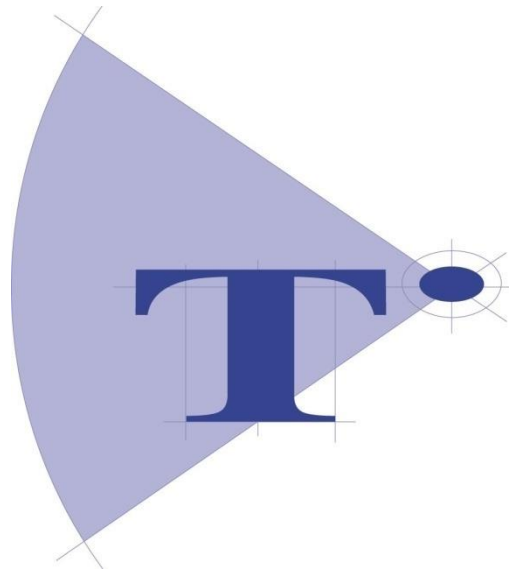




A GROUND INVESTIGATION REPORT OF LAND OFF NEW ROAD, RHOSROBIN

ISSUE 1.1

TE1239GIR

28 NOVEMBER 2019

DRAFT

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DOCUMENT CONTROL

Project No.: TE1239GIR
Report Status: DRAFT
Issue No.: 1.1
Project Engineer: Eve Rowland
Date of Issue: 28/11/2019
Signature:



Eve Rowland MEng (Hons)

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Issue No.	Description of Issue / Revision	Date of Issue	Reviewed By	Author
1.0	Draft	01/11.2019	Sean Lee	Eve Rowland
1.1	Draft. Awaiting further Gas and Groundwater monitoring results.	28/11/2019	Sean Lee	Eve Rowland



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EXECUTIVE SUMMARY

Introduction	Tier Environmental was commissioned by Liberty Properties Ltd to undertake a Ground Investigation of Land off New Road at Rhosrobin, Wrexham. The purpose of the investigation was to determine the nature and extent of soil, bedrock and groundwater beneath the site for the purposes of environmental and geotechnical assessment and the permeability of the soil and rock beneath to determine the suitability of soakaway implementation.
Site location	The site is located between New Road and Plas Acton Road, Rhosrobin, Wrexham, LL14RB
Site history	The Site has comprised agricultural land since the earliest Ordnance Survey plans with Watts Dyke crossing the Site, 2 No. unspecified buildings, land drain, footpath and a potentially infilled pond. Pertinent off-site features have included a railway line, collieries, iron works, depots and potentially infilled sand pits/ponds/shafts/brick fields.
Fieldwork	Fieldwork was undertaken by a suitably qualified Tier Environmental Geoenvironmental Engineer on 24th September to 27th September 2019 and comprised the advancement of: - Excavation of 20 No. hand excavated pits to a target depth of 1.20m bgl for service clearance purposes (WS01 to WS18); - Advancement of 20 No. window sample boreholes (WS01 to WS20) to a maximum depth of 4.45m bgl to determine shallow ground conditions, enable <i>in situ</i> geotechnical testing, obtain environmental and geotechnical samples for laboratory analysis and install 8 No. combined monitoring wells for both gas and groundwater monitoring purposes (WS06, WS07, WS08, WS09, WS10, WS10a, WS14 and WS17, WS19 and WS20); 18 No. machine excavated trial pits (TP01 to TP018) to a maximum depth of 3.00m to determine the nature and extent of shallow ground conditions, obtain environmental samples for laboratory analysis. 7 No. Machine excavated soakaway pits (SW01 to SW05, SW07 and SW09) to undertake infiltration testing for the suitability of soakaways on the Site. - A total of 30 No. DCPs to determine the approximate <i>in situ</i> CBR Values across the site for highway design. Previous fieldwork was undertaken by Tier Environmental between April and June 2016 included 6 No. window sample boreholes and 4 No. soakaway pits.
Laboratory testing	Samples of soil, soil leachate and groundwater were submitted for analysis of a range of metal, other inorganic and organic components. Geotechnical testing was scheduled on selected samples. All testing was undertaken at accredited laboratories.
Ground conditions	Made Ground was not encountered across the majority of the site. Made Ground comprising sand with coal, brick, glass, whole glass bottles and ceramic was locally encountered within TP03 in the vicinity of a possible infilled pond. Made Ground, generally comprising reworked clay with fragments of brick, was locally encountered, mainly within the western area of the residential development area. The natural ground is highly variable across the Site, comprising of a mixture of granular and cohesive Till and Glaciofluvial Sheet Deposits.
Ground stability	The Site is not considered to be in an area at risk of unacceptable settlements resulting from past mining or other extractive industries
Foundations and floor slabs	The majority of the proposed residential plots should be suitable for standard and/or widened reinforced strip footings. Production of a foundation zonation plan will require additional intrusive ground investigation once the development layout has been finalised. In areas where made ground is evident, ad subject to the development plan, reinforced strips placed on vibro stone columns may be a more optimum solution rather than deep strip foundations. The foundations should be engineered in respect to their proximity to trees.
Sulphate class	Based on chemical results; a Design Class of DS-1 and ACEC Class of AC-1 should be used for shallow buried concrete structures on site.
Contamination	After initial screening against the relevant GACs, no measured concentrations of metals, metalloids, PAHs or hydrocarbons have been reported in excess of the respective GACs for a residential land use. Of the 12 No. samples that were screened for asbestos, none were found to contain asbestos fibres. It is therefore considered that the Made Ground, Topsoil and natural soils are not considered to present a potential risk to human health for a residential with home grown produce land use.



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	It is recommended, however, that a minimum 600mm of suitable growing medium/soils be placed within proposed soft landscaped areas in the vicinity of TP103 where glass was identified within the Made Ground. These soils could be derived on site from foundation and/or drainage arisings, negating the requirement to import clean cover. No risks to controlled waters have been identified.
Gas protection	On the basis of 2 No. gas and groundwater monitoring visits undertaken to date, a Characteristic Situation 1 -Very Low Risk has been determined for the Site, for which no basic ground gas protection measures are required in accordance with BS8485:2015+A1:2019 and <u>as detailed in Section 8.5 of this report.</u>
Radon Requirements	Radon protection measures are required at this Site.
Waste Soils Classification	Basic waste characterisation has demonstrated that Made Ground 1 is <u>not suitable</u> for disposal at a hazardous landfill and would require treatment prior to disposal. The natural soils present are suitable for disposal at an inert landfill site and Made Ground 2 is suitable for disposal at a non-hazardous landfill site



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1. INTRODUCTION

Tier Environmental was commissioned by Liberty Properties Ltd to undertake a Ground Investigation Report for an area of land referred to as land off New Road at Rhosrobin, located between New Road and Plas Acton Road, Rhosrobin, Wrexham, LL114RB (the "Site").

It is understood that the Site is to be redeveloped as residential housing with associated soft landscaping, adoptable highways, drainage and infrastructure.

Taking into account the planned future use of the Site, the objectives of this appraisal were:

- To summarise the land use history and environmental setting of the Site from review of available historical documentation and maps (provided in the previous Tier Environmental PRA).
- To determine soil and groundwater conditions, including whether significant contamination has resulted from past or current land use(s).
- To determine the potential risks posed by any ground contamination and provide recommendations on remedial measures to manage such risks.
- To determine risks posed to the Site from hazardous ground gases.
- To evaluate whether past mining or other extractive industries could have an influence on the Site.
- To provide advice relating to geotechnical issues associated with the Site.
- To provide foundation recommendations.
- To provide an initial waste soils classification.
- To provide an initial understanding of the suitability of soakaways on Site.

The desk-study part of this investigation included the assessment of information provided by Tier Environmental (previous site work), GroundSure, BGS and The Coal Authority. The information provided by these organisations is provided in Appendix O.

This report, which was designed to meet the requirements of all relevant current guidance including CLR 11 and Land Contamination: Risk Management, presents the factual information available during this appraisal, interpretation of the data obtained and recommendations relevant to the defined objectives.

It has been assumed in the production of this report that the Site is to be developed for residential land use. In addition, it is assumed that ground levels will not change significantly from those described in this report. If this is not the case, then amendments to the recommendations made in this report may be required.

Where the report refers to the potential presence of invasive plants (such as Japanese Knotweed) or asbestos-containing materials, such observations are for information only and should be verified by a suitably qualified expert.



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The comments and opinions presented in this report are based on the findings of the previous desk study and ground conditions encountered during intrusive investigation works performed by Tier Environmental and the results of tests carried out within one or more laboratories. There may be other conditions prevailing on the Site which have not been revealed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for any conditions not revealed by this investigation. Any diagram or opinion on the possible configuration of the findings is conjectural and given for guidance only. Confirmation of intermediate ground conditions should be undertaken if deemed necessary.

This report has been prepared for the sole use of Liberty Properties Ltd. No other third party may rely upon or reproduce the contents of this report without the written approval of Tier Environmental. If any unauthorised third party comes into possession of this report, they rely on it entirely at their own risk and the authors do not owe them any Duty of Care or Skill.



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2. SITE DETAILS AND DESCRIPTION

Table 2.1. Current Site Overview.

Site name	Land at Rhosrobin.
Site address	Land between New Road and Plas Acton Road, Rhosrobin, Wrexham, LL114RB. A site location plan is included as Drawing No. TE1239GIR2 within Appendix A.
National Grid Reference	333268,352799.
Location description	The Site is located on the north-western edge of a large residential area (Wrexham) with agricultural land and smaller residential areas to the north (Pandy) and west (New Rhosrobin). The Site is approximately 2.4km north of Wrexham Central Station.
Approximate Site area	15.87ha.
Site shape	The Site is broadly rectangular getting gradually wider as you move north.
General topography and ground levels	The topography across the site is gently undulating with localised depressions and highs; however, the general trend of the topography is rising from between 83.00m AOD in the northwest of the Site and 84.50m AOD in the northeast of the Site to 93.50m AOD in the southwest of the Site and 97.00m AOD in the southeast of the Site. The railway line which runs along the entire western boundary of the Site is approximately 2m below the level of the Site.
Current land use	The Site currently comprises agricultural land; the northwest of the Site is currently utilised for arable crops (grass) and the remainder of the Site is utilised for livestock (horses).
Existing structures	2 No. power lines cross the Site approximately northwest to southeast, with 2 No. branches connecting to the west located in the northwest of the Site and the southwest of the Site. There are several fence lines across the Site associated with the Sites current use as agricultural fields. A bund feature of archaeological interest (Watts Dyke) is present in the north of the Site. The remains of a metal frame of a building located in the southeast of the Site.
Site ground surfaces	The majority of the Site is covered in grass with numerous trees, shrubs and bramble thickets. A discrete area of compacted gravel is present in the southeast of the Site associated with a vehicle access point connecting to New Road.
Sub-surface structures	Foundations associated with previous building located in the south of the Site. A manhole has been identified in the centre east of the Site. Additional unrecorded services should be anticipated.
Invasive plant species	Not noted during the Site walkover. A specialist survey is recommended to confirm the absence of invasive species.

The main Site features are shown on Drawing No. TE1239GIR2 within Appendix A. Relevant Site photographs are presented in Appendix D.



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3. PREVIOUS INVESTIGATION FINDINGS

Investigations pertaining to this Site have previously been undertaken, a summary of which is provided below. The corresponding logs, falling head and soakaway results are presented in Appendix P.

3.1. “Outline Approval For Residential Development. Land Off New Road, Rhosrobin, Wrexham” - Wrexham Borough Council, 17th October 2013.

This pre-application response letter (ref: ENQ/2013/0337, dated 17/10/2013) covers the entirety of the site under investigation in this report. The letter highlights, amongst others, the following 4 No. salient points:

- A pond has been infilled on site with unknown and potentially contaminative materials;
- The site lies outside of the settlement boundary of the UDP and within a designated green barrier;
- The site comprises Grade 3a agricultural land; and,
- An archaeological feature of interest (Watts Dyke) is present across the site.

3.2. “Phase 1 Tree Survey & Preliminary Tree Constraints / Impact Assessment Plan” - Tree Solutions, 12th August 2014.

This tree survey report (Ref: 14/AIA/WXM/150 dated 12/08/2014) covers the entire site under investigation in this report. The report identifies numerous early mature and mature species of tree to be present across the site and along the site boundaries, including oak, willow, sycamore, field maple, ash, alder, elm, hawthorn, beech, maple, lime, hazel, holly and blackthorn.

An updated tree survey is recommended so that foundations for the proposed development can be designed in accordance with NHBC Standards Chapter 4.2.

3.3. “Agricultural Land Quality Report” - Fisher German LLP, 12th August 2014.

The agricultural land quality report (ref: 22359 dated 12/08/2014) was undertaken across the entire site under investigation in this report.

The study and survey of the circa 40 acres of land situated in Rhosrobin indicated that the land was part of permanent pasture and grazed by horses and part temporary grass leys.

The site is covered in the main by a light loamy textured soil with low natural fertility. The inspection confirmed that soil type becomes heavier towards New Road (southern boundary of the Site).

A manhole was found approximately in the location of sample point 32, the purpose of which was undetermined; however, the presence of underground pipes poses some restrictions on some agricultural operations.



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The whole site was classified as Grade 2 under the MAFF Land Classification Maps. However, if re-surveyed, it was felt that a Land Grade of 3B would be more suitable. It is felt that based on the location, physical restrictions and soil type that the Grade 2 and 3A definitions do not fit within the parameters of what the land can produce.

3.4. Tier Preliminary Risk Assessment

A Preliminary Risk Assessment (PRA) was previously undertaken for the Site in 2014. It is not the intention of this ground investigation report to repeat the information contained within the previous PRA; however, for ease of reference, the salient points are summarised in Table 3.1 below.

Table 3.1. Summary Table of the Previous Tier PRA (T.14.1400.PRA)

Background	
Site history	The Site has comprised agricultural land with Watts Dyke crossing the Site, 2 No. unspecified buildings, land drain and footpath and a potentially infilled pond. Pertinent off-site features have included a railway line, collieries, iron works, depots and potentially infilled sand pits/ponds/shafts/brick fields.
Geology	Localised deposits of Made Ground are present on the Site, along with a potentially infilled pond. BGS maps show that Glacial Till is present in the centre of the Site and Glaciofluvial Sheet deposits are present in the northeast and south of the Site. The Site is underlain by the Salop Formation in the northeast (mudstone, sandstone and conglomerate) and the Halesowen Formation in the southwest (mudstone, siltstone and sandstone).
Mining and Quarrying	The Site is located in a coal mining area, with seams and shafts within the vicinity of the Site. However, the Coal Authority stated that any ground movement associated with these coal workings should have ceased.
Hydrogeology	The Site is located upon An Unproductive Aquifer (Glacial Till) and two Secondary A Aquifers (Glaciofluvial Sheet Deposits and bedrock). There are no recorded abstractions or Source Protection Zones on the Site.
Hydrology	The River Alyn is located 330m northwest of the Site and pond present on Site. The Site is not located within 250m of a Zone 2 or Zone 3 flood zone.
Ecological features	The Site is within a designated green barrier - Wrexham Borough Council (October 2013). Ancient and Semi-Natural Woodland within a 500m radius of the Site with numerous early mature and mature deciduous trees on Site.
Landfill and waste management	None present on site however recorded landfills within a 500m radius of the Site. Therefore, a ground gas risk assessment is required.
Locally potentially contaminative activities	Numerous off-site facilities are present within a 500m radius of the Site that could be potentially contaminative.
Potential Soil and Groundwater Contamination	It was considered that possible metal, PAH, phenol, sulphate, asbestos and TPH contamination may be present on Site based on the historical uses and surrounding land uses. Overall the risks to human health were Moderate and the risks to controlled waters are considered to be Moderate/Low.
Radon risk	The development is within a radon affected area therefore radon protection will be required as described in publication BR211.

3.5. Tier Soakaway Testing

A total of 4 No. soakaway tests were conducted in previous site work conducted by Tier Environmental on 18th April 2016. The pits were to depths of between 1.55m (SA1 and SA2) and 2.00m bgl (SA4). The infiltration rates within SA1 to SA3 were observed to be so low that a suitable infiltration rate could not be calculated. Test location SA4 was reported to have an infiltration rate of 1.127×10^{-4} m/s and was noted to have a much higher natural sand content. The full results are presented in Appendix P.



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3.6. Tier Falling Head Testing

A total of 6 No. Window Sample Boreholes (WS1 to WS6) to depths of between 2.20m and 5.50m bgl in order to undertake falling head tests to determine a coefficient of permeability of the natural ground were undertaken on 20th June and 21st June 2016. The results are summarised in Table 3.2 below.

Table 3.2. Summary of Tier Falling Head Tests (2016).

Borehole ID	Response Zone Depth	Response Zone Strata	Coefficient of Permeability (k)
WS1	2.10m bgl	Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps (Glaciofluvial Sheet Deposits)	3.52×10^{-3} m/s
WS1	2.10m bgl	Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps (Glaciofluvial Sheet Deposits)	3.46×10^{-3} m/s
WS1	2.45m to 3.15m bgl	Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps (Glaciofluvial Sheet Deposits)	8.52×10^{-5} m/s
WS1	3.15m bgl	Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone (Glacial Till)	Test Failed - Terminated after 5 minutes fall in water level of 70mm.
WS2	1.65m to 2.15m bgl	No recovery	4.57×10^{-6} m/s
WS2	2.15m bgl	Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone (Glacial Till)	Test Failed- Terminated after 5 minutes with a 90mm fall in water level.
WS2	3.15m bgl	Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone (Glacial Till)	Test Failed - Terminated after 10 minutes with a 10mm fall in water level.
WS3	2.12m bgl	No recovery	9.64×10^{-5} m/s
WS3	2.12m bgl	No recovery	9.75×10^{-5} m/s



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4. PROPOSED DEVELOPMENT

It is understood that the Site is to be developed with up to 189 No. residential units with associated hardstanding, infrastructure and soft landscaping in the southwestern part of the Site and an area of green space in the north-eastern part.

The proposed layout of the Site is presented in Cassidy Ashton Group Ltd Drawing No. C3429 - P01A, which is included within Appendix A to this report.



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5. PRELIMINARY CONCEPTUAL MODEL

Based on the desk study, a combined preliminary conceptual site model and conceptual exposure model for the proposed future land use was developed in the previous Tier PRA report. This summarises the understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors. In assessing the likely contaminants present at the Site, reference has also been made to Defra and Environment Agency supporting documentation. A preliminary qualitative risk assessment has also been made of the likelihood of the linkage operating and its potential significance.

The preliminary conceptual model is presented in schematic form in Appendix A, Drawing Nos. T/14/1400/PRA/3 and T/14/1400/PRA/4. The potential pollutant linkages identified and the qualitative risk assessment for these are presented in Table 5.1. The terms used in the preliminary qualitative risk assessment are defined in Appendix E.

5.1. Justification

The following factors were considered pertinent in defining the conceptual model.

Land Use

It is understood that the Site is to be developed for up to 189 No. residential units with associated hardstanding and soft landscaping in the southwestern part of the Site and an area of green space in the north-eastern part.

The following factors are considered pertinent in defining the conceptual model.

- There have been 2 No. buildings previously located on the Site which may have given rise to localised areas of Made Ground. The published geological mapping of the area shows Made Ground to be present along the southern and eastern boundaries of the Site. A pond has been historically located on Site but has since been infilled with unknown materials. These Made Ground deposits may be a source of potentially contaminative material to human health and may also give rise to hazardous ground gas.
- The area surrounding the Site has undergone periods of construction and demolition which may have resulted in creating Made Ground which could give rise to hazardous ground gas.
- Numerous ponds, sand pits, brick fields and shafts, located proximally to the Site, have been infilled and may give rise to hazardous ground gas.
- The Site is not located within an area vulnerable to flooding, within a groundwater source protection zone or within 1km of potable groundwater and surface water abstraction points.
- There are 2 No. seasonal ponds located on Site and 1 No. land drain (ditch); however, overall there are no significant surface water features within the close vicinity of the Site.
- Full radon protective measures are currently required.



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Potential Sources

- Metal, sulphate, phenol, PAH, TPH and asbestos contamination of Made Ground soils on Site;
- Leachable concentrations of metal, sulphate, PAH and TPH contamination in Made Ground soils on Site;
- Hazardous gases generated from deleterious material within on and off Site Made Ground soils and proximal infilled ground/landfilling.
- Radon gas generated from on and off Site strata.

Potential Pathways

- Dermal contact, ingestion and inhalation of contaminants on Site;
- Leaching of contaminants from potentially contaminated soils;
- Migration of contaminated dust during development works;
- Vertical and horizontal migration of mobile contaminants through granular soils, services and other man-made conduits;
- Migration via water pipes;
- Migration of hazardous gases and radon through permeable strata and accumulation in proposed buildings.

Potential Receptors

- Future, current and adjacent site users;
- Construction and maintenance workers;
- Buildings, hardstanding and services;
- Secondary A Aquifer within shallow Glaciofluvial Deposits and deeper bedrock (Salop Formation and Halesowen Formation of the Warwickshire Group) underlying the Site.

5.2. Uncertainties

The following uncertainties exist in the preliminary conceptual model.

- The presence of any features or unrecorded services by the historical maps;
- Any unrecorded geological features;
- Any unreported pollution events during the Site's history.



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Table 5.1. Preliminary Assessment of Potential Pollutant Linkages.

Pollutant linkage				Qualitative risk assessment
	Source	Pathway(s)	Receptor(s)	
1	Metal, sulphate, phenol, PAH, TPH and asbestos contamination in localised Made Ground soils.	Dermal contact, ingestion and inhalation of contaminants on Site. Migration of contaminated dust during redevelopment works. Migration via water pipes.	Future, current and adjacent users of the Site. Site investigation, construction, maintenance workers and ground workers. Buildings and infrastructure.	Medium x Likely = Moderate Risk
2	Metal, sulphate, phenol, PAH, TPH and asbestos contamination in Made Ground soils within infilled pond on Site.	Dermal contact, ingestion and inhalation of contaminants on Site. Migration of contaminated dust during redevelopment works. Migration via water pipes.	Future, current and adjacent users of the Site. Site investigation, construction, maintenance workers and ground workers. Buildings and infrastructure.	Medium x Likely = Moderate Risk
3	Leachable concentrations of metal, sulphate, PAH and TPH contamination in localised Made Ground soils.	Migration of contaminants along man made services and conduits. Leaching and horizontal migration of mobile contaminants through granular Made Ground soils.	Secondary A Aquifers On Site ponds and drainage	Mild x Likely = Moderate / Low Risk
4	Leachable concentrations of metal, sulphate, PAH and TPH contamination within infilled pond on Site.	Migration of contaminants along man made services and conduits. Leaching and horizontal migration of mobile contaminants through granular Made Ground soils.	Secondary A Aquifer On Site ponds and drainage	Mild x Likely = Moderate / Low Risk
5	Hazardous ground gas generation from on and off Site Made Ground soils and proximal infilled ground.	Migration of hazardous gases through permeable strata and accumulating in the proposed development.	Future users of the Site and the proposed buildings. Construction and maintenance workers	Medium x Likely = Moderate Risk
6	Radon gas generation from on and offsite bedrock	Migration of radon gas through permeable strata and accumulating in the proposed development.	Future users of the Site and the proposed buildings. Construction and maintenance workers	Severe x Likely = High Risk

For definition of the terms used in the qualitative risk assessment, please see Appendix F.



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6. FIELDWORK

6.1. Scope of Investigation

The information contained in this report is limited to areas of land accessible during the investigation within the Site boundary, as indicated on the Site plan, presented in Appendix A as Drawing No. TE1239GIR2

Tier Environmental scoped the intrusive ground investigation using guidance presented in BS 10175:2011, the remaining CLR document (Defra and Environment Agency), Land Contamination: Risk Management and BS EN 1997:2004 and 2007.

The investigation, which was supervised by a Tier Environmental Geoenvironmental Engineer, took place between 24th September and 14th October 2019 and comprised:

- Excavation of 20 No. of hand-dug pits to a depth of 1.20m for service clearance purposes.
- Drilling of 20 No. window sample boreholes (WS01 to WS20) to a maximum depth of 4.45m to determine shallow ground conditions, enable *in situ* geotechnical testing, obtain environmental and geotechnical samples for laboratory analysis and install combined monitoring wells for both gas and groundwater monitoring purposes (WS06 to WS10, WS10a, WS14, WS17, WS19 and WS20).
- Excavation of 18 No. trial pits using a tracked excavator to depths of between 1.50m to 3.00m bgl to determine the nature and extent of shallow ground conditions, obtain environmental samples for laboratory analysis; and,
- 7 No. infiltration tests to determine the suitability of soakaways on Site.

Permanent monitoring installations for either or both groundwater and ground gas monitoring were installed in WS06 to WS10, WS10a, WS14, WS17, WS19 and WS20 with response zones within the Made Ground, Glacial Till and Glaciofluvial Sheet deposits. Exploratory holes without instrumentation were backfilled with arisings and bentonite seals. Trial pits were backfilled with arisings in approximate reverse order and left slightly mounded to allow for future settlement; these are likely to settle below existing ground level with time and will be unsuitable for trafficking over.

The exploratory hole location and current Site features are shown on Drawing No. TE1239GIR2.

Depths and accurate descriptions of strata and groundwater observations made during investigation works, together with details of the samples recovered, are presented on the Engineer's exploratory hole records in Appendix C.

Tier Environmental's standard strata description criteria are compliant with BS EN ISO 14688:2002 and 2004 and BS EN ISO 14689:2003. A brief description of field sampling and testing techniques is provided in Appendix J.

6.2. Geotechnical Testing

Geotechnical laboratory testing was scheduled by Tier Environmental on selected samples as presented in Table 6.1. Samples were collected as described in Appendix K. The testing was performed by Professional Soils Laboratory. Test certificates are presented in Appendix L and discussed in Section 7, below.



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Table 6.1. Geotechnical Laboratory Testing Schedule.

Test	Stratum type	Number of tests	Purpose
1. General			
Moisture content	Glacial Till and Glaciofluvial Sheet deposits.	15	a) Assist with the determination of consistency of soil with depth. b) Assess desiccation of soils. c) Suitability of materials for reuse within earthworks.
2. Classification			
Atterberg limit	Glacial Till and Glaciofluvial sheet deposits.	15	a) Volume change potential. b) Plasticity assessment (comply with Eurocode 7 description) c) Consistency Index. d) Determine soil type (e.g., clay/silt). e) Use as an empirical guide to soil shear strength
Particle size distribution	Glacial Till and Glaciofluvial sheet deposits.	2	a) Classify soils for earthworks purposes. b) Establish type of soil (comply with Eurocode 7 description).

6.3. Chemical Testing

Based upon the historical information available for the Site and the potential pollutant linkages identified for the proposed end land use as residential with home grown produce, Tier Environmental scheduled chemical laboratory testing on selected soil and groundwater samples. The purpose of the testing was to:

- Determine the concentration and spatial distribution of potential contaminants in the Made Ground;
- Determine the chemical composition and properties of the shallow natural soils;
- Determine the chemical composition of the shallow groundwater; and,
- Undertake an initial waste soils classification.

Sampling and QA/QC protocols are presented in Appendix K. Tier Environmental's schedule of chemical laboratory testing is presented in Table 6.2. The testing was carried out by Element Deeside.



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Table 6.2. Schedule of Chemical Testing.

Laboratory analysis	Topsoil	Made Ground 1	Glacial Till	Glaciofluvial Sheet Deposit	Groundwater
Tier Environmental standard soil suite*	10	1			N/A
Asbestos screen		1			N/A
Tier Environmental standard groundwater suite*	N/A	N/A			5
Speciated TPH	4	1			5

*For definition of Tier Environmental standard analytical suites, please see Appendix K.

NA - not applicable.

All analyses were undertaken using tests accredited to UKAS and/or MCERTS standards, where available. The analytical laboratory results are presented in Appendix M to this report and discussed in Section 8, below.



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7. GROUND CONDITIONS AND MATERIAL PROPERTIES

Photographs taken during site investigation works are provided in Appendix D.

7.1. Strata Profile

A summary of the strata profile determined at this site is presented in Table 7.1 below.

Table 7.1. Strata Profile.

Strata	Depths recorded (m bgl)	Thickness (m)	General description and comments
Topsoil	Encountered at all locations from ground level to a minimum depth of 0.20m bgl (TP04) and a maximum depth of 0.60m bgl (TP15).	Between 0.20m and 0.60m. Generally, a thickness of 0.30m was encountered	Grass over topsoil, dark brown, sandy, clayey LOAM with frequent rootlets, commonly at surface. Occasional angular to rounded, fine to medium gravel of mixed natural and anthropogenic materials.
Made Ground 1	Encountered at TP03 from depths of between 0.30m bgl to 1.25m bgl.	Between 0.30m and 1.25m.	Dark brownish black, gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse of mixed anthropogenics including coal, brick, glass and ceramic. Whole glass bottles frequent throughout.
Made Ground 2	Encountered at locations in the West of the site at WS01 to WS05 and TP06, TP11 and TP13 from a minimum depth of between 0.30m (TP06, TP13, WS02 and WS05) and 0.50m (TP11) to a maximum depth of between 0.75m (TP05) and 1.30m bgl (WS04).	Between 0.45m and 1.15m	Reworked natural lithologies occurring as orangish brown and light brown, sandy, slightly gravelly CLAY. The gravel is angular to subangular, fine to coarse of mixed natural and few anthropogenics or as dark brown, sandy, rounded, fine to coarse gravel.
Glacial Till/ Glaciofluvial Sheet deposits	Encountered at all locations from a minimum depth of between 0.20m (TP01) and 1.25m bgl (WS04) to a maximum proven depth of between 1.50m (TP17, TP18) and 4.45m (WS01 to WS20).	Thickness undetermined	Cohesive deposits occurred as low to high strength, soft to firm consistency, orangish brown, reddish brown, and grey, slightly gravelly, slightly sandy to very sandy CLAY. Gravel is angular to rounded, fine to coarse of coal and mixed natural lithologies including quartz, sandstone and mudstone and igneous fragments. Granular deposits occurred as orangish brown, slightly clayey to very clayey, GRAVEL or SAND. Gravel is subangular to subrounded, fine to coarse of sandstone and mudstone.

NR - not recorded



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Topsoil

Topsoil was encountered at all locations across the Site from ground level to depths of between 0.20m bgl (TP04) and 0.60m bgl (TP15).

The Topsoil generally comprised grass topped, dark brown, slightly sandy to sandy, slightly clayey LOAM. Frequent matted fine rootlets were present at the surface and throughout.

During our works, there was no olfactory or visual evidence of hydrocarbon or similar contamination within the Topsoil.

Made Ground 1

The Made Ground encountered at this Site at 1 No. location in TP03 at depths of between 0.30m to 1.25m bgl.

Made Ground 1 was dark brownish black, gravelly, fine to coarse sand. Gravel is angular to subangular, fine to coarse of coal, and mixed anthropogenics including ceramic, glass and brock. Whole glass bottles present throughout.

The results of the specified geotechnical testing are presented in Appendix L and discussed below.

During our works, there was no olfactory or visual evidence of hydrocarbon or similar contamination within Made Ground 1.

Made Ground 2

Made Ground 2 was encountered at locations in the west of the site at WS01 to WS05 and TP06, TP11 and TP13 from a minimum depth of between 0.30m (TP06, TP13, WS02 and WS05) and 0.50m (TP11) to a maximum depth of between 0.75m (TP05) and 1.30m bgl (WS04). It occurred as reworked natural lithologies comprised of orangish brown and light brown, sandy, slightly gravelly CLAY. The gravel is angular to subangular, fine to coarse of mixed natural and few anthropogenics or as dark brown, sandy, rounded, fine to coarse gravel.

The results of the specified geotechnical testing are presented in Appendix L and discussed below.

During our works, there was no olfactory or visual evidence of hydrocarbon or similar contamination within Made Ground 2.

Drift Deposits

The drift deposits encountered at this Site comprised Glacial Till and Glaciofluvial Sheet deposits. The properties of each stratum are described below.

Glacial Till

Encountered at all locations from a minimum depth of between 0.20m (TP01) and 1.25m bgl (WS04) to a maximum proven depth of between 1.50m (TP17, TP18) and 4.45m (WS01 to WS18).

Glacial Till, where encountered, was found underlying the Topsoil, Made Ground 1 and Made Ground 2 in the western area of the Site. It comprised of low to high strength, soft to firm consistency, orangish brown, reddish brown, and grey, slightly gravelly, slightly sandy to very sandy CLAY. Gravel is angular to rounded, fine to coarse of coal and mixed natural lithologies including quartz, sandstone and mudstone and igneous fragments.



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The results of the specified geotechnical testing are presented in Appendix L and summarised in **Error! Reference source not found.**

During our works, there was no olfactory or visual evidence of hydrocarbon or similar contamination within the Glacial Till.

Glaciofluvial Sheet Deposits

The Glaciofluvial Sheet Deposits were encountered mainly in the southern and northern areas of the Site. It was encountered from a minimum depth of between 0.35m (TP09) and 0.60m bgl (TP12) to a maximum proven depth of between 2.40m (TP09) and 4.45m (WS01-WS18). It comprised of either:

- Gravel - orange, dark brown, slightly clayey, very sandy, fine to coarse gravel of sandstone, mudstone and quartz with a high cobble content of sandstone; or,
- Sand - clayey, slightly gravelly, medium to coarse sand. Gravel is subrounded to rounded, fine to coarse of coal, mudstone, sandstone and coal with a low cobble content of sandstone.

7.2. Dynamic Cone Penetrometer (DCP) Results

The equivalent California Bearing Ratio (CBR) values calculated from the 30 No. *in situ* DCP testing ranged between 0.70% and 36.89%, with an average of 5.44% for on-site Made Ground soils. Outlying CBR values have been eliminated by ignoring the lowest and highest 10% of values; when this is applied CBR values range from 1.31% to 10.68% with an average of 4.60%.

The 30 No. DCP locations are presented in Appendix A within Drawing No. TE1239GIR2.

The DCP results are presented as Appendix C.2.

7.3. Laboratory Geotechnical Testing

Of the 12 No. soil samples of the drift deposits that were confirmed as plastic, all the modified plasticity indices were below 20%, with the majority less than 14% and low plasticity.

These results indicate that the cohesive soils possess a low volume change potential in accordance with NHBC Standards Chapter 4.2.



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7.4. Determination of pH and Water-Soluble Sulphate

Representative samples of the materials encountered in the exploratory holes and trial pits, were tested to determine their pH and concentrations of water-soluble sulphate (SO_4^{2-}). The results are presented in Appendix M and summarised in Table 7..

The results show that the soils have been given a design sulphate class of DS-1 and an ACEC sulphate class of AC-1.

Table 7.2. Results of Soil pH Testing and Water-Soluble Sulphate Determination.

Borehole	Depth (m bgl)	pH	Water-soluble sulphate (mg/l)	Design sulphate class	ACEC sulphate class
Made Ground					
TP01	0.20	6.48	8.3	In line with BRE SD1 (2005), the mean of the highest 20% of the sulphate concentrations have been rounded to the nearest 100mg/l to give a design sulphate classification of <u>DS-1</u>	In line with BRE SD1 (2005), the mean of the lowest 20% of pH results give an ACEC sulphate class of <u>AC-1</u>
TP03	0.20	6.50	14.3		
TP03	0.60	6.75	58.1		
TP04	0.10	6.46	5.2		
WS08	0.20	6.55	5.7		
TP09	0.20	6.33	5.0		
TP13	0.20	7.14	<1.5		
WS12	0.20	6.34	3.5		
WS15	0.15	6.34	5.4		
WS11	0.30	6.51	11.2		
TP16	0.30	6.41	<1.5		
Natural Ground (Till)					
TP03	1.40	7.07	11.5	In line with BRE SD1 (2005), the highest measured sulphate concentration has been used rounded to the nearest 100mg/l to give a design sulphate classification of <u>DS-1</u>	In line with BRE SD1 (2005), the lowest measured pH result has been used giving an ACEC sulphate class of <u>AC-1</u>
TP10	1.50	7.68	5.7		
Groundwater					
WS07	0.98	7.27	427.3	The localised elevated sulphate concentration indicates a design sulphate classification of <u>DS-2</u>	In line with BRE SD1 (2005), the lowest measured pH result has been used giving a localised ACEC sulphate class of <u>AC-2</u>
WS08	0.84	6.78	21.7	The highest measured sulphate concentration indicates a design sulphate classification of <u>DS-1</u>	In line with BRE SD1 (2005), the lowest measured pH result has been used giving an ACEC sulphate class of <u>AC-1</u>
WS09	0.90	7.30	28.6		
WS10A	0.97	6.92	4.1		
WS17	1.16	6.93	21.0		

ACEC - Aggressive Chemical Environment for Concrete (see BRE SD1, 2005).

A further fifteen samples of natural soils were analysed for their Magnesium Aqueous Extract and Chloride Aqueous Extract. Based on this these results also show that the soils have been given a design sulphate class of DS-1 and an ACEC sulphate class of AC-1.



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7.5. Groundwater Observations and Monitoring

Table 7. provides a summary of the groundwater observations during fieldworks. The observations show a range of groundwater levels across the site.

Table 7.3. Field Observations of Groundwater.

Borehole	Strike (m bgl)	Groundwater depth during monitoring (m bgl)	Formation	Observations
TP08	2.40	-	Glacial Till/ Glaciofluvial Sheet Deposits	Pocket of wet sand encountered allowing slow groundwater seepage in trial pit.
TP11	2.40	-		Pocket of wet sand encountered allowing slow groundwater seepage in trial pit.
TP15	1.80	-		Slow groundwater seepage in trial pit.
WS03	3.00	-		Sub-artesian groundwater at 3.00m bgl.
WS04	2.80	-		Sub-artesian groundwater at 2.80m bgl.
WS06	-	3.80 - Dry		
WS07	-	0.98 - 1.09		
WS08	1.20	Well flooded		Sub-artesian groundwater at 1.20m bgl.
WS09	1.90	0.90 - 1.30		Sub-artesian groundwater at 1.90m bgl.
WS10A	-	0.92 - 1.30		
WS12	1.05	-		Sub-artesian groundwater at 1.05m bgl.
WS14	-	Dry		
WS15	2.00	-		Sub-artesian groundwater at 2.00m bgl.
WS16	3.10	-		Sub-artesian groundwater at 3.10m bgl.
WS17	2.00	0.99 - 1.19		Sub-artesian groundwater at 2.00m bgl.
WS19	-	Dry		
WS20	-	Dry		

Groundwater monitoring has been performed on 2 No. occasions on 2nd and 18th October 2019. The full results of this monitoring are presented in Appendix N.

Groundwater samples were obtained in accordance with the methods presented in Appendix K from wells WS06, WS07, WS09, WS10a and WS17 during the first monitoring visit where there was a sufficient groundwater column to facilitate groundwater sampling.

Groundwater was generally encountered at depths between 0.60m and 1.30m bgl during the monitoring, and at approximately or deeper than 4.00m bgl within WS06, WS14, WS19 and WS20 in the northern part of the development area.

Groundwater control measures may therefore be required during the installation of foundations and the drainage system across parts of the Site.



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7.6. Infiltration Testing

A total of 7 No. soakaway tests were undertaken at the Site (SW01 to SW07 and SW09). SW08 was not undertaken due to the time constraints and the low cohesive soils found in SW07 and SW09.

The three consecutive tests specified in BRE 365 are often not achievable over a reasonable timeframe (as was the case here), therefore it is generally considered that if the first test will not complete within a 24 hour period then the site is unlikely to be suitable for soakaways.

The soakaway results and groundwater level monitoring undertaken to date indicate that the ground conditions in the north-eastern area of the Site, where granular soils are dominant, should be suitable for infiltration drainage.

The full results of the infiltration tests are presented in Appendix C.1.

7.7. Ground Gas Monitoring

Ground gas monitoring installations were constructed in WS06 to WS10, WS10a, WS14, and WS17 with response zones within the Made Ground and Glacial Till/Glaciofluvial Sheet deposits.

Monitoring comprised measurement of pressure, methane (CH₄), percent of lower explosive limit (LEL), carbon dioxide (CO₂), oxygen (O₂), carbon monoxide (CO), hydrogen sulphide (H₂S) and gas flow rate.

The ground gas monitoring presented in this report was performed on the 2nd, the 18th October and 18th November 2019. Further ground gas monitoring is planned, which will give a total monitoring period of 3 months. The rationale behind this monitoring period was which is regarded as being appropriate for low gas generation potential and a proposed residential land use in accordance with CIRIA C659.

The full ground gas monitoring results from the installations are presented in Appendix N.

The total atmospheric pressure range of the ground gas monitoring data included in this report was 902mb to 1007mb. This range covers low to moderate atmospheric pressures. Monitoring events included periods of falling and rising pressure. A maximum peak and steady methane concentration of 0.1% v/v and a maximum peak and steady carbon dioxide concentration of 5.4% v/v have been reported. No measured concentrations of carbon monoxide or hydrogen sulphide have been reported which exceed the instrument's detection limit. A maximum peak and steady flow rate of 0.4l/hr has been reported.

Using the initial data received, a worst-case assessment has been undertaken giving a gas screening value of 0.0216l/h, giving a designation of CS1.

Due to the elevated concentration of CO₂ measured at 5.4% at WS10 on gas visit No. 2 it is possible that a designation of CS2 may be needed locally - the further gas monitoring visits planned will confirm if this is the case.

At this stage, the monitoring data and the ground conditions encountered during the ground investigation suggest that gas protection measures may not be required within the majority of the proposed development. This will be further assessed upon completion of the gas monitoring period.



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8. RESULTS OF CHEMICAL TESTING

Results of chemical analysis are presented in full in Appendix N.

8.1. Data Interpretation Approach

The analytical data obtained were reviewed for completeness and consistency. The data for each sample type was then compiled, screened against the GACs for a residential with home grown produce land use and those compounds or elements which were found to have exceedances of the GACs were then subjected to detailed analysis as described below.

No zoning of the Site was undertaken as part of the interpretation. The historic land use and proposed development pattern meant that zoning was not appropriate or beneficial to the site investigation or subsequent data interpretation.

Selection of Generic Assessment Criteria (GAC)

The approach for the selection of the GACs used as screening criteria for this assessment is provided in Appendix G. In short, for the majority of the contaminants of concern, LQM/CIEH Suitable 4 Use Levels (S4ULs) published in 2015 have been adopted as GACs for a residential with home grown produce land use. These values are considered as appropriate screening criteria as they incorporate updated assumption exposures derived for the production of C4SLs but within the context of deriving screening criteria above which assessment of the risks or remedial action may be needed (i.e. within the context of the planning regime rather than Part 2A context for which C4SLs were derived).

As the proposed development layout drawings are yet to be finalised, the measured concentrations of determinands have been assessed against GAC appropriate for the most sensitive receptors; residential with home grown produce.

Assessment of outliers and data distribution

Assessment of data distribution and the identification of statistical outliers was performed iteratively, applying appropriate data distribution and outlier tests for the complete and outlier-censored datasets.

The presence of outliers was determined using Grubbs' test working with untransformed values for normally distributed data and natural log-transformed values for non-normally distributed data.

The data were tested for normality by at least two of the following methods:

- Probability histogram
- Probability (q-q) plots
- Shapiro-Wilk normality test

Outliers were considered to form part of the overall site dataset *except* they were not considered to be statistically representative of the shallow soils as a whole.



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Calculation of 95% upper confidence limit of the sample mean

Based upon the normality and outlier tests, the 95% UCL of each contaminant of concern was calculated by:

- One-sample Grubb's-test for datasets that are normally distributed or close to normal distribution;
- One-sided Chebyshev test for datasets that are significantly non-normal.

Where both the one-sample Grubbs-test and one-sided Chebyshev 95th percentile results were both below the critical concentration, normality tests were not undertaken, as this would have had no effect upon the final outcome.

8.2. Human Health

Metals and Metalloids

After initial screening against the relevant GACs, none of the samples had any exceedances.

It is therefore considered that the shallow soils at the site should be considered to be uncontaminated with respect to metals and metalloids for a residential with home grown produce land use.

PAHs

Polycyclic aromatic hydrocarbons (PAHs) are a wide range of over 200 different compounds normally associated with combustion or processing of hydrocarbons and coal. Elevated levels of PAH's can also be found in tarmac. Sixteen PAH's (usually known as the USEPA 16) comprise the more common individual carcinogenic PAH compounds with a seventeenth (Coronene) included in the assessment of soil for waste disposal at landfill sites. Each of the PAH compounds have different toxicity:

After initial screening against the relevant GACs, none of the samples had any exceedances. It is therefore considered that the shallow soils at the site should be considered to be uncontaminated with respect to metals and metalloids for a residential with home grown produce land use.

Hydrocarbons

No visual or olfactory evidence of hydrocarbon contamination was encountered during the site investigation.

Of the 5 No. soil samples sent for TPH (CWG) analysis, no measured concentrations of hydrocarbons have been reported in excess of the laboratories limit of detection. It is therefore considered that the shallow soils at the site are not considered to present a potential risk to human health for a residential with home grown produce land use with respect to hydrocarbons.

Asbestos

Asbestos can be present in soil as fragments of bulk Asbestos Containing Materials (ACMs) (e.g. asbestos cement sheeting) and also as discrete asbestos fibres within the soil matrix. This investigation has carried out assessments to determine whether both bulk fragments and / or fibres are present in the soil at the site. The asbestos assessment commenced on site with inspection of the Made Ground by our site staff for the presence of bulk ACMs. During the fieldwork no suspected ACMs were identified.



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Of the 12 No. samples which were screened for asbestos screening, none were found to contain asbestos.

It is therefore considered that the shallow soils at the site do not present a potential risk to human health for a residential land use with respect to asbestos.

8.3. Groundwater Assessment

Laboratory chemical testing has been conducted on 5 No. shallow groundwater samples at the Site. Water Quality Standards have been selected as described in Appendix I; however, in summary, due consideration of **both UKDWS and appropriate EQS values** has been undertaken based in the conceptual site model and the most conservative value selected for initial screening purposes.

Table 8.1. Summary of Groundwater Concentrations Greater Than Relevant Water Quality Standards

Determinant	Units	Recorded Concentrations	Selected Water Quality Standard (EQS or UKDWS)	No. exceeding the WQS
Nickel	µg/l	<0.2 to 19.6	4 (EQS)	2 of 5 (WS7 & WS17)
Copper	µg/l	<3 to 5	1 (EQS)	4 of 5
Selenium	µg/l	<1.2 to 11.3	10 (UKDWS)	1 of 5 (WS7)
Zinc	µg/l	<1.5 to 57.5	10.9 (EQS)	3 of 5 (WS7, WS9 & WS17)
Flouranthene	µg/l	<0.01 to 0.02	0.0063 (EQS)	3 of 5 (WS7, WS9 & WS17)
Sulphate	mg/l	4.1 to 427.3	250 (UKDWS)	1 of 5 (WS7)

In some instances, the laboratory method detection limit is greater than the appropriate EQS/UKDWS value. In these instances, only measured concentrations in excess of the laboratory method detection limit have been considered likely to potentially represent a possible significant risk to controlled waters.

All the total phenols and speciated TPH (CWG) concentrations are lower than the laboratory detection limits. The results demonstrate that no measurable concentrations of speciated TPH or BTEX have been reported that exceed the respective EQS/UKDWS values.

The reported groundwater concentrations of nickel, copper, selenium, zinc, fluoranthene and sulphate have been reported at the same order of magnitude or one order of magnitude above the respective WQS.

It is not considered that these marginal WQS exceedances represent a potentially significant risk to the controlled waters environment based on the following:

- The absence of a continuous shallow groundwater body;
- The greenfield nature of the Site;
- The site history;
- The absence of Made Ground across the majority of the Site;
- The River Alyn is located 330m northwest of the Site; and,



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- The potential for dilution and attenuation between the shallow groundwater and any watercourses and deeper groundwater body.



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9. REVISED CONCEPTUAL MODEL AND GENERIC QUANTITATIVE RISK ASSESSMENT OF POLLUTANT LINKAGES

The preliminary combined conceptual site model and conceptual exposure model, developed from the previous PRA information and presented in Section 5, has been revised in light of the ground investigation and the chemical analysis results presented above.

The revised conceptual model has been developed for the proposed future land use. This summarises the understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors.

The potential pollutant linkages identified and a generic quantitative risk assessment (based on the GAC values defined in Section 8) are presented in Table 9.1. The terms used in the generic quantitative risk assessment are defined in Appendix F.

9.1. Justification

Land Use

It is understood that the Site is to be developed for up to 189 No. residential units with associated hardstanding, infrastructure and soft landscaping in the south-western part of the Site and an area of green space with infiltration drainage in the north-eastern part.

The following factors are considered pertinent in defining the conceptual model:

- There have been 2 No. buildings previously located on the Site which may have given rise to localised areas of Made Ground. The published geological mapping of the area shows Made Ground to be present along the southern and eastern boundaries of the Site. A pond has been historically located on Site but has since been infilled. These Made Ground deposits may be a source of potentially contaminative material to human health and may also give rise to hazardous ground gas.
- The area surrounding the Site has undergone periods of construction and demolition which may have resulted in creating Made Ground which could give rise to hazardous ground gas.
- Numerous ponds, sand pits, brick fields and shafts, located proximally to the Site, have been infilled and may give rise to hazardous ground gas.
- The Site is not located within an area vulnerable to flooding, within a groundwater source protection zone or within 1km of potable groundwater and surface water abstraction points.
- There are 2 No. seasonal ponds located on Site and 1 No. land drain (ditch); however, overall there are no significant surface water features within the close vicinity of the Site.
- Full radon protective measures are currently required.

Potential Sources, Pathways and Receptors

Based on the above lines of evidence no potential source, pathway, receptor linkages are considered to be present.



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9.2. Uncertainties

- The presence of any features or unrecorded services by the historical maps;
- Any unrecorded geological features;
- Any unreported pollution events during the Site's history.



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10. CONCLUSIONS AND RECOMMENDATIONS

10.1. General

This Ground Investigation Report has been performed at land at Rhosrobin, located between New Road and Plas Acton Road, Rhosrobin, Wrexham, LL114RB.

It has been assumed in the production of this report that the Site is to be redeveloped in to 189 No. residential units with associated hardstanding, infrastructure and soft landscaping in the south-western part of the Site and an area of green space in the north-eastern part. In addition, it has been assumed that ground levels will not change significantly from those described in this report. If this is not the case, then amendments to the interpretation and conclusions in this report may be required.

10.2. Flood Risk

The Site is not located in an area vulnerable to flooding.

10.3. Mining and Quarrying

The site is not considered to be at risk from shallow mining. Historical plans do not indicate any quarries, clay pits or other extractive industries in the immediate vicinity of the site. Localised workings of shallow strata cannot be wholly discounted but given the historical use of the Site this is considered unlikely.

10.4. Geotechnical Parameters

The data obtained during the Ground Investigation has been assessed for the recorded soil types in order to provide characteristic values in order to aid the final foundation design.

Soil Classification

Cohesive Soils

Moisture content and Atterberg Limit testing was undertaken on samples from cohesive superficial material at the site. A summary of the results is shown in Table 10.1 below

Table 10.1. Summary of Natural Moisture Content and Atterberg Limits

Parameter	No. Tests	Minimum	Maximum	Average
Natural MC %	15	3.9	19	13.05
Plastic Limit %	15	13	20	15.50
Liquid Limit %	15	25	40	15.77
Plasticity Index	15	11	20	13.42
Modified Plasticity Index	15	10.56	18.62	12.89

15 No. Atterberg Limit Tests were performed on samples of identified cohesive soil. Whilst the majority of samples returned results which confirm that the material is clay, 3 No. sample recorded a non plastic result. The results indicate that the Natural clay strata at the site has a low volume change potential.

Granular Soils

2 No. samples of Glaciofluvial Sheet Deposit strata were submitted for Particle Size Distribution tests. Samples of the Glaciofluvial Sheet deposit strata were generally recorded as slightly clayey to very clayey, gravelly, medium to coarse SAND, whereas the test results from the Glaciofluvial Sheet Deposit strata were recorded as a slightly gravelly to very gravelly, clayey to very gravelly silty sand.

A total of 34 No. standard penetration tests have been undertaken in material considered representative of granular Glaciofluvial Sheet Deposits, with reported N values ranging from 2 to 41, falling in the very loose to dense categories. The test results show a reasonable variation but no clear depth relationship. It is considered that a conservative N value of 12 and an angle of shearing resistance of 32° is tentatively proposed within these deposits; however, this value should be used with caution.

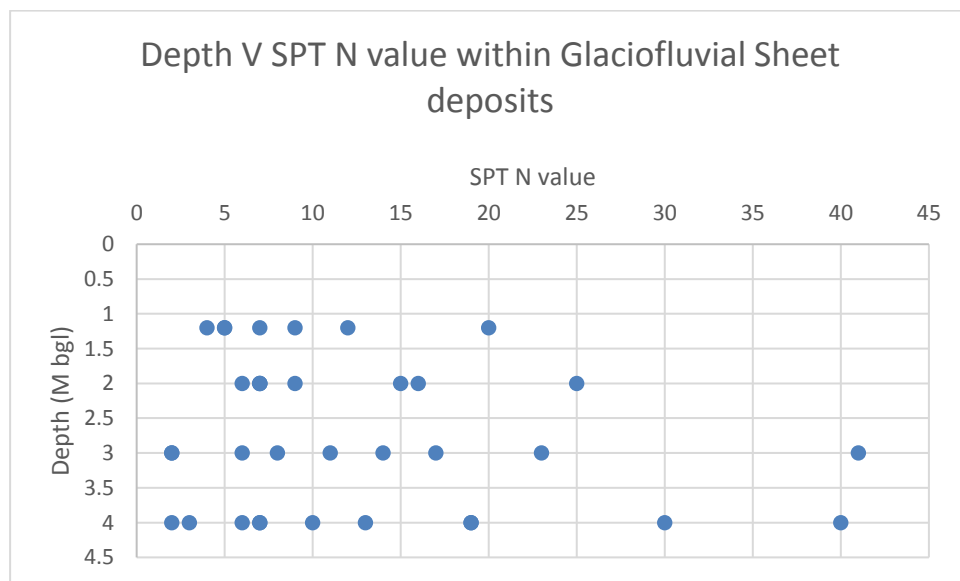


Figure 10.1 SPT N values vs Depth within the granular Glaciofluvial Sheet deposits.

Shear Strength Parameters

Standard Penetration Tests (SPT) were carried out in all of the boreholes. The undrained shear strength of the natural clay strata tested has been estimated using the relationship developed by Stroud, where:

$$C_u = f_1 \times \text{SPT N60 value}$$

The value of f_1 is dependent on the Plasticity Index (I_p). By using the moderately conservative Plasticity Index of 18.62%, a characteristic value of $f_1 = 5$ has been derived.

Results from 42 No. SPT N values in the Glacial Till strata suggest that the strength of the material ranges from low to high with majority of the material in the medium and strength category with shear strengths varying from 2 to 120 kPa. All of the shear strengths calculated from SPT N values are shown in **Error! Reference source not found.**, in which they are plotted against reduced level. The test results show a reasonable variation but also an increase with depth. It considered that a conservative N value of 25 is tentatively proposed within these deposits; however, this value should be used with caution.

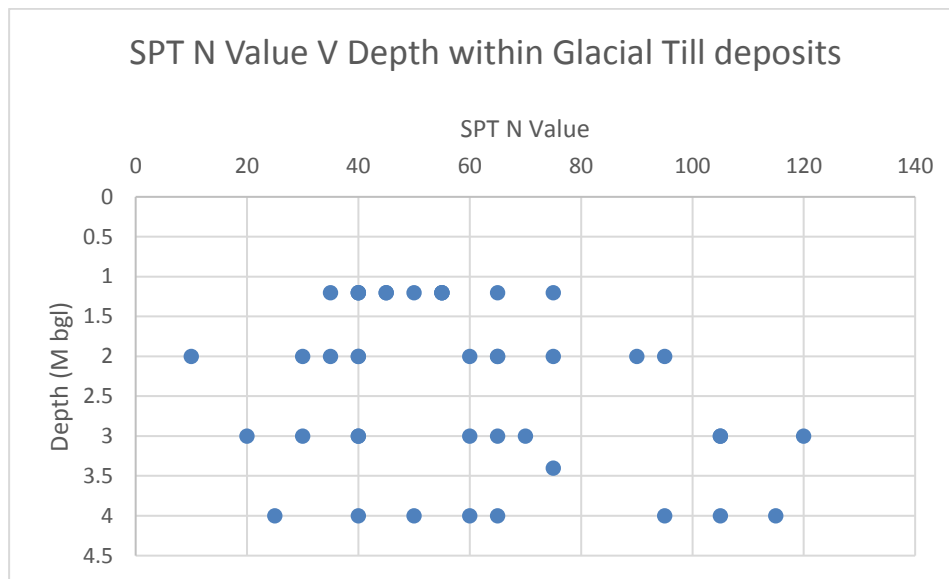


Figure 10.2. SPT N value vs depth within Glacial Till deposits.

Density Parameters

The results of Standard Penetration Tests undertaken within the granular Made Ground are considered to be very variable, ranging from N = 2 to N = 41 with most N values falling in the medium dense categories. The values show slight variation with depth with the variable test results probably caused by variable composition and obstructions.

Foundation Recommendations

The majority of the proposed residential plots may be suitable for standard and/or widened reinforced strip footings. Production of a foundation zonation plan will require additional intrusive ground investigation once the development layout has been finalised.

In areas where deep made ground is evident, and subject to the development plan, reinforced strips placed on vibro stone columns may be a more optimum solution rather than deep strip foundations. The foundations should be engineered in respect to their proximity to the tree.

Floors

With regards to the design and construction of normal ground bearing floor slabs. A ground bearing floor slab may be achievable given the low volume change potential of the natural clay deposits. The floor slabs should be suitably reinforced to minimise the risk of damage due to unacceptable heave and/or settlements. Any Made Ground beneath the floor slab may require either removal from



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site and or recompacted in layers to a recognised specification, such as Specification for Highway Works Series 600. The subgrade beneath the floor slabs should be proof rolled and any soft spots replaced with compacted suitable granular fill.

Alternatively, cast *in situ* suspended floor slabs may be the preferred solution due to the risk of potentially unacceptable heave.

Topsoil should be removed, and the underlying natural material proof rolled to the desired specification.

Earthworks

The compaction data has been assessed by comparing the results against criteria commonly used in earthworks to achieve an adequate density for engineered fills. The criteria indicate whether the samples could achieve in excess of 95% of Maximum Dry Density (MDD - a requirement often included in highways specifications) and whether they could be compacted to less than 5% air voids ratio (a requirement applied where raft foundations are to be adopted).

The results of compaction testing undertaken on samples of Glaciofluvial Sheet Deposits indicate that it could be recompacted to achieve >95% of MDD and <5% air voids. Based upon the results obtained, the Glaciofluvial Sheet Deposits Material could be used as an engineered fill, subject to other suitability considerations. It should be noted that suitability for compaction is highly dependent on the initial moisture content of the material to be compacted. Some processing of the material (including screening and crushing of unsuitable elements) may be required during the enabling works phase to remove over-sized or unsuitable material, such as metal, plastic, fabric and timber. If Made Ground is to be reused as an engineered fill, it would be sensible to select granular fills only and subject them to a confirmatory testing regime where they were required to achieve a compaction specification as a structural fill.

Construction plant should be provided with an adequate working platform in line with the requirements of BRE report, "BR 470: Working Platforms for Tracked Plant". Again, further advice should be sought from the temporary works designer.

Sulphate Attack

Based on the samples tested, a Design Sulphate Class of DS1 and an ACEC Class of AC-1 should be used for buried concrete structures.

Gross hydrocarbon contamination can also have an adverse impact on the setting of concrete, which may affect foundation construction and piling. Based on the measured concentrations of hydrocarbons at the site there is no risk of these affecting the setting of concrete.

Groundworks, Excavation Stability and Groundwater Dewatering

In our opinion, there should be no particular difficulties in excavating the strata indicated in the boreholes utilising an appropriate and suitably sized mechanical excavator. Excavations into existing Made Ground and the underlying natural soils should be assumed to be unstable. No man entry into unsupported excavations should be allowed without an appropriate risk assessment. Reference to CIRIA report 097 (1983) should be made to establish suitable means of support or battering of excavation sides.

It is recommended that all excavations to greater than 1.20 metres depth, or for shallower excavations where groundwater is encountered above this level are closely supported, especially where man entry is required. Alternatively, where space permits, the excavations might be battered back to an appropriate angle. Standing groundwater levels of between 1.20m and 3.10m were encountered in the boreholes and one trial pit. Should groundwater seepages occur, and water accumulate in shallow excavations it



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should be able to be removed by pumping from a filtered sump. However, groundwater control by more robust means, such as well pointing, may be required locally.

Pavements and Highways

Based on a visual examination of the soil and Atterberg test results, a CBR value of 2% is suggested for Glacial Till Deposits

Once the design layout is known and remediation is complete, then *in situ* testing should be carried out to confirm CBR values.

The design of pavements, highways, embankments should be discussed with the relevant local authority if highways are to be subject to Section 38 agreement.

10.5. Soil and Groundwater Contamination

Risk Evaluation for the Proposed Land Use

Human health receptors

No measured concentrations of contaminants of concern have been reported in soils beneath the Site which exceed the respective GACs. As such, it is not considered that the Site presents a potentially significant risk to human health for a proposed residential with home grown produce land use. In addition, of the 12 No. samples screened for asbestos none were found to contain asbestos.

It is therefore considered that Made Ground and natural soils on Site are not considered to present a potential risk to human health for a residential with home grown produce land use.

Controlled waters receptors

It is not considered that these marginal WQS exceedances represent a potentially significant risk to the controlled waters environment based on the following:

- The absence of a continuous shallow groundwater body;
- The greenfield nature of the Site;
- The site history;
- The absence of Made Ground across the majority of the Site;
- The River Alyn is located 330m northwest of the Site; and,
- The potential for dilution and attenuation between the shallow groundwater and any watercourses and deeper groundwater body.



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Ecological receptors

No potential pollutant linkages to ecological receptors have been identified for the Site.

Utilities

It is recommended that the results of the chemical testing and details of the proposed remedial works are provided to the appropriate utility companies to determine the necessity for service protection.

Construction and Maintenance Workers

Contamination may pose a short-term (acute) or long-term (chronic) risk to workers during construction and maintenance. The potential risks must be specifically assessed as part of the health and safety evaluation for the works to be performed in accordance with prevailing legislation. Site practices must conform to the specific legislative requirements and follow appropriate guidance (e.g., HSE, 1991; CIRIA, 1996).

On the basis of the results obtained, no potential exposure risks to construction and maintenance workers have been highlighted.

The Control of Asbestos Regulations 2012 should be adhered to. A summary of complying with CAR: risk assessments, licensing and training is provided in Appendix Q.

10.6. Outline Remediation Requirements

Ground Gas

The overall Site ground gas regime has been assessed as Characteristic Situation 1 - Very Low risk scenario based on current data available from the completed gas monitoring visits. This assessment has been based primarily on the methane, carbon dioxide concentrations and gas flow rates recorded to date. This categorisation indicates that gas protection measures are not required for the majority of the proposed development.

Gas protection measures (CS2) may be required locally within the vicinity of WS10; this will be determined upon completion of the ongoing gas monitoring.

The site is located in an area where full radon protection measures are required.

10.7. Waste Soils Classification

If the site is to be developed and materials are disposed off-site, then material exported from the site to landfill shall be hauled by a registered waste carrier in accordance with Duty of Care Regulations, 1991 and the Hazardous Waste Regulations, 2005.

It will be necessary to register the site in advance of the intended reclamation works with the Environment Agency before disposal to landfill can take place. There will be the requirement for the waste producer to provide appropriate Waste Acceptance Criteria (WAC) testing of the soils for disposal, to ensure that the soils are appropriately classified and that the landfill is licensed to receive such soils. A consignment note shall be completed, signed and retained by all parties involved. The consignment note shall state the volume of waste, a physical description of the material and statement of its chemical composition. The waste consignment notes



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shall be kept by the contractor for a period of at least two years.

Tier Environmental have assessed the chemical results in terms of basic characterisation of soils for waste. This provides a preliminary assessment of whether a material is potentially either inert/non-hazardous or hazardous waste, with the final outcome being determined by WAC testing.

Basic waste characterisation has demonstrated that the Made Ground and Natural Soils should be classified as non-hazardous.

Of the 12 No. samples that were screened for asbestos, none were found to contain asbestos fibres.

WAC testing has determined that Made Ground 1 is not suitable for disposal at a hazardous landfill and would require treatment prior to disposal; however, it is assumed that this material is suitable for retention on site. After further analysis it is understood that the Total organic Carbon of the sample is driving the over hazardous waste classification. The engineers field logs described the presence of coal within this Made Ground type. It is therefore assumed that a fragment of coal has been analysed and this result is not a true representative of this material as a whole. If it is the intention to dispose of this material, further sampling and testing may reduce the waste classification.

All natural soils on site can be disposed of to an inert landfill site, and all other made ground apart from Made Ground 1 can be disposed of to a non-hazardous landfill site.

Determination of the final disposal route of any waste soils should be determined via Waste Acceptance Criteria (WAC) testing. Final categorisation is the responsibility of the producer or holder of the waste. Additionally, liaison with the intended landfill operator may be required to confirm the receipt of the waste

10.8. Invasive Plants

Invasive plant species were not observed on this Site. It is recommended that the presence of invasive plant species is confirmed by a qualified consultant ecologist and their advice taken on appropriate treatment. Treatment of any invasive species should take place in advance of the proposed construction works.

10.9. Further Regulatory Requirements

It is considered that the regulatory authorities are likely to require a Materials Management Plan (MMP) if site won soils are to be reused on-site during the redevelopment of the Site.



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11. REGULATORY APPROVALS

The conclusions and recommendations presented above are considered reasonable based on the findings of the site investigation. However, these cannot be guaranteed to gain regulatory approval and, therefore, the report should be passed to the appropriate regulatory authorities and/or other organisations for their comment and approval prior to undertaking any works on site.

It is recommended that conditions placed on any planning permission are discharged prior to commencement of site works.



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APPENDIX A - FIGURES AND DRAWINGS

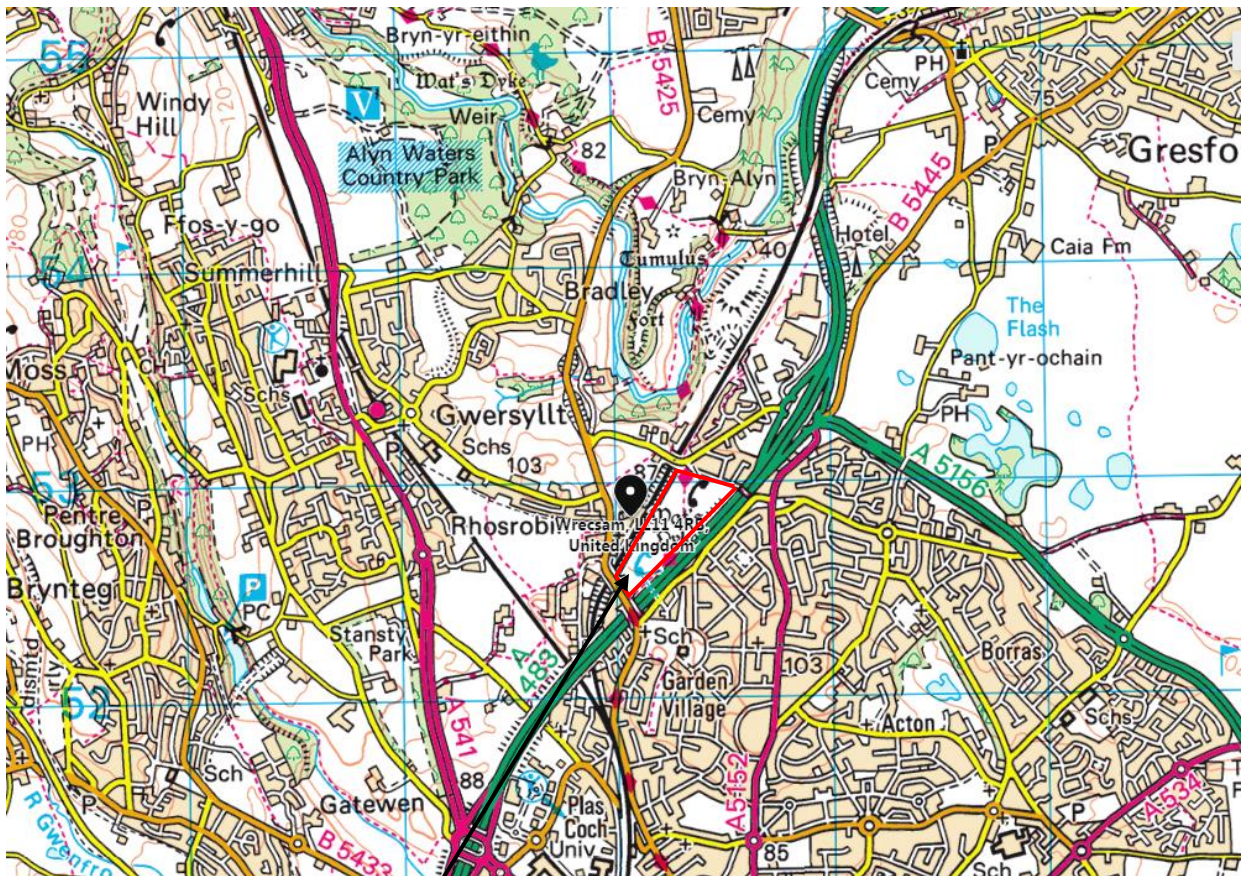


Contract Number **TE1239**

Contract **Land off New Road, Rhosrobin**

Client **Liberty Properties Ltd**

Site Location Plan



The Site

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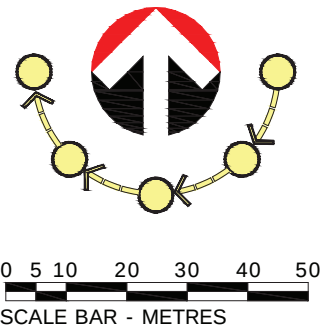
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KEY

- SITE BOUNDARY; 15.78ha (39acres)
- MAIN ACCESS / VEHICLE ACCESS
- ACCESS IMPROVEMENT TO EXISTING HIGHWAY
- PUBLIC RIGHT OF WAY
- LINE OF WAT'S DYKE
- DEVELOPMENT BOUNDARY
- KEY SETTING - EXISTING LONG DISTANCE VIEWS TO HORIZON & SETTING OF WAT'S DYKE PERMANENTLY MAINTAINED
- STREETS
- URBAN DESIGN FOCAL POINTS
- GATEWAY NODE
- ACOUSTIC ATTENUATION
- INDICATIVE RESIDENTIAL FRONTAGE
- DEVELOPMENT AREA
MEDIUM LEVEL DENSITY; UPTO 30no. Units pha
2 - 2.5 STOREY HEIGHT
DEVELOPMENT AREA; 6.31ha
UPTO 189NO. DWELLINGS
- NO BUILD BUFFER ZONE FOR SCHEDULED ANCIENT MONUMENT
ENHANCEMENT / IMPROVEMENT OF WAT'S DYKE BY AGREEMENT WITH L.A
- MAINTAINED LAND (PERMANENT GREEN BARRIER)
- LANDSCAPING (PERMANENT GREEN BARRIER)
POS AREA; 2.6ha

TOTAL UPTO 189NO. DWELLINGS



NEW ROAD - RHOSROBIN, WREXHAM
INDICATIVE MASTERPLAN / DEVELOPMENT FRAMEWORK

C3429 - P01A
SCALE - 1:2000 @ A2

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GENERAL NOTES:

This drawing is purely schematic and is a representation of the ground conditions and process, based upon information derived from the desk study and Tier Environmental site investigation.

The numbers attributed to the potential pollutant pathways presented in this drawing correspond to those within the conceptual site model (Table 5.1) within the main body of this report.

