling		Felcroft Mine
8.5						
9.0	8.8	mudstone		grey, firm drilling		
9.5						
10.0						
10.5						
11.0	11.0	shale		black, firm drilling		
11.5						
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0	15.2	coal		black, firm drilling		Pasture Mine
19.5						
20.0	20.2	shale		dark grey, firm drilling		
20.5						
21.0						
21.5						
22.0						
22.5						
23.0						
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0

drilled and logged by
Neil Catlow B.Sc FGS



REF 1825	SITE	Fox's Bank Lane, Whiston		PRINTOUT	12 Oct 2018		
Bh 10	CLIENT	Betts Geo-environmental		SCALE	1:200		
	TITLE			GL AOD	n/a		
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow		ORIENTATION	vertical		
				FLUSH	water		
				BIT	75mm T/C		
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION	
0.0	0.0	clay		brown, sandy, firm		ground level	
0.5							
1.0							
1.5							rockhead
2.0	1.8	sandstone			yellow, firm drilling		
2.5					occasional grey marl layers		
3.0							
3.5							Lower Mottled Sandstone
4.0							
4.5							
5.0							
5.5							
6.0							
6.5							
7.0							
7.5							
8.0							
8.5							
9.0							
9.5							
10.0							
10.5							
11.0							
11.5							
12.0							
12.5							
13.0							
13.5							
14.0							
14.5							
15.0							
15.5							
16.0							
16.5							
17.0							
17.5							
18.0							
18.5							
19.0							
19.5							
20.0	20.0				bottom of hole		
20.5							
21.0							
21.5							
22.0							
22.5							
23.0							
23.5							
24.0							
24.5							
25.0							
25.5							
26.0							
26.5							
27.0							
27.5							
28.0							
28.5							
29.0							
29.5							
30.0							

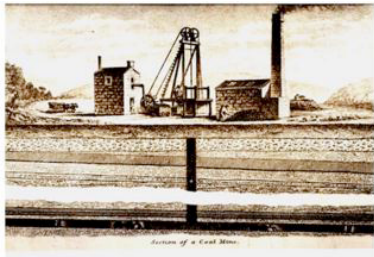
IN HOLE GAS TESTING

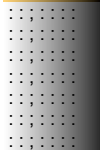


drilled and logged by
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IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0



REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	12 Oct 2018
Bh 11	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm	not taken	ground level
0.5						
1.0						
1.5						rockhead
2.0	1.8	shale		black, firm drilling		
2.5						
3.0						
3.5						
4.0						
4.5						
5.0	5.2	sandstone		brown, firm drilling		
5.5						
6.0						
6.5						
7.0						
7.5	7.6	sandstone		grey, hard drilling		
8.0						
8.5						
9.0						
9.5						
10.0						
10.5						
11.0	11.1	shale		grey, firm drilling		
11.5						
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5	18.6	shale		black, firm drilling		
19.0						
19.5						
20.0						
20.5						
21.0	21.0	coal		black, firm drilling		Yard Mine
21.5						
22.0						
22.5	22.1	shale		black, firm drilling		
23.0						
23.5	23.6	shale		dark grey, firm drilling		
24.0						
24.5						
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

IN HOLE GAS TESTING

% O2

20.6

% CH4

0.0

% CO2

0.0

% LEL

0.0

ppm H2S

0.0

ppm CO

0.0

Nkc Geotech Ltd

25 Grosvenor Road

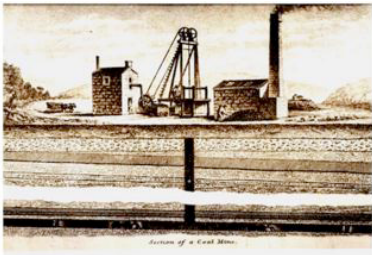
Wrexham

LL11 1BT

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drilled and logged by
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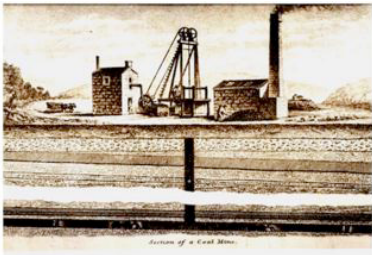


REF	1825	SITE	Fox's Bank Lane, Whiston		PRINTOUT	12 Oct 2018
Bh	12	CLIENT	Betts Geo-environmental		SCALE	1:200
		TITLE			GL AOD	n/a
		ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow		ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm		ground level
0.5						
1.0						
1.5						rockhead
2.0	1.8	sandstone		yellow, firm drilling		
2.5				occasional grey marl layers		
3.0						
3.5						Lower Mottled Sandstone
4.0						
4.5						
5.0						
5.5						
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						
10.5						
11.0						
11.5						
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						
20.0	20.0			bottom of hole		
20.5						
21.0						
21.5						
22.0						
22.5						
23.0						
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0						

drilled and logged by
Neil Catlow B.Sc FGS

IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0



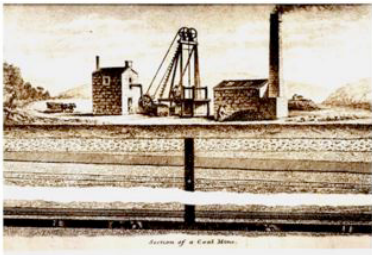
REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	12 Oct 2018
Bh 13	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm	not taken	ground level
0.5						
1.0						rockhead
1.5	1.8	sandstone		yellow, firm drilling		
2.0						Lower Mottled Sandstone
2.5						
3.0						Eccleston East Fault
3.5	3.6	shale		black, firm drilling		
4.0						
4.5						Coal Measures
5.0						
5.5						
6.0	6.2	sandstone		grey, hard drilling with grey shale layers		
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						
10.5						
11.0						
11.5	11.5	shale		dark grey, firm drilling		
12.0						
12.5						
13.0						
13.5	13.6	sandstone		grey, hard drilling with grey shale layers		
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						
20.0	20.0			bottom of hole		
20.5						
21.0						
21.5						
22.0						
22.5						
23.0						
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0						

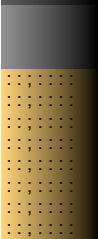


drilled and logged by
Neil Catlow B.Sc FGS

IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0



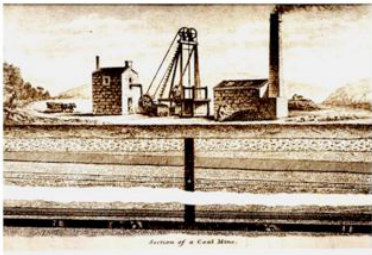
REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	15 Oct 2018
Bh 14	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm	not taken	ground level
0.5						
1.0						
1.5						rockhead
2.0	2.0	shale		black, firm drilling		
2.5						
3.0						
3.5						
4.0						
4.5						
5.0						
5.5						
6.0						
6.5	6.6	coal		black, firm drilling		Discovery Mine
7.0						
7.5						
8.0	7.8	shale		black, firm drilling		
8.5						
9.0						
9.5	9.4	shale		dark grey, firm drilling		
10.0						
10.5						
11.0	11.2	sandstone		brown, firm drilling with grey shjale layers		
11.5						
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						
15.0	15.0	mudstone		grey, firm drilling with grey sandstone layers		
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						
20.0						
20.5						
21.0						
21.5						
22.0						
22.5						
23.0						
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						
26.5						
27.0	27.0	shale		black, firm drilling		
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

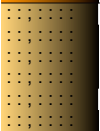
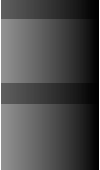
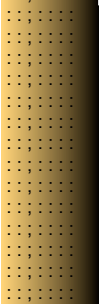
IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0



