

Bloor Homes - Barratt Homes

Ground Investigation Report

for

Holt Road, Wrexham

November 2018

REPORT NO: 18BLH002/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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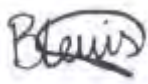
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1 EXECUTIVE SUMMARY

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

1. Site Location

The site is located south of Holt Road, Wrexham (nearest postcode: LL13 9SJ). The coordinates for the centre of the site on National Grid are 336150, 351503. The site is approximately 28.37 hectares in plan area.

2. Site Description

On Site

The site is roughly rectangular in shape and can be accessed from Bryn Estyn Road to the South. The site is predominantly agricultural fields separated by hedgerows and fences. An area of woodland is located in the north of the site surrounding a steep valley feature. Site topography varies significantly, but generally slopes from the South-West down to the North-West.

A large number of 'manure and slurry type waste' stockpiles are present along the South-East boundary of site. An area of woodland is located within the north west of site surrounding a dried-up pond.

Surrounding Area

The surrounding area consists of the former Holt Road, and the A534, to the north with Wrexham golf course beyond with residential housing and a farm to the west. Bryn Estyn Road forms the southern boundary beyond which lies Wrexham Rugby Club in SW, Erlas Victorian Walled Garden and Bryn Estyn House in the centre and agricultural land in the SE. Farmland lies to the southeast of the site with a former landfill and Hanson Ready Mix Concrete Depot to the NE.

3. Proposed Development

Low rise residential dwellings, associated gardens, public open spaces, new access roads and associated infrastructure including SUDS.

➤ Previously Undertaken Reports/Work

Bloor Homes provided Betts Geo with the following reports for the site. These reports are as follows;

- Stage 1 Contamination Assessment for Land off Holt Road, Wrexham for Barratt Manchester by Smith Grant Environmental Consultancy – November 2014 (Report ref: R2062-R01-v1 FINAL).
- Strata Renewables Ltd (SRL) Infiltration tests 15th-18th January 2018.

4. Site History

On Site

Historical review in the Smith Grant Report indicate that the site has been largely in agricultural use throughout its mapped history, with a number of potentially infilled ponds in the centre of the site.

Surrounding Area

The surrounding area has generally comprised of agricultural farmland, with the encroachment to the west from Wrexham urban development. Land to the east has historically been worked as 'sand pit' from the 1930's, part of which was used for landfilling in the 1980's.

5. 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 at significant depth from historical workings ,any associated movement should have now ceased. The risk from shallow coal workings and unrecorded mine entries is very low.

➤ Hydrogeology and Hydrology

- *The superficial deposits over all of the site and bedrock underlying the western parts of the site are classed as a Secondary A Aquifer, of variable permeability; however, the bedrock immediately to the east of the site forms a Principle Aquifer within the catchment of a Groundwater Source Protection Zone.'*

- *'The site contains two tertiary surface watercourses which drain to the west and northeast of the northern boundary before possibly entering drains accosted with the new road construction to the north or the urban surface water drainage system to the west.'*

6. Summary of Environmental Data

Possible Contamination Sources

- Current Land Use on Site – Unlikely
- Historical Land Use – On Site – Unlikely .
- Coal Mining – On Site – Low Risk.
- Pollution Incident — No.
- Landfill – Adjacent – Possible
- Tyn Twll Farm - Possible

Pathways and Receptors

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

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

7. Scope of Investigation

The fieldwork was carried out between the 15th October – 24th October 2018 for the trial pitting, window sampling and cable percussive boreholes and comprised of the following;

- Five (5 No.) cable percussive boreholes drilled to 20.00mbgl.
- Thirty-Seven (37 No.) machine excavated trial holes.
- Eleven (11 No.) small diameter boreholes to a maximum of 3.00mbgl, all installed with gas/groundwater monitoring wells.
- Seven (7 No.) soakaway tests.
- Twelve (12 No.) ground gas monitoring visits over a period of at least six months with varying barometric pressures.
- Chemical analysis (Metals, PAH's, TPH's) of thirty-four (34 No.) samples.
- Analysis of thirty-five (35 No.) samples for asbestos screening analysis.
- Asbestos Quantification of two (2 No.) samples.
- Twenty-Five (23 No.) samples for geotechnical analysis;
- Twelve (12 No.) samples for Particle Size Distribution Testing.
- Eleven (11 No.) samples for Atterberg Limits to assess heave potential and confirm classification.

8. Ground Conditions Encountered

Ground conditions generally consists of TOSPOIL (to a maximum depth of 0.90mbgl) overlying GLACIOFLUVIAL DEPOSITS principally comprising loose to medium dense SAND, gravelly SAND and GRAVEL with localised beds of firm to stiff CLAY proven to 20.00mbgl. Localised Made Ground was encountered in the north of the site within TP29 to 1.70m bgl.

9. Contamination Encountered

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

Asbestos was identified in the samples mentioned above at TP12 and TP29 within topsoil and made ground respectively.

Quantification testing has recorded a value of <0.001% of asbestos within the sample at TP12 and a value of 0.008% within the Made Ground sample from TP29.

The recorded concentration within TP29 relates to the Made Ground and although there is no current exposure pathway as it lies beneath 0.40m of topsoil, the risk will need to be further assessed once a detailed development layout is confirmed. However, based on the current site layout and the fact the contaminated strata were identified at depths of between 0.20mgl –

0.50mbgl, it may be possible to leave this material in-situ due to the affected areas being proposed as landscaping and woodland.

10. Remedial Actions

Soils

As the recorded concentration within TP12 is less than the threshold of 0.001%, it is deemed unlikely to pose a risk, however care should be taken on site as the further presence of asbestos cannot be discounted and it is recommended that vigilance during ground works in this area is maintained as it may relate to a historical farm building.

The recorded concentration within TP29 relates to the Made Ground and although there is no current exposure pathway as it lies beneath 0.40m of topsoil, the risk will need to be further assessed once a detailed development layout is confirmed. However, based on the current site layout and the fact the contaminated strata were identified at depths of between 0.20m – 0.50m, it may be possible to leave this material in-situ due to the affected areas being proposed as landscaping and woodland.

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.

Groundwater, Surface Water and Aquifer Risk

No significant risks to groundwater and aquifers are anticipated across the site due to both the lack of groundwater encountered and no significant soil contamination hotspots being identified during the ground investigation.

11. 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 made ground and natural should be possible given the chemical analysis and very different visual identification.

12. 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 ongoing. To date, generally no significantly elevated concentrations of ground gas have been identified and preliminary the majority of the site would be classified as green – with no specialist ground gas protection required. However, along the eastern boundary elevated ground gas concentrations have been identified and therefore for the purpose of pricing it would be prudent to assume Amber 1 across the majority of the site with Amber 2 ground gas protection measures for plots located in the east of the site until the ground gas monitoring is completed.

13. Foundations

Loose to medium dense sands have been encountered at shallow depth across the majority of the site and therefore the adoption of standard shallow strip foundations founded at a minimum of 0.45m bgl can be designed with an allowable bearing pressure of 125kN/m². This should limit total foundation settlement to less than 25mm and differential to less than 15mm for foundation widths up to 1m.

Locally thin to very thick beds of firm to stiff clay are present, therefore as a precaution a minimum foundation depth of 0.75m bgl should be adopted. Given the recorded ground conditions it would be prudent to undertake further trial pitting to confirm the presence of shrinkable soils at foundation depth on a plot by plot basis.

Deepening of foundations in accordance with NHBC Standards will be required.

14. Heave / Shrinkage Potential

None shrinkable to LOW volume change potential is evident; foundation design for tree heave protection should be designed accordingly following discussion with the NHBC, with a minimum foundation depth of 0.9m required where shrinkable soils are present

15. Ground Floor Construction

Generally non-shrinkable soils are present across the majority of the site at formation level and therefore ground bearing floor slabs could be adopted. Ground bearing slabs may be used if the following criteria are satisfied:

- the foundation depth (such as due to the influence of trees) is less than 1.5m;
- any fill is suitable, well-compacted granular material and less than 600mm thick; and
- it is demonstrated that desiccation is not present, and soils are at their equilibrium moisture content.

Where shrinkable soils are present at shallow depth across the site suspended floor construction (e.g. either in-situ RC slabs or block and beam flooring) should be adopted in accordance with NHBC guidance.

16. 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 sands/firm to stiff clay is anticipated, however in-situ CBR's should be undertaken during construction to confirm.

17. Site Preparation and Excavation

Stockpiles of manure and slurry/ filter cake types waste was noted within the South-East of the site removed offsite as part of the site preparation works.

A water main runs parallel with the site's western boundary. Excavation in close proximity to mains services will need to ensure that the excavation walls are stable or appropriately battered to a safe angle,

No buried obstructions were encountered during this investigation, however an allowance should be made for breaking out, for example provision of pneumatic breakers for site plant. Excavations of shallow soils should not present any difficulty for conventional plant and equipment.

Topsoil and unsuitable Made Ground should be removed from beneath all building and hard standing areas.

Excavations undertaken during site works greater than 2.0m bgl were generally unstable.

18. Control of Groundwater

No significant groundwater was encountered on site other than strata being recorded as wet or damp. However, groundwater levels may vary from those at the time of the investigation, for example in response to seasonal fluctuations as part of the scope of works long-term groundwater monitoring is ongoing.

19. Concrete Design

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

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

20. Soakaways

Infiltration rates of between 1.5×10^{-5} to 9.9×10^{-5} m/s have been recorded indicating that soakaway drains could provide a viable drainage solution.

It is recommended that further infiltration testing is undertaken once a site layout is finalised, the scope of the testing should be agreed with the local authority.

2 SITE DESCRIPTION

2.1 Introduction

This investigation was carried out on the instruction of Bloor Homes on behalf of Bloor Homes and Barratt Homes who are looking at developing the site in a joint venture. The purpose of the work was to review a previous Desk Study and undertake Ground Investigation works to provide geotechnical and contamination risk information for the proposed construction of residential dwellings and associated gardens, public open spaces, new road and associated infrastructure. A proposed concept drawing can be seen below;



Concept Layout, drwg No. 661B-01, dated 18/08/17, by Randall Thorp.

2.2 Site Location

The site is located south of Holt Road, Wrexham (nearest postcode: LL13 9SJ). The coordinates for the centre of the site on National Grid are 336150, 351503. The site is approximately 28.37 hectares in plan area. See Site Location Plan in Appendix A.

2.3 Site Description

2.3.1 On Site

The site is roughly rectangular in shape and can be accessed from Bryn Estyn Road to the South. The site is predominantly used for agricultural arable use and is split into seven (7 No.) fields separated by hedgerows and fences. An area of woodland is located in the north of the site surrounding a steep valley feature. This valley feature becomes less prominent as it runs along the northern boundary of the site.

A large number of 'manure and slurry type waste' stockpiles are present along the South-East boundary of site. A further area of woodland is located within the north west of site surrounding a dried-up pond.

Site topography varies significantly, but generally sloping from South-West down to the North-West.

2.3.2 Surrounding Area

The area surrounding the site comprises of the following;

- North – Holt Road (A534 by-pass) and Wrexham Golf Course beyond.
- East – Residential development.
- South – Bryn Estyn Road beyond which lies Wrexham Rugby Club in SW, Erlas Victorian Walled Garden and Bryn Estyn House in the centre and agricultural land in the SE.
- West – agricultural land in the SE and Hanson Ready Mix Concrete Depot to the NE.

3 ENVIRONMENTAL SETTING AND DATA

3.1 Previously Undertaken Report/Investigation

Bloor Homes provided Betts Geo with a previously undertaken report for the site. This report is as follows;

- Stage 1 Contamination Assessment for Land off Holt Road, Wrexham for Barratt Manchester by Smith Grant Environmental Consultancy – November 2014 (Report ref: R2062-R01-v1 FINAL).

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. However, the historical maps have not been viewed as part of this study.

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 experienced and qualified 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

1879, 1:10,560 – *'The site is subdivided into several fields. Two features in the centre of the site may be small ponds.'*

1881, 1:2,500 – *'The central ponds are clearly indicated. No significant changes.'*

1899, 1:2,500 – *'A very small pond is indicated in the south of the site.'*

1914, 1:10,560 – *'The larger of the central ponds has changed shape, extending slightly to the south.'*

1964, 1:10,560 – *'The smaller of the two central ponds, and the pond in the south of the site is no longer indicated.'*

1992, 1:10,000 & 1:2,500 – *'A drain is indicated in the northwest part of the site.'*

2006-2009, Satellite Imagery (Various) – *'The site does not show significant changes other than an area of rough ground present to the south of Tyn Twll Farm contained various materials which cannot be identified from the resolution of the available imagery.'*

3.2.2 Surrounding Area

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

Date First Shown	Land Uses
1879	<i>'Tyn Twll, a farm or large dwelling is present adjacent to the northwest part of the site; Bryn Estyn Hall and grounds are to the south over Bryn Estyn lane which marks the site's southern boundary. A road also runs parallel but slightly away from the site's northern boundary. The remaining surrounding land use is as fields.'</i>

1881	<i>'A small sandpit is located 100m to the east of the site.'</i>
1899-1900	<i>'A well is indicated in the shallow valley to the north of the northeast corner of the site.'</i>
1911	<i>'A building has been constructed immediately to the south of the site mid-way along its boundary off Bryn Estyn Lane.'</i>
1938-1954	<i>'A sand pit is present to the northeast of the site within 20m of the site boundary. To the north an airfield is present, some additional buildings around the settlement of Rhosnesni to the east have been constructed.'</i>
1960-1962	<i>'The sand pit to the northeast of the site has been extended southwards and now runs along the sites eastern boundary for a distance of 200m.'</i>
1964	<i>'The land to the north of the site between the lane and airfield (which is now indicated as disused) is marked as a golf course.'</i>
1968	<i>'A smaller sand pit is indicated in the centre of Llan-y-Pwll 300m away from the site.'</i>
1974-1983	<i>'The road to the north-west of the site has been widened and a new roundabout constructed. The urban area of Wrexham to the west has undergone significant expansion mainly for residential use and associated services such as schools and parks, playing fields are present to the south of the site beyond Bryn Estyn hall. The former airfield to the north is now indicated as containing a sand and gravel pit.'</i>
1992	<i>'The central and southern parts of the sand pit to the east of the site are now indicated to be a tip. An unspecified works is marked in the north part of the former extraction area.'</i>
2006-2009	<i>'Housing has been constructed on former fields immediately to the west of the site around Tyn Twll farm; a tank or silo is also present within the farm which is not indicated on the historical maps. The former tip to the east is vegetated with the works to the north of this shown as containing a number of structures associated with an existing concrete batching plant, although these cannot be identified from the resolution of the available imagery.'</i>

'Whilst there are some gaps in the historical map coverage it is considered that the available information provides adequate coverage of the development history of the site and its' immediate surroundings. Historical features within the site and in the immediate surrounds which are considered relevant to risks from ground contamination or stability hazards are summarised in Drawing 001.'

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
Glacial Fluvial Deposits – Sand & Gravel	Halesowen 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 in an area which may be impacted by coal mining activity, however the Coal Authority Report obtained for the site indicates that the only worked seam of coal underlying the site is at 710m-810m depth and any movement associated with these workings should have stopped. The site is not in the likely zone of influence of current workings or an area where a licence has been granted for deep or opencast mining and there are no indications of mine entries, faults or other weaknesses which have been impacted by mining.'

4.1.2 Radon

'The radon atlas indicates the site is in an area where 1%-3% of dwellings may be at or above the action level. No radon protection measures are necessary in the construction of new dwellings or residences.'

4.2 Hydrogeological and Hydrological Features

4.2.1 Pollution Incidents to Controlled Waters

'A pollution incident to controlled waters is recorded at the south of the site; however, details of the receiving water are not available.'

4.2.2 Water Abstractions

'Three groundwater abstractions 500m to the northeast of the site have been authorised by the Environment Agency (Now Natural Resources Wales); these are for mineral washing operations in the nearby quarries.'

4.2.3 Hydrogeology:

- *The superficial deposits over all of the site and bedrock underlying the western parts of the site are*

classed as a Secondary A Aquifer, of variable permeability; however, the bedrock immediately to the east of the site forms a Principle Aquifer and is within the catchment of a Groundwater Source Protection Zone.'

- *'The site contains two tertiary surface watercourses which drain to the west and northeast of the northern boundary before possibly entering drains accosted with the new road construction to the north or the urban surface water drainage system to the west.'*

4.2.4 Flood Risk and Drainage Management Strategy

'The soils on the site are classed as highly permeable and are unlikely to be seasonally waterlogged.'

'The EA flood risk map shows most parts of the site to be at very low risk (less than 1 in 1,000 annually) from flooding events; land within the settlement of Llan-y-Pwll, 100m to the northeast of the site, appears within Zone 2 or 3 flood areas.'

5 ENVIRONMENTAL DATA

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

5.1 Landfill Sites and Waste Treatment Sites

‘Several minor areas of infilled land in the immediate surrounds may similarly contain degradable materials with the potential to produce hazardous gas, however only one is considered a source with the potential to constrain the planned redevelopment of the site. The former sand pit to the immediate east of the northern half of the eastern side boundary accepted mixed wastes 26 years ago.’

‘The landfill site is engineered in that it has been provided with a liner, however historical monitoring data indicates that very high methane and carbon dioxide concentrations were present at the site perimeter indicate limited functionality. Concentrations have decreased over time and this may be due to stabilisation of the waste materials, however a landfill gas extraction system has been established on the site and continues to function.’

An environmental search was requested from Wrexham Council Contaminated Land Team and a summary of their response is summarised below with a copy of their full response presented in Appendix .

A landfill known as Llan-y-pwll is located adjacent to the site on the eastern boundary. The site was a former sand and gravel pit. This landfill was historically operated by WCBC as a domestic waste landfill site between 1984 and 1988. The site was constructed as three separate lined cells and was provided with a leachate collection system. On completion the site was progressively provided with a clay cap with final restoration being completed in 1994. The site was restored to open space grazing land although it is not in use as grazing land and there is now no authorised public access to the site.

The site comprised three containment cells commissioned in phases between 1984 and 1986. SGP advised wastes are 18-20m deep (no final completion drawings are available to date to confirm; information inconsistent with groundwater borehole heights). All the cells were provided with a Vorclay bentonite liner (placed as a 100mm thick layer with 100mm seal). Permeability tests showed the liner was 1×10^{-8} – 1×10^{-10} m/s in each cell.

Each cell was provided with a leachate collection chamber draining to a central collection chamber in Cell 3 (MH3). A leachate pumping chamber was retrospectively installed in 1990 and connected to MH3. The leachate drains under gravity into the pumping chamber. Information held on file indicates the base of the cells to be ~1m above the Groundwater table. The sump in the main leachate pumping chamber is below the groundwater table.

An active gas extraction system was not installed on site as part of the original construction. Following the detection of high levels of methane in the leachate manholes and BH2 (on southern boundary) in 1988 it was concluded that the bentonite liner was permeable to gas. An active gas extraction system was installed on site by UKPS Ltd in 1993 – 1994. A pumped condensate system was installed in 1995 which drains to the main leachate chamber. A new surface water drainage system was installed at the site. This is designed to direct run-off from the slopes and access track to a new soakaway to prevent the entry of rainwater into the central leachate chamber and to reduce ponding within this area. The seep on the

northern slope was directed separately to the central leachate chamber for off-site disposal. A new flare was installed in 2009. The unit runs 8hrs / day and is on automatic cut out if there is insufficient gas. The unit is currently checked on a weekly basis by Uniflare.

The site has since been subject to a number of investigations since 2005, under Part 2A of the Environmental Protection Act 1990.

It was concluded that the residual presence of infilled materials on site may form an ongoing source of contamination. The previous investigations identified leachate break-out resulting in pollution of the groundwater within the alluvial aquifer close to the site primarily comprising total ammonia, chloride, COD and zinc.

The improvement works undertaken at the site with regards to the flare and gas extraction system in 2009 have been successful in controlling the off-site migration of landfill gas towards the nearby housing.

However, it was noted that elevated ground gas concentrations continue to be identified on the site's northern perimeter, although levels are reduced in the northeast corner closest to the housing, and are lower than pre-2009 concentrations in all wells.

On the basis of the on-going effective operation and management of the gas extraction system and flare the potential for a significant possibility for significant harm to exist is considered unlikely (Category 3). However, in the event of a failure or malfunction of the system the potential for a significant possibility for significant harm to exist associated with ground gas migration is considered reasonably possible / likely (Category 2 /3).

Landfill ground gas is continued to be monitored on a monthly basis and leachate and surface water monitoring is undertaken every 6 months.

5.2 Industrial Land Uses

'The historical mapping indicates that the site was open fields, although there is evidence to suggest that a number of small ponds within the site have been infilled; these possibly may also contain waste materials including hazardous materials such as asbestos or chemical wastes, or readily degradable materials which can produce hazardous ground gasses...'

5.2.1 Surrounding Industrial Land Uses

'There are no contemporary trade directory entries within the site itself; the adjacent farm was formerly may contain a fuel store or stores of chemicals for agricultural use. Other recorded industrial activities are of low potential to cause significant pollution. A concrete batching plant and sand and gravel quarry are present nearby.'

6 PREVIOUSLY UNDERTAKEN SITE INVESTIGATION (SRL)

6.1 SRL Soakaway Testing

Strata Renewables Ltd (SRL) were previously commissioned by Wardell Armstrong to undertake soakaway testing on the site on 15th-18th January 2018, of the twelve (12 No.) soakaways attempted eight (8 No.) yielded results of between 1.00E-05m/sec at SA102 and 8.13E-05m/sec at SA113. It is worth noting that following an initial mobilisation to site, infiltration tests were abandoned due to instabilities in the excavations. SRL later remobilised to site with single size aggregate to fill and support the infiltration excavations. The full results from the soakaway testing can be found in Appendix K.

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 occupied with arable fields with associated hedgerows and trees, any agrochemicals used have low residence times in the environment. Large stockpile of presumed filter cake located along southern boundary of site possible contamination risk.	Possible
Historical Land Use	On Site	Site remains agricultural from earliest available mapping, possible infilled ponds onsite containing asbestos, metals, TPHs, PAHs, fuels and agriculturally related materials.	Possible
Former Landfill	Adjacent to East Boundary	Potential migration of ground gas and leachate from neighbouring former landfill, client provided desk study noted very high concentrations of methane and carbon dioxide from peripheral monitoring that has subsequently dropped over time. Landfill understood to be lined reducing risk of migration of contaminants and ground gas and ground gas extraction system further reduce the risk from ground gas migration.	Yes
Tyn Twll Farm	Adjacent to North-West Boundary	Farm present from earliest mapping, potential for agricultural related contaminants including asbestos, fuels, PAHs, TPHs, elevated nutrients from agrochemical storage and heavy metals.	Possible

7.2 Pathways/ Receptors

Pathway/ Receptor	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 increased due to the permeable sands and gravels anticipated on site. Additional SI to confirm.	Possible
Aquifer	Underlying Site	Bedrock underlying the site is classed as a Secondary A Aquifer with Secondary A (variable permeability) glaciofluvial deposits overlying it. Due to the anticipated sands and gravels, the downward migration potential of any contamination is increased. Additional SI to confirm.	Possible

8 INITIAL CONCEPTUAL SITE MODEL

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

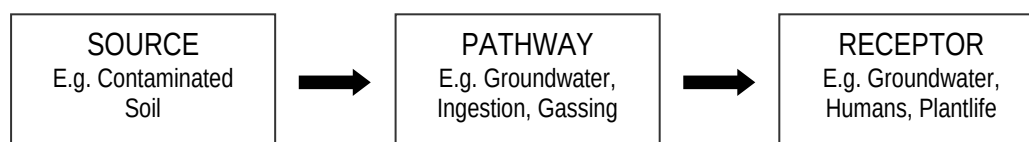
This section of the report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

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 – Infilled Ponds	Inhalation of Vapours	Construction/ Maintenance Workers	Potentially Active	Risk of ground gas from both the sites infilled ponds and adjacent former landfill. Generally granular superficial geology may not limit leachate and ground gas migration to beneath site. Historic gas monitoring data highlighted high methane and carbon dioxide. PPE to protect.	High
	Former Landfill	Vapours Penetrating Unprotected Buildings	Future Site Users	Potentially Active	Risk of ground gas from both the sites infilled ponds and adjacent former landfill. Generally granular superficial geology may not limit leachate and ground gas migration to beneath site. Historic gas monitoring data highlighted high methane and carbon dioxide. PPE to protect. Future site use to be residential.	High
Near Surface Contaminants Within Soils	Current Land Use Historic Land Use – Infilled Ponds Former Landfill Tyn Twll Farm	Ingestion, Inhalation, Dermal Contact	Current Site Users	Potentially Active	Potential for localised contaminants due to the sites infilled ponds, potential for metals, TPH's, PAH's, VOC's, SVOC's and asbestos however dependant on composition of fill materials. Previous SI only included soakaway testing therefore no previous data regarding contamination. Current and historic site use is agricultural therefore risk to current site end users is lessened. Potential for contaminated leachates migrating beneath site along eastern boundary from adjacent landfill. Possible agriculturally related contaminates from adjacent Tyn Twll farm including TPHs, PAHs, heavy metals, asbestos and agrochemicals. Additional SI required to confirm.	Low - Moderate
			Construction/ Maintenance Workers	Potentially Active	Potential for localised contaminants due to the sites infilled ponds, potential for metals, TPH's, PAH's, VOC's, SVOC's and asbestos however dependant on composition of fill materials. Previous SI only included soakaway testing therefore no previous data regarding contamination. Current and historic site use is agricultural therefore risk to current site end users is lessened. Potential for contaminated leachates migrating beneath site along eastern boundary from adjacent landfill, although landfill was lined. Possible agriculturally related contaminates from adjacent Tyn Twll farm including TPHs, PAHs, heavy metals, asbestos and agrochemicals. Additional SI required to confirm. PPE to protect.	Low - Moderate
			Future Site Users	Potentially Active	Potential for localised contaminants due to the sites infilled ponds, potential for metals, TPH's, PAH's, VOC's, SVOC's and asbestos however dependant on composition of fill materials. Previous SI only included soakaway testing therefore no previous data regarding contamination. Current and historic site use is agricultural therefore risk to current site end users is lessened. Potential for contaminated leachates migrating beneath site along eastern boundary from adjacent landfill, although landfill was lined. Possible agriculturally related contaminates from adjacent Tyn Twll farm including TPHs, PAHs, heavy metals, asbestos and agrochemicals. Additional SI required to confirm. Future site use to be residential with homegrown produce.	Moderate
			Adjacent Land Users	Potentially Active	Adjacent land uses are residential, agricultural and commercial/industrial from former landfill. Some localised contamination possible on site. Site anticipated to be surrounded by granular superficial deposits raising the risk of migration off site with high risk receptors nearby.	Low - Moderate
		Direct Contact	Structures	Potentially Active	Possible high/low pH's and high sulphates within the localised Made Ground on site which could affect foundations. Additional SI to confirm.	Low - Moderate
		Absorption in Root Zone	Plants	Potentially Active	Potential for localised contaminants due to the sites infilled ponds, potential for metals, TPH's, PAH's, VOC's, SVOC's and asbestos however dependant on	Low - Moderate

Type of Contamination	Potential Sources	Potential Pathway	Potential Receptors	Pollution Linkage	Comment	Estimated Level of Risk
					composition of fill materials. Previous SI only included soakaway testing therefore no previous data regarding contamination. Current and historic site use is agricultural therefore risk to current site end users is lessened. Potential for contaminated leachates migrating beneath site along eastern boundary from adjacent landfill, although landfill was lined. Possible agriculturally related contaminants from adjacent Tyn Twll farm including TPHs, PAHs, heavy metals, asbestos and agrochemicals. Additional SI required to confirm. Future site use to be residential with homegrown produce.	
Mobile Contaminants, Leachables e.g. from Pollution Sources on Site/Off Site	Historic Land Use – Infilled Ponds Former Landfill Tyn Twll Farm	Leaching into Groundwater	Groundwater	Potentially Active	Previous desk study highlighted limited functionality of the landfill lining therefore high likelihood of leachates escaping. Superficial and bedrock geology Secondary A aquifers. Site anticipated to be surrounded by granular superficial deposits raising risk of migration. Additional SI required to confirm.	Moderate - High
		Offsite Migration in Groundwater	Abstractions	Potentially Active	No noted abstractions nearby. Site is anticipated to be surrounded by granular superficial deposits raising lateral and vertical migration potential. High likelihood of landfill lining having limited ability to contain leachable contaminants. Superficial and bedrock geology Secondary A aquifers.	Moderate - High
			Controlled Waters	Potentially Active	A drain/stream is located running along the northern boundary of site. Possible receptor for any mobilised/leachable contamination and the site is anticipated to be surrounded by granular superficial deposits raising any risk of migration.	Moderate - High
Organic and Inorganic Contaminants Within Soils / Groundwater	Current Land Use Historic Land Use – Infilled Ponds Former Landfill Tyn Twll Farm	Potable Water Supply Pipes	Utilities Workers	Potentially Active	Potential for localised TPH contamination due to sites infilled ponds, former landfill and adjacent farm. Risk to be assessed once water pipeline routes are known then liaise with local water authority supplier.	Moderate

8.2 Summary

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

8.3 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 areas of infilling former ponds onsite.
- Possible heave / shrink in cohesive strata (should it be encountered, no anticipated) due to trees.
- Potential for running sands within granular strata.

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 15th October – 24th October 2018 for the trial pitting, window sampling and cable percussive boreholes and comprised of the following;

- Five (5 No.) cable percussive boreholes drilled to 20.00mbgl.
- Thirty-Seven (37 No.) machine excavated trial holes.
- Eleven (11 No.) small diameter boreholes to a maximum of 3.00mbgl, all installed with gas/groundwater monitoring wells.
- Seven (7 No.) soakaway tests.
- Twelve (12 No.) ground gas monitoring visits over a period of at least six months with varying barometric pressures.
- Chemical analysis (Metals, PAH's, TPH's) of thirty-four (34 No.) samples.
- Analysis of thirty-five (35 No.) samples for asbestos screening analysis.
- Asbestos Quantification of two (2 No.) samples.
- Twenty-Five (23 No.) samples for geotechnical analysis;
 - Twelve (12 No.) samples for Particle Size Distribution Testing.
 - Eleven (11 No.) samples for Atterberg Limits to assess heave potential and confirm classification.

9.3 Targeted Investigation

Trial pits were positioned across site to give an even spread and representation of site. Cable percussive boreholes were positioned along the Eastern boundary of site to identify any ground gas migration from the neighbouring former landfill. Soakaways were located at proposed infiltration pond locations and window samples were primarily located along the Eastern boundary of site with remaining locations spread across site in the vicinity of former ponds.

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 0.90mbgl) overlying GLACIOFLUVIAL DEPOSITS principally comprising loose to medium dense SAND, gravelly SAND and GRAVEL with localised beds of firm to stiff CLAY proven to 20.00mbgl.

A localised area of Made Ground was encountered in TP29 between 0.40mbgl 0 1.70mbgl where localised land raising appears to have taken place.

10.2 Ground Conditions Summary

Strata	General Description	Thickness m		No of Holes Located
		Top	Base	
TOPSOIL	Stubble/ weeds/ grass over dark brown slightly silty occasionally gravelly organic sand with rootlets.	0.00	0.90 (TP37)	All holes.
MADE GROUND	Grey brown very sandy gravel with cobbles of brick and Sandstone.	0.40 (TP29)	1.70 (TP29)	TP29.
GLACIOFLUVIAL DEPOSITS	Orangish/reddish/light brown SAND, gravelly SAND and GRAVEL with occasional firm to stiff CLAYS.	0.30 (BH01)	20.00 (BH01)	All holes.

10.2.1 Topsoil

Topsoil was encountered within all exploratory holes from ground surface to 0.90mbgl but typically 0.30m bgl and generally comprised of dark brown slightly silty occasionally gravelly organic sand.

10.2.2 Made Ground

Made Ground was encountered locally in the north of the site within TP29 between 0.40m and 1.70m bgl, comprising grey brown very sandy gravel with cobbles of brick and sandstone. This area is located adjacent to an existing valley feature (which is more pronounced to the northwest of TP29) and it appears this feature has been locally infilled to increase the accessible agricultural land.

10.2.3 Glaciofluvial

Generally, directly beneath the topsoil, a sequence of orangish, reddish to light brown Sand with variable gravel content, in places Sand and Gravel was encountered to depth. Locally thin beds of firm to stiff clays were noted becoming more significant in the west of the site. Locally within TP21 soft clays comprising low plasticity brown mottled orange brown and grey laminated in places slightly sandy silty Clay were encountered beneath firm to stiff clays from 1.70m and proven to 3.20m bgl.

Standard Penetration Test (SPT) 'N' values of between 7 and >50 were recorded within the granular deposits, but were typically between 10-18 within the upper 3m and increasing with depth. The Angle of shearing resistance Φ can be derived from SPT 'N' values using the relationship put forward by Peck et al. Based on SPT 'N' Values of between 10 and 18 an Angle of Shearing Resistance of between 23° and 33° is calculated.

Eleven Atterberg tests were undertaken on cohesive samples recovered from the Trial pits which recorded a moisture content of between 9% - 29% and a Plasticity Index of between 3% - 15%. A Modified plasticity index of between 2.88% - 14.85% has been calculated, which corresponds to a material with low volume change potential.

One 'N' value of 29 was recorded in a cohesive bed at depth.

Indicative undrained shear strengths can be derived for the cohesive soils by applying a correlation factor to SPT 'N' values according to the material's plasticity, after Stroud. Based on typical plasticity index of 15% for the clay, a correction factor of 6 is derived. For a SPT 'N' value of 29 an indicative shear strength of 174kPa was calculated.

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.

10.5 Groundwater – Fieldwork

No groundwater was encountered during field work site investigation works.

10.6 Groundwater – Post Fieldwork Monitoring (ONGOING)

The table below indicates groundwater encountered during the monitoring post fieldwork (2/12 visits have been undertaken);

Exploratory Hole	Depth to Water (mbgl)		Borehole Depth (mbgl)	
	Min	Max	Min	Max
WS1	Dry	Dry	2.95	3.15
WS2	Dry	Dry	3.00	3.01
WS3	Dry	Dry	3.00	3.17
WS4	Dry	Dry	3.14	3.14
WS5	Dry	Dry	3.00	3.10
WS6	Dry	Dry	3.00	3.10
WS7	Dry	Dry	3.10	3.12
WS8	Dry	Dry	3.05	3.06
WS9	Dry	Dry	1.51	1.52
WS10	Dry	Dry	2.07	2.08
WS11	Dry	Dry	3.08	3.10

Exploratory Hole	Depth to Water (mbgl)		Borehole Depth (mbgl)	
	Min	Max	Min	Max
BH1	Dry	Dry	19.95	20.10
BH2	Dry	Dry	18.96	19.78
BH3	Dry	Dry	19.47	19.95
BH4	Dry	Dry	20.00	20.05
BH5	Dry	Dry	18.69	19.37

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	57	Determination of pH (using Cyberscan pH meter).
Sulphate - Soluble 2:1 Extract	57	Dionex.
Arsenic, Cadmium, Chromium VI, Chromium III, Total Chromium, Lead, Mercury, Selenium, Copper, Nickel, Complex and Free Cyanide and Zinc.	34	Soil samples were analysed in accordance with UKAS/MCERTS standards Inductively coupled plasma atomic emission spectroscopy (ICP-OES)
Speciated Polycyclic Aromatic Hydrocarbons (PAH),	34	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	34	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)	34	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12).
Organic Matter	34	Determination of Organic Matter by combustion.
Asbestos Screen	34	Visual Screening for Fibres and PLM
Asbestos Quantification	2	Visual identification, hand picking, weighing and fibre counting by sedimentation/phase contrast optical microscopy.

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 Glaciofluvial Deposits are classed as a Secondary A Aquifer (Moderate Permeability). The bedrock deposits of the Salop Formation are classed as a Secondary Aquifer (Variable 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 generally indicated a Low - Moderate risk of contamination, however a historical landfill is located adjacent to the eastern boundary of the site, with a potential Moderate risk from 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

12.2.1 Topsoil

All determinants for heavy metals, TPH's and PAH's fell below the residential with home grown produce guidance values within the topsoil. However, Chrysotile board asbestos quantified to <0.001 was encountered in TP12 at 0.20-0.30mbgl.

12.2.2 Made Ground

Isolated Made Ground was encountered onsite within TP29, Chrysotile loose fibres asbestos quantified to 0.008 was encountered at this locality.

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

12.2.3 'Slurry Waste' Stockpile

The sample of slurry waste did not record any elevated concentrations of contaminants, although a relatively high organic matter content of 15% was noted.

12.2.4 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.

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 A Aquifer (Low/Negligible Permeability) and the bedrock deposits classed as a Secondary A Aquifer (Variable 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

Two (2 No.) occurrences of asbestos was identified across the site requiring further assessment.

Asbestos (Chrysotile) was identified in two samples, TP12 and TP29, at a concentration of <0.001 and 0.008% respectively.

ICRCL Guidance Note 64/85 "Asbestos on Contaminated Sites" (1990) is still the most current guidance for asbestos in soil and suggest asbestos fibres should be <0.001% w/w within soil. Dutch and Australian Guidance also suggest the use of a threshold of 0.001% as a threshold for asbestos in soil. The Dutch Guidelines consider the risk from Chrysotile to be ten times less than Amphibole asbestos but the HSE, WHO, the Australian DoH and the USEPA have chosen not to distinguish between different asbestos fibre types.

As the recorded concentration within TP12 is less than the threshold of 0.001%, it is deemed unlikely to pose a risk, however care should be taken on site as the further presence of asbestos cannot be discounted and it is recommended that vigilance during ground works in this area is maintained as it may relate to a historical farm building.

The recorded concentration within TP29 relates to the Made Ground and although there is no current exposure pathway as it lies beneath 0.40m of topsoil, the risk will need to be further assessed once a detailed development layout is confirmed. However, based on the current site layout and the fact the contaminated strata were identified at depths of between 0.20mgl – 0.50mgl, it may be possible to leave this material in-situ due to the affected areas being proposed as landscaping and woodland. The asbestos

location areas are shown as a red dots on the 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 the development layout changes further delineation may be required in the vicinity of TP29, with either the following likely to reduce the risk to proposed end users:

- A 600mm cover system (150mm topsoil/450mm subsoil with either a geotextile marker layer or hard to dig layer); or
- The Made Ground is further delineated in the vicinity of TP29 and possibly removed, disposed off site and replaced with a chemically and geotechnically suitable alternative.

Groundwater and Aquifer Risk

No significant risks to groundwater and aquifers are anticipated from the site due no significant soil contamination hotspots being identified during the ground investigation and lack of groundwater encountered.

The landfill located to the east of the site is lined and has a leachate recovery system, intrusive

investigations have indicate that leachate breakout has occurred resulting in the pollution of the aquifer within the Glaciofluvial Deposits close to the landfill, with contaminants comprising total ammonia, chloride, COD and zinc. The groundwater flow is anticipated to be in a northeast to easterly direction away from the subject site and therefore the risk to site is low.

14 GROUND GAS ASSESSMENT

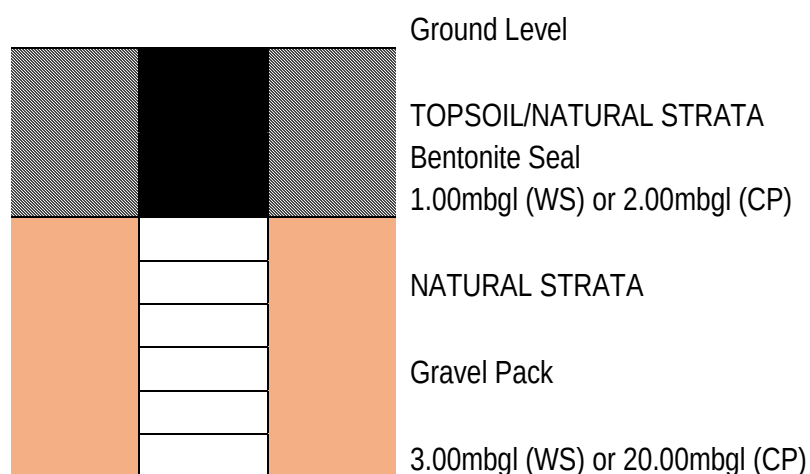
14.1 Ground Gas Requirements – Radon

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. It is recommended that this is confirmed with the local building control.

14.2 Ground Gas Assessment (ONGOING)

14.2.1 Ground Gas Boreholes Installations

The eleven (11 No.) window sample boreholes and five (5 No.) cable percussive boreholes were all installed to 3.00mbgl and 20.00mbgl respectively with 1.00m or 2.00m of plain pipe and 2.00m or 18.00m of slotted pipe into the Natural Strata below. A typical installation is shown below;



14.2.2 Summary of Results (ONGOING)

Three out of twelve (3/12) ground gas visits have been completed and the details are summarised below (see Appendix E for full results);

Borehole Number	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Barometric Pressure (mB)	Peak Flow (l/hr)	GSV CH ₄	GSV CO ₂	No. of Visits
WS1	0.0 – 0.1	1.1 – 1.4	19.5 – 19.7	1006 - 1018	0.0 - 0.1	0.000	0.001	3/12
WS2	0.0	0.5 – 2.0	19.0 - 20.2	1006 - 1018	0.1 – 0.2	0.000	0.005	3/12
WS3	0.0	0.1 – 2.1	19.3 - 20.6	1006 - 1018	0.0 – 0.5	0.000	0.011	3/12
WS4	0.0	0.3 – 4.7	16.0 - 20.3	1006 - 1018	0.1 – 0.3	0.000	0.014	3/12
WS5	0.0	0.6 – 4.5	18.0 - 20.0	1006 - 1018	0.1 – 1.0	0.000	0.045	3/12
WS6	0.0	0.5 – 5.3	14.2 - 20.1	1006 - 1018	0.3 – 2.3	0.000	0.122	3/12
WS7	0.0	0.1 – 2.1	19.6 - 20.7	1006 - 1018	0.1 – 0.2	0.000	0.004	3/12
WS8	0.0	0.7 – 1.2	20.3 - 20.6	1006 - 1018	0.0 – 0.4	0.000	0.005	3/12

WS9	0.0	1.2 – 1.3	20.1 – 20.4	1006 - 1018	0.0	0.000	0.000	2/12
WS10	0.0	0.6 – 1.0	20.6	1006 - 1018	0.0 – 0.1	0.000	0.001	2/12
WS11	0.0 - 0.1	1.2 – 1.8	19.8 - 20.3	1006 - 1018	0.0 – 0.3	0.000	0.005	2/12
BH1	0.0	0.2 – 4.0	13.5 - 20.3	1006 - 1018	0.0 – 1.9	0.001	0.076	2/12
BH2	0.0	0.1 – 7.5	9.90 - 20.5	1006 - 1018	0.0 – 0.7	0.001	0.053	2/12
BH3	0.0 – 0.2	0.1 – 12.3	2.0 - 20.5	1006 - 1018	0.0 – 2.3	0.005	0.283	2/12
BH4	0.0	0.1 – 7.9	7.4 - 20.4	1006 - 1018	0.1 – 1.4	0.001	0.182	2/12
BH5	0.0	0.1 – 6.7	10.6 - 20.6	1006 - 1018	0.0 – 0.5	0.001	0.094	2/12

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 significant elevated levels of ground gas being identified during the initial gas monitoring visits, the following preliminary ground gas assessment has been made:

Site Area	Site Classification	Recommended Ground Gas Protection Measures
Majority Site	Green	No specialist ground gas protection is required.
Area along Eastern Boundary	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.
Area in Vicinity of BH3	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.

For the purpose of pricing it would be prudent to use Amber 1 ground gas protection measures for the majority of site and Amber 2 for the area along the eastern boundary until the ground gas monitoring is completed.

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 ongoing – assume Amber 1 (majority of site) and Amber 2 (eastern boundary) until monitoring is complete.	Low
Site End Users	Ingestion of, and skin contact with, contaminated soil.	No remedial action anticipated subject to site layout.	Low
Site End Users	Ingestion of contaminants in vegetables etc. or in soils adhering to vegetables, etc	No remedial action anticipated subject to site layout.	Low
Construction/ Maintenance Workers	Inhalation of soil gases, odours or dust.	PPE, tool box talks.	Low (assumed basic PPE is used)
Construction/ Maintenance Workers	Ingestion of, and skin contact with, contaminated soil	PPE, tool box talks.	Low (assumed basic PPE is used)
Plants	Adverse effects on growth caused by presence of contaminants in soil	No remedial action required.	Low
Buildings and Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion and fire hazards	Gas monitoring ongoing – assume Amber 1 (majority of site) and Amber 2 (eastern boundary) until monitoring is complete.	Low
Foundations	Sulphate attack of foundations	Foundations to be designed as per section 18.4.	Low
Water Supplies	Hydrocarbons penetrating plastic water supply pipes.	Severn Dee 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 remedial action required.	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

No contamination was encountered on site other than localised areas of asbestos, 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.
- Asbestos was encountered on site, therefore vigilance should be adhered, and any suspected asbestos should be notified and a suitably qualified person appointed to inspect.

16.3 Site-End Users

As the recorded asbestos concentration within TP12 is less than the threshold of 0.001%, it is deemed unlikely to pose a risk, however care should be taken on site as the further presence of asbestos cannot be discounted and it is recommended that vigilance during ground works in this area is maintained as it may relate to a historical farm building.

The recorded asbestos concentration within TP29 relates to the Made Ground and although there is no current exposure pathway as it lies beneath 0.40m of topsoil, the risk will need to be further assessed once a detailed development layout is confirmed. However, based on the current site layout and the fact the contaminated strata were identified at depths of between 0.20mgl – 0.50mbgl, it may be possible to leave this material in-situ due to the affected areas being proposed as landscaping and woodland. Based on the current site layout it may be possible to leave this material in-situ due to the area being proposed as woodland however the shallow depths the contamination was encountered from 0.20mbgl this raises the risk.

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 hotspots 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.

Further testing of the onsite topsoil should be undertaken to confirm suitability for reuse. 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

No significant risks to groundwater and aquifers are anticipated across the site due to both the lack of groundwater encountered and no elevated leachable 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.

For the purpose of pricing it would be prudent to use Amber 1 ground gas protection measures for the majority of site and Amber 2 for area along the eastern boundary until the ground gas monitoring is completed.

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 Severn Dee.

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.

17 GEOTECHNICAL ASSESSMENT

17.1 Introduction

It is understood that the proposed development will consist of the construction of low-rise residential properties with associated rear gardens, associated infrastructure and public open space. No structural loadings are known at this time however it is anticipated that any proposed loadings will be low to moderate.

As part of the development it is understood that a number of attenuation ponds are likely to be required as part of the development. In addition, it is understood that the northeast and northwest of the site is unlikely to be developable due to existing site levels and such no houses will be constructed in the northern area of the site.

It is anticipated that cut and fill works will be required however, additional review and assessment is advised upon clarification of site levels, layout and earthworks methodology.

17.2 Site Preparation and Excavation

Stockpiles of manure and slurry/ filter cake types waste was noted within the South-East of the site and it is recommended that these are removed offsite as part of the site preparation works.

A water main runs parallel with the site's western boundary. Excavation in close proximity to mains services (it is assumed these are to be kept live for the majority of the works) will need to ensure that the excavation walls are stable or appropriately battered to a safe angle, temporary slope stability works may be required in any deep excavations. Liaison with Welsh Water is advised.

No buried obstructions were encountered during this investigation, however the possibility of buried obstructions being encountered cannot be discounted and an allowance should be made for breaking out, for example provision of pneumatic breakers for site plant. Following breaking out of any obstructions, excavations of shallow soils should not present any difficulty for conventional plant and equipment.

Topsoil and unsuitable Made Ground should be removed from beneath all building and hard standing areas.

Spoil resulting from excavations within the Made Ground and the recent pond deposits will not be suitable for reuse as engineered fill and may either be used for landscaping (subject to the necessary approvals/consents) or disposed of off-site.

Excavations undertaken during site works greater than 2.0m bgl were generally unstable.

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.

17.3 Control of Groundwater

Limited groundwater was encountered on site other than strata being recorded as wet or damp. However, groundwater levels may vary from those at the time of the investigation, for example in response to seasonal fluctuations as part of the scope of works long-term groundwater monitoring is ongoing.

17.4 Heave / Shrinkage Potential

A summary of Atterberg limit tests (both preliminary and additional investigation) 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
TP08	0.80	9.9	26.0	15	98	11	LOW
TP09	1.30	13.0	26.0	15	95	11	LOW
TP13	2.00	26.0	28.0	16	99	12	LOW
TP14	2.20	23.0	28.0	21	100	7	None Shrinkable
TP20	1.80	16.0	36.0	21	99	15	LOW
TP21	2.50	29.0	34.0	21	100	13	LOW
TP23	1.20	9.0	32.0	23	83	9	None Shrinkable
TP23	1.80	10.0	25.0	16	91	9	None Shrinkable
TP25	3.00	24.0	26.0	23	96	3	None Shrinkable
TP33	1.20	20.0	29.0	17	86	12	LOW
TP37	1.60	22.0	22.0	21	100	8	None Shrinkable

None shrinkable to LOW volume change potential is evident; foundation design for tree heave protection should be designed accordingly following discussion with the NHBC, with a minimum foundation depth of 0.9m required where shrinkable soils are present.

17.5 Foundations

Loose to medium dense sands have been encountered at shallow depth across the majority of the site and therefore the adoption of standard shallow strip foundations founded at a minimum of 0.45mbgl can be designed with an allowable bearing pressure of 125kN/m². This should limit total foundation settlement to less than 25mm and differential to less than 15mm for foundation widths up to 1m.

Locally thin to very thick beds of firm to stiff clay are present, therefore as a precaution a minimum foundation depth of 0.75m bgl should be adopted. Given the recorded ground conditions it would be prudent to undertake further trial pitting to confirm the presence of shrinkable soils at foundation depth on a plot by plot basis.

Deepening of foundations in accordance with NHBC Standards will be required where foundations are within the zone of influence of existing or proposed trees and proposed shrub planting and shrinkable soils are encountered at foundation level.

Where foundations are within the influence of trees and are deeper than 1.5m bgl, a suitable compressible material or void former will be required.

Where foundations require deepening to greater than 2.5m below ground level, they must be designed by an engineer, as specified in NHBC Technical Requirement R5.

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.

It is recommended that a foundation zoning plan should be undertaken when proposed levels are made available and further plot by plot trial pitting has been undertaken.

17.6 Ground Floor Construction

Generally non-shrinkable soils are present across the majority of the site at formation level and therefore ground bearing floor slabs could be adopted. Ground bearing slabs may be used if the following criteria are satisfied:

- the foundation depth (such as due to the influence of trees) is less than 1.5m;
- any fill is suitable, well-compacted granular material and less than 600mm thick; and
- it is demonstrated that desiccation is not present, and soils are at their equilibrium moisture content.

Where shrinkable soils are present at shallow depth across the site suspended floor construction (e.g. either in-situ RC slabs or block and beam flooring) should be adopted in accordance with NHBC guidance.

On completion of the ground gas monitoring it may be requirement to incorporate a ventilated subfloor void.

17.7 Soakaways

Soakaway tests were undertaken at seven locations across the site at proposed infiltration pond locations as part of the Betts Geo fieldwork to provide preliminary infiltration rates for initial soakaway design.

Infiltration rates of between 1.5×10^{-5} to 9.9×10^{-5} m/s have been recorded indicating that soakaway drains could provide a viable drainage solution.

It is recommended that further infiltration testing is undertaken once a site layout is finalised, the scope of the testing should be agreed with the local authority.

17.8 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 sands/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.

17.9 Protection of Buried Concrete

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

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

17.10 Reuse of Site-won Materials

An initial assessment has been completed on the potential to re-use site-won materials as an engineered fill material.

The geotechnical assessment of the site-won materials indicates the soils which are likely to be re-used can be classified as Class 1 granular (less than 15% finer than the 63µm), which may be able to be used for General Fill Material.

Where an increased end-performance of the material is required over and above those defined for general fill materials additional testing and specification will be required, which is outside of the scope of the current assessment.

Where it is proposed to re-use site won materials as an engineered fill, it will be necessary to develop an appropriate Site-Specific Earthworks Specification which can be adopted as part of the contract documentation. The basis for the Specification should be BS 6031 and the latest version of the SHW, Series 600 Earthworks.

In order to develop the earthworks specification, a detailed cut and fill assessment will be required. In addition, information on the design loadings and tolerable settlements for all structures will need to be provided so a full assessment of their implications can be accounted for within the acceptability limits for the various materials.

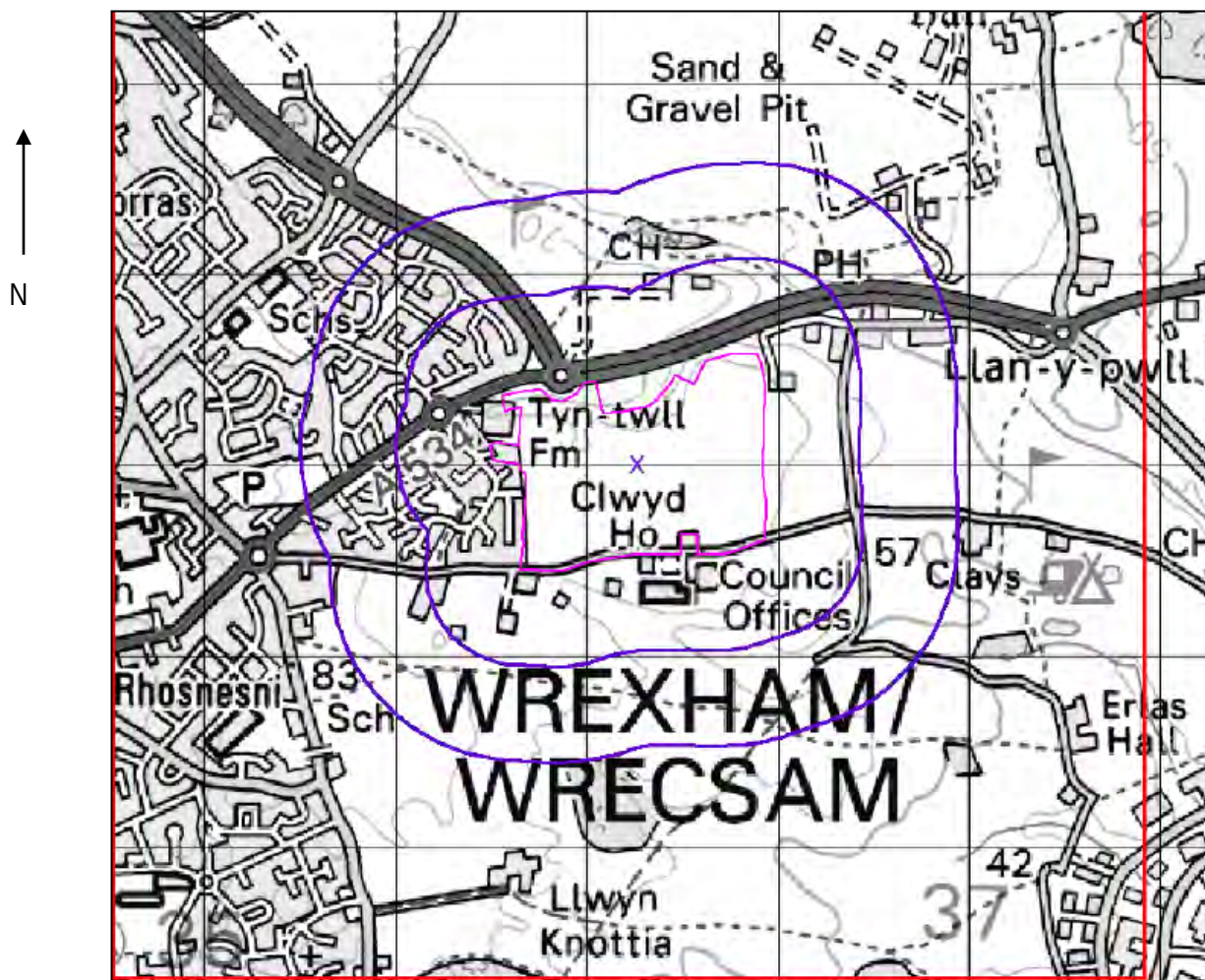
18 ADDITIONAL WORKS REQUIRED

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

- Completion of ground gas monitoring programme.
- Review of conclusions within this report once a development layout is confirmed.
- Removal of 'manure and slurry/ filter cake' stockpiles in the South-East of the site.
- Further trial pitting on a plot by plot basis to confirm heave potential and foundation depths.
- Foundation Zonation Plan.
- Earthworks Specification.
- Further infiltration testing if private soakaways are to be adopted.

APPENDIX A

(i) Site Location Plan



Site Location Plan

Land south of Holt Road, Wrexham, LL13 9SJ. The coordinates for the centre of the site on National Grid are 336130, 351500. The site is approximately 28.92 hectares in size.

APPENDIX B

(i) Betts Exploratory Hole Location Plan

APPENDIX C

(i) Betts Exploratory Hole Logs

APPENDIX D

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

APPENDIX E

(i) Gas Monitoring Data

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 Bloor Homes and Barratt Homes. In response to particular instructions, any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

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

Betts Geo Environmental Ltd accepts no responsibility or liability

a) for the consequences of this document being used for the purpose other than that for which it was commissioned and
For this document to any other party other than the person by whom it was commissioned.

APPENDIX K

(i) Soakaway Testing Results

APPENDIX L

(i) Local Authority Response

Bloor Homes

Ground Investigation Report

for

Holt Road, Wrexham

November 2018

REPORT NO: 18BLH002/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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Contract: Holt Road, Wrexham

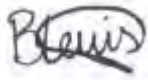
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1 EXECUTIVE SUMMARY

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

1. Site Location

The site is located south of Holt Road, Wrexham (nearest postcode: LL13 9SJ). The coordinates for the centre of the site on National Grid are 336150, 351503. The site is approximately 28.37 hectares in plan area.