This model should be revised, following the availability of any further site investigation information to ensure its relevance to actual conditions

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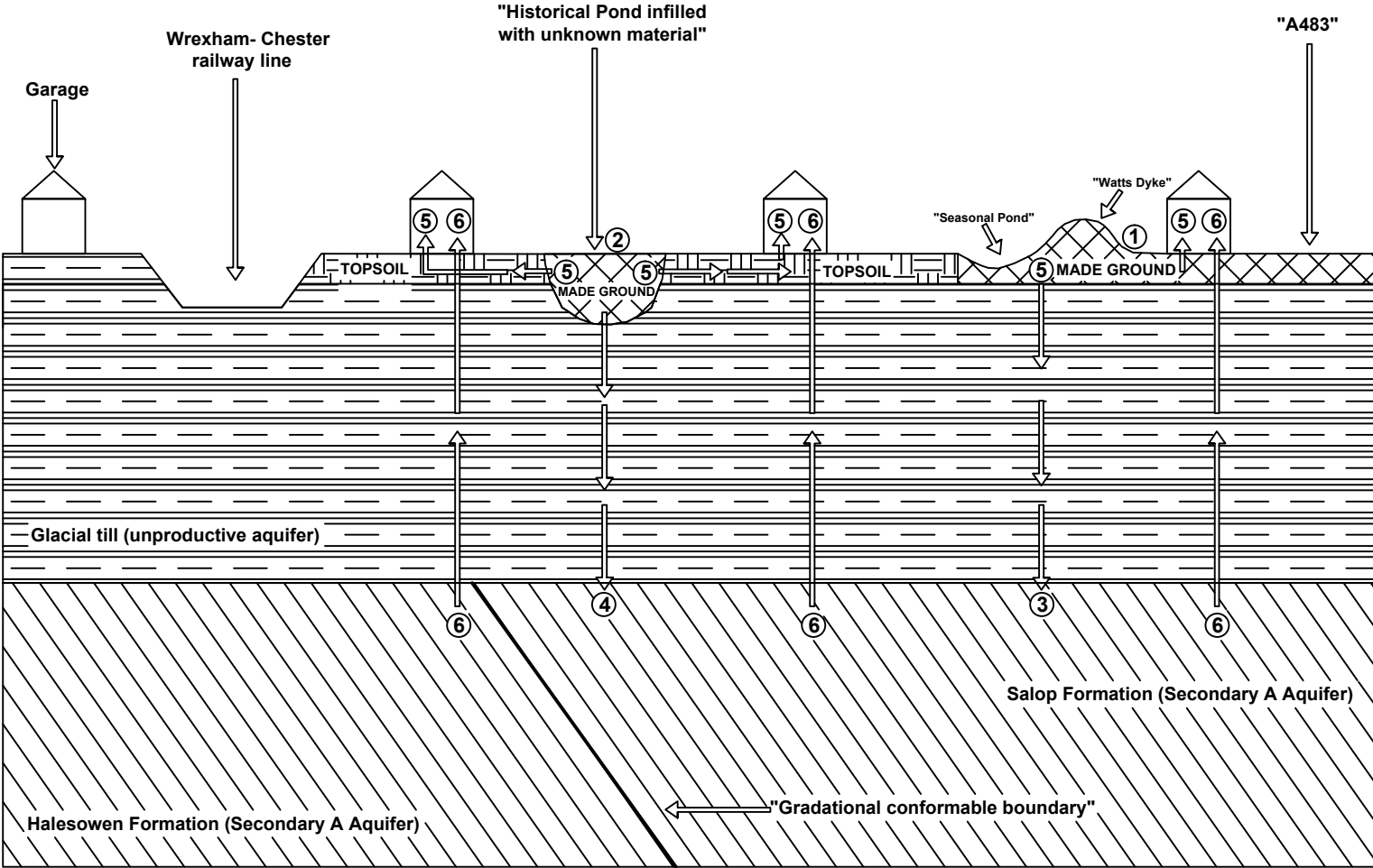
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ARCHITECT:	N / A
PROJECT:	Land off New Road, Rhosrobin
TITLE:	Conceptual Site Model

SCALE & SHEET:	CHECKED:	APPROVED:
NTS @ A1	AR	AR
DATE:	DESIGN/ISSUED:	DATE:
	CEB	October 2014
PROJECT No:	DRAWING No:	REV:
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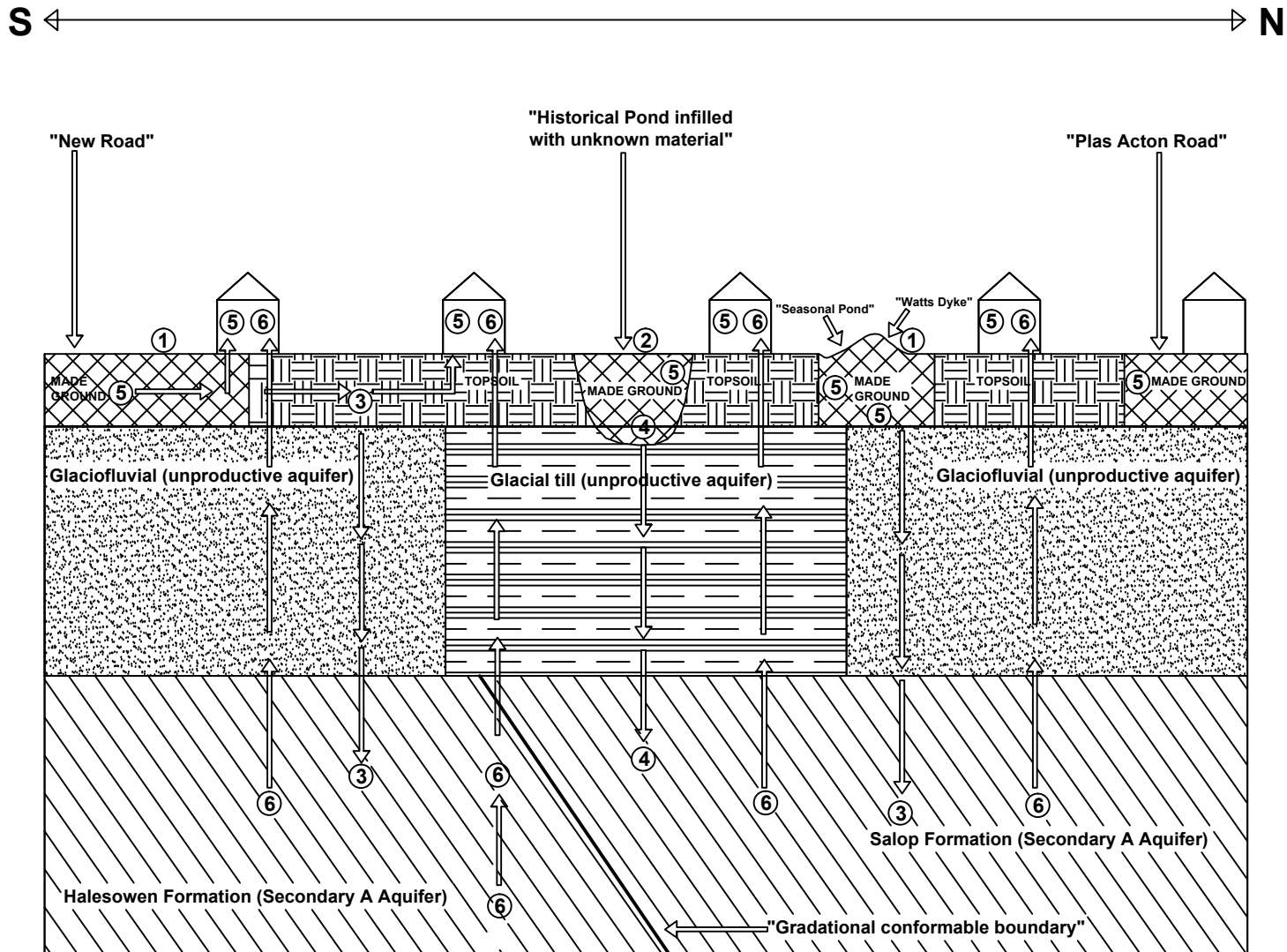


GENERAL NOTES:

This drawing is purely schematic and is a representation of the ground conditions and process, based upon information derived from the desk study and Tier Environmental site investigation.

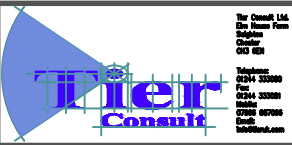
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This model should be revised, following the availability of any further site investigation information to ensure its relevance to actual conditions



REV	DATE	BY	DESCRIPTION	CHK	APP

ISSUE SOURCE



CLIENT: Liberty Properties

ARCHITECT: N / A

PROJECT: Land off New Road, Rhosrobin

TITLE: Conceptual Site Model

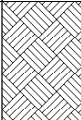
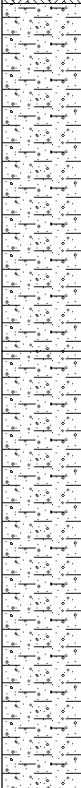
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APPENDIX B - GLOSSARY OF TERMS

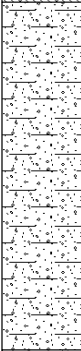
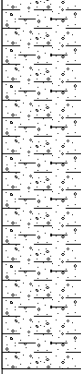
ACEC	Aggressive Chemical Environment for Concrete (classification)
aOD	Above Ordnance Datum
bgl	Below ground level
BGS	British Geological Survey
BRE	Building Research Establishment
CBR	California Bearing Ratio (test)
COMAH	Control of Major Accident Hazards (regulations)
Designated location	Site (and the ecosystem on that site) protected under national or international legislation. A potential ecological receptor to be considered as part of the assessment of land contamination. Example designated locations include SSSIs (q.v.), SACs (q.v.), national nature reserves, Ramsar sites and bird special protection areas.
DQA	Data Quality Assessment
DQO	Data Quality Objective
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EQS	Environmental Quality Standard
GAC	Generic Assessment Criterion
GQA	General Quality Assessment (Environment Agency)
GSV	Gas Screening Value
HCV	Health Criteria Value
IPPC	Integrated Pollution Prevention and Control (regulations)
K _{ow}	Octanol-water partition coefficient
LEL	Lower Explosive Limit
LL	Liquid Limit
LoD	Limit of Detection (analytical)
LoQ	Limit of Quantification (analytical)
Mean Value Test	Statistical test (described in the CIEH Guidance) to estimate the mean value of a normally distributed population of data at a given level of confidence. Normally for contaminated land assessment, the 95th percentile (referred to as the 95%UCL or US95) is applied as a reasonable but conservative estimate of the mean concentration for comparison with the relevant assessment criteria.
Maximum Value Test	Statistical test (described in the CIEH Guidance) to identify whether an elevated concentration within a normally distributed data set forms part of the underlying population from which it has been sampled or whether it is an outlier (such as a localised area of contamination) that merits further consideration.
MC	Moisture Content
NGR	National Grid Reference
NIHHS	Notification of Installations Handling Hazardous Substances (regulations)
OS	Ordnance Survey
PI	Plasticity Index
PID	Photoionisation Detector
PL	Plastic Limit
ppm	Parts per million
ppmv	Parts per million by volume
QA	Quality Assurance
QC	Quality Control
SAC	Special Area of Conservation
SOM	Soil Organic Matter
SPT	Standard Penetration Test
SPZ	Source Protection Zone (see Appendix E)
SSAC	Site-Specific Assessment Criterion
SSSI	Site of Special Scientific Interest
SVOC	Semi-Volatile Organic Compound

TEF	Toxicity Equivalent Factor
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
US95	95 th percentile estimate of the true mean value of a data population (also known as 95%UCL).
VOC	Volatile Organic Compound

APPENDIX C - EXPLORATORY HOLE LOGS

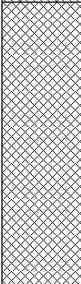
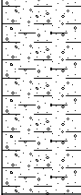
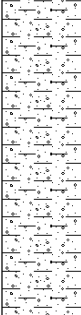
				Trial Pit Log			Trialpit No TP01 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 25/09/2019
Location: Wrexham				Dimensions (m):		3 		Scale 1:25
Client: Tier Consult Ltd				Depth 3.00		0.6 		Logged ER
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	ES		0.40			MADE GROUND: Topsoil, dark brown, sandy, clayey LOAM with frequent rootlets. TS	
	0.70	ES					Soft, locally firm, orangish brown, mottled grey, sandy, slightly gravelly CLAY. Gravel is subrounded to rounded, fine to coarse of sandstone and mudstone.	
					1.55			Firm, orangish brown mottled grey, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse of sandstone and mudstone. With a low cobble content of sandstone.
				3.00		End of pit at 3.00 m		
1 2 3 4 5								
Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.								
Stability: Stable								

				Trial Pit Log			Trialpit No TP02 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 25/09/2019
Location: Wrexham				Dimensions (m):		3 0.6		Scale 1:25
Client: Tier Consult Ltd				Depth 3.00		Logged ER		

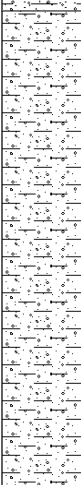
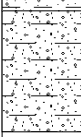
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.30			MADE GROUND: Topsoil, dark brown, slightly sandy, clayey LOAM with frequent rootlets. TS	
							Light orangish brown and grey, clayey, slightly gravelly, fine to coarse SAND. Gravel is angular to subrounded, fine to coarse of mudstone and sandstone.	1
				1.45			Stiff, orangish brown mottled grey, slightly sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of sandstone, mudstone and coal.	2
	1.90	ES		3.00				3
							End of pit at 3.00 m	4
								5

Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.		
Stability: Stable		

				Trial Pit Log			Trialpit No TP03 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 25/09/2019
Location: Wrexham				Dimensions (m):		3 0.6		Scale 1:25
Client: Tier Consult Ltd				Depth 3.00		Logged ER		

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.20	ES		0.30			MADE GROUND: Topsoil, dark brown, sandy, clayey LOAM with frequent rootlets. TS	1	
	0.60	ES							MADE GROUND: Dark brownish black, gravelly, fine to coarse SAND. GRavel is angular to subangular, fine to coarse of coal, brick, glass and ceramic. Whole glass bottles. MADE GROUND
	1.40	ES							MADE GROUND: Firm, dark grey, slightly sandy, slightly gravelly CLAY. Gravel is angular to subrounded of coal, brick, and sandstone. MADE GROUND
				1.90			Firm, orangish brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of sandstone, coal and mudstone.	2	
				3.00		End of pit at 3.00 m		3	
								4	
								5	

Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.		
Stability: Stable		

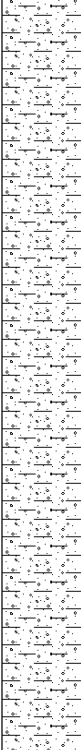
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Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 25/09/2019	
Location: Wrexham				Dimensions (m):		3 0.6		Scale 1:25	
Client: Tier Consult Ltd				Depth 3.00		Logged ER			
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.10	ES		0.20			MADE GROUND: Topsoil, dark brown, sandy, clayey LOAM with frequent rootlets.		
							TS Orangish brown, clayey to very clayey, slightly gravelly, fine to coarse SAND. Gravel is angular to subrounded, fine to coarse of sandstone, mudstone and coal.		
	1.30	ES		1.00			Firm, orangish brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of mudstone, sandstone and coal.		
	2.70	ES		2.60			Light orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subrounded to rounded, fine to coarse of mudstone, sandstones quartz and coal with a moderate cobble content of sandstone and mudstone.		
				3.00			End of pit at 3.00 m		
Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.									
Stability: Stable									

				Trial Pit Log			Trialpit No TP05 Sheet 1 of 1		
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 25/09/2019	
Location: Wrexham				Dimensions (m):		3 0.6		Scale 1:25	
Client: Tier Consult Ltd				Depth 3.00		Logged ER			

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.30			MADE GROUND: Topsoil, dark brown, sandy, clayey LOAM with frequent rootlets. TS	1
	0.40	ES					Orangish brown, clayey, slightly gravelly, fine to coarse SAND. Gravel is angular to subrounded, fine to coarse of sandstone and mudstone.	
	0.70	ES					Firm, locally stiff, dark orangish brown, sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of coal, mudstone and sandstone.	
				2.80			Orangish brown, slightly clayey, gravelly SAND. Gravel is subrounded to rounded, fine to coarse of sandstone and mudstone with a low cobble content of sandstone and quartz.	3
				3.00			End of pit at 3.00 m	
								4
								5

Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.		
Stability: Stable		

				Trial Pit Log			Trialpit No TP06 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 25/09/2019
Location: Wrexham				Dimensions (m):		3 		Scale 1:25
Client: Tier Consult Ltd				Depth 3.00		0.6 		Logged ER

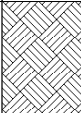
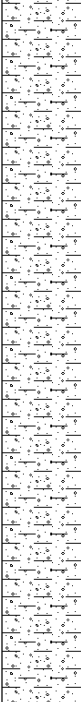
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.15	ES					MADE GROUND: Topsoil, dark brown, sandy, clayey LOAM with frequent rootlets. TS	
	0.30	ES		0.30				MADE GROUND: Firm, orangish brown and grey, sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse of coal, mudstone and sandstone.
	0.70	ES		0.50				MADE GROUND Stiff, orangish brown, slightly sandy, to sandy, slightly gravelly, CLAY. Gravel is angular to subrounded, fine to coarse of sandstone, coal and mudstone. With a low cobble content of sandstone.
				3.00			End of pit at 3.00 m	

Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.

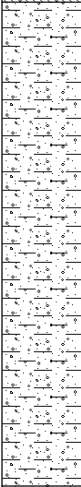
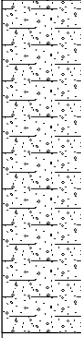
 Stability: Stable



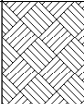
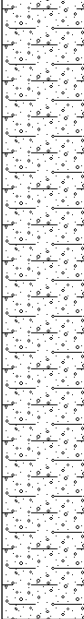
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Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 26/09/2019	
Location: Wrexham				Dimensions (m):		3 		Scale 1:25	
Client: Tier Consult Ltd				Depth 3.00		0.6 		Logged ER	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.30	ES		0.40 0.65			MADE GROUND: Topsoil, dark brown, slightly sandy to sandy, clayey LOAM with frequent rootlets. TS	1	
	0.50	ES							Firm, orangish brown, grey and dark brown, sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to medium of sandstone, coal, brick and mudstone.
	1.20	ES							Stiff, orangish brown mottled grey, sandy, gravelly CLAY. Gravel is subangular to rounded, fine to coarse of coal, mudstone, sandstone and quartz with a medium cobble content of quartz and sandstone.
				3.00			End of pit at 3.00 m	3	
								4	
								5	

Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.		
Stability: Stable		

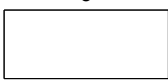
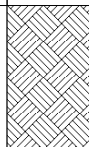
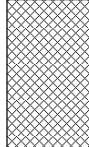
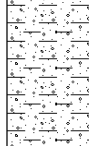
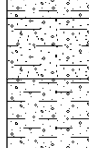
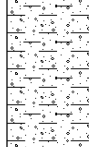
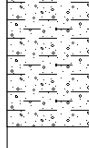
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Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 26/09/2019
Location: Wrexham				Dimensions (m):		3 		Scale 1:25
Client: Tier Consult Ltd				Depth 3.00		0.6 		Logged ER
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼	0.70	ES		0.30			MADE GROUND: Topsoil, dark brown, slightly sandy, clayey LOAM with frequent rootlets at the surface. TS	
				1.90		Firm, orangish brown mottled grey, sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse of sandstone, mudstone, quartz and coal with a low cobble content of sandstone. <i>Becomes very sandy from 1.70m to 1.90m bgl.</i>		
	2.20	ES		3.00		Orangish brown, slightly clayey, gravelly, fine to medium SAND. Gravel is subangular to subrounded, fine to coarse of sandstone and mudstone. <i>Becomes very wet SAND from 2.40m bgl.</i>		
							End of pit at 3.00 m	
Remarks: 1) Groundwater ingress encountered at 2.40m bgl. 2) Terminated at required depth of 3.00m bgl.								
Stability: Stable								

				Trial Pit Log			Trialpit No TP09 Sheet 1 of 1		
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 26/09/2019	
Location: Wrexham				Dimensions (m):		3 		Scale 1:25	
Client: Tier Consult Ltd				Depth 2.40		0.6 		Logged ER	

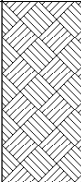
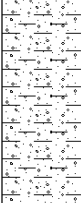
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.35			MADE GROUND: Topsoil, dark brown, slightly sandy, clayey LOAM. TS	
	0.90	ES					Orange, dark brown, slightly clayey, very sandy, fine to coarse GRAVEL of sandstone, mudstone and quartz. With a high cobble content of sandstone.	
				2.40		End of pit at 2.40 m		

Remarks: 1) No groundwater encountered. 2) Terminated at 2.40m bgl due to collapsing walls.		
Stability: Unstable		

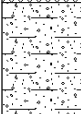
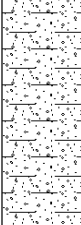
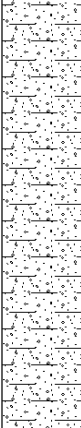
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Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 26/09/2019
Location: Wrexham				Dimensions (m):		3 		Scale 1:25
Client: Tier Consult Ltd				Depth 3.00		0.6 		Logged ER
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.30			MADE GROUND: Topsoil, dark brown, slightly sandy, clayey LOAM with frequent rootlets to 0.25m bgl. TS	
	0.70	ES					Orangish brown, slightly clayey, very sandy, fine to coarse, subrounded GRAVEL of sandstone, mudstone and coal. With a high cobble content of sandstone, mudstone and quartz.	
	1.50	ES		1.50			Firm, orangish brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of sandstone, mudstone and coal.	
							Becomes stiff at 1.95m bgl.	
				2.10			Dark orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subrounded to rounded, fine to coarse of sandstone, quartz, coal and mudstone.	
				3.00			End of pit at 3.00 m	
Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.								
Stability: Stable								

				Trial Pit Log			Trialpit No TP11 Sheet 1 of 1		
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 26/09/2019	
Location: Wrexham				Dimensions (m):		3		Scale 1:25	
Client: Tier Consult Ltd				Depth 3.00				Logged ER	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.30	ES		0.50			MADE GROUND: Topsoil, dark brown, sandy, slightly clayey LOAM. TS		
	0.80	ES		1.00			MADE GROUND: Firm, orangish brown, grey and black, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of sandstone, mudstone and quartz. MADE GROUND		
	1.20	ES		1.60			Firm, black, sandy, gravelly CLAY. Gravel is subangular to rounded, fine to coarse of mudstone, quartz and sandstone.		
	1.70	ES		1.80			Light grey, clayey, slightly gravelly SAND. Gravel is angular to subrounded, fine to coarse of sandstone and mudstone with a low cobble content of sandstone.		
	2.00	ES					Firm, dark brown, sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to medium of sandstone and mudstone.		
							Becomes stiff at 2.30m bgl.		
							Pocket of sand at 2.40m bgl allowing groundwater ingress.		
			3.00			End of pit at 3.00 m			
Remarks: 1) Groundwater ingress encountered at 2.40m bgl. 2) Terminated at required depth of 3.00m bgl.									
Stability: Stable									

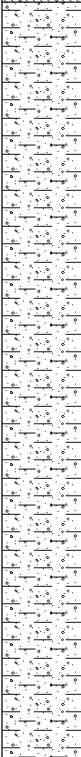


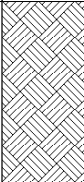
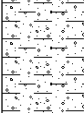
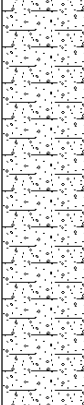
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Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 26/09/2019
Location: Wrexham				Dimensions (m):		3 		Scale 1:25
Client: Tier Consult Ltd				Depth 3.00		0.6 		Logged ER
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.40	ES		0.60			MADE GROUND: Topsoil, dark brown, sandy, slightly clayey LOAM with frequent rootlets. Gravel is angular, coarse of brick. TS	
	0.80	ES						Orangish brown, slightly clayey, gravelly, medium to coarse SAND. Gravel is subangular to rounded, fine to coarse of sandstone and mudstone with a medium cobble content of sandstone.
				1.50				Stiff, orangish brown mottled grey, sandy, locally, very sandy slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of sandstone and mudstone.
							2.20	
			3.00			End of pit at 3.00 m		
1 2 3 4 5								
Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.								
Stability: Stable								

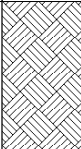
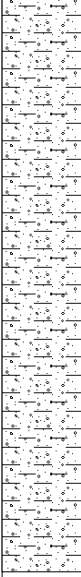
				Trial Pit Log			Trialpit No TP13 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 26/09/2019
Location: Wrexham				Dimensions (m):		3 		Scale 1:25
Client: Tier Consult Ltd				Depth 3.00		0.6 		Logged ER

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	ES		0.30			MADE GROUND: Topsoil, dark brown, sandy, slightly clayey LOAM with frequent rootlets. TS
				0.45			MADE GROUND: Dark brown, sandy, rounded, fine to coarse GRAVEL.
	0.90	ES					MADE GROUND Orangish brown, very clayey, gravelly, fine to coarse SAND. Gravel is subrounded to rounded, fine to coarse of sandstone and mudstone with a high cobble content of mudstone and sandstone.
							Lenses of stiff orangish brown, sandy, slightly gravelly CLAY. Gravel is subrounded to rounded, fine to medium of mudstone from 1.35m to 1.60m bgl.
				3.00			End of pit at 3.00 m

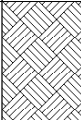
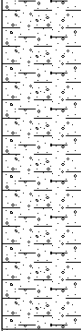
Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.		
Stability: Stable		

				Trial Pit Log			Trialpit No TP14 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 26/09/2019
Location: Wrexham				Dimensions (m):		3 		Scale 1:25
Client: Tier Consult Ltd				Depth 3.00		0.6 		Logged ER
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30			MADE GROUND: Topsoil, dark brown, slightly clayey, sandy LOAM with frequent rootlets. TS	
							Stiff, orangish brown, very sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of sandstone, coal, mudstone and quartz, with a high cobble content of sandstone, mudstone and coal.	
				2.80			Orangish brown, very sandy, clayey, fine to coarse, subangular to subrounded GRAVEL of coal, sandstone, mudstone and quartz.	
				3.00			End of pit at 3.00 m	
1 2 3 4 5								
Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.								
Stability: Stable								

				Trial Pit Log			Trialpit No TP15 Sheet 1 of 1				
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 27/09/2019			
Location: Wrexham				Dimensions (m):		3 		Scale 1:25			
Client: Tier Consult Ltd				Depth 3.00		0.6 		Logged ER			
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
	Depth	Type	Results								
	0.40	ES		0.60			MADE GROUND: Topsoil, dark brown, slightly clayey, sandy LOAM. TS				
	0.80	ES					1.00			Firm, orangish brown mottled grey, very sandy, gravelly CLAY. Gravel is subangular to rounded, fine to coarse of sandstone, mudstone and coal.	
	1.20 1.20	B ES								1.65	
	2.20 2.20	B ES		3.00			Purplish brown, clayey, slightly gravelly, medium to coarse SAND. Gravel is subrounded to rounded, fine to coarse of coal, mudstone, sandstone and coal with a low cobble content of sandstone.				
	End of pit at 3.00 m										
Remarks: 1) Groundwater encountered at 1.80m bgl 2) Terminated at required depth of 3.00m bgl.											
Stability: Stable											

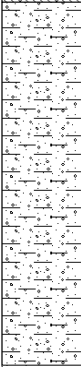
				Trial Pit Log			Trialpit No TP16 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 26/10/2019
Location: Wrexham				Dimensions (m):		3 		Scale 1:25
Client: Tier Consult Ltd				Depth 3.00		0.6 		Logged ER
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	ES		0.50			MADE GROUND: Topsoil, dark brown, slightly clayey, sandy LOAM with frequent rootlets. TS	
	0.70	ES					Light brown, very clayey, slightly gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse of mudstone, coal and sandstone.	
		1.20	ES		1.10			Firm, dark orangish brown, very sandy, gravelly CLAY. Gravel is subangular to rounded, fine to coarse of mudstone, sandstone and coal with a low cobble content of sandstone and mudstone. (Interbedded with orange brown, very clayey, fine to coarse SAND).
				3.00		End of pit at 3.00 m		
1 2 3 4 5								
Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 3.00m bgl.								
Stability: Stable								

				Trial Pit Log			Trialpit No TP17 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 27/09/2019
Location: Wrexham				Dimensions (m):		2 0.6		Scale 1:25
Client: Tier Consult Ltd				Depth 1.50		Logged ER		

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.40			MADE GROUND: Topsoil, dark brown, slightly clayey, sandy, slightly gravelly LOAM. Gravel os subrounded to rounded, fine to medium of coal and sandstone, with frequent rootlets. TS
				1.50			Stiff, orangish dark brown, sandy, gravelly CLAY. Gravel is subangular to rounded, fine to coarse of coal, sandstone, mudstone with a low cobble content of sandstone and mudstone. (Frequent clods of clay)
							----- End of pit at 1.50 m

Remarks: 1) No groundwater ingress encountered.) Terminated at required depth of 1.50m bgl.		
Stability: Stable		

				Trial Pit Log			Trialpit No TP18 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: - Level:		Date 27/09/2019
Location: Wrexham				Dimensions (m):		2 0.6		Scale 1:25
Client: Tier Consult Ltd				Depth 1.50		Logged ER		

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30			MADE GROUND: Topsoil, dark brown, sandy, slightly gravelly, clayey LOAM with frequent rootlets. TS
				1.50			Firm, orangish brown mottled grey, sandy, locally very sandy, gravelly CLAY. Gravel is subangular to rounded, fine to coarse of sandstone, mudstone, coal, with a low cobble content of coal, mudstone and sandstone.
							End of pit at 1.50 m

Remarks: 1) No groundwater ingress encountered. 2) Terminated at required depth of 1.50m bgl.

 Stability: Stable



					Borehole Log			Borehole No. WS01 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		
Client: Tier Consult Ltd					Dates: 24/09/2019 -		Logged By ER		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.45		MADE GROUND: Topsoil, dark brown, sandy clay LOAM. TS		
		0.80	ES		0.95		MADE GROUND: Firm, dark brown and grey, slightly sandy, slightly gravelly CLAY. Gravel is subangular, fine to medium of sandstone.		
		1.20 1.20 - 1.65	SPTL S	N=9 (2,2/2,3,2,2)			MADE GROUND Firm becoming stiff, dark brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of mudstone and sandstone. <i>Firm becoming stiff consistency from 1.10m bgl.</i>	1	
		2.00 2.00 - 2.45	SPTL S	N=19 (1,2/2,3,6,8)				2	
		3.00 3.00 - 3.45	SPTL S	N=8 (1,2/1,2,2,3)	3.20			3	
		3.40 3.40 - 3.85	SPTL S	N=15 (8,2/2,3,3,7)			Stiff, dark brown, sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of sandstone, mudstone and coal with a low cobble content of subangular sandstone.		
		4.00 4.00 - 4.45	SPTL S	N=23 (5,4/4,5,6,8)	4.45			4	
							End of borehole at 4.45 m	5	
								6	
								7	
								8	
								9	
								10	

Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater ingress encountered. 3) Terminated at required depth of 4.45m bgl.		
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					Borehole Log			Borehole No. WS02 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		
Client: Tier Consult Ltd					Dates: 24/09/2019 -		Logged By ER		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30		MADE GROUND: Topsoil, dark brown, sandy, clayey LOAM with frequent rootlets. TS		
		0.50	ES				MADE GROUND: Stiff, orangish brown and light brown, sandy, slightly gravelly CLAY. Gravel is angular to subangular, fine to coarse of brick, sandstone and mudstone with a low cobble content of sandstone and brick.	1	
		1.20	SPTL S	N=11 (2,3/2,3,3,3)	1.15		MADE GROUND		
		1.20 - 1.65				Firm, locally stiff, orangish brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of sandstone, coal and mudstone.	2		
		2.00	SPTL S	N=18 (4,3/3,6,4,5)				3	
		2.00 - 2.45						4	
	3.00	SPTL S	N=21 (3,4/5,5,5,6)						
	3.00 - 3.45								
	4.00	SPTL S	N=21 (4,4/5,5,5,6)						
	4.00 - 4.45								
					4.45		End of borehole at 4.45 m		
								5	
								6	
								7	
								8	
								9	
								10	

Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater ingress encountered. 3) Terminated at required depth of 4.45 m bgl.		
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					Borehole Log			Borehole No. WS03 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		
Client: Tier Consult Ltd					Dates: 24/09/2019 -		Logged By ER		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.25	ES		0.40		MADE GROUND: Topsoil, dark brown, slightly sandy, clayey LOAM with frequent rootlets. TS		
		0.60	ES		0.70		MADE GROUND: Firm, orangish brown and grey, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to medium of sandstone and mudstone.	1	
		1.20	SPTL S	N=12 (2,3/1,3,3,5)	1.30		MADE GROUND		
	1.20 - 1.65	Loose, orangish brown, slightly clayey, slightly gravelly, fine to medium SAND. Gravel is subangular to subrounded, fine to coarse of sandstone.							
		2.00	SPTL S	N=13 (5,2/3,3,3,4)			Stiff becoming firm at 2.60m bgl, orangish brown, slightly sandy, slightly gravelly CLAY. Gravel is subrounded, fine to coarse of coal, sandstone and mudstone.	2	
	2.00 - 2.45								
	3.00	SPTL S	N=14 (3,3/2,3,4,5)	3.10		Medium dense, light orangish brown, slightly gravelly, medium to coarse SAND. Gravel is subangular to subrounded, fine to coarse of mudstone and sandstone.	3		
3.00 - 3.45									
	4.00	SPTL S	N=19 (4,4/4,4,5,6)	4.45			4		
4.00 - 4.45									
		End of borehole at 4.45 m						5	
								6	
								7	
								8	
								9	
								10	

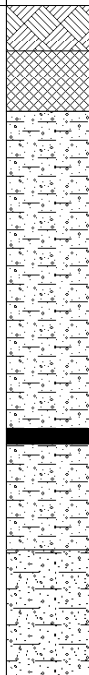
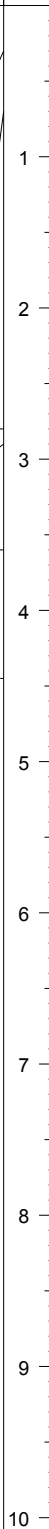
Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Groundwater ingress encountered at 3.00m bgl. 3) Terminated at required depth of 4.45m bgl.		
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					Borehole Log			Borehole No. WS04 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		
Client: Tier Consult Ltd					Dates: 24/09/2019 -		Logged By ER		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.40		 MADE GROUND: Topsoil, dark brown, sandy, clayey LOAM with frequent rootlets. TS	1	
		0.70	ES		0.90				 MADE GROUND: Firm, orangish brown, sandy to very sandy, slightly gravelly CLAY. Gravel is subrounded, fine to medium of sandstone and coal.
		1.20	SPTL S	N=9 (1,1/2,2,2,3)	1.85		 MADE GROUND: Firm, locally stiff, orangish brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to medium of coal, sandstone and mudstone.	2	
		1.20 - 1.65			2.15				 Medium dense, orangish brown, slightly clayey, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to medium of sandstone. With a low cobble content of sandstone and mudstone.
		2.00	SPTL S	N=16 (2,3/3,4,4,5)	2.60		 Firm, orangish brown, sandy, slightly gravelly CLAY. Gravel is subrounded, fine to medium of sandstone and mudstone.	3	
		2.00 - 2.45			2.80				 Lenses of medium sand between 2.40m and 2.50m bgl. Stiff, brown, slightly sandy, CLAY.
3.00	SPTL S	N=24 (3,3/5,5,6,8)	3.80		 Medium dense, light, orangish brown, medium to coarse SAND.	4			
3.00 - 3.45			4.45				End of borehole at 4.45 m		
4.00	SPTL S	N=19 (4,5/3,5,5,6)				5			
4.00 - 4.45							6		
							7		
							8		
							9		
							10		

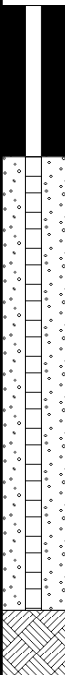
Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Groundwater ingress encountered at 2.80m bgl. 3) Terminated at required depth of 4.45m bgl.		
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					Borehole Log			Borehole No. WS05 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		Logged By ER
Client: Tier Consult Ltd					Dates: 24/09/2019 -				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Topsoil, dark brown, slightly sandy, clayey LOAM.	
		0.60	ES		0.70	MADE GROUND: Firm, orangish brown, sandy to very sandy, slightly gravelly CLAY. Gravel is subangular, fine to coarse of sandstone, coal and mudstone.			
		1.20				MADE GROUND			
		1.20 - 1.65	SPTL S	N=15 (4,3/3,3,4,5)		Stiff, orangish brown, slightly sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of coal, sandstone and mudstone.			
		2.00							
		2.00 - 2.45	SPTL S	N=13 (2,2/4,3,3,3)					
		3.00			2.80				
		3.00 - 3.45	SPTL S	N=4 (2,1/1,1,1,1)	2.90	Black, lenses of coal.			
		3.80	ES		3.60	Soft, orangish brown, slightly sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of coal, sandstone and mudstone.			
		4.00	SPTL S	N=10 (2,3/2,2,3,3)		Medium dense, orangish brown, slightly clayey, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse of sandstone.			
			4.45		End of borehole at 4.45 m				

Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater ingress encountered. 3) Terminated at required depth of 4.45m bgl.		
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				Borehole Log			Borehole No. WS06 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham				Level:		Scale 1:50		
Client: Tier Consult Ltd				Dates: 25/09/2019 -		Logged By ER		

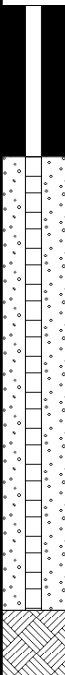
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.40		MADE GROUND: Topsoil, dark brown, slightly sandy, slightly gravelly, clayey LOAM. Frequent rootlets at surface. Gravel is subangular to rounded, fine to coarse of mixed natural lithologies.		
		0.60	ES						
		1.20	SPTL S	N=9 (2,3/2,3,2,2)	1.30		Loose, orangish brown to brown, clayey, gravelly, fine to coarse SAND with a low cobble content. Gravel and cobbles are subrounded to rounded, fine to coarse of mixed natural lithologies.	1	
		1.20 - 1.65							
		2.00	SPTL S	N=7 (1,1/1,2,2,2)	2.00		Loose, brown, slightly gravelly, fine to medium SAND. Gravel subrounded to rounded, fine to medium of mixed natural lithologies.	2	
		2.00 - 2.45							
	3.00	SPTL S	N=6 (2,2/2,1,2,1)	3.00		Loose, brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse of mixed igneous and metamorphic lithologies.	3		
	3.00 - 3.45								
	4.00	SPTL S	N=7 (2,2/2,1,2,2)	4.45		End of borehole at 4.45 m	4		
	4.00 - 4.45								

Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater ingress encountered. 3) Terminated at required depth of 4.45m bgl.		
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					Borehole Log			Borehole No. WS07 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		Logged By ER
Client: Tier Consult Ltd					Dates: 25/09/2019 -				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.40			MADE GROUND: Topsoil, dark brown, slightly sandy, slightly gravelly, clayey LOAM with frequent rootlets at the surface. TS	
		1.00	ES		0.90			Medium dense, orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse of sandstone and mudstone with a low cobble content of sandstone and mudstone.	1
		1.20		N=20 (3,4/3,6,6,5)					
		1.20 - 1.65	SPTL S						
		2.00		N=25 (6,7/6,7,5,7)					2
		2.00 - 2.45	SPTL S						
		3.00		N=17 (5,5/4,3,5,5)					3
		3.00 - 3.45	SPTL S						
		4.00		N=30 (4,5/5,7,9,9)					4
		4.00 - 4.45	SPTL S		4.45				
		End of borehole at 4.45 m							5
									6
									7
									8
									9
									10

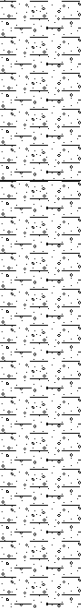
Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater ingress encountered. 3) Terminated at required depth of 4.45m bgl.		
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					Borehole Log			Borehole No. WS08 Sheet 1 of 1				
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS			
Location: Wrexham					Level:		Scale 1:50		Logged By ER			
Client: Tier Consult Ltd					Dates: 25/09/2019 -							
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
		Depth (m)	Type	Results								
		0.20	ES		0.40		 MADE GROUND: Topsoil, dark brown, sandy, clayey LOAM with frequent rootlets. TS	 Firm, dark brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of sandstone and mudstone.	 Loose, Light brown, slightly clayey, slightly gravelly, fine to medium SAND. Gravel is subrounded, fine to medium of sandstone.	1		
		1.20	ES	N=5 (1,1/2,2,1,0)	1.10							
		1.20 - 1.65	SPTL S									
		2.00	SPTL S	N=7 (1,2/1,2,2,2)								
		2.00 - 2.45	SPTL S									
		3.00	SPTL S	N=23 (2,4/5,6,6,6)			 Becoming medium dense below 3.00m bgl.			2		
		3.00 - 3.45	SPTL S							3		
		4.00	SPTL S	N=19 (1,1/2,3,5,9)	4.45					4		
		4.00 - 4.45	SPTL S							5		
End of borehole at 4.45 m										6		
										7		
										8		
										9		
										10		

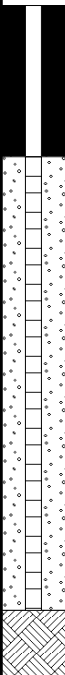
Remarks
 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Groundwater ingress encountered at 1.20m bgl. 3) Terminated at required depth of 4.45m bgl.



					Borehole Log			Borehole No. WS09 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		Logged By ER
Client: Tier Consult Ltd					Dates: 25/09/2019 -				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30					 MADE GROUND: Topsoil, dark brown, slightly sandy, clayey LOAM. TS	Firm, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse of sandstone and mudstone.	1
		1.20 1.20 - 1.65	SPTL S	N=13 (1,1/8,1,2,2)	1.60				 Firm, sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of sandstone, mudstone and quartz.
		2.00 2.00 - 2.45	SPTL S	N=2 (1,0/0,1,1,0)			3		
		3.00 3.00 - 3.45	SPTL S	N=6 (1,0/1,1,2,2)			4		
		4.00 4.00 - 4.45	SPTL S	N=12 (3,2/3,3,3,3)	4.45		End of borehole at 4.45 m	5	
									6
									7
									8
									9
									10

Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Groundwater ingress encountered at 1.90m bgl. 3) Terminated at refusal of 4.45m bgl.		
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					Borehole Log			Borehole No. WS10 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		Logged By ER
Client: Tier Consult Ltd					Dates: 27/09/2019 -				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30		 MADE GROUND: Topsoil, dark brown, sandy, clayey LOAM with frequent rootlets. TS		
		0.80	ES				 Firm, orangish brown, sandy, gravelly CLAY. Gravel is subrounded to rounded, fine to coarse of sandstone, coal, mudstone and quartz.		
		1.20		N=11 (1,2/4,2,2,3)			 <i>Becomes soft at 1.35m bgl.</i>		
		1.60	ES		1.50		 Medium dense, orangish brown, very clayey, slightly gravelly, medium SAND. Gravel is subrounded to rounded, fine to medium of sandstone, mudstone and quartz.		
		2.00		N=6 (1,1/1,1,2,2)	1.95		 Soft, orangish brown, very sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of sandstone and mudstone.		
		3.00		N=2 (1,1/0,0,1,1)	2.60		 Very loose, orangish brown, clayey, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse of sandstone and mudstone		
		4.00		N=13 (1,2/2,3,4,4)			 <i>Becoming medium dense below 4.00m bgl.</i>		
				4.45		End of borehole at 4.45 m			

Remarks
 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater ingress encountered. 3) Terminated at required depth of 4.45m bgl.





Borehole Log

Borehole No.

WS10a

Sheet 1 of 1

Project Name: Land at Rhosrobin

Project No.
TE1239

Co-ords: -

Hole Type
WLS

Location: Wrexham

Level:

Scale
1:50

Client: Tier Consult Ltd

Dates: 25/09/2019 -

Logged By
ER

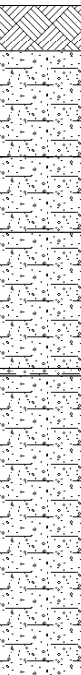
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.40			MADE GROUND: Topsoil, dark brown, slightly sandy, clayey LOAM with frequent rootlets. TS	
					0.65			Firm consistency, orangish brown, sandy to very sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to medium of sandstone and mudstone.	1
		1.20 1.20 - 1.65	SPTL S	N=4 (1,0/1,0,1,2)				Loose, orangish brown and grey, slightly clayey, gravelly, fine to coarse SAND.	
		2.00 2.00 - 2.45	SPTL S	N=7 (1,1/1,1,2,3)					2
		3.00 3.00 - 3.45	SPTL S	N=8 (2,2/2,2,1,3)					3
		4.00 4.00	SPTL S	N=7 (2,3/2,1,2,2)	4.45				4
		End of borehole at 4.45 m							5
									6
									7
									8
									9
									10

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater ingress encountered. 3) Terminated at required depth of 4.45m bgl.



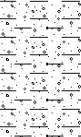
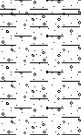
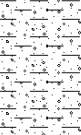
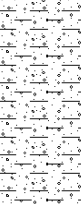


					Borehole Log			Borehole No. WS12 Sheet 1 of 1		
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS	
Location: Wrexham					Level:		Scale 1:50		Logged By BF	
Client: Tier Consult Ltd					Dates: 26/09/2019 -					
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.20	ES		0.30			MADE GROUND: Topsoil, dark brown, slightly sandy, slightly gravelly, clayey LOAM with frequent rootlets a the surface. Gravel is angular to subrounded, fine to coarse of mixed natural lithologies including quartz.		
		0.60	ES					TS		
		1.20			N=5 (2,2/2,1,1,1)	1.00			Orangish brown, slightly gravelly, slightly clayey, fine to coarse SAND. Gravel is subrounded to rounded, fine to coarse of mixed natural lithologies including quartz.	1
		1.20 - 1.65	SPTL S			1.50			Soft, brown mottled orangish brown and grey, slightly gravelly, sandy CLAY. Gravels are angular to subrounded, fine to coarse of coal and mixed natural lithologies including quartz.	
		2.00			N=15 (2,2/3,4,4,4)				Medium dense, brown, slightly clayey, slightly gravelly, fine to coarse SAND. Gravel is angular to subrounded, fine to coarse of coal and mixed natural lithologies including quartz.	2
		2.00 - 2.45	SPTL S			2.40				
		2.45								
		3.00			N=21 (3,4/4,5,6,6)				Firm, reddish brown, slightly sandy, slightly gravelly, CLAY. Gravel is angular to subrounded, fine to coarse of coal, mudstone and mixed natural lithologies including quartz.	3
		3.00 - 3.45	SPTL S						Medium dense, light brown, slightly clayey, slightly gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse of mixed natural lithologies.	4
		4.00			N=3 (1,0/1,1,0,1)				Clayey from 3.00m bgl. Rare gravels from 3.20m bgl. Becomes very loose below 4.00m bgl.	
4.00 - 4.45	SPTL S			4.45		End of borehole at 4.45 m				
								5		
								6		
								7		
								8		
								9		
								10		

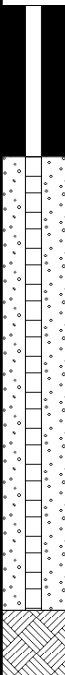
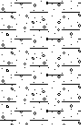
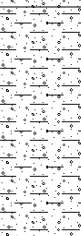
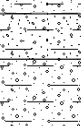
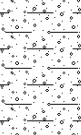
Remarks
 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Groundwater ingress encountered at 1.05m bgl. 3) Terminated at depth required of 4.45m bgl.



					Borehole Log			Borehole No. WS13 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		
Client: Tier Consult Ltd					Dates: 26/09/2019 -		Logged By ER		

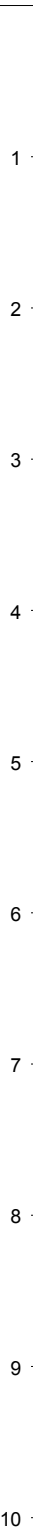
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30		 MADE GROUND: Topsoil, dark brown, sandy, slightly clayey, LOAM. TS		
		1.20 1.20 - 1.65	SPTL S	N=8 (1,2/1,2,2,3)	1.40		 Firm, orangish brown, sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse of sandstone, mudstone and coal.	1	
		2.00 2.00 - 2.45	SPTL S	N=7 (1,1/1,2,2,2)			 Lens of fine to medium SAND at 1.30m to 1.40m bgl. Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of mudstone and sandstone.	2	
		3.00 3.00 - 3.45	SPTL S	N=13 (2,2/3,3,3,4)			 Bed of angular, coarse GRAVEL of mudstone at 2.20m to 2.40m bgl.	3	
		4.00 4.00 - 4.45	SPTL S	N=10 (4,3/2,2,3,3)	4.45		 End of borehole at 4.45 m	4	
								5	
								6	
								7	
								8	
								9	
								10	

Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater ingress encountered. 3) Terminated at required depth of 4.45m bgl.		
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					Borehole Log			Borehole No. WS14 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		Logged By ER
Client: Tier Consult Ltd					Dates: 26/10/2019 -				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30		 MADE GROUND: Topsoil, dark brown, sandy, slightly clayey LOAM. TS		
		1.20 1.20 - 1.65	SPTL S	N=10 (2,2/3,2,2,3)	1.20		 Firm, orangish brown, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of coal, sandstone and mudstone.		
		2.00 2.00 - 2.45	SPTL S	N=12 (2,1/3,2,3,4)			 Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse of coal, sandstone and mudstone.		
		3.00 3.00 - 3.45	SPTL S	N=41 (9,9/11,12,10,8)	2.80 3.10		 Dense, orangish brown, slightly clayey, gravelly, medium to coarse SAND. gravel is subangular to rounded, fine to coarse of sandstone and mudstone with a low cobble content of sandstone.		
		4.00 4.00 - 4.45	SPTL S	N=2 (2,2/1,0,1,0)	4.45		 Dense, brown and grey, sandy to very sandy, slightly clayey fine to coarse GRAVEL. Gravel is angular to subrounded, of mudstone and sandstone. <i>Becoming very loose below 4.00m bgl.</i>		
End of borehole at 4.45 m									
Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No Groundwater ingress encountered. 3) Terminated at required depth of 4.45m bgl.									



					Borehole Log			Borehole No. WS15 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		
Client: Tier Consult Ltd					Dates: 26/09/2019 -		Logged By ER		

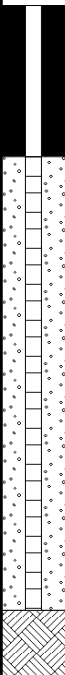
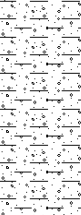
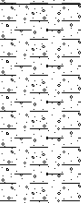
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	ES		0.25		 MADE GROUND: Topsoil, dark brown, sandy, slightly clayey LOAM. Frequent rootlets. TS		
		1.20					 Firm, orangish brown, slightly sandy, slightly gravelly CLAY. Gravel is subrounded to rounded, fine to coarse of coal, sandstone and mudstone.		
		1.20 - 1.65	SPTL S	N=8 (1,2/2,2,2,2)	1.60				
		2.00			1.90		 Orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subrounded to rounded, fine to medium of sandstone, mudstone, quartz and coal.		
		2.00 - 2.45	SPTL S	N=8 (3,2/1,2,2,3)			 Firm, orangish brown, sandy, slightly gravelly CLAY. Gravel is subrounded to rounded, fine to medium of sandstone and mudstone.		
		2.10	ES		2.70		 Lens of medium SAND at 2.10m to 2.30m bgl. Soft, locally firm, brown, sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse of sandstone and mudstone.		
		3.00							
		3.00 - 3.45	SPTL S	N=12 (1,1/2,3,3,4)					
		4.00							
		4.00 - 4.45	SPTL S	N=8 (1,1/1,2,2,3)	4.45				
End of borehole at 4.45 m									

Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Groundwater ingress encountered at 2.00m bgl. 3) Terminated at required depth of 4.45 m bgl.		
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					Borehole Log			Borehole No. WS16 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		Logged By ER
Client: Tier Consult Ltd					Dates: 27/09/2019 -				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.35		MADE GROUND: Topsoil, brown, sandy, slightly clayey LOAM. Frequent rootlets. TS	1	
		0.60	ES				 Firm, orangish brown, sandy, gravelly, CLAY. Gravel is subangular to rounded, fine to coarse of coal, mudstone and sandstone.		
		1.20 1.20 - 1.65	SPTL S	N=8 (1,2/1,2,2,3)	1.30		Firm, orangish brown, slightly sandy, slightly gravelly CLAY. Gravel is subrounded to rounded, fine to coarse of coal and sandstone.	2	
		2.00 2.00 - 2.45	SPTL S	N=9 (1,2/1,2,3,3)	1.90		Loose, orangish brown, very clayey, slightly gravelly, fine to medium SAND. Gravel is subangular to subrounded, fine to coarse of sandstone, mudstone and coal.		
		3.00 3.00 - 3.45	SPTL S	N=8 (3,2/2,2,2,2)	2.50		Firm, orangish brown, sandy, slightly gravelly CLAY. Gravel is subrounded to rounded, fine to coarse of mudstone, coal and sandstone.	3	
		3.90 4.00 4.00 - 4.45	ES SPTL S	N=6 (2,2/1,2,1,2)	3.85		Loose, dark orangish brown, clayey, gravelly, coarse SAND. Gravel is angular to subrounded, fine to coarse of quartz, coal, sandstone and mudstone.		
				4.45		End of borehole at 4.45 m		4	
								5	
								6	
								7	
								8	
								9	
								10	

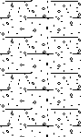
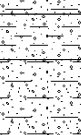
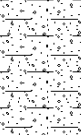
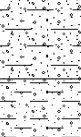
Remarks
 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Groundwater ingress encountered at 3.10m bgl. 3) Terminated at required depth of 4.45m bgl.



				Borehole Log			Borehole No. WS17 Sheet 1 of 1		
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: -		Hole Type WLS	
Location: Wrexham				Level:		Scale 1:50			
Client: Tier Consult Ltd				Dates: 27/09/2019 -		Logged By ER			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.40		 MADE GROUND: Topsoil, dark brown, sandy, clayey LOAM. Frequent rootlets. TS	1	
		1.20 1.20 - 1.65	SPTL S ES	N=7 (1,1/1,2,2,2)		 Firm, orangish brown, sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine to coarse of coal, quartz, mudstone and sandstone.			
		1.30			1.85			2	
		2.00 2.00 - 2.45	SPTL S	N=8 (1,2/2,2,2,2)		 Firm, dark greyish brown, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse, of mudstone, sandstone and coal.			
		3.00 3.00 - 3.45	SPTL S ES	N=14 (1,6/3,3,4,4)	3.20			3	
		3.30							
	4.00 4.00 - 4.45	SPTL S	40 (5,10/40 for 205mm)	4.45		 Medium dense, dark greyish brown, gravelly to very gravelly, coarse SAND. Gravel is angular to subrounded, fine to coarse of mudstone and coal.	4		
							End of borehole at 4.45 m	5	
								6	
								7	
								8	
								9	
								10	

Remarks
 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Groundwater ingress encountered at 2.00m bgl. 3) Terminated at required depth of 4.45m bgl.

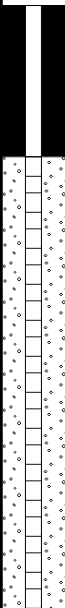
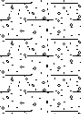


					Borehole Log			Borehole No. WS18 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		Logged By ER
Client: Tier Consult Ltd					Dates: 27/09/2019 -				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30		 MADE GROUND: Topsoil, brown, slightly clayey, sandy LOAM. TS		
		1.20					 Loose, dark brownish grey, slightly clayey, gravelly, fine to medium SAND. Gravel is subrounded, fine to medium of sandstone, mudstone and coal.	1	
	1.20 - 1.65	SPTL S	N=7 (1,2/2,2,1,2)	1.40					
	1.40	ES		1.70					
		2.00					 Soft, dark brownish grey, slightly sandy, slightly gravelly CLAY. Gravel is subrounded to rounded, fine to medium of sandstone, coal and mudstone.	2	
	2.00 - 2.45	SPTL S	N=15 (1,2/4,4,4,3)						
	2.70	ES							
		3.00					 Medium dense, dark grey, slightly clayey, gravelly, fine to coarse SAND. Gravel is subrounded to rounded, fine to coarse of sandstone, mudstone and coal with a low cobble content of sandstone.	3	
	3.00 - 3.45	SPTL S	N=11 (2,2/2,3,3,3)						
		3.60							
	4.00					 Soft, dark grey, slightly sandy, slightly gravelly CLAY. gravel is subrounded to rounded, fine to medium of sandstone and mudstone <i>Lens of medium sand 3.65m to 3.75m bgl.</i>	4		
4.00 - 4.45	SPTL S	N=5 (2,2/2,1,1,1)	4.45						
		End of borehole at 4.45 m							5
									6
									7
									8
									9
									10

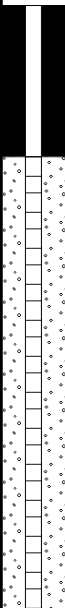
Remarks
 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater ingress encountered. 3) Terminated at required depth of 4.45m bgl.



				Borehole Log			Borehole No. WS19 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham				Level:		Scale 1:50		
Client: Tier Consult Ltd				Dates: 17/10/2019 -		Logged By ER		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.35		 MADE GROUND: Dark brown, slightly clayey, slightly gravelly LOAM. Frequent rootlets at the surface.  MADE GROUND		
					1.45		 Light orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse of sandstone, quartz and quartzite with a low cobble content of subrounded to rounded, medium sandstone.	1	
					1.60		 Brown, slightly clayey, very sandy, medium to coarse of quartzite, quartz, sandstone and mudstone.		
							 Light brown, gravelly, fine to coarse SAND. Gravel is subrounded to rounded, fine to coarse of mudstone, quartz, sandstone and igneous lithologies.	2	
					3.20		 Light brown, gravelly, fine to coarse SAND. Gravel is subrounded to rounded, fine to coarse of coal.		3
					3.65		 Light brown, slightly gravelly, fine to coarse SAND. Gravel is subrounded to rounded, fine to coarse of sandstone, coal and quartz.		4
				4.00		End of borehole at 4.00 m			
Remarks 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater encountered. 3) Terminated at target depth of 4.00m bgl.									



					Borehole Log			Borehole No. WS20 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. TE1239		Co-ords: -		Hole Type WLS
Location: Wrexham					Level:		Scale 1:50		Logged By ER
Client: Tier Consult Ltd					Dates: 17/10/2019 -				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20		 MADE GROUND: Dark brown, slightly clayey, sandy, slightly gravelly LOAM. Gravel is fine to medium, subrounded to rounded of sandstone. Frequent rootlets at the surface.	 MADE GROUND Brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is rounded, fine to coarse of sandstone, quartz, mudstone and quartzite.	1
					1.40 1.55		 Light brown, slightly clayey, slightly gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse of coal, quartz, quartzite and sandstone.		2
					3.10		 Light orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is rounded, fine to coarse of coal, quartzite and sandstone with a moderate cobble content of sandstone and mudstone. <i>Becomes clayey at 1.90m bgl.</i> <i>Cobbles lenses of rounded, sandstone, mudstone, quartzite and igneous lithologies from 2.65m to 2.80m bgl</i>		3
					4.00		 Light brown, slightly gravelly, fine to coarse SAND. Gravel is subrounded to rounded, medium to coarse of coal, sandstone, quartz and mudstone.		4
							End of borehole at 4.00 m		5
									6
									7
									8
									9
									10

Remarks
 1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) No groundwater encountered. 3) Terminated at target depth of 4.00m bgl.

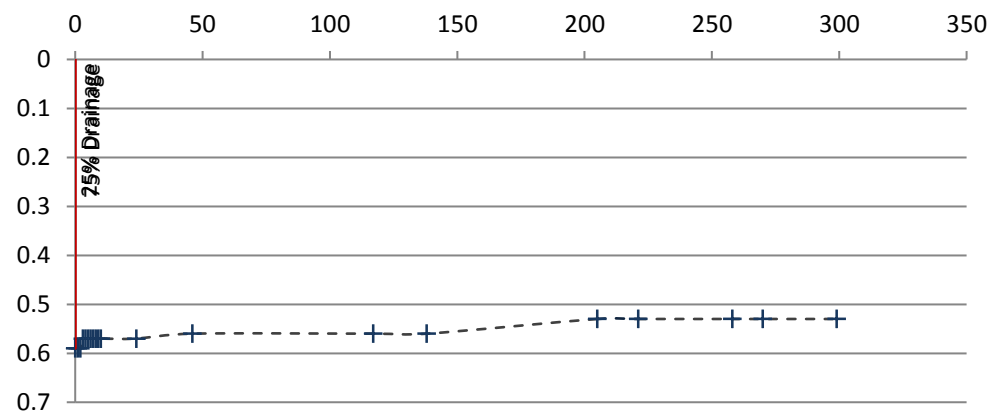


APPENDIX C.1 - INFILTRATION TEST RESULTS

	Terra 97 Ltd	Test ID:	SA1.1
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	26/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	1 of 2
		Comments:	Adverse weather .Surface water filling up excavation

Soakage Pit Width [m]	0.6
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.5
Depth to water at start of test bgl [m]	0.59
Effective Storage Depth [m]	0.91
Free Volume [%]	100

Effective Depth at 25% Drainage	0.8175
Effective Depth at 75% Drainage	1.2725
Time to Drain From 25% to 75% [s]	N/A
Internal Surface Area [m ²]	3.566
Effective Storage Volume [m ³]	0.546
Test Completion [%]	0%



Soil infiltration rate(m/s)

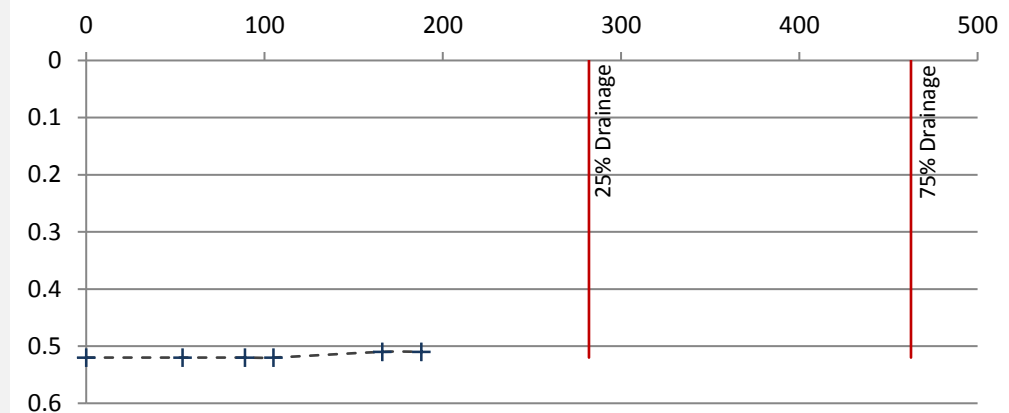
Test failed. Estimated to take at least 24 hours for drainage.

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	1	2	3	4	5	6	7	8	9	10	24	46	117	138	205	221	258	270	299
Depth to water [m]	0.59	0.59	0.59	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.56	0.56	0.56	0.53	0.53	0.53	0.53	0.53

	Terra 97 Ltd	Test ID:	SA1.2
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	27/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	2 of 2
		Comments:	Falling

Soakage Pit Width [m]	0.6
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.5
Depth to water at start of test bgl [m]	0.52
Effective Storage Depth [m]	0.98
Free Volume [%]	100



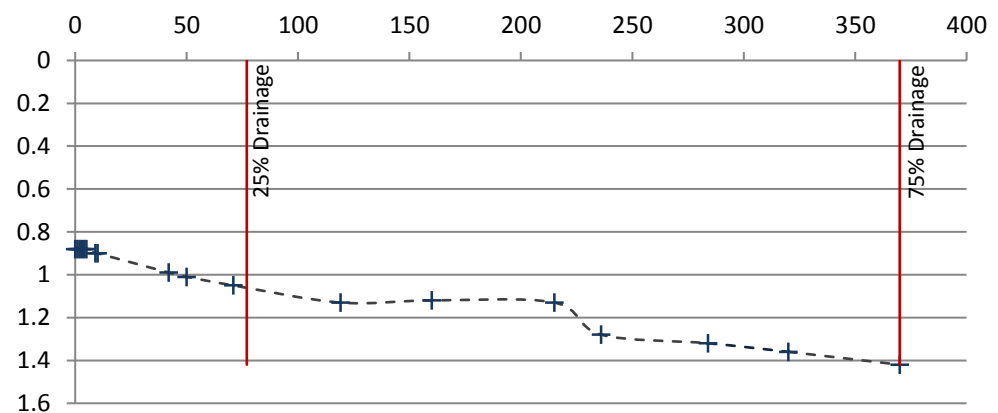
Test failed. Estimated to take at least 24 hours for drainage.

[illegible]

	Terra 97 Ltd	Test ID:	SA2.1
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	26/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	1 of 2
		Comments:	Water filling pit from surface

Soakage Pit Width [m]	0.6
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.6
Depth to water at start of test bgl [m]	0.88
Effective Storage Depth [m]	0.72
Free Volume [%]	100

Effective Depth at 25% Drainage	1.06
Effective Depth at 75% Drainage	1.42
Time to Drain From 25% to 75% [s]	17580
Internal Surface Area [m ²]	3.072
Effective Storage Volume [m ³]	0.432
Test Completion [%]	100%



Soil infiltration rate(m/s)

8.00E-06

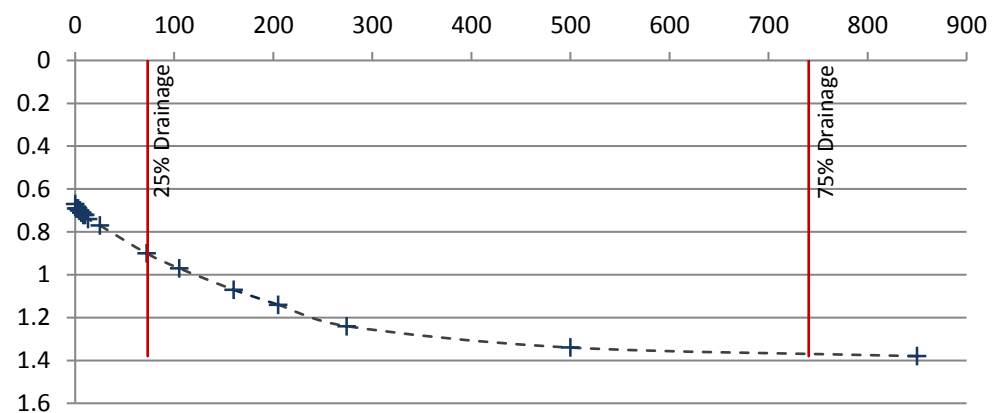
SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	1	2	3	4	5	9	10	42	50	71	119	160	215	236	284	320	370		
Depth to water [m]	0.88	0.88	0.88	0.88	0.88	0.88	0.9	0.9	0.99	1.01	1.05	1.13	1.12	1.13	1.28	1.32	1.36	1.42		

	Terra 97 Ltd	Test ID:	SA2.2
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	27/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	2 of 2
		Comments:	

Soakage Pit Width [m]	0.6
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.6
Depth to water at start of test bgl [m]	0.67
Effective Storage Depth [m]	0.93
Free Volume [%]	100

Effective Depth at 25% Drainage	0.9025
Effective Depth at 75% Drainage	1.3675
Time to Drain From 25% to 75% [s]	40047
Internal Surface Area [m ²]	3.618
Effective Storage Volume [m ³]	0.558
Test Completion [%]	100%



Soil infiltration rate(m/s)

3.85E-06

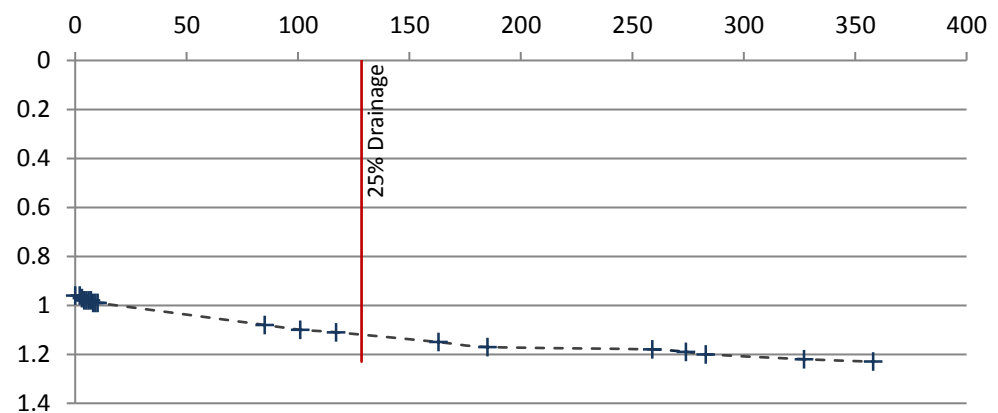
SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	1	2	3	4	5	6	7	8	9	10	13	25	72	105	160	205	274	500	850
Depth to water [m]	0.67	0.69	0.69	0.69	0.7	0.7	0.71	0.71	0.72	0.72	0.72	0.74	0.77	0.9	0.97	1.07	1.14	1.24	1.34	1.38

	Terra 97 Ltd	Test ID:	SA3.1
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	26/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	1 of 2
		Comments:	

Soakage Pit Width [m]	0.6
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.6
Depth to water at start of test bgl [m]	0.96
Effective Storage Depth [m]	0.64
Free Volume [%]	100

Effective Depth at 25% Drainage	1.12
Effective Depth at 75% Drainage	1.44
Time to Drain From 25% to 75% [s]	N/A
Internal Surface Area [m ²]	2.864
Effective Storage Volume [m ³]	0.384
Test Completion [%]	42%



Soil infiltration rate(m/s)

Soakaway failed. Estimated to take at least 16.82 hours to drain 75%

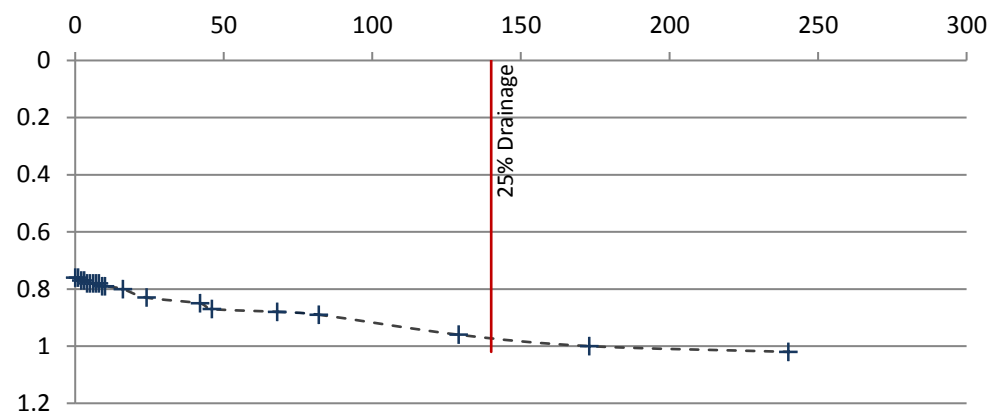
SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	2	3	4	5	6	7	8	9	10	85	101	117	163	185	259	274	283	327	358
Depth to water [m]	0.96	0.96	0.97	0.98	0.98	0.98	0.98	0.99	0.99	0.99	1.08	1.1	1.11	1.15	1.17	1.18	1.19	1.2	1.22	1.23

	Terra 97 Ltd	Test ID:	SA3.2
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	27/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	2 of 2
		Comments:	

Soakage Pit Width [m]	0.6
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.6
Depth to water at start of test bgl [m]	0.76
Effective Storage Depth [m]	0.84
Free Volume [%]	100

Effective Depth at 25% Drainage	0.97
Effective Depth at 75% Drainage	1.39
Time to Drain From 25% to 75% [s]	N/A
Internal Surface Area [m ²]	3.384
Effective Storage Volume [m ³]	0.504
Test Completion [%]	31%



Soil infiltration rate(m/s)

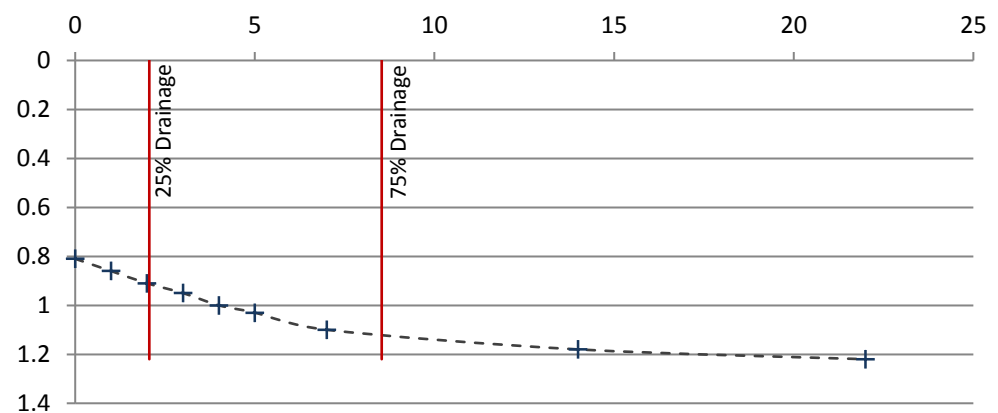
Soakaway failed. Estimated to take at least 24.66 hours to drain 75%

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	1	2	3	4	5	6	7	8	9	10	16	24	42	46	68	82	129	173	240
Depth to water [m]	0.76	0.76	0.77	0.77	0.78	0.78	0.78	0.78	0.78	0.79	0.79	0.8	0.83	0.85	0.87	0.88	0.89	0.96	1	1.02

	Terra 97 Ltd	Test ID:	SA4.1
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	25/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	1 of 3
		Comments:	None

Soakage Pit Width [m]	0.9
Soakage Pit Length [m]	2.1
Soakage Pit Depth [m]	1.22
Depth to water at start of test bgl [m]	0.81
Effective Storage Depth [m]	0.41
Free Volume [%]	100

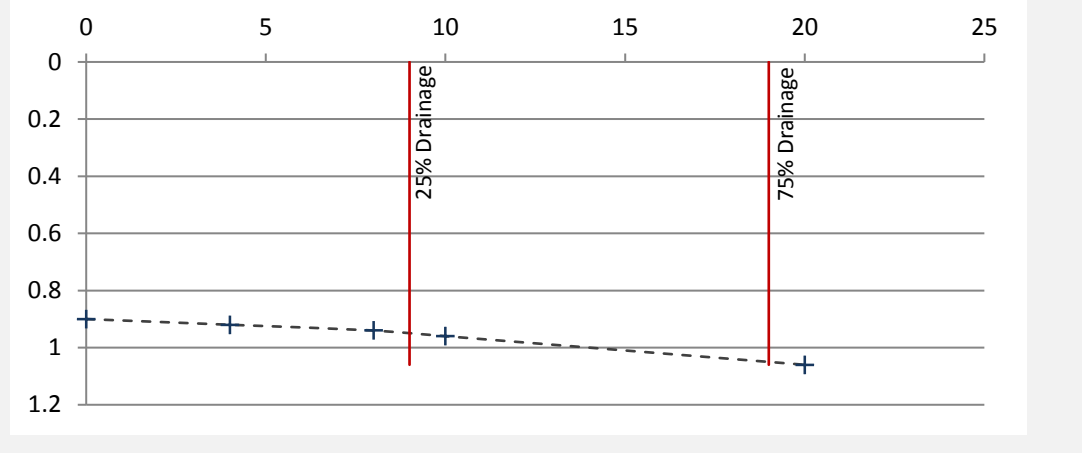


3.20E-04

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

	Terra 97 Ltd	Test ID: SA 4.2 Job Number: C.19.228 Technician: LH Test Date: 25/09/2019 Test Number: 2 of 3 Comments: Pit was collapsing during test.Ended test due to sides fully collapsing
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	
Client:	Tier Environmental Ltd	
Site:	Rhosrobin, Wrexham	

Soakage Pit Width [m]	0.90
Soakage Pit Length [m]	2.10
Soakage Pit Depth [m]	1.10
Depth to water at start of test bgl [m]	0.90
Effective Storage Depth [m]	0.20
Free Volume [%]	100.00
Effective Depth at 25% Drainage	0.95
Effective Depth at 75% Drainage	1.05
Time to Drain From 25% to 75% [s]	600
Internal Surface Area [m ²]	2.49
Effective Storage Volume [m ³]	0.189
Test Completion [%]	100%



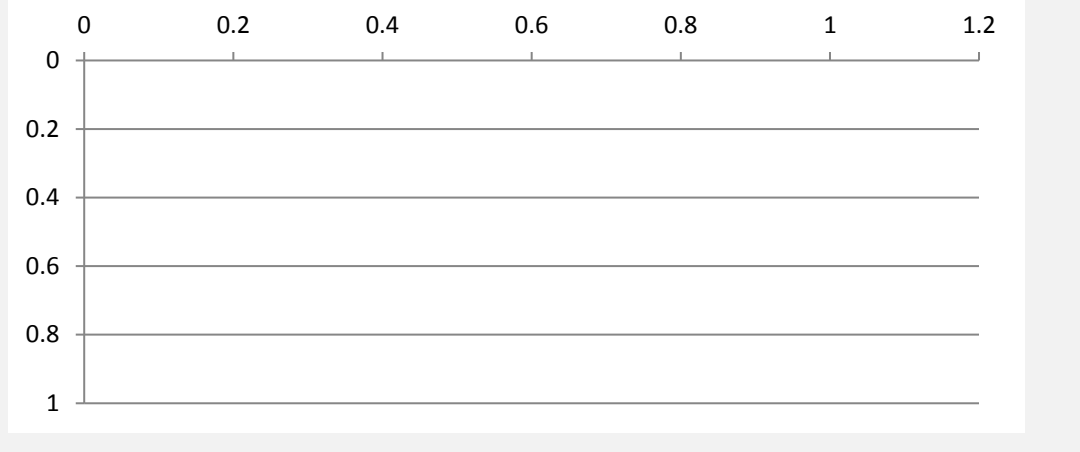
Soil infiltration rate(m/s)	1.27E-04
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SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

[illegible]

	Terra 97 Ltd	Test ID:	SA 4.3
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	26/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	3 of 3
		Comments:	Test not taken due to unstable ground conditions

Soakage Pit Width [m]	
Soakage Pit Length [m]	
Soakage Pit Depth [m]	
Depth to water at start of test bgl [m]	
Effective Storage Depth [m]	0.00
Free Volume [%]	100