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REF 1825	SITE	Fox's Bank Lane, Whiston			PRINTOUT	15 Oct 2018
Bh 15	CLIENT	Betts Geo-environmental			SCALE	1:200
	TITLE				GL AOD	n/a
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow			ORIENTATION	vertical
					FLUSH	water
					BIT	75mm T/C
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm	not taken	ground level
0.5						
1.0	1.0	sandstone		brown, firm drilling		rockhead
1.5						
2.0						
2.5						
3.0						
3.5						
4.0	4.2	shale		dark grey, firm drilling		
4.5						
5.0						
5.5						
6.0						
6.5						
7.0						
7.5						
8.0	7.9	shale		black, firm drilling		
8.5						
9.0						
9.5	9.4	coal		black, firm drilling		Pasture Mine
10.0						
10.5	10.2	shale		dark grey, firm drilling with black shale layers		
11.0						
11.5						
12.0						
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
18.0						
18.5						
19.0						
19.5						
20.0						
20.5	20.6	coal		black, firm drilling		Discovery Mine
21.0						
21.5	21.6	shale		dark grey, firm drilling		
22.0						
22.5						
23.0	23.0	sandstone		brown, firm drilling		
23.5						
24.0						
24.5						
25.0						
25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0	30.0			bottom of hole		

IN HOLE GAS TESTING

% O2

20.6

% CH4

0.0

% CO2

0.0

% LEL

0.0

ppm H2S

0.0

ppm CO

0.0

Nkc Geotech Ltd

25 Grosvenor Road

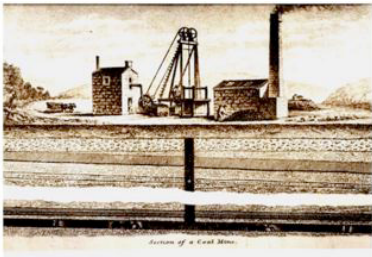
Wrexham

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REF 1825	SITE	Fox's Bank Lane, Whiston		PRINTOUT	15 Oct 2018	
Bh 16	CLIENT	Betts Geo-environmental		SCALE	1:200	
	TITLE			GL AOD	n/a	
	ORIGIN	printout direct from rig on site drilled & logged by Neil Catlow		ORIENTATION	vertical	
				FLUSH	water	
				BIT	75mm T/C	
	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, sandy, firm	not taken	ground level
0.5						
1.0						rockhead
1.5	1.5	sandstone		red and orange, firm drilling		Lower Mottled Sandstone
2.0						
2.5						
3.0						
3.5						
4.0	4.0	shale		dark grey, firm drilling		Eccleston East Fault
4.5						Coal Measures
5.0						
5.5						
6.0						
6.5						
7.0						
7.5						
8.0	8.2	shale		black, firm drilling		
8.5						
9.0						
9.5	9.6	coal		black, firm drilling		Pasture Mine
10.0						
10.5	10.2	shale		black, firm drilling		
11.0						
11.5						
12.0	12.0			bottom of hole		
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
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25.5						
26.0						
26.5						
27.0						
27.5						
28.0						
28.5						
29.0						
29.5						
30.0						

IN HOLE GAS TESTING

drilled and logged by
Neil Catlow B.Sc FGS

IN HOLE GAS TESTING

%	O2	20.6
%	CH4	0.0
%	CO2	0.0
%	LEL	0.0
ppm	H2S	0.0
ppm	CO	0.0

APPENDIX D

- (i) Contamination Test Results
- (ii) Surface Water Test Results
- (iii) Geotechnical Test Results

SUMMARY OF CONTAMINATION ANALYSIS: SOIL

SUMMARY OF CONTAMINATION ANALYSIS: METALS

Project Name Foxlane, Whiston
Project No 18TAY042
Date 15/102018

SOIL TYPE	MG	TS	NS	TS	NS	TS	NS	TS	TS	TS/MG	NS	TS	NS	TS	NS
SAMPLE LOCATION	TP1	TP3	TP4	TP6	TP7	TP8	TP9	TP11	TP12	TP13	TP15	TP16	WS4	WS5	WS6
DEPTH (m)	1.10	0.10	0.60	0.35	0.60	0.20	0.55	0.15	0.25	0.30	0.65	0.10	0.50	0.30	0.45
pH	7.97	4.55	5.41	5.95	6.38	6.34	6.82	7.13	6.99	6.45	6.51	6.45	6.63	6.73	6.02
Sulphate (water sol 2:1)	0.07	0.06	<0.01	0.03	0.03	0.03	<0.01	0.03	<0.01	0.04	<0.01	0.02	0.01	<0.01	<0.01
Organic matter	3.6	4.8	1.1	3.3	0.4	2.8	<0.1	2.1	3.7	3	1.1	3.3	0.1	3.4	1.3
Arsenic	82	8	1	8	<1	7	3	7	11	8	4	9	1	7	2
Cadmium	3	0.6	<0.5	0.9	<0.5	0.7	<0.5	0.6	1.2	0.8	<0.5	0.7	0.5	1	<0.5
Copper	419	51	7	48	7	35	<1	31	61	46	18	54	5	39	6
Chromium (hexavalent)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead	5540	70	8	52	5	42	3	34	53	52	23	60	8	51	11
Mercury	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17
Nickel	48	7	5	17	17	17	5	12	19	15	10	13	23	17	9
Selenium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	2880	52	14	74	26	69	11	65	88	74	40	53	29	90	19
Asbestos in Soil	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD
Asbestos Matrix	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Quantification	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Organic matter	3.6	4.8	1.1	3.3	0.4	2.8	<0.1	2.1	3.7	3	1.1	3.3	0.1	3.4	1.3

Metals	Mean Value Test *	Range		AtRisk 2017 (mg/kg)	AtRisk 2017 (mg/kg)	DEFRA C4SL 2017
	US ₉₅	Largest Value (mg/kg)	Smallest Value (mg/kg)	With Homegrown Produce (1% SOM)	With Homegrown Produce (6% SOM)	
pH	6.78	7.97	4.55			-
Sulphate (water sol 2:1)	0.03	0.07	0.01			-
Organic matter	2.95	4.80	0.10			
Arsenic	19.70	82.00	1.00	32	32	37
Cadmium	1.12	3.00	0.50	10	10	22.1
Copper	101.91	419.00	5.00	4730	4790	-
Chromium (hexavalent)	1.00	0.00	0.00	3.62	3.63	20.5
Lead	1047.43	5540.00	3.00			200
Mercury	0.17	0.00	0.00	8.81	15.8	-
Nickel	20.33	48.00	5.00	EA/AtRisk withdrawn Aug 2015		
Selenium	1.00	0.00	0.00	375	375	-
Zinc	571.42	2880.00	11.00	20000	20300	-

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

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

ALL RESULTS PRESENTED ARE ASSESSED UNDER THE COMBINED CLEA ASSESSMENT CRITERION AS OUTLINED WITHIN SR4ASSUMING NO FREE PRODUCT WAS OBSERVED DURING FIELDWORK- SEE GUIDANCE NOTES ON CONTAMINATION.