2. Site Description

On Site

The site is roughly rectangular in shape and can be accessed from Bryn Estyn Road to the South. The site is predominantly agricultural fields separated by hedgerows and fences. An area of woodland is located in the north of the site surrounding a steep valley feature. Site topography varies significantly, but generally slopes from the South-West down to the North-West.

A large number of 'manure and slurry type waste' stockpiles are present along the South-East boundary of site. An area of woodland is located within the north west of site surrounding a dried-up pond.

Surrounding Area

The surrounding area consists of the former Holt Road, and the A534, to the north with Wrexham golf course beyond with residential housing and a farm to the west. Bryn Estyn Road forms the southern boundary beyond which lies Wrexham Rugby Club in SW, Erlas Victorian Walled Garden and Bryn Estyn House in the centre and agricultural land in the SE. Farmland lies to the southeast of the site with a former landfill and Hanson Ready Mix Concrete Depot to the NE.

3. Proposed Development

Low rise residential dwellings, associated gardens, public open spaces, new access roads and associated infrastructure including SUDS.

➤ Previously Undertaken Reports/Work

Bloor Homes provided Betts Geo with the following reports for the site. These reports are as follows;

- Stage 1 Contamination Assessment for Land off Holt Road, Wrexham for Barratt Manchester by Smith Grant Environmental Consultancy – November 2014 (Report ref: R2062-R01-v1 FINAL).
- Strata Renewables Ltd (SRL) Infiltration tests 15th-18th January 2018.

4. Site History

On Site

Historical review in the Smith Grant Report indicate that the site has been largely in agricultural use throughout its mapped history, with a number of potentially infilled ponds in the centre of the site.

Surrounding Area

The surrounding area has generally comprised of agricultural farmland, with the encroachment to the west from Wrexham urban development. Land to the east has historically been worked as 'sand pit' from the 1930's, part of which was used for landfilling in the 1980's.

5. 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 at significant depth from historical workings, any associated movement should have now ceased. The risk from shallow coal workings and unrecorded mine entries is very low.

➤ Hydrogeology and Hydrology

- *The superficial deposits over all of the site and bedrock underlying the western parts of the site are classed as a Secondary A Aquifer, of variable permeability; however, the bedrock immediately to the east of the site forms a Principle Aquifer within the catchment of a Groundwater Source Protection Zone.'*

- *'The site contains two tertiary surface watercourses which drain to the west and northeast of the northern boundary before possibly entering drains accosted with the new road construction to the north or the urban surface water drainage system to the west.'*

6. Summary of Environmental Data

Possible Contamination Sources

- Current Land Use on Site – Unlikely
- Historical Land Use – On Site – Unlikely .
- Coal Mining – On Site – Low Risk.
- Pollution Incident — No.
- Landfill – Adjacent – Possible
- Tyn Twll Farm - Possible

Pathways and Receptors

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

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

7. Scope of Investigation

The fieldwork was carried out between the 15th October – 24th October 2018 for the trial pitting, window sampling and cable percussive boreholes and comprised of the following;

- Five (5 No.) cable percussive boreholes drilled to 20.00mbgl.
- Thirty-Seven (37 No.) machine excavated trial holes.
- Eleven (11 No.) small diameter boreholes to a maximum of 3.00mbgl, all installed with gas/groundwater monitoring wells.
- Seven (7 No.) soakaway tests.
- Twelve (12 No.) ground gas monitoring visits over a period of at least six months with varying barometric pressures.
- Chemical analysis (Metals, PAH's, TPH's) of thirty-four (34 No.) samples.
- Analysis of thirty-five (35 No.) samples for asbestos screening analysis.
- Asbestos Quantification of two (2 No.) samples.
- Twenty-Five (23 No.) samples for geotechnical analysis;
- Twelve (12 No.) samples for Particle Size Distribution Testing.
- Eleven (11 No.) samples for Atterberg Limits to assess heave potential and confirm classification.

8. Ground Conditions Encountered

Ground conditions generally consists of TOSPOIL (to a maximum depth of 0.90mbgl) overlying GLACIOFLUVIAL DEPOSITS principally comprising loose to medium dense SAND, gravelly SAND and GRAVEL with localised beds of firm to stiff CLAY proven to 20.00mbgl. Localised Made Ground was encountered in the north of the site within TP29 to 1.70m bgl.

9. Contamination Encountered

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

Asbestos was identified in the samples mentioned above at TP12 and TP29 within topsoil and made ground respectively.

Quantification testing has recorded a value of <0.001% of asbestos within the sample at TP12 and a value of 0.008% within the Made Ground sample from TP29.

The recorded concentration within TP29 relates to the Made Ground and although there is no current exposure pathway as it lies beneath 0.40m of topsoil, the risk will need to be further assessed once a detailed development layout is confirmed. However, based on the current site layout and the fact the contaminated strata were identified at depths of between 0.20mgl –

0.50mbgl, it may be possible to leave this material in-situ due to the affected areas being proposed as landscaping and woodland.

10. Remedial Actions

Soils

As the recorded concentration within TP12 is less than the threshold of 0.001%, it is deemed unlikely to pose a risk, however care should be taken on site as the further presence of asbestos cannot be discounted and it is recommended that vigilance during ground works in this area is maintained as it may relate to a historical farm building.

The recorded concentration within TP29 relates to the Made Ground and although there is no current exposure pathway as it lies beneath 0.40m of topsoil, the risk will need to be further assessed once a detailed development layout is confirmed. However, based on the current site layout and the fact the contaminated strata were identified at depths of between 0.20mgl – 0.50mbgl, it may be possible to leave this material in-situ due to the affected areas being proposed as landscaping and woodland.

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.

Groundwater, Surface Water and Aquifer Risk

No significant risks to groundwater and aquifers are anticipated across the site due to both the lack of groundwater encountered and no significant soil contamination hotspots being identified during the ground investigation.

11. 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 made ground and natural should be possible given the chemical analysis and very different visual identification.

12. 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 ongoing. To date, generally no significantly elevated concentrations of ground gas have been identified and preliminary the majority of the site would be classified as green – with no specialist ground gas protection required. However, along the eastern boundary elevated ground gas concentrations have been identified and therefore for the purpose of pricing it would be prudent to assume Amber 1 across the majority of the site with Amber 2 ground gas protection measures for plots located in the east of the site until the ground gas monitoring is completed.

13. Foundations

Loose to medium dense sands have been encountered at shallow depth across the majority of the site and therefore the adoption of standard shallow strip foundations founded at a minimum of 0.45mbgl can be designed with an allowable bearing pressure of 125kN/m². This should limit total foundation settlement to less than 25mm and differential to less than 15mm for foundation widths up to 1m.

Locally thin to very thick beds of firm to stiff clay are present, therefore as a precaution a minimum foundation depth of 0.75m bgl should be adopted. Given the recorded ground conditions it would be prudent to undertake further trial pitting to confirm the presence of shrinkable soils at foundation depth on a plot by plot basis.

Deepening of foundations in accordance with NHBC Standards will be required.

14. Heave / Shrinkage Potential

None shrinkable to LOW volume change potential is evident; foundation design for tree heave protection should be designed accordingly following discussion with the NHBC, with a minimum foundation depth of 0.9m required where shrinkable soils are present

15. Ground Floor Construction

Generally non-shrinkable soils are present across the majority of the site at formation level and therefore ground bearing floor slabs could be adopted. Ground bearing slabs may be used if the following criteria are satisfied:

- the foundation depth (such as due to the influence of trees) is less than 1.5m;
- any fill is suitable, well-compacted granular material and less than 600mm thick; and
- it is demonstrated that desiccation is not present, and soils are at their equilibrium moisture content.

Where shrinkable soils are present at shallow depth across the site suspended floor construction (e.g. either in-situ RC slabs or block and beam flooring) should be adopted in accordance with NHBC guidance.

16. 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 sands/firm to stiff clay is anticipated, however in-situ CBR's should be undertaken during construction to confirm.

17. Site Preparation and Excavation

Stockpiles of manure and slurry/ filter cake types waste was noted within the South-East of the site removed offsite as part of the site preparation works.

A water main runs parallel with the site's western boundary. Excavation in close proximity to mains services will need to ensure that the excavation walls are stable or appropriately battered to a safe angle,

No buried obstructions were encountered during this investigation, however an allowance should be made for breaking out, for example provision of pneumatic breakers for site plant. Excavations of shallow soils should not present any difficulty for conventional plant and equipment.

Topsoil and unsuitable Made Ground should be removed from beneath all building and hard standing areas.

Excavations undertaken during site works greater than 2.0m bgl were generally unstable.

18. Control of Groundwater

No significant groundwater was encountered on site other than strata being recorded as wet or damp. However, groundwater levels may vary from those at the time of the investigation, for example in response to seasonal fluctuations as part of the scope of works long-term groundwater monitoring is ongoing.

19. Concrete Design

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

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

20. Soakaways

Infiltration rates of between 1.5×10^{-5} to 9.9×10^{-5} m/s have been recorded indicating that soakaway drains could provide a viable drainage solution.

It is recommended that further infiltration testing is undertaken once a site layout is finalised, the scope of the testing should be agreed with the local authority.

2 SITE DESCRIPTION

2.1 Introduction

This investigation was carried out on the instruction of Bloor Homes. The purpose of the work was to review a previous Desk Study and undertake Ground Investigation works to provide geotechnical and contamination risk information for the proposed construction of residential dwellings and associated gardens, public open spaces, new road and associated infrastructure. A proposed concept drawing can be seen below;



Concept Layout, drwg No. 661B-01, dated 18/08/17, by Randall Thorp.

2.2 Site Location

The site is located south of Holt Road, Wrexham (nearest postcode: LL13 9SJ). The coordinates for the centre of the site on National Grid are 336150, 351503. The site is approximately 28.37 hectares in plan area. See Site Location Plan in Appendix A.

2.3 Site Description

2.3.1 On Site

The site is roughly rectangular in shape and can be accessed from Bryn Estyn Road to the South. The site is predominantly used for agricultural arable use and is split into seven (7 No.) fields separated by hedgerows and fences. An area of woodland is located in the north of the site surrounding a steep valley feature. This valley feature becomes less prominent as it runs along the northern boundary of the site.

A large number of 'manure and slurry type waste' stockpiles are present along the South-East boundary of site. A further area of woodland is located within the north west of site surrounding a dried-up pond.

Site topography varies significantly, but generally sloping from South-West down to the North-West.

2.3.2 Surrounding Area

The area surrounding the site comprises of the following;

- North – Holt Road (A534 by-pass) and Wrexham Golf Course beyond.
- East – Residential development.
- South – Bryn Estyn Road beyond which lies Wrexham Rugby Club in SW, Erlas Victorian Walled Garden and Bryn Estyn House in the centre and agricultural land in the SE.
- West – agricultural land in the SE and Hanson Ready Mix Concrete Depot to the NE.

3 ENVIRONMENTAL SETTING AND DATA

3.1 Previously Undertaken Report/Investigation

Bloor Homes provided Betts Geo with a previously undertaken report for the site. This report is as follows;

- Stage 1 Contamination Assessment for Land off Holt Road, Wrexham for Barratt Manchester by Smith Grant Environmental Consultancy – November 2014 (Report ref: R2062-R01-v1 FINAL).

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. However, the historical maps have not been viewed as part of this study.

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 experienced and qualified 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

1879, 1:10,560 – *'The site is subdivided into several fields. Two features in the centre of the site may be small ponds.'*

1881, 1:2,500 – *'The central ponds are clearly indicated. No significant changes.'*

1899, 1:2,500 – *'A very small pond is indicated in the south of the site.'*

1914, 1:10,560 – *'The larger of the central ponds has changed shape, extending slightly to the south.'*

1964, 1:10,560 – *'The smaller of the two central ponds, and the pond in the south of the site is no longer indicated.'*

1992, 1:10,000 & 1:2,500 – *'A drain is indicated in the northwest part of the site.'*

2006-2009, Satellite Imagery (Various) – *'The site does not show significant changes other than an area of rough ground present to the south of Tyn Twll Farm contained various materials which cannot be identified from the resolution of the available imagery.'*

3.2.2 Surrounding Area

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

Date First Shown	Land Uses
1879	<i>'Tyn Twll, a farm or large dwelling is present adjacent to the northwest part of the site; Bryn Estyn Hall and grounds are to the south over Bryn Estyn lane which marks the site's southern boundary. A road also runs parallel but slightly away from the site's northern boundary. The remaining surrounding land use is as fields.'</i>

1881	<i>'A small sandpit is located 100m to the east of the site.'</i>
1899-1900	<i>'A well is indicated in the shallow valley to the north of the northeast corner of the site.'</i>
1911	<i>'A building has been constructed immediately to the south of the site mid-way along its boundary off Bryn Estyn Lane.'</i>
1938-1954	<i>'A sand pit is present to the northeast of the site within 20m of the site boundary. To the north an airfield is present, some additional buildings around the settlement of Rhosnesni to the east have been constructed.'</i>
1960-1962	<i>'The sand pit to the northeast of the site has been extended southwards and now runs along the sites eastern boundary for a distance of 200m.'</i>
1964	<i>'The land to the north of the site between the lane and airfield (which is now indicated as disused) is marked as a golf course.'</i>
1968	<i>'A smaller sand pit is indicated in the centre of Llan-y-Pwll 300m away from the site.'</i>
1974-1983	<i>'The road to the north-west of the site has been widened and a new roundabout constructed. The urban area of Wrexham to the west has undergone significant expansion mainly for residential use and associated services such as schools and parks, playing fields are present to the south of the site beyond Bryn Estyn hall. The former airfield to the north is now indicated as containing a sand and gravel pit.'</i>
1992	<i>'The central and southern parts of the sand pit to the east of the site are now indicated to be a tip. An unspecified works is marked in the north part of the former extraction area.'</i>
2006-2009	<i>'Housing has been constructed on former fields immediately to the west of the site around Tyn Twll farm; a tank or silo is also present within the farm which is not indicated on the historical maps. The former tip to the east is vegetated with the works to the north of this shown as containing a number of structures associated with an existing concrete batching plant, although these cannot be identified from the resolution of the available imagery.'</i>

'Whilst there are some gaps in the historical map coverage it is considered that the available information provides adequate coverage of the development history of the site and its' immediate surroundings. Historical features within the site and in the immediate surrounds which are considered relevant to risks from ground contamination or stability hazards are summarised in Drawing 001.'

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
Glacial Fluvial Deposits – Sand & Gravel	Halesowen 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 in an area which may be impacted by coal mining activity, however the Coal Authority Report obtained for the site indicates that the only worked seam of coal underlying the site is at 710m-810m depth and any movement associated with these workings should have stopped. The site is not in the likely zone of influence of current workings or an area where a licence has been granted for deep or opencast mining and there are no indications of mine entries, faults or other weaknesses which have been impacted by mining.'

4.1.2 Radon

'The radon atlas indicates the site is in an area where 1%-3% of dwellings may be at or above the action level. No radon protection measures are necessary in the construction of new dwellings or residences.'

4.2 Hydrogeological and Hydrological Features

4.2.1 Pollution Incidents to Controlled Waters

'A pollution incident to controlled waters is recorded at the south of the site; however, details of the receiving water are not available.'

4.2.2 Water Abstractions

'Three groundwater abstractions 500m to the northeast of the site have been authorised by the Environment Agency (Now Natural Resources Wales); these are for mineral washing operations in the nearby quarries.'

4.2.3 Hydrogeology:

- *The superficial deposits over all of the site and bedrock underlying the western parts of the site are*

classed as a Secondary A Aquifer, of variable permeability; however, the bedrock immediately to the east of the site forms a Principle Aquifer and is within the catchment of a Groundwater Source Protection Zone.'

- *'The site contains two tertiary surface watercourses which drain to the west and northeast of the northern boundary before possibly entering drains accosted with the new road construction to the north or the urban surface water drainage system to the west.'*

4.2.4 Flood Risk and Drainage Management Strategy

'The soils on the site are classed as highly permeable and are unlikely to be seasonally waterlogged.'

'The EA flood risk map shows most parts of the site to be at very low risk (less than 1 in 1,000 annually) from flooding events; land within the settlement of Llan-y-Pwll, 100m to the northeast of the site, appears within Zone 2 or 3 flood areas.'

5 ENVIRONMENTAL DATA

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

5.1 Landfill Sites and Waste Treatment Sites

'Several minor areas of infilled land in the immediate surrounds may similarly contain degradable materials with the potential to produce hazardous gas, however only one is considered a source with the potential to constrain the planned redevelopment of the site. The former sand pit to the immediate east of the northern half of the eastern side boundary accepted mixed wastes 26 years ago.'

'The landfill site is engineered in that it has been provided with a liner, however historical monitoring data indicates that very high methane and carbon dioxide concentrations were present at the site perimeter indicate limited functionality. Concentrations have decreased over time and this may be due to stabilisation of the waste materials, however a landfill gas extraction system has been established on the site and continues to function.'

An environmental search was requested from Wrexham Council Contaminated Land Team and a summary of their response is summarised below with a copy of their full response presented in Appendix .

A landfill known as Llan-y-pwll is located adjacent to the site on the eastern boundary. The site was a former sand and gravel pit. This landfill was historically operated by WCBC as a domestic waste landfill site between 1984 and 1988. The site was constructed as three separate lined cells and was provided with a leachate collection system. On completion the site was progressively provided with a clay cap with final restoration being completed in 1994. The site was restored to open space grazing land although it is not in use as grazing land and there is now no authorised public access to the site.

The site comprised three containment cells commissioned in phases between 1984 and 1986. SGP advised wastes are 18-20m deep (no final completion drawings are available to date to confirm; information inconsistent with groundwater borehole heights). All the cells were provided with a Vorclay bentonite liner (placed as a 100mm thick layer with 100mm seal). Permeability tests showed the liner was 1×10^{-8} – 1×10^{-10} m/s in each cell.

Each cell was provided with a leachate collection chamber draining to a central collection chamber in Cell 3 (MH3). A leachate pumping chamber was retrospectively installed in 1990 and connected to MH3. The leachate drains under gravity into the pumping chamber. Information held on file indicates the base of the cells to be ~1m above the Groundwater table. The sump in the main leachate pumping chamber is below the groundwater table.

An active gas extraction system was not installed on site as part of the original construction. Following the detection of high levels of methane in the leachate manholes and BH2 (on southern boundary) in 1988 it was concluded that the bentonite liner was permeable to gas. An active gas extraction system was installed on site by UKPS Ltd in 1993 – 1994. A pumped condensate system was installed in 1995 which drains to the main leachate chamber. A new surface water drainage system was installed at the site. This is designed to direct run-off from the slopes and access track to a new soakaway to prevent the entry of rainwater into the central leachate chamber and to reduce ponding within this area. The seep on the

northern slope was directed separately to the central leachate chamber for off-site disposal. A new flare was installed in 2009. The unit runs 8hrs / day and is on automatic cut out if there is insufficient gas. The unit is currently checked on a weekly basis by Uniflare.

The site has since been subject to a number of investigations since 2005, under Part 2A of the Environmental Protection Act 1990.

It was concluded that the residual presence of infilled materials on site may form an ongoing source of contamination. The previous investigations identified leachate break-out resulting in pollution of the groundwater within the alluvial aquifer close to the site primarily comprising total ammonia, chloride, COD and zinc.

The improvement works undertaken at the site with regards to the flare and gas extraction system in 2009 have been successful in controlling the off-site migration of landfill gas towards the nearby housing.

However, it was noted that elevated ground gas concentrations continue to be identified on the site's northern perimeter, although levels are reduced in the northeast corner closest to the housing, and are lower than pre-2009 concentrations in all wells.

On the basis of the on-going effective operation and management of the gas extraction system and flare the potential for a significant possibility for significant harm to exist is considered unlikely (Category 3). However, in the event of a failure or malfunction of the system the potential for a significant possibility for significant harm to exist associated with ground gas migration is considered reasonably possible / likely (Category 2 /3).

Landfill ground gas is continued to be monitored on a monthly basis and leachate and surface water monitoring is undertaken every 6 months.

5.2 Industrial Land Uses

'The historical mapping indicates that the site was open fields, although there is evidence to suggest that a number of small ponds within the site have been infilled; these possibly may also contain waste materials including hazardous materials such as asbestos or chemical wastes, or readily degradable materials which can produce hazardous ground gasses...'

5.2.1 Surrounding Industrial Land Uses

'There are no contemporary trade directory entries within the site itself; the adjacent farm was formerly may contain a fuel store or stores of chemicals for agricultural use. Other recorded industrial activities are of low potential to cause significant pollution. A concrete batching plant and sand and gravel quarry are present nearby.'

6 PREVIOUSLY UNDERTAKEN SITE INVESTIGATION (SRL)

6.1 SRL Soakaway Testing

Strata Renewables Ltd (SRL) were previously commissioned by Wardell Armstrong to undertake soakaway testing on the site on 15th-18th January 2018, of the twelve (12 No.) soakaways attempted eight (8 No.) yielded results of between 1.00E-05m/sec at SA102 and 8.13E-05m/sec at SA113. It is worth noting that following an initial mobilisation to site, infiltration tests were abandoned due to instabilities in the excavations. SRL later remobilised to site with single size aggregate to fill and support the infiltration excavations. The full results from the soakaway testing can be found in Appendix K.

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 occupied with arable fields with associated hedgerows and trees, any agrochemicals used have low residence times in the environment. Large stockpile of presumed filter cake located along southern boundary of site possible contamination risk.	Possible
Historical Land Use	On Site	Site remains agricultural from earliest available mapping, possible infilled ponds onsite containing asbestos, metals, TPHs, PAHs, fuels and agriculturally related materials.	Possible
Former Landfill	Adjacent to East Boundary	Potential migration of ground gas and leachate from neighbouring former landfill, client provided desk study noted very high concentrations of methane and carbon dioxide from peripheral monitoring that has subsequently dropped over time. Landfill understood to be lined reducing risk of migration of contaminants and ground gas and ground gas extraction system further reduce the risk from ground gas migration.	Yes
Tyn Twll Farm	Adjacent to North-West Boundary	Farm present from earliest mapping, potential for agricultural related contaminants including asbestos, fuels, PAHs, TPHs, elevated nutrients from agrochemical storage and heavy metals.	Possible

7.2 Pathways/ Receptors

Pathway/ Receptor	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 increased due to the permeable sands and gravels anticipated on site. Additional SI to confirm.	Possible
Aquifer	Underlying Site	Bedrock underlying the site is classed as a Secondary A Aquifer with Secondary A (variable permeability) glaciofluvial deposits overlying it. Due to the anticipated sands and gravels, the downward migration potential of any contamination is increased. Additional SI to confirm.	Possible

8 INITIAL CONCEPTUAL SITE MODEL

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

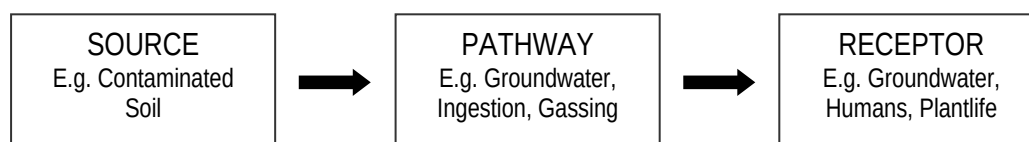
This section of the report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

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 – Infilled Ponds	Inhalation of Vapours	Construction/ Maintenance Workers	Potentially Active	Risk of ground gas from both the sites infilled ponds and adjacent former landfill. Generally granular superficial geology may not limit leachate and ground gas migration to beneath site. Historic gas monitoring data highlighted high methane and carbon dioxide. PPE to protect.	High
	Former Landfill	Vapours Penetrating Unprotected Buildings	Future Site Users	Potentially Active	Risk of ground gas from both the sites infilled ponds and adjacent former landfill. Generally granular superficial geology may not limit leachate and ground gas migration to beneath site. Historic gas monitoring data highlighted high methane and carbon dioxide. PPE to protect. Future site use to be residential.	High
Near Surface Contaminants Within Soils	Current Land Use Historic Land Use – Infilled Ponds Former Landfill Tyn Twll Farm	Ingestion, Inhalation, Dermal Contact	Current Site Users	Potentially Active	Potential for localised contaminants due to the sites infilled ponds, potential for metals, TPH's, PAH's, VOC's, SVOC's and asbestos however dependant on composition of fill materials. Previous SI only included soakaway testing therefore no previous data regarding contamination. Current and historic site use is agricultural therefore risk to current site end users is lessened. Potential for contaminated leachates migrating beneath site along eastern boundary from adjacent landfill. Possible agriculturally related contaminates from adjacent Tyn Twll farm including TPHs, PAHs, heavy metals, asbestos and agrochemicals. Additional SI required to confirm.	Low - Moderate
			Construction/ Maintenance Workers	Potentially Active	Potential for localised contaminants due to the sites infilled ponds, potential for metals, TPH's, PAH's, VOC's, SVOC's and asbestos however dependant on composition of fill materials. Previous SI only included soakaway testing therefore no previous data regarding contamination. Current and historic site use is agricultural therefore risk to current site end users is lessened. Potential for contaminated leachates migrating beneath site along eastern boundary from adjacent landfill, although landfill was lined. Possible agriculturally related contaminates from adjacent Tyn Twll farm including TPHs, PAHs, heavy metals, asbestos and agrochemicals. Additional SI required to confirm. PPE to protect.	Low - Moderate
			Future Site Users	Potentially Active	Potential for localised contaminants due to the sites infilled ponds, potential for metals, TPH's, PAH's, VOC's, SVOC's and asbestos however dependant on composition of fill materials. Previous SI only included soakaway testing therefore no previous data regarding contamination. Current and historic site use is agricultural therefore risk to current site end users is lessened. Potential for contaminated leachates migrating beneath site along eastern boundary from adjacent landfill, although landfill was lined. Possible agriculturally related contaminates from adjacent Tyn Twll farm including TPHs, PAHs, heavy metals, asbestos and agrochemicals. Additional SI required to confirm. Future site use to be residential with homegrown produce.	Moderate
			Adjacent Land Users	Potentially Active	Adjacent land uses are residential, agricultural and commercial/industrial from former landfill. Some localised contamination possible on site. Site anticipated to be surrounded by granular superficial deposits raising the risk of migration off site with high risk receptors nearby.	Low - Moderate
			Structures	Potentially Active	Possible high/low pH's and high sulphates within the localised Made Ground on site which could affect foundations. Additional SI to confirm.	Low - Moderate
			Plants	Potentially Active	Potential for localised contaminants due to the sites infilled ponds, potential for metals, TPH's, PAH's, VOC's, SVOC's and asbestos however dependant on	Low - Moderate

Type of Contamination	Potential Sources	Potential Pathway	Potential Receptors	Pollution Linkage	Comment	Estimated Level of Risk
					composition of fill materials. Previous SI only included soakaway testing therefore no previous data regarding contamination. Current and historic site use is agricultural therefore risk to current site end users is lessened. Potential for contaminated leachates migrating beneath site along eastern boundary from adjacent landfill, although landfill was lined. Possible agriculturally related contaminants from adjacent Tyn Twll farm including TPHs, PAHs, heavy metals, asbestos and agrochemicals. Additional SI required to confirm. Future site use to be residential with homegrown produce.	
Mobile Contaminants, Leachables e.g. from Pollution Sources on Site/Off Site	Historic Land Use – Infilled Ponds Former Landfill Tyn Twll Farm	Leaching into Groundwater	Groundwater	Potentially Active	Previous desk study highlighted limited functionality of the landfill lining therefore high likelihood of leachates escaping. Superficial and bedrock geology Secondary A aquifers. Site anticipated to be surrounded by granular superficial deposits raising risk of migration. Additional SI required to confirm.	Moderate - High
		Offsite Migration in Groundwater	Abstractions	Potentially Active	No noted abstractions nearby. Site is anticipated to be surrounded by granular superficial deposits raising lateral and vertical migration potential. High likelihood of landfill lining having limited ability to contain leachable contaminants. Superficial and bedrock geology Secondary A aquifers.	Moderate - High
			Controlled Waters	Potentially Active	A drain/stream is located running along the northern boundary of site. Possible receptor for any mobilised/leachable contamination and the site is anticipated to be surrounded by granular superficial deposits raising any risk of migration.	Moderate - High
Organic and Inorganic Contaminants Within Soils / Groundwater	Current Land Use Historic Land Use – Infilled Ponds Former Landfill Tyn Twll Farm	Potable Water Supply Pipes	Utilities Workers	Potentially Active	Potential for localised TPH contamination due to sites infilled ponds, former landfill and adjacent farm. Risk to be assessed once water pipeline routes are known then liaise with local water authority supplier.	Moderate

8.2 Summary

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

8.3 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 areas of infilling former ponds onsite.
- Possible heave / shrink in cohesive strata (should it be encountered, no anticipated) due to trees.
- Potential for running sands within granular strata.

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 15th October – 24th October 2018 for the trial pitting, window sampling and cable percussive boreholes and comprised of the following;

- Five (5 No.) cable percussive boreholes drilled to 20.00mbgl.
- Thirty-Seven (37 No.) machine excavated trial holes.
- Eleven (11 No.) small diameter boreholes to a maximum of 3.00mbgl, all installed with gas/groundwater monitoring wells.
- Seven (7 No.) soakaway tests.
- Twelve (12 No.) ground gas monitoring visits over a period of at least six months with varying barometric pressures.
- Chemical analysis (Metals, PAH's, TPH's) of thirty-four (34 No.) samples.
- Analysis of thirty-five (35 No.) samples for asbestos screening analysis.
- Asbestos Quantification of two (2 No.) samples.
- Twenty-Five (23 No.) samples for geotechnical analysis;
 - Twelve (12 No.) samples for Particle Size Distribution Testing.
 - Eleven (11 No.) samples for Atterberg Limits to assess heave potential and confirm classification.

9.3 Targeted Investigation

Trial pits were positioned across site to give an even spread and representation of site. Cable percussive boreholes were positioned along the Eastern boundary of site to identify any ground gas migration from the neighbouring former landfill. Soakaways were located at proposed infiltration pond locations and window samples were primarily located along the Eastern boundary of site with remaining locations spread across site in the vicinity of former ponds.

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 0.90mbgl) overlying GLACIOFLUVIAL DEPOSITS principally comprising loose to medium dense SAND, gravelly SAND and GRAVEL with localised beds of firm to stiff CLAY proven to 20.00mbgl.

A localised area of Made Ground was encountered in TP29 between 0.40mbgl 0 1.70mbgl where localised land raising appears to have taken place.

10.2 Ground Conditions Summary

Strata	General Description	Thickness m		No of Holes Located
		Top	Base	
TOPSOIL	Stubble/ weeds/ grass over dark brown slightly silty occasionally gravelly organic sand with rootlets.	0.00	0.90 (TP37)	All holes.
MADE GROUND	Grey brown very sandy gravel with cobbles of brick and Sandstone.	0.40 (TP29)	1.70 (TP29)	TP29.
GLACIOFLUVIAL DEPOSITS	Orangish/reddish/light brown SAND, gravelly SAND and GRAVEL with occasional firm to stiff CLAYS.	0.30 (BH01)	20.00 (BH01)	All holes.

10.2.1 Topsoil

Topsoil was encountered within all exploratory holes from ground surface to 0.90mbgl but typically 0.30m bgl and generally comprised of dark brown slightly silty occasionally gravelly organic sand.

10.2.2 Made Ground

Made Ground was encountered locally in the north of the site within TP29 between 0.40m and 1.70m bgl, comprising grey brown very sandy gravel with cobbles of brick and sandstone. This area is located adjacent to an existing valley feature (which is more pronounced to the northwest of TP29) and it appears this feature has been locally infilled to increase the accessible agricultural land.

10.2.3 Glaciofluvial

Generally, directly beneath the topsoil, a sequence of orangish, reddish to light brown Sand with variable gravel content, in places Sand and Gravel was encountered to depth. Locally thin beds of firm to stiff clays were noted becoming more significant in the west of the site. Locally within TP21 soft clays comprising low plasticity brown mottled orange brown and grey laminated in places slightly sandy silty Clay were encountered beneath firm to stiff clays from 1.70m and proven to 3.20m bgl.

Standard Penetration Test (SPT) 'N' values of between 7 and >50 were recorded within the granular deposits, but were typically between 10-18 within the upper 3m and increasing with depth. The Angle of shearing resistance Φ can be derived from SPT 'N' values using the relationship put forward by Peck et al. Based on SPT 'N' Values of between 10 and 18 an Angle of Shearing Resistance of between 23° and 33° is calculated.

Eleven Atterberg tests were undertaken on cohesive samples recovered from the Trial pits which recorded a moisture content of between 9% - 29% and a Plasticity Index of between 3% - 15%. A Modified plasticity index of between 2.88% - 14.85% has been calculated, which corresponds to a material with low volume change potential.

One 'N' value of 29 was recorded in a cohesive bed at depth.

Indicative undrained shear strengths can be derived for the cohesive soils by applying a correlation factor to SPT 'N' values according to the material's plasticity, after Stroud. Based on typical plasticity index of 15% for the clay, a correction factor of 6 is derived. For a SPT 'N' value of 29 an indicative shear strength of 174kPa was calculated.

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.

10.5 Groundwater – Fieldwork

No groundwater was encountered during field work site investigation works.

10.6 Groundwater – Post Fieldwork Monitoring (ONGOING)

The table below indicates groundwater encountered during the monitoring post fieldwork (2/12 visits have been undertaken);

Exploratory Hole	Depth to Water (mbgl)		Borehole Depth (mbgl)	
	Min	Max	Min	Max
WS1	Dry	Dry	2.95	3.15
WS2	Dry	Dry	3.00	3.01
WS3	Dry	Dry	3.00	3.17
WS4	Dry	Dry	3.14	3.14
WS5	Dry	Dry	3.00	3.10
WS6	Dry	Dry	3.00	3.10
WS7	Dry	Dry	3.10	3.12
WS8	Dry	Dry	3.05	3.06
WS9	Dry	Dry	1.51	1.52
WS10	Dry	Dry	2.07	2.08
WS11	Dry	Dry	3.08	3.10

Exploratory Hole	Depth to Water (mbgl)		Borehole Depth (mbgl)	
	Min	Max	Min	Max
BH1	Dry	Dry	19.95	20.10
BH2	Dry	Dry	18.96	19.78
BH3	Dry	Dry	19.47	19.95
BH4	Dry	Dry	20.00	20.05
BH5	Dry	Dry	18.69	19.37

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	57	Determination of pH (using Cyberscan pH meter).
Sulphate - Soluble 2:1 Extract	57	Dionex.
Arsenic, Cadmium, Chromium VI, Chromium III, Total Chromium, Lead, Mercury, Selenium, Copper, Nickel, Complex and Free Cyanide and Zinc.	34	Soil samples were analysed in accordance with UKAS/MCERTS standards Inductively coupled plasma atomic emission spectroscopy (ICP-OES)
Speciated Polycyclic Aromatic Hydrocarbons (PAH),	34	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	34	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)	34	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12).
Organic Matter	34	Determination of Organic Matter by combustion.
Asbestos Screen	34	Visual Screening for Fibres and PLM
Asbestos Quantification	2	Visual identification, hand picking, weighing and fibre counting by sedimentation/phase contrast optical microscopy.

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 Glaciofluvial Deposits are classed as a Secondary A Aquifer (Moderate Permeability). The bedrock deposits of the Salop Formation are classed as a Secondary Aquifer (Variable 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 generally indicated a Low - Moderate risk of contamination, however a historical landfill is located adjacent to the eastern boundary of the site, with a potential Moderate risk from 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

12.2.1 Topsoil

All determinants for heavy metals, TPH's and PAH's fell below the residential with home grown produce guidance values within the topsoil. However, Chrysotile board asbestos quantified to <0.001 was encountered in TP12 at 0.20-0.30mbgl.

12.2.2 Made Ground

Isolated Made Ground was encountered onsite within TP29, Chrysotile loose fibres asbestos quantified to 0.008 was encountered at this locality.

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

12.2.3 'Slurry Waste' Stockpile

The sample of slurry waste did not record any elevated concentrations of contaminants, although a relatively high organic matter content of 15% was noted.

12.2.4 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.

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 A Aquifer (Low/Negligible Permeability) and the bedrock deposits classed as a Secondary A Aquifer (Variable 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

Two (2 No.) occurrences of asbestos was identified across the site requiring further assessment.

Asbestos (Chrysotile) was identified in two samples, TP12 and TP29, at a concentration of <0.001 and 0.008% respectively.

ICRCL Guidance Note 64/85 "Asbestos on Contaminated Sites" (1990) is still the most current guidance for asbestos in soil and suggest asbestos fibres should be <0.001% w/w within soil. Dutch and Australian Guidance also suggest the use of a threshold of 0.001% as a threshold for asbestos in soil. The Dutch Guidelines consider the risk from Chrysotile to be ten times less than Amphibole asbestos but the HSE, WHO, the Australian DoH and the USEPA have chosen not to distinguish between different asbestos fibre types.

As the recorded concentration within TP12 is less than the threshold of 0.001%, it is deemed unlikely to pose a risk, however care should be taken on site as the further presence of asbestos cannot be discounted and it is recommended that vigilance during ground works in this area is maintained as it may relate to a historical farm building.

The recorded concentration within TP29 relates to the Made Ground and although there is no current exposure pathway as it lies beneath 0.40m of topsoil, the risk will need to be further assessed once a detailed development layout is confirmed. However, based on the current site layout and the fact the contaminated strata were identified at depths of between 0.20mgl – 0.50mgl, it may be possible to leave this material in-situ due to the affected areas being proposed as landscaping and woodland. The asbestos

location areas are shown as a red dots on the 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 the development layout changes further delineation may be required in the vicinity of TP29, with either the following likely to reduce the risk to proposed end users:

- A 600mm cover system (150mm topsoil/450mm subsoil with either a geotextile marker layer or hard to dig layer); or
- The Made Ground is further delineated in the vicinity of TP29 and possibly removed, disposed off site and replaced with a chemically and geotechnically suitable alternative.

Groundwater and Aquifer Risk

No significant risks to groundwater and aquifers are anticipated from the site due no significant soil contamination hotspots being identified during the ground investigation and lack of groundwater encountered.

The landfill located to the east of the site is lined and has a leachate recovery system, intrusive

investigations have indicate that leachate breakout has occurred resulting in the pollution of the aquifer within the Glaciofluvial Deposits close to the landfill, with contaminants comprising total ammonia, chloride, COD and zinc. The groundwater flow is anticipated to be in a northeast to easterly direction away from the subject site and therefore the risk to site is low.

14 GROUND GAS ASSESSMENT

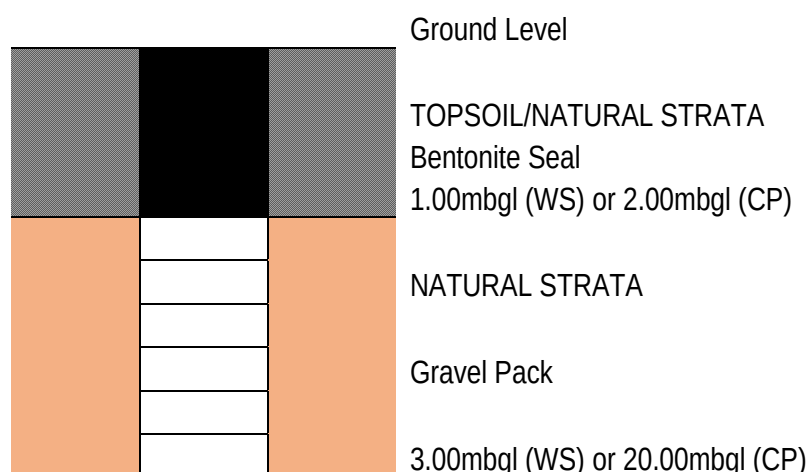
14.1 Ground Gas Requirements – Radon

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. It is recommended that this is confirmed with the local building control.

14.2 Ground Gas Assessment (ONGOING)

14.2.1 Ground Gas Boreholes Installations

The eleven (11 No.) window sample boreholes and five (5 No.) cable percussive boreholes were all installed to 3.00mbgl and 20.00mbgl respectively with 1.00m or 2.00m of plain pipe and 2.00m or 18.00m of slotted pipe into the Natural Strata below. A typical installation is shown below;



14.2.2 Summary of Results (ONGOING)

Two out of twelve (2/12) ground gas visits have been completed and the details are summarised below (see Appendix E for full results);

Borehole Number	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Barometric Pressure (mB)	Peak Flow (l/hr)	GSV CH ₄	GSV CO ₂	No. of Visits
WS1	0.0 – 0.1	1.1 – 1.4	19.5 - 19.6	1006 - 1018	0.0	0.000	0.000	2/12
WS2	0.0	0.5 – 2.0	19.0 - 20.2	1006 - 1018	0.1 – 0.2	0.000	0.004	2/12
WS3	0.0	0.1 – 1.7	19.3 - 20.6	1006 - 1018	0.0 – 0.2	0.000	0.003	2/12
WS4	0.0	0.3 – 4.3	16.0 - 20.3	1006 - 1018	0.1 – 0.3	0.000	0.013	2/12
WS5	0.0	0.6 – 3.2	18.0 - 20.0	1006 - 1018	0.0 – 0.1	0.000	0.003	2/12
WS6	0.0	0.5 – 5.3	14.2 - 20.1	1006 - 1018	0.1 – 0.3	0.000	0.016	2/12
WS7	0.0	0.1 – 2.1	19.6 - 20.7	1006 - 1018	0.0 – 0.1	0.000	0.002	2/12
WS8	0.0	0.7 – 1.2	20.3 - 20.4	1006 - 1018	0.0 – 0.3	0.000	0.004	2/12

WS9	0.0	1.2 – 1.3	20.1 – 20.3	1006 - 1018	0.0	0.000	0.000	2/12
WS10	0.0	0.6 – 1.0	20.6	1006 - 1018	0.0 – 0.1	0.000	0.001	2/12
WS11	0.0 - 0.1	1.2 – 1.8	19.8 - 20.3	1006 - 1018	0.0 – 0.3	0.000	0.005	2/12
BH1	0.0	0.2 – 3.7	14.3 - 20.3	1006 - 1018	0.0 – 0.7	0.001	0.026	2/12
BH2	0.0	0.1 – 5.7	12.8 - 20.5	1006 - 1018	0.0 – 0.7	0.001	0.040	2/12
BH3	0.0 – 0.2	0.1 – 12.0	4.0 - 20.5	1006 - 1018	0.0 – 2.3	0.002	0.276	2/12
BH4	0.0	0.1 – 7.9	7.7 - 20.4	1006 - 1018	0.1 – 1.4	0.001	0.111	2/12
BH5	0.0	0.1 – 6.7	10.6 - 20.6	1006 - 1018	0.0 – 0.5	0.001	0.034	2/12

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 significant elevated levels of ground gas being identified during the initial gas monitoring visits, the following preliminary ground gas assessment has been made:

Site Area	Site Classification	Recommended Ground Gas Protection Measures
Majority Site	Green	No specialist ground gas protection is required.
Area along Eastern Boundary	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.
Area in Vicinity of BH3	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.

For the purpose of pricing it would be prudent to use Amber 1 ground gas protection measures for the majority of site and Amber 2 for area along the eastern boundary until the ground gas monitoring is completed.

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 ongoing – assume Amber 1 (majority of site) and Amber 2 (eastern boundary) until monitoring is complete.	Low
Site End Users	Ingestion of, and skin contact with, contaminated soil.	No remedial action anticipated subject to site layout.	Low
Site End Users	Ingestion of contaminants in vegetables etc. or in soils adhering to vegetables, etc	No remedial action anticipated subject to site layout.	Low
Construction/ Maintenance Workers	Inhalation of soil gases, odours or dust.	PPE, tool box talks.	Low (assumed basic PPE is used)
Construction/ Maintenance Workers	Ingestion of, and skin contact with, contaminated soil	PPE, tool box talks.	Low (assumed basic PPE is used)
Plants	Adverse effects on growth caused by presence of contaminants in soil	No remedial action required.	Low
Buildings and Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion and fire hazards	Gas monitoring ongoing – assume Amber 1 (majority of site) and Amber 2 (eastern boundary) until monitoring is complete.	Low
Foundations	Sulphate attack of foundations	Foundations to be designed as per section 18.4.	Low
Water Supplies	Hydrocarbons penetrating plastic water supply pipes.	Severn Dee 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 remedial action required.	Low

16 OUTLINE STRATEGY FOR RISK REDUCTION/REMEDIATION 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

No contamination was encountered on site other than localised areas of asbestos, 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.
- Asbestos was encountered on site, therefore vigilance should be adhered, and any suspected asbestos should be notified and a suitably qualified person appointed to inspect.

16.3 Site-End Users

As the recorded asbestos concentration within TP12 is less than the threshold of 0.001%, it is deemed unlikely to pose a risk, however care should be taken on site as the further presence of asbestos cannot be discounted and it is recommended that vigilance during ground works in this area is maintained as it may relate to a historical farm building.

The recorded asbestos concentration within TP29 relates to the Made Ground and although there is no current exposure pathway as it lies beneath 0.40m of topsoil, the risk will need to be further assessed once a detailed development layout is confirmed. However, based on the current site layout and the fact the contaminated strata were identified at depths of between 0.20mgl – 0.50mbgl, it may be possible to leave this material in-situ due to the affected areas being proposed as landscaping and woodland. Based on the current site layout it may be possible to leave this material in-situ due to the area being proposed as woodland however the shallow depths the contamination was encountered from 0.20mbgl this raises the risk.

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 hotspots 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.

Further testing of the onsite topsoil should be undertaken to confirm suitability for reuse. 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

No significant risks to groundwater and aquifers are anticipated across the site due to both the lack of groundwater encountered and no elevated leachable 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.

For the purpose of pricing it would be prudent to use Amber 1 ground gas protection measures for the majority of site and Amber 2 for area along the eastern boundary until the ground gas monitoring is completed.

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 Severn Dee.

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.

17 GEOTECHNICAL ASSESSMENT

17.1 Introduction

It is understood that the proposed development will consist of the construction of low-rise residential properties with associated rear gardens, associated infrastructure and public open space. No structural loadings are known at this time however it is anticipated that any proposed loadings will be low to moderate.

As part of the development it is understood that a number of attenuation ponds are likely to be required as part of the development. In addition, it is understood that the northeast and northwest of the site is unlikely to be developable due to existing site levels and such no houses will be constructed in the northern area of the site.

It is anticipated that cut and fill works will be required however, additional review and assessment is advised upon clarification of site levels, layout and earthworks methodology.

17.2 Site Preparation and Excavation

Stockpiles of manure and slurry/ filter cake types waste was noted within the South-East of the site and it is recommended that these are removed offsite as part of the site preparation works.

A water main runs parallel with the site's western boundary. Excavation in close proximity to mains services (it is assumed these are to be kept live for the majority of the works) will need to ensure that the excavation walls are stable or appropriately battered to a safe angle, temporary slope stability works may be required in any deep excavations. Liaison with Welsh Water is advised.

No buried obstructions were encountered during this investigation, however the possibility of buried obstructions being encountered cannot be discounted and an allowance should be made for breaking out, for example provision of pneumatic breakers for site plant. Following breaking out of any obstructions, excavations of shallow soils should not present any difficulty for conventional plant and equipment.

Topsoil and unsuitable Made Ground should be removed from beneath all building and hard standing areas.

Spoil resulting from excavations within the Made Ground and the recent pond deposits will not be suitable for reuse as engineered fill and may either be used for landscaping (subject to the necessary approvals/consents) or disposed of off-site.

Excavations undertaken during site works greater than 2.0m bgl were generally unstable.

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.

17.3 Control of Groundwater

Limited groundwater was encountered on site other than strata being recorded as wet or damp. However, groundwater levels may vary from those at the time of the investigation, for example in response to seasonal fluctuations as part of the scope of works long-term groundwater monitoring is ongoing.

17.4 Heave / Shrinkage Potential

A summary of Atterberg limit tests (both preliminary and additional investigation) 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
TP08	0.80	9.9	26.0	15	98	11	LOW
TP09	1.30	13.0	26.0	15	95	11	LOW
TP13	2.00	26.0	28.0	16	99	12	LOW
TP14	2.20	23.0	28.0	21	100	7	None Shrinkable
TP20	1.80	16.0	36.0	21	99	15	LOW
TP21	2.50	29.0	34.0	21	100	13	LOW
TP23	1.20	9.0	32.0	23	83	9	None Shrinkable
TP23	1.80	10.0	25.0	16	91	9	None Shrinkable
TP25	3.00	24.0	26.0	23	96	3	None Shrinkable
TP33	1.20	20.0	29.0	17	86	12	LOW
TP37	1.60	22.0	22.0	21	100	8	None Shrinkable

None shrinkable to LOW volume change potential is evident; foundation design for tree heave protection should be designed accordingly following discussion with the NHBC, with a minimum foundation depth of 0.9m required where shrinkable soils are present.

17.5 Foundations

Loose to medium dense sands have been encountered at shallow depth across the majority of the site and therefore the adoption of standard shallow strip foundations founded at a minimum of 0.45mbgl can be designed with an allowable bearing pressure of 125kN/m². This should limit total foundation settlement to less than 25mm and differential to less than 15mm for foundation widths up to 1m.

Locally thin to very thick beds of firm to stiff clay are present, therefore as a precaution a minimum foundation depth of 0.75m bgl should be adopted. Given the recorded ground conditions it would be prudent to undertake further trial pitting to confirm the presence of shrinkable soils at foundation depth on a plot by plot basis.

Deepening of foundations in accordance with NHBC Standards will be required where foundations are within the zone of influence of existing or proposed trees and proposed shrub planting and shrinkable soils are encountered at foundation level.

Where foundations are within the influence of trees and are deeper than 1.5m bgl, a suitable compressible material or void former will be required.

Where foundations require deepening to greater than 2.5m below ground level, they must be designed by an engineer, as specified in NHBC Technical Requirement R5.

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.

It is recommended that a foundation zoning plan should be undertaken when proposed levels are made available and further plot by plot trial pitting has been undertaken.

17.6 Ground Floor Construction

Generally non-shrinkable soils are present across the majority of the site at formation level and therefore ground bearing floor slabs could be adopted. Ground bearing slabs may be used if the following criteria are satisfied:

- the foundation depth (such as due to the influence of trees) is less than 1.5m;
- any fill is suitable, well-compacted granular material and less than 600mm thick; and
- it is demonstrated that desiccation is not present, and soils are at their equilibrium moisture content.

Where shrinkable soils are present at shallow depth across the site suspended floor construction (e.g. either in-situ RC slabs or block and beam flooring) should be adopted in accordance with NHBC guidance.

On completion of the ground gas monitoring it may be requirement to incorporate a ventilated subfloor void.

17.7 Soakaways

Soakaway tests were undertaken at seven locations across the site at proposed infiltration pond locations as part of the Betts Geo fieldwork to provide preliminary infiltration rates for initial soakaway design.

Infiltration rates of between 1.5×10^{-5} to 9.9×10^{-5} m/s have been recorded indicating that soakaway drains could provide a viable drainage solution.

It is recommended that further infiltration testing is undertaken once a site layout is finalised, the scope of the testing should be agreed with the local authority.

17.8 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 sands/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.

17.9 Protection of Buried Concrete

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

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

17.10 Reuse of Site-won Materials

An initial assessment has been completed on the potential to re-use site-won materials as an engineered fill material.

The geotechnical assessment of the site-won materials indicates the soils which are likely to be re-used can be classified as Class 1 granular (less than 15% finer than the 63µm), which may be able to be used for General Fill Material.

Where an increased end-performance of the material is required over and above those defined for general fill materials additional testing and specification will be required, which is outside of the scope of the current assessment.

Where it is proposed to re-use site won materials as an engineered fill, it will be necessary to develop an appropriate Site-Specific Earthworks Specification which can be adopted as part of the contract documentation. The basis for the Specification should be BS 6031 and the latest version of the SHW, Series 600 Earthworks.

In order to develop the earthworks specification, a detailed cut and fill assessment will be required. In addition, information on the design loadings and tolerable settlements for all structures will need to be provided so a full assessment of their implications can be accounted for within the acceptability limits for the various materials.

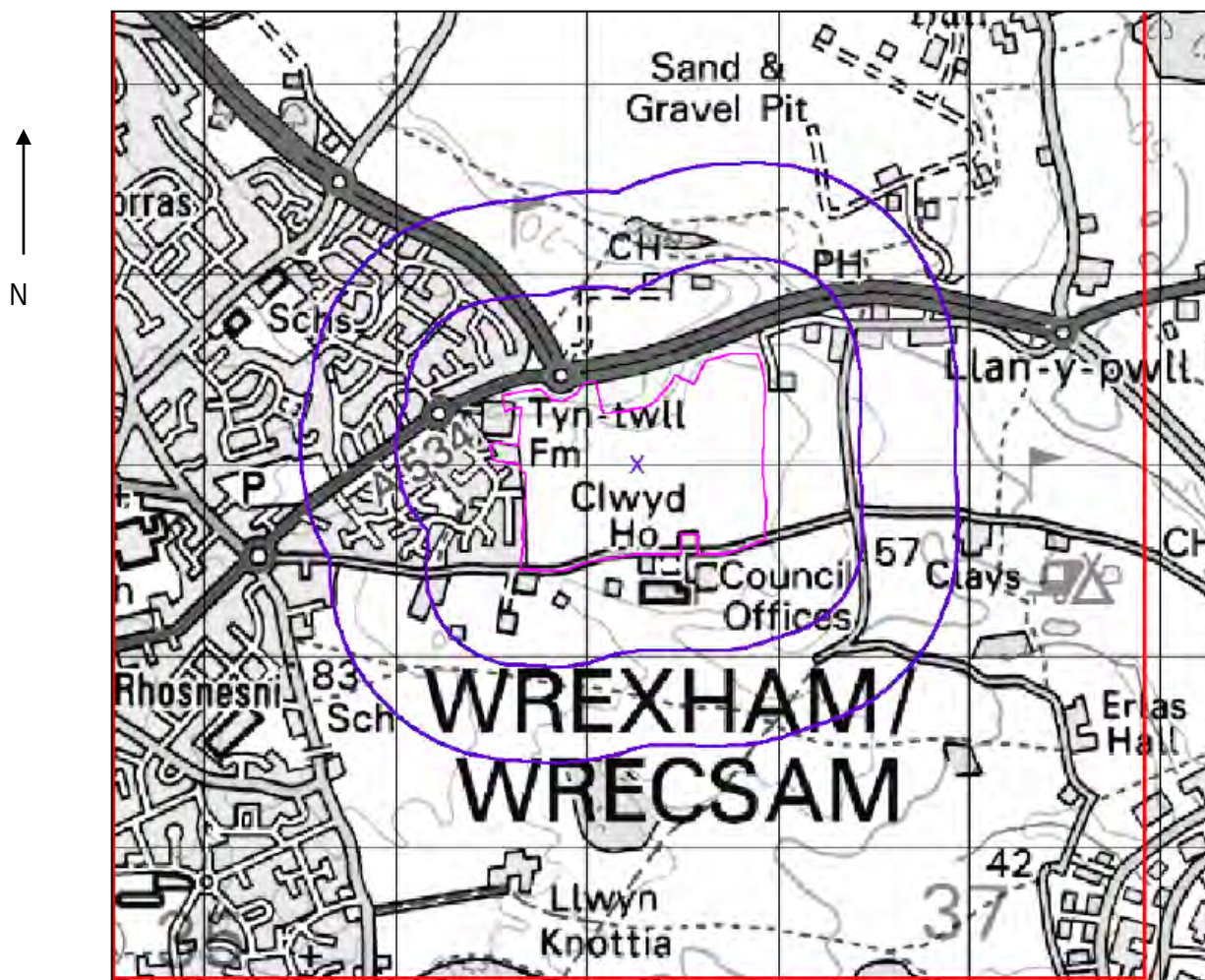
18 ADDITIONAL WORKS REQUIRED

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

- Completion of ground gas monitoring programme.
- Review of conclusions within this report once a development layout is confirmed.
- Removal of 'manure and slurry/ filter cake' stockpiles in the South-East of the site.
- Further trial pitting on a plot by plot basis to confirm heave potential and foundation depths.
- Foundation Zonation Plan.
- Earthworks Specification.
- Further infiltration testing if private soakaways are to be adopted.

APPENDIX A

(i) Site Location Plan



Site Location Plan

Land south of Holt Road, Wrexham, LL13 9SJ. The coordinates for the centre of the site on National Grid are 336130, 351500. The site is approximately 28.92 hectares in size.

APPENDIX B

(i) Betts Exploratory Hole Location Plan



NOTES

DO NOT SCALE

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

THE PLAN OVERLAYS THE TOPOGRAPHICAL SURVEY.