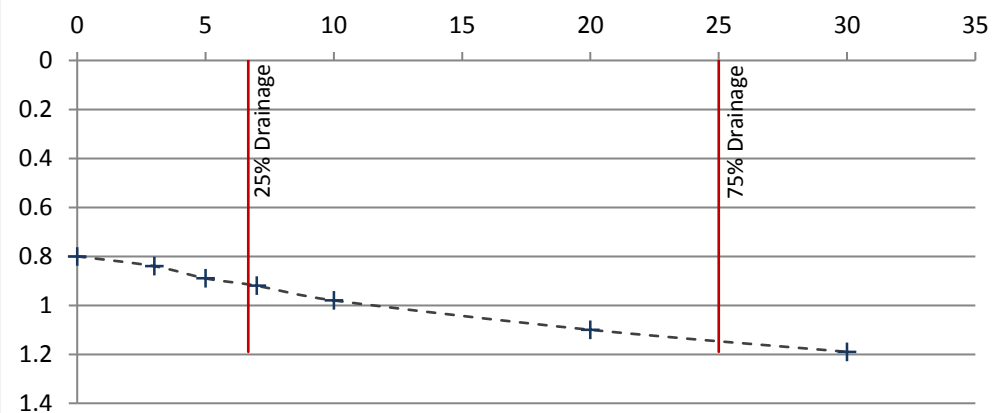
Soil infiltration rate(m/s)	#N/A
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SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

	Terra 97 Ltd	Test ID:	SA5.2
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	25/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	2 of 3
		Comments:	Pit collapsing

Soakage Pit Width [m]	0.6
Soakage Pit Length [m]	2.1
Soakage Pit Depth [m]	1.26
Depth to water at start of test bgl [m]	0.8
Effective Storage Depth [m]	0.46
Free Volume [%]	100

Effective Depth at 25% Drainage	0.915
Effective Depth at 75% Drainage	1.145
Time to Drain From 25% to 75% [s]	1100
Internal Surface Area [m²]	2.502
Effective Storage Volume [m³]	0.2898
Test Completion [%]	100%



Soil infiltration rate(m/s)

1.05E-04

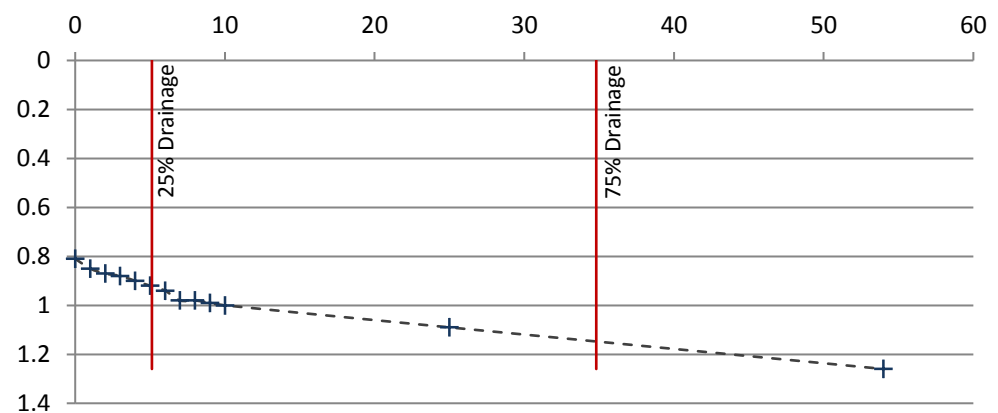
SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

[illegible]

	Terra 97 Ltd	Test ID:	SA5.3
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	26/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	3 of 3
		Comments:	

Soakage Pit Width [m]	0.6
Soakage Pit Length [m]	2.1
Soakage Pit Depth [m]	1.26
Depth to water at start of test bgl [m]	0.81
Effective Storage Depth [m]	0.45
Free Volume [%]	100

Effective Depth at 25% Drainage	0.9225
Effective Depth at 75% Drainage	1.1475
Time to Drain From 25% to 75% [s]	1781
Internal Surface Area [m ²]	2.475
Effective Storage Volume [m ³]	0.2835
Test Completion [%]	100%



Soil infiltration rate(m/s)

6.43E-05

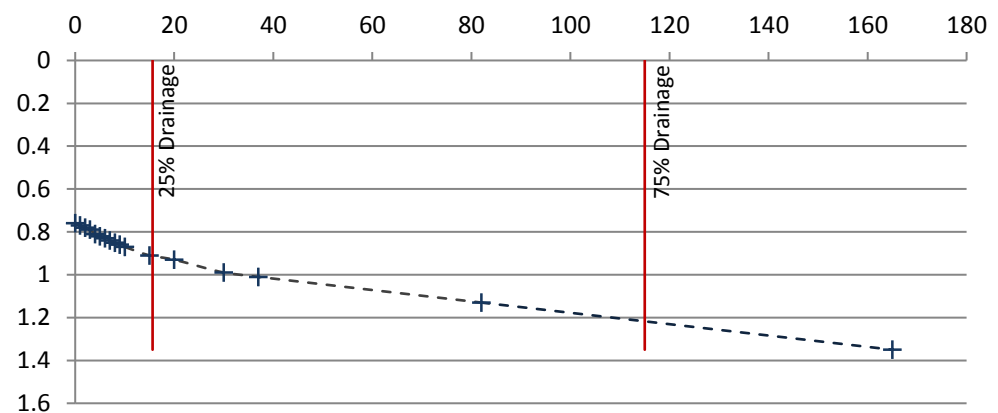
SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	1	2	3	4	5	6	7	8	9	10	25	54							
Depth to water [m]	0.81	0.85	0.87	0.88	0.9	0.92	0.94	0.98	0.98	0.99	1	1.09	1.26							

	Terra 97 Ltd	Test ID:	SA6.1
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	25/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	1 of 3
		Comments:	None

Soakage Pit Width [m]	0.65
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.37
Depth to water at start of test bgl [m]	0.76
Effective Storage Depth [m]	0.61
Free Volume [%]	100

Effective Depth at 25% Drainage	0.9125
Effective Depth at 75% Drainage	1.2175
Time to Drain From 25% to 75% [s]	5963
Internal Surface Area [m ²]	2.9165
Effective Storage Volume [m ³]	0.3965
Test Completion [%]	100%



Soil infiltration rate(m/s)

2.28E-05

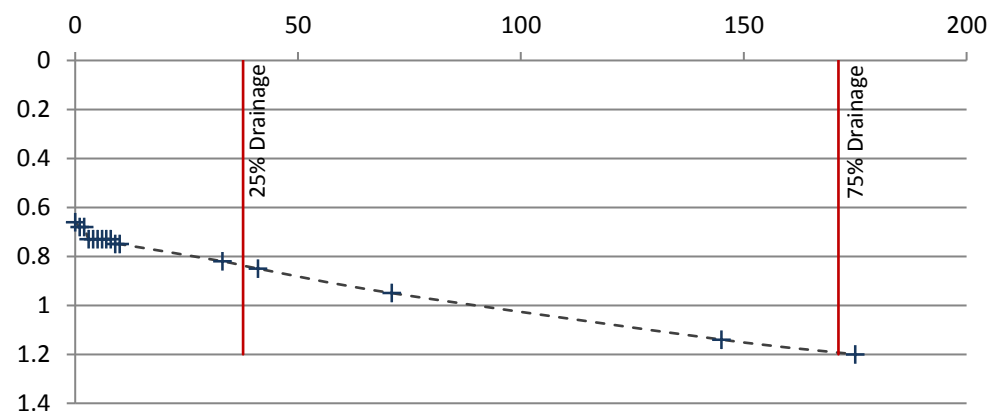
SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	1	2	3	4	5	6	7	8	9	10	15	20	30	37	82	165			
Depth to water [m]	0.76	0.77	0.78	0.79	0.81	0.82	0.83	0.84	0.85	0.86	0.87	0.91	0.93	0.99	1.01	1.13	1.35			

	Terra 97 Ltd	Test ID:	SA6.2
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	25/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	2 of 3
		Comments:	

Soakage Pit Width [m]	0.65
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.37
Depth to water at start of test bgl [m]	0.66
Effective Storage Depth [m]	0.71
Free Volume [%]	100

Effective Depth at 25% Drainage	0.8375
Effective Depth at 75% Drainage	1.1925
Time to Drain From 25% to 75% [s]	8015
Internal Surface Area [m ²]	3.1815
Effective Storage Volume [m ³]	0.4615
Test Completion [%]	100%



Soil infiltration rate(m/s)

1.81E-05

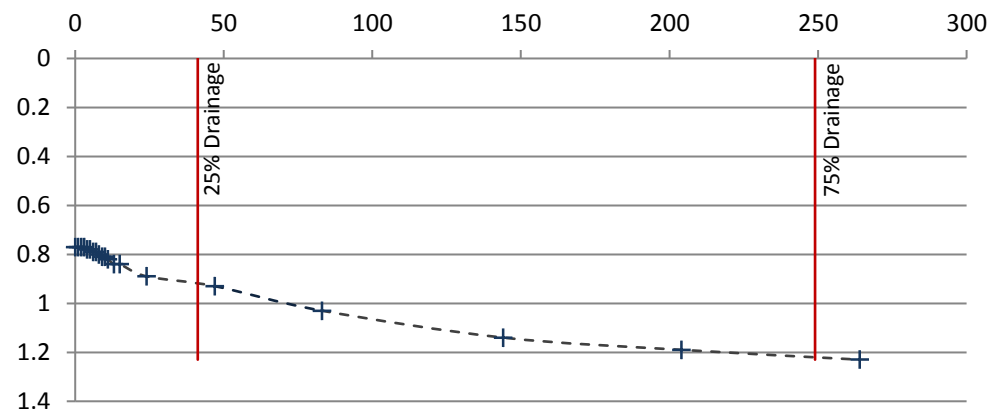
SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	1	2	3	4	5	6	7	8	9	10	33	41	71	145	175				
Depth to water [m]	0.66	0.68	0.68	0.73	0.73	0.73	0.73	0.73	0.73	0.75	0.75	0.82	0.85	0.95	1.14	1.2				

	Terra 97 Ltd	Test ID:	SA6.3
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	26/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	3 of 3
		Comments:	

Soakage Pit Width [m]	0.65
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.37
Depth to water at start of test bgl [m]	0.77
Effective Storage Depth [m]	0.60
Free Volume [%]	100

Effective Depth at 25% Drainage	0.92
Effective Depth at 75% Drainage	1.22
Time to Drain From 25% to 75% [s]	12465
Internal Surface Area [m ²]	2.89
Effective Storage Volume [m ³]	0.39
Test Completion [%]	100%



Soil infiltration rate(m/s)

1.08E-05

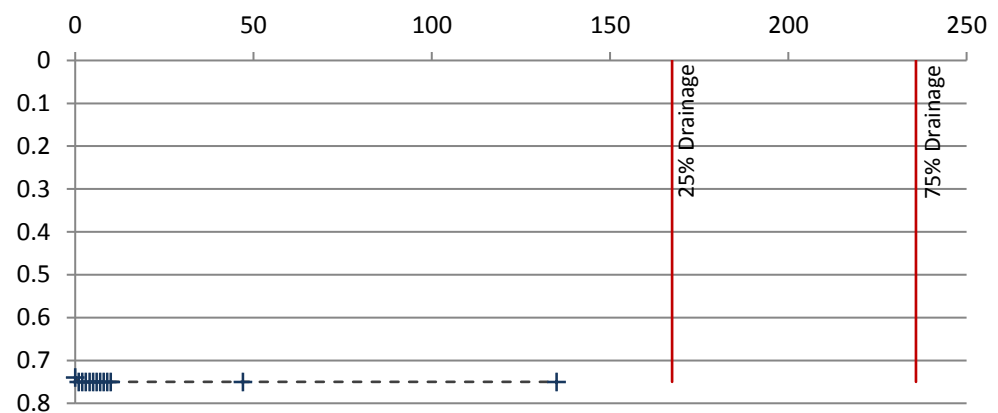
SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	1	2	3	4	5	6	7	8	9	10	11	13	15	24	47	83	144	204	264
Depth to water [m]	0.77	0.77	0.77	0.77	0.78	0.78	0.79	0.79	0.8	0.81	0.81	0.82	0.84	0.84	0.89	0.93	1.03	1.14	1.19	1.23

	Terra 97 Ltd	Test ID:	SA7.1
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	27/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	1 of 1
		Comments:	Adverse weather, heavy rain

Soakage Pit Width [m]	0.6
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.5
Depth to water at start of test bgl [m]	0.74
Effective Storage Depth [m]	0.76
Free Volume [%]	100

Effective Depth at 25% Drainage	0.93
Effective Depth at 75% Drainage	1.31
Time to Drain From 25% to 75% [s]	N/A
Internal Surface Area [m ²]	3.176
Effective Storage Volume [m ³]	0.456
Test Completion [%]	1%



Soil infiltration rate(m/s)

Test failed. Estimated to take at least 24 hours for drainage.

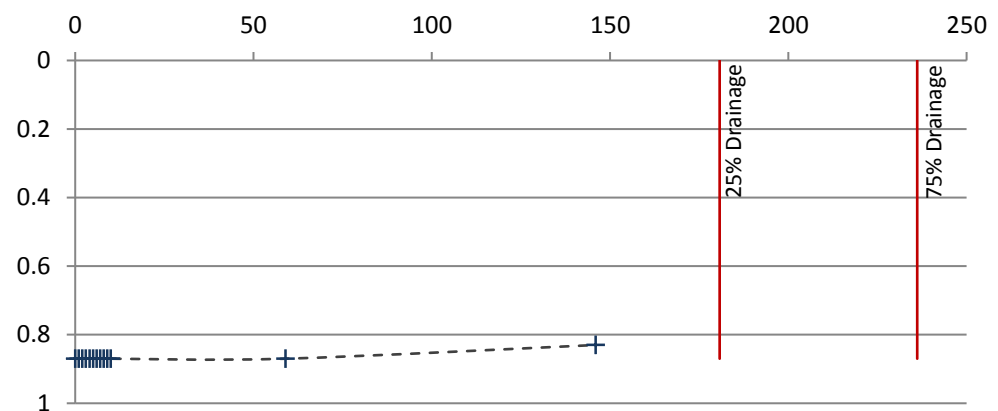
SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	1	2	3	4	5	6	7	8	9	10	47	135							
Depth to water [m]	0.74	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75							

	Terra 97 Ltd	Test ID:	SA9.1
TERRA97	Swan Buildings 20 Swan Street Manchester M4 5JW	Job Number:	C.19.228
		Technician:	LH
Client:	Tier Environmental Ltd	Test Date:	27/09/2019
Site:	Rhosrobin, Wrexham	Test Number:	1 of 1
		Comments:	Adverse weather, heavy rain

Soakage Pit Width [m]	0.6
Soakage Pit Length [m]	2
Soakage Pit Depth [m]	1.5
Depth to water at start of test bgl [m]	0.87
Effective Storage Depth [m]	0.63
Free Volume [%]	100

Effective Depth at 25% Drainage	1.0275
Effective Depth at 75% Drainage	1.3425
Time to Drain From 25% to 75% [s]	N/A
Internal Surface Area [m ²]	2.838
Effective Storage Volume [m ³]	0.378
Test Completion [%]	0%



Soil infiltration rate(m/s)

Test failed. Estimated to take at least 24 hours for drainage.

SOAKAGE TRIAL PIT INFILTRATION TEST RESULTS

Measurement N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Time [min]	0	1	2	3	4	5	6	7	8	9	10	59	146							
Depth to water [m]	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.83							

APPENDIX C.2 - DYNAMIC CONE PENETROMETER TEST RESULTS

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP1
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph illustrates the relationship between the number of blows and the depth of penetration. The y-axis represents Depth in millimeters below ground level (mm bgl), ranging from 0 to 1000. The x-axis represents the Number of Blows, ranging from 0 to 25. A blue curve shows the data points. Two horizontal red lines indicate the boundaries of Layer 1 and Layer 2.

Depth (mm bgl)	Number of Blows
0	1
50	2
100	3
150	4
200	5
250	6
300	7
350	8
400	9
450	10
500	11
550	12
600	13
650	14
700	15
750	16
800	17
850	18
900	19
950	20
1000	21

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	73	521	9	49.78	2.94
2	521	959	22	33.69	4.82
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP2
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

Number of Blows

0 5 10 15 20

0 100 200 300 400 500 600 700 800 900 1000

Layer 1

Layer 2

Layer 3

Depth (mm bgl)

Depth (mm bgl)	Number of Blows
0	1
50	2
100	3
150	4
200	5
250	6
300	7
350	8
400	9
450	10
500	11
550	12
600	13
650	14
700	15
750	16
800	17
850	18
900	19
930	20

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	70	165	1	95.00	1.29
2	165	647	11	48.20	3.06
3	647	934	15	71.75	1.84
4					
5					

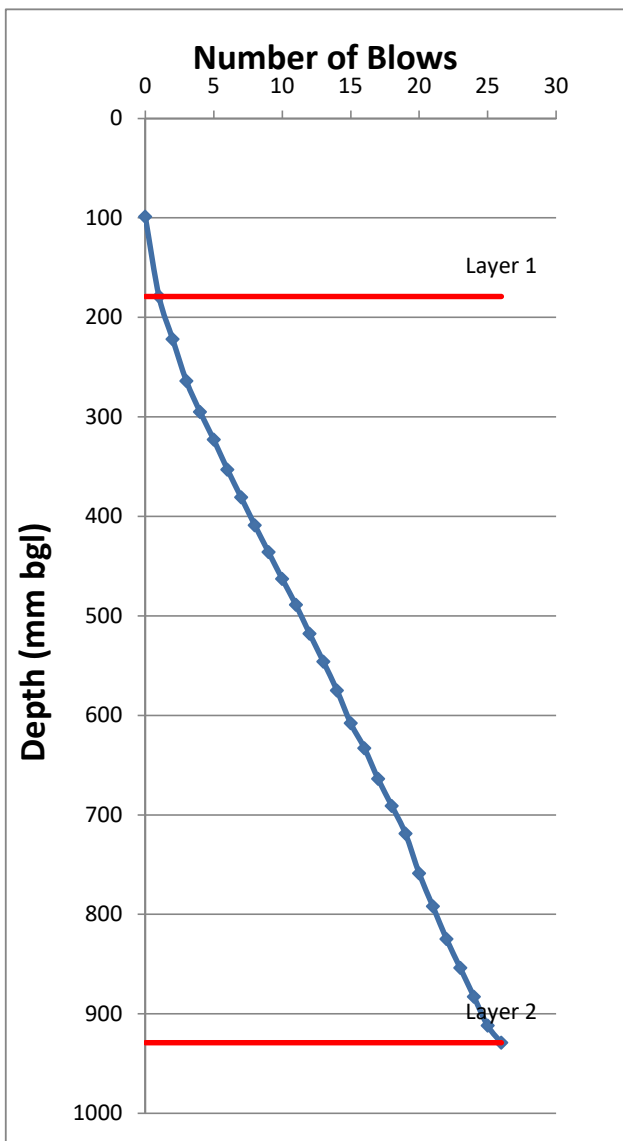
DYNAMIC CONE PENETROMETER RECORD SHEET

TERRA97

JOB DETAILS

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP3
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

No of Blows (Cumulative)	Height (mm)	Depth (mm bgl)
0	100	99
1	180	179
2	223	222
3	265	264
4	296	295
5	324	323
6	354	353
7	382	381
8	410	409
9	437	436
10	464	463
11	490	489
12	519	518
13	547	546
14	576	575
15	609	608
16	634	633
17	665	664
18	692	691
19	720	719
20	760	759
21	793	792
22	826	825
23	855	854
24	884	883
25	913	912
26	930	929



Based on the Kleyn and Van Heerden Model

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	99	179	1	80.00	1.60
2	179	929	26	30.00	5.59
3					
4					
5					

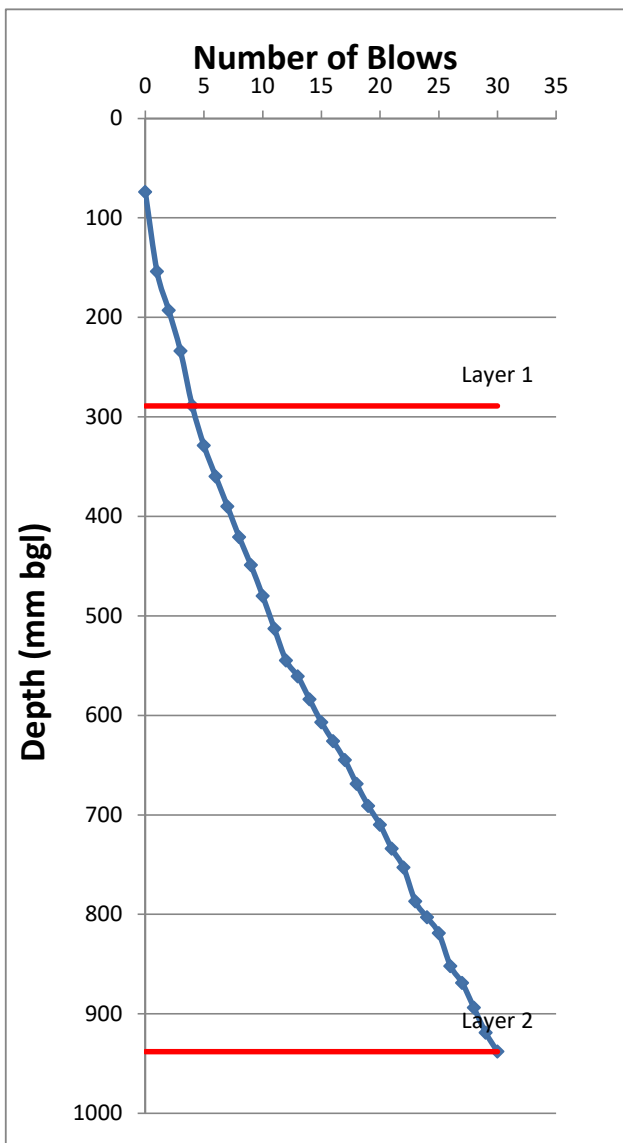
DYNAMIC CONE PENETROMETER RECORD SHEET

TERRA97

JOB DETAILS

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP4
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

No of Blows (Cumulative)	Height (mm)	Depth (mm bgl)
0	75	74
1	155	154
2	194	193
3	235	234
4	290	289
5	330	329
6	361	360
7	391	390
8	422	421
9	450	449
10	481	480
11	514	513
12	546	545
13	562	561
14	585	584
15	608	607
16	627	626
17	646	645
18	670	669
19	692	691
20	711	710
21	735	734
22	754	753
23	788	787
24	804	803
25	820	819
26	853	852
27	870	869
28	895	894
29	920	919
30	939	938



Based on the Kleyn and Van Heerden Model

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	74	289	4	53.75	2.66
2	289	938	30	24.96	7.07
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP5
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

This graph shows the relationship between the number of blows and the depth (in mm bgl) for two layers. The x-axis represents the Number of Blows (0 to 30), and the y-axis represents the Depth (mm bgl) (0 to 1000). Layer 1 is defined by a red horizontal line at approximately 530 mm bgl, and Layer 2 is defined by a red horizontal line at approximately 920 mm bgl. The data points for Layer 1 are connected by a blue line, showing a rapid increase in blows as depth increases from 0 to 500 mm bgl, followed by a more gradual increase. The data points for Layer 2 are also connected by a blue line, showing a rapid increase in blows as depth increases from 500 to 920 mm bgl.

Depth (mm bgl)	Number of Blows	Layer
0	2	1
100	3	1
200	4	1
250	5	1
300	6	1
350	7	1
400	8	1
450	9	1
500	10	1
530	11	1
550	12	1
600	13	1
650	14	1
700	15	1
750	16	1
800	17	1
850	18	1
900	19	1
920	20	1

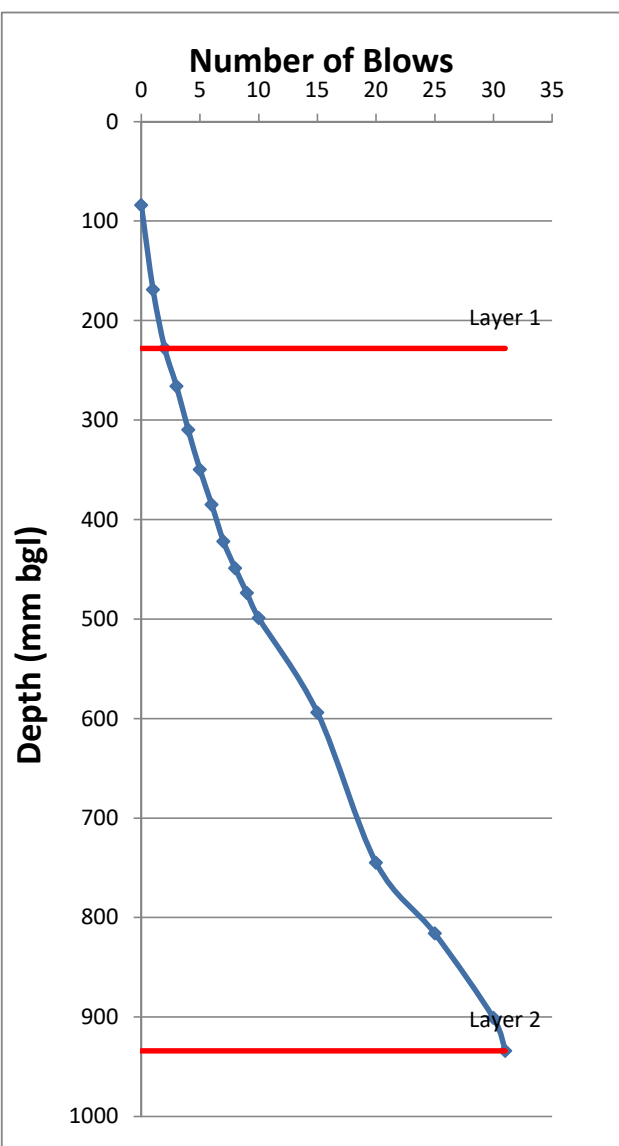
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	74	531	9	50.78	2.86
2	531	922	28	20.58	9.04
3					
4					
5					

DYNAMIC CONE PENETROMETER RECORD SHEET

TERRA97

JOB DETAILS

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP6
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

[illegible]

Based on the Kleyn and Van Heerden Model

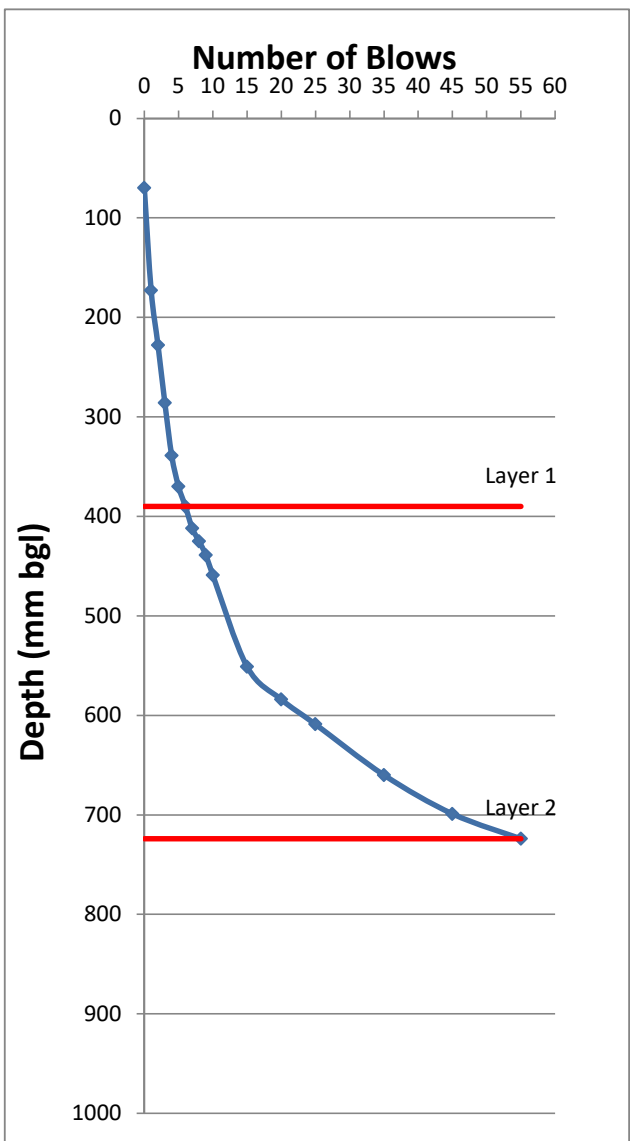
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	84	228	2	72.00	1.83
2	228	934	31	24.34	7.30

DYNAMIC CONE PENETROMETER RECORD SHEET
TERRA97

TERRA97

JOB DETAILS	
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Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP7
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

[illegible]

Based on the Kleyn and Van Heerden Model

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	70	390	6	53.33	2.69
2	390	724	55	6.82	36.89
3					
4					
5					

TERRA97

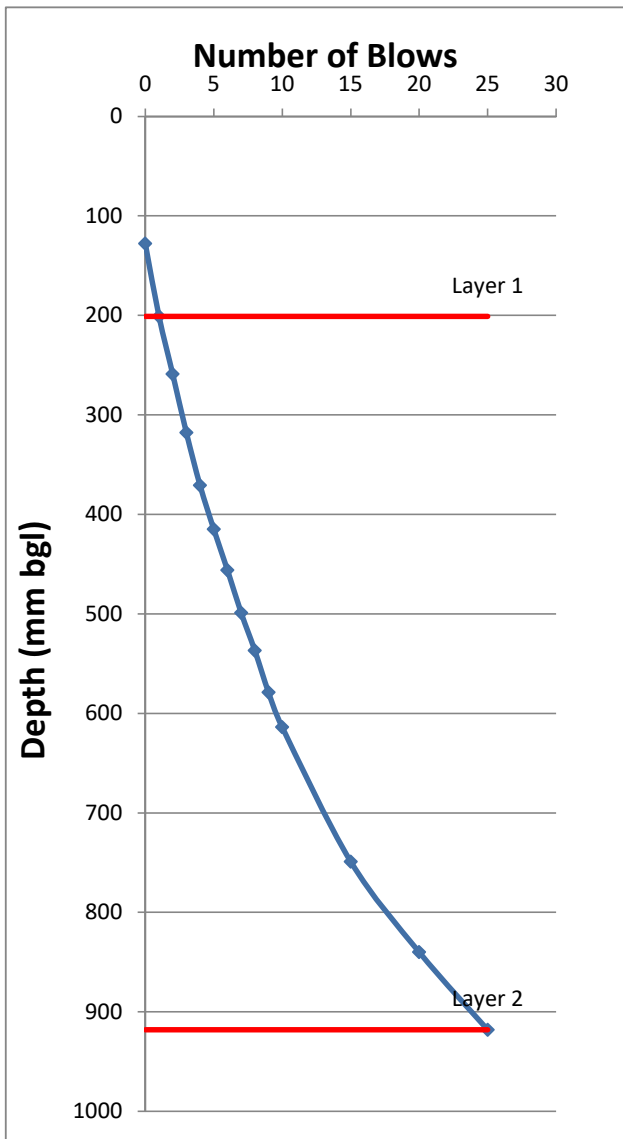
Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP8
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph illustrates the relationship between the depth of penetration (in mm bgl) and the number of blows required to reach that depth. The data points are plotted as blue diamonds connected by a line. Two horizontal red lines represent the boundaries of Layer 1 and Layer 2.

Depth (mm bgl)	Number of Blows
0	25
75	1
125	2
175	3
225	4
275	5
325	6
375	7
425	8
475	9
525	10
575	11
625	12
675	13
725	14
775	15
825	16
875	17
925	18
975	19
1025	20

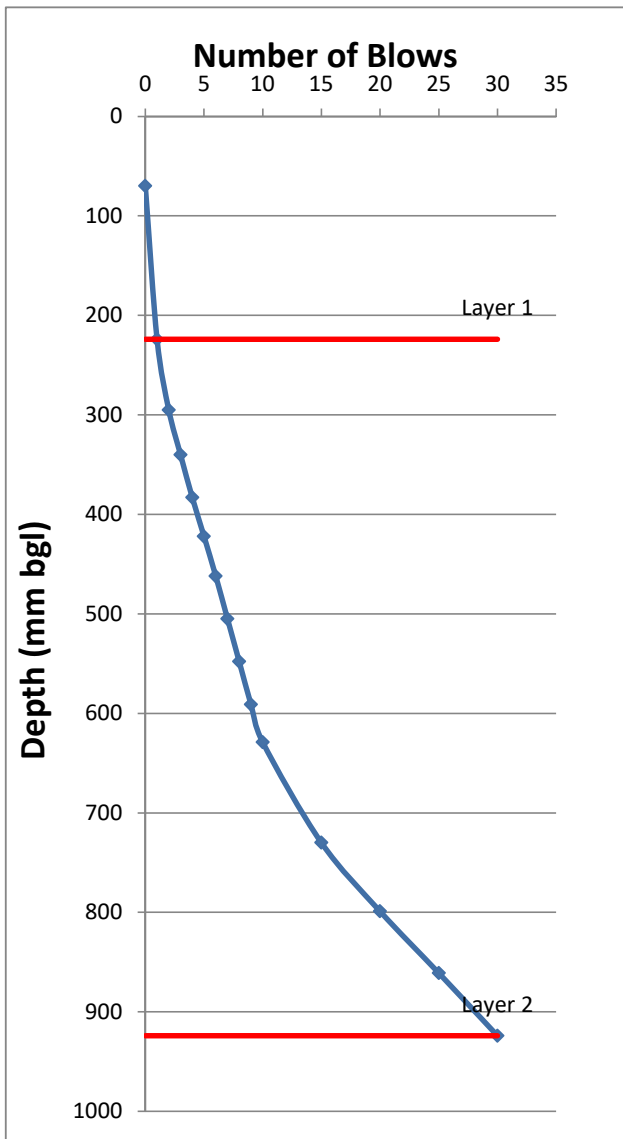
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	74	168	1	94.00	1.31
2	168	419	6	50.20	2.90
3					
4					
5					

TERRA97

[illegible]

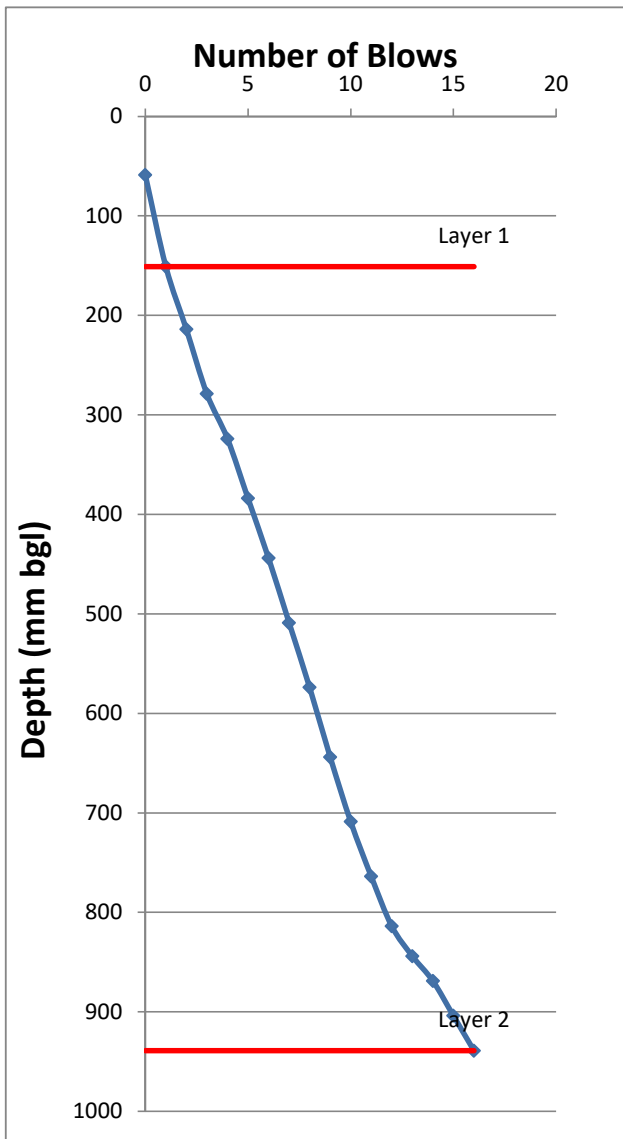
Based on the Kleyn and Van Heerden Model					
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	128	201	1	73.00	1.80
2	201	918	25	29.88	5.62
3					
4					
5					

TERRA97

[illegible]

Based on the Kleyn and Van Heerden Model					
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	70	224	1	154.00	0.70
2	224	924	30	24.14	7.38
3					
4					
5					

TERRA97

[illegible]

Based on the Kleyn and Van Heerden Model					
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	59	151	1	92.00	1.34
2	151	939	16	52.53	2.74
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP12
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

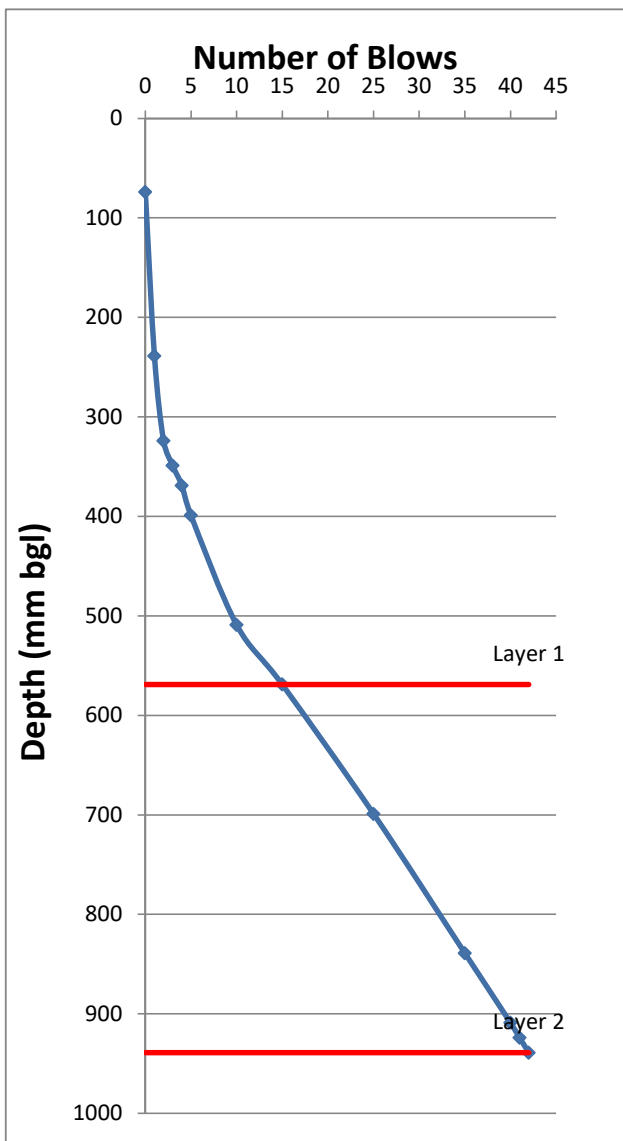
The graph illustrates the relationship between the depth of penetration (in mm below ground level) and the number of blows required to reach that depth. The data points are plotted as blue diamonds connected by a line. Two distinct layers are identified by horizontal red lines: Layer 1 at approximately 800 mm bgl and Layer 2 at approximately 930 mm bgl. The number of blows increases significantly as the depth increases, especially within the layers.

Depth (mm bgl)	Number of Blows
0	1
100	2
200	3
250	4
300	5
350	6
400	7
450	8
500	9
550	10
600	11
650	12
700	13
750	14
800	15
850	16
900	17
930	18
960	19
990	20

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	71	804	13	56.38	2.50
2	804	929	20	17.86	10.83
3					
4					
5					

TERRA97

JOB DETAILS	
Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP13
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

[illegible]

Based on the Kleyn and Van Heerden Model					
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	74	569	15	33.00	4.95
2	569	939	42	13.70	15.16
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP14
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph illustrates the relationship between the depth of penetration (in mm bgl) and the number of blows required to reach that depth. The y-axis is labeled 'Depth (mm bgl)' and ranges from 0 to 1000. The x-axis is labeled 'Number of Blows' and ranges from 0 to 20. A blue curve with diamond markers shows the data points. Two horizontal red lines indicate the boundaries of Layer 1 (at approximately 210 mm) and Layer 2 (at approximately 940 mm).

Depth (mm bgl)	Number of Blows
0	0
10	0.5
20	1.0
30	1.5
40	2.0
50	2.5
60	3.0
70	3.5
80	4.0
90	4.5
100	5.0
110	5.5
120	6.0
130	6.5
140	7.0
150	7.5
160	8.0
170	8.5
180	9.0
190	9.5
200	10.0
210	10.5
220	11.0
230	11.5
240	12.0
250	12.5
260	13.0
270	13.5
280	14.0
290	14.5
300	15.0
310	15.5
320	16.0
330	16.5
340	17.0
350	17.5
360	18.0
370	18.5
380	19.0
390	19.5
400	20.0

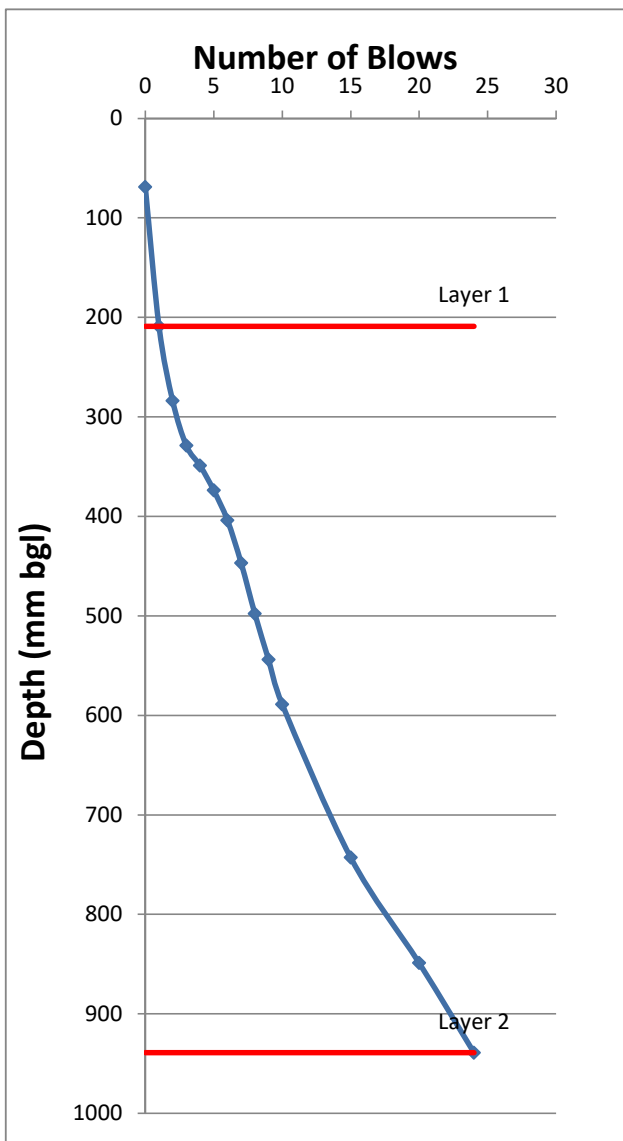
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	61	209	1	148.00	0.73
2	209	939	19	40.56	3.81
3					
4					
5					

DYNAMIC CONE PENETROMETER RECORD SHEET

TERRA97

JOB DETAILS

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP15
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

[illegible]

Based on the Kleyn and Van Heerden Model

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	69	209	1	140.00	0.79
2	209	939	24	31.74	5.21
3					
4					
5					

TERRA97

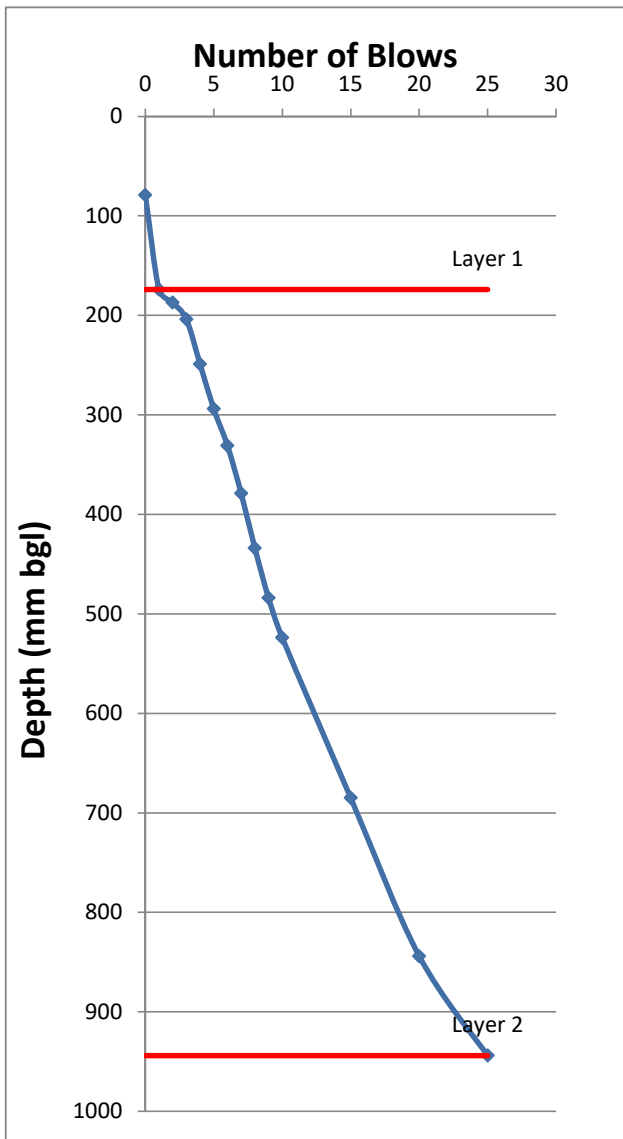
Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP16
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph plots the Number of Blows (X-axis, 0 to 35) against Depth in millimeters below ground level (Y-axis, 0 to 1000). A blue curve represents the data points. Two horizontal red lines indicate soil layers: Layer 1 at 390 mm and Layer 2 at 940 mm.

Depth (mm bgl)	Number of Blows
75	1
175	2
250	3
300	4
340	5
390	6
420	7
460	8
490	9
540	10
590	11
680	15
800	20
880	25
940	28
950	29
960	30
970	31
980	32
990	33

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	69	389	5	64.00	2.13
2	389	939	30	22.00	8.30
3					
4					
5					

TERRA97

[illegible]

Based on the Kleyn and Van Heerden Model					
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	79	174	1	95.00	1.29
2	174	944	25	32.08	5.13
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP18
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

A line graph showing the relationship between the number of blows and depth for Layer 1. The x-axis is labeled 'Number of Blows' and ranges from 0 to 20. The y-axis is labeled 'Depth (mm bgl)' and ranges from 0 to 1000, with 0 at the top. A blue line with diamond markers represents the data points. A horizontal red line is drawn at a depth of approximately 950 mm, labeled 'Layer 1'.

Depth (mm bgl)	Number of Blows
75	1
190	2
265	3
330	4
380	5
450	6
525	7
595	8
635	9
685	10
740	11
790	12
840	13
885	14
935	15
955	16

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	71	959	15	59.20	2.35
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP19
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph shows the relationship between the number of blows and the depth of penetration. The x-axis represents the Number of Blows (0 to 45), and the y-axis represents the Depth in millimeters below ground level (0 to 1000). The curve starts at (0, 0) and increases to (45, 900). Two horizontal red lines indicate the boundaries of Layer 1 (at 470 mm) and Layer 2 (at 920 mm).

Depth (mm bgl)	Number of Blows
0	0
10	2
20	4
30	6
40	8
50	10
60	12
70	14
80	16
90	18
100	20
110	22
120	24
130	26
140	28
150	30
160	32
170	34
180	36
190	38
200	40
210	42
220	44
230	46
240	48
250	50
260	52
270	54
280	56
290	58
300	60
310	62
320	64
330	66
340	68
350	70
360	72
370	74
380	76
390	78
400	80
410	82
420	84
430	86
440	88
450	90
460	92
470	94
480	96
490	98
500	100
510	102
520	104
530	106
540	108
550	110
560	112
570	114
580	116
590	118
600	120
610	122
620	124
630	126
640	128
650	130
660	132
670	134
680	136
690	138
700	140
710	142
720	144
730	146
740	148
750	150
760	152
770	154
780	156
790	158
800	160
810	162
820	164
830	166
840	168
850	170
860	172
870	174
880	176
890	178
900	180
910	182
920	184
930	186
940	188
950	190
960	192
970	194
980	196
990	198
1000	200

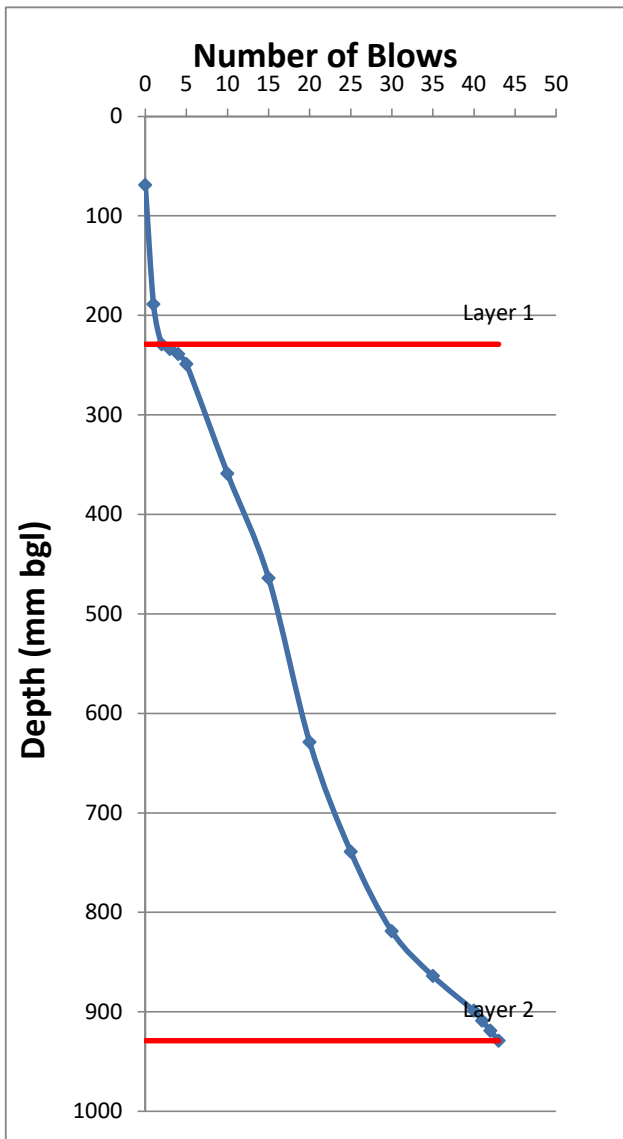
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1		469	10		
2	469	919	0	-45.00	
3					
4					
5					

DYNAMIC CONE PENETROMETER RECORD SHEET

TERRA97

JOB DETAILS

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP20
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

[illegible]

Based on the Kleyn and Van Heerden Model

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	69	229	2	80.00	1.60
2	229	929	43	17.07	11.46
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP21
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

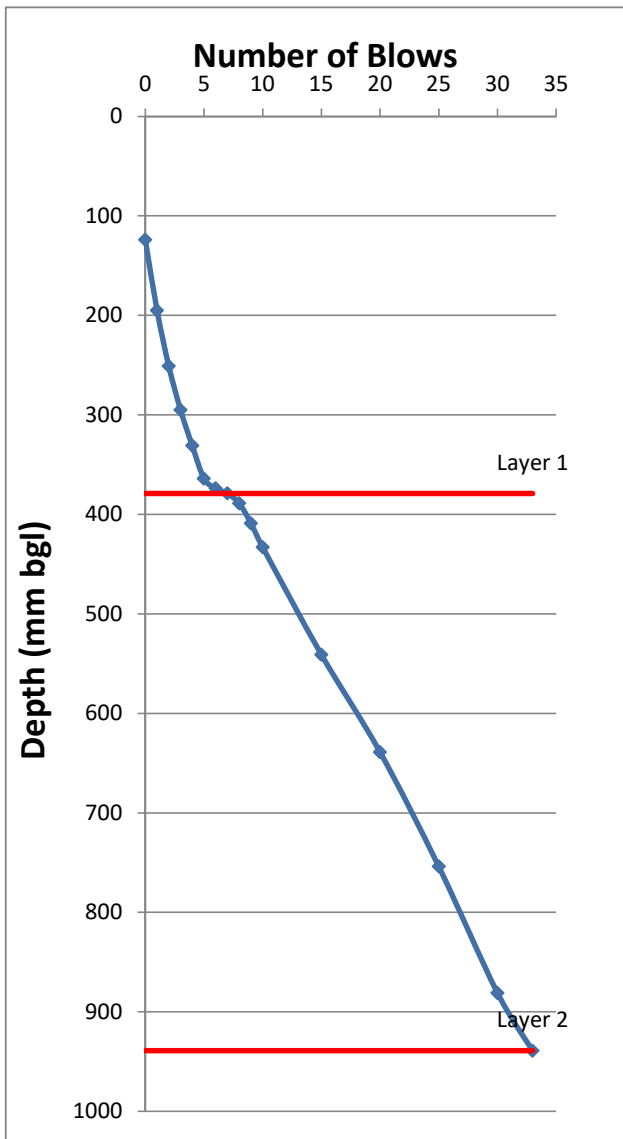
The graph illustrates the relationship between the Number of Blows (X-axis) and Depth (mm bgl) (Y-axis). The Y-axis ranges from 0 to 1000 mm bgl, and the X-axis ranges from 0 to 40 blows. Two distinct layers are identified: Layer 1 (top) and Layer 2 (bottom), separated by red horizontal lines.

The data points show a sharp increase in blows as depth increases, particularly between 300 mm and 600 mm bgl, indicating a transition from Layer 1 to Layer 2.

Depth (mm bgl)	Number of Blows
75	1
135	2
195	3
255	4
315	5
350	6
360	7
370	8
385	9
415	10
445	11
455	12
495	13
600	15
720	18
810	22
885	26
935	30

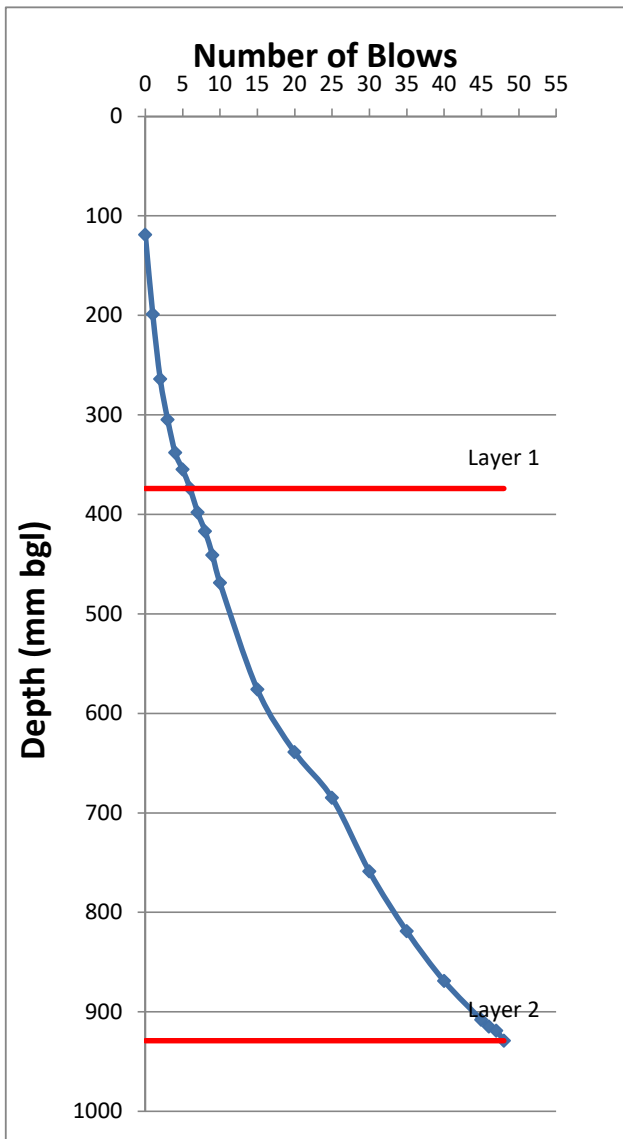
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	69	347	5	55.60	2.55
2	347	934	35	19.57	9.64
3					
4					
5					

TERRA97

[illegible]

Based on the Kleyn and Van Heerden Model					
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	124	379	7	36.43	4.37
2	379	939	33	21.54	8.53
3					
4					
5					

TERRA97

[illegible]

Based on the Kleyn and Van Heerden Model					
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	119	374	6	42.50	3.59
2	374	929	48	13.21	15.88
3					
4					
5					

TERRA97

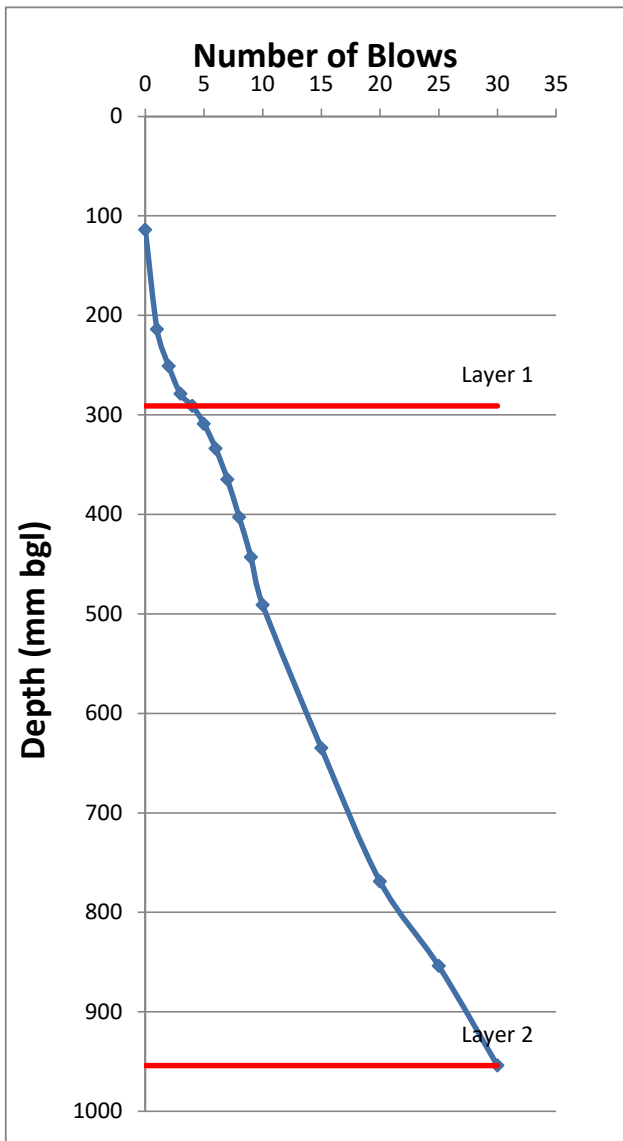
Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP24
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph illustrates the relationship between the number of blows and the depth of penetration. The y-axis represents Depth in mm bgl, ranging from 0 to 1000. The x-axis represents the Number of Blows, ranging from 0 to 50. Two distinct layers are identified: Layer 1 (175 to 185 mm) and Layer 2 (185 to 940 mm). The curve shows a sharp increase in blows at 175 mm and a gradual increase thereafter.

Depth (mm bgl)	Number of Blows
125	10
135	12
145	14
155	16
165	18
175	20
185	22
195	24
205	26
215	28
225	30
235	32
245	34
255	36
265	38
275	40
285	42
295	44
305	46
315	48
325	50
335	52
345	54
355	56
365	58
375	60
385	62
395	64
405	66
415	68
425	70
435	72
445	74
455	76
465	78
475	80
485	82
495	84
505	86
515	88
525	90
535	92
545	94
555	96
565	98
575	100
585	102
595	104
605	106
615	108
625	110
635	112
645	114
655	116
665	118
675	120
685	122
695	124
705	126
715	128
725	130
735	132
745	134
755	136
765	138
775	140
785	142
795	144
805	146
815	148
825	150
835	152
845	154
855	156
865	158
875	160
885	162
895	164
905	166
915	168
925	170
935	172
940	175

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	119	181	3	20.67	8.99
2	181	939	45	18.05	10.68
3					
4					
5					

TERRA97

[illegible]

Based on the Kleyn and Van Heerden Model					
Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	114	291	4	44.25	3.41
2	291	954	30	25.50	6.88
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP26
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph illustrates the relationship between the depth of penetration (in mm bgl) and the number of blows required to reach that depth. The data points are plotted as blue diamonds connected by a line. Two distinct layers are identified by horizontal red lines: Layer 1 at approximately 350 mm bgl and Layer 2 at approximately 950 mm bgl. The number of blows increases significantly as the depth increases, especially after passing through Layer 1.

Depth (mm bgl)	Number of Blows
0	2
20	3
40	4
60	5
80	6
100	7
120	8
140	9
160	10
180	11
200	12
220	13
240	14
260	15
280	16
300	17
320	18
340	19
360	20
380	21
400	22
420	23
440	24
460	25
480	26
500	27
520	28
540	29
560	30
580	31
600	32
620	33
640	34
660	35
680	36
700	37
720	38
740	39
760	40
780	41
800	42
820	43
840	44
860	45
880	46
900	47
920	48
940	49
960	50
980	51
1000	52

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	69	354	5	57.00	2.47
2	354	954	30	24.00	7.43
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP27
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph plots the Number of Blows (X-axis, 0 to 30) against Depth in mm below ground level (Y-axis, 0 to 1000). The data points are connected by a blue line, showing a sharp increase in blows at two specific depths, labeled Layer 1 and Layer 2. Layer 1 is indicated by a red horizontal line at approximately 360 mm depth, and Layer 2 is indicated by a red horizontal line at approximately 930 mm depth.

Depth (mm bgl)	Number of Blows
75	2
125	3
175	4
225	5
275	6
325	7
360	8
375	9
390	10
425	12
460	14
495	16
540	18
585	20
630	22
675	24
720	26
765	28
810	30
855	32
900	34
930	36
945	38

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	74	364	5	58.00	2.42
2	364	941	24	30.37	5.51
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP28
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph illustrates the relationship between the depth of penetration (in mm bgl) and the number of blows required to reach that depth. The y-axis is labeled 'Depth (mm bgl)' and ranges from 0 to 1000. The x-axis is labeled 'Number of Blows' and ranges from 0 to 35. A blue curve shows the relationship, starting at approximately 75 blows at 0 mm bgl and decreasing to approximately 32 blows at 940 mm bgl. Two horizontal red lines indicate the depths of Layer 1 (at approximately 550 mm bgl) and Layer 2 (at approximately 940 mm bgl).

Depth (mm bgl)	Number of Blows
0	75
50	65
100	55
150	45
200	38
250	32
300	28
350	25
400	22
450	20
500	18
550 (Layer 1)	16
600	14
650	12
700	10
750	8
800	6
850	4
900	3
940 (Layer 2)	3

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	74	544	10	47.00	3.16
2	544	939	30	19.75	9.52
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP29
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph plots the number of blows required to penetrate the soil at various depths. The y-axis represents depth in millimeters below ground level (mm bgl), ranging from 0 to 1000. The x-axis represents the number of blows, ranging from 0 to 30. A blue curve shows the penetration resistance. Two horizontal red lines indicate the boundaries of Layer 1 (from 600 mm to 950 mm) and Layer 2 (from 950 mm to 1000 mm).

Depth (mm bgl)	Number of Blows
0	0
100	1
200	2
270	3
340	4
400	5
460	6
490	7
530	8
570	9
630	10
740	15
850	20
950	25

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	74	602	9	58.67	2.38
2	602	959	25	22.31	8.15
3					
4					
5					

TERRA97

Job No:	C.19.228
Site:	Rhosrobin, Wrexham
Location	DCP30
Test Date	17.10.2019
Zero Error mm	1
Cone Angle	60
Layers Removed	0

The graph illustrates the relationship between the depth of penetration (in mm bgl) and the number of blows required. The y-axis is labeled 'Depth (mm bgl)' and ranges from 0 to 1000. The x-axis is labeled 'Number of Blows' and ranges from 0 to 30. A blue curve with diamond markers shows the data points. Two horizontal red lines indicate the boundaries of Layer 1 (approx. 370 mm) and Layer 2 (approx. 930 mm).

Depth (mm bgl)	Number of Blows
100	1
220	2
290	3
340	4
410	5
450	6
490	7
540	8
580	9
620	10
750	15
840	20
930	25

Layer	Top of layer	Base of Layer	Total blows	DCP (mm / blow)	CBR %
1	109	369	4	65.00	2.09
2	369	929	25	26.67	6.50
3					
4					
5					

APPENDIX D - PHOTOGRAPHS TAKEN DURING SITE WALKOVER AND INVESTIGATION

Photograph 1: Photo looking north from Plas Acton road of the southern section of the Site.



Photograph 2: Photo looking south from New road of the northern section of the Site.



Photograph 3: presence of overhead power lines on Site.



Photograph 4: Entrance to site from Plas Acton Road with Wat's Dyke present to the right of the

photo



Photograph 5: Entrance to Site looking towards New Road.



APPENDIX E - DEFINITION OF SOURCE PROTECTION ZONES AND GROUNDWATER VULNERABILITY ASSESSMENTS

Source Protection Zones

Source Protection Zones (SPZs) are defined by the Environment Agency (for England and Wales), SEPA (Scotland) and the Environment and Heritage Service (Northern Ireland) for groundwater sources such as wells, boreholes and springs that are used for public drinking water supply. The zones show the risk of contamination from activities that might cause groundwater pollution in the area. The size and shape of a zone depends upon subsurface conditions, how the groundwater is removed, and other environmental factors.

SPZs are classified into four categories:

- **Zone 1 (Inner protection zone).** Any pollution that can travel to the abstraction point within 50 days from any point within the zone is classified as being inside Zone 1. This applies at and below the groundwater table. This zone also has a minimum 50 m protection radius around the abstraction point. These criteria are designed to protect against the transmission of toxic chemicals and water-borne disease.
- **Zone 2 (Outer protection zone).** The outer zone covers pollution that takes up to 400 days to travel to the abstraction point, or 25% of the total catchment area, whichever area is the largest. This travel time is the minimum period over which the Environment Agency considers that pollutants need to be diluted, reduced in strength or delayed by the time they reach the abstraction point.
- **Zone 3 (Total catchment).** This is the total area needed to support removal of water from the abstraction point, and to support any discharge from this.
- **Zone of special interest.** This may occasionally be defined as a special case. This is usually where local conditions mean that industrial sites and other potential sources of contamination could affect the groundwater source, even though they are outside the normal catchment area.

Groundwater Vulnerability Assessments

From 1 April 2010 The Environment Agency Groundwater Protection Policy began to use aquifer designations which are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems.

The aquifer designation data is based on geological mapping provided by the British Geological Survey. It is updated regularly to reflect their ongoing programme of improvements to these maps. The maps are split into two different type of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels.
- Bedrock -solid permeable formations e.g. sandstone, chalk and limestone.

The maps display the following aquifer designations:

Table 1. Aquifer Classification (“Geological Classification”).

Classification	Definition
Principal Aquifers (Highly Permeable)	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
Secondary A Aquifers	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
Secondary B Aquifers	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
Secondary Undifferentiated Aquifers	This has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Unproductive Strata	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

APPENDIX F - DEFINITIONS OF TERMS USED IN QUALITATIVE AND QUANTITATIVE RISK ASSESSMENTS

For the qualitative and quantitative assessment of risks posed by potential pollutant linkages have been undertaken using the risk matrix adapted from CIRIA C552 and outlined in the table below.

	Category	Definition
Potential severity	Severe	Acute (short term) risk to human health, Major pollution of sensitive controlled waters, ecosystems or habitat. Catastrophic damage to buildings or property or crops.
	Medium	Chronic (Medium / long term) risk to human health Pollution of sensitive controlled waters, ecosystems or species, Significant damage to crops, buildings or structures
	Mild	Easily preventable permanent health effects on humans. Pollution of non-sensitive controlled waters. Minor damage to buildings or structures.
	Minor	Easily preventable non-permanent health effects on humans, or no effects. Minor, low level and localised contamination of on-site soil. Easily repairable damage to buildings or structures.
Probability of risk	High Likelihood	Pollutant linkage may be present and the risk is almost certain to occur , or there is evidence of harm already occurring.
	Likely	Pollutant linkage may be present and it is probable that the risk will occur over the long term.
	Low Likelihood	Pollutant linkages may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
	Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur are improbable.

		Potential Severity			
		Severe	Medium	Mild	Minor
Probability of risk	High Likelihood	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Negligible
	Unlikely	Moderate/Low	Low	Negligible	Negligible

APPENDIX G - ASSESSMENT CRITERIA APPLIED FOR GROUND GAS

Monitoring for the following is generally performed as part of ground gas assessment:

- Methane (CH₄): an odourless, flammable gas. Mixtures of methane with air containing between 5 and 15% v/v methane are explosive.
- Carbon dioxide (CO₂): an asphyxiant at elevated concentrations. Denser than air, it can accumulate in excavations, and within low points inside buildings
- Oxygen (O₂): important in the assessment of the potential formation of explosive mixtures with methane. Monitoring normally measures both methane and oxygen concentrations in ground gas to derive an indication of the risk of explosive mixture formation, expressed as a percentage of the Lower Explosive Limit (LEL). Low concentrations of oxygen in ground gas can also exacerbate the risk of CO₂ asphyxiation.
- Hydrogen sulphide (H₂S): odorous and toxic, capable of forming flammable mixtures with air.
- Volatile Organic Compounds (VOCs): present as chemical contaminants of soil and sometimes also biologically produced in low concentrations.

Assessment of methane (CH₄) and carbon dioxide (CO₂)

Methane and CO₂ can arise from natural geological sources, mine workings, rotting organic matter (peat, landfilled materials, etc.) and/or contaminant biodegradation. Assessment of ground gas composition and flows is therefore an essential part of site assessment. The need to adequately address potential risks from ground gas on development sites is therefore required under the planning regime.

In order to appropriately assess the site risks, the Construction Industry Research and Information Association (CIRIA) and others have issued several guidance documents on landfill and ground gas that are intended to provide advice on how to investigate and deal with gas contaminated ground with respect to development. These are:

- Report 149: 'Protecting Development from Methane' (CIRIA, 1995a)
- Report 150: 'Methane Investigation Strategies' (CIRIA, 1995b)
- Report 151: 'Interpreting Measurement of Gas in the Ground' (CIRIA, 1995c)
- Report 152: 'Risk Assessment for Methane and Other Gases from the Ground' (CIRIA, 1995d)

More recent guidance has been published to update the documents detailed above to collaborate and promote industry 'good practice'. These are:

- CIRIA Report 665: 'Assessing risks posed by hazardous ground gases to buildings (CIRIA, 2008)
- NHBC: 'Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present' (NHBC, 2007)
- BS8485: Code of Practice for the characterisation and remediation from ground gas in affected developments (BSI Group, 2007)

The earlier CIRIA 149 approach is now considered to be too conservative. A more realistic measure of the risk posed by methane and CO₂ in ground gas can be established by determining an appropriate Gas Screening Value (GSV), using the methods described in the NHBC and CIRIA 659 documents. These values are based upon earlier work undertaken by Wilson and Card (1999).

GSVs are calculated by multiplying the borehole flow rate (l/hr) by the percentage (% v/v) concentration in the gas stream of the specific component, i.e.:

$$\text{GSV} = (\text{Concentration} / 100) \times \text{Flow rate.}$$

A risk-based methodology for deriving GSVs is defined for two situations (designated A and B), which are adequate for the great majority of site cases:

- Situation A: All development types except low rise housing with gardens
- Situation B: Low rise housing with gardens.

Under Situation A, classification of the scope of protection required is determined from the site GSV, summarised in Table 1. For Situation B, GSVs derived are used in a 'Traffic Light' classification (summarised in Table 2) which determines the required level and scope of protection measures. Tables 1 and 2 are summaries only: the details provided in the body text, footnotes and appendices of the above-referenced documents should be read in conjunction with the results to determine the appropriate level of protection.

For conservatism, Tier Environmental uses the maximum concentration and gas flow rate of methane detected in any borehole during all of the monitoring visits in deriving recommendations on appropriate protection measures. This represents the worst-case risk of forming an explosive mixtures. For CO₂, steady state concentrations and flow data are applied, as these determine the development of an asphyxiating mixture. All values are selected whether or not they occurred in the same borehole or during the same monitoring event.

Exceedences of the maximum concentrations used in a Tier 1 Gas Risk Assessment can be tolerated, when the conceptual model indicates that it is safe to do so. However, GSV values must never be exceeded - where site-specific circumstances permit the derivation of alternative GSVs according to the defined conceptual model, then the appropriate GSV values should be applied.

Table 1. GSV Categories Defined for Situation A (Summarised from CIRIA Report 665).

Risk classification	GSV (CH ₄ or CO ₂ ; l/hr)	Additional factors	Characteristic situation
Very low	<0.07	Typically methane <=1% and/or CO ₂ <=5%, otherwise consider increase to Low Risk.	1
Low	<0.7	Typically borehole ground gas flow rate <=70 l/hr; otherwise consider increase to Moderate Risk.	2
Moderate	<3.5	---	3
Moderate to high	<15	QRA required to evaluate scope of remediation measures.	4
High	<70	---	5
Very high	>70	---	6

Table 2. GSV Categories Defined for Situation B (Summarised from NHBC, 2007).

Methane		CO ₂		“Traffic light” classification
Typical max. conc. (% v/v)	GSV (l/hr)	Typical max. conc. (% v/v)	GSV (l/hr)	
				Green
1	0.13	5	0.78	Amber 1
5	0.63	10	1.60	
20	1.60	30	3.10	Amber 2
				Red

Assessment of hydrogen sulphide (H₂S)

H₂S is toxic and highly odorous (“rotten eggs”) gas. It is often a minor component within mine gases, in ground gas within or overlying strata rich in pyrites or other sulphide-rich ores, and in most natural gas fields.

H₂S can be generated biologically in significant concentrations by the decomposition by sulphate-reducing bacteria of natural or anthropogenic organic matter under oxygen-free conditions. Its potential generation will be greater in environments containing elevated sulphate concentrations (including sea water). H₂S is therefore common within the gas arising from estuarine and marine sediments, pond sediment, stagnant water bodies, bogs and marshlands and landfilled waste, for example.

It must be noted that H₂S normally occurs together with other potentially hazardous ground gases. The measures adopted for protection against these will prove equally protective against H₂S.

There are no standards by which H₂S concentrations in ground gas can be assessed directly. Therefore, the significance of measured H₂S concentrations in ground gas must be evaluated on a case-by-case basis, taking into account the measured concentrations of other components and the specific conceptual site and exposure models. To assist in this process, the following standards and guidance may be applied.

General protection of land users

There are no UK air quality standards for general exposure to H₂S. The World Health Organisation has derived ambient air quality standards (WHO, 2000) for this gas, which may be used to inform risk assessment and decision-making:

- The 24 hour average exposure guideline value for ambient air: 0.15 mg/m³ (0.1 ppmv, approx.; this was derived by the application of a 100x safety factor to the LOAEL for long-term exposure).
- This is significantly above the odour threshold, which is typically around 0.01 mg/m³. To avoid substantial nuisance odour complaints, WHO (2000) recommends that the 30 minute average H₂S concentration in ambient air should not exceed: 0.007 mg/m³ (0.005 ppmv, approx.).

Occupational exposures

For occupational exposure, the HSE (2005) limits for H₂S are applicable:

- 8 hour time weighted average occupational exposure limit: 5 ppmv (7 mg/m³).
- Short-term exposure limit (15 minute reference period): 10 ppmv (14 mg/m³).