SGVs are derived from the EA 2009 SGV's which are taken from AtRisk 2015. Category 4 screening levels have been adopted by the EA and have been included as new guidance.
Note: The SGV for elemental mercury has been used to assess total mercury concentrations at the site. The Environment Agency's Science Report SC050021. Mercury SGV states that for general surface contamination and to simplify the assessment the SGV's for inorganic mercury can normally be compared with chemical analysis for total mercury content.... Based on the latter, SGV for elemental mercury (170mg/kg) in the soil assessment is used
NAD - NO ASBESTOS DETECTED

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

SUMMARY OF CONTAMINATION ANALYSIS: SOIL

SUMMARY OF CONTAMINATION ANALYSIS: TPH

Project Name Foxslane, Whiston
Project No 18TAY042
Date 15/10/2018

SOIL TYPE	MG	TS	NS	TS	NS	TS	NS	TS	TS	TS/MG	NS	TS	NS	TS	NS
SAMPLE LOCATION	TP1	TP3	TP4	TP6	TP7	TP8	TP9	TP11	TP12	TP13	TP15	TP16	WS4	WS5	WS6
DEPTH (m)	1.10	0.10	0.60	0.35	0.60	0.20	0.55	0.15	0.25	0.30	0.65	0.10	0.50	0.30	0.45
Ali >C5-C6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ali >C6-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ali >C8-C10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ali >C10-C12	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ali >C12-C16	<1	1	<1	<1	<1	<1	<1	<1	<1	1	<1	2	<1	<1	<1
Ali >C16-C21	1	3	<1	2	<1	1	<1	2	1	2	<1	2	<1	1	<1
Ali >C21-C35	3	21	2	10	<1	7	<1	16	7	14	2	13	<1	5	<1
Total Aliphatics	4	25	2	12	<1	9	<1	19	8	19	2	16	<1	6	<1
Aro >C5-C7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aro >C7-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aro >C8-C10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aro >C10-C12	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aro >C12-C16	<1	2	<1	1	<1	1	<1	1	1	1	<1	1	<1	1	<1
Aro >C16-C21	<1	2	<1	1	<1	1	<1	1	2	1	<1	1	<1	5	<1
Aro >C21-C35	4	30	2	12	<1	10	2	16	10	19	4	16	<1	33	3
Total Aromatics	4	35	2	14	<1	13	2	19	14	22	4	19	<1	40	3
TPH (Ali & Aro)	8	60	4	26	<1	21	3	38	22	41	7	35	<1	46	3
BTEX - Benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - Toluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - Ethyl Benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - m & p Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - o Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MTBE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Organic Matter	3.6	4.8	1.1	3.3	0.4	2.8	<0.1	2.1	3.7	3	1.1	3.3	0.1	3.4	1.3

TPH	Mean Value Test *	Range		AIRisk 2017 (mg/kg) Residential with Home Grown Produce	AIRisk 2017 (mg/kg) Residential with Home Grown Produce	DEFRA CASL 2017
	US ₉₅	Largest Value (mg/kg)	Smallest Value (mg/kg)	1% SOM WITHOUT Free Product***	6% SOM WITHOUT Free Product***	6% SOM WITHOUT Free Product***
Ali >C5-C6	0.01	<0.01	<0.01	42.7	369	-
Ali >C6-C8	0.01	<0.01	<0.01	99.3	1240	-
Ali >C8-C10	1.00	<1	<1	13.9	204	-
Ali >C10-C12	1.00	<1	<1	81.7	1180	-
Ali >C12-C16	1.18	2.00	<1	385	4130	-
Ali >C16-C21	1.69	3.00	<1	210000	210100	-
Ali >C21-C35	9.87	21.00	<1			
Total Aliphatics	12.04	25.00	<1			
Aro >C5-C7	0.01	<0.01	<0.01	0.137	0.871	-
Aro >C7-C8	0.01	<0.01	<0.01	113	780	-
Aro >C8-C10	1.00	<1	<1	20.5	232	-
Aro >C10-C12	1.00	<1	<1	70	468	-
Aro >C12-C16	1.18	2.00	<1	165	830	-
Aro >C16-C21	1.88	5.00	<1	319	1040	-
Aro >C21-C35	15.55	33.00	<1	1120	1710	-
Total Aromatics	18.52	40.00	<1			
TPH (Ali & Aro)	29.80	60.00	<1			
BTEX - Benzene	0.01	<0.01	<0.01	0.0493	0.33	0.871
BTEX - Toluene	0.01	<0.01	<0.01	113	780	-
BTEX - Ethyl Benzene	0.01	<0.01	<0.01	50.7	453	-
BTEX - m & p Xylene	0.01	<0.01	<0.01	24	312	-
BTEX - o Xylene	0.01	<0.01	<0.01	26.4	336	-
MTBE	0.01	<0.01	<0.01	27.6	220	

Results expressed as mg/kg air dried unless otherwise stated.

* - The calculations for the mean value test include outliers

*** THESE RESULTS PRESENTED ARE ASSESSED UNDER THE COMBINED CLEA ASSESSMENT CRITERION AS OUTLINED WITHIN SR4 ASSUMING NO FREE PRODUCT WAS OBSERVED DURING FIELDWORK- SEE GUIDANCE NOTES ON CONTAMINATION.

NOTES:

For the Purpose of this investigation- results will be assessed against RESIDENTIAL GUIDELINES WITH HOMEGROWN PRODUCE WITH NO FREE PRODUCT.

UU Drinking Water Guidelines	
PE Threshold	
Total BTEX & MTBE	0.1
EC5-EC10 Ali-Aro	2
EC10-EC16 Ali-Aro	10
EC16-EC40 Ali-Aro	500

SUMMARY OF CONTAMINATION ANALYSIS: PAH

Project Name Foxslane, Whiston
Project No 18TAY042
Date 15/10/2018

SOIL TYPE	MG	TS	NS	TS	NS	TS	NS	TS	TS	TS/MG	NS	TS	NS	TS	NS
SAMPLE LOCATION	TP1	TP3	TP4	TP6	TP7	TP8	TP9	TP11	TP12	TP13	TP15	TP16	WS4	WS5	WS6
DEPTH (m)	1.10	0.10	0.60	0.35	0.60	0.20	0.55	0.15	0.25	0.30	0.65	0.10	0.50	0.30	0.45
Acenaphthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01
Anthracene	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.1	<0.02
Benzo(a)anthracene	<0.04	0.09	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	<0.04	<0.04	<0.04	1.06	<0.04
Benzo(a)pyrene	<0.04	0.12	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.05	0.06	<0.04	0.05	<0.04	1.27	<0.04
Benzo(b)fluoranthene	<0.05	0.16	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	0.07	0.09	<0.05	0.08	<0.05	1.56	<0.05
Benzo(ghi)perylene	<0.05	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.59	<0.05
Benzo(k)fluoranthene	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.58	<0.07
Chrysene	<0.06	0.13	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.08	<0.06	<0.06	<0.06	1.15	<0.06
Dibenzo(ah)anthracene	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.12	<0.04
Fluoranthene	<0.08	0.19	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.09	<0.08	<0.08	<0.08	1.89	<0.08
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Indeno(123-cd)pyrene	<0.03	0.08	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.03	0.05	<0.03	<0.03	<0.03	0.71	<0.03
Naphthalene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Phenanthrene	<0.03	0.06	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	0.03	<0.03	0.34	<0.03
Pyrene	<0.07	0.17	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.09	<0.07	0.08	<0.07	1.82	<0.07
Organic Matter	3.6	4.8	1.1	3.3	0.4	2.8	<0.1	2.1	3.7	3	1.1	3.3	0.1	3.4	1.3

PAH	Mean Value Test *	Range		AtRisk 2017 (mg/kg) Residential with Home Grown Produce	AtRisk 2017 (mg/kg) Residential with Home Grown Produce	DEFRA's C4SL 2017
	US ₉₅	Largest Value (mg/kg)	Smallest Value (mg/kg)	1% SOM WITHOUT Free Product***	6% SOM WITHOUT Free Product***	6% SOM WITHOUT Free Product***
Acenaphthene	0.01	0.02	<0.01	608	2760	-
Acenaphthylene	0.01	0.02	<0.01			-
Anthracene	0.03	0.10	<0.02	10200	26200	-
Benzo(a)anthracene	0.23	1.06	<0.04	4.52	8.54	-
Benzo(a)pyrene	0.27	1.27	<0.04	1.51	2.05	4.95
Benzo(b)fluoranthene	0.34	1.56	<0.05	7.72	9.86	-
Benzo(ghi)perylene	0.15	0.59	<0.05	96.2	103	-
Benzo(k)fluoranthene	0.16	0.58	<0.07	84.4	100	-
Chrysene	0.27	1.15	<0.06	585	927	-
Dibenzo(ah)anthracene	0.05	0.12	<0.04	0.838	1	-
Fluoranthene	0.42	1.89	<0.08	983	2980	-
Fluorene	0.01	0.01	<0.01	735	2610	-
Indeno(123-cd)pyrene	0.16	0.71	<0.03	7.31	9.75	-
Naphthalene	0.03	0.00	<0.03	0.829	12.2	-
Phenanthrene	0.09	0.34	<0.03			-
Pyrene	0.40	1.82	<0.07	668	2120	-

Results expressed as mg/kg air dried unless otherwise stated.