KEY

TP

INDICATIVE TRIAL HOLE LOCATION

SA

INDICATIVE SOAK-AWAY LOCATION

WS

INDICATIVE WINDOW SAMPLE LOCATION

BH

INDICATIVE CABLE PERCUSSIVE BOREHOLE LOCATION

INDICATIVE LOCATION OF POND

INDICATIVE LOCATION OF WATER MAIN – 300mm

INDICATIVE LOCATION OF BADGER SETT

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: DRAFT

Old Marsh Farm Borne, Welsh Road, Sealand, Flintshire, CH5 2LY
Tel: 01244 288178 Fax: 01244 288179 enquiries@betts-associates.co.uk

BLOOR HOMES

PROJECT: HOLT ROAD, WREXHAM

TITLE: PROPOSED EXPLORATORY HOLE LOCATION PLAN

DATE: 22.10.18	SCALE & SIZE: 1:1250 @ A1	DRAWN: PH	CHECKED: BL
PROJECT No: 18BLH002	DRAWING No: EXP 101	REV: -	

APPENDIX C

(i) Betts Exploratory Hole Logs

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No WS1	
Job No 18BLH002	Date 15-10-18 15-10-18	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		
0.10-0.20	ES					(0.60) 0.60	Grass over dark brown clayey slightly gravelly medium sand with frequent rootlets. Gravel medium rounded to subangular of mixed lithologies. [TOPSOIL]		
						(0.40) 1.00	Orange brown fine slightly clayey slightly gravelly fine to medium SAND with low cobble content. Gravel and cobble fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
1.20	N13					(0.50) 1.50 1.60 1.70 1.90	Light orange brown very gravelly fine to coarse SAND. Gravel fine to medium rounded to subangular of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
2.00	N20					(0.50) 2.40 2.60	Reddish brown slightly gravelly fine SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
2.90-3.00	D					(0.40) 3.00	Light orange brown very gravelly fine to coarse SAND. Gravel fine to medium rounded to subangular of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
3.00	N15						Reddish brown slightly gravelly fine SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
							Firm to stiff becoming very stiff reddish brown very sandy slightly gravelly CLAY. Sand fine to medium. Gravel fine subrounded of coal. [GLACIOFLUVIAL DEPOSIT]		

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	
											No groundwater encountered. No visual or olfactory evidence of contamination.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Competitor Rig			Logged By RD		

BOREHOLE LOG

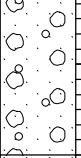
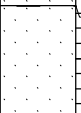
Project Holt Road, Wrexham				BOREHOLE No WS2	
Job No 18BLH002	Date 15-10-18 15-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.50-0.60	ES					(0.40) 0.40	Grass over dark brown clayey slightly gravelly fine to medium sand with frequent rootlets. Gravel medium rounded to subangular of mixed lithologies. [TOPSOIL]		
1.20		N24				(1.00) 1.40	Orange brown slightly clayey slightly gravelly fine to medium SAND with low cobble content. Gravel fine to medium subrounded of mixed lithologies. Cobble fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
1.50-1.60	D					(0.90) 2.30	Firm to stiff becoming very stiff reddish brown mottled yellow orange brown and grey very sandy slightly gravelly CLAY. Sand fine to medium. Gravel fine subangular of coal. [GLACIOFLUVIAL DEPOSIT]		
2.00		N30				(0.70) 3.00	Light orange brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]		
3.00		N24							

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	
											No groundwater encountered. No visual or olfactory evidence of contamination.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Competitor Rig			Logged By RD		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No WS3	
Job No 18BLH002	Date 15-10-18 15-10-18	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		
0.10-0.20	ES					(0.50) 0.50	Grass over dark brown slightly clayey slightly gravelly fine to medium sand with frequent rootlets. Gravel fine to medium subrounded of mixed lithologies. [TOPSOIL]		
1.20	N12					(1.10) 1.10	Light orange brown gravelly fine to medium SAND with low cobble content. Gravel fine to coarse subrounded to subangular of mixed lithologies. Cobble fine subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
2.00	N16					1.60 1.65 (1.35)	Reddish brown slightly clayey fine to medium SAND. [GLACIOFLUVIAL DEPOSIT] Light orange brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]		
3.00	N13					3.00			

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	
											No groundwater encountered. No visual or olfactory evidence of contamination.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Competitor Rig			Logged By RD		

AGS3 UK BH 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS 3.1.GDT 2/11/18

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No WS4	
Job No 18BLH002	Date 15-10-18 15-10-18	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		
0.10-0.20	ES					(0.50) 0.50	Grass over dark brown slightly clayey slightly gravelly fine to medium sand with frequent rootlets. Gravel fine to medium subrounded of mixed lithologies. [TOPSOIL]		
						(0.80) 1.30	Orange brown fine to medium very gravelly SAND. Gravel fine subangular of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
1.20		N16				(0.50) 1.80	Light orange brown slightly gravelly fine to medium SAND. Gravel fine to medium angular to subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
1.80-2.00						2.00	Firm reddish brown very sandy slightly gravelly CLAY. Sand fine to medium.		
2.00	D	N15				2.20	Gravel fine angular of coal. [GLACIOFLUVIAL DEPOSIT]		
						(0.80) 3.00	Light brown very gravelly fine to medium SAND. Gravel fine to medium subangular of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
3.00		N17				3.00	Light brown fine to medium SAND. Gravel band at 2.5m of medium to coarse subrounded mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		

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	
											No groundwater encountered. No visual or olfactory evidence of contamination.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Competitor Rig			Logged By RD		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No WS5	
Job No 18BLH002	Date 15-10-18 15-10-18	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 (Thick- ness)	DESCRIPTION			
0.70-0.80	ES	N24				(0.50) 0.50	Crop stubble over dark brown slightly clayey slightly gravelly fine to medium sand. Gravel fine to medium subrounded of mixed lithologies. [TOPSOIL]			
1.20	D					(0.70) 1.20	Light orange brown very gravelly fine to medium SAND. Gravel fine to coarse subrounded to angular of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]			
1.40-1.60						1.40 1.60	Orange brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
2.00					(0.40) 2.00	Stiff brown mottled cream, reddish brown and black very sandy CLAY. Sand fine to medium. [GLACIOFLUVIAL DEPOSIT]				
3.00	N17				(1.00) 3.00	Orange brown fine to medium SAND. Gravel band at 1.7m of fine to medium subrounded to angular mixed lithologies. [GLACIOFLUVIAL DEPOSIT]				
	N14					Orange brown slightly gravelly fine to medium SAND. Gravel fine to medium rounded to subangular of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]				
		</								

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

AGS3 UK BH 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS 3.1.GDT 2/11/18

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No WS6	
Job No 18BLH002	Date 15-10-18 15-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 1	

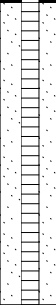
SAMPLES & TESTS			STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)		
0.10-0.20	ES					(0.40) 0.40		
								
								
1.20	N11					(1.90)		
								
2.00	N11					2.30		
								
3.00	N12					(0.70) 3.00		
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								
								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered. No visual or olfactory evidence of contamination.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Competitor Rig			Logged By RD		

AGS3 UK BH 18BLH002 - HOLT ROAD, WREXHAM GPJ GINT STD AGS 3.1 GDT 2/11/18

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No WS7
Job No 18BLH002	Date 15-10-18 15-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

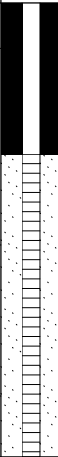
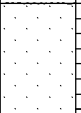
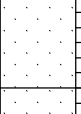
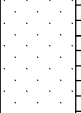
SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.60-0.70	ES	N17				(0.50) 0.50	Crop stubble over dark brown slightly clayey slightly gravelly fine to medium sand. Gravel fine to medium subrounded of mixed lithologies. [TOPSOIL]		
1.20	D					(0.90) 1.40	Pale cream brown slightly clayey slightly gravelly SAND. Gravel medium to coarse subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
1.40-1.60						1.60	Firm to stiff reddish brown mottled creamy brown very sandy slightly gravelly CLAY.		
2.00		N8				(1.40) 3.00	Sand fine to medium. Gravel fine angular of mixed lithologies. [GLACIOFLUVIAL DEPOSIT] Orange brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]		
3.00		N13							

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered. No visual or olfactory evidence of contamination.
All dimensions in metres Scale 1:50		Client Bloor Homes				Method/ Plant Used Competitor Rig					Logged By RD

AGS3 UK BH 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS3 1.GDT 2/11/18

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No WS8	
Job No 18BLH002	Date 16-10-18 16-10-18	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		
1.20	N23					0.30	Dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]		
						(1.30)	Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]		
2.00	N14					1.60 (1.00)	Light brown speckled black fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]		
3.00	N17					2.60 (0.40) 3.00	Orange brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]		

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	
											No groundwater encountered. No visual or olfactory evidence of contamination.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Competitor Rig			Logged By DK		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No WS10	
Job No 18BLH002	Date 16-10-18 16-10-18	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		
1.20 1.80-2.00 2.00	D	N39 N50/ 190 mm	Water			0.30	Dark brown slightly organic slightly silty gravelly fine to medium SAND.	Geology	Instrument/ Backfill
						(0.40) 0.70	Gravel fine to medium subrounded of mixed lithologies. [TOPSOIL]		
						(1.10)	Orange brown slightly gravelly clayey fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
						1.80 2.00	Light brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT] No gravel below 1.4mbgl.		
						(1.00) 3.00	Very stiff red brown sandy CLAY. [GLACIOFLUVIAL DEPOSIT] Window sample refusal at 2.0mbgl, advanced with SPT rods to 3.0mbgl.		

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	
											No groundwater encountered. No visual or olfactory evidence of contamination.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Competitor Rig			Logged By DK		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No WS11
Job No 18BLH002	Date 16-10-18 16-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

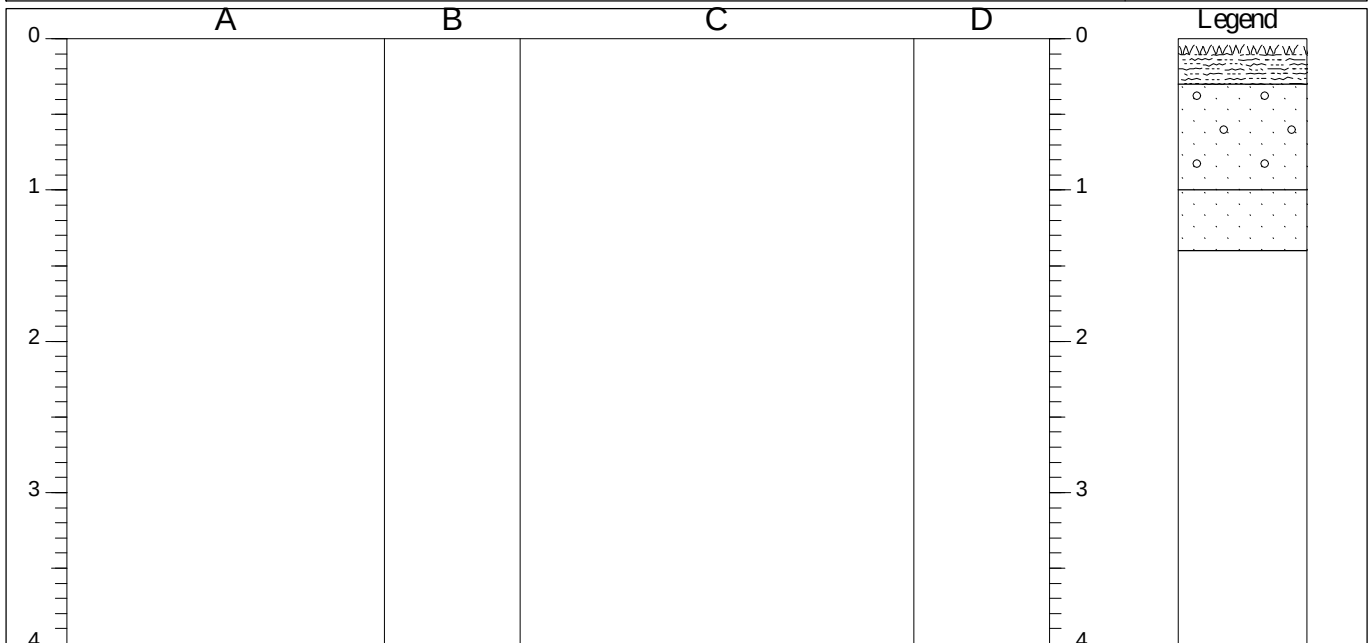
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Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered. No visual or olfactory evidence of contamination.
All dimensions in metres Scale 1:50		Client Bloor Homes				Method/ Plant Used Competitor Rig					Logged By DK

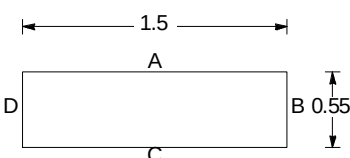
AGS3 UK BH 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS3_1.GDT 2/11/18

TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No SA1
Job No 18BLH002	Date 17-10-18 17-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



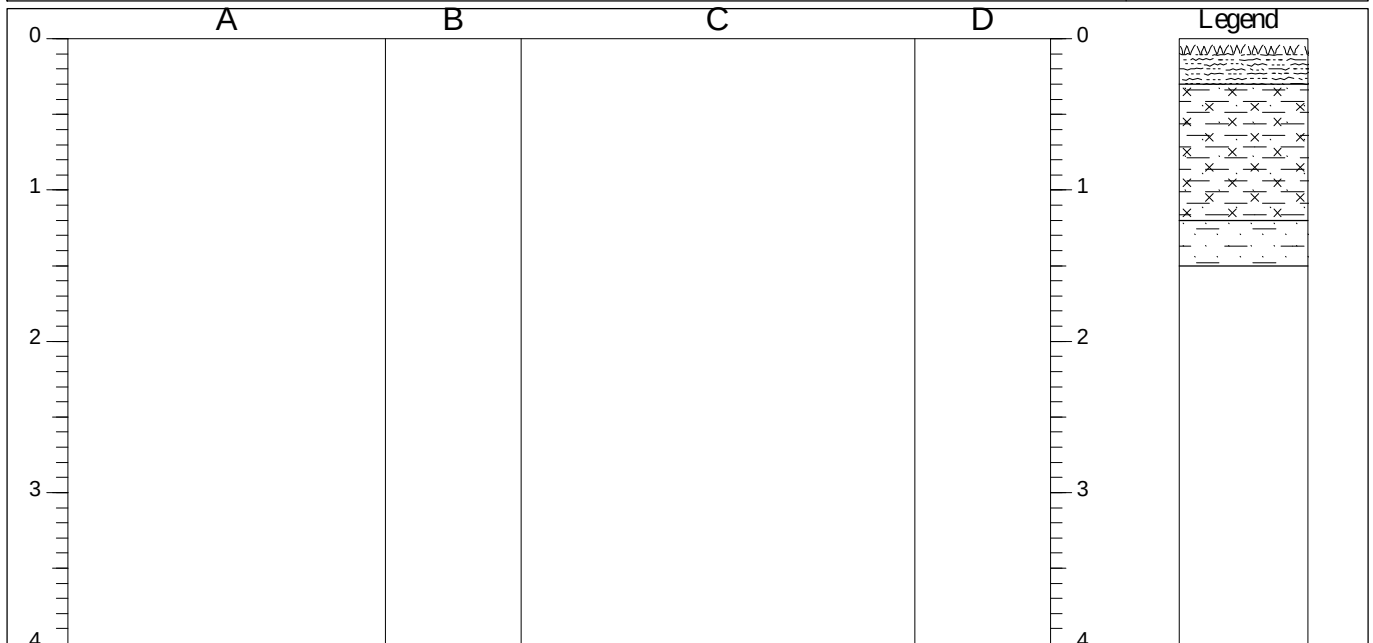
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.30		Stubble/weeds over dark brown slightly organic slightly silty sand. [TOPSOIL]				
0.30-1.00		Light brown slightly clayey very gravelly fine to coarse SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]				
1.00-1.40		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS]				

Shoring/Support: None. Stability: Stable.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
	

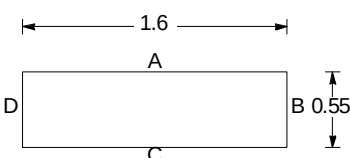
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No SA2
Job No 18BLH002	Date 17-10-18 17-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



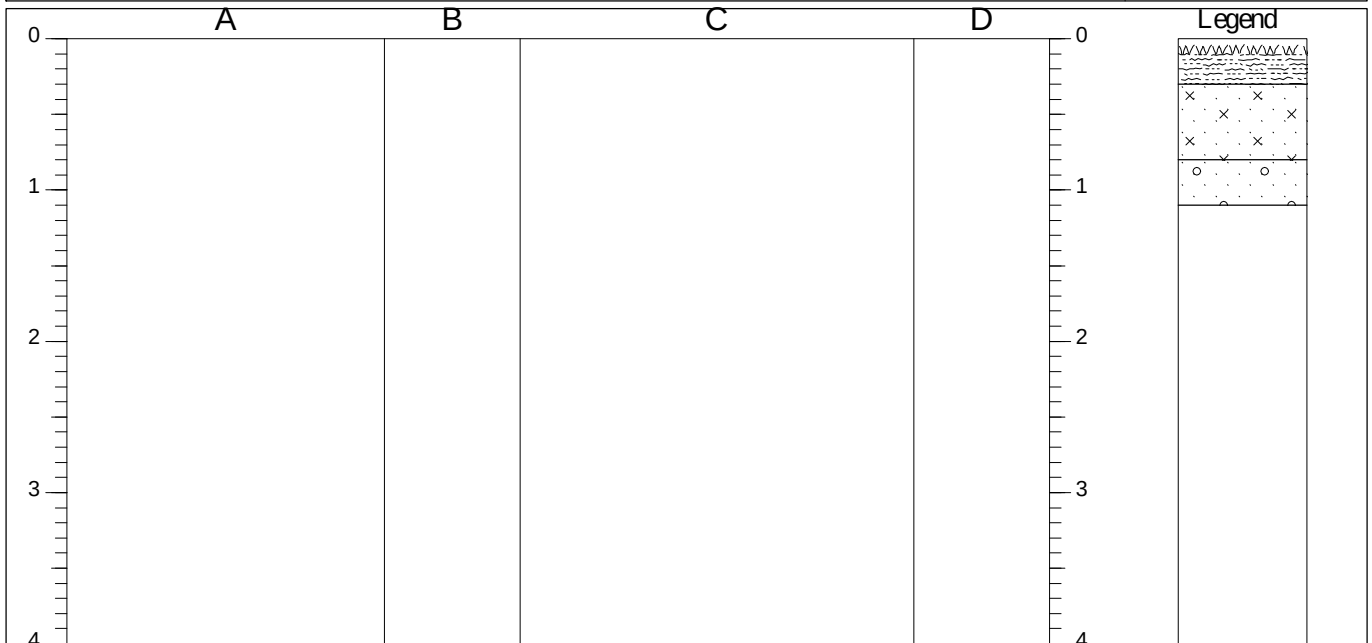
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.30		Stubble/weeds over dark brown slightly organic slightly silty sand. [TOPSOIL]				
0.30-1.20		Firm red brown slightly sandy silty CLAY. [GLACIOFLUVIAL DEPOSITS]				
1.20-1.50		Light Creamy brown clayey fine to medium SAND. [GLACIOFLUVIAL DEPOSITS]				

Shoring/Support: None. Stability: Stable. 	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
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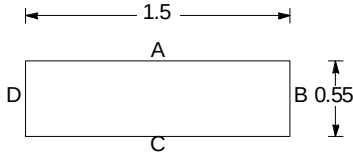
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No SA3
Job No 18BLH002	Date 18-10-18 18-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



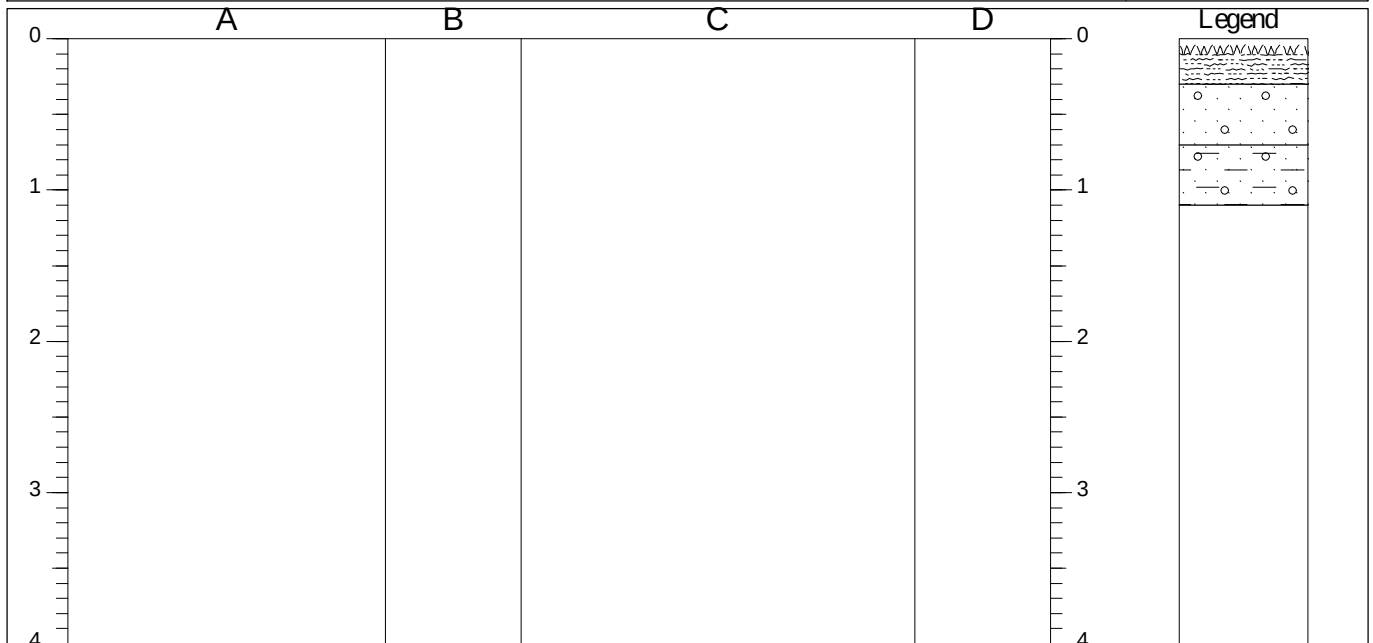
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.30		Stubble/weeds over dark brown slightly organic slightly silty sand. [TOPSOIL]				
0.30-0.80		Orange brown very slightly silty fine to medium SAND with rare rootlets. [GLACIOFLUVIAL DEPOSITS]				
0.80-1.10		Light creamy brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. Rare rootlets in upper 0.8m. [GLACIOFLUVIAL DEPOSIT]				

Shoring/Support: None. Stability: Stable.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

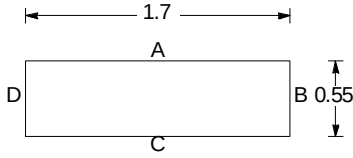
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No SA4
Job No 18BLH002	Date 18-10-18 18-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



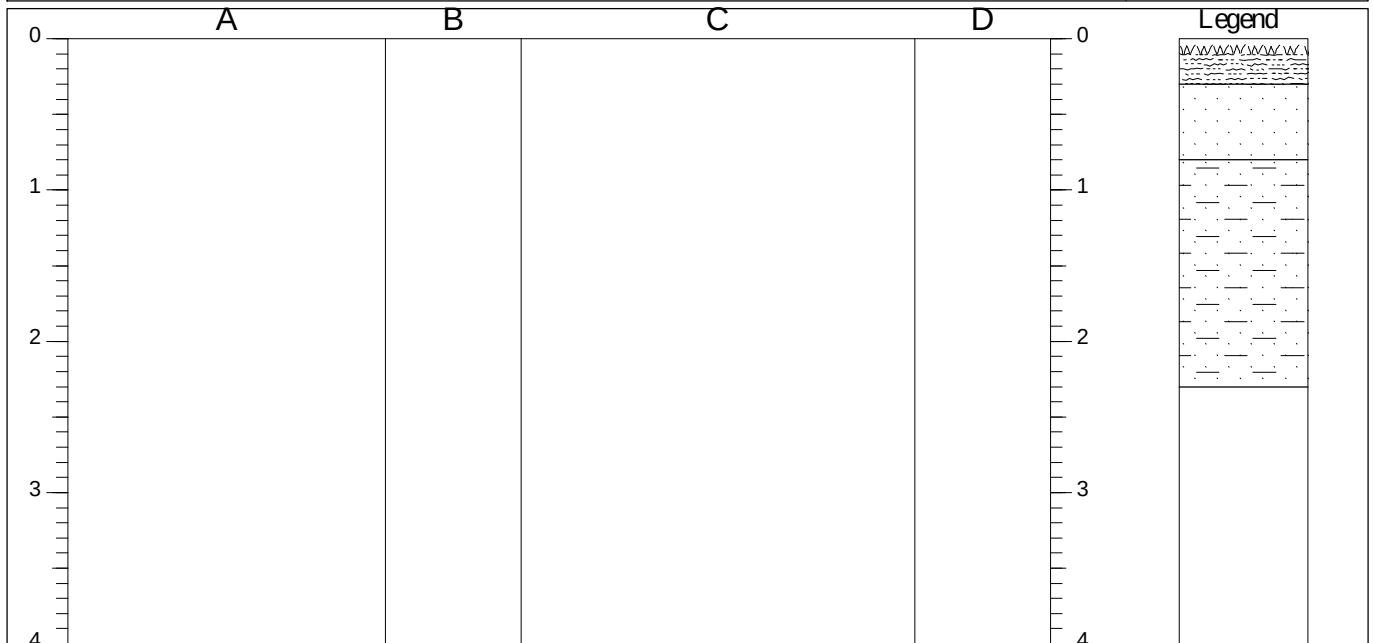
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Stubble/weeds over dark brown slightly organic slightly silty sand. [TOPSOIL]			
0.30-0.70		Brown very slightly clayey silty gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]			
0.70-1.10		Light brown speckled black clayey gravelly fine to coarse SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]			

Shoring/Support: None. Stability: Stable.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

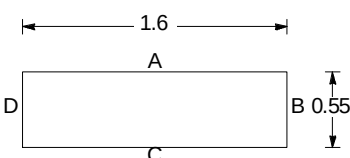
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No SA5
Job No 18BLH002	Date 19-10-18 19-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



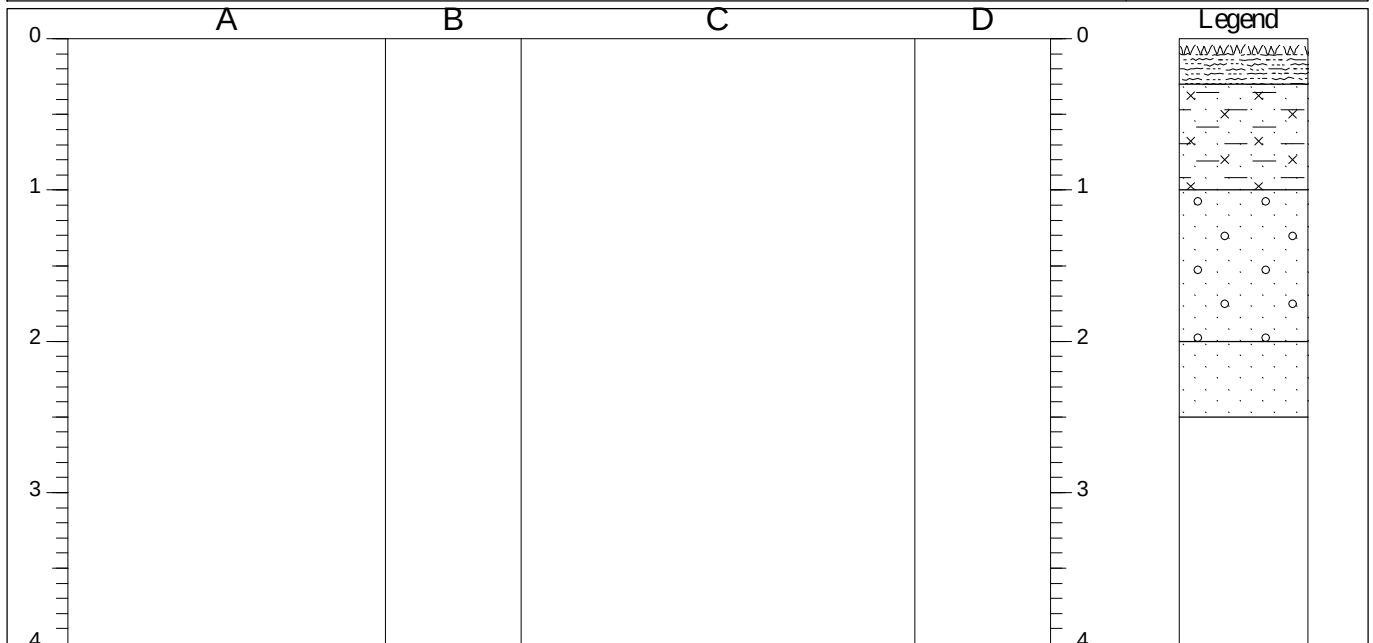
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.30		Stubble/weeds over dark brown slightly organic slightly silty sand. [TOPSOIL]				
0.30-0.80		Orange brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS]				
0.80-2.30		Light brown speckled black slightly clayey fine to medium SAND. [GLACIOFLUVIAL DEPOSITS]				

Shoring/Support: None. Stability: Stable.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
	

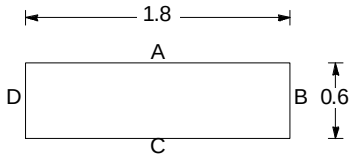
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No SA5A
Job No 18BLH002	Date 18-10-18 18-10-18	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		Stubble/weeds over dark brown slightly organic slightly silty sand. [TOPSOIL]				
0.30-1.00		Brown slightly clayey silty fine to medium SAND with rare gravel and rootlets. Gravel fine to medium subrounded of siltstone. [GLACIOFLUVIAL DEPOSITS]				
1.00-2.00		Light brown gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]				
2.00-2.50		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS]				

Shoring/Support: None. Stability: Stable.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

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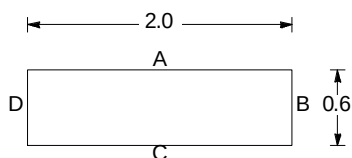
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No SA6
Job No 18BLH002	Date 19-10-18 19-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

Figure 1 displays the spatial distribution of four fish species across four depth zones (0, 1, 2, 3) in four panels (A, B, C, D). The legend indicates the species: *A. balearicum* (white circle), *A. melanocephalum* (black circle), *A. melanocephalum* (white circle), and *A. melanocephalum* (black circle). The distribution is shown as a grid of cells, with the top row (depth 0) containing the species names and the bottom row (depth 3) containing the species names. The species names are repeated in the legend.

STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Stubble/weeds over dark brown slightly organic slightly silty sand. [TOPSOIL]			
0.30-1.40		Light brown speckled black slightly clayey slightly gravelly fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]			

Shoring/Support: None.
Stability: Stable.

GENERAL
REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

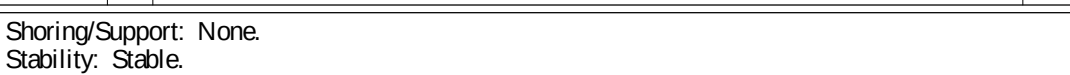
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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AGS3 UK TP 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS3_1.GDT 13/11/18

TRIAL PIT LOG

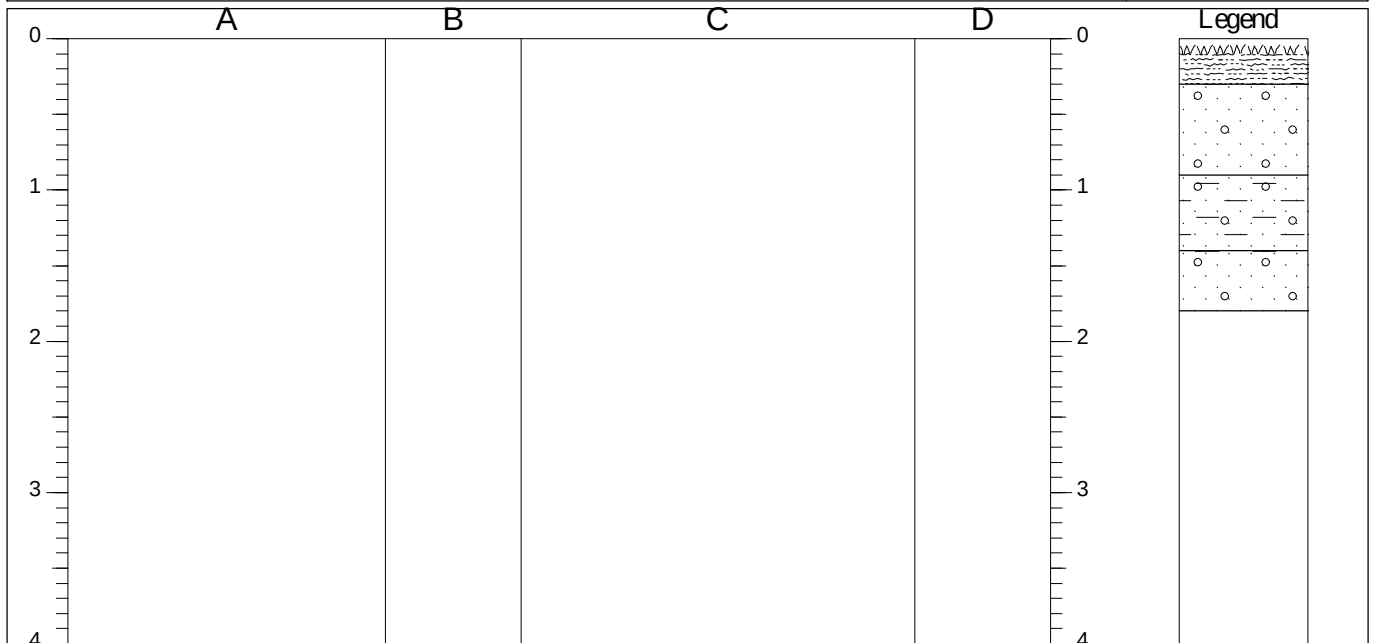
Project Holt Road, Wrexham				TRIAL PIT No SA6A
Job No 18BLH002	Date 18-10-18 18-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Stubble/weeds over dark brown slightly organic slightly silty sand. [TOPSOIL]			
0.30-1.80		Orange brown slightly silty gravelly fine to coarse SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]			

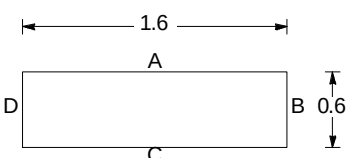
Shoring/Support: None. Stability: Stable. 	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No SA7
Job No 18BLH002	Date 19-10-18 19-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



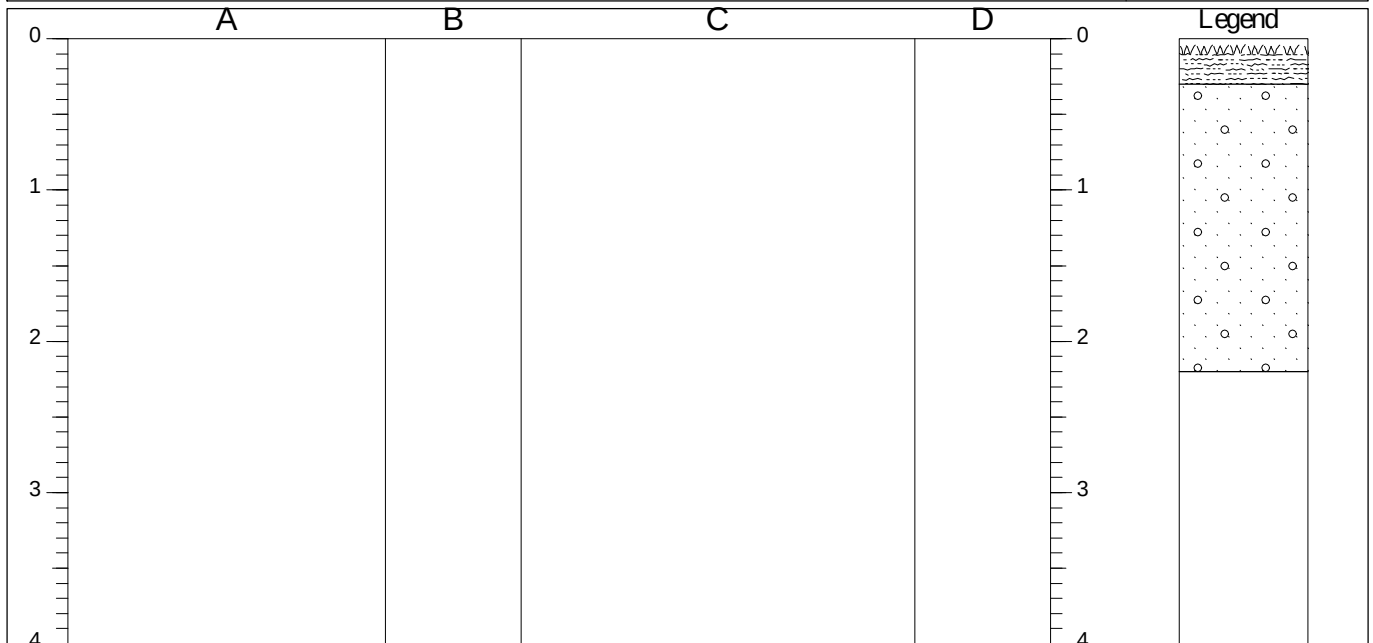
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.30		Stubble/weeds over dark brown slightly organic slightly silty sand. [TOPSOIL]				
0.30-0.90		Orange brown gravelly fine to coarse SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]				
0.90-1.40		Brown speckled black gravelly slightly clayey gravelly fine to coarse SAND. [GLACIOFLUVIAL DEPOSITS]				
1.40-1.80		Light brown speckled black fine to coarse SAND with rare gravel. Gravel fine to medium subrounded of siltstone. [GLACIOFLUVIAL DEPOSITS]				

Shoring/Support: None. Stability: Stable.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
	

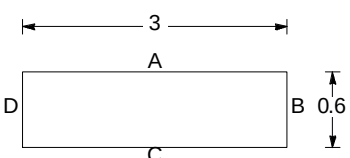
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP01
Job No 18BLH002	Date 15-10-18 15-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



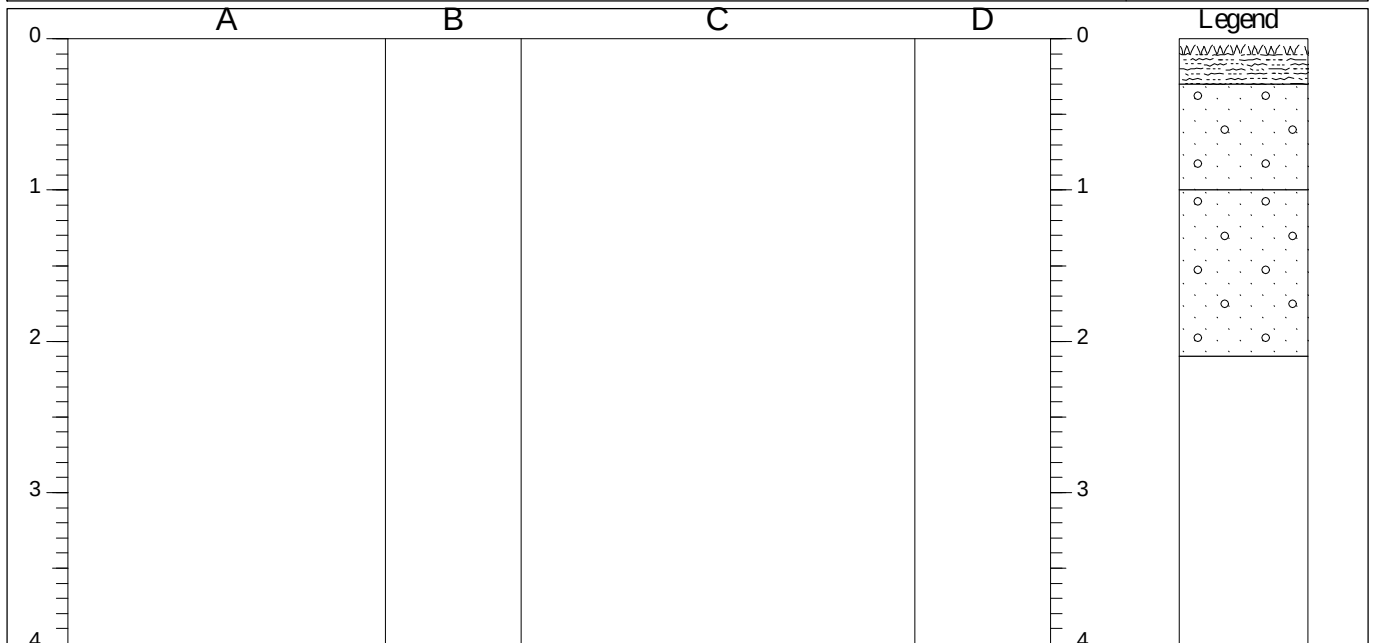
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Stubble over dark brown slightly silty organic gravelly sand with rootlets. [TOPSOIL]	0.10-0.20	ES	
0.30-2.20		Orange brown gravelly fine to coarse SAND with lenses of fine to coarse SAND. Gravel fine to coarse subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]	1.80-2.00	B	
2.20-4.00		Trial pit terminated at 2.2mbgl due to collapse.			

Shoring/Support: None. Stability: Side walls collapsing at 2.2mbgl.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

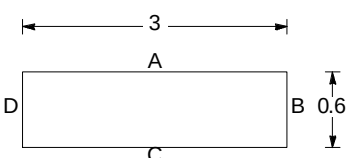
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP02
Job No 18BLH002	Date 15-10-18 15-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



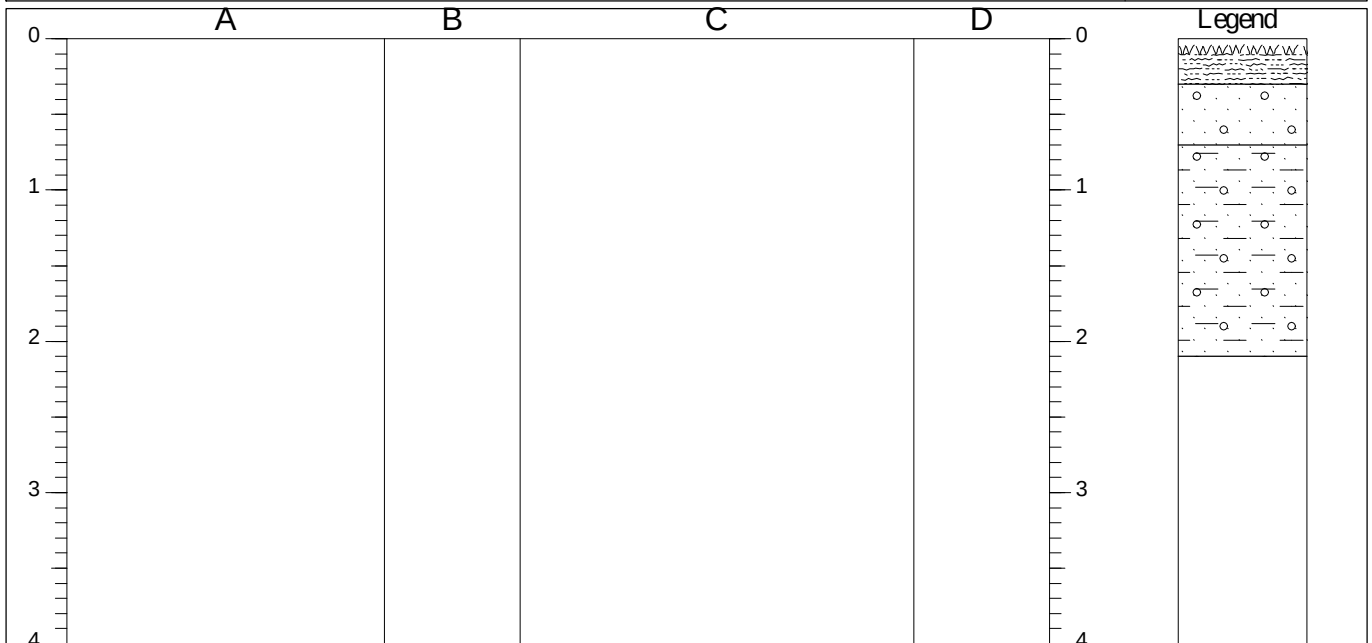
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Stubble/weeds over dark brown slightly silty slightly organic gravelly sand. [TOPSOIL]			
0.30-1.00		Orange brown gravelly fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]			
1.00-2.10		Light orange brown slightly gravelly fine to coarse SAND lenses of fine to coarse SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]			
2.10-4.00		Trial pit terminated at 2.1mbgl due to collapse.			

Shoring/Support: None. Stability: Side walls collapsing at 2.1mbgl.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

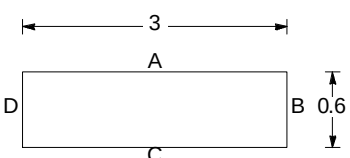
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP03
Job No 18BLH002	Date 15-10-18 15-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



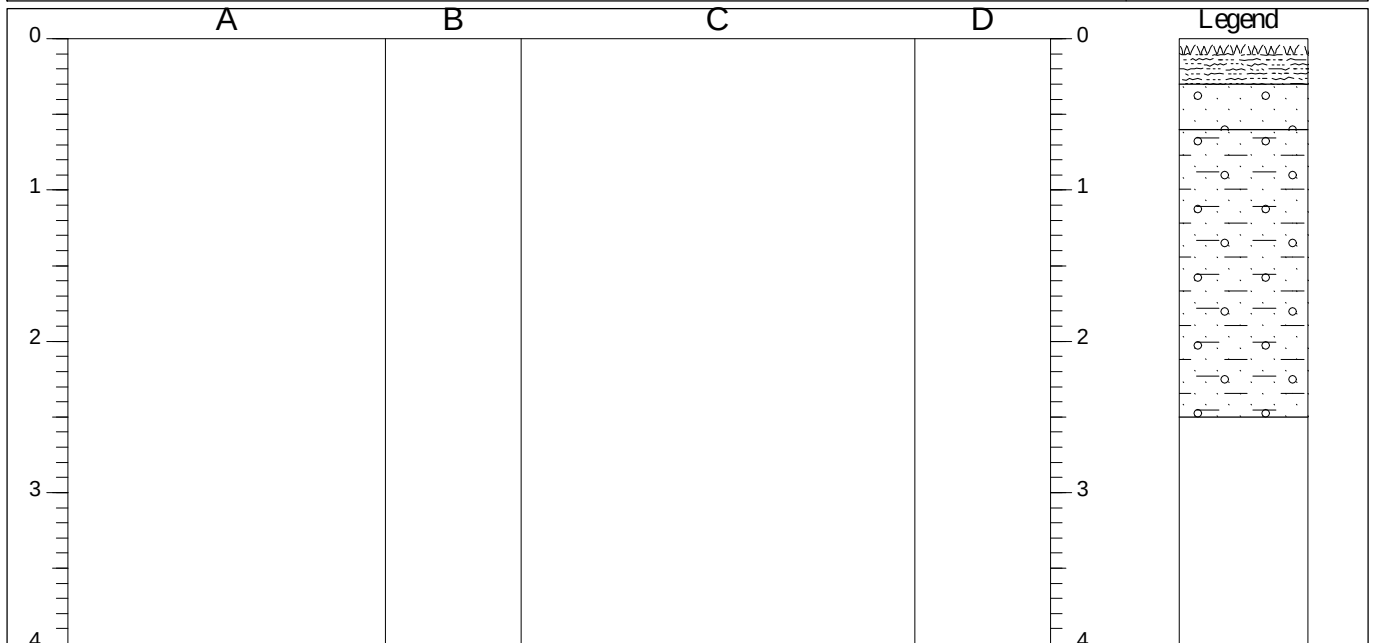
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.30		Stubble/weeds over dark brown slightly organic slightly silty sand. [TOPSOIL]				
0.30-0.70		Orange brown gravelly fine to coarse SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]				
0.70-2.10		Orange brown slightly clayey very gravelly fine to coarse SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]				
		1.8 - 1.9mbgl brown and black slightly sandy very gravelly CLAY. Gravel fine to coarse fragments of coal. [GLACIOFLUVIAL DEPOSIT]				
2.10-4.00		Trial pit terminated at 2.1mbgl.				

Shoring/Support: None. Stability: Side walls collapsing at 2.1mbgl.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
	

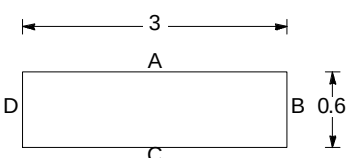
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP04
Job No 18BLH002	Date 15-10-18 15-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



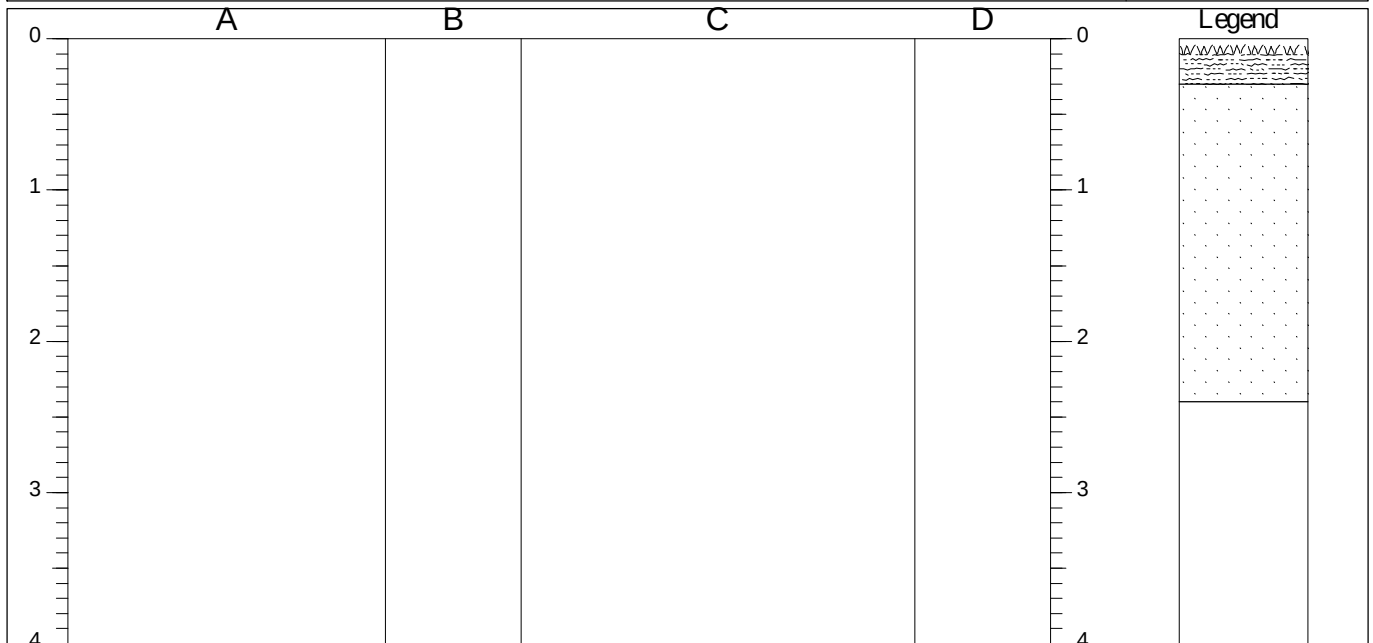
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass and nettles over dark brown slightly organic slightly silty SAND. [TOPSOIL]	0.10-0.20	ES	
0.30-0.60		Orange brown slightly gravelly fine to medium SAND.	1.40-1.80	B	
0.60-2.50		Gravel of fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]			
		Light orange brown thinly bedded slightly clayey gravelly fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
2.50-4.00		Trial pit terminated at 2.5mbgl due to collapse.			

Shoring/Support: None. Stability: Trial pit collapsed at 2.5mbgl.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

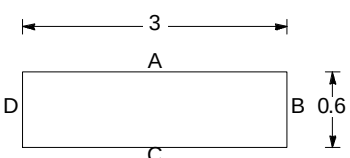
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP05
Job No 18BLH002	Date 15-10-18 15-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



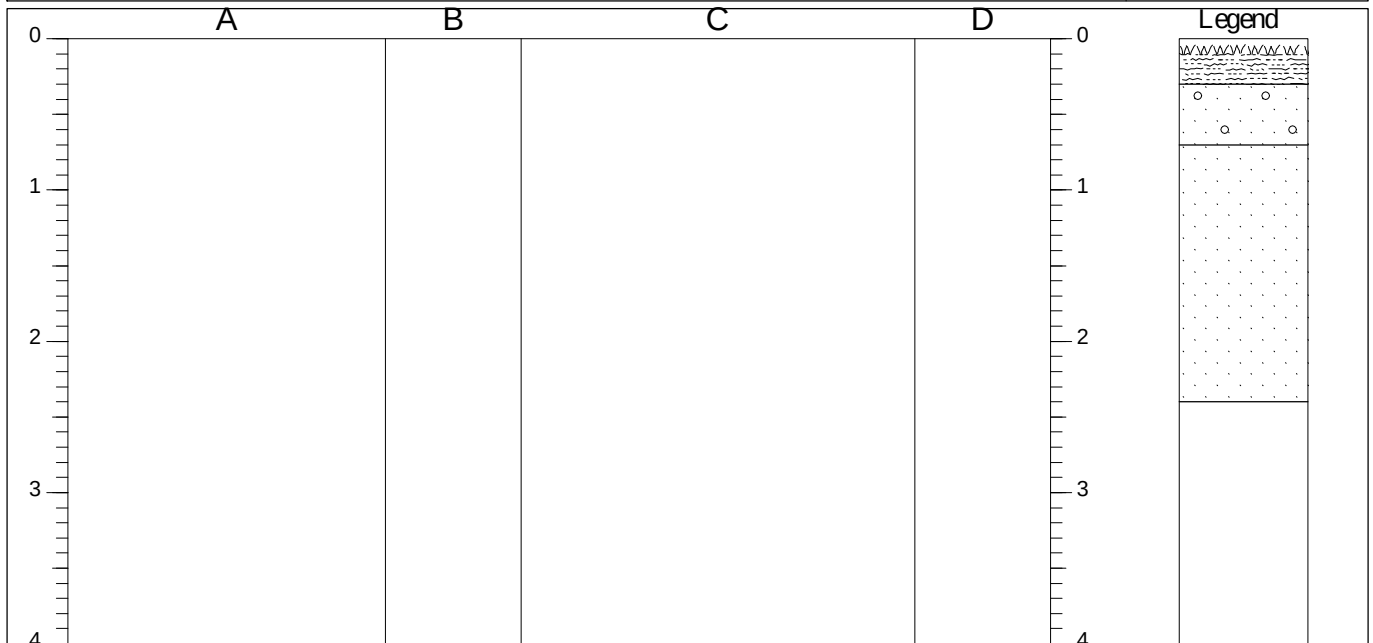
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty sand. [TOPSOIL]			
0.30-2.40		Dark brown becoming light orange brown fine to medium SAND. Rare rootlets and bioturbation in upper 1m. [GLACIOFLUVIAL DEPOSIT]	0.30-0.40	ES	
2.40-4.00		Trial pit terminated at 2.4mbgl due to collapse.			

Shoring/Support: None. Stability: Collapse at 2.4mbgl.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
	

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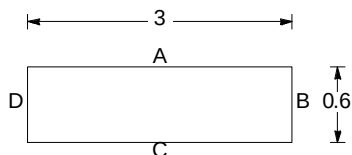
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP06
Job No 18BLH002	Date 15-10-18 15-10-18	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		Grass stubble over dark brown slightly organic slightly silty sand. [TOPSOIL]	0.10-0.20	ES	
0.30-0.70		Orange brown slightly gravelly fine to medium SAND. Gravel fine to coarse subrounded of Mudstone and Limestone. Rare rootlets and bioturbation.			
0.70-2.40		[GLACIOFLUVIAL DEPOSIT] Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]	2.00	D	
2.40-4.00		Trial pit terminated at 2.4mbgl due to collapse.			

Shoring/Support: None.
Stability: Side walls collapsed repeatedly at 2.4mbgl.