Assessment of VOC data

The assessment of VOC concentrations is not covered by above-referenced reports. These data can be used to inform the human health risk assessment for site occupants but should not be relied upon to assess human health risk due to uncertainties in the ground gas flow regime, variability in the (generally low) contaminant concentrations measured and inaccuracies in the concentrations measured by PID instruments.

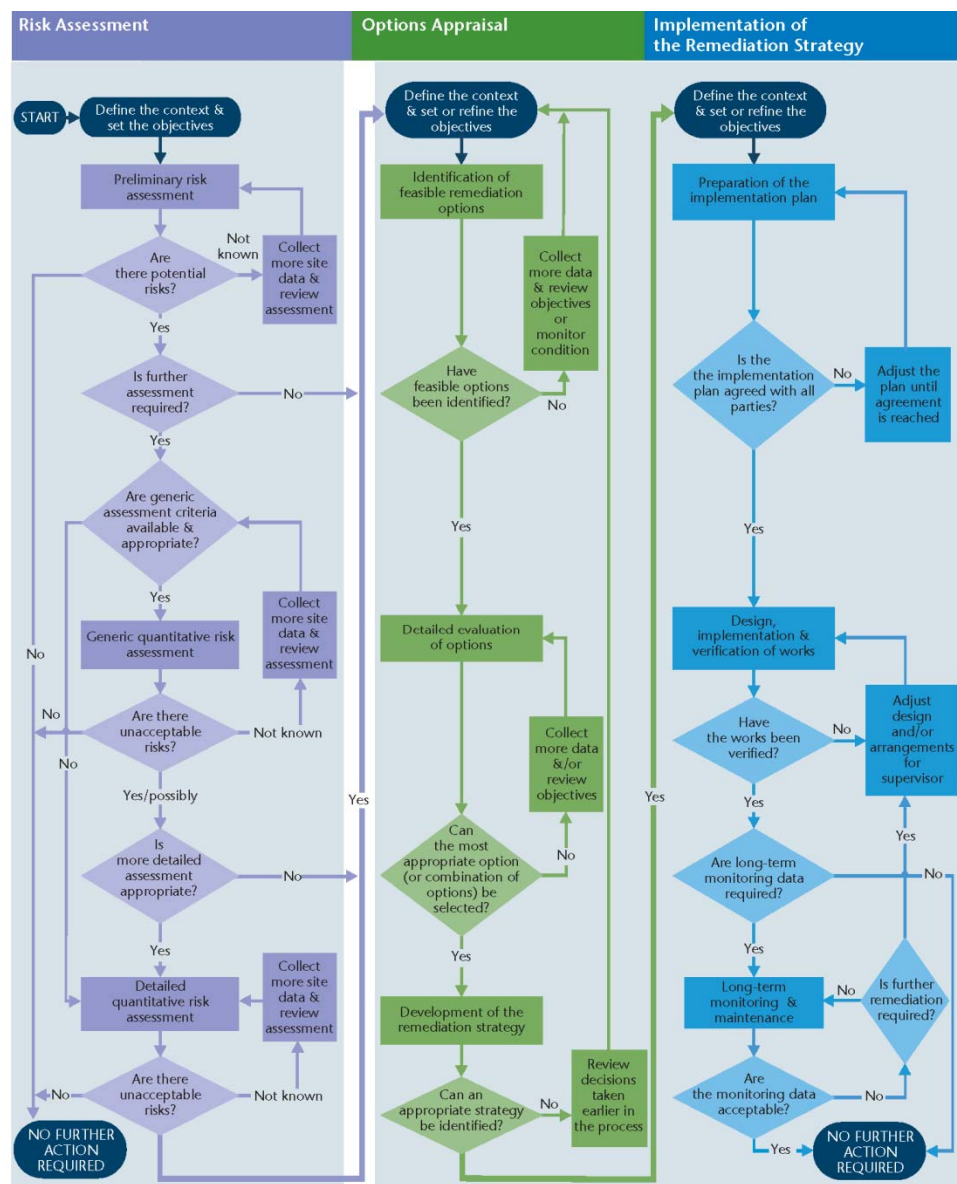
Data on the VOC concentration in ground gas can also help inform potential occupational exposure risks to construction and similar workers. For this purpose, the measured values can be compared to the relevant occupational exposure limit (OEL) for the contaminant(s) of concern, as given in HSE (2005). In cases of doubt as to the identity of the organic contaminants within the ground gas or when these are present as a complex mixture, then the 8 hour time-weighted average (TWA) exposure limit for benzene (1 ppmv) will be applied for screening purposes. This is a reasonably conservative approach since the OEL for benzene is lower than that for the great majority of organic contaminants commonly encountered in soil and groundwater at contaminated sites

APPENDIX H - HUMAN HEALTH ASSESSMENT CRITERIA

Context

Contaminated Land is defined under law through Part IIA of the Environmental Protection Act 1990, implemented through Section 57 of the Environment Act 1995 and associated guidance (“Part IIA”). These specify that a “suitable for use” approach is to be applied in the assessment of potentially contaminated land, implemented through a phased programme of site investigation and risk assessment appropriate to the site under consideration.

The assessment of potential risks posed by contaminated land is based upon the assessment of plausible contaminant source - pathway - receptor linkages (“pollutant linkages”) for the current and/or proposed future use of the site. The process for the assessment of contaminated land adopted in this report is in line with guidance issued by DEFRA and Environment Agency (EA) 2004: “Model Procedures for the Management of Contaminated Land (CLR11)”. The overall process for the management of land contamination is shown Figure 1 of CLR11 and reproduced below:



Note: The process may apply to one or more pollutant linkages each of which may follow a different route. For some linkages, it may be possible to stop at an early stage – others will progress all the way through the process. The level of complexity of each stage may also vary and in some cases may be very simple.

The risk assessment and subsequent investigation, remediation and verification must address all potential sources of pollutants that may be present on the site (the “hazards”), all receptors that may be harmed by these (e.g. human health, controlled waters, ecological receptors) and the pathways by which the contamination may be transported from the contaminant source(s)

to the receptor(s). This is defined within the conceptual model for the site, which represents the characteristics of the site in a form that shows the possible pollutant linkages. As further information becomes available (for example, through site investigation), so the conceptual model will be refined.

Remedial action can be specified at any phase within this assessment process to break the identified pollutant linkage. In determining whether or not to undertake further assessment or to undertake remediation, the potential cost-savings arising from a more thorough assessment of the pollutant linkages and more tightly defined remedial strategy must be considered against the direct costs involved in the work and the time that this will take to execute and gain regulatory approval.

A different approach to the statistical appraisal of data is required depending on whether the assessment is being undertaken to assess land as Contaminated Land in accordance with the regulations or whether the assessment is to assess whether the site is suitable for new development in accordance with the Planning regime. The statistical approach to assessment is discussed further in CL:AIRE:2009 "Guidance on Comparing Data with a Critical Concentration".

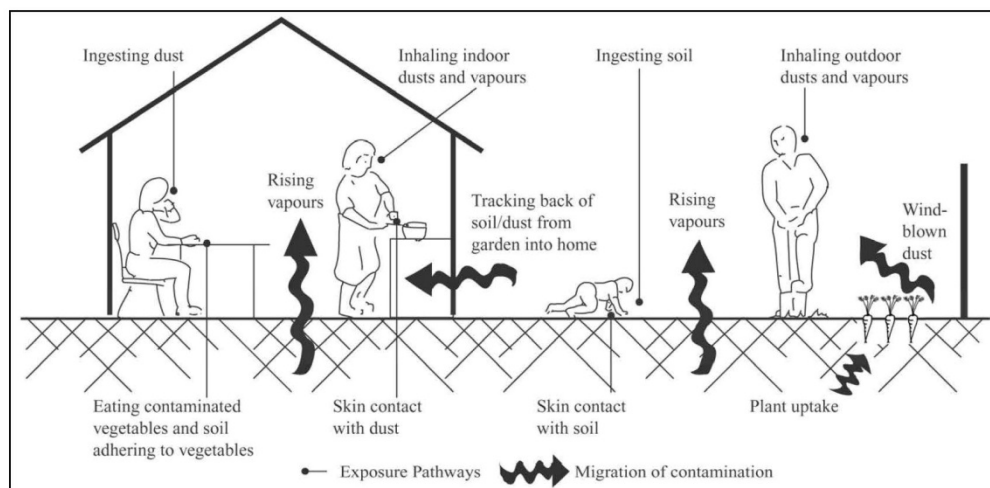
Some form of Detailed Quantitative Risk Assessment (DQRA) will be essential for those cases where appropriate GAC values cannot be established for the contaminant linkages under consideration.

Generic Assessment Criteria for Human Health Risk Assessment

In March 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency (EA) published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports and guidance. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. The initial documents (CLR7 - 10) were withdrawn and replaced with revised guidance issued by the Environment Agency including:

- “Using Soil Guideline Values”; SC050021/SGV Introductions, EA, 2009;
- “Human Health toxicology assessment of contaminants in soil”; SC050021/SR2, EA, 2009;
- “Update technical background to the CLEA model”; SC050021/SR3, EA, 2009;
- CLEA Software (Version) Handbook; SC050021/SR4; EA, 2008;
- Compilation of Data for priority Organic Contaminants for Derivation of Soil Guideline Values; Science Report SC050021/SR7, 2008; and,
- Guidance on Comparing Data with a Critical Concentration; CL:AIRE, 2009.

The CLEA model and associated guidance was developed to calculate an estimated tolerable daily intake (TDI) of contaminants for site users given a set of ‘typical’ human health exposure pathways which are detailed in “SR3: Updated technical background to the CLEA model” (Science Report SC050021/SR3, EA, 2009) and reproduced below.



- **Ingestion**
 - o Outdoor soil;
 - o Indoor dust;
 - o Home grown produce;
 - o Soil attached to home grown produce.
- **Dermal Contact**
 - o Outdoor soil;
 - o Indoor dust.
- **Inhalation**
 - o Outdoor dust;
 - o Indoor dust;
 - o Outdoor vapour;
 - o Indoor vapour.

It should be noted that the CLEA model does not include an exhaustive list of potential exposure pathways, e.g. certain compounds can pass through plastic water pipes into drinking water supply.

The potential significance of each of the exposure pathways is dependant upon the type of land use and the nature of the contaminant being considered. The CLEA model considers principal 'default' land use scenarios and makes a series of assumptions with regards to building type (where applicable), identification of the critical human receptor group, exposure frequency and duration. The definitions of the principal land use types given in SR3 (EA, 2009) are:

- **Residential land use:**

A typical residential property consisting of a two story terraced house built on a ground-bearing slab of 0.15m thickness with a private garden consisting of lawn, flowerbeds, and a small fruit and vegetable patch. The occupants are assumed to be parents with young children, who make regular use of the garden. The critical receptor is a 0 - 6 year old female.

Active exposure pathways are: ingestion of outdoor soil, ingestion of indoor dust, ingestion of home grown produce and soil adhering to home grown produce; direct dermal contact with outdoor soil and indoor dust; inhalation of outdoor dust and vapour and indoor dust and vapour.

- **Allotments**

A plot of open space commonly made available by the Local Authority to tenants to grow fruit and vegetables for their own consumption. There are usually several plots to a site and the overall site area may cover more than one hectare. The tenants are assumed to be the parents or grandparents and that young children make occasional accompanied visits to the plots. The critical receptor is a 0 - 6 year old female and there is no building present on Site.

Active exposure pathways are ingestion of outdoor soil, ingestion of home grown produce and soil adhering to home grown produce; direct dermal contact with outdoor soil; inhalation of outdoor vapour.

- **Commercial and industrial land use.**

A typical commercial or light industrial property consisting of a three-story office building (pre-1970) with a ground bearing floor slab at which employees spend most time indoors and are involved in office based or related light physical work. The critical receptor is a working female adult aged 16 - 65 years.

Active exposure pathways are ingestion of outdoor soil, ingestion of indoor dust; direct dermal contact with outdoor soil and indoor dust; inhalation of outdoor dust and vapour and inhalation of indoor dust and vapour.

Soil Guideline Values

Based on the assumption of each land use type, the EA and DEFRA developed and published Soil Guideline Value (SGV) using the CLEA model for a number of principal contaminants and 'default' end-use scenarios of residential, allotments and commercial/industrial use. The primary purpose of the SGVs are as trigger value for the tolerable daily intake (TDI), below which it can be assumed that the soil does not pose an unacceptable risk to the identified receptor. Where soils contamination is present above this level further assessment may be required. SGVs were developed for the following contaminants:

- Heavy metals and other inorganic compounds: arsenic, cadmium, chromium, cyanide, lead (now withdrawn), mercury, nickel and selenium;
- Benzene, ethylbenzene, toluene and xylenes;
- Phenol;
- Dioxins and dioxin-like polychlorinated biphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs) - 11 substances

LQM/CIEH Generic Assessment Criteria of Human Health Risk Assessment

In addition, in 2009 CIEH through LQM and EIC published generic assessment criteria (GACs) for 82 substances including metals, petroleum hydrocarbons, PAHs and explosive substances for a variety of soil types and the three 'default' land uses - (residential, allotments and commercial end-uses) as described in SR3 (EA, 2009). These have been superseded as described below.

Category 4 Screening Values

In 2013 "SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination" (CL:AIRE 2013) was issued which detailed findings of a research project undertaken by CL:AIRE to set out the framework by which potential Category 4 Screening Levels (pC4SL) may be derived. This was supplemented in 2014 by "SP1010: Development of Category 4 Screening Levels for the Assessment of Land Affected by Contamination - Policy Companion Document" (DEFRA, 2014). SP1010 proposed several updated toxicology information relating to contaminant behaviour updated assumptions relating to the modelling of human exposure to soil contaminants, derivation of separate C4SLs for residential with the consumption of home grown produce, residential without the consumption of home grown produce, and two new land uses: public open spaces near residential housing (POS resi) and public parks (POS park).

- **Public Open Space: Residential**

For public open space in close proximity to residential housing and the central green area around which houses are located, as on many housing estates from the 1930s to 1970s. It is also applicable for smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting. It is considered to be a generally grassed area up to 0.5ha with up to 50% bare soil. The land use is an important resource for children and the area is near the homes. The critical receptor is a female child age >3 - <9 years old (CLEA age class 4 - 9) as younger children are unlikely to play outdoors unsupervised.

Active exposure pathways are: ingestion of outdoor soil, ingestion of indoor dust; direct dermal contact with outdoor soil and indoor soil derived dust; inhalation of outdoor and indoor dust and inhalation of outdoor vapour.

- **Public Open Space: Park**

A public park is defined as an area of open space provided for recreational use and usually owned and maintained by the Local Authority. It is anticipated the park could be used for a wide range of activities, including the following:

- o Family visits and picnics;
- o Children's play area;
- o Sporting activities such as football on an informal basis (i.e no a dedicated sports pitch); and
- o Dog walking.

The park is modelled as an area >0.5 ha of predominantly grasses open space with no more than 25% of exposed soil. The critical receptor is a female child with CLEA age classes 1 - 6.

Active exposure pathway are: ingestion of outdoor soil; direct dermal contact with outdoor soil; inhalation of outdoor dust and inhalation of outdoor vapour.

Furthermore the C4SLs are based on a different toxicological benchmark, the 'low level of toxicological concern' (LLTC). This difference in approach was adopted because the C4SLs were primarily intended for use under Part2A of the EPA 1990 to quickly screen out Category 4 sites where there is "*no risk or that the level of risk posed is low*". SGVs and LQM GACs are based on the more conservative 'minimal or tolerable level of risk' as defined in SR2 (EA, 2009) and were derived for assessment of contamination for the Planning process.

Lead

The SGV for lead was withdrawn in 2011 and is not used in this report. The C4SL for lead provides a technically robust and conservative assessment tool using significantly updated toxicological modelling than the withdrawn SGV and derived in line with current science of lead toxicology.

LQM/CIEH Sutable 4 Use Levels (S4ULs)

The publication of the C4SLs resulted in considerable and inconclusive debate about the applicability of the lower level of protection of the C4SL, which are underlain by the LLTC, outside of the Part 2A context for which they were derived. In 2014 LQM/CIEH presented a Sutable 4 Use Levels (S4ULs), which incorporate the updated assumption exposure derived for the production of the C4SLs but within the context of deriving screening criteria above which further assessment of the risks or remedial action may be needed. The S4ULs replace the 82 substances, species and fractions and congeners contained in the previous LQM/CIEH GACs issued in 2009. Additionally, following changes and new land uses proposed in the C4SL research project, S4ULs have also been derived for the majority of substances for which the EA derived SGVs in 2009.

The GAC values adopted in this report are summarised in Table 1, below.

[illegible]

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)						
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
PAHs																			
Acenaphthene	210	510	1100	3000 (57)	4700(141)	6000 (336)	34	85	200	84000 (57)	97000 (141)	100000	15000	15000	15000	29000	30000	30000	LQM (2014)
Acenaphthylene	170	420	920	2900 (86.1)	4600 (212)	6000 (506)	28	69	160	8300 (86.1)	97000 (212)	100000	15000	15000	15000	29000	30000	30000	LQM (2014)
Anthracene	2400	5400	11000	31000 (1.17)	35000	37000	380	950	2200	520000	540000	540000	74000	74000	74000	150000	150000	150000	LQM (2014)
Benzo(a)anthracene	7.2	11	13	11	14	15	2.9	6.5	13	170	170	180	29	29	29	49	56	62	LQM (2014)
Benzo(a)pyrene	2.2	2.7	3	3.2	3.2	3.2	0.97	2	3.5	35	35	36	5.7	5.7	5.7	11	12	13	LQM (2014)
Benzo(b)fluoranthene	2.6	3.3	3.7	3.9	4	4	0.99	2.1	3.9	44	44	45	7.1	7.1	7.1	13	15	16	LQM (2014)
Benzo(g,h,i)perylene	320	340	350	360	360	360	290	470	640	3900	4000	4000	640	640	640	1400	1500	1600	LQM (2014)
Benzo(k)fluoranthene	77	93	100	110	110	110	37	75	130	1200	1200	1200	190	190	190	370	410	440	LQM (2014)
Chrysene	15	22	27	30	31	32	4.1	9.4	19	350	350	350	57	57	57	93	110	120	LQM (2014)
Dibenz(a,h)anthracene	0.24	0.28	0.3	0.31	0.32	0.32	0.14	0.27	0.61	3.5	3.6	3.6	0.57	0.57	0.58	1.1	1.3	1.4	LQM (2014)
Fluoranthene	280	560	890	1500	1600	1600	52	130	290	23000	23000	23000	3100	3100	3100	63	6300	6400	LQM (2014)
Fluorene	170	400	860	2800 (30.9)	3800 (76.5)	4500 (183)	27	67	160	63000 (30.9)	68000	71000	9900	9900	9900	20000	20000	20000	LQM (2014)
Indeno(1,2,3-cd)pyrene	27	36	41	45	46	46	9.5	21	39	500	510	510	82	82	82	150	170	180	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce (mg/kg, unless otherwise stated)			Residential <u>without</u> homegrown produce (mg/kg, unless otherwise stated)			Allotment (mg/kg, unless otherwise stated)			Commercial / Industrial (mg/kg, unless otherwise stated)			Public Open Space near Residential (mg/kg, unless otherwise stated)			Public Open Space - Park (mg/kg, unless otherwise stated)			Source
	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
SOM																			
Naphthalene	2.3	5.6	13	2.3	5.6	13	4.1	10	24	190 (76.4)	460 (183)	1100 (432)	4900	4900	4900	1200 (76.4)	1900 (183)	3000	LQM (2014)
Phenanthrene	95	220	440	1300 (36)	1500	1500	15	38	90	22000	22000	23000	3100	3100	3100	6200	6200	6300	LQM (2014)
Pyrene	620	1200	2000	3700	3800	3800	110	270	620	54000	54000	54000	7400	7400	7400	15000	15000	15000	LQM (2014)
Coal Tar (BaP as surrogate marker)	0.79	0.98	1.1	1.2	1.2	1.2	0.32	0.67	1.2	15	15	15	2.2	2.2	2.2	4.4	4.7	4.8	LQM (2014)
BTEX and TPH																			
Benzene	0.087	0.17	0.37	0.38	0.7	1.4	0.017	0.034	0.075	27	47	90	72	72	73	90	100	110	LQM (2014)
Toluene	130	290	660	880 vap (869)	1900	3900	22	51	120	56000 vap (869)	110000 vap (1920)	180000 vap (4360)	56000	56000	56000	87000 vap (869)	95000 vap (1920)	100000 vap (4360)	LQM (2014)
Ethylbenzene	47	110	260	83	190	440	16	39	91	5700 vap (518)	13000 vap (1220)	27000 vap (2840)	24000	24000	25000	17000 vap (518)	22000 vap (1220)	27000 vap (2840)	LQM (2014)
Xylene - o	60	140	330	88	210	480	28	67	160	6600 (478)	15000 (1120)	33000 (2620)	41000	42000	43000	17000 (478)	24000 (1120)	33000 (2620)	LQM (2014)
Xylene - m	59	140	320	82	190	450	31	74	170	6200 (625)	14000 (1470)	31000 (3460)	41000	42000	43000	17000 (625)	24000 (1470)	32000 (3460)	LQM (2014)
Xylene - p	56	130	310	79	180	430	29	69	160	5900 (576)	14000 (1350)	30000 (3170)	41000	42000	43000	17000 (576)	23000 (1350)	31000 (3170)	LQM (2014)
Aliphatic EC 5-6	42	78	160	42	78	160	730	1700	3900	3200 (304)	5900 (558)	12000 (1150)	570000 (304)	590000	600000	95000 (304)	130000 (558)	180000 (1150)	LQM (2014)
Aliphatic EC >6-8	100	230	530	100	230	530	2300	5600	13000	7800 (144)	17000 (322)	40000 (736)	600000	610000	620000	150000 (144)	220000 (322)	320000 (736)	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)						
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
Aliphatic EC >8-10	27	65	150	27	65	150	320	770	1700	2000 (78)	4800 (190)	11000 (451)	13000	13000	13000	14000 (78)	18000 (190)	21000 (451)	LQM (2014)
Aliphatic EC >10-12	130 (48)	330 (118)	760 (283)	130 (48)	330 (118)	760 (283)	2200	4400	7300	9700 (48)	23000 (118)	47000 (283)	13000	13000	13000	21000 (48)	23000 (118)	24000(2 83)	LQM (2014)
Aliphatic EC >12-16	1100 (24)	2400 (59)	4300 (142)	1100 (24)	2400 (59)	4300 (142)	11000	13000	13000	59000 (24)	82000 (59)	90000 (142)	13000	13000	13000	25000 (24)	25000 (59)	26000 (142)	LQM (2014)
Aliphatic EC >16-35	65000 (8.48)	92000 (21)	110000	65000 (8.48)	92000 (21)	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000	LQM (2014)
Aliphatic EC >35-44	65000 (8.48)	92000 (21)	110000	65000 (8.48)	92000 (21)	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000	LQM (2014)
Aromatic EC 5-7	70	140	300	370	690	1400	13	27	57	26000 (1220)	46000 (2260)	86000 (4710)	56000	56000	56000	76000 (1220)	84000 (2260)	92000 (4710)	LQM (2014)
Aromatic EC >7-8	130	290	660	860	1800	3900	22	51	120	56000 (869)	110000 (1920)	180000 (4360)	56000	56000	56000	87000 (869)	95000 (1920)	100000 (4360)	LQM (2014)
Aromatic EC >8-10	34	83	190	47	110	270	8.6	21	51	3500 (613)	8100 (1500)	17000 (3580)	5000	5000	5000	7200 (613)	8500 (1500)	9300 (3580)	LQM (2014)
Aromatic EC >10-12	74	180	380	250	590	1200	13	31	74	16000 (364)	28000 (899)	34000 (2150)	5000	5000	5000	9200 (364)	9700 (899)	10000	LQM (2014)
Aromatic EC >12-16	140	330	660	1800	2300 (419)	2500	23	27	130	36000 (169)	37000	38000	5100	5100	5000	10000	10000	10000	LQM (2014)
Aromatic EC >16-21	260	540	930	1900	1900	1900	46	110	260	28000	28000	28000	3800	3800	3800	7600	7700	7800	LQM (2014)
Aromatic EC >21-35	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce (mg/kg, unless otherwise stated)			Residential <u>without</u> homegrown produce (mg/kg, unless otherwise stated)			Allotment (mg/kg, unless otherwise stated)			Commercial / Industrial (mg/kg, unless otherwise stated)			Public Open Space near Residential (mg/kg, unless otherwise stated)			Public Open Space - Park (mg/kg, unless otherwise stated)			Source
	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
SOM																			
Aromatic EC >35-44	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
Aromatic EC >44-75	1600	1800	1900	1900	1900	1900	1200	2100	3000	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
VOCs																			
1,2-dichloroethane (1,2-DCA)	0.0071	0.011	0.019	0.0092	0.013	0.023	0.0046	0.0083	0.016	0.67	0.97	1.7	29	29	29	21	24	28	LQM (2014)
1,1,1-trichloroethane	8.8	18	39	9	18	40	48	110	240	660	1300	3000	140000	140000	140000	57000 (1425)	76000 (2915)	100000 (6392)	LQM (2014)
1,1,2,2,tetrachloroethane	1.6	3.4	7.5	3.9	8	17	0.41	0.89	2	270	550	1100	1400	1400	1400	1800	2100	2300	LQM (2014)
tetrachloroethene	0.18	0.39	0.9	0.18	0.4	0.92	0.65	1.5	3.6	19	45	95	1400	1400	1400	810 (424)	1100 (951)	1500	LQM (2014)
tetrachloromethane (Carbon tetrachloride)	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	2.9	6.3	14	890	920	950	190	270	400	LQM (2014)
Trichloroethene	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	1.2	2.6	5.7	120	120	120	70	91	120	LQM (2014)
Trichloromethane (chloroform)	0.91	1.7	3.4	1.2	2.1	4.2	0.42	0.83	1.7	99	170	350	2500	2500	2500	2600	2800	3100	LQM (2014)
Chloroethene (Vinyl chloride)	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	0.00055	0.001	0.0018	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4	LQM (2014)
2,4,6-Trinitrotoluene (TNT)	1.6	3.7	8.1	65	66	66	0.24	0.58	1.4	1000	1000	1000	130	130	130	260	270	270	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)						
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
RDX	120	250	540	13000	13000	13000	17	38	85	210000	210000	210000	26000	26000	27000	49000 (18.7)	51000	53000	LQM (2014)
HMX	5.7	13	26	6700	6700	6700	0.86	1.9	3.9	110000	110000	110000	13000	13000	13000	23000 (0.35)	23000 (0.39)	24000 (0.48)	LQM (2014)
Aldrin	5.7	6.6	7.1	7.3	7.4	7.5	3.2	6.1	9.6	170	170	170	18	18	18	30	31	31	LQM (2014)
Dieldrin	0.97	2	3.5	7	7.3	7.4	0.17	0.41	0.96	170	170	170	18	18	18	30	30	31	LQM (2014)
Atrazine	3.3	7.6	17.4	610	620	620	0.5	1.2	2.7	9300	9400	9400	1200	1200	1200	2300	2400	2400	LQM (2014)
Dichlovos	0.032	0.066	0.014	6.4	6.5	6.6	0.0049	0.01	0.022	140	140	140	16	16	16	26	26	27	LQM (2014)
Alpha-Endosulfan	7.4	18	41	160 (0.003)	280 (0.007)	410 (0.016)	1.2	2.9	6.8	5600 (0.003)	7400 (0.007)	8400 (0.016)	1200	1200	1200	2400	2400	2500	LQM (2014)
alpha- Hexachlorocyclohe xane	0.23	0.55	1.2	6.9	9.2	11	0.035	0.087	0.21	170	180	180	24	24	24	47	48	48	LQM (2014)
beta- hexachlorocyclohe xanes	0.085	0.2	0.46	3.7	3.8	3.8	0.013	0.032	0.077	65	65	65	8.1	8.1	8.1	15	15	16	LQM (2014)
gamma- hexachlorocyclohe xanes	0.06	0.14	0.33	2.9	3.3	3.5	0.0092	0.023	0.054	67	69	70	8.2	8.2	8.2	14	15	15	LQM (2014)
Chlorobenzene	0.46	1	2.4	0.46	1	2.4	5.9	14	32	56	130	290	11000	13000	14000	1300 (675)	2000 (1520)	2900	LQM (2014)
1,2- Dichlorobenzene	23	55	130	24	57	130	94	230	540	2000 (571)	4800 (1370)	11000 (3240)	90000	95000	98000	24000 (571)	36000 (1370)	51000 (3240)	LQM (2014)
1,3- Dichlorobenzene	0.4	1	2.3	0.44	1.1	2.5	0.25	0.6	1.5	30	73	170	300	300	300	390	440	470	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)						
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
1,4-Dichlorobenzene	61	150	350	61	150	350	15	37	88	4400 (224)	10000 (540)	25000 (1280)	17000	17000	17000	36000 (224)	36000 (540)	36000 (1280)	LQM (2014)
VOCs Continued																			
1,2,3-Trichlorobenzene	1.5	3.6	8.6	1.5	3.7	8.8	4.7	12	28	102	250	590	1800	1800	1800	770 (134)	1100 (330)	1600 (789)	LQM (2014)
1,2,4-Trichlorobenzene	2.6	6.4	15	2.6	6.4	15	55	140	320	220	530	1300	15000	17000	19000	1700 (318)	2600 (786)	4000 (1880)	LQM (2014)
1,3,5-Trichlorobenzene	0.33	0.81	1.9	0.33	0.81	1.9	4.7	12	28	23	55	130	1700	1700	1800	380 (36.7)	580 (90.8)	860 (217)	LQM (2014)
1,2,3,4-Tetrachlorobenzen e	15	36	78	24	56	120	4.4	11	26	1700 (122)	3080 (304)	4400 (728)	830	830	830	1500 (122)	1600	1600	LQM (2014)
1,2,3,5-Tetrachlorobenzen e	0.66	1.6	3.7	0.75	1.9	4.3	0.38	0.9	2.2	49 (39.4)	120 (98.1)	240 (235)	78	79	79	110 (39)	120	130	LQM (2014)
1,2,4,5-Tetrachlorobenzen e	0.33	0.77	1.6	0.73	1.7	3.5	0.06	0.16	0.37	42 (19.7)	72 (49.1)	96	13	13	13	25	26	26	LQM (2014)
Pentachlorobenzen e	5.8	12	22	19	30	38	1.2	3.1	7	640 (43)	770 (107)	830	100	100	100	190	190	190	LQM (2014)
Hexachlorobenzen e	1.8 (0.2)	3.3 (0.5)	4.9	4.1 (0.2)	5.7 (0.5)	6.7 (1.2)	0.47	1.1	2.5	110 (0.2)	120	120	16	16	16	30	30	30	LQM (2014)
Phenol	280	550	1100	750	1300	2300	66	140	280	760 _{dir} (31000)	1500 _{dir} (35000)	3200 _{dir} (37000)	760 _{dir} (31000)	1500 _{dir} (35000)	3200 _{dir} (37000)	760 _{dir} (31000)	1500 _{dir} (35000)	3200 _{dir} (37000)	LQM (2014)

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)						
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
Chlorophenols (excluding pentachlorophenol)	0.87 (g)	2	4.5	94	150	210	0.13 (g)	0.3	0.7	3500	4000	4300	620	620	620	1100	1100	1100	LQM (2014)
Pentachlorophenol	0.22	0.52	1.2	27 (16.4)	29	31	0.03	0.08	0.19	400	400	400	60	60	60	110	120	120	LQM (2014)
Carbon Disulphide	0.14	0.29	0.62	0.14	0.29	0.62	4.8	10	23	11	22	47	11000	11000	12000	1300	1900	2700	LQM (2014)
Hexachlorobutadie ne	0.29	0.7	1.6	0.32	0.78	1.8	0.25	0.61	1.4	31	66	120	25	25	25	48	50	51	LQM (2014)

(g) derived based on 2,3,4,6-tetrachlorophenol; dir - based on a threshold protective of direct skin contact with phenol (guideline in brackets based on health effects following long term exposure provided for illustration only); (vap) calculated for vapour phase only. SOM - Soil Organic Matter; (4.5) solubility.

APPENDIX I - CONTROLLED WATERS RISK ASSESSMENT

CURRENT GUIDANCE FOR CONTROLLED WATERS RISK ASSESSMENT

Regulatory Context

Government policy is based upon a “suitable for use approach,” which is relevant to both the current use of land and also to any proposed future use. When considering the current use of land, Part IIA of the Environment Protection Act 1990 (EPA 1990) provides the regulatory regime, which was introduced by Section 57 of the Environment Act 1995, which came into force in England on 1 April 2000. The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health, controlled waters or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

“any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

(a) Significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) Pollution of controlled waters is being, or is likely to be, caused.”

Part IIA provides a statutory definition of the pollution of controlled waters under Section 78A(9) as:

“the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter”

Controlled Waters are defined Section 104 of the Water Resources Act 1991. They include in summary: Relevant territorial waters which extend seaward for three miles from the low-tide limit from which the territorial sea adjacent to England and Wales is measured.

The Environment Agency has powers under Part 7 of The Water Resources Act (1991) to take action to prevent or remedy the pollution of controlled waters, including circumstances where the pollution arises from contamination in the land. This is reinforced in The Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) which came into force in early April 2012.

Part IIA introduces the concept of a contaminant linkage; where for potential harm to exist there must be a connection between the source of the hazard and the receptor via a pathway. Risk assessment in contaminated land is therefore directed towards identifying the contaminants, pathways and receptors that can provide contaminant linkages. This is known as the contaminant-pathway-receptor link (CPR or contaminant linkage).

Part IIA places contaminated land responsibility as a part of the planning and redevelopment process, rather than Local Authority or Environment Agency directly, except in cases of very high pollution risk or where harm is occurring. In the planning process, guidance is provided by National Planning Policy Framework (NPPF) of March 2012. The NPPF requires that a site which has been developed shall not be capable of being determined “contaminated land” under Part IIA. Therefore, appropriate risk-based investigation is required to identify the contaminant linkages that can then be assessed, and then mitigated using methods that can be agreed with the planners.

Environment Agency Guidance

The Environment Agency's stance on groundwater resources is:

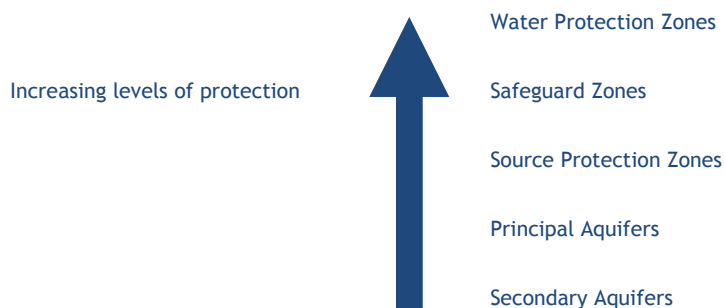
“to protect and manage groundwater resources for present and future generations in ways that are appropriate for the risks we identify” (Groundwater Protection: Policy and Practice GP3, 2012).

At present, the legislation and guidance pertaining to the protection of controlled waters in the UK is complex; however, the core objectives seek to enforce the position given above.

In 1992, the National Rivers Authority published their Policy and Practice for the Protection of Groundwater (PPPG), this document introduced areas of focus for developments such as Source Protection Zones (SPZs) and Groundwater Vulnerability Maps. The Policy was revised in 1998, since which there have been substantial changes in legislation, driven by key European Directives relating to groundwater include the Groundwater Directive (80/68/EEC) and the Water Framework Directive (2000/60/EC). Aspects of these directives are controlled by primary UK legislation such as the Water Resources Act 1991 as amended by the Water Act 2003. Gaps in the 1998 PPPG that emerged as the result of further legislative changes were addressed in the Environment Agency Policy document *Groundwater Protection: Policy and Practice (GP3)*, Version 1 of November 2012. The three main parts of GP3 were:

- Groundwater principals;
- Position statements and legislation; and
- Technical information.

The Environment Agency has a tiered risk based approach to drinking water protection as summarised below:



Controlled Waters Risk Assessment

A number of tools are available (as detailed in GP3) in order for a developer of a potentially contaminated site to fulfil their obligations under the legislation. A site assessment would be required in order to identify any potential risks to controlled waters and to derive suitable clean up criteria, if required, to ensure the protection of controlled waters.

There are three main stages to any risk assessment of controlled waters:

- 1) Risk Screening (devise Conceptual Site Model, making reference to groundwater vulnerability maps, site setting, controlled waters context etc)
- 2) Generic Risk Assessment (EA Remedial Targets Methodology Tier 1 / Comparison of groundwater data with relevant standards)
- 3) Detailed Quantitative Risk Assessment (Consideration of aquifer properties and site specific parameters, EA Remedial Targets Methodology Tiers 2 & 3)

Risk Screening

Here, the Conceptual Site Model (CSM) is a critical tool to assessing any potentially contaminated site. The information from a robust CSM can be used to establish any pathways or receptors that do not require further assessment at an early stage. For example, it may be possible to confirm the absence of a particular sensitive controlled water receptor (such as a surface water feature) within the vicinity of the Site thereby breaking the associated source-pathway-receptor pollutant linkage. Information from subsequent tiers of risk assessment, such as following intrusive investigations, are used to update the CSM accordingly.

Generic Risk Assessment - England and Wales

When undertaking the Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Tier 1), comparison of chemical analytical results is made with those screening criteria. Values of screening criteria with which chemical test results can be compared are published in the following:

- EQS Directive 2008/105/EC
- Priority Substances Directive 2013/39/EU
- Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015
- UK Drinking Water Standards (UK DWS)
- World Health Organisation (WHO Guidelines) for Drinking Water Quality
- Council Directive 98/83/EC on the quality of water intended for human consumption (Drinking water directive)

Generic Risk Assessment is generally undertaken via comparison of reported leachate and/or groundwater concentrations against selected assessment criteria for the potential contaminants of concern identified for the Site from a preliminary desk based assessment.

The selected Generic Assessment Criteria (GAC) derived from a Water Quality Standard (WQS) for any specific substance may not necessarily be a simple number and can often be found to be expressed as:

- Annual mean concentration;
- Maximum allowable concentration;
- 95th percentile concentration for n samples;
- Total concentration;
- Dissolved concentration (applicable to filtered samples)

The values may sometimes be expressed for individual substances (e.g. arsenic or for groups of substances e.g. total xylenes or sums of certain PAHs).

Environmental Quality Standards (EQS) have been used where available for Priority Substances and Priority Hazardous Substances set at a European level:

- Priority Substances Directive 2013/39/EU;
- Amending 2008/105 and 2000/118/EC

In addition, EQS values derived for Specific Pollutants have been used as presented in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

For assessing risks to potable water abstraction supplies, UK Drinking Water Standards presented in the Water Supply (Water Quality) Regulations 2000 (SI/2000/3184) (as amended) have been applied.

In selecting a GAC for a particular Site, Tier Environmental considers the following factors:

- Current use/function of the groundwater (e.g. drinking water, irrigation water, industrial use, base-flow to rivers and streams);
- Plausible, proposed or planned future uses of the water and nearby waters;
- Sensitivity of the critical receptor (e.g. human health, aquatic life); and,
- Requirements to trigger action under the legal context

In accordance with Part 2A:

"in deciding whether pollution of controlled waters is occurring, the assessor will have regard to all of the water quality standards that are relevant to the specific site and make a judgment against the most stringent of those relevant standards".

Please note that there is no quantitative criterion for total petroleum hydrocarbons (TPH), or speciated TPH fractions. Historically, standards provided for petroleum hydrocarbons ranges from 10µg/l (Private Water Supply Regulations 1991, removed from the 2009 regulations) to 50µg/l-1000µg/l (Surface Waters (Abstraction for Drinking Water) Regulations 1989) which related to the degree of treatment of water prior to use as drinking water. Over time, the legislative standards have been rescinded and no alternative standard provided, although the Environment Agency planned to release speciated TPH criteria (Fretwell et al., 2009). In the absence of suitable

criteria, Tier Environmental adopts a value of 10 µg/l for more sensitive locations (e.g. Principal Aquifer, drinking water abstraction), and a value of 50µg/l for locations considered less sensitive (e.g. low permeability aquifers) or where a site is located in close proximity to a surface watercourse.

Should the Level 1 or 2 assessments indicate threshold levels to be exceeded, then there are three alternative ways in which to proceed:

- To devise suitable remedial solutions;
- To carry out more investigation, sampling and analysis;
- To conduct a site-specific Detailed Quantitative Risk Assessment (DQRA) to whether or not the soil materials are suitable for their site-specific intended use or to devise a site-specific clean-up level.

Detailed Quantitative Risk Assessment (DQRA)

The decision to carry out a DQRA will be informed by the initial qualitative and generic assessment. The scope of any such assessment will be accurately defined by the outcomes of the former two stages. The robust CSM will be sufficiently refined by this stage that only certain contaminants of concern, certain pathways and certain receptors will require further assessment.

Additional site specific data is normally required for this stage of assessment, as explained above, more processes that are capable of affecting contaminant concentrations are considered (such as dilution and attenuation).

Remediation criteria derived will therefore be specific to each site and will be based on a detailed assessment of the potential impact at the identified receptor or compliance point. A greater level of confidence can be placed on the predicted impact on the compliance point following a DQRA.

Aquifer Designations

The Environment Agency have classified different types of aquifer from which groundwater can be extracted. The aquifer designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. It is updated regularly to reflect their ongoing programme of improvements to these maps. The maps are split into two different type of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels.
- Bedrock -solid permeable formations e.g. sandstone, chalk and limestone.

The maps display the following aquifer designations:

Classification	Definition
Principal Aquifers (Highly Permeable)	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
Secondary A Aquifers	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
Secondary B Aquifers	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
Secondary Undifferentiated Aquifers	This has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Unproductive Strata	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Hazardous and Non Hazardous Substances

The Groundwater (England and Wales) Regulations 2009 control the disposal to the hydrogeological environment of potentially polluting substances which are divided into Hazardous Substances and Non-hazardous Contaminants (this roughly approximates to the former List 1 and List 2 substances).

Hazardous Substances are the most damaging and toxic and must be prevented from directly or indirectly entering the groundwater environment. Hazardous Substances include mineral oils and hydrocarbons, pesticides, biocides, herbicides, solvents and some metals. Discharge of Hazardous Substances to Controlled Waters must be prevented.

Non-hazardous Pollutants are any contaminants other than Hazardous Substances. Non-hazardous Pollutants are potentially toxic but are less harmful than Hazardous Substances, but their direct discharge to groundwater is generally not permitted and any indirect discharge to groundwater must be limited and be controlled by technical precautions in order to prevent pollution. Non-hazardous Pollutants include ammonia and nitrites, many metals and fluorides.

APPENDIX J - ENGINEER'S FIELD TESTING

Samples for field testing were selected by a representative of Tier Environmental during the site investigation works in accordance with the sampling specification presented elsewhere in this report.

Field testing for geotechnical parameters

In situ Standard Penetration Tests (SPTs) were also carried out throughout the full depth of the cable percussive boreholes using either a split spoon sampler or a 60° solid cone. These tests assess the relative density of granular soils encountered and indicate the undrained shear strength of cohesive soils or the strength of rock. The results of these tests are shown as 'N' values and can be found adjacent to the appropriate sample level on the exploratory hole records in Appendix C.

Hand shear vane testing was also undertaken, where required, to establish the undrained shear strength of cohesive soils within trial pits. Testing was performed, when safe to do so, at shallow depth (<1.0 m) within the trial pit or upon intact samples collected within the digger bucket. Where possible a set of at least 3 No. tests was performed at each depth.

In order for stratum descriptions to comply with BS EN ISO 14688 and 14689, the Engineer performs the following assessment of soil properties in the field.

- Determination of consistency (BS EN ISO 14688 Part 1 Section 5.14);
- Assessment of dry strength (BS EN ISO 14688 Part 1 Section 5.6);
- Shear strength (BS EN ISO 14688 Part 2 Section 5.3);
- Plasticity (BS EN ISO 14688 Part 1 Section 5.8);
- Assessment of particle shape (BS EN ISO 14688 Part 1 Section 5.2).

APPENDIX K - CHEMICAL AND GEOTECHNICAL TEST SAMPLING

Samples were selected by a representative of Tier Environmental during the site investigation works in accordance with the sampling approach described elsewhere in this report.

Samples for geotechnical and related testing

Bulk samples were placed within robust heavy duty plastic bags and sealed, together with small disturbed samples, within airtight 1 litre plastic containers.

100 mm diameter ‘undisturbed’ samples (“U100 samples”) were obtained where possible from cable percussive and large diameter window sample boreholes within cohesive materials.

Samples for chemical analysis

All samples for chemical analysis were placed into clean new containers as summarised in Table 1. Unless explicitly stated elsewhere in this report, no preservatives were used to eliminate the risk that preservatives cause contaminant dissolution or analytical interference. Containers for VOC analysis were fully filled to exclude headspace.

Soil samples were dispensed as soon as possible after collection using reusable stainless steel spatulas, trowels or similar implements.

Ground water samples were collected from boreholes using single-use Teflon bailers or dedicated Waterra tubing with foot valves, except as otherwise noted within this report. Caution was taken to avoid excessive agitation during collection

New disposable gloves were used by the engineer for the collection of each sample.

Reusable equipment was washed down with distilled or deionised water between samples, except where tarry or similarly sticky materials were present. In such cases specific cleaning procedures were adopted as specifically described elsewhere in this report.

All sub-samples taken for chemical analysis were placed into refrigerators or cool boxes containing frozen ice packs immediately after aliquoting. All samples were transferred in cool boxes containing frozen ice packs to the relevant UKAS/MCERTS accredited laboratory as soon as possible. Recommended maximum holding times before analysis are summarised in Table 1.

Table 1. Sample containers and holding times.

Analysis	Container/special requirements	Max. holding time at 4°C before analysis
Soil and sediment samples		
VOCs	30-60 g brown or green glass jar with VOC-resistant cap and inert cap liner. <i>Must be fully filled.</i>	14 days
TPHCWG	30-60 g brown or green glass jar with VOC-resistant cap and inert cap liner PLUS 250-500 g brown or green glass jar with unwaxed cap liner. ¹ <i>The former must be fully filled.</i>	14 days
All other organics	250-500 g brown or green glass jar with unwaxed cap liner.	7 days
Inorganics	Air-tight 0.5-2.0 kg plastic container (250-500 g brown or green glass jar may also be used).	14 days ²
Water samples		
VOCs	40-50 ml glass vial with VOC resistant screw cap and inert liner. <i>Must be fully filled.</i>	14 days
TPHCWG	40-50 ml glass vial with VOC resistant screw cap and inert liner PLUS 500-1000 ml brown or green glass bottle with screw cap and unwaxed liner. ¹ <i>The former must be fully filled, the latter should be filled if possible.</i>	14 days
All other organics	500-1000 ml brown or green glass bottle with screw cap. <i>Fill if possible.</i>	7 days
Inorganics	500-1000 ml translucent or opaque screw cap plastic or brown or green glass bottles. <i>Fill if possible.</i>	14 days ³

¹ The smaller vessel is used for analysis of the volatile components within the TPH mixture and the larger one is for the non-volatile components.

² 14 days is set as a reasonable limit for all routine analyses of soil for those inorganic components vulnerable to chemical and/or biological breakdown. Samples for sulphate analysis are vulnerable to biological sulphate-reduction but can be held for up to 28 days. For total metals, a holding period of up to 6 months is acceptable.

³ 14 days applies for all routine analyses of most inorganic components that may be vulnerable to chemical and/or biological reactions. In the specific cases of sulphide, nitrite, nitrate and phosphate analyses, storage time must not exceed 48 hours. For total metals, a holding time of up to 6 months is acceptable.

Tier Environmental standard analytical suites

The analyses included with Tier Environmental's standard analytical suites for soil, soil leachate and water samples are presented in Table 2. Other individual analyses were specified as described within this report.

Table 2. Tier Environmental Standard Analytical Suites.

Parameter	Sample type					
	Soil		Leachate ¹		Water	
		LoD ² (mg/kg or as stated)		LoD (µg/l or as stated)		LoD (µg/l or as stated)
Metals and metalloids						
Arsenic	✓	1	✓	10	✓	10
Cadmium	✓	1	✓	5	✓	5
Chromium	✓	1	✓	5	✓	5
Mercury	✓	1	✓	1	✓	1
Lead	✓	1	✓	4	✓	4
Selenium	✓	2	✓	10	✓	10
Copper	✓	1	✓	1	✓	1
Nickel	✓	1	✓	50	✓	50
Zinc	✓	1	✓	8	✓	8
Other inorganics						
Ammonia (as NH ₄ -N)					✓	15
Total sulphate	✓	100			✓	50 mg/l
Water-soluble sulphate	✓	0.1 g/l				
Hardness (as CaCO ₃)					✓	1 mg/l
Organics						
Monohydric phenol	✓	1	✓	0.5	✓	0.5
Speciated PAHs (USEPA 16)	✓	0.1	✓	0.01	✓	0.01
Total Organic Carbon	✓	0.1 wt%				
Others						
Electrical conductivity					✓	NA
pH	✓	NA	✓	NA	✓	NA

NA - Not applicable

1 Leachate preparation according to NRA (1994), 10:1 liquid to solid ratio.

2 The table presents the desired limit of detection for the analysis. Higher LoDs may be reported on analytical data sheets due to interference between analytes within specific samples or if the laboratory needed to dilute samples to achieve results within the calibrated range for that instrument.

Analytical QA procedures

Introduction

Quality Assurance (QA) is a system of review and audit that assesses the effectiveness of that product and assures the producer and user that defined standards of quality have been met. If we consider site investigation and chemical analysis, QA is the management system that ensures these measures are in place and working as intended.

QA within the laboratory form part of relevant certification programmes (such as UKAS and MCERTS) and, indeed, will be undertaken in some form by any reputable analyst, whether for a certified technique or not. Laboratory QA/QC is beyond the control of Tier Environmental and will not be considered further in this document, although the relevant laboratory documentation can be obtained upon request. QA must also form part of the design and execution of a site investigation.

Two parameters often used to assess measurement quality objectives are bias and precision. Bias is a systematic deviation in the data. For example, a positive bias (concentrations higher than in reality) would be introduced if sampling bottles were a source of the analyte and this fact was unknown. Precision is the variation in the measurements around a central 'expected' value. This could be due both to real variability in the environmental medium being measured and random errors in the analytical process. Both precision and bias can be assessed by the use of appropriate blanks and replicates within the site investigation programme.

The objectives of the QA activities undertaken in this present site investigation were to recognise and quantify systematic bias within the analytical dataset and to obtain an indication of precision. In environmental samples, much of the observed variability is likely to result from heterogeneity in the sampled medium, particularly for soil and sediment samples.

Such QA practice within the sampling programme is required by current guidance (e.g., Environment Agency report P5-065/TR (2000); Environment Agency LFTGN02 (2002); BS 10175:2001).

Alternative QA procedures to the generic approach presented in this appendix may be specified for a project, provided case-specific justification is given.

QA checking procedure (data validation)

The responsible Engineer and Project Reviewer are required to undertake data validation and provide comment on data quality within the main body of the report(s) issued, when noteworthy matters arise. This QA checking should involve:

- Confirming that data reported by the laboratory have achieved the standards specified by the certification scheme (MCERTS or UKAS). This will be indicated on the analytical certificates issued by the laboratory.
- Checking that the limit of detection (LoD) and limit of quantification (LoQ) achieved by the laboratory for an individual analyte is appropriate for the purposes of the report. LoD and LoQ will vary dependent upon analyte concentrations, sample matrix properties and interference from co-contaminants.
- A check that the reported range of concentrations are reasonable for the analyte. For example, the dissolved concentration of an analyte in a water sample should not exceed saturation. If it does, then this merits further consideration (e.g., was colloidal organic matter or other solid-phase material present or could there have been unobserved free-phase organic liquid?) and explicit comment. At it's simplest, there may be a unit error.

- Where analysis involves reporting of Tentatively Identified Compounds (TICs; normally by mass spectrometry), the reviewers should check that these might reasonably be expected at the site under consideration. The uncertainties in identification by MS mean that it is not uncommon that TICs are incorrectly assigned. In cases of doubt, the analytical laboratory can re-check the raw data and confirm.
- A review of the analytical precision by comparing data obtained for duplicate samples. There is no absolute threshold - variability is entirely dependent upon the sample matrix and manner in which the contaminant has entered the sample. Variability that cannot reasonably be assigned to such factors (for example a very high apparent variability in data for sediment-free water samples) should be reviewed with the laboratory. Variability that is attributable to the sample matrix can nevertheless provide important pointers to improve understanding of contaminant transport pathways and the risks posed by pollutant linkages (e.g., soil heterogeneity, the association of contamination with particular soil fractions, the presence of residual NAPL within soil pores or the role of suspended sediments in contaminant transport).
- Confirmation that no errors have been introduced by data transcription, unit conversion or corrections between preliminary and certificates issued by the laboratory. The reviewer should audit a proportion (typically 5-10%) of all data from the original (final) certificates of analysis through to the equivalent values in the report for those specific samples.

It is important to consult the analytical laboratory if apparent QA issues arise. Many apparent concerns can be adequately resolved on the basis of revisiting the raw analytical data or by obtaining a better understanding of the inherent limitations of the analysis for a particular matrix or sample type.

APPENDIX L - GEOTECHNICAL TEST RESULTS



LABORATORY REPORT



4043

Contract Number: PSL19/5889

Report Date: 28 October 2019
Client's Reference: TE1239
Client Name: Tier Consult
Chadwick House
Warrington Road
Birchwood Park
Cheshire
WA3 6AE

For the attention of: Sean Lee

Contract Title: Land at Rhosrobin
Date Received: 2/10/2019
Date Commenced: 2/10/2019
Date Completed: 28/10/2019

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson
(Director)

S Royle
(Laboratory Manager)

A Watkins
(Director)

S Eyre
(Senior Technician)

R Berriman
(Quality Manager)

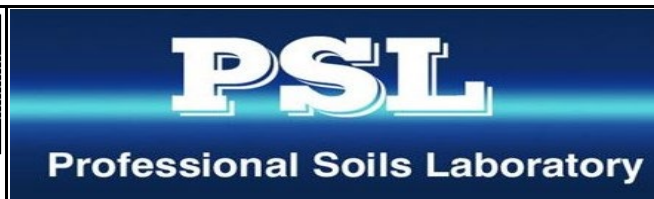
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Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP13		BULK	1.40		Brown very gravelly clayey silty SAND.
TP15		BULK	1.20		Brown slightly gravelly very clayey silty SAND.
WS01		SPT	1.20		Brown slightly gravelly very sandy CLAY.
WS02		SPT	1.20		Brown mottled grey slightly gravelly sandy CLAY.
WS03		SPT	1.20		Brown slightly gravelly very sandy CLAY.
WS06		SPT	1.20		Brown slightly gravelly SAND.
WS09		SPT	1.20		Brown slightly gravelly very sandy CLAY.
WS08		SPT	1.20		Brown slightly gravelly very sandy CLAY.
WS11		SPT	1.20		Brown slightly gravelly SAND.
WS12		SPT	1.20		Brown slightly gravelly very sandy CLAY.
WS14		SPT	1.20		Brown slightly gravelly very sandy CLAY.
WS16		SPT	1.20		Brown slightly gravelly very sandy CLAY.
WS17		SPT	2.00		Brown slightly gravelly very sandy CLAY.
WS18		SPT	2.00		Brown slightly gravelly very sandy CLAY.
WS02		SPT	2.00		Brown slightly gravelly very sandy CLAY.
WS06		SPT	2.00		Brown gravelly SAND.
WS13		SPT	2.00		Brown slightly gravelly very sandy CLAY.



Land at Rhosrobin

Contract No:

PSL19/5889

Client Ref:

TE1239

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m ³ Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
WS01		SPT	1.20		17			28	15	13	97	Low plasticity CL.
WS02		SPT	1.20		19			40	20	20	97	Intermediate plasticity CL.
WS03		SPT	1.20		18			37	18	19	98	Intermediate plasticity CL.
WS06		SPT	1.20		3.9				NP			
WS09		SPT	1.20		9.7			26	14	12	95	Low plasticity CL.
WS08		SPT	1.20		12			26	13	13	94	Low plasticity CL.
WS11		SPT	1.20		13				NP			
WS12		SPT	1.20		14			25	14	11	96	Low plasticity CL.
WS14		SPT	1.20		12			27	15	12	93	Low plasticity CL.
WS16		SPT	1.20		16			27	16	11	98	Low plasticity CL.
WS17		SPT	2.00		15			29	16	13	94	Low plasticity CL.
WS18		SPT	2.00		15			27	15	12	96	Low plasticity CL.
WS02		SPT	2.00		14			30	16	14	97	Low plasticity CL.
WS06		SPT	2.00		4.1				NP			
WS13		SPT	2.00		13			25	14	11	96	Low plasticity CL.

SYMBOLS : NP : Non Plastic

* : Liquid Limit and Plastic Limit Wet Sieved.



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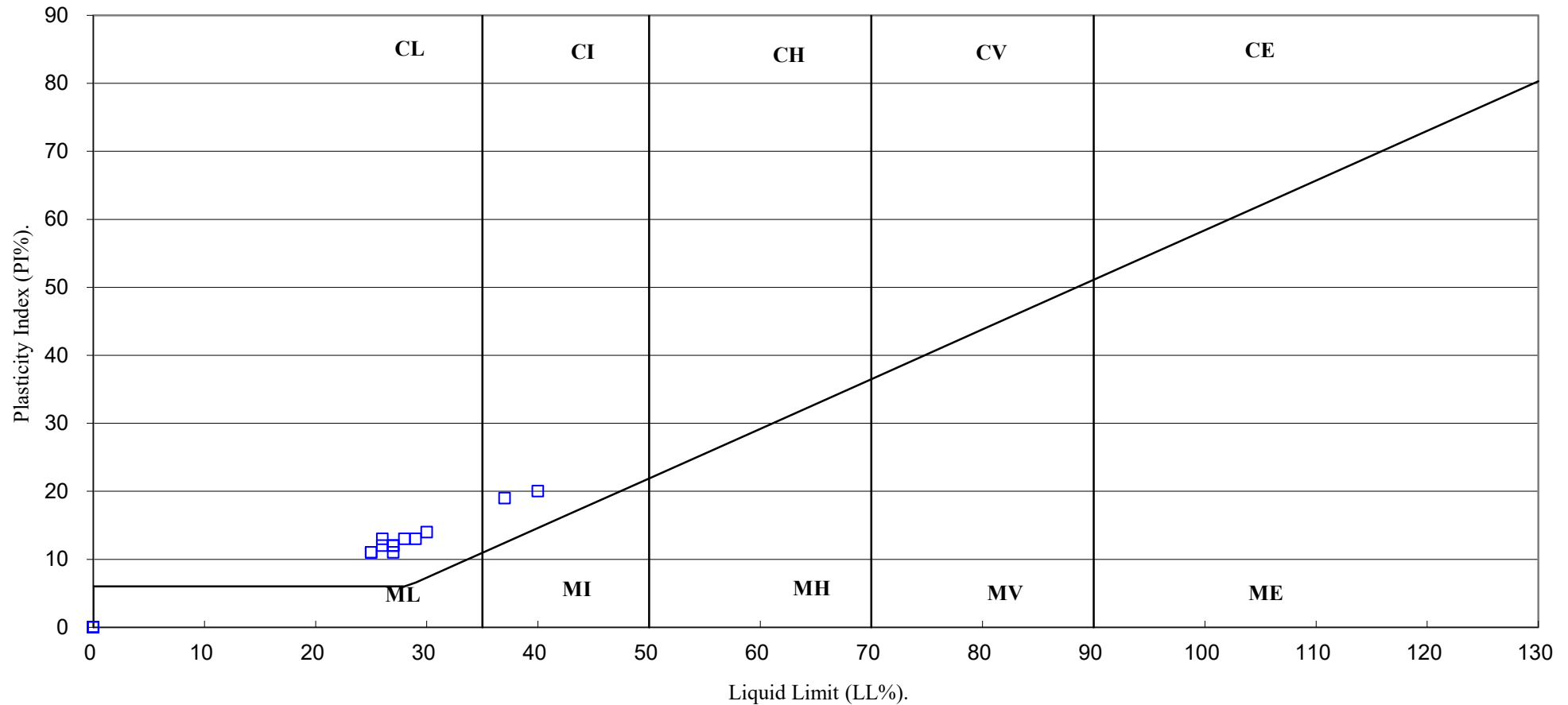
Contract No:

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PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



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PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

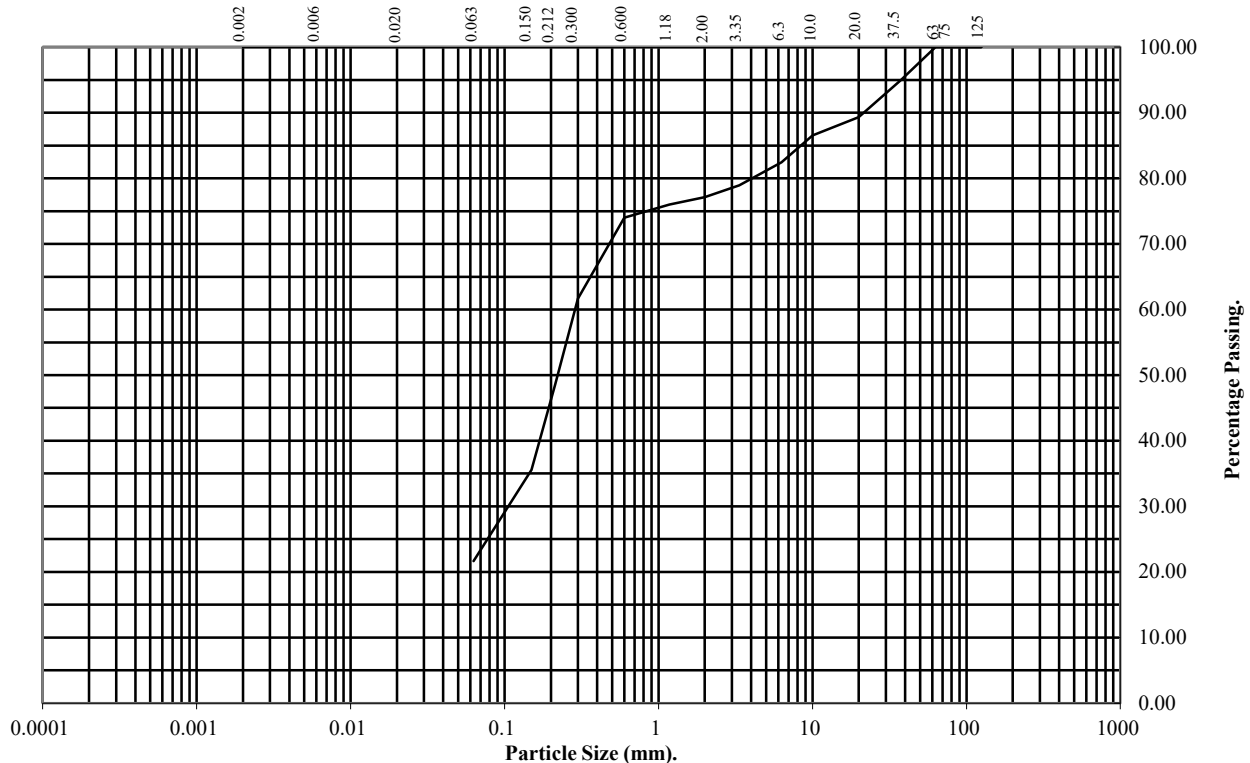
Hole Number: TP13

Top Depth (m): 1.40

Sample Number:

Base Depth(m):

Sample Type: BULK



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	95
20	89
10	87
6.3	82
3.35	79
2	77
1.18	76
0.6	74
0.3	62
0.212	48
0.15	36
0.063	22

Soil Fraction	Total Percentage
Cobbles	0
Gravel	23
Sand	55
Silt/Clay	22

Remarks:

See Summary of Soil Descriptions



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DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.4 : 1990

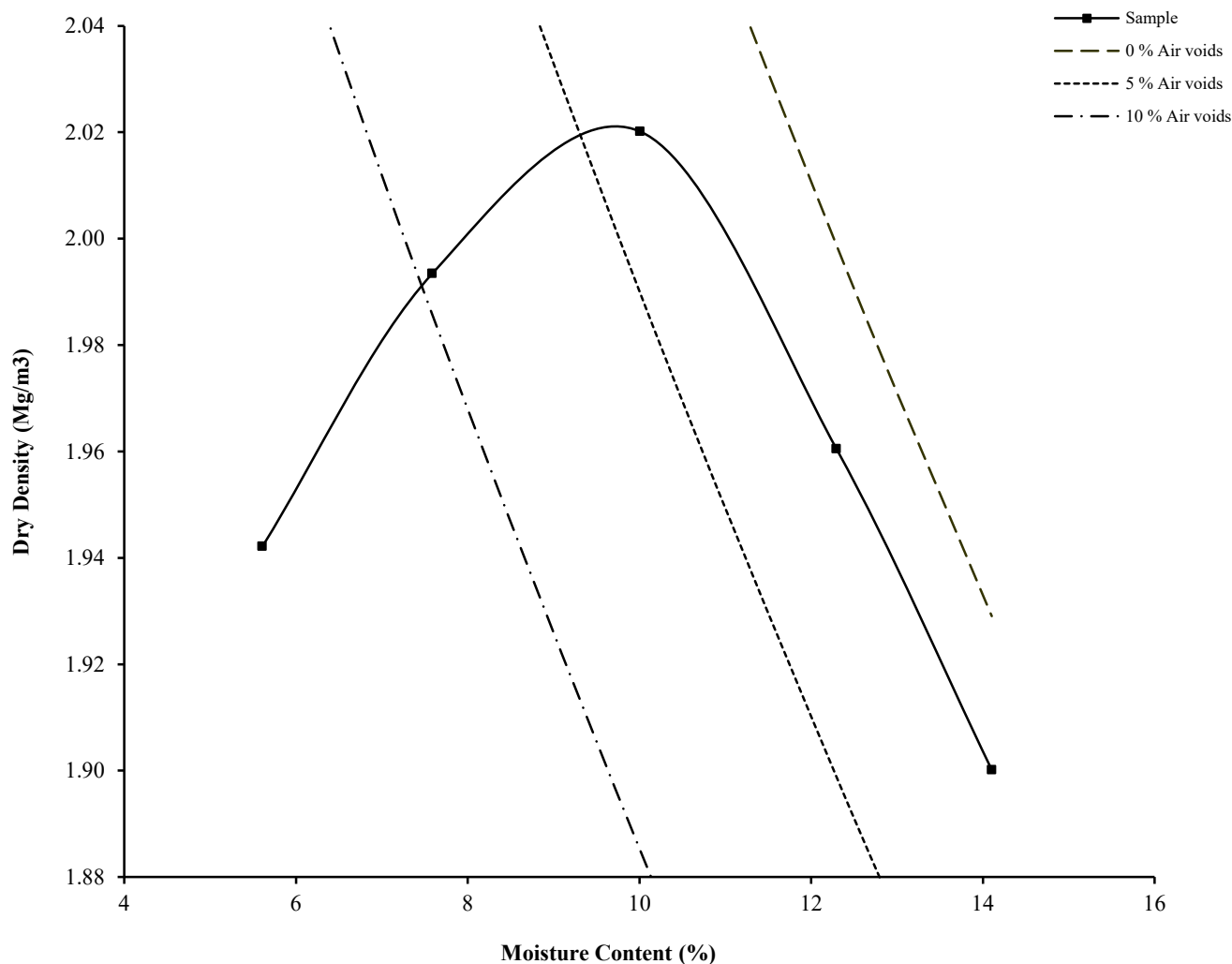
Hole Number: TP13

Top Depth (m) : 1.40

Sample Number:

Base Depth (m) :

Sample Type:



Initial Moisture Content:	12	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m ³):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):	5
Maximum Dry Density (Mg/m ³):	2.02		Material Retained on 20.0 mm Test Sieve (%):	6
Optimum Moisture Content (%):	10			
Remarks				
See summary of soil descriptions.				



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PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

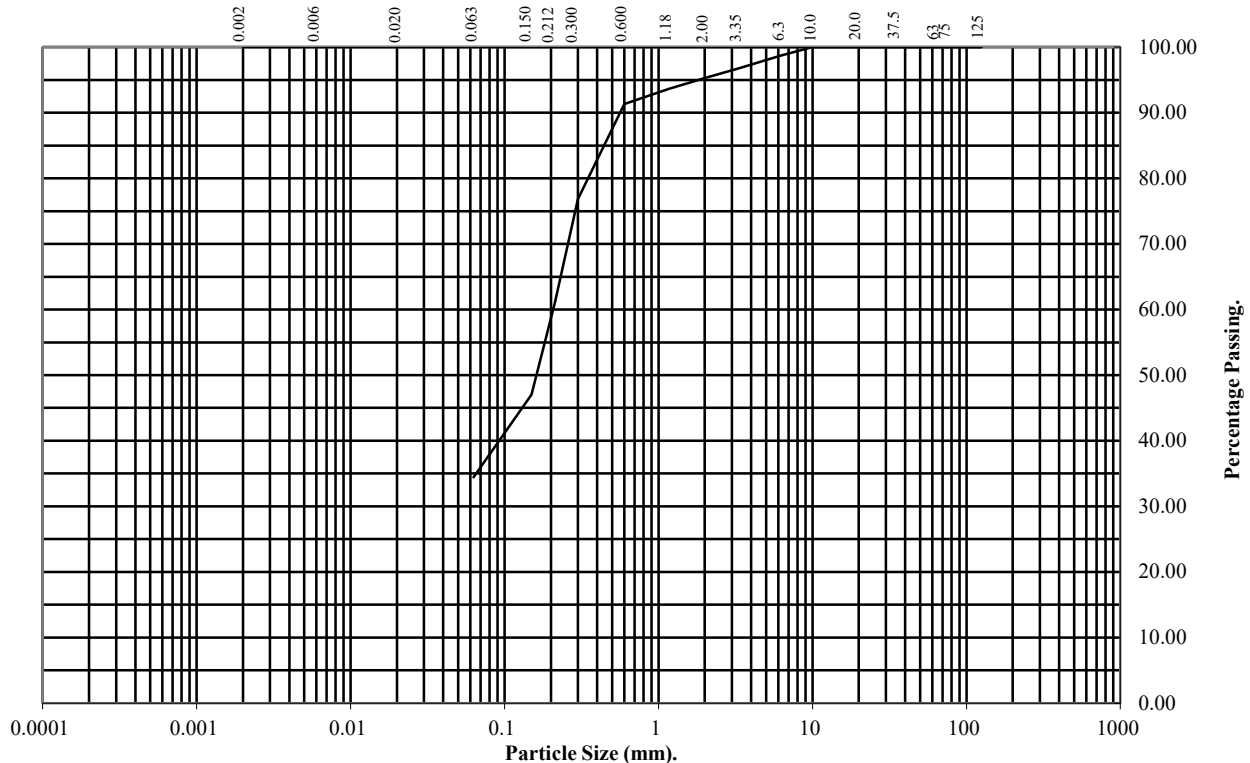
Hole Number: TP15

Top Depth (m): 1.20

Sample Number:

Base Depth(m):

Sample Type: BULK



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	99
3.35	97
2	95
1.18	94
0.6	91
0.3	77
0.212	61
0.15	47
0.063	34

Soil Fraction	Total Percentage
Cobbles	0
Gravel	5
Sand	61
Silt/Clay	34

Remarks:

See Summary of Soil Descriptions



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Contract No:
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Client Ref:
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DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.3 : 1990

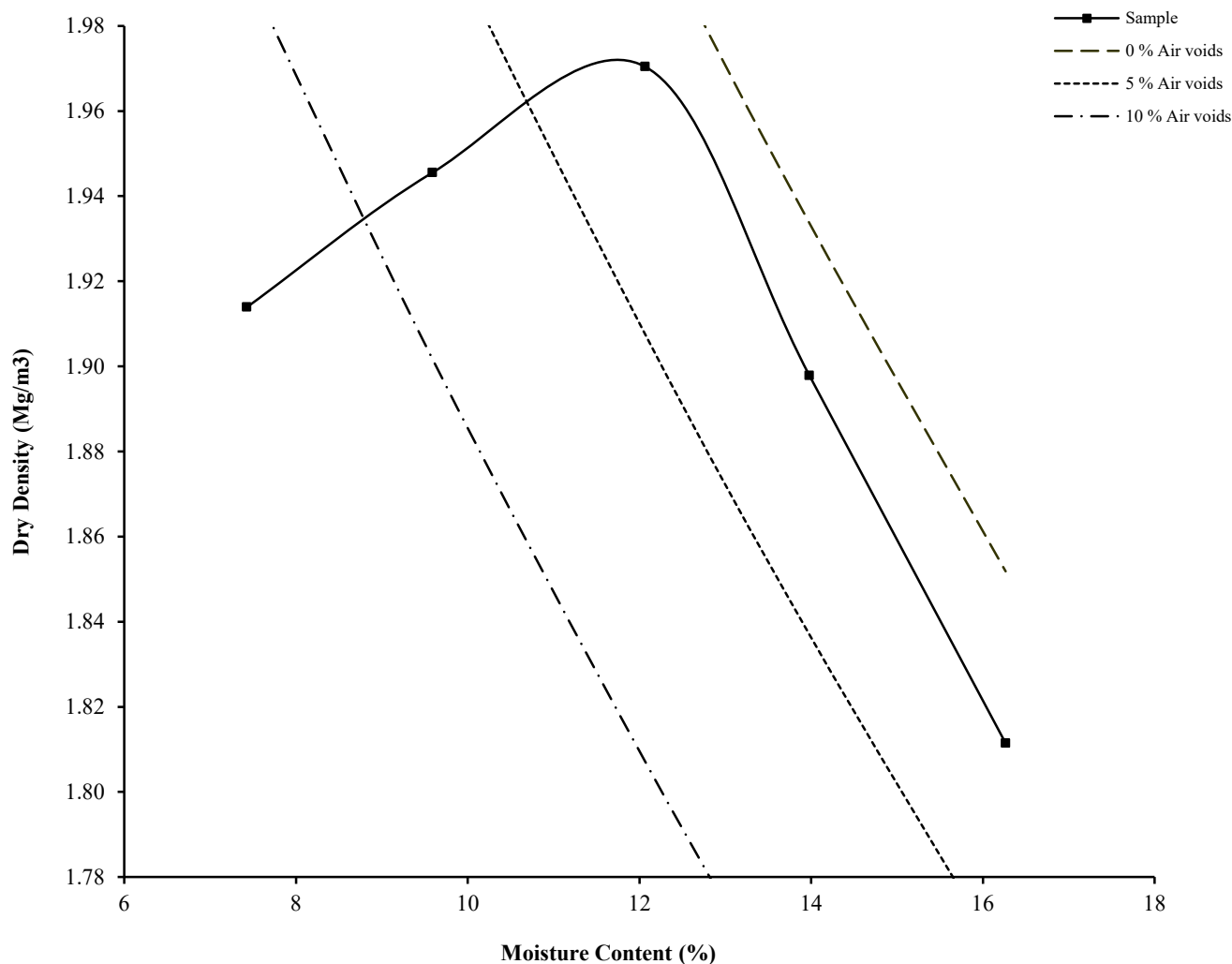
Hole Number: TP15

Top Depth (m) : 1.20

Sample Number:

Base Depth (m) :

Sample Type:



Initial Moisture Content:	16	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):	0
Maximum Dry Density (Mg/m3):	1.97		Material Retained on 20.0 mm Test Sieve (%):	0
Optimum Moisture Content (%):	12			
Remarks				
See summary of soil descriptions.				