* - The calculations for the mean value test include outliers

*** THESE RESULTS PRESENTED ARE ASSESSED UNDER THE COMBINED CLEA ASSESSMENT CRITERION AS OUTLINED WITHIN SR4 ASSUMING NO FREE PRODUCT WAS OBSERVED DURING FIELDWORK- SEE 'GUIDANCE NOTES ON CONTAMINATION'.

NOTES:

For the Purpose of this investigation- results will be assessed against RESIDENTIAL GUIDELINES WITH HOMEGROWN PRODUCE WITH NO FREE PRODUCT.

FINAL ANALYTICAL TEST REPORT SUPPLEMENT TO TEST REPORT 18/07784/1

Envirolab Job Number: 18/07784
Issue Number: 2

Date: 05 November, 2018

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

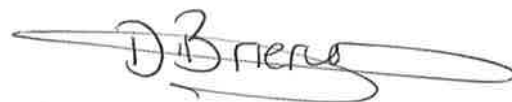
Project Manager: Betts Geolab
Project Name: Foxslane, Whiston
Project Ref: 18TAY042
Order No: BG2990
Date Samples Received: 25/09/18
Date Instructions Received: 25/09/18
Date Analysis Completed: 04/11/18

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/1	18/07784/2	18/07784/3	18/07784/4	18/07784/5	18/07784/6	18/07784/7	18/07784/8	Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP3	TP4	TP6	TP7	TP8	TP9	TP11		
Depth to Top	1.10	0.10	0.60	0.35	0.60	0.20	0.55	0.15		
Depth To Bottom										
Date Sampled	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	5	4E	5	6E	5A	4AE	5A	6E		
% Stones >10mm _A	<0.1	<0.1	<0.1	<0.1	10.6	2.8	9.9	<0.1	% w/w	A-T-044
pH _D ^{M#}	7.97	4.55	5.41	5.95	6.38	6.34	6.82	7.13	pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.07	0.06	<0.01	0.03	0.03	0.03	<0.01	0.03	g/l	A-T-026s
Organic matter _D ^{M#}	3.6	4.8	1.1	3.3	0.4	2.8	<0.1	2.1	% w/w	A-T-032 OM
Arsenic _D ^{M#}	82	8	1	8	<1	7	3	7	mg/kg	A-T-024s
Cadmium _D ^{M#}	3.0	0.6	<0.5	0.9	<0.5	0.7	<0.5	0.6	mg/kg	A-T-024s
Copper _D ^{M#}	419	51	7	48	7	35	<1	31	mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-040s
Lead _D ^{M#}	5540	70	8	52	5	42	3	34	mg/kg	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	mg/kg	A-T-024s
Nickel _D ^{M#}	48	7	5	17	17	17	5	12	mg/kg	A-T-024s
Selenium _D [#]	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-024s
Zinc _D ^{M#}	2880	52	14	74	26	69	11	65	mg/kg	A-T-024s
VPH total (>C5-C10)	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	Calc-stone+mois
Leachate Prep BS EN 12457-1 (2:1) (1 no) _A	*	-	-	-	-	-	-	-		A-T-001
Arsenic (leachable) _A [#]	2	-	-	-	-	-	-	-	µg/l	A-T-025w
Lead (leachable) _A [#]	147	-	-	-	-	-	-	-	µg/l	A-T-025w

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/1	18/07784/2	18/07784/3	18/07784/4	18/07784/5	18/07784/6	18/07784/7	18/07784/8	Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP3	TP4	TP6	TP7	TP8	TP9	TP11		
Depth to Top	1.10	0.10	0.60	0.35	0.60	0.20	0.55	0.15		
Depth To Bottom										
Date Sampled	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	5	4E	5	6E	5A	4AE	5A	6E		
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/1	18/07784/2	18/07784/3	18/07784/4	18/07784/5	18/07784/6	18/07784/7	18/07784/8	Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP3	TP4	TP6	TP7	TP8	TP9	TP11		
Depth to Top	1.10	0.10	0.60	0.35	0.60	0.20	0.55	0.15		
Depth To Bottom										
Date Sampled	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	5	4E	5	6E	5A	4AE	5A	6E		
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	0.09	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	0.12	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	0.16	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	A-T-019s
Chrysene _A ^{M#}	<0.06	0.13	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	A-T-019s
Fluoranthene _A ^{M#}	<0.08	0.19	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	0.08	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	A-T-019s
Phenanthrene _A ^{M#}	<0.03	0.06	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	A-T-019s
Pyrene _A ^{M#}	<0.07	0.17	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	1.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	mg/kg	A-T-019s

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/1	18/07784/2	18/07784/3	18/07784/4	18/07784/5	18/07784/6	18/07784/7	18/07784/8	Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP3	TP4	TP6	TP7	TP8	TP9	TP11		
Depth to Top	1.10	0.10	0.60	0.35	0.60	0.20	0.55	0.15		
Depth To Bottom										
Date Sampled	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18	19-Sep-18		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	5	4E	5	6E	5A	4AE	5A	6E		
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C8-C10 _A ^{M#}	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C16-C21 _A ^{M#}	1	3	<1	2	<1	1	<1	2	mg/kg	A-T-055s
Ali >C21-C35 _A	3	21	2	10	<1	7	<1	16	mg/kg	A-T-055s
Total Aliphatics >C5-C35 _A	4	25	2	12	<1	9	<1	19	mg/kg	A-T-055s
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C8-C10 _A ^{M#}	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Aro >C10-C12 _A ^{M#}	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Aro >C12-C16 _A	<1	2	<1	1	<1	1	<1	1	mg/kg	A-T-055s
Aro >C16-C21 _A ^{M#}	<1	2	<1	1	<1	1	<1	1	mg/kg	A-T-055s
Aro >C21-C35 _A ^{M#}	4	30	2	12	<1	10	2	16	mg/kg	A-T-055s
Total Aromatics >C5-C35 _A	4	35	2	14	<1	13	2	19	mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35) _A	8	60	4	26	<1	21	3	38	mg/kg	A-T-055s
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/9	18/07784/10	18/07784/11	18/07784/12	18/07784/13	18/07784/14	18/07784/15	18/07784/16	Units	Method ref
Client Sample No										
Client Sample ID	TP2	TP6	TP12	TP13	TP15	TP16	TP15	WS4		
Depth to Top	1.50	1.70	0.25	0.30	0.65	0.10	1.70	0.50		
Depth To Bottom										
Date Sampled	19-Sep-18	19-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	21-Sep-18		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	5A	5A	4AE	4E	6E	4AE	5	5E		
% Stones >10mm _A	13.5	3.2	0.9	<0.1	<0.1	2.2	<0.1	<0.1	% w/w	A-T-044
pH _D ^{M#}	7.82	7.47	6.99	6.45	6.51	6.45	6.90	6.63	pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	0.03	<0.01	0.04	<0.01	0.02	0.01	0.01	g/l	A-T-026s
Organic matter _D ^{M#}	-	-	3.7	3.0	1.1	3.3	-	0.1	% w/w	A-T-032 OM
Arsenic _D ^{M#}	-	-	11	8	4	9	-	1	mg/kg	A-T-024s
Cadmium _D ^{M#}	-	-	1.2	0.8	<0.5	0.7	-	0.5	mg/kg	A-T-024s
Copper _D ^{M#}	-	-	61	46	18	54	-	5	mg/kg	A-T-024s
Chromium (hexavalent) _D	-	-	<1	<1	<1	<1	-	<1	mg/kg	A-T-040s
Lead _D ^{M#}	-	-	53	52	23	60	-	8	mg/kg	A-T-024s
Mercury _D	-	-	<0.17	<0.17	<0.17	<0.17	-	<0.17	mg/kg	A-T-024s
Nickel _D ^{M#}	-	-	19	15	10	13	-	23	mg/kg	A-T-024s
Selenium _D [#]	-	-	<1	<1	<1	<1	-	<1	mg/kg	A-T-024s
Zinc _D ^{M#}	-	-	88	74	40	53	-	29	mg/kg	A-T-024s
VPH total (>C5-C10)	-	-	<1	<1	<1	<1	-	<1	mg/kg	Calc-stone+mois
1.01 % Moisture BS1377 1990 pt2 cl3.2 _A [#]	Appended	Appended	-	-	-	-	Appended	-		Subcon SS
1.02 Atterburg 4Pt BS1377 1990 pt2 cl4.4,5.3+5.4 _A [#]	Appended	Appended	-	-	-	-	Appended	-		Subcon SS