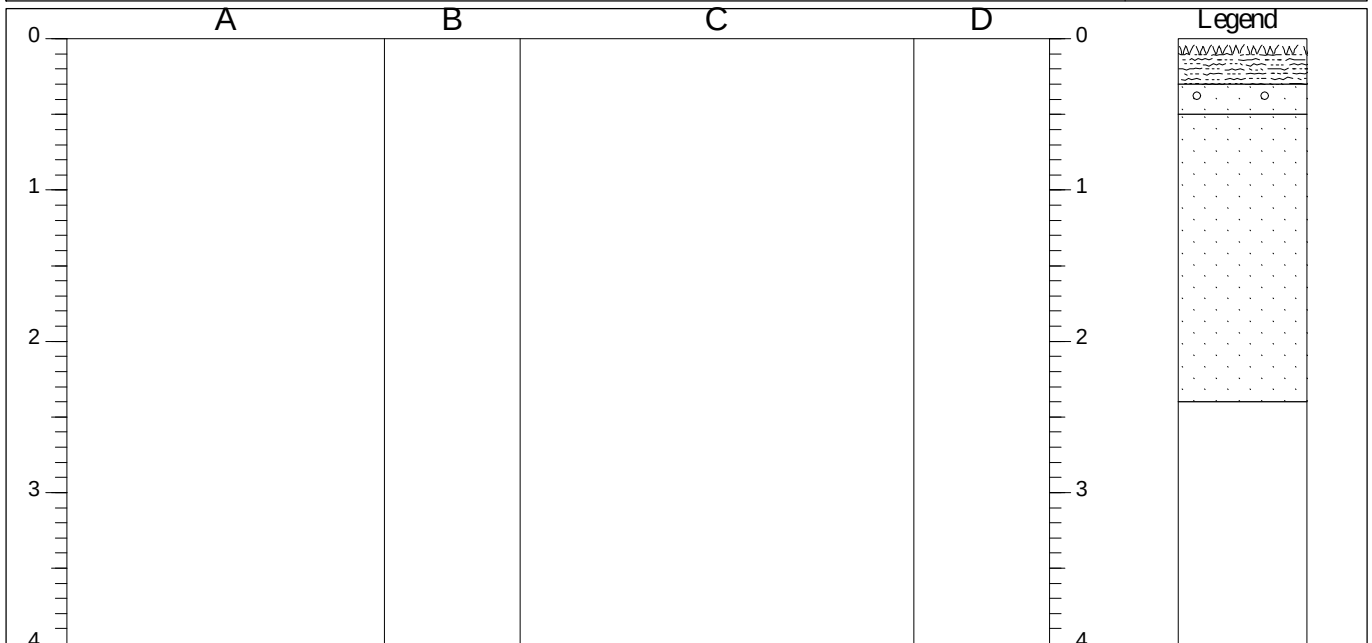
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

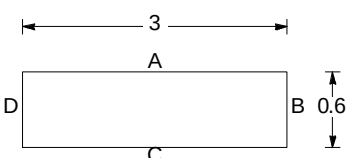
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP07
Job No 18BLH002	Date 15-10-18 15-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



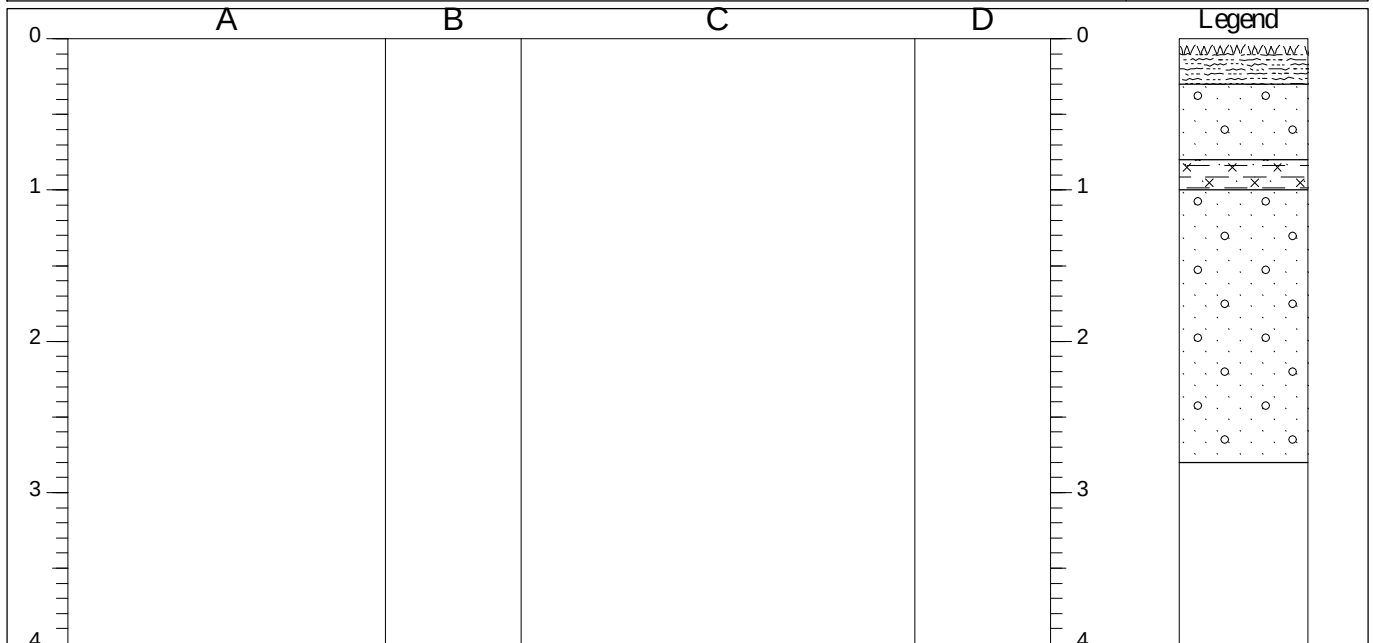
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Stubble/grass over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]			
0.30-0.50		Orange brown slightly gravelly SAND with rare rootlets and bioturbation. [GLACIOFLUVIAL DEPOSIT]			
0.50-2.40		Light brown fine to medium SAND. Rare rootlet and bioturbation in upper 1m. [GLACIOFLUVIAL DEPOSIT]			
2.40-4.00		Trial pit terminated at 2.4mbgl due to collapse.			

Shoring/Support: None. Stability: Repeated collapses at 2.4mbgl.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
	

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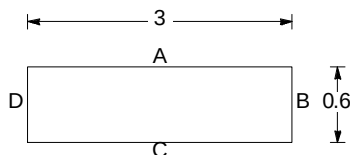
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP08
Job No 18BLH002	Date 15-10-18 15-10-18	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		Stubble/grass over dark brown slightly organic slightly silty gravelly sand with very rare fragments of pottery.	0.10-0.20	ES	
0.30-0.80		[TOPSOIL] Orange brown slightly gravelly fine to medium SAND with rare rootlets. Gravel fine to medium subrounded of Mudstone and Limestone.			
0.80-1.00		[GLACIOFLUVIAL DEPOSIT]	0.80-1.00	D	
1.00-2.80		Stiff low plasticity red brown mottled light brown slighty sandy silty CLAY. [GLACIOFLUVIAL DEPOSIT] Light brown slightly gravelly SAND. Gravel fine to medium subrounded of Mudstone and Limestone. [GLACIOFLUVIAL DEPOSIT]			
2.80-4.00		Trial pit terminated at 2.8mbgl.			

Shoring/Support: None.
Stability: Trial pit terminated at 2.8mbgl as unable to excavate deeper due to length of pit.



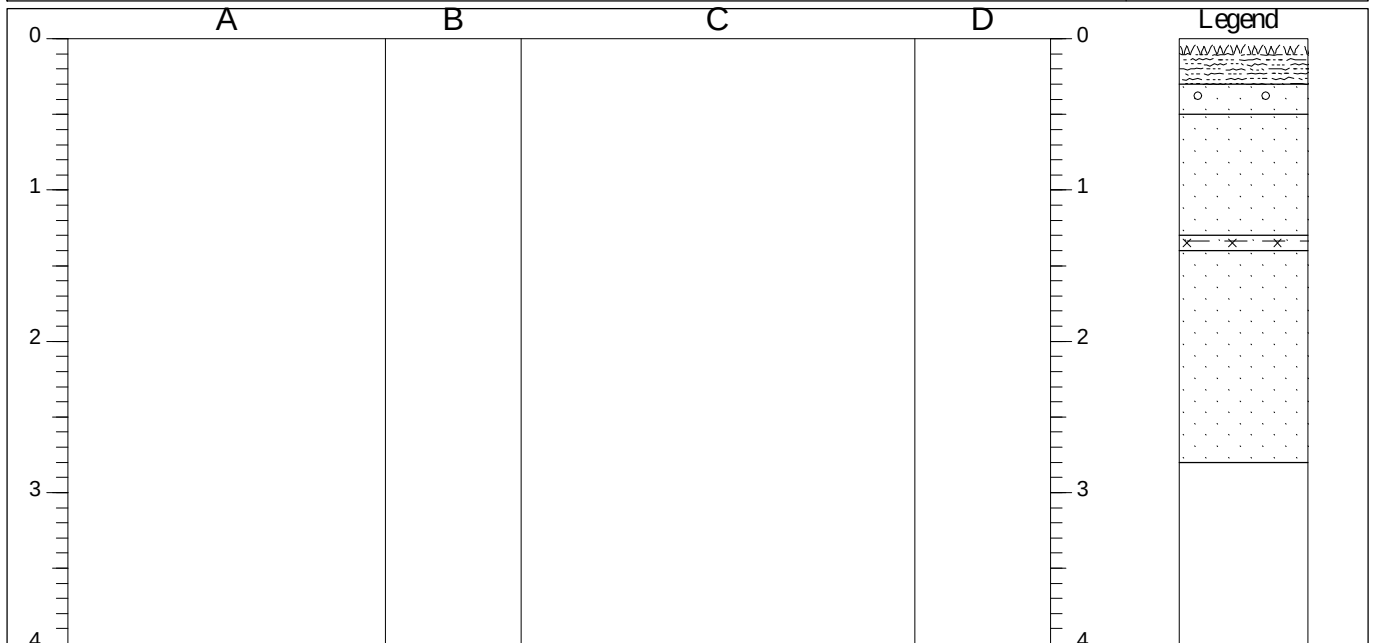
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

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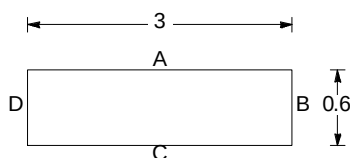
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP09
Job No 18BLH002	Date 15-10-18 15-10-18	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		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	0.40-0.50	ES	
0.30-0.50		Orange brown slightly gravelly SAND with rare rootlets and bioturbation. [GLACIOFLUVIAL DEPOSIT]			
0.50-1.30		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
1.30-1.40		Stiff low plasticity red brown slightly sandy silty CLAY. [GLACIOFLUVIAL DEPOSIT]	1.30-1.40	D	
1.40-2.80		Light brown fine to medium SAND with rare subrounded fine to coarse gravel. [GLACIOFLUVIAL DEPOSIT]			
2.80-4.00		Trial pit terminated at target depth.			

Shoring/Support: None.
Stability: Stable.



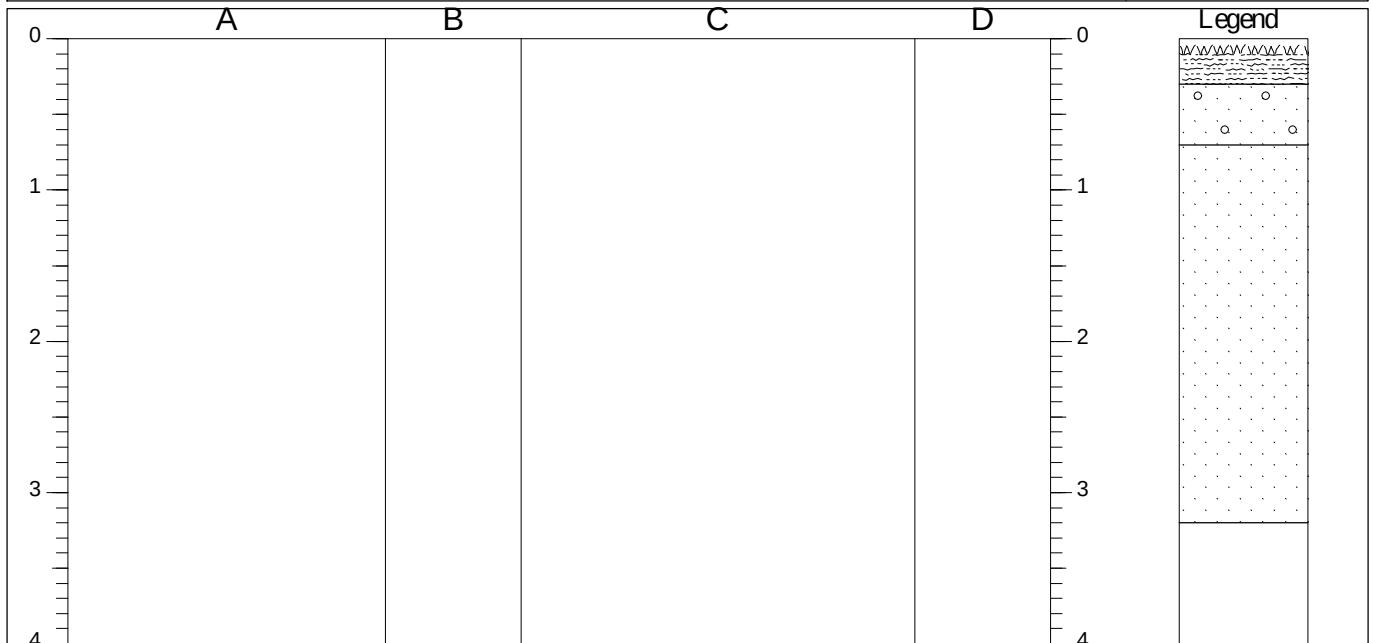
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

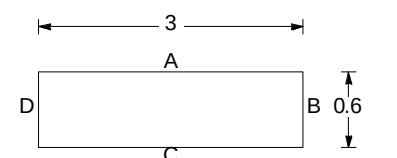
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP10
Job No 18BLH002	Date 15-10-18 15-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



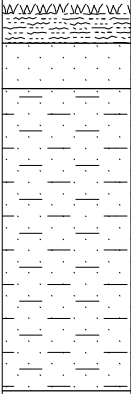
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]			
0.30-0.70		Orange brown slightly gravelly SAND with rare rootlets. [GLACIOFLUVIAL DEPOSIT]			
0.70-3.20		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
3.20-4.00		Trial pit terminated at target depth.			

Shoring/Support: None. Stability: Stable.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
	

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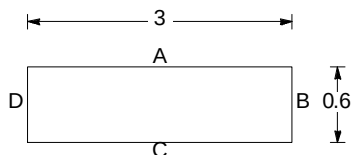
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP11
Job No 18BLH002	Date 16-10-18 16-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

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

STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Stubble over dark brown slightly organic slightly clayey gravelly sand. [TOPSOIL]	0.40-0.50	ES	
0.30-0.60		Brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded mixed lithologies.			
0.60-2.60		[GLACIOFLUVIAL DEPOSIT] Light brown to orange brown thinlly bedded slightly clayey fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
			2.00-2.20	B	
2.60-4.00		Trial pit terminated at 2.6mbgl.			

Shoring/Support: None.
Stability: Trial pit collapsed at 2.6mbgl.



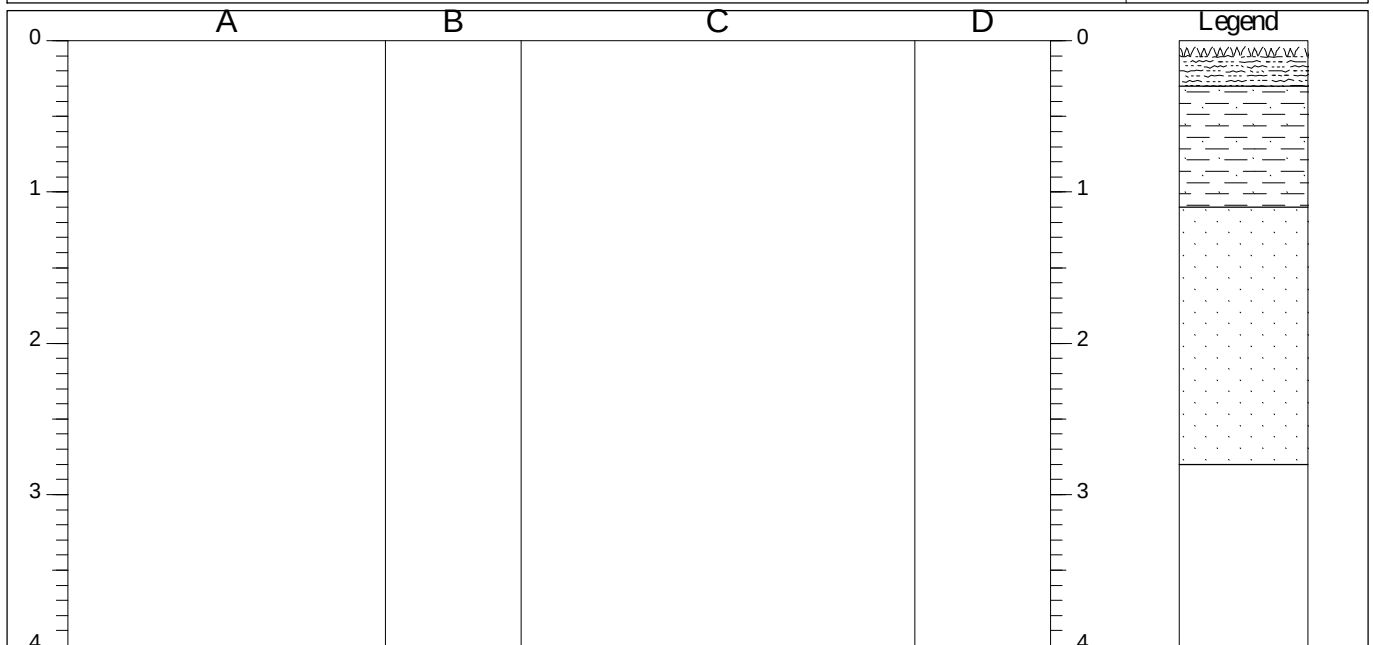
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

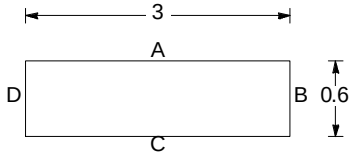
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP12
Job No 18BLH002	Date 16-10-18 16-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



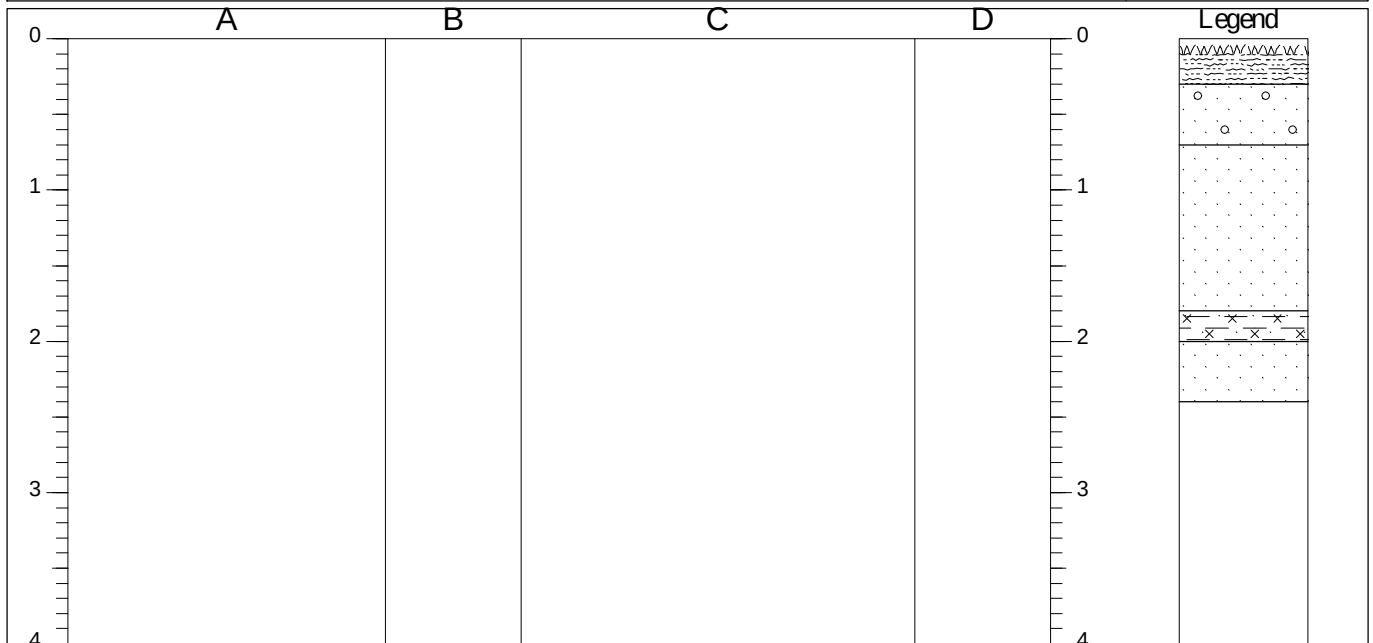
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	0.20-0.30	ES		
0.30-1.10		Stiff orange brown slightly sandy CLAY with pockets of very sandy clay. [GLACIOFLUVIAL DEPOSIT]	0.80	D		
1.10-2.80		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]				
2.80-4.00		Trial pit terminated at target depth.				

Shoring/Support: None. Stability: Stable.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
	

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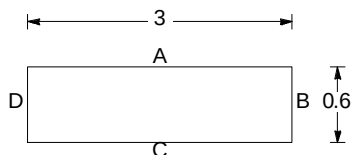
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP13
Job No 18BLH002	Date 16-10-18 16-10-18	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		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]				
0.30-0.70		Brown slightly clayey slightly gravelly fine to medium SAND with rare rootlets and bioturbation. [GLACIOFLUVIAL DEPOSIT]				
0.70-1.80		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]				
1.80-2.00		Firm low plasticity light brown thinly to thickly laminated slightly sandy silty CLAY. [GLACIOFLUVIAL DEPOSIT]	2.00	D		
2.00-2.40		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]				
2.40-4.00		Trial pit terminated at 2.4mbgl due to collapse.				

Shoring/Support: None.
Stability: Side walls collapsing at 2.4mbgl.



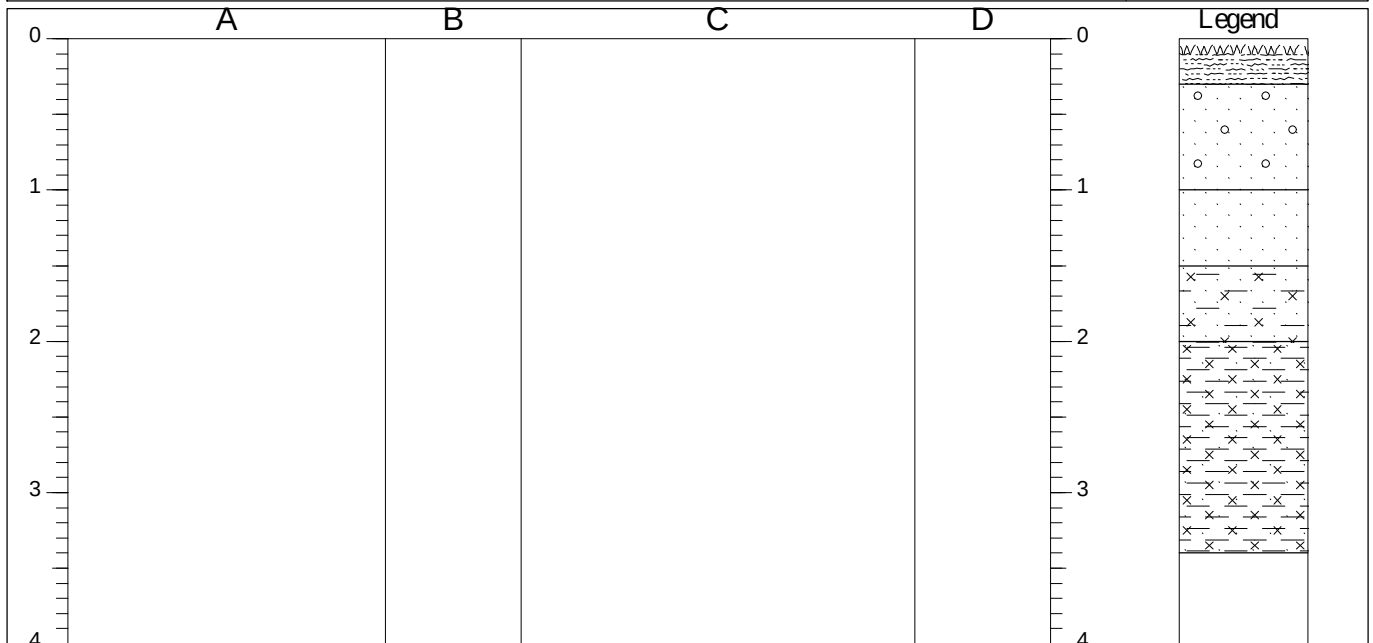
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

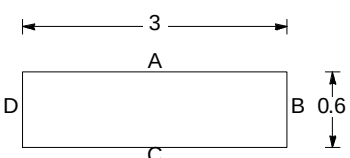
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP14
Job No 18BLH002	Date 16-10-18 16-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



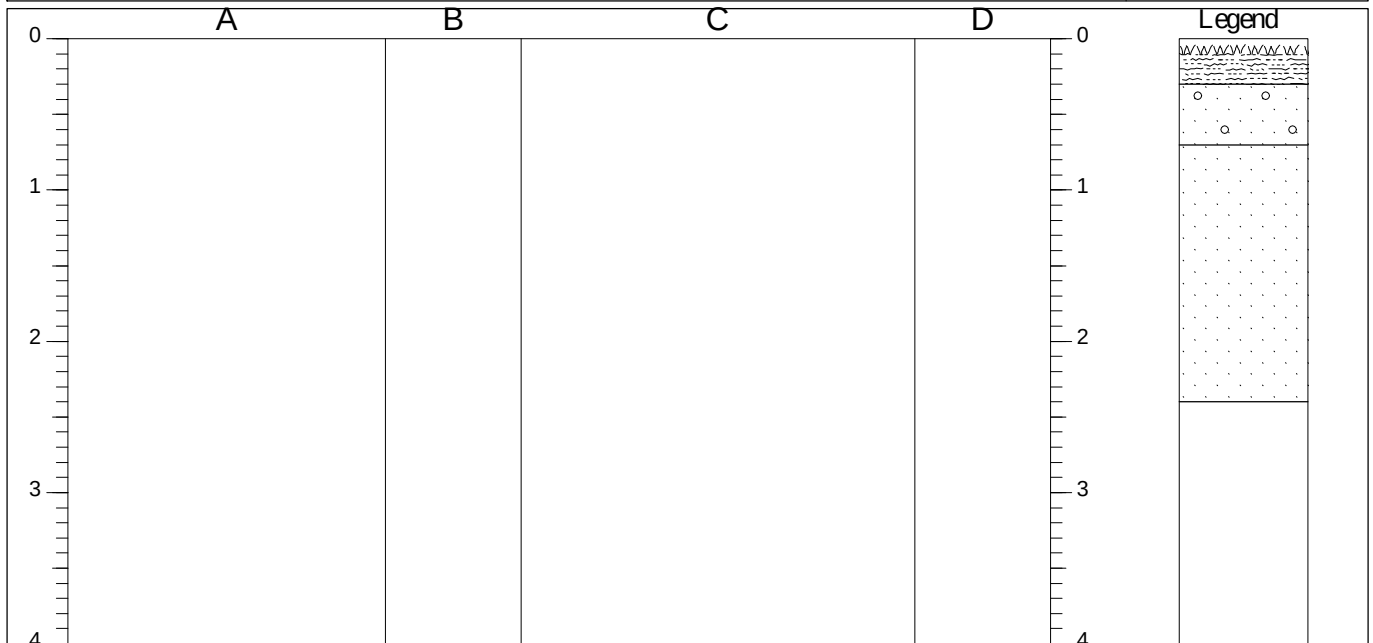
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	0.10-0.20	ES	
0.30-1.00		Brown slightly gravelly fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
1.00-1.50		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
1.50-2.00		Light brown slightly clayey silty fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]	1.80	D	
2.00-3.40		Soft to firm low plasticity thinly and thickly laminated light brown, orange brown and light grey sandy silty CLAY. [GLACIOFLUVIAL DEPOSIT]	2.20-2.40	D	
3.40-4.00		Trial pit terminated at 3.40mbgl.			

Shoring/Support: None. Stability: Stable.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

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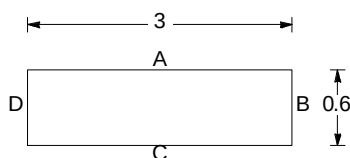
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP15
Job No 18BLH002	Date 16-10-18 16-10-18	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		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	1.40-1.60	B	
0.30-0.70		Dark orange brown gravelly fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]			
0.70-2.40		Light brown to brown fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT] Dark black sandy gravel size fragments of coal - wash in lenses at:- 1.00-1.10mbgl. 1.20-1.30mbgl. 1.70-1.80mbgl.			
2.40-4.00		Trial pit terminated 2.4mbgl due to collapse.			

Shoring/Support: None.
Stability: Collapsed side walls at 2.4mbgl.



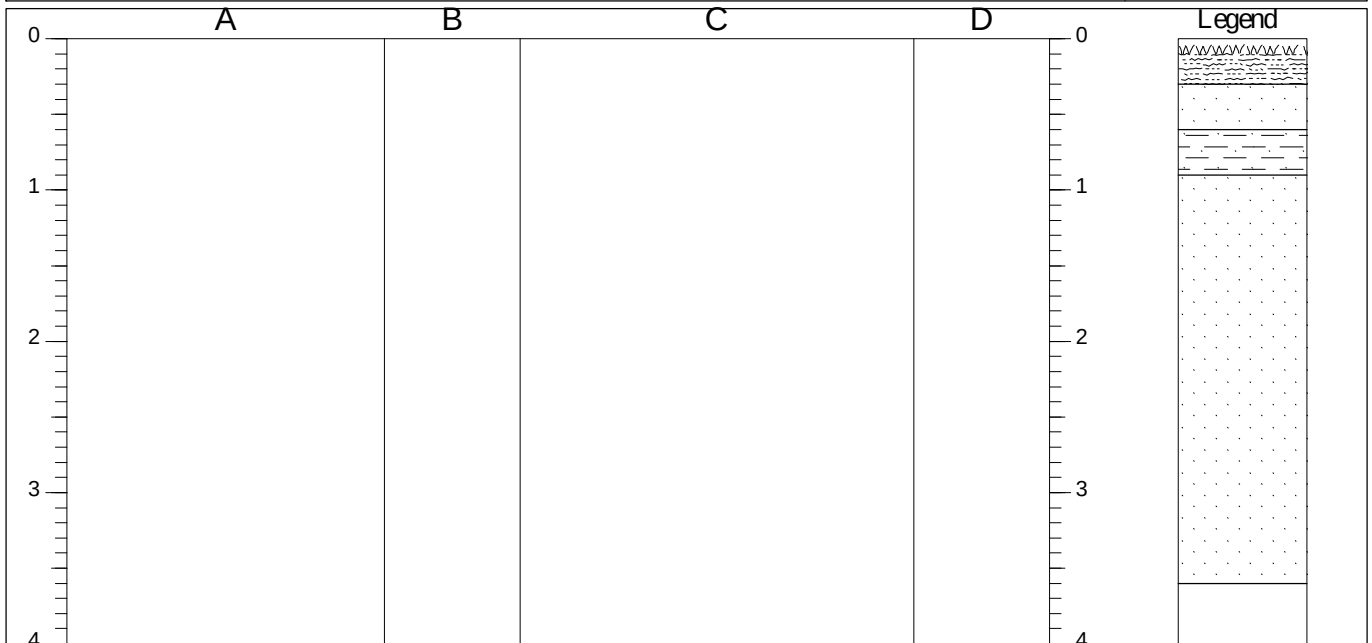
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

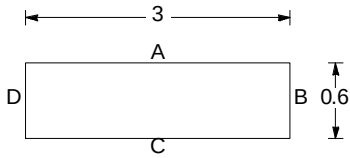
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP16
Job No 18BLH002	Date 16-10-18 16-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



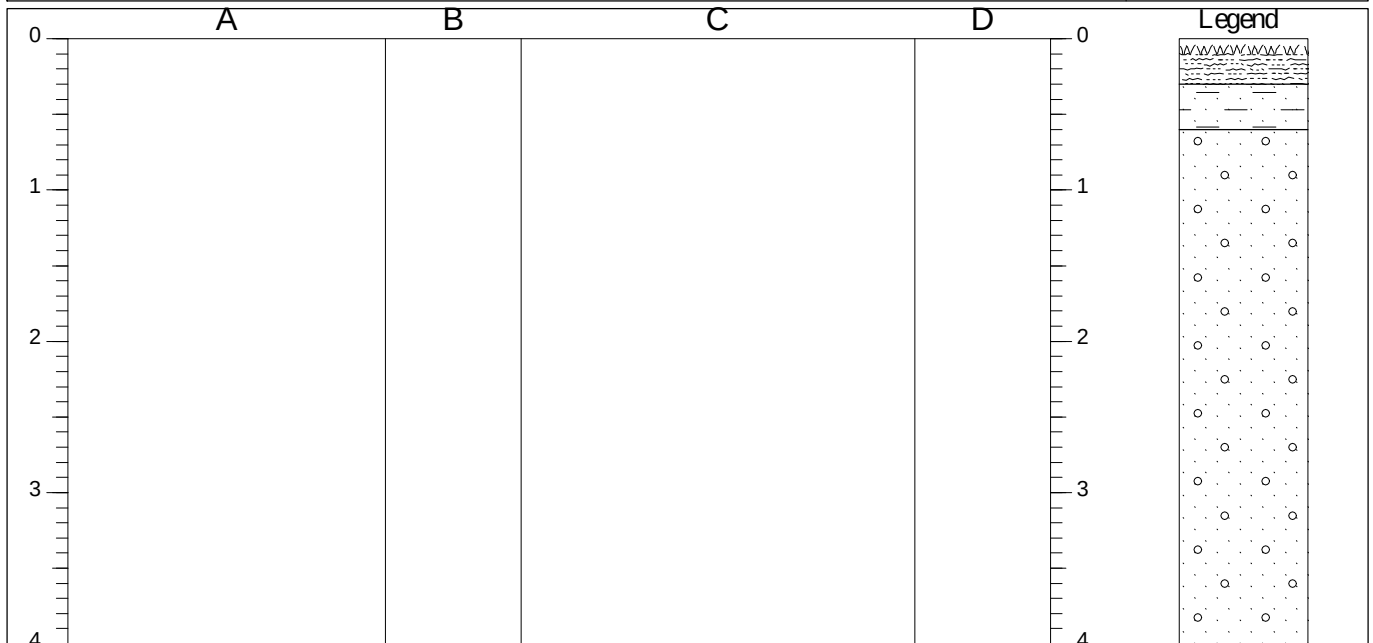
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	0.10-0.20	ES		
0.30-0.60		Brown slightly clayey gravelly SAND. [GLACIOFLUVIAL DEPOSIT]				
0.60-0.90		Firm to stiff red brown slightly sandy CLAY. [GLACIOFLUVIAL DEPOSIT]	0.80	D		
0.90-3.60		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]				
3.60-4.00		Trial pit terminated at target depth.				

Shoring/Support: None. Stability: Stable.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

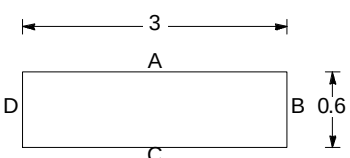
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP17
Job No 18BLH002	Date 16-10-18 16-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



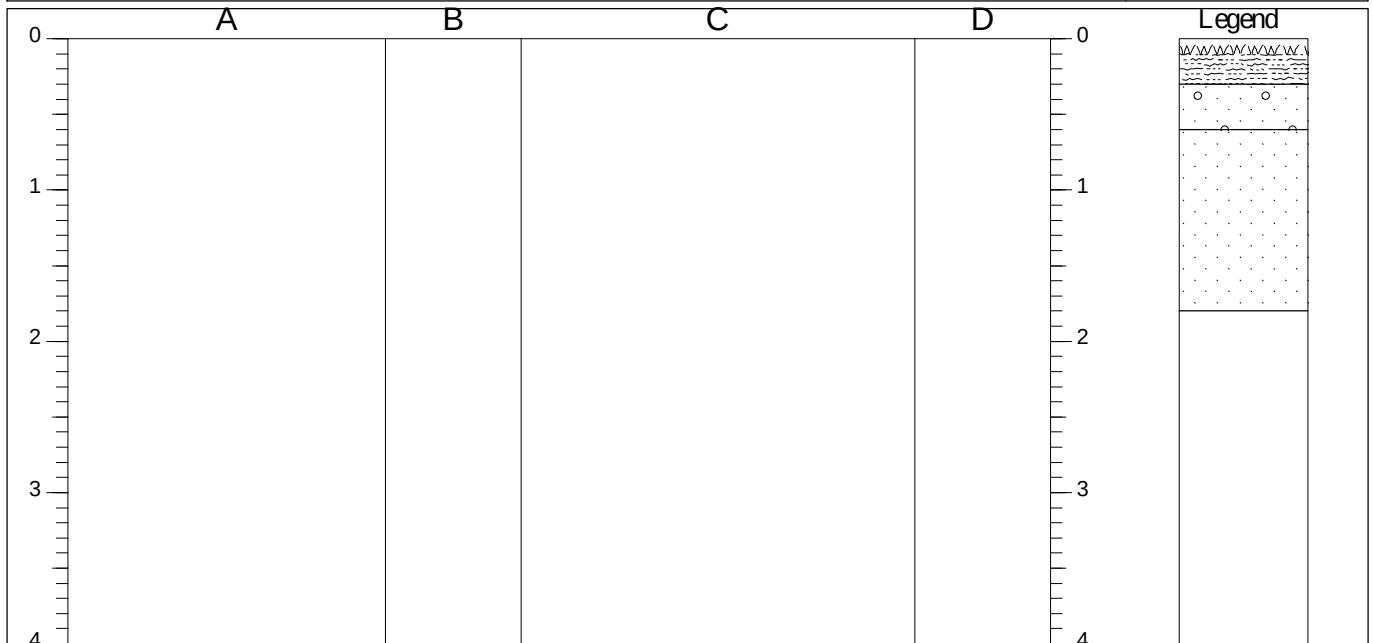
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	1.00-1.40	B	
0.30-0.60		Brown very slightly clayey fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
0.60-4.00		Brown and light brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT] Lense of fine to medium gravel of coal at 0.8mbgl.			

Shoring/Support: None. Stability: Stable.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
	

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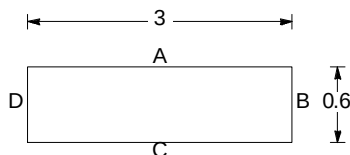
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP18
Job No 18BLH002	Date 16-10-18 16-10-18	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		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	0.10-0.20	ES	
0.30-0.60		Orange brown gravelly fine to coarse SAND with low cobble content. Gravel fine to coarse subrounded of mixed lithologies.			
0.60-1.80		Cobble subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]			
		Light brown fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]			
1.80-4.00		Trial pit terminated at 1.80mbgl due to collapse.			

Shoring/Support: None.
Stability: Side walls collapsed at 1.8mbgl.



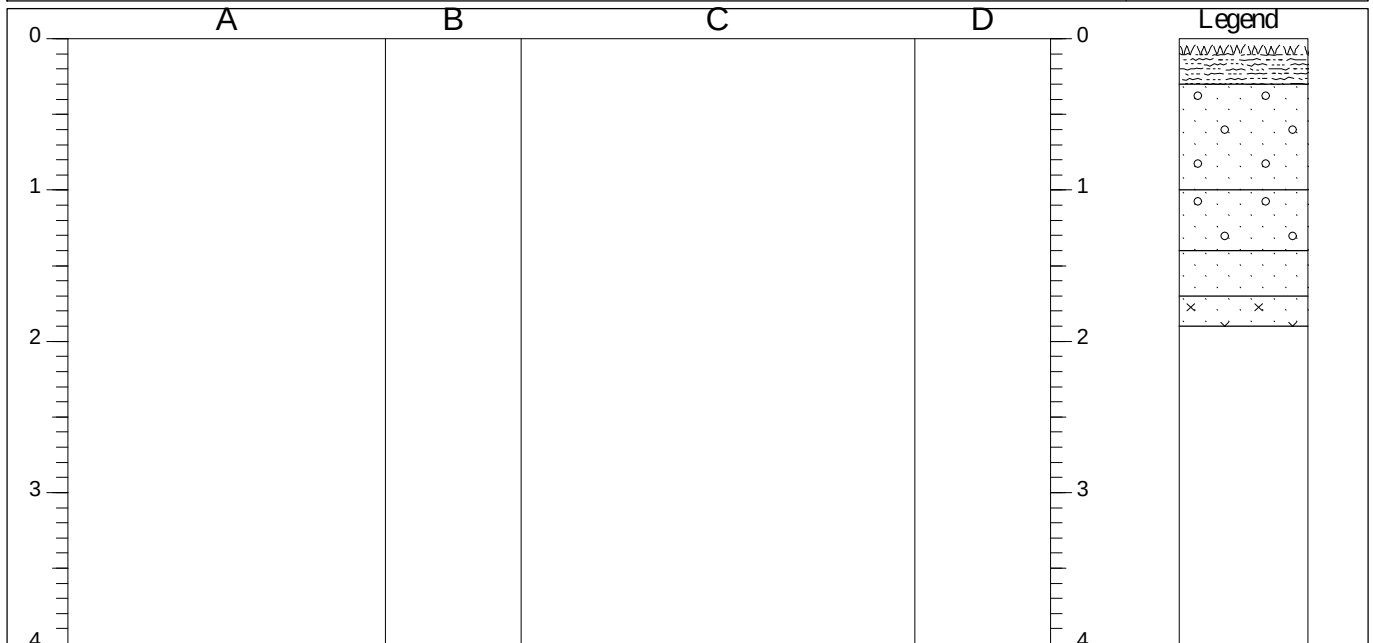
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

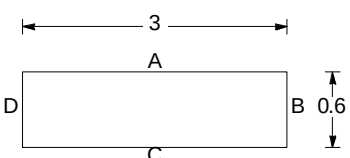
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP19
Job No 18BLH002	Date 16-10-18 16-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

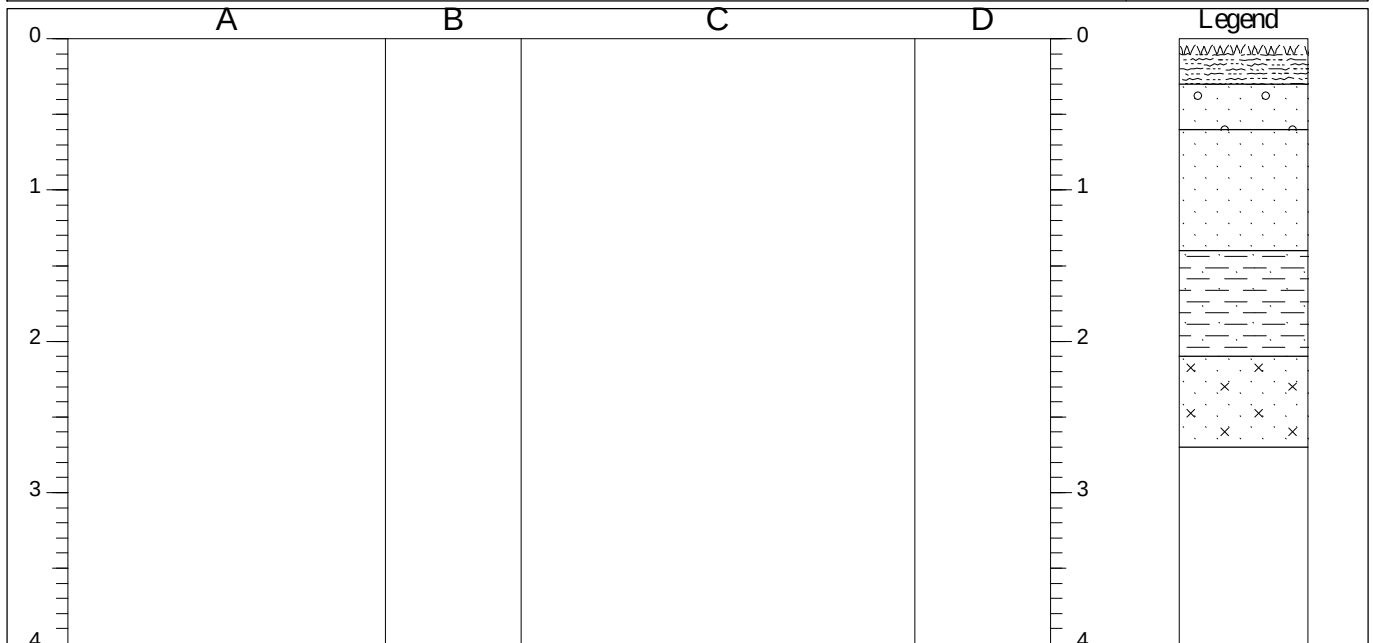


STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	1.70-1.80	D	
0.30-1.00		Orange brown gravelly fine to coarse SAND with lenses of gravel of coal. [GLACIOFLUVIAL DEPOSIT]			
1.00-1.40		Brown speckled black very gravelly fine to coarse SAND with moderate cobble content and very rare boulder.			
1.40-1.70		Gravel fine to coarse subrounded of mixed lithologies. Cobbles and boulders subrounded to subangular of Siltstone. [GLACIOFLUVIAL DEPOSIT]			
1.70-1.90		Light brown fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]			
1.90-4.00		Wet brown silty fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
		Trial pit terminated at 1.9mbgl due to collapse.			

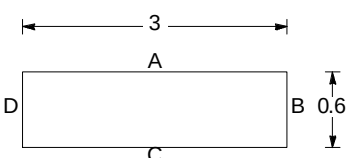
Shoring/Support: None. Stability: Trial pit collapsed at 1.9mbgl.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX
		Logged By DK

TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP20
Job No 18BLH002	Date 17-10-18 17-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



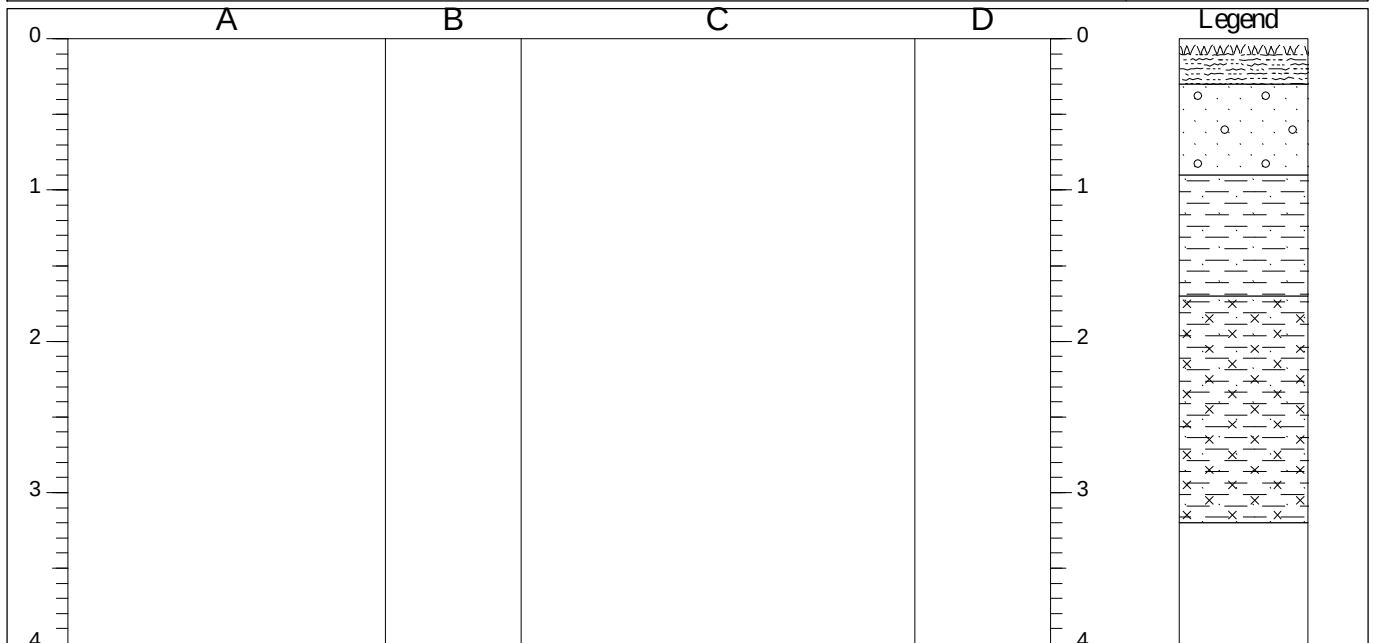
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	1.80	D	
0.30-0.60		Orange brown slightly gravelly fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]			
0.60-1.40		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
1.40-2.10		Firm to stiff intermediate plasticity reddish brown mottled grey in places very slightly sandy CLAY. [GLACIOFLUVIAL DEPOSIT]			
2.10-2.70		Light brown silty fine SAND with interbedded sandy silt and fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]	2.40	D	
2.70-4.00		Trial pit terminated at target depth.			

Shoring/Support: None. Stability: Stable.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

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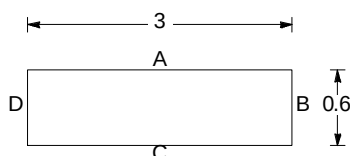
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP21
Job No 18BLH002	Date 17-10-18 17-10-18	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		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	0.30-0.40	ES	
0.30-0.90		Brown speckled black slightly gravelly in upper 0.5m fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT] Lense of gravel size fragments of coal at 0.5-0.6mbgl.			
0.90-1.70		Firm to stiff red brown mottled grey and light creamy brown slightly sandy CLAY with pockets of sandy clay. [GLACIOFLUVIAL DEPOSIT]	1.20-1.40	B	
1.70-3.20		Soft low plasticity brown mottled orange brown and grey laminated in places slightly sandy silty CLAY. [GLACIOFLUVIAL DEPOSIT]	2.50-2.80	B	
3.20-4.00		Trial pit terminated at target depth.			

Shoring/Support: None.
Stability: Stable.



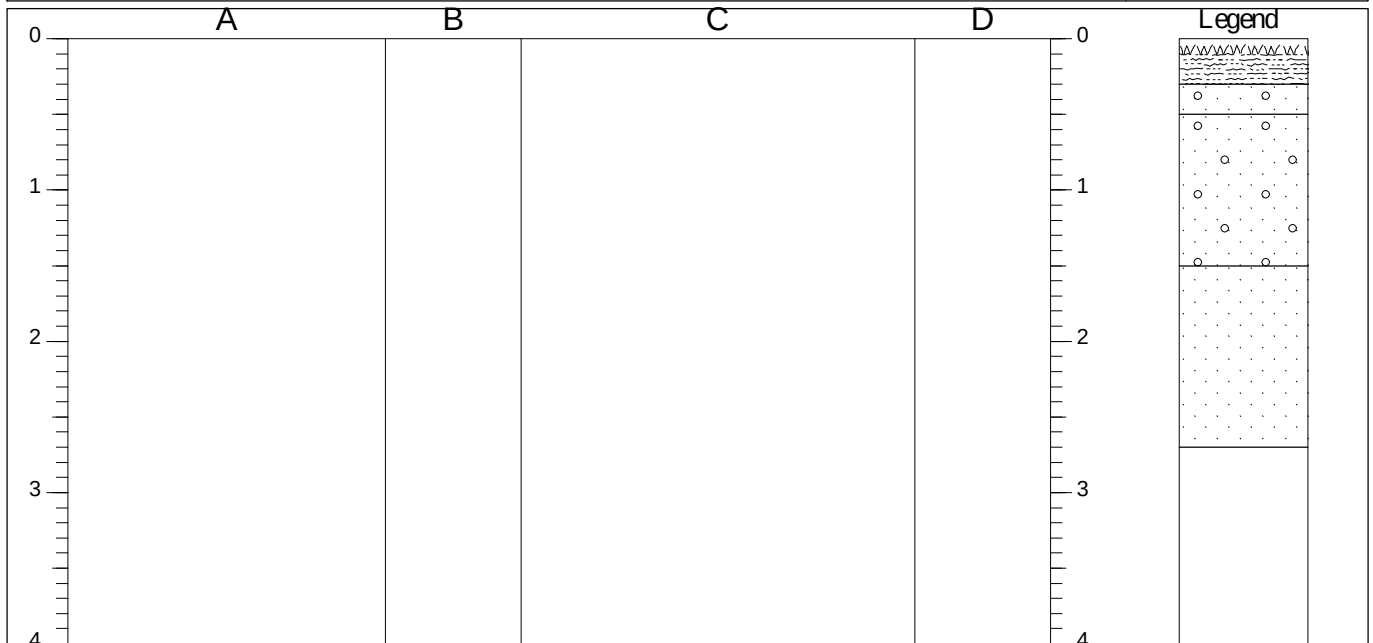
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

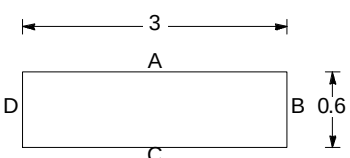
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP22
Job No 18BLH002	Date 17-10-18 17-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



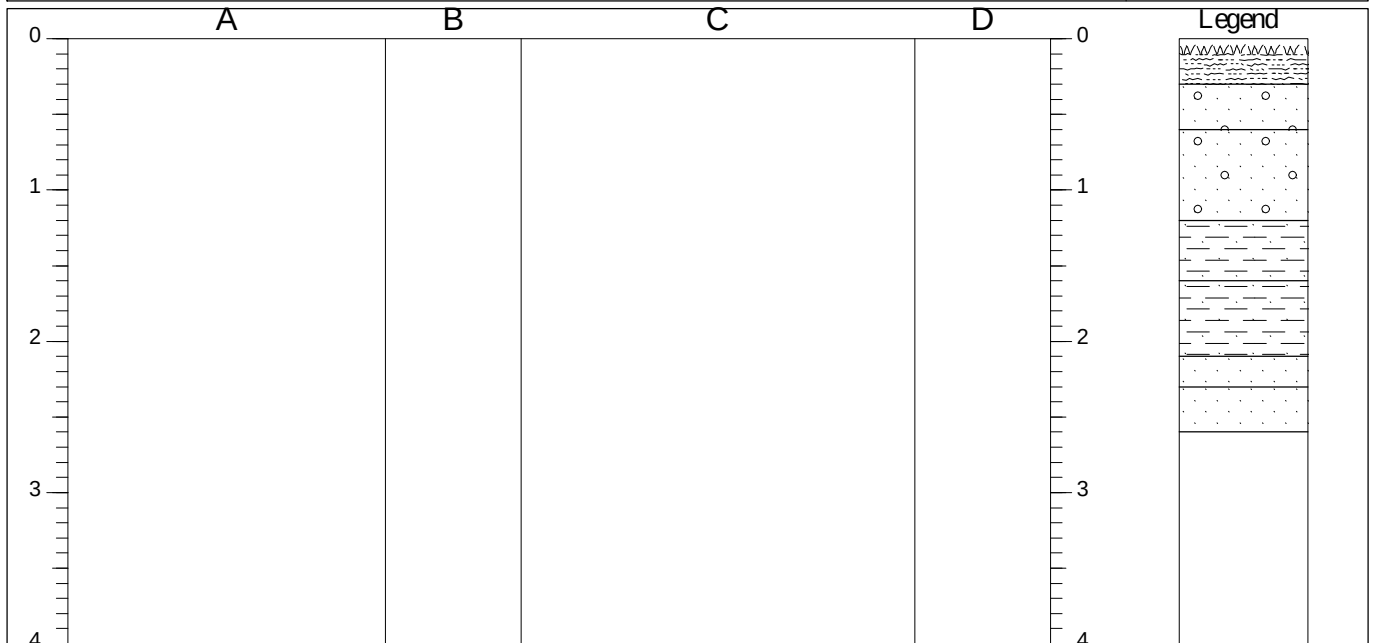
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]			
0.30-0.50		Orange brown gravelly fine to coarse SAND with pockets of sandy clay. [GLACIOFLUVIAL DEPOSIT]			
0.50-1.50		Light brown speckled black slightly gravelly fine to coarse SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]			
1.50-2.70		Light brown speckled black fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]			
2.70-4.00		Trial pit terminated at 2.7mbgl due to collapse.			

Shoring/Support: None. Stability: Side walls collapsing at 2.7mbgl. 	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
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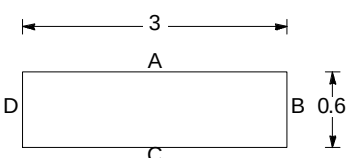
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP23
Job No 18BLH002	Date 17-10-18 17-10-18	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		Dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	1.20	D	
0.30-0.60		Orange brown gravelly SAND. [GLACIOFLUVIAL DEPOSIT]			
0.60-1.20		Light brown slightly gravelly fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]			
1.20-1.60		Very stiff to hard low plasticity red brown mottled light brown and light grey slightly sandy CLAY with pockets of fine to coarse sand. [GLACIOFLUVIAL DEPOSIT]	1.80	D	
1.60-2.10		Firm low plasticity red brown sandy CLAY. [GLACIOFLUVIAL DEPOSIT]			
2.10-2.30		Light brown fine SAND. [GLACIOFLUVIAL DEPOSIT]			
2.30-2.60		Light brown speckled black fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]			
2.60-4.00		Trial pit terminated at target depth.			