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Contract
PSL19/5889
Client Ref
TE1239



DETS

Certificate of Analysis

Certificate Number 19-20926

29-Oct-19

Client Professional Soils Laboratory Ltd
5/7 Hexthorpe Road
Hexthorpe
DN4 0AR

Our Reference 19-20926

Client Reference PSL19/5889

Order No (not supplied)

Contract Title Land at Rhosrobin

Description 15 Soil samples.

Date Received 17-Oct-19

Date Started 17-Oct-19

Date Completed 29-Oct-19

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By



Adam Fenwick
Contracts Manager



Summary of Chemical Analysis Soil Samples

Our Ref 19-20926

Client Ref PSL19/5889

Contract Title Land at Rhosrobin

Lab No	1583315	1583316	1583317	1583318	1583319	1583320	1583321	1583322	1583323	1583324	1583325
Sample ID	WS01	WS02	WS06	WS08	WS12	WS16	WS13	WS04	WS05	WS17	WS15
Depth	1.20	1.20	1.20	1.20	1.20	1.20	2.00	1.20	1.20	1.20	1.20
Other ID											
Sample Type	SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT	SPT
Sampling Date	14/10/19	14/10/19	14/10/19	14/10/19	14/10/19	14/10/19	14/10/19	14/10/19	14/10/19	14/10/19	14/10/19
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units											
Metals														
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	18	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Inorganics														
pH	DETSC 2008#		pH	8.2	8.7	8.5	8.2	7.3	6.1	7.4	7.2	6.9	5.7	7.3
Chloride Aqueous Extract	DETSC 2055	1	mg/l	6.8	5.7	13	5.6	10	4.8	8.9	6.2	6.9	5.4	5.7
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	< 1.0	1.2	< 1.0	1.2	< 1.0	1.1	2.6	1.1	1.2	< 1.0	< 1.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	86	51	29	24	24	41	17	27	26	34	26
Sulphur as S, Total	DETSC 2320	0.01	%	0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sulphate as SO4, Total	DETSC 2321#	0.01	%	0.03	0.02	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01	0.01	< 0.01

Summary of Chemical Analysis

Soil Samples

Our Ref 19-20926

Client Ref PSL19/5889

Contract Title Land at Rhosrobin

Lab No	1583326	1583327	1583328	1583329
Sample ID	WS07	WS18	WS14	WS03
Depth	2.00	2.00	2.00	2.00
Other ID				
Sample Type	SPT	SPT	SPT	SPT
Sampling Date	14/10/19	14/10/19	14/10/19	14/10/19
Sampling Time	n/s	n/s	n/s	n/s

Test	Method	LOD	Units				
Metals							
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10	< 10	< 10	< 10
Inorganics							
pH	DETSC 2008#		pH	8.8	8.2	8.1	8.0
Chloride Aqueous Extract	DETSC 2055	1	mg/l	4.3	6.7	18	6.8
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	1.3	1.2	1.1	1.4
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	19	69	31	34
Sulphur as S, Total	DETSC 2320	0.01	%	< 0.01	0.09	0.01	0.03
Sulphate as SO4, Total	DETSC 2321#	0.01	%	0.01	0.04	0.03	0.02

Information in Support of the Analytical Results

Our Ref 19-20926
 Client Ref PSL19/5889
 Contract Land at Rhosrobin

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1583315	WS01 1.20 SOIL	14/10/19	PT 500ml		
1583316	WS02 1.20 SOIL	14/10/19	PT 500ml		
1583317	WS06 1.20 SOIL	14/10/19	PT 500ml		
1583318	WS08 1.20 SOIL	14/10/19	PT 500ml		
1583319	WS12 1.20 SOIL	14/10/19	PT 500ml		
1583320	WS16 1.20 SOIL	14/10/19	PT 500ml		
1583321	WS13 2.00 SOIL	14/10/19	PT 500ml		
1583322	WS04 1.20 SOIL	14/10/19	PT 500ml		
1583323	WS05 1.20 SOIL	14/10/19	PT 500ml		
1583324	WS17 1.20 SOIL	14/10/19	PT 500ml		
1583325	WS15 1.20 SOIL	14/10/19	PT 500ml		
1583326	WS07 2.00 SOIL	14/10/19	PT 500ml		
1583327	WS18 2.00 SOIL	14/10/19	PT 500ml		
1583328	WS14 2.00 SOIL	14/10/19	PT 500ml		
1583329	WS03 2.00 SOIL	14/10/19	PT 500ml		

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

APPENDIX M - RESULTS OF LABORATORY CHEMICAL ANALYSES

Tier Environmental
Suite 513, Chadwick House
Warrington Rd
Birchwood
Warrington
WA3 6AE



Attention :	Eve Rowland
Date :	4th October, 2019
Your reference :	TE1239
Our reference :	Test Report 19/15656 Batch 3
Location :	Land at Rhosrobin, Wrexham
Date samples received :	27th September, 2019
Status :	Final report
Issue :	1

Twenty three samples were received for analysis on 27th September, 2019 of which three were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:



Bruce Leslie
Project Manager

Please include all sections of this report if it is reproduced

Element Materials Technology

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland
EMT Job No: 19/15656

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	189-191	201-203	213-215								Please see attached notes for all abbreviations and acronyms		
Sample ID	TP15	TP16	WS11										
Depth	0.40	0.30	0.30										
COC No / misc													
Containers	V J T	V J T	V J T										
Sample Date	27/09/2019	27/09/2019	27/09/2019										
Sample Type	Soil	Soil	Soil										
Batch Number	3	3	3										
Date of Receipt	27/09/2019	27/09/2019	27/09/2019								LOD/LOR	Units	Method No.
Arsenic #	-	9.5	9.5								<0.5	mg/kg	TM30/PM15
Cadmium #	-	0.3	0.2								<0.1	mg/kg	TM30/PM15
Chromium #	-	64.7	43.6								<0.5	mg/kg	TM30/PM15
Copper #	-	37	21								<1	mg/kg	TM30/PM15
Lead #	-	74	61								<5	mg/kg	TM30/PM15
Mercury #	-	<0.1	<0.1								<0.1	mg/kg	TM30/PM15
Nickel #	-	12.9	13.3								<0.7	mg/kg	TM30/PM15
Selenium #	-	<1	<1								<1	mg/kg	TM30/PM15
Total Sulphate as SO4 #	-	548	360								<50	mg/kg	TM50/PM29
Zinc #	-	86	80								<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	-	<0.04	<0.04								<0.04	mg/kg	TM4/PM8
Acenaphthylene	-	<0.03	<0.03								<0.03	mg/kg	TM4/PM8
Acenaphthene #	-	<0.05	<0.05								<0.05	mg/kg	TM4/PM8
Fluorene #	-	<0.04	<0.04								<0.04	mg/kg	TM4/PM8
Phenanthrene #	-	<0.03	0.06								<0.03	mg/kg	TM4/PM8
Anthracene #	-	<0.04	<0.04								<0.04	mg/kg	TM4/PM8
Fluoranthene #	-	0.07	0.15								<0.03	mg/kg	TM4/PM8
Pyrene #	-	0.07	0.14								<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	-	0.08	0.10								<0.06	mg/kg	TM4/PM8
Chrysene #	-	0.04	0.09								<0.02	mg/kg	TM4/PM8
Benzo(b)fluoranthene #	-	<0.07	0.17								<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	-	<0.04	0.10								<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene	-	<0.04	0.07								<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	-	<0.04	<0.04								<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	-	<0.04	0.07								<0.04	mg/kg	TM4/PM8
PAH 16 Total	-	<0.6	1.0								<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	-	<0.05	0.12								<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	-	<0.02	0.05								<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	-	94	97								<0	%	TM4/PM8
TPH CWG													
Aliphatics													
>C5-C6 #	<0.1 ^{SV}	-	-								<0.1	mg/kg	TM36/PM12
>C6-C8 #	<0.1 ^{SV}	-	-								<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1 ^{SV}	-	-								<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	-	-								<0.2	mg/kg	TM5/PM8/PM16
>C12-C16 #	<4	-	-								<4	mg/kg	TM5/PM8/PM16
>C16-C21 #	<7	-	-								<7	mg/kg	TM5/PM8/PM16
>C21-C35 #	<7	-	-								<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-35	<19	-	-								<19	mg/kg	TM4/PM8/PM16/PM12/PM15

Element Materials Technology

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland
EMT Job No: 19/15656

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	189-191	201-203	213-215								Please see attached notes for all abbreviations and acronyms		
Sample ID	TP15	TP16	WS11										
Depth	0.40	0.30	0.30										
COC No / misc													
Containers	V J T	V J T	V J T										
Sample Date	27/09/2019	27/09/2019	27/09/2019										
Sample Type	Soil	Soil	Soil										
Batch Number	3	3	3										
Date of Receipt	27/09/2019	27/09/2019	27/09/2019								LOD/LOR	Units	Method No.
TPH CWG													
Aromatics													
>C5-EC7 #	<0.1 ^{SV}	-	-								<0.1	mg/kg	TM36/PM12
>EC7-EC8 #	<0.1 ^{SV}	-	-								<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1 ^{SV}	-	-								<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	<0.2	-	-								<0.2	mg/kg	TM5/PM8/PM16
>EC12-EC16 #	<4	-	-								<4	mg/kg	TM5/PM8/PM16
>EC16-EC21 #	<7	-	-								<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 #	<7	-	-								<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-35 #	<19	-	-								<19	mg/kg	TM5/PM8/PM16/PM12/PM15
Total aliphatics and aromatics(C5-35)	<38	-	-								<38	mg/kg	TM5/PM8/PM16/PM12/PM15
MTBE #	<5 ^{SV}	-	-								<5	ug/kg	TM31/PM12
Benzene #	<5 ^{SV}	-	-								<5	ug/kg	TM31/PM12
Toluene #	<5 ^{SV}	-	-								<5	ug/kg	TM31/PM12
Ethylbenzene #	<5 ^{SV}	-	-								<5	ug/kg	TM31/PM12
m/p-Xylene #	<5 ^{SV}	-	-								<5	ug/kg	TM31/PM12
o-Xylene #	<5 ^{SV}	-	-								<5	ug/kg	TM31/PM12
Total Phenols HPLC	-	<0.15	<0.15								<0.15	mg/kg	TM26/PM21
Natural Moisture Content	30.6	33.8	14.7								<0.1	%	PM4/PM0
Hexavalent Chromium #	-	<0.3	<0.3								<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	-	<0.0015	0.0112								<0.0015	g/l	TM38/PM20
Total Organic Carbon #	-	4.27	1.94								<0.02	%	TM21/PM24
pH #	-	6.41	6.51								<0.01	pH units	TM73/PM11

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

Signed on behalf of Element Materials Technology:

[Handwritten signature]

Ryan Butterworth
Asbestos Team Leader

[illegible]

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 19/15656

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Please include all sections of this report if it is reproduced

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

EMT Job No: 19/15656

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details	Yes		AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM21	As received solid or water samples are extracted in Methanol: Sodium Hydroxide (0.1M NaOH) (60:40) by orbital shaker.			AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM31	Modified USEPA 8015B. Determination of Methylterbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes

EMT Job No: 19/15656

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GC/FID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GC/FID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM50	Acid soluble sulphate (Total Sulphate) analysed by ICP-OES	PM29	A hot hydrochloric acid digest is performed on a dried and ground sample, and the resulting liquor is analysed.	Yes		AD	Yes
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No

Tier Environmental
Suite 513, Chadwick House
Warrington Rd
Birchwood
Warrington
WA3 6AE



Attention :	Eve Rowland
Date :	4th October, 2019
Your reference :	TE1239
Our reference :	Test Report 19/15656 Batch 1
Location :	Land at Rhosrobin, Wrexham
Date samples received :	25th September, 2019
Status :	Final report
Issue :	1

Thirty seven samples were received for analysis on 25th September, 2019 of which eleven were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:



Bruce Leslie
Project Manager

Please include all sections of this report if it is reproduced

Element Materials Technology

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland
EMT Job No: 19/15656

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-3	13-15	16-18	19-21	22-24	49-51	58-60	99-101			Please see attached notes for all abbreviations and acronyms		
Sample ID	TP01	TP03	TP03	TP03	TP04	WS01	WS02	WS08					
Depth	0.30	0.20	0.60	1.40	0.10	0.30	0.20	0.20					
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T					
Sample Date	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	24/09/2019	24/09/2019	25/09/2019					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019			LOD/LOR	Units	Method No.
Arsenic [#]	8.3	26.8	27.4	5.7	9.1	-	-	8.3			<0.5	mg/kg	TM30/PM15
Cadmium [#]	0.2	0.2	0.5	<0.1	<0.1	-	-	0.2			<0.1	mg/kg	TM30/PM15
Chromium [#]	60.5	43.3	36.8	53.5	57.0	-	-	66.5			<0.5	mg/kg	TM30/PM15
Copper [#]	25	103	91	10	18	-	-	18			<1	mg/kg	TM30/PM15
Lead [#]	54	118	67	29	57	-	-	67			<5	mg/kg	TM30/PM15
Mercury [#]	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	<0.1			<0.1	mg/kg	TM30/PM15
Nickel [#]	11.2	33.2	30.6	12.6	15.8	-	-	12.5			<0.7	mg/kg	TM30/PM15
Selenium [#]	<1	2	2	<1	<1	-	-	<1			<1	mg/kg	TM30/PM15
Total Sulphate as SO ₄ [#]	510	812	1958	336	417	-	-	456			<50	mg/kg	TM50/PM29
Zinc [#]	64	346	381	45	68	-	-	61			<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene [#]	<0.04	0.12	0.08	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	-	-	<0.03			<0.03	mg/kg	TM4/PM8
Acenaphthene [#]	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	<0.05			<0.05	mg/kg	TM4/PM8
Fluorene [#]	<0.04	<0.04	<0.04	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Phenanthrene [#]	<0.03	0.12	0.15	<0.03	<0.03	-	-	<0.03			<0.03	mg/kg	TM4/PM8
Anthracene [#]	<0.04	<0.04	<0.04	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Fluoranthene [#]	0.09	0.21	0.21	<0.03	0.08	-	-	0.06			<0.03	mg/kg	TM4/PM8
Pyrene [#]	0.09	0.18	0.18	<0.03	0.06	-	-	0.06			<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene [#]	0.09	0.16	0.20	<0.06	<0.06	-	-	<0.06			<0.06	mg/kg	TM4/PM8
Chrysene [#]	0.06	0.13	0.14	<0.02	0.05	-	-	0.04			<0.02	mg/kg	TM4/PM8
Benzo(b)fluoranthene [#]	0.12	0.27	0.21	<0.07	0.09	-	-	<0.07			<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene [#]	0.07	0.16	0.11	<0.04	0.05	-	-	0.05			<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene	0.05	0.11	0.08	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene [#]	<0.04	<0.04	<0.04	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene [#]	0.05	0.11	0.09	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
PAH 16 Total	0.6	1.6	1.5	<0.6	<0.6	-	-	<0.6			<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	0.09	0.19	0.15	<0.05	0.06	-	-	<0.05			<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	0.03	0.08	0.06	<0.02	0.03	-	-	<0.02			<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	102	103	103	102	102	-	-	95			<0	%	TM4/PM8
TPH CWG													
Aliphatics													
>C5-C6 [#]	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>C6-C8 [#]	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>C8-C10	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>C10-C12 [#]	-	-	<0.2	-	-	<0.2	<0.2	-			<0.2	mg/kg	TM5/PM8/PM16
>C12-C16 [#]	-	-	<4	-	-	<4	<4	-			<4	mg/kg	TM5/PM8/PM16
>C16-C21 [#]	-	-	<7	-	-	<7	<7	-			<7	mg/kg	TM5/PM8/PM16
>C21-C35 [#]	-	-	<7	-	-	<7	<7	-			<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-35	-	-	<19	-	-	<19	<19	-			<19	mg/kg	TM5/PM8/PM16/PM12/PM15

Element Materials Technology

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland
EMT Job No: 19/15656

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-3	13-15	16-18	19-21	22-24	49-51	58-60	99-101			Please see attached notes for all abbreviations and acronyms		
Sample ID	TP01	TP03	TP03	TP03	TP04	WS01	WS02	WS08					
Depth	0.30	0.20	0.60	1.40	0.10	0.30	0.20	0.20					
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T					
Sample Date	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	24/09/2019	24/09/2019	25/09/2019					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019			LOD/LOR	Units	Method No.
TPH CWG													
Aromatics													
>C5-EC7 #	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>EC7-EC8 #	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	-	-	<0.2	-	-	<0.2	<0.2	-			<0.2	mg/kg	TM5/PM8/PM16
>EC12-EC16 #	-	-	<4	-	-	<4	<4	-			<4	mg/kg	TM5/PM8/PM16
>EC16-EC21 #	-	-	<7	-	-	<7	<7	-			<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 #	-	-	<7	-	-	<7	<7	-			<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-35 #	-	-	<19	-	-	<19	<19	-			<19	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-35)	-	-	<38	-	-	<38	<38	-			<38	mg/kg	TM5/TM36/PM8/PM12/PM16
MTBE #	-	-	<5 ^{SV}	-	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
Benzene #	-	-	<5 ^{SV}	-	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
Toluene #	-	-	<5 ^{SV}	-	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
Ethylbenzene #	-	-	<5 ^{SV}	-	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
m/p-Xylene #	-	-	<5 ^{SV}	-	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
o-Xylene #	-	-	<5 ^{SV}	-	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
Total Phenols HPLC	<0.15	<0.15	<0.15	<0.15	<0.15	-	-	<0.15			<0.15	mg/kg	TM26/PM21
Natural Moisture Content	21.9	20.6	51.3	25.7	25.2	29.1	23.3	27.4			<0.1	%	PM4/PM0
Hexavalent Chromium #	<0.3	<0.3	<0.3	<0.3	<0.3	-	-	<0.3			<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	0.0083	0.0143	0.0581	0.0115	0.0052	-	-	0.0057			<0.0015	g/l	TM38/PM20
Total Organic Carbon #	3.75	14.44	56.34	1.87	2.88	-	-	2.73			<0.02	%	TM21/PM24
pH #	6.48	6.50	6.75	7.07	6.46	-	-	6.55			<0.01	pH units	TM73/PM11

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

Signed on behalf of Element Materials Technology:



Ryan Butterworth
 Asbestos Team Leader

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Date Of Analysis	Analysis	Result
19/15656	1	TP03	0.60	18	01/10/2019	General Description (Bulk Analysis)	soil.stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD
19/15656	1	TP04	0.10	24	01/10/2019	General Description (Bulk Analysis)	soil/stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD
19/15656	1	TP05	0.20	33	01/10/2019	General Description (Bulk Analysis)	soil/stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD
19/15656	1	WS03	0.25	63	01/10/2019	General Description (Bulk Analysis)	soil/stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD
19/15656	1	WS04	0.30	75	01/10/2019	General Description (Bulk Analysis)	soil/stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD
19/15656	1	WS08	0.20	101	01/10/2019	General Description (Bulk Analysis)	soil.stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 19/15656

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Please include all sections of this report if it is reproduced

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

EMT Job No: 19/15656

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GC/FID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details	Yes		AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO ₂ generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM21	As received solid or water samples are extracted in Methanol: Sodium Hydroxide (0.1M NaOH) (60:40) by orbital shaker.			AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM31	Modified USEPA 8015B. Determination of Methylterbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes

EMT Job No: 19/15656

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GC/FID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GC/FID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM50	Acid soluble sulphate (Total Sulphate) analysed by ICP-OES	PM29	A hot hydrochloric acid digest is performed on a dried and ground sample, and the resulting liquor is analysed.	Yes		AD	Yes
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No

Tier Environmental
Suite 513, Chadwick House
Warrington Rd
Birchwood
Warrington
WA3 6AE



Attention :	Eve Rowland
Date :	21st October, 2019
Your reference :	TE1239
Our reference :	Test Report 19/15656 Batch 1
Location :	Land at Rhosrobin, Wrexham
Date samples received :	25th September, 2019
Status :	Final report
Issue :	2

Thirty seven samples were received for analysis on 25th September, 2019 of which eleven were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied. All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:



Phil Sommerton BSc
Senior Project Manager

Please include all sections of this report if it is reproduced

Element Materials Technology

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland
EMT Job No: 19/15656

Report : Solid

Solids: V=60g VOC jar. J=250g glass jar. T=plastic tub

EMT Sample No.	1-3	13-15	16-18	19-21	22-24	49-51	58-60	99-101			Please see attached notes for all abbreviations and acronyms		
Sample ID	TP01	TP03	TP03	TP03	TP04	WS01	WS02	WS08					
Depth	0.30	0.20	0.60	1.40	0.10	0.30	0.20	0.20					
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T					
Sample Date	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	24/09/2019	24/09/2019	25/09/2019					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019			LOD/LOR	Units	Method No.
Arsenic #	8.3	26.8	27.4	5.7	9.1	-	-	8.3			<0.5	mg/kg	TM30/PM15
Cadmium #	0.2	0.2	0.5	<0.1	<0.1	-	-	0.2			<0.1	mg/kg	TM30/PM15
Chromium #	60.5	43.3	36.8	53.5	57.0	-	-	66.5			<0.5	mg/kg	TM30/PM15
Copper #	25	103	91	10	18	-	-	18			<1	mg/kg	TM30/PM15
Lead #	54	118	67	29	57	-	-	67			<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	<0.1			<0.1	mg/kg	TM30/PM15
Nickel #	11.2	33.2	30.6	12.6	15.8	-	-	12.5			<0.7	mg/kg	TM30/PM15
Selenium #	<1	2	2	<1	<1	-	-	<1			<1	mg/kg	TM30/PM15
Total Sulphate as SO4 #	510	812	1958	336	417	-	-	456			<50	mg/kg	TM50/PM29
Zinc #	64	346	381	45	68	-	-	61			<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	<0.04	0.12	0.08	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	-	-	<0.03			<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	<0.05			<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	0.12	0.15	<0.03	<0.03	-	-	<0.03			<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Fluoranthene #	0.09	0.21	0.21	<0.03	0.08	-	-	0.06			<0.03	mg/kg	TM4/PM8
Pyrene #	0.09	0.18	0.18	<0.03	0.06	-	-	0.06			<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	0.09	0.16	0.20	<0.06	<0.06	-	-	<0.06			<0.06	mg/kg	TM4/PM8
Chrysene #	0.06	0.13	0.14	<0.02	0.05	-	-	0.04			<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	0.12	0.27	0.21	<0.07	0.09	-	-	<0.07			<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	0.07	0.16	0.11	<0.04	0.05	-	-	0.05			<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene	0.05	0.11	0.08	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	0.05	0.11	0.09	<0.04	<0.04	-	-	<0.04			<0.04	mg/kg	TM4/PM8
Coronene	-	-	<0.04	<0.04	-	-	-	-			<0.04	mg/kg	TM4/PM8
PAH 16 Total	0.6	1.6	1.5	<0.6	<0.6	-	-	<0.6			<0.6	mg/kg	TM4/PM8
PAH 17 Total	-	-	1.45	<0.64	-	-	-	-			<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	0.09	0.19	0.15	<0.05	0.06	-	-	<0.05			<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	0.03	0.08	0.06	<0.02	0.03	-	-	<0.02			<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	102	103	103	102	102	-	-	95			<0	%	TM4/PM8
Mineral Oil (C10-C40)	-	-	<30	<30	-	-	-	-			<30	mg/kg	TM5/PM8/PM16

Element Materials Technology

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland
EMT Job No: 19/15656

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-3	13-15	16-18	19-21	22-24	49-51	58-60	99-101			Please see attached notes for all abbreviations and acronyms		
Sample ID	TP01	TP03	TP03	TP03	TP04	WS01	WS02	WS08					
Depth	0.30	0.20	0.60	1.40	0.10	0.30	0.20	0.20					
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T					
Sample Date	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	24/09/2019	24/09/2019	25/09/2019					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019			LOD/LOR	Units	Method No.
TPH CWG													
Aliphatics													
>C5-C6 #	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>C6-C8 #	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>C8-C10	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>C10-C12 #	-	-	<0.2	-	-	<0.2	<0.2	-			<0.2	mg/kg	TMS/PM8/PM16
>C12-C16 #	-	-	<4	-	-	<4	<4	-			<4	mg/kg	TMS/PM8/PM16
>C16-C21 #	-	-	<7	-	-	<7	<7	-			<7	mg/kg	TMS/PM8/PM16
>C21-C35 #	-	-	<7	-	-	<7	<7	-			<7	mg/kg	TMS/PM8/PM16
Total aliphatics C5-35	-	-	<19	-	-	<19	<19	-			<19	mg/kg	TMS/PM8/PM16/PM12/PM10
Aromatics													
>C5-EC7 #	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>EC7-EC8 #	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	-	-	<0.1 ^{SV}	-	-	<0.1 ^{SV}	<0.1	-			<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	-	-	<0.2	-	-	<0.2	<0.2	-			<0.2	mg/kg	TMS/PM8/PM16
>EC12-EC16 #	-	-	<4	-	-	<4	<4	-			<4	mg/kg	TMS/PM8/PM16
>EC16-EC21 #	-	-	<7	-	-	<7	<7	-			<7	mg/kg	TMS/PM8/PM16
>EC21-EC35 #	-	-	<7	-	-	<7	<7	-			<7	mg/kg	TMS/PM8/PM16
Total aromatics C5-35 #	-	-	<19	-	-	<19	<19	-			<19	mg/kg	TMS/PM8/PM16/PM12/PM10
Total aliphatics and aromatics(C5-35)	-	-	<38	-	-	<38	<38	-			<38	mg/kg	TMS/PM8/PM16/PM12/PM10
MTBE #	-	-	<5 ^{SV}	<5	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
Benzene #	-	-	<5 ^{SV}	<5	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
Toluene #	-	-	<5 ^{SV}	<5	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
Ethylbenzene #	-	-	<5 ^{SV}	<5	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
m/p-Xylene #	-	-	<5 ^{SV}	<5	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
o-Xylene #	-	-	<5 ^{SV}	<5	-	<5 ^{SV}	<5	-			<5	ug/kg	TM31/PM12
PCB 28 #	-	-	<25 ^{AA}	<5	-	-	-	-			<5	ug/kg	TM17/PM8
PCB 52 #	-	-	<25 ^{AA}	<5	-	-	-	-			<5	ug/kg	TM17/PM8
PCB 101 #	-	-	<25 ^{AA}	<5	-	-	-	-			<5	ug/kg	TM17/PM8
PCB 118 #	-	-	<25 ^{AA}	<5	-	-	-	-			<5	ug/kg	TM17/PM8
PCB 138 #	-	-	<25 ^{AA}	<5	-	-	-	-			<5	ug/kg	TM17/PM8
PCB 153 #	-	-	<25 ^{AA}	<5	-	-	-	-			<5	ug/kg	TM17/PM8
PCB 180 #	-	-	<25 ^{AA}	<5	-	-	-	-			<5	ug/kg	TM17/PM8
Total 7 PCBs #	-	-	<175 ^{AA}	<35	-	-	-	-			<35	ug/kg	TM17/PM8
Total Phenols HPLC	<0.15	<0.15	<0.15	<0.15	<0.15	-	-	<0.15			<0.15	mg/kg	TM26/PM21
Natural Moisture Content	21.9	20.6	51.3	25.7	25.2	29.1	23.3	27.4			<0.1	%	PM4/PM0
Hexavalent Chromium #	<0.3	<0.3	<0.3	<0.3	<0.3	-	-	<0.3			<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	0.0083	0.0143	0.0581	0.0115	0.0052	-	-	0.0057			<0.0015	g/l	TM38/PM20

Element Materials Technology

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland
EMT Job No: 19/15656

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

[illegible]

Mass of sample taken (kg)	-	Moisture Content Ratio (%) =	44.3
Mass of dry sample (kg) =	0.09	Dry Matter Content Ratio (%) =	69.3
Particle Size <4mm =	>95%		
EMT Job No	19/15656	Landfill Waste Acceptance Criteria Limits	
Sample No	18		
Client Sample No	TP03		
Depth/Other	0.60		
Sample Date	25/09/2019		
Batch No	1		
Solid Waste Analysis		Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non- Hazardous Landfill
Total Organic Carbon (%)	56.34	3	5
Loss on Ignition (%)	28.8	-	10
Sum of BTEX (mg/kg)	<0.025	6	-
Sum of 7 PCBs (mg/kg)	<0.175	1	-
Mineral Oil (mg/kg)	<30	500	-
PAH Sum of 17(mg/kg)	1.45	100	-
pH (pH Units)	6.75	-	>6
ANC to pH 7 (mol/kg)	NDP	-	to be evaluated
ANC to pH 4 (mol/kg)	NDP	-	to be evaluated
Eluate Analysis	10:1 conc ⁿ leached		Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg
	C ₁₀ mg/l	A ₁₀ mg/kg	
Arsenic	<0.0025	<0.025	0.5
Barium	0.110	1.10	20
Cadmium	<0.0005	<0.005	0.04
Chromium	<0.0015	<0.015	0.5
Copper	<0.007	<0.07	2
Mercury	<0.001	<0.01	0.01
Molybdenum	<0.002	<0.02	0.5
Nickel	0.002	<0.02	0.4
Lead	<0.005	<0.05	0.5
Antimony	<0.002	<0.02	0.06
Selenium	<0.003	<0.03	0.1
Zinc	0.083	0.83	4
Chloride	<0.3	<3	800
Fluoride	<0.3	<3	10
Sulphate as SO ₄	13.8	138	1000
Total Dissolved Solids	38	380	4000
Phenol	<0.01	<0.1	1
Dissolved Organic Carbon	2	<20	500

Mass of sample taken (kg)	-	Moisture Content Ratio (%) =	28.5
Mass of dry sample (kg) =	0.09	Dry Matter Content Ratio (%) =	77.8
Particle Size <4mm =	>95%		
EMT Job No	19/15656	Landfill Waste Acceptance Criteria Limits	
Sample No	21		
Client Sample No	TP03		
Depth/Other	1.40		
Sample Date	25/09/2019		
Batch No	1		
Solid Waste Analysis		Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non- Hazardous Landfill
Total Organic Carbon (%)	1.87	3	5
Loss on Ignition (%)	7.0	-	10
Sum of BTEX (mg/kg)	<0.025	6	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-
Mineral Oil (mg/kg)	<30	500	-
PAH Sum of 17(mg/kg)	<0.64	100	-
pH (pH Units)	7.07	-	>6
ANC to pH 7 (mol/kg)	NDP	-	to be evaluated
ANC to pH 4 (mol/kg)	0.03	-	to be evaluated
Eluate Analysis	10:1 conc ⁿ leached		Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg
	C ₁₀ mg/l	A ₁₀ mg/kg	
Arsenic	0.0064	0.064	0.5
Barium	0.005	0.05	20
Cadmium	<0.0005	<0.005	0.04
Chromium	<0.0015	<0.015	0.5
Copper	<0.007	<0.07	2
Mercury	<0.001	<0.01	0.01
Molybdenum	<0.002	<0.02	0.5
Nickel	<0.002	<0.02	0.4
Lead	<0.005	<0.05	0.5
Antimony	<0.002	<0.02	0.06
Selenium	<0.003	<0.03	0.1
Zinc	0.009	0.09	4
Chloride	1.4	14	800
Fluoride	0.3	<3	10
Sulphate as SO ₄	3.2	32	1000
Total Dissolved Solids	111	1110	4000
Phenol	<0.01	<0.1	1
Dissolved Organic Carbon	15	150	500

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

Signed on behalf of Element Materials Technology:



Ryan Butterworth
 Asbestos Team Leader

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Date Of Analysis	Analysis	Result
19/15656	1	TP03	0.60	18	01/10/2019	General Description (Bulk Analysis)	soil/stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD
19/15656	1	TP04	0.10	24	01/10/2019	General Description (Bulk Analysis)	soil/stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD
19/15656	1	TP05	0.20	33	01/10/2019	General Description (Bulk Analysis)	soil/stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD
19/15656	1	WS03	0.25	63	01/10/2019	General Description (Bulk Analysis)	soil/stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD
19/15656	1	WS04	0.30	75	01/10/2019	General Description (Bulk Analysis)	soil/stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD
19/15656	1	WS08	0.20	101	01/10/2019	General Description (Bulk Analysis)	soil/stones
					01/10/2019	Asbestos Fibres	NAD
					01/10/2019	Asbestos ACM	NAD
					01/10/2019	Asbestos Type	NAD
					01/10/2019	Asbestos Level Screen	NAD

Matrix : Solid

[illegible]

Client Name: Tier Environmental
Reference: TE1239
Location: Land at Rhosrobin, Wrexham
Contact: Eve Rowland

Matrix : Solid

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 19/15656

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Please include all sections of this report if it is reproduced

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution

EMT Job No: 19/15656

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details	Yes		AR	Yes
TM17	Modified US EPA method 8270. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM20	Modified BS 1377-3: 1990/USEPA 160.3 Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.			AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO ₂ generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes

EMT Job No: 19/15656

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM22	Modified BS1377-3:1990 Gravimetric determination of Loss on Ignition by temperature controlled Muffle Furnace (35C-440C). On request modified ASTM D2974-00 LOI (105C-440C)	PM0	No preparation is required.	Yes		AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM21	As received solid or water samples are extracted in Methanol: Sodium Hydroxide (0.1M NaOH) (60:40) by orbital shaker.			AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM17	Modified method BS EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.	Yes		AR	Yes
TM31	Modified USEPA 8015B. Determination of Methylterbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM31	Modified USEPA 8015B. Determination of Methylterbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.	Yes		AR	Yes

EMT Job No: 19/15656

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM50	Acid soluble sulphate (Total Sulphate) analysed by ICP-OES	PM29	A hot hydrochloric acid digest is performed on a dried and ground sample, and the resulting liquor is analysed.	Yes		AD	Yes
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060, APHA Standard Methods for Examination of Water and Wastewater 5310B, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.			AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
TM77	Modified DDCEN/TS method 15364:2006. Determination of Acid Neutralization Capacity by Metrohm automated probe analyser.	PM0	No preparation is required.			AR	No
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 340.2	PM0	No preparation is required.			AR	Yes
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.			AR	

APPENDIX N - GAS AND GROUNDWATER MONITORING RESULTS

Ground Gas and Groundwater Monitoring Record Sheet

GAS MONITORING ACROSS BOREHOLE LOCATIONS

JOB DETAILS:	Land at Rhosrobin, Wrexham	Job No:	TE1239		
Client:	Tier Environmental	Visit No:	1	of	6
Site:	Rhosrobin	Operator:	ER		
Date:	02/10/2019	Project Manager:	SL		



Monitoring Point	Gas Concentrations												Flow Data		Well and Water Data					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Water Depth (mbgl)	Depth of Well (mbgl)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady						
WS10	ND	ND	2.0	2.0	3.9	0.1	ND	ND	ND	ND	14.3	18.0	ND	ND						COULD NOT REMOVE BUNG
WS07	ND	ND	2.0	2.0	0.9	0.9	ND	ND	ND	ND	14.9	15.1	-0.3	ND	0.98	2.48				
WS08															0.60	1.47				WELL FLOODED
WS06	ND	ND	2.0	2.0	0.7	0.2	ND	ND	ND	ND	18.7	20.2	ND	ND	4.05	4.09				
WS14	0.1	ND	2.0	2.0	2.9	2.8	ND	ND	ND	ND	16.7	17.2	0.4	ND						WELL DRY
WS09	0.1	ND	2.0	2.0	3.6	2.4	ND	ND	ND	ND	10.9	20.0	ND	ND	0.90	2.61				
WS10a	0.1	ND	2.0	2.0	2.7	1.7	ND	ND	ND	ND	16.8	18.7	-0.3	-0.1	0.92	3.25				
WS17	0.1	ND	2.0	2.0	3.1	1.9	ND	ND	ND	ND	15.6	19.1	0.4	0.1	1.19	2.24				
Max	0.1	0.1	2.0	2.0	3.9	2.8	ND	ND	ND	ND	18.7	20.2	0.4	0.1	4.05	4.09				
Min	0.1	0.1	2.0	2.0	0.7	0.1	ND	ND	ND	ND	10.9	15.1	0.1	0.1	0.60	1.47				

METEOROLOGICAL AND SITE INFORMATION:	
State of ground:	
Wind:	
Cloud cover:	
Precipitation:	
Barometric pressure (mbar):	
Pressure trend:	
Ground gas meter:	GA2000
Ambient Gas concentration:	

☐	Dry	☒	Moist	☐	Wet	☐	Snow	☐	Frozen
☐	Calm	☒	Light	☐	Moderate	☐	Strong		
☐	None	☐	Slight	☒	Cloudy	☐	Overcast		
☐	None	☒	Slight	☐	Moderate	☐	Heavy		
		1004	Before			1007	After		
		☐	Falling	☐	Steady	☒	Rising		

CH ₄	ND	CO ₂	0.2%	O ₂	19.8%
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GAS MONITORING ACROSS BOREHOLE LOCATIONS



JOB DETAILS:	Land at Rhosrobin, Wrexham	Job No:	TE1239		
Client:	Tier Environmental	Visit No:	2	of	6
Site:	Rhosrobin	Operator:	MW		
Date:	18.10.2019	Project Manager:	SL		

Monitoring Point	GAS CONCENTRATIONS												FLOW DATA		WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Water Depth (mbgl)	Depth of Well (mbgl)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady						
WS10	ND	ND	ND	ND	5.4	5.4	ND	ND	ND	ND	15.6	15.6	ND	ND	ND	ND				Could not remove bung
WS07	ND	ND	ND	ND	4.8	4.8	ND	ND	ND	ND	10.7	10.7	ND	ND	1.09	1.09				
WS08																				Well flooded
WS06	ND	ND	ND	ND	3.6	3.6	ND	ND	ND	ND	15.0	15.2	0.4	0.3	3.80	4.10				
WS14																				Could not find
WS09	0.1	ND	2.0	ND	2.4	2.4	ND	ND	ND	ND	14.7	14.8	ND	ND	1.30	2.60				
WS10a	0.1	0.1	2.0	2.0	2.0	1.8	ND	ND	ND	ND	17.3	17.3	0.3	ND	1.30	3.20				
WS17	ND	ND	ND	ND	0.1	0.1	ND	ND	ND	ND	19.7	19.7	ND	ND	0.99	2.24				Cone smashed. Bung removed & replaced
WS19															ND	3.80				
WS20															ND	3.60				
Max	0.1	0.1	2.0	2.0	5.4	5.4	ND	ND	ND	ND	19.7	19.7	0.4	0.3	3.80	4.10				
Min	0.1	0.1	2.0	2.0	0.1	0.1	ND	ND	ND	ND	10.7	10.7	0.1	0.1	0.99	1.09				

METEOROLOGICAL AND SITE INFORMATION:	
State of ground:	
Wind:	
Cloud cover:	
Precipitation:	
Barometric pressure (mbar):	
Pressure trend:	
Ground gas meter:	GA2000
Ambient Gas concentration:	

☐	Dry	☐	Moist	☒	Wet	☐	Snow	☐	Frozen
☒	Calm	☐	Light	☐	Moderate	☐	Strong		
☐	None	☐	Slight	☒	Cloudy	☐	Overcast		
☐	None	☐	Slight	☒	Moderate	☐	Heavy		
		902	Before			☐	After		
		x	Falling	☐	Steady	☐	Rising		
CH ₄	ND	CO ₂	0.4%	O ₂	19.3%				

Ground Gas and Groundwater Monitoring Record Sheet

GAS MONITORING ACROSS BOREHOLE LOCATIONS

JOB DETAILS:		Job No:	TE1239		
Client:	Tier Environmental	Visit No:	3	of	6
Site:	Rhosrobin	Operator:	TH		
Date:	18/11/2019	Project Manager:	SL		



Monitoring Point	GAS CONCENTRATIONS												FLOW DATA		WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Water Depth (mbgl)	Depth of Well (mbgl)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady						
WS10	0.1	0.1	2.0	2.0	5.3	5.3	ND	ND	ND	ND	8.0	8.2	ND	ND	1.78	3.46				
WS07	0.1	0.1	2.0	2.0	5.9	5.8	1	1	ND	ND	11.2	11.4	9.1	ND	0.92	2.29				
WS08																1.30				Flooded
WS06	0.1	ND	2.0	ND	0.5	0.2	ND	ND	ND	ND	19.1	19.4	ND	ND	3.85	4.10				
WS14	ND	ND	ND	ND	2.0	2.0	ND	ND	ND	ND	16.7	16.8	ND	ND	3.90	3.91				
WS09	ND	ND	ND	ND	4.9	4.9	ND	ND	ND	ND	5.1	5.1	ND	ND	0.95	2.34				
WS10a	ND	ND	ND	ND	0.7	0.3	ND	ND	ND	ND	19.5	19.6	ND	ND	0.32	2.92				
WS17	ND	ND	ND	ND	3.2	2.7	ND	ND	ND	ND	16.4	17.1	ND	ND	1.60	2.20				
Max	0.1	0.1	2.0	2.0	5.9	5.8	1.0	1.0	ND	ND	19.5	19.6	9.1	0.1	3.90	4.10				
Min	ND	ND	ND	ND	0.5	0.2	ND	ND	ND	ND	5.1	5.1	ND	ND	0.32	1.30				

METEOROLOGICAL AND SITE INFORMATION:	
State of ground:	
Wind:	
Cloud cover:	
Precipitation:	
Barometric pressure (mbar):	
Pressure trend:	
Ground gas meter:	GA2000
Ambient Gas concentration:	

☐	Dry	☒	Moist	☐	Wet	☐	Snow	☐	Frozen
☐	Calm	☒	Light	☐	Moderate	☐	Strong		
☐	None	☒	Slight	☐	Cloudy	☐	Overcast		
☒	None	☐	Slight	☐	Moderate	☐	Heavy		
		1006	Before			1006	After		
		☐	Falling	☐	Steady	☐	Rising		
CH ₄	ND	CO ₂	ND	O ₂	20.3%				

APPENDIX O - GROUNDSURE REPORT

Tier Environmental

Elm House Farm, Saughton Lane Saughton,
Saughton, CH3 6EN

GroundSure
Reference:

HMD-341-1633272

Your Reference: PE00362

Report Date 27 Aug 2014

Report Delivery Method: Email - pdf

GroundSure Geoinsight

Address: LAND OFF NEW ROAD, RHOSROBIN, WREXHAM,

Dear Sir/ Madam,

Thank you for placing your order with GroundSure. Please find enclosed the **GroundSure GeoInsight** as requested.

If you need any further assistance, please do not hesitate to contact our helpline on 08444 159000 quoting the above GroundSure reference number.

Yours faithfully,



Managing Director
Groundsure Limited

Enc.
GroundSure GeoInsight



Site Size: 15.87ha

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Overview of Findings

The GroundSure GeoInsight provides high quality geo-environmental information that allows geo-environmental professionals and their clients to make informed decisions and be forewarned of potential ground instability problems that may affect the ground investigation, foundation design and possibly remediation options that could lead to possible additional costs.

The report is based on the BGS 1:50,000 Digital Geological Map of Great Britain, BGS Geosure data; BRITPITS database; Shallow Mining data and Borehole Records, Coal Authority data including brine extraction areas, PBA non-coal mining and natural cavities database, Johnson Poole and Bloomer mining data and GroundSure's unique database including historical surface ground and underground workings.

For further details on each dataset, please refer to each individual section in the report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Section 1:Geology

1.1 Artificial Ground	1.1.1 Is there any Artificial Ground/ Made Ground present beneath the study site?	Yes
	1.1.2 Are there any records relating to permeability of artificial ground within the study site* boundary?	Yes
1.2 Superficial Geology and Landslips	1.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site?	Yes
	1.2.2 Are there any records relating to permeability of superficial geology within the study site boundary?	Yes
	1.2.3 Are there any records of landslip within 500m of the study site boundary?	No
	1.2.4 Are there any records relating to permeability of landslips within the study site boundary?	No
1.3 Bedrock, Solid Geology & Faults	1.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
	1.3.2 Are there any records relating to permeability of bedrock within the study site boundary?	Yes
	1.3.3 Are there any records of faults within 500m of the study site boundary?	Yes
1.4 Radon data	1.4.1 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is in a Radon Affected Area, as between 10 and 30% of properties are above the Action Level
	1.4.2 Is the property in an area where Radon Protection Measures are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	Full radon protective measures are necessary

Section 2:Ground Workings	On-site	0-50m	51-250	251-500	501-1000
2.1 Historical Surface Ground Working Features from Small Scale Mapping	14	17	57	Not Searched	Not Searched
2.2 Historical Underground Workings from Small Scale Mapping	0	1	10	6	6
2.3 Current Ground Workings	0	0	0	0	3
Section 3:Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000

3.1 Historical Mining	0	1	10	6	6
-----------------------	---	---	----	---	---

Section 3: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
3.2 Coal Mining	1	0	0	0	0
3.3 Johnson Poole and Bloomer Mining Area	0	0	0	0	0
3.4 Non-Coal Mining	0	0	1	0	1
3.5 Non-Coal Mining Cavities	0	0	0	0	0
3.6 Natural Cavities	0	0	0	0	0
3.7 Brine Extraction	0	0	0	0	0
3.8 Gypsum Extraction	0	0	0	0	0
3.9 Tin Mining	0	0	0	0	0
3.10 Clay Mining	0	0	0	0	0

Section 4: Natural Ground Subsidence	On-site
4.1 Shrink Swell Clay	Very Low
4.2 Landslides	Very Low
4.3 Ground Dissolution of Soluble Rocks	Negligible
4.4 Compressible Deposits	Very Low
4.5 Collapsible Deposits	Very Low
4.6 Running Sand	Very Low

Section 5: Borehole Records	On-site	0-50m	51-250
5 BGS Recorded Boreholes	0	5	14

Section 6: Estimated Background Soil Chemistry	On-site	0-50m	51-250
6 Records of Background Soil Chemistry	10	2	11

Section 7: Railways and Tunnels	On-site	0-50m	51-250	251-500
7.1 Tunnels	0	0	0	Not Searched
7.2 Historical Railway and Tunnel Features	6	15	11	Not Searched
7.3 Historical Railways	0	0	0	Not Searched
7.4 Active Railways	0	6	0	Not Searched

Section 7: Railways and Tunnels	On-site	0-50m	51-250	251-500
7.5 Railway Projects	0	0	0	0

1 Geology

1.1 Artificial Ground Map

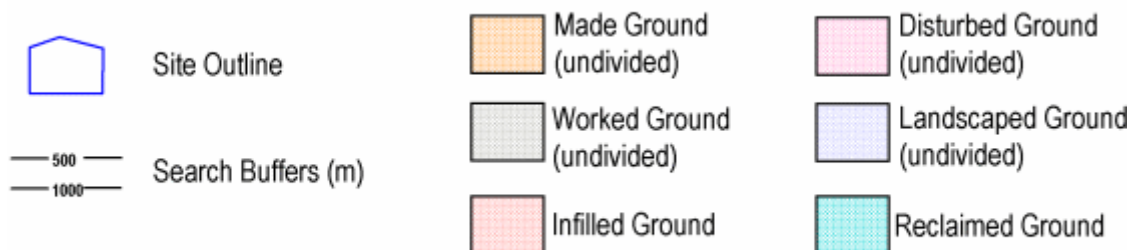


Artificial Ground Legend

Mapping
sourced from



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1 Geology

1.1 Artificial Ground

1.1.1 Artificial/ Made Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No:121

Are there any records of Artificial/Made Ground within 500m of the study site boundary? Yes

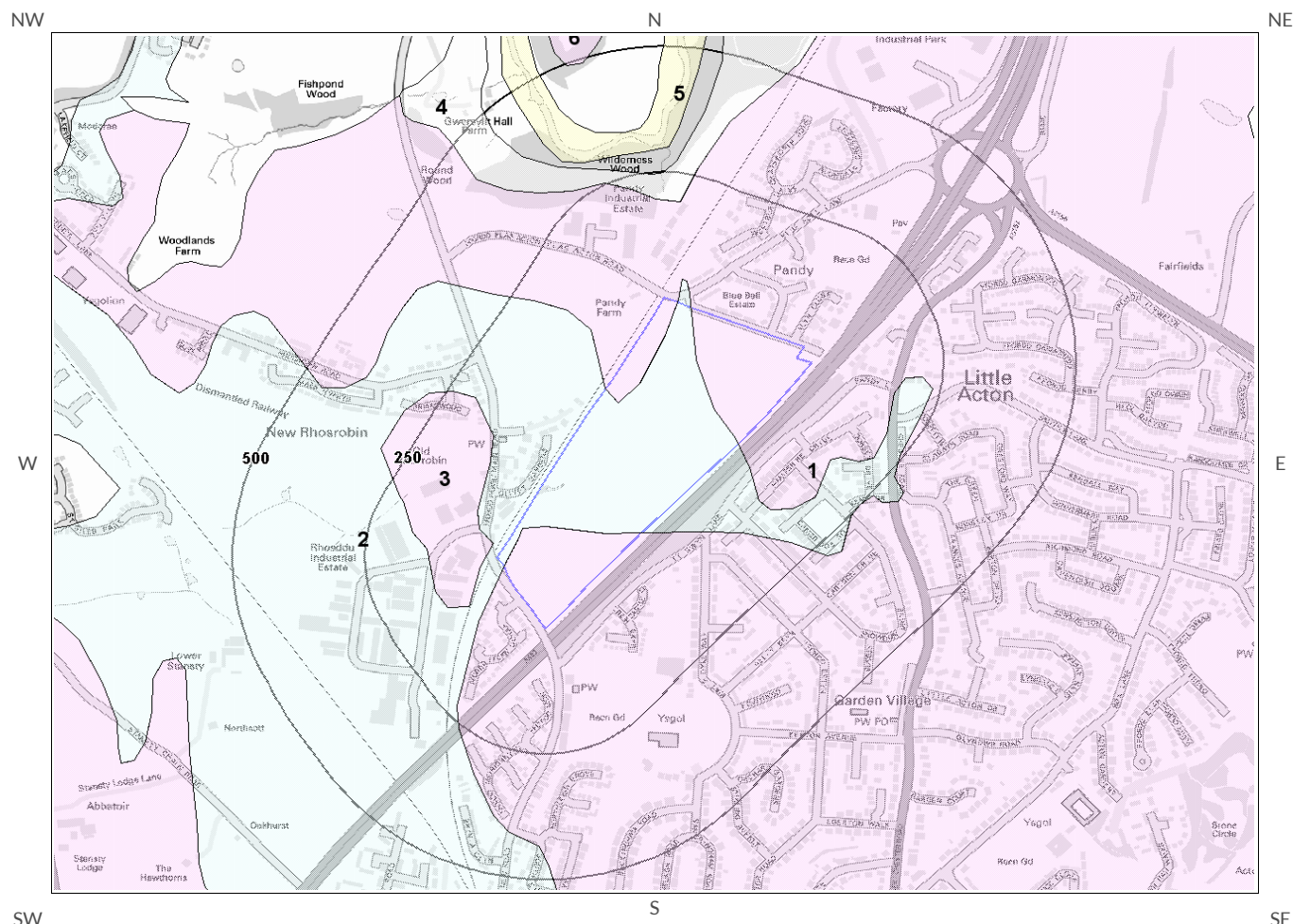
ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	MGR-MGRD	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT
2	0.0	On Site	MGR-MGRD	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT
3	21.0	NW	MGR-MGRD	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT
4	158.0	N	MGR-MGRD	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT
5	164.0	N	MGR-MGRD	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT

1.1.2 Permeability of Artificial Ground

Are there any records relating to permeability of artificial ground within the study site boundary? Yes

Distance (m)	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Intergranular	Very High	Very Low
0.0	On Site	Intergranular	Very High	Very Low
21.0	NW	Intergranular	Very High	Very Low

1.2 Superficial Deposits and Landslips Map



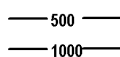
Superficial Deposits and Landslips
Legend



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Site Outline



Search Buffers (m)

1.2 Superficial Deposits and Landslips

1.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary? Yes

ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	GFSDD-SAGR	GLACIOFLUVIAL SHEET DEPOSITS, DEVENSIAN	SAND AND GRAVEL
2	0.0	On Site	TILLD-DMTN	TILL, DEVENSIAN	DIAMICTON
3	21.0	NW	GFDUD-SAGR	GLACIOFLUVIAL DEPOSITS, DEVENSIAN	SAND AND GRAVEL
4	193.0	N	GLLDD-CLSI	GLACIOLACUSTRINE DEPOSITS, DEVENSIAN	CLAY AND SILT
5	291.0	N	ALV-CSSG	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL
6	492.0	N	GFDUD-SAGR	GLACIOFLUVIAL DEPOSITS, DEVENSIAN	SAND AND GRAVEL

1.2.2 Permeability of Superficial Ground

Are there any records relating to permeability of superficial ground within the study site boundary? Yes

Distance (m)	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Intergranular	Very High	High
0.0	On Site	Mixed	High	Low
21.0	NW	Intergranular	Very High	High

1.2.3 Landslip

Are there any records of Landslip within 500m of the study site boundary? No

Database searched and no data found.

This Geology shows the main components as discrete layers, these are: Artificial / Made Ground, Superficial / Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

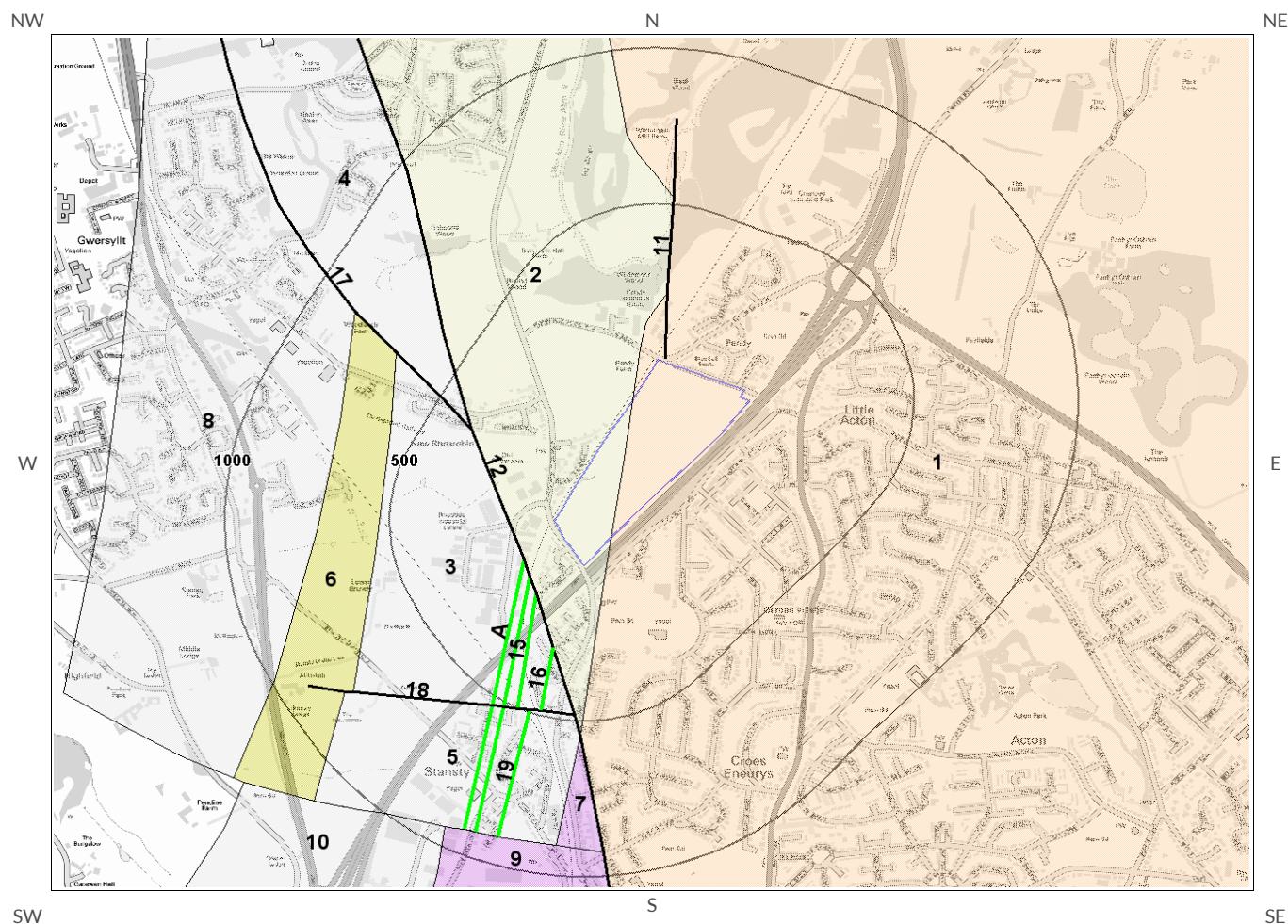
1.2.4 Landslip Permeability

Are there any records relating to permeability of landslips within the study site** boundary? No

Database searched and no data found.

* This includes an automatically generated 50m buffer zone around the site

1.3 Bedrock and Faults Map



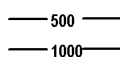
Bedrock and Faults Legend



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Site Outline



Search Buffers (m)

1.3 Bedrock, Solid Geology & Faults

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No:121

1.3.1 Bedrock/ Solid Geology

Records of Bedrock/ Solid Geology within 500m of the study site boundary:

ID	Distance (m)	Direction	LEX Code	Description	Rock Age
1	0.0	On Site	SAL-MDSC	Salop Formation - Mudstone, Sandstone And Conglomerate	/ Westphalian D
2	0.0	On Site	HA-MDSS	Halesowen Formation - Mudstone, Siltstone And Sandstone	Westphalian D
3	130.0	W	PLMC-MDSS	Pennine Lower Coal Measures Formation And Pennine Middle Coal Measures Formation (undifferentiated) - Mudstone, Siltston	Bolsovia (westphalian C) / Langsettian (westphalian A)
4	363.0	NW	PLMC-MDSS	Pennine Lower Coal Measures Formation And Pennine Middle Coal Measures Formation (undifferentiated) - Mudstone, Siltston	Bolsovia (westphalian C) / Langsettian (westphalian A)
5	480.0	S	PLMC-MDSS	Pennine Lower Coal Measures Formation And Pennine Middle Coal Measures Formation (undifferentiated) - Mudstone, Siltston	Bolsovia (westphalian C) / Langsettian (westphalian A)

1.3.2 Permeability of Bedrock Ground

Are there any records relating to permeability of bedrock ground within the study site* boundary? Yes

Distance (m)	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Fracture	Moderate	Low
0.0	On Site	Fracture	Moderate	Low

1.3.3 Faults

Are there any records of Faults within 500m of the study site boundary? Yes

ID	Distance (m)	Direction	Category Description	Feature Description
11	9.0	NE	FAULT	Normal fault, inferred
12	130.0	W	FAULT	Normal fault, inferred
13A	139.0	SW	ROCK	Coal seam, inferred
14A	157.0	SW	ROCK	Coal seam, inferred
15	169.0	SW	ROCK	Coal seam, inferred
16	282.0	S	ROCK	Coal seam, inferred
17	363.0	NW	FAULT	Normal fault, inferred
18	480.0	S	FAULT	Normal fault, inferred
19	492.0	S	ROCK	Coal seam, inferred

* This includes an automatically generated 50m buffer zone around the site

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

This Geology shows the main components as discrete layers, these are: Bedrock/ Solid Geology and linear features such as Faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

1.4 Radon Data

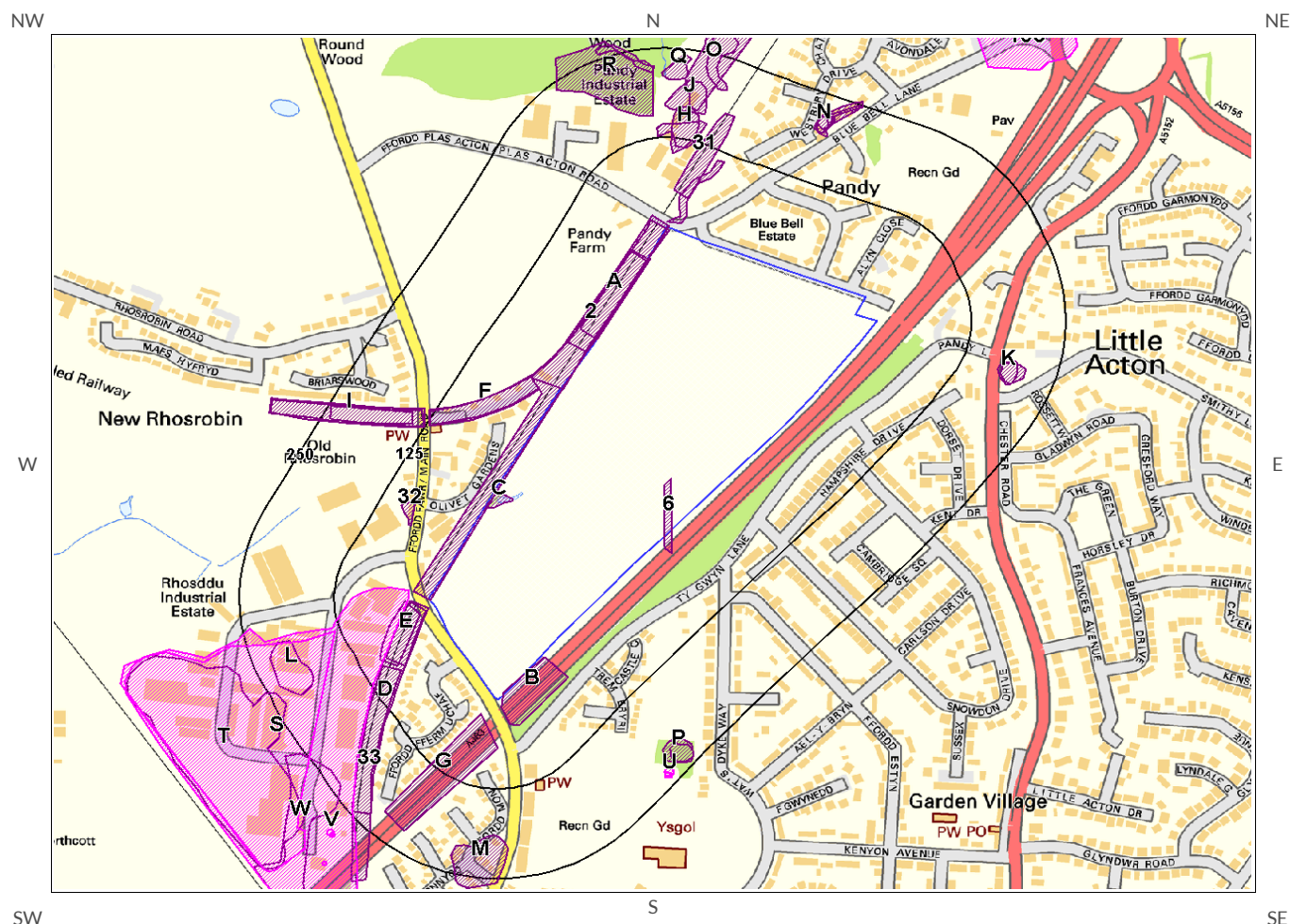
1.4.1 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is in a Radon Affected Area, as between 10 and 30% of properties are above the Action Level

1.4.2 Radon Protection

Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment? Full radon protective measures are necessary

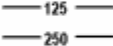
2 Ground Workings Map



Ground Workings Legend



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-  Site Outline
-  Historic Surface Ground Workings
-  Historic Underground Workings
-  Current Ground Workings
-  Search Buffers (m)



2 Ground Workings

2.1 Historical Surface Ground Working Features derived from Historical Mapping

This dataset is based on GroundSure's unique Historical Land Use Database derived from 1:10,560 and 1:10,000 scale historical mapping.

Are there any Historical Surface Ground Working Features within 250m of the study site boundary? **Yes**

The following Historical Surface Ground Working Features are provided by GroundSure:

ID	Distance (m)	Direction	NGR	Use	Date
1B	0.0	On Site	333125 352437	Cuttings	1980
2	0.0	On Site	333196 352954	Cuttings	1939
3A	0.0	On Site	333231 352990	Cuttings	1938
4	0.0	On Site	333214 352974	Cuttings	1872
5C	0.0	On Site	333078 352701	Pond	1980
6	0.0	On Site	333301 352681	Pond	1964
7A	0.0	On Site	333235 353005	Cuttings	1989
8A	0.0	On Site	333235 353005	Cuttings	1992
9A	0.0	On Site	333235 353005	Cuttings	1980
10A	0.0	On Site	333235 353005	Cuttings	1974
11A	0.0	On Site	333235 353005	Cuttings	1985
12A	0.0	On Site	333235 353005	Cuttings	1964
13B	0.0	On Site	333125 352437	Cuttings	1974
14C	0.0	On Site	333078 352701	Pond	1974
15	8.0	N	333328 353133	Unspecified Ground Workings	1939
16D	9.0	SW	332920 352414	Cuttings	1938
17D	9.0	SW	332920 352414	Cuttings	1898
18D	9.0	SW	332920 352414	Cuttings	1939
19E	13.0	SW	332955 352517	Cuttings	1872
20E	23.0	SW	332947 352517	Cuttings	1974
21E	23.0	SW	332947 352517	Cuttings	1992

ID	Distance (m)	Direction	NGR	Use	Date
22E	23.0	SW	332947 352517	Cuttings	1980
23E	23.0	SW	332947 352517	Cuttings	1989
24E	23.0	SW	332947 352517	Cuttings	1985
25E	23.0	SW	332947 352517	Cuttings	1964
26F	24.0	NW	333059 352842	Cuttings	1938
27F	24.0	NW	333059 352842	Cuttings	1939
28S	26.0	W	332862 352219	Colliery	1939
29G	30.0	SW	333001 352323	Cuttings	1980
30G	30.0	SW	333001 352323	Cuttings	1974
31	46.0	NE	333349 353179	Cuttings	1872
32	72.0	NW	332958 352684	Pond	1872
33	80.0	SW	332899 352322	Cuttings	1872
34H	104.0	N	333324 353220	Refuse Heap	1939
35H	113.0	N	333319 353213	Unspecified Ground Workings	1964
36H	113.0	N	333319 353213	Unspecified Ground Workings	1980
37H	113.0	N	333319 353213	Unspecified Ground Workings	1974
38I	126.0	NW	332877 352824	Cuttings	1872
39I	126.0	NW	332877 352825	Cuttings	1939
40I	126.0	NW	332877 352825	Cuttings	1938
41I	141.0	NW	332909 352822	Cuttings	1980
42I	141.0	NW	332909 352822	Cuttings	1989
43I	141.0	NW	332909 352822	Cuttings	1992
44I	141.0	NW	332909 352822	Cuttings	1974
45I	141.0	NW	332909 352822	Cuttings	1985
46I	141.0	NW	332909 352822	Cuttings	1964
47R	156.0	N	333218 353291	Sewage Works	1939
48J	163.0	N	333325 353265	Unspecified Heap	1964
49J	163.0	N	333325 353265	Unspecified Heap	1974
50J	163.0	N	333325 353265	Unspecified Heap	1980
51O	167.0	N	333419 353376	Unspecified Heap	1939

ID	Distance (m)	Direction	NGR	Use	Date
52K	174.0	E	333750 352881	Pond	1872
53K	174.0	E	333750 352881	Pond	1898
54K	178.0	E	333757 352880	Pond	1980
55K	178.0	E	333757 352880	Pond	1974
56K	178.0	E	333757 352880	Pond	1964
57L	185.0	SW	332804 352469	Unspecified Heap	1939
58L	185.0	SW	332804 352469	Unspecified Heap	1938
59M	190.0	S	333052 352198	Sand Pit	1938
60M	190.0	S	333052 352198	Old Sand Pit	1898
61N	193.0	N	333508 353224	Sand Pit	1872
62N	194.0	N	333509 353226	Old Gravel Pit	1938
63N	194.0	N	333509 353226	Old Gravel Pit	1939
64N	194.0	N	333509 353226	Old Gravel Pit	1898
65N	200.0	N	333513 353239	Unspecified Ground Workings	1980
66N	200.0	N	333513 353239	Unspecified Ground Workings	1964
67N	200.0	N	333513 353239	Unspecified Ground Workings	1974
68O	204.0	N	333384 353352	Unspecified Ground Workings	1964
69O	204.0	N	333384 353352	Unspecified Ground Workings	1980
70O	204.0	N	333384 353352	Unspecified Ground Workings	1974
71P	205.0	SE	333314 352354	Unspecified Heap	1964
72P	205.0	SE	333314 352354	Unspecified Heap	1980
73P	205.0	SE	333314 352354	Unspecified Heap	1985
74P	205.0	SE	333314 352354	Unspecified Heap	1992
75P	205.0	SE	333314 352354	Unspecified Heap	1989
76P	205.0	SE	333314 352354	Unspecified Heap	1974
77Q	205.0	N	333313 353307	Unspecified Pit	1980
78Q	205.0	N	333313 353307	Unspecified Pit	1989
79Q	205.0	N	333313 353307	Unspecified Pit	1985
80Q	205.0	N	333313 353307	Unspecified Pit	1974
81Q	205.0	N	333313 353307	Unspecified Pit	1964

ID	Distance (m)	Direction	NGR	Use	Date
82P	213.0	SE	333319 352350	Unspecified Heap	1939
83P	213.0	SE	333319 352350	Unspecified Heap	1938
84R	217.0	N	333257 353319	Unspecified Ground Workings	1989
85R	217.0	N	333257 353319	Unspecified Ground Workings	1985
86R	217.0	N	333257 353319	Unspecified Ground Workings	1992
87T	236.0	SW	332703 352337	Unspecified Heap	1939
88W	236.0	SW	332800 352155	Unspecified Heap	1872

2.2 Historical Underground Working Features derived from Historical Mapping

This data is derived from the GroundSure unique Historical Land Use Database. It contains data derived from 1:10,000 and 1:10,560 historical Ordnance Survey Mapping and includes some natural topographical features (Shake Holes for example) as well as manmade features that may have implications for ground stability. Underground and mining features have been identified from surface features such as shafts. The distance that these extend underground is not shown.

Are there any Historical Underground Working Features within 1000m of the study site boundary? Yes

The following Historical Underground Working Features are provided by GroundSure:

ID	Distance (m)	Direction	NGR	Use	Date
89S	26.0	W	332862 352219	Colliery	1939
90T	133.0	W	332719 352352	Unspecified Disused Mine	1974
91T	133.0	W	332719 352352	Unspecified Disused Mine	1964
92P	229.0	SE	333303 352324	Unspecified Disused Shaft	1989
93P	229.0	SE	333303 352324	Unspecified Disused Shaft	1992
94P	229.0	SE	333303 352324	Unspecified Disused Shaft	1980
95P	229.0	SE	333303 352324	Unspecified Disused Shaft	1974
96P	229.0	SE	333303 352324	Unspecified Disused Shaft	1985
97P	229.0	SE	333303 352324	Unspecified Disused Shaft	1964
98U	231.0	SE	333302 352319	Unspecified Old Shaft	1898
99U	232.0	SE	333301 352320	Old Coal Shaft	1939
100V	283.0	SW	332855 352239	Unspecified Disused Shaft	1992
101V	285.0	SW	332858 352236	Unspecified Shaft	1872
102W	320.0	SW	332847 352196	Unspecified Shafts	1872

ID	Distance (m)	Direction	NGR	Use	Date
103	360.0	NE	333965 353841	Unspecified Mine	1964
Not shown	391.0	SW	332841 352109	Unspecified Shaft	1872
Not shown	394.0	SW	332804 352134	Unspecified Shafts	1872
Not shown	624.0	N	333789 353571	Unspecified Shaft	1938
Not shown	632.0	N	333797 353577	Unspecified Disused Shaft	1989
Not shown	632.0	N	333797 353577	Unspecified Disused Shaft	1992
Not shown	632.0	N	333797 353577	Unspecified Disused Shaft	1985
Not shown	658.0	N	333797 353603	Unspecified Shaft	1939
Not shown	686.0	N	333814 353628	Unspecified Shaft	1938

2.3 Current Ground Workings

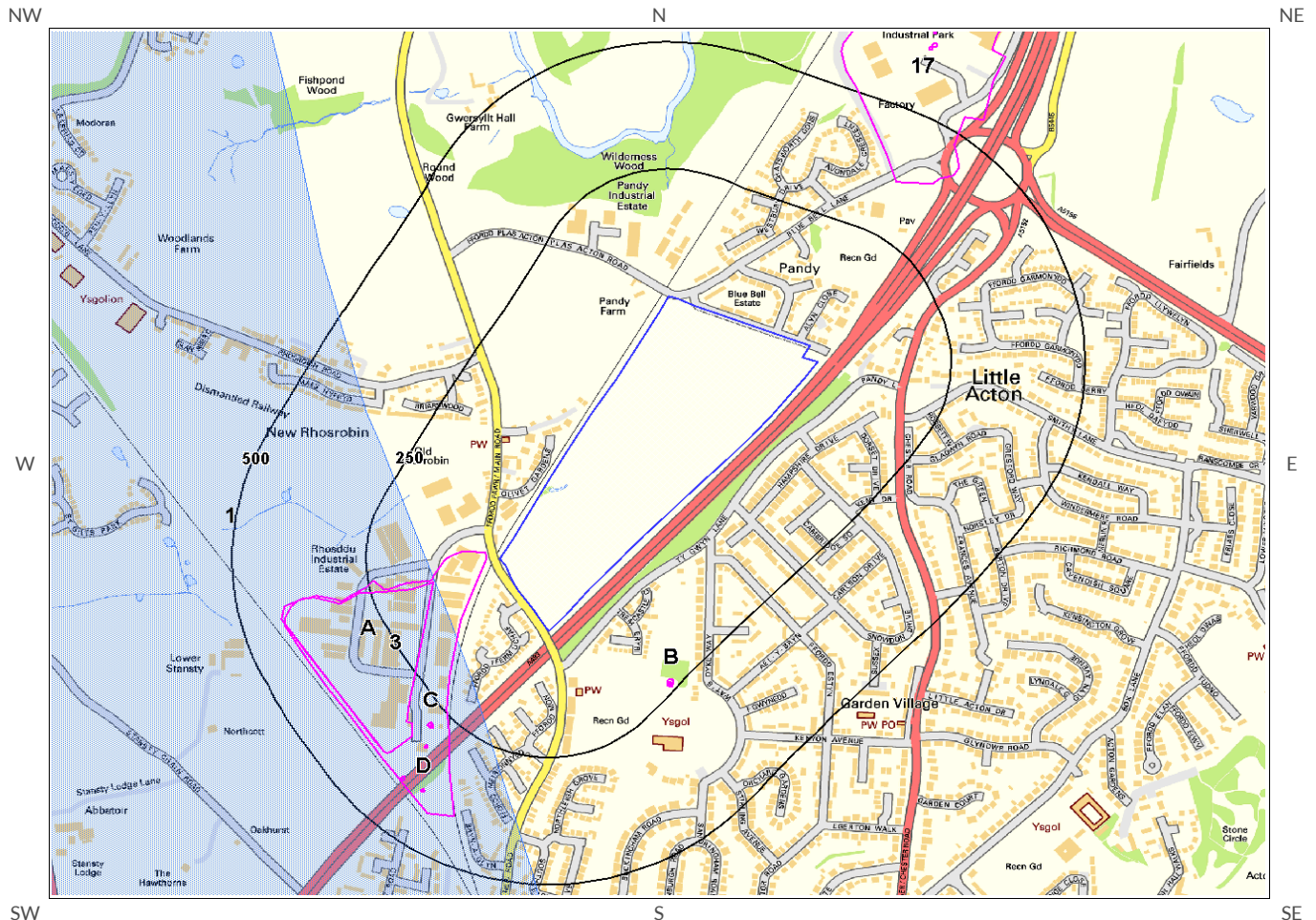
This dataset is derived from the BGS BRITPITS database covering active; inactive mines; quarries; oil wells; gas wells and mineral wharves; and rail deposits throughout the British Isles.