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/9	18/07784/10	18/07784/11	18/07784/12	18/07784/13	18/07784/14	18/07784/15	18/07784/16	Units	Method ref
Client Sample No										
Client Sample ID	TP2	TP6	TP12	TP13	TP15	TP16	TP15	WS4		
Depth to Top	1.50	1.70	0.25	0.30	0.65	0.10	1.70	0.50		
Depth To Bottom										
Date Sampled	19-Sep-18	19-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	21-Sep-18		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	5A	5A	4AE	4E	6E	4AE	5	5E		
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	-	-	NAD	NAD	NAD	NAD	-	NAD		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	-	-	N/A	N/A	N/A	N/A	-	N/A		

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/9	18/07784/10	18/07784/11	18/07784/12	18/07784/13	18/07784/14	18/07784/15	18/07784/16	Units	Method ref
Client Sample No										
Client Sample ID	TP2	TP6	TP12	TP13	TP15	TP16	TP15	WS4		
Depth to Top	1.50	1.70	0.25	0.30	0.65	0.10	1.70	0.50		
Depth To Bottom										
Date Sampled	19-Sep-18	19-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	21-Sep-18		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	5A	5A	4AE	4E	6E	4AE	5	5E		
PAH-16MS										
Acenaphthene _A ^{M#}	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-019s
Anthracene _A ^{M#}	-	-	<0.02	<0.02	<0.02	<0.02	-	<0.02	mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	-	-	<0.04	0.05	<0.04	<0.04	-	<0.04	mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	-	-	0.05	0.06	<0.04	0.05	-	<0.04	mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	-	-	0.07	0.09	<0.05	0.08	-	<0.05	mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	-	-	<0.05	<0.05	<0.05	<0.05	-	<0.05	mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	-	-	<0.07	<0.07	<0.07	<0.07	-	<0.07	mg/kg	A-T-019s
Chrysene _A ^{M#}	-	-	<0.06	0.08	<0.06	<0.06	-	<0.06	mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	-	-	<0.04	<0.04	<0.04	<0.04	-	<0.04	mg/kg	A-T-019s
Fluoranthene _A ^{M#}	-	-	<0.08	0.09	<0.08	<0.08	-	<0.08	mg/kg	A-T-019s
Fluorene _A ^{M#}	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	-	-	0.03	0.05	<0.03	<0.03	-	<0.03	mg/kg	A-T-019s
Naphthalene _A ^{M#}	-	-	<0.03	<0.03	<0.03	<0.03	-	<0.03	mg/kg	A-T-019s
Phenanthrene _A ^{M#}	-	-	<0.03	0.04	<0.03	0.03	-	<0.03	mg/kg	A-T-019s
Pyrene _A ^{M#}	-	-	<0.07	0.09	<0.07	0.08	-	<0.07	mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	-	-	0.15	0.55	<0.08	0.24	-	<0.08	mg/kg	A-T-019s

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/9	18/07784/10	18/07784/11	18/07784/12	18/07784/13	18/07784/14	18/07784/15	18/07784/16	Units	Method ref
Client Sample No										
Client Sample ID	TP2	TP6	TP12	TP13	TP15	TP16	TP15	WS4		
Depth to Top	1.50	1.70	0.25	0.30	0.65	0.10	1.70	0.50		
Depth To Bottom										
Date Sampled	19-Sep-18	19-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	20-Sep-18	21-Sep-18		
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		
Sample Matrix Code	5A	5A	4AE	4E	6E	4AE	5	5E		
TPH CWG										
Ali >C5-C6 _A [#]	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C6-C8 _A [#]	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C8-C10 _A ^{M#}	-	-	<1	<1	<1	<1	-	<1	mg/kg	A-T-055s
Ali >C10-C12 _A ^{M#}	-	-	<1	<1	<1	<1	-	<1	mg/kg	A-T-055s
Ali >C12-C16 _A ^{M#}	-	-	<1	1	<1	2	-	<1	mg/kg	A-T-055s
Ali >C16-C21 _A ^{M#}	-	-	1	2	<1	2	-	<1	mg/kg	A-T-055s
Ali >C21-C35 _A	-	-	7	14	2	13	-	<1	mg/kg	A-T-055s
Total Aliphatics >C5-C35 _A	-	-	8	19	2	16	-	<1	mg/kg	A-T-055s
Aro >C5-C7 _A [#]	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C7-C8 _A [#]	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C8-C10 _A ^{M#}	-	-	<1	<1	<1	<1	-	<1	mg/kg	A-T-055s
Aro >C10-C12 _A ^{M#}	-	-	<1	<1	<1	<1	-	<1	mg/kg	A-T-055s
Aro >C12-C16 _A	-	-	1	1	<1	1	-	<1	mg/kg	A-T-055s
Aro >C16-C21 _A ^{M#}	-	-	2	1	<1	1	-	<1	mg/kg	A-T-055s
Aro >C21-C35 _A ^{M#}	-	-	10	19	4	16	-	<1	mg/kg	A-T-055s
Total Aromatics >C5-C35 _A	-	-	14	22	4	19	-	<1	mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35) _A	-	-	22	41	7	35	-	<1	mg/kg	A-T-055s
BTEX - Benzene _A [#]	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - Toluene _A [#]	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - o Xylene _A [#]	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
MTBE _A [#]	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/17	18/07784/18	18/07784/19	18/07784/20					Units	Method ref
Client Sample No										
Client Sample ID	WS5	WS6	WS1	WS2						
Depth to Top	0.30	0.45	1.90	1.50						
Depth To Bottom			2.00	1.60						
Date Sampled	21-Sep-18	21-Sep-18	21-Sep-18	21-Sep-18						
Sample Type	Soil	Soil	Soil	Soil						
Sample Matrix Code	4AE	5A	5A	5A						
% Stones >10mm _A	6.8	11.1	1.6	9.2					% w/w	A-T-044
pH _D ^{M#}	6.73	6.02	6.49	7.75					pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	<0.01	0.04	0.02					g/l	A-T-026s
Organic matter _D ^{M#}	3.4	1.3	-	-					% w/w	A-T-032 OM
Arsenic _D ^{M#}	7	2	-	-					mg/kg	A-T-024s
Cadmium _D ^{M#}	1.0	<0.5	-	-					mg/kg	A-T-024s
Copper _D ^{M#}	39	6	-	-					mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	-	-					mg/kg	A-T-040s
Lead _D ^{M#}	51	11	-	-					mg/kg	A-T-024s
Mercury _D	<0.17	<0.17	-	-					mg/kg	A-T-024s
Nickel _D ^{M#}	17	9	-	-					mg/kg	A-T-024s
Selenium _D [#]	<1	<1	-	-					mg/kg	A-T-024s
Zinc _D ^{M#}	90	19	-	-					mg/kg	A-T-024s
VPH total (>C5-C10)	<1	<1	-	-					mg/kg	Calc-stone+mois
1.01 % Moisture BS1377 1990 pt2 cl3.2 _A [#]	-	-	Appended	Appended						Subcon SS
1.02 Atterburg 4Pt BS1377 1990 pt2 cl4.4,5.3+5.4 _A [#]	-	-	Appended	Appended						Subcon SS