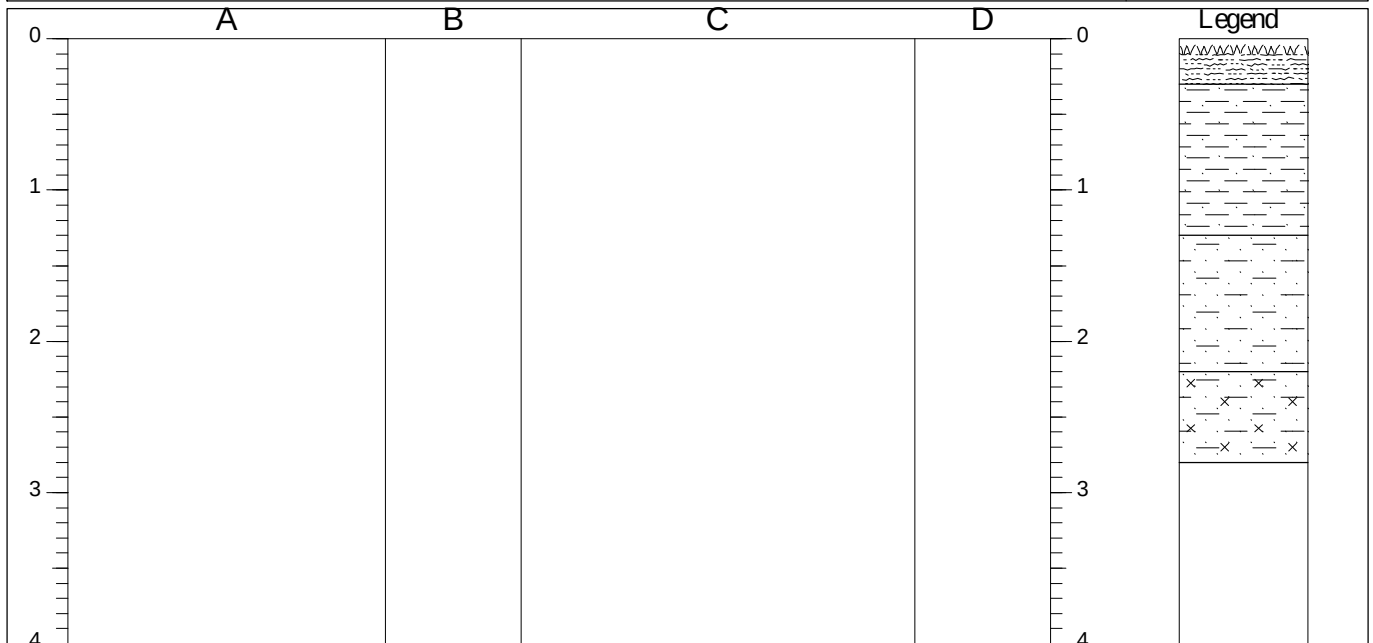
Shoring/Support: None. Stability: Stable.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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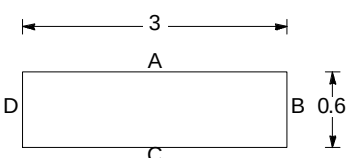
AGS3 UK TP 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS 3_1.GDT 13/11/18

TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP24
Job No 18BLH002	Date 17-10-18 17-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



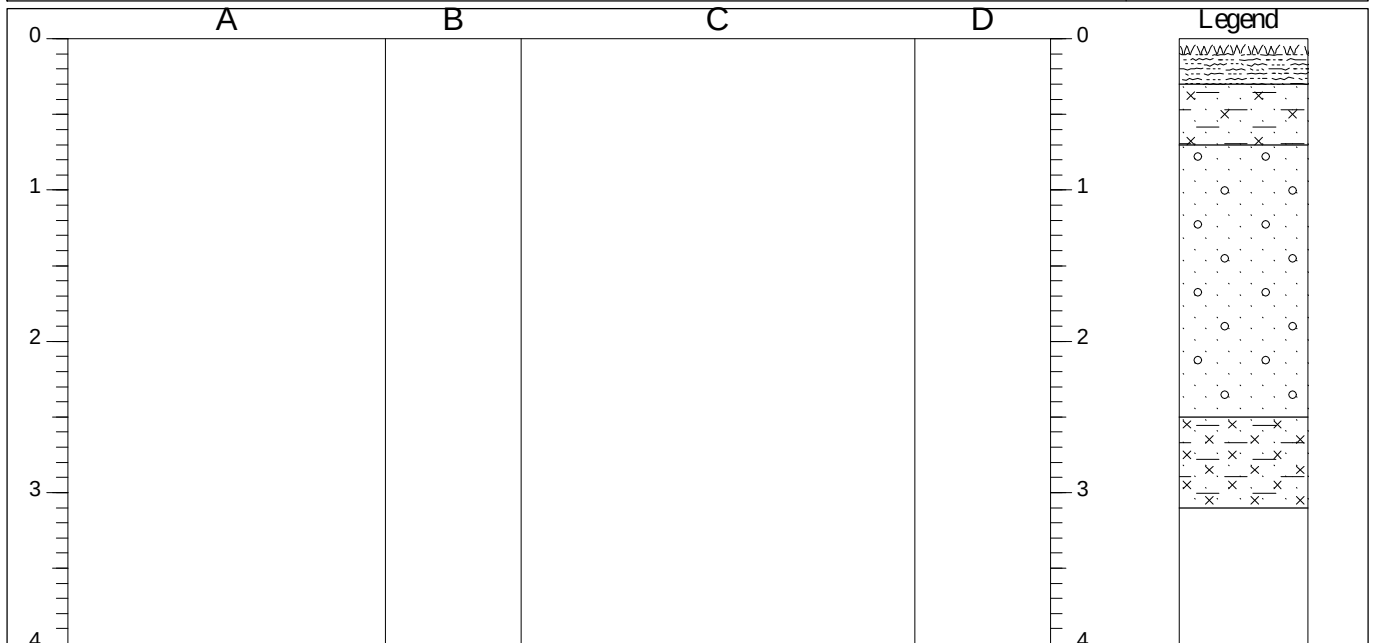
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	1.00-1.20	D	
0.30-1.30		Light brown, mottled cream, orange brown sandy CLAY with pockets of very sandy clay and slightly clayey sand. [GLACIOFLUVIAL DEPOSIT]			
1.30-2.20		Red brown and light brown slightly clayey fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
2.20-2.80		Brown slightly clayey silty fine SAND laminated with fine to medium sand and sandy silt. [GLACIOFLUVIAL DEPOSIT]	2.40	D	
2.80-4.00		Trial pit terminated at target depth.			

Shoring/Support: None. Stability: Stable.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

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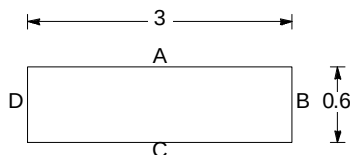
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP25
Job No 18BLH002	Date 18-10-18 18-10-18	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		Dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	3.00	D	
0.30-0.70		Orange brown very slightly clayey slightly silty fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
0.70-2.50		Light brown fine to medium SAND with rare gravel.			
2.50-3.10		Low plasticity brown mottled light grey and orange brown slightly sandy clayey SILT interbedded with fine to coarse sand and brown sandy silt. [GLACIOFLUVIAL DEPOSIT]			
3.10-4.00		Trial pit terminated at target depth.			

Shoring/Support: None.
Stability: Stable.



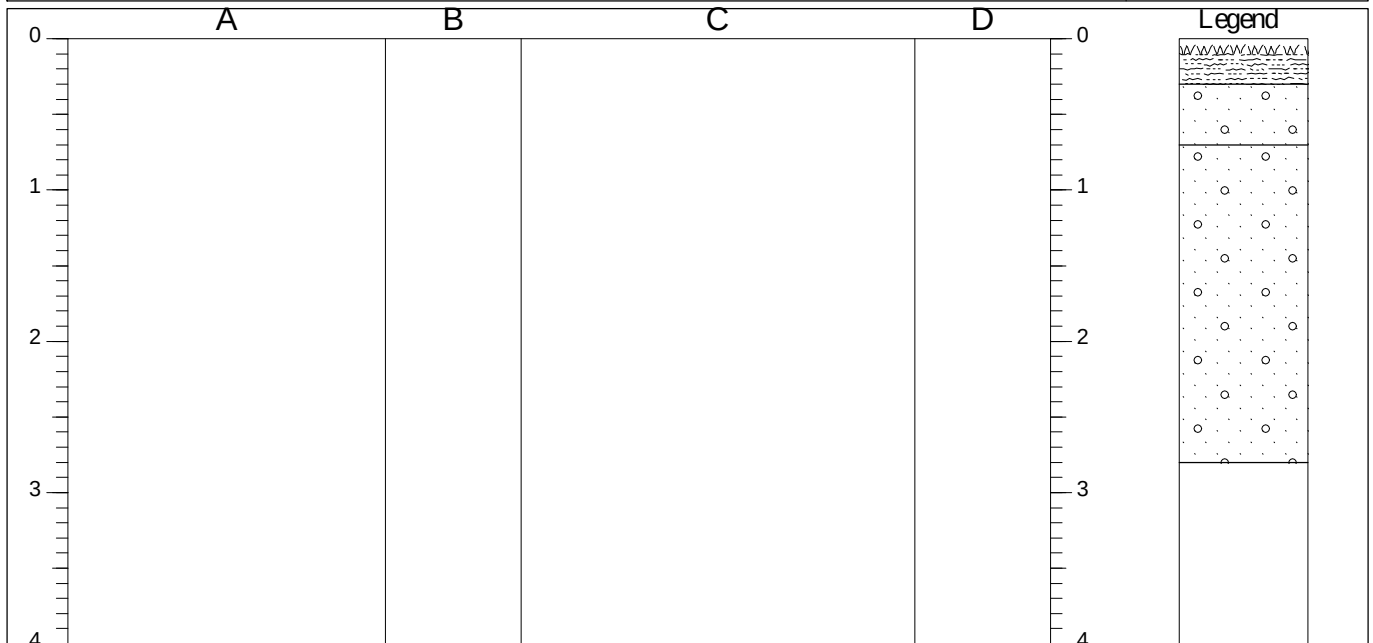
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

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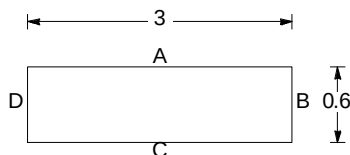
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP26
Job No 18BLH002	Date 18-10-18 18-10-18	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		Dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]			
0.30-0.70		Orange brown gravelly fine to coarse SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]			
0.70-2.80		Light creamy brown slightly gravelly fine to coarse SAND rare subrounded cobble. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]			
2.80-4.00		Trial pit terminated at 2.8mbgl due to collapse.			

Shoring/Support: None.
Stability: Side walls collapsed at 2.8mbgl.



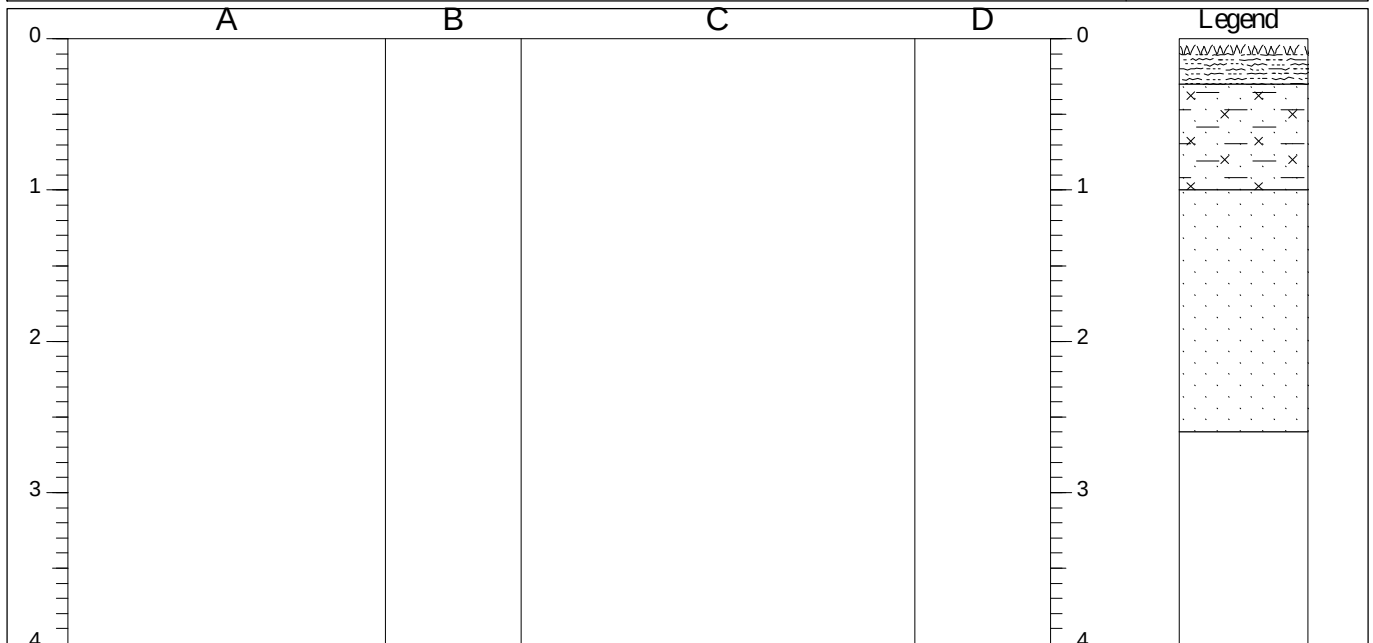
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

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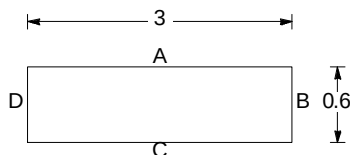
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP27
Job No 18BLH002	Date 18-10-18 18-10-18	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		Dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]	0.40-0.50	ES	
0.30-1.00		Orange brown very slightly clayey slightly silty gravelly fine to medium SAND with rare cobble. Gravel fine to medium subrounded of mixed lithologies. Cobbles subrounded of siltstone. Rare rootlets in upper 0.7m. [GLACIOFLUVIAL DEPOSIT]			
1.00-2.60		Light creamy brown speckled black fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]			
2.60-4.00		Trial pit terminated.			

Shoring/Support: None.
Stability: Side walls collapsing at 2.6mbgl.



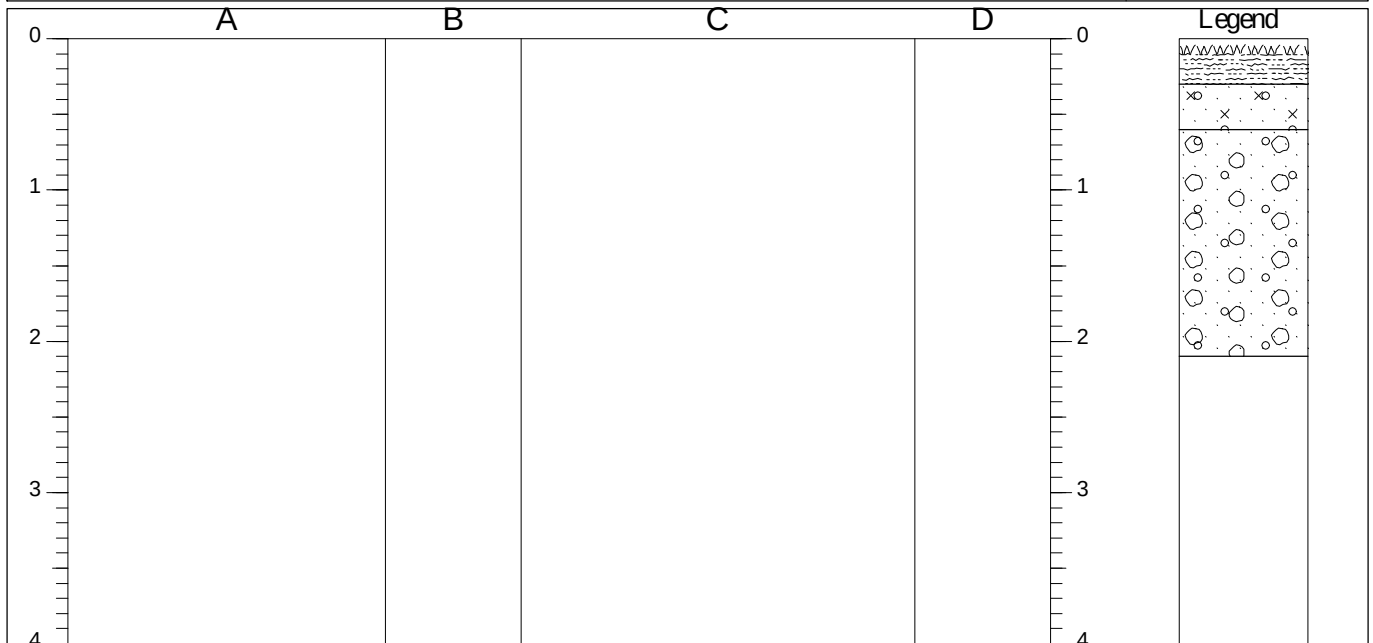
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

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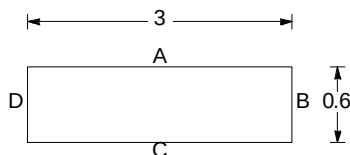
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP28
Job No 18BLH002	Date 18-10-18 18-10-18	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		Dark brown slightly organic slightly silty gravelly sand. [TOPSOIL]			
0.30-0.60		Orange brown slightly silty gravelly fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
0.60-2.10		Ligth brown speckled black gravelly fine to coarse SAND with low cobble content. Gravel fine to coarse subrounded. Cobble subrounded of Sandstone and Siltstone. [GLACIOFLUVIAL DEPOSIT]			
2.10-4.00		Trial pit terminated at 2.1mbgl due to collapse.			

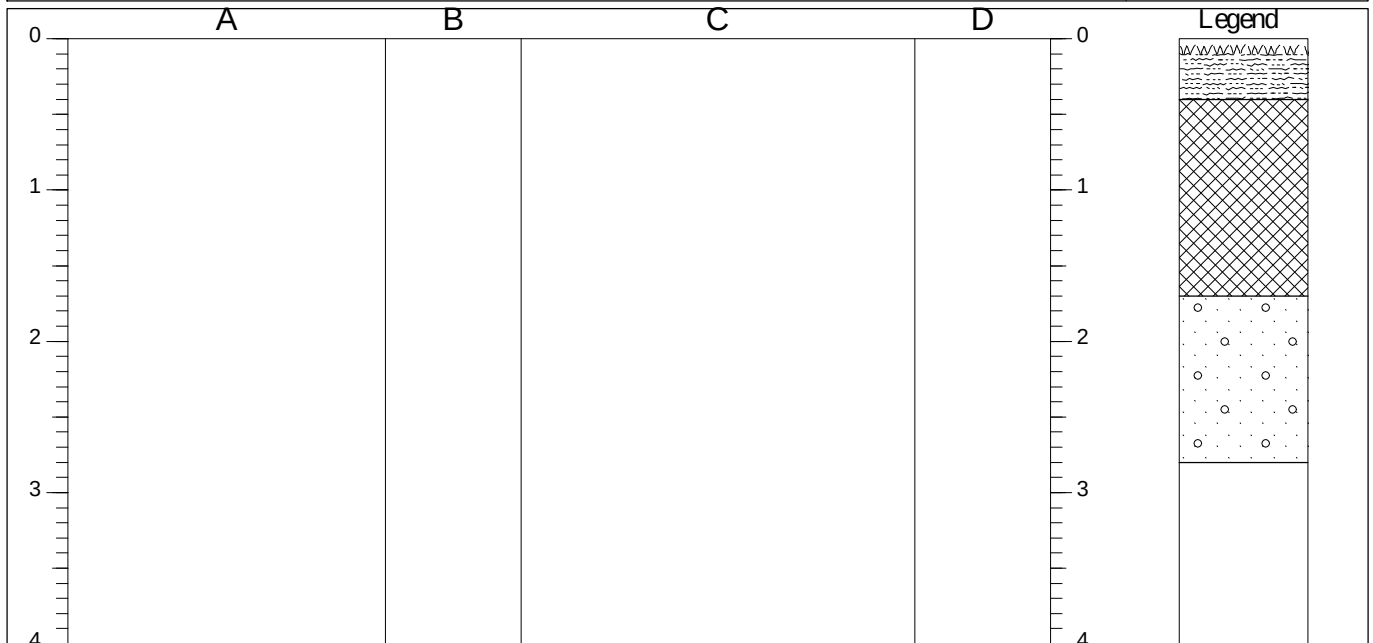
Shoring/Support: None. Stability: Side walls collapsing at 2.1mbgl.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
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All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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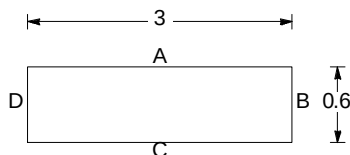
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP29
Job No 18BLH002	Date 18-10-18 18-10-18	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		Grass/stubble over dark brown slightly organic slightly silty gravelly sand with rare fragment of brick, rootlets. [TOPSOIL]	0.50-0.60	ES	
0.40-1.70		Grey brown very sandy gravel with cobbles of brick and Sandstone. Gravel fine to coarse subrounded to subangular concrete, brick, tile, siltstone and sandstone with rootlets and very rare fragment of rope. [MADE GROUND] Many cobbles at base 1.4-1.7m and boulders of sandstone - some cut.			
1.70-2.80		Brown slightly gravelly fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
2.80-4.00		Trial pit terminated at target depth.			

Shoring/Support: None.
Stability: Stable.



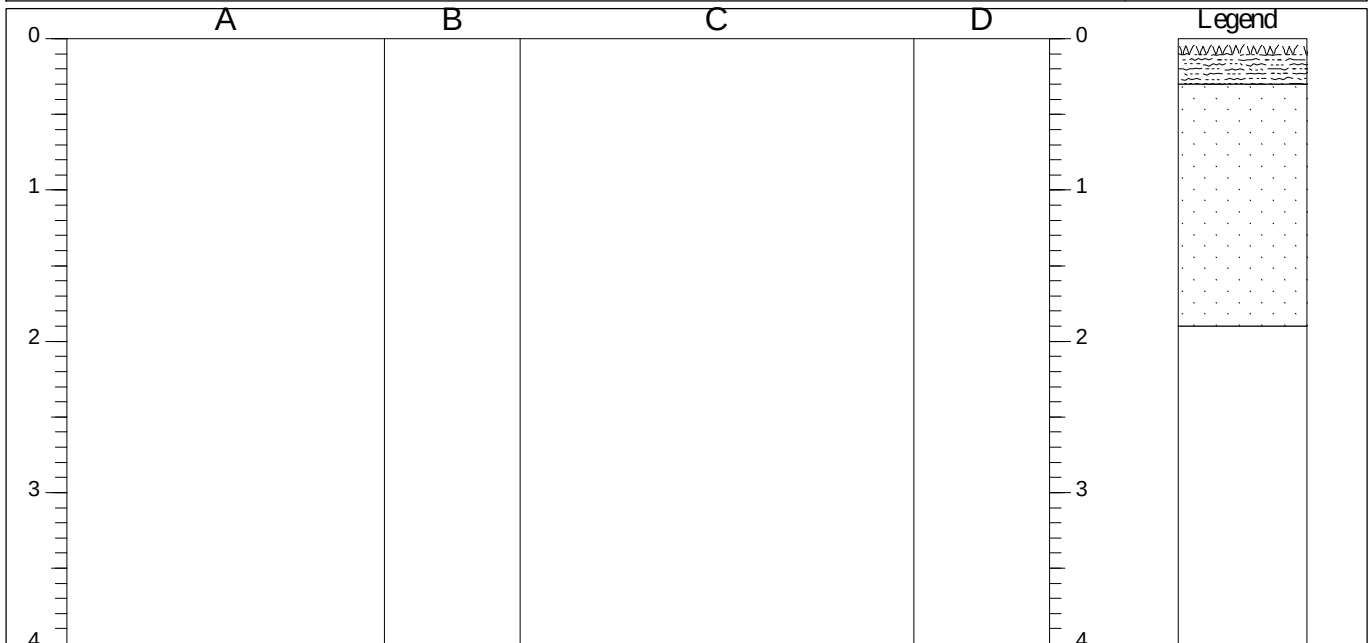
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

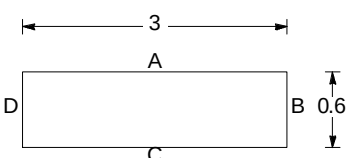
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP30
Job No 18BLH002	Date 18-10-18 18-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



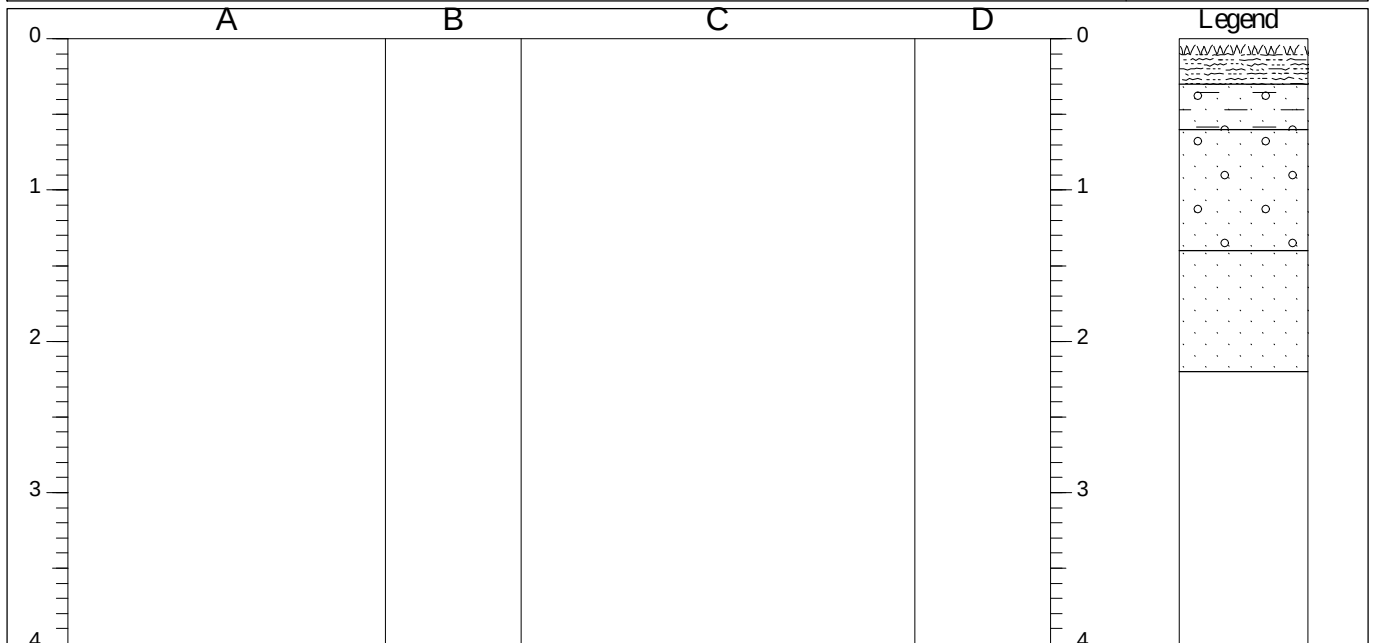
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand with rootlets. [TOPSOIL]			
0.30-1.90		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT] Visible laminations in side walls.			
1.90-4.00		Trial pit terminated at 1.9mbgl due to collapse.			

Shoring/Support: None. Stability: Side walls collapsed at 1.9mbgl. 	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
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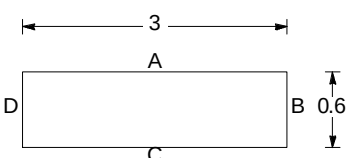
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP31
Job No 18BLH002	Date 18-10-18 18-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



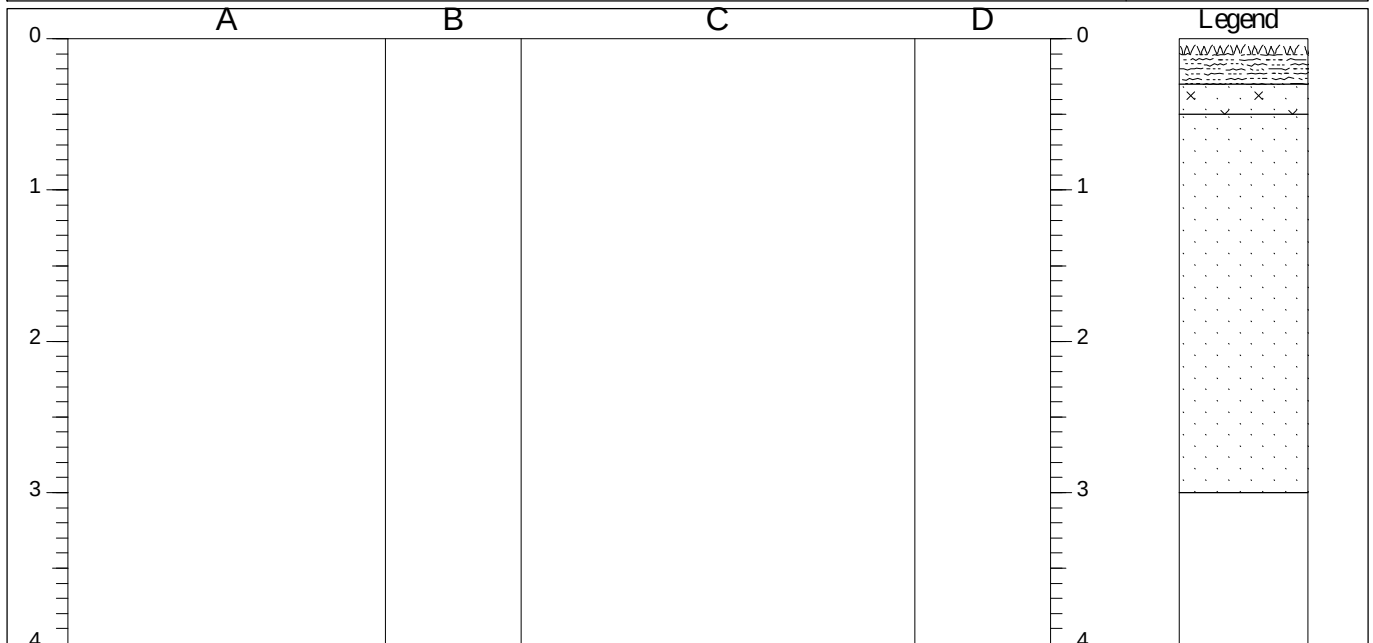
STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests	
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand with rootlets. [TOPSOIL]				
0.30-0.60		Orange brown slightly clayey gravelly SAND. [GLACIOFLUVIAL DEPOSIT]				
0.60-1.40		In centre of pit dark brown clayey gravelly SAND between 0.4-0.5mbgl. Light brown speckled black very gravelly fine to coarse SAND with low cobble content and very rare boulder. [GLACIOFLUVIAL DEPOSIT]				
1.40-2.20		Light brown speckled black fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]				
2.20-4.00		Trial pit terminated at 2.2mbgl due to collapse.				

Shoring/Support: None. Stability: Side walls collapsing at 2.2mbgl.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

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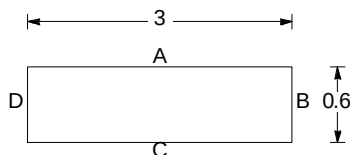
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP32
Job No 18BLH002	Date 18-10-18 18-10-18	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		Grass/stubble over dark brown slightly organic slightly silty gravelly sand with rootlets. [TOPSOIL]			
0.30-0.50		Orange brown slightly silty fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]	0.40-0.50	ES	
0.50-3.00		Light brown fine to medium SAND with rare reddish brown lamination. [GLACIOFLUVIAL DEPOSIT]			
3.00-4.00		Trial pit terminated at target depth.			

Shoring/Support: None.
Stability: Stable.



GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

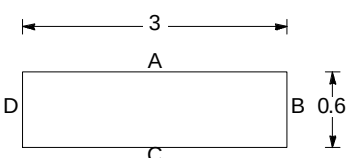
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP33
Job No 18BLH002	Date 18-10-18 18-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1

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

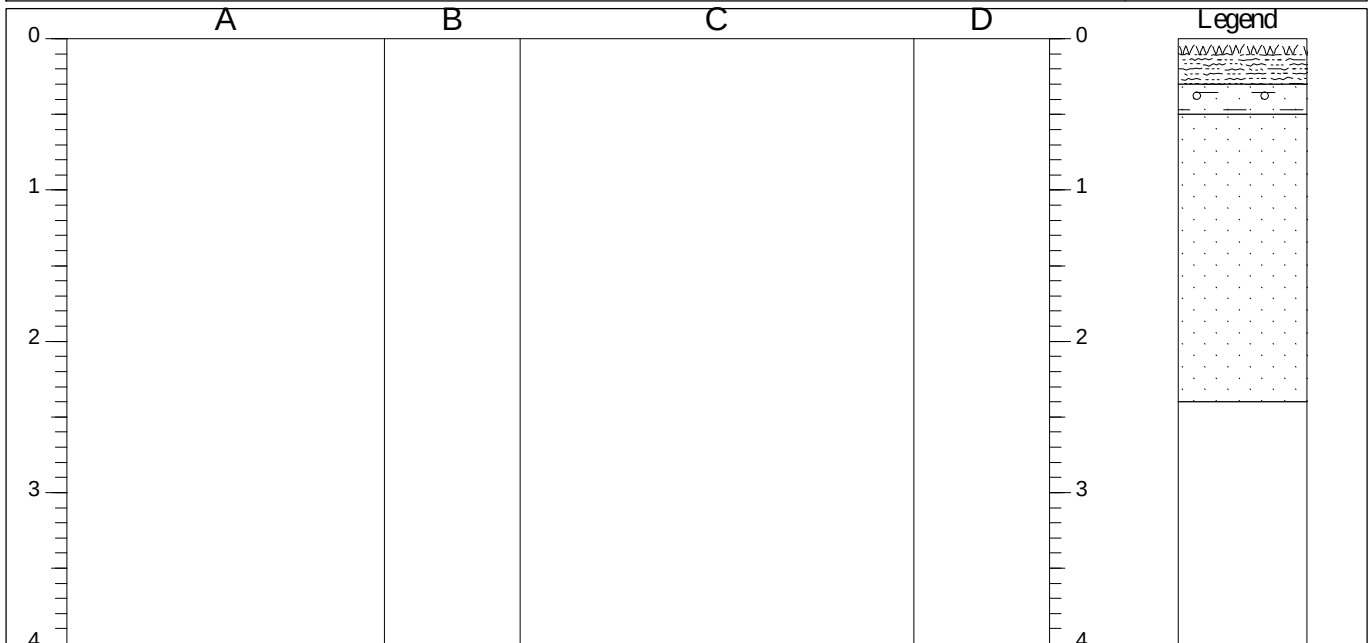
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand with rootlets. [TOPSOIL]	0.10-0.20	ES	
0.30-1.70		Firm low plasticity brown becoming light grey brown mottled orange brown very sandy CLAY with lenses of fine to medium sand. [GLACIOFLUVIAL DEPOSIT]	1.20	D	
1.70-2.40		Firm light brown, light grey and reddish brown thickly laminated very sandy clayey SILT and medium slightly clayey silty fine SAND. [GLACIOFLUVIAL DEPOSIT]			
2.40-4.00		Trial pit terminated at target depth.			

Shoring/Support: None. Stability: Stable. 			GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.	
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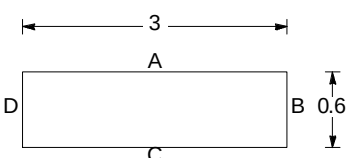
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP34
Job No 18BLH002	Date 18-10-18 18-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



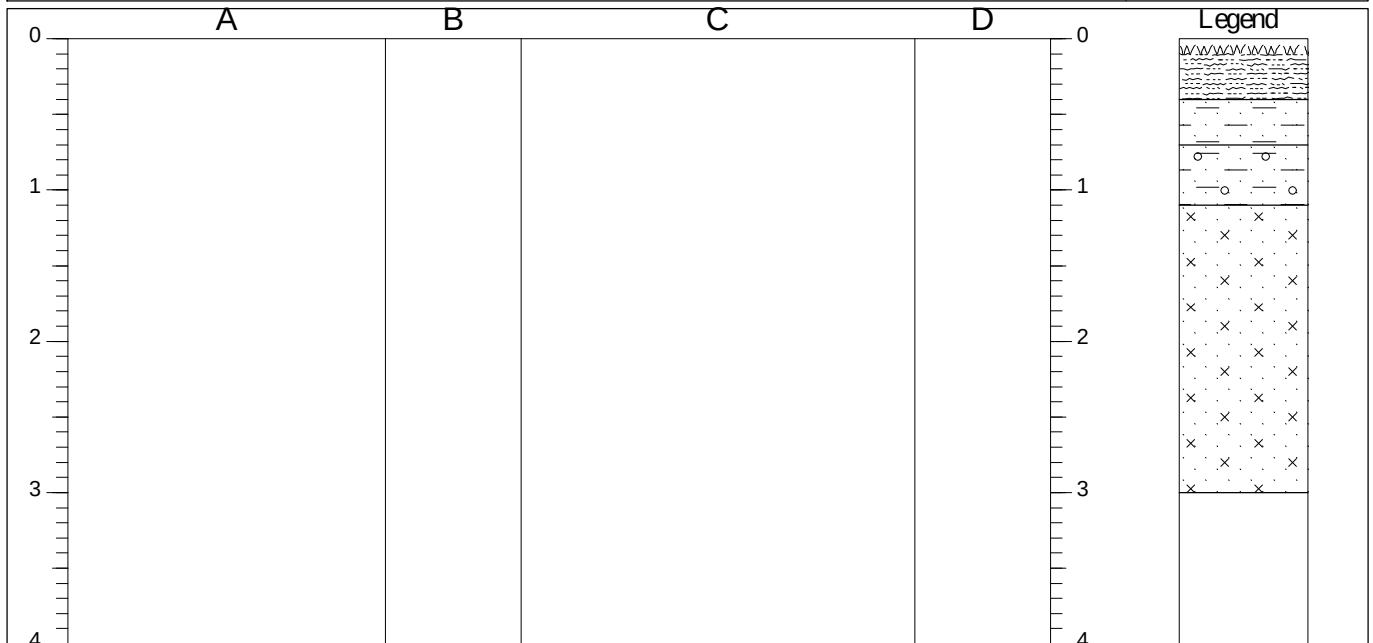
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand with rootlets. [TOPSOIL]	0.40-0.50	ES	
0.30-0.50		Brown slightly clayey gravelly fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
0.50-2.40		Light creamy brown fine to coarse SAND with rare gravel horizon. [GLACIOFLUVIAL DEPOSIT] Rare rootlet and bioturbation in upper 1m.			
2.40-4.00		Trial pit terminated at 2.4mbgl due to collapse.			

Shoring/Support: None. Stability: Side walls collapsed at 2.4mbgl.	GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
	

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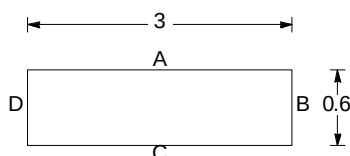
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP35
Job No 18BLH002	Date 18-10-18 18-10-18	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		Grass/stubble over dark brown slightly organic slightly silty gravelly sand with rootlets. [TOPSOIL]	0.30-0.40	ES	
0.40-0.70		Brown slightly clayey SAND with rootlets. [GLACIOFLUVIAL DEPOSIT]			
0.70-1.10		Light brown very slightly clayey gravelly SAND with rootlets. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]			
1.10-3.00		Orange brown slightly silty fine to medium SAND with rare gravel and cobble subrounded of siltstone. [GLACIOFLUVIAL DEPOSIT]	1.80-2.00	B	
3.00-4.00		Trial pit terminated at target depth.			

Shoring/Support: None.
Stability: Stable.



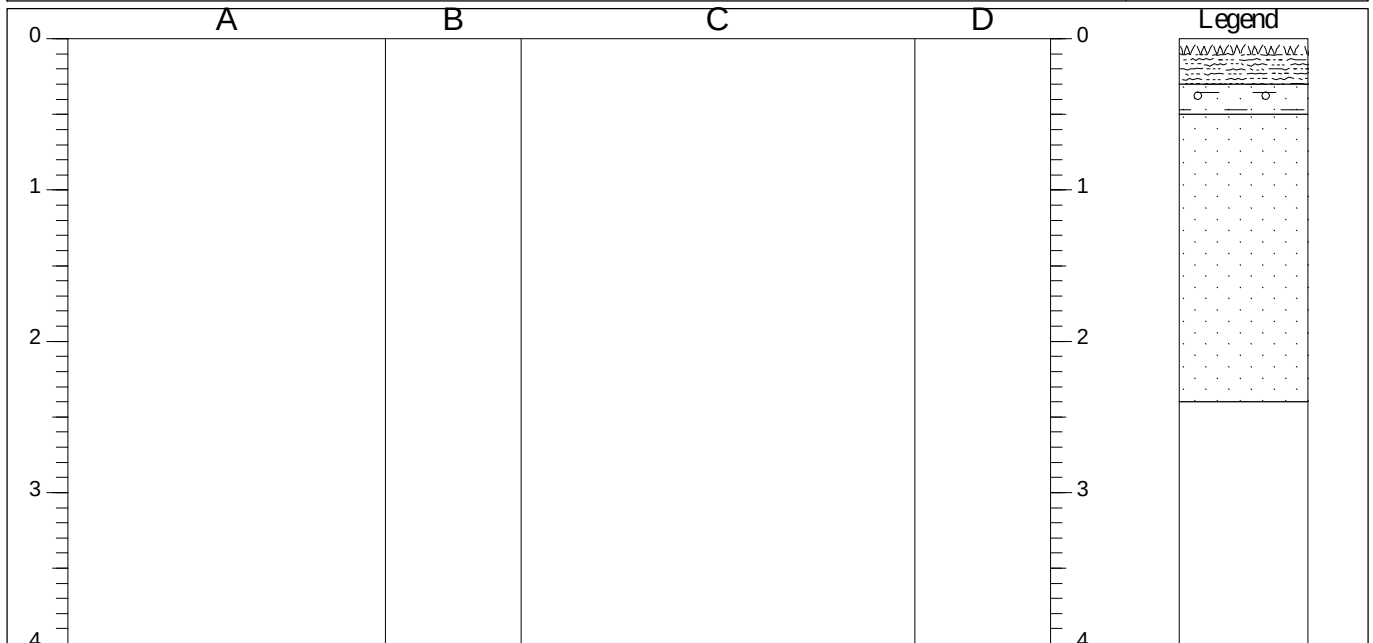
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

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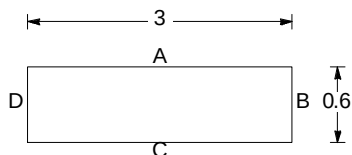
TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP36	
Job No 18BLH002	Date 18-10-18 18-10-18	Ground Level (m)	Co-Ordinates ()	Sheet 1 of 1	
Contractor BETTS GEO Ltd					



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass/stubble over dark brown slightly organic slightly silty gravelly sand with rootlets. [TOPSOIL]	0.10-0.20	ES	
0.30-0.50		Orange brown slightly clayey slightly gravelly SAND with rare rootlets and bioturbation. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]			
0.50-2.40		Light brown fine to medium SAND with very rare laminations of coarse sand to fine gravel size fragments of charcoal. [GLACIOFLUVIAL DEPOSIT]			
2.40-4.00		Trial pit terminated at 2.4mbgl due to collapse.			

Shoring/Support: None.
Stability: Side walls collapsed at 2.4mbgl.



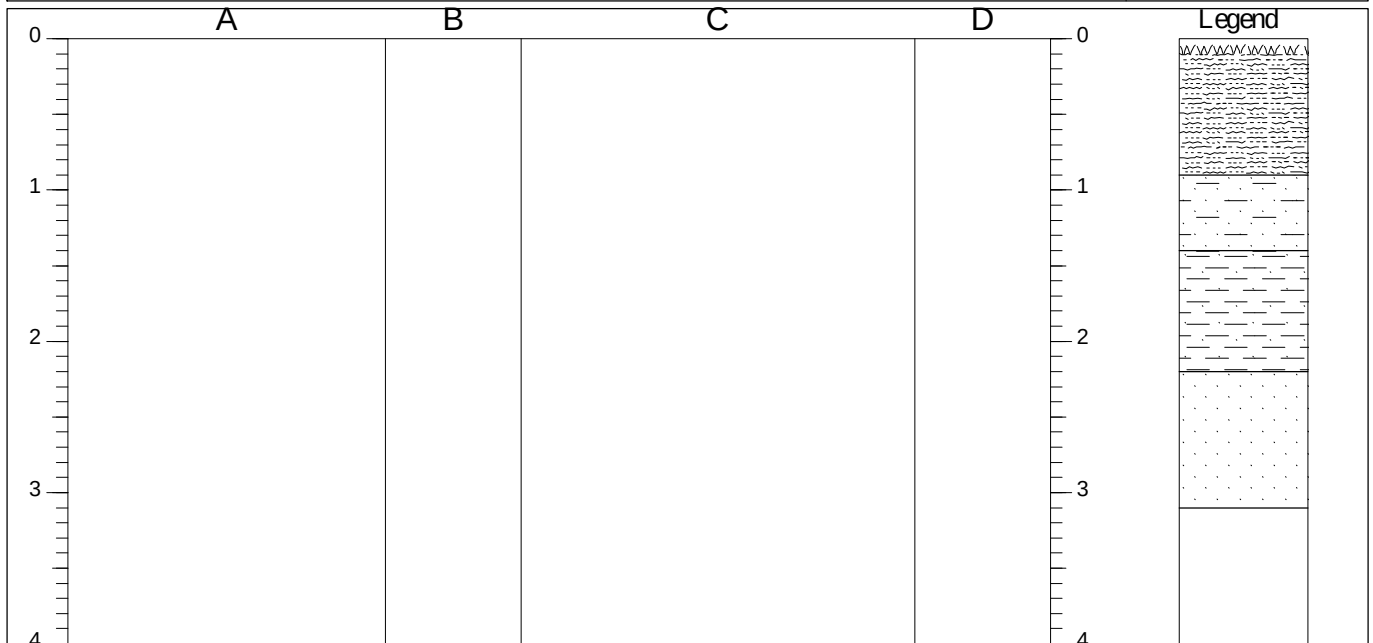
GENERAL REMARKS

No groundwater encountered. No visual or olfactory evidence of contamination.

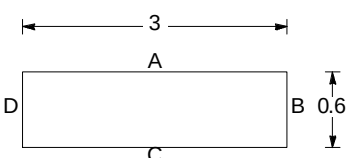
All dimensions in metres Scale 1:50	Client Bloor Homes	Method/ Plant Used JCB 3CX	Logged By DK
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TRIAL PIT LOG

Project Holt Road, Wrexham				TRIAL PIT No TP37
Job No 18BLH002	Date 17-10-18 17-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 1 of 1



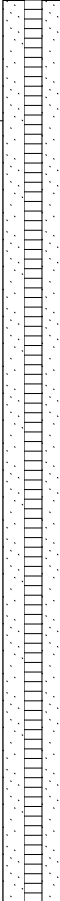
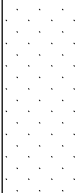
STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.90		Grass/stubble over dark brown slightly organic slightly silty gravelly sand with rootlets. [TOPSOIL]	0.50-0.60	ES	
0.90-1.40		Orange brown slightly clayey gravelly SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]			
1.40-2.20		Firm low plasticity orange brown mottled light brown and light grey slightly sandy CLAY with laminations of fine to medium sand. [GLACIOFLUVIAL DEPOSIT]	1.60	D	
2.20-3.10		Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSIT]			
3.10-4.00		Trial pit terminated at target depth.			

Shoring/Support: None. Stability: Stable.		GENERAL REMARKS No groundwater encountered. No visual or olfactory evidence of contamination.
		

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

Project Holt Road, Wrexham				BOREHOLE No BH01	
Job No 18BLH002	Date 15-10-18 16-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 3	

SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)		
0.00-0.30	B	N12			0.30	Stubble over dark brown slightly silty organic gravelly sand with rootlets.		
0.10	D					[TOPSOIL]		
0.30-0.90	B					Loose orange brown gravelly fine to coarse SAND. Gravel fine to coarse subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
0.30	D							(0.60)
								0.90
0.90-1.20	B	N13			(0.60)	Medium dense light brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]		
0.90	D					1.50		
1.20-1.70	B					Medium dense light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS]		
1.20	D							(1.30)
								2.80
1.70	D	N18				Medium dense orangish brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS]		
2.00-2.50	B							
2.00	D							
2.50	D							
3.00-3.50	B							
3.00	D	N17						
3.50	D							
4.00-4.50	B							
4.00	D							
4.50	D							
5.00-5.50	B	N29						
5.00	D							
5.50	D							
6.00-6.50	B							
6.00	D							
6.50	D	N31						
7.50-8.00	B							
7.50	D							
		N20						

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 19.50mbgl. Chiselling at 16.70 to 17.00mbgl and 19.00 to 19.40mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring installed by to 20.00mbgl.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Signed By DK		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH01	
Job No 18BLH002	Date 15-10-18 16-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 2 of 3	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
8.50	D	N21				(13.70)	Medium dense orangish brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS] <i>(continued)</i>		
9.00-9.50	B								
9.00									
10.00	D	N20							
10.50-11.00	B								
10.50									
11.50	D	N15							
12.00-12.50	B								
12.00									
13.00	D	N16							
13.50-14.00	B								
13.50									
14.50	D	N15							
15.00-15.50	B								
15.00									

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl, 150mm casing 9.00 to 19.50mbgl. Chiselling at 16.70 to 17.00mbgl and 19.00 to 19.40mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring installed by to 20.00mbgl. Signed By DK
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000					

BOREHOLE LOG

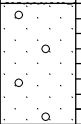
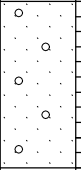
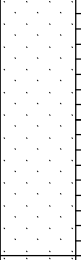
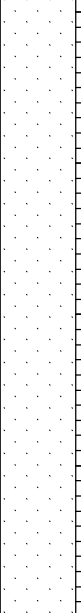
Project Holt Road, Wrexham				BOREHOLE No BH01	
Job No 18BLH002	Date 15-10-18 16-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 3 of 3	

SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill	
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)			DESCRIPTION
16.00	D	N50/ 182 mm				Medium dense orangish brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS] <i>(continued)</i>			
16.50-17.00 16.50	B					16.50	Medium dense to dense orange brown fine to medium SAND with medium spaced thinnly bedded sandy clay. [GLACIOFLUVIAL DEPOSITS]		
17.50	D								
18.00-18.50 18.00	B	N28				(3.50)			
19.00	D								
19.50-20.00 19.50	B	N27							
20.00 20.00	D	N26				20.00			

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 19.50mbgl. Chiselling at 16.70 to 17.00mbgl and 19.00 to 19.40mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring installed to 20.00mbgl.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Signed By DK		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH02	
Job No 18BLH002	Date 17-10-08 17-10-08	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 3	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.00-0.30	B					0.30	Stubble over dark brown slightly silty organic gravelly sand with rootlets.		
0.30-0.80	B					(0.80)	[TOPSOIL] Orange brown gravelly fine to coarse SAND. Gravel fine to coarse subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSIT]		
1.10-1.60	B					1.10	Light brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]		
2.20-2.70	B					2.20	Light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS]		
3.90-4.50	B					3.90	Orangish brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS]		
7.50-8.00	B								

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 20.00mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring install 2.00 to 20.00mbgl.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Logged By DK		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH02	
Job No 18BLH002	Date 17-10-08 17-10-08	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 2 of 3	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
10.50-11.00	B					(10.70)	Orangish brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS] <i>(continued)</i>		
13.50-14.00	B					14.60	Orange brown fine to medium SAND with medium spaced thinly bedded sandy clay. [GLACIOFLUVIAL DEPOSITS]		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 20.00mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring install 2.00 to 20.00mbgl.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Logged By DK		

AGS3 UK BH 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS 3.1.GDT 13/11/18

BOREHOLE LOG

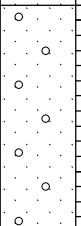
Project Holt Road, Wrexham				BOREHOLE No BH02	
Job No 18BLH002	Date 17-10-08 17-10-08	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 3 of 3	

SAMPLES & TESTS			STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)		
16.50-17.00	B					(5.40)		
19.50-20.00	B					20.00		

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 20.00mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring install 2.00 to 20.00mbgl.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Logged By DK		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH03	
Job No 18BLH002	Date 18-10-18 19-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 3	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.50 0.10	B D	N17				(0.50) 0.50	Stubble over dark brown slightly silty organic gravelly sand with rootlets. [TOPSOIL]		
0.50-0.90 0.50	B D					(0.40) 0.90	Loose orange brown fine to coarse SAND. [GLACIOFLUVIAL DEPOSIT]		
0.90-1.20 0.90 1.20-1.70 1.20	B D B					(1.50)	Medium dense light brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]		
1.70 2.00-2.50 2.00	D B					2.40			
2.50	D	N14					Medium dense light brown fine to medium SAND. [GLACIOFLUVIAL DEPOSITS]		
3.00-3.50 3.00	B	N8							
3.50	D								
4.00-4.50 4.00	B	N12							
4.50	D								
5.00-5.50 5.00	B	N16							
5.50	D					(6.40)			
6.00-6.50 6.00	B	N16							
7.00	D								
7.50-8.00 7.50	B	N10							

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 20.00mbgl. Slow progress 17.10 to 17.60mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring install 2.00 to 20.00mbgl.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Logged By DK		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH03	
Job No 18BLH002	Date 18-10-18 19-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 2 of 3	

SAMPLES & TESTS			STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)		
8.50	D	N14				8.80		
9.00-9.50 9.00	B							
10.00	D	N15						
10.50-11.00 10.50	B							
11.50	D	N13						
12.00-12.50 12.00	B							
13.00	D	N14						
13.50-14.00 13.50	B							
14.50	D	N25						
15.00-15.50 15.00	B							

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 20.00mbgl. Slow progress 17.10 to 17.60mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring install 2.00 to 20.00mbgl.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Logged By DK		

AGS3 UK BH 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS 3.1.GDT 13/11/18

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH03	
Job No 18BLH002	Date 18-10-18 19-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 3 of 3	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
16.00	D	N16				16.30			
16.50-17.00 16.50	B				(0.80)	Medium dense brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]			
17.10-17.60	B				17.10				
17.50	D	N24			(0.70)	Firm to stiff brown very slightly sandy slightly gravelly CLAY. Gravel fine to medium subrounded to subangular of mixed lithologies. [GLACIOFLUVIAL/GLACIAL TILL]			
18.00-18.50 18.00	B				17.80				
19.00	D				(2.20)	Medium dense brown fine to medium SAND. [GLACIOFLUVIAL/GLACIAL TILL]			
19.50-20.00 19.50	B	N21							
20.00 20.00	D	N19							
									
									
									
									
									
									
									
									
									
									
									
									
									
									
									
									
									
									

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 20.00mbgl. Slow progress 17.10 to 17.60mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring install 2.00 to 20.00mbgl.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Logged By DK		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH04	
Job No 18BLH002	Date 22-10-18 22-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 3	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.40	B					(0.40)	Stubble over dark brown slightly silty organic gravelly sand with rootlets. [TOPSOIL]		
0.40-1.00	B					0.40	Light brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]		
1.00-1.50	B					(1.50)			
1.90-2.40	B					1.90	Brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]		
						(1.90)			
4.00-4.50	B					3.80	Brown fine to medium clayey SAND with medium spaced thinly bedded sandy clay. [GLACIOFLUVIAL DEPOSITS]		
									
7.00-7.50	B								
									
									
									
									
									
									

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 19.50mbgl. Chiselling at 17.50 to 18.00mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring install 2.00 to 20.00mbgl.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Logged By DK		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH04	
Job No 18BLH002	Date 22-10-18 22-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 2 of 3	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
10.00-10.50	B					(11.50)	Brown fine to medium clayey SAND with medium spaced thinly bedded sandy clay. [GLACIOFLUVIAL DEPOSITS] <i>(continued)</i>		
13.00-13.50	B					15.30	Brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 19.50mbgl. Chiselling at 17.50 to 18.00mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring install 2.00 to 20.00mbgl.
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Logged By DK		

AGS3 UK BH 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS 3.1.GDT 13/11/18

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH04
Job No 18BLH002	Date 22-10-18 22-10-18	Ground Level (m)	Co-Ordinates ()	
Contractor BETTS GEO Ltd				Sheet 3 of 3

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Geology	Instrument/Backfill
16.00-16.50	B					(1.90)	Brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS] <i>(continued)</i>		
17.20-17.70	B					17.20 (0.80)	Firm to stiff brown very slightly sandy slightly gravelly CLAY. Gravel fine to medium subrounded to subangular of mixed lithologies. [GLACIOFLUVIAL/GLACIAL TILL]		
						18.00 (2.00)	Medium dense brown fine to medium SAND. [GLACIOFLUVIAL/GLACIAL TILL]		
19.50-20.00	B					20.00			

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl, 150mm casing 9.00 to 19.50mbgl. Chiselling at 17.50 to 18.00mbgl. Borehole terminated at 20.00mbgl target depth. Gas Monitoring install 2.00 to 20.00mbgl.
All dimensions in metres Scale 1:50		Client Bloor Homes				Method/ Plant Used Dando 2000			Logged By DK		

AGS3 UK BH 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS3 1 GDT 13/11/18

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH05	
Job No 18BLH002	Date 23-10-18 24-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 1 of 3	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.80 0.10	B D					(0.80)	Stubble over dark brown slightly silty organic gravelly sand with rootlets. [TOPSOIL]		
0.80-1.20 0.80	B D					0.80	Loose light brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]		
1.20-1.70 1.20	B	N10							
1.70 D									
2.00-2.50 2.00	B	N11				(2.70)	Medium dense light brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS]		
2.50 D									
3.00-3.50 3.00	B	N10				3.50			
3.50 D									
4.00-4.50 4.00	B	N10							
4.50 D									
5.00-5.50 5.00	B	N7							
5.50 D									
6.00-6.50 6.00	B	N12							
7.00 D						(7.50)			
7.50-8.00 7.50	B	N12							

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 19.50mbgl. Slow progress at 12.00 to 12.50mbgl, 13.00 to 13.40mbgl, 18.60 to 18.90mbgl and 19.50 to 20.00mbgl. Borehole
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Terminated at 20.00mbgl target depth. Gas Monitoring install 2.00 to 20.00mbgl.		

AGS3 UK BH 18BLH002 - HOLT ROAD, WREXHAM.GPJ GINT STD AGS 3.1.GDT 13/11/18

BOREHOLE LOG

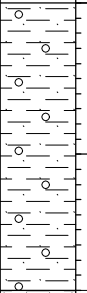
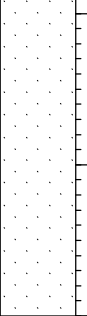
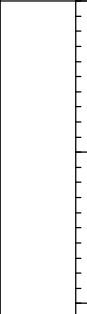
Project Holt Road, Wrexham				BOREHOLE No BH05	
Job No 18BLH002	Date 23-10-18 24-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 2 of 3	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
8.50	D	N14					Medium dense light brown slightly gravelly fine to medium SAND. Gravel fine to medium subrounded of mixed lithologies. [GLACIOFLUVIAL DEPOSITS] <i>(continued)</i>		
9.00-9.50 9.00	B								
10.00	D								
10.50-11.00 10.50	B	N12							
						11.00			
11.50	D	N24				(0.60) 11.60	Medium dense brown fine to medium SAND with medium spaced thinly bedded sandy clay. [GLACIOFLUVIAL DEPOSITS]		
12.00-12.50 12.00	B								
						(2.40)			
13.00	D	N17							
13.50-14.00 13.50	B					14.00			
						(1.00)	Medium dense brown fine to medium SAND with medium spaced thinly bedded sandy clay. [GLACIOFLUVIAL DEPOSITS]		
14.50	D	N13				15.00			
15.00-15.50 15.00	B					(0.50) 15.50	Medium dense brown fine to medium SAND. [GLACIOFLUVIAL/GLACIAL TILL]		
							Firm to stiff brown very slightly sandy slightly gravelly CLAY. Gravel fine to medium subrounded to subangular of mixed lithologies. [GLACIOFLUVIAL/GLACIAL TILL]		

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 19.50mbgl. Slow progress at 12.00 to 12.50mbgl, 13.00 to 13.40mbgl, 18.60 to 18.90mbgl and 19.50 to 20.00mbgl. Borehole
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Terminated at 20.00mbgl target depth. Gas Monitoring instal 2.00 to 20.00mbgl.		