Are there any BGS Current Ground Workings within 1000m of the study site boundary? Yes

The following Current Ground Workings information is provided by British Geological Survey:

ID	Distance (m)	Direction	NGR	Commodity Produced	Pit Name	Type of working	Status
Not shown	636.0	N	333790 353580	Coal, Deep	Martin Pit, Gresford Colliery	Working is wholly underground, access by shaft, adit or drift. Working may be termed Colliery, Mine, Drift Mine, Slant, Level, Adit or Ingoing Eye (Ingaun Ee - Scots)	Ceased
Not shown	703.0	N	333820 353640	Coal, Deep	Dennis Pit, Gresford Colliery	Working is wholly underground, access by shaft, adit or drift. Working may be termed Colliery, Mine, Drift Mine, Slant, Level, Adit or Ingoing Eye (Ingaun Ee - Scots)	Ceased
Not shown	845.0	N	333555 353890	Clay & Shale	Wilderness Clay Pit	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased

3 Mining, Extraction & Natural Cavities Map



Mining, Extraction and Natural Cavities Legend

Mapping sourced from **Ordnance Survey**

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3 Mining, Extraction & Natural Cavities

3.1 Historical Mining

This dataset is derived from GroundSure unique Historical Land-use Database that are indicative of mining or extraction activities.

Are there any Historical Mining areas within 1000m of the study site boundary?

Yes

The following Historical Mining information is provided by GroundSure:

ID	Distance (m)	Direction	NGR	Details	Date
3	26.0	W	332862 352219	Colliery	1939
4A	133.0	W	332719 352352	Unspecified Disused Mine	1974
5A	133.0	W	332719 352352	Unspecified Disused Mine	1964
6B	229.0	SE	333303 352324	Unspecified Disused Shaft	1985
7B	229.0	SE	333303 352324	Unspecified Disused Shaft	1974
8B	229.0	SE	333303 352324	Unspecified Disused Shaft	1989
9B	229.0	SE	333303 352324	Unspecified Disused Shaft	1992
10B	229.0	SE	333303 352324	Unspecified Disused Shaft	1964
11B	229.0	SE	333303 352324	Unspecified Disused Shaft	1980
12B	231.0	SE	333302 352319	Unspecified Old Shaft	1898
13B	232.0	SE	333301 352320	Old Coal Shaft	1939
14C	283.0	SW	332855 352239	Unspecified Disused Shaft	1992
15C	285.0	SW	332858 352236	Unspecified Shaft	1872
16C	320.0	SW	332847 352196	Unspecified Shafts	1872
17	360.0	NE	333965 353841	Unspecified Mine	1964
18D	391.0	SW	332841 352109	Unspecified Shaft	1872
19D	394.0	SW	332804 352134	Unspecified Shafts	1872
20E	624.0	N	333789 353571	Unspecified Shaft	1938
21E	632.0	N	333797 353577	Unspecified Disused Shaft	1985
22E	632.0	N	333797 353577	Unspecified Disused Shaft	1989
23E	632.0	N	333797 353577	Unspecified Disused Shaft	1992

ID	Distance (m)	Direction	NGR	Details	Date
24E	658.0	N	333797 353603	Unspecified Shaft	1939
Not shown	686.0	N	333814 353628	Unspecified Shaft	1938

3.2 Coal Mining

This dataset provides information as to whether the study site lies within a known coal mining affected area as defined by the coal authority.

Are there any Coal Mining areas within 1000m of the study site boundary? Yes

The following Coal Mining information provided by the Coal Authority is not represented on Mapping:

Distance (m)	Direction	Details
0.0	On Site	The study site is located within the specified search distance of an identified mining area. Further details concerning this can be obtained from the Coal Authority Helpline on 0845 762 6848.

3.3 Johnson Poole and Bloomer

This dataset provides information as to whether the study site lies within an area where JPB hold information relating to mining.

Are there any JPB Mining areas within 1000m of the study site boundary? No

The following information provided by JPB is not represented on mapping: Database searched and no data found.

3.4 Non-Coal Mining

This dataset provides information as to whether the study site lies within an area which may have been subject to non-coal historic mining.

Are there any Non-Coal Mining areas within 1000m of the study site boundary? Yes

The following non-coal mining information is provided by the BGS:

ID	Distance (m)	Direction	Name	Commodity	Assessment of likelihood
1	130.0	W	Not available	Iron Ore (Bedded)	Highly Unlikely - Localised small scale mining may have occurred but restricted in extent.
Not shown	547.0	S	Not available	Vein Mineral	Rare - Infrequent minor mining may have occurred but restricted in extent.

3.5 Non-Coal Mining Cavities

This dataset provides information from the Peter Brett Associates (PBA) mining cavities database (compiled for the national study entitled "Review of mining instability in Great Britain, 1990" PBA has also continued adding to this database) on mineral extraction by mining.

Are there any Non-Coal Mining cavities within 1000m of the study site boundary? No

Database searched and no data found.

3.6 Natural Cavities

This dataset provides information based on Peter Brett Associates natural cavities database.

Are there any Natural Cavities within 1000m of the study site boundary? No

Database searched and no data found.

3.7 Brine Extraction

This dataset provides information from the Brine Compensation Board which has been discontinued and is now covered by the Coal Authority.

Are there any Brine Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

3.8 Gypsum Extraction

This dataset provides information on Gypsum extraction from British Gypsum records.

Are there any Gypsum Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

3.9 Tin Mining

This dataset provides information on tin mining areas and is derived from tin mining records. This search is based upon postcode information to a sector level.

Are there any Tin Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

3.10 Clay Mining

This dataset provides information on Kaolin and Ball Clay mining from relevant mining records.

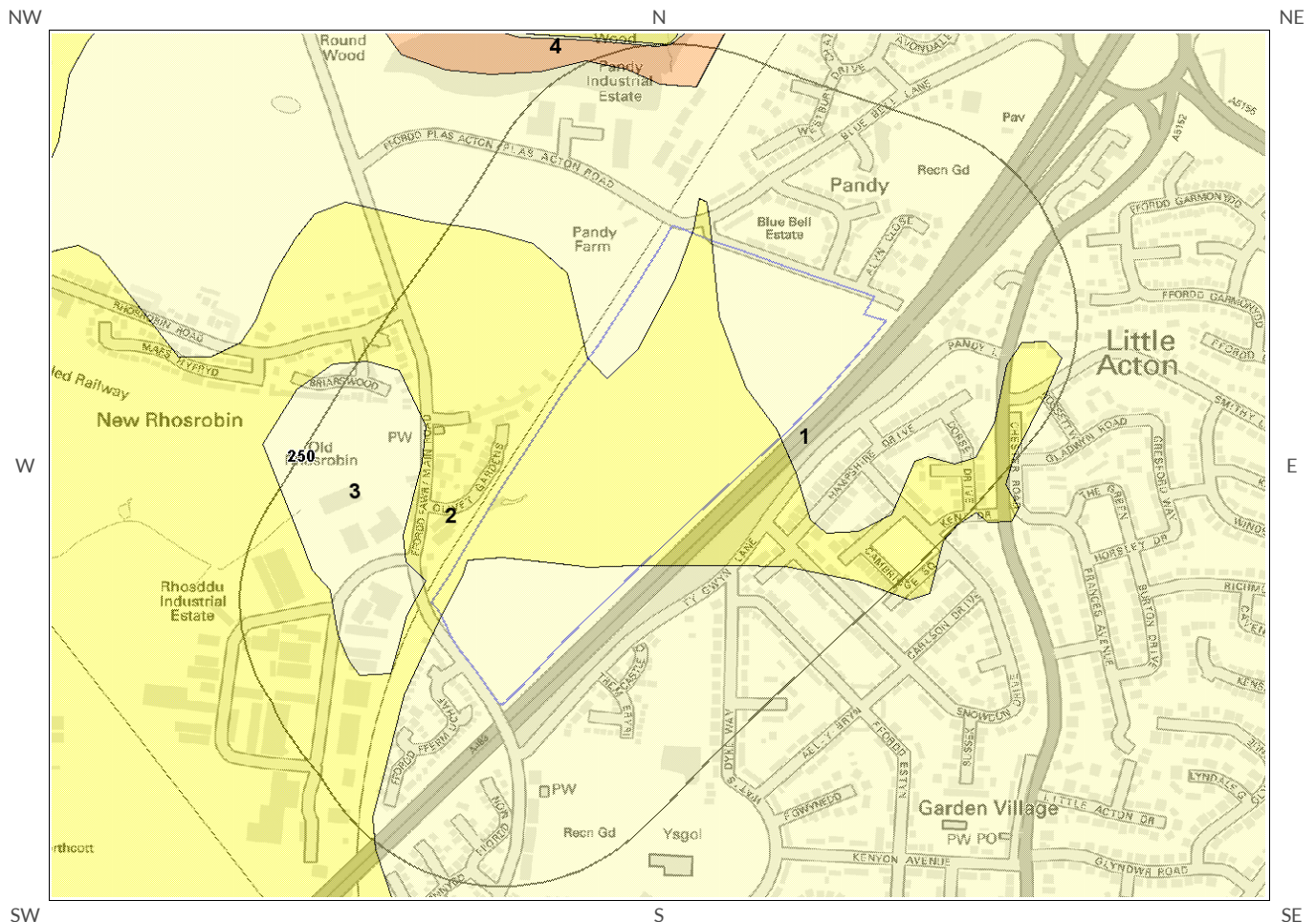
Are there any Clay Mining areas within 1000m of the study site boundary?

No

Database searched and no data found.

4 Natural Ground Subsidence

4.1 Shrink-Swell Clay Map



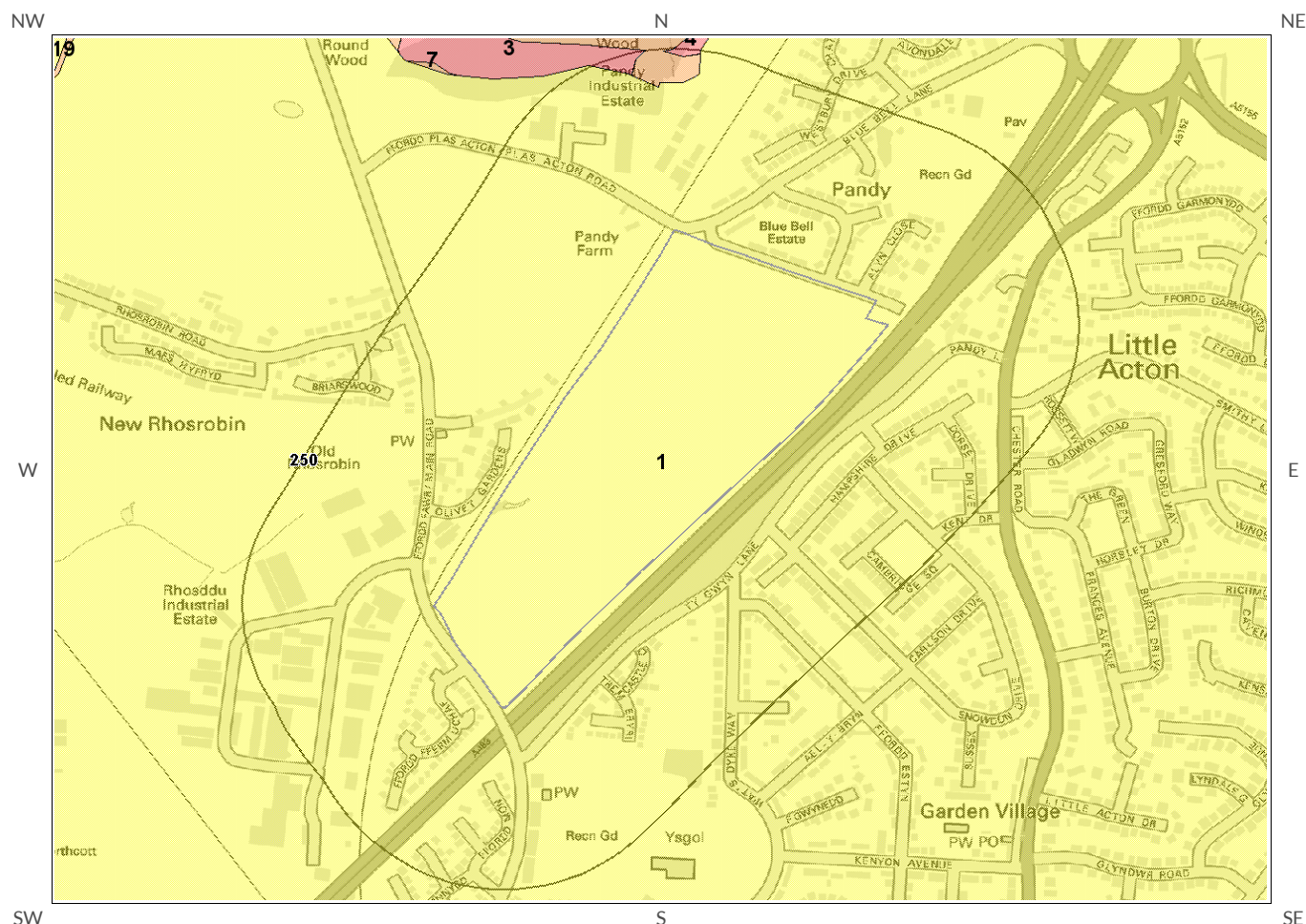
Shrink Swell Clay Legend



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4.2 Landslides Map



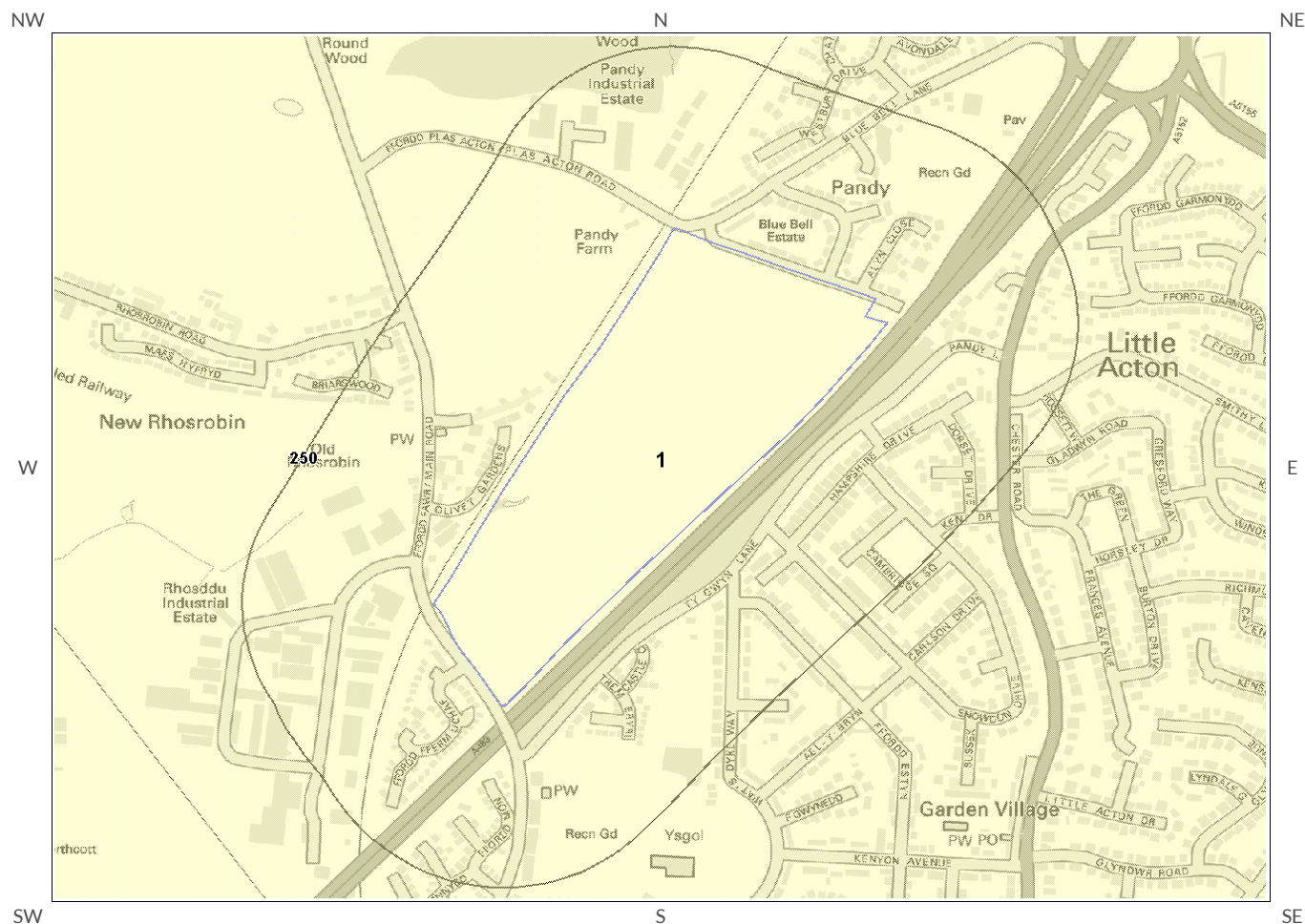
Landslides Legend



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4.3 Ground Dissolution Soluble Rocks Map



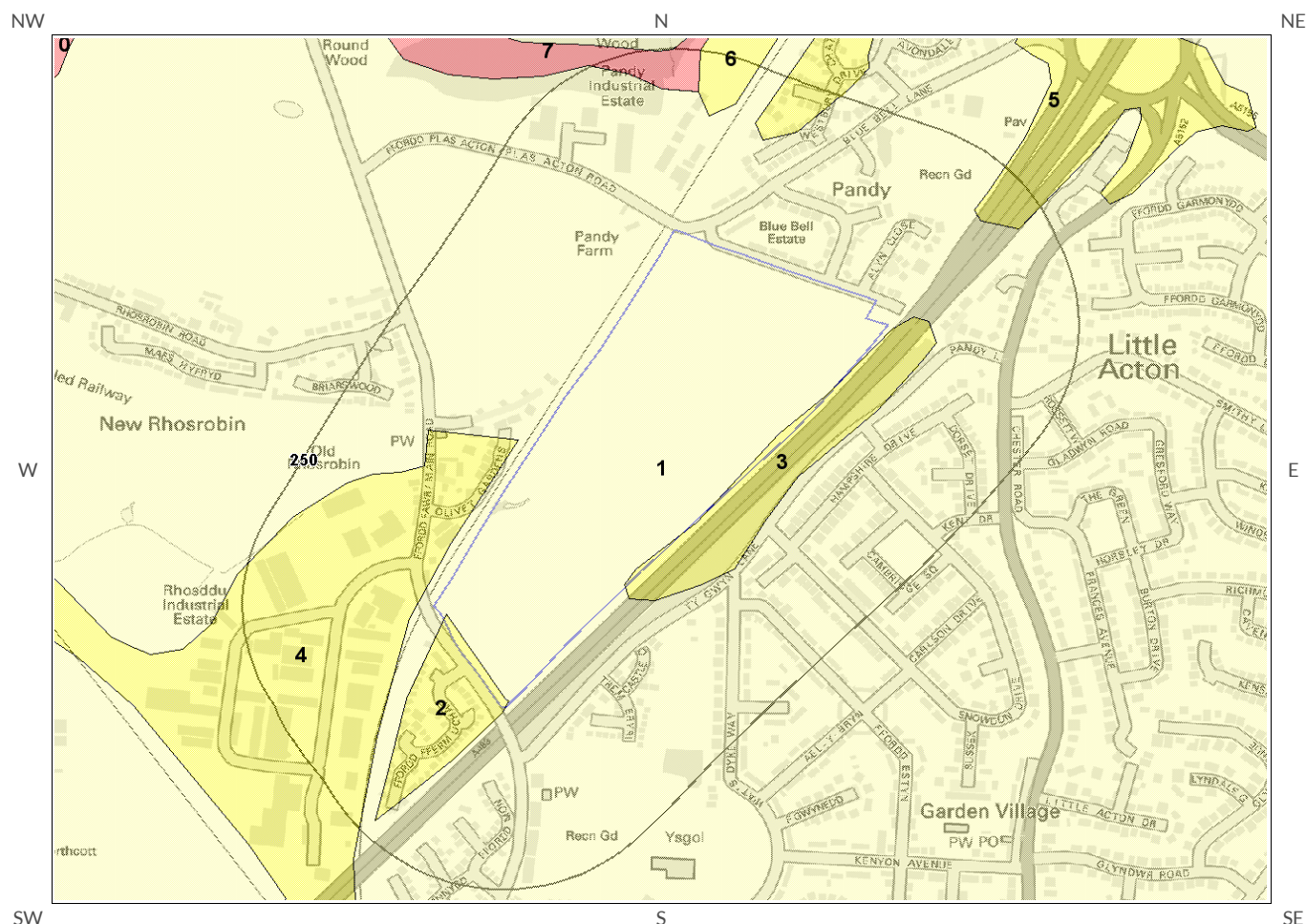
Ground Dissolution
Soluble Rocks Legend



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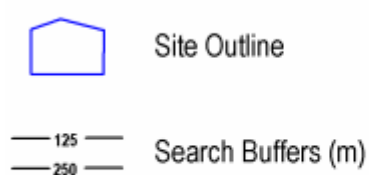
4.4 Compressible Deposits Map



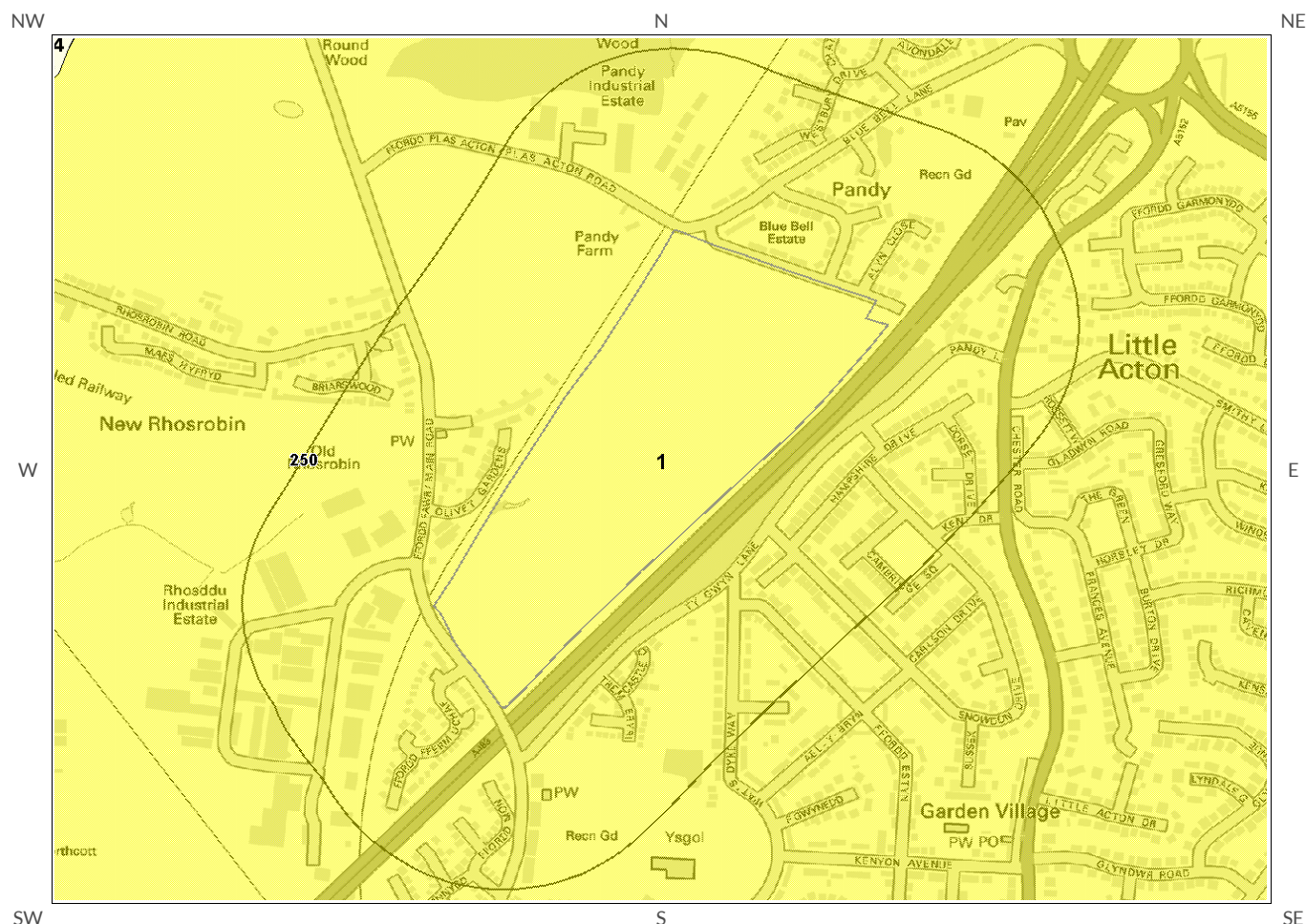
Compressible Deposits Legend



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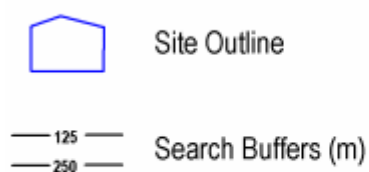
4.5 Collapsible Deposits Map



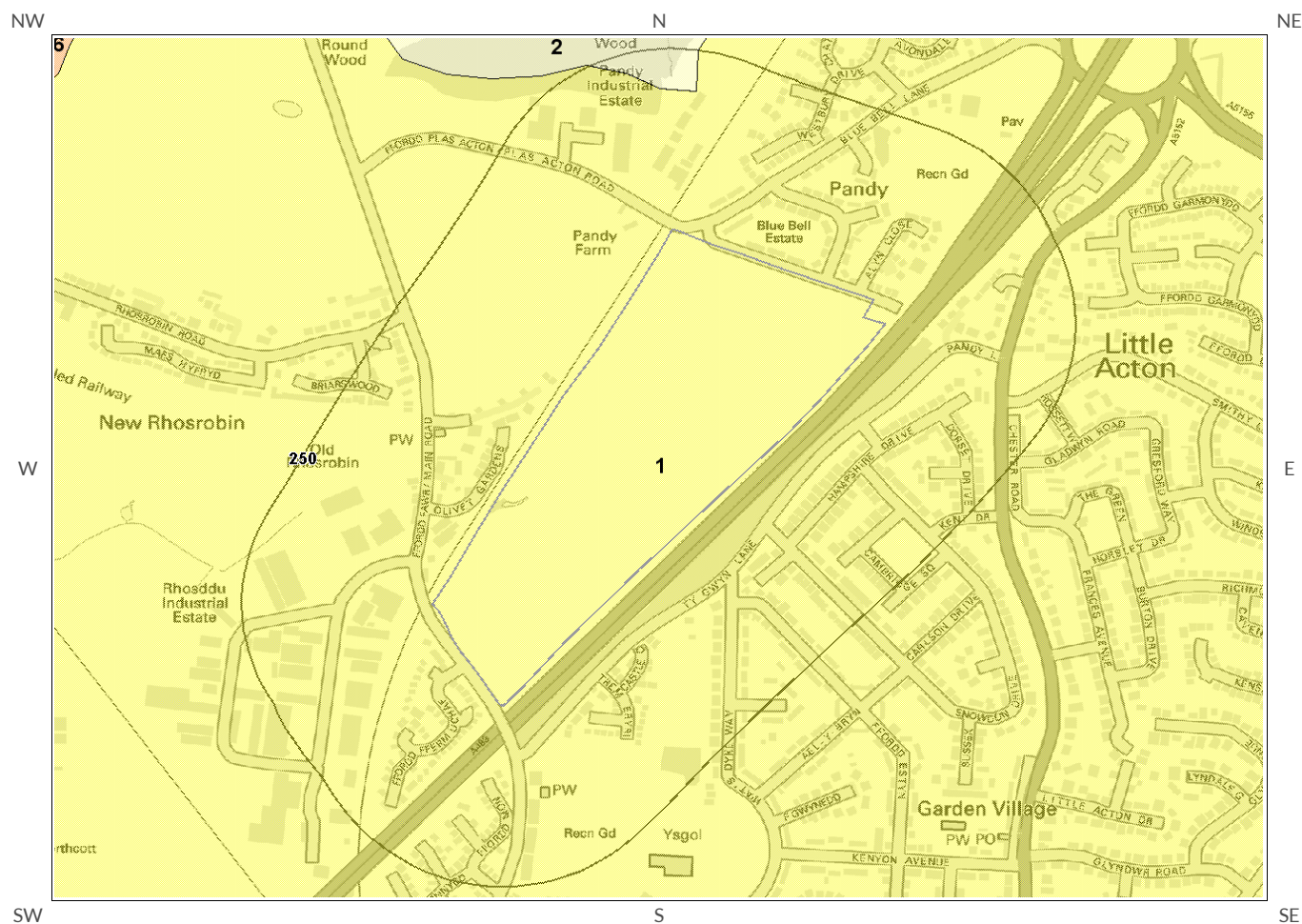
Collapsible Deposits Legend



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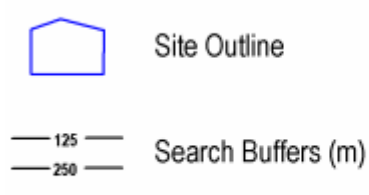
4.6 Running Sand Map



Running Sand Legend



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4 Natural Ground Subsidence

The National Ground Subsidence rating is obtained through the 6 natural ground stability hazard datasets, which are supplied by the British Geological Survey (BGS).

The following GeoSure data represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

What is the maximum hazard rating of natural subsidence within the study site* boundary? **Very Low**

4.1 Shrink-Swell Clays

The following Shrink Swell information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.
2	0.0	On Site	Very Low	Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.
3	21.0	NW	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.

4.2 Landslides

The following Landslides information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

4.3 Ground Dissolution of Soluble Rocks

The following Ground Dissolution information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

* This includes an automatically generated 50m buffer zone around the site

4.4 Compressible Deposits

The following Compressible Deposits information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.
2	0.0	On Site	Very Low	Very low potential for compressible deposits to be present. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.
3	0.0	On Site	Very Low	Very low potential for compressible deposits to be present. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.
4	21.0	NW	Very Low	Very low potential for compressible deposits to be present. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

4.5 Collapsible Deposits

The following Collapsible Rocks information provided by the British Geological Survey:

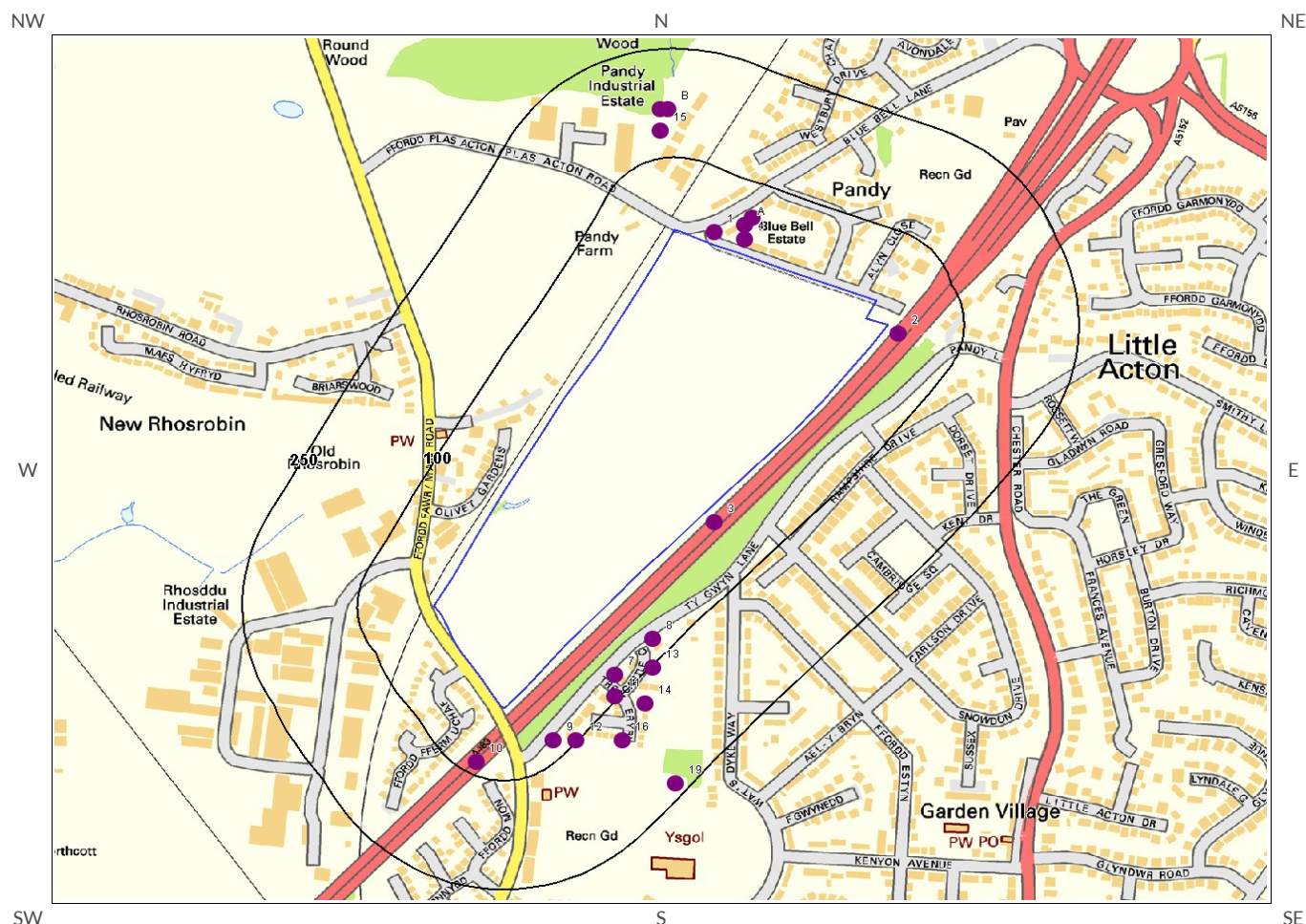
ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

4.6 Running Sands

The following Running Sands information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

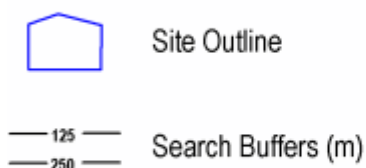
5 Borehole Records Map



Borehole Records Legend



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Borehole Locations



5 Borehole Records

The systematic analysis of data extracted from the BGS Borehole Records database provides the following information.

Records of boreholes within 250m of the study site boundary:

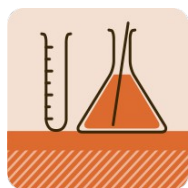
19

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
1	16.0	NE	333350 353080	SJ35SW678	3.27	PANDY, BLUEBELL LANE 2
2	18.0	SE	333590 352940	SJ35SW786	10.67	WREXHAM BY-PASS A483 80
3	18.0	SE	333350 352680	SJ35SW785	3.05	WREXHAM BY-PASS A483 75
4	20.0	N	333390 353070	SJ35SW677	3.2	PANDY, BLUEBELL LANE 1
5A	39.0	N	333390 353090	SJ35SW679	3.2	PANDY, BLUEBELL LANE 3
6A	51.0	N	333400 353100	SJ35SW680	3.2	PANDY, BLUEBELL LANE 4
7	75.0	SE	333220 352470	SJ35SW1031	3.5	TY GWYN LANE, WREXHAM TP 2
8	75.0	SE	333270 352520	SJ35SW1030	3.3	TY GWYN LANE, WREXHAM TP 1
9	76.0	SE	333140 352380	SJ35SW1033	3.8	TY GWYN LANE, WREXHAM TP 4
10	83.0	SW	333040 352350	SJ35SW784	11.89	WREXHAM BY-PASS A483 70
11	95.0	SE	333220 352440	SJ35SW1038	2.5	TY GWYN LANE, WREXHAM TP 9
12	98.0	SE	333170 352380	SJ35SW1034	3.4	TY GWYN LANE, WREXHAM TP 5
13	103.0	SE	333270 352480	SJ35SW1037	3.2	TY GWYN LANE, WREXHAM TP 8
14	131.0	SE	333260 352430	SJ35SW1036	3.3	TY GWYN LANE, WREXHAM TP 7
15	137.0	N	333280 353220	SJ35SW1118	-1.0	PANDY PUMPING STATION TP17
16	142.0	SE	333230 352380	SJ35SW1035	3.0	TY GWYN LANE, WREXHAM TP 6
17B	166.0	N	333290 353250	SJ35SW1116	-1.0	PANDY PUMPING STATION 1
18B	167.0	N	333280 353250	SJ35SW1117	-1.0	PANDY PUMPING STATION TP16
19	235.0	SE	333300 352320	SJ35SW634	-1.0	WREXHAM & ACTON COLL. SHAFT

Additional online information is available for the following boreholes listed above:

- #1: scans.bgs.ac.uk/sobi_scans/boreholes/155538
- #2: scans.bgs.ac.uk/sobi_scans/boreholes/155646
- #3: scans.bgs.ac.uk/sobi_scans/boreholes/155645
- #4: scans.bgs.ac.uk/sobi_scans/boreholes/155537

#5A: scans.bgs.ac.uk/sobi_scans/boreholes/155539
#6A: scans.bgs.ac.uk/sobi_scans/boreholes/155540
#7: scans.bgs.ac.uk/sobi_scans/boreholes/15363109
#8: scans.bgs.ac.uk/sobi_scans/boreholes/15363074
#9: scans.bgs.ac.uk/sobi_scans/boreholes/15363145
#10: scans.bgs.ac.uk/sobi_scans/boreholes/155644
#11: scans.bgs.ac.uk/sobi_scans/boreholes/15363180
#12: scans.bgs.ac.uk/sobi_scans/boreholes/15363146
#13: scans.bgs.ac.uk/sobi_scans/boreholes/15363179
#14: scans.bgs.ac.uk/sobi_scans/boreholes/15363163
#16: scans.bgs.ac.uk/sobi_scans/boreholes/15363147
#19: scans.bgs.ac.uk/sobi_scans/boreholes/155494



6 Estimated Background Soil Chemistry

Records of background estimated soil chemistry within 250m of the study site boundary:

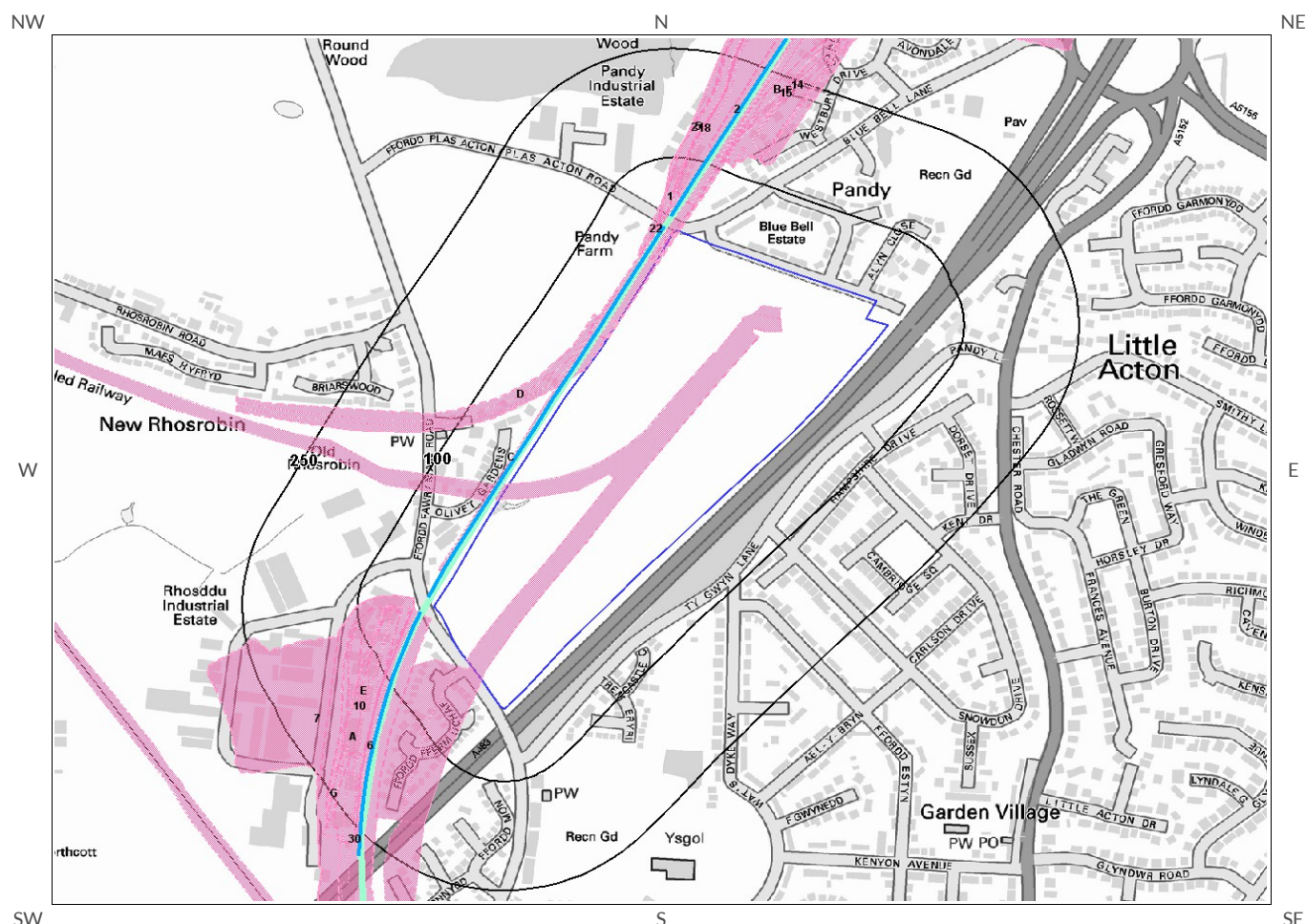
23

For further information on how this data is calculated and limitations upon its use, please see the GroundSure Geolnsight User Guide, available on request.

Distance (m)	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	<15 mg/kg	150 - 300 mg/kg
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	<15 mg/kg	150 - 300 mg/kg
19.0	NW	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
21.0	NW	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
72.0	NW	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
128.0	W	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
130.0	W	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
130.0	W	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	150 - 300 mg/kg
162.0	W	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
166.0	SW	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
184.0	NW	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
193.0	N	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
193.0	N	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
212.0	NW	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg
247.0	N	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<150 mg/kg

*As this data is based upon underlying 1:50,000 scale geological information, a 50m buffer has been added to the search radius.

7 Railways and Tunnels Map



Railways and Tunnels Legend



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- | | | | |
|--|--|--|---|
| | Underground or Partially Underground Railway / Subway System | | Railway Track (OpenStreetMap) |
| | Site Outline | | Railway Tunnel (OS Mapping) |
| | Search Buffers (m) | | High Speed 2 |
| | Abandoned or Dismantled Railway (OpenStreetMap) | | Crossrail |
| | Railway Track (OS Mapping) | | Railway and/or Tunnel Feature from Historical Mapping |



7 Railways and Tunnels

7.1 Tunnels

This data is derived from OpenStreetMap and provides information on the possible locations of underground railway systems in the UK - the London Underground, the Tyne & Wear Metro and the Glasgow Subway.

Have any underground railway lines been identified within the study site boundary? No

Have any underground railway lines been identified within 250m of the study site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

This data is derived from Ordnance Survey mapping and provides information on the possible locations of railway tunnels forming part of the UK overground railway network.

Have any other railway tunnels been identified within the site boundary? No

Have any other railway tunnels been identified within 250m of the site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

7.2 Historical Railway and Tunnel Features

This data is derived from GroundSure's unique Historical Land-use Database and contains features relating to tunnels, railway tracks or associated works that have been identified from historical Ordnance Survey mapping.

Have any historical railway or tunnel features been identified within the study site boundary? Yes

Have any historical railway or tunnel features been identified within 250m of the study site boundary? Yes

ID	Distance (m)	Direction	NGR	Details	Date
1	0	On Site	333420 353415	Railway Sidings	1898
2	0	On Site	333445 353483	Railway Sidings	1938
3	0	On Site	333421 353417	Railway Sidings	1938
4D	0	On Site	333150 352886	Railway Sidings	1964
16	0	On Site	n/a	Railway	1939
17	0	On Site	n/a	Railway	1912
18	5	NW	333366 353270	Railway Sidings	1912
5	12	NW	333439 353491	Tramway Sidings	1909
19C	12	NW	333085 352765	Railway Sidings	1874

ID	Distance (m)	Direction	NGR	Details	Date
20C	12	NW	333085 352765	Railway Sidings	1899
6	13	SW	332879 352220	Railway Sidings	1872
21	16	NW	333442 353467	Railway Sidings	1899
22	17	NW	333275 353080	Railway Sidings	1937
23D	18	NW	333165 352907	Railway Sidings	1961
7	26	W	332862 352219	Railway Sidings	1949
8A	26	W	332862 352219	Railway Sidings	1938
9A	26	W	332862 352219	Railway Sidings	1898
10	31	W	332900 352403	Railway Sidings	1938
24E	35	W	332915 352444	Railway Sidings	1912
25	38	NE	333743 353456	Railway Sidings	1912
11E	45	W	332894 352420	Railway Sidings	1909
26E	54	W	332894 352450	Railway Sidings	1874
27E	54	W	332893 352451	Railway Sidings	1899
12B	108	NE	333628 353606	Railway Sidings	1980
13B	108	NE	333628 353606	Railway Sidings	1974
14	108	NE	333771 353742	Railway Sidings	1964
28F	111	NE	333643 353555	Railway Sidings	1937
15	113	NE	333643 353511	Railway Sidings	1949
29F	115	NE	333659 353592	Railway Sidings	1961
30	192	SW	333016 351533	Railway Sidings	1912
31G	222	SW	332856 352301	Railway Sidings	1912
32G	223	SW	332857 352309	Railway Sidings	1899

Any records that have been identified are represented on the Railways and Tunnels Map.

7.3 Historical Railways

This data is derived from OpenStreetMap and provides information on the possible alignments of abandoned or dismantled railway lines in proximity to the study site.

Have any historical railway lines been identified within the study site boundary? No

Have any historical railway lines been identified within 250m of the study site boundary? No

Database searched and no data found.

Note: multiple sections of the same track may be listed in the detail above

Any records that have been identified are represented on the Railways and Tunnels Map.

7.4 Active Railways

These datasets are derived from Ordnance Survey mapping and OpenStreetMap and provide information on the possible locations of active railway lines in proximity to the study site.

Have any active railway lines been identified within the study site boundary? No

Have any active railway lines been identified within 250m of the study site boundary? Yes

Distance (m)	Direction	Name	Type
10	NW	Not given	Rail
12	NW	Not given	Single Track
13	NW	Not given	Single Track
14	NW	Not given	Single Track
19	SW	Not given	Single Track
20	N	Not given	Single Track

Note: multiple sections of the same track may be listed in the detail above

Any records that have been identified are represented on the Railways and Tunnels Map.

7.5 Railway Projects

These datasets provide information on the location of large scale railway projects High Speed 2 and Crossrail.

Is the study site within 5km of the route of the High Speed 2 rail project? No

Is the study site within 500m of the route of the Crossrail rail project? No

Further information on proximity to these routes, the project construction status and associated works can be obtained through the purchase of a GroundSure HS2 and Crossrail Report.

Contact Details

GroundSure Helpline
Telephone: 08444 159 000
info@groundsure.com



British Geological Survey Enquiries

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Tel: 0115 936 3143.
Fax: 0115 936 3276.
Email: enquiries@bgs.ac.uk
Web: www.bgs.ac.uk

BGS Geological Hazards Reports and general geological enquiries



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Tel: 0345 7626 848
DX 716176 Mansfield 5
www.coal.gov.uk



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<https://www.gov.uk/government/organisations/public-health-england>
Email: enquiries@phe.gov.uk
Main switchboard: 020 7654 8000



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Report Reference: HMD-341-1633272

Client Reference: PE00362

Standard Terms and Conditions

1 Definitions

In these terms and conditions unless the context otherwise requires:

"Beneficiary" means the person or entity for whose benefit the Client has obtained the Services.

"Client" means the party or parties entering into a Contract with GroundSure.

"Commercial" means any building or property which is not Residential.

"Confidential Information" means the contents of this Contract and all information received from the Client as a result of, or in connection with, this Contract other than

(i) information which the Client can prove was rightfully in its possession prior to disclosure by GroundSure and

(ii) any information which is in the public domain (other than by virtue of a breach of this Contract).

"Support Services" means Support Services provided by GroundSure including, without limitation, interpreting third party and in-house environmental data, providing environmental support advice, undertaking environmental audits and assessments, Site investigation, Site monitoring and related items.

"Contract" means the contract between GroundSure and the Client for the provision of the Services, and which shall incorporate these terms and conditions, the Order, and the relevant User Guide.

"Third Party Data Provider" means any third party providing Third Party Content to GroundSure.

"Data Reports" means reports comprising factual data with no accompanying interpretation.

"Fees" has the meaning set out in clause 5.1.

"GroundSure" means GroundSure Limited, a company registered in England and Wales under number 03421028.

"GroundSure Materials" means all materials prepared by GroundSure and provided as part of the Services, including but not limited to Third Party Content, Data Reports, Mapping, and Risk Screening Reports.

"Intellectual Property" means any patent, copyright, design rights, trade or service mark, moral rights, data protection rights, know-how or trade mark in each case whether registered or not and including applications for the same or any other rights of a similar nature anywhere in the world.

"Mapping" means a map, map data or a combination of historical maps of various ages, time periods and scales.

"Order" means an electronic, written or other order form submitted by the Client requesting Services from GroundSure in respect of a specified Site.

"Ordnance Survey" means the Secretary of State for Business, Innovation and Skills, acting through Ordnance Survey, Adanac Drive, Southampton, SO16 0AS, UK.

"Order Website" means the online platform through which Orders may be placed by the Client and accepted by GroundSure.

"Report" means a Risk Screening Report or Data Report for Commercial or Residential property.

"Residential" means any building or property used as or intended to be used as a single dwelling.

"Risk Screening Report" means a risk screening report comprising factual data with an accompanying interpretation by GroundSure.

"Services" means any Report, Mapping and/or Support Services which GroundSure has agreed to provide by accepting an Order pursuant to clause 2.6.

"Site" means the area of land in respect of which the Client has requested GroundSure to provide the Services.

"Third Party Content" means data, database information or other information which is provided to GroundSure by a Third Party Data Provider.

"User Guide" means the user guide, as amended from time to time, available upon request from GroundSure and on the website (www.GroundSure.com) and forming part of this Contract.

2 Scope of Services, terms and conditions, requests for insurance and quotations

2.1 GroundSure agrees to provide the Services in accordance with the Contract.

2.2 GroundSure shall exercise reasonable skill and care in the provision of the Services.

2.3 Subject to clause 7.3 the Client acknowledges that it has not relied on any statement or representation made by or on behalf of GroundSure which is not set out and expressly agreed in writing in the Contract and all such statements and representations are hereby excluded to the fullest extent permitted by law.

2.4 The Client acknowledges that terms and conditions appearing on a Client's order form, printed stationery or other communication, or any terms or conditions implied by custom, practice or course of dealing shall be of no effect, and that this Contract shall prevail over all others in relation to the Order.

2.5 If the Client or Beneficiary requests insurance in conjunction with or as a result of the Services, GroundSure shall use reasonable endeavours to recommend such insurance, but makes no warranty that such insurance shall be available from insurers or that it will be offered on reasonable terms. Any insurance purchased by the Client or Beneficiary shall be subject solely to the terms of the policy issued by insurers and GroundSure will have no liability therefor. In addition you acknowledge and agree that GroundSure does not act as an agent or broker for any insurance providers. The Client should take (and ensure that the Beneficiary takes) independent advice to ensure that the insurance policy requested or offered is suitable for its requirements.

2.6 GroundSure's quotations or proposals are valid for a period of 30 days only unless an alternative period of time is explicitly stipulated by GroundSure. GroundSure reserves the right to withdraw any quotation or proposal at any time before an Order is accepted by GroundSure. GroundSure's acceptance of an Order

shall be binding only when made in writing and signed by GroundSure's authorised representative or when accepted through the Order Website.

3 The Client's obligations

3.1 The Client shall comply with the terms of this Contract and

(i) procure that the Beneficiary or any third party relying on the Services complies with and acts as if it is bound by the Contract and

(ii) be liable to GroundSure for the acts and omissions of the Beneficiary or any third party relying on the Services as if such acts and omissions were those of the Client.

3.2 The Client shall be solely responsible for ensuring that the Services are appropriate and suitable for its and/or the Beneficiary's needs.

3.3 The Client shall supply to GroundSure as soon as practicable and without charge all requisite information (and the Client warrants that such information is accurate, complete and appropriate), including without limitation any environmental information relating to the Site and shall give such assistance as GroundSure shall reasonably require in the provision of the Services including, without limitation, access to the Site, facilities and equipment.

3.4 Where the Client's approval or decision is required to enable GroundSure to carry out work in order to provide the Services, such approval or decision shall be given or procured in reasonable time and so as not to delay or disrupt the performance of the Services.

3.5 Save as expressly permitted by this Contract the Client shall not, and shall procure that the Beneficiary shall not, re-sell, alter, add to, or amend the GroundSure Materials, or use the GroundSure Materials in a manner for which they were not intended. The Client may make the GroundSure Materials available to a third party who is considering acquiring some or all of, or providing funding in relation to, the Site, but such third party cannot rely on the same unless expressly permitted under clause 4.

3.6 The Client is responsible for maintaining the confidentiality of its user name and password if using the Order Website and the Client acknowledges that GroundSure accepts no liability of any kind for any loss or damage suffered by the Client as a consequence of using the Order Website.

4 Reliance

4.1 The Client acknowledges that the Services provided by GroundSure consist of the presentation and analysis of Third Party Content and other content and that information obtained from a Third Party Data Provider cannot be guaranteed or warranted by GroundSure to be reliable.

4.2 In respect of Data Reports, Mapping and Risk Screening Reports, the following classes of person and no other are entitled to rely on their contents;

- (i) the Beneficiary,
- (ii) the Beneficiary's professional advisers, (iii) any person providing funding to the Beneficiary in relation to the Site (whether directly or as part of a lending syndicate),
- (iv) the first purchaser or first tenant of the Site, and
- (v) the professional advisers and lenders of the first purchaser or tenant of the Site.

4.3 In respect of Support Services, only the Client, Beneficiary and parties expressly named in a Report and no other parties are entitled to rely on its contents.

4.4 Save as set out in clauses 4.2 and 4.3 and unless otherwise expressly agreed in writing, no other person or entity of any kind is entitled to rely on any Services or Report issued or provided by GroundSure. Any party considering such Reports and Services does so at their own risk.

5 Fees and Disbursements

5.1 GroundSure shall charge and the Client shall pay fees at the rate and frequency specified in the written proposal, Order Website or Order acknowledgement form, plus (in the case of Support Services) all proper disbursements incurred by GroundSure. The Client shall in addition pay all value added tax or other tax payable on such fees and disbursements in relation to the provision of the Services (together "Fees").

5.2 The Client shall pay all outstanding Fees to GroundSure in full without deduction, counterclaim or set off within 30 days of the date of GroundSure's invoice or such other period as may be agreed in writing between GroundSure and the Client ("Payment Date"). Interest on late payments will accrue on a daily basis from the Payment Date until the date of payment (whether before or after judgment) at the rate of 8% per annum.

5.3 The Client shall be deemed to have agreed the amount of any invoice unless an objection is made in writing within 28 days of the date of the invoice. As soon as reasonably practicable after being notified of an objection, without prejudice to clause 5.2 a member of GroundSure's management team will contact the Client and the parties shall then use all reasonable endeavours to resolve the dispute within 15 days.

6 Intellectual Property and Confidentiality

6.1 Subject to

- (i) full payment of all relevant Fees and
- (ii) compliance with this Contract, the Client is granted (and is permitted to sub-licence to the Beneficiary) a royalty-free, worldwide, non-assignable and (save to the extent set out in this Contract) non-transferable licence to make use of the GroundSure Materials.

6.2 All Intellectual Property in the GroundSure Materials are and shall remain owned by GroundSure or GroundSure's licensors (including without limitation the Third Party Data Providers) the Client acknowledges, and shall procure acknowledgement by the Beneficiary of, such ownership. Nothing in this Contract purports to transfer or assign any rights to the Client or the Beneficiary in respect of such Intellectual Property.

6.3 Third Party Data Providers may enforce any breach of clauses 6.1 and 6.2 against the Client or Beneficiary.

6.4 The Client shall, and shall procure that any recipients of the GroundSure Materials shall:

- (i) not remove, suppress or modify any trade mark, copyright or other proprietary marking belonging to GroundSure or any third party from the Services;
 - (ii) use the information obtained as part of the Services in respect of the subject Site only, and shall not store or reuse any information obtained as part of the Services provided in respect of adjacent or nearby sites;
 - (iii) not create any product or report which is derived directly or indirectly from the Services (save that those acting in a professional capacity to the Beneficiary may provide advice based upon the Services);
 - (iv) not combine the Services with or incorporate such Services into any other information data or service;
 - (v) not reformat or otherwise change (whether by modification, addition or enhancement), the Services (save that those acting for the Beneficiary in a professional capacity shall not be in breach of this clause 6.4(v) where such reformatting is in the normal course of providing advice based upon the Services);
 - (vi) where a Report and/or Mapping contains material belonging to Ordnance Survey, acknowledge and agree that such content is protected by Crown Copyright and shall not use such content for any purpose outside of receiving the Services; and
 - (vii) not copy in whole or in part by any means any map prints or run-on copies containing content belonging to Ordnance Survey (other than that contained within Ordnance Survey's OS Street Map) without first being in possession of a valid Paper Map Copying Licence from Ordnance Survey,
- 6.5 Notwithstanding clause 6.4, the Client may make reasonable use of the GroundSure Materials in order to advise the Beneficiary in a professional capacity. However, GroundSure shall have no liability in respect of any advice, opinion or report given or provided to Beneficiaries by the Client.

6.6 The Client shall procure that any person to whom the Services are made available shall notify GroundSure of any request or requirement to disclose, publish or disseminate any information contained in the Services in accordance with the Freedom of Information Act 2000, the Environmental Information Regulations 2004 or any associated legislation or regulations in force from time to time.

7. Liability: Particular Attention Should Be Paid To This Clause

7.1 This Clause 7 sets out the entire liability of GroundSure, including any liability for the acts or omissions of its employees, agents, consultants, subcontractors and Third Party Content, in respect of:

- (i) any breach of contract, including any deliberate breach of the Contract by GroundSure or its employees, agents or subcontractors;
- (ii) any use made of the Reports, Services, Materials or any part of them; and
- (iii) any representation, statement or tortious act or omission (including negligence) arising under or in connection with the Contract.

7.2 All warranties, conditions and other terms implied by statute or common law are, to the fullest extent permitted by law, excluded from the Contract.

7.3 Nothing in the Contract limits or excludes the liability of the Supplier for death or personal injury resulting from negligence, or for any damage or liability incurred by the Client or Beneficiary as a result of fraud or fraudulent misrepresentation.

7.4 GroundSure shall not be liable for

- (i) loss of profits;
- (ii) loss of business;
- (iii) depletion of goodwill and/or similar losses;
- (iv) loss of anticipated savings;
- (v) loss of goods;
- (vi) loss of contract;
- (vii) loss of use;
- (viii) loss or corruption of data or information;
- (ix) business interruption;
- (x) any kind of special, indirect, consequential or pure economic loss, costs, damages, charges or expenses;
- (xi) loss or damage that arise as a result of the use of all or part of the GroundSure Materials in breach of the Contract;
- (xii) loss or damage arising as a result of any error, omission or inaccuracy in any part of the GroundSure Materials where such error, omission or inaccuracy is caused by any Third Party Content or any reasonable interpretation of Third Party Content;
- (xiii) loss or damage to a computer, software, modem, telephone or other property; and
- (xiv) loss or damage caused by a delay or loss of use of GroundSure's internet ordering service.

7.5 GroundSure's total liability in relation to or under the Contract shall be limited to £10 million for any claim or claims.

7.6 GroundSure shall procure that the Beneficiary shall be bound by limitations and exclusions of liability in favour of GroundSure which accord with those detailed in clauses 7.4 and 7.5 (subject to clause 7.3) in respect of all claims which the Beneficiary may bring against GroundSure in relation to the Services or other matters arising pursuant to the Contract.

8 GroundSure's right to suspend or terminate

8.1 If GroundSure reasonably believes that the Client or Beneficiary has not provided the information or assistance required to enable the proper provision of the Services, GroundSure shall be entitled to suspend all further performance of the Services until such time as any such deficiency has been made good.

8.2 GroundSure shall be entitled to terminate the Contract immediately on written notice in the event that:

- (i) the Client fails to pay any sum due to GroundSure within 30

days of the Payment Date; or

- (ii) the Client (being an individual) has a bankruptcy order made against him or (being a company) shall enter into liquidation whether compulsory or voluntary or have an administration order made against it or if a receiver shall be appointed over the whole or any part of its property assets or undertaking or if the Client is struck off the Register of Companies or dissolved; or
- (iii) the Client being a company is unable to pay its debts within the meaning of Section 123 of the Insolvency Act 1986 or being an individual appears unable to pay his debts within the meaning of Section 268 of the Insolvency Act 1986 or if the Client shall enter into a composition or arrangement with the Client's creditors or shall suffer distress or execution to be levied on his goods; or
- (iv) the Client or the Beneficiary breaches any term of the Contract (including, but not limited to, the obligations in clause 4) which is incapable of remedy or if remediable, is not remedied within five days of notice of the breach.

9. Client's Right to Terminate and Suspend

9.1 Subject to clause 10.1, the Client may at any time upon written notice terminate or suspend the provision of all or any of the Services.

9.2 In any event, where the Client is a consumer (and not a business) he/she hereby expressly acknowledges and agrees that:

- (i) the supply of Services under this Contract (and therefore the performance of this Contract) commences immediately upon GroundSure's acceptance of the Order; and
- (ii) the Reports and/or Mapping provided under this Contract are
 - (a) supplied to the Client's specification(s) and in any event
 - (b) by their nature cannot be returned.

10 Consequences of Withdrawal, Termination or Suspension

10.1 Upon termination of the Contract:

- (i) GroundSure shall take steps to bring to an end the Services in an orderly manner, vacate any Site with all reasonable speed and shall deliver to the Client and/or Beneficiary any property of the Client and/or Beneficiary in GroundSure's possession or control; and
- (ii) the Client shall pay to GroundSure all and any Fees payable in respect of the performance of the Services up to the date of termination or suspension. In respect of any Support Services provided, the Client shall also pay GroundSure any additional costs incurred in relation to the termination or suspension of the Contract.

11 Anti-Bribery

11.1 The Client warrants that it shall:

- (i) comply with all applicable laws, statutes and regulations relating to anti-bribery and anti-corruption including but not limited to the Bribery Act 2010;
- (ii) comply with such of GroundSure's anti-bribery and anti-corruption policies as are notified to the Client from time to time; and
- (iii) promptly report to GroundSure any request or demand for any undue financial or other advantage of any kind received by or on behalf of the Client in connection with the performance of this Contract.

11.2 Breach of this Clause 11 shall be deemed a material breach of this Contract.

12 General

12.1 The Mapping contained in the Services is protected by Crown copyright and must not be used for any purpose other than as part of the Services or as specifically provided in the Contract.

12.2 The Client shall be permitted to make one copy only of each Report or Mapping Order. Thereafter the Client shall be entitled to make unlimited copies of the Report or Mapping Order only in accordance with an Ordnance Survey paper map copy license available through GroundSure.

12.3 GroundSure reserves the right to amend or vary this Contract. No amendment or variation to this Contract shall be valid unless signed by an authorised representative of GroundSure.

12.4 No failure on the part of GroundSure to exercise, and no delay in exercising, any right, power or provision under this Contract shall operate as a waiver thereof.

12.5 Save as expressly provided in this Contract, no person other than the persons set out therein shall have any right under the Contract (Rights of Third Parties) Act 1999 to enforce any terms of the Contract.

12.6 The Secretary of State for Business, Innovation and Skills ("BIS") or BIS' successor body, as the case may be, acting through Ordnance Survey may enforce a breach of clause 6.4(vi) and clause 6.4(vii) of these terms and conditions against the Client in accordance with the provisions of the Contracts (Rights of Third Parties) Act 1999.

12.7 GroundSure shall not be liable to the Client if the provision of the Services is delayed or prevented by one or more of the following circumstances:

- (i) the Client or Beneficiary's failure to provide facilities, access or information;
- (ii) fire, storm, flood, tempest or epidemic;
- (iii) Acts of God or the public enemy;
- (iv) riot, civil commotion or war;
- (v) strikes, labour disputes or industrial action;
- (vi) acts or regulations of any governmental or other agency;
- (vii) suspension or delay of services at public registries by Third Party Data Providers;
- (viii) changes in law; or
- (ix) any other reason beyond GroundSure's reasonable control.

In the event that GroundSure is prevented from performing the Services (or any part thereof) in accordance with this clause 12.6 for a period of not less than 30 days then GroundSure shall be entitled to terminate this Contract immediately on written notice to the Client.

12.8 Any notice provided shall be in writing and shall be deemed to be properly

given if delivered by hand or sent by first class post, facsimile or by email to the address, facsimile number or email address of the relevant party as may have been notified by each party to the other for such purpose or in the absence of such notification the last known address.

12.9 Such notice shall be deemed to have been received on the day of delivery if delivered by hand, facsimile or email (save to the extent such day is not a working day where it shall be deemed to have been delivered on the next working day) and on the second working day after the day of posting if sent by first class post.

12.10 The Contract constitutes the entire agreement between the parties and shall supersede all previous arrangements between the parties relating to the subject matter hereof.

12.11 Each of the provisions of the Contract is severable and distinct from the others and if one or more provisions is or should become invalid, illegal or unenforceable, the validity and enforceability of the remaining provisions shall not in any way be tainted or impaired.

12.12 This Contract shall be governed by and construed in accordance with English law and any proceedings arising out of or connected with this Contract shall be subject to the exclusive jurisdiction of the English courts.

12.13 GroundSure is an executive member of the Council of Property Search Organisation (CoPSO) and has signed up to the Search Code administered by the Property Codes Compliance Board (PCCB). All Risk Screening Reports shall be supplied in accordance with the provisions of the Search Code.

12.14 If the Client or Beneficiary has a complaint about the Services, written notice should be given to the Compliance Officer at GroundSure who will respond in a timely manner.

12.15 The Client agrees that it shall, and shall procure that each Beneficiary shall, treat in confidence all Confidential Information and shall not, and shall procure that each Beneficiary shall not (i) disclose any Confidential Information to any third party other than in accordance with the terms of this Contract; and (ii) use Confidential Information for a purpose other than the exercise of its rights and obligations under this Contract. Subject to clause 6.6, nothing shall prevent the Client or any Beneficiary from disclosing Confidential Information to the extent required by law

Tier Environmental

Elm House Farm, Saighton Lane Saighton,
Saighton, CH3 6EN

GroundSure
Reference:

HMD-341-1633271

Your Reference: PE00362

Report Date 27 Aug 2014

Report Delivery Method: Email - pdf

GroundSure EnviroInsight

Address: LAND OFF NEW ROAD, RHOSROBIN, WREXHAM,

Dear Sir/ Madam,

Thank you for placing your order with GroundSure. Please find enclosed the **GroundSure Enviroinsight** as requested.

If you need any further assistance, please do not hesitate to contact our helpline on 08444 159000 quoting the above GroundSure reference number.

Yours faithfully,



Managing Director
Groundsure Limited

Enc.
GroundSure EnviroInsight



GroundSure EnvirolInsight

Address: LAND OFF NEW ROAD, RHOSROBIN, WREXHAM,

Date: 27 Aug 2014

Reference: HMD-341-1633271

Client: Tier Environmental

NW

N

NE

W

E



SW

S

SE

Aerial Photograph Capture date: 11-May-2009
Grid Reference: 333268,352799
Site Size: 15.87ha

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Overview of Findings

For further details on each dataset, please refer to each individual section in the main report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Section 1: Environmental Permits, Incidents and Registers		On-site	0-50m	51-250	251-500		
1.1 Industrial Sites Holding Environmental Permits and/or Authorisations							
1.1.1	Records of historic IPC Authorisations	0	0	0	0		
1.1.2	Records of Part A(1) and IPPC Authorised Activities	0	0	0	0		
1.1.3	Records of Water Industry Referrals (potentially harmful discharges to the public sewer)	0	0	0	0		
1.1.4	Records of Red List Discharge Consents (potentially harmful discharges to controlled waters)	0	0	0	0		
1.1.5	Records of List 1 Dangerous Substances Inventory sites	0	0	0	0		
1.1.6	Records of List 2 Dangerous Substances Inventory sites	0	0	0	0		
1.1.7	Records of Part A(2) and Part B Activities and Enforcements	0	0	1	0		
1.1.8	Records of Category 3 or 4 Radioactive Substances Authorisations	0	0	0	0		
1.1.9	Records of Licensed Discharge Consents	0	0	3	4		
1.1.10	Records of Planning Hazardous Substance Consents and Enforcements	0	0	0	1		
1.2	Records of COMAH and NIHHS sites	0	0	0	1		
1.3 Environment Agency Recorded Pollution Incidents							
1.3.1	National Incidents Recording System, List 2	0	0	0	0		
1.3.2	National Incidents Recording System, List 1	0	0	0	0		
1.4	Sites Determined as Contaminated Land under Part 2A EPA 1990	0	0	0	0		
Section 2: Landfill and Other Waste Sites		On-site	0-50m	51-250	251-500	501-1000	1000-5000
2.1 Landfill Sites							
2.1.1	Environment Agency Registered Landfill Sites	0	0	0	0	0	Not searched
2.1.2	Environment Agency Historic Landfill Sites	0	0	0	2	1	7
2.1.3	BGS/DoE Landfill Site Survey	0	0	0	0	0	0
2.1.4	GroundSure Local Authority Landfill Sites Data	0	0	0	0	0	0
2.2 Landfill and Other Waste Sites Findings							
2.2.1	Operational and Non-Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	0	Not searched	Not searched
2.2.2	Environment Agency Licensed Waste Sites	0	0	1	0	0	1

Section 3: Current Land Use	On-site	0-50m	51-250	251-500
3.1 Current Industrial Sites Data	0	2	31	Not searched
3.2 Records of Petrol and Fuel Sites	0	0	2	0
3.3 Underground High Pressure Oil and Gas Pipelines	0	0	0	0

Section 4: Geology	
4.1 Are there any records of Artificial Ground and Made Ground present beneath the study site?	Yes
4.2 Are there any records of Superficial Ground and Drift Geology present beneath the study site?	Yes
4.3 For records of Bedrock and Solid Geology beneath the study site see the detailed findings section.	

Section 5: Hydrogeology and Hydrology	0-500m					
5.1 Are there any records of Strata Classification in the Superficial Geology within 500m of the study site?	Yes					
5.2 Are there any records of Strata Classification in the Bedrock Geology within 500m of the study site?	Yes					
	On-site	0-50m	51-250	251-500	501-1000	1000-2000
5.3 Groundwater Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	5
5.4 Surface Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	0
5.5 Potable Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	0
5.6 Source Protection Zones (within 500m of the study site)	0	0	0	0	Not searched	Not searched
5.7 Groundwater Vulnerability and Soil Leaching Potential (within 500m of the study site)	2	0	0	1	Not searched	Not searched
	On-site	0-50m	51-250	251-500	501-1000	1000-1500
5.8 Is there any Environment Agency information on river quality within 1500m of the study site?	No	No	No	No	No	Yes
5.9 Detailed River Network entries within 500m of the site	0	0	1	2	Not searched	Not searched
5.10 Surface water features within 250m of the study site	No	No	Yes	Not searched	Not searched	Not searched

Section 6: Flooding	
6.1 Are there any Environment Agency Zone 2 floodplains within 250m of the study site?	No
6.2 Are there any Environment Agency Zone 3 floodplains within 250m of the study site?	No
6.3 Are there any Flood Defences within 250m of the study site?	No
6.4 Are there any areas benefiting from Flood Defences within 250m of the study site?	No
6.5 Are there any areas used for Flood Storage within 250m of the study site?	No
6.6 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site?	Limited potential
6.7 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas?	High

Section 7: Designated Environmentally Sensitive Sites

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
7.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	1
7.2 Records of National Nature Reserves (NNR)	0	0	0	0	0	0
7.3 Records of Special Areas of Conservation (SAC)	0	0	0	0	0	0
7.4 Records of Special Protection Areas (SPA)	0	0	0	0	0	0
7.5 Records of Ramsar sites	0	0	0	0	0	0
7.6 Records of Ancient Woodlands	0	0	1	1	0	2
7.7 Records of Local Nature Reserves (LNR)	0	0	0	0	0	1
7.8 Records of World Heritage Sites	0	0	0	0	0	0
7.9 Records of Environmentally Sensitive Areas	0	0	0	0	0	0
7.10 Records of Areas of Outstanding Natural Beauty (AONB)	0	0	0	0	0	0
7.11 Records of National Parks	0	0	0	0	0	0
7.12 Records of Nitrate Sensitive Areas	0	0	0	0	0	0
7.13 Records of Nitrate Vulnerable Zones	0	0	0	0	0	0

Section 8: Natural Hazards

8.1 What is the maximum risk of natural ground subsidence?	Very Low
8.1.1 What is the maximum Shrink-Swell hazard rating identified on the study site?	Very Low
8.1.2 What is the maximum Landslides hazard rating identified on the study site?	Very Low
8.1.3 What is the maximum Soluble Rocks hazard rating identified on the study site?	Negligible
8.1.4 What is the maximum Compressible Ground hazard rating identified on the study site?	Very Low
8.1.5 What is the maximum Collapsible Rocks hazard rating identified on the study site?	Very Low
8.1.6 What is the maximum Running Sand hazard rating identified on the study site?	Very Low

Section 9: Mining

9.1 Are there any coal mining areas within 75m of the study site?	Yes
9.2 What is the risk of subsidence relating to shallow mining within 150m of the study site?	Low
9.3 Are there any brine affected areas within 75m of the study site?	No

Using this report

The following report is designed by Environmental Consultants for Environmental Professionals bringing together the most up-to-date market leading environmental data. This report is provided under and subject to the Terms & Conditions agreed between GroundSure and the Client. The document contains the following sections:

1. Environmental Permits, Incidents and Registers

Provides information on Regulated Industrial Activities and Pollution Incidents as recorded by Regulatory Authorities, and sites determined as Contaminated Land. This search is conducted using radii up to 500m.

2. Landfills and Other Waste Sites

Provides information on landfills and other waste sites that may pose a risk to the study site. This search is conducted using radii up to 1500m.

3. Current Land Uses

Provides information on current land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. These searches are conducted using radii of up to 500m. This includes information on potentially contaminative industrial sites, petrol stations and fuel sites as well as high pressure underground oil and gas pipelines.

4. Geology

Provides information on artificial and superficial deposits and bedrock beneath the study site.

5. Hydrogeology and Hydrology

Provides information on productive strata within the bedrock and superficial geological layers, abstraction licenses, Source Protection Zones (SPZs) and river quality. These searches are conducted using radii of up to 2000m.

6. Flooding

Provides information on surface water flooding, flood defences, flood storage areas and groundwater flood areas. This search is conducted using radii of up to 250m.