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/17	18/07784/18	18/07784/19	18/07784/20					Units	Method ref
Client Sample No										
Client Sample ID	WS5	WS6	WS1	WS2						
Depth to Top	0.30	0.45	1.90	1.50						
Depth To Bottom			2.00	1.60						
Date Sampled	21-Sep-18	21-Sep-18	21-Sep-18	21-Sep-18						
Sample Type	Soil	Soil	Soil	Soil						
Sample Matrix Code	4AE	5A	5A	5A						
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	-	-						A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	-	-						

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/17	18/07784/18	18/07784/19	18/07784/20					Units	Method ref
Client Sample No										
Client Sample ID	WS5	WS6	WS1	WS2						
Depth to Top	0.30	0.45	1.90	1.50						
Depth To Bottom			2.00	1.60						
Date Sampled	21-Sep-18	21-Sep-18	21-Sep-18	21-Sep-18						
Sample Type	Soil	Soil	Soil	Soil						
Sample Matrix Code	4AE	5A	5A	5A						
PAH-16MS										
Acenaphthene _A ^{M#}	0.02	<0.01	-	-					mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	0.02	<0.01	-	-					mg/kg	A-T-019s
Anthracene _A ^{M#}	0.10	<0.02	-	-					mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	1.06	<0.04	-	-					mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	1.27	<0.04	-	-					mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	1.56	<0.05	-	-					mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	0.59	<0.05	-	-					mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	0.58	<0.07	-	-					mg/kg	A-T-019s
Chrysene _A ^{M#}	1.15	<0.06	-	-					mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	0.12	<0.04	-	-					mg/kg	A-T-019s
Fluoranthene _A ^{M#}	1.89	<0.08	-	-					mg/kg	A-T-019s
Fluorene _A ^{M#}	0.01	<0.01	-	-					mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.71	<0.03	-	-					mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	-	-					mg/kg	A-T-019s
Phenanthrene _A ^{M#}	0.34	<0.03	-	-					mg/kg	A-T-019s
Pyrene _A ^{M#}	1.82	<0.07	-	-					mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	11.2	<0.08	-	-					mg/kg	A-T-019s

Envirolab Job Number: 18/07784

Client Project Name: Foxslane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/07784/17	18/07784/18	18/07784/19	18/07784/20					Units	Method ref
Client Sample No										
Client Sample ID	WS5	WS6	WS1	WS2						
Depth to Top	0.30	0.45	1.90	1.50						
Depth To Bottom			2.00	1.60						
Date Sampled	21-Sep-18	21-Sep-18	21-Sep-18	21-Sep-18						
Sample Type	Soil	Soil	Soil	Soil						
Sample Matrix Code	4AE	5A	5A	5A						
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	-	-					mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	-	-					mg/kg	A-T-022s
Ali >C8-C10 _A ^{M#}	<1	<1	-	-					mg/kg	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	-	-					mg/kg	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	<1	-	-					mg/kg	A-T-055s
Ali >C16-C21 _A ^{M#}	1	<1	-	-					mg/kg	A-T-055s
Ali >C21-C35 _A	5	<1	-	-					mg/kg	A-T-055s
Total Aliphatics >C5-C35 _A	6	<1	-	-					mg/kg	A-T-055s
Aro >C5-C7 _A [#]	<0.01	<0.01	-	-					mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	-	-					mg/kg	A-T-022s
Aro >C8-C10 _A ^{M#}	<1	<1	-	-					mg/kg	A-T-055s
Aro >C10-C12 _A ^{M#}	<1	<1	-	-					mg/kg	A-T-055s
Aro >C12-C16 _A	1	<1	-	-					mg/kg	A-T-055s
Aro >C16-C21 _A ^{M#}	5	<1	-	-					mg/kg	A-T-055s
Aro >C21-C35 _A ^{M#}	33	3	-	-					mg/kg	A-T-055s
Total Aromatics >C5-C35 _A	40	3	-	-					mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35) _A	46	3	-	-					mg/kg	A-T-055s
BTEX - Benzene _A [#]	<0.01	<0.01	-	-					mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	-	-					mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	-	-					mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	-	-					mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	-	-					mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01	-	-					mg/kg	A-T-022s

REPORT NOTES

General:

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

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

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

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

Soil chemical analysis:

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

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

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

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

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

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

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

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

Asbestos:

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

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

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

Predominant Matrix Codes:

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

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

Secondary Matrix Codes:

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

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

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

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

Please contact us if you need any further information.

Envirolab Deviating Samples Report

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

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

Project: Foxslane, Whiston

Clients Project No: 18TAY042

Project No: 18/07784

Date Instructions Received: 25/09/2018 (am)

Cool Box Temperatures (°C): 13.0, 13.5

NO DEVIATIONS IDENTIFIED

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

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/09239
Issue Number: 1

Date: 12 November, 2018

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

Project Manager: Betts Geolab
Project Name: Foxes Lane, Whiston
Project Ref: 18TAY042
Order No: BG3065
Date Samples Received: 05/11/18
Date Instructions Received: 06/11/18
Date Analysis Completed: 12/11/18

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Iain Haslock
Analytical Consultant

Envirolab Job Number: 18/09239

Client Project Name: Foxes Lane, Whiston

Client Project Ref: 18TAY042

Lab Sample ID	18/09239/1	18/09239/2							Units	Method ref
Client Sample No										
Client Sample ID	Pond 1	Pond 2								
Depth to Top										
Depth To Bottom										
Date Sampled	05-Nov-18	05-Nov-18								
Sample Type	Water - EW	Water - EW								
Sample Matrix Code	N/A	N/A								
pH (w) _A [#]	7.45	7.44							pH	A-T-031w
COD (settled) _A [#]	30	31							mg/l	A-T-034w
BOD (settled, 5 day) _A	8	4							mg/l	A-T-048
Arsenic (dissolved) _A [#]	1	1							µg/l	A-T-025w
Cadmium (dissolved) _A [#]	<0.2	<0.2							µg/l	A-T-025w
Copper (dissolved) _A [#]	3	5							µg/l	A-T-025w
Chromium (dissolved) _A [#]	<1	<1							µg/l	A-T-025w
Lead (dissolved) _A [#]	<1	<1							µg/l	A-T-025w
Mercury (dissolved) _A [#]	<0.1	<0.1							µg/l	A-T-025w
Nickel (dissolved) _A [#]	2	3							µg/l	A-T-025w
Selenium (dissolved) _A [#]	<1	<1							µg/l	A-T-025w
Zinc (dissolved) _A [#]	2	4							µg/l	A-T-025w

REPORT NOTES

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If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

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

Soil chemical analysis:

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

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

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

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

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

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

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

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

Asbestos:

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

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

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

Predominant Matrix Codes:

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

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

Secondary Matrix Codes:

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

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

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

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

Please contact us if you need any further information.