BOREHOLE LOG

Project Holt Road, Wrexham				BOREHOLE No BH05	
Job No 18BLH002	Date 23-10-18 24-10-18	Ground Level (m)	Co-Ordinates ()		
Contractor BETTS GEO Ltd				Sheet 3 of 3	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
16.00	D	N29				(2.40)	Firm to stiff brown very slightly sandy slightly gravelly CLAY. Gravel fine to medium subrounded to subangular of mixed lithologies. [GLACIOFLUVIAL/GLACIAL TILL] (<i>continued</i>)		
16.50-17.00	B								
16.50									
17.50	D	N22				(2.10)	Medium dense brown fine to medium SAND. [GLACIOFLUVIAL/GLACIAL TILL]		
18.00-18.50	B								
18.00									
19.00	D	N25							
19.50-20.00	B								
19.50									
20.00		N28							

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	
											No ground water encountered. Inspection pit to 1.2mbgl. 200mm casing to 9.00mbgl. 150mm casing 9.00 to 19.50mbgl. Slow progress at 12.00 to 12.50mbgl, 13.00 to 13.40mbgl, 18.60 to 18.90mbgl and 19.50 to 20.00mbgl. Borehole
All dimensions in metres Scale 1:50			Client Bloor Homes			Method/ Plant Used Dando 2000			Target depth at 20.00mbgl logged by Gas Monitoring instal 2.00 to 20.00mbgl.		

APPENDIX D

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

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/08813
Issue Number: 1

Date: 01 November, 2018

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

Project Manager: Betts Geolab/David Kitching/Robert Davies
Project Name: Holt Rd, Wrexham (Batch 3)
Project Ref: 18BLH002
Order No: BG3047
Date Samples Received: 23/10/18
Date Instructions Received: 24/10/18
Date Analysis Completed: 31/10/18

Prepared by:



Richard Wong
Client Manager

Approved by:



Georgia King
Admin & Client Services Supervisor

Envirolab Job Number: 18/08813

Client Project Name: Holt Rd, Wrexham (Batch 3)

Client Project Ref: 18BLH002

Lab Sample ID	18/08813/1	18/08813/2	18/08813/3						Units	Method ref
Client Sample No										
Client Sample ID	TP25	TP27	TP29							
Depth to Top	0.10	0.40	0.50							
Depth To Bottom	0.20	0.50	0.60							
Date Sampled	18-Oct-18	18-Oct-18	18-Oct-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4	4A	4A							
% Stones >10mm _A	<0.1	12.1	<0.1						% w/w	A-T-044
pH _D ^{M#}	7.26	7.25	7.92						pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.01	<0.01	0.02						g/l	A-T-026s
Organic matter _D ^{M#}	3.2	1.4	4.9						% w/w	A-T-032 OM
Arsenic _D ^{M#}	<1	<1	3						mg/kg	A-T-024s
Cadmium _D ^{M#}	1.1	0.9	1.6						mg/kg	A-T-024s
Copper _D ^{M#}	11	5	21						mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1						mg/kg	A-T-040s
Lead _D ^{M#}	39	18	75						mg/kg	A-T-024s
Mercury _D	<0.17	<0.17	<0.17						mg/kg	A-T-024s
Nickel _D ^{M#}	10	6	19						mg/kg	A-T-024s
Selenium _D [#]	<1	<1	<1						mg/kg	A-T-024s
Zinc _D ^{M#}	50	23	117						mg/kg	A-T-024s
VPH total (>C5-C10)	<1	<1	<1						mg/kg	Calc-stone+mols

Envirolab Job Number: 18/08813

Client Project Name: Holt Rd, Wrexham (Batch 3)

Client Project Ref: 18BLH002

Lab Sample ID	18/08813/1	18/08813/2	18/08813/3						Units	Method ref
Client Sample No										
Client Sample ID	TP25	TP27	TP29							
Depth to Top	0.10	0.40	0.50							
Depth To Bottom	0.20	0.50	0.60							
Date Sampled	18-Oct-18	18-Oct-18	18-Oct-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4	4A	4A							
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	Chrysotile							A-T-045
Asbestos Matrix (microscope) ^A	-	-	Loose fibres							A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A							
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing) ^o	-	-	0.008						% w/w	A-T-054

Envirolab Job Number: 18/08813

Client Project Name: Holt Rd, Wrexham (Batch 3)

Client Project Ref: 18BLH002

Lab Sample ID	18/08813/1	18/08813/2	18/08813/3						Units	Method ref
Client Sample No										
Client Sample ID	TP25	TP27	TP29							
Depth to Top	0.10	0.40	0.50							
Depth To Bottom	0.20	0.50	0.60							
Date Sampled	18-Oct-18	18-Oct-18	18-Oct-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4	4A	4A							
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	<0.01	0.03						mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	0.02						mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02	0.14						mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	<0.04	1.21						mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	<0.04	1.16						mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	<0.05	1.38						mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	<0.05	0.73						mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	0.56						mg/kg	A-T-019s
Chrysene _A ^{M#}	<0.06	<0.06	1.28						mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	0.17						mg/kg	A-T-019s
Fluoranthene _A ^{M#}	<0.08	<0.08	1.87						mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01	0.02						mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	<0.03	0.79						mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03						mg/kg	A-T-019s
Phenanthrene _A ^{M#}	<0.03	<0.03	0.43						mg/kg	A-T-019s
Pyrene _A ^{M#}	<0.07	<0.07	1.72						mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	<0.08	11.5						mg/kg	A-T-019s

Envirolab Job Number: 18/08813

Client Project Name: Holt Rd, Wrexham (Batch 3)

Client Project Ref: 18BLH002

Lab Sample ID	18/08813/1	18/08813/2	18/08813/3						Units	Method ref
Client Sample No										
Client Sample ID	TP25	TP27	TP29							
Depth to Top	0.10	0.40	0.50							
Depth To Bottom	0.20	0.50	0.60							
Date Sampled	18-Oct-18	18-Oct-18	18-Oct-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4	4A	4A							
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C8-C10 _A ^{M#}	<1	<1	<1						mg/kg	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	<1						mg/kg	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	<1	<1						mg/kg	A-T-055s
Ali >C16-C21 _A ^{M#}	<1	<1	2						mg/kg	A-T-055s
Ali >C21-C35 _A	2	<1	10						mg/kg	A-T-055s
Total Aliphatics >C5-C35 _A	2	<1	12						mg/kg	A-T-055s
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C8-C10 _A ^{M#}	<1	<1	<1						mg/kg	A-T-055s
Aro >C10-C12 _A ^{M#}	<1	<1	<1						mg/kg	A-T-055s
Aro >C12-C16 _A	<1	<1	<1						mg/kg	A-T-055s
Aro >C16-C21 _A ^{M#}	<1	<1	7						mg/kg	A-T-055s
Aro >C21-C35 _A ^{M#}	5	<1	106						mg/kg	A-T-055s
Total Aromatics >C5-C35 _A	5	<1	113						mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35) _A	7	<1	125						mg/kg	A-T-055s
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01						mg/kg	A-T-022s

REPORT NOTES

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

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

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

If results are in italic font they are associated with an AQC failure, 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.

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/08812
Issue Number: 1
Date: 30 October, 2018

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

Project Manager: Betts Geolab/David Kitching
Project Name: Holt Road, Wrexham
Project Ref: 18BLH002
Order No: BG3051
Date Samples Received: 23/10/18
Date Instructions Received: 24/10/18
Date Analysis Completed: 30/10/18

Prepared by:


Melanie Marshall
Laboratory Coordinator

Approved by:


Georgia King
Admin & Client Services Supervisor

Envirolab Job Number: 18/08812

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08812/1	18/08812/2	18/08812/3	18/08812/4					Units	Method ref
Client Sample No										
Client Sample ID	BH3	BH3	BH4	BH4						
Depth to Top	6.00	13.50	4.00	16.00						
Depth To Bottom	6.50	14.00	4.50	16.50						
Date Sampled	22-Oct-18	22-Oct-18	22-Oct-18	22-Oct-18						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	4	4	4	4A						
% Stones >10mm _A	<0.1	<0.1	<0.1	2.1					% w/w	A-T-044
pH _D ^{M#}	8.74	8.81	8.08	8.93					pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	<0.01	<0.01	<0.01					g/l	A-T-026s
Organic matter _D ^{M#}	0.3	<0.1	0.4	0.5					% w/w	A-T-032 OM
Arsenic _D ^{M#}	<1	<1	<1	<1					mg/kg	A-T-024s
Cadmium _D ^{M#}	0.6	0.7	0.9	1.5					mg/kg	A-T-024s
Copper _D ^{M#}	7	8	9	12					mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1					mg/kg	A-T-040s
Lead _D ^{M#}	9	11	13	21					mg/kg	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	<0.17					mg/kg	A-T-024s
Nickel _D ^{M#}	8	11	10	14					mg/kg	A-T-024s
Selenium _D [#]	<1	<1	<1	<1					mg/kg	A-T-024s
Zinc _D ^{M#}	19	24	24	43					mg/kg	A-T-024s
VPH total (>C5-C10)	<1	<1	<1	<1					mg/kg	Calc-stone+mois

Envirolab Job Number: 18/08812

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08812/1	18/08812/2	18/08812/3	18/08812/4					Units	Method ref
Client Sample No										
Client Sample ID	BH3	BH3	BH4	BH4						
Depth to Top	6.00	13.50	4.00	16.00						
Depth To Bottom	6.50	14.00	4.50	16.50						
Date Sampled	22-Oct-18	22-Oct-18	22-Oct-18	22-Oct-18						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	4	4	4	4A						
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD						A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A						

Envirolab Job Number: 18/08812

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08812/1	18/08812/2	18/08812/3	18/08812/4					Units	Method ref
Client Sample No										
Client Sample ID	BH3	BH3	BH4	BH4						
Depth to Top	6.00	13.50	4.00	16.00						
Depth To Bottom	6.50	14.00	4.50	16.50						
Date Sampled	22-Oct-18	22-Oct-18	22-Oct-18	22-Oct-18						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	4	4	4	4A						
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02	<0.02	<0.02					mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04					mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	<0.04	<0.04	<0.04					mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	<0.05	<0.05	<0.05					mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<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					mg/kg	A-T-019s
Chrysene _A ^{M#}	<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					mg/kg	A-T-019s
Fluoranthene _A ^{M#}	<0.08	<0.08	<0.08	<0.08					mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	<0.03	<0.03	<0.03					mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	<0.03					mg/kg	A-T-019s
Phenanthrene _A ^{M#}	<0.03	<0.03	<0.03	<0.03					mg/kg	A-T-019s
Pyrene _A ^{M#}	<0.07	<0.07	<0.07	<0.07					mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	<0.08	<0.08	<0.08					mg/kg	A-T-019s

Envirolab Job Number: 18/08812

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08812/1	18/08812/2	18/08812/3	18/08812/4					Units	Method ref
Client Sample No										
Client Sample ID	BH3	BH3	BH4	BH4						
Depth to Top	6.00	13.50	4.00	16.00						
Depth To Bottom	6.50	14.00	4.50	16.50						
Date Sampled	22-Oct-18	22-Oct-18	22-Oct-18	22-Oct-18						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	4	4	4	4A						
TPH CWG										
Ali >C5-C6 _A [#]	<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					mg/kg	A-T-022s
Ali >C8-C10 _A ^{M#}	<1	<1	<1	<1					mg/kg	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	<1	<1					mg/kg	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	<1	<1	<1					mg/kg	A-T-055s
Ali >C16-C21 _A ^{M#}	<1	<1	<1	<1					mg/kg	A-T-055s
Ali >C21-C35 _A	1	<1	<1	1					mg/kg	A-T-055s
Total Aliphatics >C5-C35 _A	1	<1	<1	1					mg/kg	A-T-055s
Aro >C5-C7 _A [#]	<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					mg/kg	A-T-022s
Aro >C8-C10 _A ^{M#}	<1	<1	<1	<1					mg/kg	A-T-055s
Aro >C10-C12 _A ^{M#}	<1	<1	<1	<1					mg/kg	A-T-055s
Aro >C12-C16 _A	<1	<1	<1	<1					mg/kg	A-T-055s
Aro >C16-C21 _A ^{M#}	<1	<1	<1	<1					mg/kg	A-T-055s
Aro >C21-C35 _A ^{M#}	2	<1	1	3					mg/kg	A-T-055s
Total Aromatics >C5-C35 _A	2	<1	1	3					mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35) _A	3	<1	1	4					mg/kg	A-T-055s
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s
BTEX - Toluene _A [#]	<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					mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<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					mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s

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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.

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/08648
Issue Number: 1
Date: 26 October, 2018

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

Project Manager: Betts Geolab/David Kitching/Robert Davies
Project Name: Holt Rd, Wrexham (Batch 2)
Project Ref: 18BLH002
Order No: BG3041
Date Samples Received: 18/10/18
Date Instructions Received: 19/10/18
Date Analysis Completed: 25/10/18

Prepared by:


Melanie Marshall
Laboratory Coordinator

Approved by:


Richard Wong
Client Manager

Envirolab Job Number: 18/08648

Client Project Name: Holt Rd, Wrexham (Batch 2)

Client Project Ref: 18BLH002

Lab Sample ID	18/08648/1	18/08648/2	18/08648/3	18/08648/4	18/08648/5	18/08648/6	18/08648/7	18/08648/8	Units	Method ref
Client Sample No										
Client Sample ID	WS11	TP11	TP12	TP14	TP16	TP18	TP21	TP32		
Depth to Top	0.20	0.40	0.20	0.10	0.10	0.10	0.30	0.40		
Depth To Bottom	0.30	0.50	0.30	0.20	0.20	0.20	0.40	0.50		
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	17-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	4E	4E	4AE	4E	4AE	4AE	1		
% Stones >10mm _A	16.0	<0.1	<0.1	3.2	<0.1	9.9	8.1	<0.1	% w/w	A-T-044
pH _D ^{M#}	6.75	6.63	6.71	6.79	6.77	6.36	6.54	6.61	pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	g/l	A-T-026s
Organic matter _D ^{M#}	4.1	1.3	3.4	4.4	4.5	3.2	2.4	1.1	% w/w	A-T-032 OM
Arsenic _D ^{M#}	3	<1	3	4	3	4	3	<1	mg/kg	A-T-024s
Cadmium _D ^{M#}	0.8	<0.5	0.7	0.8	0.7	0.8	0.6	<0.5	mg/kg	A-T-024s
Copper _D ^{M#}	24	14	27	27	24	16	13	7	mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-040s
Lead _D ^{M#}	99	33	84	88	75	52	37	14	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#}	13	10	10	12	13	10	9	12	mg/kg	A-T-024s
Selenium _D [#]	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-024s
Zinc _D ^{M#}	80	48	96	94	68	78	53	26	mg/kg	A-T-024s
VPH total (>C5-C10)	2	<1	2	2	1	2	1	<1	mg/kg	Calc-stone+mois

Envirolab Job Number: 18/08648

Client Project Name: Holt Rd, Wrexham (Batch 2)

Client Project Ref: 18BLH002

Lab Sample ID	18/08648/1	18/08648/2	18/08648/3	18/08648/4	18/08648/5	18/08648/6	18/08648/7	18/08648/8	Units	Method ref
Client Sample No										
Client Sample ID	WS11	TP11	TP12	TP14	TP16	TP18	TP21	TP32		
Depth to Top	0.20	0.40	0.20	0.10	0.10	0.10	0.30	0.40		
Depth To Bottom	0.30	0.50	0.30	0.20	0.20	0.20	0.40	0.50		
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	17-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	4E	4E	4AE	4E	4AE	4AE	1		
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	Chrysotile	NAD	NAD	NAD	NAD	NAD		A-T-045
Asbestos Matrix (microscope) _A	-	-	Board	-	-	-	-	-		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	No	N/A	N/A	N/A	N/A	N/A		
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing) ₀	-	-	<0.001	-	-	-	-	-	% w/w	A-T-054

Envirolab Job Number: 18/08648

Client Project Name: Holt Rd, Wrexham (Batch 2)

Client Project Ref: 18BLH002

Lab Sample ID	18/08648/1	18/08648/2	18/08648/3	18/08648/4	18/08648/5	18/08648/6	18/08648/7	18/08648/8	Units	Method ref
Client Sample No										
Client Sample ID	WS11	TP11	TP12	TP14	TP16	TP18	TP21	TP32		
Depth to Top	0.20	0.40	0.20	0.10	0.10	0.10	0.30	0.40		
Depth To Bottom	0.30	0.50	0.30	0.20	0.20	0.20	0.40	0.50		
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	17-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	4E	4E	4AE	4E	4AE	4AE	1		
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#}	0.13	<0.04	0.15	0.06	<0.04	0.06	<0.04	<0.04	mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.15	<0.04	0.18	0.08	<0.04	0.07	<0.04	<0.04	mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.17	<0.05	0.23	0.10	0.06	0.09	<0.05	<0.05	mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	0.13	<0.05	0.13	0.07	<0.05	0.05	<0.05	<0.05	mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	0.08	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	A-T-019s
Chrysene _A ^{M#}	0.14	<0.06	0.20	0.07	<0.06	0.08	<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#}	0.21	<0.08	0.22	<0.08	<0.08	0.11	<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#}	0.15	<0.03	0.16	0.07	0.05	0.06	<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#}	0.07	<0.03	0.07	<0.03	<0.03	0.05	<0.03	<0.03	mg/kg	A-T-019s
Pyrene _A ^{M#}	0.19	<0.07	0.21	<0.07	<0.07	0.10	<0.07	<0.07	mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	1.34	<0.08	1.63	0.45	0.11	0.67	<0.08	<0.08	mg/kg	A-T-019s

Envirolab Job Number: 18/08648

Client Project Name: Holt Rd, Wrexham (Batch 2)

Client Project Ref: 18BLH002

Lab Sample ID	18/08648/1	18/08648/2	18/08648/3	18/08648/4	18/08648/5	18/08648/6	18/08648/7	18/08648/8	Units	Method ref
Client Sample No										
Client Sample ID	WS11	TP11	TP12	TP14	TP16	TP18	TP21	TP32		
Depth to Top	0.20	0.40	0.20	0.10	0.10	0.10	0.30	0.40		
Depth To Bottom	0.30	0.50	0.30	0.20	0.20	0.20	0.40	0.50		
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	16-Oct-18	17-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	4E	4E	4AE	4E	4AE	4AE	1		
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	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C21-C35 _A	4	<1	5	6	4	4	3	<1	mg/kg	A-T-055s
Total Aliphatics >C5-C35 _A	4	<1	5	6	4	4	3	<1	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#}	2	<1	2	2	1	2	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	<1	2	1	1	1	<1	<1	mg/kg	A-T-055s
Aro >C16-C21 _A ^{M#}	3	<1	2	2	1	1	<1	<1	mg/kg	A-T-055s
Aro >C21-C35 _A ^{M#}	16	1	18	13	8	12	6	1	mg/kg	A-T-055s
Total Aromatics >C5-C35 _A	22	1	23	18	13	16	7	1	mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35) _A	26	1	28	24	15	21	10	1	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: 18/08648

Client Project Name: Holt Rd, Wrexham (Batch 2)

Client Project Ref: 18BLH002

Lab Sample ID	18/08648/9	18/08648/10	18/08648/11	18/08648/12	18/08648/13				Units	Method ref
Client Sample No										
Client Sample ID	TP33	TP34	TP35	TP36	TP37					
Depth to Top	0.10	0.40	0.30	0.10	0.50					
Depth To Bottom	0.20	0.50	0.40	0.20	0.60					
Date Sampled	17-Oct-18	17-Oct-18	17-Oct-18	17-Oct-18	17-Oct-18					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	4AE	4AE	4AE	4AE	4E					
% Stones >10mm _A	1.6	0.8	3.8	1.4	<0.1				% w/w	A-T-044
pH _D ^{M#}	6.73	6.78	6.52	6.51	6.04				pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01				g/l	A-T-026s
Organic matter _D ^{M#}	<0.1	1.2	4.5	3.3	2.9				% w/w	A-T-032 OM
Arsenic _D ^{M#}	2	2	3	4	3				mg/kg	A-T-024s
Cadmium _D ^{M#}	<0.5	0.6	0.7	0.7	0.8				mg/kg	A-T-024s
Copper _D ^{M#}	18	11	19	20	18				mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1				mg/kg	A-T-040s
Lead _D ^{M#}	56	30	69	57	61				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#}	8	12	11	9	9				mg/kg	A-T-024s
Selenium _D [#]	<1	<1	<1	<1	<1				mg/kg	A-T-024s
Zinc _D ^{M#}	55	42	65	62	92				mg/kg	A-T-024s
VPH total (>C5-C10)	2	1	2	1	2				mg/kg	Calc-stone+mois

Envirolab Job Number: 18/08648

Client Project Name: Holt Rd, Wrexham (Batch 2)

Client Project Ref: 18BLH002

Lab Sample ID	18/08648/9	18/08648/10	18/08648/11	18/08648/12	18/08648/13				Units	Method ref
Client Sample No										
Client Sample ID	TP33	TP34	TP35	TP36	TP37					
Depth to Top	0.10	0.40	0.30	0.10	0.50					
Depth To Bottom	0.20	0.50	0.40	0.20	0.60					
Date Sampled	17-Oct-18	17-Oct-18	17-Oct-18	17-Oct-18	17-Oct-18					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	4AE	4AE	4AE	4AE	4E					
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: 18/08648

Client Project Name: Holt Rd, Wrexham (Batch 2)

Client Project Ref: 18BLH002

Lab Sample ID	18/08648/9	18/08648/10	18/08648/11	18/08648/12	18/08648/13				Units	Method ref
Client Sample No										
Client Sample ID	TP33	TP34	TP35	TP36	TP37					
Depth to Top	0.10	0.40	0.30	0.10	0.50					
Depth To Bottom	0.20	0.50	0.40	0.20	0.60					
Date Sampled	17-Oct-18	17-Oct-18	17-Oct-18	17-Oct-18	17-Oct-18					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	4AE	4AE	4AE	4AE	4E					
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	0.02				mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02	<0.02	<0.02	0.04				mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04	0.26				mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	<0.04	0.05	<0.04	0.33				mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.06	<0.05	0.07	<0.05	0.42				mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	<0.05	<0.05	<0.05	0.27				mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	<0.07	<0.07	0.14				mg/kg	A-T-019s
Chrysene _A ^{M#}	<0.06	<0.06	<0.06	<0.06	0.33				mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04	0.05				mg/kg	A-T-019s
Fluoranthene _A ^{M#}	<0.08	<0.08	<0.08	<0.08	0.48				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#}	0.05	<0.03	0.05	<0.03	0.30				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	<0.03	<0.03	<0.03	0.15				mg/kg	A-T-019s
Pyrene _A ^{M#}	<0.07	<0.07	<0.07	<0.07	0.44				mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	0.11	<0.08	0.17	<0.08	3.23				mg/kg	A-T-019s

Envirolab Job Number: 18/08648

Client Project Name: Holt Rd, Wrexham (Batch 2)

Client Project Ref: 18BLH002

Lab Sample ID	18/08648/9	18/08648/10	18/08648/11	18/08648/12	18/08648/13				Units	Method ref
Client Sample No										
Client Sample ID	TP33	TP34	TP35	TP36	TP37					
Depth to Top	0.10	0.40	0.30	0.10	0.50					
Depth To Bottom	0.20	0.50	0.40	0.20	0.60					
Date Sampled	17-Oct-18	17-Oct-18	17-Oct-18	17-Oct-18	17-Oct-18					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	4AE	4AE	4AE	4AE	4E					
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	<1	<1				mg/kg	A-T-055s
Ali >C16-C21 _A ^{M#}	<1	<1	<1	<1	<1				mg/kg	A-T-055s
Ali >C21-C35 _A	5	1	5	2	5				mg/kg	A-T-055s
Total Aliphatics >C5-C35 _A	5	1	5	2	5				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#}	2	1	2	1	2				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#}	1	<1	1	1	4				mg/kg	A-T-055s
Aro >C21-C35 _A ^{M#}	12	3	9	8	22				mg/kg	A-T-055s
Total Aromatics >C5-C35 _A	17	4	13	12	30				mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35) _A	21	6	18	15	35				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

REPORT NOTES

General:

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

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

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

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

If results are in italic font they are associated with an AQC failure, 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.

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/08591
Issue Number: 1
Date: 24 October, 2018

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

Project Manager: Betts Geolab/David Kitching/Robert Davies
Project Name: Holt Road, Wrexham
Project Ref: 18BLH002
Order No: BG3040
Date Samples Received: 17/10/18
Date Instructions Received: 18/10/18
Date Analysis Completed: 24/10/18

Prepared by:



Danielle Brierley
Client Manager

Approved by:



Georgia King
Admin & Client Services Supervisor

Envirolab Job Number: 18/08591

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08591/1	18/08591/2	18/08591/3	18/08591/4	18/08591/5	18/08591/6	18/08591/7	18/08591/8	Units	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS3	WS4	WS5	WS6	WS7	Stockpile		
Depth to Top	0.10	0.50	0.10	0.10	0.70	0.10	0.60			
Depth To Bottom	0.20	0.60	0.20	0.20	0.80	0.20	0.70			
Date Sampled	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	4A	4AE	4AE	4A	4AE	4A	3		
% Stones >10mm _A	8.4	33.6	7.0	17.3	6.2	4.5	<0.1	<0.1	% w/w	A-T-044
pH _D ^{M#}	7.85	7.69	7.43	7.77	7.98	7.74	7.82	7.71	pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.11	g/l	A-T-026s
Organic matter _D ^{M#}	5.0	0.3	3.6	2.7	0.7	2.3	0.3	15.5	% w/w	A-T-032 OM
Arsenic _D ^{M#}	5	<1	4	2	<1	3	1	<1	mg/kg	A-T-024s
Cadmium _D ^{M#}	0.7	<0.5	0.7	<0.5	0.6	<0.5	<0.5	<0.5	mg/kg	A-T-024s
Copper _D ^{M#}	24	5	19	17	8	14	9	13	mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-040s
Lead _D ^{M#}	101	15	80	44	16	61	21	<1	mg/kg	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	0.69	mg/kg	A-T-024s
Nickel _D ^{M#}	11	9	9	9	13	9	12	6	mg/kg	A-T-024s
Selenium _D [#]	<1	<1	<1	<1	<1	<1	<1	5	mg/kg	A-T-024s
Zinc _D ^{M#}	77	21	64	45	26	52	32	39	mg/kg	A-T-024s
VPH total (>C5-C10)	<1	<1	1	<1	<1	<1	<1	<1	mg/kg	Calc-stone+mois

Envirolab Job Number: 18/08591

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08591/1	18/08591/2	18/08591/3	18/08591/4	18/08591/5	18/08591/6	18/08591/7	18/08591/8	Units	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS3	WS4	WS5	WS6	WS7	Stockpile		
Depth to Top	0.10	0.50	0.10	0.10	0.70	0.10	0.60			
Depth To Bottom	0.20	0.60	0.20	0.20	0.80	0.20	0.70			
Date Sampled	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	4A	4AE	4AE	4A	4AE	4A	3		
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: 18/08591

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08591/1	18/08591/2	18/08591/3	18/08591/4	18/08591/5	18/08591/6	18/08591/7	18/08591/8	Units	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS3	WS4	WS5	WS6	WS7	Stockpile		
Depth to Top	0.10	0.50	0.10	0.10	0.70	0.10	0.60			
Depth To Bottom	0.20	0.60	0.20	0.20	0.80	0.20	0.70			
Date Sampled	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	4A	4AE	4AE	4A	4AE	4A	3		
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	<0.01	<0.01	0.05	<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	0.17	<0.02	<0.02	<0.02	<0.02	mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.11	<0.04	0.09	0.22	<0.04	<0.04	<0.04	<0.04	mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.11	<0.04	0.08	0.13	<0.04	0.05	<0.04	<0.04	mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.13	<0.05	0.10	0.14	<0.05	0.08	<0.05	<0.05	mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	0.06	<0.05	<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#}	0.13	<0.06	0.10	0.22	<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#}	0.17	<0.08	0.14	0.53	<0.08	<0.08	<0.08	<0.08	mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01	<0.01	0.23	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.07	<0.03	0.05	0.06	<0.03	0.04	<0.03	<0.03	mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	0.06	<0.03	<0.03	<0.03	<0.03	mg/kg	A-T-019s
Phenanthrene _A ^{M#}	0.04	<0.03	0.05	0.95	<0.03	<0.03	<0.03	<0.03	mg/kg	A-T-019s
Pyrene _A ^{M#}	0.16	<0.07	0.12	0.39	<0.07	<0.07	<0.07	<0.07	mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	0.98	<0.08	0.73	3.22	<0.08	0.17	<0.08	<0.08	mg/kg	A-T-019s

Envirolab Job Number: 18/08591

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08591/1	18/08591/2	18/08591/3	18/08591/4	18/08591/5	18/08591/6	18/08591/7	18/08591/8	Units	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS3	WS4	WS5	WS6	WS7	Stockpile		
Depth to Top	0.10	0.50	0.10	0.10	0.70	0.10	0.60			
Depth To Bottom	0.20	0.60	0.20	0.20	0.80	0.20	0.70			
Date Sampled	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	4A	4AE	4AE	4A	4AE	4A	3		
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	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C21-C35 _A	5	<1	5	4	<1	3	<1	3	mg/kg	A-T-055s
Total Aliphatics >C5-C35 _A	5	<1	5	5	<1	3	<1	3	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	<1	1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Aro >C16-C21 _A ^{M#}	2	<1	3	2	<1	1	<1	<1	mg/kg	A-T-055s
Aro >C21-C35 _A ^{M#}	17	<1	21	13	<1	13	<1	13	mg/kg	A-T-055s
Total Aromatics >C5-C35 _A	20	<1	27	15	<1	14	<1	13	mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35) _A	25	<1	32	18	<1	18	<1	16	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: 18/08591

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08591/9	18/08591/10	18/08591/11	18/08591/12	18/08591/13	18/08591/14			Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP4	TP5	TP6	TP8	TP9				
Depth to Top	0.10	0.10	0.30	0.10	0.10	0.40				
Depth To Bottom	0.20	0.20	0.40	0.20	0.20	0.50				
Date Sampled	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4E	4E	4A	4AE	4AE	4A				
% Stones >10mm _A	<0.1	<0.1	3.1	1.5	9.4	2.7			% w/w	A-T-044
pH _D ^{M#}	8.01	7.88	8.13	8.30	7.44	7.94			pH	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.03	0.03	<0.01	<0.01	<0.01	<0.01			g/l	A-T-026s
Organic matter _D ^{M#}	5.9	3.3	0.6	3.9	3.7	0.3			% w/w	A-T-032 OM
Arsenic _D ^{M#}	5	5	<1	3	5	<1			mg/kg	A-T-024s
Cadmium _D ^{M#}	0.8	0.7	<0.5	0.6	0.7	<0.5			mg/kg	A-T-024s
Copper _D ^{M#}	31	42	7	26	26	9			mg/kg	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1	<1			mg/kg	A-T-040s
Lead _D ^{M#}	132	69	17	114	93	15			mg/kg	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17			mg/kg	A-T-024s
Nickel _D ^{M#}	16	10	8	10	11	10			mg/kg	A-T-024s
Selenium _D [#]	1	<1	<1	<1	<1	<1			mg/kg	A-T-024s
Zinc _D ^{M#}	104	67	27	73	75	29			mg/kg	A-T-024s
VPH total (>C5-C10)	1	1	<1	<1	<1	<1			mg/kg	Calc-stone+mois

Envirolab Job Number: 18/08591

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08591/9	18/08591/10	18/08591/11	18/08591/12	18/08591/13	18/08591/14			Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP4	TP5	TP6	TP8	TP9				
Depth to Top	0.10	0.10	0.30	0.10	0.10	0.40				
Depth To Bottom	0.20	0.20	0.40	0.20	0.20	0.50				
Date Sampled	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4E	4E	4A	4AE	4AE	4A				
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD	NAD	NAD				A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A	N/A				

Envirolab Job Number: 18/08591

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08591/9	18/08591/10	18/08591/11	18/08591/12	18/08591/13	18/08591/14			Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP4	TP5	TP6	TP8	TP9				
Depth to Top	0.10	0.10	0.30	0.10	0.10	0.40				
Depth To Bottom	0.20	0.20	0.40	0.20	0.20	0.50				
Date Sampled	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4E	4E	4A	4AE	4AE	4A				
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	0.01	<0.01			mg/kg	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02			mg/kg	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.08	0.07	<0.04	0.07	0.07	<0.04			mg/kg	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.09	0.08	<0.04	0.09	0.09	<0.04			mg/kg	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.12	0.10	<0.05	0.10	0.11	<0.05			mg/kg	A-T-019s
Benzo(ghi)perylene _A ^{M#}	0.07	0.06	<0.05	0.07	0.06	<0.05			mg/kg	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07			mg/kg	A-T-019s
Chrysene _A ^{M#}	0.11	0.09	<0.06	0.09	0.10	<0.06			mg/kg	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			mg/kg	A-T-019s
Fluoranthene _A ^{M#}	0.15	0.14	<0.08	0.11	0.13	<0.08			mg/kg	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.07	0.07	<0.03	0.06	0.07	<0.03			mg/kg	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			mg/kg	A-T-019s
Phenanthrene _A ^{M#}	0.07	0.07	<0.03	0.03	0.06	<0.03			mg/kg	A-T-019s
Pyrene _A ^{M#}	0.14	0.11	<0.07	0.10	0.12	<0.07			mg/kg	A-T-019s
Total PAH-16MS _A ^{M#}	0.90	0.79	<0.08	0.72	0.82	<0.08			mg/kg	A-T-019s

Envirolab Job Number: 18/08591

Client Project Name: Holt Road, Wrexham

Client Project Ref: 18BLH002

Lab Sample ID	18/08591/9	18/08591/10	18/08591/11	18/08591/12	18/08591/13	18/08591/14			Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP4	TP5	TP6	TP8	TP9				
Depth to Top	0.10	0.10	0.30	0.10	0.10	0.40				
Depth To Bottom	0.20	0.20	0.40	0.20	0.20	0.50				
Date Sampled	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18	15-Oct-18				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4E	4E	4A	4AE	4AE	4A				
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Ali >C8-C10 _A ^{M#}	<1	<1	<1	<1	<1	<1			mg/kg	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	<1	<1	<1	<1			mg/kg	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	<1	<1	<1	<1	<1			mg/kg	A-T-055s
Ali >C16-C21 _A ^{M#}	<1	<1	<1	<1	<1	<1			mg/kg	A-T-055s
Ali >C21-C35 _A	8	8	<1	6	5	<1			mg/kg	A-T-055s
Total Aliphatics >C5-C35 _A	8	8	<1	6	5	<1			mg/kg	A-T-055s
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
Aro >C8-C10 _A ^{M#}	1	1	<1	<1	<1	<1			mg/kg	A-T-055s
Aro >C10-C12 _A ^{M#}	<1	<1	<1	<1	<1	<1			mg/kg	A-T-055s
Aro >C12-C16 _A	1	<1	<1	<1	<1	<1			mg/kg	A-T-055s
Aro >C16-C21 _A ^{M#}	2	1	<1	1	2	<1			mg/kg	A-T-055s
Aro >C21-C35 _A ^{M#}	23	18	1	16	16	<1			mg/kg	A-T-055s
Total Aromatics >C5-C35 _A	27	22	1	18	18	<1			mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35) _A	35	30	1	23	22	<1			mg/kg	A-T-055s
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	A-T-022s

REPORT NOTES

General:

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

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

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

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

If results are in italic font they are associated with an AQC failure, 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.

SUMMARY OF CONTAMINATION ANALYSIS: SOIL

SUMMARY OF CONTAMINATION ANALYSIS: METALS

Project Name Holt Road, Wrexham (Batch 4)
Project No 18BLH002
Date 22/10/2018

SOIL TYPE	-	-	-	-
SAMPLE LOCATION	BH3	BH3	BH4	BH4
DEPTH (m)	6.00	13.50	4.00	16.00
pH	8.74	8.81	8.08	8.93
Sulphate (water sol 2:1)	<0.01	<0.01	<0.01	<0.01
Organic matter	0.3	<0.1	0.4	0.5
Arsenic	<1	<1	<1	<1
Cadmium	0.6	0.7	0.9	1.5
Copper	7	8	9	12
Chromium (hexavalent)	<1	<1	<1	<1
Lead	9	11	13	21
Mercury	<0.17	<0.17	<0.17	<0.17
Nickel	8	11	10	14
Selenium	<1	<1	<1	<1
Zinc	19	24	24	43
Asbestos in Soil	NAD	NAD	NAD	NAD
Asbestos Matrix	N/A	N/A	N/A	N/A
Quantification	NAD	NAD	NAD	NAD
Organic matter	0.3	<0.1	0.4	0.5

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	9.09	8.93	8.08			-
Sulphate (water sol 2:1)	0.01	<0.01	<0.01			-
Organic matter	0.53	0.50	0.30			
Arsenic	1.00	<1	<1	32	32	37
Cadmium	1.40	1.50	0.60	10	10	22.1
Copper	11.54	12.00	7.00	4730	4790	-
Chromium (hexavalent)	1.00	<1	<1	3.62	3.63	20.5
Lead	19.69	21.00	9.00			200
Mercury	0.17	<0.17	<0.17	8.81	15.8	-
Nickel	13.69	14.00	8.00	EA/ATRISK withdrawn Aug 2015		
Selenium	1.00	<1	<1	375	375	-
Zinc	39.97	43.00	19.00	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 SR4 ASSUMING NO FREE PRODUCT WAS OBSERVED DURING FIELDWORK- SEE 'GUIDANCE NOTES ON CONTAMINATION'.

SGVs are derived from the EA 2009 SGVs 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 SGVs 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: TPH

Project Name Holt Road, Wrexham (Batch 4)
Project No 18BLH002
Date 22/10/2018

SOIL TYPE	-	-	-	-
SAMPLE LOCATION	BH3	BH3	BH4	BH4
DEPTH (m)	6.00	13.50	4.00	16.00
Ali >C5-C6	<0.01	<0.01	<0.01	<0.01
Ali >C6-C8	<0.01	<0.01	<0.01	<0.01
Ali >C8-C10	<1	<1	<1	<1
Ali >C10-C12	<1	<1	<1	<1
Ali >C12-C16	<1	<1	<1	<1
Ali >C16-C21	<1	<1	<1	<1
Ali >C21-C35	1	<1	<1	1
Total Aliphatics	1	<1	<1	1
Aro >C5-C7	<0.01	<0.01	<0.01	<0.01
Aro >C7-C8	<0.01	<0.01	<0.01	<0.01
Aro >C8-C10	<1	<1	<1	<1
Aro >C10-C12	<1	<1	<1	<1
Aro >C12-C16	<1	<1	<1	<1
Aro >C16-C21	<1	<1	<1	<1
Aro >C21-C35	2	<1	1	3
Total Aromatics	2	<1	1	3
TPH (Ali & Aro)	3	<1	1	4
BTEX - Benzene	<0.01	<0.01	<0.01	<0.01
BTEX - Toluene	<0.01	<0.01	<0.01	<0.01
BTEX - Ethyl Benzene	<0.01	<0.01	<0.01	<0.01
BTEX - m & p Xylene	<0.01	<0.01	<0.01	<0.01
BTEX - o Xylene	<0.01	<0.01	<0.01	<0.01
MTBE	<0.01	<0.01	<0.01	<0.01
Organic Matter	0.3	<0.1	0.4	0.5

TPH	Mean Value Test *	Range		AtRisk 2017 (mg/kg) Residential with Home Grown Produce	AtRisk 2017 (mg/kg) Residential with Home Grown Produce	DEFRA 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***
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	1.00	<1	<1	385	4130	-
Ali >C16-C21	1.00	<1	<1	210000	210100	-
Ali >C21-C35	1.00	1.00	<1			
Total Aliphatics	1.00	1.00	<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	1.00	<1	<1	165	830	-
Aro >C16-C21	1.00	<1	<1	319	1040	-
Aro >C21-C35	2.88	3.00	<1	1120	1710	-
Total Aromatics	2.88	3.00	<1			
TPH (Ali & Aro)	4.02	4.00	<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 Holt Road, Wrexham (Batch 4)
Project No 18BLH002
Date 22/10/18

SOIL TYPE	-	-	-	-
SAMPLE LOCATION	BH3	BH3	BH4	BH4
DEPTH (m)	6.00	13.50	4.00	16.00
Acenaphthene	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	<0.01	<0.01	<0.01	<0.01
Anthracene	<0.02	<0.02	<0.02	<0.02
Benzo(a)anthracene	<0.04	<0.04	<0.04	<0.04
Benzo(a)pyrene	<0.04	<0.04	<0.04	<0.04
Benzo(b)fluoranthene	<0.05	<0.05	<0.05	<0.05
Benzo(ghi)perylene	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	<0.07	<0.07	<0.07	<0.07
Chrysene	<0.06	<0.06	<0.06	<0.06
Dibenzo(ah)anthracene	<0.04	<0.04	<0.04	<0.04
Fluoranthene	<0.08	<0.08	<0.08	<0.08
Fluorene	<0.01	<0.01	<0.01	<0.01
Indeno(123-cd)pyrene	<0.03	<0.03	<0.03	<0.03
Naphthalene	<0.03	<0.03	<0.03	<0.03
Phenanthrene	<0.03	<0.03	<0.03	<0.03
Pyrene	<0.07	<0.07	<0.07	<0.07
Organic Matter	0.3	<0.1	0.4	0.5

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	<0.01	<0.01	608	2760	-
Acenaphthylene	0.01	<0.01	<0.01			-
Anthracene	0.02	<0.02	<0.02	10200	26200	-
Benzo(a)anthracene	0.04	<0.04	<0.04	4.52	8.54	-
Benzo(a)pyrene	0.04	<0.04	<0.04	1.51	2.05	4.95
Benzo(b)fluoranthene	0.05	<0.05	<0.05	7.72	9.86	-
Benzo(ghi)perylene	0.05	<0.05	<0.05	96.2	103	-
Benzo(k)fluoranthene	0.07	<0.07	<0.07	84.4	100	-
Chrysene	0.06	<0.06	<0.06	585	927	-
Dibenzo(ah)anthracene	0.04	<0.04	<0.04	0.838	1	-
Fluoranthene	0.08	<0.08	<0.08	983	2980	-
Fluorene	0.01	<0.01	<0.01	735	2610	-
Indeno(123-cd)pyrene	0.03	<0.03	<0.03	7.31	9.75	-
Naphthalene	0.03	<0.03	<0.03	0.829	12.2	-
Phenanthrene	0.03	<0.03	<0.03			-
Pyrene	0.07	<0.07	<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.**

SUMMARY OF CONTAMINATION ANALYSIS: SOIL

SUMMARY OF CONTAMINATION ANALYSIS: METALS

Project Name Holt Rd, Wrexham (Batch 3)
Project No 18BLH002
Date 18/10/2018

SOIL TYPE	TS	N	N
SAMPLE LOCATION	TP25	TP27	TP29
DEPTH (m)	0.10	0.40	0.50
pH	7.26	7.25	7.92
Sulphate (water sol 2:1)	0.01	<0.01	0.02
Organic matter	3.2	1.4	4.9
Arsenic	<1	<1	3
Cadmium	1.1	0.9	1.6
Copper	11	5	21
Chromium (hexavalent)	<1	<1	<1
Lead	39	18	75
Mercury	<0.17	<0.17	<0.17
Nickel	10	6	19
Selenium	<1	<1	<1
Zinc	50	23	117
Asbestos in Soil	NAD	NAD	Chrysotile
Asbestos Matrix	N/A	N/A	Loose fibres
Quantification	NAD	NAD	0.008
Organic matter	3.2	1.4	4.9

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	-	7.92	7.25			-
Sulphate (water sol 2:1)	-	0.02	<0.01			-
Organic matter	-	4.90	1.40			
Arsenic	-	3.00	<1	32	32	37
Cadmium	-	1.60	0.90	10	10	22.1
Copper	-	21.00	5.00	4730	4790	-
Chromium (hexavalent)	-	<1	<1	3.62	3.63	20.5
Lead	-	75.00	18.00			200
Mercury	-	<0.17	<0.17	8.81	15.8	-
Nickel	-	19.00	6.00	EA/AtRisk withdrawn Aug 2015		
Selenium	-	<1	<1	375	375	-
Zinc	-	117.00	23.00	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 SR4 ASSUMING NO FREE PRODUCT WAS OBSERVED DURING FIELDWORK- SEE 'GUIDANCE NOTES ON CONTAMINATION'.

SGVs are derived from the EA 2009 SGVs 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: TPH

Project Name Holt Rd, Wrexham (Batch 3)
Project No 18BLH002
Date 18/10/2018

SOIL TYPE	TS	N	N
SAMPLE LOCATION	TP25	TP27	TP29
DEPTH (m)	0.10	0.40	0.50
Ali >C5-C6	<0.01	<0.01	<0.01
Ali >C6-C8	<0.01	<0.01	<0.01
Ali >C8-C10	<1	<1	<1
Ali >C10-C12	<1	<1	<1
Ali >C12-C16	<1	<1	<1
Ali >C16-C21	<1	<1	2
Ali >C21-C35	2	<1	10
Total Aliphatics	2	<1	12
Aro >C5-C7	<0.01	<0.01	<0.01
Aro >C7-C8	<0.01	<0.01	<0.01
Aro >C8-C10	<1	<1	<1
Aro >C10-C12	<1	<1	<1
Aro >C12-C16	<1	<1	<1
Aro >C16-C21	<1	<1	7
Aro >C21-C35	5	<1	106
Total Aromatics	5	<1	113
TPH (Ali & Aro)	7	<1	125
BTEX - Benzene	<0.01	<0.01	<0.01
BTEX - Toluene	<0.01	<0.01	<0.01
BTEX - Ethyl Benzene	<0.01	<0.01	<0.01
BTEX - m & p Xylene	<0.01	<0.01	<0.01
BTEX - o Xylene	<0.01	<0.01	<0.01
MTBE	<0.01	<0.01	<0.01
Organic Matter	3.2	1.4	4.9

TPH	Mean Value Test *	Range		AtRisk 2017 (mg/kg) Residential with Home Grown Produce	AtRisk 2017 (mg/kg) Residential with Home Grown Produce	DEFRA 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***
Ali >C5-C6	-	<0.01	<0.01	42.7	369	-
Ali >C6-C8	-	<0.01	<0.01	99.3	1240	-
Ali >C8-C10	-	<1	<1	13.9	204	-
Ali >C10-C12	-	<1	<1	81.7	1180	-
Ali >C12-C16	-	<1	<1	385	4130	-
Ali >C16-C21	-	2.00	<1	210000	210100	-
Ali >C21-C35	-	10.00	<1			
Total Aliphatics	-	12.00	<1			
Aro >C5-C7	-	<0.01	<0.01	0.137	0.871	-
Aro >C7-C8	-	<0.01	<0.01	113	780	-
Aro >C8-C10	-	<1	<1	20.5	232	-
Aro >C10-C12	-	<1	<1	70	468	-
Aro >C12-C16	-	<1	<1	165	830	-
Aro >C16-C21	-	7.00	<1	319	1040	-
Aro >C21-C35	-	106.00	<1	1120	1710	-
Total Aromatics	-	113.00	<1			
TPH (Ali & Aro)	-	125.00	<1			
BTEX - Benzene	-	<0.01	<0.01	0.0493	0.33	0.871
BTEX - Toluene	-	<0.01	<0.01	113	780	-
BTEX - Ethyl Benzene	-	<0.01	<0.01	50.7	453	-
BTEX - m & p Xylene	-	<0.01	<0.01	24	312	-
BTEX - o Xylene	-	<0.01	<0.01	26.4	336	-
MTBE	-	<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 Holt Rd, Wrexham (Batch 3)
Project No 18BLH002
Date 18/10/18

SOIL TYPE	TS	N	N
SAMPLE LOCATION	TP25	TP27	TP29
DEPTH (m)	0.10	0.40	0.50
Acenaphthene	<0.01	<0.01	0.03
Acenaphthylene	<0.01	<0.01	0.02
Anthracene	<0.02	<0.02	0.14
Benzo(a)anthracene	<0.04	<0.04	1.21
Benzo(a)pyrene	<0.04	<0.04	1.16
Benzo(b)fluoranthene	<0.05	<0.05	1.38
Benzo(ghi)perylene	<0.05	<0.05	0.73
Benzo(k)fluoranthene	<0.07	<0.07	0.56
Chrysene	<0.06	<0.06	1.28
Dibenzo(ah)anthracene	<0.04	<0.04	0.17
Fluoranthene	<0.08	<0.08	1.87
Fluorene	<0.01	<0.01	0.02
Indeno(123-cd)pyrene	<0.03	<0.03	0.79
Naphthalene	<0.03	<0.03	<0.03
Phenanthrene	<0.03	<0.03	0.43
Pyrene	<0.07	<0.07	1.72
Organic Matter	3.2	1.4	4.9

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	-	0.03	<0.01	608	2760	-
Acenaphthylene	-	0.02	<0.01			-
Anthracene	-	0.14	<0.02	10200	26200	-
Benzo(a)anthracene	-	1.21	<0.04	4.52	8.54	-
Benzo(a)pyrene	-	1.16	<0.04	1.51	2.05	4.95
Benzo(b)fluoranthene	-	1.38	<0.05	7.72	9.86	-
Benzo(ghi)perylene	-	0.73	<0.05	96.2	103	-
Benzo(k)fluoranthene	-	0.56	<0.07	84.4	100	-
Chrysene	-	1.28	<0.06	585	927	-
Dibenzo(ah)anthracene	-	0.17	<0.04	0.838	1	-
Fluoranthene	-	1.87	<0.08	983	2980	-
Fluorene	-	0.02	<0.01	735	2610	-
Indeno(123-cd)pyrene	-	0.79	<0.03	7.31	9.75	-
Naphthalene	-	<0.03	<0.03	0.829	12.2	-
Phenanthrene	-	0.43	<0.03			-
Pyrene	-	1.72	<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.**

SUMMARY OF CONTAMINATION ANALYSIS: SOIL

SUMMARY OF CONTAMINATION ANALYSIS: METALS

Project Name Holt Rd, Wrexham (Batch 2)
Project No 18BLH002
Date 16/10/18 - 17/10/18

SOIL TYPE	WS11	TP11	TP12	TP14	TP16	TP18	TP21	TP32	TP33	TP34	TP35	TP36	TP37
SAMPLE LOCATION	0.20	0.40	0.20	0.10	0.10	0.10	0.30	0.40	0.10	0.40	0.30	0.10	0.50
DEPTH (m)	0.30	0.50	0.30	0.20	0.20	0.20	0.40	0.50	0.20	0.50	0.40	0.20	0.60
pH	6.75	6.63	6.71	6.79	6.77	6.36	6.54	6.61	6.73	6.78	6.52	6.51	6.04
Sulphate (water sol 2:1)	<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	4.1	1.3	3.4	4.4	4.5	3.2	2.4	1.1	<0.1	1.2	4.5	3.3	2.9
Arsenic	3	<1	3	4	3	4	3	<1	2	2	3	4	3
Cadmium	0.8	<0.5	0.7	0.8	0.7	0.8	0.6	<0.5	<0.5	0.6	0.7	0.7	0.8
Copper	24	14	27	27	24	16	13	7	18	11	19	20	18
Chromium (hexavalent)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead	99	33	84	88	75	52	37	14	56	30	69	57	61
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
Nickel	13	10	10	12	13	10	9	12	8	12	11	9	9
Selenium	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Zinc	80	48	96	94	68	78	53	26	55	42	65	62	92
Asbestos in Soil	NAD	NAD	Chrysotile	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD
Asbestos Matrix	N/A	N/A	Board	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Quantification	NAD	NAD	<0.001	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD
Organic matter	4.1	1.3	3.4	4.4	4.5	3.2	2.4	1.1	<0.1	1.2	4.5	3.3	2.9

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	6.70	6.79	6.04			-
Sulphate (water sol 2:1)	0.01	<0.01	<0.01			-
Organic matter	3.53	4.50	<0.1			
Arsenic	3.27	4.00	<1	32	32	37
Cadmium	0.73	0.80	<0.5	10	10	22.1
Copper	21.34	27.00	7.00	4730	4790	-
Chromium (hexavalent)	1.00	<1	<1	3.62	3.63	20.5
Lead	70.44	99.00	14.00			200
Mercury	0.17	<0.17	<0.17	8.81	15.8	-
Nickel	11.44	13.00	8.00	EA/AtRisk withdrawn Aug 2015		
Selenium	1.00	<1	<1	375	375	-
Zinc	76.67	96.00	26.00	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 SR4 ASSUMING NO FREE PRODUCT WAS OBSERVED DURING FIELDWORK- SEE 'GUIDANCE NOTES ON CONTAMINATION'.

SGVs are derived from the EA 2009 SGVs 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 SGVs 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 Holt Rd, Wrexham (Batch 2)
Project No 18BLH002
Date 16/10/18 - 17/10/18

SOIL TYPE	WS11	TP11	TP12	TP14	TP16	TP18	TP21	TP32	TP33	TP34	TP35	TP36	TP37
SAMPLE LOCATION	0.20	0.40	0.20	0.10	0.10	0.10	0.30	0.40	0.10	0.40	0.30	0.10	0.50
DEPTH (m)	0.30	0.50	0.30	0.20	0.20	0.20	0.40	0.50	0.20	0.50	0.40	0.20	0.60
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
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
Ali >C8-C10	<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
Ali >C12-C16	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ali >C16-C21	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ali >C21-C35	4	<1	5	6	4	4	3	<1	5	1	5	2	5
Total Aliphatics	4	<1	5	6	4	4	3	<1	5	1	5	2	5
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
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
Aro >C8-C10	2	<1	2	2	1	2	1	<1	2	1	2	1	2
Aro >C10-C12	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aro >C12-C16	<1	<1	2	1	1	1	<1	<1	1	<1	1	1	1
Aro >C16-C21	3	<1	2	2	1	1	<1	<1	1	<1	1	1	4
Aro >C21-C35	16	1	18	13	8	12	6	1	12	3	9	8	22
Total Aromatics	22	1	23	18	13	16	7	1	17	4	13	12	30
TPH (Ali & Aro)	26	1	28	24	15	21	10	1	21	6	18	15	35
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
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
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
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
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
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
Organic Matter	4.1	1.3	3.4	4.4	4.5	3.2	2.4	1.1	<0.1	1.2	4.5	3.3	2.9

TPH	Mean Value Test *	Range		AtRisk 2017 (mg/kg) Residential with Home Grown Produce	AtRisk 2017 (mg/kg) Residential with Home Grown Produce	DEFRA C4SL 2017	UU Drinking Water Guidelines	
	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***	PE Threshold	
Ali >C5-C6	0.01	<0.01	<0.01	42.7	369	-	Total BTEX & MTBE	0.1
Ali >C6-C8	0.01	<0.01	<0.01	99.3	1240	-		
Ali >C8-C10	1.00	<1	<1	13.9	204	-	EC5-EC10 Ali-Aro	2
Ali >C10-C12	1.00	<1	<1	81.7	1180	-		
Ali >C12-C16	1.00	<1	<1	385	4130	-	EC10-EC16 Ali-Aro	10
Ali >C16-C21	1.00	<1	<1	210000	210100	-		
Ali >C21-C35	4.41	6.00	<1					
Total Aliphatics	4.41	6.00	<1				EC16-EC40 Ali-Aro	500
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	1.79	2.00	<1	20.5	232	-		
Aro >C10-C12	1.00	<1	<1	70	468	-		
Aro >C12-C16	1.21	2.00	<1	165	830	-		
Aro >C16-C21	2.02	4.00	<1	319	1040	-		
Aro >C21-C35	13.10	22.00	1.00	1120	1710	-		
Total Aromatics	17.95	30.00	1.00					
TPH (Ali & Aro)	22.14	35.00	1.00					
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 SR44 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.