7. Designated Environmentally Sensitive Sites

Provides information on the Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites, Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Environmentally Sensitive Areas, Nitrate Sensitive Areas, Nitrate Vulnerable Zones and World Heritage Sites and Scheduled Ancient Woodland. These searches are conducted using radii of up to 2000m.

8. Natural Hazards

Provides information on a range of natural hazards that may pose a risk to the study site. These factors include natural ground subsidence.

9. Mining

Provides information on areas of coal and shallow mining.

10. Contacts

This section of the report provides contact points for statutory bodies and data providers that may be able to provide further information on issues raised within this report. Alternatively, GroundSure provide a free Technical Helpline (08444 159000) for further information and guidance.

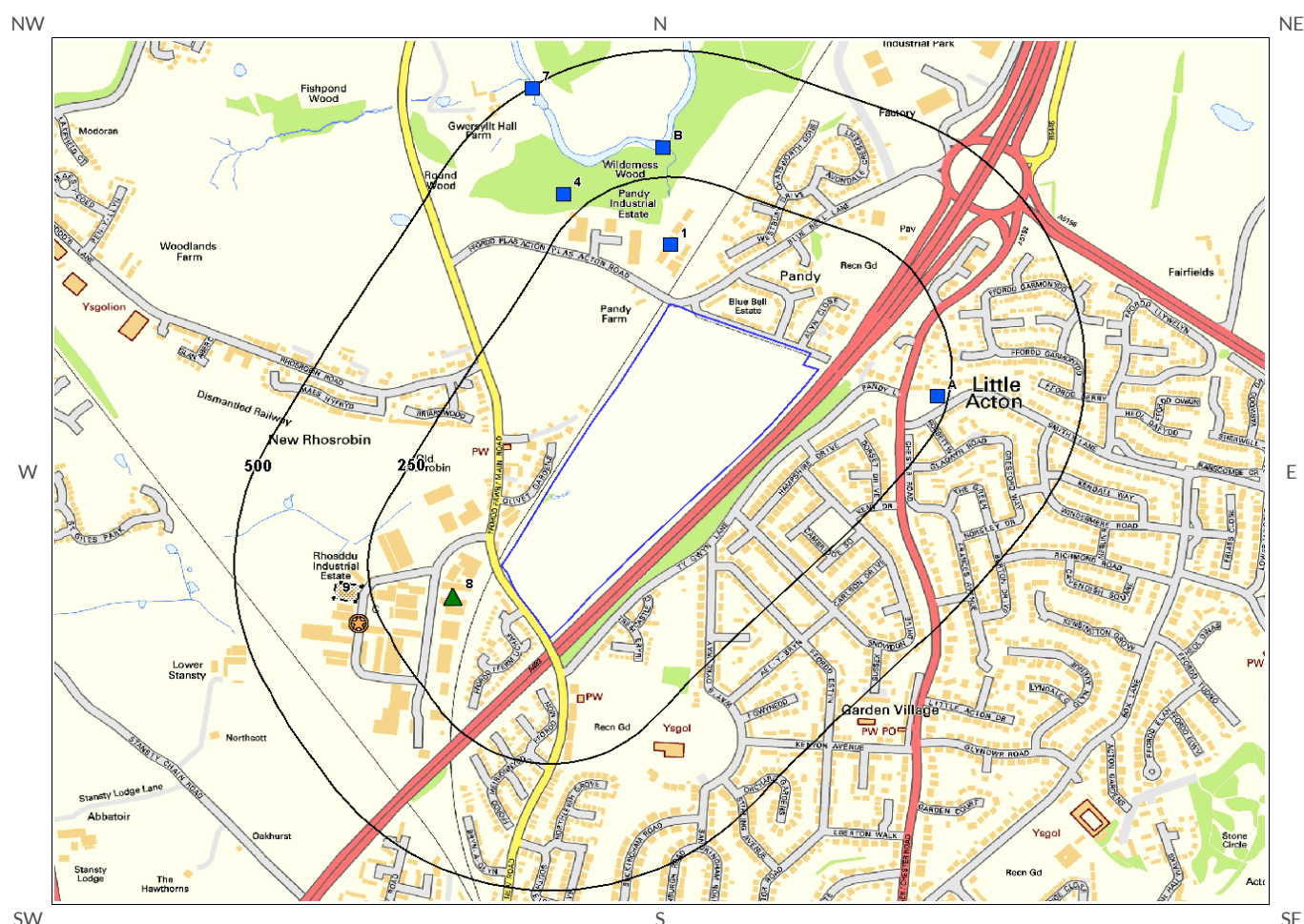
Note: Maps

Only certain features are placed on the maps within the report. All features represented on maps found within this search are given an identification number. This number identifies the feature on the mapping and correlates it to the additional information provided below. This identification number precedes all other information and takes the following format -Id: 1, Id: 2, etc. Where numerous features on the same map are in such close proximity that the numbers would obscure each other a letter identifier is used instead to represent the features. (e.g. Three features which overlap may be given the identifier "A" on the map and would be identified separately as features 1A, 3A, 10A on the data tables provided).

Where a feature is reported in the data tables to a distance greater than the map area, it is noted in the data table as "Not Shown".

All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

1. Environmental Permits, Incidents and Registers Map



Environmental Permits,
Incidents and Registers Legend

Mapping
sourced from
Ordnance Survey

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- | | | |
|--|---|--|
| Site Outline | Recorded Pollution Incident | RAS 3 & 4 Authorisations |
| Dangerous Substances (List 1) | Dangerous Substances (List 2) | Part A(1) Authorised Processes and Historic IPC Authorisations |
| Search Buffers (m)
— 250 —
— 500 — | Part A(2) and Part B Authorised Processes | COMAH / NIHHS Sites |
| Water Industry Referrals | Licenced Discharge Consents | Sites Determined as Contaminated Land |
| Red List Discharge Consents | Hazardous Substance Consents and Enforcements | |



1. Environmental Permits, Incidents and Registers

1.1 Industrial Sites Holding Licences and/or Authorisations

Searches of information provided by the Environment Agency and Local Authorities reveal the following information:

1.1.1 Records of historic IPC Authorisations within 500m of the study site:

0

Database searched and no data found.

1.1.2 Records of Part A(1) and IPPC Authorised Activities within 500m of the study site:

0

Database searched and no data found.

1.1.3 Records of Water Industry Referrals (potentially harmful discharges to the public sewer) within 500m of the study site:

0

Database searched and no data found.

1.1.4 Records of Red List Discharge Consents (potentially harmful discharges to controlled waters) within 500m of the study site:

0

Database searched and no data found.

1.1.5 Records of List 1 Dangerous Substances Inventory Sites within 500m of the study site:

0

Database searched and no data found.

1.1.6 Records of List 2 Dangerous Substance Inventory Sites within 500m of the study site:

0

Database searched and no data found.

1.1.7 Records of Part A(2) and Part B Activities and Enforcements within 500m of the study site:

1

The following Part A(2) and Part B Activities are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance	Direction	NGR	Details
8	112.0	SW	332893 352502	Address: CEMEX, Rhosddu Industrial Estate, Rhosddu, Wrexham, LL11 4YL Process: Mineral Process Status: Current Permit Permit Type: Part B Enforcement: No Enforcement Notified. Date of Enforcement: No Enforcement Notified. Comment: No Enforcement Notified.

1.1.8 Records of Category 3 or 4 Radioactive Substances Authorisations:

0

Database searched and no data found.

1.1.9 Records of Licensed Discharge Consents within 500m of the study site:

7

The following Licensed Discharge Consents records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance	Direction	NGR	Details
1	116.0	N	333300 353200	Address: Pandy Pumping Station, Pandy Industrial Estate, Pandy, Wrexham, LL11 2UD Effluent Type: Unspecified Permit Number: CM0176801 Permit Version: 1 Receiving Water: Alyn Status: New Consent, By Application (wra 91, Section 88) Issue date: - Effective Date: - Revocation Date: 30/3/2005
2A	229.0	E	333800 352900	Address: Acton Ps, Acton Ps, LL12 8AQ Effluent Type: Sewage Discharges - Pumping Station - Water Company Permit Number: CM0194001 Permit Version: 2 Receiving Water: Pond Adj Status: Varied Under Epr 2010 Issue date: 8/9/2010 Effective Date: 8/9/2010 Revocation Date: -
3A	229.0	E	333800 352900	Address: Acton Ps, Acton Ps, LL12 8AQ Effluent Type: Sewage Discharges - Pumping Station - Water Company Permit Number: CM0194001 Permit Version: 1 Receiving Water: Pond Adj Status: New Consent, By Application (wra 91, Section 88) Issue date: - Effective Date: - Revocation Date: 7/9/2010

ID	Distance	Direction	NGR	Details	
4	294.0	NW	333100 353300	Address: Wilderness Stw, Wilderness Stw Effluent Type: Unspecified Permit Number: CM0005801 Permit Version: 1	Receiving Water: Alyn Status: Consent Expired - Time Limit Issue date: 14/2/1958 Effective Date: 14/2/1958 Revocation Date: 28/3/1995
5B	308.0	N	333286 353392	Address: Pandy Pumping Station, Pandy Industrial Estate, Pandy, Wrexham, LL11 2UD Effluent Type: Sewage Discharges - Sewer Storm Overflow - Water Company Permit Number: CM0176801 Permit Version: 2	Receiving Water: River Alyn Status: Varied By Application - (wra 91 Sched 10 - As Amended By Env Act 1995) Issue date: - Effective Date: 31/3/2005 Revocation Date: -
6B	308.0	N	333286 353392	Address: Pandy Pumping Station, Pandy Industrial Estate, Pandy, Wrexham, LL11 2UD Effluent Type: Miscellaneous Discharges - Emergency Discharges Permit Number: CM0176801 Permit Version: 2	Receiving Water: River Alyn Status: Varied By Application - (wra 91 Sched 10 - As Amended By Env Act 1995) Issue date: - Effective Date: 31/3/2005 Revocation Date: -
7	497.0	NW	333042 353509	Address: Gwersyllt Hall Lodge, Llay New Road, Bradley, Wrexham, Clwyd, LL11 4BG Effluent Type: Sewage Discharges - Final/treated Effluent - Not Water Company Permit Number: NPSWQD003972 Permit Version: 1	Receiving Water: Un-named Trib Of River Alyn Status: New Consent (wra 91, S88 & Sched 10 As Amended By Env Act 1995) Issue date: - Effective Date: - Revocation Date: -

1.1.10 Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site:

1

The following records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance	Direction	Application Reference Number	NGR	Application Status	Application Date	Address	Details	Details of Enforcement Action
11C	293.0	SW	6/0002/0881	332716 352451	Approved	16/11/1992	A.A. Butler & Co (Wrexham) Ltd, The Calor Shop, Rhosddu Industrial Estate, Gwersyllt, Wrexham, Clwyd, LL11 4AF	Deemed Hazardous Substance Consent	Enforcement: No Enforcement Notified. Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified

1.2 Dangerous or Hazardous Sites

Records of COMAH & NIHHS sites within 500m of the study site:

1

The following COMAH & NIHHS Authorisation records provided by the Health and Safety Executive are represented as polygons or buffered points on the Environmental Permits, Incidents and Registers Map:

ID	Distance	Direction	Company	Address	Operational Status	Tier
9	265.0	W	A A Butler & Co (wrexham) Ltd	A A Butler And Co (wrexham) Ltd, Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4yl	Historical NIHHS Site	-

1.3 Environment Agency Recorded Pollution Incidents

1.3.1 Records of National Incidents Recording System, List 2 within 500m of the study site:

0

Database searched and no data found.

1.3.2 Records of National Incidents Recording System, List 1 within 500m of the study site:

0

Database searched and no data found.

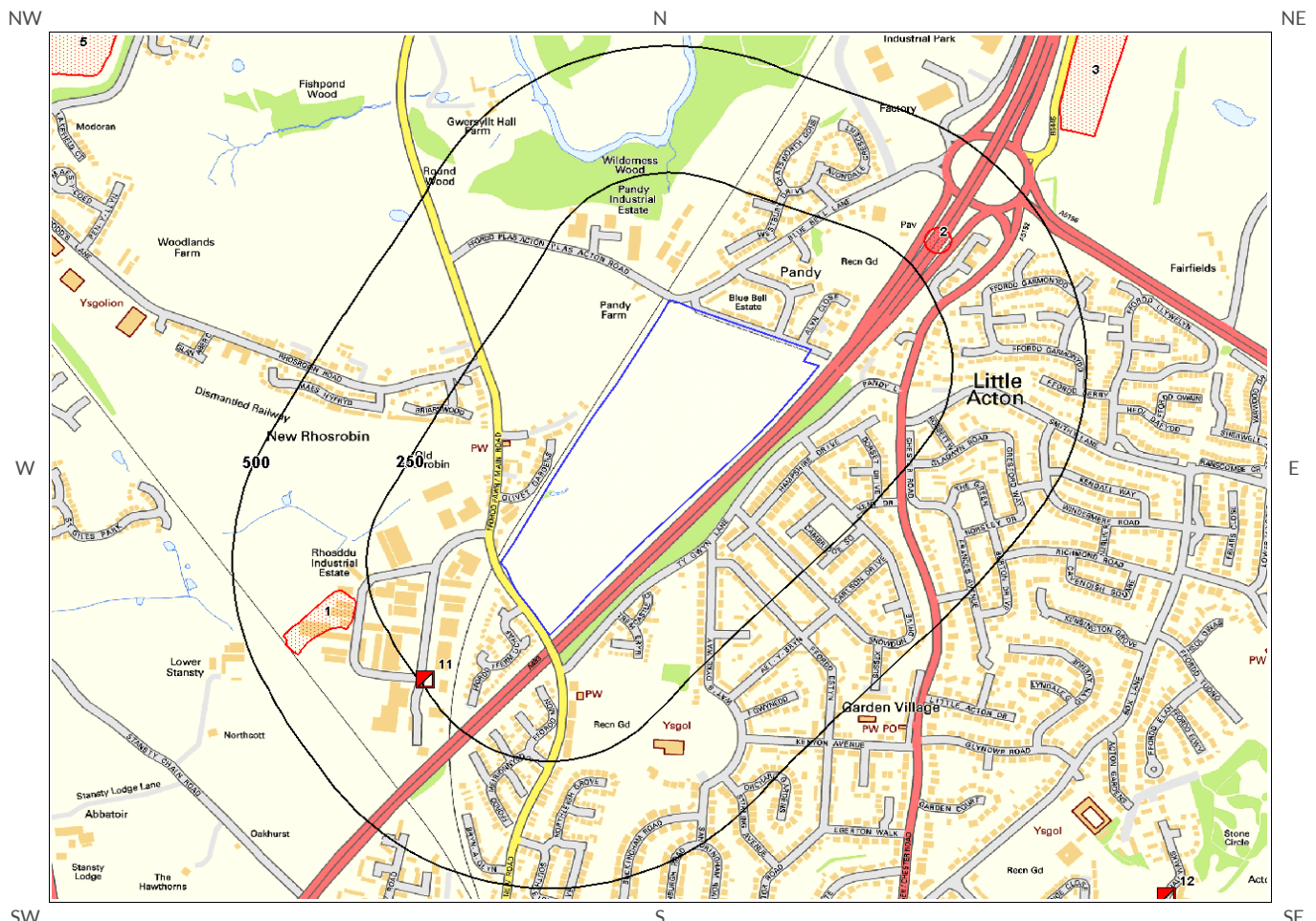
1.4 Sites Determined as Contaminated Land under Part 2A EPA 1990

How many records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990 are there within 500m of the study site?

0

Database searched and no data found.

2. Landfill and Other Waste Sites Map



Landfill and Other Waste Sites Legend



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- | | | | | | |
|---|--------------------------|---|--------------------------|---|----------------------------------|
|  | Site Outline |  | E.A. Active Landfill |  | Historic and Planned Waste Sites |
|  | E.A. Historic Landfill |  | E.A. Licensed Waste Site |  | BGS / DoE Survey Landfill |
|  | Local Authority Landfill | | | | |
|  | Search Buffers (m) | | | | |
|  | | | | | |



2. Landfill and Other Waste Sites

2.1 Landfill Sites

2.1.1 Records from Environment Agency landfill data within 1000m of the study site:

0

Database searched and no data found.

2.1.2 Records of Environment Agency historic landfill sites within 1500m of the study site:

10

The following landfill records are represented as either points or polygons on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Details
1	280.0	W	332600 352400	Site Address: Holmes Plant Hire, Rhosddu Waste Licence: Yes Site Reference: - Waste Type: Industrial Environmental Permitting Regulations (Waste) Reference: - Licence Issue: Licence Surrendered: Licence Hold Address: - Operator: -
2	294.0	NE	333800 353200	Site Address: Pandy Industrial Estate, Pandy Industrial Estate, Pandy Waste Licence: - Site Reference: - Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: - Licence Issue: Licence Surrendered: Licence Hold Address: - Operator: -
3	636.0	NE	334100 353700	Site Address: Chester Road, Gresford Waste Licence: Yes Site Reference: WMBC L/45 Waste Type: Inert, Industrial Environmental Permitting Regulations (Waste) Reference: - Licence Issue: 02-Jul-1987 Licence Surrendered: 31-Dec-1987 Licence Hold Address: Hooton, South Wirral, Cheshire Operator: -
Not shown	1055.0	NE	334200 354100	Site Address: Pont-Y-Capel Lane, Gresford, Wrexham, Clwyd Waste Licence: Yes Site Reference: - Waste Type: Industrial, Household, Environmental Permitting Regulations (Waste) Reference: - Licence Issue: 02-Jul-1987 Licence Surrendered: Licence Hold Address: Hooton, South Wirral, Cheshire Operator: -
5	1142.0	NW	332100 353700	Site Address: The Wauns, Gwersyllt, Cardiff Waste Licence: Yes Site Reference: - Waste Type: Inert, Industrial, Commercial, Household, Special, Environmental Permitting Regulations (Waste) Reference: - Licence Issue: Licence Surrendered: Licence Hold Address: - Operator: -

ID	Distance (m)	Direction	NGR	Details
Not shown	1286.0	W	331600 352400	Site Address: Stansty Gardens, Mold Road, Wrexham, Summerhill Waste Licence: Yes Site Reference: WMBC L/41 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: - Licence Issue: 28-Jul-1983 Licence Surrendered: Licence Hold Address: - Operator: -
Not shown	1295.0	N	333000 354500	Site Address: New Road, Llay Waste Licence: Yes Site Reference: - Waste Type: Industrial, Commercial, Household, Environmental Permitting Regulations (Waste) Reference: - Licence Issue: 24-Feb-1988 Licence Surrendered: Licence Hold Address: - Operator: -
Not shown	1337.0	NW	332000 354400	Site Address: Gwersyllt Park, Wrexham Waste Licence: Yes Site Reference: - Waste Type: Inert, Industrial, Commercial, Household, Special, Environmental Permitting Regulations (Waste) Reference: - Licence Issue: Licence Surrendered: Licence Hold Address: - Operator: -
Not shown	1388.0	W	331500 352300	Site Address: Rosenheath, Highfield, Wrexham, Stansty Waste Licence: Yes Site Reference: WMBC L/37 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: - Licence Issue: 08-Aug-1984 Licence Surrendered: Licence Hold Address: - Operator: -
Not shown	1486.0	NW	332600 354400	Site Address: Gwersyllt Park Quarry, Bradley, Wrexham Waste Licence: Yes Site Reference: WMBC L/18 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: - Licence Issue: 19-Jul-1977 Licence Surrendered: Licence Hold Address: - Operator: -

2.1.3 Records of BGS/DoE non-operational landfill sites within 1500m of the study site:

0

Database searched and no data found.

2.1.4 Records of Local Authority landfill sites within 1500m of the study site:

0

Database searched and no data found.

2.2 Other Waste Sites

2.2.1 Records of waste treatment, transfer or disposal sites within 500m of the study site:

0

Database searched and no data found.

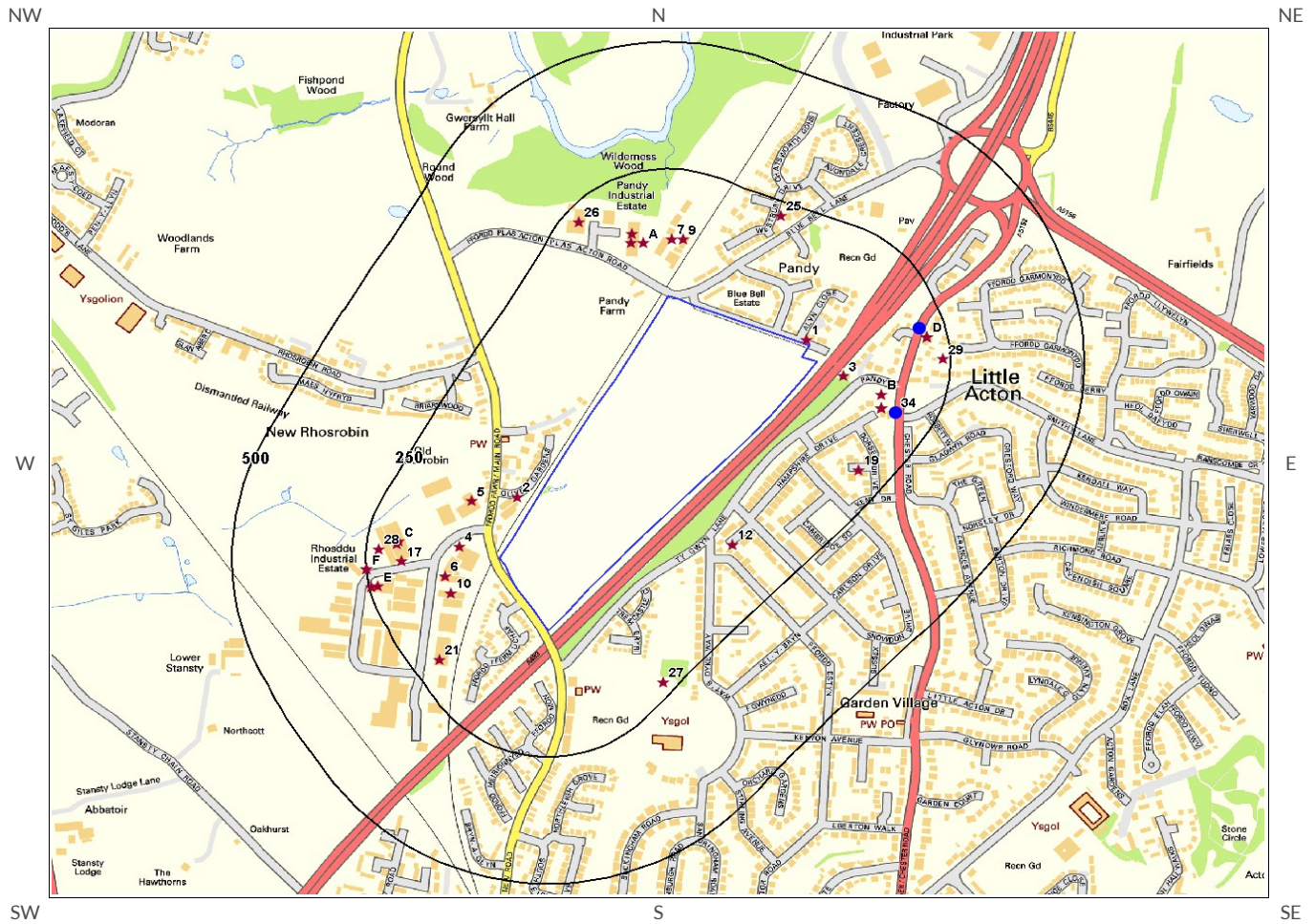
2.2.2 Records of Environment Agency licensed waste sites within 1500m of the study site:

2

The following waste treatment, transfer or disposal sites records are represented as points on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Details
11	242.0	SW	332843 352336	Site Address: T Milner, Rhosddu Ind Est, Rhosddu, Wrexham, Clwyd, LL11 4YL Type: Metal Recycling Site (mixed MRS's) Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: THO002 EPR reference: EA/EPR/EP3194FT/A001 Operator: Thomas Milner & Stephen Milner Waste Management licence No: 37161 Annual Tonnage: 4520.0 Issue Date: 31/03/1999 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: T Milner & Son Correspondence Address: -, -
12	1180.0	SE	334225 351910	Site Address: Herbert Jennings Ave, Acton Park, Wrexham, Clwyd, LL12 0PJ Type: Household, Commercial & Industrial Waste T Stn Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: 3CW007 EPR reference: EA/EPR/MP3994FT/S003 Operator: 3 C Waste Ltd Waste Management licence No: 37041 Annual Tonnage: 255890.0 Issue Date: 01/10/1992 Effective Date: 13/11/2001 Modified: 10/12/2003 Surrendered Date: 26/10/2005 Expiry Date: - Cancelled Date: - Status: Surrendered Site Name: Acton Park Civic Amenity Site Correspondence Address: -, -

3. Current Land Use Map



Current Land Use Legend



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Site Outline



Search Buffers (m)



Current Industrial Sites



Petrol & Fuel Sites



Underground High Pressure Oil & Fuel Pipelines



3. Current Land Uses

3.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site:

33

The following records are represented as points on the Current Land Uses map.

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
1	8.0	N	Electricity Sub Station	333557 352997	LL11	Electrical Features	Infrastructure and Facilities
2	33.0	NW	Depot	333017 352687	LL11	Container and Storage	Transport, Storage and Delivery
3	57.0	SE	Electricity Sub Station	333627 352925	LL11	Electrical Features	Infrastructure and Facilities
4	80.0	W	Enterprise Rent-A-Car	332908 352589	Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4YL	Vehicle Hire and Rental	Hire Services
5	104.0	NW	Wrexham Volkswagon	332931 352678	Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4YL	New Vehicles	Motoring
6	108.0	W	Owen Automotive Ltd	332882 352530	Unit 1 The Sidings, Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4RE	Vehicle Repair, Testing and Servicing	Repair and Servicing
7	111.0	N	Pandy Industrial Estate	333306 353195	LL11	Business Parks and Industrial Estates	Industrial Features
8A	113.0	NW	Electricity Sub Station	333253 353187	LL11	Electrical Features	Infrastructure and Facilities
9	114.0	N	Jolly Good Van Hire	333327 353194	Unit 5 Pandy Business Park, Plas Acton Road, Wrexham, LL11 2UD	Vehicle Hire and Rental	Hire Services
10	115.0	SW	Body Perfect	332892 352497	Unit 5-6 The Sidings, Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4RE	Vehicle Repair, Testing and Servicing	Repair and Servicing
11A	125.0	NW	Wrexham Tool Hire	333230 353187	Unit 5 Plas Acton Industrial Estate, Plas Acton Road, Wrexham, LL11 2UB	Construction and Tool Hire	Hire Services
12	129.0	SE	Electricity Sub Station	333420 352593	LL11	Electrical Features	Infrastructure and Facilities
13B	137.0	SE	Smithy View Service Station	333698 352889	Smithy View Service Station, Chester Road, Wrexham, LL12 8DY	Vehicle Cleaning Services	Personal, Consumer and Other Services
14A	139.0	NW	Stoneacre Ltd	333231 353205	Unit 4 Plas Acton Industrial Estate, Plas Acton Road, Wrexham, LL11 2UB	New Vehicles	Motoring
15B	151.0	SE	Smithy View Service Station	333697 352862	Smithy View Service Station, Chester Road, Wrexham, LL12 8DY	Petrol and Fuel Stations	Road and Rail
16B	151.0	SE	Smithy View Service Station	333697 352862	Smithy View Service Station, Chester Road, Wrexham, LL12 8DY	Petrol and Fuel Stations	Road and Rail

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
17	184.0	W	Electricity Sub Station	332801 352560	LL11	Electrical Features	Infrastructure and Facilities
18C	193.0	W	Soleil Foodservice Ltd	332795 352599	The Grange, Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4YY	Distribution and Haulage	Transport, Storage and Delivery
19	193.0	SE	Electricity Sub Station	333654 352740	LL11	Electrical Features	Infrastructure and Facilities
20C	194.0	W	C E S UK Ltd	332793 352595	Alyn Courts Units 1 2 3 & 4 Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4YL	Vehicle Parts and Accessories	Motoring
21	200.0	SW	Wrexham Tyre Centre Ltd	332872 352366	Unit 3, Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4YL	Vehicle Parts and Accessories	Motoring
22D	211.0	E	Plas Acton Garage	333782 353002	Plas Acton Garage 282, Chester Road, Wrexham, LL12 8DU	Petrol and Fuel Stations	Road and Rail
23D	211.0	E	Derosa Plas Acton Garage	333782 353002	Plas Acton Garage 282, Chester Road, Wrexham, LL12 8DU	Petrol and Fuel Stations	Road and Rail
24D	211.0	E	Plas Acton Garage	333782 353002	Plas Acton Garage 282, Chester Road, Wrexham, LL12 8DU	Vehicle Repair, Testing and Servicing	Repair and Servicing
25	221.0	N	Webstyle Blinds	333508 353240	21, Westbury Drive, Pand, Wrexham, LL12 8PZ	Curtains and Blinds	Consumer Products
26	222.0	NW	Speed Six Citroen Ltd	333131 353229	Plas Acton Road, Wrexham, LL11 2UB	New Vehicles	Motoring
27	226.0	SE	Shaft (Disused)	333290 352322	LL11	Unspecified Quarries Or Mines	Extractive Industries
28	227.0	W	Rhosddu Industrial Estate	332759 352584	LL11	Business Parks and Industrial Estates	Industrial Features
29	235.0	E	Tank	333812 352959	LL12	Tanks (Generic)	Industrial Features
30E	235.0	W	D & G Auto Services	332756 352511	Unit D, Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4YL	Vehicle Repair, Testing and Servicing	Repair and Servicing
31E	247.0	W	Matthews Control Solutions Ltd	332744 352509	Heritage House, Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4YL	Electrical and Electronic Engineers	Engineering Services
32F	250.0	W	MTF Systems Ltd	332736 352544	Unit 1 Meadows View, Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4YL	Beds and Bedding	Consumer Products
33F	250.0	W	Cash 4 Clothes Ltd	332736 352544	3 Meadows View, Rhosddu Industrial Estate, Rhosrobin, Wrexham, LL11 4YL	Rag Merchants	Recycling Services

3.2 Petrol and Fuel Sites

Records of petrol or fuel sites within 500m of the study site:

2

The following petrol or fuel site records provided by Catalist are represented as points on the Current Land Use map:

ID	Distance (m)	Direction	NGR	Company	Address	LPG	Status
34	178.0	SE	333724 352853	Unbranded	Smithy View Service Station, Chester Road, Chester Road, Acton, Wrexham, Clwyd, LL12 8DY	Yes	Open
35D	202.0	E	333768 353019	Uk	Plas Acton Garage, Chester Road, Chester Road, Acton, Wrexham, Clwyd, LL12 8DU	No	Open

3.3 Underground High Pressure Oil and Gas Pipelines

Records of high pressure underground pipelines within 500m of the study site:

0

Database searched and no data found.



4. Geology

4.1 Artificial Ground and Made Ground

The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
MGR-MGRD	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT
MGR-MGRD	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT
MGR-MGRD	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT

4.2 Superficial Ground and Drift Geology

The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
GFSDD-SAGR	GLACIOFLUVIAL SHEET DEPOSITS, DEVENSIAN	SAND AND GRAVEL
TILLD-DMTN	TILL, DEVENSIAN	DIAMICTON
GFDUD-SAGR	GLACIOFLUVIAL DEPOSITS, DEVENSIAN	SAND AND GRAVEL

4.3 Bedrock and Solid Geology

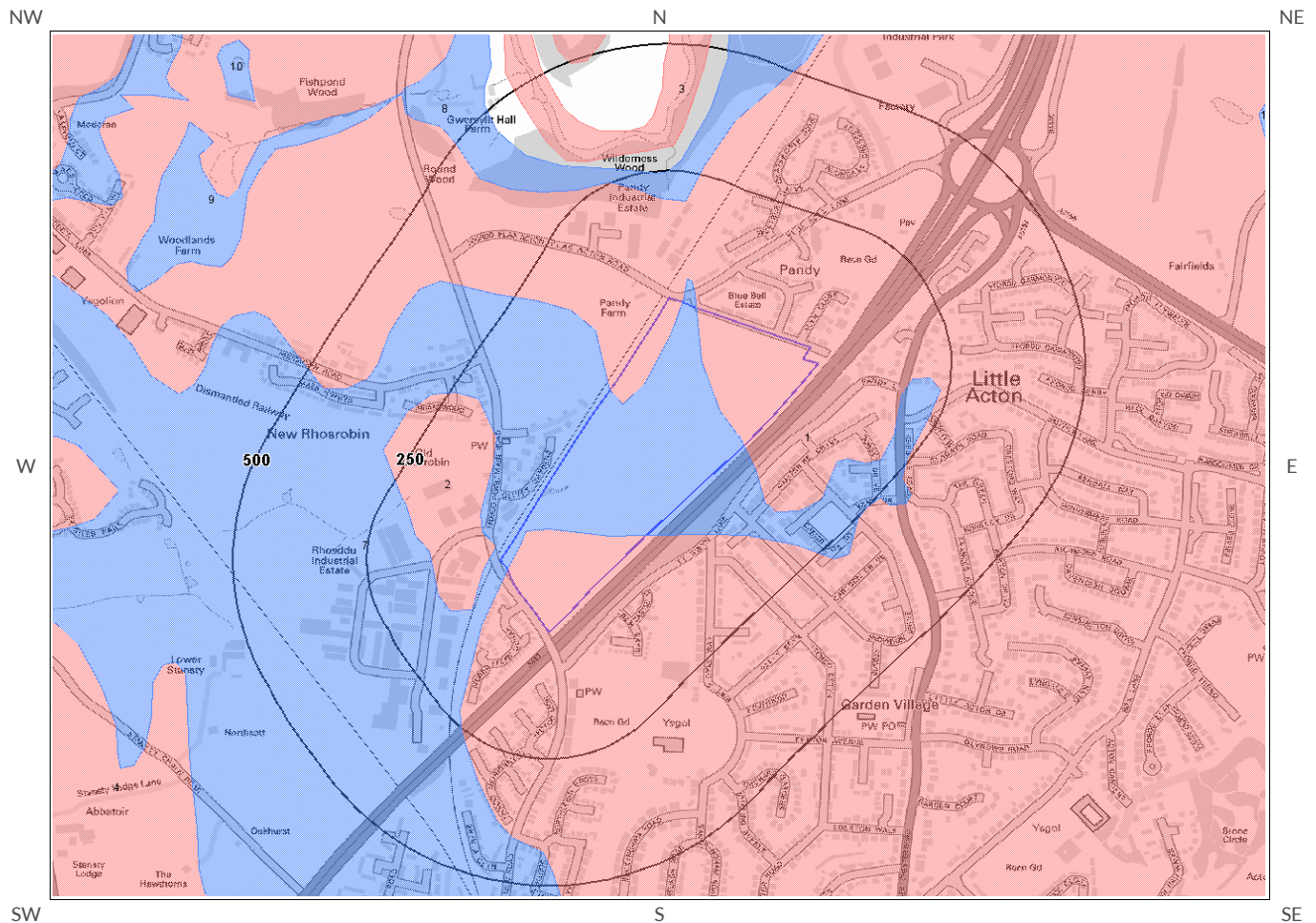
The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
SAL-MDSC	SALOP FORMATION	MUDSTONE, SANDSTONE AND CONGLOMERATE
HA-MDSS	HALESOWEN FORMATION	MUDSTONE, SILTSTONE AND SANDSTONE

(Derived from the BGS 1:50,000 Digital Geological Map of Great Britain)

5. Hydrogeology and Hydrology

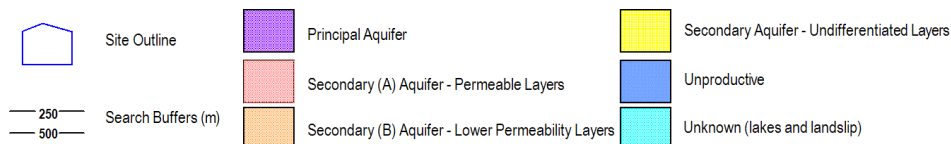
5a. Aquifer Within Superficial Geology



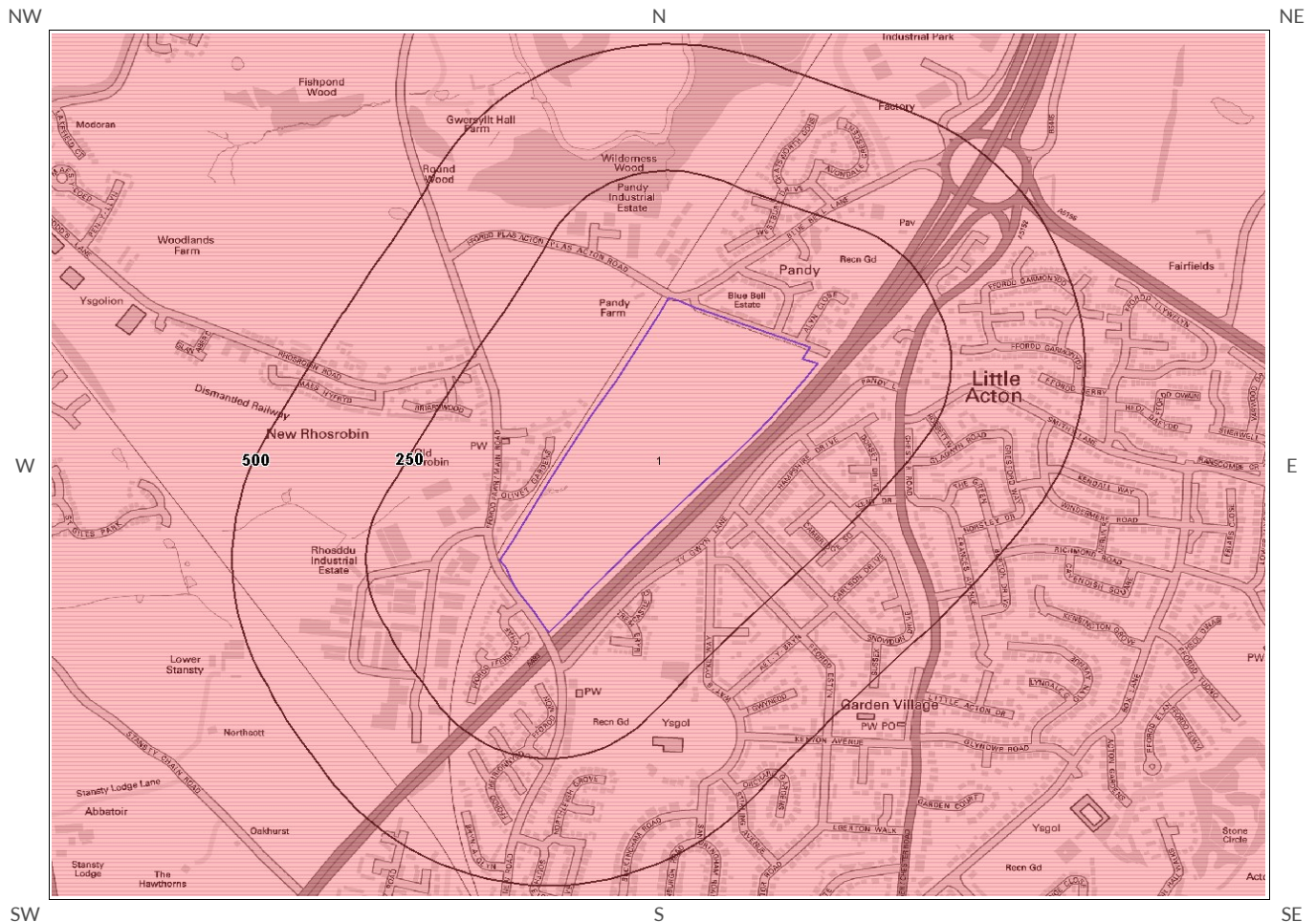
Map Legend

Mapping sourced from **Ordnance Survey**

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5b. Aquifer Within Bedrock Geology and Abstraction Licenses

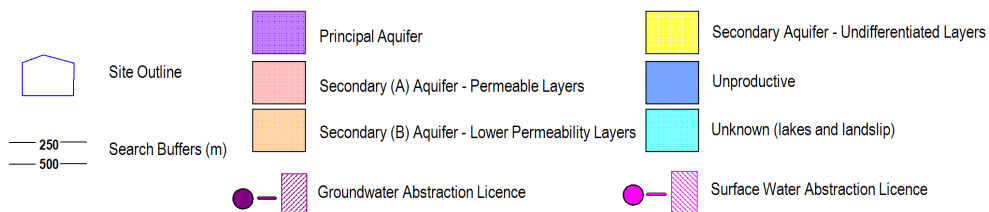


Map Legend

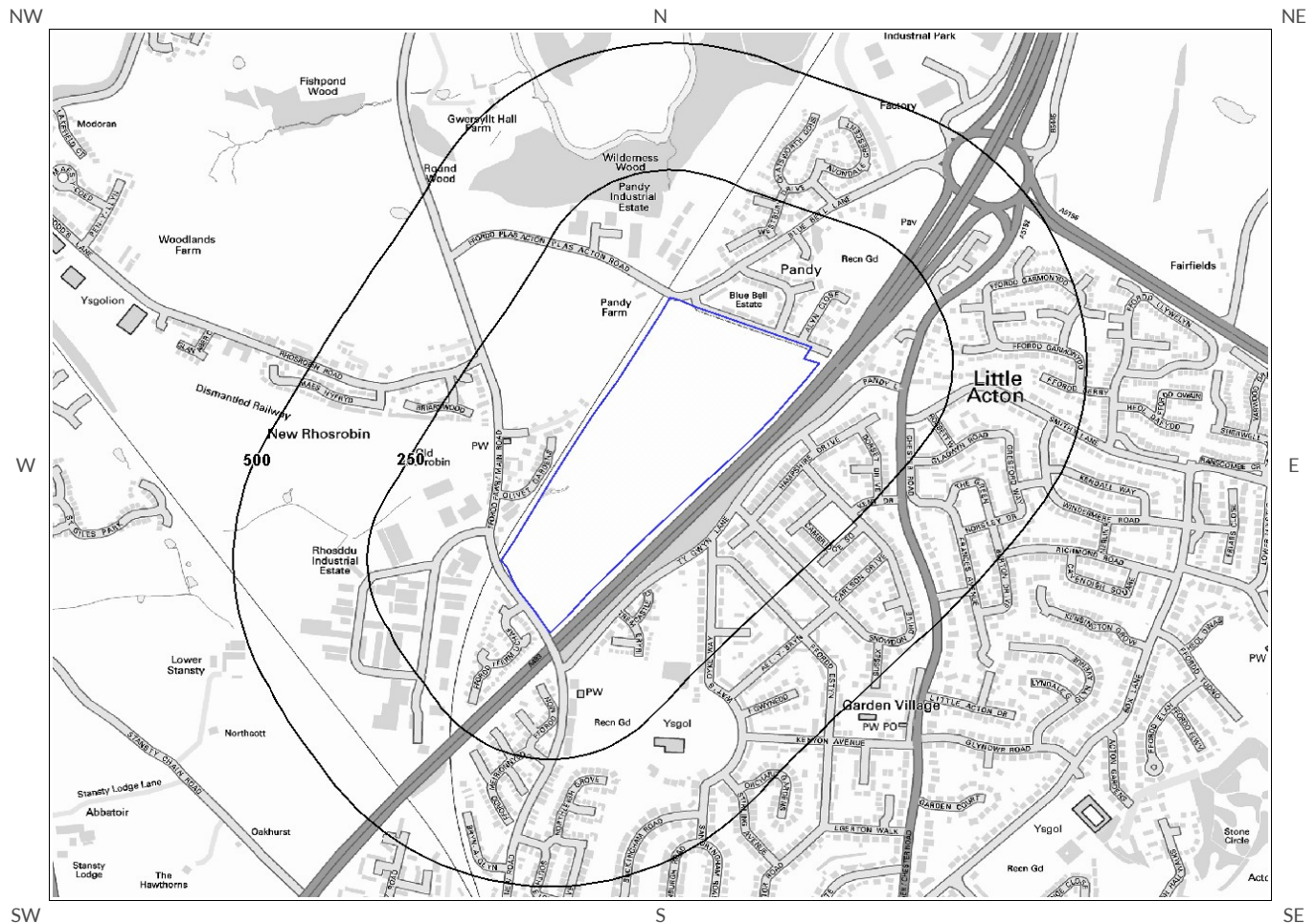
Mapping
sourced from

Ordnance Survey

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5c. Hydrogeology – Source Protection Zones and Potable Water Abstraction Licenses

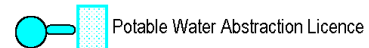


Map Legend

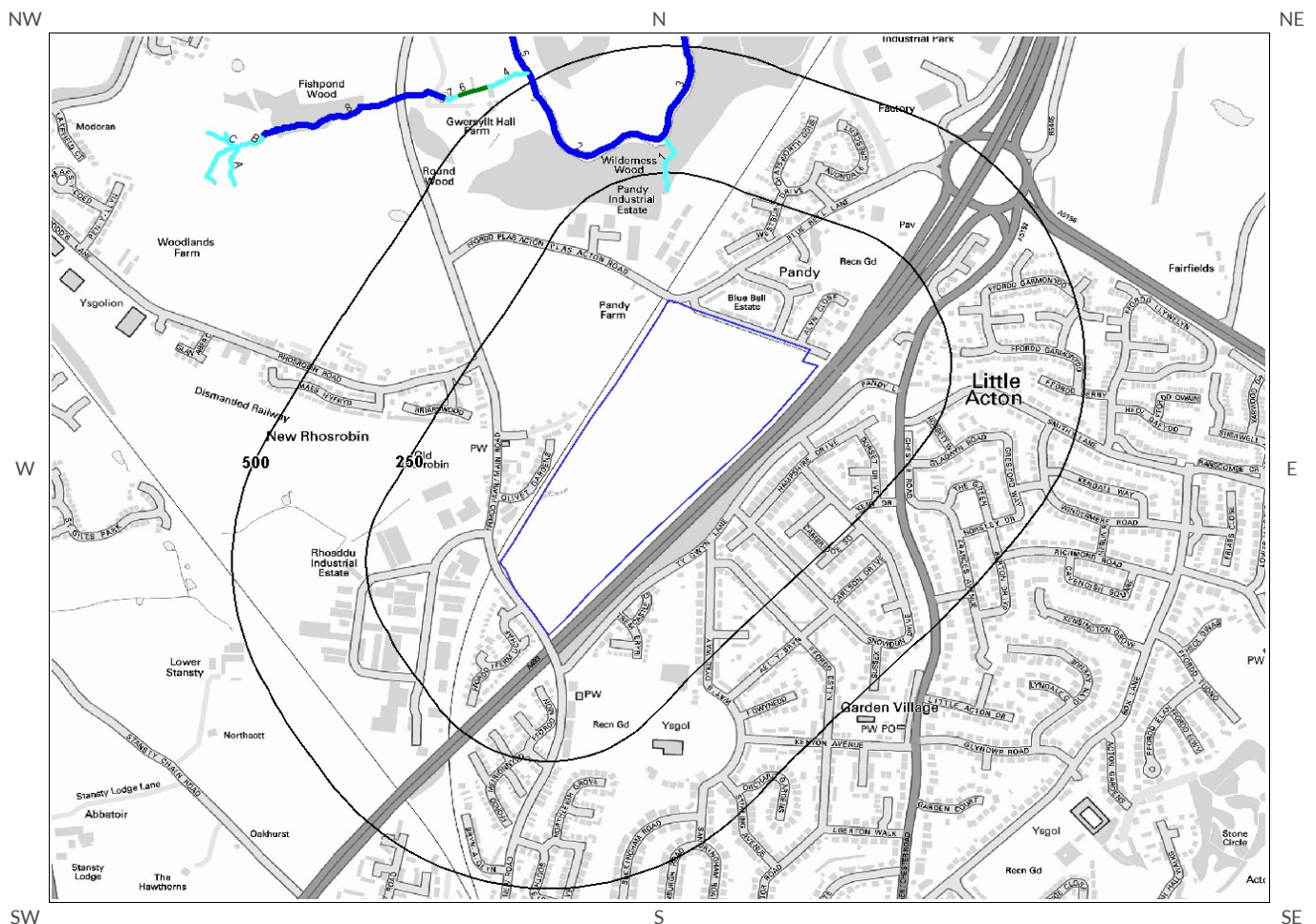


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- Site Outline
- 250 Search Buffers (m)
- 500 Search Buffers (m)
- Source Protection Zone 1 - Inner Catchment
- Source Protection Zone 2 - Outer Catchment
- Source Protection Zone 3 - Total Catchment
- Source Protection Zone 4 - Zone of Special Interest



5d. Hydrology – Detailed River Network and River Quality

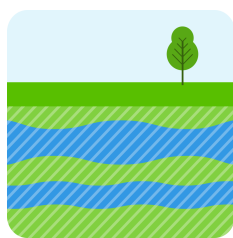


Map Legend



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	Primary River		Canal
	Secondary River		Canal Tunnel
	Tertiary River		Culvert
	Lake/Reservoir		Multiple Channel Culvert
	Underground River (inferred)		Underground River (Potential Sewer)
	General Quality Assessment: Biology		Underground River (local knowledge)
	General Quality Assessment: Chemistry		



5. Hydrogeology and Hydrology

5.1 Aquifer within Superficial Deposits

Are there records of strata classification within the superficial geology at or in proximity to the property? Yes

From 1 April 2010, the Environment Agency's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the GroundSure Enviroinsight User Guide.

The following aquifer records are shown on the Aquifer within Superficial Geology Map (5a):

ID	Distance (m)	Direction	Designation	Description
1	0.0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
7	0.0	On Site	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
2	21.0	NW	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
8	193.0	N	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
3	291.0	N	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers

5.2 Aquifer within Bedrock Deposits

Are there records of strata classification within the bedrock geology at or in proximity to the property? Yes

From 1 April 2010, the Environment Agency's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the GroundSure Enviroinsight User Guide.

The following aquifer records are shown on the Aquifer within Bedrock Geology Map (5b):

ID	Distance (m)	Direction	Designation	Description
1	0.0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers

5.3 Groundwater Abstraction Licences

Are there any Groundwater Abstraction Licences within 2000m of the study site?

Yes

The following Abstraction Licences records are represented as points, lines and regions on the Aquifer within Bedrock Geology Map (5b):

ID	Distance (m)	Direction	NGR	Details
Not shown	1121.0	E	334640 353310	Licence No: 24/67/8/0017 Details: General Farming & Domestic Direct Source: Eaw Groundwater Point: Well 2 Data Type: Point Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: 503 Original Start Date: 9/8/1966 Expiry Date: - Issue No: 100 Version Start Date: 1/4/1995 Version End Date:
Not shown	1143.0	E	334620 353421	Licence No: 24/67/8/0017 Details: General Farming & Domestic Direct Source: Eaw Groundwater Point: Well 1 Data Type: Point Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: 503 Original Start Date: 9/8/1966 Expiry Date: - Issue No: 100 Version Start Date: 1/4/1995 Version End Date:
Not shown	1712.0	S	332600 350780	Licence No: 24/67/7/0012 Details: Process water Direct Source: Eaw Groundwater Point: Well No.1 Data Type: Point Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: 319 Original Start Date: 25/2/1966 Expiry Date: - Issue No: 100 Version Start Date: 4/5/1970 Version End Date:
Not shown	1772.0	S	332630 350710	Licence No: 24/67/7/0012 Details: Process water Direct Source: Eaw Groundwater Point: Well No.3 Data Type: Point Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: 319 Original Start Date: 25/2/1966 Expiry Date: - Issue No: 100 Version Start Date: 4/5/1970 Version End Date:
Not shown	1805.0	S	332610 350681	Licence No: 24/67/7/0012 Details: Process water Direct Source: Eaw Groundwater Point: Well No.2 Data Type: Point Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: 319 Original Start Date: 25/2/1966 Expiry Date: - Issue No: 100 Version Start Date: 4/5/1970 Version End Date:

5.4 Surface Water Abstraction Licences

Are there any Surface Water Abstraction Licences within 2000m of the study site?

No

Database searched and no data found.

5.5 Potable Water Abstraction Licences

Are there any Potable Water Abstraction Licences within 2000m of the study site?

No

Database searched and no data found.

5.6 Source Protection Zones

Are there any Source Protection Zones within 500m of the study site?

No

Database searched and no data found.

5.7 Groundwater Vulnerability and Soil Leaching Potential

Is there any Environment Agency information on groundwater vulnerability and soil leaching potential within 500m of the study site?

Yes

Distance (m)	Direction	Classification	Soil Vulnerability Category	Description
0	On Site	Minor Aquifer/High Leaching Potential	HU	Soil information for urban areas and restored mineral workings. These soils are therefore assumed to be highly permeable in the absence of site-specific information.
0	On Site	Minor Aquifer/High Leaching Potential	H2	Deep, permeable, coarse textured soils which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential.
407	SW	Minor Aquifer/High Leaching Potential	H2	Deep, permeable, coarse textured soils which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential.

5.8 River Quality

Is there any Environment Agency information on river quality within 1500m of the study site?

Yes

5.8.1 Biological Quality:

Database searched and no data found.

5.8.2 Chemical Quality:

Chemical quality data is based on the General Quality Assessment Headline Indicators scheme (GQAH). In England, each chemical sample is measured for ammonia and dissolved oxygen. In Wales, the samples are measured for biological oxygen demand (BOD), ammonia and dissolved oxygen. The results are graded from A ('Very Good') to F ('Bad').

The following Chemical Quality records are shown on the Hydrology Map (5d):

ID	Distance (m)	Direction	NGR	River Quality Grade	Chemical Quality Grade				
					2005	2006	2007	2008	2009
Not shown	1397.0	NW	332560 354270	River Name: Alyn Reach: Gresford - Conf. Cegidog End/Start of Stretch: Sample Point NGR	A	A	B	B	-

5.9 Detailed River Network

Are there any Detailed River Network entries within 500m of the study site? Yes

The following Detailed River Network records are represented on the Hydrology Map (5d):

ID	Distance (m)	Direction	Details	
1	213.0	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
2	316.0	N	River Name: River Alyn Welsh River Name: Afon Alun Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
3	320.0	N	River Name: River Alyn Welsh River Name: Afon Alun Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined

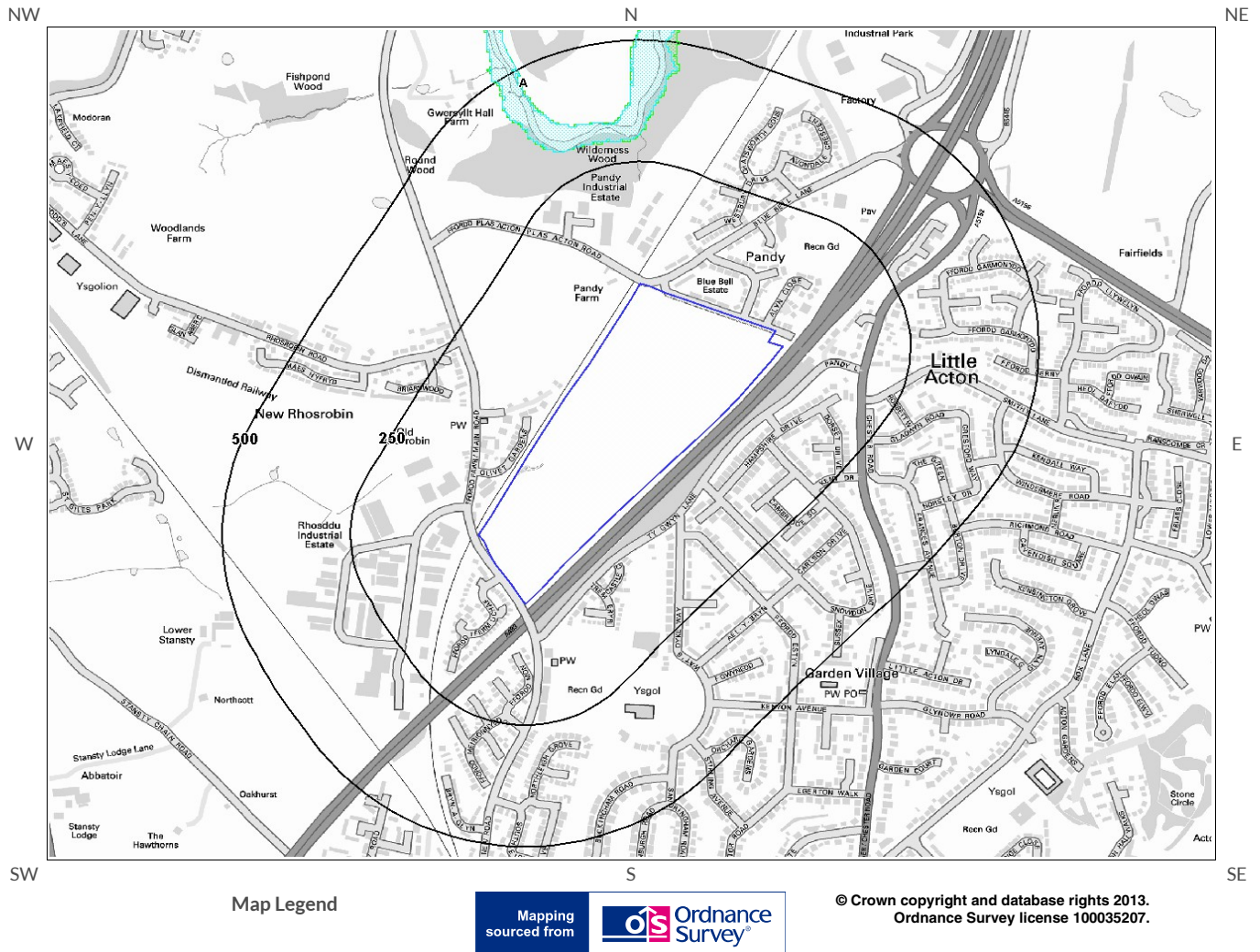
5.10 Surface Water Features

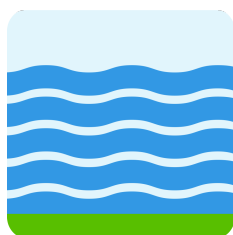
Are there any surface water features within 250m of the study site? Yes

The following surface water records are not represented on mapping:

Distance (m)	Direction
213.0	NW
213.0	N

6. Environment Agency Flood Map for planning (from rivers and the sea)





6. Flooding

6.1 Zone 2 Flooding

Environment Agency Zone 2 floodplains estimate the annual probability of flooding as between 1 in 1000 (0.1%) and 1 in 100 (1%) from rivers and between 1 in 1000 (0.1%) and 1 in 200 (0.5%) from the sea. Any relevant data is represented on Map 1 – Environment Agency Flood Map for Planning:

Is the site within 250m of an Environment Agency Zone 2 floodplain? No

Database searched and no data found.

6.2 Zone 3 Flooding

Zone 3 shows the extent of a river flood with a 1 in 100 (1%) or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year. Any relevant data is represented on Map 1 – Environment Agency Flood Map for Planning.

Is the site within 250m of an Environment Agency Zone 3 floodplain? No

Database searched and no data found.

6.3 Flood Defences

Are there any Flood Defences within 250m of the study site? No

Database searched and no data found.

6.4 Areas benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 250m of the study site? No

6.5 Areas benefiting from Flood Storage

Are there any areas used for Flood Storage within 250m of the study site? No

6.6 Groundwater Flooding Susceptibility Areas

6.6.1 Are there any British Geological Survey groundwater flooding susceptibility areas within 50m of the boundary of the study site?

Yes

Does this relate to Clearwater Flooding or Superficial Deposits Flooding?

Superficial Deposits Flooding

Notes: Groundwater flooding may either be associated with shallow unconsolidated sedimentary aquifers which overlie unproductive aquifers (Superficial Deposits Flooding), or with unconfined aquifers (Clearwater Flooding).

6.6.2 What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions?

Limited potential

Where limited potential for groundwater flooding to occur is indicated, this means that although given the geological conditions there may be a groundwater flooding hazard, unless other relevant information, e.g. records of previous flooding, suggests groundwater flooding has occurred before in this area, you need take no further action in relation to groundwater flooding hazard.

6.7 Groundwater Flooding Confidence Areas

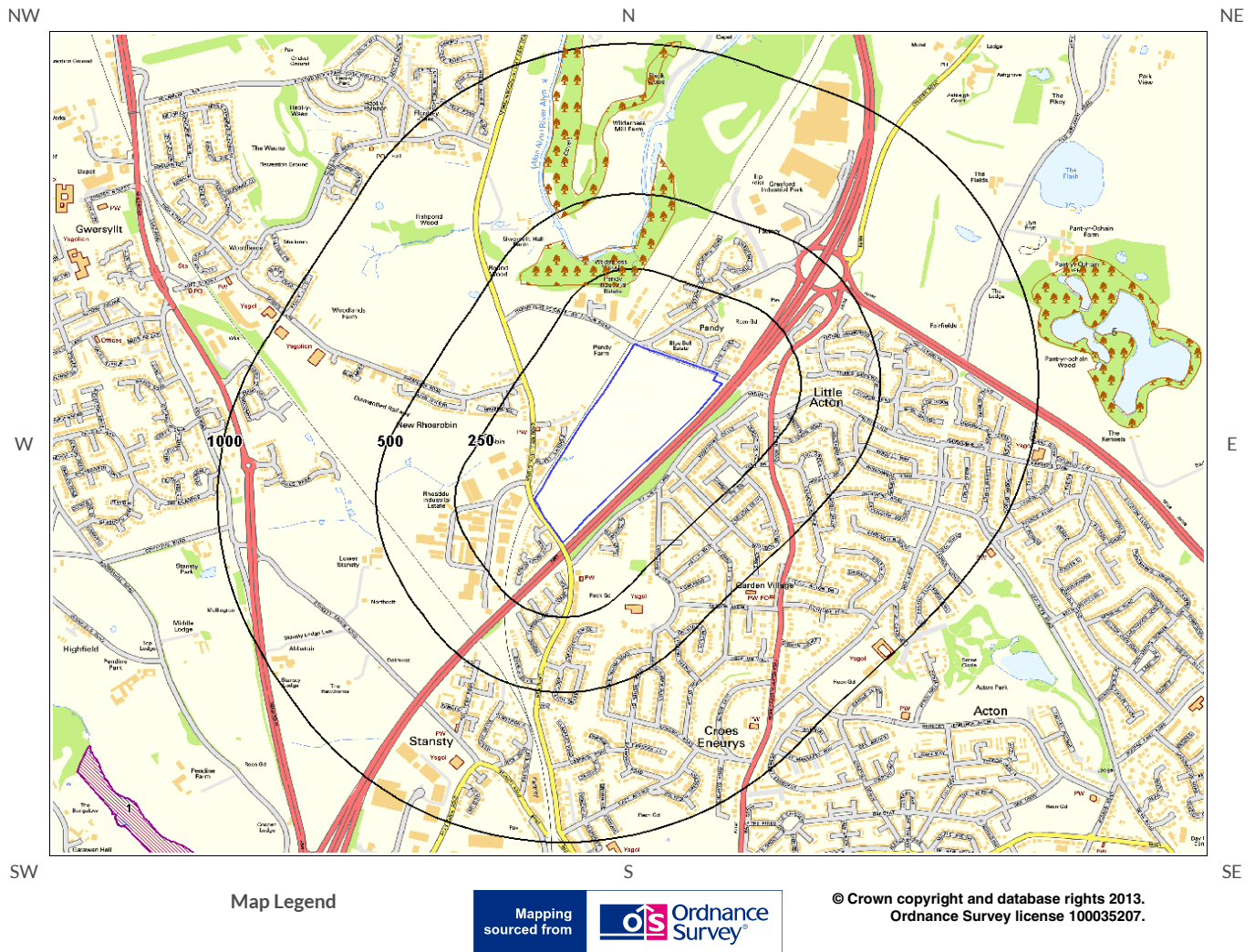
What is the British Geological Survey confidence rating in this result?

High

Notes: Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

The confidence rating is on a threefold scale - Low, Moderate and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.

7. Designated Environmentally Sensitive Sites Map





7. Designated Environmentally Sensitive Sites

Presence of Designated Environmentally Sensitive Sites within 2000m of the study site?

Yes

7.1 Records of Sites of Special Scientific Interest (SSSI) within 2000m of the study site:

1

The following Site of Special Scientific Interest (SSSI) records provided by Natural England/Countryside Council for Wales and Scottish Natural Heritage are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	SSSI Name	Data Source
1	1544.0	SW	Gatewen Marsh	Countryside Council for Wales

7.2 Records of National Nature Reserves (NNR) within 2000m of the study site:

0

Database searched and no data found.

7.3 Records of Special Areas of Conservation (SAC) within 2000m of the study site:

0

Database searched and no data found.

7.4 Records of Special Protection Areas (SPA) within 2000m of the study site:

0

Database searched and no data found.

7.5 Records of Ramsar sites within 2000m of the study site:

0

Database searched and no data found.

7.6 Records of Ancient Woodland within 2000m of the study site:

4

The following Ancient Woodland records are supplied by English Nature/Scottish Natural Heritage/Countryside Council for Wales and are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	Ancient Woodland Name	Data Source
3	194.0	N	WILDERNESS WOOD	Ancient and Semi-Natural Woodland
4	479.0	NW	Unknown	Ancient and Semi-Natural Woodland
5	1014.0	E	PANT-YR-OCHAIN WOOD	Ancient and Semi-Natural Woodland
Not shown	1355.0	N	Unknown	Ancient and Semi-Natural Woodland

7.7 Records of Local Nature Reserves (LNR) within 2000m of the study site:

1

The following Local Nature Reserve (LNR) records provided by Natural England/Countryside Council for Wales and Scottish Natural Heritage are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	LNR Name	Data Source
Not shown	1618.0	N	Alyn Waters	Countryside Council for Wales

7.8 Records of World Heritage Sites within 2000m of the study site:

0

Database searched and no data found.

7.9 Records of Environmentally Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

7.10 Records of Areas of Outstanding Natural Beauty (AONB) within 2000m of the study site:

0

Database searched and no data found.

7.11 Records of National Parks (NP) within 2000m of the study site:

0

Database searched and no data found.

7.12 Records of Nitrate Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

7.13 Records of Nitrate Vulnerable Zones within 2000m of the study site:

0

Database searched and no data found.



8. Natural Hazards Findings

8.1 Detailed BGS GeoSure Data

BGS GeoSure Data has been searched to 50m. The data is included in tabular format. If you require further information on geology and ground stability, please obtain a **GroundSure GeoInsight**, available from [our website](#). The following information has been found:

8.1.1 Shrink Swell

What is the maximum Shrink-Swell** hazard rating identified on the study site?

Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.

8.1.2 Landslides

What is the maximum Landslide* hazard rating identified on the study site?

Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

* This indicates an automatically generated 50m buffer and site.

8.1.3 Soluble Rocks

What is the maximum Soluble Rocks* hazard rating identified on the study site?

Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

8.1.4 Compressible Ground

What is the maximum Compressible Ground* hazard rating identified on the study site?

Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Very low potential for compressible deposits to be present. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

8.1.5 Collapsible Rocks

What is the maximum Collapsible Rocks* hazard rating identified on the study site?

Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

8.1.6 Running Sand

What is the maximum Running Sand** hazard rating identified on the study site?

Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

* This indicates an automatically generated 50m buffer and site.



9. Mining

9.1 Coal Mining

Are there any coal mining areas within 75m of the study site?

Yes

The following coal mining information provided by the Coal Authority is not represented on Mapping:

Distance	Direction	Details
0.0	On Site	The study site is located within the specified search distance of an identified mining area. Further details concerning this can be obtained from the Coal Authority Helpline on 0845 762 6848.

9.2 Shallow Mining

What is the subsidence hazard relating to shallow mining on-site*?

Low

*Please note this data is searched with a 150m buffer.

9.3 Brine Affected Areas

Are there any brine affected areas within 75m of the study site?

No

Guidance: No Guidance Required.

Contact Details

GroundSure Helpline
 Telephone: 08444 159 000
 info@groundsure.com



British Geological Survey Enquiries

Kingsley Dunham Centre
 Keyworth, Nottingham NG12 5GG
 Tel: 0115 936 3143.
 Fax: 0115 936 3276.
 Email: enquiries@bgs.ac.uk
 Web: www.bgs.ac.uk

BGS Geological Hazards Reports and general geological enquiries



Environment Agency

National Customer Contact Centre, PO Box 544
 Rotherham, S60 1BY
 Tel: 08708 506 506
 Web: www.environment-agency.gov.uk
 Email: enquiries@environment-agency.gov.uk



Public Health England

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 133-155 Waterloo Road, London, SE1 8UG
<https://www.gov.uk/government/organisations/public-health-england>
 Email: enquiries@phe.gov.uk
 Main switchboard: 020 7654 8000



The Coal Authority

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 Notts NG18 4RG
 Tel: 0345 7626 848
 DX 716176 Mansfield 5
www.coal.gov.uk



Ordnance Survey

Adanac Drive, Southampton
 SO16 0AS
 Tel: 08456 050505



Local Authority

Authority: Wrexham County Borough Council
 Phone: 01978 292000
 Web: www.wrexham.gov.uk
 Address: The Guildhall, Wrexham, LL11 1AY

Gemapping PLC

Virginia Villas, High Street, Hartley Witney,
 Hampshire RG27 8NW
 Tel: 01252 845444



Acknowledgements: Site of Special Scientific Interest, National Nature Reserve, Ramsar Site, Special Protection Area, Special Area of Conservation data is provided by, and used with the permission of, English Nature who retain the Copyright and Intellectual Property Rights for the data. PointX © Database Right/Copyright, Thomson Directories Limited © Copyright Link Interchange Network Limited © Database Right/Copyright and Ordnance Survey © Crown Copyright and/or Database Right. All Rights Reserved. Licence Number [03421028].
 This report has been prepared in accordance with the GroundSure Ltd standard Terms and Conditions of business for work of this nature.

Standard Terms and Conditions

1 Definitions

In these terms and conditions unless the context otherwise requires:

“Beneficiary” means the person or entity for whose benefit the Client has obtained the Services.

“Client” means the party or parties entering into a Contract with GroundSure.

“Commercial” means any building or property which is not Residential.

“Confidential Information” means the contents of this Contract and all information received from the Client as a result of, or in connection with, this Contract other than

(i) information which the Client can prove was rightfully in its possession prior to disclosure by GroundSure and

(ii) any information which is in the public domain (other than by virtue of a breach of this Contract).

“Support Services” means Support Services provided by GroundSure including, without limitation, interpreting third party and in-house environmental data, providing environmental support advice, undertaking environmental audits and assessments, Site investigation, Site monitoring and related items.

“Contract” means the contract between GroundSure and the Client for the provision of the Services, and which shall incorporate these terms and conditions, the Order, and the relevant User Guide.

“Third Party Data Provider” means any third party providing Third Party Content to GroundSure.

“Data Reports” means reports comprising factual data with no accompanying interpretation.

“Fees” has the meaning set out in clause 5.1.

“GroundSure” means GroundSure Limited, a company registered in England and Wales under number 03421028.

“GroundSure Materials” means all materials prepared by GroundSure and provided as part of the Services, including but not limited to Third Party Content, Data Reports, Mapping, and Risk Screening Reports.

“Intellectual Property” means any patent, copyright, design rights, trade or service mark, moral rights, data protection rights, know-how or trade mark in each case whether registered or not and including applications for the same or any other rights of a similar nature anywhere in the world.

“Mapping” means a map, map data or a combination of historical maps of various ages, time periods and scales.

“Order” means an electronic, written or other order form submitted by the Client requesting Services from GroundSure in respect of a specified Site.

“Ordnance Survey” means the Secretary of State for Business, Innovation and Skills, acting through Ordnance Survey, Adanac Drive, Southampton, SO16 0AS, UK.

“Order Website” means the online platform through which Orders may be placed by the Client and accepted by GroundSure.

“Report” means a Risk Screening Report or Data Report for Commercial or Residential property.

“Residential” means any building or property used as or intended to be used as a single dwelling.

“Risk Screening Report” means a risk screening report comprising factual data with an accompanying interpretation by GroundSure.

“Services” means any Report, Mapping and/or Support Services which GroundSure has agreed to provide by accepting an Order pursuant to clause 2.6.

“Site” means the area of land in respect of which the Client has requested GroundSure to provide the Services.

“Third Party Content” means data, database information or other information which is provided to GroundSure by a Third Party Data Provider.

“User Guide” means the user guide, as amended from time to time, available upon request from GroundSure and on the website (www.GroundSure.com) and forming part of this Contract.

2 Scope of Services, terms and conditions, requests for insurance and quotations

2.1 GroundSure agrees to provide the Services in accordance with the Contract.

2.2 GroundSure shall exercise reasonable skill and care in the provision of the Services.

2.3 Subject to clause 7.3 the Client acknowledges that it has not relied on any statement or representation made by or on behalf of GroundSure which is not set out and expressly agreed in writing in the Contract and all such statements and representations are hereby excluded to the fullest extent permitted by law.

2.4 The Client acknowledges that terms and conditions appearing on a Client's order form, printed stationery or other communication, or any terms or conditions

implied by custom, practice or course of dealing shall be of no effect, and that this Contract shall prevail over all others in relation to the Order.

2.5 If the Client or Beneficiary requests insurance in conjunction with or as a result of the Services, GroundSure shall use reasonable endeavours to recommend such insurance, but makes no warranty that such insurance shall be available from insurers or that it will be offered on reasonable terms. Any insurance purchased by the Client or Beneficiary shall be subject solely to the terms of the policy issued by insurers and GroundSure will have no liability therefor. In addition you acknowledge and agree that GroundSure does not act as an agent or broker for any insurance providers. The Client should take (and ensure that the Beneficiary takes) independent advice to ensure that the insurance policy requested or offered is suitable for its requirements.

2.6 GroundSure's quotations or proposals are valid for a period of 30 days only unless an alternative period of time is explicitly stipulated by GroundSure. GroundSure reserves the right to withdraw any quotation or proposal at any time before an Order is accepted by GroundSure. GroundSure's acceptance of an Order shall be binding only when made in writing and signed by GroundSure's authorised representative or when accepted through the Order Website.

3 The Client's obligations

3.1 The Client shall comply with the terms of this Contract and

(i) procure that the Beneficiary or any third party relying on the Services complies with and acts as if it is bound by the Contract and

(ii) be liable to GroundSure for the acts and omissions of the Beneficiary or any third party relying on the Services as if such acts and omissions were those of the Client.

3.2 The Client shall be solely responsible for ensuring that the Services are appropriate and suitable for its and/or the Beneficiary's needs.

3.3 The Client shall supply to GroundSure as soon as practicable and without charge all requisite information (and the Client warrants that such information is accurate, complete and appropriate), including without limitation any environmental information relating to the Site and shall give such assistance as GroundSure shall reasonably require in the provision of the Services including, without limitation, access to the Site, facilities and equipment.

3.4 Where the Client's approval or decision is required to enable GroundSure to carry out work in order to provide the Services, such approval or decision shall be given or procured in reasonable time and so as not to delay or disrupt the performance of the Services.

3.5 Save as expressly permitted by this Contract the Client shall not, and shall procure that the Beneficiary shall not, re-sell, alter, add to, or amend the GroundSure Materials, or use the GroundSure Materials in a manner for which they were not intended. The Client may make the GroundSure Materials available to a third party who is considering acquiring some or all of, or providing funding in relation to, the Site, but such third party cannot rely on the same unless expressly permitted under clause 4.

3.6 The Client is responsible for maintaining the confidentiality of its user name and password if using the Order Website and the Client acknowledges that GroundSure accepts no liability of any kind for any loss or damage suffered by the Client as a consequence of using the Order Website.