Envirolab Deviating Samples Report

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

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

Project No: 18/09239

Date Instructions Received: 06/11/2018 (am)

Cool Box Temperatures (°C): 14.6

Project: Foxes Lane, Whiston

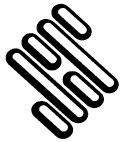
Clients Project No: 18TAY042

Lab Sample ID	18/09239/1	18/09239/2
Client Sample No		
Client Sample ID/Depth	Pond 1	Pond 2
Date Sampled	05/11/18	05/11/18
Deviation Code		
A9 (no H2SO4)	✓	✓

Key

A9 (no H2SO4) No H2SO4 preserved bottle provided (phenols, ammonia, DOC, COD will be deviating)

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



STRUCTURAL SOILS LTD
TEST REPORT



Report No. 783408 R1

Date 08-October-2018 Contract 18/07784

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

For the Attention of Iain Haslock

Samples submitted by client 25/09/2018
Testing Started 27/09/2018
Testing Completed 10/08/2018

Client Reference 18/07784
Client Order No. PO739129
Instruction Type Written

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

UKAS Accredited Tests Undertaken

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

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

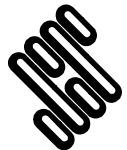
Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of.
Test were undertaken on samples 'as received' unless otherwise stated.
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

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

SUMMARY OF SOIL CLASSIFICATION TESTS

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

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425um	Description of Sample
TP2	18/07784/9	D	1.50	15	24	14	10	68	Brown slightly sandy slightly gravelly CLAY
TP6	18/07784/10	D	1.70	14	31	18	13	84	Brown slightly sandy slightly gravelly CLAY
TP15	18/07784/15	D	1.70	12	33	20	13	84	Brown slightly sandy slightly gravelly CLAY
WS1	18/07784/19	D	1.90	10	29	17	12	80	Brown slightly gravelly CLAY
WS2	18/07784/20	D	1.50	10	33	19	14	92	Brown slightly sandy slightly gravelly CLAY



**STRUCTURAL
SOILS LTD**

Contract:

18/07784

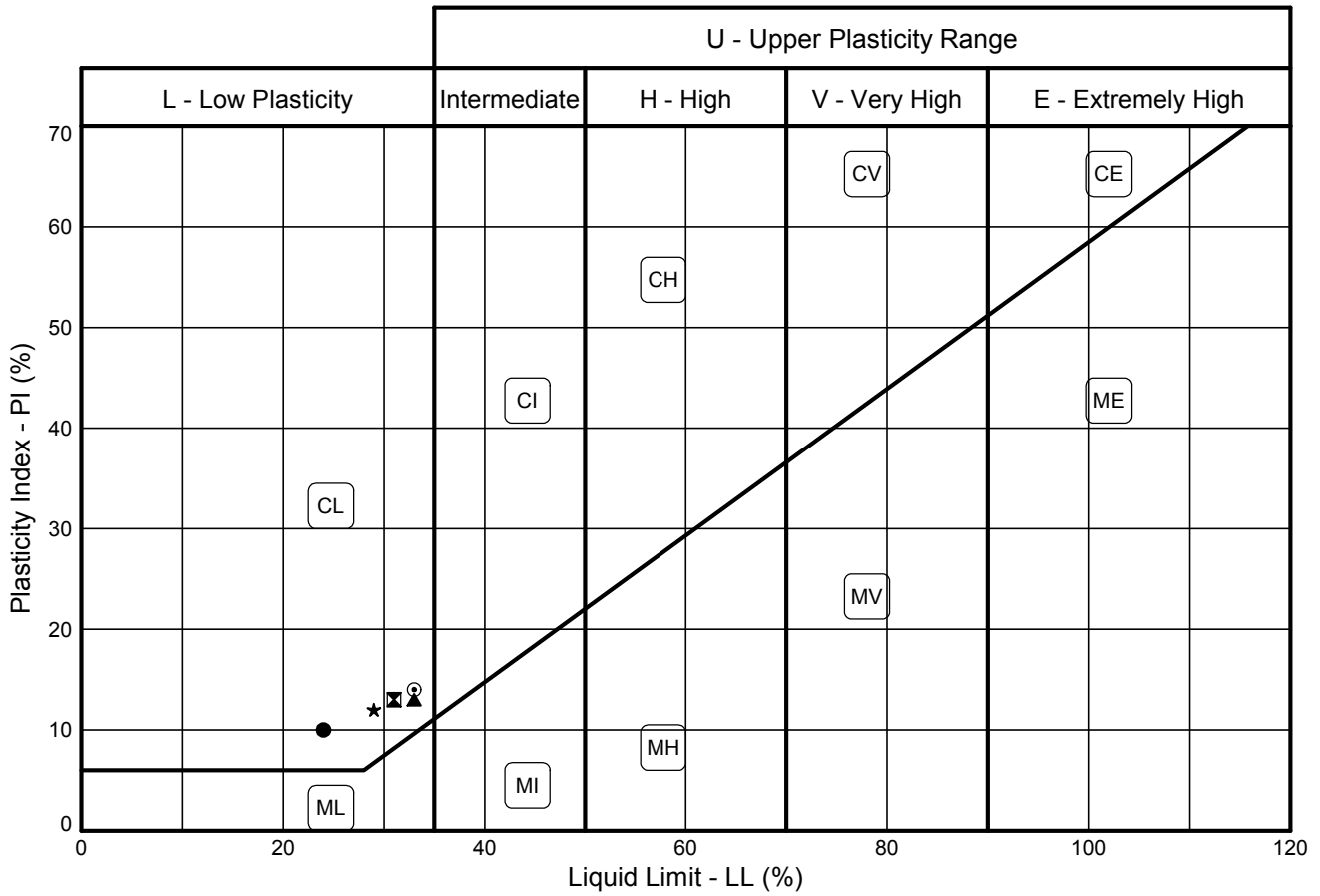
Contract Ref:

783408



PLASTICITY CHART - PI Vs LL

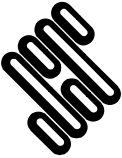
In accordance with BS5930:2015
Testing in accordance with BS1377-2:1990



Sample Identification				BS Test Method #	Preparation Method +	MC %	LL %	PL %	PI %	<425um %	Lab location	
Exploratory Position ID	Sample	Depth (m)										
●	TP2	18/07784/9D	1.50	3.2/4.3/5.3/5.4	4.2.4	15	24	14	10	68		C
⊠	TP6	18/07784/10D	1.70	3.2/4.3/5.3/5.4	4.2.4	14	31	18	13	84		C
▲	TP15	18/07784/15D	1.70	3.2/4.3/5.3/5.4	4.2.4	12	33	20	13	84		C
★	WS1	18/07784/19D	1.90	3.2/4.3/5.3/5.4	4.2.4	10	29	17	12	80		C
⊙	WS2	18/07784/20D	1.50	3.2/4.3/5.3/5.4	4.2.4	10	33	19	14	92		C

# Tested in accordance with the following clauses of BS1377-2:1990. 3.2 - Moisture Content 4.3 - Cone Penetrometer Method 4.4 - One Point Cone Penetrometer Method 4.6 - One Point Casagrande Method 5.3 - Plastic Limit Method 5.4 - Plasticity Index	+ Tested in accordance with the following clauses of BS1377-2:1990. 4.2.3 - Natural State 4.2.4 - Wet Sieved Key: * = Non-standard test, NP = Non plastic.
--	---

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



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

Compiled By		Date
<i>Sarah Mundy</i>		08/10/18
Contract		Contract Ref:
18/07784		783408



TESTING VERIFICATION CERTIFICATE



1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **08/10/2018 17:12:58**.

Testing reported after this date is not covered by this Verification Certificate.