SUMMARY OF CONTAMINATION ANALYSIS: PAH

Project Name Holt Rd, Wrexham (Batch 2)
Project No 18BLH002
Date 16/10/18 - 17/10/18

SOIL TYPE	WS11	TP11	TP12	TP14	TP16	TP18	TP21	TP32	TP33	TP34	TP35	TP36	TP37
SAMPLE LOCATION	0.20	0.40	0.20	0.10	0.10	0.10	0.30	0.40	0.10	0.40	0.30	0.10	0.50
DEPTH (m)	0.30	0.50	0.30	0.20	0.20	0.20	0.40	0.50	0.20	0.50	0.40	0.20	0.60
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
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	0.02
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	0.04
Benzo(a)anthracene	0.13	<0.04	0.15	0.06	<0.04	0.06	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.26
Benzo(a)pyrene	0.15	<0.04	0.18	0.08	<0.04	0.07	<0.04	<0.04	<0.04	<0.04	0.05	<0.04	0.33
Benzo(b)fluoranthene	0.17	<0.05	0.23	0.1	0.06	0.09	<0.05	<0.05	0.06	<0.05	0.07	<0.05	0.42
Benzo(ghi)perylene	0.13	<0.05	0.13	0.07	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.27
Benzo(k)fluoranthene	<0.07	<0.07	0.08	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.14
Chrysene	0.14	<0.06	0.2	0.07	<0.06	0.08	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.33
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	0.05
Fluoranthene	0.21	<0.08	0.22	<0.08	<0.08	0.11	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.48
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
Indeno(123-cd)pyrene	0.15	<0.03	0.16	0.07	0.05	0.06	<0.03	<0.03	0.05	<0.03	0.05	<0.03	0.3
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
Phenanthrene	0.07	<0.03	0.07	<0.03	<0.03	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.15
Pyrene	0.19	<0.07	0.21	<0.07	<0.07	0.1	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.44
Organic Matter	4.1	1.3	3.4	4.4	4.5	3.2	2.4	1.1	<0.1	1.2	4.5	3.3	2.9

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	<0.01	<0.01	608	2760	-
Acenaphthylene	0.01	0.02	<0.01			-
Anthracene	0.02	0.04	<0.02	10200	26200	-
Benzo(a)anthracene	0.11	0.26	<0.04	4.52	8.54	-
Benzo(a)pyrene	0.13	0.33	<0.04	1.51	2.05	4.95
Benzo(b)fluoranthene	0.16	0.42	<0.05	7.72	9.86	-
Benzo(ghi)perylene	0.11	0.27	<0.05	96.2	103	-
Benzo(k)fluoranthene	0.09	0.14	<0.07	84.4	100	-
Chrysene	0.14	0.33	<0.06	585	927	-
Dibenzo(ah)anthracene	0.04	0.05	<0.04	0.838	1	-
Fluoranthene	0.19	0.48	<0.08	983	2980	-
Fluorene	0.01	<0.01	<0.01	735	2610	-
Indeno(123-cd)pyrene	0.12	0.30	<0.03	7.31	9.75	-
Naphthalene	0.03	<0.03	<0.03	0.829	12.2	-
Phenanthrene	0.06	0.15	<0.03			-
Pyrene	0.17	0.44	<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**.

SUMMARY OF CONTAMINATION ANALYSIS: SOIL

SUMMARY OF CONTAMINATION ANALYSIS: METALS

Project Name Holt Road, Wrexham (Batch 1)
Project No 18BLH002
Date 15/10/2018

SOIL TYPE	WS1	WS2	WS3	WS4	WS5	WS6	WS7	Stockpile	TP1	TP4	TP5	TP6	TP8	TP9
SAMPLE LOCATION	0.10	0.50	0.10	0.10	0.70	0.10	0.60	-	0.10	0.10	0.30	0.10	0.10	0.40
DEPTH (m)	0.20	0.60	0.20	0.20	0.80	0.20	0.70	-	0.20	0.20	0.40	0.20	0.20	0.50
pH	7.85	7.69	7.43	7.77	7.98	7.74	7.82	7.71	8.01	7.88	8.13	8.3	7.44	7.94
Sulphate (water sol 2:1)	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.11	0.03	0.03	<0.01	<0.01	<0.01	<0.01
Organic matter	5	0.3	3.6	2.7	0.7	2.3	0.3	15.5	5.9	3.3	0.6	3.9	3.7	0.3
Arsenic	5	<1	4	2	<1	3	1	<1	5	5	<1	3	5	<1
Cadmium	0.7	<0.5	0.7	<0.5	0.6	<0.5	<0.5	<0.5	0.8	0.7	<0.5	0.6	0.7	<0.5
Copper	24	5	19	17	8	14	9	13	31	42	7	26	26	9
Chromium (hexavalent)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead	101	15	80	44	16	61	21	<1	132	69	17	114	93	15
Mercury	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	0.69	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17
Nickel	11	9	9	9	13	9	12	6	16	10	8	10	11	10
Selenium	<1	<1	<1	<1	<1	<1	<1	5	1	<1	<1	<1	<1	<1
Zinc	77	21	64	45	26	52	32	39	104	67	27	73	75	29
Asbestos in Soil	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
Quantification	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD
Organic matter	5	0.3	3.6	2.7	0.7	2.3	0.3	15.5	5.9	3.3	0.6	3.9	3.7	0.3

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	7.95	8.30	7.43			-
Sulphate (water sol 2:1)	0.03	0.11	<0.01			-
Organic matter	5.30	15.50	0.30			
Arsenic	3.55	5.00	<1	32	32	37
Cadmium	0.64	0.80	<0.5	10	10	22.1
Copper	22.95	42.00	5.00	4730	4790	-
Chromium (hexavalent)	1.00	<1	<1	3.62	3.63	20.5
Lead	76.05	132.00	<1			200
Mercury	0.27	0.69	<0.17	8.81	15.8	-
Nickel	11.35	16.00	6.00	EA/AtRisk withdrawn Aug 2015		
Selenium	1.79	5.00	<1	375	375	-
Zinc	64.01	104.00	21.00	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 SR4 ASSUMING 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

Project Name Holt Road, Wrexham (Batch 1)
Project No 18BLH002
Date 15/10/2018

SOIL TYPE	WS1	WS2	WS3	WS4	WS5	WS6	WS7	Stockpile	TP1	TP4	TP5	TP6	TP8	TP9
SAMPLE LOCATION	0.10	0.50	0.10	0.10	0.70	0.10	0.60	-	0.10	0.10	0.30	0.10	0.10	0.40
DEPTH (m)	0.20	0.60	0.20	0.20	0.80	0.20	0.70	-	0.20	0.20	0.40	0.20	0.20	0.50
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
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
Ali >C8-C10	<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
Ali >C12-C16	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ali >C16-C21	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ali >C21-C35	5	<1	5	4	<1	3	<1	3	8	8	<1	6	5	<1
Total Aliphatics	5	<1	5	5	<1	3	<1	3	8	8	<1	6	5	<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
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
Aro >C8-C10	<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
Aro >C12-C16	1	<1	1	<1	<1	<1	<1	<1	1	<1	<1	<1	<1	<1
Aro >C16-C21	2	<1	3	2	<1	1	<1	<1	2	1	<1	1	2	<1
Aro >C21-C35	17	<1	21	13	<1	13	<1	13	23	18	1	16	16	<1
Total Aromatics	20	<1	27	15	<1	14	<1	13	27	22	1	18	18	<1
TPH (Ali & Aro)	25	<1	32	18	<1	18	<1	16	35	30	1	23	22	<1
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
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
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
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
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
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
Organic Matter	5	0.3	3.6	2.7	0.7	2.3	0.3	15.5	5.9	3.3	0.6	3.9	3.7	0.3

TPH	Mean Value Test *	Range		AtRisk 2017 (mg/kg) Residential with Home Grown Produce	AtRisk 2017 (mg/kg) Residential with Home Grown Produce	DEFRA 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***
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	1.00	<1	<1	385	4130	-
Ali >C16-C21	1.00	<1	<1	210000	210100	-
Ali >C21-C35	4.92	8.00	<1			
Total Aliphatics	5.01	8.00	<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	1.00	<1	20.5	232	-
Aro >C10-C12	1.00	0.00	<1	70	468	-
Aro >C12-C16	1.00	1.00	<1	165	830	-
Aro >C16-C21	1.73	3.00	<1	319	1040	-
Aro >C21-C35	14.99	23.00	<1	1120	1710	-
Total Aromatics	17.51	27.00	<1			
TPH (Ali & Aro)	22.03	35.00	<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 Holt Road, Wrexham (Batch 1)
Project No 18BLH002
Date 15/10/18

SOIL TYPE	WS1	WS2	WS3	WS4	WS5	WS6	WS7	Stockpile	TP1	TP4	TP5	TP6	TP8	TP9
SAMPLE LOCATION	0.10	0.50	0.10	0.10	0.70	0.10	0.60	-	0.10	0.10	0.30	0.10	0.10	0.40
DEPTH (m)	0.20	0.60	0.20	0.20	0.80	0.20	0.70	-	0.20	0.20	0.40	0.20	0.20	0.50
Acenaphthene	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<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	<0.01
Anthracene	<0.02	<0.02	<0.02	0.17	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)anthracene	0.11	<0.04	0.09	0.22	<0.04	<0.04	<0.04	<0.04	0.08	0.07	<0.04	0.07	0.07	<0.04
Benzo(a)pyrene	0.11	<0.04	0.08	0.13	<0.04	0.05	<0.04	<0.04	0.09	0.08	<0.04	0.09	0.09	<0.04
Benzo(b)fluoranthene	0.13	<0.05	0.1	0.14	<0.05	0.08	<0.05	<0.05	0.12	0.1	<0.05	0.1	0.11	<0.05
Benzo(ghi)perylene	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	0.06	<0.05	0.07	0.06	<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	<0.07
Chrysene	0.13	<0.06	0.1	0.22	<0.06	<0.06	<0.06	<0.06	0.11	0.09	<0.06	0.09	0.1	<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	<0.04
Fluoranthene	0.17	<0.08	0.14	0.53	<0.08	<0.08	<0.08	<0.08	0.15	0.14	<0.08	0.11	0.13	<0.08
Fluorene	<0.01	<0.01	<0.01	0.23	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(123-cd)pyrene	0.07	<0.03	0.05	0.06	<0.03	0.04	<0.03	<0.03	0.07	0.07	<0.03	0.06	0.07	<0.03
Naphthalene	<0.03	<0.03	<0.03	0.06	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Phenanthrene	0.04	<0.03	0.05	0.95	<0.03	<0.03	<0.03	<0.03	0.07	0.07	<0.03	0.03	0.06	<0.03
Pyrene	0.16	<0.07	0.12	0.39	<0.07	<0.07	<0.07	<0.07	0.14	0.11	<0.07	0.1	0.12	<0.07
Organic Matter	5	0.3	3.6	2.7	0.7	2.3	0.3	15.5	5.9	3.3	0.6	3.9	3.7	0.3

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	0.02	0.05	<0.01	608	2760	-
Acenaphthylene	0.01	0.01	<0.01			-
Anthracene	0.05	0.17	<0.02	10200	26200	-
Benzo(a)anthracene	0.09	0.22	<0.04	4.52	8.54	-
Benzo(a)pyrene	0.08	0.13	<0.04	1.51	2.05	4.95
Benzo(b)fluoranthene	0.10	0.14	<0.05	7.72	9.86	-
Benzo(ghi)perylene	0.06	0.07	<0.05	96.2	103	-
Benzo(k)fluoranthene	0.07	0.07	<0.07	84.4	100	-
Chrysene	0.11	0.22	<0.06	585	927	-
Dibenzo(ah)anthracene	0.04	<0.04	<0.04	0.838	1	-
Fluoranthene	0.19	0.53	<0.08	983	2980	-
Fluorene	0.05	0.23	<0.01	735	2610	-
Indeno(123-cd)pyrene	0.06	0.07	<0.03	7.31	9.75	-
Naphthalene	0.04	0.06	<0.03	0.829	12.2	-
Phenanthrene	0.22	0.95	<0.03			-
Pyrene	0.16	0.39	<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.**

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: **09/11/2018 16:58:49**.

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

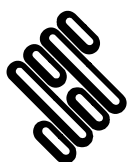
Approved Signatory
Mark Athorne (Laboratory Manager)

(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:

18/08978

Job No:

783504





STRUCTURAL SOILS LTD
TEST REPORT



Report No. 783504 R1

Date 09-November-2018 Contract 18/08978

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 29/10/2018
Testing Started 30/10/2018
Testing Completed 09/11/2018

Client Reference 18/08978
Client Order No. P0739410
Instruction Type Written

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
Particle Size Distribution wet sieve method BS1377:Part 2:1990,clause 9.2

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

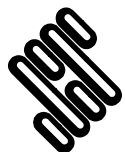
Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of.
Test were undertaken on samples 'as received' unless otherwise stated.
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

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
TP08	18/08978/3	D	0.80	9.9	26	15	11	98	Brown sandy slightly gravelly CLAY
TP09	18/08978/4	D	1.30	13	26	15	11	95	Brown sandy slightly gravelly CLAY
TP13	18/08978/6	D	2.00	26	28	16	12	99	Brown slightly sandy CLAY
TP14	18/08978/8	D	2.20	23	28	21	7	100	Brown silty CLAY
TP20	18/08978/9	D	1.80	16	36	21	15	99	Brown slightly sandy slightly gravelly CLAY
TP21	18/08978/11	D	2.50	29	34	21	13	100	Brown slightly sandy CLAY
TP23	18/08978/12	D	1.20	9.0	32	23	9	83	Brown slightly sandy slightly gravelly CLAY
TP23	18/08978/13	D	1.80	10	25	16	9	91	Brown sandy slightly gravelly CLAY



**STRUCTURAL
SOILS LTD**

Contract:

18/08978

Contract Ref:

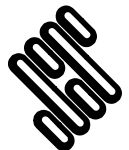
783504



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
TP25	18/08978/21	D	3.00	24	26	23	3	96	Brown sandy slightly gravelly CLAY
TP33	18/08978/18	D	1.20	20	29	17	12	86	Brown slightly gravelly CLAY
TP37	18/08978/15	D	1.60	22	29	21	8	100	Brown slightly silty CLAY



**STRUCTURAL
SOILS LTD**

Contract:

18/08978

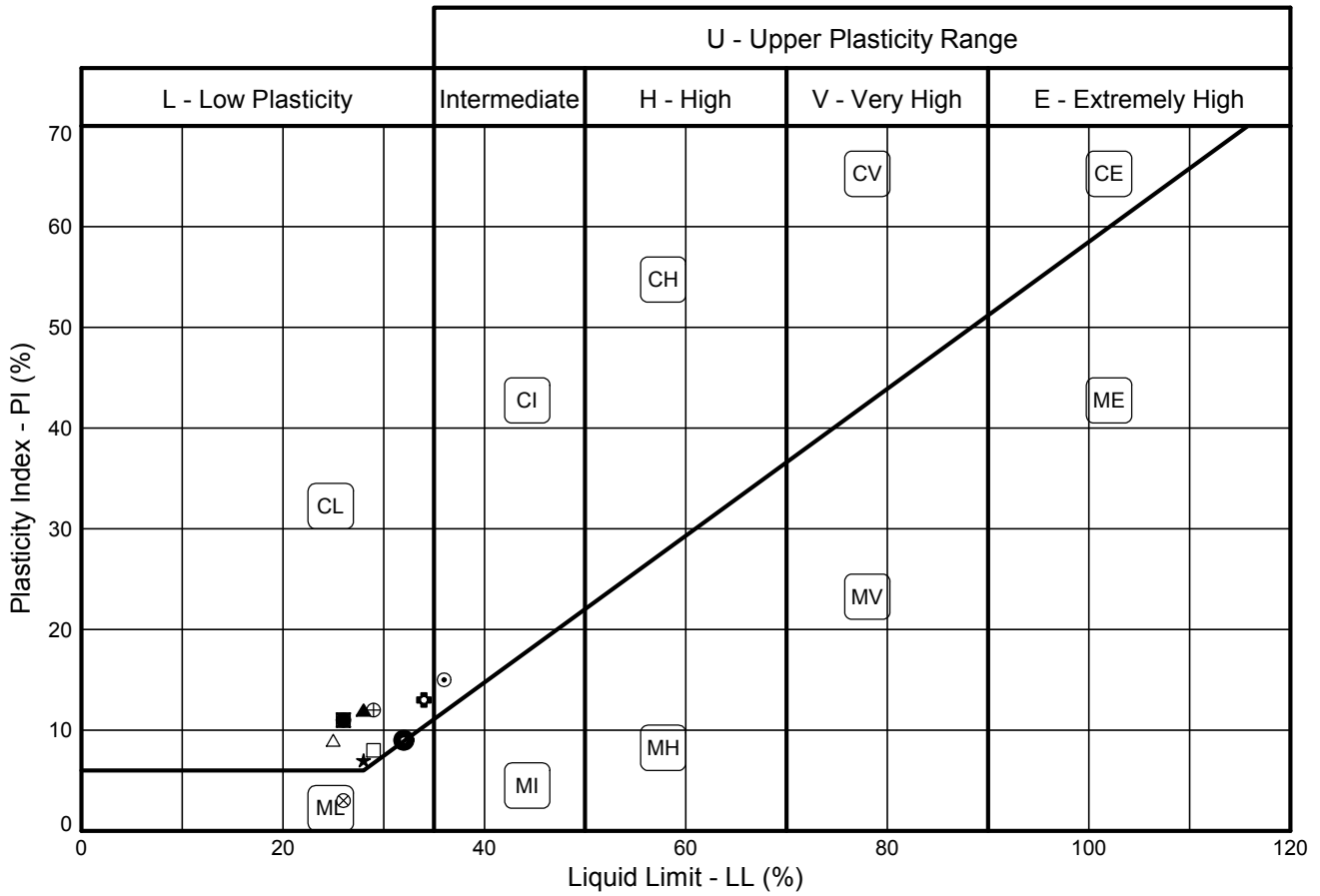
Contract Ref:

783504



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)									
●	TP08	18/08978/3D	0.80	3.2/4.3/5.3/5.4	4.2.4	9.9	26	15	11	98	C
⊠	TP09	18/08978/4D	1.30	3.2/4.3/5.3/5.4	4.2.4	13	26	15	11	95	C
▲	TP13	18/08978/6D	2.00	3.2/4.3/5.3/5.4	4.2.4	26	28	16	12	99	C
★	TP14	18/08978/8D	2.20	3.2/4.3/5.3/5.4	4.2.3	23	28	21	7	100	C
⊙	TP20	18/08978/9D	1.80	3.2/4.3/5.3/5.4	4.2.4	16	36	21	15	99	C
⊕	TP21	18/08978/11D	2.50	3.2/4.3/5.3/5.4	4.2.4	29	34	21	13	100	C
⊗	TP23	18/08978/12D	1.20	3.2/4.3/5.3/5.4	4.2.4	9.0	32	23	9	83	C
△	TP23	18/08978/13D	1.80	3.2/4.3/5.3/5.4	4.2.4	10	25	16	9	91	C
⊗	TP25	18/08978/21D	3.00	3.2/4.3/5.3/5.4	4.2.4	24	26	23	3	96	C
⊕	TP33	18/08978/18D	1.20	3.2/4.3/5.3/5.4	4.2.4	20	29	17	12	86	C
□	TP37	18/08978/15D	1.60	3.2/4.3/5.3/5.4	4.2.3	22	29	21	8	100	C

Tested in accordance with the following clauses of BS1377-2:1990.

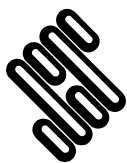
3.2 - Moisture Content
4.3 - Cone Penetrometer Method
4.4 - One Point Cone Penetrometer Method
4.6 - One Point Casagrande Method
5.3 - Plastic Limit Method
5.4 - Plasticity Index

+ 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

Sarah Mundy

Date

SARAH MUNDY

09/11/18

Contract

18/08978

Contract Ref:

783504



PARTICLE SIZE DISTRIBUTION TEST

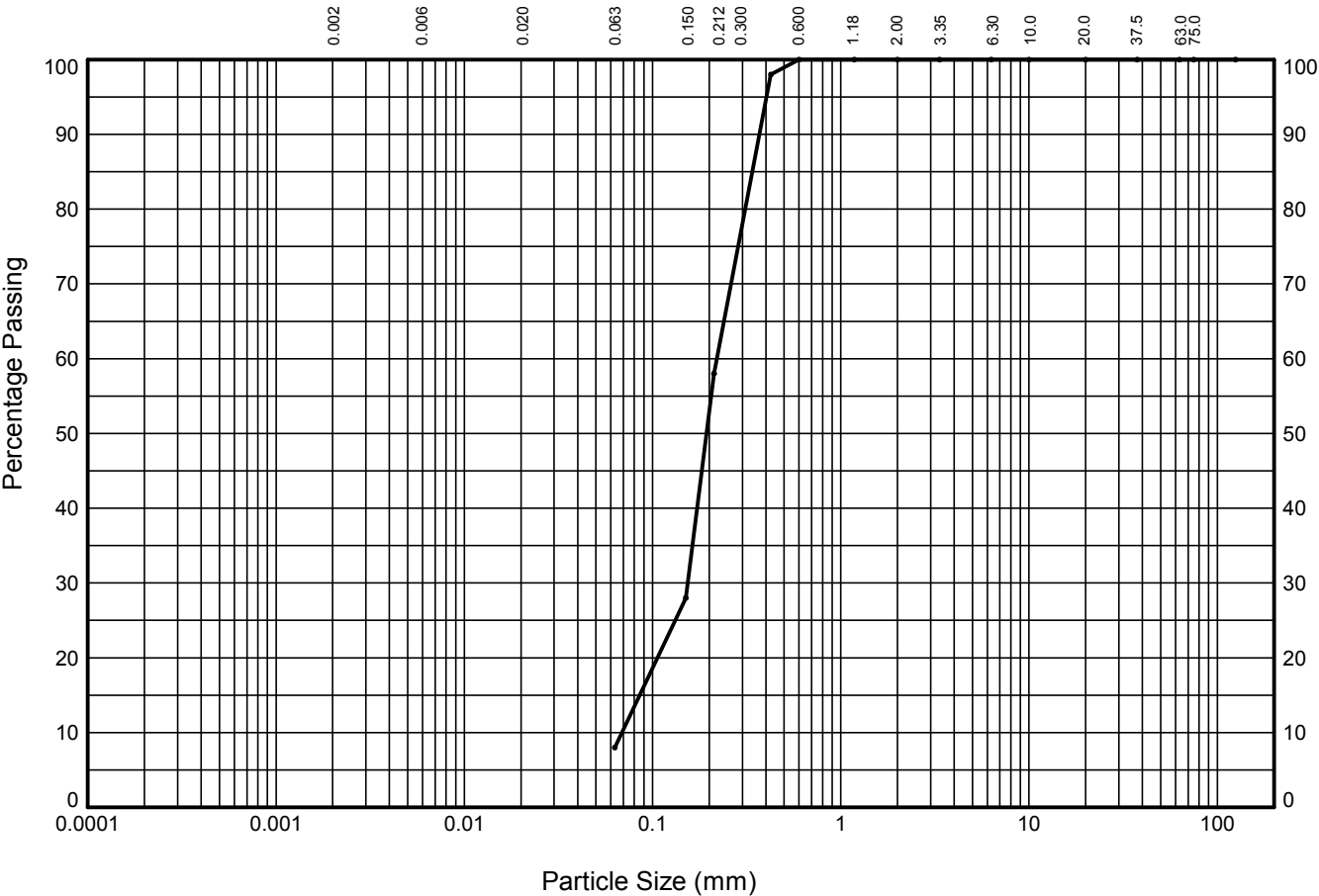
In accordance with clauses 9.2 of BS1377:Part 2:1990

Borehole: **BH4**

Sample Ref: **18/08978/24**

Sample Type: **D**

Depth (m): **4.00**



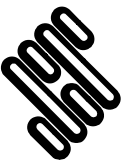
CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

Test Sieve (mm)	Percent Passing (%)
125.0	100
75.0	100
63.0	100
37.5	100
20.0	100
10.0	100
6.30	100
3.35	100
2.00	100
1.18	100
0.600	100
0.425	98
0.212	58
0.150	28
0.063	8

Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	0
SAND	92
SILT/CLAY	8

Soil Description:
Brown clayey SAND



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

Compiled By

Sarah Mundy

SARAH MUNDY

Date

09/11/18

Contract

18/08978

Contract Ref:

783504



PARTICLE SIZE DISTRIBUTION TEST

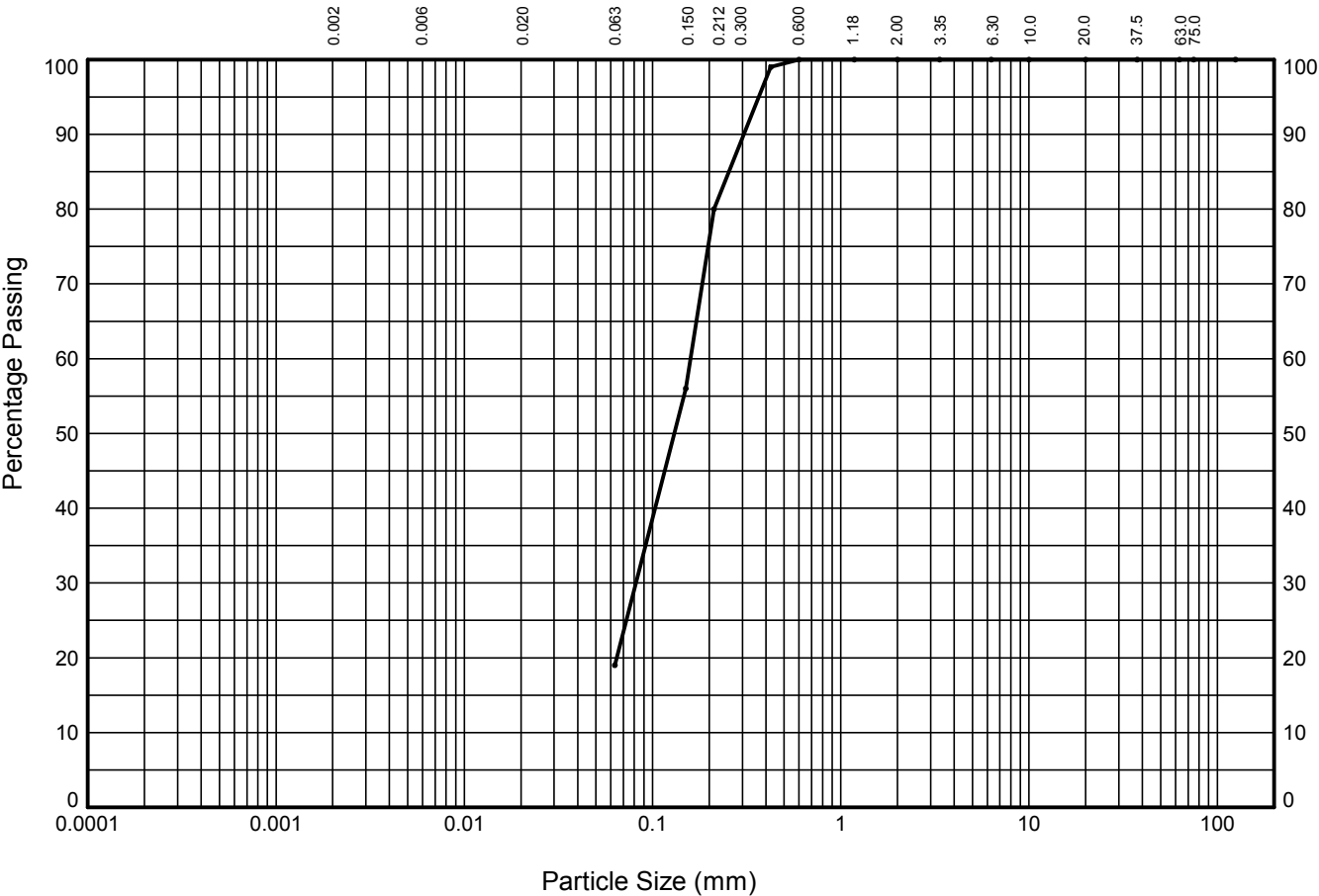
In accordance with clauses 9.2 of BS1377:Part 2:1990

Borehole: **BH4**

Sample Ref: **18/08978/25**

Sample Type: **D**

Depth (m): **7.00**



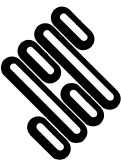
CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

Test Sieve (mm)	Percent Passing (%)
125.0	100
75.0	100
63.0	100
37.5	100
20.0	100
10.0	100
6.30	100
3.35	100
2.00	100
1.18	100
0.600	100
0.425	99
0.212	80
0.150	56
0.063	19

Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	0
SAND	81
SILT/CLAY	19

Soil Description:
Brown clayey SAND



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

Compiled By

Sarah Mundy

SARAH MUNDY

Date

09/11/18

Contract

18/08978

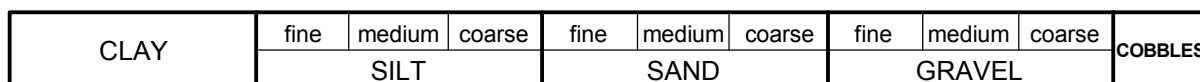
Contract Ref:

783504



In accordance with clauses 9.2 of BS1377:Part 2:1990

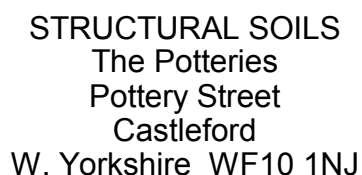
Depth (m): **0.60**



Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	44
SAND	52
SILT/CLAY	4

Brown slightly clayey very gravelly SAND



Date _____

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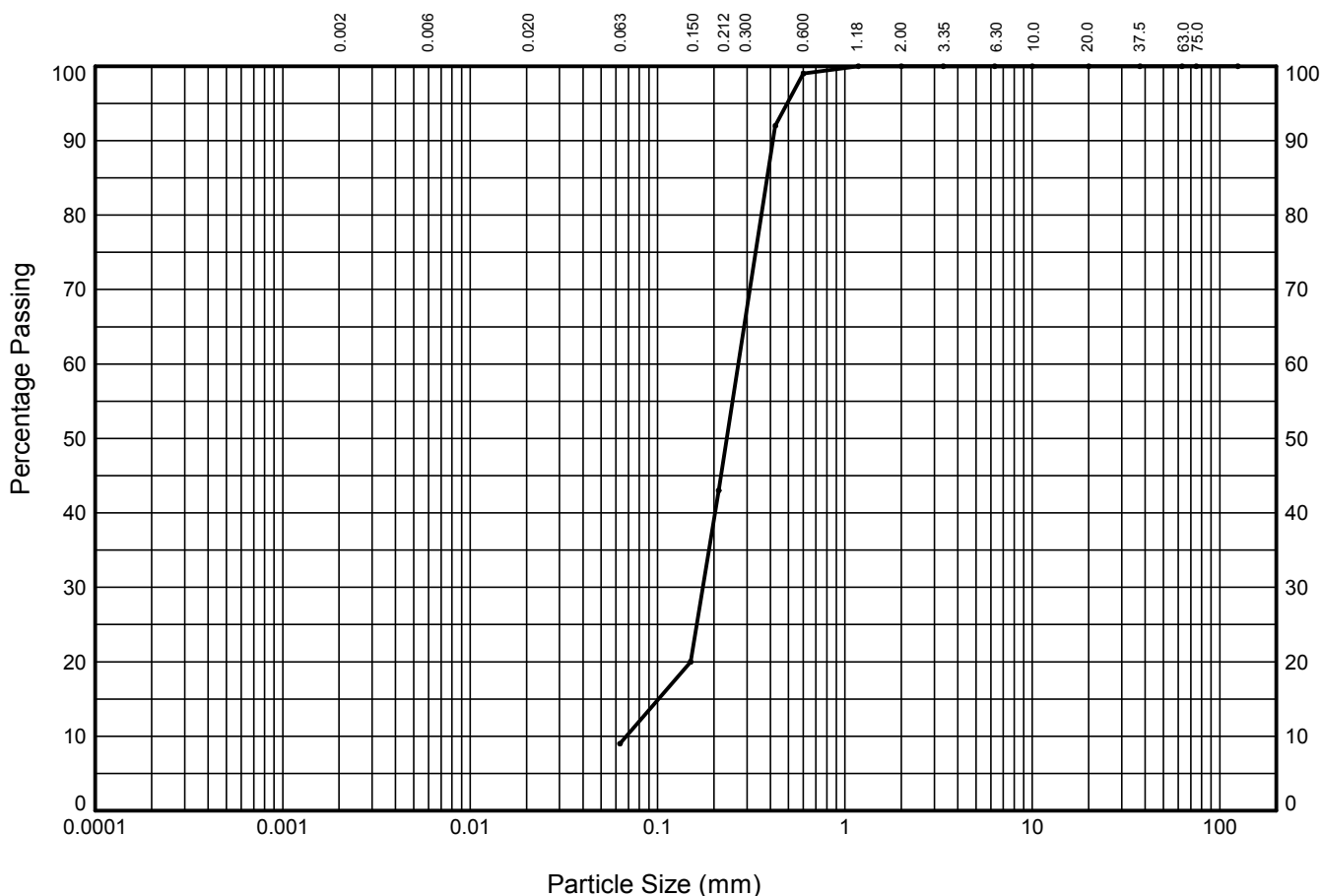
Contract Ref:

783504



In accordance with clauses 9.2 of BS1377:Part 2:1990

Depth (m): **1.40**



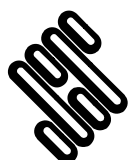
CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

Test Sieve (mm)	Percent Passing (%)
125.0	100
75.0	100
63.0	100
37.5	100
20.0	100
10.0	100
6.30	100
3.35	100
2.00	100
1.18	100
0.600	99
0.425	92
0.212	43
0.150	20
0.063	9

Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	0
SAND	91
SILT/CLAY	9

Soil Description:
Brown clayey SAND



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PARTICLE SIZE DISTRIBUTION TEST

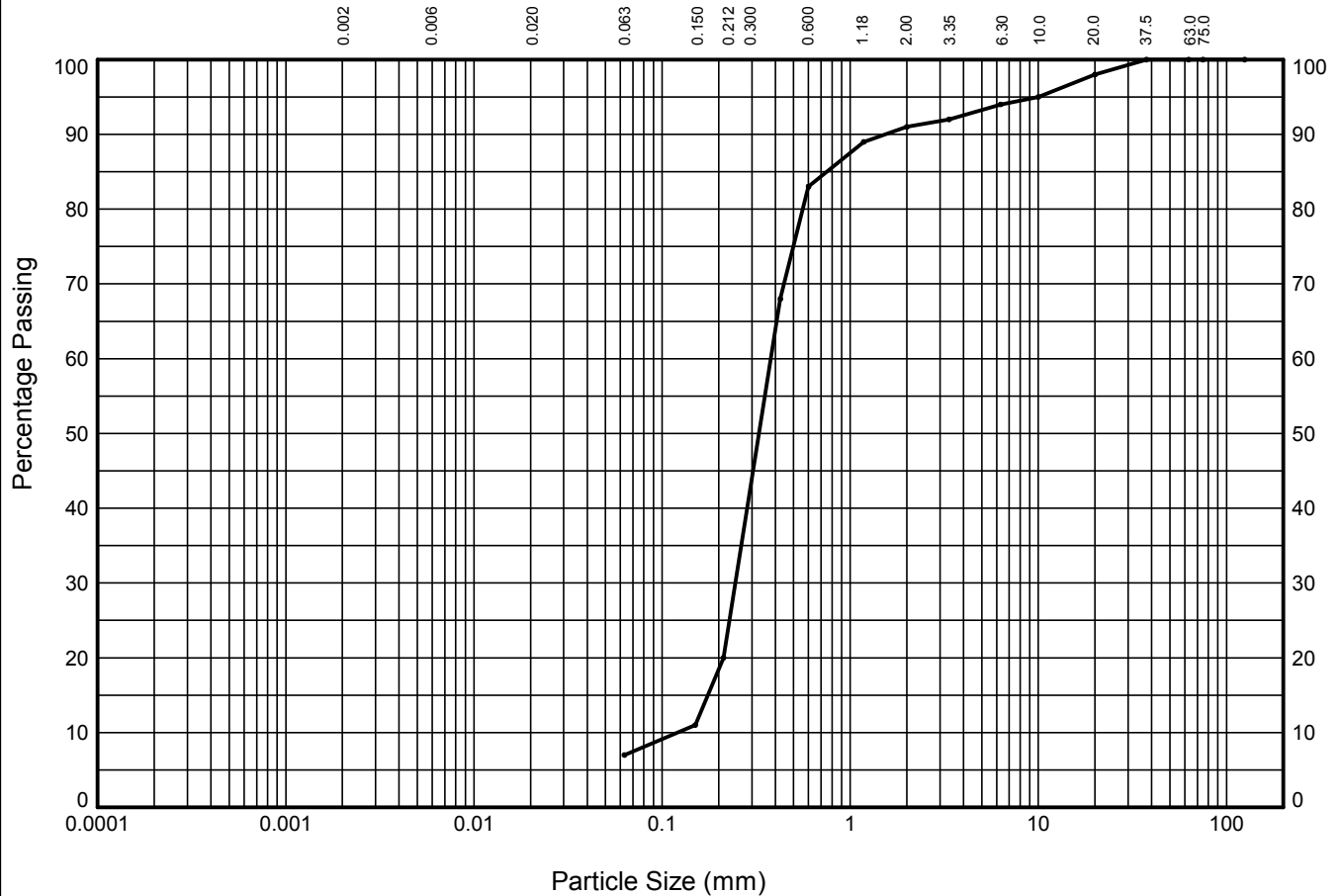
In accordance with clauses 9.2 of BS1377:Part 2:1990

Position ID: **SA4**

Sample Ref: **18/08978/23**

Sample Type: **D**

Depth (m): **0.80**



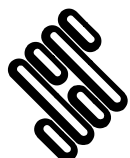
CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

Test Sieve (mm)	Percent Passing (%)
125.0	100
75.0	100
63.0	100
37.5	100
20.0	98
10.0	95
6.30	94
3.35	92
2.00	91
1.18	89
0.600	83
0.425	68
0.212	20
0.150	11
0.063	7

Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	9
SAND	84
SILT/CLAY	7

Soil Description:
Brown clayey gravelly SAND



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The Potteries
Pottery Street
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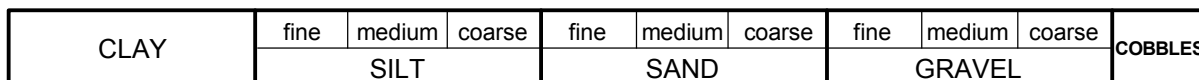
Contract Ref:

783504



In accordance with clauses 9.2 of BS1377:Part 2:1990

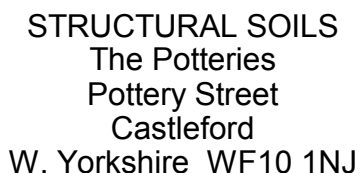
Depth (m): **0.80**



Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	0
SAND	98
SILT/CLAY	2

Soil Description:
Brown slightly clayey SAND



Date _____

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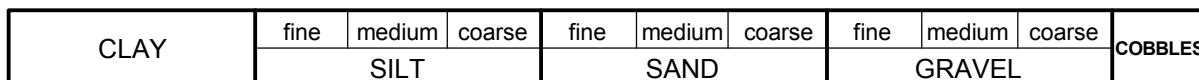
Contract Ref:

783504



In accordance with clauses 9.2 of BS1377:Part 2:1990

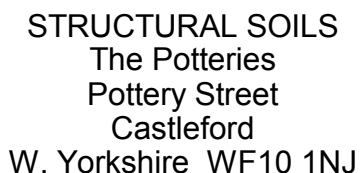
Depth (m): **0.50**



Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	1
SAND	98
SILT/CLAY	1

Brown slightly clayey slightly gravelly SAND



Date _____

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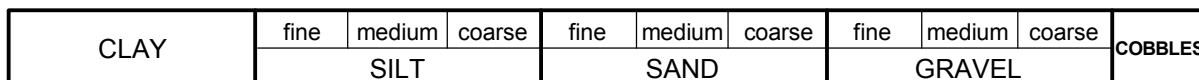
09/11/18

Contract Ref:

783504



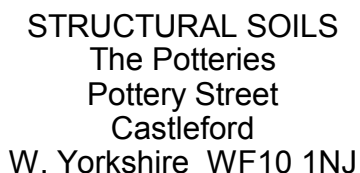
In accordance with clauses 9.2 of BS1377:Part 2:1990

Depth (m): **1.00**

Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	14
SAND	83
SILT/CLAY	3

Brown slightly clayey gravelly SAND



Date _____

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09/11/18

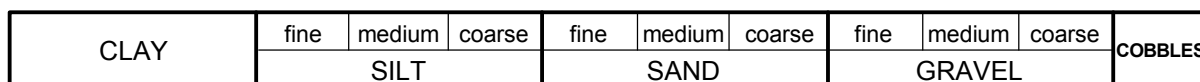
Contract Ref:

783504



In accordance with clauses 9.2 of BS1377:Part 2:1990

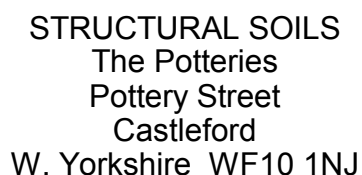
Depth (m): **1.60**



Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	34
SAND	63
SILT/CLAY	3

Brown slightly clayey very gravelly SAND



Date _____

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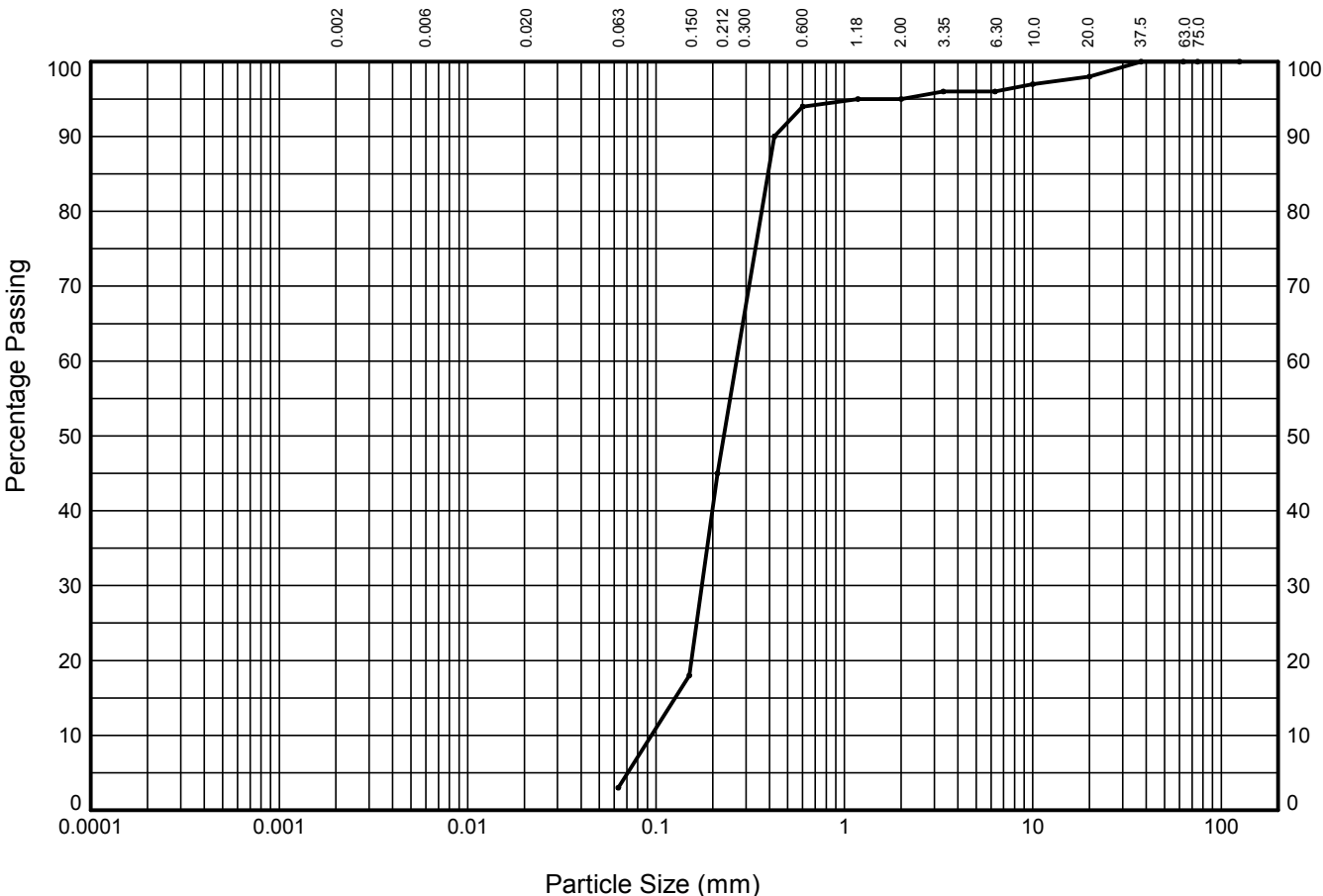
783504



PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2 of BS1377:Part 2:1990

Trial Pit: **TP04** Sample Ref: **18/08978/2** Sample Type: **D** Depth (m): **1.40**



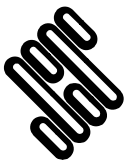
CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

Test Sieve (mm)	Percent Passing (%)
125.0	100
75.0	100
63.0	100
37.5	100
20.0	98
10.0	97
6.30	96
3.35	96
2.00	95
1.18	95
0.600	94
0.425	90
0.212	45
0.150	18
0.063	3

Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	5
SAND	92
SILT/CLAY	3

Soil Description:
Brown slightly clayey gravelly SAND



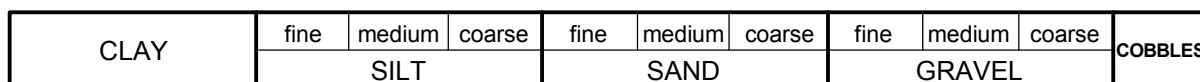
STRUCTURAL SOILS
The Potteries
Pottery Street
Castleford
W. Yorkshire WF10 1NJ

Compiled By		Date
<i>Sarah Mundy</i>		09/11/18
Contract		Contract Ref:
18/08978		783504



In accordance with clauses 9.2 of BS1377:Part 2:1990

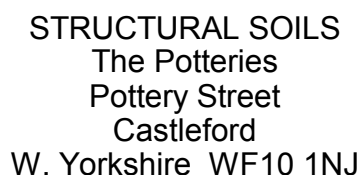
Depth (m): **2.00**



Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	0
SAND	96
SILT/CLAY	4

Soil Description:
Brown slightly clayey SAND



Date _____

SARAH MUNDY

09/11/18

Contract Ref:

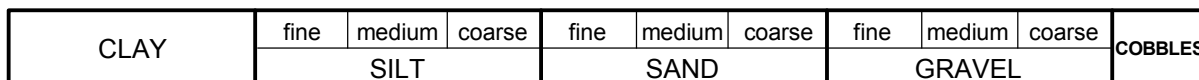
18/08978

783504



In accordance with clauses 9.2 of BS1377:Part 2:1990

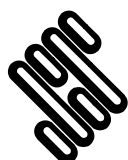
Depth (m): **2.50**



Particle Diameter (mm)	Percent Passing (%)
Sedimentation sample was not pre-treated	

Soil Fraction	Sieve Percentage (%)
GRAVEL	0
SAND	23
SILT/CLAY	77

Soil Description:
Brown slightly sandy CLAY



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09/11/18



APPENDIX E

(i) Gas Monitoring Data

Site: Holt Road, Wrexham
 Job Number: 18BLH002
 Date of Monitoring: 28/11/2018

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	0.0	1018	0.1	0.1	1.1	0.9	19.6	19.9	-	-	-	Dry	2.95
WS2	0.1	1018	0.0	0.0	0.5	0.4	20.2	20.2	-	-	-	Dry	3.01
WS3	0.0	1018	0.0	0.0	0.1	0.1	20.6	20.6	-	-	-	Dry	3.00
WS4	0.1	1018	0.0	0.0	0.3	0.3	20.3	20.3	-	-	-	Dry	3.14
WS5	0.0	1018	0.0	0.0	0.6	0.5	20.0	20.1	-	-	-	Dry	3.10
WS6	0.1	1018	0.0	0.0	0.5	0.5	20.1	20.2	-	-	-	Dry	3.00
WS7	0.0	1018	0.0	0.0	0.1	0.1	20.7	20.7	-	-	-	Dry	3.10
WS8	0.0	1018	0.0	0.0	0.7	0.7	20.4	20.4	-	-	-	Dry	3.06
WS9	0.0	1018	0.0	0.0	1.2	1.1	20.1	20.2	-	-	-	Dry	1.52
WS10	0.0	1018	0.0	0.0	0.6	0.6	20.6	20.6	-	-	-	Dry	2.08
WS11	0.0	1018	0.1	0.1	1.2	1.1	20.3	20.4	-	-	-	Dry	3.10
BH1	0.0	1018	0.0	0.0	0.2	0.1	20.3	20.4	-	-	-	Dry	20.10
BH2	0.0	1018	0.0	0.0	0.1	0.1	20.5	20.5	-	-	-	Dry	19.78
BH3	0.0	1018	0.0	0.0	12.3	12.0	20.5	20.5	-	-	-	Dry	19.95
BH4	0.1	1018	0.0	0.0	0.1	0.1	20.4	20.5	-	-	-	Dry	20.05
BH5	0.0	1018	0.0	0.0	0.1	0.1	20.6	20.7	-	-	-	Dry	19.37

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, sunny, no wind, warm.
Equipment Used:	GA2000+
Visible signs of damage/stress:	N/A
Other Comments/Observations:	Pressure falling.

Site: Holt Road, Wrexham
 Job Number: 18BLH002
 Date of Monitoring: 28/11/2018

Ground Gas Monitoring Round 2



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS1	0.0	1006	0.0	0.0	1.4	1.3	19.5	19.7	-	-	-	Dry	3.15
WS2	0.2	1006	0.0	0.0	2.0	1.9	19.0	19.1	-	-	-	Dry	3.00
WS3	0.2	1006	0.0	0.0	1.7	1.6	19.3	19.8	-	-	-	Dry	3.17
WS4	0.3	1006	0.0	0.0	4.3	4.2	16.0	17.1	-	-	-	Dry	3.14
WS5	0.1	1006	0.0	0.0	3.2	3.0	18.0	18.7	-	-	-	Dry	3.00
WS6	0.3	1006	0.0	0.0	5.3	5.3	14.2	14.3	-	-	-	Dry	3.10
WS7	0.1	1006	0.0	0.0	2.1	2.1	19.6	19.6	-	-	-	Dry	3.12
WS8	0.3	1006	0.0	0.0	1.2	1.2	20.3	20.3	-	-	-	Dry	3.05
WS9	0.0	1006	0.0	0.0	1.3	1.2	20.3	20.4	-	-	-	Dry	1.51
WS10	0.1	1006	0.0	0.0	1.0	1.0	20.6	20.6	-	-	-	Dry	2.07
WS11	0.3	1006	0.0	0.0	1.8	1.8	19.8	19.8	-	-	-	Dry	3.08
BH1	0.7	1006	0.0	0.0	3.7	3.7	14.3	14.4	-	-	-	Dry	19.95
BH2	0.7	1006	0.0	0.0	5.7	5.9	12.8	13.9	-	-	-	Dry	18.96
BH3	2.3	1006	0.2	0.2	12.3	12.0	4.0	4.8	-	-	-	Dry	19.47
BH4	1.4	1006	0.0	0.0	7.9	7.9	7.7	8.1	-	-	-	Dry	20.00
BH5	0.5	1006	0.0	0.0	6.7	6.7	10.6	10.6	-	-	-	Dry	18.69

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:	Cold, overcast, slight wind.
Equipment Used:	GA2000+
Visible signs of damage/stress:	N/A
Other Comments/Observations:	Pressure falling.

Site: Holt Road, Wrexham
 Job Number: 18BLH002
 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	0.1	986	0.0	0.0	1.3	1.3	19.7	19.8	-	-	-	Dry	3.01
WS2	0.0	986	0.0	0.0	2.3	2.2	18.8	18.9	-	-	-	Dry	2.95
WS3	0.5	986	0.0	0.0	2.1	2.0	19.0	19.3	-	-	-	Dry	2.97
WS4	0.0	986	0.0	0.0	4.7	4.6	16.0	16.2	-	-	-	Dry	3.10
WS5	1.0	986	0.0	0.0	4.5	2.7	15.5	18.4	-	-	-	Dry	3.00
WS6	2.3	986	0.0	0.0	3.4	2.6	16.5	17.5	-	-	-	Dry	3.10
WS7	0.2	986	0.0	0.0	1.8	1.7	19.9	19.8	-	-	-	Dry	3.09
WS8	0.4	986	0.0	0.0	0.9	0.9	20.6	20.7	-	-	-	Dry	3.02
WS9	0.0	986	0.0	0.0	1.1	1.0	20.4	20.5	-	-	-	Dry	1.50
WS10	0.1	986	0.0	0.0	0.9	0.8	20.6	20.7	-	-	-	Dry	2.06
WS11	0.0	986	0.0	0.0	1.5	1.4	20.0	20.3	-	-	-	Dry	3.07
BH1	1.9	986	0.0	0.0	4.0	4.0	13.5	13.6	-	-	-	Dry	19.75
BH2	0.2	986	0.0	0.0	7.5	7.3	9.9	9.9	-	-	-	Dry	19.50
BH3	0.1	986	0.2	0.2	12.3	12.0	2.0	2.1	-	-	-	Dry	19.60
BH4	0.4	986	0.0	0.0	7.8	7.7	7.4	8.1	-	-	-	Dry	19.59
BH5	0.0	986	0.0	0.0	3.3	3.0	15.8	16.6	-	-	-	Dry	18.86

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:	Squally showers, strong wind, occasional sun, warm.
Equipment Used:	GA2000+
Visible signs of damage/stress:	N/A
Other Comments/Observations:	Pressure rising.

APPENDIX F

(i) Conceptual Model

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

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

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

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

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

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

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

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



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

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

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

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

Initial Conceptual Model

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

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

Initial Environmental Risk Assessment

General

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

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

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

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

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

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

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

CIRIA C665 Situation A Ground Gas Conceptual Model

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

APPENDIX G

(i) Notes on Ground Gas

Ground Gas

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

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

A gas regime is essentially defined by two parameters:

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

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

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

Three recent publications are used for ground gas risk assessment:

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

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

CIRIA C665 Situation A Ground Gas Conceptual Model

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

High Rise / Flats (CIRIA 665 Table 8.5)

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

Notes:

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

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

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

Notes:

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

Low Rise Residential (NHBC)

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

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

Notes:

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

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

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

BS8485: 2007

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

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

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

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

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

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

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

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

Table 3: Solutions Scores

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

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

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

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

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

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

APPENDIX H

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

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

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

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

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

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

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

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

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

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

APPENDIX I

(i) Validation Report Guidance Notes

Unforeseen Hotspots of Contamination

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

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

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

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

Validation Report Recommendations

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

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

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

The validation report will include the following:

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

APPENDIX J

(i) Notes on Limitations

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

The 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 Bloor Homes. In response to particular instructions, any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

This document has been prepared for the titled project only and should any third party wish to use or rely upon the contents of

the report, written approval from Betts Geo Environmental Ltd must be sought.

Betts Geo Environmental Ltd accepts no responsibility or liability

a) for the consequences of this document being used for the purpose other than that for which it was commissioned and
For this document to any other party other than the person by whom it was commissioned.