4 Reliance

4.1 The Client acknowledges that the Services provided by GroundSure consist of the presentation and analysis of Third Party Content and other content and that information obtained from a Third Party Data Provider cannot be guaranteed or warranted by GroundSure to be reliable.

4.2 In respect of Data Reports, Mapping and Risk Screening Reports, the following classes of person and no other are entitled to rely on their contents;

- (i) the Beneficiary,
- (ii) the Beneficiary's professional advisers, (iii) any person providing funding to the Beneficiary in relation to the Site (whether directly or as part of a lending syndicate),
- (iv) the first purchaser or first tenant of the Site, and
- (v) the professional advisers and lenders of the first purchaser or tenant of the Site.

4.3 In respect of Support Services, only the Client, Beneficiary and parties expressly named in a Report and no other parties are entitled to rely on its contents.

4.4 Save as set out in clauses 4.2 and 4.3 and unless otherwise expressly agreed in writing, no other person or entity of any kind is entitled to rely on any Services or Report issued or provided by GroundSure. Any party considering such Reports and Services does so at their own risk.

5 Fees and Disbursements

5.1 GroundSure shall charge and the Client shall pay fees at the rate and frequency specified in the written proposal, Order Website or Order acknowledgement form, plus (in the case of Support Services) all proper disbursements incurred by GroundSure. The Client shall in addition pay all value added tax or other tax payable on such fees and disbursements in relation to the provision of the Services (together “Fees”).

5.2 The Client shall pay all outstanding Fees to GroundSure in full without deduction, counterclaim or set off within 30 days of the date of GroundSure's invoice or such other period as may be agreed in writing between GroundSure and the Client ("Payment Date"). Interest on late payments will accrue on a daily basis from the Payment Date until the date of payment (whether before or after judgment) at the rate of 8% per annum.

5.3 The Client shall be deemed to have agreed the amount of any invoice unless an objection is made in writing within 28 days of the date of the invoice. As soon as reasonably practicable after being notified of an objection, without prejudice to clause 5.2 a member of GroundSure's management team will contact the Client and the parties shall then use all reasonable endeavours to resolve the dispute within 15 days.

6 Intellectual Property and Confidentiality

6.1 Subject to

(i) full payment of all relevant Fees and

(ii) compliance with this Contract, the Client is granted (and is permitted to sub-licence to the Beneficiary) a royalty-free, worldwide, non-assignable and (save to the extent set out in this Contract) non-transferable licence to make use of the GroundSure Materials.

6.2 All Intellectual Property in the GroundSure Materials are and shall remain owned by GroundSure or GroundSure's licensors (including without limitation the Third Party Data Providers) the Client acknowledges, and shall procure acknowledgement by the Beneficiary of, such ownership. Nothing in this Contract purports to transfer or assign any rights to the Client or the Beneficiary in respect of such Intellectual Property.

6.3 Third Party Data Providers may enforce any breach of clauses 6.1 and 6.2 against the Client or Beneficiary.

6.4 The Client shall, and shall procure that any recipients of the GroundSure Materials shall:

(i) not remove, suppress or modify any trade mark, copyright or other proprietary marking belonging to GroundSure or any third party from the Services;

(ii) use the information obtained as part of the Services in respect of the subject Site only, and shall not store or reuse any information obtained as part of the Services provided in respect of adjacent or nearby sites;

(iii) not create any product or report which is derived directly or indirectly from the Services (save that those acting in a professional capacity to the Beneficiary may provide advice based upon the Services);

(iv) not combine the Services with or incorporate such Services into any other information data or service;

(v) not reformat or otherwise change (whether by modification, addition or enhancement), the Services (save that those acting for the Beneficiary in a professional capacity shall not be in breach of this clause 6.4(v) where such reformatting is in the normal course of providing advice based upon the Services);

(vi) where a Report and/or Mapping contains material belonging to Ordnance Survey, acknowledge and agree that such content is protected by Crown Copyright and shall not use such content for any purpose outside of receiving the Services; and

(vii) not copy in whole or in part by any means any map prints or run-on copies containing content belonging to Ordnance Survey (other than that contained within Ordnance Survey's OS Street Map) without first being in possession of a valid Paper Map Copying Licence from Ordnance Survey,

6.5 Notwithstanding clause 6.4, the Client may make reasonable use of the GroundSure Materials in order to advise the Beneficiary in a professional capacity. However, GroundSure shall have no liability in respect of any advice, opinion or report given or provided to Beneficiaries by the Client.

6.6 The Client shall procure that any person to whom the Services are made available shall notify GroundSure of any request or requirement to disclose, publish or disseminate any information contained in the Services in accordance with the Freedom of Information Act 2000, the Environmental Information Regulations 2004 or any associated legislation or regulations in force from time to time.

7.Liability: Particular Attention Should Be Paid To This Clause

7.1 This Clause 7 sets out the entire liability of GroundSure, including any liability for the acts or omissions of its employees, agents, consultants, subcontractors and Third Party Content, in respect of:

(i) any breach of contract, including any deliberate breach of the Contract by GroundSure or its employees, agents or subcontractors;

(ii) any use made of the Reports, Services, Materials or any part of them; and

(iii) any representation, statement or tortious act or omission (including negligence) arising under or in connection with the Contract.

7.2 All warranties, conditions and other terms implied by statute or common law are, to the fullest extent permitted by law, excluded from the Contract.

7.3 Nothing in the Contract limits or excludes the liability of the Supplier for death

or personal injury resulting from negligence, or for any damage or liability incurred by the Client or Beneficiary as a result of fraud or fraudulent misrepresentation.

7.4 GroundSure shall not be liable for

- (i) loss of profits;
- (ii) loss of business;
- (iii) depletion of goodwill and/or similar losses;
- (iv) loss of anticipated savings;
- (v) loss of goods;
- (vi) loss of contract;
- (vii) loss of use;
- (viii) loss or corruption of data or information;
- (ix) business interruption;
- (x) any kind of special, indirect, consequential or pure economic

loss, costs, damages, charges or expenses;

(xi) loss or damage that arise as a result of the use of all or part of the GroundSure Materials in breach of the Contract;

(xii) loss or damage arising as a result of any error, omission or inaccuracy in any part of the GroundSure Materials where such error, omission or inaccuracy is caused by any Third Party Content or any reasonable interpretation of Third Party Content;

(xiii) loss or damage to a computer, software, modem, telephone or other property; and

(xiv) loss or damage caused by a delay or loss of use of GroundSure's internet ordering service.

7.5 GroundSure's total liability in relation to or under the Contract shall be limited to £10 million for any claim or claims.

7.6 GroundSure shall procure that the Beneficiary shall be bound by limitations and exclusions of liability in favour of GroundSure which accord with those detailed in clauses 7.4 and 7.5 (subject to clause 7.3) in respect of all claims which the Beneficiary may bring against GroundSure in relation to the Services or other matters arising pursuant to the Contract.

8 GroundSure's right to suspend or terminate

8.1 If GroundSure reasonably believes that the Client or Beneficiary has not provided the information or assistance required to enable the proper provision of the Services, GroundSure shall be entitled to suspend all further performance of the Services until such time as any such deficiency has been made good.

8.2 GroundSure shall be entitled to terminate the Contract immediately on written notice in the event that:

(i) the Client fails to pay any sum due to GroundSure within 30 days of the Payment Date; or

(ii) the Client (being an individual) has a bankruptcy order made against him or (being a company) shall enter into liquidation whether compulsory or voluntary or have an administration order made against it or if a receiver shall be appointed over the whole or any part of its property assets or undertaking or if the Client is struck off the Register of Companies or dissolved; or

(iii) the Client being a company is unable to pay its debts within the meaning of Section 123 of the Insolvency Act 1986 or being an individual appears unable to pay his debts within the meaning of Section 268 of the Insolvency Act 1986 or if the Client shall enter into a composition or arrangement with the Client's creditors or shall suffer distress or execution to be levied on his goods; or

(iv) the Client or the Beneficiary breaches any term of the Contract (including, but not limited to, the obligations in clause 4) which is incapable of remedy or if remediable, is not remedied within five days of notice of the breach.

9. Client's Right to Terminate and Suspend

9.1 Subject to clause 10.1, the Client may at any time upon written notice terminate or suspend the provision of all or any of the Services.

9.2 In any event, where the Client is a consumer (and not a business) he/she hereby expressly acknowledges and agrees that:

(i) the supply of Services under this Contract (and therefore the performance of this Contract) commences immediately upon GroundSure's acceptance of the Order; and

(ii) the Reports and/or Mapping provided under this Contract are

(a) supplied to the Client's specification(s) and in any event

(b) by their nature cannot be returned.

10 Consequences of Withdrawal, Termination or Suspension

10.1 Upon termination of the Contract:

(i) GroundSure shall take steps to bring to an end the Services in an orderly manner, vacate any Site with all reasonable speed and shall deliver to the Client and/or Beneficiary any property of the Client and/or Beneficiary in

GroundSure's possession or control; and

(ii) the Client shall pay to GroundSure all and any Fees payable in respect of the performance of the Services up to the date of termination or suspension. In respect of any Support Services provided, the Client shall also pay GroundSure any additional costs incurred in relation to the termination or suspension of the Contract.

11 Anti-Bribery

11.1 The Client warrants that it shall:

(i) comply with all applicable laws, statutes and regulations relating to anti-bribery and anti-corruption including but not limited to the Bribery Act 2010;

(ii) comply with such of GroundSure's anti-bribery and anti-corruption policies as are notified to the Client from time to time; and

(iii) promptly report to GroundSure any request or demand for any undue financial or other advantage of any kind received by or on behalf of the Client in connection with the performance of this Contract.

11.2 Breach of this Clause 11 shall be deemed a material breach of this Contract.

12 General

12.1 The Mapping contained in the Services is protected by Crown copyright and must not be used for any purpose other than as part of the Services or as specifically provided in the Contract.

12.2 The Client shall be permitted to make one copy only of each Report or Mapping Order. Thereafter the Client shall be entitled to make unlimited copies of the Report or Mapping Order only in accordance with an Ordnance Survey paper map copy license available through GroundSure.

12.3 GroundSure reserves the right to amend or vary this Contract. No amendment or variation to this Contract shall be valid unless signed by an authorised representative of GroundSure.

12.4 No failure on the part of GroundSure to exercise, and no delay in exercising, any right, power or provision under this Contract shall operate as a waiver thereof.

12.5 Save as expressly provided in this Contract, no person other than the persons set out therein shall have any right under the Contract (Rights of Third Parties) Act 1999 to enforce any terms of the Contract.

12.6 The Secretary of State for Business, Innovation and Skills ("BIS") or BIS' successor body, as the case may be, acting through Ordnance Survey may enforce a breach of clause 6.4(vi) and clause 6.4(vii) of these terms and conditions against the Client in accordance with the provisions of the Contracts (Rights of Third Parties) Act 1999.

12.7 GroundSure shall not be liable to the Client if the provision of the Services is delayed or prevented by one or more of the following circumstances:

- (i) the Client or Beneficiary's failure to provide facilities, access or information;
- (ii) fire, storm, flood, tempest or epidemic;
- (iii) Acts of God or the public enemy;
- (iv) riot, civil commotion or war;
- (v) strikes, labour disputes or industrial action;
- (vi) acts or regulations of any governmental or other agency;
- (vii) suspension or delay of services at public registries by Third Party Data Providers;
- (viii) changes in law; or
- (ix) any other reason beyond GroundSure's reasonable control.

In the event that GroundSure is prevented from performing the Services (or any part thereof) in accordance with this clause 12.6 for a period of not less than 30 days then GroundSure shall be entitled to terminate this Contract immediately on written notice to the Client.

12.8 Any notice provided shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post, facsimile or by email to the address, facsimile number or email address of the relevant party as may have been notified by each party to the other for such purpose or in the absence of such notification the last known address.

12.9 Such notice shall be deemed to have been received on the day of delivery if delivered by hand, facsimile or email (save to the extent such day is not a working day where it shall be deemed to have been delivered on the next working day) and on the second working day after the day of posting if sent by first class post.

12.10 The Contract constitutes the entire agreement between the parties and shall supersede all previous arrangements between the parties relating to the subject matter hereof.

12.11 Each of the provisions of the Contract is severable and distinct from the others and if one or more provisions is or should become invalid, illegal or unenforceable, the validity and enforceability of the remaining provisions shall not in any way be tainted or impaired.

12.12 This Contract shall be governed by and construed in accordance with English

law and any proceedings arising out of or connected with this Contract shall be subject to the exclusive jurisdiction of the English courts.

12.13 GroundSure is an executive member of the Council of Property Search Organisation (CoPSO) and has signed up to the Search Code administered by the Property Codes Compliance Board (PCCB). All Risk Screening Reports shall be supplied in accordance with the provisions of the Search Code.

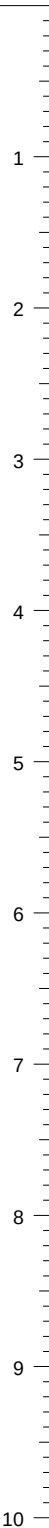
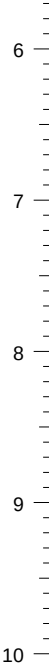
12.14 If the Client or Beneficiary has a complaint about the Services, written notice should be given to the Compliance Officer at GroundSure who will respond in a timely manner.

12.15 The Client agrees that it shall, and shall procure that each Beneficiary shall, treat in confidence all Confidential Information and shall not, and shall procure that each Beneficiary shall not (i) disclose any Confidential Information to any third party other than in accordance with the terms of this Contract; and (ii) use Confidential Information for a purpose other than the exercise of its rights and obligations under this Contract. Subject to clause 6.6, nothing shall prevent the Client or any Beneficiary from disclosing Confidential Information to the extent required by law. © GroundSure Limited June 2013

APPENDIX P - PREVIOUS SITE INVESTIGATION REPORT

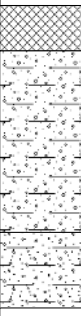
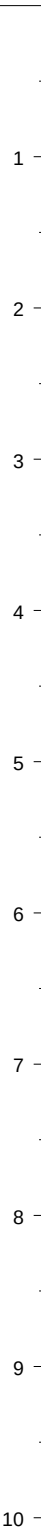


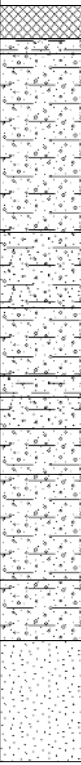
					Borehole Log			Borehole No. WS2 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. T/14/1400		Co-ords: 333279.00 - 352928.00		Hole Type WS
Location: Wrexham					Level: 84.25		Scale 1:50		Logged By DR
Client: Liberty Properties					Dates: 21/06/2016 -				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					0.20	84.05		MADE GROUND: Soft consistency, dark brown, slightly gravelly, very sandy CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone, with abundant rootlets.		
					0.95	83.30		MADE GROUND		
					1.10	83.15		Red brown, slightly gravelly, very clayey, fine SAND. Gravel is subangular to rounded, fine to medium occasionally coarse of quartzite.		
					1.20	83.05		GLACIOFLUVIAL DEPOSITS		
					2.00	82.25		Red brown, slightly clayey, gravelly, fine to medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.		
								GLACIOFLUVIAL DEPOSITS		
								Brown, slightly clayey, subangular to rounded, fine to medium occasionally coarse GRAVEL of quartz and quartzite.		
										GLACIOFLUVIAL DEPOSITS
										No recovery.
										Rounded cobble of quartzite at 1.20m bgl.
							Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone.			
							GLACIAL TILL			
							Red brown, fine to medium SAND.			
							GLACIOFLUVIAL DEPOSITS			
							Brown, slightly gravelly, medium to coarse SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.			
							GLACIOFLUVIAL DEPOSITS			
							Red brown, slightly gravelly, fine to medium SAND. Gravel is subangular to rounded, fine of quartz and quartzite.			
							GLACIOFLUVIAL DEPOSITS			
							End of borehole at 4.20 m			

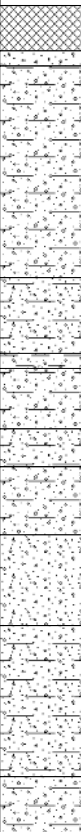
Remarks
 1) Hand dug pit to 1.20m bgl. 2) Borehole dry. 3) Borehole cased to 3.00m bgl. 4) Falling head tests undertaken for response zones at 1.65 to 2.15m, 2.15m and 3.15m bgl. 5) Terminated at 4.20m bgl at refusal in natural ground.



					Borehole Log			Borehole No. WS3 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. T/14/1400		Co-ords: 333398.00 - 353014.00		Hole Type WS
Location: Wrexham					Level: 83.40		Scale 1:50		
Client: Liberty Properties					Dates: 21/06/2016 -		Logged By DR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30	83.10		MADE GROUND: Soft consistency, dark brown, slightly gravelly, very sandy CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone, with abundant rootlets.	
					1.50	81.90		MADE GROUND Red brown, sandy, clayey, subangular to rounded, fine to medium occasionally coarse, GRAVEL of quartzite, quartz and sandstone, with occasional cobbles of rounded quartzite.	
					2.00	81.40		GLACIOFLUVIAL DEPOSITS Red brown, slightly clayey, very gravelly, coarse occasionally medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.	
								GLACIOFLUVIAL DEPOSITS No recovery.	
					5.00	78.40		End of borehole at 5.00 m	
Remarks 1) Hand dug pit to 1.20m bgl. 2) Borehole dry. 3) Borehole cased to 3.00m bgl. 4) Falling head tests undertaken for response zones at 2.15m and 3.15m bgl. 5) Terminated at 5.00m bgl in natural ground.									

					Borehole Log			Borehole No. WS4 Sheet 1 of 1			
Project Name: Land at Rhosrobin					Project No. T/14/1400		Co-ords: 333389.00 - 352924.00		Hole Type WS		
Location: Wrexham					Level: 83.45		Scale 1:50				
Client: Liberty Properties					Dates: 20/06/2016 -		Logged By DR				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
					0.22	83.23		MADE GROUND: Soft consistency, dark brown, slightly gravelly, very sandy CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone, with abundant rootlets. MADE GROUND Soft consistency, red brown, sandy, very gravelly CLAY. Gravel is subangular to rounded, fine to medium of quartzite and quartz. GLACIOFLUVIAL DEPOSITS Red brown, sandy, very clayey, subangular to rounded, fine to medium GRAVEL of quartzite, quartz and siltstone. GLACIOFLUVIAL DEPOSITS <i>Rare 20mm to 40mm pieces of decaying plant matter from 0.80m to 1.00m bgl.</i> <i>Occasional 10mm to 30mm clay clumps from 1.10m to 1.50m bgl.</i> Red brown, slightly clayey, gravelly, medium occasionally fine and coarse SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz. GLACIOFLUVIAL DEPOSITS Brown, slightly sandy, clayey subangular to rounded, fine to medium occasionally coarse GRAVEL of quartzite and quartz. GLACIOFLUVIAL DEPOSITS Firm consistency, red brown, slightly sandy, gravelly CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone. GLACIOFLUVIAL DEPOSITS Red brown, slightly clayey, gravelly, medium occasionally fine and coarse SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz. GLACIOFLUVIAL DEPOSITS Brown, slightly clayey, sandy, angular to rounded, fine to coarse GRAVEL of quartzite and quartz with occasional coal. GLACIOFLUVIAL DEPOSITS Brown, slightly sandy, slightly clayey, slightly cobbly, angular to rounded, medium to coarse GRAVEL of quartzite and quartz. GLACIOFLUVIAL DEPOSITS Brown, slightly clayey, sandy, angular to rounded, fine to coarse GRAVEL of quartzite and quartz with occasional coal. GLACIOFLUVIAL DEPOSITS Red brown, gravelly, medium to coarse SAND. Gravel is fine to medium, occasionally coarse of quartzite, quartz and siltstone. GLACIOFLUVIAL DEPOSITS End of borehole at 5.00 m	0.32	83.13	1
					1.50	81.95			2		
					2.00	81.45			3		
					2.45	81.00			4		
					2.59	80.86			5		
					2.80	80.65			6		
					3.10	80.35			7		
					3.80	79.65			8		
					4.20	79.25			9		
					5.00	78.45			10		
Remarks 1) Hand dug pit to 1.20m bgl. 2) Borehole dry. 3) Borehole cased to 3.00m bgl. 4) Falling head tests undertaken for response zones at 1.64m to 2.14m, 2.14m and 3.14m bgl. 5) Terminated at 5.00m bgl in natural ground.											
											



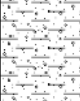
					Borehole Log			Borehole No. WS6 Sheet 1 of 1	
Project Name: Land at Rhosrobin					Project No. T/14/1400		Co-ords: 333458.00 - 352894.00		Hole Type WS
Location: Wrexham					Level: 83.20		Scale 1:50		
Client: Liberty Properties					Dates: 20/06/2016 -		Logged By DR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30	82.90		MADE GROUND: Soft consistency, dark brown, slightly gravelly, very sandy CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone, with abundant rootlets. MADE GROUND Red brown, slightly clayey, very gravelly, medium to coarse SAND. Gravel is subangular to subrounded of quartz and quartzite. GLACIOFLUVIAL DEPOSITS Red brown, sandy, clayey, subangular to rounded, fine to medium occasionally coarse, GRAVEL of quartzite, quartz and sandstone, with rare 10mm to 30mm clumps of clay. GLACIOFLUVIAL DEPOSITS <i>Very sandy from 1.00m to 1.80m bgl.</i> Red brown, slightly clayey, very gravelly, coarse occasionally medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz. GLACIOFLUVIAL DEPOSITS Firm consistency, red brown, slightly sandy, gravelly CLAY. Gravel is subangular to rounded, fine to medium of quartzite and siltstone. GLACIOFLUVIAL DEPOSITS Brown, slightly sandy, slightly clayey, subrounded to rounded, fine to medium GRAVEL of quartzite and quartz. GLACIOFLUVIAL DEPOSITS <i>Occasional decaying wood fragments from 2.70m to 2.80m bgl.</i> Brown, slightly clayey, very gravelly, coarse SAND. Gravel is angular to subangular, fine to medium of quartzite and quartz. GLACIOFLUVIAL DEPOSITS Brown, sandy, clayey, subangular to subrounded, fine to medium GRAVEL of quartzite, quartz and siltstone. GLACIOFLUVIAL DEPOSITS Red brown, very gravelly, coarse SAND. Gravel is subangular to rounded, fine to medium of quartz and siltstone. GLACIOFLUVIAL DEPOSITS Orange brown, slightly clayey, very gravelly, medium SAND. Gravel is subangular to rounded, fine to medium of quartzite, siltstone and quartz, with rare coal. GLACIOFLUVIAL DEPOSITS Brown, sandy, clayey, subangular to subrounded, fine to medium GRAVEL of quartzite, quartz and siltstone. GLACIOFLUVIAL DEPOSITS End of borehole at 5.50 m	1
					0.40	82.80			2
					1.80	81.40			3
					2.30	80.90			4
					2.40	80.80			5
					2.80	80.40			6
					3.05	80.15			7
					3.50	79.70			8
					4.10	79.10			9
					5.10	78.10			10
			5.50	77.70					
Remarks 1) Hand dug pit to 1.20m bgl. 2) Borehole dry. 3) Borehole cased to 3.00m bgl. 4) Falling head tests undertaken for response zones at 2.10m and 3.00m bgl 5) Terminated at 5.50m bgl in natural ground.									

				Trial Pit Log			Trialpit No SA1 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. T/14/1400		Co-ords: - Level:		Date 18/04/2016
Location: Wrexham				Dimensions (m):		Scale 1:25		
Client: Liberty Properties				Depth 1.55		Logged DB		

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30		 Grass over dark brown clayey gravelly fine to medium loamy SAND. Gravel is subangular to rounded fine to coarse of natural lithologies. TOPSOIL		
				0.80		 Light mottled yellow orangey very clayey fine to coarse SAND. Gravels are fine to coarse angular to rounded of natural lithologies. GLACIOFLUVIAL DEPOSITS		
				1.55		 Firm mottled brown yellow orange sandy slightly gravelly CLAY. Sand is fine to coarse. Gravels are fine to medium sub angular to rounded of natural lithologies. GLACIAL TILL	1	
						End of pit at 1.55 m		2
								3
								4
								5

Remarks: 1) Trial pit terminated in natural soils.	
Stability:	

				Trial Pit Log			Trialpit No SA2 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. T/14/1400		Co-ords: - Level:		Date 18/04/2016
Location: Wrexham				Dimensions (m):		Scale 1:25		
Client: Liberty Properties				Depth 1.55		Logged DB		

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30		 Grass over dark brown clayey gravelly fine to medium loamy SAND. Gravel is subangular to rounded fine to coarse of natural lithologies. TOPSOIL	1	
				1.20		 Light mottled yellow orangey clayey fine to coarse SAND. GLACIOFLUVIAL DEPOSITS		
				1.55		 Mottled orangey brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravels are fine to medium subangular to rounded of natural lithologies. GLACIAL TILL		
							End of pit at 1.55 m	2 3 4 5

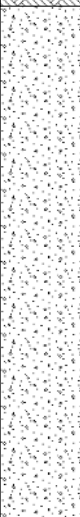
Remarks: 1) Trial pit terminated in natural soils. 2) Groundwater strike at 0.90m bgl. 3) Spalling from 0.30m to 1.20m bgl. Stability:	
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				Trial Pit Log			Trialpit No SA3 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. T/14/1400		Co-ords: - Level:		Date 18/04/2016
Location: Wrexham				Dimensions (m):		Scale 1:25		
Client: Liberty Properties				Depth 1.80		Logged DB		

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20			Grass over dark brown clayey gravelly fine to medium loamy SAND. Gravel is subangular to rounded fine to coarse of natural lithologies. MADE GROUND
				1.50			Firm light yellow grey orangey sandy slightly gravelly CLAY. Sand is fine to medium. Gravels are fine to coarse subangular to rounded of natural lithologies. GLACIAL TILL
				1.80			End of pit at 1.80 m

Remarks: 1) Trial pit terminated in natural soils. 2) Groundwater strike at 0.90m bgl.		
Stability:		

				Trial Pit Log			Trialpit No SA4 Sheet 1 of 1	
Project Name: Land at Rhosrobin				Project No. T/14/1400		Co-ords: - Level:		Date 18/04/2016
Location: Wrexham				Dimensions (m):		Scale 1:25		
Client: Liberty Properties				Depth 2.00		Logged DB		

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30			Grass over dark brown clayey gravelly fine to medium loamy SAND. Gravel is subangular to rounded fine to coarse of natural lithologies. TOPSOIL
				2.00			Orangey brown slightly gravelly medium to coarse SAND. Gravels are fine to medium subangular to rounded of natural lithologies. GLACIOFLUVIAL DEPOSITS
							End of pit at 2.00 m

Remarks: 1) Trial pit terminated in natural soils. 2) Groundwater strike at 0.90m bgl. 3) Spalling from 0.30m bgl.	
Stability:	

DETERMINATION OF SOIL INFILTRATION RATE IN SOAKAGE PIT
BRE Digest 365:2003, Figure 2, Page 5



Client:	Liberty Properties	Job No:	T14/1400
Site:	Land Off New Road, Rhosrobin, Wrexham	Test No:	SA1
Date:	18/04/2016	Cycle No.	1
Project manager:	Adrian Read	Operator:	D. Bromley

CALCULATION OF SOIL INFILTRATION RATE

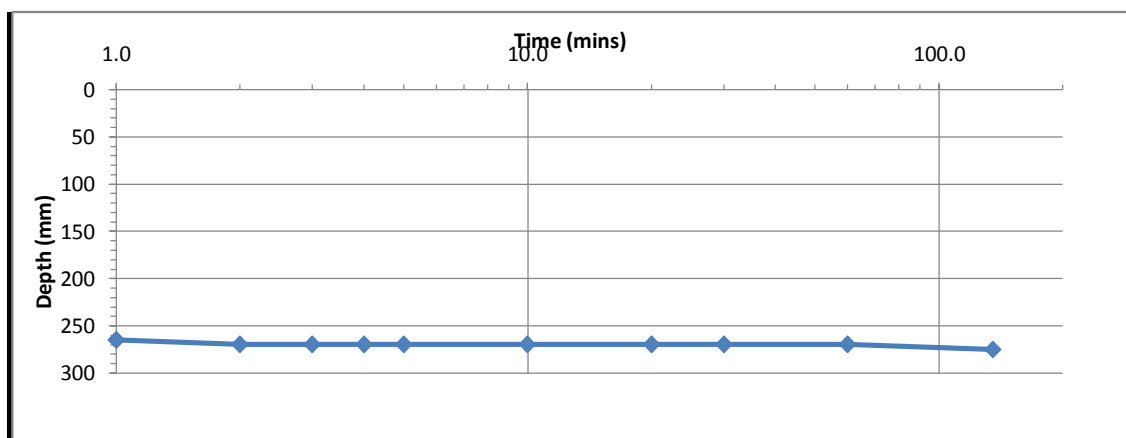
Time (min)	Depth (mm)	Size of Soakaway	Length (m) =	1.70
0.0	265		Width (m) =	0.40
1.0	265		Depth (m) =	1.53
2.0	270			
3.0	270	Depth at start of test (effective water level) = 265mm		
4.0	270	Depth at end of test = 275mm		
5.0	270	Depth to 75% effective water level = 581mm		
10.0	270	Depth to 50% effective water level = 898mm		
20.0	270	Depth to 25% effective water level = 1214mm		
30.0	270			
60.0	270			
135.0	275	Test completed		
		Base area of pit (m ²) = 0.680		

Test completed	
Base area of pit (m ²) =	0.680
Eff area of loss 75 - 25% (m ²) =	3.337
Volume outflow 75 - 25% (m ³) =	0.430

From the graph:	
tp 75 (sec) =	N/A
tp 25 (sec) =	N/A

Soil infiltration rate, f, (m/s) =	N/A
------------------------------------	-----

No Results for the soil infiltration rate can be obtained due to the time lapsed conducting the test and nature of the tested material exhibiting low permeability characteristics



DETERMINATION OF SOIL INFILTRATION RATE IN SOAKAGE PIT
BRE Digest 365:2003, Figure 2, Page 5



Client:	Liberty Properties	Job No:	T14/1400
Site:	Land Off New Road, Rhosrobin, Wrexham	Test No:	SA2
Date:	18/04/2016	Cycle No.	1
Project manager:	Adrian Read	Operator:	D. Bromley

CALCULATION OF SOIL INFILTRATION RATE

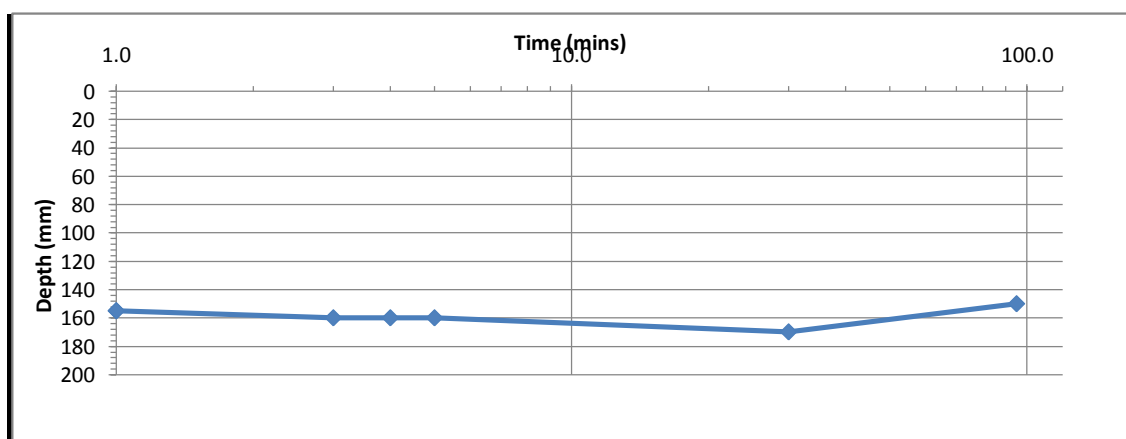
Time (min)	Depth (mm)	Size of Soakaway	Length (m) =	1.60
0.0	155		Width (m) =	0.40
1.0	155		Depth (m) =	1.60
3.0	160			
4.0	160	Depth at start of test (effective water level) = 155mm		
5.0	160	Depth at end of test = 150mm		
30.0	170	Depth to 75% effective water level = 516mm		
95.0	150	Depth to 50% effective water level = 878mm		
		Depth to 25% effective water level = 1239mm		

Test completed	
Base area of pit (m ²) =	0.640
Eff area of loss 75 - 25% (m ²) =	3.530
Volume outflow 75 - 25% (m ³) =	0.462

From the graph:	
tp 75 (sec) =	N/A
tp 25 (sec) =	N/A

Soil infiltration rate, f, (m/s) =	N/A
------------------------------------	-----

No Results for the soil infiltration rate can be obtained due to the time lapsed conducting the test and nature of the tested material exhibiting low permeability characteristics



DETERMINATION OF SOIL INFILTRATION RATE IN SOAKAGE PIT
BRE Digest 365:2003, Figure 2, Page 5



Client:	Liberty Properties	Job No:	T14/1400
Site:	Land Off New Road, Rhosrobin, Wrexham	Test No:	SA3
Date:	18/04/2016	Cycle No.	1
Project manager:	Adrian Read	Operator:	D. Bromley

CALCULATION OF SOIL INFILTRATION RATE

Time (min)	Depth (mm)		Size of Soakaway	Length (m) =	0.40
0.0	200			Width (m) =	1.80
2.0	205			Depth (m) =	1.70
3.0	205				
5.0	205	Depth at start of test (effective water level) =			
		200mm			
13.0	210	Depth at end of test =			
		235mm			
45.0	215	Depth to 75% effective water level =			
		575mm			
83.0	225	Depth to 50% effective water level =			
		950mm			
133.0	235	Depth to 25% effective water level =			
		1325mm			

Test completed

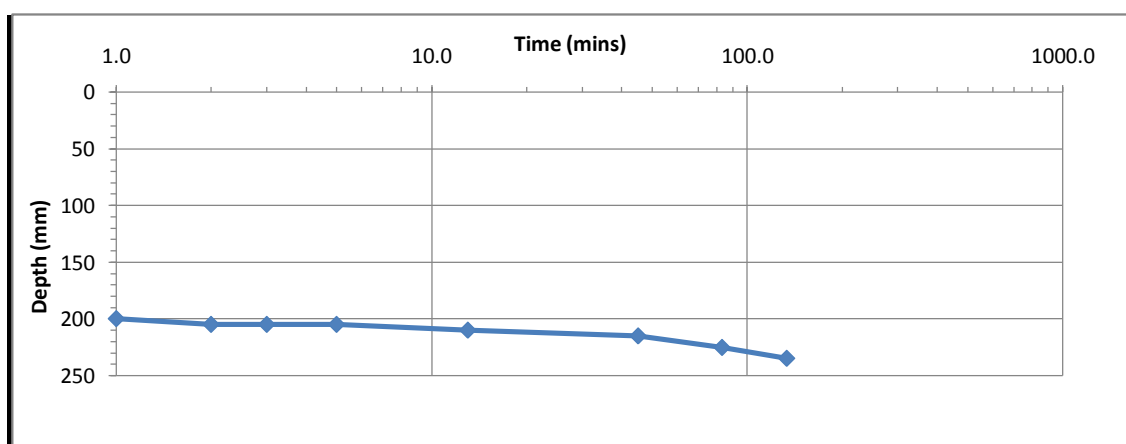
Base area of pit (m ²) =	0.720
Eff area of loss 75 - 25% (m ²) =	4.020
Volume outflow 75 - 25% (m ³) =	0.540

From the graph:

tp 75 (sec) =	N/A
tp 25 (sec) =	N/A

Soil infiltration rate, f, (m/s) = N/A

No Results for the soil infiltration rate can be obtained due to the time lapsed conducting the test and nature of the tested material exhibiting low permeability characteristics



DETERMINATION OF SOIL INFILTRATION RATE IN SOAKAGE PIT

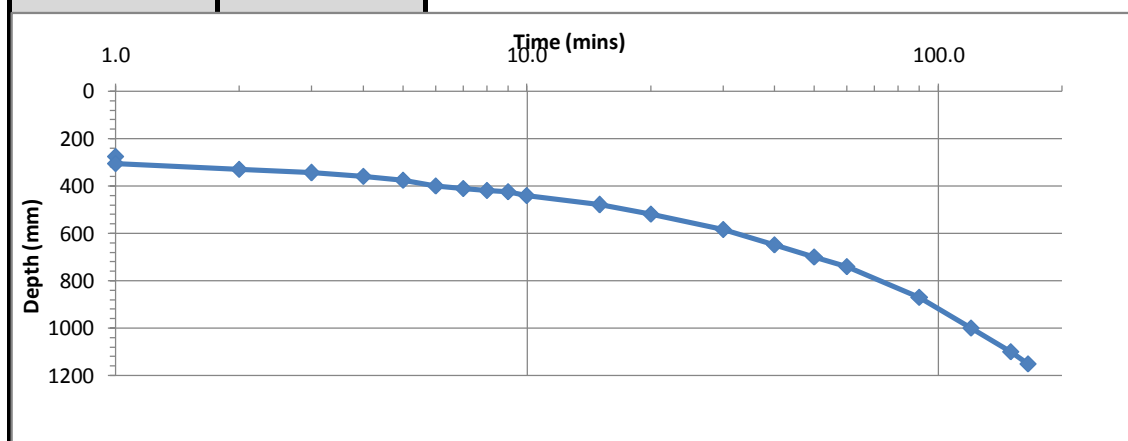
BRE Digest 365:2003, Figure 2, Page 5



Client:	Liberty Properties	Job No:	T14/1400
Site:	Land Off New Road, Rhosrobin, Wrexham	Test No:	SA4
Date:	18/04/2016	Cycle No.	1
Project manager:	Adrian Read	Operator:	D. Bromley

CALCULATION OF SOIL INFILTRATION RATE

Time (min)	Depth (mm)	Size of Soakaway	Length (m) =	1.90								
0.0	275		Width (m) =	0.40								
1.0	305		Depth (m) =	1.20								
2.0	330											
3.0	345	Depth at start of test (effective water level) = 275mm										
4.0	360	Depth at end of test = 1150mm										
5.0	375	Depth to 75% effective water level = 506mm										
6.0	400	Depth to 50% effective water level = 738mm										
7.0	410	Depth to 25% effective water level = 969mm										
8.0	420	<table><tr><th colspan="2">Test completed</th></tr><tr><td>Base area of pit (m²) =</td><td>0.760</td></tr><tr><td>Eff area of loss 75 - 25% (m²) =</td><td>2.888</td></tr><tr><td>Volume outflow 75 - 25% (m³) =</td><td>0.352</td></tr></table>			Test completed		Base area of pit (m ²) =	0.760	Eff area of loss 75 - 25% (m ²) =	2.888	Volume outflow 75 - 25% (m ³) =	0.352
Test completed												
Base area of pit (m ²) =	0.760											
Eff area of loss 75 - 25% (m ²) =	2.888											
Volume outflow 75 - 25% (m ³) =	0.352											
9.0	425											
10.0	440											
15.0	480											
20.0	520	<table><tr><th colspan="2">From the graph:</th></tr><tr><td>tp 75 (sec) =</td><td>1080</td></tr><tr><td>tp 25 (sec) =</td><td>6780</td></tr></table>			From the graph:		tp 75 (sec) =	1080	tp 25 (sec) =	6780		
From the graph:												
tp 75 (sec) =	1080											
tp 25 (sec) =	6780											
30.0	585											
40.0	650	<table><tr><td>Soil infiltration rate, f, (m/s) =</td><td>1.1271E-04</td></tr></table>			Soil infiltration rate, f, (m/s) =	1.1271E-04						
Soil infiltration rate, f, (m/s) =	1.1271E-04											
50.0	700											
60.0	740											
90.0	870											
120.0	1000											
150.0	1100											
165.0	1150											



VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS1	TEST No.:		1				
		DEPTH (m)	2.10		DATE	28/06/2016		SHEET	1

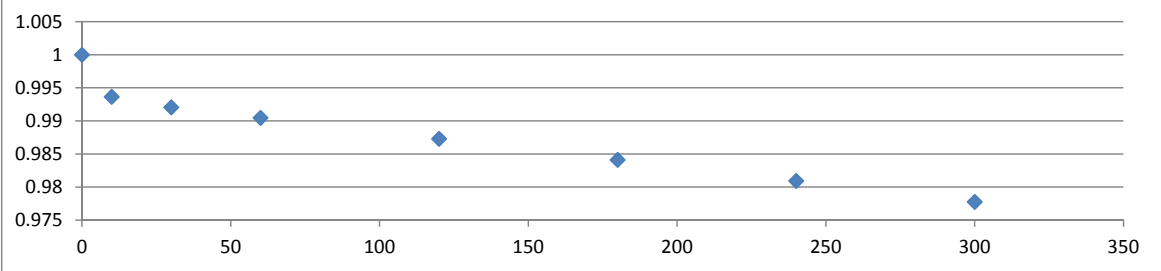
Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i -d _i)	h _i /h ₀				
0	0.9	1.2	1		Test Section Depth	m	2.1
10	1.29	0.81	0.675		Borehole Depth	m	2.1
20	1.57	0.53	0.4416667		Borehole Diameter	m	0.103
30	1.96	0.14	0.1166667		Casing Depth	m	2.1
40	2.09	0.01	0.0083333		Depth to Standing Water Level (d ₁)	Assumed m	
					Height of casing agl (h _c)	m	0
					Height of top of casing above water table	m	0
					Depth to Water at Start of Test below casing level (d ₀)	m	0
					Depth to Water at End of Test below casing level	m	0
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
					Basic Time Lag = (T)	t ₁ =	0.00
						t ₂ =	40.00
						s.h ₁ =	1.00
						s.h ₂ =	0.01
					Coefficient of Permeability (k) ms ⁻¹ =		3.52E-03
Remarks Borehole cleaned out prior to test. Compiled By JB Date 17/11/2014 Checked By AR Date 19/11/2014 Geology of Test Section: Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps. Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388							

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS1	TEST No.:		2				
		DEPTH (m)	2.10		DATE	28/06/2016		SHEET	1

Time (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _i)	h _i /h ₀
0	1	1.1	1
10	1.35	0.75	0.6818182
20	1.69	0.41	0.3727273
30	1.99	0.11	0.1
40	2.09	0.01	0.0090909

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _i)	h _i /h ₀			
0	1	1.1	1	Test Section Depth	m	2.1
10	1.35	0.75	0.6818182	Borehole Depth	m	2.1
20	1.69	0.41	0.3727273	Borehole Diameter	m	0.103
30	1.99	0.11	0.1	Casing Depth	m	2.1
40	2.09	0.01	0.0090909	Depth to Standing Water Level (d ₁)	Assumed m	
				Height of casing agl (h _c)	m	0
				Height of top of casing above water table	m	0
				Depth to Water at Start of Test below casing level (d ₀)	m	0
				Depth to Water at End of Test below casing level	m	0
				Depth to Filter at Start of Test	m	
				Depth to Filter at End of Test	m	
				Response Zone Length	m	0
				Borehole Diameter in Test Section	m	0.103
				Cross-sectional Area of Borehole	m ²	0.01
				Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
				Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00
					t ₂ = 40.00	s.h ₂ = 0.01
				Coefficient of Permeability (k) ms ⁻¹ =	3.46E-03	
<u>Remarks</u> Borehole cleaned out prior to test. Compiled By: JB Date: 17/11/2014 Checked By: AR Date: 19/11/2014 <u>Geology of Test Section:</u> Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps.						
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388				Project Number: T/14/1400 Project Name: Land at Rhosrobin Client: Liberty Property		

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS1	TEST No.:		3				
		DEPTH (m)	3.15		DATE	28/06/2016		SHEET	1



Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i -d _l)	h _i /h ₀				
0	0	3.15	1		Test Section Depth	m	3.15
10	0.02	3.13	0.9936508		Borehole Depth	m	3.15
30	0.025	3.125	0.9920635		Borehole Diameter	m	0.103
60	0.03	3.12	0.9904762		Casing Depth	m	3.15
120	0.04	3.11	0.9873016		Depth to Standing Water Level (d _l)	Assumed m	
180	0.05	3.1	0.984127		Height of casing agl (h _c)	m	0
240	0.06	3.09	0.9809524		Height of top of casing above water table	m	0
300	0.07	3.08	0.9777778		Depth to Water at Start of Test below casing level (d ₀)	m	0
					Depth to Water at End of Test below casing level	m	0
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
					Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00
						t ₂ = 300.00	s.h ₂ = 0.98
					Coefficient of Permeability (k) ms ⁻¹ =	2.20E-06	
Remarks							
Borehole cleaned out prior to test.							
Compiled By	JB	Date	17/11/2014				
Checked By	AR	Date	19/11/2014				
Geology of Test Section:		Red brown, slightly sandy, clayey, subangular to rounded, medium to coarse occasionally fine GRAVEL of quartzite, quartz and siltstone, with occasional clay 5mm to 30mm clay clumps.					
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388							
				Project Number	T/14/1400		
				Project Name	Land at Rhosrobin		
				Client	Liberty Property		

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS1	TEST No.:		4				
		DEPTH (m)	3.15		DATE	28/06/2016		SHEET	1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _l)	h _i /h ₀						
0	0.09	3.06	1		Test Section Depth	m	3.15		
55	2.1	1.05	0.3431373		Borehole Depth	m	3.15		
80	2.2	0.95	0.3104575		Borehole Diameter	m	0.103		
90	2.5	0.65	0.2124183		Casing Depth	m	2.45		
120	2.5	0.65	0.2124183		Depth to Standing Water Level (d _l)	Assumed m			
180	2.51	0.64	0.2091503		Height of casing agl (h _c)	m	0		
240	2.52	0.63	0.2058824		Height of top of casing above water table	m	0		
					Depth to Water at Start of Test below casing level (d ₀)	m	0		
					Depth to Water at End of Test below casing level	m	0		
					Depth to Filter at Start of Test	m			
					Depth to Filter at End of Test	m			
					Response Zone Length	m	0.7		
					Borehole Diameter in Test Section	m	0.103		
					Cross-sectional Area of Borehole	m ²	0.01		
					Intake factor (BS5930 p51):	Figure 7 (F) =	1.68		
					Basic Time Lag = (T)	t ₁ =	0.00	s.h ₁ = 1.00	
						t ₂ =	90.00	s.h ₂ = 0.21	
					Coefficient of Permeability (k) ms ⁻¹ =	8.52E-05			
Remarks									
Borehole cleaned out prior to test.									
Compiled By	JB	Date	17/11/2014						
Checked By	AR	Date	19/11/2014						
Geology of Test Section:		Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone.							
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388									
					Project Number	T/14/1400			
					Project Name	Land at Rhosrobin			
					Client	Liberty Property			

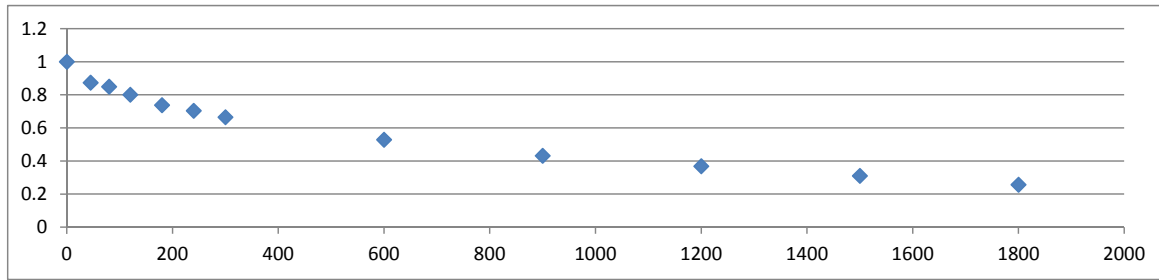
VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS2	TEST No.:		1				
		DEPTH (m)	2.15	DATE		28/06/2016	SHEET		1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _i)	h _i /h ₀
0	0	2.15	1
10	0.025	2.125	0.9883721
30	0.035	2.115	0.9837209
60	0.045	2.105	0.9790698
120	0.065	2.085	0.9697674
300	0.09	2.06	0.9581395

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _i)	h _i /h ₀			
0	0	2.15	1	Test Section Depth	m	2.15
10	0.025	2.125	0.9883721	Borehole Depth	m	2.15
30	0.035	2.115	0.9837209	Borehole Diameter	m	0.103
60	0.045	2.105	0.9790698	Casing Depth	m	2.15
120	0.065	2.085	0.9697674	Depth to Standing Water Level (d ₁)	Assumed m	
300	0.09	2.06	0.9581395	Height of casing agl (h _c)	m	0
				Height of top of casing above water table	m	0
				Depth to Water at Start of Test below casing level (d ₀)	m	0
				Depth to Water at End of Test below casing level	m	0
				Depth to Filter at Start of Test	m	
				Depth to Filter at End of Test	m	
				Response Zone Length	m	0
				Borehole Diameter in Test Section	m	0.103
				Cross-sectional Area of Borehole	m ²	0.01
				Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
				Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00
					t ₂ = 300.00	s.h ₂ = 0.96
				Coefficient of Permeability (k) ms ⁻¹ =	4.19E-06	
Remarks Borehole cleaned out prior to test. Compiled By: JB Date: 17/11/2014 Checked By: AR Date: 19/11/2014 Geology of Test Section: Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone.						
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388				Project Number: T/14/1400 Project Name: Land at Rhosrobin Client: Liberty Property		

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE

BOREHOLE No.:	WS2	TEST No.:	2		
	DEPTH (m)	2.15	DATE	28/06/2016	SHEET 1



Time Elapsed (secs)	Depth of water below top of casing - d ₁ (m)	h (m) - (d ₁ -d ₂)	h ₁ /h ₀				
0	0.09	2.06	1		Test Section Depth	m	2.15
45	0.35	1.8	0.8737864		Borehole Depth	m	2.15
80	0.4	1.75	0.8495146		Borehole Diameter	m	0.103
120	0.5	1.65	0.8009709		Casing Depth	m	1.65
180	0.63	1.52	0.7378641		Depth to Standing Water Level (d ₁)	Assumed m	
240	0.7	1.45	0.7038835		Height of casing agl (h _c)	m	0
300	0.78	1.37	0.6650485		Height of top of casing above water table	m	0
600	1.06	1.09	0.5291262		Depth to Water at Start of Test below casing level (d ₀)	m	0
900	1.26	0.89	0.4320388		Depth to Water at End of Test below casing level	m	0
1200	1.39	0.76	0.368932		Depth to Filter at Start of Test	m	
1500	1.51	0.64	0.3106796		Depth to Filter at End of Test	m	
1800	1.62	0.53	0.2572816		Response Zone Length	m	0.5
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	1.38
					Basic Time Lag = (T)	t ₁ =	0.00 s.h ₁ = 1.00
						t ₂ =	1800.00 s.h ₂ = 0.26
					Coefficient of Permeability (k) ms ⁻¹ =		4.57E-06
Remarks							
Borehole cleaned out prior to test.							
Compiled By	JB	Date	17/11/2014				
Checked By	AR	Date	19/11/2014				
Geology of Test Section:		No recovery.					
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388				Project Number		T/14/1400	
				Project Name		Land at Rhosrobin	
				Client		Liberty Property	

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS2	TEST No.:		2				
		DEPTH (m)	3.15	DATE		28/06/2016	SHEET		1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i -d _l)	h _i /h ₀				
0	0	3.15	1		Test Section Depth	m	3.15
10	0.01	3.14	0.9968254		Borehole Depth	m	3.15
30	0.01	3.14	0.9968254		Borehole Diameter	m	0.103
60	0.01	3.14	0.9968254		Casing Depth	m	3.15
120	0.01	3.14	0.9968254		Depth to Standing Water Level (d _l)	Assumed m	
					Height of casing agl (h _c)	m	0
					Height of top of casing above water table	m	0
					Depth to Water at Start of Test below casing level (d ₀)	m	0
					Depth to Water at End of Test below casing level	m	0
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
					Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00
						t ₂ = 120.00	s.h ₂ = 1.00
					Coefficient of Permeability (k) ms ⁻¹ =	7.79E-07	
Remarks							
Compiled By	JB	Date	17/11/2014				
Checked By	AR	Date	19/11/2014				
Geology of Test Section:		Stiff consistency, brown, sandy, gravelly CLAY. Gravel is angular to rounded, fine to medium of quartzite, quartz and siltstone.					
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388 Project Number Project Name Client T/14/1400 Land at Rhosrobin Liberty Property							

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS3	TEST No.:		1				
		DEPTH (m)	2.12	DATE		28/06/2016	SHEET		1

Time Elapsed (secs)	Depth of water below top of casing - d _t (m)	h (m) - (d ₁ -d _t)	h _t /h ₀														
0	0	2.12	1		Test Section Depth	m	2.12										
10	0.32	1.8	0.8490566		Borehole Depth	m	2.12										
20	0.55	1.57	0.740566		Borehole Diameter	m	0.103										
30	0.7	1.42	0.6698113		Casing Depth	m	2.12										
40	0.88	1.24	0.5849057		Depth to Standing Water Level (d ₁)	Assumed m											
60	1.05	1.07	0.504717		Height of casing agl (h _c)	m	0										
90	1.23	0.89	0.4198113		Height of top of casing above water table	m	0										
120	1.37	0.75	0.3537736		Depth to Water at Start of Test below casing level (d ₀)	m	0										
150	1.44	0.68	0.3207547		Depth to Water at End of Test below casing level	m	0										
180	1.5	0.62	0.2924528		Depth to Filter at Start of Test	m											
240	1.58	0.54	0.254717		Depth to Filter at End of Test	m											
300	1.64	0.48	0.2264151		Response Zone Length	m	0										
360	1.7	0.42	0.1981132		Borehole Diameter in Test Section	m	0.103										
420	1.75	0.37	0.1745283		Cross-sectional Area of Borehole	m ²	0.01										
480	1.79	0.33	0.1556604		Intake factor (BS5930 p51):	Figure 7 (F) =	0.28										
600	1.86	0.26	0.1226415		Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00										
720	1.92	0.2	0.0943396			t ₂ = 720.00	s.h ₂ = 0.09										
					Coefficient of Permeability (k) ms ⁻¹ =	9.64E-05											
Remarks																	
Borehole cleaned out prior to test.																	
Compiled By	JB	Date	17/11/2014														
Checked By	AR	Date	19/11/2014														
Geology of Test Section:		No recovery.															
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388 <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Project Number</td><td>T/14/1400</td></tr> <tr><td>Project Name</td><td>Land at Rhosrobin</td></tr> <tr><td>Client</td><td>Liberty Property</td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> </table>								Project Number	T/14/1400	Project Name	Land at Rhosrobin	Client	Liberty Property				
Project Number	T/14/1400																
Project Name	Land at Rhosrobin																
Client	Liberty Property																

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS3	TEST No.:		2				
		DEPTH (m)	2.12	DATE		28/06/2016	SHEET		1

Time Elapsed (secs)	Depth of water below top of casing - d ₁ (m)	h (m) - (d ₁ - d ₂)	h ₁ /h ₀				
0	0	2.12	1		Test Section Depth	m	2.12
10	0.28	1.84	0.8679245		Borehole Depth	m	2.12
20	0.5	1.62	0.7641509		Borehole Diameter	m	0.103
30	0.66	1.46	0.6886792		Casing Depth	m	2.12
40	0.85	1.27	0.5990566		Depth to Standing Water Level (d ₁)	Assumed m	
50	0.95	1.17	0.5518868		Height of casing agl (h _c)	m	0
60	1.05	1.07	0.504717		Height of top of casing above water table	m	0
90	1.205	0.915	0.4316038		Depth to Water at Start of Test below casing level (d ₀)	m	0
120	1.31	0.81	0.3820755		Depth to Water at End of Test below casing level	m	2.58
150	1.4	0.72	0.3396226		Depth to Filter at Start of Test	m	
180	1.48	0.64	0.3018868		Depth to Filter at End of Test	m	
240	1.56	0.56	0.2641509		Response Zone Length	m	0
300	1.63	0.49	0.2311321		Borehole Diameter in Test Section	m	0.103
360	1.69	0.43	0.2028302		Cross-sectional Area of Borehole	m ²	0.01
430	1.74	0.38	0.1792453		Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
480	1.76	0.36	0.1698113		Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00
600	1.83	0.29	0.1367925			t ₂ = 600.00	s.h ₂ = 0.14
					Coefficient of Permeability (k) ms ⁻¹ =	9.75E-05	
Remarks							
Borehole cleaned out prior to test.							
Compiled By	JB	Date	17/11/2014				
Checked By	AR	Date	19/11/2014				
Geology of Test Section:		No recovery.					
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388							
Project Number		T/14/1400					
Project Name		Land at Rhosrobin					
Client		Liberty Property					

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS3	TEST No.:		3				
		DEPTH (m)	3.15		DATE	28/06/2016		SHEET	1

Time Elapsed (secs)	Depth of water below top of casing - d ₁ (m)	h (m) - (d ₁ - d ₂)	h ₁ /h ₀						
0	0.18	2.97	1		Test Section Depth	m	3.15		
10	0.51	2.64	0.8888889		Borehole Depth	m	3.15		
20	0.69	2.46	0.8282828		Borehole Diameter	m	0.103		
30	0.81	2.34	0.7878788		Casing Depth	m	3.15		
60	1.12	2.03	0.6835017		Depth to Standing Water Level (d ₁)	Assumed m			
90	1.29	1.86	0.6262626		Height of casing agl (h _c)	m	0		
120	1.43	1.72	0.5791246		Height of top of casing above water table	m	0		
150	1.52	1.63	0.5488215		Depth to Water at Start of Test below casing level (d ₀)	m	0		
180	1.59	1.56	0.5252525		Depth to Water at End of Test below casing level	m	0		
240	1.68	1.47	0.4949495		Depth to Filter at Start of Test	m			
300	1.76	1.39	0.4680135		Depth to Filter at End of Test	m			
420	1.95	1.2	0.4040404		Response Zone Length	m	0		
540	2.08	1.07	0.3602694		Borehole Diameter in Test Section	m	0.103		
600	2.15	1	0.3367003		Cross-sectional Area of Borehole	m ²	0.01		
720	2.23	0.92	0.3097643		Intake factor (BS5930 p51):	Figure 7 (F) =	0.28		
840	2.31	0.84	0.2828283		Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00		
960	2.36	0.79	0.2659933			t ₂ = 1080.00	s.h ₂ = 0.25		
1080	2.41	0.74	0.2491582		Coefficient of Permeability (k) ms ⁻¹ =	3.78E-05			
<u>Remarks</u> Borehole cleaned out prior to test. Compiled By: JB Date: 17/11/2014 Checked By: AR Date: 19/11/2014 Geology of Test Section: No recovery.									
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388								Project Number: T/14/1400 Project Name: Land at Rhosrobin Client: Liberty Property	

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS4	TEST No.:		1				
		DEPTH (m)	2.10	DATE		28/06/2016	SHEET		1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d ₁ - d ₀)	h _i /h ₀				
0	0	2.14	1		Test Section Depth	m	2.14
10	0.04	2.1	0.9813084		Borehole Depth	m	2.14
20	0.05	2.09	0.9766355		Borehole Diameter	m	0.103
30	0.062	2.078	0.971028		Casing Depth	m	2.1
40	0.067	2.073	0.9686916		Depth to Standing Water Level (d ₁)	Assumed m	
60	0.075	2.065	0.9649533		Height of casing agl (h _c)	m	0
120	0.087	2.053	0.9593458		Height of top of casing above water table	m	0
300	0.1	2.04	0.953271		Depth to Water at Start of Test below casing level (d ₀)	m	0
600	0.13	2.01	0.9392523		Depth to Water at End of Test below casing level	m	2.58
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0.2
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
					Basic Time Lag = (T)	t ₁ = 0.00	s.h ₁ = 1.00
						t ₂ = 600.00	s.h ₂ = 0.94
					Coefficient of Permeability (k) ms ⁻¹ =	3.07E-06	
<u>Remarks</u> Borehole cleaned out prior to test. Compiled By: JB Date: 17/11/2014 Checked By: AR Date: 19/11/2014 <u>Geology of Test Section:</u> Brown, slightly sandy, clayey subangular to rounded, fine to medium occasionally coarse GRAVEL of quartzite and quartz.							

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE										
BOREHOLE No.:		WS4	TEST No.:		2					
		DEPTH (m)	2.14		DATE		28/06/2016		SHEET	1

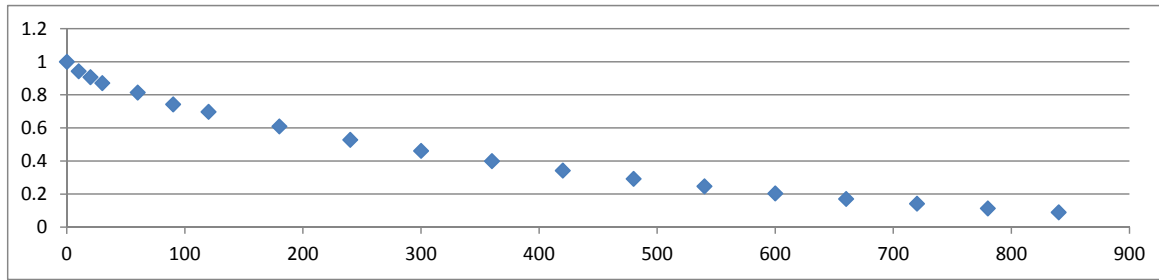
Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _l)	h _i /h ₀				
0	0.13	2.01	1		Test Section Depth	m	2.14
25	1.35	0.79	0.3930348		Borehole Depth	m	2.14
60	1.55	0.59	0.2935323		Borehole Diameter	m	0.103
80	1.65	0.49	0.2437811		Casing Depth	m	1.64
120	1.76	0.38	0.1890547		Depth to Standing Water Level (d _l)	Assumed m	
180	1.85	0.29	0.1442786		Height of casing agl (h _c)	m	0
240	1.91	0.23	0.1144279		Height of top of casing above water table	m	0
					Depth to Water at Start of Test below casing level (d ₀)	m	0
					Depth to Water at End of Test below casing level	m	0
					Depth to Filter at Start of Test	m	
					Depth to Filter at End of Test	m	
					Response Zone Length	m	0.5
					Borehole Diameter in Test Section	m	0.103
					Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	1.38
					Basic Time Lag = (T)	t ₁ =	0.00
						t ₂ =	240.00
						s ₁ h ₁ =	1.00
						s ₂ h ₂ =	0.11
					Coefficient of Permeability (k) ms ⁻¹ =		5.47E-05
<u>Remarks</u> Borehole cleaned out prior to test. Compiled By: JB Date: 17/11/2014 Checked By: AR Date: 19/11/2014 <u>Geology of Test Section:</u> Red brown, slightly clayey, gravelly, medium occasionally fine and coarse SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.							
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388					Project Number Project Name Client T/14/1400 Land at Rhosrobin Liberty Property		

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS4	TEST No.:		3				
		DEPTH (m)	3.14		DATE	28/06/2016		SHEET	1

Time Elapsed (secs)	Depth of water below top of casing - d _i (m)	h (m) - (d _i - d _l)	h _i /h ₀														
0	0.2	2.94	1		Test Section Depth	m	3.14										
10	0.84	2.3	0.7823129		Borehole Depth	m	3.14										
20	1.44	1.7	0.5782313		Borehole Diameter	m	0.103										
30	1.93	1.21	0.4115646		Casing Depth	m	3.14										
40	2.22	0.92	0.3129252		Depth to Standing Water Level (d _l)	Assumed m											
60	2.57	0.57	0.1938776		Height of casing agl (h _c)	m	0										
70	2.79	0.35	0.1190476		Height of top of casing above water table	m	0										
90	2.95	0.19	0.0646259		Depth to Water at Start of Test below casing level (d ₀)	m	0.2										
100	3.03	0.11	0.037415		Depth to Water at End of Test below casing level	m	0										
120	3.09	0.05	0.0170068		Depth to Filter at Start of Test	m											
140	3.13	0.01	0.0034014		Depth to Filter at End of Test	m											
					Response Zone Length	m	0										
					Borehole Diameter in Test Section	m	0.103										
					Cross-sectional Area of Borehole	m ²	0.01										
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28										
					Basic Time Lag = (T)	t ₁ =	0.00										
						t ₂ =	140.00										
						s ₁ h ₁ =	1.00										
						s ₂ h ₂ =	0.00										
					Coefficient of Permeability (k) ms ⁻¹ =		1.19E-03										
Remarks																	
Borehole cleaned out prior to test.																	
Compiled By	JB	Date	17/11/2014														
Checked By	AR	Date	19/11/2014														
Geology of Test Section:		Brown, slightly sandy, slightly clayey, slightly cobbly, angular to rounded, medium to coarse GRAVEL of quartzite and quartz.															
Tier Environmental Ltd Chadwick House Birchwood Park Warrington, WA3 6AE Tel. 01925 818 388 <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Project Number</td> <td>T/14/1400</td> </tr> <tr> <td>Project Name</td> <td>Land at Rhosrobin</td> </tr> <tr> <td>Client</td> <td>Liberty Property</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> </table>								Project Number	T/14/1400	Project Name	Land at Rhosrobin	Client	Liberty Property				
Project Number	T/14/1400																
Project Name	Land at Rhosrobin																
Client	Liberty Property																

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE

BOREHOLE No.:	WS6	TEST No.:	1		
	DEPTH (m)	2.10	DATE	28/06/2016	SHEET



Time Elapsed (secs)	Depth of water below top of casing - d ₁ (m)	h (m) - (d ₁ -d ₂)	h ₁ /h ₀					
0	0	2.1	1		Test Section Depth	m	2.1	
10	0.12	1.98	0.9428571		Borehole Depth	m	2.1	
20	0.195	1.905	0.9071429		Borehole Diameter	m	0.103	
30	0.27	1.83	0.8714286		Casing Depth	m	2.1	
60	0.39	1.71	0.8142857		Depth to Standing Water Level (d ₁)	Assumed m	0	
90	0.54	1.56	0.7428571		Height of casing agl (h _c)	m	0	
120	0.635	1.465	0.697619		Height of top of casing above water table	m	0	
180	0.82	1.28	0.6095238		Depth to Water at Start of Test below casing level (d ₀)	m	0	
240	0.99	1.11	0.5285714		Depth to Water at End of Test below casing level	m	0	
300	1.13	0.97	0.4619048		Depth to Filter at Start of Test	m		
360	1.26	0.84	0.4		Depth to Filter at End of Test	m		
420	1.38	0.72	0.3428571		Response Zone Length	m	0	
480	1.485	0.615	0.2928571		Borehole Diameter in Test Section	m	0.103	
540	1.58	0.52	0.247619		Cross-sectional Area of Borehole	m ²	0.01	
600	1.67	0.43	0.2047619		Intake factor (BS5930 p51):	Figure 7 (F) =	0.28	
660	1.74	0.36	0.1714286		Basic Time Lag = (T)	t ₁ =	0.00	s.h ₁ = 1.00
720	1.8	0.3	0.1428571			t ₂ =	840.00	s.h ₂ = 0.09
780	1.86	0.24	0.1142857		Coefficient of Permeability (k) ms ⁻¹ =			8.41E-05
840	1.91	0.19	0.0904762					
Remarks								
Borehole cleaned out prior to test.								
Compiled By	JB	Date	17/11/2014					
Checked By	AR	Date	19/11/2014					
Geology of Test Section:		Red brown, slightly clayey, very gravelly, coarse occasionally medium SAND. Gravel is subangular to rounded, fine to medium of quartzite and quartz.						
Tier Environmental Ltd								
Chadwick House					Project Number			
Birchwood Park					T/14/1400			
Warrington, WA3 6AE					Project Name			
Tel. 01925 818 388					Land at Rhosrobin			
					Client			
					Liberty Property			

VARIABLE HEAD PERMEABILITY TEST IN BOREHOLE									
BOREHOLE No.:		WS6	TEST No.:		2				
		DEPTH (m)	3.00		DATE	28/06/2016		SHEET	1

Time Elapsed (secs)	Depth of water below top of casing - d ₁ (m)	h (m) - (d ₁ - d ₂)	h ₁ /h ₀				
0	0	3	1		Test Section Depth	m	3
10	0.05	2.95	0.9833333		Borehole Depth	m	3
40	0.07	2.93	0.9766667		Borehole Diameter	m	0.103
120	0.09	2.91	0.97		Casing Depth	m	3
240	0.11	2.89	0.9633333		Depth to Standing Water Level (d ₁)	Assumed m	
360	0.13	2.87	0.9566667		Height of casing agl (h _c)	m	0
480	0.15	2.85	0.95		Height of top of casing above water table	m	0
600	0.175	2.825	0.9416667		Depth to Water at Start of Test below casing level (d ₀)	m	0
900	0.195	2.805	0.935		Depth to Water at End of Test below casing level	m	0
1200	0.23	2.77	0.9233333		Depth to Filter at Start of Test	m	
1800	0.3	2.7	0.9		Depth to Filter at End of Test	m	
2400	0.36	2.64	0.88		Response Zone Length	m	0
3000	0.415	2.585	0.8616667		Borehole Diameter in Test Section	m	0.103
3600	0.47	2.53	0.8433333		Cross-sectional Area of Borehole	m ²	0.01
					Intake factor (BS5930 p51):	Figure 7 (F) =	0.28
					Basic Time Lag = (T)	t ₁ =	0.00
						t ₂ =	3600.00
						s ₁ h ₁ =	1.00
						s ₂ h ₂ =	0.84
					Coefficient of Permeability (k) ms ⁻¹ =		1.39E-06
<u>Remarks</u> Borehole cleaned out prior to test. Compiled By: JB Date: 17/11/2014 Checked By: AR Date: 19/11/2014 <u>Geology of Test Section:</u> Brown, slightly clayey, very gravelly, coarse SAND. Gravel is angular to subangular, fine to medium of quartzite and quartz.							

**APPENDIX Q - COMPLYING WITH CONTROL OF ASBESTOS REGULATION
2012**

Complying with Control of Asbestos Regulations (CAR): Risk Assessments, Licensing and Training

This appendix outlines CAR risk assessments and where they should be applied in relation to assessing and remediating brownfield sites. The information below details the different classifications of work with asbestos under CAR, summarises the legal requirements for asbestos awareness training for all involved in the investigation and management of asbestos containing soil (ACS), and details the potential requirements for suitable proficiency training relating specifically to ACS.

CAR RISK ASSESSMENTS

A CAR Risk Assessment is required for any work which may expose employees to asbestos. It is recommended that a precautionary approach is adopted if there is any doubt about risks associated with asbestos.

There are three main activities for potential asbestos exposure during work on brownfield sites:

- Site reconnaissance visits;
- Site investigation works; and
- Site remediation.

CAR risk assessments are needed at each stage but may be incorporated during the site investigation stage into the overarching health and safety risk assessments.

The CAR risk assessment must:

- Identify the type of asbestos to which employees are liable to be exposed, where possible, or assume it is present in different forms;
- Determine the type and extent of exposures to asbestos that may occur during the work
- Identify the steps to be taken to prevent exposure or reduce it to the lowest level reasonably practicable; and,
- Consider the effects of control measures that have been or will be taken.

The CAR risk assessment should include any information used to inform the risk assessment such as asbestos reports or desk study information. In the event that this information is not available, the assessor should be assumed that all forms of asbestos may be present on Site.

For all investigation and remediation of ACSs, a detailed written work plan should be produced and followed as detailed on the HSE website and in the CAR.

The CAR risk assessments for specific investigations or remediation projects, will determine whether or not work is 'licensable work' (LW), 'notifiable non-licensable work' (NNLW) or 'non-licensed work' (NLW). In addition, training requirements are also defined by the CAR risk assessment.

Some examples of control measures that apply during site reconnaissance, site investigation works and site remediation are given below and should be applied depending on the asbestos risks identified for the Site at each stage of investigation:

- Avoiding stirring up dust;
- Cleaning footwear after site works;
- Removing and bagging any overalls for disposal/laundry;
- Respirators and hygiene facilities for high risk sites;
- Segregated welfare units;
- Wetting ground
- Minimising soil disturbances;
- Implementation or retention of capping/break layers;
- Implementation of awareness training;
- Air monitoring;
- Managing stockpiles;
- Area segregation;
- Wheel washing
- Road washing/cleaning

It is important to note that during Site reconnaissance visits, Site investigation works and Site remediation that asbestos should not be considered in isolation and control measures are likely to form part of a wider health and safety precautions.

Respiratory protective equipment (RPE)

RPE is the last line of defence and its requirement would be defined by the CAR risk assessment. HSE (2013b) advises that RPE should have an assigned protection factor of 20 or more for all work with asbestos. In certain instances, full face-piece, positive pressure respirators with a protection factor of 40 are necessary (to EN 12942:1998, TM3).

Suitable types of RPE for most *short* duration non-licensed asbestos work:

- Disposable respirator to standards EN149 (type FFP3) or EN1827 (type FMP3)
- Half mask respirator (to standard EN140) with P3 filter
- Semi-disposable respirator (to EN405) with P3 filter

These filters are not suitable for people with beards/stubble or for long or continuous use.

LICENSING

CAR defined certain types of activities involving asbestos as 'licensable work' (LW) or as 'notifiable non-licensable work' (NNLW). All other work would be 'non-licensable work' (NLW).

LW is defined as:

- work where exposure is not 'sporadic and low intensity'
- work where the risk assessment cannot demonstrate that the control limits (four hour and 10 minute limits) will not be exceeded
- work on asbestos coating
- work on AIB or insulation where risk assessment is either of first two points above or not of short duration (where short duration is defined for any work liable to disturb asbestos as taking less than two hours per week (including ancillary work) and no one person carries out that work for more than one hour').

NNLW includes work with:

- AIB or asbestos insulation of short duration that is not licensable
- fire-damaged asbestos cement or asbestos cement damaged so as to create significant dust and debris
- asbestos ropes, yarns, woven cloths in poor condition or handling cutting or breaking up the materials
- asbestos papers, felts and cardboard in poor condition, unencapsulated or not bound into another material.

Work with weathered asbestos cement, air monitoring and collecting samples of ACM in buildings would not normally be notifiable.

It is impossible to specify definitively what activities will and will not be licensable. This decision should be made as part of the CAR risk assessment. CAR is not primarily aimed at work with ACSs and there is little published information on airborne asbestos concentrations during work with ACSs. Nevertheless, CAR will require some remediation projects, and occasionally site investigations, to be LW. Investigations on other sites may involve NNLW. The decision as to whether work is LW or NNLW should be made during the CAR risk assessment by those in charge of the brownfield site investigations and remediation projects.

TRAINING REQUIREMENTS

Asbestos health and safety courses are offered by a number of providers in the UK. Training courses that include the problem of identifying ACMs in soil should be undertaken at regular intervals by those involved in the investigation, assessment and management of sites where ACs are known or suspected. It is the role of the employer to identify the level of training required for an employee based on their role, experience and duties. Reference to Regulation 10 of CAR should be referred to for more information on training requirements.

Recognising asbestos within soils is challenging due to the heterogeneity of such soils and the discolouration of asbestos by smeared soil. Specific training for ground workers should include understanding fibre release potential, potential control measures in the field, how to take representative ACSs safely, sample labelling and what analytical tests are available and when they should be implemented.

Health and safety training required under CAR includes asbestos awareness, non-licensable work (including notifiable non-licensable work) and licensable work with asbestos.

In addition to health and safety training, some staff involved in the technical identification on site of ACMs, sampling and analysis may require technical proficiency training (competency training).

Training vs. Competence

HSE (2005) identifies that 'training alone does not make people competent. Training must be consolidated by practical experience so that the person becomes confident, skilful and knowledgeable in practice on the job'. It is critical that ACS surveyors demonstrate competency with details of relevant field experience alongside training and examples of previous works/ references.