Approved Signatory
Mark Athorne (Laboratory Manager)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU



**STRUCTURAL
SOILS LTD**

Contract:

18/07784

Job No:

783408



APPENDIX E

(i) Gas Monitoring Data

Site: Land at Fox's Lane, Whiston

Job Number: 18TAY042

Date of Monitoring: 03/10/2018

Ground Gas Monitoring Round 1



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS1	0.1	1025	0.0	0.0	2.9	2.9	17	17.1	-	-	-	2.73	2.97
WS2	0.1	1025	0.0	0.0	1.3	1.3	19.5	19.5	-	-	1	2.45	2.92
WS3	0.2	1025	0.0	0.0	0.6	0.6	20.3	20.3	-	-	-	Dry	1.04
WS4	0.1	1025	0.0	0.0	0.4	0.4	20.3	20.3	-	-	-	Dry	2.75
WS5	0.1	1025	0.0	0.0	2.7	2.7	17.9	17.9	-	1	-	Dry	2.97
WS6	0.1	1025	0.0	0.0	0.7	0.7	19.8	20.3	-	-	-	Dry	1.51

Notes:

Monitoring order is left to right across the table

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

Relevant Information at the Time of Monitoring	
Monitored by:	PH
Weather:	Blue sky, windy, warmish
Equipment Used:	GA2000+
Visible signs of damage/stress:	
Other Comments/Observations:	Air pressure steady

Date of Monitoring: 05/11/2018

Notes: Monitoring order is left to right across the table Monitoring should be for not less than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes
--

Relevant Information at the Time of Monitoring	
Monitored by:	RD
Weather:	Cool, overcast with light cloud, no wind.
Equipment Used:	GA5000
Visible signs of damage/stress:	N/A
Other Comments/Observations:	Pressure stable.

Site: Land at Fox's Lane, Whiston

Job Number: 18TAY042

Date of Monitoring: 28/11/2018

Ground Gas Monitoring Round 3



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS1	0.5	991	0.0	0.0	1.1	1.1	19.8	19.9	-	-	-	2.46	3.14
WS2	0.0	991	0.0	0.0	1.0	1.0	20.2	20.2	-	-	1	2.48	2.97
WS3	0.7	991	0.0	0.0	1.8	1.7	19.3	19.4	-	-	-	Dry	1.20
WS4	0.0	991	0.0	0.0	1.4	1.3	19.1	19.3	-	-	-	Dry	1.87
WS5	0.7	991	0.0	0.0	1.2	1.2	20.0	20.0	-	-	-	Dry	3.08
WS6	0.3	991	0.0	0.0	1.7	1.7	19.3	19.4	-	1	-	Dry	1.63

Notes:

Monitoring order is left to right across the table

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

Relevant Information at the Time of Monitoring	
Monitored by:	RD
Weather:	Sunny with showers, light cloud, very windy.
Equipment Used:	GA5000
Visible signs of damage/stress:	N/A
Other Comments/Observations:	Pressure rising.

Site: Land at Fox's Lane, Whiston

Job Number: 18TAY042

Date of Monitoring: 18/12/2018

Ground Gas Monitoring Round 4



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS1	0.5	999	0.0	0.0	4.9	4.9	15.2	15.2	-	1	-	0.78	3.00
WS2	0.0	999	0.0	0.0	0.9	0.9	20.2	20.2	-	-	-	1.35	2.89
WS3	0.1	999	0.0	0.0	1.1	1.1	19.5	19.5	-	-	-	1.04	1.06
WS4	0.5	999	0.0	0.0	0.6	0.6	19.7	19.7	-	-	-	Dry	1.71
WS5	0.1	999	0.0	0.0	1.5	1.5	18.4	18.4	-	-	-	2.50	2.96
WS6	0.1	999	0.0	0.0	1.3	1.3	19.4	19.4	-	1	-	Dry	1.50

Notes:

Monitoring order is left to right across the table

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

Relevant Information at the Time of Monitoring	
Monitored by:	PH
Weather:	Cold, Windy, Heavy Cloud
Equipment Used:	GA5000
Visible signs of damage/stress:	N/A
Other Comments/Observations:	Air pressure falling

Site: Land at Fox's Lane, Whiston

Job Number: 18TAY042

Date of Monitoring: 4/1/19

Ground Gas Monitoring Round 5



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS1	0.0	1038	0.0	0.0	4.6	4.5	14.5	15.4	-	-	-	2.95	3.05
WS2	0.1	1038	0.0	0.0	0.9	0.9	20.3	20.4	-	-	-	Dry	2.98
WS3	0.0	1038	0.0	0.0	0.9	0.9	19.7	19.7	-	-	-	Dry	1.10
WS4	0.1	1038	0.0	0.0	0.3	0.3	20.3	20.3	-	-	-	Dry	1.75
WS5	0.0	1038	0.0	0.0	2.1	2.0	16.7	19.6	-	-	-	2.40	3.02
WS6	0.1	1038	0.0	0.0	1.7	0.9	19.8	19.8	-	-	-	Dry	1.55

Notes:

Monitoring order is left to right across the table

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

Relevant Information at the Time of Monitoring	
Monitored by:	RD
Weather:	Overcast with light cloud, no wind, cold.
Equipment Used:	GA2000+
Visible signs of damage/stress:	N/A
Other Comments/Observations:	Pressure falling.

Site: Land at Fox's Lane, Whiston

Job Number: 18TAY042

Date of Monitoring: 16/01/19

Ground Gas Monitoring Round 6



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS1	0.0	997	0.0	0.0	4.2	3.8	16.7	17.6	-	-	-	1.96	3.07
WS2	0.1	997	0.0	0.0	0.9	0.9	20.4	20.4	-	-	-	Dry	3.00
WS3	0.1	997	0.0	0.0	1.7	1.6	19.1	19.3	-	-	-	Dry	1.10
WS4	0.1	997	0.0	0.0	0.4	0.3	20.2	20.3	-	-	-	Dry	1.83
WS5	0.0	997	0.0	0.0	0.7	0.6	19.8	19.8	-	-	-	2.50	3.05
WS6	0.0	997	0.0	0.0	1.4	1.4	19.5	19.6	-	-	-	Dry	1.50

Notes:

Monitoring order is left to right across the table

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

Relevant Information at the Time of Monitoring	
Monitored by:	RD
Weather:	Blue sky with light cloud and sun, no wind, cool.
Equipment Used:	GA2000+
Visible signs of damage/stress:	N/A
Other Comments/Observations:	Pressure rising.

APPENDIX F

(i) Conceptual Model

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

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

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

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

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

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

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

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



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

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

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

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

Initial Conceptual Model

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

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

Initial Environmental Risk Assessment

General

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

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

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

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

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

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

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

CIRIA C665 Situation A Ground Gas Conceptual Model

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

APPENDIX G

(i) Notes on Ground Gas

Ground Gas

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

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

A gas regime is essentially defined by two parameters:

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

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

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

Three recent publications are used for ground gas risk assessment:

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

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

CIRIA C665 Situation A Ground Gas Conceptual Model

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

High Rise / Flats (CIRIA 665 Table 8.5)

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

Notes:

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

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

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

Notes:

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

Low Rise Residential (NHBC)

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

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

Notes:

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

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

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

BS8485: 2007

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

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

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

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

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

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

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

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

Table 3: Solutions Scores

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

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

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

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

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

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

APPENDIX H

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

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

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

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

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

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

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

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

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

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

APPENDIX I

(i) Validation Report Guidance Notes

Unforeseen Hotspots of Contamination

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

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

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

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

Validation Report Recommendations

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

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

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

The validation report will include the following:

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

APPENDIX J

(i) Notes on Limitations

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

The ground conditions described in the above reports relate only to the points of investigation and do not necessarily guarantee a continuation of the ground conditions throughout the non-inspected area of the site. Whilst such exploratory holes would usually provide a reasonable indication as to the general ground conditions, these cannot be determined with complete certainty. Betts Geo has endeavoured to assess all information provided to them, but makes no guarantees or warranties as to the accuracy or completeness of this information.

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

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

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

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

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

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

This report was prepared by Betts Geo Environmental Ltd for the sole and exclusive use of:

- (1) **GINO FREDERICK FANTIN & DAWN SARA FANTIN** of Cherry Tree Farm, Foxs Bank Lane, Whiston L35 3SS and **CATHERINE SARAH JANE GRIFFIN** of Moss House, Whixall, Whitchurch, Shropshire SY13 2PG (**Seller**);

- (2) **TAYLOR WIMPEY UK LIMITED** a Gate House, Turnpike Road, High Wycombe, Buckinghamshire HP12 3NR (**Buyer**); and
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