APPENDIX K

(i) Soakaway Testing Results

SOAKAWAY TEST RESULTS

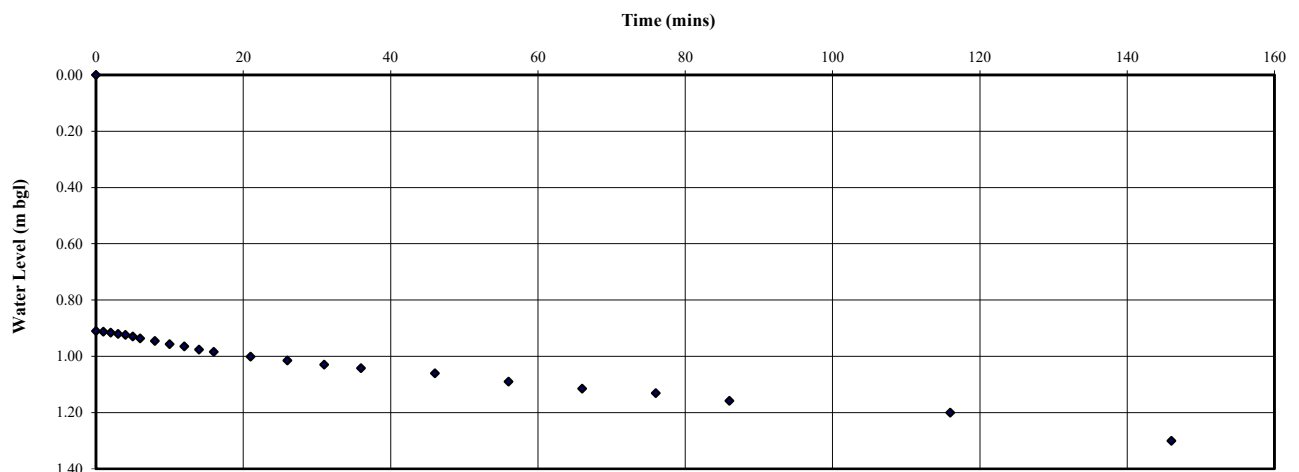
Date of Test: 17/10/18

Hole ID: SA1

Test No 1

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	2.00	0.60	1.40	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.35 m ³
0.0	0.910			
1.0	0.913			
2.0	0.916			
3.0	0.920			
4.0	0.924			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.73 m ²
5.0	0.930			
6.0	0.936			
8.0	0.946			
10.0	0.957			
12.0	0.965			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 106 min
14.0	0.976			
16.0	0.984			
21.0	1.001			
26.0	1.015			
31.0	1.030			Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$
36.0	1.042			
46.0	1.060			
56.0	1.090			
66.0	1.115			
76.0	1.131			$Depth_{(25\%)} = 1.2525$ $Depth_{(75\%)} = 0.958$ m
86.0	1.158			
116.0	1.200			
146.0	1.300			
				Soil infiltration rate = 2.0E-05 m/sec
				Remarks * Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

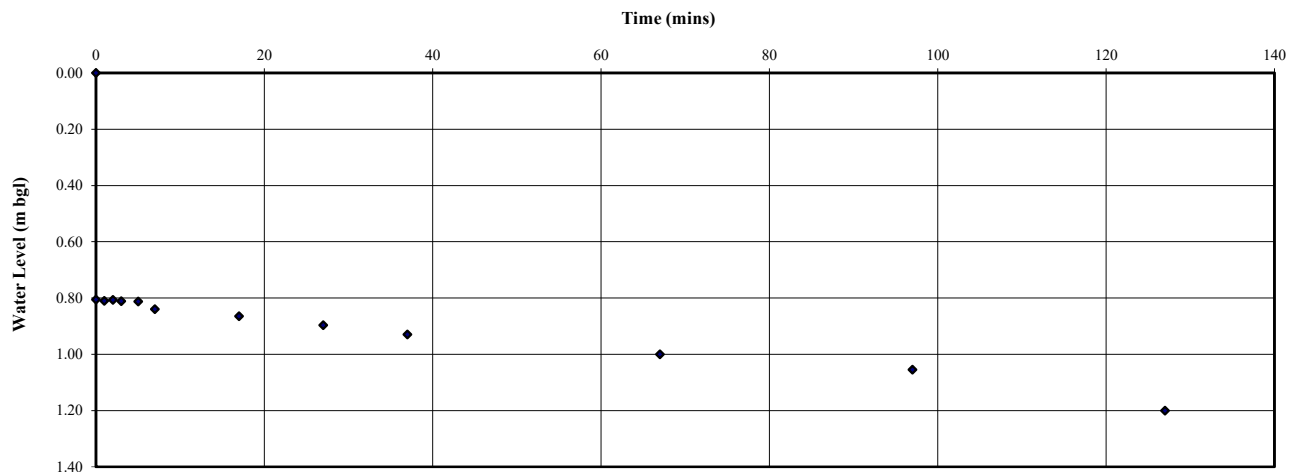
Date of Test: 17/10/18

Hole ID: SA1

Test No 2

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	2.00	0.60	1.40	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.35 m ³
0.0	0.805			
1.0	0.810			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.73 m ²
2.0	0.807			
3.0	0.811			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 106 min
5.0	0.812			
7.0	0.840			Soil infiltration rate = $\frac{\cdot}{t_{(p75-25)} \times a_{(p50)} \times 60}$
17.0	0.865			
27.0	0.896			$\text{Depth}_{(25\%)} = 1.2525$ $\text{Depth}_{(75\%)} = 0.958 \text{ m}$
37.0	0.930			
67.0	1.000			Soil infiltration rate = 2.0E-05 m/sec
97.0	1.055			
127.0	1.200			Remarks * Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

Date of Test: 17/10/18

Hole ID: SA1

Test No 3

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	2.00	0.60	1.20	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.35 m ³
0.0	0.710			
1.0	0.720			
2.0	0.730			
3.0	0.742			
4.0	0.750			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.73 m ²
9.0	0.765			
14.0	0.780			
19.0	0.793			
29.0	0.820			
59.0	0.850			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 121 min
89.0	0.910			
109.0	0.950			
				Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$
				$\text{Depth}_{(25\%)} = 1.0525$ $\text{Depth}_{(75\%)} = 0.758 \text{ m}$
				Soil infiltration rate = 1.8E-05 m/sec
				Remarks * Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

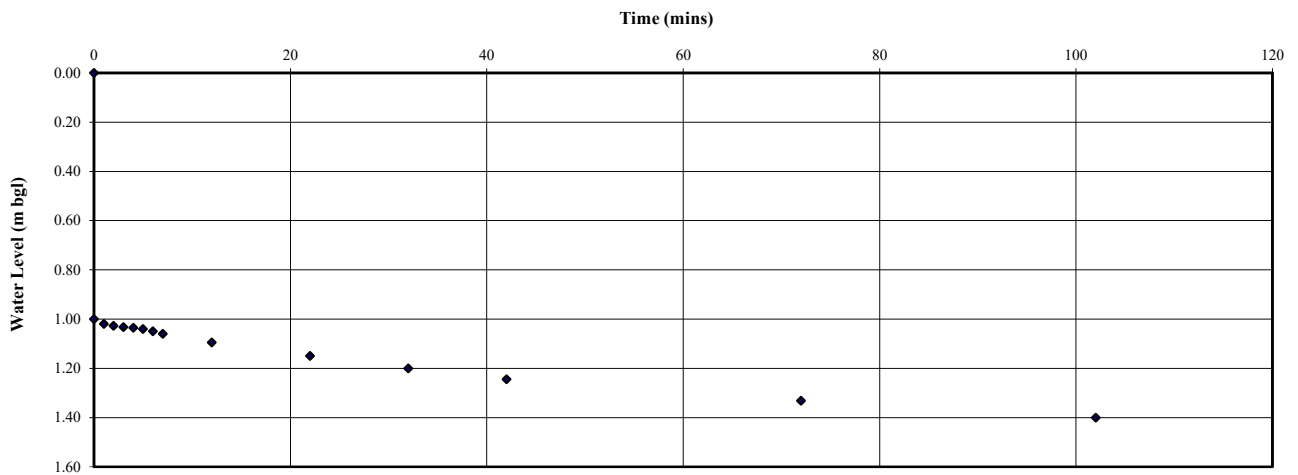
Date of Test: 17/10/18

Hole ID: SA2

Test No 1

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.50	0.60	1.40	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)		
0.0	1.000			Effective storage volume in trial pit $V_{(p75-25)} =$ between effective depths 25% to 75%. $= 0.27 \text{ m}^3$	
1.0	1.020			Initial surface area of trial pit up to $a_{(p50)} =$ 50% effective depth and including the base area. $= 2.14 \text{ m}^2$	
2.0	1.027			Time for the water level to fall from $t_{(p75-25)} =$ 75 % to 25% effective depth. $= 49 \text{ min}$	
3.0	1.032			Soil infiltration rate = $\frac{.}{t_{(p75-25)} \times a_{(p50)} \times 60}$	
4.0	1.035			Depth $_{(25\%)} = 1.2525$ Depth $_{(75\%)} = 0.958 \text{ m}$	
5.0	1.040			Soil infiltration rate = $4.2\text{E-}05 \text{ m/sec}$	
6.0	1.049			Remarks * Extrapolated soil infiltration rate	
7.0	1.060				
12.0	1.095				
22.0	1.150				
32.0	1.200				
42.0	1.245				
72.0	1.332				
102.0	1.400				



SOAKAWAY TEST RESULTS

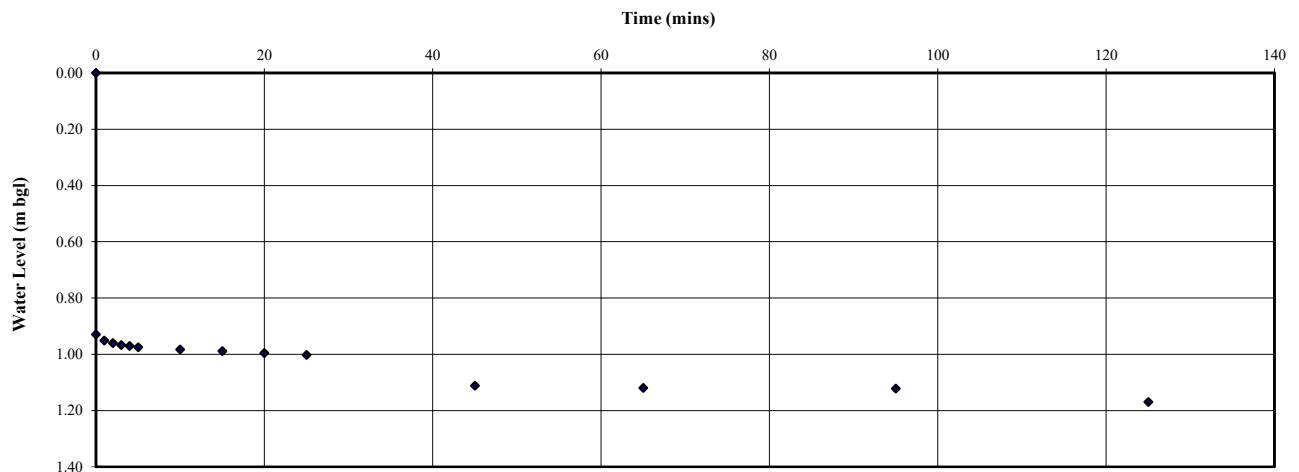
Date of Test: 17/10/18

Hole ID: SA2

Test No 2

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.50	0.60	1.40	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.27 m ³
0.0	0.930			
1.0	0.951			
2.0	0.960			
3.0	0.967			
4.0	0.971			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.14 m ²
5.0	0.975			
10.0	0.983			
15.0	0.989			
20.0	0.996			
25.0	1.002			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 140 min
45.0	1.112			
65.0	1.120			
95.0	1.122			
125.0	1.170			
				Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$
				Depth _(25%) = 1.2525 Depth _(75%) = 0.958 m
				Soil infiltration rate = 1.5E-05 m/sec
				Remarks * Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

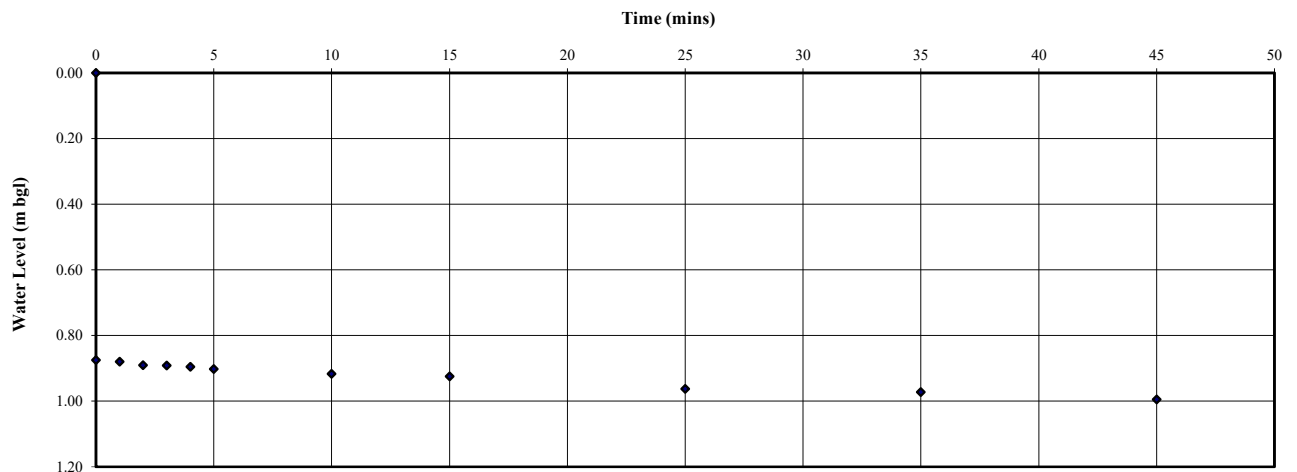
Date of Test: 17/10/18

Hole ID: SA2

Test No 3

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.50	0.60	1.40	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	Effective storage volume in trial pit between effective depths 25% to 75%. $V_{(p75-25)} =$ = 0.27 m ³	
0.0	0.875			Initial surface area of trial pit up to 50% effective depth and including the base area. $a_{(p50)} =$ = 2.14 m ²	
1.0	0.880				
2.0	0.890				
3.0	0.891				
4.0	0.895				
5.0	0.902			Time for the water level to fall from 75 % to 25% effective depth. $t_{(p75-25)} =$ = 110 min	
10.0	0.917				
15.0	0.925				
25.0	0.963				
35.0	0.972				
45.0	0.995			Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$	
				Depth _(25%) = 1.2525	Depth _(75%) = 0.958 m
				Soil infiltration rate = 1.9E-05 m/sec	
				Remarks * Extrapolated soil infiltration rate	



SOAKAWAY TEST RESULTS

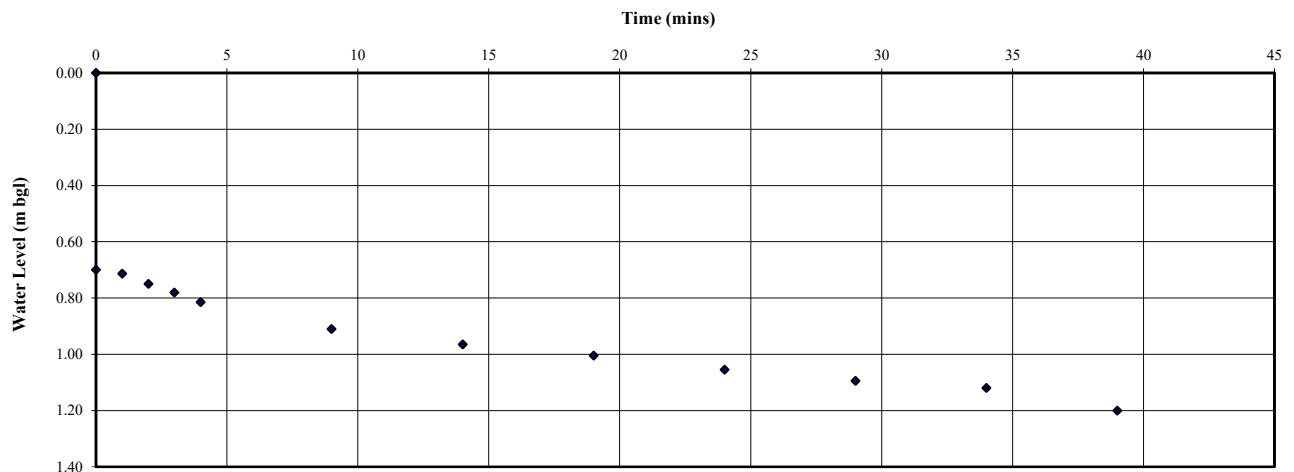
Date of Test: 18/10/18

Hole ID: SA3

Test No 1

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.50	0.60	1.20	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.27 m ³
0.0	0.700			
1.0	0.713			
2.0	0.750			
3.0	0.780			
4.0	0.815			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.14 m ²
9.0	0.910			
14.0	0.965			
19.0	1.005			
24.0	1.055			
29.0	1.095			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 21 min
34.0	1.120			
39.0	1.200			
				Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$
				$\text{Depth}_{(25\%)} = 1.0525$ $\text{Depth}_{(75\%)} = 0.758 \text{ m}$
				Soil infiltration rate = 9.9E-05 m/sec
				Remarks * Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

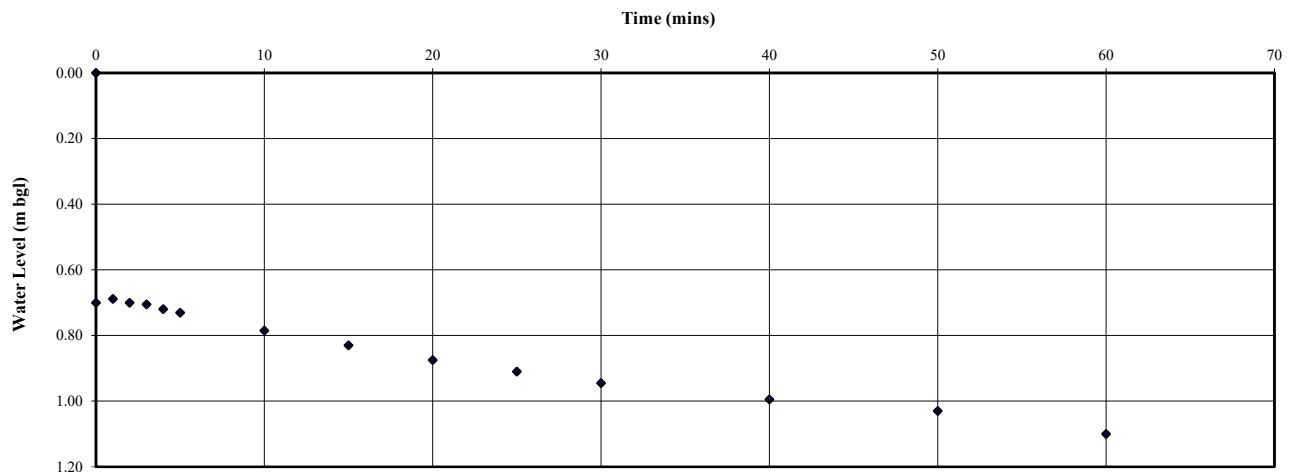
Date of Test: 18/10/18

Hole ID: SA3

Test No 2

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.50	0.60	1.20	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.27 m ³
0.0	0.700			
1.0	0.689			
2.0	0.700			
3.0	0.705			
4.0	0.720			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.14 m ²
5.0	0.730			
10.0	0.785			
15.0	0.830			
20.0	0.875			
25.0	0.910			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 30 min
30.0	0.945			
40.0	0.995			
50.0	1.030			
60.0	1.100			
				Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$
				Depth _(25%) = 1.0525 Depth _(75%) = 0.758 m
				Soil infiltration rate = 6.9E-05 m/sec
				Remarks * Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

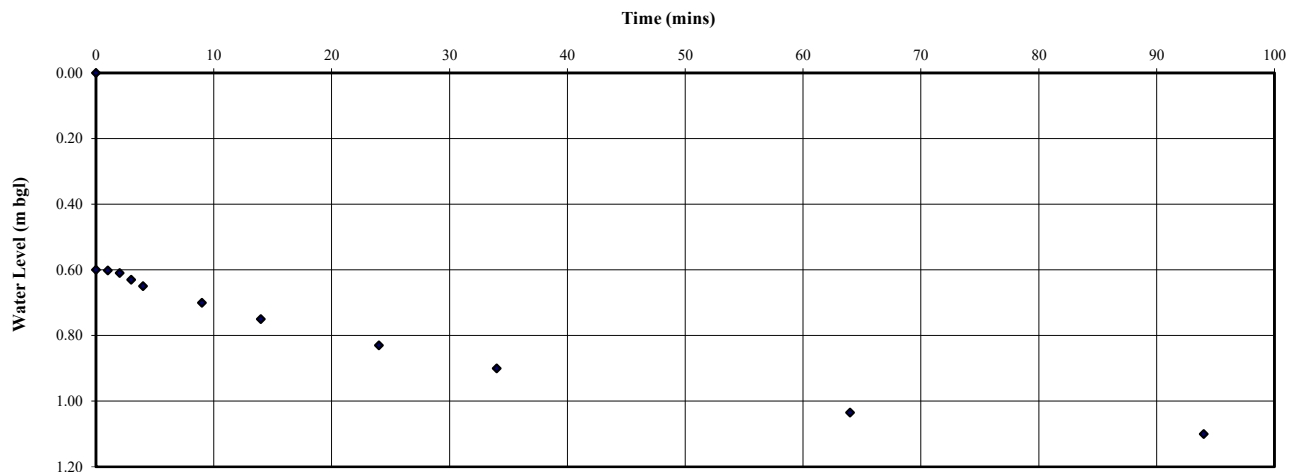
Date of Test: 18/10/18

Hole ID: SA3

Test No 3

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.50	0.60	1.10	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	Effective storage volume in trial pit $V_{(p75-25)}$ = between effective depths 25% to 75%. = 0.27 m ³	
0.0	0.600			Initial surface area of trial pit up to $a_{(p50)}$ = 50% effective depth and including the base area. = 2.14 m ²	
1.0	0.602				
2.0	0.610				
3.0	0.630				
4.0	0.650				
9.0	0.700			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 39 min	
14.0	0.750				
24.0	0.830				
34.0	0.900				
64.0	1.035				
94.0	1.100			Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$	
				Depth _(25%) = 0.9525	Depth _(75%) = 0.658 m
				Soil infiltration rate = 5.3E-05 m/sec	
				Remarks * Extrapolated soil infiltration rate	



SOAKAWAY TEST RESULTS

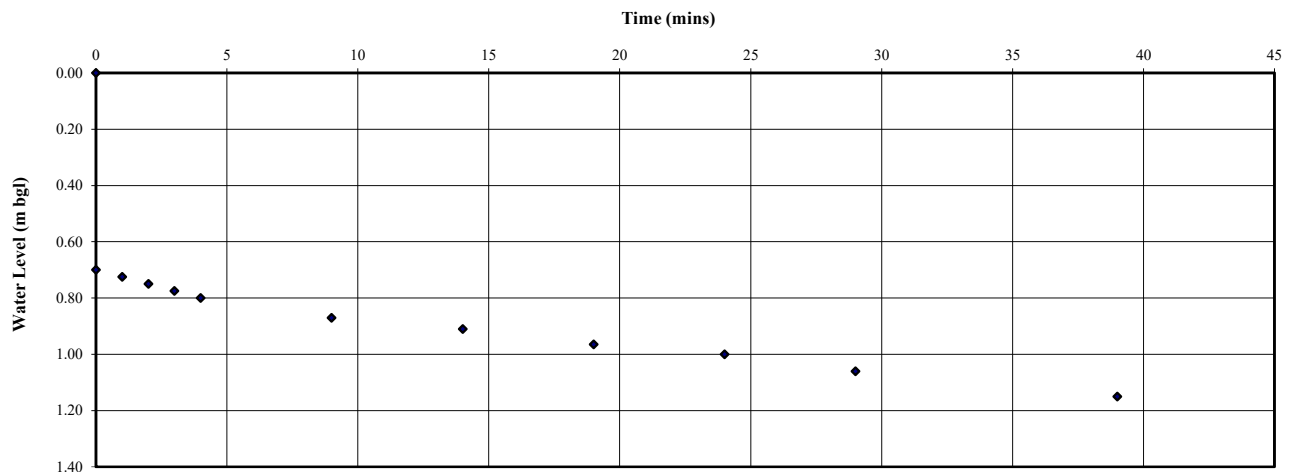
Date of Test: 18/10/18

Hole ID: SA4

Test No 1

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.50	0.60	1.20	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	Effective storage volume in trial pit $V_{(p75-25)}$ = between effective depths 25% to 75%. = 0.27 m ³	
0.0	0.700				
1.0	0.725				
2.0	0.750				
3.0	0.775			Initial surface area of trial pit up to $a_{(p50)}$ = 50% effective depth and including the base area. = 2.14 m ²	
4.0	0.800				
9.0	0.870				
14.0	0.910				
19.0	0.965			Time for the water level to fall from $t_{(p75-25)}$ = 75 % to 25% effective depth. = 25 min	
24.0	1.000				
29.0	1.060				
39.0	1.150				
				Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$	
				Depth _(25%) = 1.0525	Depth _(75%) = 0.758 m
				Soil infiltration rate = 8.3E-05 m/sec	
				Remarks * Extrapolated soil infiltration rate	



SOAKAWAY TEST RESULTS

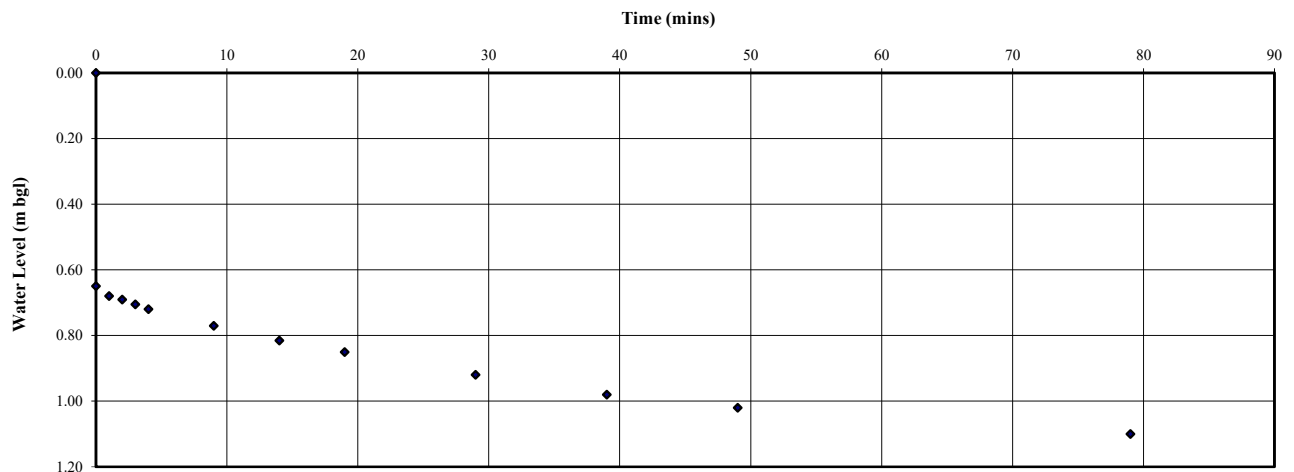
Date of Test: 18/10/18

Hole ID: SA4

Test No 2

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.50	0.60	1.20	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.27 m ³
0.0	0.650			
1.0	0.680			
2.0	0.690			
3.0	0.705			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.14 m ²
4.0	0.720			
9.0	0.770			
14.0	0.815			
19.0	0.850			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 33 min
29.0	0.920			
39.0	0.980			
49.0	1.020			
79.0	1.100			Soil infiltration rate = $\frac{.}{t_{(p75-25)} \times a_{(p50)} \times 60}$
				Depth _(25%) = 1.0525 Depth _(75%) = 0.758 m
				Soil infiltration rate = 6.3E-05 m/sec
				Remarks
				* Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

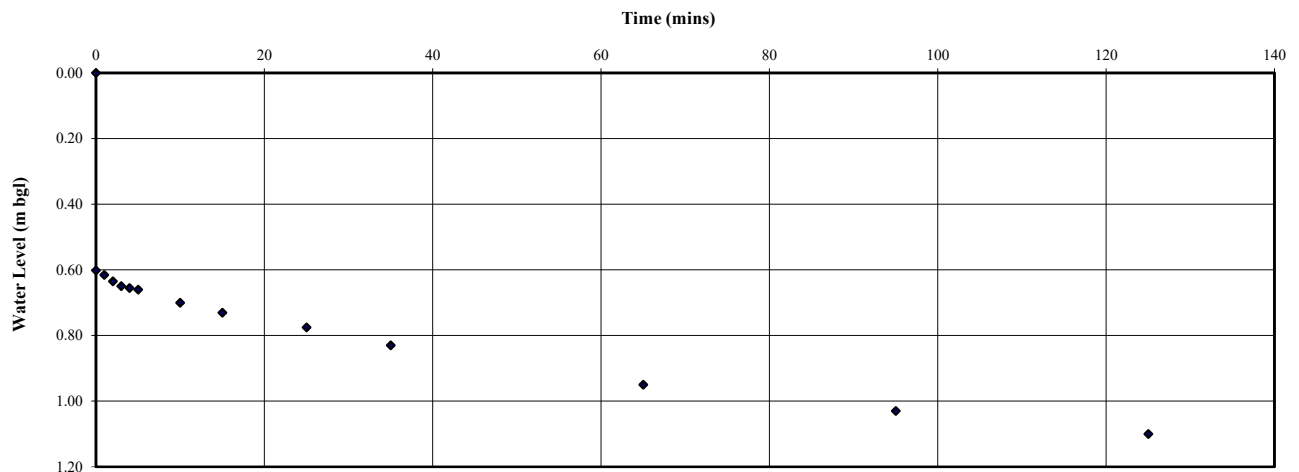
Date of Test: 18/10/18

Hole ID: SA4

Test No 3

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.50	0.60	1.20	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.27 m ³
0.0	0.602			
1.0	0.615			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.14 m ²
2.0	0.635			
3.0	0.650			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 60 min
4.0	0.655			
5.0	0.660			Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$
10.0	0.700			
15.0	0.730			$\text{Depth}_{(25\%)} = 1.0525$ $\text{Depth}_{(75\%)} = 0.758 \text{ m}$
25.0	0.775			
35.0	0.830			Soil infiltration rate = 3.4E-05 m/sec
65.0	0.950			
95.0	1.030			Remarks
125.0	1.100			
				* Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

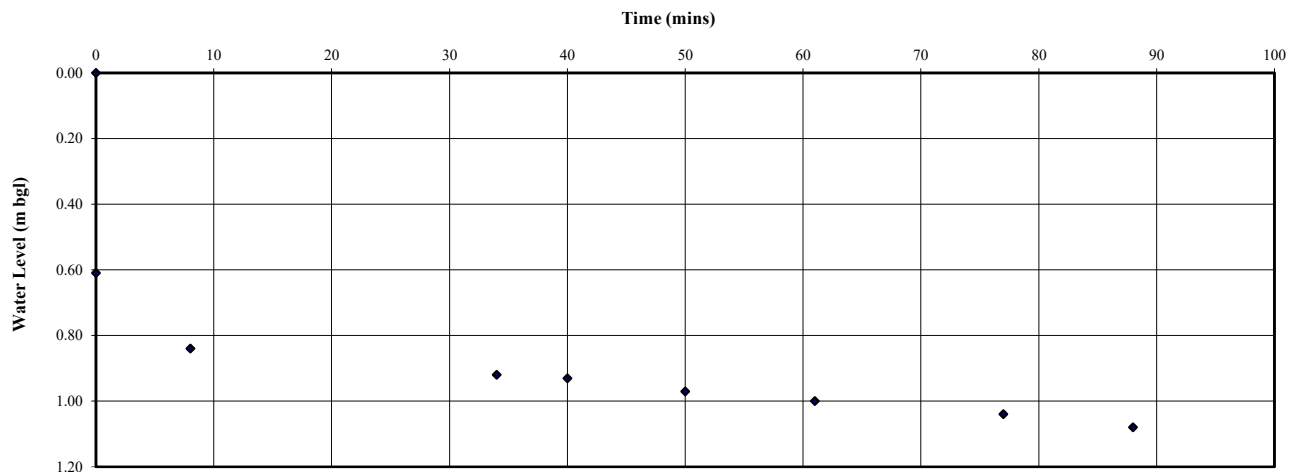
Date of Test: 19-10-18

Hole ID: SA5

Test No 1

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.80	0.60	1.18	0.60

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.32 m ³
0.0	0.610			
8.0	0.840			
34.0	0.920			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.52 m ²
40.0	0.930			
50.0	0.970			
61.0	1.000			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 66 min
77.0	1.040			
88.0	1.080			
				Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$
				$\text{Depth}_{(25\%)} = 1.03$ $\text{Depth}_{(75\%)} = 0.730 \text{ m}$
				Soil infiltration rate = 3.2E-05 m/sec
				Remarks * Extrapolated soil infiltration rate



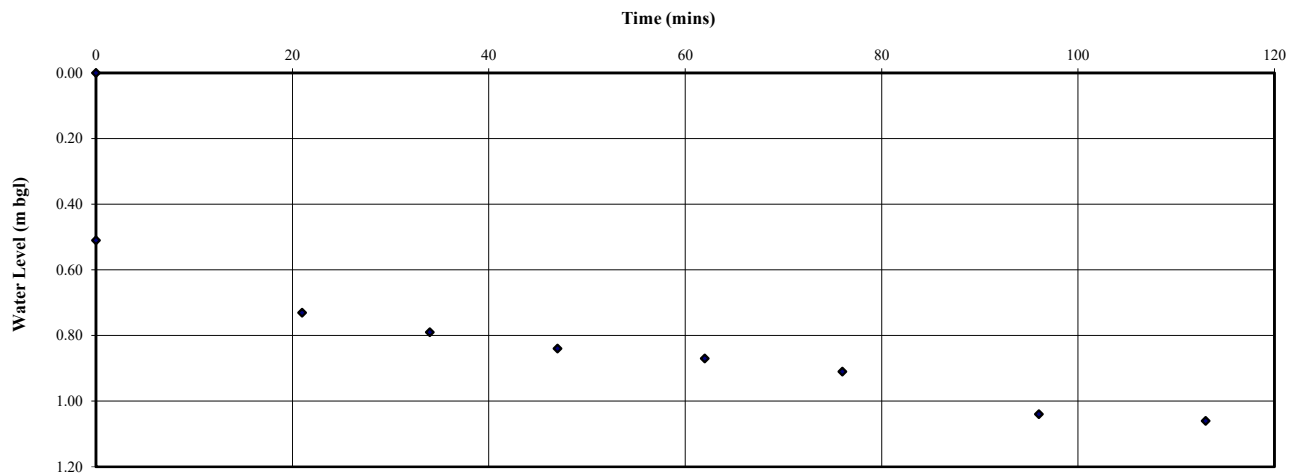
SOAKAWAY TEST RESULTS

Date of Test: 19-10-18

Hole ID: SA5

Test No 2

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.80	0.60	1.18	0.55

[illegible]

SOAKAWAY TEST RESULTS

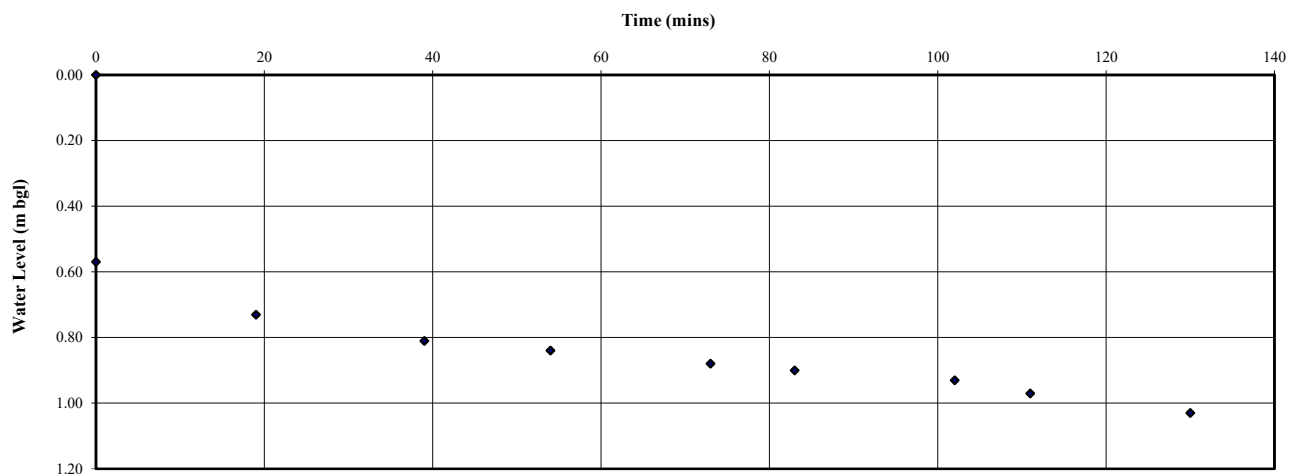
Date of Test: 19-10-18

Hole ID: SA5

Test No 3

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.80	0.60	1.18	0.57

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.31 m ³
0.0	0.570			
19.0	0.730			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.45 m ²
39.0	0.810			
54.0	0.840			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 101 min
73.0	0.880			
83.0	0.900			Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$
102.0	0.930			
111.0	0.970			$\text{Depth}_{(25\%)} = 1.0375$ $\text{Depth}_{(75\%)} = 0.753 \text{ m}$
130.0	1.030			
				Soil infiltration rate = 2.1E-05 m/sec
				Remarks * Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

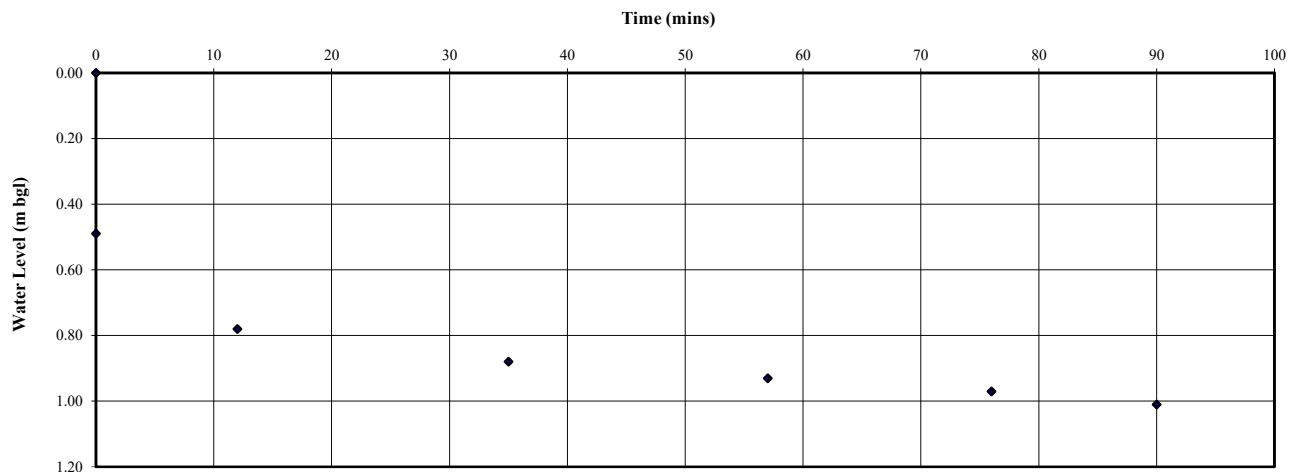
Date of Test: 19-10-18

Hole ID: SA6

Test No 1

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	2.00	0.60	1.10	0.77

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	Effective storage volume in trial pit between effective depths 25% to 75%. $V_{(p75-25)} =$ = 0.46 m ³	
0.0	0.490			Initial surface area of trial pit up to 50% effective depth and including the base area. $a_{(p50)} =$ = 3.20 m ²	
12.0	0.780				
35.0	0.880				
57.0	0.930				
76.0	0.970				
90.0	1.010				
				Time for the water level to fall from 75 % to 25% effective depth. $t_{(p75-25)} =$ = 53 min	
				Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$	
				Depth _(25%) = 0.9075	Depth _(75%) = 0.523 m
				Soil infiltration rate = 4.5E-05 m/sec	
				Remarks * Extrapolated soil infiltration rate	



SOAKAWAY TEST RESULTS

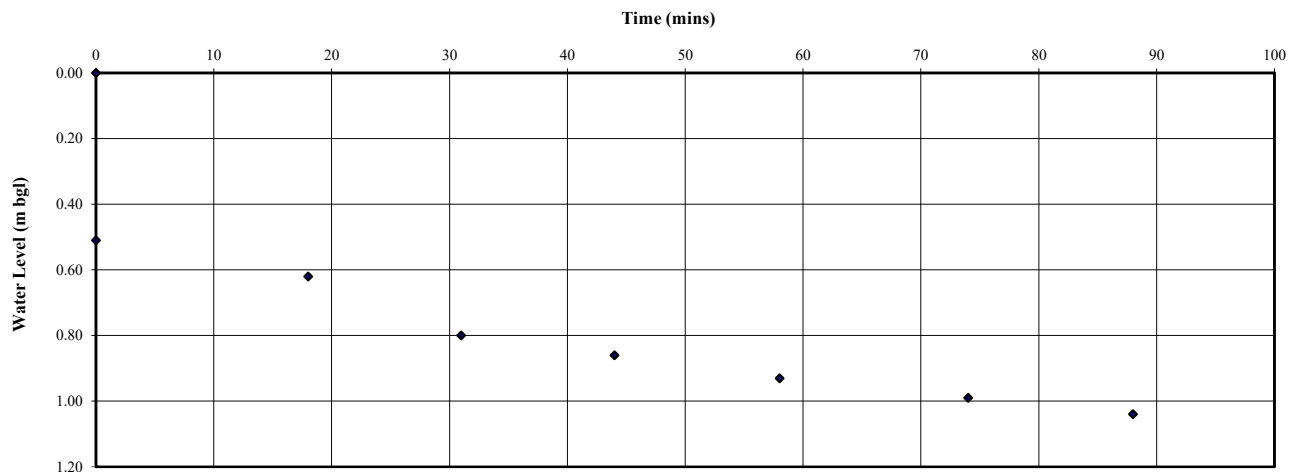
Date of Test: 19-10-18

Hole ID: SA6

Test No 2

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	2.00	0.60	1.10	0.58

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.35 m ³
0.0	0.510			
18.0	0.620			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.71 m ²
31.0	0.800			
44.0	0.860			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 45 min
58.0	0.930			
74.0	0.990			Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$
88.0	1.040			
				$\text{Depth}_{(25\%)} = 0.955$ $\text{Depth}_{(75\%)} = 0.665 \text{ m}$
				Soil infiltration rate = 4.8E-05 m/sec
				Remarks * Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

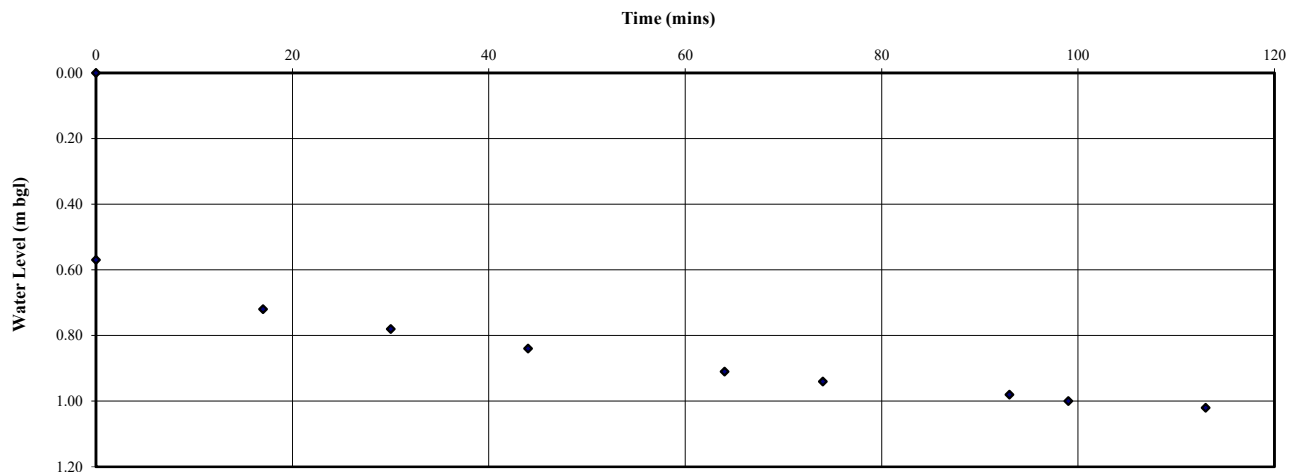
Date of Test: 19-10-18

Hole ID: SA6

Test No 3

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	2.00	0.60	1.10	0.64

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	Effective storage volume in trial pit between effective depths 25% to 75%. $V_{(p75-25)} =$ = 0.38 m ³	
0.0	0.570			Initial surface area of trial pit up to 50% effective depth and including the base area. $a_{(p50)} =$ = 2.86 m ²	
17.0	0.720				
30.0	0.780				
44.0	0.840				
64.0	0.910				
74.0	0.940			Time for the water level to fall from 75 % to 25% effective depth. $t_{(p75-25)} =$ = 65 min	
93.0	0.980				
99.0	1.000				
113.0	1.020			Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$	
				Depth (25%) = 0.94	Depth (75%) = 0.620 m
				Soil infiltration rate = 3.4E-05 m/sec	
				Remarks * Extrapolated soil infiltration rate	



SOAKAWAY TEST RESULTS

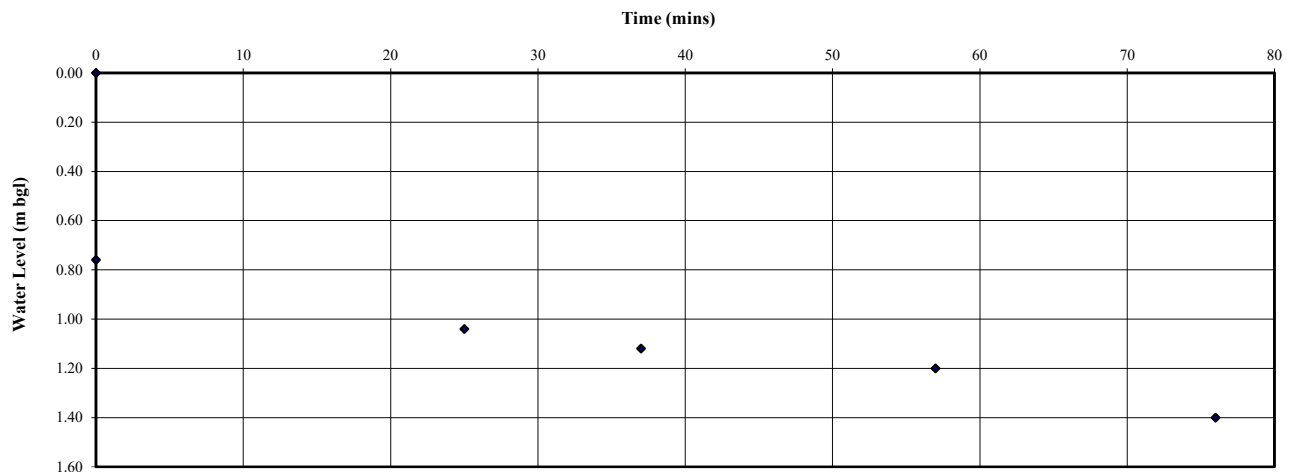
Date of Test: 19-10-18

Hole ID: SA7

Test No 1

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.60	0.60	1.40	0.70

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	Effective storage volume in trial pit between effective depths 25% to 75%. $V_{(p75-25)} =$ = 0.34 m ³	
0.0	0.760			Initial surface area of trial pit up to 50% effective depth and including the base area. $a_{(p50)} =$ = 2.50 m ²	
25.0	1.040				
37.0	1.120				
57.0	1.200				
76.0	1.400				
				Time for the water level to fall from 75 % to 25% effective depth. $t_{(p75-25)} =$ = 50 min	
				Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$	
				Depth (25%) = 1.225	Depth (75%) = 0.875 m
				Soil infiltration rate = 4.5E-05 m/sec	
				Remarks * Extrapolated soil infiltration rate	



SOAKAWAY TEST RESULTS

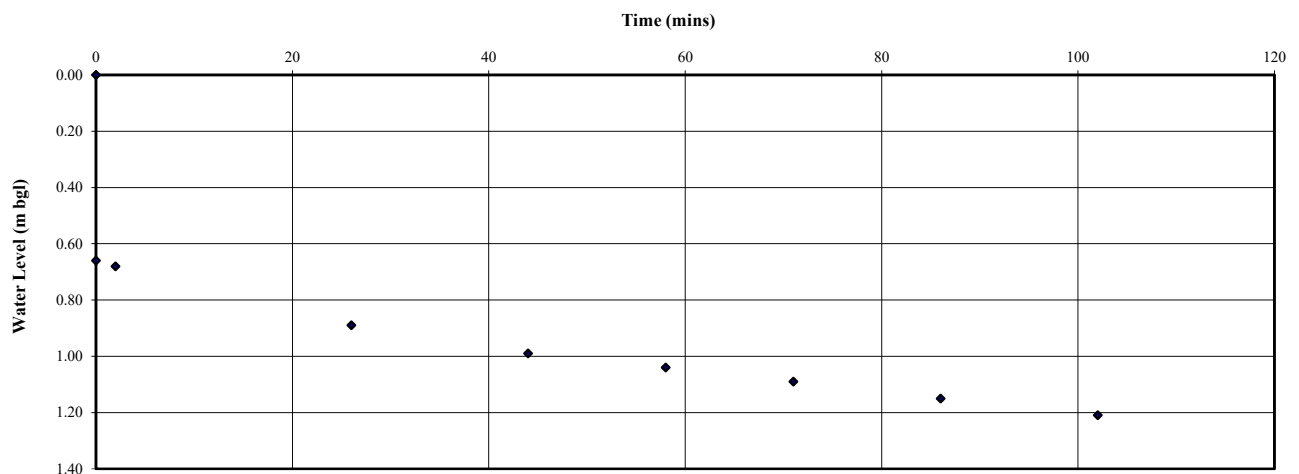
Date of Test: 19-10-18

Hole ID: SA7

Test No 2

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.60	0.60	1.40	0.53

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	$V_{(p75-25)}$ = Effective storage volume in trial pit between effective depths 25% to 75%. = 0.25 m ³
0.0	0.660			
2.0	0.680			$a_{(p50)}$ = Initial surface area of trial pit up to 50% effective depth and including the base area. = 2.13 m ²
26.0	0.890			
44.0	0.990			$t_{(p75-25)}$ = Time for the water level to fall from 75 % to 25% effective depth. = 62 min
58.0	1.040			
71.0	1.090			Soil infiltration rate = $\frac{.}{t_{(p75-25)} \times a_{(p50)} \times 60}$
86.0	1.150			
102.0	1.210			$\text{Depth}_{(25\%)} = 1.2675$ $\text{Depth}_{(75\%)} = 1.003 \text{ m}$
				Soil infiltration rate = 3.2E-05 m/sec
				Remarks * Extrapolated soil infiltration rate



SOAKAWAY TEST RESULTS

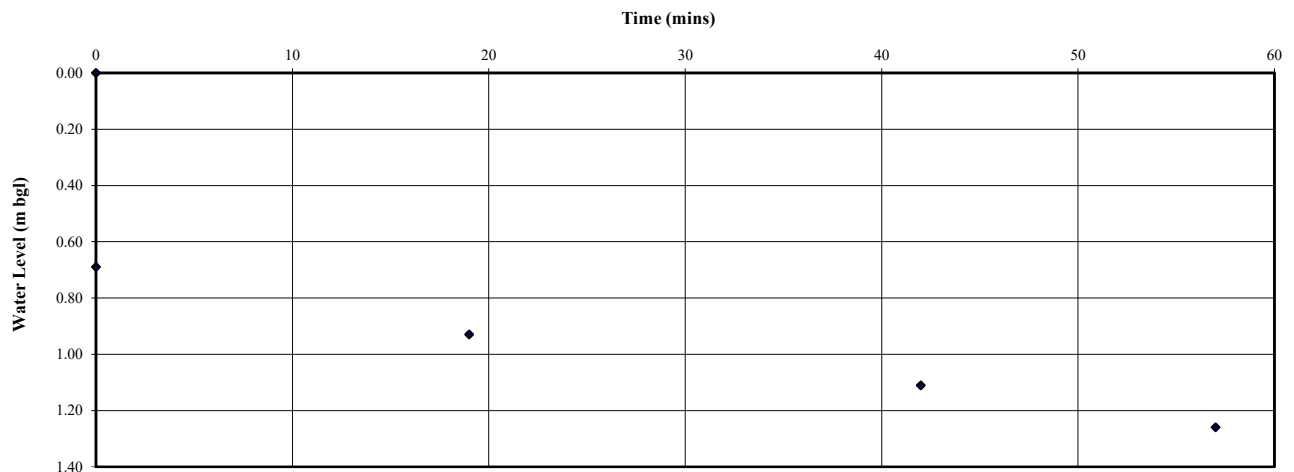
Date of Test: 19-10-18

Hole ID: SA7

Test No 3

Trial Pit Dimensions (m)	Length	Width	Depth	Depth for Analysis
	1.60	0.60	1.40	0.59

Time (mins)	Depth of water (m bgl)	Time (mins)	Depth of water (m bgl)	Effective storage volume in trial pit between effective depths 25% to 75%. $V_{(p75-25)} =$ = 0.28 m ³	
0.0	0.690			Initial surface area of trial pit up to 50% effective depth and including the base area. $a_{(p50)} =$ = 2.26 m ²	
19.0	0.930				
42.0	1.110				
57.0	1.260				
				Time for the water level to fall from 75 % to 25% effective depth. $t_{(p75-25)} =$ = 29 min	
				Soil infiltration rate = $\frac{V_{(p75-25)}}{t_{(p75-25)} \times a_{(p50)} \times 60}$	
				Depth _(25%) = 1.2525	Depth _(75%) = 0.958 m
				Soil infiltration rate = 7.2E-05 m/sec	
				Remarks * Extrapolated soil infiltration rate	



APPENDIX L

(i) Local Authority Response

Beverley Lewis
Betts Geo Associates
Old Marsh Farm Barns
Welsh Road
Sealand
Flintshire CH5 2LY

Eich Cyf/Your Ref
Ein Cyf/Our ref
Dyddiad/Date
Gofynner am/Ask for
Rhif Cyswllt/Contact No
E-bost/E-mail

Land at Holt Road
Search 767
07 September 2018
Helen Bradshawe
01978 298 774
Helen.Bradshawe@wrexham.gov.uk

Dear Beverley,

RE: Land at Holt Road, Wrexham

Thank you for your environmental search query and payment in relation to the above property. I can provide you with the following comments.

This Authority does not yet have a comprehensive database regarding historic land use or contamination. However, the information available to the Contaminated Land Team confirms that there is a landfill known as Llan-y-pwll adjacent to the site on the eastern boundary. The site was a former sand and gravel pit. This landfill was historically operated by WCBC as a domestic waste landfill site between 1984 and 1988. The site was constructed as three separate lined cells and was provided with a leachate collection system. On completion the site was progressively provided with a clay cap with final restoration being completed in 1994. The site was restored to open space grazing land although it is not in use as grazing land and there is now no authorised public access to the site.

The surrounding area is rural with residential properties (Hillside Farm and Smithy Cottages) located within 50m to the north/northeast. A concrete batching plant (Hanson) is located to the immediate northwest located within a residual unfilled area of the former quarry. A soakaway, for the collection of overflow from the settlement tanks at the concrete batching plant is located to the rear of the gas extraction rig.

The site comprised 3 containment cells commissioned in phases between 1984 and 1986. SGP advised wastes are 18-20m deep (no final completion drawings to confirm; information inconsistent with groundwater borehole heights). All the cells were provided with a Vorclay bentonite liner (placed as a 100mm thick layer with 100mm seal). Permeability tests showed the liner was 1×10^{-8} – 1×10^{-10} m/s in each cell.

Each cell was provided with a leachate collection chamber draining to a central collection chamber in Cell 3 (MH3). A leachate pumping chamber was retrospectively installed in 1990 and connected to MH3. The chamber is located in the unfilled land to the immediate northwest of the landfill (close to the site access and concrete batching plant). The leachate drains under gravity into the pumping chamber – there is no in-situ pump. Information held on file indicates the base of the cells to be ~1m above the

Groundwater table. The sump in the main leachate pumping chamber is below the groundwater table.

An active gas extraction system was not installed on site as part of the original construction. Following the detection of high levels of methane in the leachate manholes and BH2 (on southern boundary) in 1988 it was concluded that the bentonite liner was permeable to gas. An active gas extraction system was installed on site by UKPS Ltd in 1993 – 1994. The system comprises 12 wells with interconnecting pipework along with a gas extraction / flare unit. A digital recorded data logger was installed to record the flare stack temperature, times of motor running and methane concentrations by Initial Project Ltd (successors to UPS) in 1999. A pumped condensate system was installed in 1995 which drains to the main leachate chamber. A new surface water drainage system was installed at the site (within the low lying area incorporating the central leachate chamber and gas extraction flare system). This is designed to direct run-off from the slopes and access track to a new soakaway to prevent the entry of rainwater into the central leachate chamber and to reduce ponding within this area. The seep on the northern slope was directed separately to the central leachate chamber for off-site disposal. A new flare was installed in 2009. The unit runs 8hrs / day and is on automatic cut out if there is insufficient gas. The unit is currently checked on a weekly basis by Uniflare.

The site has since been subject to a number of investigations since 2005, under Part 2A of the Environmental Protection Act 1990.

The residual presence of infilled materials on site may form an ongoing source of contamination. The previous investigations identified leachate break-out resulting in pollution of the groundwater within the alluvial aquifer close to the site primarily comprising total ammonia, chloride, COD and zinc.

Summary of Part 2A Assessment for Controlled Waters¹

	Statutory Guidance Condition1	Comment
4.38 a)	pollution equivalent to 'environmental damage'	Unlikely
4.38 b)	inputs resulting in deterioration of quality of water abstracted for human consumption	Unlikely
4.38 c)	breach of statutory surface water EQS	reasonably possible, minor exceedances have occurred, but can not be directly attributed to the landfill – further investigation / assessment recommended
4.38 d)	input resulting in significant and sustained upward trend in concentration of contaminants	Unlikely
4.39	significant concentration of hazardous / non-hazardous pollutants in groundwater	reasonably possible – further investigation / assessment recommended
	significant concentrations of priority, hazardous, priority substances or other specific polluting substances in surface water	reasonably possible – further investigation / assessment recommended

1: For full details of the conditions reference should be made to the Statutory Guidance

It was concluded that it remained possible that significant pollution of controlled waters was being caused with regards to entry of pollutants into the groundwater or a significant possibility for significant pollution of controlled waters was reasonably possible (category 2/3) should a plume of contamination be migrating towards the spring-line.

However, there is no current breach of EQS and no likelihood of future breach of EQS for chloride at the spring's compliance point. With respect to ammonia, there have been minor breaches of the EQS at the springs and receiving watercourse, part of which may be attributable to Llanypwll landfill leachate, although other sources are also implicated.

Landfill gas had been detected on the site perimeter to a maximum of 59% methane including on the northern site boundary in proximity to housing along with corresponding elevated carbon dioxide (max. 35%) and depleted oxygen (min. 0%). The elevated levels of landfill gas on the boundary were indicative of a moving front associated with operation of the extraction system. Elevated levels of gas were also detected on the southern and southwestern boundaries. Elevated levels of methane and carbon dioxide, with depleted oxygen, were detected in wells to the north of the site (to a maximum of 14.8% methane). The raised levels corresponded with periods of low and falling atmospheric pressure. The improvement works undertaken at the site with regards to the flare and gas extraction system in 2009 have been successful in controlling the off-site migration of landfill gas towards the nearby housing. However, it is noted that elevated ground gas concentrations continue to be identified on the site's northern perimeter, although levels are reduced in the northeast corner closest to the housing, and are lower than pre-2009 concentrations in all wells.

On the basis of the on-going effective operation and management of the gas extraction system and flare the **potential for a significant possibility for significant harm to exist is considered *unlikely (Category 3)***. However, in the event of a failure or malfunction of the system **the potential for a significant possibility for significant harm to exist associated with ground gas migration is considered *reasonably possible / likely (Category 2 /3)***.

Landfill ground gas is continued to be monitored on a monthly basis and leachate and surface water monitoring is undertaken every 6 months.

The area to the north of Holt Road, known as Borrass Airfield was previously a sand and gravel quarry that has been reclaimed. Our limited records indicate that material was brought onto the sand and gravel quarry for reclamation, however we do not have any records detailing the type of material that the land was infilled with and whether it has the potential to generate methane.

If you require any further information, please do not hesitate to contact me.

Yours sincerely



Helen Bradshawe
Contaminated Land Officer